HARDWARE MANUAL - ORIGINAL INSTRUCTIONS

Programmable logic controllers

AC500-eCo V3, AC500 V3, AC500-XC V3



Table of contents

1 Preface ... 4
1.1 Documentation guide ... 4
1.2 Do I use AC500 V2 or AC500 V3? ... 4
1.3 Regulations ... 5
1.4 Older revisions of this document ... 7
1.5 Use the "magic button" to display your current position in the table of contents ... 7
1.6 Structure of safety notices ... 7
2 Safety instructions ... 9
3 System structure ... 14
3.1 AC500-eCo/S500-eCo system structure ... 15
3.2 AC500/S500 system structure ... 16
3.3 AC500-eCo/S500-eCo: Short description hardware ... 18
3.4 AC500/S500: Short description hardware ... 20
3.5 AC500-S ... 23
4 Technical data of the system ... 25
4.1 System data AC500-eCo ... 25
4.1.1 Environmental conditions ... 25
4.1.2 Creepage distances and clearances ... 32
4.1.3 Power supply units ... 32
4.1.4 Electromagnetic compatibility ... 33
4.1.5 Mechanical data ... 34
4.1.6 Approvals and certifications ... 34
4.2 System data AC500 ... 34
4.2.1 Environmental conditions ... 34
4.2.2 Creepage distances and clearances ... 36
4.2.3 Power supply units ... 36
4.2.4 Electromagnetic compatibility ... 37
4.2.5 Mechanical data ... 38
4.2.6 Approvals and certifications ... 38
4.3 System data AC500-XC ... 38
4.3.1 Environmental conditions ... 38
4.3.2 Creepage distances and clearances ... 40
4.3.3 Power supply units ... 41
4.3.4 Electromagnetic compatibility ... 41
4.3.5 Mechanical data ... 42
4.3.6 Approvals and certifications ... 43
4.4 AC500-S ... 43
4.5 CP600 ... 43
5 Device specifications ... 44
5.1 Processor modules ... 44
5.1.1 AC500-eCo ... 44
5.1.2 AC500 and AC500-XC ... 207
5.2 Communication modules for AC500(-XC) processor modules ... 234
5.2.1 Features ... 234
5.2.2 Compatibility of communication modules and communication interface modules ... 236
5.2.3 Technical data (Overview) ... 237
5.2.4 Serial ... 238

5.2.5 CANopen ... 243
5.2.6 EtherCAT ... 250
5.2.7 Ethernet ... 255
5.2.8 PROFIBUS ... 261
5.2.9 PROFINET ... 272
5.3 Terminal bases for AC500(-XC) processor modules and communication modules ... 284
5.3.1 TB5600, TB5610, TB5620, TB5640, TB5660 ... 284
5.4 I/O modules ... 295
5.4.1 Safety instructions ... 295
5.4.2 I/O bus - Data transfer ... 295
5.4.3 Digital I/O modules ... 298
5.4.4 Analog I/O modules ... 522
5.4.5 Digital/Analog I/O modules ... 816
5.4.6 Function modules ... 877
5.5 Terminal units for S500(-XC) I/O modules ... 946
5.5.1 Safety instructions ... 946
5.5.2 TU515, TU516, TU541 and TU542 for I/O modules ... 946
5.5.3 TU531 and TU532 for I/O modules ... 953
5.6 Communication interface modules ... 961
5.6.1 Safety instructions ... 961
5.6.2 Compatibility of communication modules and communication interface modules ... 961
5.6.3 CANopen ... 963
5.6.4 CS31 ... 1028
5.6.5 EtherCAT ... 1076
5.6.6 Modbus ... 1127
5.6.7 PROFIBUS ... 1194
5.6.8 PROFINET ... 1261
5.7 Terminal units for communication interface modules ... 1347
5.7.1 Safety instructions ... 1347
5.7.2 TU507-ETH and TU508-ETH for Ethernet communication interface modules ... 1348
5.7.3 TU509 and TU510 for communication interface modules ... 1351
5.7.4 TU517 and TU518 for communication interface modules ... 1355
5.7.5 TU520-ETH for PROFINET communication interface modules ... 1359
5.7.6 TU551-CS31 and TU552-CS31 for CS31 communication interface modules ... 1363
5.8 Accessories ... 1367
5.8.1 AC500-eCo ... 1367
5.8.2 AC500 and AC500-XC ... 1390
5.8.3 S500 and S500-XC ... 1411
5.9 Storage devices ... 1418
5.9.1 Overview ... 1418
5.9.2 Functionalities ... 1420
5.9.3 Memory sizes ... 1421
5.9.4 Storage device details ... 1422
6 Decommissioning ... 1425
7 Recycling ... 1426
8 Glossary ... 1427
9 Index ... 1430

1 Preface

1.1 Documentation guide



Where to find the latest information about:

- PLC system
  - Overall manual for PLC Automation
    Chapter 1.1 “Documentation guide” on page 4
    Online help
    PDF
  - System manual
    Online help
    PDF
  - Getting started: First steps with the platform and creation of your first program
    Online help
    PDF
    Starter kit (PDF)
  - Safety user manual for safety PLCs
    Online help
    PDF
- Devices
  - Data sheets
    PDF
  - Installation instructions
    PDF
  - PLC hardware descriptions
    Online help
    PDF
  - Safety user manual for safety PLCs
    Online help
    PDF
  - Control panels
    PDF
- Software and programming
  - Configuration and programming
    Online help
    PDF
  - Programming examples available for download
    PDF
  - Programming examples available in the engineering suite: Open Automation Builder menu *“Help ➔ Project examples”*
  - Application descriptions for specific features and use cases
    PDF
  - Release notes for the latest version of the engineering suite Automation Builder
    PDF

1.2 Do I use AC500 V2 or AC500 V3?

This document describes AC500 V3 products.

We offer different ranges of the processor modules (V2, V3). You can easily find out which ones are used in your system. Either have a look at your used modules or your configuration.

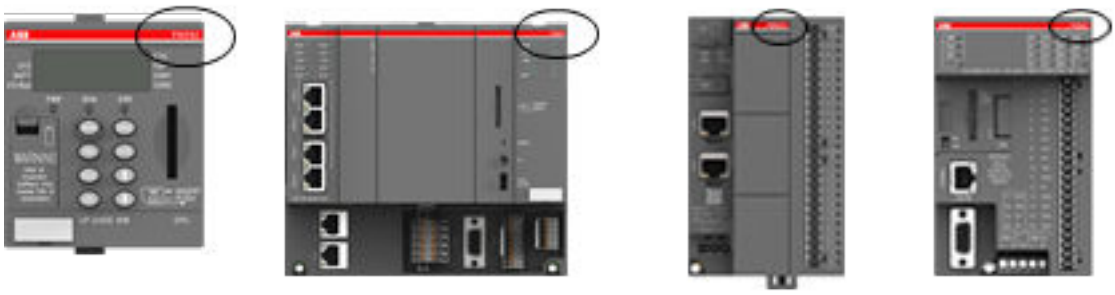


Fig. 1: Hardware: Processor modules

Written type on the module	Example	Range	Relevant manual
Processor module type PM + **3 digits**	PM595	V2	*AC500 V2*
Processor module type PM + **4 digits**	PM5670	V3	AC500 V3 (this manual)

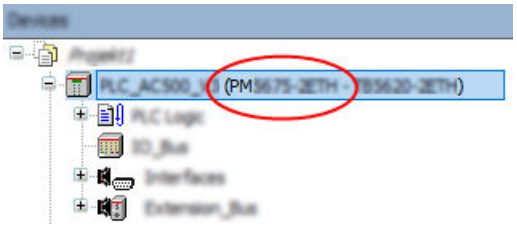


Fig. 2: Software: Configuration in engineering software Automation Builder

Written type in brackets	Example	Range	Relevant manual
Processor module type PM + **3 digits**	PM595	V2	*AC500 V2*
Processor module type PM + **4 digits**	PM5670	V3	AC500 V3 (this manual)

1.3 Regulations

Planning and installation of the electrical system

Industrial environment
The products have been designed for use in an industrial environment in compliance with the 2014/30/EU directive.

The planning and installation of the electrical system must be carried out in compliance with the applicable regulations and standards. Hazards due to malfunctions must be prevented by taking appropriate measures.

The suitability of the products for the respective application is proven by declarations of conformity and certificates.

The PLC Automation catalog contains an
overview of the available declarations of conformity and certificates.

Distributer contacts

For all PLC devices the ABB AG is manufacturer or importer according to EU regulations.

The rating plate on the PLC devices shows the manufactoring location and if necessary the importer contact details.

ABB AG Eppelheimerstraße 82 69123 Heidelberg Germany	UK importer address: **ABB Ltd** Daresbury Park WA4 4BT Cheshire - United Kingdom

Qualified personnel

Both the AC500 control system and other components in the vicinity are operated with dangerous touch voltages. Touching live components can lead to serious health implications or even death.

To avoid such risks and the occurrence of property damage, persons involved in the installation, commissioning and maintenance must have relevant knowledge about the following:

- Automation technology
- Handling of hazardous voltages
- Application of relevant standards and regulations (e.g. EN 60204-1), accident prevention regulations and regulations on special environmental conditions (e.g., hazardous areas due to explosive substances, heavy soiling or corrosive influences).

Applications in UL hazardous locations

Suitable for use in Class 1, Division 2, Groups A, B, C and D-T4 hazardous locations, or non-hazardous locations only.

Substitution of any component may impair suitability for Class 1, Division 2.



WARNING!

Explosion hazard

Exposure to some chemicals may degrade the sealing properties of material used in the relays.



WARNING!

Removal/Insertion under power

Removal or insertion under power is permissible only if all conditions for hot swapping are fullfilled.

↳ *“Conditions for hot swap” on page 12*

The devices are not designed for removal or insertion under power when the conditions for hot swap do not apply. Because of unforeseeable consequences, it is not allowed to plug in or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing any of the following actions:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while they are energized in a hazardous location could result in an electric arc, which could create an ignition source resulting in fire or explosion.

Prior to proceeding, make sure that power is been disconnected and that the area has been thoroughly checked to ensure that flammable materials or ignitable concentrations are not present.

The devices must not be opened when in operation. The same applies to the network interfaces.

1.4 Older revisions of this document

You can always find all revisions of our documents on our website.

Hardware manual



Revisions	Select any of the revisions
Latest revision	Get a link to the latest revision
This revision	Get a direct link to the selected revision

1.5 Use the "magic button" to display your current position in the table of contents

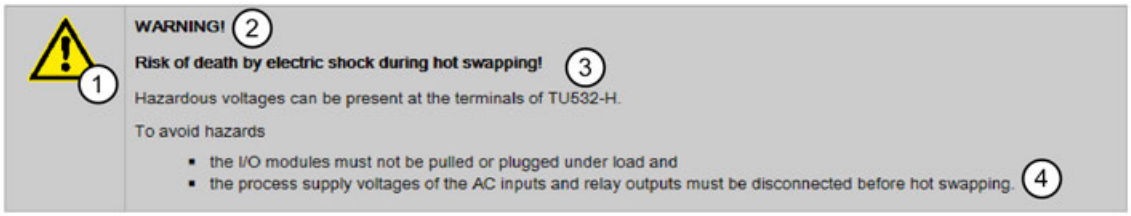
☑ Documentation is opened in a PDF reader. PDF readers often provide a button to synchronize with the table of contents. Usually, you can find the "magic button" in the bookmarks tab. For example, it looks like this: /

▷ Select the "magic button".

⇨ Your current position will be highlighted in the bookmark tab.

1.6 Structure of safety notices

Throughout the documentation we use the following types of safety and information notices. They make you aware of safety considerations or give advice on AC500 products usage.



1 **Safety alert symbol** indicates the danger.
2 **Signal word** classifies the danger.
3 **Type and source of the risk** are mentioned and **possible consequences** are described.
4 **Measures to avoid these consequences** (enumerations).

Signal words



DANGER!
DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.

Ensure to take measures to prevent the described impending danger.



WARNING!
WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.

Ensure to take measures to prevent the described dangerous situation.



CAUTION!
CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

Ensure to take measures to prevent the described dangerous situation.



NOTICE!
NOTICE is used to address practices not related to physical injury but might lead to property damage for example damage of the product.

Ensure to take measures to prevent the described dangerous situation.



NOTE provides additional information on the product, e.g., advices for configuration or best practice scenarios.

2 Safety instructions

Industrial environment

The products have been designed for use in an industrial environment in compliance with the 2014/30/EU directive.

Relevant standards and regulations, accident prevention regulations and regulations on special environmental conditions must be observed (e.g. hazardous areas due to explosive substances, heavy soiling or corrosive influences).

The devices must be handled and operated within the specified technical data and system data.

The devices contain no serviceable parts and must not be opened.

Removable covers must be closed during operation unless otherwise specified.

If the equipment is used in a manner not specified by ABB, the protection provided by the equipment may be compromised. Any liability for the consequences of incorrect use or unauthorized repairs is rejected.

Qualified personnel

Both the AC500 control system and other components in the vicinity are operated with dangerous touch voltages. Touching live components can lead to serious health implications or even death.

To avoid such risks and the occurrence of property damage, persons involved in the installation, commissioning and maintenance must have relevant knowledge about the following:

- Automation technology
- Handling of hazardous voltages
- Application of relevant standards and regulations (e.g. EN 60204-1), accident prevention regulations and regulations on special environmental conditions (e.g., hazardous areas due to explosive substances, heavy soiling or corrosive influences).

Functional safety

The AC500-S safety user manual must be read and understood before using the safety configuration and programming tools of Automation Builder/PS501 Control Builder Plus. Only qualified personnel are permitted to work with AC500-S safety PLCs.

AC500-S safety user manual

General information

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variants and requirements associated with any particular installation, ABB cannot assume responsibility or liability for actual use based on the examples and diagrams.

The PLC was developed according to the relevant standards. Any module-specific measures are described in the individual descriptions of the modules.

PLC-specific safety notices

The product family AC500 control system is designed according to the EN 61131-2 and IEC 61131-2 standards. Any data that differs from IEC 61131-2, is due to the higher requirements of Maritime Services. Other differences are described in the technical data description of the devices.

NOTICE!

Avoidance of electrostatic charging

PLC devices and equipment are sensitive to electrostatic discharge, which can cause internal damage and affect normal operation.

Observe the following rules when handling the system:

- Touch a grounded object to discharge potential static.
- Wear an approved grounding wrist strap.
- Do not touch connectors or pins on component boards.
- Do not touch circuit components inside the equipment.
- If available, use a static-safe workstation.
- When not in use, store the equipment in appropriate static-safe packaging.

NOTICE!

Use of suitable enclosure

The devices must be mounted in a control cabinet that ensures compliance with the specified environmental conditions.

Cleaning instructions

Do not use cleaning agent for cleaning the device.

Use a damp cloth instead.

Connection plans and a user program must be created so that no dangerous situations can occur during normal operation or failure.

The application must be tested to ensure that no dangerous situations can occur during operation.

Do not operate devices outside of the specified, technical data!

Trouble-free functioning cannot be ensured outside of the specified data.

NOTICE!

PLC damage due to missing grounding

- Make sure to ground the devices.
- The grounding (switch cabinet grounding) is supplied both by the mains connection (or 24 V supply voltage) and via the DIN rail. The DIN rail must be connected to ground before power is supplied to the device. The grounding may be removed only if it is certain that no more power is being supplied to the control system.
- In case of screw mounting, use metal screws for grounding.

CAUTION!

Do not obstruct the ventilation for cooling!

The ventilation slots on the upper and lower sides of the devices must not be covered.

CAUTION!

Run signal and power wiring separately!

Signal and supply lines (power cables) must be laid out so that no malfunctions due to capacitive and inductive interference can occur (EMC).

WARNING!

Warning sign on the module!

This indicates that dangerous voltages may be present or that surfaces may have dangerous temperatures.

WARNING!

Splaying of strands can cause hazards!

Avoid splayed strands when wiring terminals with stranded conductors.

– Ferrules can be used to prevent splaying.

WARNING!

Removal/Insertion under power

Removal or insertion under power is permissible only if all conditions for hot swapping are fullfilled.

↳ *“Conditions for hot swap” on page 12*

The devices are not designed for removal or insertion under power when the conditions for hot swap do not apply. Because of unforeseeable consequences, it is not allowed to plug in or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing any of the following actions:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while they are energized in a hazardous location could result in an electric arc, which could create an ignition source resulting in fire or explosion.

Prior to proceeding, make sure that power is been disconnected and that the area has been thoroughly checked to ensure that flammable materials or ignitable concentrations are not present.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Except when using hot swap terminal units, the I/O bus is not designed for pulling and plugging modules during operation.

If a module is pulled or plugged on a terminal unit that is **not** hot swap capable while the bus is running, the following consequences are possible.

- Reset of the station or of the processor module.
- System lockup.
- Damage of the module.

Conditions for hot swap

NOTICE!

Risk of device damage!

- I/O modules with a device index **above** F0 can be hot-swapped. When I/O modules **below** F0 are inserted or removed from the terminal unit in a powered system the I/O modules can be damaged.
  Before hot swapping a device, check the device index and ensure that the modules meet the requirements. *Table 297 “Allowed device indexes for I/O modules for hot swapping” on page 950*
- Terminal units that support hot swapping of I/O modules have the appendix TU5xx**-H**.
- Hot swap is not supported by AC500-eCo CPU!

The following I/O bus masters support hot swapping of attached I/O modules:

- Communication interface modules CI5xx as of index F0.
- Processor modules PM56xx-2ETH with firmware version as of V3.2.0.

NOTICE!

Risk of damage to I/O modules!

Hot swapping is only allowed for I/O modules.

Processor modules and communication interface modules must not be removed or inserted during operation.

Conditions for hot swapping

- *Digital outputs are not under load.*
- *Input/output voltages above safety extra low voltage/ protective extra low voltages (SELV/PELV) are switched off.*
- *Modules are completely plugged on the terminal unit with both snap fit engaged before switching on loads or input/output voltage.*

Information on batteries

CAUTION!

Use only ABB approved lithium battery modules!

At the end of the battery’s lifetime, always replace it only with a genuine battery module.



CAUTION!

Risk of explosion!

Do not open, re-charge or disassemble primary lithium battery. Attempting to charge primary lithium battery will lead to overheating and can cause explosions.

Protect them from heat and fire and store them in a dry place.

Never short-circuit or operate primary lithium battery with the polarities reversed. The primary lithium battery are likely to overheat and explode. Avoid unintentional short circuiting do not store primary lithium batteries in metal containers and do not place them on metallic surfaces. Escaping lithium is a health hazard.



Environment considerations

Recycle exhausted batteries. Dispose of batteries in an environmentally conscious manner in accordance with regulations issued by the local authorities.

3 System structure

AC500 programmable logic controllers (PLCs)

The AC500 (Standard), AC500-eCo, AC500-S and AC500-XC scalable PLC ranges provide solutions for small, medium and high-end applications. Our AC500 platform offers different performance levels and is the ideal choice for high availability, extreme environments or safety solutions. Our AC500 PLC platform offers interoperability and compatibility in hardware and software from compact PLCs up to high-end and safety PLCs.

Due to the flexible combinations of AC500 devices and components, AC500 PLCs can be used for controlling a wide variety of applications to fulfill your automation needs.



Features of AC500 PLCs

- Scalable and consistently expandable system
- Different performance classes of processor modules (CPUs) available
- Several fieldbusses available
- Parallel connection to several fieldbusses which can be combined arbitrarily

The AC500 product family consists of the following product groups:

- AC500 (Standard):
  AC500 standard PLCs offer a wide range of performance levels and scalability. The PLCs are highly capable of communication and extension for flexible application.
- AC500-eCo:
  AC500-eCo PLCs are cost-effective, high-performance compact PLCs that offer total interoperability with the core AC500 range and provide battery-free buffering of remanent data. All I/O modules can be freely connected in a simple, stable and reliable manner.
- AC500-S:
  AC500-S PLCs are designed for safety applications in factory, process or machine automation.
- AC500-XC:
  AC500 (Standard) and AC500-S provide devices with -XC extension as a product variant.
  These variants operate according to their product group and can, in addition, be operated under extreme conditions. AC500-XC PLCs can be used at high altitudes, extended operating temperature and in humid conditions. The devices also provids a high level of resistance to vibration and corrosive gases. The AC500-XC series is consistent with standard devices concerning the overall dimensions, the control function and the software compatibility ↬ *Chapter 4.3 “System data AC500-XC” on page 38*.

The AC500 product family is characterized by functional modularity. As the complete AC500 product family shares the same hardware platform and programming software tool, the devices of the AC500 product groups can be flexibly combined.

S500 devices represent the I/O modules of the product group AC500 (Standard), whereas S500-eCo devices represent the I/O modules of the product group AC500-eCo. Both S500 and S500-eCo devices can be flexibly combined with devices of the AC500 product family.

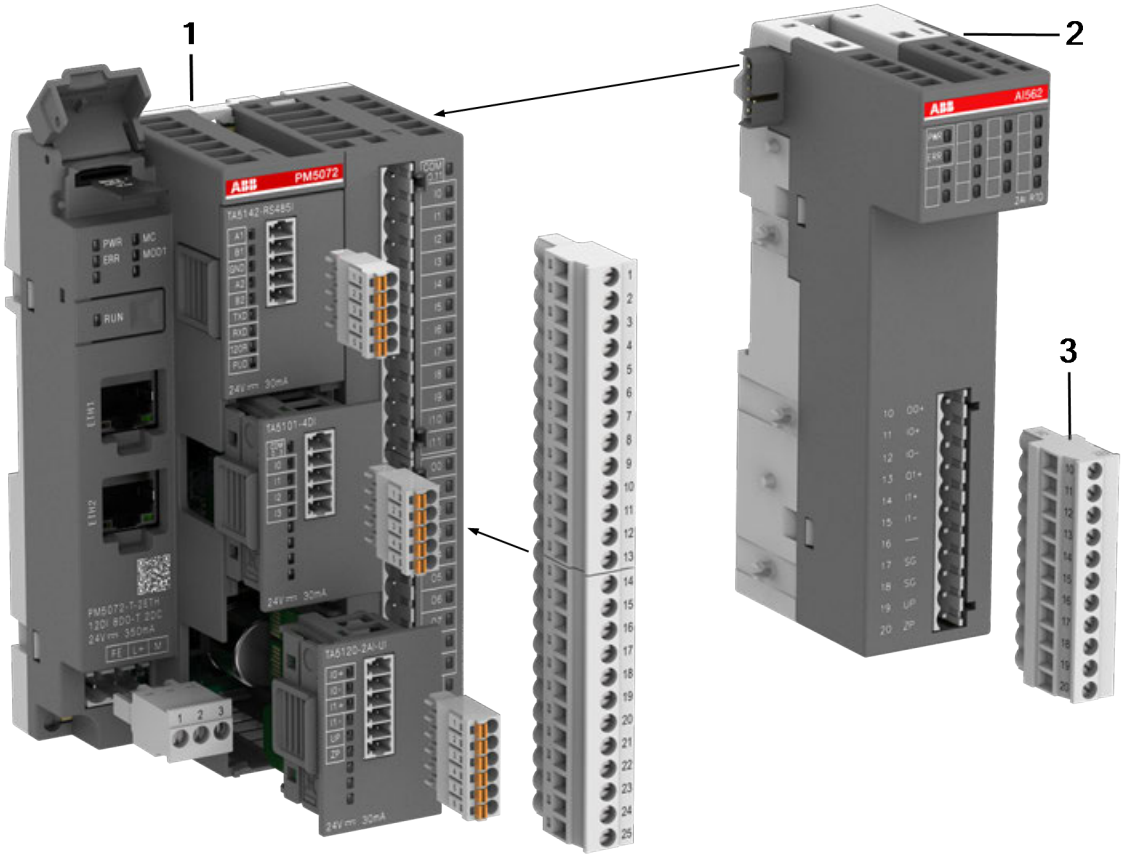
3.1 AC500-eCo/S500-eCo system structure

AC500-eCo/S500-eCo series is compatible with AC500/S500.

The compact AC500-eCo processor module can be used for small applications with the integrated I/O channels.

The functionality of the processor modules can be extended with option boards, e.g., for additional I/O channels.

For larger applications, I/O modules can be connected centralized or decentralized.



1 AC500-eCo processor module with option boards, different memory sizes, inputs and outputs available
2 S500-eCo I/O module, up to 10 I/O modules can be connected, also for decentralized extension
3 Terminal blocks in different variants available

Centralized I/O extension

Processor modules with an I/O bus interface on the right side can be expanded by up to 10 I/O modules to increase the number of the I/O channels.

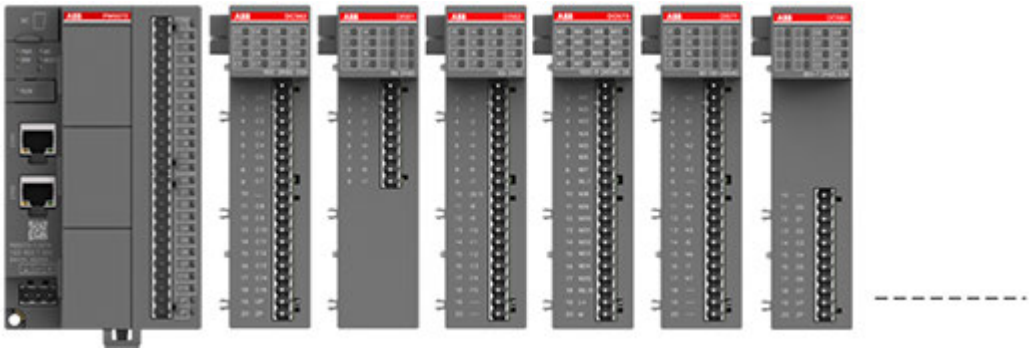


Fig. 3: I/O modules (S500-eCo) directly connected to an AC500-eCo processor module

Decentralized I/O extension

Up to 10 I/O modules can be connected remotely with the onboard Ethernet interface. Usually, a Modbus/TCP, PROFINET or EtherCAT communication interface module or a processor module is used for the decentralized I/O extension.

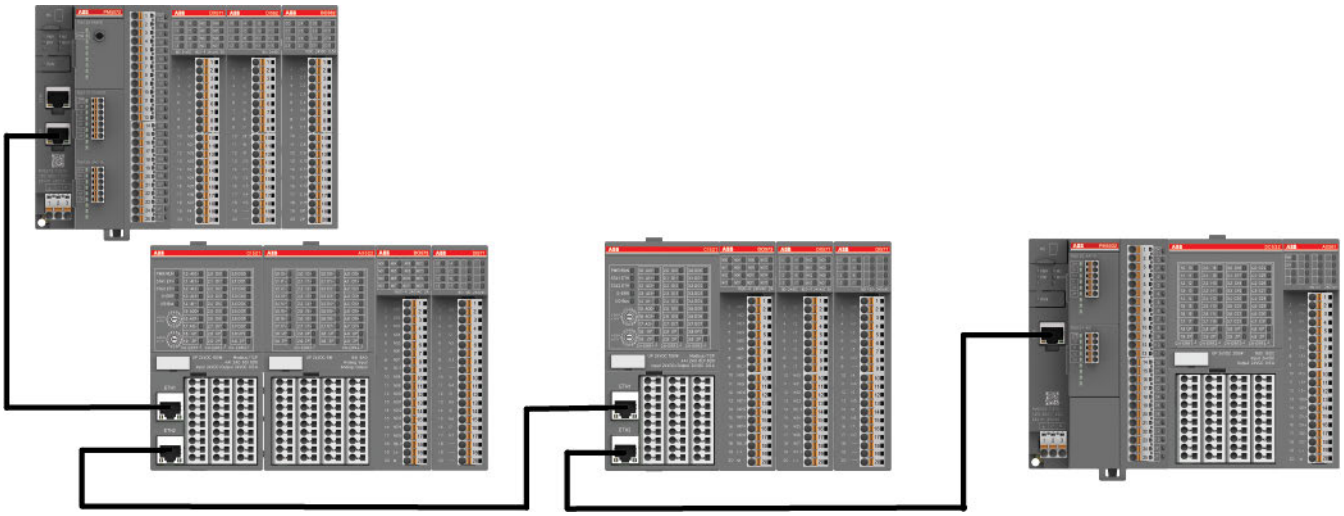
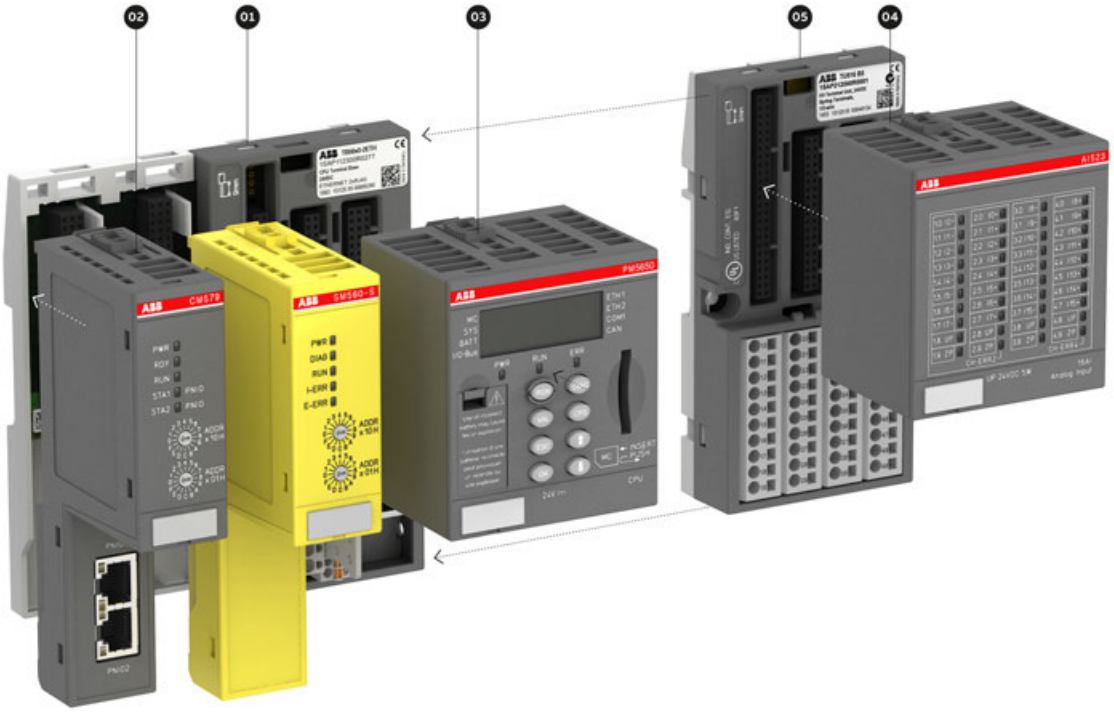


Fig. 4: I/O modules (S500-eCo) connected to an AC500-eCo processor module via Modbus/TCP network, using a Modbus/TCP, PROFINET or EtherCAT communication interface module or a processor module as client.

3.2 AC500/S500 system structure

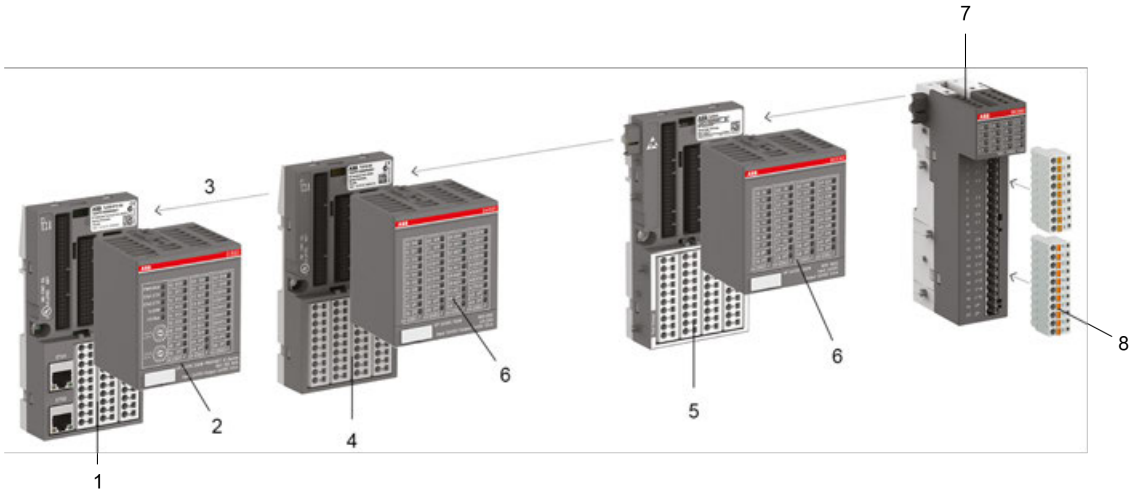
The AC500 product family provides a variety of modules and pluggable components for expanding the capabilities of the processor module with additional I/Os or other communication protocols. Depending on the features and functions of the processor module (CPU) compatible components can be added to a complete AC500 PLC system.

Centralized I/O extension



01 Terminal base for processor module and 0 to 6 communication modules, with serial and Ethernet interfaces
02 Communication module for, e.g., PROFIBUS, PROFINET, CAN,EtherCAT, and for support of safety solution
03 Processor module with integrated communication
04 I/O module, up to 10 I/O modules can be connected
05 Terminal unit for I/O modules, also for decentralized extension

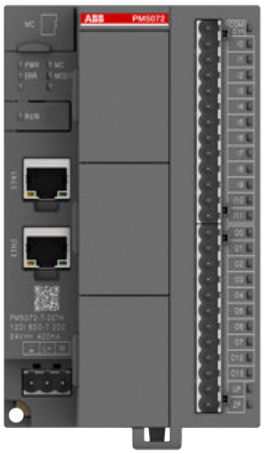
Decentralized I/O extension



1 Terminal unit for communication interface modules
2 Communication interface module with up to 24 integrated I/Os
3 I/O bus
4 Terminal unit for I/O modules, with screw or spring connection
5 Terminal unit for hot swap of I/O modules to exchange of I/O modules while the system is running
6 S500 I/O modules with up to 32 channels for analog and/or digital signals
7 Compact S500-eCo I/O modules with up to 16 channels for analog and/or digital signals
8 Removable terminal blocks

3.3 AC500-eCo/S500-eCo: Short description hardware

Processor modules



AC500-eCo processor modules contains the CPU with the core microprocessor of the PLC. It is integrated with power supply, onboard I/Os and communication interface.

Functions of the processor modules:

- Download the user programs.
- Run the CPU.
- Execute user programs in loops.
- Monitor the program input devices and the program output devices.

Processor modules are available in different performance classes and provide different numbers of onboard I/Os.

Only one processor module is required for a valid system architecture.

Option boards

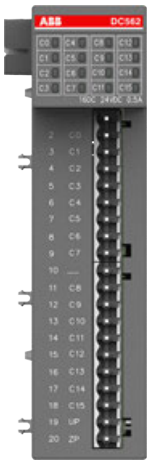


AC500-eCo processor modules can be extended with option boards. Option boards provide specific functionality. According to the processor module type, up to three option board slots are available for extension. Each option board slot supports most existing types of option board.

The option boards provide the following functionality for processor module extension:

- Serial interface RS232 (isolated), RS485 (isolated or not isolated) and CAN (interface isolated)
- Digital I/O channels extension (digital inputs, digital outputs, or mixed type)
- Analog I/O channels extension (analog inputs, analog outputs) for standard signal voltage or current, but also temperature measurement with RTD/NTC or thermocouple sensors
- RTC real-time clock board for processor module PM5012 (other processor modules include RTC functionality)
- Configuration address switch board for KNX protocol, only for processor modules PM5072, PM5082 and PM5092

I/O modules



If the number of onboard I/Os provided on the processor module is insufficient for a certain use case, the PLC can be expanded with I/O modules to meet the control requirements.

Memory

In the PLC, the memory is mainly used for saving system programs, user programs and work data. There are two types of memory: Volatile memory and nonvolatile memory.

- Volatile memory:
  All saved data will be lost after power failure of the memory but the memory can provide a high access rate and unlimited programming cycles. Common volatile memories mainly include SRAM and DRAM (including common memories such as SDRAM).
- Nonvolatile memory:
  All saved data will not be lost after power failure of the memory, but the memory is subject to a low read-write rate and limited rewrite cycles. Common nonvolatile memories mainly include NORflash, NANDflash, EEPROM, memory card, etc.

AC500 PLCs store all user programs in the nonvolatile memory to protect them from power failure. The programs are exported to the volatile memory during PLC operation to ensure high-speed and efficient operation. If user program debugging is finished, the programs can be fixed in the nonvolatile memory when they need no change. The work data is subject to frequent change and access during PLC operation. It is saved in the volatile memory to meet the requirements for random access.

The work data memory of the PLC has the memory area for input and output relay, auxiliary relay, timer, counter and other logic devices. The state of these devices depends on initial setting and operation of the user programs. Some data maintains its existing state by using built-in supercapacitors or backup batteries in the event of a power failure. The memory area for data saving in the event of a power failure is called the data retention area.

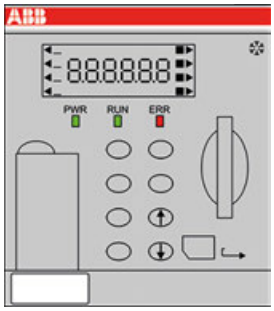
Power supply

The PLC is equipped with a switching power supply for the internal supply. In comparison with an ordinary power supply, the switching power supply has a higher stability and a higher noise immunity.

Some modules include a stabilized power supply for the supply of external sensors.

3.4 AC500/S500: Short description hardware

Processor modules



AC500 processor modules contain the CPU with the core component of the PLC. The CPU is connected with the user memory, input and output module, communication port and other units via the system bus and performs tasks by means of system programs preset in the system memory. The CPU adopts the function preset by the application program to command the PLC for operation.

The CPU has the following functions:

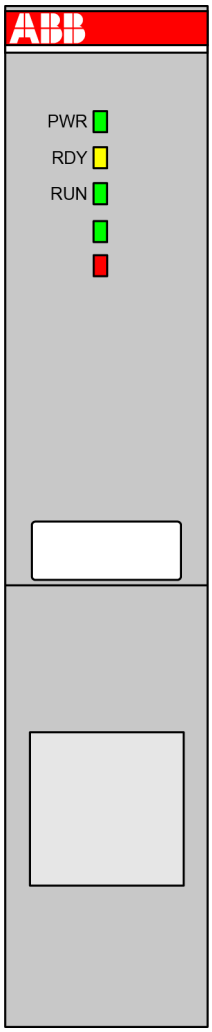
- To receive user programs and data entered
- To diagnose work faults of the power supply and PLC circuit as well as syntax errors in programming
- To receive the state or data of the site via the input interface and save it into the shadow register or data register
- To read the user programs in the memory one by one and execute them after interpretation
- To updating the state of the associated flag bits and the contents of the shadow register according to the execution results and providing output control using the output unit.

Processor modules are available in different performance classes. Only one processor module is required for a valid system architecture.

There are different types of processor module available that differ in the features and functions they provide, e.g. performance, LED display etc.

If required, processor modules are also available with an integrated Ethernet communication module (TCP/IP).

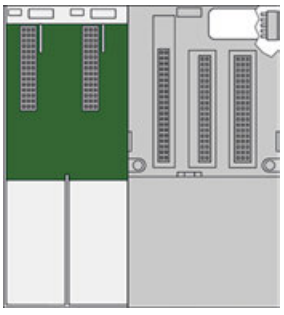
Communication modules



AC500 communication modules are required for the following:

- The connection to standard fieldbus systems.
- The integration into existing networks.
- The communication modules enable communication on different fieldbuses.
- The communication modules are mounted on the left side of the processor module on the same terminal base.
- The communication modules are directly powered via the internal communication module bus of the terminal base.
  A separate voltage source is not required.

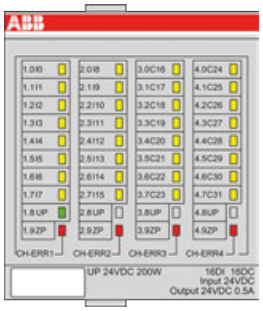
Terminal bases



The terminal base is needed for mounting and connecting the processor module and the communication modules. The modules are plugged on the terminal base.

> *The AC500-eCo processor modules and special AC500 (e.g. PM595) processor modules don't have a removable terminal base. The connections normally supported by a terminal base are part of the device.*

I/O modules



The I/O modules are the input/output unit which connects the PLC with the process. The PLC can detect controlled object data via the input interface and the data is taken as the basis for PLC control on the controlled object. In addition, the PLC sends processing results via the output interface to the controlled object to execute the control.

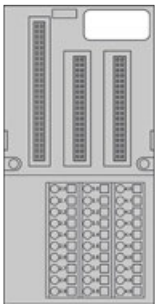
External input equipment and output equipment needs various signal levels whereas the information processed by the processor module in the PLC can only be the standard level. In order to perform this conversion, the I/O interface generally uses optical isolation and filtering to improve the interference immunity of the PLC. In addition, the I/O interface can generally indicate the working state to facilitate maintenance.

The PLC provides multiple I/O interfaces for operation level and drive capability to users for selection such as digital input, digital output, analog input, analog output, etc. I/O interfaces of the PLC interpret the number of input/output signals as the number of PLC I/O points. The number of I/O points is an important basis for PLC selection. If the system has insufficient I/O points, it can be expanded via the I/O extension interface of the PLC.

The I/O modules for digital and/or analog inputs and outputs are available in different versions and allow flexible use thanks to configurable channels.

The modules can be simply plugged onto a terminal unit for a centralized or decentralized I/O extension via communication interface modules.

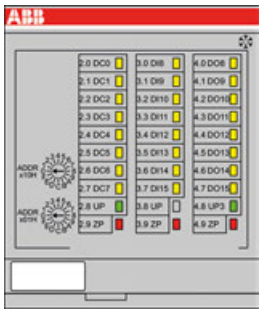
Terminal units



I/O modules and function modules are plugged on a terminal unit.

Terminal units enable simple prewiring without electronics and are available for 24 V DC and 120/230 V AC, optionally for spring or screw-type terminals.

Communication interface modules



Communication interface modules are used to build decentralized I/O stations in decentralized systems. They contain the fieldbus interface and a set of onboard I/O channels. Additional I/O modules can be attached to build larger decentralized I/O stations. A communication interface module is mounted on a terminal unit.

Function modules

Function modules extend the PLC system to perform special task control. These modules often provide independent components such as a CPU, system programs, memory and interfaces connected with the PLC system bus.

Function modules are connected with the PLC via the I/O bus to exchange data and independently work under cooperative management of the PLC.

Memory

In the PLC, the memory is mainly used for saving system programs, user programs and work data. There are two types of memory: volatile memory and non-volatile memory.

- Volatile memory:
  All saved data will be lost after power failure of the memory but the memory can provide a high access rate and unlimited programming cycles. Common volatile memories mainly include SRAM and DRAM (including common memories such as SDRAM).
- Nonvolatile memory:
  All saved data will not be lost after power failure of the memory, but the memory is subject to a low read-write rate and limited rewrite cycles. Common non-volatile memories mainly include NORflash, NANDflash, EEPROM, memory card, etc.

AC500 PLCs store all user programs in the non-volatile memory to protect them from power failure. The programs are exported to the volatile memory during operation of the PLC to ensure high-speed and efficient operation. If user program debugging is finished, the programs can be fixed in the non-volatile memory when they need no change. The work data is subject to frequent change and access during the PLC operation. It is saved in the volatile memory to meet the requirements for random access.

The work data memory of the PLC has the memory area for input and output relay, auxiliary relay, timer, counter and other logic devices. The state of these devices depends on initial setting and operation of the user programs. Some data maintains its existing state by using built-in supercapacitors or backup batteries in the event of a power failure. The memory area for data saving in the event of a power failure is called the data retention area.

Power supply

The PLC is equipped with a switching power supply for the internal supply. In comparison with an ordinary power supply, the switching power supply has a higher stability and a higher noise immunity.

Some modules include a stabilized power supply for the supply of external sensors.

3.5 AC500-S

Functional safety

The AC500-S safety user manual must be read and understood before using the safety configuration and programming tools of Automation Builder/PS501 Control Builder Plus. Only qualified personnel are permitted to work with AC500-S safety PLCs.

AC500-S safety user manual

The AC500-S safety PLC includes the following safety-relevant hardware components.

- SM560-S/SM560-S-FD-1/SM560-S-FD-4
- DI581-S
- DX581-S
- AI581-S
- TU582-S

4 Technical data of the system

4.1 System data AC500-eCo

4.1.1 Environmental conditions

Table 1: Process and supply voltages

Parameter		Value
24 V DC		
	Voltage	24 V (-15 %, +20 %)
	Protection against reverse polarity	Yes
24 V AC		
	Voltage	24 V (-15 %, +10 %)
	Frequency	50/60 Hz (-6 %, +4 %)
100 V AC ... 240 V AC wide-range supply		
	Voltage	100 V ... 240 V (-15 %, +10 %)
	Frequency	50/60 Hz (-6 %, +4 %)
Allowed interruptions of power supply, according to EN 61131-2		
	DC supply	Interruption < 10 ms, time between 2 interruptions > 1 s, PS2
	DC supply (only for analog option boards TA512x)	Interruption < 1 ms, time between 2 interruptions > 1s, PS1

NOTICE!

Risk of damaging the PLC due to improper voltage levels!

– Never exceed the maximum tolerance values for process and supply voltages.
– Never fall below the minimum tolerance values for process and supply voltages.

Observe the **system data** and the **technical data** of the used module.

↳ *Chapter 4.1 “System data AC500-eCo” on page 25*

NOTICE!

Improper voltage level or frequency range which cause damage of AC inputs:

– AC voltage above 264 V.
– Frequency below 47 Hz or above 62.4 Hz.

NOTICE!

Improper connection leads cause overtemperature on terminals.

PLC modules may be destroyed by using wrong cable type, wire size and cable temperature classification.

4.1.1.1 Processor modules

Table 2: Temperature ranges for processor modules revision 0

Parameter			**Value**		
			PM5012-x-ETH	**PM5032-x-ETH, PM5052-x-ETH, PM5072-T-2ETH**	**PM5072-T-2ETHW**
Temperature					
	Operating				
		Horizontal mounting	0 °C ... +55 °C	0 °C ... +60 °C	-20 °C ... +70 °C Between 60 °C ... 70° C: **I/O derating to 75 %** Only 75 % of the I/O channels are allowed to be energized simultaneously, e.g., only 6 of 8 output channels.
		Vertical mounting (output load reduced to 50 % per group)	0 °C ... +40 °C		-20 °C ... +40 °C
	Storage		-40 °C ... +70 °C		
	Transport		-40 °C ... +70 °C		
Humidity			Max. 95 %, without condensation		
Air pressure					
	Operating		> 800 hPa / < 2000 m		
	Storage		> 660 hPa / < 3500 m		



The PM5072-T-2ETHW (R0273) can be used down to -40 °C from the production index B0. The production index and the temperature range are printed on the side stickers of the module and packaging stickers.

Table 3: Temperature ranges for processor modules revision 1

Parameter			**Value**		
			PM5012-x-ETH	**PM5032-x-ETH, PM5052-x-ETH, PM5072-T-2ETH, PM5082-T-2ETH, PM5092-T-2ETH**	**PM5072-T-2ETHW**
Temperature					
	Operating				
		Horizontal mounting	0 °C ... +55 °C	-20 °C ... +60 °C	-40 °C ... +70 °C Between 60 °C ... 70° C: **I/O derating to 75 %** Only 75 % of the I/O channels are allowed to be energized simultaneously, e.g., only 6 of 8 output channels.

Parameter			Value		
			PM5012-x-ETH	**PM5032-x-ETH, PM5052-x-ETH, PM5072-T-2ETH, PM5082-T-2ETH, PM5092-T-2ETH**	**PM5072-T-2ETHW**
		Vertical mounting (output load reduced to 50 % per group)	0 °C ... +40 °C	-20 °C ... +40 °C	-40 °C ... +40 °C
	Storage		-40 °C ... +70 °C		
	Transport		-40 °C ... +70 °C		
Humidity			Max. 95 %, without condensation		
Coating			-		Basic PCB coating to enhance robustness.
Air pressure					
	Operating		> 800 hPa / < 2000 m		
	Storage		> 660 hPa / < 3500 m		

4.1.1.2 Option boards

Table 4: Standard temperature ranges with processor modules revision 0

Option boards	Configuration	Processor modules	Operating temperature ranges	Derating
Digital I/O option boards				
TA5101-4DI	Not relevant	PM5012-x-ETH	0 °C ... +55 °C	**No derating**
TA5105-4DOT		PM50x2-x-ETH	0 °C ... +60 °C	**No derating**
TA5110-2DI2DOT		PM5072-T-2ETH		
Analog input option boards				
TA5120-2AI-UI	Not relevant	PM5012-x-ETH	0 °C ... +55 °C	**No derating**
TA5122-2AI-TC		PM50x2-x-ETH	0 °C ... +60 °C	**No derating**
TA5123-2AI-RTD		PM5072-T-2ETH		
Analog output option boards				
TA5126-2AO-UI	0 V ... +10 V	PM5012-T-ETH	0 °C ... +55 °C	**No derating**
		PM50x2-R-ETH		
		PM50x2-T-ETH	0 °C ... +60 °C	**No derating**
		PM5072-T-2ETH		
	0 mA ... +20 mA	PM50x2-x-ETH	0 °C ... +45 °C	**No derating**
		PM5072-T-2ETH		Load: 0 Ω ... 500 Ω
			+45 °C ... +50 °C	**50 %**
				Load: 250 Ω ... 500 Ω
			+50 °C ... +55 °C	**100 %**
				Load: 500 Ω
Analog input/output option boards				
TA5128-2AI1AO	**Input:**	PM5012-x-ETH	0 °C ... +55 °C	**No derating**
	0 V ... +10 V			

Option boards	Configuration	Processor modules	Operating temperature ranges	Derating
		PM50x2-x-ETH PM5072-T-2ETH	0 °C ... +60 °C	**No derating**
	Output: 0 V ... +10 V	PM5012-x-ETH	0 °C ... +55 °C	**No derating**
		PM50x2-x-ETH PM5072-T-2ETH	0 °C ... +60 °C	**No derating**
	Output: 0 mA ... +20 mA	PM50x2-x-ETH PM5072-T-2ETH	0 °C ... +45 °C	**No derating** Load: 0 Ω ... 500 Ω
			+45 °C ... +50 °C	**50 %** Load: 250 Ω ... 500 Ω
			+50 °C ... +55 °C	**100 %** Load: 500 Ω
Accessory option boards				
TA5130-KNXPB	Not relevant	PM5072-T-2ETH	0 °C ... 60 °C	**No derating**
TA5131-RTC	Not relevant	PM5012-x-ETH	0 °C ... +55 °C	**No derating**
Option boards for serial interface				
TA5141-RS232I	Not relevant	PM5012-x-ETH	0 °C ... +55 °C	**No derating**
TA5142-RS485I TA5142-RS485		PM50x2-x-ETH PM5072-T-2ETH	0 °C ... +60 °C	**No derating**

Table 5: Standard temperature ranges with processor modules revision 1

Option boards	Configuration	Processor modules	Operating temperature ranges	Derating
Digital I/O option boards				
TA5101-4DI	Not relevant	PM5012-x-ETH	0 °C ... +55 °C	**No derating**
TA5105-4DOT TA5110-2DI2DOT		PM50x2-x-ETH PM50x2-T-2ETH	-20 °C ... +60 °C	**No derating**
Analog input option boards				
TA5120-2AI-UI	Not relevant	PM5012-x-ETH	0 °C ... +55 °C	**No derating**
TA5122-2AI-TC TA5123-2AI-RTD		PM50x2-x-ETH PM50x2-T-2ETH	-20 °C ... +60 °C	**No derating**
Analog output option boards				
TA5126-2AO-UI	0 V ... +10 V	PM5012-T-ETH	0 °C ... +55 °C	**No derating**
		PM50x2-R-ETH	-20 °C ... +55 °C	**No derating**
		PM50x2-T-ETH PM50x2-T-2ETH	-20 °C ... +60 °C	**No derating**
	0 mA ... +20 mA	PM5012-x-ETH	0 °C ... +45 °C	**No derating** Load: 0 Ω ... 500 Ω
		PM50x2-x-ETH PM50x2-T-2ETH	-20 °C ... +45 °C	
		PM50x2-x-ETH PM50x2-T-2ETH	+45 °C ... +50 °C	**50 %** Load: 250 Ω ... 500 Ω

Option boards	Configuration	Processor modules	Operating temperature ranges	Derating
		PM50x2-x-ETH PM50x2-T-2ETH	+50 °C ... +55 °C	**100 %** Load: 500 Ω
Analog input/output option boards				
TA5128-2AI1AO	**Input:** 0 V ... +10 V	PM5012-x-ETH	0 °C ... +55 °C	**No derating**
		PM50x2-x-ETH PM50x2-T-2ETH	-20 °C ... +60 °C	**No derating**
	Output: 0 V ... +10 V	PM5012-x-ETH	0 °C ... +55 °C	**No derating**
		PM50x2-x-ETH PM50x2-T-2ETH	-20 °C ... +60 °C	**No derating**
	Output: 0 mA ... +20 mA	PM5012-x-ETH	0 °C ... +55 °C	**No derating**
		PM50x2-x-ETH PM50x2-T-2ETH	-20 °C ... +60 °C	**No derating**
Accessory option boards				
TA5130-KNXPB	Not relevant	PM50x2-T-2ETH	-20 °C ... 60 °C	**No derating**
TA5131-RTC	Not relevant	PM5012-x-ETH	0 °C ... +55 °C	**No derating**
Option boards for serial interface				
TA5141-RS232I	Not relevant	PM5012-x-ETH	0 °C ... +55 °C	**No derating**
TA5142-RS485I TA5142-RS485		PM50x2-x-ETH PM50x2-T-2ETH	-20 °C ... +60 °C	**No derating**
TA5146-CN	Not relevant	PM50x2-x-ETH PM50x2-T-2ETH	-20 °C ... +60 °C	**No derating**

The option bords W version can be used down to -40 °C from the production index B0. The production index and the temperature range are printed on the side stickers of the module and packaging stickers.

Table 6: Wide temperature ranges

Option boards	Configuration	Processor modules	Operating temperature ranges	Derating
Digital I/O option boards				
TA5101-4DIW TA5105-4DOTW TA5110-2DI2DOW	Not relevant	PM5072-T-2ETHW	-40 °C ... +60 °C	**No derating**
			+60 °C ... +70 °C	**I/O derating to 75 %** Only 3 of 4 I/O channels are allowed to be energized simultaneously.
Analog input option boards				
TA5120-2AI-UIW TA5123-2AI-RTW	Not relevant	PM5072-T-2ETHW	-40 °C ... +60 °C	**No derating**
TA5122-2AI-TC(W)	Not relevant	PM5072-T-2ETHW	-40 °C ... +70 °C	**No derating**

Option boards	Configuration	Processor modules	Operating temperature ranges	Derating
Analog output option boards				
TA5126-2AO-UIW	0 V ... +10 V	PM5072-T-2ETHW	-40 °C ... +60 °C	**No derating**
	0 mA ... +20 mA	PM5072-T-2ETHW	-40 °C ... +45 °C	**No derating** Load: 0 Ω ... 500 Ω
			+45 °C ... +50 °C	**50 %** Load: 250 Ω ... 500 Ω
			+50 °C ... +55 °C	**100 %** Load: 500 Ω
Analog input/output option boards				
TA5128-2AI1AOW	**Input:** 0 V ... +10 V	PM5072-T-2ETHW	-40 °C ... +70 °C	**No derating**
	Output: 0 V ... +10 V	PM5072-T-2ETHW	-40 °C ... +70 °C	**No derating**
	Output: 0 mA ... +20 mA	PM5072-T-2ETHW	-40 °C ... +65 °C	**No derating**
Option boards for serial interface				
TA5141-RS232IW TA5142-RS485IW TA5142-RS485W	Not relevant	PM5072-T-2ETHW	-40 °C ... +70 °C	**No derating**
TA5146-CNW	Not relevant	PM5072-T-2ETHW	-40 °C ... +70 °C	**No derating**

4.1.1.3 I/O modules

Table 7: Temperature ranges and environmental conditions for I/O modules

Parameter	Value	
Temperature		
Operating		
Horizontal mounting		
Module type	**Index below E0**	**From index E0**
AI561	0 °C … +60 °C	-20 °C ... +60 °C
AI562	0 °C … +60 °C	-20 °C ... +60 °C
AI563	0 °C … +60 °C	-20 °C ... +60 °C
AI564	-20 °C ... +60 °C	
AI565	-20 °C ... +60 °C	
AI568	-20 °C ... +60 °C	
AO561	0 °C … +60 °C	-20 °C ... +60 °C
AO562	-20 °C ... +60 °C	
AO568	-20 °C ... +60 °C	
AX561	0 °C … +60 °C	-20 °C ... +60 °C
DC562	0 °C … +60 °C	

Parameter		Value	
DI561	0 °C … +60 °C	-20 °C ... +60 °C	
DI562	0 °C … +60 °C	-20 °C ... +60 °C	
DI571	0 °C … +60 °C		
DI572	0 °C … +60 °C		
DO561	0 °C … +60 °C	-20 °C ... +60 °C	
DO562	0 °C … +60 °C		
DO571	0 °C … +60 °C		
DO572	0 °C … +60 °C		
DO573	0 °C … +60 °C		
DX561	0 °C … +60 °C	-20 °C ... +60 °C	
DX571	0 °C … +60 °C		
FM565	-20 °C ... +60 °C		
FM566	-20 °C ... +60 °C		
Vertical mounting (output load reduced to 50 % per group)			
Module type	**Index below E0**	**From index E0**	
AI561	0 °C ... +40 °C	-20 °C … +40 °C	
AI562	0 °C ... +40 °C	-20 °C … +40 °C	
AI563	0 °C ... +40 °C	-20 °C … +40 °C	
AI564	-20 °C … +40 °C		
AI565	-20 °C … +40 °C		
AI568	-20 °C … +40 °C		
AO561	0 °C ... +40 °C	-20 °C … +40 °C	
AO562	-20 °C … +40 °C		
AO568	-20 °C … +40 °C		
AX561	0 °C ... +40 °C	-20 °C … +40 °C	
DC562	0 °C ... +40 °C		
DI561	0 °C ... +40 °C	-20 °C … +40 °C	
DI562	0 °C ... +40 °C	-20 °C … +40 °C	
DI571	0 °C ... +40 °C		
DI572	0 °C ... +40 °C		
DO561	0 °C ... +40 °C	-20 °C … +40 °C	
DO562	0 °C ... +40 °C		
DO571	0 °C ... +40 °C		
DO572	0 °C ... +40 °C		
DO573	0 °C ... +40 °C		
DX561	0 °C ... +40 °C	-20 °C … +40 °C	
DX571	0 °C ... +40 °C		
FM565	-20 °C … +40 °C		
FM566	-20 °C … +40 °C		

Parameter			Value
	Storage		
		All module types	-40 °C ... +70 °C
	Transport		
		All module types	-40 °C ... +70 °C
Humidity			
	All module types		Max. 95 %, without condensation
Air pressure			
	Operating		
		All module types	> 800 hPa / < 2000 m
	Storage		
		All module types	> 660 hPa / < 3500 m

4.1.2 Creepage distances and clearances

The creepage distances and clearances meet the requirements of the overvoltage category II, pollution degree 2.

4.1.3 Power supply units

AC500 and AC500-eCo PLC devices are Class II/Class III devices and do not require a Protective Earth (PE) connection.

For proper EMC performance, all metal parts, DIN rails, mounting screws, and cable shield connection terminals are connected to a common ground and provide Functional Earth (FE). This is typically connected to a common reference potential, such as equipotential bonding rails.

Signal Grounds (SGND or GND) are used for signal reference and must not be connected to cable shields, FE or other signals unless otherwise specified in the specific device description.

For the supply of the modules, power supply units according to SELV or PELV specifications must be used.

Safety Extra Low Voltage (SELV) and Protective Extra Low Voltage (PELV)

To ensure electrical safety of AC500/AC500-eCo extra low voltage circuits, 24 V DC supply, communication interfaces, I/O circuits, and all connected devices must be powered from sources meeting requirements of SELV, PELV, class 2, limited voltage or limited power according to applicable standards.



WARNING!

Improper installation can lead to death by touching hazardous voltages!

To avoid personal injury, safe separation, double or reinforced insulation and separation of the primary and secondary circuit must be observed and implemented during installation.

– Only use power converters for safety extra-low voltages (SELV) with safe galvanic separation of the primary and secondary circuit.
– Safe separation means that the primary circuit of mains transformers must be separated from the secondary circuit by double or reinforced insulation. The protective extra-low voltage (PELV) offers protection against electric shock.

4.1.4 Electromagnetic compatibility

Table 8: Electromagnetic compatibility

Parameter	Value
Device suitable only as *Control Equipment for Industrial Applications*, including marine applications. IEC 61131-2, zone B ↬ *Chapter 4.1.6 "Approvals and certifications" on page 34*	
Radiated emission according to IEC 61000-6-4 CISPR11, class A	Yes
Conducted emission according to IEC 61000-6-4 CISPR11, class A	Yes
Electrostatic discharge (ESD) according to IEC 61000-4-2, criterion B	Air discharge: 8 kV Contact discharge: 6 kV
Fast transient interference voltages (burst) according to IEC 61000-4-4, criterion B	Power supply (DC): 2 kV Digital inputs/outputs (24 V DC): 1 kV Digital inputs/outputs (240 V AC): 2 kV Analog inputs/outputs: 1 kV Communication lines shielded: 1 kV
High energy transient interference voltages (surge) according to IEC 61000-4-5, criterion B	Power supply (DC): - Line to ground: 1 kV - Line to line: 0,5 kV Digital inputs/outputs/relay: (24 V DC): - Line to ground: 1 kV (AC): - Line to ground: 2 kV - Line to line: 1 kV Analog inputs/outputs: - Line to ground: 1 kV Communication lines: - Line to ground: 1 kV

Parameter	Value
Influence of radiated disturbances IEC 61000-4-3, criterion A	Test field strength: 10 V/m
Influence of line-conducted interferences IEC 61000-4-6, criterion A	Test voltage: 10 V
Power frequency magnetic fields IEC 61000-4-8, criterion A	30 A/m 50 Hz 30 A/m 60 Hz

4.1.5 Mechanical data

Parameter	Value
Mounting	Horizontal/vertical
Wiring method	Spring/screw terminals
Degree of protection	PLC system: IP 20 ● With all modules or option boards plugged in. ● With all terminals plugged in. ● With all covers closed.
Housing	Classification V-0 according to UL 94
Vibration resistance (sinusoidal) acc. to IEC 60068-2-6	All three axes 2 Hz ... 8.4 Hz, 3.5 mm peak, 8.4 Hz ... 150 Hz, 1 g
Shock test acc. to IEC 60068-2-27	All three axes 15 g, 11 ms, half-sinusoidal
Mounting of the modules:	
Mounting Rail Top Hat according to IEC 60715	35 mm, depth 7.5 mm or 15 mm
Mounting with screws	M4
Fastening torque	1.2 Nm

4.1.6 Approvals and certifications

The PLC Automation catalog contains an *overview of the available approvals and certifications*.

4.2 System data AC500

4.2.1 Environmental conditions

Table 9: Process and supply voltages

Parameter		Value
24 V DC		
	Voltage	24 V (-15 %, +20 %)
	Protection against reverse polarity	Yes
100 V AC...240 V AC wide-range supply		

Parameter		Value
	Voltage	100 V ... 240 V (-15 %, +10 %)
	Frequency	50/60 Hz (-6 %, +4 %)
Allowed interruptions of power supply, according to EN 61131-2		
	DC supply	Interruption < 10 ms, time between 2 interruptions > 1 s, PS2
	AC supply	Interruption < 0.5 periods, time between 2 interruptions > 1 s

NOTICE!

Risk of damaging the PLC due to improper voltage levels!

– Never exceed the maximum tolerance values for process and supply voltages.
– Never fall below the minimum tolerance values for process and supply voltages.

Observe the **system data** *Chapter 4.2 “System data AC500” on page 34* and the **technical data** of the module used.

NOTICE!

Improper voltage level or frequency range which cause damage of AC inputs:

– AC voltage above 264 V.
– Frequency below 47 Hz or above 62.4 Hz.

NOTICE!

Improper connection leads cause overtemperature on terminals.

PLC modules may be destroyed by using wrong cable type, wire size and cable temperature classification.

Parameter		Value
Temperature		
	Operating	0 °C ... +60 °C: Horizontal mounting of modules. 0 °C ... +40 °C: Vertical mounting of modules. Output load reduced to 50 % per group.
	Storage	-40 °C ... +70 °C
	Transport	-40 °C ... +70 °C
Humidity		Max. 95 %, without condensation
Air pressure		
	Operating	> 800 hPa / < 2000 m
	Storage	> 660 hPa / < 3500 m

4.2.2 Creepage distances and clearances

The creepage distances and clearances meet the requirements of the overvoltage category II, pollution degree 2.

4.2.3 Power supply units



AC500 and AC500-eCo PLC devices are Class II/Class III devices and do not require a Protective Earth (PE) connection.

For proper EMC performance, all metal parts, DIN rails, mounting screws, and cable shield connection terminals are connected to a common ground and provide Functional Earth (FE). This is typically connected to a common reference potential, such as equipotential bonding rails.

Signal Grounds (SGND or GND) are used for signal reference and must not be connected to cable shields, FE or other signals unless otherwise specified in the specific device description.

For the supply of the modules, power supply units according to SELV or PELV specifications must be used.



Safety Extra Low Voltage (SELV) and Protective Extra Low Voltage (PELV)

To ensure electrical safety of AC500/AC500-eCo extra low voltage circuits, 24 V DC supply, communication interfaces, I/O circuits, and all connected devices must be powered from sources meeting requirements of SELV, PELV, class 2, limited voltage or limited power according to applicable standards.



WARNING!

Improper installation can lead to death by touching hazardous voltages!

To avoid personal injury, safe separation, double or reinforced insulation and separation of the primary and secondary circuit must be observed and implemented during installation.

- Only use power converters for safety extra-low voltages (SELV) with safe galvanic separation of the primary and secondary circuit.
- Safe separation means that the primary circuit of mains transformers must be separated from the secondary circuit by double or reinforced insulation. The protective extra-low voltage (PELV) offers protection against electric shock.

4.2.4 Electromagnetic compatibility

Table 10: Electromagnetic compatibility

Parameter	Value
Device suitable only as *Control Equipment for Industrial Applications*, including marine applications. IEC 61131-2, zone B *Chapter 4.2.6 "Approvals and certifications" on page 38*	
Radiated emission according to IEC 61000-6-4 CISPR11, class A	Yes
Conducted emission according to IEC 61000-6-4 CISPR11, class A	Yes
Electrostatic discharge (ESD) according to IEC 61000-4-2, criterion B	Air discharge: 8 kV Contact discharge: 6 kV
Fast transient interference voltages (burst) according to IEC 61000-4-4, criterion B	Power supply (DC): 2 kV Digital inputs/outputs (24 V DC): 1 kV Digital inputs/outputs (240 V AC): 2 kV Analog inputs/outputs: 1 kV Communication lines shielded: 1 kV
High energy transient interference voltages (surge) according to IEC 61000-4-5, criterion B	Power supply (DC): - Line to ground: 1 kV - Line to line: 0,5 kV Digital inputs/outputs/relay: (24 V DC): - Line to ground: 1 kV (AC): - Line to ground: 2 kV - Line to line: 1 kV Analog inputs/outputs: - Line to ground: 1 kV Communication lines: - Line to ground: 1 kV
Influence of radiated disturbances IEC 61000-4-3, criterion A	Test field strength: 10 V/m
Influence of line-conducted interferences IEC 61000-4-6, criterion A	Test voltage: 10 V
Power frequency magnetic fields IEC 61000-4-8, criterion A	30 A/m 50 Hz 30 A/m 60 Hz

4.2.5 Mechanical data

Parameter	Value
Mounting	Horizontal/Vertical
Wiring method	Spring/screw terminals
Degree of protection	PLC system: IP 20 ● With all modules or option boards plugged in. ● With all terminals plugged in. ● With all covers closed.
Housing	Classification V-2 according to UL 94
Vibration resistance (sinusoidal) acc. to IEC 60068-2-6	All three axes 2 Hz ... 8.4 Hz, 3.5 mm peak, 8.4 Hz ... 150 Hz, 1 g
Shock test acc. to IEC 60068-2-27	All three axes 15 g, 11 ms, half-sinusoidal
Mounting of the modules:	
Mounting Rail Top Hat according to IEC 60715	35 mm, depth 7.5 mm or 15 mm
Mounting with screws	M4
Fastening torque	1.2 Nm

4.2.6 Approvals and certifications

The PLC Automation catalog contains an *overview of the available approvals and certifications*.

4.3 System data AC500-XC

4.3.1 Environmental conditions

Table 11: Process and supply voltages

Parameter		Value
24 V DC		
	Voltage	24 V (-15 %, +20 %)
	Protection against reverse polarity	Yes
100 V AC...240 V AC wide-range supply		
	Voltage	100 V ... 240 V (-15 %, +10 %)
	Frequency	50/60 Hz (-6 %, +4 %)
Allowed interruptions of power supply, according to EN 61131-2		
	DC supply	Interruption < 10 ms, time between 2 interruptions > 1 s, PS2
	AC supply	Interruption < 0.5 periods, time between 2 interruptions > 1 s

NOTICE!

Risk of damaging the PLC due to improper voltage levels!

– Never exceed the maximum tolerance values for process and supply voltages.
– Never fall below the minimum tolerance values for process and supply voltages.

Observe the **system data** *Chapter 4.2 “System data AC500” on page 34* and the **technical data** of the module used.

NOTICE!

Improper voltage level or frequency range which cause damage of AC inputs:

– AC voltage above 264 V.
– Frequency below 47 Hz or above 62.4 Hz.

NOTICE!

Improper connection leads cause overtemperature on terminals.

PLC modules may be destroyed by using wrong cable type, wire size and cable temperature classification.

Parameter		**Value**
Temperature		
	Operating	-40 °C ... +70 °C -40 °C ... 0 °C: Due to the LCD technology, the display might respond very slowly. -40 °C ... +40 °C: Vertical mounting of modules possible, output load limited to 50 % per group +60 °C ... +70 °C with the following deratings: ● System is limited to maximum 2 communication modules per terminal base. ● Digital inputs: maximum number of simultaneously switched on input channels limited to 75 % per group (e.g. 8 channels => 6 channels). ● Digital outputs: output current maximum value (all channels together) limited to 75 % per group (e.g. 8 A => 6 A). ● Analog outputs only if configured as voltage output: maximum total output current per group is limited to 75 % (e.g. 40 mA => 30 mA). ● Analog outputs only if configured as current output: maximum number of simultaneously used output channels limited to 75 % per group (e.g. 4 channels => 3 channels).
	Storage / Transport	-40 °C ... +85 °C
Humidity		Operating / Storage: 100 % r. H. with condensation

Parameter	Value
Air pressure	Operating: -1000 m .... 5000 m (1080 hPa ... 620 hPa) > 2000 m (< 795 hPa): ● Maximum operating temperature must be reducted by 10 K for each 1000 m exceeding 2000 m. ● I/O module relay contacts must be operated with 24 V nominal only.
Immunity to corrosive gases	Yes, according to: ISA S71.04.1985 Harsh group A, G3/GX IEC60068-2-60 Method 4 with the following concentrations: ● H2S 100 ± 10ppb ● NO2 1250 ± 20ppb ● CL2 100 ± 10ppb ● SO2 300 ± 20ppb
Immunity to salt mist	Yes, horizontal mounting only, according to IEC 60068-2-52 severity level: 1

NOTICE!

Risk of corrosion!

Unused connectors and slots may corrode if XC devices are used in salt-mist environments.

Protect unused connectors and slots with TA535 protective caps for XC devices ↳ *Chapter 5.8.3.6 “TA535 - Protective caps for XC devices” on page 1418*.

NOTICE!

Risk of malfunctions!

Unused slots for communication modules are not protected against accidental physical contact.

– Unused slots for communication modules must be covered with dummy communication modules to achieve IP20 rating ↳ *Chapter 5.8.2.5 “TA524 - Dummy communication module” on page 1409*.
– I/O bus connectors must not be touched during operation.

4.3.2 Creepage distances and clearances

The creepage distances and clearances meet the requirements of the overvoltage category II, pollution degree 2.

4.3.3 Power supply units

AC500 and AC500-eCo PLC devices are Class II/Class III devices and do not require a Protective Earth (PE) connection.

For proper EMC performance, all metal parts, DIN rails, mounting screws, and cable shield connection terminals are connected to a common ground and provide Functional Earth (FE). This is typically connected to a common reference potential, such as equipotential bonding rails.

Signal Grounds (SGND or GND) are used for signal reference and must not be connected to cable shields, FE or other signals unless otherwise specified in the specific device description.

Safety Extra Low Voltage (SELV) and Protective Extra Low Voltage (PELV)

To ensure electrical safety of AC500/AC500-eCo extra low voltage circuits, 24 V DC supply, communication interfaces, I/O circuits, and all connected devices must be powered from sources meeting requirements of SELV, PELV, class 2, limited voltage or limited power according to applicable standards.

WARNING!

Improper installation can lead to death by touching hazardous voltages!

To avoid personal injury, safe separation, double or reinforced insulation and separation of the primary and secondary circuit must be observed and implemented during installation.

- Only use power converters for safety extra-low voltages (SELV) with safe galvanic separation of the primary and secondary circuit.
- Safe separation means that the primary circuit of mains transformers must be separated from the secondary circuit by double or reinforced insulation. The protective extra-low voltage (PELV) offers protection against electric shock.

4.3.4 Electromagnetic compatibility

Table 12: Electromagnetic compatibility

Parameter	Value
Device suitable only as *Control Equipment for Industrial Applications*, including marine applications. IEC 61131-2, zone B *Chapter 4.3.6 “Approvals and certifications” on page 43*	
Radiated emission according to IEC 61000-6-4 CISPR11, class A	Yes
Conducted emission according to IEC 61000-6-4 CISPR11, class A	Yes
Electrostatic discharge (ESD) according to IEC 61000-4-2, criterion B	Air discharge: 8 kV Contact discharge: 6 kV

Parameter	Value
Fast transient interference voltages (burst) according to IEC 61000-4-4, criterion B	Power supply (DC): 4 kV Digital inputs/outputs (24 V DC): 2 kV Digital inputs/outputs (240 V AC): 4 kV Analog inputs/outputs: 2 kV Communication lines shielded: 2 kV
High energy transient interference voltages (surge) according to IEC 61000-4-5, criterion B	Power supply (DC): - Line to ground: 1 kV - Line to line: 0,5 kV Digital inputs/outputs/relay: (24 V DC): - Line to ground: 1 kV (AC): - Line to ground: 2 kV - Line to line: 1 kV Analog inputs/outputs: - Line to ground: 1 kV Communication lines: - Line to ground: 1 kV
Influence of radiated disturbances IEC 61000-4-3, criterion A	Test field strength: 10 V/m
Influence of line-conducted interferences IEC 61000-4-6, criterion A	Test voltage: 10 V
Power frequency magnetic fields IEC 61000-4-8, criterion A	30 A/m 50 Hz 30 A/m 60 Hz

4.3.5 Mechanical data

Parameter	Value
Mounting	Horizontal/vertical (no application in salt mist environment)
Wiring method	Spring terminals
Degree of protection	PLC system: IP 20 ● With all modules or option boards plugged in. ● With all terminals plugged in. ● With all covers closed.
Housing	Classification V-2 according to UL 94
Vibration resistance (sinusoidal) acc. to IEC 60068-2-6	2 Hz ... 8.4 Hz, 3.5 mm peak, 8.4 Hz ... 500 Hz, 2 g
Vibration resistance (broadband random) acc. to IEC 60068-2-64	5 Hz ... 500 Hz, 1,9 g rms (operational) 5 Hz ... 500 Hz, 4 g rms (non operational)

Parameter	Value
Shock resistance	All three axes 15 g, 11 ms, half-sinusoidal
Mounting of the modules:	
Mounting Rail Top Hat according to IEC 60715	35 mm, depth 7.5 mm or 15 mm
Mounting with screws	M4
Fastening torque	1.2 Nm

4.3.6 Approvals and certifications

The PLC Automation catalog contains an *overview of the available approvals and certifications*.

4.4 AC500-S

Functional safety

The AC500-S safety user manual must be read and understood before using the safety configuration and programming tools of Automation Builder/PS501 Control Builder Plus. Only qualified personnel are permitted to work with AC500-S safety PLCs.

AC500-S safety user manual

The AC500-S safety PLC includes the following safety-relevant hardware components.

- SM560-S/SM560-S-FD-1/SM560-S-FD-4
- DI581-S
- DX581-S
- AI581-S
- TU582-S

4.5 CP600

The technical data of the CP600 control panels are included in the *CP600 data sheets*.

5 Device specifications

5.1 Processor modules

5.1.1 AC500-eCo

5.1.1.1 PM5012, PM5032, PM5052, PM5072, PM5082, PM5092

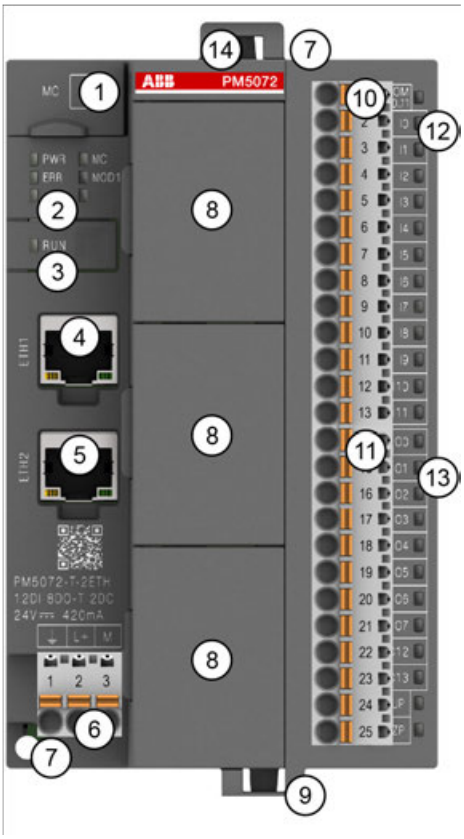


Fig. 5: Example: PM5072-T-2ETH

1 Micro memory card slot
2 5 LEDs to display the states of the processor module (Power, Error, Run, MC, MOD1)
3 RUN button
4 RJ45 female connector for Ethernet1 connection
5 RJ45 female connector for Ethernet2 connection (available for PM50x2-T-2ETH)
6 3-pin terminal block for power supply 24 V DC
7 2 holes for screw mounting
8 Option board slot cover for option board slot (the number of available slots varies according to the CPU type)
9 Cable fixing
10 13-pin terminal block for onboard I/Os
11 12-pin terminal block for onboard I/Os (not available on PM5012-x-ETH)
12 12 LEDs to display the states of the signals
13 10 LEDs to display the states of the signals
14 Cable fixing accessory TA5301-CFA on the top of the housing (optional)

The processor module is shown with pluggable terminal blocks. These terminal blocks must be ordered separately.

The cable fixing accessory on the top of the housing is optional.

Please use TA5301-CFA cable fixing accessory to provide strain relief.

It can also be used for AC500-eCo I/O modules.

The PM50x2 processor modules are supplied with option board slot covers as standard.

There are various TA51xx option boards for the processor modules that can be ordered separately.

Which and how many option boards can be plugged, depends on the respective processor module.

NOTICE!

Risk of damaging low voltage devices

Make sure that all channels of installed low voltage devices (between 100 VAC...240 VAC) are supplied from the same phase.

Table 13: AC500-eCo processor modules with their most important properties

Processor modules	Total maximum downloadable application size	Configurable input/output	Digital inputs	Digital outputs	Power supply	Ethernet interfaces	Option board slots
Basic CPUs							
PM5012-T-ETH	1 MB thereof 256 kB for user program code and data dynamically allocated	-	6	4 (Transistor)	24 V DC	1	1
PM5012-R-ETH	1 MB thereof 256 kB for user program code and data dynamically allocated	-	6	4 (Relay)	24 V DC	1	1
Standard CPUs							
PM5032-T-ETH	5 MB thereof 512 kB for user program code and data dynamically allocated	2 (Transistor)	12	8 (Transistor)	24 V DC	1	2

Processor modules	Total maximum downloadable application size	Configurable input/output	Digital inputs	Digital outputs	Power supply	Ethernet interfaces	Option board slots
PM5032-R-ETH	5 MB thereof 512 kB for user program code and data dynamically allocated	2 (Transistor)	12	6 (Relay)	24 V DC	1	2
PM5052-T-ETH	7 MB thereof 768 kB for user program code and data dynamically allocated	2 (Transistor)	12	8 (Transistor)	24 V DC	1	3
PM5052-R-ETH	7 MB thereof 768 kB for user program code and data dynamically allocated	2 (Transistor)	12	6 (Relay)	24 V DC	1	3
Pro CPUs							
PM5072-T-2ETH	9 MB thereof 1 MB for user program code and data dynamically allocated	2 (Transistor)	12	8 (Transistor)	24 V DC	2	3
PM5072-T-2ETHW *)	9 MB thereof 1 MB for user program code and data dynamically allocated	2 (Transistor)	12	8 (Transistor)	24 V DC	2	3

Processor modules	Total maximum downloadable application size	Configurable input/output	Digital inputs	Digital outputs	Power supply	Ethernet interfaces	Option board slots
PM5082-T-2ETH	9 MB thereof 1 MB for user program code and data dynamically allocated	2 (Transistor)	12	8 (Transistor)	24 V DC	2	3
PM5092-T-2ETH	9 MB thereof 2 MB for user program code and data dynamically allocated	2 (Transistor)	12	8 (Transistor)	24 V DC	2	3

*) W = wide temperature range

5.1.1.1.1 Short description

The processor modules are the central units of the PLC.

The main characteristics of the processor modules:

- Power supply 24 V DC
- I/O bus (not for PM5012-x-ETH)
- Real-time clock (PM5012-x-ETH needs additional RTC option board)
- Option board slots for extension on the CPU (1 for PM5012-x-ETH, 2 for PM5032-x-ETH, 3 for PM5052-x-ETH and PM50x2-T-2ETH)
- 6 digital inputs (PM5012-x-ETH), 12 digital inputs (PM5032-x-ETH, PM5052-x-ETH, PM50x2-T-2ETH)
- 4 transistor outputs (PM5012-T-ETH), 8 transistor outputs (PM5032-T-ETH, PM5052-T-ETH, PM50x2-T-2ETH)
- 4 relay outputs (PM5012-R-ETH), 6 relay outputs (PM5032-R-ETH, PM5052-R-ETH)
- 2 configurable digital inputs/outputs (not for PM5012-x-ETH)

The various processor module variants differ in the following characteristics:

- Type of the digital outputs (transistor or relays)
- Ethernet interface one or two independent interfaces

All processor module variants include a micro memory card slot.

Details and technical data are provided in the technical data section *Chapter 5.1.1.1.7 “Technical data” on page 58*.

5.1.1.1.2 Assortment

Detailed data

Parameter	Value					
	PM5012	PM5032	PM5052	PM5072	PM5082	PM5092
DRAM memory (HW installed)	128 MB	128 MB	128 MB	128 MB	256 MB	256 MB
Total maximum downloadable application size [1)]	1 MB	5 MB	7 MB	9 MB	18 MB	24 MB

Parameter		Value					
		PM5012	**PM5032**	**PM5052**	**PM5072**	**PM5082**	**PM5092**
	Thereof user program code / data memory dynamically allocated	256 KB	512 KB	768 KB	1 MB	2 MB	3 MB
	Thereof user web server memory for web visualization max.	no web	1.5 MB	3.2 MB	7 MB	16 MB	21 MB
Flash memory for user data							
	Flash memory EMMc (HW installed)	128 MB	128 MB	128 MB	128 MB	512 MB	512 MB
	Remaining for all other usage (project save, infra- structure...)	30 MB	30 MB	30 MB	30 MB	285 MB	285 MB
Buffered (FRAM)		8 KB	32 KB	32 KB	100 KB	100 KB	100 KB
	VAR_RETAIN persistent	4 KB	16 KB	16 KB	36 KB	36 KB	36 KB
	%MB data	4 KB	16 KB	16 KB	64 KB	64 KB	64 KB
Expandable memory		None	None	None	None	None	None
Integrated mass storage memory (FLASH)		None	None	None	None	None	None
Slot for pluggable memory card		x	x	x	x	x	x
Real-time clock (RTC)		Optional with TA5131-RTC	Built in				
Min. retention time for RTC at room temperature (if at least powered for 8 hours)		7 days	20 days				
	Accuracy	±2 s/ day					
Programming languages		● Instruction List (IL) ● Function Block Diagram (FBD) ● Ladder Diagram (LD) ● Sequential Function Chart (SFC) ● Structured Text (ST) ● Continuous Function Chart (CFC)					
	Processor type	TI ARM Cortex-A9 32-bit-RISC					
	Processor clock speed	300 MHz				600 MHz	800 MHz
Calculation time per instructions (minimum)		PM5012	PM5032	PM5052	PM5072	PM5082	PM5092
	Binary	20 ns				10 ns	10 ns
	Word	50 ns				10 ns	10 ns
	Floating point	600 ns				10 ns	10 ns
	Lowest cycle time usable (also f. PTO)	-	5 ms	2 ms	1 ms	1 ms	0.5 ms
Using onboard EtherCAT protocol (licensed) in preparation							

Parameter		Value					
		PM5012	**PM5032**	**PM5052**	**PM5072**	**PM5082**	**PM5092**
EtherCAT onboard No. of synchronized axis		PM5012	PM5032	PM5052	PM5072	PM5082	PM5092
	axis per 1 ms typically	-	-	-	-	2 - 4*	3 - 6*
	axis per 2 ms typically	-	-	-	2 - 4*	4 - 8*	8 - 12*
	axis per 4 ms typically	-	-	-	4 - 8*	8 - 16	16 - 24
	Cyclic min. configurable	10 ms	5 ms	2 ms	1 ms	1 ms	1 ms
	Time-controlled	Yes					
	Multitasking	Yes					
	Interruption	Yes					
LEDs		Power, Error, Run, MC, MOD1, States of I/Os					
RUN/STOP button		Yes					
Protection of the user program by password		On request					
Usable accessories		On request					
Remarks: * Depending an application complexity the available performance is limited and shared. [1)]: The values are for information only and cannot be fulfilled altogether. The available resources are limited at the end by the maximal downloadable application size for each CPU.							

Data of I/Os	**PM5012-x-ETH**	**PM5032-x-ETH**	**PM5052-x-ETH**	**PM5072-T-2ETH(W)**	**PM5082-T-2ETH**	**PM5092-T-2ETH**
Onboard digital inputs						
Channels	6 (incl. 2 counter inputs 5 kHz and 4 interrupts)	12 (incl. 4 fast counter/encoder inputs (100 kHz/200 kHz), 4 inputs (5 kHz), 4 standard inputs)				
Signal voltage	24 V DC type 1					
Onboard digital outputs						
Type of digital outputs	PM5012-T-ETH: Transistor	PM5032-T-ETH: Transistor	PM5052-T-ETH: Transistor	PM5072-T-2ETH(W): Transistor	PM5082-T-2ETH: Transistor	PM5092-T-2ETH: Transistor
	PM5012-R-ETH: Relay	PM5032-R-ETH: Relay	PM5052-R-ETH: Relay	-	-	-
Channels for transistor version	4 (5 kHz standard and PWM)	8 (incl. 4 fast outputs for standard or 4 PWM/4 PTO (100 kHz/200 kHz), 4 standard outputs (5 kHz))				

Data of I/Os	PM5012-x-ETH	PM5032-x-ETH	PM5052-x-ETH	PM5072-T-2ETH(W)	PM5082-T-2ETH	PM5092-T-2ETH
Channels digital input/output configurable (valid for both PLC version relais or transistor)	-	2 Relay version: The DC channels can be used as 1 PTO/2 PWM (100 kHz) or standard digital inputs/outputs Transistor version: The DC channels can only be used as standard digital inputs/outputs		2 Transistor version: The DC channels can only be used as standard digital inputs/outputs		
Rated voltage transistor	24 V DC					
Nominal current per transistor channel	0.5 A resistive					
Channels for relay version	4	6		-	-	-
Rated voltage relay	100 V AC ... 240 V AC or 24 V DC			-	-	-
Nominal current per relay channel	2 A resistive			-	-	-
Analog inputs	Optional					
Analog outputs	Optional					
Number of option board slots	1	2	3	3	3	3
Usage of option board	Each slot can be used for all type of existing option boards, same option board for serial interface or digital/analog I/O extension can be used on several slot per CPU. Note: RTC option board is only for PM5012 possible.					
KNX address switch	No			TA5130-KNXPB only on 1 slot		
Real-time clock (RTC)	TA5131-RTC	No				
Serial interface	TA5141-RS232I, TA5142-RS485/TA5142-RS485I					
	No	TA5146-CN				
Digital in/out channels	TA5101-4DI, TA5105-4DOT, TA5110-2DI2DOT					

Data of I/Os	PM5012-x-ETH	PM5032-x-ETH	PM5052-x-ETH	PM5072-T-2ETH(W)	PM5082-T-2ETH	PM5092-T-2ETH
Analog in/out channels	TA5120-2AI-UI, TA5122-2AI-TC, TA5123-2AI-RTD, TA5126-2AO-UI, TA5128\-2AI1AO					
Max. number of I/O modules on I/O bus	0	10				
Digital inputs	Onboard I/O only	128 byte	1 KB			
Digital outputs		128 byte	1 KB			
Number of decentralized inputs and outputs	Depending on the fieldbus used					
Internal interfaces						
Serial COMx	Optional, use a dedicated serial interface option board (up to 1)	Optional, use a dedicated serial interface option board (up to 2)	Optional, use a dedicated serial interface option board (up to 3)			
	Modbus RTU Master/Slave, ASCII					
Ethernet interface RJ45	1			2 Independent with switch functionality		
Ethernet functions	Programming, TCP/IP, UDP/IP, DHCP, PING, network variables, and other listed below					
Modbus TCP/IP client/server	Yes 8 / 3	Yes 13 / 8	Yes 20 / 10	Yes 30 / 15	Yes 40 / 20	Yes 50 / 25
SNTP client/server	No	Yes				
HTTPs and WebVisu number of connections	No	Yes 1	Yes 2	Yes 4	Yes 4	Yes 6
FTPs number of connections	No	Yes 1	Yes 2	Yes 2	Yes 2	Yes 2
OPC UA server number of free tags	No	Yes 125	Yes 250	Yes 1000	Yes 3000	Yes 5000
MQTT and JSON library	No	Yes				
OPC DA server	Yes					

Data of I/Os	PM5012-x-ETH	PM5032-x-ETH	PM5052-x-ETH	PM5072-T-2ETH(W)	PM5082-T-2ETH	PM5092-T-2ETH
IEC 60870-5-104 telecontrol protocol	No			Yes Substation only, 5 connections max., only 1 Ethernet supported		
number of free tags				1000	2000	3000
Licensed protocols (runtime protocol per CPU)						
BACnet IP B-BC	No			Yes (max. 1000 object variables)		
KNXIP	No			Yes (max. 1000 object variables)		
IEC 61850 MMS server/ goose pub/sub	No			Yes (max. 1000 data attributes)		
EtherNet/IP adapter/ scanner	No	Yes max. 512 byte in / 512 byte out data for adapter				
EtherCAT Master	No			Yes max. 512 byte in / 512 byte out data for adapter		

Data of I/Os	PM5012-x-ETH	PM5032-x-ETH	PM5052-x-ETH	PM5072-T-2ETH(W)	PM5082-T-2ETH	PM5092-T-2ETH
DNP3 Outstation	NO			Yes (max. 400 tags, 8 client sessions)	Yes (max. 700 tags, 8 client sessions)	Yes (max. 700 tags, 8 client sessions)

5.1.1.1.3 Connections and interfaces

General

I/O bus

The I/O bus is not available for PM5012-T-ETH and PM5012-R-ETH. I/O channel extension using option board slot only.

The I/O bus is the I/O data bus for the I/O modules. Through this bus, I/O and diagnosis data are transferred between the processor module and the I/O modules. Up to 10 I/O modules for PM5032-x-ETH (but with a limit of 128 Bytes input/ 128 Bytes output variables) and 10 I/O modules for PM5052-x-ETH and PM50x2-T-2ETH can be added.

Option board slot interface

Depending on the processor module variants, an additional option board can be connected to the option board slot to extend the feature of the processor module.

Chapter 5.1.1.3 “Option boards” on page 89

Serial interface

RS-232 communication interface is available by using the following option board:

- TA5141-RS232I (isolated)
  Chapter 5.1.1.3.11 “TA5141-RS232I - Option board for COMx serial communication” on page 182

RS-485 communication interface is available by using the following option boards:

- TA5142-RS485I (isolated)
  Chapter 5.1.1.3.12 “TA5142-RS485I - Option board for COMx serial communication” on page 186
- TA5142-RS485 (non isolated)
  Chapter 5.1.1.3.13 “TA5142-RS485 - Option board for COMx serial communication” on page 194

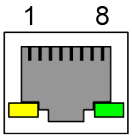
CAN communication interface is available by using the following option board:

- TA5146-CN (non isolated)
  Chapter 5.1.1.3.14 “TA5146-CN - Option board for CAN communication” on page 201

Ethernet interface

The Ethernet interface is carried out via a RJ45 jack.

Table 14: Pin assignment of the Ethernet interface

Interface	Pin	Description	
	1	Tx+	Transmit data +
	2	Tx-	Transmit data -
	3	Rx+	Receive data +
	4	NC	Not connected
	5	NC	Not connected
	6	Rx-	Receive data -
	7	NC	Not connected
	8	NC	Not connected
	Shield	Cable shield	Functional earth

Onboard I/Os

The processor modules PM50x2 have onboard I/Os which provide several functionalities. According to the CPU type, the number or the functionality of the onboard I/Os can be different *Chapter 5.1.1.2 “Onboard I/Os in processor module PM50x2” on page 68*.

Modbus RTU connection details

The Modbus RTU protocol is implemented in the AC500 processor modules.

Modbus is a master-slave (client-server) protocol. The client sends a request to the server(s) and receives the response(s).

Available serial interfaces can work as Modbus interfaces simultaneously.

The Modbus client operating mode of an interface is set with the function block COM_MOD_MAST.

Technical data

Table 15: Description of the Modbus protocol

Parameter	Value
Supported standard	Modbus RTU Server, Modbus RTU Client
Number of connection points	1 client Max. 1 server with RS-232 interface Max. 31 servers with RS-485
Protocol	Modbus
Operating mode	Client/server
Address	Server only
Data transmission control	CRC16
Data transmission speed	From 9,600 bits/s to 115,200 bits/s
Encoding	1 start bit 8 data bits 1 or 2 stop bits 1 parity bit
Max. cable length for RS-485 on serial interface option board used on the CPU.	1.200 m at 19.200 baud

Bus topology

Point-to-point with RS-232 or bus topology with RS-485. Modbus is a master-slave protocol.

5.1.1.1.4 Power supply

The processor modules PM50x2 can be connected to the 24 V DC supply voltage via a removable 3-pin spring terminal block or a 3-pin screw terminal block.

Table 16: Removable terminal block for the supply voltage 24 V DC

3-pin spring terminal block	3-pin screw terminal block
	

The terminal block is available as a set for AC500-eCo processor modules.

Basic CPU (PM5012)		**Standard CPUs (PM5032, PM5052) and Pro CPUs (PM5072, PM5082, PM5092)**	
Spring type	**Screw type**	**Spring type**	**Screw type**
TA5211-TSPF-B	TA5211-TSCL-B	TA5212-TSPF	TA5212-TSCL

Further information on power supply and onboard inputs/outputs of the terminal blocks

Pin assignment

Pin Assignment	Pin	Label	Function	Description
 Terminal block inserted	1	⏚	FE	Functional earth
	2	L+	+24 V DC	Positive pin of the power supply voltage
	3	M	0 V	Negative pin of the power supply voltage

NOTICE!
Risk of damaging the PLC due to improper voltage levels!

– Never exceed the maximum tolerance values for process and supply voltages.
– Never fall below the minimum tolerance values for process and supply voltages.

Observe the **system data** and the **technical data** of the used module.

Chapter 4.1 “System data AC500-eCo” on page 25

5.1.1.1.5 State LEDs and operating elements

RUN/STOP button

The processor modules, PM50xx series, have a RUN/STOP button. By pressing the RUN/STOP button, the processor modules switch between RUN mode and STOP mode. By long-pressing RUN/STOP button during the processor module power on phase, the processor module will be in MOD1.

State LEDs

The processor modules PM50xx indicate their states of operation via 5 LEDs located on the upper left side of the processor module.

LED	State	Color	LED = ON	LED = OFF	LED flashing
PWR	Power supply	Green	Power supply present	Power supply missing	-
MC	Micro memory card indication	Yellow	Micro memory card is in the socket	Micro memory card is not in the socket	Micro memory card is in read/ write state: any file on card is opened, means activity on card

LED	State	Color	LED = ON	LED = OFF	LED flashing
ERR	Error indication	Red	An error occurred	No errors or only warnings encountered (E4 errors). The LED behavior for the error classes 2 to 4 is configurable.	Fast flashing (4 Hz) displays together with the RUN LED a currently running firmware-upgrade or writing data to the flash EPROM. Slow flashing (1 Hz) alone displays shutdown of Request To Send. Medium flashing (2 Hz) alone displays at start of PLC if reboot after watchdog.
MOD1	Mode 1 indication	Yellow	Processor module is in mode 1 state	Processor module is not in mode 1 state	-
RUN	RUN/STOP state	Green	Processor module is in state RUN	Processor module is in state STOP	Fast flashing (4 Hz): The processor module is reading/writing data from/to the memory card. If the ERR-LED is also flashing, data is being written to the flash EPROM.

LED	State	Color	LED = ON	LED = OFF	LED flashing
					Slow flashing (1 Hz): The firmware update from the memory card has been completed successfully or Boot project is being updated. Slow flashing (0.5 Hz) together with MOD1 LED ON: Mode1: Boot project is not loaded.
Two LEDs below “ERR” and “MOD1”	Configurable	Yellow	Configurable	Configurable	Additional two LEDs are reserved and can be controlled from IEC user code with FB PmLedSet

User configurable LEDs

The processor module also provides 2 LEDs below the state LEDs which can be used by user and driven by an application.

The LEDs can be used into a project and controlled using special function blocks which are contained in the PM library. The POU is PmLedSet located in folder LED control.

I/O LEDs

The processor module provides up to 10 LEDs (PM5012-x-ETH), 20 LEDs (PM5032-R-ETH, PM5052-R-ETH), or 22 LEDs (PM5032-T-ETH, PM5052-T-ETH, PM5072-T-2ETH(W), PM5082-T-2ETH, PM5092-T-2ETH) to display the states of the inputs and outputs.

Processor module	LED	State	Color	LED = ON	LED = OFF
PM5012-x-ETH	I0 ... I5	Digital input	Yellow	Input is ON	Input is OFF
	O0 ... O3	Transistor output	Yellow	Output is ON	Output is OFF
	NO0 ... NO3	Relay output	Yellow	Output is ON	Output is OFF
PM5032-x-ETH PM5052-x-ETH	I0 ... I11	Digital input	Yellow	Input is ON	Input is OFF
	O0 ... O7	Transistor output	Yellow	Output is ON	Output is OFF
	NO0 ... NO5	Relay output	Yellow	Output is ON	Output is OFF
	C12, C13	Digital configurable input/ output	Yellow	Input/Output is ON	Input/Output is OFF
PM5072-T-2ETH(W)	I0 ... I11	Digital input	Yellow	Input is ON	Input is OFF

Processor module	LED	State	Color	LED = ON	LED = OFF
PM5082-T-2ETH PM5092-T-2ETH	O0 ...O7	Transistor output	Yellow	Output is ON	Output is OFF
	C12, C13	Digital configurable input/ output	Yellow	Input/Output is ON	Input/Output is OFF

Ethernet state LEDs

Table 17: State LEDs at Ethernet connector

LED	Color	OFF	ON	Flashing
Activity	Yellow	No activity	---	Activity
Link	Green	No link	Link	---

5.1.1.1.6 Diagnosis

The AC500 processor module can display various errors according to the error classes. The following error classes are possible. The reaction of the processor module is different for each type of error.

Error class	Type	Description	Example
E1 ERR-LED is ON	Fatal error	A safe function of the operating system is no longer guaranteed.	Checksum error in the system flash or RAM error
E2 ERR-LED is ON	Severe error	The operating system is functioning without problems, but the error-free processing of the user program is no longer guaranteed.	Checksum error in the user flash memory, independent of the task duration
E3 ERR-LED is ON/OFF *)	Light error	It depends on the application if the user program should be stopped by the operating system or not. The user should determine which reaction is necessary.	Flash could not be programmed, I/O module has failed
E4 ERR-LED is ON/OFF *)	Warning	Error in the periphery (e.g. I/O) which may show an impact in the future. The user should determine which reaction is necessary.	Short-circuit at an I/O module, the battery is run down or not inserted
*) The behaviour if the ERR-LED lights up at error classes E3 or E4 is configurable.			

Occurred errors can be displayed with the commands diagshow all in the PLC-Browser of Automation Builder software.

5.1.1.1.7 Technical data

The system data apply.

↳ *Chapter 4.1 “System data AC500-eCo” on page 25*

Only additional details are therefore documented below.

General data

Parameter		Value					
		PM5012	**PM5032**	**PM5052**	**PM5072**	**PM5082**	**PM5092**
Power supply		24 V DC					
Connection of power supply		Via removable 3-pin terminal					
Current consumption from power supply (max.)							
	Transistor version	200 mA	340 mA	400 mA	420 mA	420 mA	420 mA
	Relay version	200 mA	340 mA	400 mA	-	-	-
Melting integral of a fuse at 24 V DC		0.9 A^2s					
Peak inrush current from 24 V DC		65 A					
Max. power dissipation within the processor module							
	Transistor version	5.7 W	8.1 W	9.0 W	9.2 W	9.2 W	9.2 W
	Relay version	5.9 W	8.3 W	9.2 W	-	-	-
Processor module interfaces		RS485/RS232 (optional), Ethernet					
		-	I/O bus				
Weight							
	Transistor version	225 g	253 g	257 g	265 g	265 g	265 g
	Relay version	235 g	268 g	273 g	-	-	-
Mounting position		Horizontal or vertical					

Detailed data

Parameter		Value					
		PM5012	**PM5032**	**PM5052**	**PM5072**	**PM5082**	**PM5092**
DRAM memory (HW installed)		128 MB	128 MB	128 MB	128 MB	256 MB	256 MB
Total maximum downloadable application size [1)]		1 MB	5 MB	7 MB	9 MB	18 MB	24 MB
	Thereof user program code / data memory dynamically allocated	256 KB	512 KB	768 KB	1 MB	2 MB	3 MB
	Thereof user web server memory for web visualization max.	no web	1.5 MB	3.2 MB	7 MB	16 MB	21 MB
Flash memory for user data							
	Flash memory EMMc (HW installed)	128 MB	128 MB	128 MB	128 MB	512 MB	512 MB
	Remaining for all other usage (project save, infra- structure...)	30 MB	30 MB	30 MB	30 MB	285 MB	285 MB
Buffered (FRAM)		8 KB	32 KB	32 KB	100 KB	100 KB	100 KB
	VAR_RETAIN persistent	4 KB	16 KB	16 KB	36 KB	36 KB	36 KB
	%MB data	4 KB	16 KB	16 KB	64 KB	64 KB	64 KB

Parameter		Value					
		PM5012	**PM5032**	**PM5052**	**PM5072**	**PM5082**	**PM5092**
Expandable memory		None	None	None	None	None	None
Integrated mass storage memory (FLASH)		None	None	None	None	None	None
Slot for pluggable memory card		x	x	x	x	x	x
Real-time clock (RTC)		Optional with TA5131-RTC	Built in				
Min. retention time for RTC at room temperature (if at least powered for 8 hours)		7 days	20 days				
	Accuracy	±2 s/ day					
Programming languages		• Instruction List (IL) • Function Block Diagram (FBD) • Ladder Diagram (LD) • Sequential Function Chart (SFC) • Structured Text (ST) • Continuous Function Chart (CFC)					
	Processor type	TI ARM Cortex-A9 32-bit-RISC					
	Processor clock speed	300 MHz				600 MHz	800 MHz
Calculation time per instructions (minimum)		PM5012	PM5032	PM5052	PM5072	PM5082	PM5092
	Binary	20 ns				10 ns	10 ns
	Word	50 ns				10 ns	10 ns
	Floating point	600 ns				10 ns	10 ns
	Lowest cycle time usable (also f. PTO)	-	5 ms	2 ms	1 ms	1 ms	0.5 ms
Using onboard EtherCAT protocol (licensed) in preparation							
EtherCAT onboard No. of synchronized axis		PM5012	PM5032	PM5052	PM5072	PM5082	PM5092
	axis per 1 ms typically	-	-	-	-	2 - 4*	3 - 6*
	axis per 2 ms typically	-	-	-	2 - 4*	4 - 8*	8 - 12*
	axis per 4 ms typically	-	-	-	4 - 8*	8 - 16	16 - 24
	Cyclic min. configurable	10 ms	5 ms	2 ms	1 ms	1 ms	1 ms
	Time-controlled	Yes					
	Multitasking	Yes					
	Interruption	Yes					
LEDs		Power, Error, Run, MC, MOD1, States of I/Os					
RUN/STOP button		Yes					
Protection of the user program by password		On request					

Parameter	Value					
	PM5012	PM5032	PM5052	PM5072	PM5082	PM5092
Usable accessories	On request					
Remarks: * Depending an application complexity the available performance is limited and shared. 1): The values are for information only and cannot be fulfilled altogether. The available resources are limited at the end by the maximal downloadable application size for each CPU.						

Data of I/Os	PM5012-x-ETH	PM5032-x-ETH	PM5052-x-ETH	PM5072-T-2ETH(W)	PM5082-T-2ETH	PM5092-T-2ETH
Onboard digital inputs						
Channels	6 (incl. 2 counter inputs 5 kHz and 4 interrupts)	12 (incl. 4 fast counter/encoder inputs (100 kHz/200 kHz), 4 inputs (5 kHz), 4 standard inputs)				
Signal voltage	24 V DC type 1					
Onboard digital outputs						
Type of digital outputs	PM5012-T-ETH: Transistor	PM5032-T-ETH: Transistor	PM5052-T-ETH: Transistor	PM5072-T-2ETH(W): Transistor	PM5082-T-2ETH: Transistor	PM5092-T-2ETH: Transistor
	PM5012-R-ETH: Relay	PM5032-R-ETH: Relay	PM5052-R-ETH: Relay	-	-	-
Channels for transistor version	4 (5 kHz standard and PWM)	8 (incl. 4 fast outputs for standard or 4 PWM/4 PTO (100 kHz/200 kHz), 4 standard outputs (5 kHz))				
Channels digital input/output configurable (valid for both PLC version relais or transistor)	-	2 Relay version: The DC channels can be used as 1 PTO/2 PWM (100 kHz) or standard digital inputs/outputs Transistor version: The DC channels can only be used as standard digital inputs/outputs		2 Transistor version: The DC channels can only be used as standard digital inputs/outputs		
Rated voltage transistor	24 V DC					
Nominal current per transistor channel	0.5 A resistive					

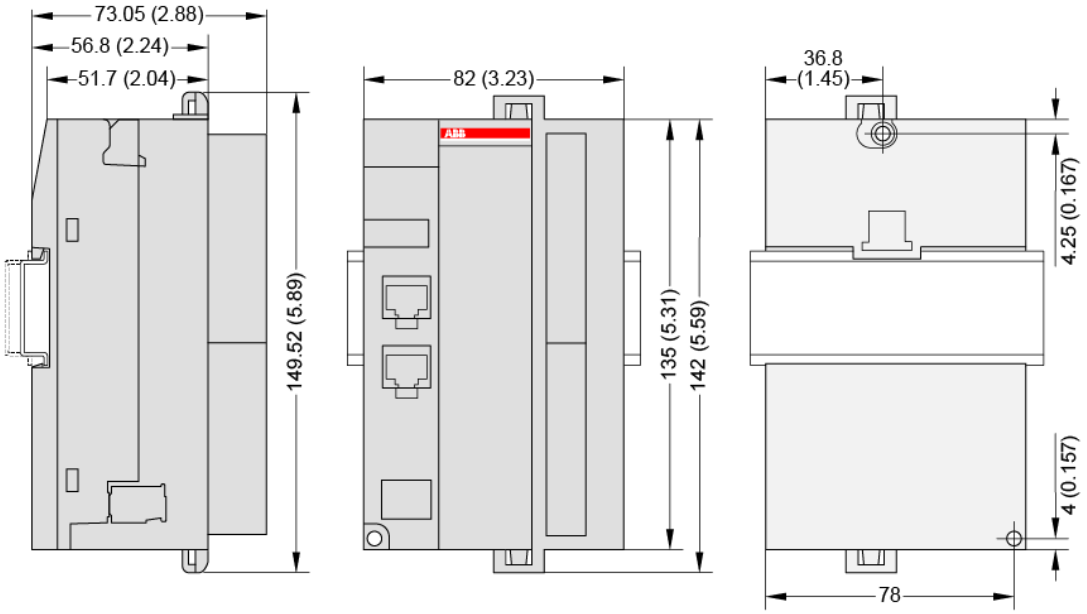
Data of I/Os	PM5012-x-ETH	PM5032-x-ETH	PM5052-x-ETH	PM5072-T-2ETH(W)	PM5082-T-2ETH	PM5092-T-2ETH
Channels for relay version	4	6		-	-	-
Rated voltage relay	100 V AC ... 240 V AC or 24 V DC			-	-	-
Nominal current per relay channel	2 A resistive			-	-	-
Analog inputs	Optional					
Analog outputs	Optional					
Number of option board slots	1	2	3	3	3	3
Usage of option board	Each slot can be used for all type of existing option boards, same option board for serial interface or digital/analog I/O extension can be used on several slot per CPU. Note: RTC option board is only for PM5012 possible.					
KNX address switch	No			TA5130-KNXPB only on 1 slot		
Real-time clock (RTC)	TA5131-RTC	No				
Serial interface	TA5141-RS232I, TA5142-RS485/TA5142-RS485I					
	No	TA5146-CN				
Digital in/out channels	TA5101-4DI, TA5105-4DOT, TA5110-2DI2DOT					
Analog in/out channels	TA5120-2AI-UI, TA5122-2AI-TC, TA5123-2AI-RTD, TA5126-2AO-UI, TA5128\-2AI1AO					
Max. number of I/O modules on I/O bus	0	10				
Digital inputs	Onboard I/O only	128 byte	1 KB			
Digital outputs		128 byte	1 KB			
Number of decentralized inputs and outputs	Depending on the fieldbus used					
Internal interfaces						

Data of I/Os	PM5012-x-ETH	PM5032-x-ETH	PM5052-x-ETH	PM5072-T-2ETH(W)	PM5082-T-2ETH	PM5092-T-2ETH
Serial COMx	Optional, use a dedicated serial interface option board (up to 1)	Optional, use a dedicated serial interface option board (up to 2)	Optional, use a dedicated serial interface option board (up to 3)			
	Modbus RTU Master/Slave, ASCII					
Ethernet interface RJ45	1			2 Independent with switch functionality		
Ethernet functions	Programming, TCP/IP, UDP/IP, DHCP, PING, network variables, and other listed below					
Modbus TCP/IP client/server	Yes 8 / 3	Yes 13 / 8	Yes 20 / 10	Yes 30 / 15	Yes 40 / 20	Yes 50 / 25
SNTP client/server	No	Yes				
HTTPs and WebVisu number of connections	No	Yes 1	Yes 2	Yes 4	Yes 4	Yes 6
FTPs number of connections	No	Yes 1	Yes 2	Yes 2	Yes 2	Yes 2
OPC UA server number of free tags	No	Yes 125	Yes 250	Yes 1000	Yes 3000	Yes 5000
MQTT and JSON library	No	Yes				
OPC DA server	Yes					
IEC 60870-5-104 telecontrol protocol	No			Yes Substation only, 5 connections max., only 1 Ethernet supported		
number of free tags				1000	2000	3000
Licensed protocols (runtime protocol per CPU)						
BACnet IP B-BC	No			Yes (max. 1000 object variables)		
KNXIP	No			Yes (max. 1000 object variables)		
IEC 61850 MMS server/ goose pub/sub	No			Yes (max. 1000 data attributes)		

Data of I/Os	PM5012-x-ETH	PM5032-x-ETH	PM5052-x-ETH	PM5072-T-2ETH(W)	PM5082-T-2ETH	PM5092-T-2ETH
EtherNet/IP adapter/ scanner	No	Yes max. 512 byte in / 512 byte out data for adapter				
EtherCAT Master	No			Yes max. 512 byte in / 512 byte out data for adapter		

Data of I/Os	PM5012-x-ETH	PM5032-x-ETH	PM5052-x-ETH	PM5072-T-2ETH(W)	PM5082-T-2ETH	PM5092-T-2ETH
DNP3 Out-station	NO			Yes (max. 400 tags, 8 client ses-sions)	Yes (max. 700 tags, 8 client ses-sions)	Yes (max. 700 tags, 8 client ses-sions)

5.1.1.1.8 Dimensions



The dimensions are in mm and in brackets in inch.

5.1.1.1.9 Ordering Data

To enable better product availability into the production and to provide some new features, a revision of the existing processor module was necessary. The existing processor module with rubric **R007x** will move to classic and will be replaced by the compatible new processor module revision 1 with rubric **R017x**.

For example: The processor module revision 1 PM5012-T-ETH (1SAP122 600 **R0172**) replaces the existing processor module PM5012-T-ETH (1SAP 122 600 **R0072**) and provides the same features or functionality of the previous ones.

Following points must be considered with the processor module revision 1:



- *The processor module revision 1 (R017x) requires a new BootFW / CPUFW from V3.6.x and higher.*
- ***It cannot be downgraded** and used with lower FW versions than V3.6.0.*
- *The processor module revision 1 (R017x) provides the same features as the processor module (R007x) existing today and is fully compatible.*
- *An existing application using a processor module (R007x) built with Automation Builder < 2.6 can run on a processor module revision 1 (R017x) but the application **must be upgraded** to at least AB 2.6.0 or higher.*

What must be done using a new processor module revision 1 (R017x)?

- On a new application?
  - Just use the processor module revision 1 (R017x)
  - Use the latest Automation Builder Software from 2.6.0 or higher.
- On an existing application using an Automation Builder software version smaller than 2.6.0?
  - To use a processor module revision 1 in an existing application (e.g., replacement of the processor module), the application must be upgraded to at least AB 2.6.0 or higher.
  - If several processor module (revision 1 and revision 0) are used within the same project, all the processor modules used in the same application must be upgraded to the FW Version V3.6.x and higher.

Table 18: AC500-eCo processor modules

Part no.	Description	Product life cycle phase *)
1SAP 122 600 R0072 (processor module revision 0)	Basic CPU PM5012-T-ETH, AC500-eCo processor module, programmable logic controller 1 MB, 6DI/4DO-Transistor, Ethernet, 24 V DC, 1 option board slot	Classic (replaced by processor module revision 1)
1SAP 122 600 **R0172** (processor module revision 1)	Basic CPU PM5012-T-ETH, AC500-eCo processor module, programmable logic controller 1 MB, 6DI/4DO-Transistor, Ethernet, 24 V DC, 1 option board slot	Active
1SAP 122 700 R0072 (processor module revision 0)	Basic CPU PM5012-R-ETH, AC500-eCo processor module, programmable logic controller 1 MB, 6DI/4DO-Relay, Ethernet, 24 V DC, 1 option board slot	Classic (replaced by processor module revision 1)
1SAP 122 700 **R0172** (processor module revision 1)	Basic CPU PM5012-R-ETH, AC500-eCo processor module, programmable logic controller 1 MB, 6DI/4DO-Relay, Ethernet, 24 V DC, 1 option board slot	Active
1SAP 123 400 R0072 (processor module revision 0)	Standard CPU PM5032-T-ETH, AC500-eCo processor module, programmable logic controller 2 MB, 12DI/8DO-Transistor/2DC, Ethernet, 24 V DC, 2 option board slots	Classic (replaced by processor module revision 1)

Part no.	Description	Product life cycle phase *)
1SAP 123 400 **R0172** (processor module revision 1)	Standard CPU PM5032-T-ETH, AC500-eCo processor module, programmable logic controller 2 MB, 12DI/8DO-Transistor/2DC, Ethernet, 24 V DC, 2 option board slots	Active
1SAP 123 500 R0072 (processor module revision 0)	Standard CPU PM5032-R-ETH, AC500-eCo processor module, programmable logic controller 2 MB, 12DI/6DO-Relay/2DC, Ethernet, 24 V DC, 2 option board slots	Classic (replaced by processor module revision 1)
1SAP 123 500 **R0172** (processor module revision 1)	Standard CPU PM5032-R-ETH, AC500-eCo processor module, programmable logic controller 2 MB, 12DI/6DO-Relay/2DC, Ethernet, 24 V DC, 2 option board slots	Active
1SAP 124 000 R0072 (processor module revision 0)	Standard CPU PM5052-T-ETH, AC500-eCo processor module, programmable logic controller 4 MB, 12DI/8DO-Transistor/2DC, Ethernet, 24 V DC, 3 option board slots	Classic (replaced by processor module revision 1)
1SAP 124 000 **R0172** (processor module revision 1)	Standard CPU PM5052-T-ETH, AC500-eCo processor module, programmable logic controller 4 MB, 12DI/8DO-Transistor/2DC, Ethernet, 24 V DC, 3 option board slots	Active
1SAP 124 100 R0072 (processor module revision 0)	Standard CPU PM5052-R-ETH, AC500-eCo processor module, programmable logic controller 4 MB, 12DI/6DO-Relay/2DC, Ethernet, 24 V DC, 3 option board slots	Classic (replaced by processor module revision 1)
1SAP 124 100 **R0172** (processor module revision 1)	Standard CPU PM5052-R-ETH, AC500-eCo processor module, programmable logic controller 4 MB, 12DI/6DO-Relay/2DC, Ethernet, 24 V DC, 3 option board slots	Active
1SAP 124 500 R0073 (processor module revision 0)	Pro CPU PM5072-T-2ETH, AC500-eCo processor module, programmable logic controller 8 MB, 12DI/8DO-Transistor/2DC, 2 Ethernet, 24 V DC, 3 option board slots	Classic (replaced by processor module revision 1)
1SAP 124 500 **R0173** (processor module revision 1)	Pro CPU PM5072-T-2ETH, AC500-eCo processor module, programmable logic controller 8 MB, 12DI/8DO-Transistor/2DC, 2 Ethernet, 24 V DC, 3 option board slots	Active
1SAP 124 400 R0073 (processor module revision 0)	Pro CPU PM5072-T-2ETHW, AC500-eCo processor module, programmable logic controller 8 MB, 12DI/8DO-Transistor/2DC, 2 Ethernet, 24 V DC, 3 option board slots, wide temperature	Classic (replaced by processor module revision 1)
1SAP 124 400 **R0173** (processor module revision 1)	Pro CPU PM5072-T-2ETHW, AC500-eCo processor module, programmable logic controller 8 MB, 12DI/8DO-Transistor/2DC, 2 Ethernet, 24 V DC, 3 option board slots, wide temperature	Active

Part no.	Description	Product life cycle phase *)
1SAP 124 600 **R0173** (processor module revision 1)	Pro CPU PM5082-T-2ETH, AC500-eCo processor module, programmable logic controller 18 MB, 12DI/8DO-Transistor/2DC, 2 Ethernet, 24 V DC, 3 option board slots	Active
1SAP 124 700 **R0173** (processor module revision 1)	Pro CPU PM5092-T-2ETH, AC500-eCo processor module, programmable logic controller 24 MB, 12DI/8DO-Transistor/ 2DC, 2 Ethernet, 24 V DC, 3 option board slots	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

Table 19: Accessories for AC500-eCo

Part no.	Description	Product life cycle phase *)
Required accessories		
1SAP 187 400 R00xx	TA52xx, terminal block set ↳ *Chapter 5.8.1.2 “TA5211, TA 5212 - Terminal block sets” on page 1372*	Active
Optional accessories		
1SAP 187 000 R0xxx	TA51xx, option board ↳ *Chapter 5.1.1.3 “Option boards” on page 89*	Active
1SAP 180 100 R0002	MC5102, memory card ↳ *Chapter 5.8.1.1 “MC5102 - Micro memory card with adapter” on page 1367*	Active
1SAP 182 800 R0001	TA543, screw mounting accessory, 20 pieces per packing unit	Active
1SAP 187 500 R0003	TA5301-CFA, cable fixing part accessory, 20 pieces per packing unit	Active
1SAP 187 500 R0001	TA5300-CVR, option board slot cover, 6 pieces	Active
1SAP 187 600 R0001	TA5400-SIM, input simulator for testing and training purposes, 6 switches ↳ *Chapter 5.8.1.4 “TA5400-SIM - Input simulator” on page 1386*	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.1.1.2 Onboard I/Os in processor module PM50x2

The processor modules PM50x2 have onboard I/Os which provide several functionalities. According to the CPU type, the number or the functionality of the onboard I/Os can be different.

With the processor modules revision 1 (rubric R017x), the fast output channels provides up to 4 PTO pulse/direction with up to 200 kHz (rubric R007x, only 100 kHz). The processor modules revision 1 are supported from AB 2.6.0 and the AB software automatically recognizes the used processor module.

<table>
<tr><th rowspan="2">Parameter</th><th colspan="4">Value</th></tr>
<tr><th>PM5012-T-ETH</th><th>PM5012-R-ETH</th><th>PM5032-T-ETH
PM5052-T-ETH
PM5072-T-2ETH(W)
PM5082-T-2ETH
PM5092-T-2ETH</th><th>PM5032-R-ETH
PM5052-R-ETH</th></tr>
<tr><td>Digital inputs</td><td colspan="2">6</td><td colspan="2">12</td></tr>
<tr><td>Functionality of digital inputs
(encoder, fast counter, counter, interrupt)</td><td colspan="2" rowspan="3">6 DI fast input 24 V DC (max. 5 kHz)
The digital inputs are usable as the following:
6 DI 24 V DC standard.
2 channel 5 kHz encoder with frequency measurement.
2 channel 5 kHz encoder with frequency measurement and with touch/reset using standard DI.
2 fast counter (5 kHz).
4 DI as interrupt input with 1 dedicated interrupt task and input information.</td><td colspan="2">4 DI fast input 24 V DC (max. 200 kHz)
The digital inputs are usable as the following:
4 DI 24 V DC standard.
4 fast counter (100 kHz).
2 A/B encoder (200 kHz) with frequency measurement.
2 full A/B encoders 0 and 1 (200 kHz) with frequency measurement and with touch/reset using standard highspeed (5 kHz) DI.
1 full A/B encoder 0 (200 kHz) with frequency measurement and optional with touch/reset using 2 touch/sync inputs with A/B encoder 0.</td></tr>
<tr><td colspan="2">4 DI fast input 24 V DC (5 kHz)
The digital inputs are usable as the following:
4 DI 24 V DC standard.
4 DI as interrupt input with 1 dedicated interrupt task and input information.
4 touch/sync inputs with A/B encoder 0 or 1.</td></tr>
<tr><td colspan="2">4 standard DI 24 V DC</td></tr>
<tr><td>Digital outputs</td><td colspan="2">4</td><td>8</td><td>6</td></tr>
</table>

Parameter	Value			
	PM5012-T-ETH	**PM5012-R-ETH**	**PM5032-T-ETH** **PM5052-T-ETH** **PM5072-T-2ETH(W)** **PM5082-T-2ETH** **PM5092-T-2ETH**	**PM5032-R-ETH** **PM5052-R-ETH**
Functionality of digital outputs	**4 fast output DO-T** 24 V DC/0.5 A (max. 5 kHz) The digital outputs are usable as the following: ● 4 DO-T 24 V DC/0.5 A. ● 4 PWM. Note: The speed must be limited below 100 Hz. The low speed PWM can be used for heating control. ● 4 limit switch.	**4 DO-R** 24 V DC / 120/240 V AC 2A in 2 groups	**4 fast output DO-T** 24 V DC (100 kHz) The digital outputs are usable as the following: ● 4 DO-T 24 V DC/0.5 A. ● 4 limit/ switch outputs for encoder/ counter. ● 4 PWM (30 kHz, 2 µs accuracy and maximum duty 95 %). ● 2 PTO (200 kHz) CW/CCW or Pulse/Direction. ● 4 PTO (PWM) 100...200 kHz Pulse/Direction using standard output.	**6 DO-R** 24 V DC / 120/240 V AC 2A in 2 groups

Parameter	Value			
	PM5012-T-ETH	**PM5012-R-ETH**	**PM5032-T-ETH** **PM5052-T-ETH** **PM5072-T-2ETH(W)** **PM5082-T-2ETH** **PM5092-T-2ETH**	**PM5032-R-ETH** **PM5052-R-ETH**
			4 fast output DO-T 24 V DC/0.5 A (5 kHz) (max. 5 kHz) The digital outputs are usable as the following: ● 4 DO-T 24 V DC/0.5 A. ● 4 limit/ switch outputs for encoder/ counter. ● 4 PWM. Note: The speed must be limited below 100 Hz. The low speed PWM can be used for heating control. ● 4 direction outputs together with 4 high speed pulses for up to 4 PTO Pulse/Direction outputs up to 200 kHz.	
Digital inputs/ outputs, configurable	-	-	2	2

Parameter	Value			
	PM5012-T-ETH	**PM5012-R-ETH**	**PM5032-T-ETH** **PM5052-T-ETH** **PM5072-T-2ETH(W)** **PM5082-T-2ETH** **PM5092-T-2ETH**	**PM5032-R-ETH** **PM5052-R-ETH**
Functionality of digital inputs/ outputs, configurable	-	-	**2 DC 24 V DC** ● 2 standard I/Os configurable	**2 DC 24 V DC** The digital inputs/ outputs are usable as the following: ● 2 DC standard (DI 24 V DC or DO-T). ● 2 PWM (30 kHz). ● 1 PTO (200 kHz) as Pulse/Direction or CW/ CCW.
LED displays	For signal states.			
Internal power supply	Via processor module.			
External power supply	Via UP and ZP terminal.			

5.1.1.2.1 Connections

General



WARNING!
Risk of death by electric shock!
Hazardous voltages can be present at the terminals of the module.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.



NOTICE!
Risk of damaging the PLC modules!
The PLC modules must not be removed while the plant is connected to a power supply.

Make sure that all voltage sources (supply and process voltage) are switched off before you do the following:

– Connect or disconnect any signal or terminal block.
– Remove or replace a module.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

When replacing a processor module, it is recommended to mark each wire connected to the onboard I/O terminal block before disconnecting it. This should make sure that the wires can be reconnected in the same order.

The connection is carried out by using removable 12-pin and 13-pin terminal blocks.

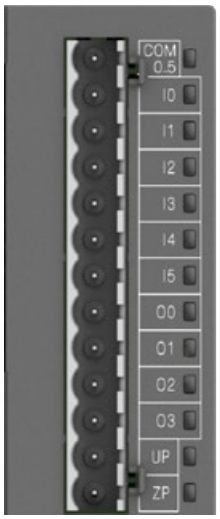


Table 20: Assignment of the terminals for PM5012-T-ETH:

Terminal	Signal	Description
1	COM 0..5	Input common for digital input signals I0 to I5
2	I0	Digital input signal I0 (5 kHz)
3	I1	Digital input signal I1 (5 kHz)
4	I2	Digital input signal I2 (5 kHz)
5	I3	Digital input signal I3 (5 kHz)
6	I4	Digital input signal I4 (5 kHz)
7	I5	Digital input signal I5 (5 kHz)
8	O0	Digital output signal O0 (5 kHz)
9	O1	Digital output signal O1 (5 kHz)
10	O2	Digital output signal O2 (5 kHz)
11	O3	Digital output signal O3 (5 kHz)
12	UP	Process supply voltage UP +24 V DC
13	ZP	Process supply voltage ZP 0 V DC



Table 21: Assignment of the terminals for PM5012-R-ETH:

Terminal	Signal	Description
1	COM 0..5	Input common for digital input signals I0 to I5
2	I0	Digital input signal I0 (5 kHz)
3	I1	Digital input signal I1 (5 kHz)
4	I2	Digital input signal I2 (5 kHz)
5	I3	Digital input signal I3 (5 kHz)
6	I4	Digital input signal I4 (5 kHz)
7	I5	Digital input signal I5 (5 kHz)
8	NO0	Normally-open relay contact of the output NO0
9	NO1	Normally-open relay contact of the output NO1
10	R0..1	Output common for signals NO0 to NO1

Terminal	Signal	Description
11	NO2	Normally-open relay contact of the output NO2
12	NO3	Normally-open relay contact of the output NO3
13	R2..3	Output common for signals NO2 to NO3

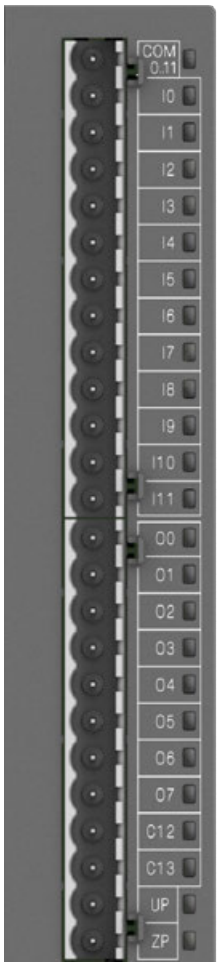


Table 22: Assignment of the terminals for PM5032-T-ETH, PM5052-T-ETH, PM5072-T-2ETH(W), PM5082-T-2ETH and PM5092-T-2ETH:

Terminal	Signal	Description
1	COM 0..11	Input common for digital input signals I0 to I11
2	I0	Digital input signal I0 (max. 5 kHz)
3	I1	Digital input signal I1 (max. 5 kHz)
4	I2	Digital input signal I2 (max. 5 kHz)
5	I3	Digital input signal I3 (max. 5 kHz)
6	I4	Digital input signal I4 Forward counter (max. 100 kHz), Encoder (max. 200 kHz)
7	I5	Digital input signal I5 (100 kHz) Forward counter (max. 100 kHz), Encoder (max. 200 kHz)
8	I6	Digital input signal I6 (100 kHz) Forward counter (max. 100 kHz), Encoder (max. 200 kHz)
9	I7	Digital input signal I7 (100 kHz) Forward counter (max. 100 kHz), Encoder (max. 200 kHz)
10	I8	Digital input signal I8
11	I9	Digital input signal I9
12	I10	Digital input signal I10
13	I11	Digital input signal I11
14	O0	Digital output signal O0 (max. 5 kHz)
15	O1	Digital output signal O1 (max. 5 kHz)
16	O2	Digital output signal O2 (max. 5 kHz)
17	O3	Digital output signal O3 (max. 5 kHz)
18	O4	Digital output signal O4 PWM (max. 100 kHz), PTO (max. 200 kHz)
19	O5	Digital output signal O5 PWM (max. 100 kHz), PTO (max. 200 kHz)
20	O6	Digital output signal O6 PWM (max. 100 kHz), PTO (max. 200 kHz)
21	O7	Digital output signal O7 PWM (max. 100 kHz), PTO (max. 200 kHz)
22	C12	Digital input/output signal configurable C12
23	C13	Digital input/output signal configurable C13

Terminal	Signal	Description
24	UP	Process supply voltage UP +24 V DC
25	ZP	Process supply voltage ZP 0 V DC

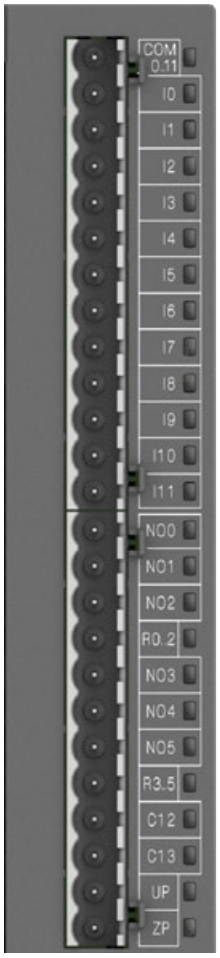
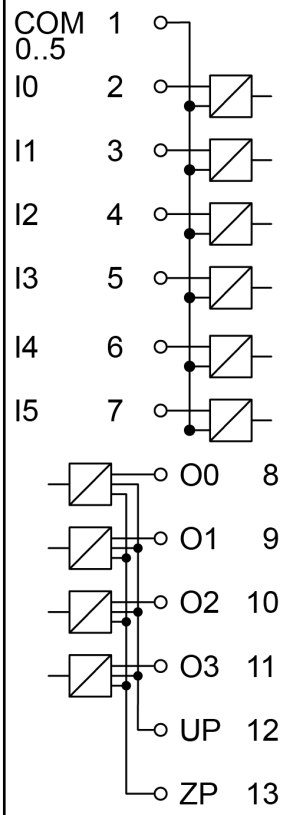
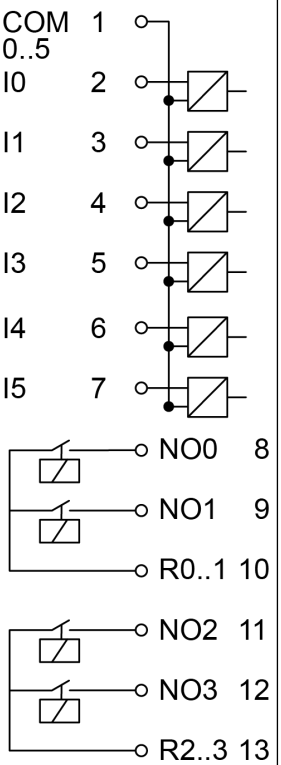
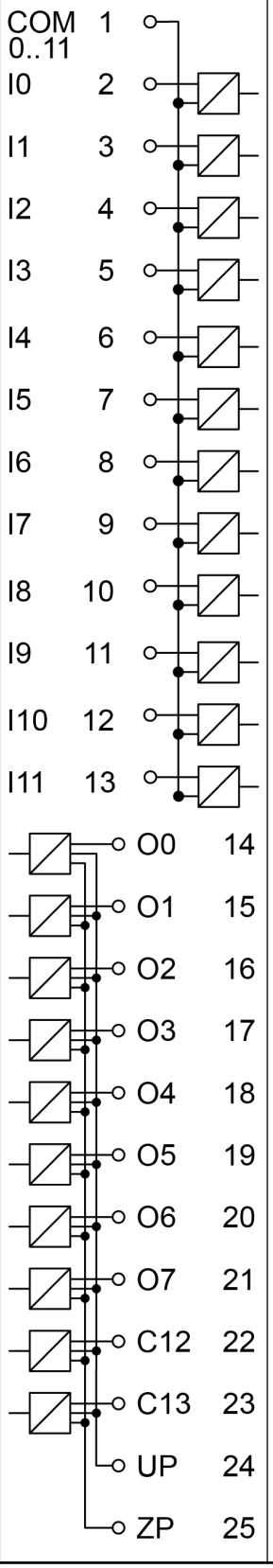
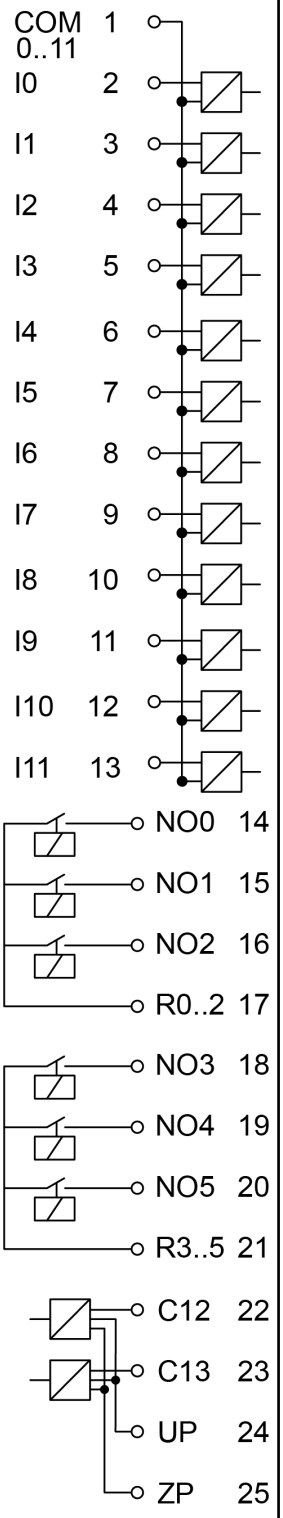


Table 23: Assignment of the terminals for PM5032-R-ETH and PM5052-R-ETH:

Terminal	Signal	Description
1	COM 0..11	Input common for digital input signals I0 to I11
2	I0	Digital input signal I0 (max. 5 kHz)
3	I1	Digital input signal I1 (max. 5 kHz)
4	I2	Digital input signal I2 (max. 5 kHz)
5	I3	Digital input signal I3 (max. 5 kHz)
6	I4	Digital input signal I4 Forward counter (max. 100 kHz), Encoder (max. 200 kHz)
7	I5	Digital input signal I5 Forward counter (max. 100 kHz), Encoder (max. 200 kHz)
8	I6	Digital input signal I6 Forward counter (max. 100 kHz), Encoder (max. 200 kHz)
9	I7	Digital input signal I7 Forward counter (max. 100 kHz), Encoder (max. 200 kHz)
10	I8	Digital input signal I8
11	I9	Digital input signal I9
12	I10	Digital input signal I10
13	I11	Digital input signal I11
14	NO0	Normally-open relay contact of the output NO0
15	NO1	Normally-open relay contact of the output NO1
16	NO2	Normally-open relay contact of the output NO2
17	R0..2	Output common for signals NO0 to NO2
18	NO3	Normally-open relay contact of the output NO3
19	NO4	Normally-open relay contact of the output NO4
20	NO5	Normally-open relay contact of the output NO5
21	R3..5	Output common for signals NO3 to NO5
22	C12	Digital input/output signal configurable C12 PWM (max. 100 kHz), PTO (max. 200 kHz)
23	C13	Digital input/output signal configurable C13 PWM (max. 100 kHz), PTO (max. 200 kHz)
24	UP	Process supply voltage UP +24 V DC
25	ZP	Process supply voltage ZP 0 V DC

Block diagrams

Table 24: Internal structure of the onboard I/Os

PM5012-T-ETH	PM5012-R-ETH	PM5032-ETH PM5052-T-ETH PM5072-T-2ETH(W) PM5082-T-2ETH PM5092-T-2ETH	PM5032-R-ETH PM5052-R-ETH
			

Connection of the digital inputs

The digital inputs can be used as source inputs or as sink inputs.

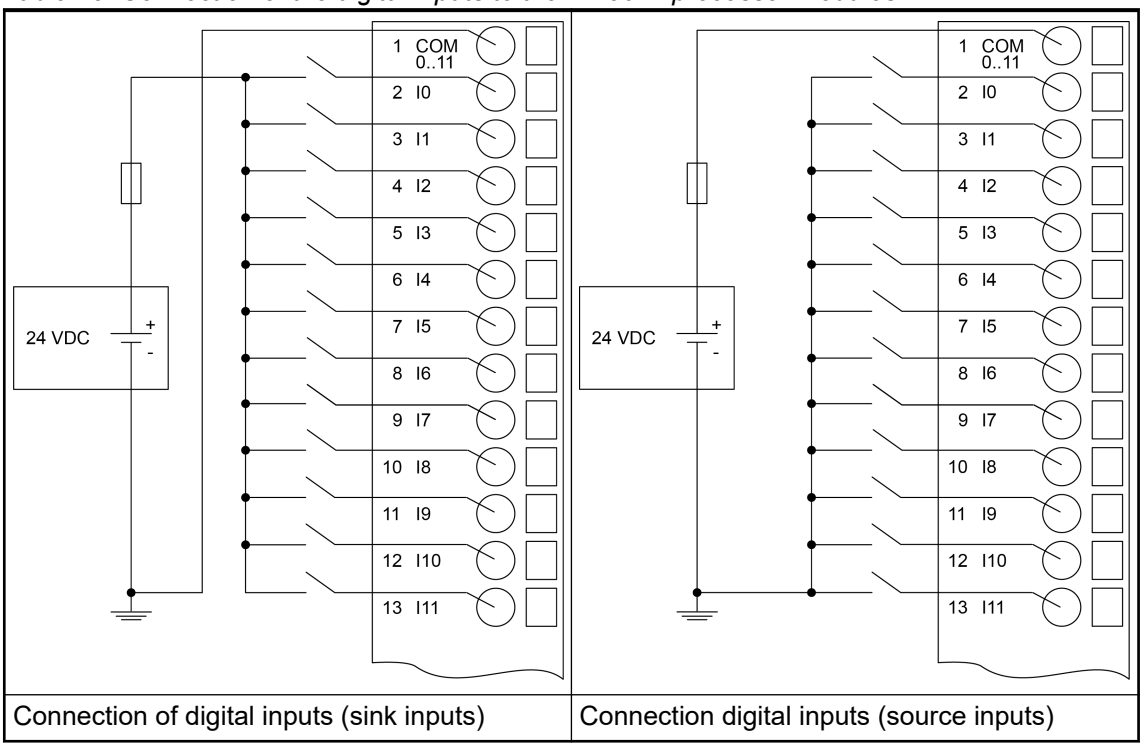
NOTICE!

Risk of malfunctions in the plant!

A ground fault, e. g. caused by a damaged cable insulation, can bridge switches accidentally.

Use sink inputs when possible or make sure that, in case of error, there will be no risks to persons or plant.

Table 25: Connection of the digital inputs to the PM50x2 processor modules



Connection of digital inputs (sink inputs)	Connection digital inputs (source inputs)

Connection of the digital transistor outputs (PM50xx-T-xETH only)

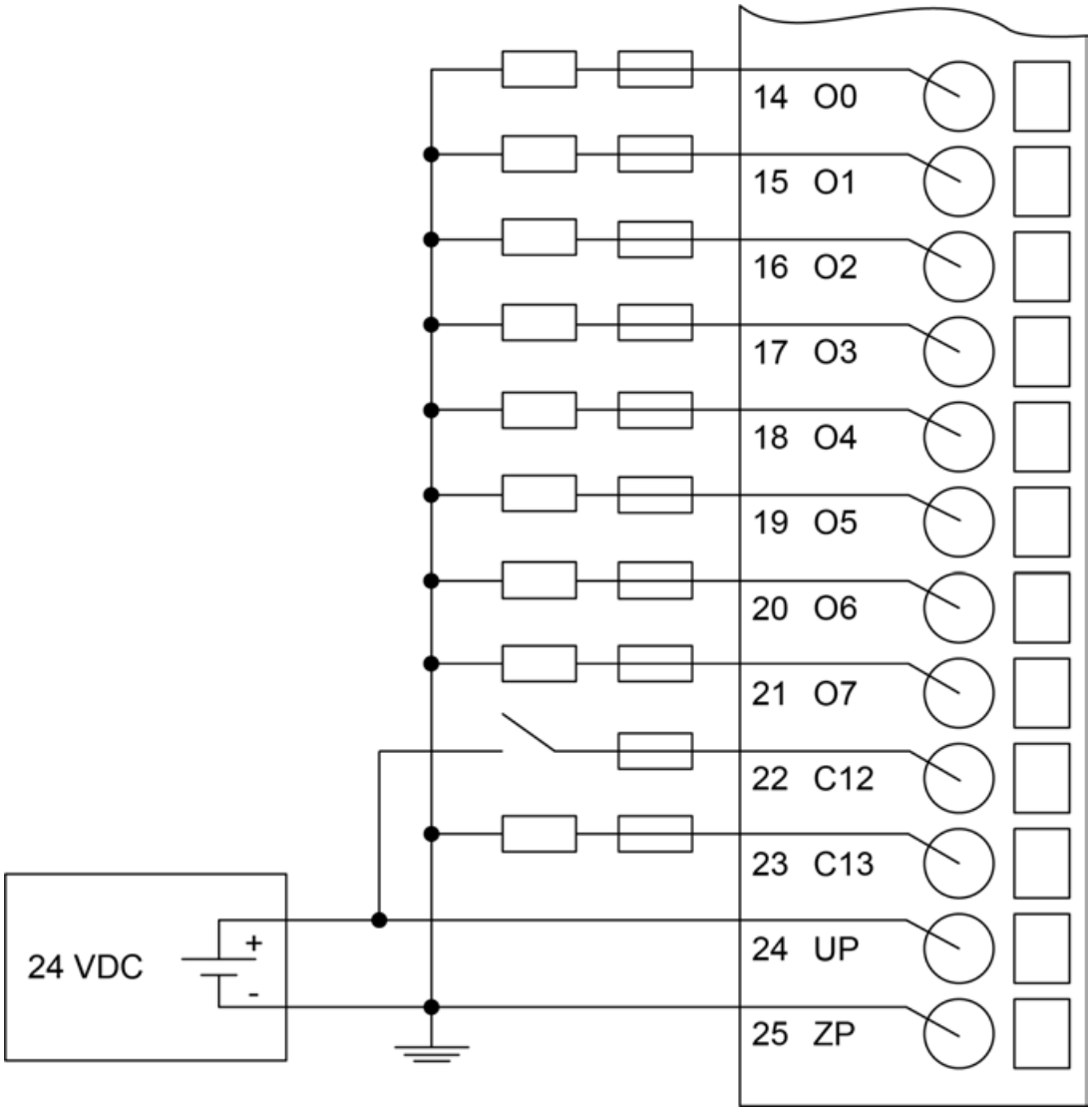


Fig. 6: Connection of digital transistor outputs and configurable digital inputs/outputs

C12 used as configurable digital input
C13 used as configurable digital transistor output

CAUTION!
Risk of damaging the processor module!
The outputs are not protected against short circuit and overload.

- Never short-circuit or overload the outputs.
- Never connect the outputs to other voltages.
- Use an external fuse for each output.

The configurable digital channels (C12 and C13) used as digital inputs have the same electrical characteristics as standard digital inputs.

The configurable digital channels (C12 and C13) used as digital transistor outputs have the same electrical characteristics as standard digital outputs.

Connection of the digital relay outputs (PM50xx-R-ETH only)

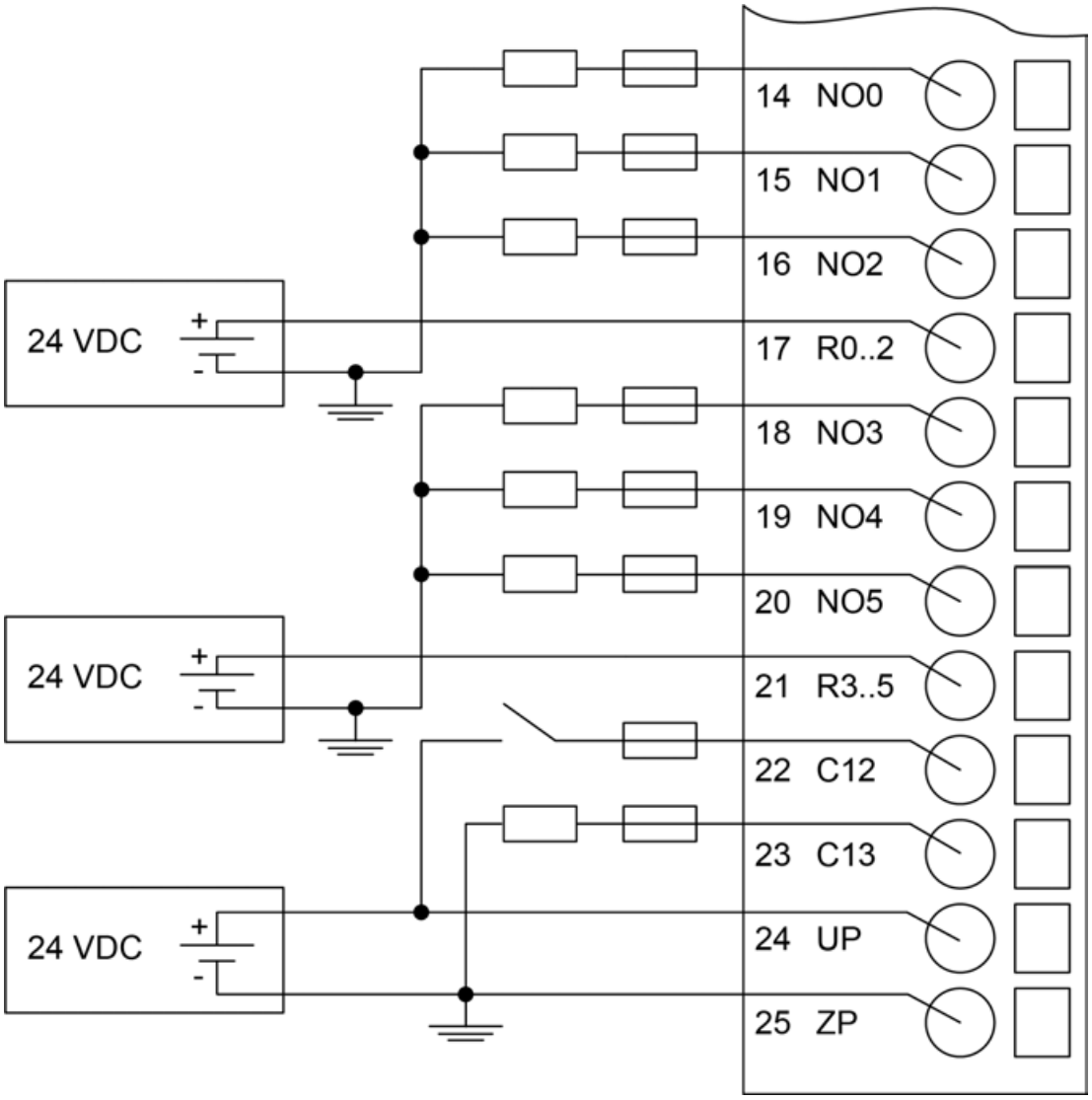


Fig. 7: Connection of digital relay outputs and configurable digital inputs/outputs

C12 used as configurable digital input
C13 used as configurable digital transistor output

WARNING!

Risk of death by electric shock!

Hazardous voltages can be present at the terminals of the module.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.

CAUTION!

Risk of damaging the processor module!

- Never short-circuit or overload the outputs.
- Never connect inductive loads without an external suppression against voltage peaks due to inductive kickback.
- Never connect voltages > 240 V. All outputs must be fed from the same phase.
- Use an external fuse for each output.

> *The configurable digital channels (C12 and C13) used as digital inputs have the same electrical characteristics as standard digital inputs.*
>
> *The configurable digital channels (C12 and C13) used as digital transistor outputs have the same electrical characteristics as standard digital outputs.*

5.1.1.2.2 I/O configuration

The configuration data of the onboard I/Os is stored in the processor modules PM50x2.

5.1.1.2.3 Parameterization

For information about parameterization, refer to the configuration description for onboard I/Os for processor modules PM50x2.

5.1.1.2.4 Diagnosis

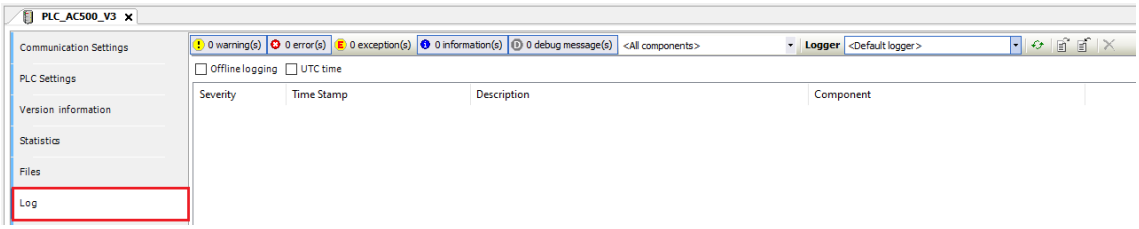
No diagnosis is generated for the onboard I/O.

There is only an error message if the configuration does not work. A log entry is generated.

The Automation Builder already prevents faulty values from being entered in the configuration.

If the configuration does not work, there is a system error, if e.g. faulty software or wrong versions are installed.

Otherwise there are error messages from the blocks for the individual functions.



5.1.1.2.5 State LEDs

Table 26: States of the I/Os

LED	Status	Color	LED = ON	LED = OFF
I	Digital input	yellow	Input is ON	Input is OFF
O	Digital transistor output	yellow	Output is ON	Output is OFF
NO	Digital relay output	yellow	Relay contact is closed	Relay contact is open
C	Digital configurable input/output	yellow	Configured input/ output is ON	Configured input/ output is OFF

5.1.1.2.6 Technical data

Technical data of the digital inputs

Table 27: PM5012-x-ETH

Parameter		Value	
Number of channels per module		6	
Distribution of the channels into groups		1 group of 6 channels	
Galvanic isolation		Yes, per group	
Connections of the channels I0 to I11		Terminals 2 to 7	
Reference potential for the channels I0 to I11		Terminal 1	
Indication of the input signals		1 yellow LED per channel; the LED is ON when the input signal is high (signal 1) and the module's logic is in operation	
Input type according to EN 61131-2		Type 1 source	Type 1 sink
Input signal voltage		-24 V DC	+24 V DC
	Signal 0	-5 V .. .+3 V	-3 V ... +5 V
	Undefined signal	-15 V ... - 5 V	+5 V ... +15 V
	Signal 1	-30 V ... -15 V	+15 V ... +30 V
Ripple with signal 0		Within -5 V ... +3 V	Within -3 V ... +5 V
Ripple with signal 1		Within -30 V ... -15 V	Within +15 V ... +30 V
Input current per channel			
	Input voltage +24 V	Typ. 4.6 mA	
	Input voltage +5 V	Typ. 0.8 mA	
	Input voltage +15 V	> 2.5 mA	
	Input voltage +30 V	< 8 mA	
Max. permissible leakage current (at 2-wire proximity switches)		1 mA	
Input delay (0->1 or 1->0)		On request	
Max. cable length *)			
	Shielded	500 m	
	Unshielded	300 m	

*) For fast inputs, a shielded cable must be used and the max. cable length is 50 m.

Table 28: PM5032-x-ETH, PM5052-x-ETH, PM5072-T-2ETH(W), PM5082-T-2ETHand PM5092-T-2ETH

Parameter	Value
Number of channels per module	12
Distribution of the channels into groups	1 group of 12 channels
Galvanic isolation	Yes, per group
Connections of the channels I0 to I11	Terminals 2 to 13
Reference potential for the channels I0 to I11	Terminal 1
Indication of the input signals	1 yellow LED per channel; the LED is ON when the input signal is high (signal 1) and the module's logic is in operation

Parameter		Value	
Input type according to EN 61131-2		Type 1 source	Type 1 sink
Input signal voltage		-24 V DC	+24 V DC
	Signal 0	-5 V ... +3 V	-3 V ... +5 V
	Undefined signal	-15 V ... - 5 V	+5 V ... +15 V
	Signal 1	-30 V ... -15 V	+15 V ... +30 V
Ripple with signal 0		Within -5 V ... +3 V	Within -3 V ... +5 V
Ripple with signal 1		Within -30 V ... -15 V	Within +15 V ... +30 V
Input current per channel			
	Input voltage +24 V	Typ. 4.6 mA	
	Input voltage +5 V	Typ. 0.8 mA	
	Input voltage +15 V	> 2.5 mA	
	Input voltage +30 V	< 8 mA	
Max. permissible leakage current (at 2-wire proximity switches)		1 mA	
Input delay (0->1 or 1->0)		On request	
Max. cable length *)			
	Shielded	500 m	
	Unshielded	300 m	

*) For fast inputs, a shielded cable must be used and the max. cable length is 50 m.

Technical data of the fast counter inputs

For AC500 devices the function "fast counter" is available in S500 I/O modules as of firmware version V1.3.

For AC500-eCo devices the function "fast counter" is available in onboard I/Os of PM50xx.

The AC500-eCo processor modules with onboard I/Os provide some special functionality on the digital inputs or digital outputs. Fast counter, encoder inputs, interrupt inputs or PWM/PTO outputs are available depending on the device used.

The fast counter functionality can be activated within the onboard I/O configuration.

The fast counter can work in pulse/direction mode or A/B track counter mode.

As AC500-eCo PLCs provide the fast counters via their onboard I/Os not only the correct power distribution to the PLC has to be made, but also the correct wiring to the signal wires. How to connect and use fast counters in AC500-eCo PLCs is described in an *application example*.

The pulse/direction counter detects the rising edge of the counter input. It will increase or decrease the count value (depending on the direction input) at every rising edge.

The A/B track counter is used to count the signal from an encoder.

The counter can count with quad phases. In the following the behavior of the A/B track counter is described.

Parameter		PM5012-T-ETH	PM5012-R-ETH	PM5032-T-ETH PM5052-T-ETH PM5072-T-2ETH(W) PM5082-T-2ETH PM5092-T-2ETH	PM5032-R-ETH PM5052-R-ETH
Fast counter					
	Useable inputs	2	2	4	4
	Fast input max. 5 kHz	I4 ... I5	I4 ... I5	-	-
	Fast input, max. 100 kHz	-	-	I4 … I7	I4 … I7

Technical data of the interrupt inputs

Parameter		PM5012-T-ETH	PM5012-R-ETH	PM5032-T-ETH PM5052-T-ETH PM5072-T-2ETH(W) PM5082-T-2ETH PM5092-T-2ETH	PM5032-R-ETH PM5052-R-ETH
Interrupt					
	Useable inputs	4	4	4	4
	Fast input max. 5 kHz	I0 ... I3	I0 ... I3	I0 ... I3	I0 ... I3

Technical data of the Touch/Reset inputs

Parameter		PM5012-T-ETH	PM5012-R-ETH	PM5032-T-ETH PM5052-T-ETH PM5072-T-2ETH(W) PM5082-T-2ETH PM5092-T-2ETH	PM5032-R-ETH PM5052-R-ETH
Touch/Reset					
	Useable inputs	-	-	4 together with dedicated encoder	4 together with dedicated encoder

Parameter		PM5012-T-ETH	PM5012-R-ETH	PM5032-T-ETH PM5052-T-ETH PM5072-T-2ETH(W) PM5082-T-2ETH PM5092-T-2ETH	PM5032-R-ETH PM5052-R-ETH
	Fast input max. 5 kHz	-	-	I0 ... I3	I0 ... I3
	Fast input, max. 100 kHz	-	-	I6 ... I7 When using the A/B encoder on I04...I05 and the Touch/ Reset inputs on fast inputs	I6 ... I7 When using the A/B encoder on I04...I05 and the Touch/ Reset inputs on fast inputs

Technical data of the digital transistor outputs

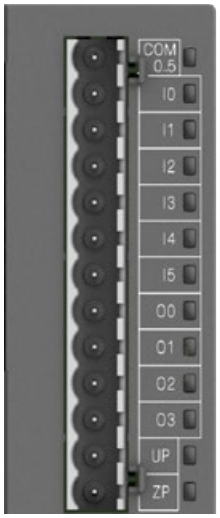


Table 29: PM5012-T-ETH

Parameter		Value
Number of channels per module		4
Distribution of the channels into groups		1 group of 4 channels
Galvanic isolation		Yes, per group
Connection of the channels O0 to O3		Terminals 8 to 11
Common power supply voltage		Terminals 12 (+24 V DC, signal name UP)
Reference potential for the channels O0 to O3		Terminal 13 (0 V DC, negative pole of the process voltage, signal name ZP)
Indication of the output signals		1 yellow LED per channel; the LED is on when the output signal is high (signal 1)
Way of operation		Non-latching type
Min. output voltage at signal 1		UP - 0.1 V
Output delay (max. at rated load)		
	0 to 1	On request
	1 to 0	On request
Rated protection fuse (per channel)		2 A fast
Output current		
	Rated current per channel (max.)	0.5 A at UP 24 V DC (resistance, general use and pilot duty)
	Rated current per group (max.)	2 A
	Rated current (all channels together, max.)	2 A
Max. leakage current with signal 0		On request
Demagnetization when inductive loads are switched off		Must be performed externally according to driven load specification
Switching Frequencies		

Parameter		Value
	With inductive loads	On request
Short-circuit-proof / Overload-proof		No
Overload message		No
Output current limitation		No
Resistance to feedback against 24 V DC		No
Connection of 2 outputs in parallel		Not possible
Max. cable length *)		
	Shielded	500 m
	Unshielded	150 m

*) For PWM and PTO outputs, a shielded cable must be used.

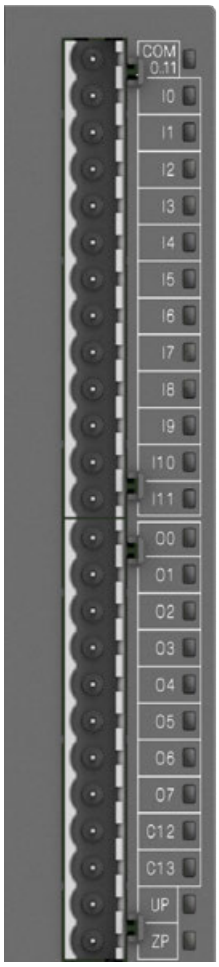


Table 30: PM5032-T-ETH, PM5052-T-ETH, PM5072-T-2ETH(W), PM5082-T-2ETHand PM5092-T-2ETH

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Galvanic isolation		Yes, per group
Connection of the channels O0 to O7		Terminals 14 to 21
Common power supply voltage		Terminals 24 (+24 V DC, signal name UP)
Reference potential for the channels O0 to O7		Terminal 25 (0 V DC, negative pole of the process voltage, signal name ZP)
Indication of the output signals		1 yellow LED per channel; the LED is on when the output signal is high (signal 1)
Way of operation		Non-latching type
Min. output voltage at signal 1		UP - 0.1 V
Output delay (max. at rated load)		
	0 to 1	On request
	1 to 0	On request
Rated protection fuse (per channel)		2 A fast
Output current		
	Rated current per channel (max.)	0.5 A at UP 24 V DC (resistance, general use and pilot duty)
	Rated current per group (max.)	4 A
	Rated current (all channels together, max.)	4 A
Max. leakage current with signal 0		0.5 mA
Demagnetization when inductive loads are switched off		Must be performed externally according to driven load specification
Switching Frequencies		
	With inductive loads	On request
Short-circuit-proof / Overload-proof		No
Overload message		No
Output current limitation		No
Resistance to feedback against 24 V DC		No

Parameter		Value
Connection of 2 outputs in parallel		Not possible
Max. cable length *)		
	Shielded	500 m
	Unshielded	150 m

*) For PWM and PTO outputs, a shielded cable must be used.

Technical data of the digital relay outputs



Table 31: PM5012-R-ETH

Parameter		Value
Number of channels per module		4 normally-open relay outputs
Distribution of the channels into groups		2 groups for 2 channels
Galvanic isolation		Yes, per group
Connection of the channels NO0 to NO1		Terminals 8 to 9
Connection of the channels NO2 to NO3		Terminals 11 to 12
Reference potential R0..1 for the channels NO0 to NO1		Terminal 10
Reference potential R2..3 for the channels NO2 to NO3		Terminal 13
Relay output voltage		
	Rated value	24 V DC or 100 V AC ... 240 V AC 50 Hz/60 Hz
	Range	5 V DC ... 30 V DC or 5 V AC ... 250 V AC
Indication of the output signals		1 yellow LED per channel; the LED is on when the output signal is high (signal 1)
Way of operation		Non-latching type
Output delay		
	0 to 1	Typ. 10 ms
	1 to 0	Typ. 10 ms
Output current		
	Rated current per channel (max.)	2.0 A (24 V DC resistance and general use, 100 V AC ... 240 V AC, resistance, general use and pilot duty)
	Rated current per group (max.)	6 A
	Rated current (all channels together, max.)	12 A
Demagnetization when inductive loads are switched off		External demagnetization measures must be implemented when switching inductive loads.
Spark suppression with inductive AC loads		Must be performed externally according to driven load specification
Switching frequencies		

Parameter		Value
	With resistive loads	Max. 1 Hz
	With inductive loads	On request
	With lamp loads	On request
Short-circuit-proof / Overload-proof		No, should be provided by an external fuse or circuit breaker
Rated protection fuse (for each channel)		5 A fast
Overload message		No
Output current limitation		No
Resistance to feedback against 24 V DC		No
Connection of 2 outputs in parallel		Not possible
Lifetime of relay contacts (cycles)		100,000 at rated load
Max. cable length *)		
	Shielded	500 m
	Unshielded	150 m

*) For PWM and PTO outputs, a shielded cable must be used.

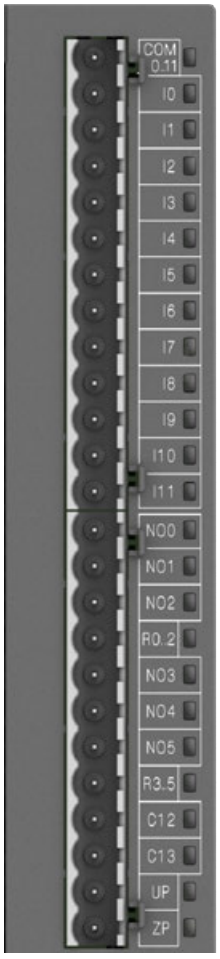


Table 32: PM5032-R-ETH and PM5052-R-ETH

Parameter		Value
Number of channels per module		6 normally-open relay outputs
Distribution of the channels into groups		2 groups for 3 channels
Galvanic isolation		Yes, per group
Connection of the channels NO0 to NO2		Terminals 14 to 16
Connection of the channels NO3 to NO5		Terminals 18 to 20
Reference potential R0..2 for the channels NO0 to NO2		Terminal 17
Reference potential R3..5 for the channels NO3 to NO5		Terminal 21
Relay output voltage		
	Rated value	24 V DC or 100 V AC ... 240 V AC 50 Hz/60 Hz
	Range	5 V DC ... 30 V DC or 5 V AC ... 250 V AC
Indication of the output signals		1 yellow LED per channel; the LED is on when the output signal is high (signal 1) and the module is powered through the I/O bus
Way of operation		Non-latching type
Output delay		
	0 to 1	Typ. 10 ms
	1 to 0	Typ. 10 ms
Output current		

Parameter		Value
	Rated current per channel (max.)	2.0 A (24 V DC resistance and general use, 100 V AC ... 240 V AC, resistance, general use and pilot duty)
	Rated current per group (max.)	6 A
	Rated current (all channels together, max.)	12 A
Demagnetization when inductive loads are switched off		External demagnetization measures must be implemented when switching inductive loads.
Spark suppression with inductive AC loads		Must be performed externally according to driven load specification
Switching frequencies		
	With resistive loads	Max. 1 Hz
	With inductive loads	On request
	With lamp loads	On request
Short-circuit-proof / Overload-proof		No, should be provided by an external fuse or circuit breaker
Rated protection fuse (for each channel)		5 A fast
Overload message		No
Output current limitation		No
Resistance to feedback against 24 V DC		No
Connection of 2 outputs in parallel		Not possible
Lifetime of relay contacts (cycles)		100,000 at rated load
Max. cable length *)		
	Shielded	500 m
	Unshielded	150 m

*) For PWM and PTO outputs, a shielded cable must be used.

Technical data of the limit switch outputs

Parameter		PM5012-T-ETH	PM5012-R-ETH	PM5032-T-ETH PM5052-T-ETH PM5072-T-2ETH(W) PM5082-T-2ETH PM5092-T-2ETH	PM5032-R-ETH PM5052-R-ETH
Limit switch					
	Useable outputs	4	-	8	2
	Fast output max. 5 kHz	O0 ... O3	-	O0 … O3	-
	Fast output, max. 100 kHz	-	-	O4 … O7	C12 … C13

Technical data of the PTO outputs

Parameter		PM5012-T-ETH	PM5012-R-ETH	PM5032-T-ETH PM5052-T-ETH PM5072-T-2ETH(W) PM5082-T-2ETH PM5092-T-2ETH	PM5032-R-ETH PM5052-R-ETH
PTO					
	Useable outputs	-	-	4	1 pair of output
	Fast output, max. up to 200 kHz [2])	-	-	O4 … O7 For 2 PTO 200 kHz [1]) Pulse/ Direction or CC/Ccw modes as pair of outputs	C12 … C13
				O4 … O7 as 4 PTO up to 200 kHz Pulse outputs / Direction using fast output 5kHz O0...O3 [2])	

[1]) If the load is less than 100 mA it is strongly recommended to connect an additional load resistor (240 Ω/5 W or 270 Ω/5 W) to the output to improve the pulse signal.

[2]) With the processor modules revision 1 (rubric R017x), the fast output provides then 200 kHz PTO Pulse output instead of 100 kHz. The processor modules revision 1 needs at least AB 2.6.0 and higher.

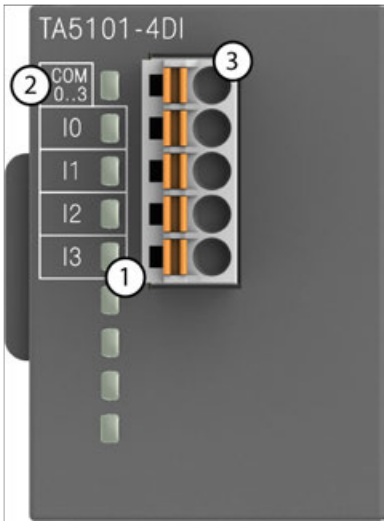
Technical data of the PWM outputs

Parameter		PM5012-T-ETH	PM5012-R-ETH	PM5032-T-ETH PM5052-T-ETH PM5072-T-2ETH(W) PM5082-T-2ETH PM5092-T-2ETH	PM5032-R-ETH PM5052-R-ETH
PWM					
	Useable outputs	4	-	8	2
	Fast output max. 5 kHz	O0 ... O3	-	O0 … O3	-
	Fast output, max. 100 kHz	-	-	O4 … O7	C12 … C13

5.1.1.3 Option boards

5.1.1.3.1 TA5101-4DI - Digital input option board

- 4 digital inputs 24 V DC (I0 to I3) in 1 group
- Module-wise galvanically isolated
- W variant available for use in extended (wide) temperature range



1 4 yellow LEDs to display the signal states at the digital inputs I0 to I3
2 Allocation of signal name
3 5-pin terminal block for input signals

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.

Intended purpose

The device is used as an optional I/O extension module for AC500-eCo CPUs (PM50x2).

The inputs/outputs are group-wise galvanically isolated from each other.

All other circuitry of the module is galvanically isolated from the inputs/outputs.

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via internal CPU connection
External power supply	Not necessary

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the system assembly chapter.

The connection is carried out by using a removable 5-pin terminal block. For more information, please refer to the chapter terminal blocks for AC500-eCo system. The terminal blocks are included in the module's scope of delivery and additional terminal blocks as spare parts can be ordered separately.

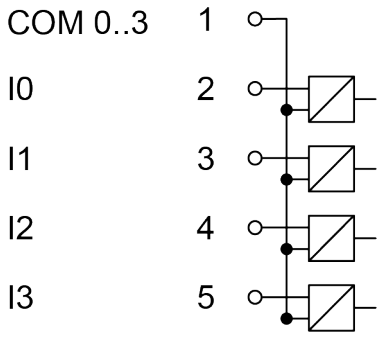


Fig. 8: Internal construction of the digital inputs

Table 33: Assignment of the terminals:

Terminal	Signal	Description
1	COM 0..3	Input common for signals I0 to I3
2	I0	Input signal I0
3	I1	Input signal I1
4	I2	Input signal I2
5	I3	Input signal I3

The internal power supply voltage for the module's circuitry is carried out via the connection to CPU. Thus, the current consumption from 24 V DC power supply at the terminals L+ and M of the CPU module increases by 10 mA per TA5101-4DI.

An external power supply connection is not needed.

WARNING!

Removal/Insertion under power

The option cards are not designed to be removed or inserted while the device is switched on. Due to unpredictable consequences, it is not permitted to connect or remove option cards while the device is powered on.

Make sure that all power sources (supply and process power) are switched off before you do the following:

– Connection or disconnection of signals or terminal blocks.
– Removal, installation or replacement of an option card.

Disconnecting a powered option card under voltage in a potentially explosive atmosphere may result in an electric arc, which could ignite combustible materials and cause a fire or explosion.

Make sure that the power supply is disconnected and the area has been toughly checked to ensure that no combustible materials are present before proceeding.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.

The digital inputs can be used as source inputs or as sink inputs.

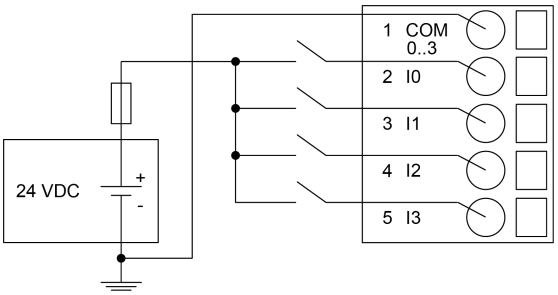
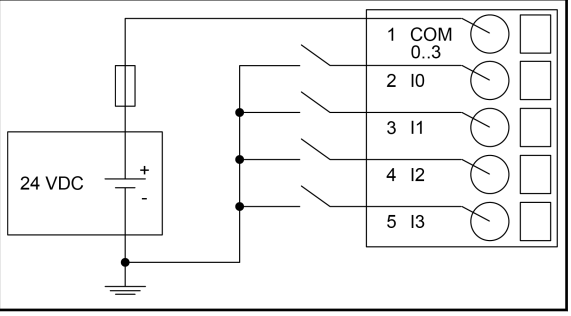
NOTICE!

Risk of malfunctions in the plant!

A ground fault, e. g. caused by a damaged cable insulation, can bridge switches accidentally.

Use sink inputs when possible or make sure that, in case of error, there will be no risks to persons or plant.

Table 34: Connection of the option board for digital I/O extension TA5101-4DI

Sink inputs of TA5101-4DI	Source inputs of TA5101-4DI
	

The module provides several diagnosis functions *“Diagnosis” on page 92*.

The meaning of the LEDs is described in the section 'State LEDs' *“State LEDs” on page 92*.

I/O configuration

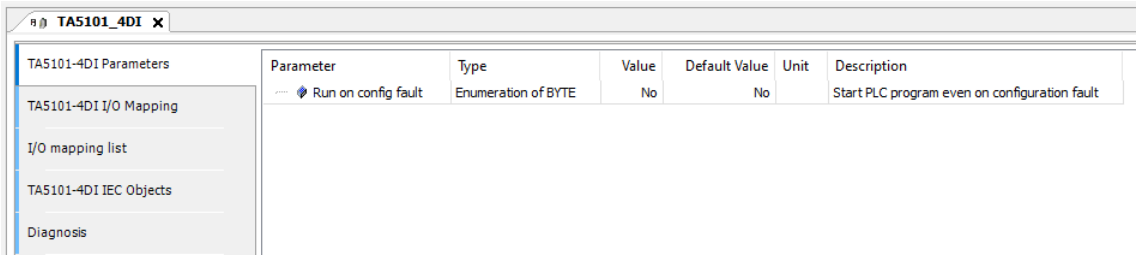
The module itself does not store configuration data. It receives its parameterization data from the CPU module during power-up of the system.

Hence, replacing optional modules is possible without any re-parameterization via software.

Parameterization

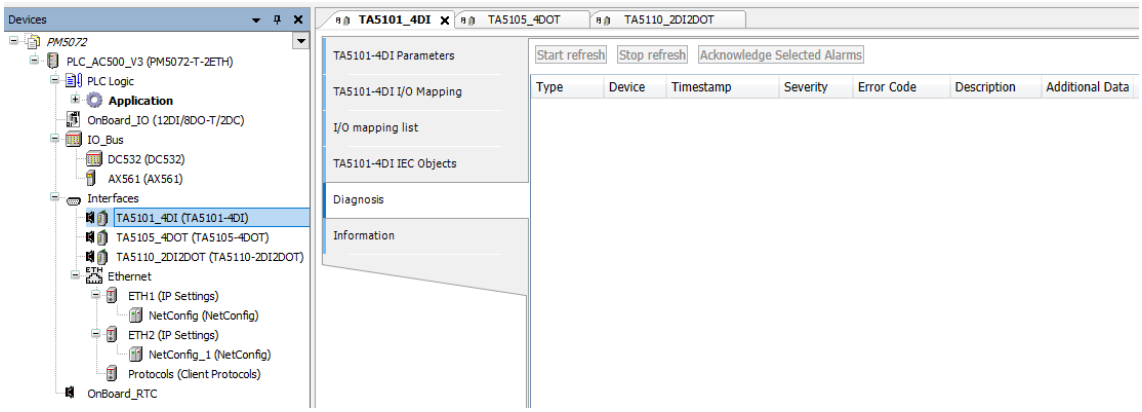
The arrangement of the parameter data is performed with Automation Builder software.

1. In the device tree, double-click the desired option board.
2. Select the *“TA51xx Parameters”* tab to edit the parameterization of the desired option board.



Diagnosis

Diagnosis



1. In the device tree, double-click the desired option board.
2. Select the *“Diagnosis”* tab to view the diagnosis messages of the desired option board.

Table 35: Diagnosis messages

Device	Severity	Error code	Description	
			Error Message	Remedy
TA5101-4DI	11	1	Wrong or no board plugged	Replace with correct functional board
TA5101-4DI	11	2	Board defective	Replace with correct functional board
TA5101-4DI	11	3	Failed to set direction	Replace with correct functional board
TA5101-4DI	11	4	Parameter wrong	Verify setting of parameter “Run on config fault”
TA5101-4DI	11	5	Parameter value failure	Update Configuration
TA5101-4DI	3	6	Communication failed, set address	Replace with correct functional board
TA5101-4DI	3	7	Communication failed, write	Replace with correct functional board
TA5101-4DI	3	8	Communication failed, read	Replace with correct functional board

State LEDs

LED	State	Color	LED = OFF	LED = ON
Inputs I0...I3	Digital input	Yellow	Input is OFF	Input is ON

Technical data

The system data apply.

Chapter 4.1 “System data AC500-eCo” on page 25

Only additional details are therefore documented below.

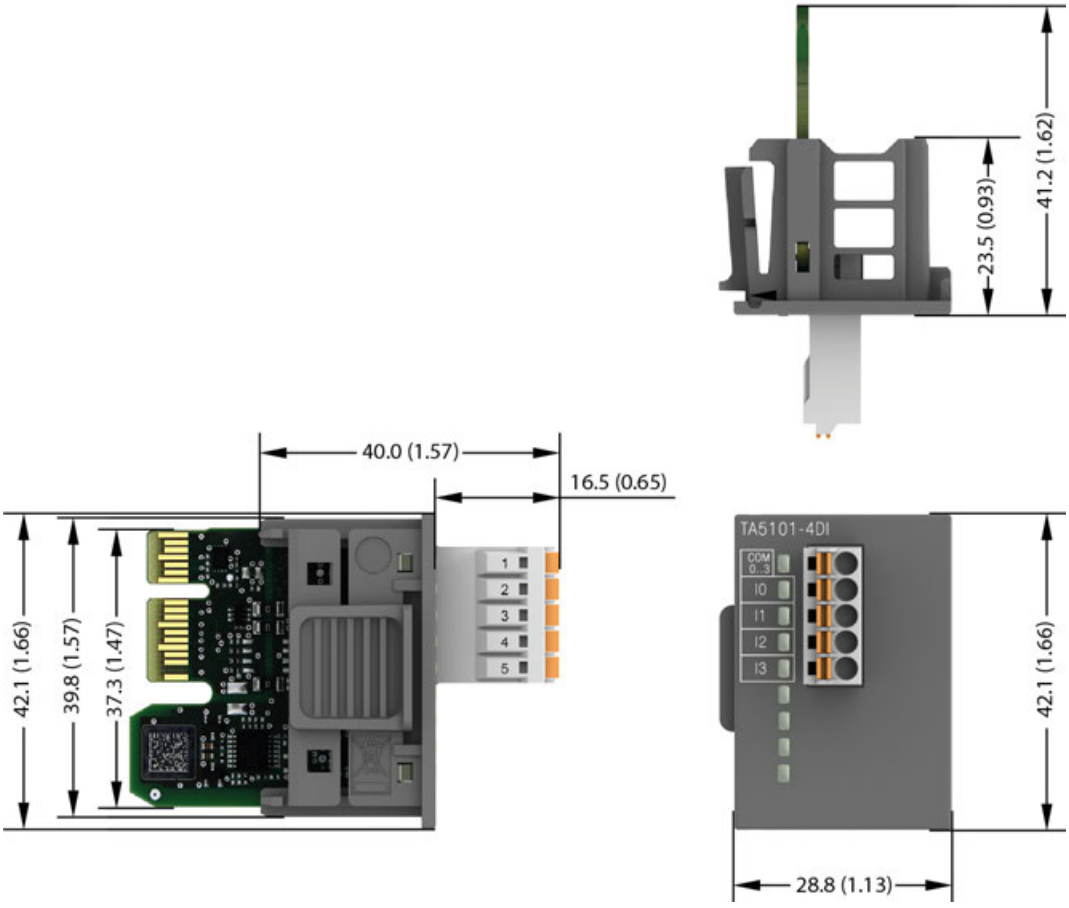
Parameter	Value
Galvanic isolation	Yes, between the input group and the rest of the module
Isolated groups	1 (4 channels per group)
Current consumption from 24 V DC power supply at the L+ and M terminals of the CPU	Ca. 10 mA
Max. power dissipation within the module	0.8 W
Weight	15 g
Mounting position	Horizontal or vertical
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

Table 36: Technical data of the digital inputs

Parameter	Value	
Number of channels per module	4 inputs 24 V DC	
Distribution of the channels into groups	1 (4 channels per group)	
Connections of the channels I0 to I3	Terminals 2 to 5	
Reference potential for the channels I0 to I3	Terminal 1 (plus or negative pole of the process supply voltage, signal name COM 0 ... 3)	
Indication of the input signals	1 yellow LED per channel; the LED is ON when the input signal is high (signal 1). The module is powered through the CPU connection.	
Monitoring point of input indicator	LED	
Input type according to EN 61131-2	Type 1 source	Type 1 sink
Input signal range	-24 V DC	+24 V DC
Signal 0	-5 V ... +3 V	-3 V...+5 V
Undefined signal	-15 V ... -5 V	+5 V ... +15 V
Signal 1	-30 V ... -15 V	+15 V ... +30 V
Input current per channel		
Input voltage 24 V	Typ. 5 mA	
Input voltage 5 V	Typ. 1 mA	
Input voltage 14 V		
Input voltage 15 V	< 3 mA	
Input voltage 27 V		
Input voltage 30 V	< 7 mA	
Max. permissible leakage current (at 2-wire proximity switches)	1 mA	

Parameter		Value
Input delay (0->1 or 1->0)		Typ. 8 ms
Input data length		1 byte
Max. cable length		
	Shielded	500 m
	Unshielded	300 m

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 187 000 R0001	TA5101-4DI: AC500-eCo, digital input option board, 4DI 24 V DC, spring/ cable front terminal 3.50 mm pitch	Active
1SAP 187 000 R0201	TA5101-4DIW: AC500-eCo, digital input option board, 4DI 24 V DC, spring/cable front terminal 3.50 mm pitch, wide temperature range	Active
Spare parts		
1SAP 187 400 R0012 **)	TA5220-SPF5: spring terminal block, removable, 5-pin, spring front, cable front, 6 pieces per packing unit	Active

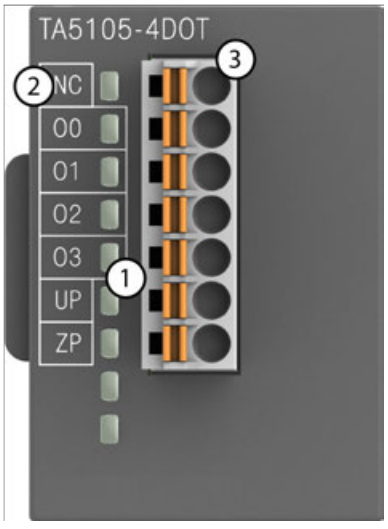
**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

***) The needed spring terminal block is always delivered with the option board.*

The terminal block listed in the table is for spare part only if needed.

5.1.1.3.2 TA5105-4DOT - Digital output option board

- 4 digital outputs 24 V DC (O0 to O3) in 1 group
- Module-wise galvanically isolated
- W variant available for use in extended (wide) temperature range



1 4 yellow LEDs to display the signal states at the digital outputs O0 ... O3
2 Allocation of signal name
3 7-pin terminal block for output signals

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.

Intended purpose

The device is used as an optional I/O extension module for AC500-eCo CPUs (PM50x2).

The inputs/outputs are group-wise galvanically isolated from each other.

All other circuitry of the module is galvanically isolated from the inputs/outputs.

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via internal CPU connection
External power supply	Via the terminals ZP and UP (process supply voltage 24 V DC)

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the system assembly chapter.

The connection is carried out by using a removable 7-pin terminal block. For more information, please refer to the chapter terminal blocks for AC500-eCo system. The terminal blocks are included in the module's scope of delivery and additional terminal blocks as spare parts can be ordered separately.

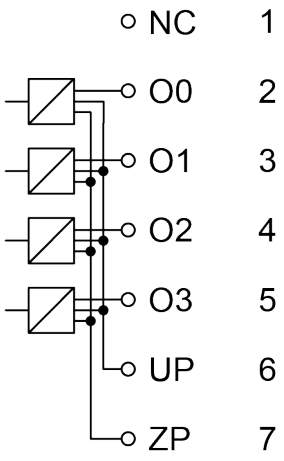


Fig. 9: Internal construction of the digital outputs

Table 37: Assignment of the terminals:

Terminal	Signal	Description
1	NC	Not connected
2	O0	Output signal O0
3	O1	Output signal O1
4	O2	Output signal O2
5	O3	Output signal O3
6	UP	Process supply voltage UP +24 V DC
7	ZP	Process supply voltage ZP 0 V DC

The internal power supply voltage for the module's circuitry is carried out via the connection to CPU. Thus, the current consumption from 24 V DC power supply at the terminals L+ and M of the CPU module increases by 10 mA per TA5105-4DOT.

The external power supply connection is carried out via the UP (+24 V DC) and ZP (0 V DC) terminals.

WARNING!

Removal/Insertion under power

The option cards are not designed to be removed or inserted while the device is switched on. Due to unpredictable consequences, it is not permitted to connect or remove option cards while the device is powered on.

Make sure that all power sources (supply and process power) are switched off before you do the following:

– Connection or disconnection of signals or terminal blocks.
– Removal, installation or replacement of an option card.

Disconnecting a powered option card under voltage in a potentially explosive atmosphere may result in an electric arc, which could ignite combustible materials and cause a fire or explosion.

Make sure that the power supply is disconnected and the area has been toughly checked to ensure that no combustible materials are present before proceeding.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.

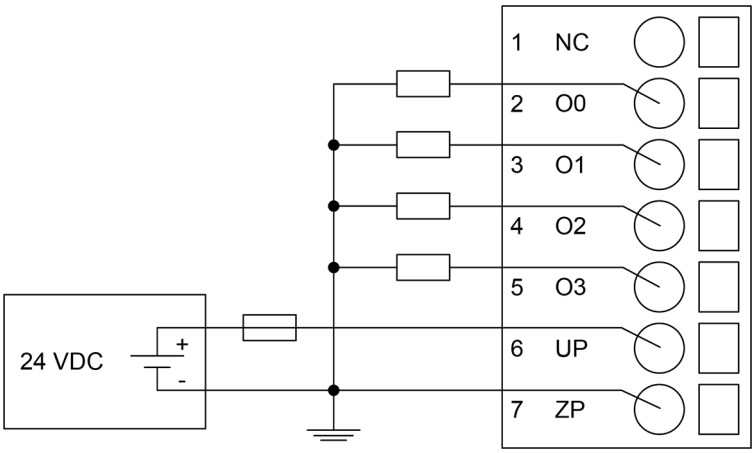


Fig. 10: Connection of the option board for digital I/O extension TA5105-4DOT

NOTICE!

Risk of malfunctions in the plant!

Only if L+/M of the CPU is available and the outputs are already configured in the AB program, the outputs will switch on as soon as the UP/ZP is available.

This must be considered in the application planning.

NOTICE!

Risk of damaging the I/O module!

The outputs are not protected against short circuits and overload.

- Never short-circuit or overload the outputs.
- Never connect the outputs to other voltages.
- Use an external fuse for the outputs.

The module provides several diagnosis functions *Further information on page 99*.

The meaning of the LEDs is described in the section State LEDs *"State LEDs" on page 100*.

I/O configuration

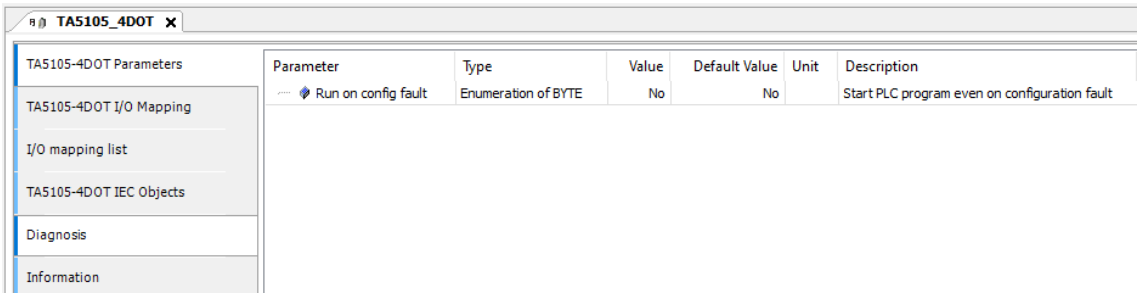
The module itself does not store configuration data. It receives its parameterization data from the CPU module during power-up of the system.

Hence, replacing optional modules is possible without any re-parameterization via software.

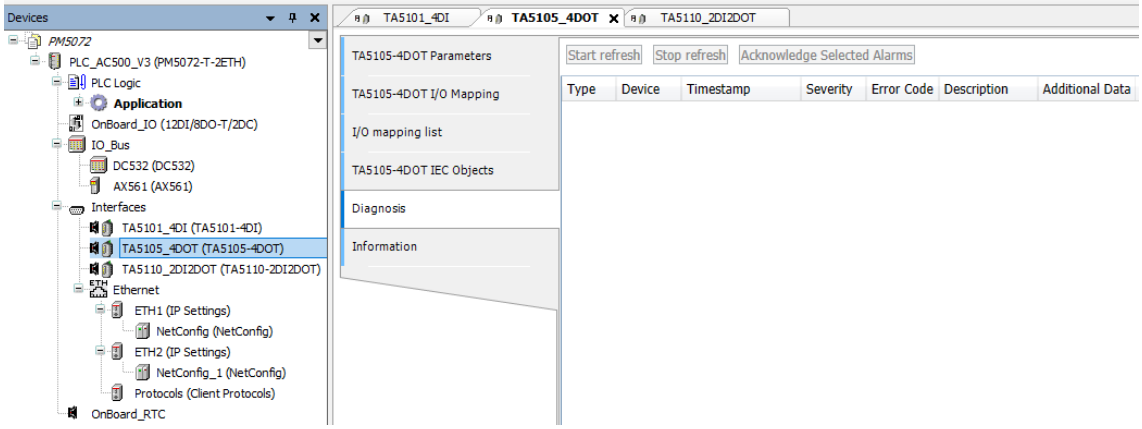
Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

1. In the device tree, double-click the desired option board.
2. Select the *"TA51xx Parameters"* tab to edit the parameterization of the desired option board.



Diagnosis



1. In the device tree, double-click the desired option board.
2. Select the *“Diagnosis”* tab to view the diagnosis messages of the desired option board.

Table 38: Diagnosis messages

Device	Severity	Error code	Description	
			Error Message	Remedy
TA5105-4DOT	11	1	Wrong or no board plugged	Replace with correct functional board
TA5105-4DOT	11	2	Board defective	Replace with correct functional board
TA5105-4DOT	11	3	Failed to set direction	Replace with correct functional board
TA5105-4DOT	11	4	Parameter wrong	Verify setting of parameter “Run on config fault”
TA5105-4DOT	11	5	Parameter value failure	Update Configuration
TA5105-4DOT	3	6	Communication failed, set address	Replace with correct functional board
TA5105-4DOT	3	7	Communication failed, write	Replace with correct functional board
TA5105-4DOT	3	8	Communication failed, read	Replace with correct functional board

State LEDs

LED	State	Color	LED = OFF	LED = ON
Outputs O0...O3	Digital output	Yellow	Output is OFF	Output is ON (The output voltage (normally 24 V DC) is only displayed if UP/ZP and L+/M (supply voltages for the module) are switched ON)

Technical data

The system data apply.

↳ *Chapter 4.1 “System data AC500-eCo” on page 25*

Only additional details are therefore documented below.

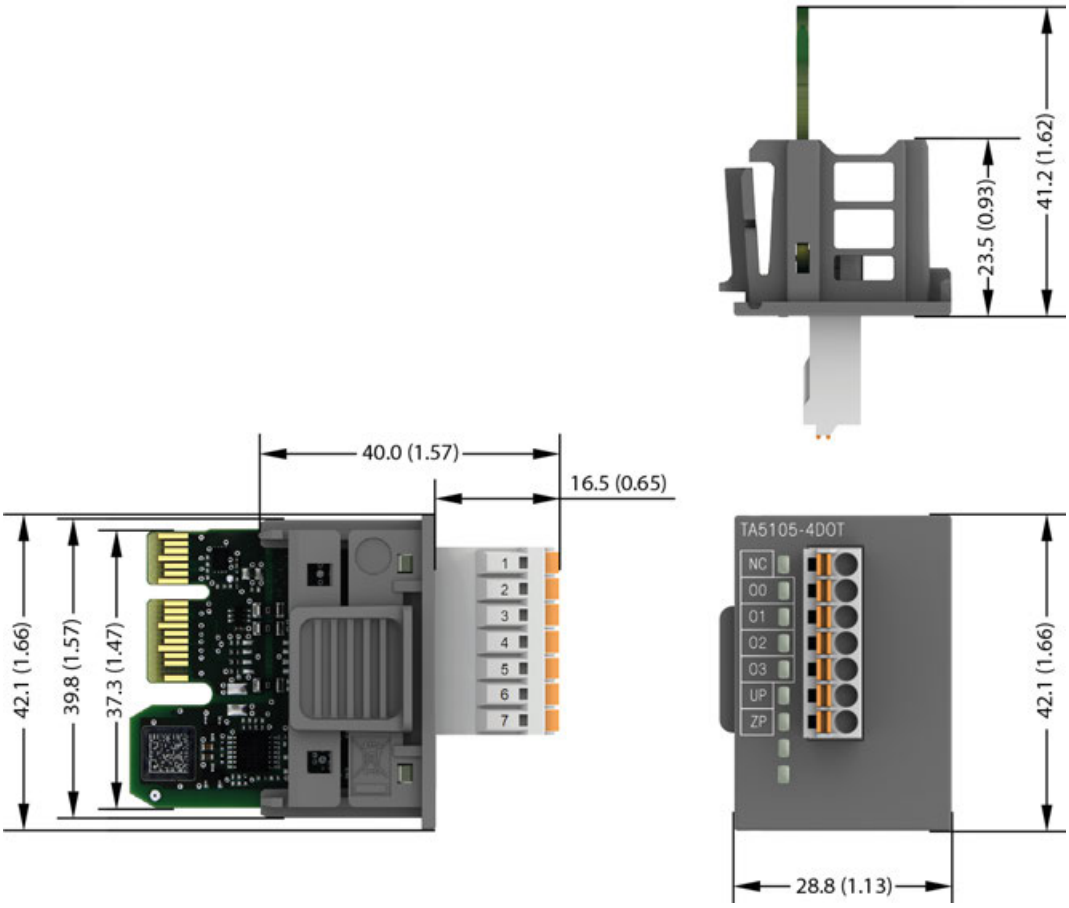
Parameter		Value
Process supply voltage UP		
	Connections	Terminal 6 for UP (+24 V DC) and terminal 7 for ZP (0 V DC)
	Rated value	24 V DC
	Current consumption via UP terminal	5 mA + max. 0.5 A per output
	Max. ripple	5 %
	Inrush current	0.000002 A^2s
	Protection against reversed voltage	Yes
	Rated protection fuse for UP	On request
Current consumption from 24 V DC power supply at the L+/M terminals of the CPU		Ca. 10 mA
Galvanic isolation		Yes, between the output group and the rest of the module
Isolated groups		1 (4 channels per group)
Surge-voltage (max.)		35 V DC for 0.5 s
Max. power dissipation within the module		0.5 W
Weight		16 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

Table 39: Technical data of the digital outputs

Parameter	Value
Number of channels per module	4 transistor outputs (24 V DC, 0.5 A max.)
Distribution of the channels into groups	1 (4 channels per group)
Connection of the channels O0 to O3	Terminals 2 to 5

Parameter		Value
Common power supply voltage		Terminal 6 (positive pole of the process voltage, signal name UP)
Reference potential for the channels O0 to O3		Terminal 7 (negative pole of the process voltage, signal name ZP)
Indication of the output signals		1 yellow LED per channel; the LED is on when the output signal is high (signal 1). Only internal logic is powered from CPU. Outputs are powered from UP/ZP terminals.
Way of operation		Non-latching type
Min. output voltage at signal 1		UP - 0.1 V
Output delay (max. at rated load)		
	0 to 1	50 µs
	1 to 0	200 µs
Output data length		1 byte
Output current		
	Rated current per channel (max.)	0.5 A at UP 24 V DC (resistance, general use and pilot duty)
	Rated current per group (max.)	2 A (4 channels * 0.5 A)
Max. leakage current with signal 0		0.5 mA
Output type		Non-protected
Protection type		External fuse on each channel
Rated protection fuse (for each channel)		On request
Demagnetization when inductive loads are switched off		Must be performed externally according to driven load specification
Switching Frequencies		
	With resistive load	Limited by CPU cycle time
	With inductive load	Max. 0.5 Hz
	With lamp load	Max. 11 Hz at max. 5 W
Short-circuit-proof / Overload-proof		No
	Overload message	No
	Output current limitation	No
	Resistance to feedback against 24 V DC	No
Connection of 2 outputs in parallel		Not possible
Max. cable length		
	Shielded	500 m
	Unshielded	150 m

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 187 000 R0002	TA5105-4DOT: AC500-eCo, digital output option board, 4DO-T 24 V DC / 0.5 A, spring/cable front terminal 3.50 mm pitch	Active
1SAP 187 000 R0202	TA5105-4DOTW: AC500-eCo, digital output option board, 4DO-T 24 V DC / 0.5 A, spring/cable front terminal 3.50 mm pitch, wide temperature range	Active
Spare parts		
1SAP 187 400 R0014 **)	TA5220-SPF7: spring terminal block, removable, 7-pin, spring front, cable front, 6 pieces per packing unit	Active

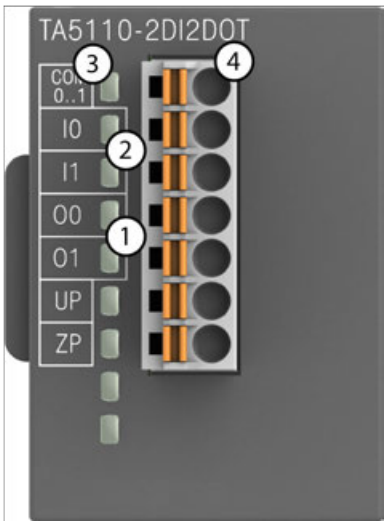
*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

**) The needed spring terminal block is always delivered with the option board.

The terminal block listed in the table is for spare part only if needed.

5.1.1.3.3 TA5110-2DI2DOT - Digital I/O option board

- 2 digital inputs 24 V DC (I0 to I1) in 1 group
- 2 digital transistor outputs 24 V DC (O0 to O1) in 1 group
- Group-wise galvanically isolated
- W variant available for use in extended (wide) temperature range



1 2 yellow LEDs to display the signal states at the digital outputs O0 to O1
2 2 yellow LEDs to display the signal states at the digital inputs I0 to I1
3 Allocation of signal name
4 7-pin terminal block for input/output signals

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.

Intended purpose

The device is used as an optional I/O extension module for AC500-eCo CPUs (PM50x2).

The inputs/outputs are group-wise galvanically isolated from each other.

All other circuitry of the module is galvanically isolated from the inputs/outputs.

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via internal CPU connection
External power supply	Via the terminals ZP and UP (process supply voltage 24 V DC)

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the system assembly chapter.

The connection is carried out by using a removable 7-pin terminal block. For more information, please refer to the chapter terminal blocks for AC500-eCo system. The terminal blocks are included in the module's scope of delivery and additional terminal blocks as spare parts can be ordered separately.

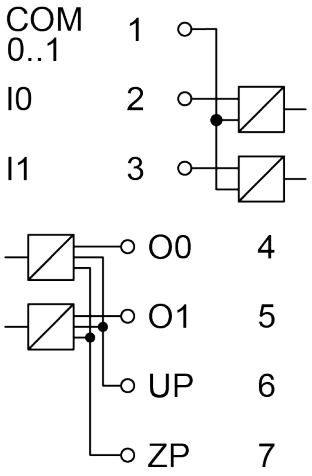


Fig. 11: Internal construction of the digital inputs and outputs

Table 40: Assignment of the terminals:

Terminal	Signal	Description
1	COM 0 ... 1	Input common for signals I0 to I1
2	I0	Input signal I0
3	I1	Input signal I1
4	O0	Output signal O0
5	O1	Output signal O1
6	UP	Process supply voltage UP +24 V DC
7	ZP	Process supply voltage ZP 0 V DC

The internal power supply voltage for the module's circuitry is carried out via the connection to CPU. Thus, the current consumption from 24 V DC power supply at the terminals L+ and M of the CPU module increases by 10 mA per TA5110-2DI2DOT.

The external power supply connection is carried out via the UP (+24 V DC) and ZP (0 V DC) terminals.

WARNING!

Removal/Insertion under power

The option cards are not designed to be removed or inserted while the device is switched on. Due to unpredictable consequences, it is not permitted to connect or remove option cards while the device is powered on.

Make sure that all power sources (supply and process power) are switched off before you do the following:

– Connection or disconnection of signals or terminal blocks.
– Removal, installation or replacement of an option card.

Disconnecting a powered option card under voltage in a potentially explosive atmosphere may result in an electric arc, which could ignite combustible materials and cause a fire or explosion.

Make sure that the power supply is disconnected and the area has been toughly checked to ensure that no combustible materials are present before proceeding.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.

The digital inputs can be used as source inputs or as sink inputs.

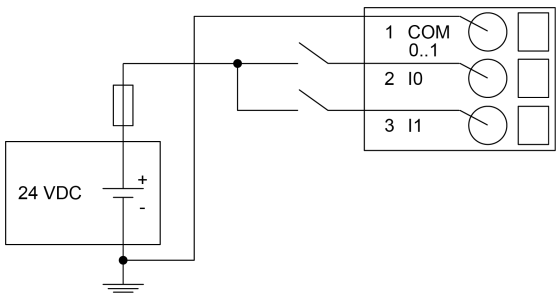
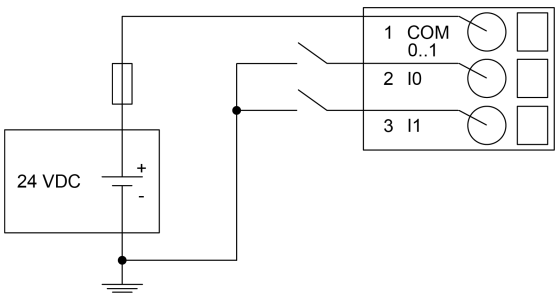
NOTICE!

Risk of malfunctions in the plant!

A ground fault, e. g. caused by a damaged cable insulation, can bridge switches accidentally.

Use sink inputs when possible or make sure that, in case of error, there will be no risks to persons or plant.

Table 41: Connection for inputs of the option board for digital I/O extension TA5110-2DI2DOT

Sink inputs of TA5110-2DI2DOT	Source inputs of TA5110-2DI2DOT
	

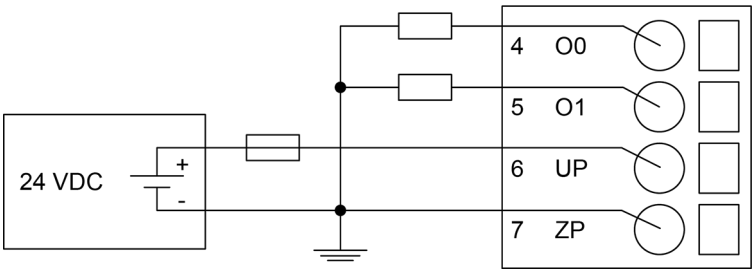


Fig. 12: Connection for outputs of the option board for digital I/O extension TA5110-2DI2DOT

NOTICE!

Risk of malfunctions in the plant!

Only if L+/M of the CPU is available and the outputs are already configured in the AB program, the outputs will switch on as soon as the UP/ZP is available.

This must be considered in the application planning.

NOTICE!

Risk of damaging the I/O module!

The outputs are not protected against short circuits and overload.

- Never short-circuit or overload the outputs.
- Never connect the outputs to other voltages.
- Use an external fuse for the outputs.

The module provides several diagnosis functions *Further information on page 107*.

The meaning of the LEDs is described in the section State LEDs *"State LEDs" on page 108*.

I/O configurations

The module itself does not store configuration data. It receives its parameterization data from the CPU module during power-up of the system.

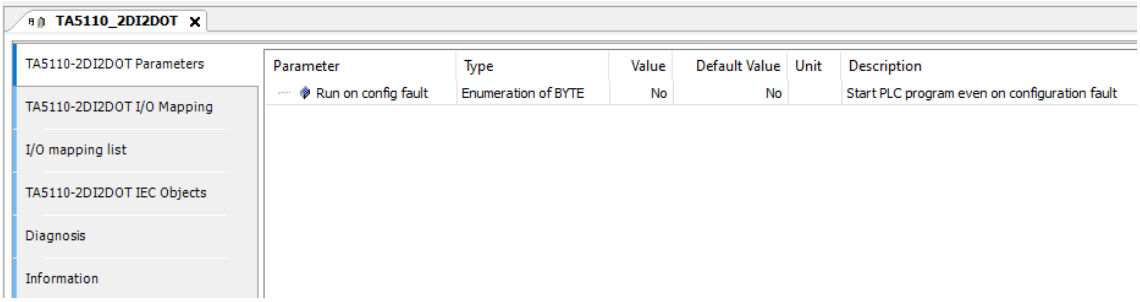
Hence, replacing optional modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

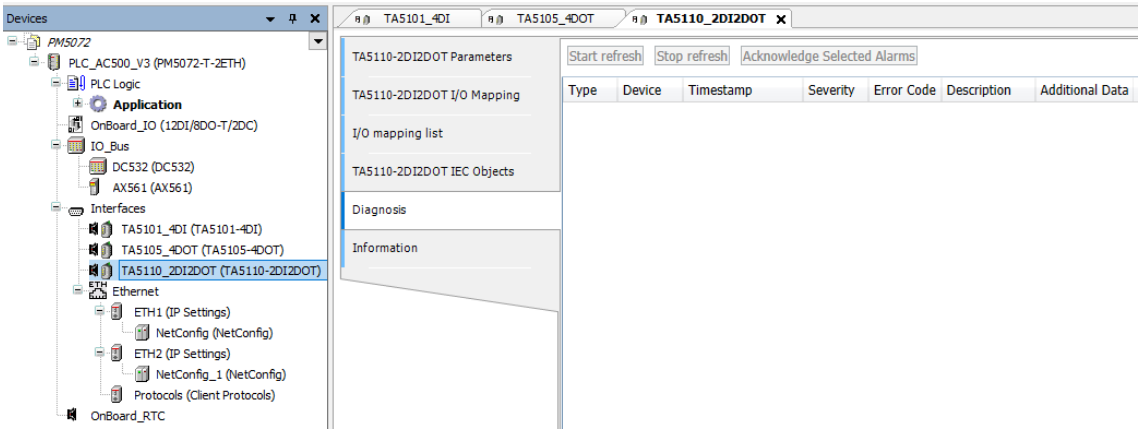
Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

1. In the device tree, double-click the desired option board.
2. Select the *"TA51xx Parameters"* tab to edit the parameterization of the desired option board.



Diagnosis



1. In the device tree, double-click the desired option board.
2. Select the *“Diagnosis”* tab to view the diagnosis messages of the desired option board.

Table 42: Diagnosis messages

Device	Severity	Error code	Description	
			Error Message	Remedy
TA5110-2DI2DOT	11	1	Wrong or no board plugged	Replace with correct functional board
TA5110-2DI2DOT	11	2	Board defective	Replace with correct functional board
TA5110-2DI2DOT	11	3	Failed to set direction	Replace with correct functional board
TA5110-2DI2DOT	11	4	Parameter wrong	Verify setting of parameter “Run on config fault”
TA5110-2DI2DOT	11	5	Parameter value failure	Update Configuration
TA5110-2DI2DOT	3	6	Communication failed, set address	Replace with correct functional board
TA5110-2DI2DOT	3	7	Communication failed, write	Replace with correct functional board
TA5110-2DI2DOT	3	8	Communication failed, read	Replace with correct functional board

State LEDs

LED	State	Color	LED = OFF	LED = ON
Inputs I0...I1	Digital input	Yellow	Input is OFF	Input is ON
Outputs O0...O1	Digital output	Yellow	Output is OFF	Output is ON

Technical data

The system data apply.

Chapter 4.1 “System data AC500-eCo” on page 25

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage UP		
	Connections	Terminal 6 for UP (+24 V DC) and terminal 7 for ZP (0 V DC)
	Rated value	24 V DC
	Current consumption via UP terminal	5 mA + max. 0.5 A per output
	Max. ripple	5 %
	Inrush current	0.000002 A^2s
	Protection against reversed voltage	Yes
	Rated protection fuse for UP	On request
Current consumption from 24 V DC power supply at the L+/M terminals of the CPU		Ca. 10 mA
Galvanic isolation		Yes, between the input group and the output group and the rest of the module
Isolated groups		2 groups (1 group for 2 input channels, 1 group for 2 output channels)
Surge-voltage (max.)		35 V DC for 0.5 s
Max. power dissipation within the module		0.7 W
Weight		15 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

Table 43: Technical data of the digital inputs

Parameter	Value
Number of channels per module	2
Distribution of the channels into groups	1 group for 2 channels
Connections of the channels I0 to I1	Terminals 2 to 3
Reference potential for the channels I0 to I1	Terminal 1
Indication of the input signals	1 yellow LED per channel; the LED is ON when the input signal is high (signal 1)

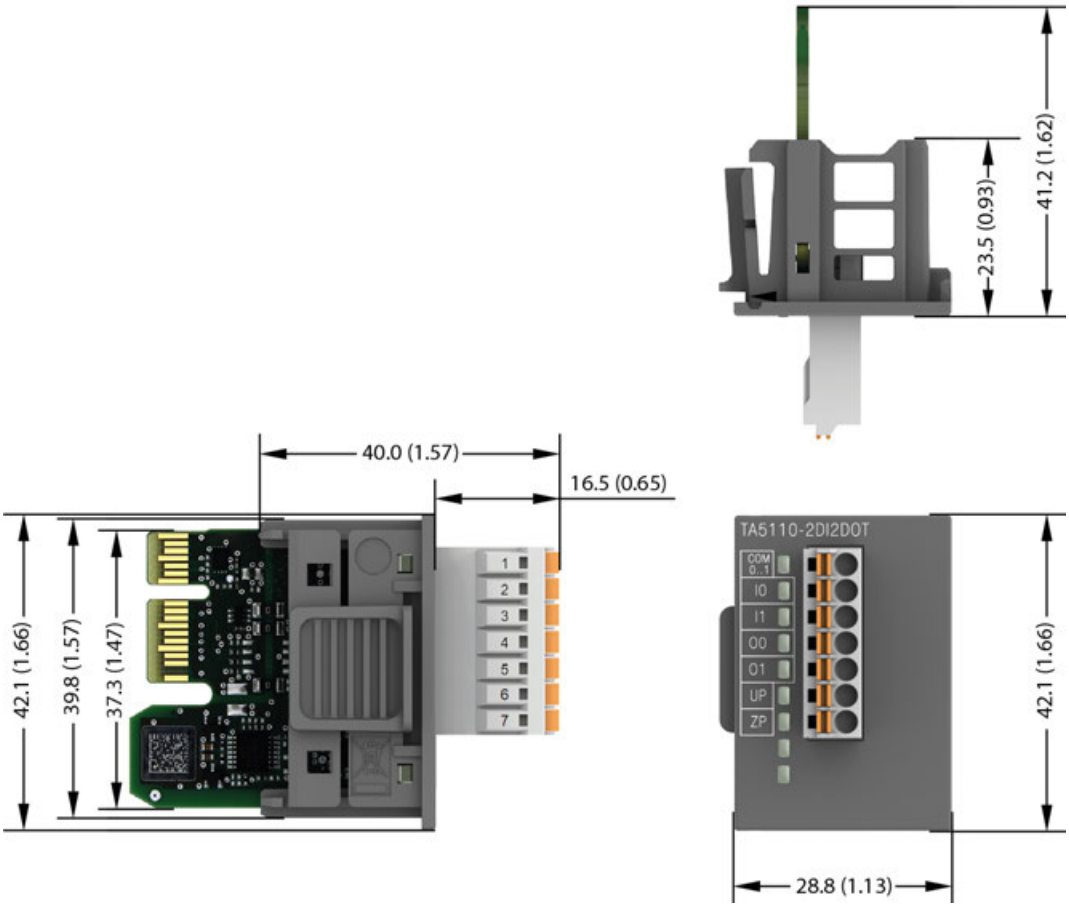
Parameter		Value	
Monitoring point of input indicator		LED It is not part of input circuit (its controlled by processor side, not process side)	
Input type according to EN 61131-2		Type 1 source	Type 1 sink
Input signal range		-24 V DC	+24 V DC
Signal 0		-5 V ... +3 V	-3 V ... +5 V
Undefined signal		-15 V ... + 5 V	+5 V ... +15 V
Signal 1		-30 V ... -15 V	+15 V ... +30 V
Ripple with signal 0		-5 V ... +3 V	-3 V ... +5 V
Ripple with signal 1		-30 V ... -15 V	+15 V ... +30 V
Input current per channel			
	Input voltage +24 V	Typ. 5 mA	
	Input voltage +5 V	Typ. 1 mA	
	Input voltage +15 V	< 3 mA	
	Input voltage +30 V	< 7 mA	
Max. permissible leakage current (at 2-wire proximity switches)		1 mA	
Input delay (0->1 or 1->0)		Typ. 8 ms	
Input data length		1 byte	
Max. cable length			
	Shielded	500 m	
	Unshielded	150 m	

Table 44: Technical data of the digital outputs

Parameter		Value
Number of channels per module		2 transistor outputs (24 V DC, 0.5 A max.)
Distribution of the channels into groups		1 group of 2 channels
Connection of the channels O0 to O1		Terminals 4 to 5
Reference potential for the channels O0 to O17		Terminal 7 (negative pole of the process voltage, name ZP)
Common power supply voltage		Terminal 6 (positive pole of the process voltage, name UP)
Indication of the output signals		1 yellow LED per channel; the LED is on when the output signal is high (signal 1) and the module is powered via the I/O bus
Monitoring point of output indicator		Controlled together with transistor
Way of operation		Non-latching type
Min. output voltage at signal 1		UP - 0.1 V
Output delay		
	0 to 1	50 µs
	1 to 0	200 µs
Output data length		1 byte

Parameter		Value
Output current		
	Rated current per channel (max.)	0.5 A at UP 24 V DC (resistance, general use and pilot duty)
	Rated current per group (max.)	1 A
	Rated current (all channels together, max.)	1 A
	Max. leakage current with signal 0	0.5 mA
Output type		Non-protected
Protection type		External fuse on each channel
Rated protection fuse (for each channel)		On request
Demagnetization when inductive loads are switched off		Must be performed externally according to driven load specification
Switching Frequencies		
	With resistive load	Limited by CPU cycle time
	With inductive load	Max. 0.5 Hz
	With lamp load	Max. 11 Hz at max. 5 W
Short-circuit-proof / Overload-proof		No
	Overload message	No
	Output current limitation	No
	Resistance to feedback against 24 V DC	No
Connection of 2 outputs in parallel		Not possible
Max. cable length		
	Shielded	500 m
	Unshielded	150 m

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 187 000 R0003	TA5110-2DI2DOT: AC500-eCo, digital I/O option board, 2DI 24 V DC, 2DO-T 24 V DC / 0.5 A, spring/cable front terminal 3.50 mm pitch	Active
1SAP 187 000 R0203	TA5110-2DI2DOW: AC500-eCo, digital I/O option board, 2DI 24 V DC, 2DO-T 24 V DC / 0.5 A, spring/cable front terminal 3.50 mm pitch, wide temperature range	Active
Spare parts		
1SAP 187 400 R0014 **)	TA5220-SPF7: spring terminal block, removable, 7-pin, spring front, cable front, 6 pieces per packing unit	Active

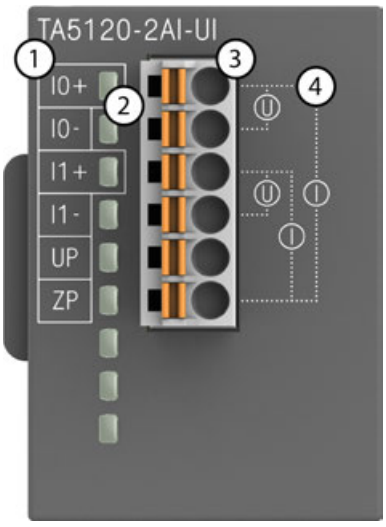
*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

**) The needed spring terminal block is always delivered with the option board.

The terminal block listed in the table is for spare part only if needed.

5.1.1.3.4 TA5120-2AI-UI - Analog input option board

- 2 configurable analog inputs (I0 and I1) in 1 group
  Resolution 12 bits including sign
- Option board is galvanically isolated
- W variant available for use in extended (wide) temperature range



1 Allocation of terminal and signal name
2 2 yellow LEDs to display the signal states at the analog inputs I0 and I1
3 6-pin terminal block for analog input signals and power supply (UP, ZP)
4 Input connection diagram for U and I

Intended purpose

The option board is used as analog input extension module for AC500-eCo CPUs (PM50xx).

The analog option boards TA5120-2AI-UI and TA5126-2AO-UI can only be used from AB 2.5.2, SystemFW 3.5.0_HF-7, BootFW 3.5.1 and higher.

Using the option boards with lower versions will create a configuration error and the CPU will not start.

Functionality

2 analog inputs, individually configurable:

- Unused (default setting)
- 0 V ... 10 V
- 0 mA ... 20 mA
- 4 mA ... 20 mA

Parameter		Value
Resolution of the analog channels		
	Voltage 0 V ... 10 V	12 bits
	Current 0 mA ... 20 mA,	12 bits
	Current 4 mA ... 20 mA	12 bits
LED displays		2 LEDs for signals I0 and I1
Internal power supply		Via the CPU PM50xx
External power supply		Via the terminals UP and ZP (process voltage 24 V DC)
Required CPU		PM50xx

Connection

WARNING!

Removal/Insertion under power

The option cards are not designed to be removed or inserted while the device is switched on. Due to unpredictable consequences, it is not permitted to connect or remove option cards while the device is powered on.

Make sure that all power sources (supply and process power) are switched off before you do the following:

– Connection or disconnection of signals or terminal blocks.
– Removal, installation or replacement of an option card.

Disconnecting a powered option card under voltage in a potentially explosive atmosphere may result in an electric arc, which could ignite combustible materials and cause a fire or explosion.

Make sure that the power supply is disconnected and the area has been toughly checked to ensure that no combustible materials are present before proceeding.

The option board TA5120-2AI-UI for analog input extension is plugged into an AC500-eCo processor module PM50xx.

The electrical connection is made via a removable 6-pin terminal block.

The terminal block is included in the scope of delivery of the option board. Further terminal blocks can be ordered separately as spare parts.

Chapter 5.8.1.2 “TA5211, TA 5212 - Terminal block sets” on page 1372

Table 45: Assignment of the terminals:

Terminal	Signal	Description
1	I0+	Positive analog input I0
2	I0-	Negative analog input I0
3	I1+	Positive analog input I1
4	I1-	Negative analog input I1
5	UP	Process voltage UP = +24 V DC
6	ZP	Process voltage ZP = 0 V DC

CAUTION!
The negative terminal of the analog inputs are connected internally and form an internal analog ground (AGND). This analog ground is connected to ZP via a PTC resistor. There is no galvanic isolation between the analog circuitry and ZP/UP. Hence, analog inputs can not be connected in series.

The internal power supply of the circuits of the module takes place via the connection to the CPU. Thus, the current consumption from 24 V DC power supply at the terminals L+ and M of the CPU module increases by << 1 mA per TA5120-2AI-UI.

The external power supply is connected via the terminals UP (+24 V DC) and ZP (0 V DC).

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.

Generally, analog signals must be laid in shielded cables. The cable shields must be grounded at both sides of the cables. To avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

The following figure shows the connection of the module:

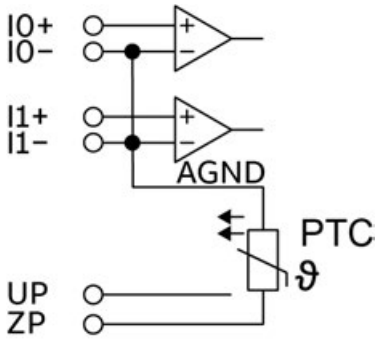


Fig. 13: Internal construction of the analog inputs

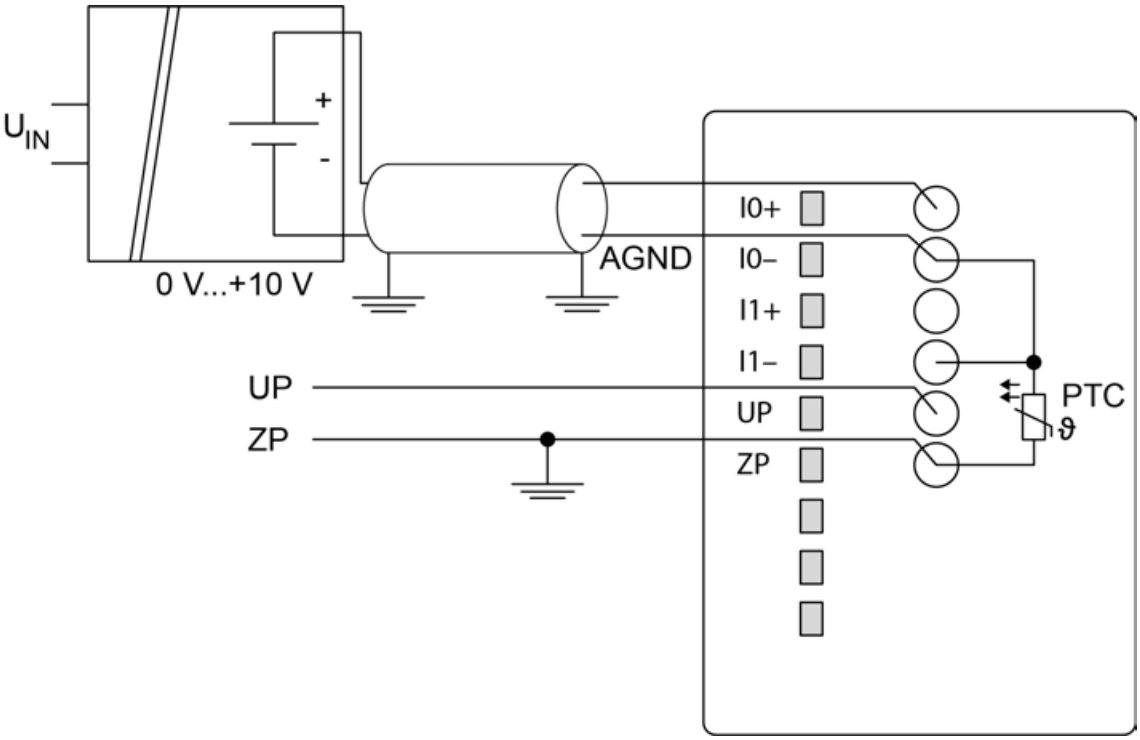
CAUTION!
By installing equipotential bonding conductors between the different parts of the system, it must be ensured that the potential difference between ZP and AGND never can exceed 1 V.

CAUTION!
The process supply voltage must be included in the grounding concept (e. g. grounding of the negative terminal).

The option board provides several diagnosis functions.

Chapter 5.1.1.3.4.7 “Diagnosis” on page 119

Connection of active-type analog sensors (Voltage) with galvanically isolated power supply



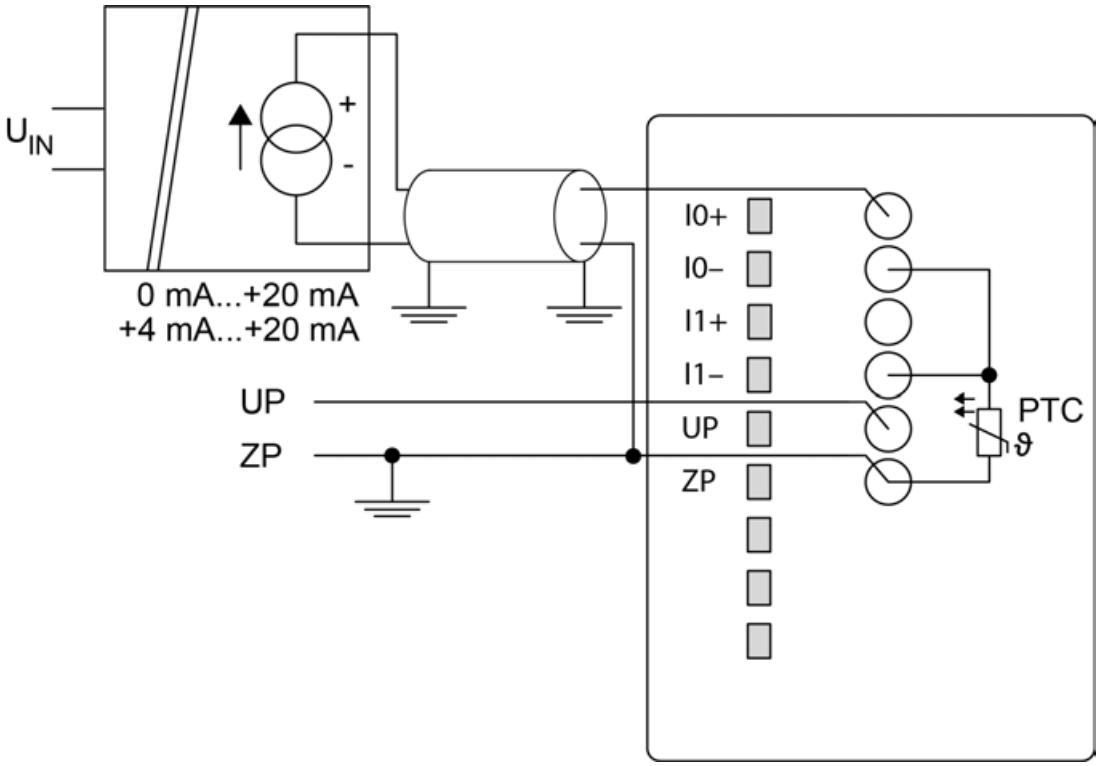
By connecting the sensor's negative terminal of the output voltage to AGND, the galvanically isolated voltage source of the sensor is referred to ZP.

Table 46: Configurable measuring ranges for TA5120-2AI-UI

Parameter	Value
Channel configuration	0 V...+10 V

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "not used".

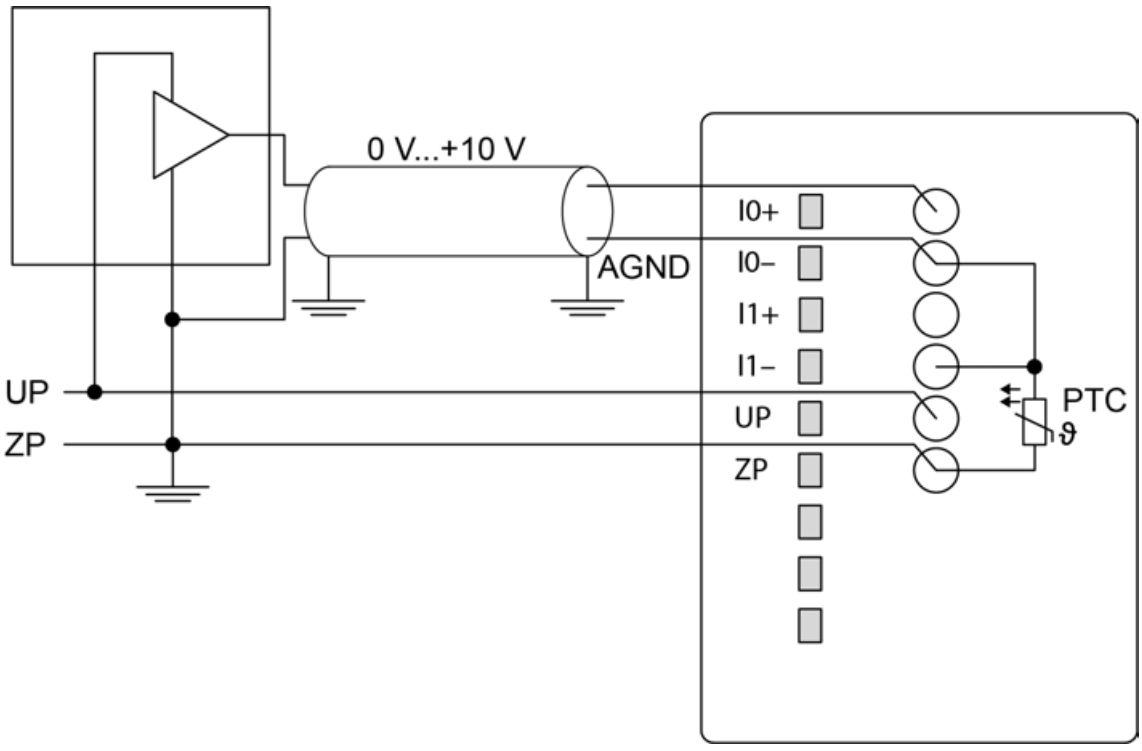
Connection of active-type analog sensors (Current) with galvanically isolated power supply



Parameter	Value
Channel configuration	0 mA...+20 mA or +4 mA...+20 mA

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "not used".

Connection of active-type analog sensors (Voltage) with no galvanically isolated power supply



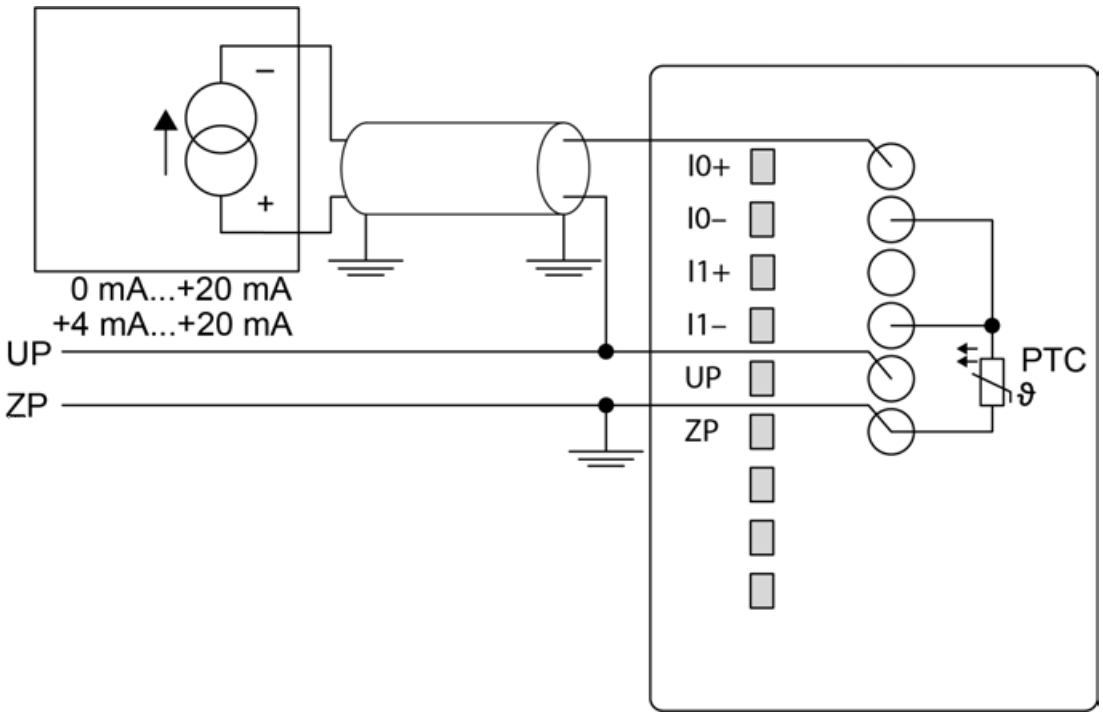
CAUTION!
The potential difference between AGND and ZP at the module must not be greater than 1 V, not even in case of long lines.

If AGND does not get connected to ZP, the sensor supply current flows to ZP via the AGND line. This current will distort the measuring signal, as a very small current flows through the AGND line. ZP connection should be close to the sensor. The total current through the PTC should not exceed 50 mA. This measuring method is therefore only suitable for short lines and small compensation currents via the AGND line.

Parameter	Value
Channel configuration	0 V...+10 V

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "not used".

Connection of passive-type analog sensors (current)



Parameter	Value
Channel configuration	0 mA...+20 mA or +4 mA...+20 mA

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "not used".



CAUTION!

Risk of overloading the analog input!

If an analog current sensor supplies more than 25 mA for more than 1 second during initialization, this input is switched off by the module (input protection).

Only use sensors with fast initialization or without current peaks higher than 25 mA. If not possible, connect a 10-volt Zener diode in parallel to I+ and ZP.

I/O configuration

The option board itself does not store configuration data. It receives its parameterization from the CPU module during power-up of the system.

Hence, replacing option boards is possible without any re-parameterization via software.

Parameter	Value
Configurability	0 V...10 V 0 mA...20 mA 4 mA...20 mA (each input can be configured individually)
Unused voltage inputs	Must be configured as "not used"
Unused current inputs	Must be configured as "not used"

Firmware update via memory card

The following steps describe the procedure for updating the firmware for the analog option boards using a memory card. Prerequisite is the previous download of the current firmware to the memory card either from the Automation Builder or as *download* from ABB.

1. Download the relevant firmware package.
2. Unpack the zip archive file at any location of your hard disc.
3. Insert an empty formatted (FAT16 / FAT32) memory card in the PC card reader.
4. Execute the unpacked *.exe file.
5. Select the PC card reader as the final destination and confirm.
   ⇨ All directories, files and SDCARD.INI file will be automatically created on memory card and properly configured.

After the process is complete, one has the prepared memory card with the relevant updates.

Firmware update

☑ Precondition: Prepared memory card with boot project and firmware.

1. Switch off the device.
2. Insert the memory card.

3. Switch on the device.

   ⇨ The alternate flashing of the RUN and the ERR LED indicates the running update process.

   At the end of the update process a reboot is executed and the system firmware is started for the finishing of the update process.

   If RUN LED blinks (ERR LED is off), the update was successful and the display shows *done*.

   If ERR LED blinks (RUN LED is off), the update failed and the display shows *FAIL*.

   The text file “SDCARD.RDY” includes the results of the different updates. If the update fails, the file contains the reasons for the abort. Based on this, further steps can be taken to fix the problem.

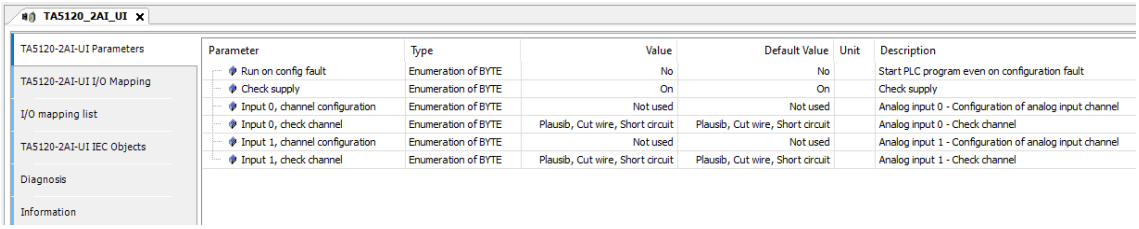
4. Switch off the device.
5. Remove the memory card.
6. Switch on the device.

   ⇨ The system starts with the new firmware.

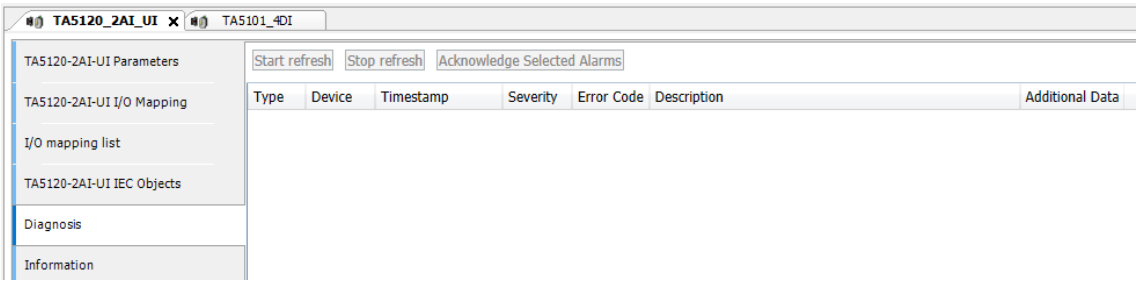
Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

1. In the device tree, double-click the desired option board.
2. Select the *“TA5120-2AI-UI Parameters”* tab to edit the parameterization of the desired option board.



Diagnosis



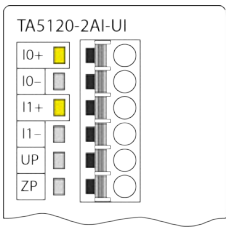
1. In the device tree, double-click the desired option board.
2. Select the *“Diagnosis”* tab to view the diagnosis messages of the desired option board.

Severity	Error	Description	Remedy
Option board error (Channel 255)			
3	3	Timeout Communication timeout to CPU	If the process voltage is connected properly, replace the option board.
3	51	Invalid slot Wrong or missing option board in the appropriate slot	Check the configuration and the hardware setup.
4	11	Process voltage is too low	Check the process voltage.
4	34	Data not ready Data synchronization warning	Check PLC program and synchronize. [1])
3	40	SW-mismatch Hardware does not match the firmware version	Replace the option board.
3	53	Download failed Power loss during firmware update	Replace the option board. [2])
3	9	DIAG_BUF_OVERFLOW Overflow in Diagnosis buffer	Diagnosis overflow usually means too many repeated warnings or errors. Please check all diagnosis in detail and take the appropriate action. A restart will clear the diagnosis.
3	43	DIAG_INTERNAL_ERR Internal error in the option board	Replace the option board.
3	26	DIAG_CFG_PRM_ERR Parameterization error	Check the CPU parameterization.
3	19	DIAG_CRC_ERR Checksum error in option board	Replace the option board.
Channel warning			
4	4	Highest level Voltage measurement overflow	Check the input value.
4	7	Lowest level Measurement underflow, or broken wire in current range 4 mA…20 mA	Check the input value and the wiring.
4	48	Overload wire break Broken wire in voltage mode, overflow in current mode	Check the input value and the wiring.

Remarks:

[1])	If no other error occurs, the programs are not identical and the parameter is set to report an error in this case.
[2])	Do not remove the power supply from the option board during the firmware update.

State LEDs

	LED	State	Color	LED = OFF	LED = ON	LED flashes
	Inputs I0 ... I1	Analog input	Yellow	Input is OFF or input value is too low	Input is ON (brightness depends on the value of the analog signal)	--

Measuring ranges

Measuring ranges - Input ranges of voltage and current

The represented resolution corresponds to 12 bits.

Table 47: Measuring range: 0 V ... 10 V

Range	Input [V]	Digital value	
		Decimal	Hex.
Wire break	> 13.1784	32767	7FFF
Overflow	> 11.7564	32767	7FFF
Input voltage too high	11.7564 : 10.0029	32504 : 27656	7EF8 : 6C08
Normal range	10.0000 : 0.0029	27648 : 8	6C00 : 0008
	0.0000	0	0
Input voltage too low	-0.0029 : -1.7593	-8 : -4864	FFF8 : ED00
Underflow	< -1.7593	-32768	8000

Table 48: Measuring range: 0 mA ... 20 mA

Range	Input [mA]	Digital value	
		Decimal	Hex.
Overflow	> 23.5127	32767	7FFF
Input current too high	23.5127 : 20.0058	32504 : 27656	7EF8 : 6C08
Normal range	20.0000 : 0.0058	27648 : 8	6C00 : 0008
	0.0000	0	0

Range	Input [mA]	Digital value	
		Decimal	Hex.
Input current too low	-0.0058 : -3.5185	-8 : -4864	FFF8 : ED00
Underflow	< -3.5185	-32768	8000
Negative overange	< -23.5185	-32768	8000

Table 49: Measuring range: 4 mA ... 20 mA

Range	Input [mA]	Digital value	
		Decimal	Hex.
Overflow	> 22.8102	32767	7FFF
Input current too high	22.8102 : 20.0046	32504 : 27656	7EF8 : 6C08
Normal range	20.0000 : 4.0046	27648 : 8	6C00 : 0008
	4.0000	0	0
Input current too low	3.9954 : 1.1898 1.1852	-8 : -4856 -4864	FFF8 : ED08 ED00
Underflow	< 1.1852	-32768	8000
Negative overange	< -14.8148	-32768	8000

Technical data

The system data apply.

↳ *Chapter 4.1 “System data AC500-eCo” on page 25*

Only additional details are therefore documented below.

Parameter		Value
Process voltage		
	Connections	Terminal 5 for +24 V (UP) as well as terminal 6 for 0 V (ZP)
	Rated value	24 V DC
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	1 A slow
	Galvanic isolation	Yes, per module (no isolation between channels)
Current consumption		

Parameter			Value
		From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU PM50xx	< 1 mA
		From UP at normal operation	max. 20 mA
Inrush current from UP (at power up)			0.005 A^2s
Max. length of analog cables, conductor cross section > 0.2 mm²			On request
Weight			20 g
Mounting position			Horizontal or vertical with derating
Cooling			The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

Technical data of the analog inputs

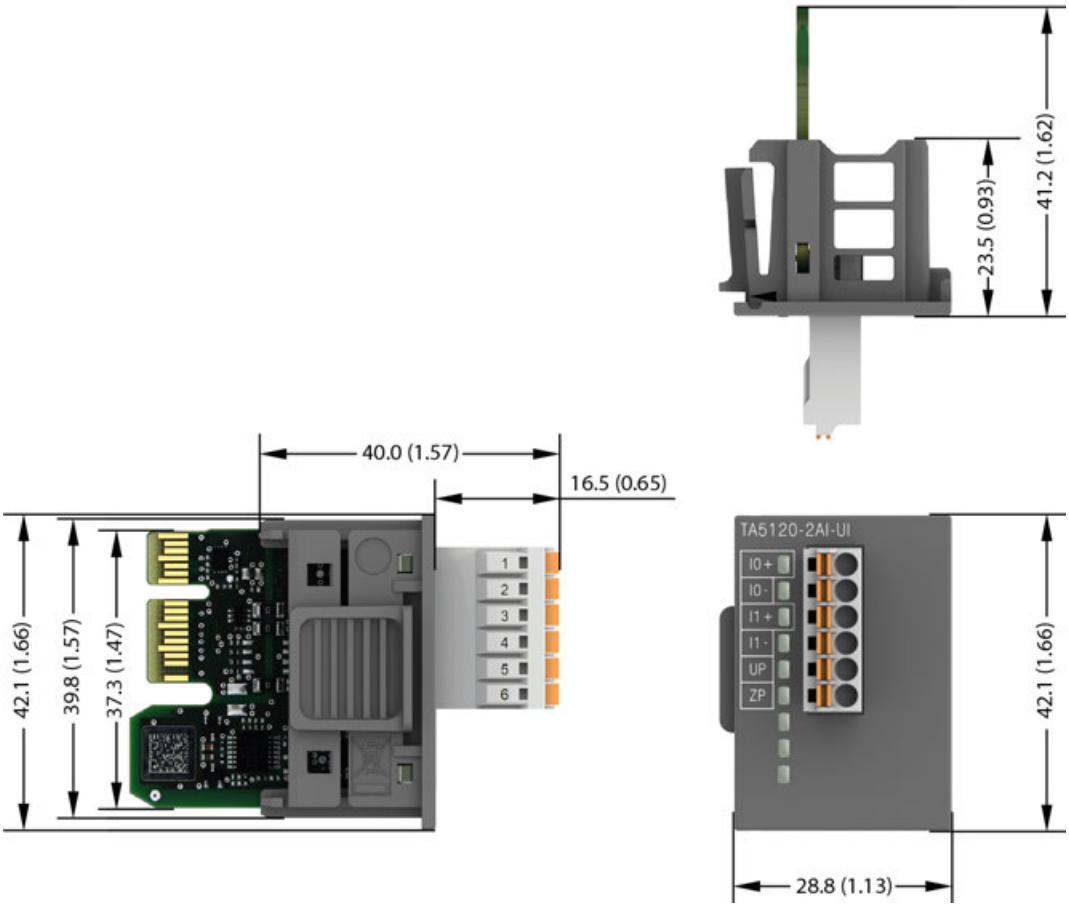
NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Parameter			Value
Number of channels per module			2
Distribution of channels into groups			1 group of 2 channels
Connections of the channel 0			
	Voltage mode		
		Terminal I0+ and I0-	Terminals 1 and 2
	Current mode		
		Terminal I0+ and ZP	Termnal 1 and 6
Connections of the channel 1			
	Voltage mode		
		Terminal I1+ and I1-	Terminals 3 and 4
	Current mode		
		Terminal I1+ and ZP	Terminals 3 and 6
Input type			Unipolar
Galvanic isolation			Yes, per option board (no isolation between channels)
Configurability			0 V...10 V 0 mA...20 mA 4 mA...20 mA (each input can be configured individually)
Channel input resistance			Voltage: > 100 kΩ Current: ca. 330 Ω Not used: > 100 kΩ

Parameter		Value	
Time constant of the input filter		Voltage: 10 µs Current: 10 µs	
Indication of the input signals		1 LED per channel	
Conversion cycle *)			
	1 activated channel	1 ms	
	2 activated channel	2 ms	
Resolution for all configurations		12 bits	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Max.	±0.3 % at +25 °C
		Max.	±0.5 % over full temperature range
Temperature coefficient (is related to the max error at +25°C and max error in the full range)		±0.005 %/K	
Temporary deviation during EMC disturbance		Max.	±1 %
Mapping between input signal and digital value		Input ranges of voltage and current	
Unused voltage inputs		Must be configured as "not used"	
Unused current inputs		Must be configured as "not used"	
Overvoltage protection		Yes	

*) The value is the sampling time on the option board. The complete conversion cycle time is also related to the CPU cycle time.

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 187 100 R0001	TA5120-2AI-UI: AC500-eCo, analog input option board, 2AI U/I, 12 bits, spring/cable front terminal 3.50 mm pitch	Active
1SAP 187 100 R0201	TA5120-2AI-UIW: AC500-eCo, analog input option board, 2AI U/I, 12 bits, spring/cable front terminal 3.50 mm pitch, wide temperature range	Active
Spare parts		
1SAP 187 400 R0013 **)	TA5220-SPF6: spring terminal block, removable, 6-pin, spring front, cable front, 6 pieces per packing unit	Active

*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

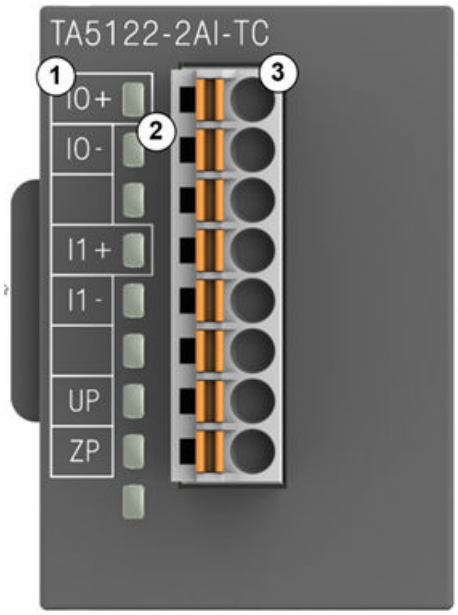
**) The needed spring terminal block is always delivered with the option board.

The terminal block listed in the table is for spare part only if needed.

5.1.1.3.5 TA5122-2AI-TC - Analog input option board

- 2 configurable analog inputs (I0 and I1) in 1 group
  Resolution 16 bits including sign
- Option board is galvanically isolated
- W variant available for use in extended (wide) temperature range

Intended purpose



1 Allocation of signal name
2 2 yellow LEDs to display the signal states at the analog inputs I0 and I1
3 8-pin terminal block for analog input signals and power supply (UP, ZP)

The option board is used as analog input extension module for AC500-eCo processor modules (PM50xx).

The analog option boards TA5122-2AI-TC can only be used from AB 2.9.0 SystemFW 3.9.0., Boot-FW 3.8.0. and higher.

Functionality

2 analog inputs, individually configurable for

- Not used (default setting)
- Thermocouple B 0 °C ... +1820 °C
- Thermocouple E -270 °C ... +1000 °C
- Thermocouple J -210 °C ... +1200 °C
- Thermocouple K -270 °C ... +1372 °C
- Thermocouple N -270 °C ... +1300 °C
- Thermocouple R -50 °C ... +1768 °C
- Thermocouple S -50 °C ... +1768 °C
- Thermocouple T -270 °C ... +400 °C

Parameter		Value
Resolution of the analog channels		
	Temperature	0.1 °C
LED displays		2 LEDs for signals I0 and I1
Internal power supply		Via the CPU PM50xx
External power supply		Via the terminals UP and ZP (process voltage 24 V DC)
Required CPU		PM50xx

Additionally both channels can be configured individually (debug functionality only, no guaranteed accuracy) for:

- -50… +50 mV
- Cold junction temperature internal
- Common mode voltage

Connections



WARNING!
Removal/Insertion under power
The option cards are not designed to be removed or inserted while the device is switched on. Due to unpredictable consequences, it is not permitted to connect or remove option cards while the device is powered on.

Make sure that all power sources (supply and process power) are switched off before you do the following:

– Connection or disconnection of signals or terminal blocks.
– Removal, installation or replacement of an option card.

Disconnecting a powered option card under voltage in a potentially explosive atmosphere may result in an electric arc, which could ignite combustible materials and cause a fire or explosion.

Make sure that the power supply is disconnected and the area has been toughly checked to ensure that no combustible materials are present before proceeding.

The option board TA5122-2AI-TC for analog input extension is plugged into a processor module PM50x2.

Insert the module and press it until it locks into place. A detailed description of the assembly and disassembly of the module can be found in the chapter **Mounting and demounting option boards**.

The electrical connection is made via a removable 8-pin terminal block. For more information, please refer to the chapter **TA52xx(-x) - Terminal block sets** *Chapter 5.8.1.2 “TA5211, TA 5212 - Terminal block sets” on page 1372*. One terminal block is included in the scope of delivery of the module. Additional terminal blocks can be ordered separately as spare parts.

Table 50: Assignment of the terminals:

Terminal	Signal	Description
1	I0+	Positive analog input I0
2	I0-	Negative analog input I0
4	I1+	Positive analog input I1
5	I1-	Negative analog input I1
7	UP	Process voltage UP = +24 V DC
8	ZP	Process voltage ZP = 0 V

NOTICE!

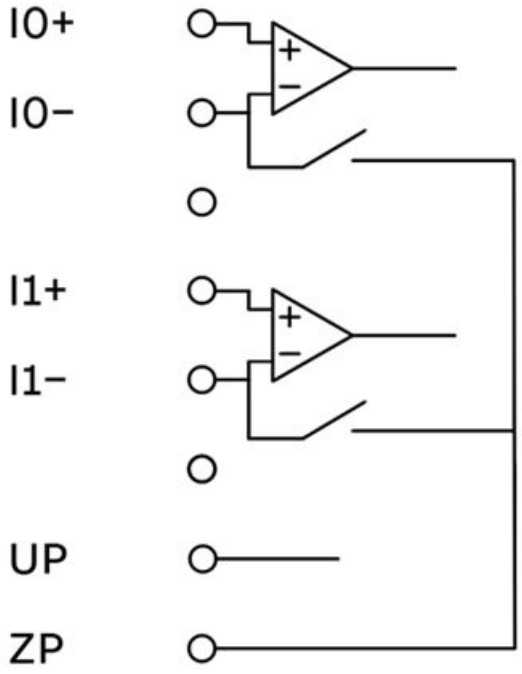
Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.

Generally, analog signals must be laid in shielded cables. The cable shields must be grounded at both sides of the cables. To avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

The following block diagram shows the internal construction of the analog inputs:



CAUTION!
By installing equipotential bonding conductors between the different parts of the system, it must be ensured that the potential difference between ZP and AGND never can exceed 1 V.

CAUTION!
The process supply voltage must be included in the grounding concept (e. g. grounding of the negative terminal ZP).

The module provides several diagnosis functions, see Diagnosis *Further information on page 131*.

The meaning of the LEDs is described in the section State LEDs *Further information on page 133*.

Grounded thermocouple

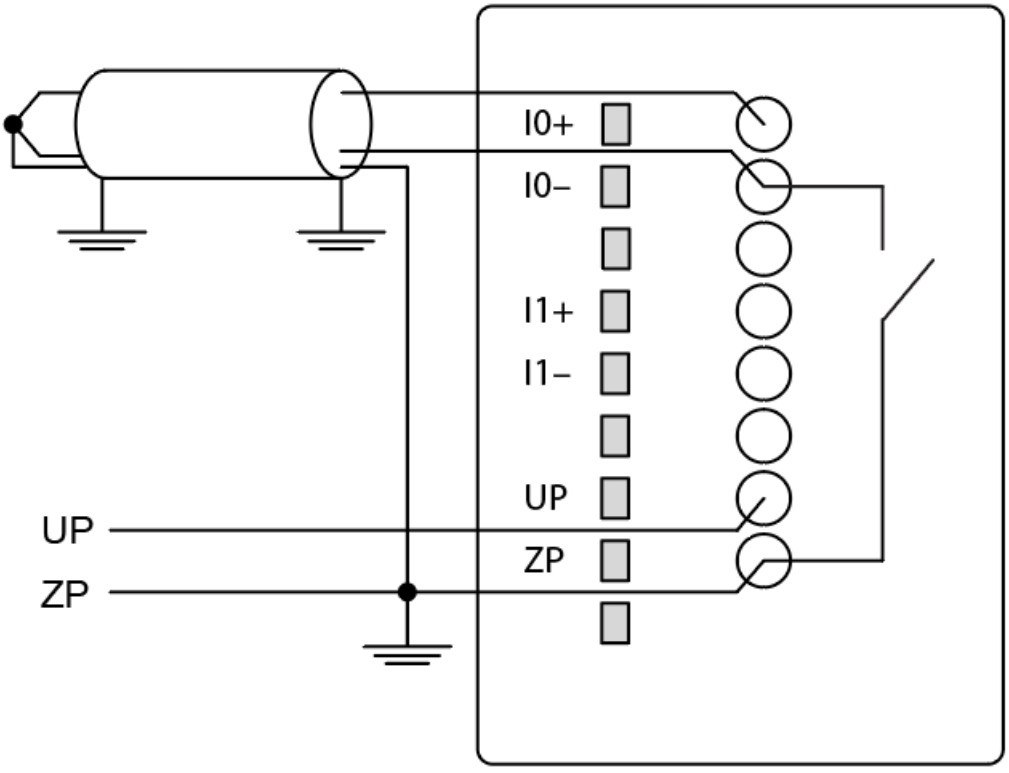


Fig. 14: Grounded thermocouple

For grounded thermocouple the parameter “Thermocouple potential” should be set to “grounded”. In this configuration the terminal IO- can float internally from -1 V.. +1 V referenced to ZP.

CAUTION!
It is necessary to pay attention that the thermocouple temperature measurement point is connected to ZP.

Isolated thermo-couple

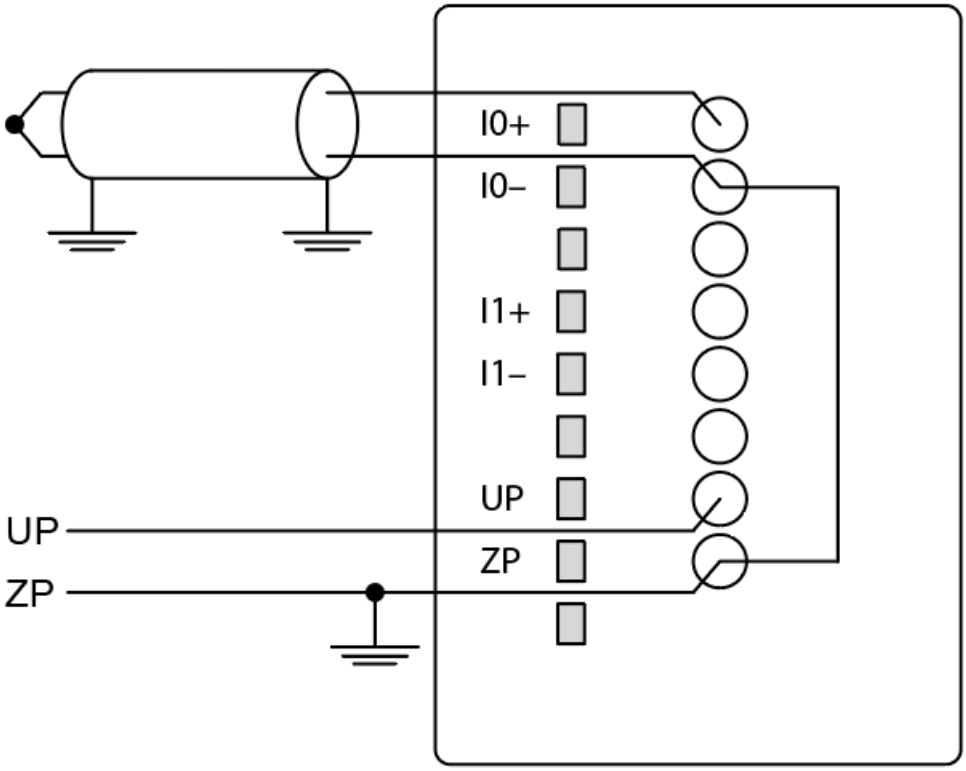


Fig. 15: Isolated thermocouple

For isolated thermocouples the parameter “Thermocouple potential” should be set to “isolated”. In this configuration the terminal IO- will be grounded internally to ZP.

CAUTION!
Carefully make sure that the entire thermocouple line, including the temperature measurement point, is isolated from any other potential.

The following measuring ranges can be configured:

B type	0 °C...1820 °C	Pt30Rh-Pt6Rh	1 channel used
E type	-270 °C...1000 °C	NiCr-CuNi	1 channel used
J type	-210 °C...1200 °C	Fe-CuNi	1 channel used
K type	-270 °C...1372 °C	Ni-CrNi	1 channel used
N type	-270 °C...1300 °C	NiCrSi-NiSi	1 channel used
R type	-50 °C...1768 °C	Pt13Rh-Pt	1 channel used
S type	-50 °C...1768 °C	Pt10Rh-Pt	1 channel used
T type	-270 °C...400 °C	Cu-CuNi	1 channel used

The module linearizes the characteristics of the thermocouple. It supports the following options for temperature compensation and cold junction handling:

- Internal compensation
- External compensation with temperature input
- External compensation with compensation box

Cable recommendations

The cable from the option board to the thermocouple temperature measurement point may interact as an interference sink. Interference can be caused by galvanic, capacitive, inductive coupling and radiated emission. To reduce or even eliminate undesirable effects of interference sources following steps should be considered:

1. Identify and separate different potentials to eliminate balancing currents.
2. Keep analog signals as far as possible away from frequency transformers, motors and cables with alternating current.
3. Complete close-meshed shielding of the signal cable without interruptions or gaps. A gap size of 10% of the wavelengths is sufficient to receive significant signal components unintentionally.
4. Low-resistance connection of the shield to system earth on one side. The use of twisted pair cables will reduce inductive coupling.

I/O configuration

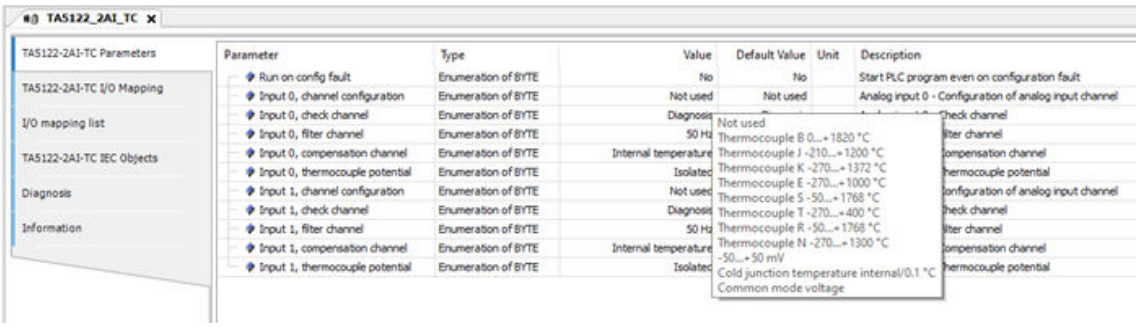
The module itself does not store any configuration data. It receives its parameterization data from the CPU module during system start-up.

This means that optional modules can be replaced without any re-parameterization via software.

Parameterization

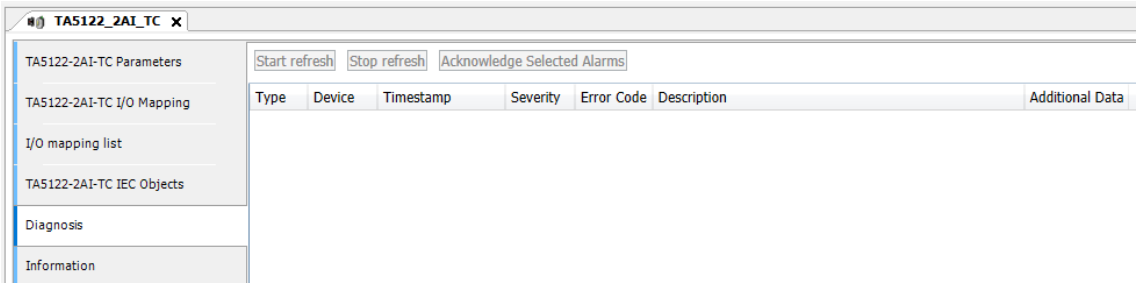
The arrangement of the parameter data is performed with Automation Builder software.

1. In the device tree, double-click the desired option board.
2. Select the *"TA5122-2AI-TC Parameters"* tab to edit the parameterization of the desired option board.



Diagnosis

1. In the device tree, double-click the desired option board.
2. Select the *"Diagnosis"* tab to view the diagnosis messages of the desired option board.



The following table shows the diagnosis messages.

Option board error:

Table 51: Module error

Device	Severity	Error code	Description	
			Error Message	**Remedy**
TA5122--2AI-TC	3	3	Diag timeout	If the process voltage is connected properly, replace the option board.
TA5122--2AI-TC	3	51	Invalid slot	Check the configuration and the hardware setup.
TA5122--2AI-TC	3	52	Module does not answer	Check the configuration.
TA5122--2AI-TC	3	40	SW-mismatch	Replace the option board.
TA5122--2AI-TC	3	53	Download failed	Replace the option board.[1)]
TA5122--2AI-TC	3	9	Overflow diagnosis buffer	Diagnosis overflow usually means too many repeated warnings or errors. Check all diagnosis in detail and take the appropriate action. A restart will clear the diagnosis.
TA5122--2AI-TC	3	26	Configuration error	Check configuration and correct errors.
TA5122--2AI-TC	3	19	Eeprom CRC error	Replace I/O module.

Table 52: Channel error

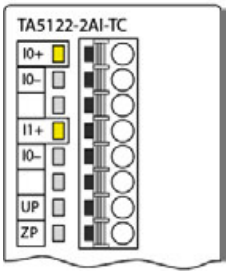
Device	Severity	Error code	Description	
			Error Message	**Remedy**
TA5122--2AI-TC	4	1	ColdJunction Temperature Error	Check the temperature compensation channel.
TA5122--2AI-TC	4	2	Wrong measurement; CommonMode Voltage is too high	Check channel wiring and sensor power supply.

Device	Severity	Error code	Description	
			Error Message	Remedy
TA5122--2AI-TC	4	7	Measurement underflow at the module	Check the input value.
TA5122--2AI-TC	4	48	Overload or cut wire	Check the input value and the wiring.

Remarks:

1)	Do not remove the power supply from the option board during the firmware update.

State LEDs

	LED	State	Color	LED = OFF	LED = ON	LED flashes
	Inputs I0...I1	Analog input	Yellow	Input is OFF	Input is ON (brightness depends on the value of the analog signal)	--

Measuring ranges

Measuring ranges - Thermocouple input ranges

The represented resolution corresponds to 16 bits.

Table 53: Thermocouple type B 0 °C ... +1820 °C

Range	Typ B [°C]	Digital value	
		Decimal	Hex.
Overflow	> 1830.0	32767	7FFF
Overshoot range	1830 : 1820.1	18300 : 18201	477C : 4719
Normal range	1820.0 : 0.1	18200 : 1	4718 : 0001
	0.0000	0	0000
Underflow	< 0.0	-32768	8000

Table 54: Thermocouple type E -210 °C .. +1200 °C

Range	Typ E [°C]	Digital value	
		Decimal	Hex.
Overflow	> 1010.0	32767	7FFF
Overshoot range	1010 : 1000.1	10100 : 10001	2774 : 2711
Normal range	1000.0 : 0.1	10000 : 1	2710 : 0001
	0.0000	0	0000
	-0.1 : -270.0	10000 : -2700	FFFF : F574
Underflow	< -270.0	-32768	8000

Table 55: Thermocouple type J -210 °C .. +1200 °C

Range	Typ J [°C]	Digital value	
		Decimal	Hex.
Overflow	> 1210.0	32767	7FFF
Overshoot range	1210 : 1200.1	12100 : 12001	2FF4 : 2EE1
Normal range	1200.0 : 0.1	12000 : 1	2EE0 : 0001
	0	0	0000
	-0.1 : -210.0	10000 : -2100	FFFF : F7CC
Underflow	< -210.0	-32768	8000

Table 56: Thermocouple type K -270 °C .. +1372 °C

Range	Typ K [°C]	Digital value	
		Decimal	Hex.
Overflow	> 1382.0	32767	7FFF
Overshoot range	1382 : 1372.1	13820 : 13721	35FC : 3599

Range	Typ K [°C]	Digital value	
		Decimal	Hex.
Normal range	1372.0 : 0.1	13720 : 1	3598 : 0001
	0	0	0000
	-0.1 : -270.0	10000 : -2700	FFFF : F574
Underflow	< -270.0	-32768	8000

Table 57: Thermocouple type N -270 °C .. +1300 °C

Range	Typ N [°C]	Digital value	
		Decimal	Hex.
Overflow	> 1310.0	32767	7FFF
Overshoot range	1310 : 1300.1	13100 : 13001	332C : 32C9
Normal range	1300.0 : 0.1	13000 : 1	32C8 : 0001
	0	0	0000
	-0.1 : -270.0	10000 : -2700	FFFF : F574
Underflow	< -270.0	-32768	8000

Table 58: Thermocouple type R, S -50 °C .. +1768 °C

Range	Typ R, S [°C]	Digital value	
		Decimal	Hex.
Overflow	> 1778.0	32767	7FFF
Overshoot range	1778 : 1768.1	17780 : 17681	4574 : 4511
Normal range	1768.0 : 0.1	17680 : 1	4510 : 0001
	0	0	0000

Range	Typ R, S [°C]	Digital value	
		Decimal	Hex.
	-0.1 : -50.0	-1 : -50	FFFF : FE0C
Underflow	< -50.0	-32768	8000

Table 59: Thermocouple type T -50 °C .. +1768 °C

Range	Typ T [°C]	Digital value	
		Decimal	Hex.
Overflow	> 410.0	32767	7FFF
Overshoot range	410 : 400.1	4100 : 4001	1004 : 0FA1
Normal range	400.0 : 0.1	4000 : 1	0FA0 : 0001
	0	0	0000
	-0.1 : -270.0	-1 : -2700	FFFF : F574
Underflow	< -270.0	-32768	8000

Technical data

The system data apply.

↳ *Chapter 4.1 “System data AC500-eCo” on page 25*

Only additional details are therefore documented below.

Parameter		Value
Process voltage		
	Connections	Terminals 7 for +24 V (UP) and 8 for 0 V (ZP)
	Rated value	24 V DC
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	1 A fast
	Galvanic isolation	Yes, from the CPU, 500 V DC
Current consumption		
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU PM50x2	<< 1 mA
	From UP at normal operation	11 mA
Inrush current from UP (at power up)		0.005 A^2s

Parameter	Value
Maximum allowed overvoltage to any pin (1-8)	30V for 10 seconds
Weight	20 g[4)]
Mounting position	Horizontal or vertical
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

Technical data of the analog inputs

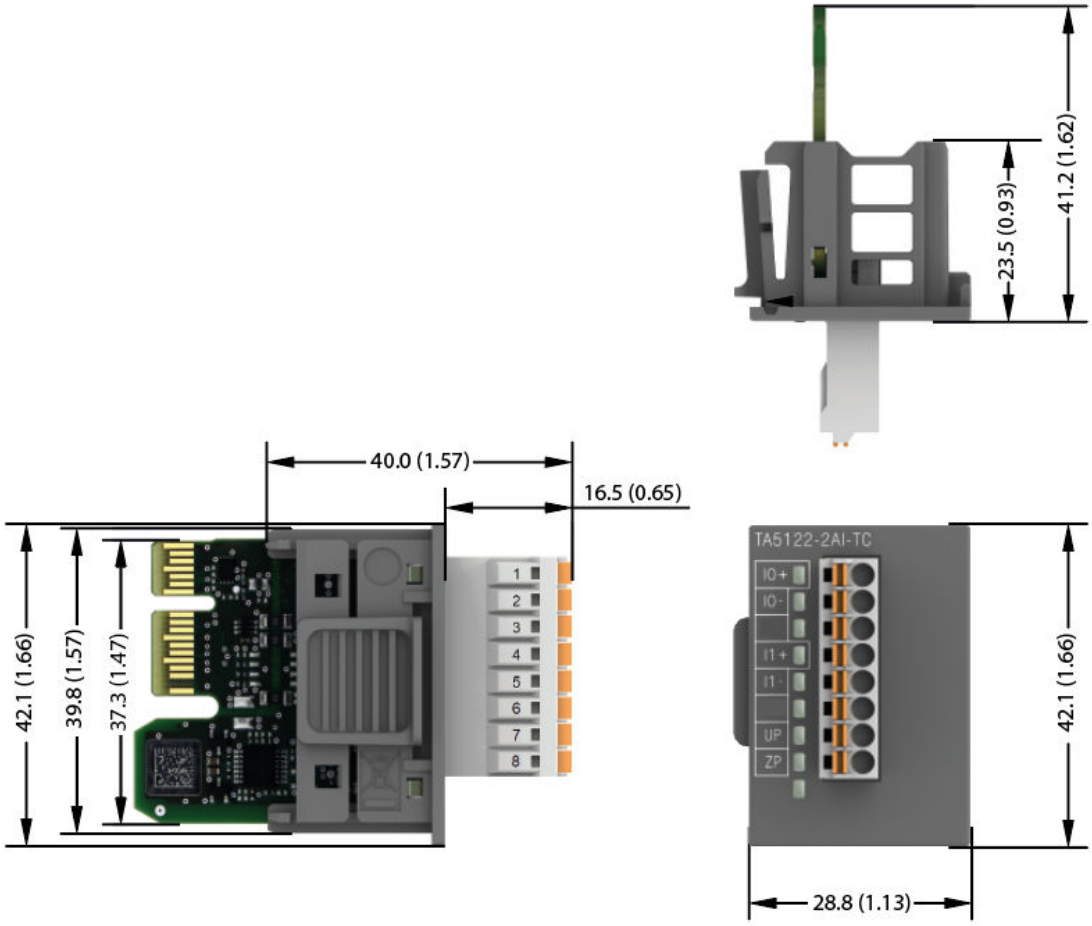
NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Parameter	Value
Number of channels per module	2
Distribution of channels into groups	1 group of 2 channels
Connections of the channels I0+ and I1+ Connections of the channels I0- and I1-	Terminals 1 and 4 Terminals 2 and 5
Input type	Differential for thermocouples B, E, J, K, N, R, S, T
Configurability	Thermocouple B 0 °C...+1820 °C Thermocouple E -270 °C...+1000 °C Thermocouple J -210 °C...+1200 °C Thermocouple K -270 °C...+1372 °C Thermocouple N -270 °C...+1300 °C Thermocouple R -50 °C...+1768 °C Thermocouple S -50 °C...+1768 °C Thermocouple T -270 °C...+400 °C (each input can be configured individually)
Input impedance (on state)	>1 MOhm
Max. resistance of analog cable	100 Ohm (back and forth)
Max. length of analog cables, conductor cross section > 0.2 mm²	100 m to sensor max.
Type of protection	RC & TVS
Sample repetition time	1.56 ms
Indication of the input signals	1 LED per channel
Refresh rate of analog values[1)]	15 ms (filter & diagnosis inactive) 142 ms (filter inactive) 380 ms (filter & diagnosis activated)
Input filter characteristic:	First order Transition frequency 4,5 kHz
Resolution	Range 16 bits including sign

Parameter		Value
Conversion error of the analog values at 25 °C [2]		
	Thermocouple B	+/- 1,9 K in the range 1000 °C…1820 °C +/- 2,9 K in the range 600 °C …1000 °C
	Thermocouple E	+/- 1,9 K in the range 0 °C …1000 °C +/- 4,0 K in the range -200 °C …0 °C
	Thermocouple J	+/- 0,8 K in the range 0 °C …1200 °C +/- 2,0 K in the range -200 °C …0 °C
	Thermocouple K	+/- 1,2 K in the range 0 °C …1372 °C +/- 2,4 K in the range -200 °C …0 °C
	Thermocouple N	+/- 1,2 K in the range 0 °C …1372 °C +/- 3,0 K in the range -200 °C …0 °C
	Thermocouple R, S	+/- 1,9 K in the range 200 °C …1768 °C +/- 3,5 K in the range 0 °C …200 °C
	Thermocouple T	+/- 0,8 K in the range 0 °C …400 °C +/- 2,4 K in the range -200 °C…0 °C
	Cold junction error [3]	+/- 4 K
Maximum conversion error of the analog values at full temperature range [2]		
	Thermocouple B	+/- 2,9 K in the range 1000 °C…1820 °C +/- 4,5 K in the range 600 °C …1000 °C
	Thermocouple E	+/- 2,9 K in the range 0 °C …1000 °C +/- 5,8 K in the range -200 °C …0 °C
	Thermocouple J	+/- 1,9 K in the range 0 °C …1200 °C +/- 5,9 K in the range -200 °C …0 °C
	Thermocouple K	+/- 2,4 K in the range 0 °C …1372 °C +/- 4,8 K in the range -200 °C …0 °C
	Thermocouple N	+/- 2,9 K in the range 0 °C …1372 °C +/- 7,2 K in the range -200 °C …0 °C
	Thermocouple R, S	+/- 4,6 K in the range 200 °C …1768 °C +/- 7,4 K in the range 0 °C …200 °C
	Thermocouple T	+/- 2,4 K in the range 0 °C …400 °C +/- 6,0 K in the range -200 °C…0 °C
	Cold junction error [3]	+/- 4 K
Crosstalk between channels		< -110 dB for thermocouple inputs [4]
Common mode rejection ration		> 100 dB at 50/60 Hz regarding max. amplitude[4]
Monotonicity		Yes
Repeatability at fixed temperature after specified stabilization time		0,0X % of full scale
Non-linearity		0,0X % of full scale
Galvanic isolation		
	Between the channels	No

Parameter		Value
	Between the channels and I/O bus	Yes
	Between the channels and process supply voltage (UP/ZP)	No
Temperature coefficient (is related to the max error at +25 °C and max error in the full range)		+/- 0,00x %/K
Unused temperature inputs		Must be configured as “Not used”
Remarks: [1] It is highly recommended to use the TA5122 only with the advanced filter (50 Hz or 60 Hz). Using no filter will increase the repeatabilty error of the values. [2] Valid for maritime applications only: In the presence of radiated radio frequency of 1 GHz to 2 GHz, the accuracy may be degraded. Values might change. It is still under verification. [3] The module and the corresponding CPU module require at least 30 minutes of warm-up time to meet this specification. [4] Values might change. It is still under verification.		

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 187 100 R0004	TA5122-2AI-TC: AC500-eCo, analog input option board, 2AI thermocouple B/E/J/K/N/R/S/T types, 16 bits including sign, spring/cable front terminal 3.50 mm pitch	Active
1SAP 187 100 R0204	TA5122-2AI-TCW: AC500-eCo, analog input option board, 2AI thermocouple B/E/J/K/N/R/S/T types, 16 bits including sign, spring/cable front terminal 3.50 mm pitch, wide temperature range	In preparation
Spare parts		
1SAP 187 400 R0015 **)	TA5220-SPF8: spring terminal block, removable, 8-pin, spring front, cable front, 6 pieces per packing unit	Active

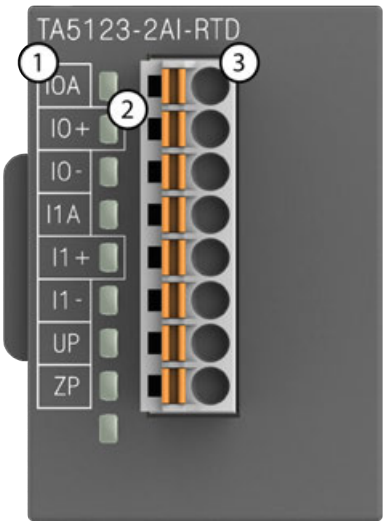
**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

***) The needed spring terminal block is always delivered with the option board.*

The terminal block listed in the table is for spare part only if needed.

5.1.1.3.6 TA5123-2AI-RTD - Analog input option board

- 2 configurable analog inputs (I0 and I1) in 1 group
  Resolution 16 bits including sign
- Option board is galvanically isolated
- W variant available for use in extended (wide) temperature range



1 Allocation of signal name
2 2 yellow LEDs to display the signal states at the analog inputs I0 and I1
3 8-pin terminal block for analog input signals and power supply (UP, ZP)

Intended purpose

The option board is used as analog input extension module for AC500-eCo CPUs (PM50xx).

The analog option board TA5123-2AI-RTD can only be used from AB 2.6.0, SystemFW 3.6.0, BootFW 3.6 and higher.

Using the option board with lower versions will create a configuration error and the CPU will not start.

In the first 5 seconds after power on, the analog option board TA5123-2AI-RTD is in self-calibration mode, so the measured values may not be accurate.

Functionality

2 analog inputs, individually configurable:

- Unused (default setting)
- Pt100, -50 °C...+400 °C (2-wire)
- Pt100, -50 °C...+400 °C (3-wire)
- Pt100, -50 °C...+130 °C (2-wire)
- Pt100, -50 °C...+130 °C (3-wire)
- Pt1000, -50 °C...+400 °C (2-wire)
- Pt1000, -50 °C...+400 °C (3-wire)
- Ni1000, -50 °C...+150 °C (2-wire)
- Ni1000, -50 °C...+150 °C (3-wire)
- NTC (2-wire)

Parameter		Value
Resolution of the analog channels		
	Temperature	0.1 °C
LED displays		2 LEDs for signals I0 and I1
Internal power supply		Via the CPU PM50xx
External power supply		Via the terminals UP and ZP (process voltage 24 V DC)
Required CPU		PM50xx

Connections

WARNING!
Removal/Insertion under power
The option cards are not designed to be removed or inserted while the device is switched on. Due to unpredictable consequences, it is not permitted to connect or remove option cards while the device is powered on.

Make sure that all power sources (supply and process power) are switched off before you do the following:

– Connection or disconnection of signals or terminal blocks.
– Removal, installation or replacement of an option card.

Disconnecting a powered option card under voltage in a potentially explosive atmosphere may result in an electric arc, which could ignite combustible materials and cause a fire or explosion.

Make sure that the power supply is disconnected and the area has been toughly checked to ensure that no combustible materials are present before proceeding.

The option board TA5123-2AI-RTD for analog input extension is plugged into an AC500-eCo CPU PM50x2.

Insert the module and press it until it locks into place.

*A detailed description of the assembly and disassembly of the module can be found in the chapter **Mounting and demounting option boards**.*

The electrical connection is made via a removable 8-pin terminal block. For more information, please refer to the chapter **TA52xx(-x) - Terminal block sets**.

The terminal block is included in the scope of delivery of the option board. Further terminal blocks can be ordered separately as spare parts.

Table 60: Assignment of the terminals:

Terminal	Signal	Description
1	I0A	Connection for 3-wire measurement of the analog input I0
2	I0+	Positive analog input I0

Terminal	Signal	Description
3	I0-	Negative analog input I0
4	I1A	Connection for 3-wire measurement of the analog input I1
5	I1+	Positive analog input I1
6	I1-	Negative analog input I1
7	UP	Process voltage UP = +24 VDC
8	ZP	Process voltage ZP = 0 V



CAUTION!

The negative terminal of the analog inputs are connected internally and form an internal analog ground (AGND). This analog ground is connected to ZP via a PTC resistor. There is no galvanic isolation between the analog circuitry and ZP/UP. Hence, analog inputs can not be connected in series.

The internal power supply of the circuits of the module takes place via the connection to the CPU. Thus, the current consumption from 24 VDC power supply at the terminals L+ and M of the CPU module increases by << 1 mA per TA5123-2AI-RTD.

The external power supply is connected via the UP (+24 VDC) and the ZP (0 VDC) terminals.

NOTICE!

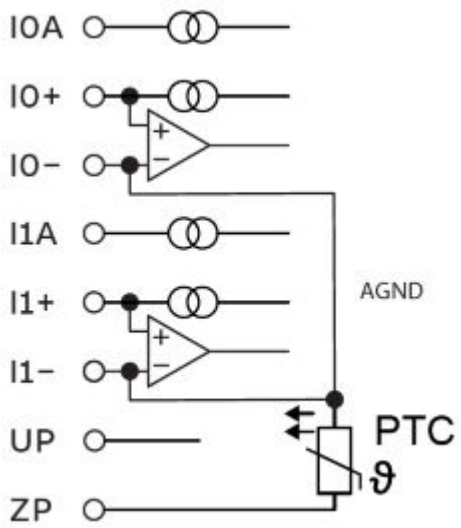
Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.

Generally, analog signals must be laid in shielded cables. The cable shields must be grounded at both sides of the cables. To avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

The following block diagram shows the internal construction of the analog inputs:



CAUTION!
By installing equipotential bonding conductors between the different parts of the system, it must be ensured that the potential difference between ZP and AGND never can exceed 1 V.

CAUTION!
The process supply voltage must be included in the grounding concept (e. g. grounding of the negative terminal).

The module provides several diagnosis functions, see section Diagnosis.

The meaning of the LEDs is described in the section State LEDs.

Connection of resistance thermometers in 2-wire configuration

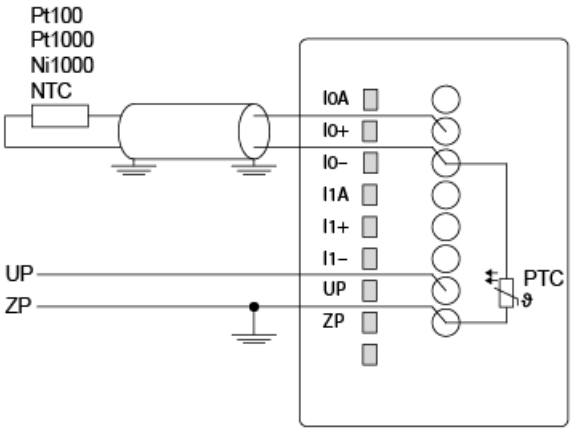


Fig. 16: Connection example

The following measuring ranges can be configured ↳ *Chapter 5.4.4.2.3.6 “Parameterization” on page 727*:

Parameter	Resistance thermometers	Value
Channel configuration	Pt100	-50 °C...+400 °C
		-50 °C...+130 °C
	Pt1000	-50 °C...+400 °C
	Ni1000	-50 °C...+150 °C
	NTC	803 Ω...100 kΩ

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "not used".

Connection of resistance thermometers in 3-wire configuration

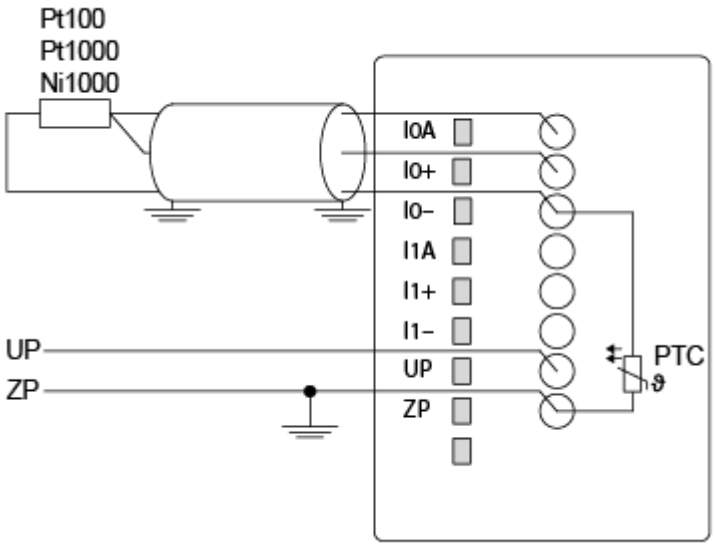


Fig. 17: Connection example

Parameter	Resistance thermometers	Value
Channel configuration	Pt100	-50 °C...+400 °C
		-50 °C...+130 °C
	Pt1000	-50 °C...+400 °C
	Ni1000	-50 °C...+150 °C

The module linearizes the resistance thermometer characteristics. In order to keep measuring errors as small as possible, it is necessary by all means to have all the involved conductors in the same cable. All the conductors must have the same cross section.

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "not used".

I/O configuration

The option board itself does not store configuration data. It receives its parameterization data from the CPU module during power-up of the system.

Hence, replacing option boards is possible without any re-parameterization via software.

↳ *Further information to the option board.*

Firmware update via memory card

The following steps describe the procedure for updating the firmware for the analog option boards using a memory card. Prerequisite is the previous download of the current firmware to the memory card either from the Automation Builder or as *download* from ABB.

1. Download the relevant firmware package.
2. Unpack the zip archive file at any location of your hard disc.
3. Insert an empty formatted (FAT16 / FAT32) memory card in the PC card reader.
4. Execute the unpacked *.exe file.
5. Select the PC card reader as the final destination and confirm.
   ⇨ All directories, files and SDCARD.INI file will be automatically created on memory card and properly configured.

After the process is complete, one has the prepared memory card with the relevant updates.

Firmware update

☑ Precondition: Prepared memory card with boot project and firmware.

1. Switch off the device.
2. Insert the memory card.
3. Switch on the device.
   ⇨ The alternate flashing of the RUN and the ERR LED indicates the running update process.

   At the end of the update process a reboot is executed and the system firmware is started for the finishing of the update process.

   If RUN LED blinks (ERR LED is off), the update was successful and the display shows *done*.

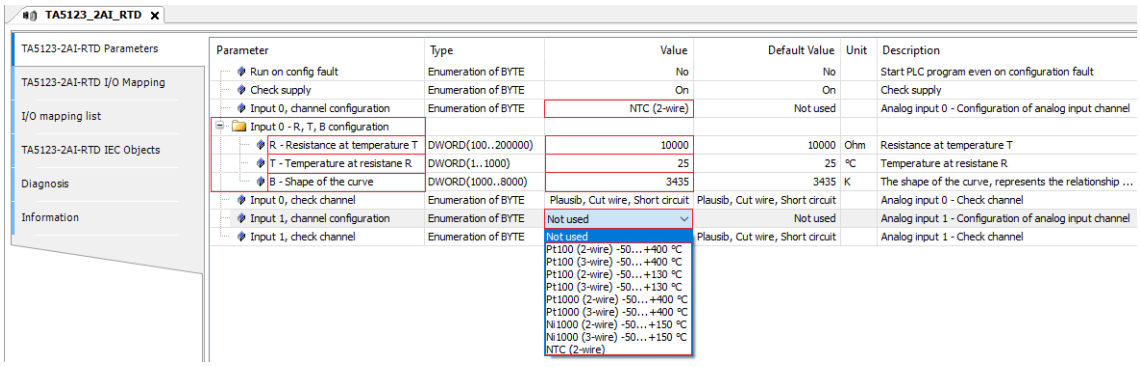
   If ERR LED blinks (RUN LED is off), the update failed and the display shows *FAIL*.

   The text file “SDCARD.RDY” includes the results of the different updates. If the update fails, the file contains the reasons for the abort. Based on this, further steps can be taken to fix the problem.
4. Switch off the device.
5. Remove the memory card.
6. Switch on the device.
   ⇨ The system starts with the new firmware.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

1. In the device tree, double-click the desired option board.
2. Select the *“TA5123-2AI-RTD Parameters”* tab to edit the parameterization of the desired option board.



1. The two inputs are set to *“Not used”* by default.

   Select your 2 individually configurable analog inputs.

2. If you select Pt100 (2-wire), PT100 (3-wire), Pt100 (2-wire), PT100 (3-wire), NI1000 (2-wire) or NI1000 (3-wire) by double-clicking, parameterization is completed.

   If you select NTC (2-wire) by double-clicking, you still have to make further entries.

3. **The following steps are only required for the NTC (2-wire) selection.**

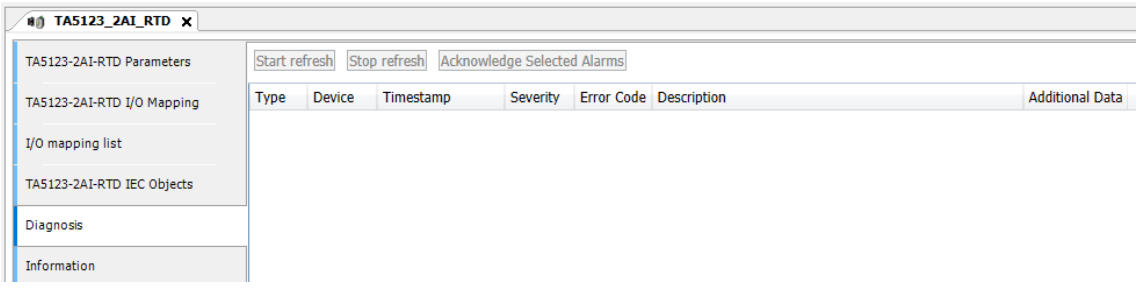
   If you have selected NTC (2-wire) on input 0 (1) , a folder Input 0 (1) - R, T, B configuration appears.

> ***Data sheet of used NTC***
>
> *Take the following values from the data sheet of the NTC used.*
>
> – *Resistance at temperature T [Ω]*
> – *Temperature at resistance R [°C] (the reference temperature is usually 25 °C)*
> – *B [K] - The shape of the curve, represents the relationship between the resistance and the temperature of a particular thermistor.*

4. Enter these values in the column *“Value”* in the respective cells R, T and B. Observe the correct units in the note.

   When you have entered the 3 values with double-click, the parameterization is completed.

Diagnosis



1. In the device tree, double-click the desired option board.
2. Select the *“Diagnosis”* tab to view the diagnosis messages of the desired option board.

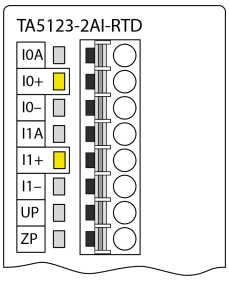
The following table shows the diagnosis messages.

Severity	Error	Description	Remedy
Option board error (Channel 255)			
3	3	Timeout Communication timeout to CPU	If the process voltage is connected properly, replace the option board.
3	51	Invalid slot Wrong or missing option board in the appropriate slot	Check the configuration and the hardware setup.
4	11	Process voltage is too low	Check the process voltage.
4	34	Data not ready Data synchronization warning	Check PLC program and synchronize. [1])
3	40	SW-mismatch Hardware does not match the firmware version	Replace the option board.
3	53	Download failed Power loss during firmware update	Replace the option board. [2])
3	9	DIAG_BUF_OVERFLOW Overflow in Diagnosis buffer	Diagnosis overflow usually means too many repeated warnings or errors. Please check all diagnosis in detail and take the appropriate action. A restart will clear the diagnosis.
3	43	DIAG_INTERNAL_ERR Internal error in the option board	Replace the option board.
3	26	DIAG_CFG_PRM_ERR Parameterization error	Check the CPU parameterization.
3	19	DIAG_CRC_ERR Checksum error in option board	Replace the option board.
Channel warning			
4	5	DIAG_HIGH_LEVEL NTC value too high	Check the NTC input and configuration.
4	6	DIAG_LOW_LEVEL NTC value too low	Check the input value and the wiring.
4	7	Lowest Level Measurement underflow	Check the input value.
4	47	DIAG_WIRE_SHORTCUT Short circuit at analog input	Check the wiring.
4	48	Overload Cut Wire Overflow or broken wire	Check the NTC input and configuration.

Remarks:

[1])	If no other error occurs, the programs are not identical and the parameter is set to report an error in this case.
[2])	Do not remove the power supply from the option board during the firmware update.

State LEDs

	LED	State	Color	LED = OFF	LED = ON	LED flashes
	Inputs I0...I1	Analog input	Yellow	Input is OFF or input value is too low	Input is ON (brightness depends on the value of the analog signal)	--

Measuring ranges

Measuring ranges - resistance temperature detector

Table 61: Measuring range: Pt100 /Pt1000 -50 °C ... +400 °C

Range/ LED behavior	Input	Digital value	
		Decimal	Hex.
Wire break/LED OFF	>> 450.0 °C	32767	7FFF
Overflow/LED OFF	> 450.0 °C	32767	7FFF
Temperature too high/LED 100 %	450.0 °C : 400.1 °C	4500 : 4001	1194 : 0FA1
Normal range/LED 0 % ... 100 %	400 °C : 0.1 °C	4000 : 1	0FA0 : 0001
	0.0000	0	0
	-0.1 °C : -50.0 °C	-1 : -500	FFFF : FE0C
Temperature too low/LED OFF	-50.1 °C : -60.0 °C	-501 : -600	FE0B : FDA8
Underflow/LED OFF	< -60.0 °C	-32768	8000
Short circuit/LED OFF	<< -60.0 °C	-32768	8000

Table 62: Measuring range: Pt100/Pt1000 -50 °C ... +130 °C

Range/ LED behavior	Input	Digital value	
		Decimal	Hex.
Wire break/LED OFF	>> 140.0 °C	32767	7FFF
Overflow/LED OFF	> 140.0 °C	32767	7FFF
Temperature too high/LED 100 %	140.0 °C : 130.1 °C	1400 : 1301	0578 : 0515

Range/ LED behavior	Input	Digital value	
		Decimal	Hex.
Normal range/LED 0 % ... 100 %	130.0 °C : 0.1 °C	1300 : 1	0514 : 0001
	0.0000	0	0
	-0.1 °C : -50.0 °C	-1 : -500	FFFF : FE0C
Temperature too low/LED OFF	-50.1 °C : -60.0 °C	-501 : -600	FE0B : FDA8
Underflow/LED OFF	< -60.0 °C	-32768	8000
Short circuit/LED OFF	<< -60.0 °C	-32768	8000

Table 63: Measuring range: Ni1000 -50 °C ... +150 °C

Range/ LED behavior	Input	Digital value	
		Decimal	Hex.
Wire break/LED OFF	>> 160.0 °C	32767	7FFF
Overflow/LED OFF	> 160.0 °C	32767	7FFF
Temperature too high/LED 100 %	160.0 °C : 150.1 °C	1600 : 1501	0640 : 05DD
Normal range/LED 0 % ... 100 %	150.0 °C : 0.1 °C	1500 : 1	05DC : 0001
	0.0000	0	0
	-0.1 °C : -50.0 °C	-1 : -500	FFFF : FE0C
Temperature too low/LED OFF	-50.1 °C : -60.0 °C	-501 : -600	FE0B : FDA8
Underflow/LED OFF	< -60.0 °C	-32768	8000
Short circuit/LED OFF	<< -60.0 °C	-32768	8000

Variable measuring range

With the NTC, a resistance is measured. Depending on the values R, T and B a temperature value can be calculated, from which the digital values (dec. and hex.) are derived.

The following table shows an example with the default value:

- *R = 10000 Ω*
- *T = 25 °C*
- *B = 3435 K*

Table 64: Measuring range: NTC

Range/ LED behavior	Calculated value	Measured value [Ω]	Digital value	
			Decimal	Hex.
Short circuit/LED ON	*>> 223.6 °C*	30	32767	7FFF
Overflow/LED ON	*> 223.6 °C*	< 100	32767	7FFF
Temperature medium accuracy/LED 100 %	*223.5 °C* : *108.7 °C*	100 : 801	*2235* : *1087*	*08BB* : *043E*
Normal range/LED 0 % ... 100 %	*108.6 °C* : *25.1 °C*	803.06 : 9961	*1086* : *251*	*043D* : *00FB*
	25.0	10000	*250*	*00FA*
	24.9 °C : *-24.7 °C*	10039 : 100000	*249* : *-247*	*00F9* : *FF09*
Temperature medium accuracy/LED 0 %	*-24.8 °C* : *-36.5 °C*	100558 : 200000	*-248* : *-365*	*FF08* : *FE93*
Underflow/LED OFF	*< -36.6 °C*	> 200000	-32768	8000
Wire break/LED OFF	*<< -36.6 °C*	> 400000	-32768	8000

Values written in italics

Values written in italics are variable and depend on the parameters R, T and B.

Here, the default values are used (R: 10000 Ω, T: 25 °C, B: 3435 K)

Technical data

The system data apply.

↳ *Chapter 4.1 “System data AC500-eCo” on page 25*

Only additional details are therefore documented below.

Parameter		Value
Process voltage		
	Connections	Terminals 7 for +24 V (UP) and 8 for 0 V (ZP)
	Rated value	24 V DC
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	1 A slow
	Galvanic isolation	Yes, per module (no isolation between channels)
Current consumption		
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU PM50x2	< 1 mA
	From UP at normal operation	max. 20 mA
Inrush current from UP (at power up)		0.005 A^2s
Max. length of analog cables, conductor cross section ≥ 0.2 mm²		On request
Weight		20 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

Technical data of the analog inputs

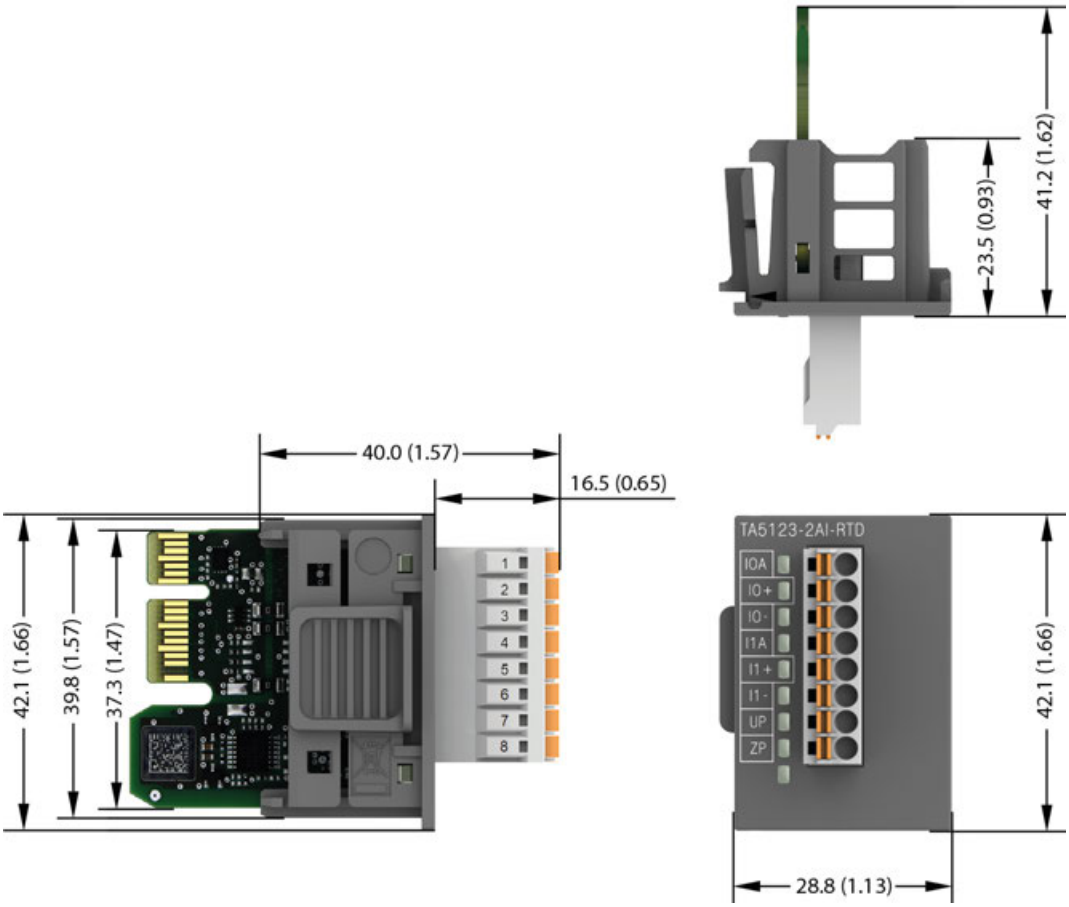
NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Parameter	Value
Number of channels per module	2
Distribution of channels into groups	1 group of 2 channels
Input type	Unipolar with Pt100, Pt1000, Ni1000 and NTC
Galvanic isolation	Yes, per module (no isolation between channels)

Parameter			Value
Configurability			Pt100 (2-wire) -50 °C...+400 °C Pt100 (3-wire) -50 °C...+400 °C Pt100 (2-wire) -50 °C...+130 °C Pt100 (3-wire) -50 °C...+130 °C Pt1000 (2-wire) -50 °C...+400 °C Pt1000 (3-wire) -50 °C...+400 °C Ni1000 (2-wire) -50 °C...+150 °C Ni1000 (3-wire) -50 °C...+150 °C NTC (2-wire) (each input can be configured individually)
Indication of the input signals			1 LED per channel
Conversion cycle *)			
	Configurations		
		2 activated channels with 3-wire measurement	2 s
		all others	1 s
Resolution			Range 16 bits including sign
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range			
	PT100, PT1000, Ni1000		0,3% max at 25 °C 0,5% max at full temperature range
	NTC Reference sensor R: 10000Ω, T: 25 °C B: 3435 K accuracy specified in the range 806 Ω - 100kΩ		0,3% max at 25 °C 0,5% max at full temperature range
Temperature coefficient (is related to the max error at +25°C and max error in the full range)			+-0,006 %/K
Temporary deviation during EMC disturbance			3%
Unused temperature inputs			Must be configured as "Not used"
Overvoltage protection			Yes

*) The value is the sampling time on the option board. The complete conversion cycle time is also related to the CPU cycle time.

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 187 100 R0002	TA5123-2AI-RTD: AC500-eCo, analog input option board, 2AI RTD, 16 bits including sign, spring/cable front terminal 3.50 mm pitch	Active
1SAP 187 100 R0202	TA5123-2AI-RTW: AC500-eCo, analog input option board, 2AI RTD, 16 bits including sign, spring/cable front terminal 3.50 mm pitch, wide temperature range	Active
Spare parts		
1SAP 187 400 R0015 **)	TA5220-SPF8: spring terminal block, removable, 8-pin, spring front, cable front, 6 pieces per packing unit	Active

*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

**) The needed spring terminal block is always delivered with the option board.

The terminal block listed in the table is for spare part only if needed.

5.1.1.3.7 TA5126-2AO-UI - Analog output option board

- 2 configurable analog outputs (O0 and O1) in 1 group
  Resolution 12 bits
- Option board is galvanically isolated
- W variant available for use in extended (wide) temperature range

Intended purpose

The option board is used as analog output extension module for AC500-eCo CPUs (PM50xx).

The analog option boards TA5120-2AI-UI and TA5126-2AO-UI can only be used from AB 2.5.2, SystemFW 3.5.0_HF-7, BootFW 3.5.1 and higher.

Using the option boards with lower versions will create a configuration error and the CPU will not start.

Functionality

2 analog outputs, individually configurable for

- Not used (default setting)
- 0 V...10 V
- 0 mA...20 mA
- 4 mA...20 mA

Parameter		Value
Resolution of the analog channels		
	Voltage 0 V...10 V	12 bits
	Current 0 mA...20 mA,	12 bits
	Current 4 mA...20 mA	12 bits
LED displays		2 LEDs for signals O0 and O1
Internal power supply		Via the CPU PM50xx
External power supply		Via the terminals UP and ZP (process voltage 24 V DC)
Required CPU		PM50xx

Connections

WARNING!

Removal/Insertion under power

The option cards are not designed to be removed or inserted while the device is switched on. Due to unpredictable consequences, it is not permitted to connect or remove option cards while the device is powered on.

Make sure that all power sources (supply and process power) are switched off before you do the following:

– Connection or disconnection of signals or terminal blocks.
– Removal, installation or replacement of an option card.

Disconnecting a powered option card under voltage in a potentially explosive atmosphere may result in an electric arc, which could ignite combustible materials and cause a fire or explosion.

Make sure that the power supply is disconnected and the area has been toughly checked to ensure that no combustible materials are present before proceeding.

The option board TA5126-2AO-UI for analog output extension is plugged into an AC500-eCo CPU PM50xx.

The electrical connection is made via a removable 6-pin terminal block.

The terminal block is included in the scope of delivery of the option board. Further terminal blocks can be ordered separately as spare parts

Chapter 5.8.1.2 “TA5211, TA 5212 - Terminal block sets” on page 1372

Table 65: Assignment of the terminals:

Terminal	Signal	Description
1	O0+	Positive analog output O0
2	O0-	Negative analog output O0
3	O1+	Positive analog output O1
4	O1-	Negative analog output O1
5	UP	Process voltage UP = +24 V DC
6	ZP	Process voltage ZP = 0 V DC

CAUTION!

The negative terminal of the analog outputs (voltage 0 V…10 V) are connected internally and form an internal analog ground (AGND). This analog ground is connected to ZP via a PTC resistor. There is no galvanic isolation between the analog circuitry and ZP/UP.

The internal power supply voltage for the module's circuitry is carried out via the connection to CPU. Thus, the current consumption from 24 V DC power supply at the terminals L+ and M of the CPU module increases by << 1 mA per TA5126-2AO-UI.

The external power supply connection is carried out via the terminals UP (+24 V DC) and ZP (0 V DC).

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.

Generally, analog signals must be laid in shielded cables. The cable shields must be grounded at both sides of the cables. To avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

The following figure shows the connection of the module:

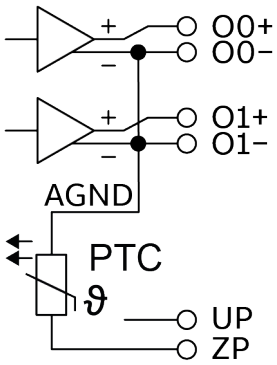


Fig. 18: Internal construction of the analog outputs

CAUTION!

By installing equipotential bonding conductors between the different parts of the system, it must be ensured that the potential difference between ZP and AGND never can exceed 1 V.

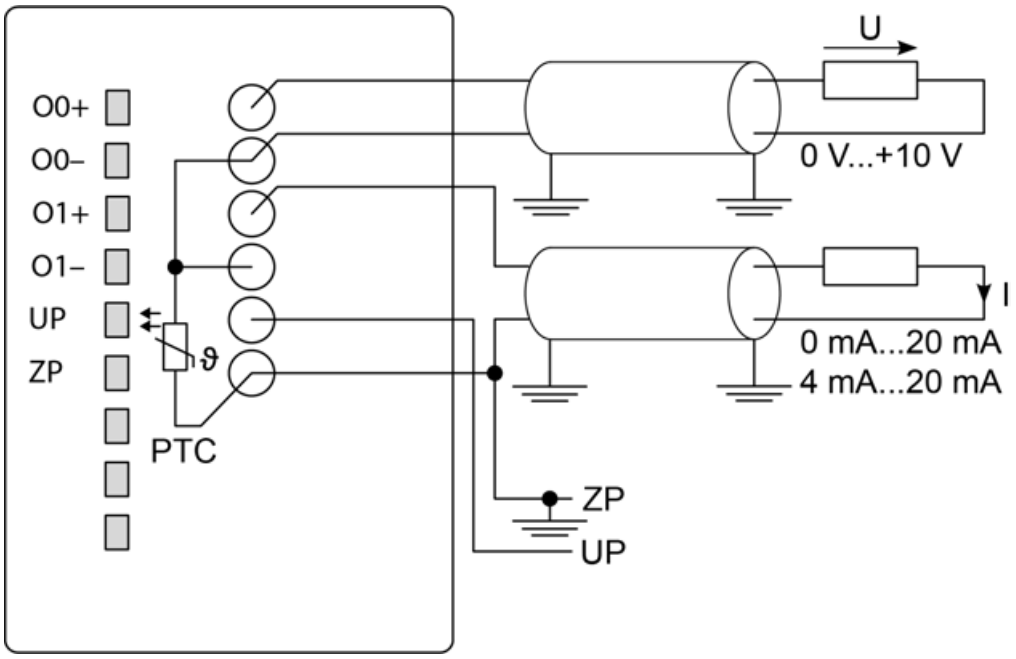
CAUTION!

The process supply voltage must be included in the grounding concept (e. g. grounding of the negative terminal).

The module provides several diagnosis functions

Chapter 5.1.1.3.7.7 “Diagnosis” on page 160

Connection of analog output loads (Voltage, current)



Parameter	Value
Channel configuration	0 V...+10 V
	0 mA...20 mA
	4 mA...20 mA

In order to avoid error messages or long processing times, it is useful to configure unused analog output channels as "not used".

I/O configuration

The option board itself does not store configuration data. It receives its parameterization from the CPU module during power-up of the system.

Hence, replacing optional modules is possible without any re-parameterization via software.

Parameter	Value
Configurability	0 V...10 V 0 mA...20 mA 4 mA...20 mA (each input can be configured individually)
Unused voltage outputs	Must be configured as "not used"
Unused current outputs	Must be configured as "not used"

Firmware update via memory card

The following steps describe the procedure for updating the firmware for the analog option boards using a memory card. Prerequisite is the previous download of the current firmware to the memory card either from the Automation Builder or as *download* from ABB.

1. Download the relevant firmware package.
2. Unpack the zip archive file at any location of your hard disc.
3. Insert an empty formatted (FAT16 / FAT32) memory card in the PC card reader.
4. Execute the unpacked *.exe file.
5. Select the PC card reader as the final destination and confirm.
   ⇨ All directories, files and SDCARD.INI file will be automatically created on memory card and properly configured.

After the process is complete, one has the prepared memory card with the relevant updates.

Firmware update

☑ Precondition: Prepared memory card with boot project and firmware.

1. Switch off the device.
2. Insert the memory card.
3. Switch on the device.
   ⇨ The alternate flashing of the RUN and the ERR LED indicates the running update process.

   At the end of the update process a reboot is executed and the system firmware is started for the finishing of the update process.

   If RUN LED blinks (ERR LED is off), the update was successful and the display shows *done*.

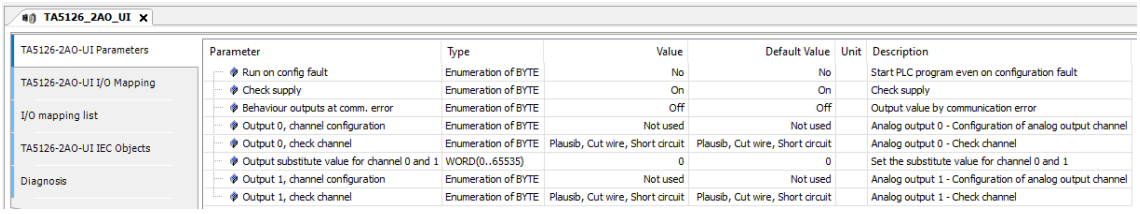
   If ERR LED blinks (RUN LED is off), the update failed and the display shows *FAIL*.

   The text file “SDCARD.RDY” includes the results of the different updates. If the update fails, the file contains the reasons for the abort. Based on this, further steps can be taken to fix the problem.
4. Switch off the device.
5. Remove the memory card.
6. Switch on the device.
   ⇨ The system starts with the new firmware.

Parameterization

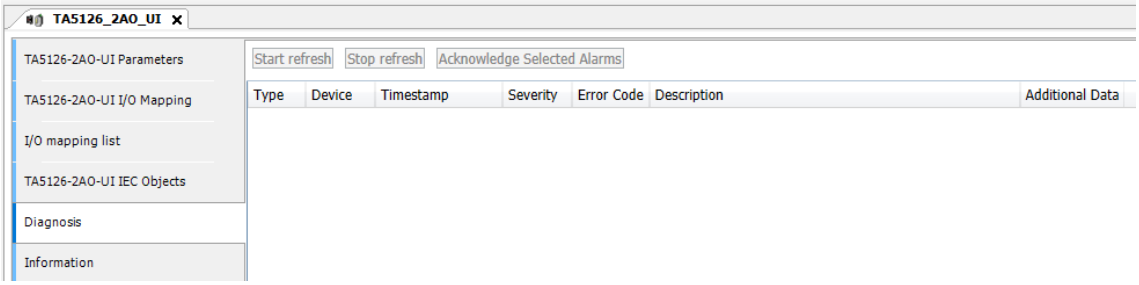
The arrangement of the parameter data is performed with Automation Builder software.

1. In the device tree, double-click the desired option board.
2. Select the *“TA5126-2AO-UI Parameters”* tab to edit the parameterization of the desired option board.



Parameter	Type	Value	Default Value	Unit	Description
Run on config fault	Enumeration of BYTE	No	No		Start PLC program even on configuration fault
Check supply	Enumeration of BYTE	On	On		Check supply
Behaviour outputs at comm. error	Enumeration of BYTE	Off	Off		Output value by communication error
Output 0, channel configuration	Enumeration of BYTE	Not used	Not used		Analog output 0 - Configuration of analog output channel
Output 0, check channel	Enumeration of BYTE	Plausib, Cut wire, Short circuit	Plausib, Cut wire, Short circuit		Analog output 0 - Check channel
Output substitute value for channel 0 and 1	WORD(0..65535)	0	0		Set the substitute value for channel 0 and 1
Output 1, channel configuration	Enumeration of BYTE	Not used	Not used		Analog output 1 - Configuration of analog output channel
Output 1, check channel	Enumeration of BYTE	Plausib, Cut wire, Short circuit	Plausib, Cut wire, Short circuit		Analog output 1 - Check channel

Diagnosis



1. In the device tree, double-click the desired option board.
2. Select the *"Diagnosis"* tab to view the diagnosis messages of the desired option board.

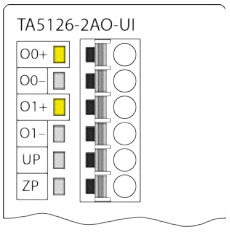
Bus pos.	Type	Channel	Class	Error	Description	Remedy
Module error (Channel 255)						
0..2	31	255	3	3	Timeout Communication timeout to CPU	If the process voltage is connected properly, replace the option board.
0..2	31	255	3	51	Invalid slot Wrong or missing option board in the appropriate slot	Check the configuration and the hardware setup.
0..2	31	255	4	11	Process voltage is too low	Check the process voltage.
0..2	31	255	4	34	Data not ready Data synchronization warning	Check PLC program and synchronize. [1])
0..2	31	255	3	40	SW-mismatch Hardware does not match the firmware version	Replace the option board.
0..2	31	255	3	53	Download failed Power loss during firmware update	Replace the option board. [2])
0..2	31	255	3	9	DIAG_BUF_OVERFLOW Overflow in Diagnosis buffer	Diagnosis overflow usually means too many repeated warnings or errors. Please check all diagnosis in detail and take the appropriate action. A restart will clear the diagnosis.
0..2	31	255	3	43	DIAG_INTERNAL_ERR Internal error in the option board	Replace the option board.
0..2	31	255	3	26	DIAG_CFG_PRM_ERR Parameterization error	Check the CPU parameterization.
0..2	31	255	3	19	DIAG_CRC_ERR Checksum error in option board	Replace the option board.

Bus pos.	Type	Channel	Class	Error	Description	Remedy
Channel warning						
0..2	1	0..1	4	4	Highest level Output value is greater than the highest level	Check the output value.
0..2	1	0..1	4	7	Lowest level Output value is lower than the lowest level	Check the output value.
0..2	1	0..1	4	46	DIAG_EXT_VOLTAGE_FEEDED Output is short circuited to another voltage	Check the wiring. [3])
0..2	1	0..1	4	48	Overload wire break Output value is overflow or broken wire in current mode, or output value overflow in voltage mode	Check the output value and the wiring. [4])

Remarks:

[1])	If no other error occurs, the programs are not identical and the parameter is set to report an error in this case.
[2])	Do not remove the power supply from the option board during the firmware update.
[3])	In this case, output will be switched ON /OFF with a 10 sec cycle
[4])	in this case, if the output is configured as voltage output, the output will be switched ON /OFF with a 10 sec cycle

State LEDs

	LED	State	Color	LED = OFF	LED = ON	LED flashes
	Outputs O0...O1	Analog output	Yellow	Output is OFF or output value is too low	Output is ON (brightness depends on the value of the analog signal)	--

Measuring ranges

Measuring ranges - Output ranges of voltage and current

The represented resolution corresponds to 12 bits.

Table 66: Measuring range: 0 V ... 10 V

Range	Output [V]	Digital value	
		Decimal	Hex.
Overflow	0 V	> 32504	> 7EF8
Output value too high	11.7564 : 10.0029	32504 : 27656	7EF8 : 6C08
Normal range	10.0000 : 0.0029	27648 : 8	6C00 : 0008
	0.0000	0	0
Output value too low	-0.0029 : -1.7593	-8 : -4864	FFF8 : ED00
Underflow	0	< -4864	< ED00

Table 67: Measuring range: 0 mA ... 20 mA

Range	Output [mA]	Digital value	
		Decimal	Hex.
Overflow	0.0000	> 32504	> 7EF8
Output value too high	23.5127 : 20.0058	32504 : 27656	7EF8 : 6C08
Normal range	20.0000 : 0.0058	27648 : 8	6C00 : 0008
	0.0000	0	0
Underflow	0	< 0	< 0

Table 68: Measuring range: 4 mA ... 20 mA

Range	Output [mA]	Digital value	
		Decimal	Hex.
Overflow	0.0000	> 32504	> 7EF8
Output value too high	22.8102 : 20.0046	32504 : 27656	7EF8 : 6C08
Normal range	20.0000 : 4.0046	27648 : 8	6C00 : 0008
	4.0000	0	0

Range	Output [mA]	Digital value	
		Decimal	Hex.
Output value too low	3.995	-8	FFF8
	:	:	:
	0.0046	-6904	E508
	0.0000	-6912	E500
Underflow	0	< -6912	< E500

Technical data

The system data apply.

Chapter 4.1 “System data AC500-eCo” on page 25

Only additional details are therefore documented below.

Parameter		Value
Process voltage		
	Connections	Terminal 5 for +24 V (UP) as well as terminal 6 for 0 V (ZP)
	Rated value	24 V DC
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	1 A slow
	Galvanic isolation	Yes, per module (no isolation between channels)
Current consumption		
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU PM50xx	<< 1 mA
	From UP at normal operation	max. 70 mA
Inrush current from UP (at power up)		0.005 A^2s
Max. length of analog cables, conductor cross section > 0.2 mm²		On request
Weight		20 g
Mounting position		Horizontal or vertical with derating (output load reduced to 50 % at +40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

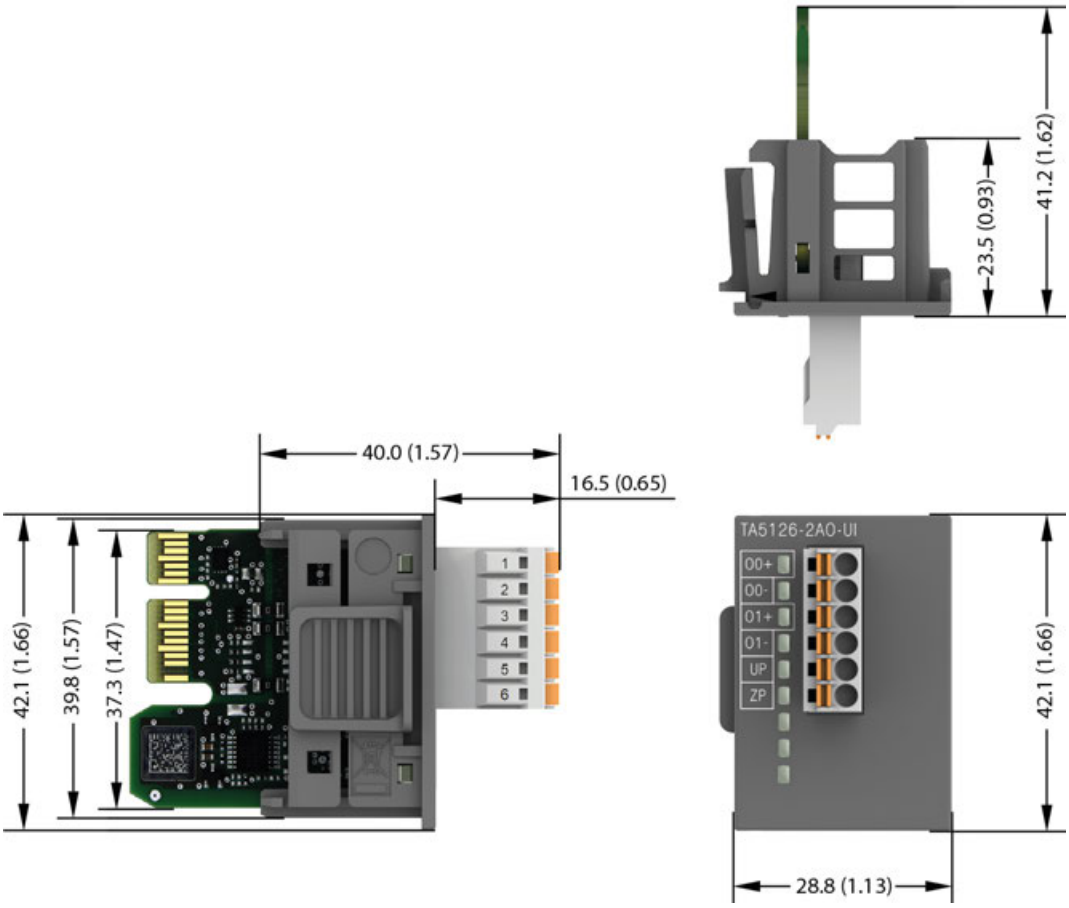
Technical data of the analog outputs

NOTICE!

All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Parameter			Value	
Number of channels per module			2	
Distribution of channels into groups			1 group of 2 channels	
Connections of the channel 0				
	Voltage mode			
		Terminal O0+ and O0-	Terminals 1 and 2	
	Current mode			
		Terminal O0+ and ZP	Termnal 1 and 6	
Connections of the channel 1				
	Voltage mode			
		Terminal O1+ and O1-	Terminals 3 and 4	
	Current mode			
		Terminal O1+ and ZP	Terminals 3 and 6	
Output type			Unipolar	
Galvanic isolation			Yes, per option board (no isolation between channels)	
Configurability			0 V ... 10 V 0 mA ... 20 mA 4 mA ... 20 mA (each output can be configured individually)	
Output resistance (load), as current output			0 Ω...500 Ω	
Output loadability, as voltage output			Max. ±10 mA	
Indication of the output signals			One LED per channel	
Conversion cycle				
	1 activated channel		250 µs	
	2 activated channel		500 µs	
Resolution for all configurations			12 bits	
Settling time for full range change (resistive load, output signal within specified tolerance)			Typ. 5 ms	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range			Max.	±0.3 % at +25 °C
			Max.	±0.3 % over full temperature range
Temperature coefficient (is related to the max error at +25°C and max error in the full range)			±0.003 %/K	
Temporary deviation during EMC disturbance			Max.	±3 %
Mapping between output signal and digital value			Output ranges of voltage and current	
Unused voltage outputs			Must be configured as "not used"	
Unused current outputs			Must be configured as "not used"	

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 187 100 R0003	TA5126-2AO-UI: AC500-eCo, analog output option board, 2AO U/I, 12 bits, spring/cable front terminal 3.50 mm pitch	Active
1SAP 187 100 R0203	TA5126-2AO-UIW: AC500-eCo, analog output option board, 2AO U/I, 12 bits, spring/cable front terminal 3.50 mm pitch, wide range temperature	Active
Spare parts		
1SAP 187 400 R0013 **)	TA5220-SPF6: spring terminal block, removable, 6-pin, spring front, cable front, 6 pieces per packing unit	Active

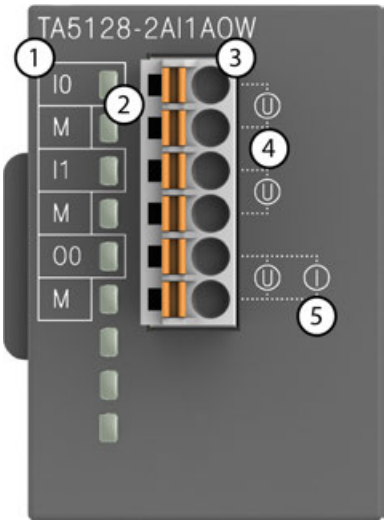
*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

**) The needed spring terminal block is always delivered with the option board.

The terminal block listed in the table is for spare part only if needed.

5.1.1.3.8 TA5128-2AI1AO - Analog input/output option board

- 2 configurable analog inputs (I0 and I1) in 1 group
  Resolution 10 bits
- 1 configurable analog output (O0)
  Resolution 10 bits
- Option board is not galvanically isolated
- W variant available for use in extended (wide) temperature range



1 Allocation of terminal and signal name
2 3 yellow LEDs to display the signal states at the analog inputs and analog output
3 6-pin terminal block for analog input/output signals
4 Input connection diagram for U
5 Output connection diagram for U and I

Intended purpose

The option board is used as analog input extension module for processor modules (PM50xx).

The analog option boards TA5120-2AI-UI, TA5122-2AI-TC, TA5123-2AI-RTD and TA5126-2AO-UI can only be used from AB 2.5.2, SystemFW 3.5.0_HF-7, BootFW 3.5.1 and higher.

The TA5128-2AI1AO can only be used from AB 2.8.0, with CPU FW 3.7.0 and higher.

Using the option boards with lower versions will create a configuration error and the CPU will not start.

Functionality

Analog input 2 analog inputs, individually configurable for

- Unused (default setting)
- 0 V ... 10 V

Parameter		Value
Resolution of the analog channels		
	Voltage 0 V ... 10 V	10 bits
LED displays		2 LEDs for signals I0 and I1
Internal power supply		Via the CPU PM50xx
Required CPU		PM50xx

Analog output 1 analog output, individually configurable for

- Not used (default setting)
- 0 V...10 V
- 0 mA...20 mA
- 4 mA...20 mA

Parameter		Value
Resolution of the analog channels		
	Voltage 0 V...10 V	10 bits
	Current 0 mA...20 mA,	10 bits
	Current 4 mA...20 mA	10 bits
LED displays		1 LED for signal O0
Internal power supply		Via the CPU PM50xx
Required CPU		PM50xx

Connection

WARNING!

Removal/Insertion under power

The option cards are not designed to be removed or inserted while the device is switched on. Due to unpredictable consequences, it is not permitted to connect or remove option cards while the device is powered on.

Make sure that all power sources (supply and process power) are switched off before you do the following:

– Connection or disconnection of signals or terminal blocks.
– Removal, installation or replacement of an option card.

Disconnecting a powered option card under voltage in a potentially explosive atmosphere may result in an electric arc, which could ignite combustible materials and cause a fire or explosion.

Make sure that the power supply is disconnected and the area has been toughly checked to ensure that no combustible materials are present before proceeding.

The option board TA5128-2AI1AO for analog input/output extension is plugged into a processor module PM50xx.

The electrical connection is made via a removable 6-pin terminal block.

The terminal block is included in the scope of delivery of the option board. Further terminal blocks can be ordered separately as spare parts.

Chapter 5.8.1.2 “TA5211, TA 5212 - Terminal block sets” on page 1372

Table 69: Assignment of the terminals:

Terminal	Signal	Description
1	I0	Analog input I0
2	M	Reference of analog input I0
3	I1	Analog input I1
4	M	Reference of analog input I1
5	O0	Analog output O0
6	M	Reference of analog output O0

CAUTION!

The reference terminal of the analog output and analog inputs are connected internally to system power reference M.

The internal power supply of the circuits of the module takes place via the connection to the CPU. Thus, the current consumption from 24 V DC power supply at the terminals L+ and M of the CPU module increases by max. 30 mA per TA5128-2AI1AO.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

Generally, analog signals must be laid in shielded cables. The cable shields must be grounded at both sides of the cables. To avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

The following figure shows the connection of the module:

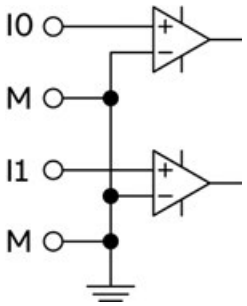


Fig. 19: Internal construction of the analog inputs

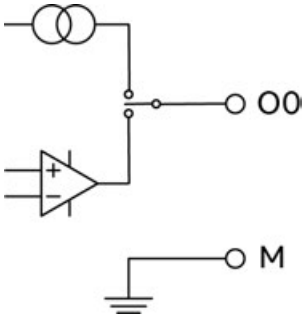
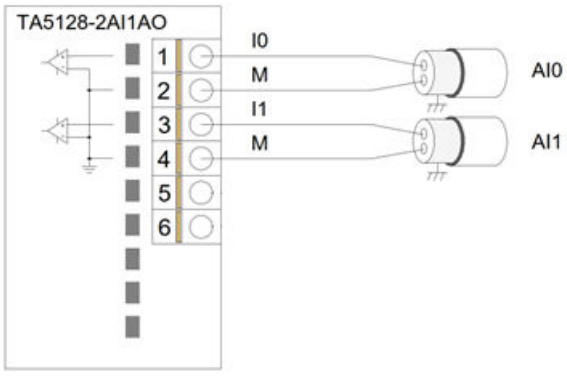


Fig. 20: Internal construction of the analog output

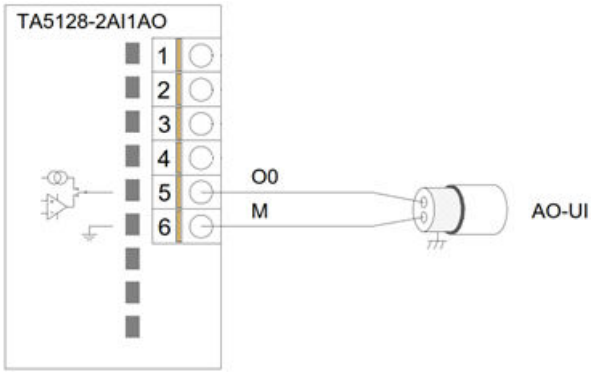
Connection of analog input loads (Voltage)



Parameter	Value
Channel configuration	0 V...+10 V

To avoid error messages or long processing times, it is useful to configure unused analog input/output channels as "not used".

Connection of analog output loads (Voltage, current)



Parameter	Value
Channel configuration	0 V...+10 V
	0 mA...20 mA
	4 mA...20 mA

To avoid error messages or long processing times, it is useful to configure unused analog input/output channels as "not used".

I/O configuration

The option board itself does not store configuration data. It receives its parameterization from the CPU module during power-up of the system.

Hence, replacing option boards is possible without any re-parameterization via software.

Table 70: Analog inputs I0 and I1

Parameter	Value
Configurability	0 V...10 V (each input can be configured individually)
Unused voltage inputs	Must be configured as "not used"

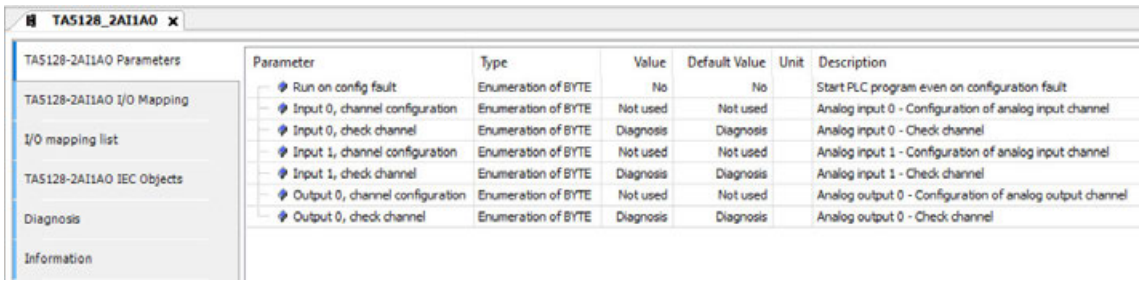
Table 71: Analog outputs O0

Parameter	Value
Configurability	0 V...10 V 0 mA...20 mA 4 mA...20 mA (each output can be configured individually)
Unused voltage inputs	Must be configured as "not used"
Unused current inputs	Must be configured as "not used"

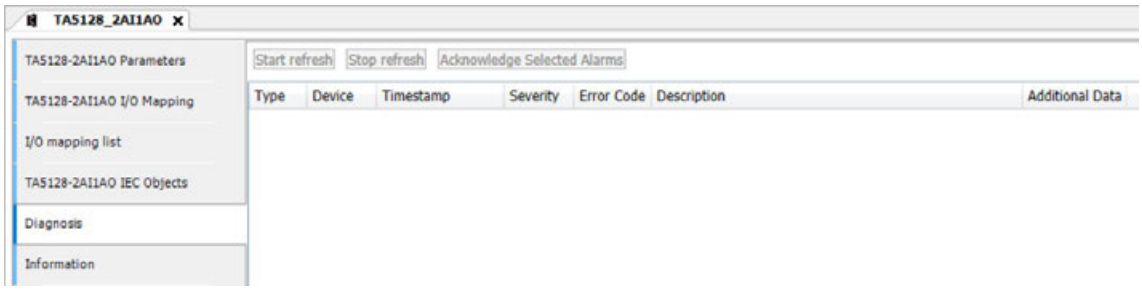
Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

1. In the device tree, double-click the desired option board.
2. Select the *"TA5128-2AI1AO Parameters"* tab to edit the parameterization of the desired option board.



Diagnosis



1. In the device tree, double-click the desired option board.
2. Select the *"Diagnosis"* tab to view the diagnosis messages of the desired option board.

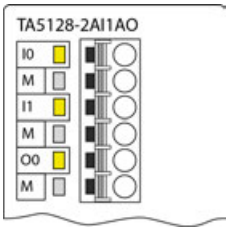
Severity	Error	Description	Remedy
Option board error (Channel 255)			
3	3	Timeout Communication timeout to CPU	If the process voltage is connected properly, replace the option board.
3	51	Invalid slot Wrong or missing option board in the appropriate slot	Check the configuration and the hardware setup.
4	11	Process voltage is too low	Check the process voltage.
4	34	Data not ready Data synchronization warning	Check PLC program and synchronize. [1])
3	40	SW-mismatch Hardware does not match the firmware version	Replace the option board.
3	53	Download failed Power loss during firmware update	Replace the option board. [2])
3	9	DIAG_BUF_OVERFLOW Overflow in Diagnosis buffer	Diagnosis overflow usually means too many repeated warnings or errors. Please check all diagnosis in detail and take the appropriate action. A restart will clear the diagnosis.

Severity	Error	Description	Remedy
3	43	DIAG_INTERNAL_ERR Internal error in the option board	Replace the option board.
3	26	DIAG_CFG_PRM_ERR Parameterization error	Check the CPU parameterization.
3	19	DIAG_CRC_ERR Checksum error in option board	Replace the option board.
Channel warning			
4	304	Overload or cut wire	Check the input value.
4	263	Measurement underflow at the module.	Check the output values and the wiring.
4	260	Measurement overflow at the module.	Check the output values and the wiring.

Remarks:

[1])	If no other error occurs, the programs are not identical and the parameter is set to report an error in this case.
[2])	Do not remove the power supply of the CPU during the firmware update.

State LEDs

	LED	State	Color	LED = OFF	LED = ON	LED flashes
	Inputs I0 ... I1	Analog input	Yellow	Input is OFF or input value is too low	Input is ON or open circuit error (brightness depends on the value of the analog signal)	--
	Output O0	Analog output	Yellow	Output is OFF or output value is too low	Output is ON (brightness depends on the value of the analog signal)	--

Measuring ranges

Input ranges of voltage

The represented resolution corresponds to 10 bits.

Table 72: Measuring range: 0 V ... 10 V

Range	Input [V]	Digital value	
		Decimal	Hex.
Overflow LED 100 %	> 11.758	32767	7FFF
Input voltage too high LED 100 %	11.747 : 10.016	32480 : 27680	7EE0 : 6C20
Normal range LED 0 %...100 %	10.0000 : 0.016	27648 : 32	6C00 : 0020
	0.0000	0	0
Input voltage too low LED OFF	< 0 V	0	0

Output ranges of voltage and current

The represented resolution corresponds to 10 bits.

Table 73: Measuring range: 0 V ... 10 V

Range	Output [V]	Digital value	
		Decimal	Hex.
Overflow LED OFF	0 V	> 32511	> 7EFF
Output value too high LED 100 %	11.752 : 10.015	32480 : 27680	7EE0 : 6C20
Normal range LED 0 %...100 %	10.0000 : 0.0115	27648 : 32	6C00 : 0020
	0.0000	0	0
Underflow LED OFF	0	< 0	< 0

Table 74: Measuring range: 0 mA ... 20 mA

Range	Output [mA]	Digital value	
		Decimal	Hex.
Overflow LED OFF	0.0000	> 32511	> 7EFF
Output value too high LED 100 %	23.552 : 20.053	32480 : 27680	7EE0 : 6C20

Range	Output [mA]	Digital value	
		Decimal	Hex.
Normal range LED 0 %...100 %	20.0000 : 0.023	27648 : 32	6C00 : 0020
	0.0000	0	0
Underflow LED OFF	0	< 0	< 0

Table 75: Measuring range: 4 mA ... 20 mA

Range	Output [mA]	Digital value	
		Decimal	Hex.
Overflow LED OFF	0.0000	> 32511	> 7EFF
Output value too high LED 100 %	22.838 : 20.053	32480 : 27680	7EE0 : 6C20
Normal range LED 0 %...100 %	20.0000 : 4.029	27648 : 33	6C00 : 0021
	4.0000	0	0
Output value too low LED OFF	3.983 : 0.023 0.0000	-32 : -6772 -6912	FFE0 : E520 E500
Underflow LED OFF	0	< -6912	< E500

Technical data

The system data apply.

↳ *Chapter 4.1 “System data AC500-eCo” on page 25*

Only additional details are therefore documented below.

Parameter		Value
Process voltage		
	Galvanic isolation	No
	Connections	Internally powered from CPU PM50xx
	Protection against reversed voltage	Yes. Covered through CPU PM50xx
Current consumption		

Parameter			Value
		From 24 V DC power supply at the terminals L+ and M of the CPU PM50xx	max. 30 mA
Max. length of analog cables, conductor cross section > 0.2 mm²			On request
Weight			20 g
Mounting position			Horizontal or vertical with derating
Cooling			The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

Technical data of the analog inputs

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Parameter			Value	
Number of channels per module			2	
Distribution of channels into groups			1 group of 2 channels	
Connections of the channel 0				
	Voltage mode			
		Terminal I0 and M	Terminals 1 and 2	
Connections of the channel 1				
	Voltage mode			
		Terminal I1 and M	Terminals 3 and 4	
Input type			Unipolar	
Galvanic isolation			No, zero potential "M" from CPU is used	
Configurability			0 V...10 V (each input can be configured individually)	
Channel input resistance			Voltage: > 100 kΩ Not used: > 100 kΩ	
Time constant of the input filter			Voltage: 1 ms	
Indication of the input signals			1 LED per channel	
Conversion cycle *)				
	1 activated channel		1 ms	
	2 activated channel		2 ms	
Resolution for all configurations			10 bits	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range			Max.	±1 % at +25 °C
			Max.	±2.5 % over full temperature range

Parameter	Value	
Temperature coefficient (is related to the max error at +25°C and max error in the full range)	±0.02 %/K	
Temporary deviation during EMC disturbance	Max.	±2.5 %
Mapping between input signal and digital value	Input ranges of voltage *"Input ranges of voltage" on page 172*	
Unused voltage inputs	Must be configured as "not used"	
Overvoltage protection	Yes	

*) The value is the sampling time on the option board. The complete conversion cycle time is also related to the CPU cycle time.

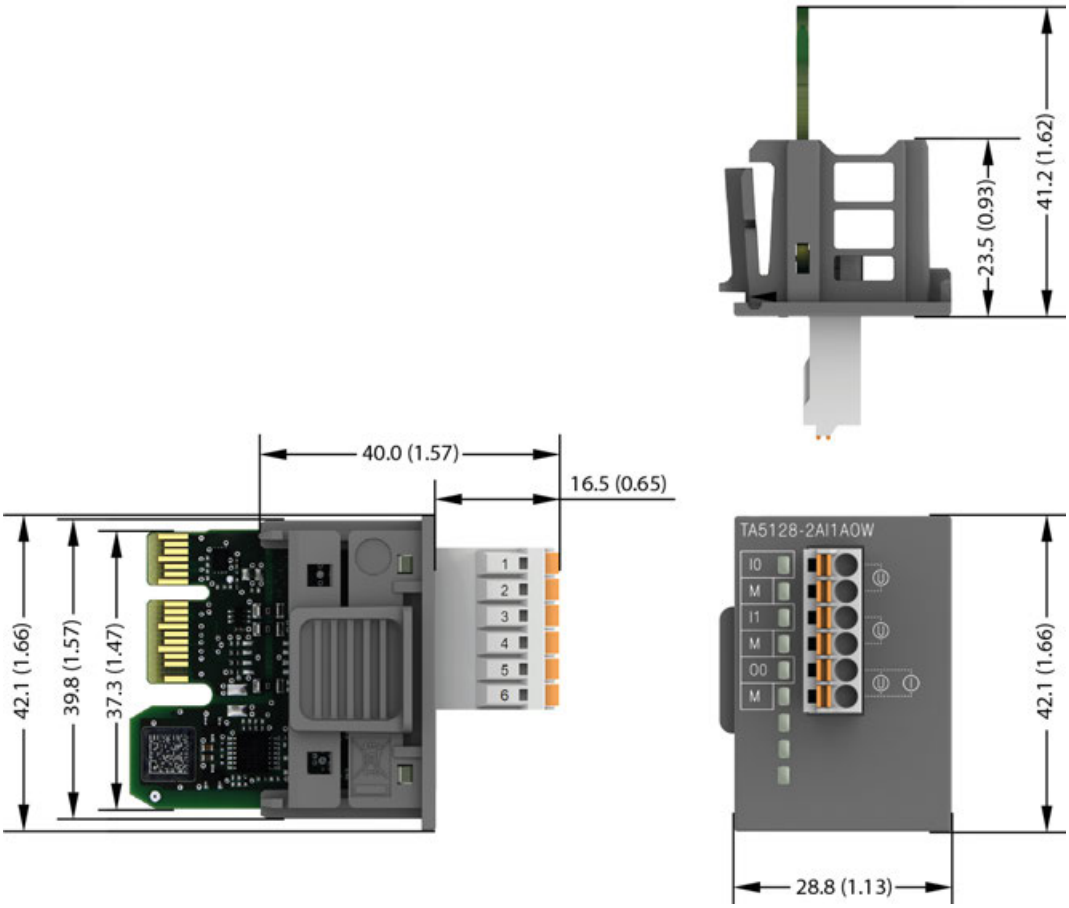
Technical data of the analog outputs

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Parameter			Value	
Number of channels per module			1	
Distribution of channels into groups			1	
Connections of the channel 0				
	Voltage mode			
		Terminal O0 and M	Terminals 5 and 6	
	Current mode			
		Terminal O0 and M	Termnals 5 and 6	
Output type			Unipolar	
Galvanic isolation			No	
Configurability			0 V ... 10 V 0 mA ... 20 mA 4 mA ... 20 mA (each output can be configured individually)	
Output resistance (load), as current output			0 Ω...500 Ω	
Output loadability, as voltage output			Max. ±2 mA	
Indication of the output signals			1 LED per channel	
Conversion cycle				
	1 activated channel		2 ms	
Resolution for all configurations			10 bits	
Settling time for full range change (resistive load, output signal within specified tolerance)			Typ. 2 ms	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range			Max.	±1 % at +25 °C
			Max.	±2.5 % over full temperature range

Parameter	Value	
Temperature coefficient (is related to the max error at +25°C and max error in the full range)	±0.02 %/K	
Temporary deviation during EMC disturbance	Max.	±2.5 %
Mapping between output signal and digital value	Output ranges of voltage and current ↳ *"Output ranges of voltage and current" on page 173*	
Unused voltage outputs	Must be configured as "not used"	
Unused current outputs	Must be configured as "not used"	

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 187 300 R0003	TA5128-2AI1AO: AC500-eCo, analog input/output option board, 2AI U/I, 10 bits, spring/cable front terminal 3.50 mm pitch	Active
1SAP 187 300 R0203	TA5128-2AI1AOW: AC500-eCo, analog input/output option board, 2AI U/I, 10 bits, spring/cable front terminal 3.50 mm pitch, wide temperature range	Active
Spare parts		
1SAP 187 400 R0013 **)	TA5220-SPF6: spring terminal block, removable, 6-pin, spring front, cable front, 6 pieces per packing unit	Active

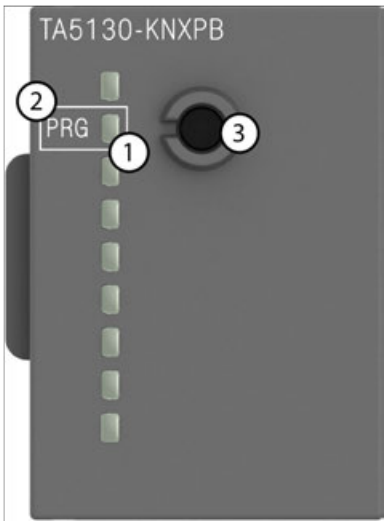
**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

***) The needed spring terminal block is always delivered with the option board.*

The terminal block listed in the table is for spare part only if needed.

5.1.1.3.9 TA5130-KNXPB - Option board KNX address push button

- W variant available for use in extended (wide) temperature range



1 State LED
2 Allocation of signal name
3 Push-Button

Intended purpose

This option board is only intended to be used with PM5072-T-2ETH(W), PM5082-T-2ETH and PM5092-T-2ETH.

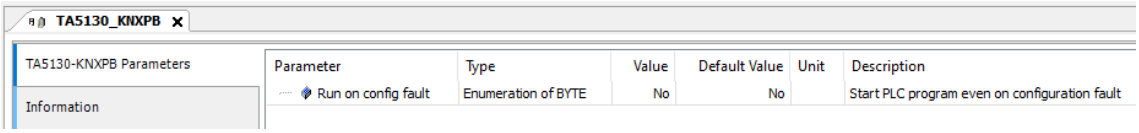
This option board can only be used once on one slot at a time!

The option board is not supported by other AC500-eCo PLCs.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

1. In the device tree, double-click the desired option board.
2. Select the *"TA51xx Parameters"* tab to edit the parameterization of the desired option board.



State LEDs

Signal	Color	State	Description
PRG	Red	ON	Programming state

Technical data

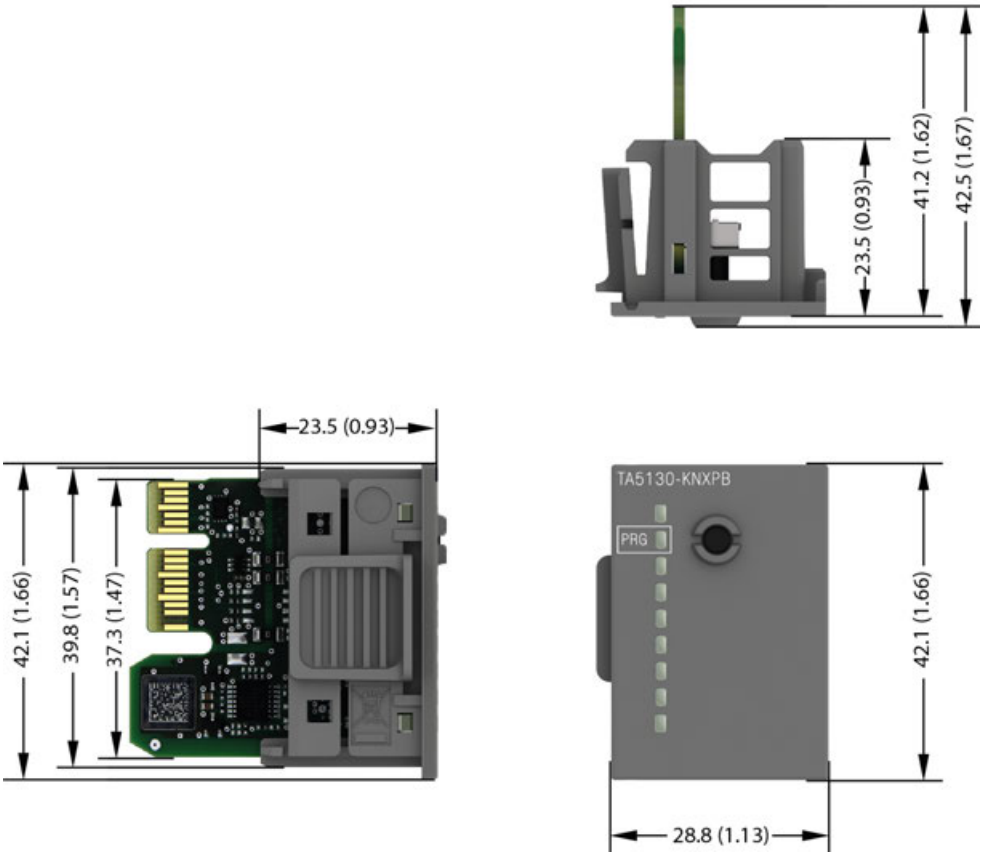
The system data apply.

Chapter 4.1 "System data AC500-eCo" on page 25

Only additional details are therefore documented below.

Parameter	Value
Usable CPUs	PM5072-T-2ETH(W), PM5082-T-2ETH and PM5092-T-2ETH
Internal power supply	Via internal CPU connection
Additional current consumption from 24 V DC power supply at CPU	Max. 25 mA
Weight	14 g

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 187 200 R0001	TA5130-KNXPB: AC500-eCo, option board KNX address push button for AC500-eCo Pro CPU only	Active
1SAP 187 200 R0201	TA5130-KNXPBW: AC500-eCo, option board KNX address push button for AC500-eCo Pro CPU only, wide temperature range	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.1.1.3.10 TA5131-RTC - Option board for real-time clock

This option board is only for the basic CPUs PM5012-T-ETH and PM5012-R-ETH.

All other AC500-eCo CPUs have the real-time clock already integrated.

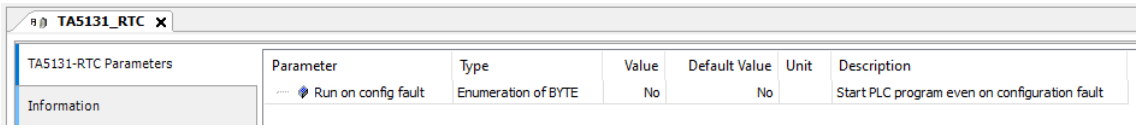


1 TA5131-RTC option board

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

1. In the device tree, double-click the desired option board.
2. Select the *"TA51xx Parameters"* tab to edit the parameterization of the desired option board.



Technical data

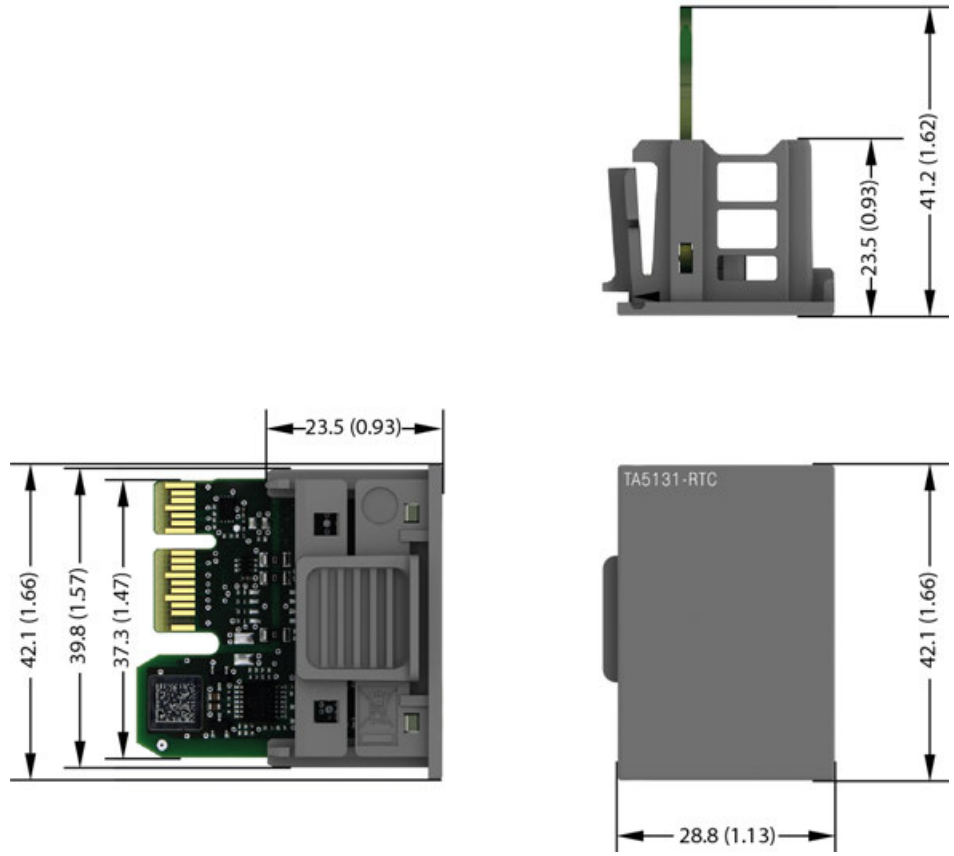
The system data apply.

↳ *Chapter 4.1 "System data AC500-eCo" on page 25*

Only additional details are therefore documented below.

Parameter		Value
Buffering time (if at least powered for 8 hours)		7 days at room temperature
	Accuracy	±2 s/day
Usable CPUs		PM5012
Internal power supply		Via internal CPU connection
Additional current consumption from 24 V DC power supply at CPU		Max. 25 mA
Weight		16 g

Dimensions



The dimensions are in mm and in brackets in inch.

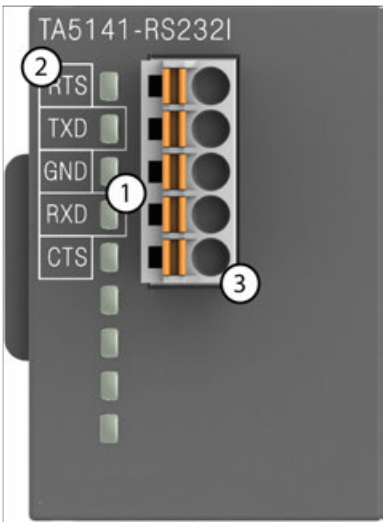
Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 187 200 R0002	TA5131-RTC:AC500-eCo, real-time clock without battery, option board for AC500-eCo Basic CPU only	Active

*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

5.1.1.3.11 TA5141-RS232I - Option board for COMx serial communication

- W variant available for use in extended (wide) temperature range



1 2 LEDs for communication state display (TxD and RxD)
2 Allocation of signal name
3 5-pin terminal block for communication interface

Option board for COMx serial communication TA5141-RS232I(W) is equipped with 1 RS-232 serial interface with handshake.

*The serial interface option boards TA5141-RS232I(W), TA5142-RS485I(W) and TA5142-RS485(W) produced from 2023 can only be used from AB 2.5.2, SystemFW 3.5.0_HF-7, BootFW 3.5.1 and higher. These new produced option boards can be recognized with the Date/Code printed on the sticker or also on the product packaging, the date code looks like **2**xx**3**, where 2 and 3 are for the year and the xx for the production week.*

Using the option boards with lower versions will create a configuration error and the CPU will not start.

These new produced option boards cannot be used with lower Automation Builder Version and the CPU BootFW/FW and the application must be upgraded to AB 2.5.2 HF8 or higher. Background information on the new produced option boards is provided in an application note.

Connections

Serial interfaces

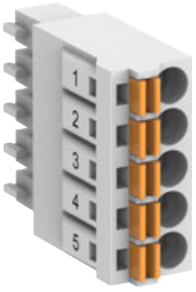
NOTICE!

Damage to the serial communication interface by using 5-pin terminal block of the TA5101-4DI!

If the 5-pin terminal block of the TA5101-4DI option board is plugged into a option board for COMx serial communication TA5141-RS232I, TA5142-RS485I or TA5142-RS485, the communication interface will be damaged by the 24 V.

Please do not confuse the 5-pin terminal block of the TA5101-4DI with the 5-pin terminal block for serial communication interface of TA5141-RS232I, TA5142-RS485I or TA5142-RS485.

Table 76: TA5141-RS232I

Serial interface	Pin	Signal	Description
	1	RTS	Request To Send DCE is ready to accept data from the DTE
	2	TxD	Transmit data (output)
	3	GND	Common Ground
	4	RxD	Receive data (input)
	5	CTS	Clear To Send (input) DCE is ready to accept data from the DTE

Cable length

The maximum possible cable length of a serial connection subnet within a segment depends on the transmission rate.

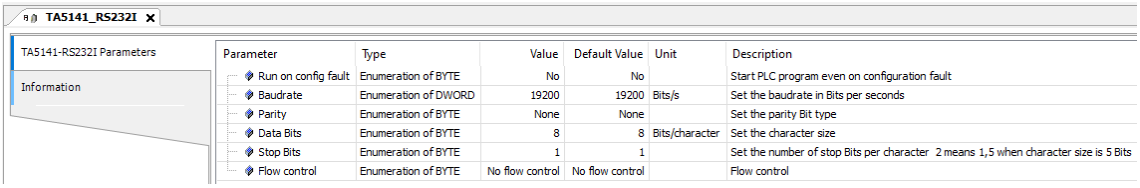
RS-232 for point-to-point connection:

Parameter	Value
Transmission rate	9.6 kBit/s to 115.2 kBit/s
Maximum cable length	On request

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

1. In the device tree, double-click the desired option board.
2. Select the *"TA51xx Parameters"* tab to edit the parameterization of the desired option board.



State LEDs

Signal	Color	State	Description
TxD	Yellow	ON (blinking)	Transmitting
RxD	Yellow	ON (blinking)	Receiving

Technical data

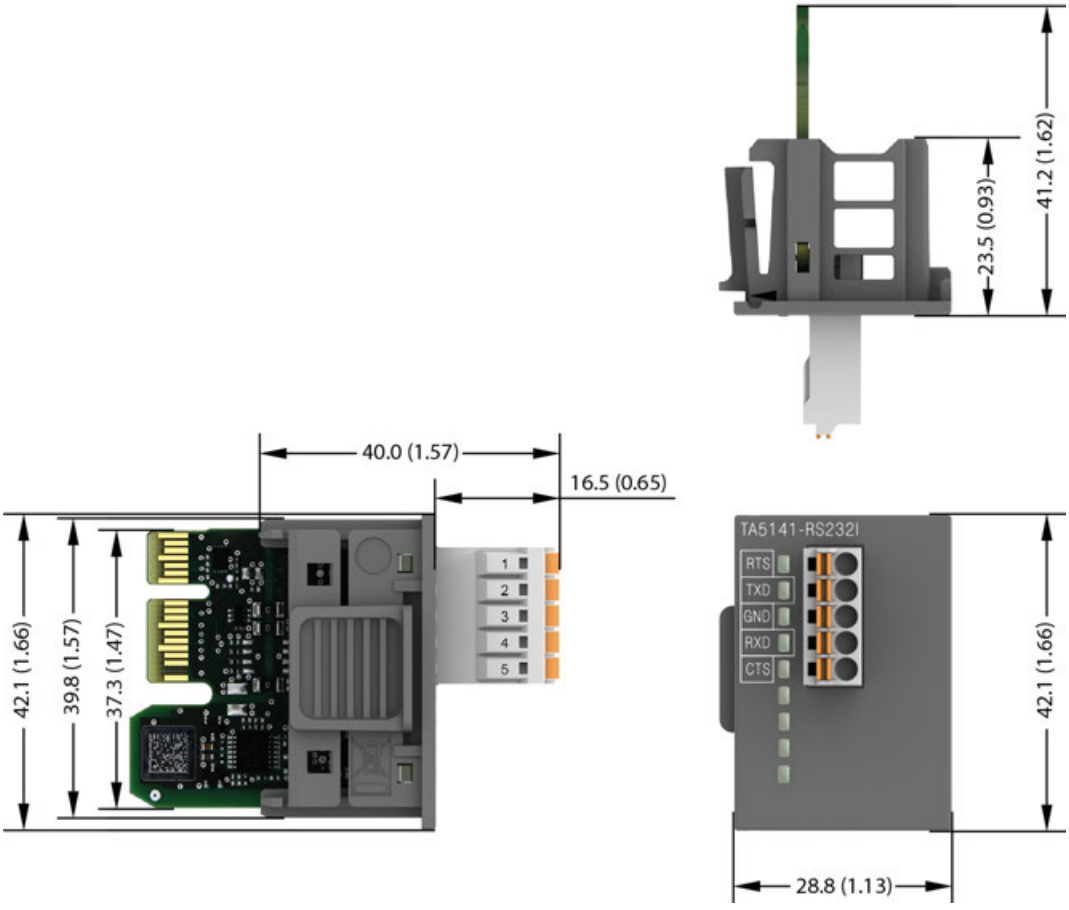
The system data apply.

↳ *Chapter 4.1 "System data AC500-eCo" on page 25*

Only additional details are therefore documented below.

Parameter	Value
Protocol	Programmable with Automation Builder e.g. Modbus RTU / CAA SerialCom via serial interfaces
Interface	Serial interface
Serial interface standard	EIA RS-232
Potential separation	Yes, from the CPU, 500 V DC
Serial interface parameters	Configurable via software
Modes of operation	Data exchange
Transmission rate	9.6 kbit/s to 115.2 kbit/s
Protocol	Programmable
Interface connector	5-pin terminal block, male
Usable CPUs	PM50xx
Internal power supply	Via internal CPU connection
Additional current consumption from 24 V DC power supply at CPU	Max. 25 mA
Weight	Ca. 15 g

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 187 300 R0001	TA5141-RS232I: AC500-eCo, RS-232 isolated option board for COMx serial communication, spring/cable front terminal, 3.50 mm pitch	Active
1SAP 187 300 R0201	TA5141-RS232IW: AC500-eCo, RS-232 isolated option board for COMx serial communication, spring/cable front terminal, 3.50 mm pitch, wide temperature range	Active
Spare parts		
1SAP 187 400 R0012 **)	TA5220-SPF5: spring terminal block, removable, 5-pin, spring front, cable front, 3.5 mm pitch, 6 pieces per packing unit	Active

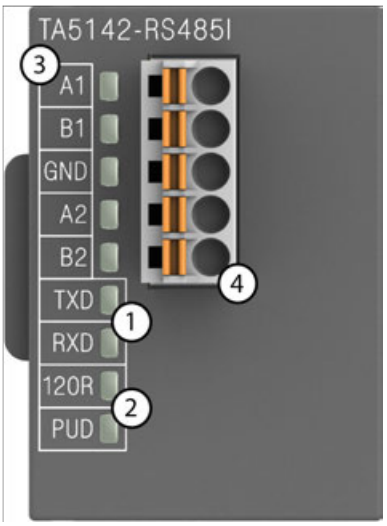
**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

***) The needed spring terminal block is always delivered with the option board.*

The terminal block listed in the table is for spare part only if needed.

5.1.1.3.12 TA5142-RS485I - Option board for COMx serial communication

- W variant available for use in extended (wide) temperature range



1 2 LEDs for communication state display (TxD and RxD)
2 2 LEDs for termination state display
3 Allocation of signal name
4 5-pin terminal block for communication interface

Option boards for COMx serial communication TA5142-RS485I(W) and TA5142-RS485(W) are equipped with 1 RS-485 (2-wire half-duplex) serial interface which can be used for communication via Modbus RTU or CAA SerialCom.

Bus terminations are built-in and configurable.

*The serial interface option boards TA5141-RS232I(W), TA5142-RS485I(W) and TA5142-RS485(W) produced from 2023 can only be used from AB 2.5.2, SystemFW 3.5.0_HF-7, BootFW 3.5.1 and higher. These new produced option boards can be recognized with the Date/Code printed on the sticker or also on the product packaging, the date code looks like **2**xx**3**, where 2 and 3 are for the year and the xx for the production week.*

Using the option boards with lower versions will create a configuration error and the CPU will not start.

These new produced option boards cannot be used with lower Automation Builder Version and the CPU BootFW/FW and the application must be upgraded to AB 2.5.2 HF8 or higher. Background information on the new produced option boards is provided in an application note.

Connections

Serial interfaces

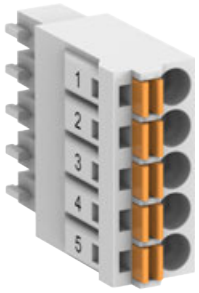
NOTICE!

Damage to the serial communication interface by using 5-pin terminal block of the TA5101-4DI!

If the 5-pin terminal block of the TA5101-4DI option board is plugged into a option board for COMx serial communication TA5141-RS232I, TA5142-RS485I or TA5142-RS485, the communication interface will be damaged by the 24 V.

Please do not confuse the 5-pin terminal block of the TA5101-4DI with the 5-pin terminal block for serial communication interface of TA5141-RS232I, TA5142-RS485I or TA5142-RS485.

Table 77: TA5142-RS485(I)

Serial interface	Pin	Signal
	1	A1 internally connected to A2
	2	B1 internally connected to B2
	3	GND
	4	A2 internally connected to A1
	5	B2 internally connected to B1

Protocols

No.	Protocol	Description
1	Modbus	Modbus RTU, master or slave
2	CAA SerialCom	Support for blocks contained in the CAA_SerialCom.lib library

Bus cable

Bus line	
Construction	2 cores, twisted, with common shield
Conductor cross section	> 0.22 mm² (24 AWG)
Twisting rate	> 10 per meter (symmetrically twisted)
Core insulation	Polyethylene (PE)
Resistance per core	< 100 Ω/km
Characteristic impedance	ca. 120 Ω (100 Ω ... 150 Ω)
Capacitance between the cores	< 55 nF/km (if higher, the max. bus length must be reduced)
Terminating resistors	120 Ω ¼ W at both line ends
Remarks	Commonly used telephone cables with PE insulation and a core diameter of > 0.8 mm are usually sufficient.
	Cables with PVC core insulation and core diameter of 0.8 mm can be used up to a length of approx. 250 m. In this case, the bus terminating resistor is approx. 100 Ω.

Cable length

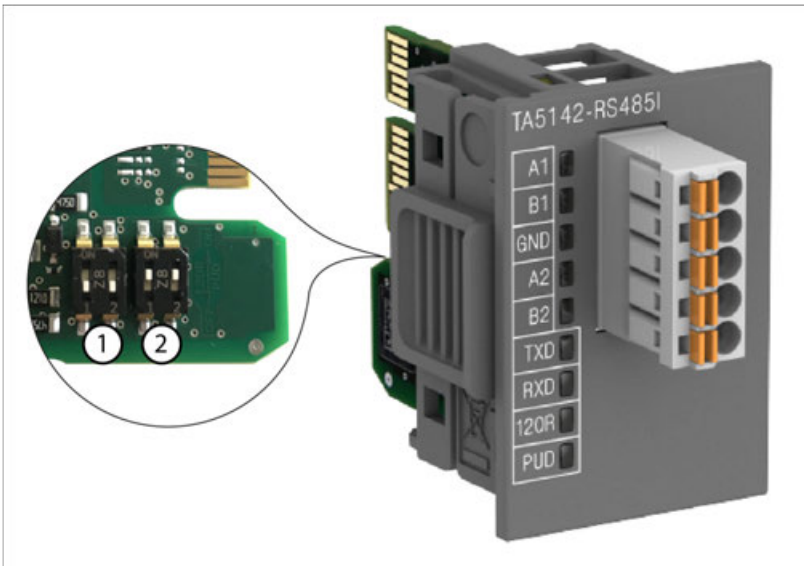
The maximum possible cable length of a serial connection subnet within a segment depends on the transmission rate.

RS-485 for point-to-point or bus connection:

Parameter	Value
Transmission rate	9.6 kbit/s to 115.2 kbit/s
Maximum cable length	On request

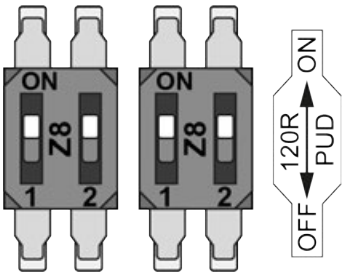
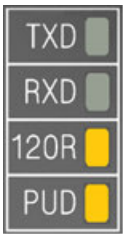
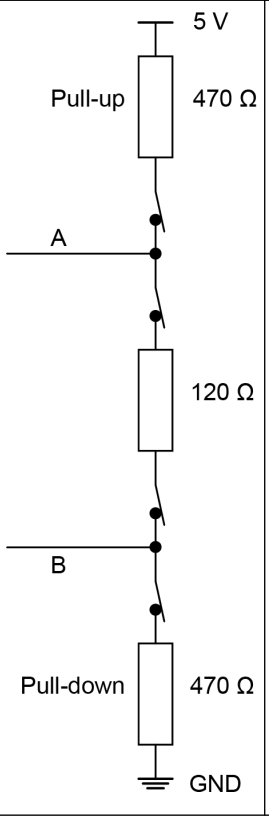
Bus termination

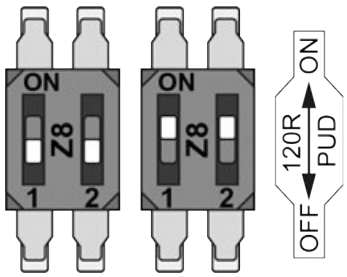
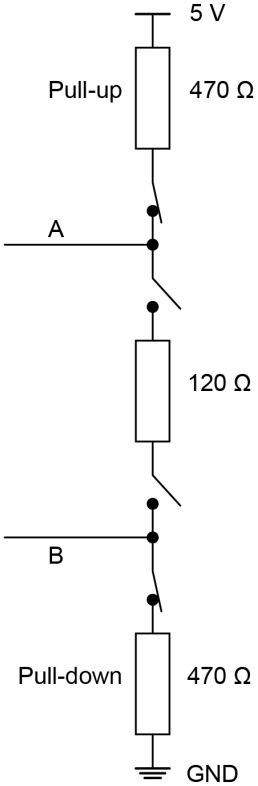
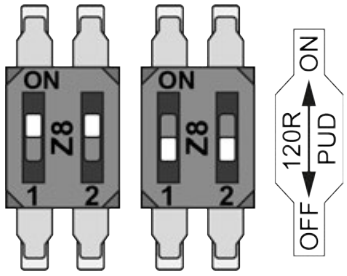
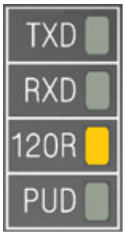
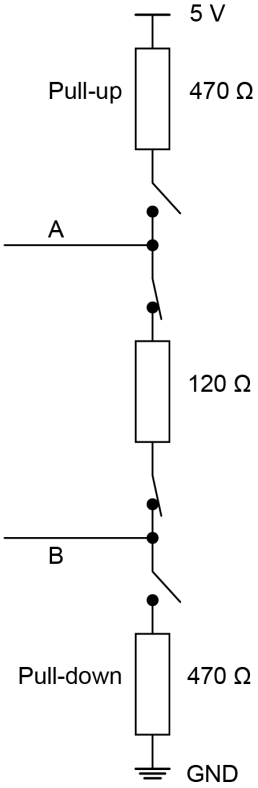
The line ends of the bus segment must be equipped with bus terminating resistors. These resistors are integrated in the module TA5142-RS485I. The pull-up and pull-down settings must also be made on the circuit board of the module.

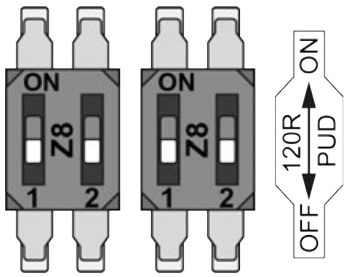
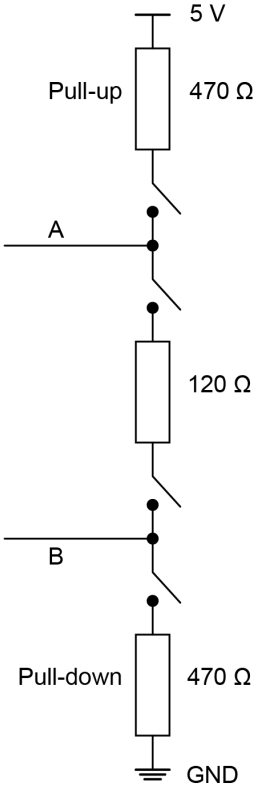


1 Termination resistance settings
2 Pull-up and pull-down settings

Table 78: Configuration

Settings on the module	State of LEDs	Internal wiring diagram	Description
			Master at the bus line end, pull-up and pull-down activated, bus termination 120 Ω

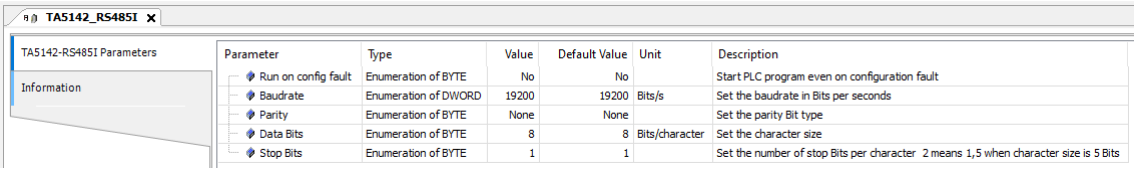
Settings on the module	State of LEDs	Internal wiring diagram	Description
			Master within the bus line, pull-up and pull-down activated
			Slave at the bus line end, bus termination 120 Ω

Settings on the module	State of LEDs	Internal wiring diagram	Description
			Slave within the bus line

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

1. In the device tree, double-click the desired option board.
2. Select the *"TA51xx Parameters"* tab to edit the parameterization of the desired option board.



State LEDs

	Signal	Color	State	Description
	TxD	Yellow	ON (blinking)	Transmitting
	RxD	Yellow	ON (blinking)	Receiving
	120R	Yellow	ON	Bus termination
	PUD	Yellow	ON	Pull-up / Pull-down

Technical data

The system data apply.

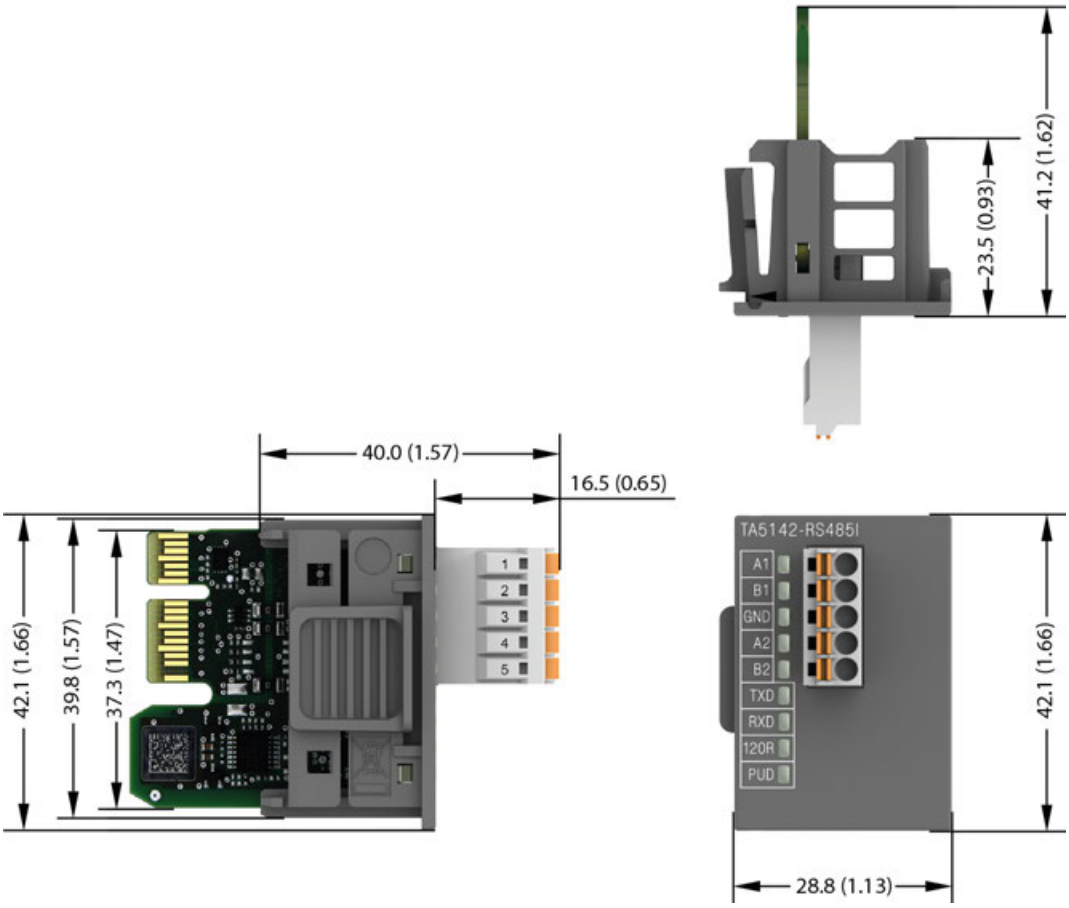
Chapter 4.1 “System data AC500-eCo” on page 25

Only additional details are therefore documented below.

Table 79: TA5142-RS485I

Parameter	Value
Protocol	Programmable with Automation Builder e.g. Modbus RTU / CAA_SerialCom via serial interfaces
Interface	Serial interface
Serial interface standard	EIA RS-485
Potential separation	Yes, from the CPU, 500 V DC
Serial interface parameters	Configurable via software
Modes of operation	Data exchange
Transmission rate	9.6 kbit/s to 115.2 kbit/s
Protocol	Programmable
Interface connector	5-pin terminal block, male
Usable CPUs	PM50xx
Internal power supply	Via internal CPU connection
Additional current consumption from 24 V DC power supply at CPU	Max. 25 mA
Weight	Ca. 16 g

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 187 300 R0002	TA5142-RS485I: AC500-eCo, RS-485 isolated option board for COMx serial communication, spring/cable front terminal, 3.50 mm pitch	Active
1SAP 187 300 R0202	TA5142-RS485IW: AC500-eCo, RS-485 isolated option board for COMx serial communication, spring/cable front terminal, 3.50 mm pitch, wide range temperature	Active
Spare parts		
1SAP 187 400 R0012 **)	TA5220-SPF5: spring terminal block, removable, 5-pin, spring front, cable front, 3.5 mm pitch, 6 pieces per packing unit	Active

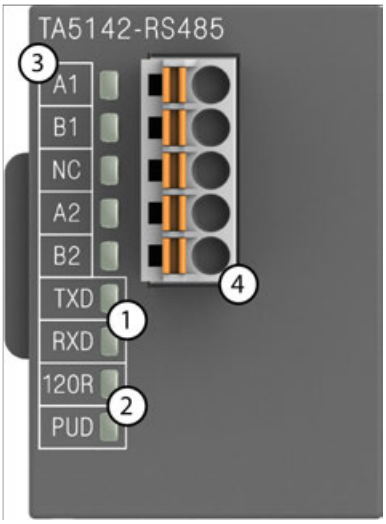
*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

**) The needed spring terminal block is always delivered with the option board.

The terminal block listed in the table is for spare part only if needed.

5.1.1.3.13 TA5142-RS485 - Option board for COMx serial communication

- W variant available for use in extended (wide) temperature range



1 2 LEDs for communication state display (TxD and RxD)
2 2 LEDs for termination state display
3 Allocation of signal name
4 5-pin terminal block for communication interface

Option boards for COMx serial communication TA5142-RS485I(W) and TA5142-RS485(W) are equipped with 1 RS-485 (2-wire half-duplex) serial interface which can be used for communication via Modbus RTU or CAA SerialCom.

Bus terminations are built-in and configurable.

*The serial interface option boards TA5141-RS232I(W), TA5142-RS485I(W) and TA5142-RS485(W) produced from 2023 can only be used from AB 2.5.2, SystemFW 3.5.0_HF-7, BootFW 3.5.1 and higher. These new produced option boards can be recognized with the Date/Code printed on the sticker or also on the product packaging, the date code looks like **2**xx**3**, where 2 and 3 are for the year and the xx for the production week.*

Using the option boards with lower versions will create a configuration error and the CPU will not start.

These new produced option boards cannot be used with lower Automation Builder Version and the CPU BootFW/FW and the application must be upgraded to AB 2.5.2 HF8 or higher. Background information on the new produced option boards is provided in an application note.

Connections

Serial interfaces

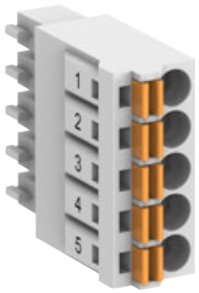
NOTICE!

Damage to the serial communication interface by using 5-pin terminal block of the TA5101-4DI!

If the 5-pin terminal block of the TA5101-4DI option board is plugged into a option board for COMx serial communication TA5141-RS232I, TA5142-RS485I or TA5142-RS485, the communication interface will be damaged by the 24 V.

Please do not confuse the 5-pin terminal block of the TA5101-4DI with the 5-pin terminal block for serial communication interface of TA5141-RS232I, TA5142-RS485I or TA5142-RS485.

Table 80: TA5142-RS485(I)

Serial interface	Pin	Signal
	1	A1 internally connected to A2
	2	B1 internally connected to B2
	3	GND
	4	A2 internally connected to A1
	5	B2 internally connected to B1

Protocols

No.	Protocol	Description
1	Modbus	Modbus RTU, master or slave
2	CAA SerialCom	Support for blocks contained in the CAA_SerialCom.lib library

Bus cable

Bus line	
Construction	2 cores, twisted, with common shield
Conductor cross section	> 0.22 mm² (24 AWG)
Twisting rate	> 10 per meter (symmetrically twisted)
Core insulation	Polyethylene (PE)
Resistance per core	< 100 Ω/km
Characteristic impedance	ca. 120 Ω (100 Ω ... 150 Ω)
Capacitance between the cores	< 55 nF/km (if higher, the max. bus length must be reduced)
Terminating resistors	120 Ω ¼ W at both line ends
Remarks	Commonly used telephone cables with PE insulation and a core diameter of > 0.8 mm are usually sufficient.
	Cables with PVC core insulation and core diameter of 0.8 mm can be used up to a length of approx. 250 m. In this case, the bus terminating resistor is approx. 100 Ω.

Cable length

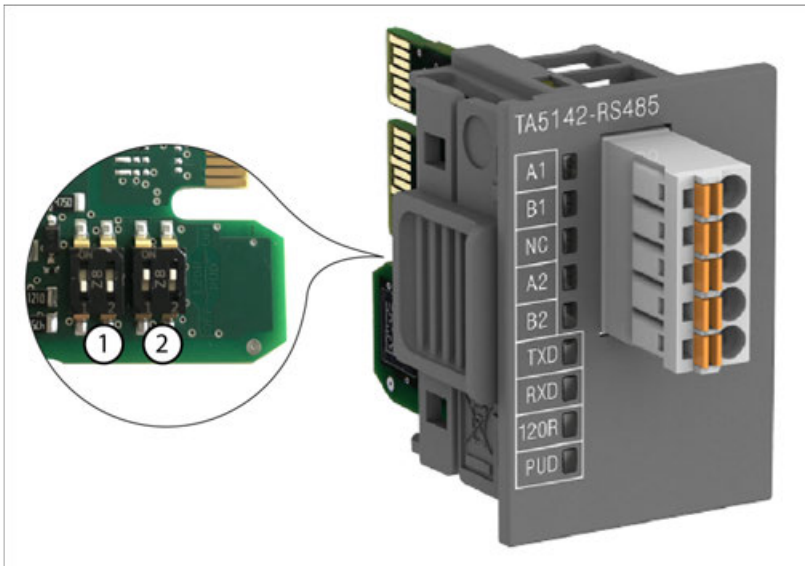
The maximum possible cable length of a serial connection subnet within a segment depends on the transmission rate.

RS-485 for point-to-point or bus connection:

Parameter	Value
Transmission rate	9.6 kbit/s to 115.2 kbit/s
Maximum cable length	On request

Bus termination

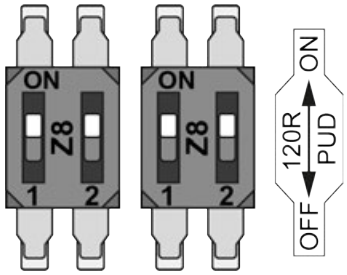
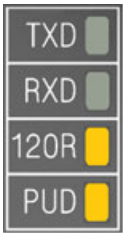
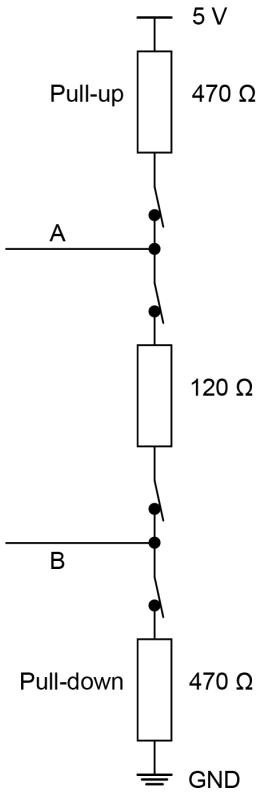
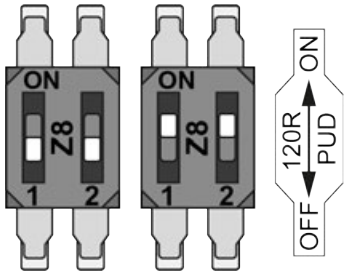
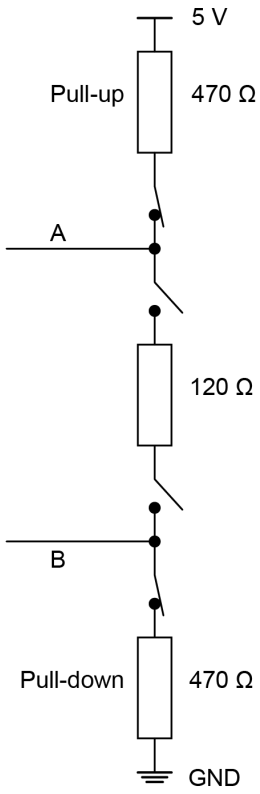
The line ends of the bus segment must be equipped with bus terminating resistors. These resistors are integrated in the module TA5142-RS485. The pull-up and pull-down settings must also be made on the circuit board of the module.

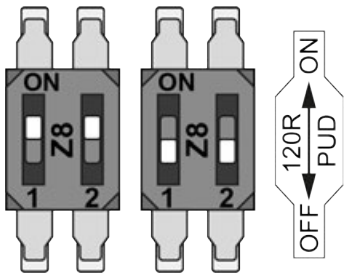
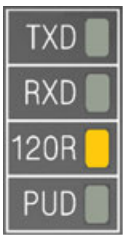
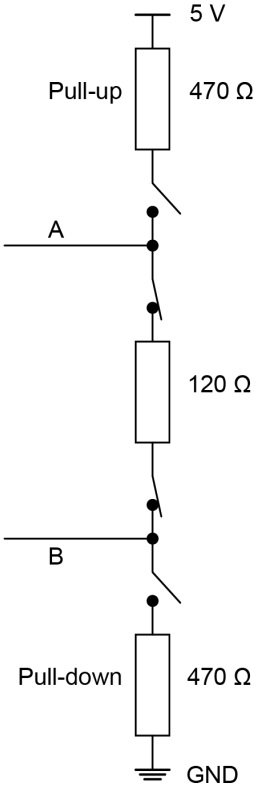
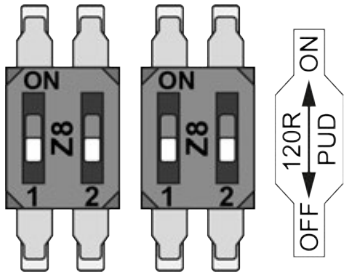
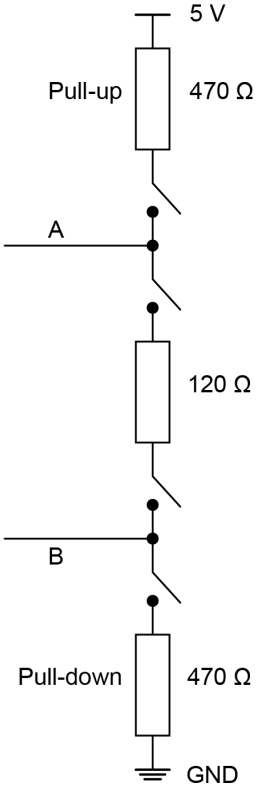


1 Termination resistance settings
2 Pull-up and pull-down settings

Avoid changing the position of the switch in the temperature range from -20°C to -40°C to prevent the switch from malfunctioning.

Table 81: Configuration

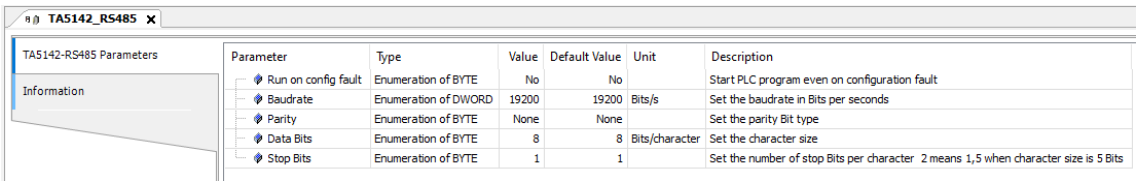
Settings on the module	State of LEDs	Internal wiring diagram	Description
			Master at the bus line end, pull-up and pull-down activated, bus termination 120 Ω
			Master within the bus line, pull-up and pull-down activated

Settings on the module	State of LEDs	Internal wiring diagram	Description
			Slave at the bus line end, bus termination 120 Ω
			Slave within the bus line

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

1. In the device tree, double-click the desired option board.
2. Select the *"TA51xx Parameters"* tab to edit the parameterization of the desired option board.



State LEDs

	Signal	Color	State	Description
	TxD	Yellow	ON (blinking)	Transmitting
	RxD	Yellow	ON (blinking)	Receiving
	120R	Yellow	ON	Bus termination
	PUD	Yellow	ON	Pull-up / Pull-down

Technical data

The system data apply.

↳ *Chapter 4.1 "System data AC500-eCo" on page 25*

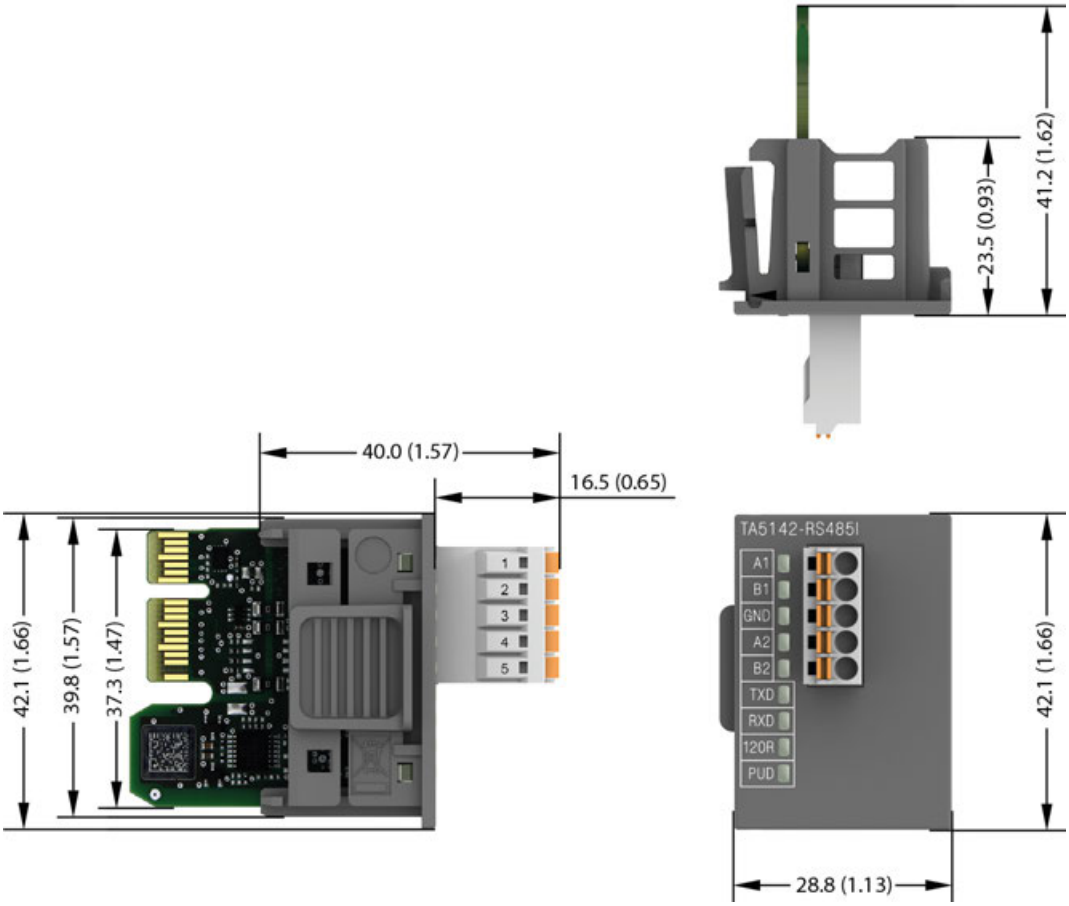
Only additional details are therefore documented below.

Table 82: TA5142-RS485

Parameter	Value
Protocol	Programmable with Automation Builder e.g. Modbus RTU / CAA_SerialCom via serial interfaces
Interface	Serial interface
Serial interface standard	EIA RS-485
Potential separation	No
Serial interface parameters	Configurable via software
Modes of operation	Programming or data exchange
Transmission rate	9.6 kbit/s to 115.2 kbit/s
Protocol	Programmable
Interface connector	5-pin terminal block, male
Usable CPUs	PM50xx
Internal power supply	Via internal CPU connection

Parameter	Value
Additional current consumption from 24 V DC power supply at CPU	Max. 25 mA
Weight	Ca. 15 g

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 187 300 R0003	TA5142-RS485: AC500-eCo, RS-485 non isolated option board for COMx serial communication, spring/cable front terminal, 3.50 mm pitch	Active
1SAP 187 300 R0203	TA5142-RS485W: AC500-eCo, RS-485 non isolated option board for COMx serial communication, spring/ cable front terminal, 3.50 mm pitch, wide range temperature	Active

Part no.	Description	Product life cycle phase *)
Spare parts		
1SAP 187 400 R0012 **)	TA5220-SPF5: spring terminal block, removable, 5-pin, spring front, cable front, 3.5 mm pitch, 6 pieces per packing unit	Active

*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

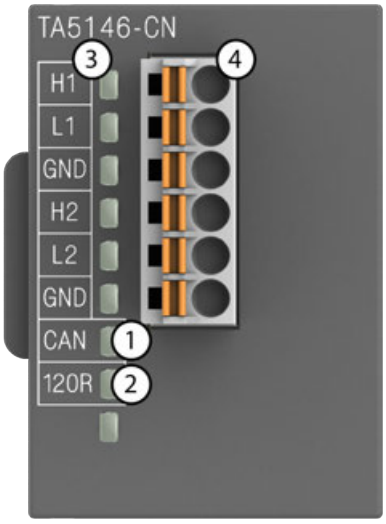
**) The needed spring terminal block is always delivered with the option board.

The terminal block listed in the table is for spare part only if needed.

5.1.1.3.14 TA5146-CN - Option board for CAN communication

Features

- W variant available for use in extended (wide) temperature range



1 1 yellow LED to display CAN activity
2 1 yellow LED to display the activation of 120 Ω termination resistor
3 Allocation of signal name
4 6-pin terminal block for CAN communication

The option board TA5146-CN can only be used from AB 2.8.0, with CPU FW 3.7.0 and higher.

Using the option boards with lower versions will create a configuration error and the CPU will not start.

The TA5146-CN(W) option board is a hardware serial interface adapter providing a CAN interface to an AC500-eCo V3 CPU.

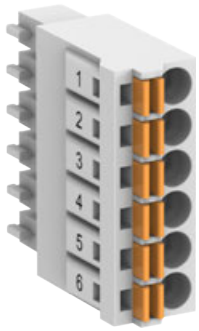
This option board is not a communication module like the CM598-CN e.g. and then the CAN onboard communication performances of the AC500-eCo V3 CPU are not comparable to the CM598-CN ones.

Depending on the AC500-eCo V3 CPU used, the CAN onboard communication performances are limited and influence the CPU load. As comparison, the CAN onboard interface of an AC500-eCo V3 PLC PM5032, PM5052 or PM5072 will have similar performances as an AC500 V3 CPU PM5630, the AC500-eCo V3 PLC PM5082 or PM5092 will be closer to the AC500 V3 PM5650 CPU.

Connections

CAN interfaces

Table 83: TA5146-CN

Terminal block for CAN	Terminal	Signal	Description
	1	H1 internally connected to H2	Bus line, receive/transmit line, HIGH
	2	L1 internally connected to L2	Bus line, receive/transmit line, LOW
	3	GND	CAN reference potential
	4	H2 internally connected to H1	Bus line, receive/transmit line, HIGH
	5	L2 internally connected to L1	Bus line, receive/transmit line, LOW
	6	GND	CAN reference potential

Protocols

AC500 V3 PLCs provide the following methods for CAN integration:

Table 84: Supported protocols on various interfaces

Protocols	Onboard CAN **)	CM598-CN(-XC) *)
CANopen master	X	X
CAN 2A/2B	X	X
J1939	X	
CI58x-CN(-XC) (CANopen slave) communication interface module as remote I/O with local I/O connected to a CANopen master	X	X

Remark:

*) only for AC500



***Onboard CAN** **) interface is available for AC500-eCo V3 CPUs PM50x2 with option board TA5146-CN(W) (except Basic CPUs). Use slot 1 or 2 only.*

Supported protocols

Onboard CAN interface supports the following protocols

- CANopen master
- CAN 2A/2B
- J1939

Configuration in Automation Builder is described in chapter 'CANopen'.

Further information can be found in chapter 'CAN onboard'.

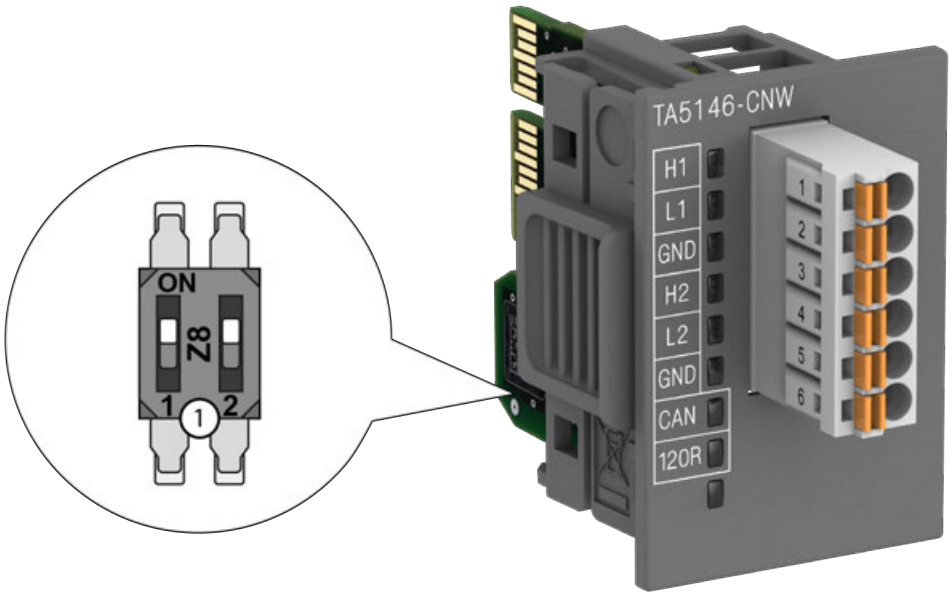
Types of bus cables

For CANopen, only bus cables with characteristics as recommended in ISO 11898 are to be used. The requirements for the bus cables depend on the length of the bus segment. Regarding this, the following recommendations are given by ISO 11898:

Length of segment [m]	**Bus cable (shielded, twisted pair)**			**Max. transmission rate [kbit/s]**
	Conductor cross section [mm²]	**Line resistance [Ω/km]**	**Wave impedance [Ω]**	
0...40	0.25 ... 0.34 / AWG23, AWG22	70	120	1000 at 40 m
40...300	0.34 ... 0.60 / AWG22, AWG20	< 60	120	< 500 at 100 m
300...600	0.50 ... 0.60 / AWG20	< 40	120	< 100 at 500 m
600...1000	0.75 ... 0.80 / AWG18	< 26	120	< 50 at 1000 m

Bus termination

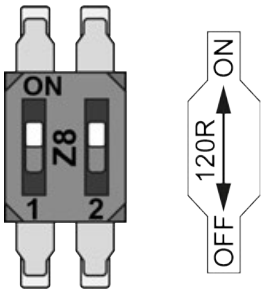
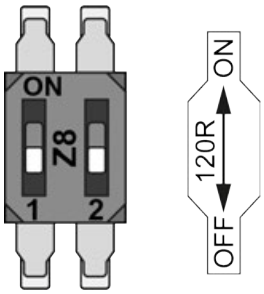
The ends of the data lines have to be terminated with a 120 Ω bus terminating resistor. The bus terminating resistor is usually installed directly at the bus connector.



1 Termination resistance settings

Position 1 of the DIP switch activates/deactivates the 120 Ω termination resistor. The position 2 turns ON/OFF the 120R LED

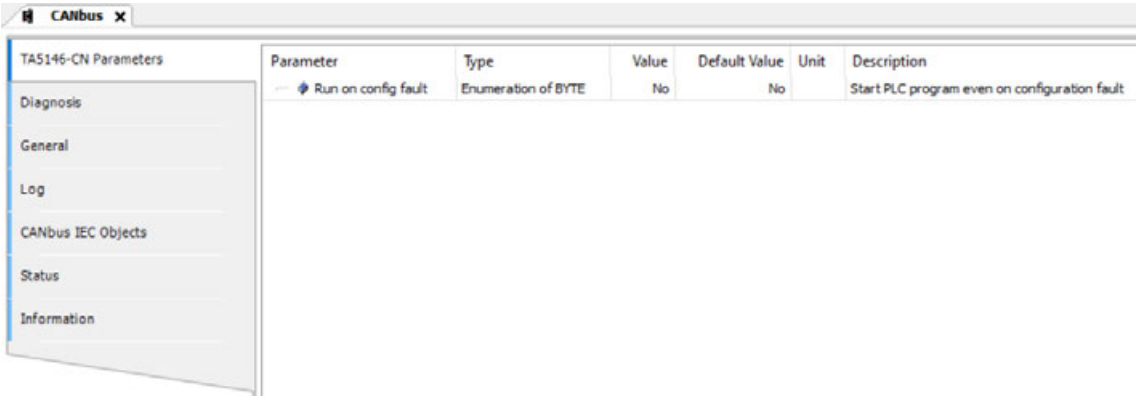
Table 85: Configuration

Settings on the module	State of LEDs	Description
		Bus termination 120 Ω is activated (Position 1 is ON). Termination LED - 120R is turned ON (Position 2)
		Bus termination 120 Ω is deactivated (Position 1 is OFF). Termination LED - 120R is turned OFF (Position 2)

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

1. In the device tree, double-click the desired option board.
2. Select the *"TA51xx Parameters"* tab to edit the parameterization of the desired option board.



State LEDs

	Signal	Color	State	Description
	CAN	Yellow	ON (blinking)	Transmitting/Receiving
	120R	Yellow	ON	Bus termination

Technical data

The system data apply.

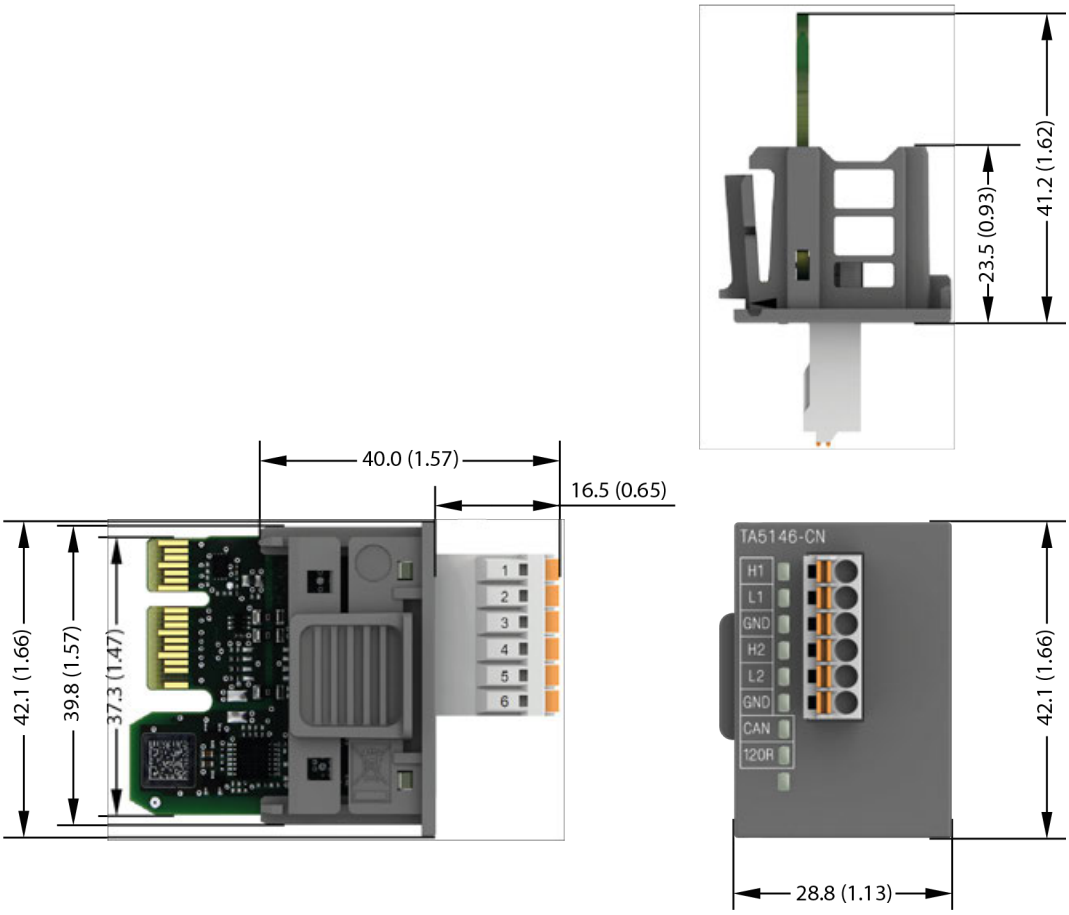
Chapter 4.1 “System data AC500-eCo” on page 25

Only additional details are therefore documented below.

Table 86: TA5146-CN

Parameter	Value
Protocol	CANopen, CAN 2A/2B, J1939
Interface	CAN interface
Serial interface standard	CAN
Potential separation	Yes, from the CPU, 500 V DC
Serial interface parameters	Configurable via software
Modes of operation	Data exchange
Transmission rate	10 kbit/s to 1 Mbit/s
Protocol	Programmable
Interface connector	6-pin terminal block, male
Usable CPUs	PM50xx
Internal power supply	Via internal CPU connection
Additional current consumption from 24 V DC power supply at CPU	Max. 25 mA
Weight	Ca. 16 g

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 187 300 R0005	TA5146-CN: AC500-eCo, CAN isolated option board for COMx serial communication, spring/cable front terminal, 3.50 mm pitch	Active
1SAP 187 300 R0205	TA5146-CNW: AC500-eCo, CAN isolated option board for COMx serial communication, spring/cable front terminal, 3.50 mm pitch, wide range temperature	Active
Spare parts		
1SAP 187 400 R0013 **)	TA5220-SPF6: spring terminal block, removable, 6-pin, spring front, cable front, 6 pieces per packing unit	Active

*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

**) The needed spring terminal block is always delivered with the option board.

The terminal block listed in the table is for spare part only if needed.

5.1.1.3.15 FAQs

Frequently asked and important questions about the option boards for serial communication from 2023 are collected and answered in an *application note*.

5.1.2 AC500 and AC500-XC

5.1.2.1 Product overview and comparison

5.1.2.1.1 Comparison of AC500 terminal bases

With the latest Automation Builder version the following terminal bases are compatible with the AC500 processor modules:

Table 87: Terminal base compatibility

	PM5630	PM5650	PM5670	PM5675	PM5680	PM5685
TB5600-2ETH	x	x	x	x	x	x
TB5610-2ETH	x	x	x	x	x	x
TB5620-2ETH	x	x	x	x	x	x
TB5640-2ETH		x	x	x	x	x
TB5660-2ETH			x	x		x

The number of slots that are available on a terminal base for connecting communication modules or AC500-S modules differs within the terminal base range.

Table 88: Combination of TB56xx-2ETH(-XC) and PM56xx(-XC)

Processor module	PM5630	PM5650	PM5670	PM5675	PM5680 [2)]	PM5685 [2)]
TB5600-2ETH	0 slot	0 slot	0 slot	0 slot	0 slot	0 slot
TB5610-2ETH	1 slot	1 slot	1 slot	1 slot	1 slot	1 slot
TB5620-2ETH	2 slots	2 slots	2 slots	2 slots	2 slots	2 slots
TB5640-2ETH	-	4 slots	4 slots	4 slots	4 slots	4 slots

Processor module	PM5630	PM5650	PM5670	PM5675	PM5680 [2]	PM5685 [2]
TB5660-2ETH	-	-	6 slots [1]	6 slots [1]	-	6 slots

Remarks:

The slots can be used for connecting communication modules or AC500-S modules. Note that only one AC500-S module can be connected at one terminal base.

[1] PM567x must have the order numbers 1SAP151000R0378, 1SAP151500R0378 or a production index ≥ C0.

[2] XC variant is not applicable.

Supported devices

The AC500 terminal bases can be equipped with the following supported devices:

Table 89: Comparison: TB56xx

Processor module		PM5630	PM5650	PM5670	PM5675	PM5680	PM5685
Max. number of variables allowed for each communication module supported							
	Input variables	4 kB	4 kB	5 kB	5 kB	5 kB	5 kB
	Output variables	4 kB	4 kB	5 kB	5 kB	5 kB	5 kB
Type of communication module supported							
	CM5610-2RS - 2 serial interfaces	x	x	x	x	x	x
	CM582-DP - PROFIBUS DP V0/V1 slave	x	x	x	x	x	x
	CM592-DP - PROFIBUS DP V0/V1 master	x	x	x	x	x	x
	CM579-ETHCAT - EtherCAT master	x	x	x	x	x	x
	CM579-PNIO - PROFINET IO RT controller	x	x	x	x	x	x
	CM589-PNIO - PROFINET IO RT device	x	x	x	x	x	x
	CM589-PNIO-4 - PROFINET IO RT with 4 devices	x	x	x	x	x	x
	CM5640-2ETH - 2 Ethernet interfaces	x	x	x	x	x	x
	CM598-CN - CAN, CANopen master	x	x	x	x	x	x
Type of AC500-S module supported							
	SM560-S - safety module	x	x	x	x	x	x
	SM560-S-FD-1 - safety module with F-Device functionality for 1 PROFIsafe network	x	x	x	x	x	x
	SM560-S -FD-4 - safety module with F-Device functionality for 1 PROFIsafe network	x	x	x	x	x	x

Memory size and performance

Table 90: Comparison: PM56xx

Processor module		PM5630	PM5650	PM5670	PM5675	PM5680	PM5685
Total maximum downloadable application size [1)]		9 MB	84 MB	176 MB	176 MB	176 MB	320 MB
	Thereof user program code and data (dynamically allocated)	2 MB	8 MB	32 MB	32 MB	32 MB	64 MB
	Thereof user webserver data max.	6 MB	72 MB	128 MB	128 MB	128 MB	256 MB
Flash memory for User data							
	Remaining for all other usage (project save, infrastructure...)	40 MB	380 MB	850 MB	850 MB	850 MB	850 MB
	Buffered (SRAM)	256 kB	256 kB	1.5 MB	1.5 MB	1.5 MB	1.5 MB
	Thereof VAR retain persistent	128 kB	128 kB	1024 kB	1024 kB	1024 kB	1024 kB
	Thereof %M memory (e.g. Modbus register)	128 kB	128 kB	512 kB	512 kB	512 kB	512 kB
Expandable memory		None	None	None	None	None	None
Integrated mass storage memory (FLASH)		None	None	None	8 GB	None	None
Slot for pluggable memory card		x	x	x	x	x	x
Processor type		TI ARM Cortex-A9 32-bit-RISC				Multi-Core ARM Cortex-A53 64-bit	
Processor clock speed		300 MHz	600 MHz	1 GHz	1 GHz	1 GHz	1 GHz
Cycle time for 1 instruction (minimum):							
	Binary	Min. 0.02 µs	Min. 0.01 µs	Min. 0.002 µs	Min. 0.002 µs	Min. 0.002 µs	Min. 0.002 µs
	Word	Min. 0.02 µs	Min. 0.01 µs	Min. 0.002 µs	Min. 0.002 µs	Min. 0.002 µs	Min. 0.002 µs
	Floating point	Min. 0.12 µs	Min. 0.01 µs	Min. 0.002 µs	Min. 0.002 µs	Min. 0.002 µs	Min. 0.002 µs
	Mathematic co-processor	x	x	x	x	x	x
Motion capability							
	No. synchronized axis per 1 ms on EtherCAT CM typically	-	8*	16*	16*	16*	16*
	No. synchronized axis per 2 ms on EtherCAT CM typically	4*	16*	32*	32*	32*	32*
	No. synchronized axis per 4 ms on EtherCAT CM or CANopen onboard typically	8*	32*	64*	64*	64*	64*
	Min. bus cycle time for EtherCAT using external CM579	2 ms	1 ms	0,5 ms	0,5 ms	0,5 ms	0,5 ms
* in addition: 1 virtual axis							
Max. number of central inputs and outputs (10 exp. modules):							
	Digital inputs	320					
	Digital outputs	320					

Processor module		PM5630	PM5650	PM5670	PM5675	PM5680	PM5685
	Analog inputs	160					
	Analog outputs	160					
Number of decentralized inputs and outputs		Depends on the used fieldbus					
Data backup		Battery					
Data buffering time at 25 °C		Typ. 3 years					
Battery low indication		via application program					
Real-time clock:							
	With battery backup	x					
	Accuracy	Typ. ± 2 s / day at +25 °C					
Program execution:							
	Cyclic	x					
	Time-controlled	x					
	Multitasking	x					
	Minimum cycle time configurable for cyclical task	1 ms	1 ms	0,5 ms	0,5 ms	0,5 ms	0,5 ms
User program protection by password		x (user management)					
Internal interfaces for communication:							
Serial interface COM1:							
	Physical link	Configurable for RS-232 or RS-485 (9.6 kb/s, 19.2 kb/s, 38.4 kb/s, 57.6 kb/s and 115.2 kb/s)					
	Connection	Pluggable terminal block, spring connection					
	Usage	Serial ASCII communication,Modbus RTU					
CAN interface:							
	Physical link	CAN 2A/2B (from 50 kb/s to 1 Mb/s)					
	Connection	Pluggable terminal block, spring connection					
	Usage	CANopen master communication, CAN 2A/2B, J1939 protocol, CAN sync					
	Max. number of variables allowed						
	Input variables	2 kB	4 kB	5 kB	5 kB	5 kB	5 kB
	Output variables	2 kB	4 kB	5 kB	5 kB	5 kB	5 kB
Network interface ETH1, ETH2:							
	Usage	Ethernet					
	Physical link	10/100 base-TX, configurable as internal switch or independent Interfaces					
	Connection	2x RJ45 socket, provided on TB56xx-2ETH					
LEDs, LCD display, function keys		RUN / STOP, status, diagnosis, settings					
Number of timers		Unlimited					
Number of counters		Unlimited					
Programming languages:							

Processor module		PM5630	PM5650	PM5670	PM5675	PM5680	PM5685
	Structured Text ST	x					
	Instruction list IL	x					
	Function Block Diagram FBD	x					
	Ladder Diagram LD	x					
	Sequential function chart SFC	x					
	Continuous function chart (CFC)	x					

Remarks:

1) The values are for information only and cannot be fulfilled altogether. The available resources are limited at the end by the maximal downloadable application size for each CPU.

5.1.2.1.2 Comparison of features and protocols

Communication and onboard protocols

Table 91: OPC UA server / OPC DA server

Processor module		PM5630	PM5650	PM5670	PM5675	PM5680	PM5685
OPC UA server[1)]		x	x	x	x	x	x
	Number of free tags	3.000	10.000	30.000	30.000	30.000	60.000
	Number of connections	10	20	50	50	50	100
	Min. sampling rate (limit)	500 ms	100 ms	50 ms	50 ms	50 ms	50 ms
OPC DA server AE		x	x	x	x	x	x
	Number of connections	8	8	8	8	8	8

Remarks:

1) Maximum number of free tags using arrays.

Table 92: Modbus, Telecontrol

Processor module		PM5630	PM5650	PM5670	PM5675	PM5680	PM5685
Modbus TCP client / server		x	x	x	x	x	x
	Number of Modbus clients ModMast in parallel on a CPU master (server)	30	50	120	120	120	300
	Number of Modbus server in parallel (e.g. for SCADA access)	15	25	50	50	50	250
IEC 60870-5-104 telecontrol protocol		x	x	x	x	-	x
	Number of free tags	1.000	5.000	10.000	10.000	-	20.000
	Control station (number of connections)	5	10	20	20	-	40
	Sub-station (number of connections)	5	10	20	20	-	40

5.1.2.1.3 Ethernet protocols and ports for AC500 processor modules

General

The communication module CM5640-2ETH acts as a port extender of the used processor module.

It is not offloading the CPU for the protocols.

- The stacks are still executed in CPU.
- The performance is slightly lower or the load is slightly higher than directly from the main CPU, because each communication module and the communication module bus must also be handled.

Each CM5640-2ETH provides the following:

- 2 additional independent onboard Ethernet interfaces controlled by the CPU and not switched.
- All Ethernet ports, wherever located - on the communication module or on the CPU - must be in different subnets.

  Addressing is not done via slot numbers but via IP addresses.

The Ethernet limitations of the CPU used together with CM5640-2ETH apply to all onboard and additional interfaces.



All interfaces of the onboard and CM5640-2ETH modules need to be in different subnets. Overlapping of subnets must be avoided. The selection of the used interface (ETH port) is done automatically according the match of the IP-address of the server and the subnet of the interfaces.



AC500 V3 supports only one active Gateway for all Ethernet interfaces.

Description	≥CPU firmware	PM5630-2ETH	PM5650-2ETH	PM5670-2ETH	PM5675-2ETH	≥ CPU firmware	CM5640-2ETH	≥CPU firmware	PM5680-2ETH	PM5685-2ETH
ABB netConfig	V3.0.0	x	x	x	x	V3.6.0	x	V3.8.0	x	x
Online access with driver 3S TCP/IP BlkDrvTcp	V3.0.0	x	x	x	x	V3.6.0	x	V3.8.0	x	x
Modbus TCP server	V3.0.3	x	x	x	x	V3.6.0	x	V3.8.0	x	x
Modbus TCP client with POU ModTcpMast	V3.0.1	x	x	x	x	V3.6.0	x	V3.8.0	x	x
UDP out of user program with library netBaseService.lib	V3.0.0	x	x	x	x	V3.6.0	x	V3.8.0	x	x
UDP data exchange, Network variables	V3.0.0	x	x	x	x	V3.6.0	x	V3.8.0	x	x
TCP/IP out of user program with library netBaseService.lib	V3.0.0	x	x	x	x	V3.6.0	x	V3.8.0	x	x

Description	≥CPU firmware	PM5630-2ETH	PM5650-2ETH	PM5670-2ETH	PM5675-2ETH	≥ CPU firmware	CM5640-2ETH	≥CPU firmware	PM5680-2ETH	PM5685-2ETH
Web server on PLC with web visualization	V3.0.0	x	x	x	x	V3.6.0	x	V3.8.0	x	x
NTP/SNTP ((Simple) Network Time Protocol) client with 3S licenced store package SNTPService.package. Library container: SNTPService	V3.0.0	x	x	x	x	V3.6.0	x	V3.8.0	x	x
IEC60870-5-104 control station incl. 2nd connection and 2nd port	V3.0.0	x	x	x	x	V3.6.0	x	V3.8.0		x
IEC60870-5-104 substation incl. 2nd port	V3.0.0	x	x	x	x	V3.6.0	x	V3.8.0		x
FTP server	V3.0.0	x	x	x	x	V3.6.0	x	V3.8.0	x	x
CODESYS network variables	V3.0.0	x	x	x	x	V3.6.0	x	V3.8.0	x	x
OPC DA server	V3.0.0	x	x	x	x	V3.6.0	x	V3.8.0	x	x
OPC UA server	V3.0.0	x	x	x	x	V3.6.0	x	V3.8.0	x	x
ICMP – ping out of user project with POU *ETHx_ICMP_PING*	V3.0.0	x	x	x	x	V3.6.0	x	V3.8.0	x	x
DHCP client	V3.1.0	x	x	x	x	V3.6.0	x	V3.8.0	x	x
NTP/SNTP ((Simple) Network Time Protocol) client system solution	V3.1.0	x	x	x	x	V3.6.0	x	V3.8.0	x	x
NTP/SNTP ((Simple) Network Time Protocol) server system solution	V3.1.0	x	x	x	x	V3.6.0	x	V3.8.0	x	x

Description	≥CPU firmware	PM5630-2ETH	PM5650-2ETH	PM5670-2ETH	PM5675-2ETH	≥ CPU firmware	CM5640-2ETH	≥CPU firmware	PM5680-2ETH	PM5685-2ETH
Maximum number of Input/output allowed variable on Ethernet for the protocol	V3.4.0	2 kB/ 2 kB	4 kB/ 4 kB	5 kB/ 5 kB	5 kB/ 5 kB	V3.6.0	Depends on used CPU	V3.8.0	5 kB/ 5 kB	5 kB/ 5 kB
IEC 61850 (MMS server, GOOSE) 2)	V3.1.0	x	x	x	x	V3.6.0	x	V3.8.0		x
EthernetIP Scanner 1), 2)	AB 2.4.1/ FW 3.4.1	x	x	x	x	AB 2.6.0/ FW 3.6.0		V3.8.0	x	x
EthernetIP Adapter 1), 2)	AB 2.4.1/ FW 3.4.1	x	x	x	x	AB 2.6.0/ FW 3.6.0	x	V3.8.0	x	x
KNX - Building communication 2)	V3.2.x	x	x	x	x	V3.6.0	x	V3.8.0		x
BACnet-BC - Infrastructure communication 2)	V3.3.1	x	x	x	x	V3.6.0	x	V3.8.0		x
HTTPS – secure web server on PLC with CODESYS web visualization	V3.1.0	x	x	x	x	V3.6.0	x	V3.8.0	x	x
WebVisu for data visualisation on web server HTML5	V3.0.0	x	x	x	x	V3.6.0	x	V3.8.0	x	x
FTPS – secure FTP	V3.1.0	x	x	x	x	V3.6.0	x	V3.8.0	x	x
Secure online access with driver 3S UDP BlkDrvUdp	V3.1.0	x	x	x	x	V3.6.0	x	V3.8.0	x	x
Secure online access with driver 3S TCP/IP BlkDrvTcp	V3.1.0	x	x	x	x	V3.6.0	x	V3.8.0	x	x

Description	≥CPU firm-ware	PM5630 -2ETH	PM5650 -2ETH	PM5670 -2ETH	PM5675 -2ETH	≥ CPU firm-ware	CM5640-2ETH	≥CPU firm-ware	PM5680 -2ETH	PM5685 -2ETH
ICMP – ping out of user project with POU ETHx_ICMP_PING or EthIcmpPing (PLCopen style)	V3.1.0	x	x	x	x	V3.6.0	x	V3.8.0	x	x
Modbus TCP client (master) with ModTcpMast (PLCopen style)	V3.1.0	x	x	x	x	V3.6.0	x	V3.8.0	x	x
DNP3 Outstation	V3.7.0	x	x	x	x	V3.7.0		V3.8.0		x
SysLog client	V3.8.1	x	x	x	x	V3.8.1	x	V3.8.0	x	x
PRP (Paralell Reduncancy Protocol)						V3.8.1	x			
Remarks: [1] in preparation [2] feature is licensed										

Default open Ethernet ports of PM56xx-2ETH

After startup without a PLC project the PM56xx-2ETH contains the following Ethernet ports and sockets:

Protocol	Port
ABB NetConfig [1]	UDP 24576
Online access with driver 3S Tcp/Ip BlkDrvTcp (no scan) [3]	TCP 11740
OPC UA server [2]	TCP 4840
DNP3	20000
Remarks: [1] The port 24576 for ABB NetConfig protocol can be disabled via PLC configuration by deleting the protocol node from configuration tree of Ethernet interfaces ETH1 and ETH2. [2] The port 4840 for OPC UA server is closed by default as of SystemFW V3.6.0. [3] The port for Online Access Protocol can be disabled, for details see .	

All other ports are closed by default.

Overview of protocols, sockets and ports

Protocol	Port	Sockets
ABB netConfig	24576	1 permanent socket per interface
3S gateway client (e.g. CODESYS) to gateway server	1217	1 permanent socket
Online access with driver 3S block driver TCP/IP (no scan) (Online access - multi download tool)	11740	1 socket per connection + 1 listen
Modbus TCP server	502 or configurable	1 socket listen + 1 socket per server connection, number of server connections is configurable in AB
Modbus TCP client with POU *ModTcpMast*	Random	1 socket per connection with POU *ModTcpMast*
UDP out of user program with library SysLibSockets.lib	1 ... 65535	1 socket per connection
TCP/IP out of user program with library SysLibSockets.lib	1 ... 65535	1 socket per connection
Web server on PLC with web visualization	80	1 listen and 1 per connection
NTP/SNTP client	123	1 permanent socket
IEC60870-5-104 control station	Random	1 per connection
IEC60870-5-104 substation	2404	1 per connection
FTP server (TCP ports - multi download tool)	Command port = 21 Data active mode = 20 Data passive mode = random	1 per session, max. 4 allowed
CODESYS network variables	1202	(UDP broadcast)
OPC DA server (default 3S block driver)	UDP = 1740 or TCP/IP =11740	1 socket per connection
OPC UA server	4840	1 permanent socket
ICMP – ping out of user project with POU ETHx_ICMP_PING DHCP	none	No socket
DHCP	67	1 socket during startup
NTP/SNTP ((Simple) Network Time Protocol) client system solution	123	1 permanent socket
NTP/SNTP ((Simple) Network Time Protocol) server system solution	123	1 permanent socket
HTTPS – secure web server on PLC with CODESYS web visualization	443	1 listen and 1 per connection

Protocol	Port	Sockets
FTPS – secure FTP	Command port = 21 Data active mode = 20 Data passive mode = random	1 per session, max. 4 allowed
Secure online access with driver 3S TCP/IP BlkDrvTcp	11740	1 socket per connection + 1 listen
ICMP – ping out of user project with POU *ETHx_ICMP_PING* or EthIcmpPing (PLCopen style)	None	No socket
Modbus TCP client (master) with POU *ModTcpMast* (PLCopen style)	Random	1 socket per connection with POU *ModTcpMast*
DNP3 Outstation	20000	1 socket per connection
SysLog client	Random	1 socket when Syslog client is configured.

Limitation of connections per protocol

The limitation for each CPU apply to all onboard Ethernet interfaces either directly on the CPU itself or also on all CM5640-2ETH interfaces that are added to this CPU.

Protocol	PM5630-2ETH	PM5650-2ETH	PM5670-2ETH	PM5675-2ETH	PM5680-2ETH	PM5685-2ETH	≥ CPU firmware
Modbus TCP server (e.g. for SCADA access)	30	100	100	100	n/a	n/a	3.0.3
	40	40	40	40	n/a	n/a	3.1.0
	15	25	50	50	n/a	n/a	3.1.3
	15	25	50	50	50	250	3.8.0
Modbus TCP client with POU *Mod-TcpMast* (PLCopen style)	30	100	100	100	n/a	n/a	3.1.0
	30	50	120	120	n/a	n/a	3.1.3
	30	50	120	120	120	300	3.8.0
IEC60870-5-104 control station incl. 2nd connection and 2nd port	10	10	10	10	n/a	n/a	3.1.0
	5	10	20	20	n/a	n/a	3.4.0
	5	10	20	20	n/a	40	3.8.0
IEC60870-5-104 substation incl. 2nd port	10	10	10	10	n/a	n/a	3.1.0
	5	10	20	20	n/a	n/a	3.4.0
	5	10	20	20	n/a	40	3.8.0
IEC60870-5-104: No. of free tags	1.000	5.000	10.000	10.000	n/a	n/a	3.4.0
	1.000	5.000	10.000	10.000	n/a	20.000	3.8.0
FTP server	4	4	4	4	n/a	n/a	3.1.0
	4	4	4	4	4	4	3.8.0

Protocol		PM5630-2ETH	PM5650-2ETH	PM5670-2ETH	PM5675-2ETH	PM5680-2ETH	PM5685-2ETH	≥ CPU firmware
Online access with driver 3S TCP/IP BlkDrvTcp		n/a 8 8	4 8 8	n/a 8 8	n/a 8 8	n/a n/a 8	n/a n/a 8	3.0.0 3.1.0 3.8.0
OPC DA server (number of connections)		n/a 8 8	4 8 8	n/a 8 8	n/a 8 8	n/a n/a 8	n/a n/a 8	3.0.0 3.1.0 3.8.0
OPC UA server (number of connections) [2]		50 10 10	50 20 20	50 50 50	50 50 50	n/a n/a 50	n/a n/a 100	3.1.0 3.4.0 3.8.0
	No. of free tags + additional license for extension [1]	3.000 3.000	10.000 10.000	30.000 30.000	30.000 30.000	n/a 30.000	n/a 60.000	3.4.0 3.8.0
	min sampling rate (limit)	500 ms 500 ms	100 ms 100 ms	50 ms 50 ms	50 ms 50 ms	n/a 50 ms	n/a 50 ms	3.4.0 3.8.0
Secure online access with driver 3S TCP/IP BlkDrvTcp		8 8	8 8	8 8	8 8	n/a 8	n/a 8	3.1.0 3.8.0
FTPS - secure FTP server		4 4	4 4	4 4	4 4	n/a 4	n/a 4	3.1.0 3.8.0
HTTPS – Integrated webserver – number of connections		4 4	8 8	12 12	12 12	n/a 12	n/a 12	3.4.0 3.8.0
Ethernet/IP Maximum number of Input/Output		0.5 kB/ 0.5 kB 0.5 kB/ 0.5 kB	0.5 kB/ 0.5 kB 0.5 kB/ 0.5 kB	0.5 kB/ 0.5 kB 0.5 kB/ 0.5 kB	0.5 kB/ 0.5 kB 0.5 kB/ 0.5 kB	n/a 0.5 kB/ 0.5 kB	n/a 0.5 kB/ 0.5 kB	3.4.1 3.8.0
	DNP3 Outstation Number of tags	1000 10000	3000 3000	10000 10000	10000 10000	n/a n/a	n/a 15000	V3.7.0 3.8.0
	Number of clients	8 8	8 8	8 8	8 8	n/a n/a	n/a 8	V3.7.0 3.8.0
	Maximum number of events buffering	200000 200000	350000 350000	800000 800000	800000 800000	n/a n/a	n/a 800000	V3.7.0 3.8.0

Remarks:

[1] The feature can be enabled via PLC configuration.

[2] Maximum number of free tags using arrays.



The PLC types PM5630-2ETH, PM5670-2ETH and PM5675-2ETH are available as of SystemFW 3.1.0.

Default Ethernet configuration

Module	IP Address	Netmask	Comment
PM5xx2-x-ETH	ETH: 192.168.0.10	255.255.255.0	
PM50x2-T-2ETH	ETH1: 192.168.0.10 ETH2: 192.168.1.10	255.255.255.0	The Ethernet ports must be configured in different sub networks.
PM56xx-2ETH	ETH1: 192.168.0.10 ETH2: 192.168.1.10	255.255.255.0	The Ethernet ports must be configured in different sub networks.
CM5640-2ETH	SLOT1: 192.168.11.10, 192.168.12.10 SLOT2: 192.168.21.10, 192.168.22.10 ...	255.255.255.0	The Ethernet ports must be configured in different sub networks.

Online access

3S TCP/IP block driver.

This driver requires at least 2 sockets:

- 1x driver “BlkDrvTcp” on port 11740
- 1x listen on port 11740 if PLC has established online connection



Online access can be established from:

- *Automation Builder command 'Login'.*
- *CODESYS OPC DA server.*
- *Panel CP600 series.*

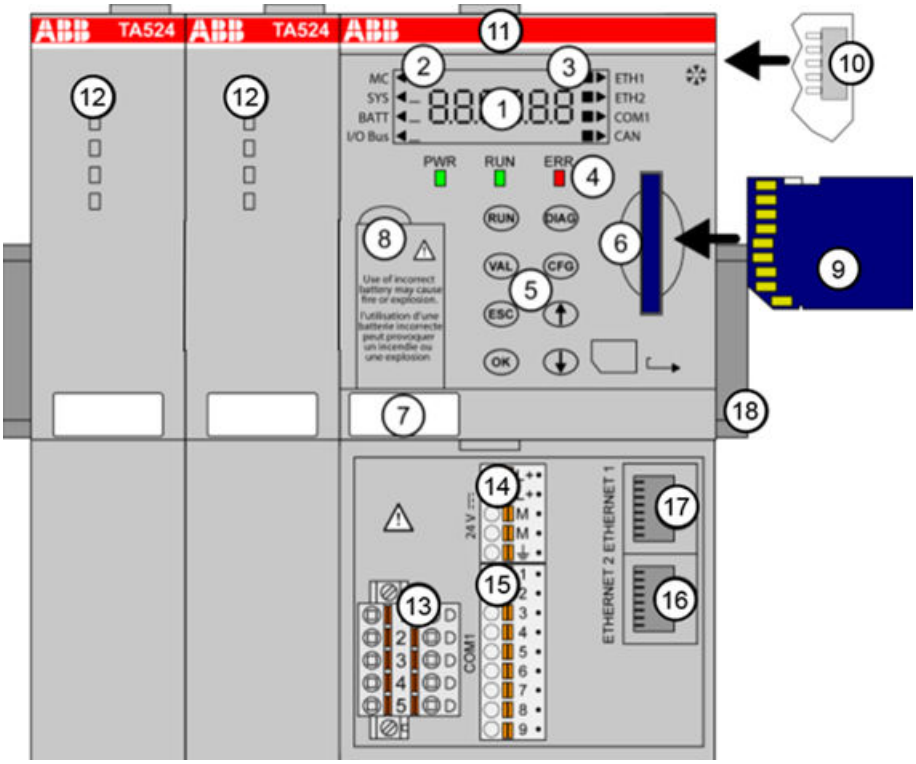
Each established connection needs one socket. In addition one socket on port 11740 is listening.

1. Startup the PLC.
   ⇨ One socket on port 11740 (listen).
2. Login from Automation Builder via driver “BlKDrvTcp”.
   ⇨ 2 sockets on port 11740 (1x online, 1x listen)
3. Additional login out of OPC server with the same driver.
   ⇨ 3 sockets on port 11740 (2x online, 1x listen)
4. Additional connect CP600 via driver “BlkDrvTcp”.
   ⇨ 4 sockets on port 11740 (3x online, 1x listen)

5.1.2.2 PM5630, PM5650, PM5670, PM5675, PM5680, PM5685

Processor modules with onboard interfaces:

- PM5630-2ETH: processor module, memory 8 MB, with Ethernet support (onboard Ethernet) – 2 network interfaces RJ45, CAN and COM1 on the terminal base.
- PM5650-2ETH: processor module, memory 80 MB, with Ethernet support (onboard Ethernet) – 2 network interfaces RJ45, CAN and COM1 on the terminal base.
- PM5670-2ETH: processor module, memory 160 MB, with Ethernet support (onboard Ethernet) – 2 network interfaces RJ45, CAN and COM1 on the terminal base.
- PM5675-2ETH: processor module, 160 MB, 8 GB flash disk, with Ethernet support (onboard Ethernet) – 2 network interfaces RJ45, CAN and COM1 on the terminal base.
- PM5680-2ETH: processor module, 160 MB, with Ethernet support (onboard Ethernet) – 2 network interfaces RJ45, CAN and COM1 on the terminal base.
- PM5685-2ETH: processor module, 320 MB, with Ethernet support (onboard Ethernet) – 2 network interfaces RJ45, CAN and COM1 on the terminal base.
- XC version for use in extreme ambient conditions available



1 6 7-segment state displays with backlight
2 "Triangle" displays for "item"
3 "Square" displays for "state"
4 3 state LEDs
5 8 function keys
6 Slot for memory card
7 Label
8 Compartment for TA521 - adapter cable with button cell or TA522 - adapter for CR2450 battery
9 Memory card
10 I/O bus for connection of I/O modules
11 Slot for processor module (processor module mounted on terminal base)
12 Slots for communication modules (multiple, depending on terminal base; unused slots must be covered with TA524)
13 Interface for CAN (5-pin terminal block, removable)
14 Power supply (5-pin terminal block, removable)
15 Serial interface COM1 (9-pin terminal block, removable)
16 RJ45 female connector for ETHERNET1 connection
17 RJ45 female connector for ETHERNET2 connection
18 DIN rail
❄ Sign for XC version

5.1.2.2.1 Short description

The processor modules are the central units of the control system AC500. The types differ in their performance (memory size, speed etc.). Each processor module must be mounted on a suitable terminal base.

The terminal base type (TB56xx) depends on the number of communication modules which are used together with the processor module.

Table 93: Comparison: TB56xx

Processor module		PM5630	PM5650	PM5670	PM5675	PM5680	PM5685
Max. number of variables allowed for each communication module supported							
	Input variables	4 kB	4 kB	5 kB	5 kB	5 kB	5 kB
	Output variables	4 kB	4 kB	5 kB	5 kB	5 kB	5 kB
Type of communication module supported							
	CM5610-2RS - 2 serial interfaces	x	x	x	x	x	x
	CM582-DP - PROFIBUS DP V0/V1 slave	x	x	x	x	x	x
	CM592-DP - PROFIBUS DP V0/V1 master	x	x	x	x	x	x
	CM579-ETHCAT - EtherCAT master	x	x	x	x	x	x
	CM579-PNIO - PROFINET IO RT controller	x	x	x	x	x	x
	CM589-PNIO - PROFINET IO RT device	x	x	x	x	x	x
	CM589-PNIO-4 - PROFINET IO RT with 4 devices	x	x	x	x	x	x
	CM5640-2ETH - 2 Ethernet interfaces	x	x	x	x	x	x
	CM598-CN - CAN, CANopen master	x	x	x	x	x	x
Type of AC500-S module supported							
	SM560-S - safety module	x	x	x	x	x	x
	SM560-S-FD-1 - safety module with F-Device functionality for 1 PROFIsafe network	x	x	x	x	x	x
	SM560-S -FD-4 - safety module with F-Device functionality for 1 PROFIsafe network	x	x	x	x	x	x

All terminal bases (TB56xx) provide the same communication interfaces (ETH1, ETH2, CAN and COM1) *Chapter 5.3.1.3 “Technical data” on page 291*.

All other processor modules can operate multiple communication modules via their communication module interface.

The communication modules are mounted on the left side of the processor module on the same terminal base.

On the right side of the processor module, up to 10 digital or analog I/O expansion modules can be connected to the I/O bus. Each I/O module requires a suitable terminal unit depending on the module type.

Terminal bases, terminal units, I/O modules, communication modules and accessories have their own technical descriptions.

Each processor module can be used as:

- Stand-alone processor module
- Stand-alone processor module with local I/Os
- Remote IO server
- Remote IO client

The processor modules are powered with 24 V DC.



WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing the following:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

5.1.2.2.2 Connections

All terminals for connection are available on the terminal base.

Information on connection and available interfaces



Processor modules PM56xx-2ETH can only be used with TB56xx-2ETH terminal bases.

Table 94: Combination of TB56xx-2ETH(-XC) and PM56xx(-XC)

Processor module	PM5630	PM5650	PM5670	PM5675	PM5680 [2)]	PM5685 [2)]
TB5600-2ETH	0 slot	0 slot	0 slot	0 slot	0 slot	0 slot
TB5610-2ETH	1 slot	1 slot	1 slot	1 slot	1 slot	1 slot
TB5620-2ETH	2 slots	2 slots	2 slots	2 slots	2 slots	2 slots
TB5640-2ETH	-	4 slots	4 slots	4 slots	4 slots	4 slots
TB5660-2ETH	-	-	6 slots [1)]	6 slots [1)]	-	6 slots

Remarks:

The slots can be used for connecting communication modules or AC500-S modules. Note that only one AC500-S module can be connected at one terminal base.

[1)] PM567x must have the order numbers 1SAP151000R0378, 1SAP151500R0378 or a production index ≥ C0.

[2)] XC variant is not applicable.

5.1.2.2.3 Storage elements

Lithium battery

The processor modules are supplied without primary lithium battery. It must be ordered separately. The TA521 adapter cable with button cell or TA522 adapter for CR2450 battery is used for data (SRAM) and RTC buffering while the processor module is not powered.

The CPU monitors the discharge degree of the primary lithium battery. A warning is issued before the primary lithium battery condition becomes critical (about 2 weeks before). Once the warning message appears, the primary lithium battery should be replaced as soon as possible.

The technical data, handling instructions and the insertion/replacement of the battery is described in detail in the chapter TA521 adapter cable with button cell or TA522 battery holder ↳ *Chapter 5.8.2.3 “TA521 - Adapter cable with button cell” on page 1400*.

Memory card

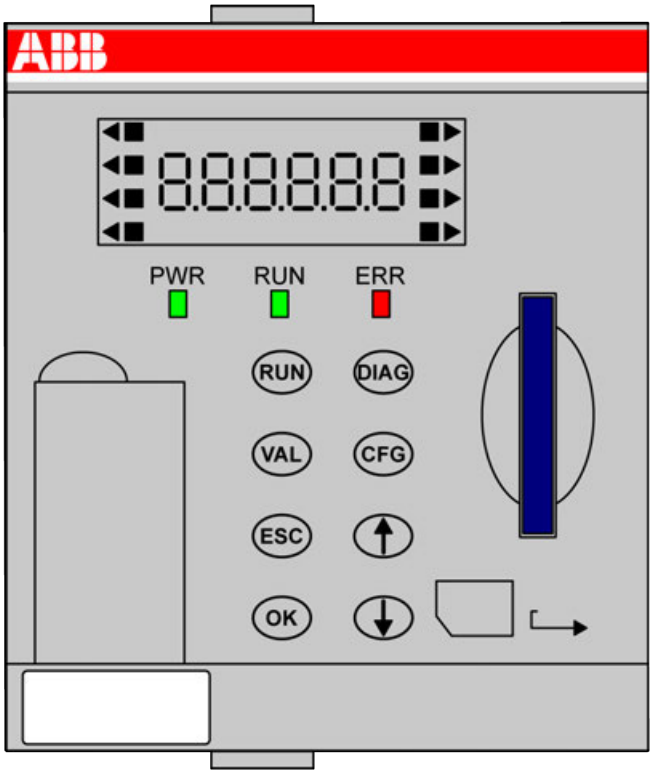
AC500 processor modules are supplied without memory card. It must be ordered separately.

The memory card can be used for the following:

- Reading and writing user files.
- Downloading a user program.
- Updating the firmware.
- Storing the program source code.

AC500 processor modules can be operated with and without memory cards. The processor module uses a standard file system (FAT). This allows standard card readers to read and write the memory cards.

5.1.2.2.4 LEDs, display and function keys on the front panel



5.1.2.2.5 Technical data

The system data of AC500 and S500 is applicable to the standard version. ↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version. ↳ *Chapter 4.3 “System data AC500-XC” on page 38*

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Processor module and terminal base

Parameter	Value
Connection of the supply voltage 24 V DC at the terminal base of the processor module	Removable 5-pin terminal block with spring connection
Current consumption on 24 V DC	
Min. typ. (module alone)	PM5630-2ETH: 110 mA PM5650-2ETH: 120 mA PM5670-2ETH: 140 mA PM5675-2ETH: 140 mA PM5680-2ETH: 160 mA PM5685-2ETH: 160 mA
Max. typ. (all communication modules and I/Os)	PM5630-2ETH: 400 mA PM5650-2ETH: 600 mA PM5670-2ETH: 800 mA PM5675-2ETH: 800 mA PM5680-2ETH: 800 mA PM5685-2ETH: 800 mA
Number of slots for processor modules	1 (on all terminal bases)
Processor module interfaces at the terminal bases TB56xx	I/O bus, ETH1, ETH2, CAN, COM1
Weight (processor module without terminal base)	135 g
Mounting position	Horizontal or vertical

Table 95: Comparison: PM56xx

Processor module	PM5630	PM5650	PM5670	PM5675	PM5680	PM5685
Total maximum downloadable application size [1)]	9 MB	84 MB	176 MB	176 MB	176 MB	320 MB
Thereof user program code and data (dynamically allocated)	2 MB	8 MB	32 MB	32 MB	32 MB	64 MB
Thereof user webserver data max.	6 MB	72 MB	128 MB	128 MB	128 MB	256 MB
Flash memory for User data						
Remaining for all other usage (project save, infrastructure...)	40 MB	380 MB	850 MB	850 MB	850 MB	850 MB

Processor module		PM5630	PM5650	PM5670	PM5675	PM5680	PM5685
	Buffered (SRAM)	256 kB	256 kB	1.5 MB	1.5 MB	1.5 MB	1.5 MB
	Thereof VAR retain persistent	128 kB	128 kB	1024 kB	1024 kB	1024 kB	1024 kB
	Thereof %M memory (e.g. Modbus register)	128 kB	128 kB	512 kB	512 kB	512 kB	512 kB
Expandable memory		None	None	None	None	None	None
Integrated mass storage memory (FLASH)		None	None	None	8 GB	None	None
Slot for pluggable memory card		x	x	x	x	x	x
Processor type		TI ARM Cortex-A9 32-bit-RISC				Multi-Core ARM Cortex-A53 64-bit	
Processor clock speed		300 MHz	600 MHz	1 GHz	1 GHz	1 GHz	1 GHz
Cycle time for 1 instruction (minimum):							
	Binary	Min. 0.02 µs	Min. 0.01 µs	Min. 0.002 µs	Min. 0.002 µs	Min. 0.002 µs	Min. 0.002 µs
	Word	Min. 0.02 µs	Min. 0.01 µs	Min. 0.002 µs	Min. 0.002 µs	Min. 0.002 µs	Min. 0.002 µs
	Floating point	Min. 0.12 µs	Min. 0.01 µs	Min. 0.002 µs	Min. 0.002 µs	Min. 0.002 µs	Min. 0.002 µs
	Mathematic co-processor	x	x	x	x	x	x
Motion capability							
	No. synchronized axis per 1 ms on EtherCAT CM typically	-	8*	16*	16*	16*	16*
	No. synchronized axis per 2 ms on EtherCAT CM typically	4*	16*	32*	32*	32*	32*
	No. synchronized axis per 4 ms on EtherCAT CM or CANopen onboard typically	8*	32*	64*	64*	64*	64*
	Min. bus cycle time for EtherCAT using external CM579	2 ms	1 ms	0,5 ms	0,5 ms	0,5 ms	0,5 ms
* in addition: 1 virtual axis							
Max. number of central inputs and outputs (10 exp. modules):							
	Digital inputs	320					
	Digital outputs	320					
	Analog inputs	160					
	Analog outputs	160					
Number of decentralized inputs and outputs		Depends on the used fieldbus					
Data backup		Battery					
Data buffering time at 25 °C		Typ. 3 years					
Battery low indication		via application program					
Real-time clock:							
	With battery backup	x					
	Accuracy	Typ. ± 2 s / day at +25 °C					

Processor module		PM5630	PM5650	PM5670	PM5675	PM5680	PM5685
Program execution:							
	Cyclic	x					
	Time-controlled	x					
	Multitasking	x					
	Minimum cycle time configurable for cyclical task	1 ms	1 ms	0,5 ms	0,5 ms	0,5 ms	0,5 ms
User program protection by password		x (user management)					
Internal interfaces for communication:							
Serial interface COM1:							
	Physical link	Configurable for RS-232 or RS-485 (9.6 kb/s, 19.2 kb/s, 38.4 kb/s, 57.6 kb/s and 115.2 kb/s)					
	Connection	Pluggable terminal block, spring connection					
	Usage	Serial ASCII communication,Modbus RTU					
CAN interface:							
	Physical link	CAN 2A/2B (from 50 kb/s to 1 Mb/s)					
	Connection	Pluggable terminal block, spring connection					
	Usage	CANopen master communication, CAN 2A/2B, J1939 protocol, CAN sync					
	Max. number of variables allowed						
	Input variables	2 kB	4 kB	5 kB	5 kB	5 kB	5 kB
	Output variables	2 kB	4 kB	5 kB	5 kB	5 kB	5 kB
Network interface ETH1, ETH2:							
	Usage	Ethernet					
	Physical link	10/100 base-TX, configurable as internal switch or independent Interfaces					
	Connection	2x RJ45 socket, provided on TB56xx-2ETH					
LEDs, LCD display, function keys		RUN / STOP, status, diagnosis, settings					
Number of timers		Unlimited					
Number of counters		Unlimited					
Programming languages:							
	Structured Text ST	x					
	Instruction list IL	x					
	Function Block Diagram FBD	x					
	Ladder Diagram LD	x					
	Sequential function chart SFC	x					
	Continuous function chart (CFC)	x					

Remarks:

[1] The values are for information only and cannot be fulfilled altogether. The available resources are limited at the end by the maximal downloadable application size for each CPU.

Table 96: Combination of TB56xx-2ETH(-XC) and PM56xx(-XC)

Processor module	PM5630	PM5650	PM5670	PM5675	PM5680 [2]	PM5685 [2]
TB5600-2ETH	0 slot	0 slot	0 slot	0 slot	0 slot	0 slot
TB5610-2ETH	1 slot	1 slot	1 slot	1 slot	1 slot	1 slot
TB5620-2ETH	2 slots	2 slots	2 slots	2 slots	2 slots	2 slots
TB5640-2ETH	-	4 slots	4 slots	4 slots	4 slots	4 slots
TB5660-2ETH	-	-	6 slots [1]	6 slots [1]	-	6 slots

Remarks:

The slots can be used for connecting communication modules or AC500-S modules. Note that only one AC500-S module can be connected at one terminal base.

[1] PM567x must have the order numbers 1SAP151000R0378, 1SAP151500R0378 or a production index ≥ C0.

[2] XC variant is not applicable.

Table 97: Comparison: TB56xx

Processor module		PM5630	PM5650	PM5670	PM5675	PM5680	PM5685
Max. number of variables allowed for each communication module supported							
	Input variables	4 kB	4 kB	5 kB	5 kB	5 kB	5 kB
	Output variables	4 kB	4 kB	5 kB	5 kB	5 kB	5 kB
Type of communication module supported							
	CM5610-2RS - 2 serial interfaces	x	x	x	x	x	x
	CM582-DP - PROFIBUS DP V0/V1 slave	x	x	x	x	x	x
	CM592-DP - PROFIBUS DP V0/V1 master	x	x	x	x	x	x
	CM579-ETHCAT - EtherCAT master	x	x	x	x	x	x
	CM579-PNIO - PROFINET IO RT controller	x	x	x	x	x	x
	CM589-PNIO - PROFINET IO RT device	x	x	x	x	x	x
	CM589-PNIO-4 - PROFINET IO RT with 4 devices	x	x	x	x	x	x
	CM5640-2ETH - 2 Ethernet interfaces	x	x	x	x	x	x
	CM598-CN - CAN, CANopen master	x	x	x	x	x	x
Type of AC500-S module supported							
	SM560-S - safety module	x	x	x	x	x	x

Processor module	PM5630	PM5650	PM5670	PM5675	PM5680	PM5685
SM560-S-FD-1 - safety module with F-Device functionality for 1 PROFIsafe network	x	x	x	x	x	x
SM560-S -FD-4 - safety module with F-Device functionality for 1 PROFIsafe network	x	x	x	x	x	x

Communication and onboard protocols

Table 98: OPC UA server / OPC DA server

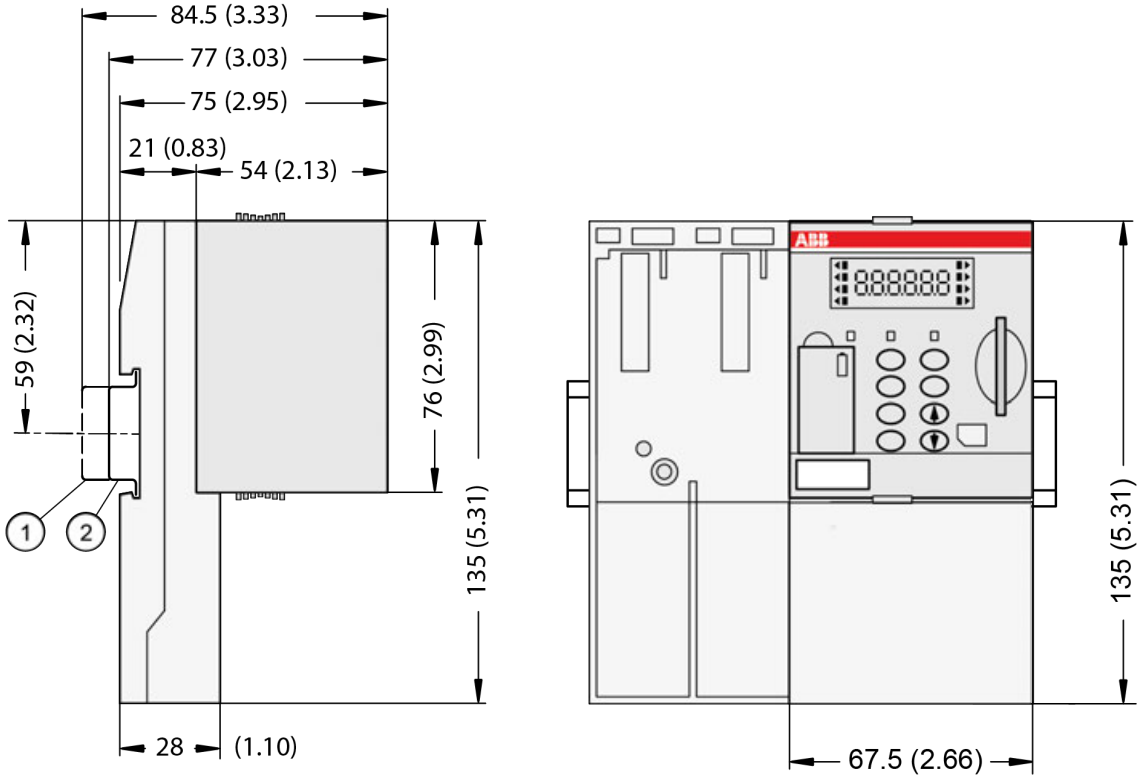
Processor module	PM5630	PM5650	PM5670	PM5675	PM5680	PM5685
OPC UA server[1)]	x	x	x	x	x	x
Number of free tags	3.000	10.000	30.000	30.000	30.000	60.000
Number of connections	10	20	50	50	50	100
Min. sampling rate (limit)	500 ms	100 ms	50 ms	50 ms	50 ms	50 ms
OPC DA server AE	x	x	x	x	x	x
Number of connections	8	8	8	8	8	8
Remarks: 1) Maximum number of free tags using arrays.						

Table 99: Modbus, Telecontrol

Processor module	PM5630	PM5650	PM5670	PM5675	PM5680	PM5685
Modbus TCP client / server	x	x	x	x	x	x
Number of Modbus clients ModMast in parallel on a CPU master (server)	30	50	120	120	120	300
Number of Modbus server in parallel (e.g. for SCADA access)	15	25	50	50	50	250
IEC 60870-5-104 telecontrol protocol	x	x	x	x	-	x
Number of free tags	1.000	5.000	10.000	10.000	-	20.000
Control station (number of connections)	5	10	20	20	-	40
Sub-station (number of connections)	5	10	20	20	-	40

DNP3 Out-station	PM5630	PM5650	PM5670	PM5675	PM5680	PM5685
Number of tags	1000	3000	10000	10000	-	15000
Number of clients	8	8	8	8	-	8
Maximum number of events buf-fering	200000	350000	800000	800000	-	800000

5.1.2.2.6 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

5.1.2.2.7 Ordering data

Processor modules

To enable better product availability into the production and to provide some new features, a revision 3 of the existing AC500 processor module was necessary. The existing processor module revision 2 with rubric R0**2**78 will move to classic and will be replaced by compatible new processor module revision 3 with rubric R0**3**78.

For example: The processor module revision 3 PM5630-2ETH (1SAP131 000 **R0378**) replaces the existing processor module revision 2 PM5630-2ETH (1SAP 131 000 **R0278**) and provides the same features or functionality of the previous ones.

For PM568x only processor module revision 3 is applicable.

Following points must be considered with the processor module revision 3:

- *The processor module revision 3 (R037x) requires a new BootFW / CPUFW from V3.6.x and higher.*
- ***It cannot be downgraded** and used with lower FW versions than V3.6.0.*
- *The processor module revision 3 (R037x) provides the same features as the processor module revision 2 (R027x) existing today and is fully compatible.*
- *An existing application using a processor module revision 2 (R027x) built with Automation Builder < 2.6 can run on a processor module revision 3 (R037x) but the application **must be upgraded** to at least AB 2.6.0 or higher.*

What must be done using a new processor module revision 3 (R037x)?

- On a new application?
  - Just use the new processor module revision 3 (R037x)
  - Use the latest Automation Builder software from 2.6.0 or higher.
- On an existing application using an Automation Builder software version smaller than 2.6.0?
  - To use a new processor module revision 3 in an existing application (e.g., replacement of the processor module revision 2), the application must be upgraded to at least AB 2.6.0 or higher.
  - If several processor module (revision 3 and revision 2) are used within the same project, all the processor modules used in the same application must be upgraded to the FW Version V3.6.x and higher.

Table 100: Processor modules for AC500 (Standard)

Part no.	Description	Product life cycle phase *)
1SAP 131 000 R0278 (processor module revision 2)	PM5630-2ETH, processor module, memory 8 MB, 24 V DC, memory card slot, interface 1 RS-232/485, display, 2 RJ45 independent onboard Ethernet TCP/IP interfaces with Modbus TCP, web server, IEC60870-5-104 or selectable Ethernet based protocols	Classic (replaced by processor module revision 3)
1SAP 131 000 **R0378** (processor module revision 3)	PM5630-2ETH, processor module, memory 8 MB, 24 V DC, memory card slot, interface 1 RS-232/485, display, 2 RJ45 independent onboard Ethernet TCP/IP interfaces with Modbus TCP, web server, IEC60870-5-104 or selectable Ethernet based protocols	Active
1SAP 331 000 R0278 (processor module revision 2)	PM5630-2ETH-XC, processor module, memory 8 MB, 24 V DC, memory card slot, interface 1 RS-232/485, display, 2 RJ45 independent onboard Ethernet TCP/IP interfaces with Modbus TCP, web server, IEC60870-5-104 or selectable Ethernet based protocols, XC version	Classic (replaced by processor module revision 3)

Part no.	Description	Product life cycle phase *)
1SAP 331 000 **R0378** (processor module revision 3)	PM5630-2ETH-XC, processor module, memory 8 MB, 24 V DC, memory card slot, interface 1 RS-232/485, display, 2 RJ45 independent onboard Ethernet TCP/IP interfaces with Modbus TCP, web server, IEC60870-5-104 or selectable Ethernet based protocols, XC version	Active
1SAP 141 000 R0278 (processor module revision 2)	PM5650-2ETH, processor module, memory 80 MB, 24 V DC, memory card slot, interface 1 RS-232/485, display, 2 RJ45 independent onboard Ethernet TCP/IP interfaces with Modbus TCP, web server, IEC60870-5-104 or selectable Ethernet based protocols	Classic (replaced by processor module revision 3)
1SAP 141 000 **R0378** (processor module revision 3)	PM5650-2ETH, processor module, memory 80 MB, 24 V DC, memory card slot, interface 1 RS-232/485, display, 2 RJ45 independent onboard Ethernet TCP/IP interfaces with Modbus TCP, web server, IEC60870-5-104 or selectable Ethernet based protocols	Active
1SAP 341 000 R0278 (processor module revision 2)	PM5650-2ETH-XC, processor module, memory 80 MB, 24 V DC, memory card slot, interface 1 RS-232/485, display, 2 RJ45 independent onboard Ethernet TCP/IP interfaces with Modbus TCP, web server, IEC60870-5-104 or selectable Ethernet based protocols, XC version	Classic (replaced by processor module revision 3)
1SAP 341 000 **R0378** (processor module revision 3)	PM5650-2ETH-XC, processor module, memory 80 MB, 24 V DC, memory card slot, interface 1 RS-232/485, display, 2 RJ45 independent onboard Ethernet TCP/IP interfaces with Modbus TCP, web server, IEC60870-5-104 or selectable Ethernet based protocols, XC version	Active
1SAP 151 000 R0278 (processor module revision 2)	PM5670-2ETH, processor module, memory 160 MB, 24 V DC, memory card slot, interface 1 RS-232/485, display, 2 RJ45 independent onboard Ethernet TCP/IP interfaces with Modbus TCP, web server, IEC60870-5-104 or selectable Ethernet based protocols	Classic (replaced by processor module revision 3)
1SAP 151 000 **R0378** (processor module revision 3)	PM5670-2ETH, processor module, memory 160 MB, 24 V DC, memory card slot, interface 1 RS-232/485, display, 2 RJ45 independent onboard Ethernet TCP/IP interfaces with Modbus TCP, web server, IEC60870-5-104 or selectable Ethernet based protocols	Active

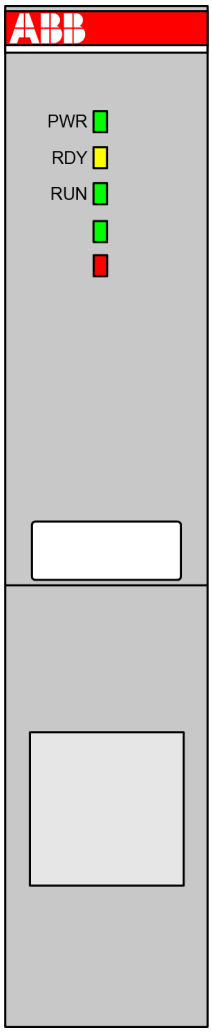
Part no.	Description	Product life cycle phase *)
1SAP 351 000 R0278 (processor module revision 2)	PM5670-2ETH-XC, processor module, memory 160 MB, 24 V DC, memory card slot, interface 1 RS-232/485, display, 2 RJ45 independent onboard Ethernet TCP/IP interfaces with Modbus TCP, web server, IEC60870-5-104 or selectable Ethernet based protocols, XC version	Classic (replaced by processor module revision 3)
1SAP 351 000 **R0378** (processor module revision 3)	PM5670-2ETH-XC, processor module, memory 160 MB, 24 V DC, memory card slot, interface 1 RS-232/485, display, 2 RJ45 independent onboard Ethernet TCP/IP interfaces with Modbus TCP, web server, IEC60870-5-104 or selectable Ethernet based protocols, XC version	Active
1SAP 151 500 R0278 (processor module revision 2)	PM5675-2ETH, processor module, memory 160 MB, 8 GB flash disk, 24 V DC, memory card slot, interface 1 RS-232/485, display, 2 RJ45 independent onboard Ethernet TCP/IP interfaces with Modbus TCP, web server, IEC60870-5-104 or selectable Ethernet based protocols	Classic (replaced by processor module revision 3)
1SAP 151 500 **R0378** (processor module revision 3)	PM5675-2ETH, processor module, memory 160 MB, 8 GB flash disk, 24 V DC, memory card slot, interface 1 RS-232/485, display, 2 RJ45 independent onboard Ethernet TCP/IP interfaces with Modbus TCP, web server, IEC60870-5-104 or selectable Ethernet based protocols	Active
1SAP 351 500 R0278 (processor module revision 2)	PM5675-2ETH-XC, processor module, memory 160 MB, 8 GB flash disk, 24 V DC, memory card slot, interface 1 RS-232/485, display, 2 RJ45 independent onboard Ethernet TCP/IP interfaces with Modbus TCP, web server, IEC60870-5-104 or selectable Ethernet based protocols, XC version	Classic (replaced by processor module revision 3)
1SAP 351 500 **R0378** (processor module revision 3)	PM5675-2ETH-XC, processor module, memory 160 MB, 8 GB flash disk, 24 V DC, memory card slot, interface 1 RS-232/485, display, 2 RJ45 independent onboard Ethernet TCP/IP interfaces with Modbus TCP, web server, IEC60870-5-104 or selectable Ethernet based protocols, XC version	Active

Part no.	Description	Product life cycle phase *)
1SAP 152 000 **R0378**	PM5680-2ETH, Multi-Core processor module, memory 160 MB, 24 V DC, memory card slot, interface 1 RS-232/485, display, 2 RJ45 independent onboard Ethernet TCP/IP interfaces with Modbus TCP, web server or selectable Ethernet based protocols	Active
1SAP 152 500 **R0378**	PM5685-2ETH, Multi-Core processor module, memory 320 MB, 24 V DC, memory card slot, interface 1 RS-232/485, display, 2 RJ45 independent onboard Ethernet TCP/IP interfaces with Modbus TCP, web server, IEC60870-5-104 or selectable Ethernet based protocols	Active
1SAP 131 000 R0379	PM5630-MC-KIT: AC500, Machine Controller Kit with PM5630-2ETH, CM579-ETHCAT, TB5610-ETH, PS5611-MC	Active
1SAP 141 000 R0379	PM5650-MC-KIT: AC500, Machine Controller Kit with PM5650-2ETH, CM579-ETHCAT, TB5610-ETH, PS5611-MC	Active
1SAP 151 000 R0379	PM5670-MC-KIT: AC500, Machine Controller Kit with PM5670-2ETH, CM579-ETHCAT, TB5610-ETH, PS5611-MC	Active
1SAP 152 000 R0379	PM5680-MC-KIT: AC500, Machine Controller Kit with PM5680-2ETH, CM579-ETHCAT, TB5610-ETH, PS5611-MC	Active
Required accessories		
1SAP xxx 300 R0278	TB56xx, terminal base *Chapter 5.3.1 “TB5600, TB5610, TB5620, TB5640, TB5660” on page 284*	Active
Optional accessories		
1SAP 180 300 R0001	TA521, adapter cable with button cell *Chapter 5.8.2.3 “TA521 - Adapter cable with button cell” on page 1400*	Active
1SAP 180 100 R00xx	MC51xx, memory card *Chapter 5.8.1.1 “MC5102 - Micro memory card with adapter” on page 1367* *Chapter 5.8.2.2 “MC5141 - Memory card” on page 1396*	Active

*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

5.2 Communication modules for AC500(-XC) processor modules

5.2.1 Features



AC500 communication modules are required for the following:

- The connection to standard fieldbus systems.
- The integration into existing networks.

- The communication modules enable communication on different fieldbuses.
- The communication modules are mounted on the left side of the processor module on the same terminal base.
- The communication modules are directly powered via the internal communication module bus of the terminal base.

  A separate voltage source is not required.



WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing the following:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

The communication between the processor module and the communication modules takes place via the communication module bus. The communication module bus is integrated in the terminal base. Depending on the used terminal base up to 6 communication modules can be connected.

Chapter 5.3.1 “TB5600, TB5610, TB5620, TB5640, TB5660” on page 284

There are no restrictions concerning which communication modules can be arranged for a processor module.

Within the AC500 control system, the communication modules can be used as one of the following:

- Bus master.
- Slave.

Depending on the following:

- Selected protocol.
- The functionality of the communication module.
- The several field buses and networks.

The following name extensions of the device names describe the supported field bus or supported protocol:

- CM5640-2ETH: Ethernet
- CM5x2-DP: PROFIBUS
- CM5x9-PNIO: PROFINET
- CM579-ETHCAT: EtherCAT
- CM598-CN: CANopen
- CM5610-2RS: 2 serial interfaces (COM1/COM2)

If a XC version of the device is available, for use in extreme ambient conditions (e.g. wider temperature and humidity range), this is indicated with a snowflake sign.

5.2.2 Compatibility of communication modules and communication interface modules

Table 101: Modbus TCP

Communication module	Communication interface module	I/O expansion module S500	I/O expansion module S500-eCo	I/O expansion module S500-S	Applications
Onboard Ethernet interface	CI521-MODTCP CI522-MODTCP	x	x	--	high availability, remote I/O
Onboard Ethernet interface	CI521-MODTCP CI522-MODTCP	x	--	--	hot-swap I/O
CM5640-2ETH	CI521-MODTCP CI522-MODTCP	x	x	--	high availability, remote I/O
CM5640-2ETH	CI521-MODTCP CI522-MODTCP	x	--	--	hot-swap I/O

Table 102: PROFIBUS DP

Communication module	Communication interface module	I/O expansion module S500	I/O expansion module S500-eCo	I/O expansion module S500-S	Applications
CM592-DP master	CI541-DP CI542-DP	x	x	--	remote I/O
CM592-DP master	CI541-DP CI542-DP	x	--	--	hot-swap I/O

Table 103: PROFINET IO RT

Communication module	Communication interface module	I/O expansion module S500	I/O expansion module S500-eCo	I/O expansion module S500-S	Applications
CM579-PNIO controller	CI501-PNIO CI502-PNIO	x	x	x	remote I/O, safety I/O
CM579-PNIO controller	CI501-PNIO CI502-PNIO	x	--	--	hot-swap I/O

Table 104: CANopen

Communication module	Communication interface module	I/O expansion module S500	I/O expansion module S500-eCo	I/O expansion module S500-S	Applications
Onboard CAN interface	CI581-CN CI582-CN	--	--	--	remote I/O

Table 105: EtherCAT

Communication module	Communication interface module	I/O expansion module S500	I/O expansion module S500-eCo	I/O expansion module S500-S	Applications
CM579-ETHCAT master	CI511-ETHCAT CI512-ETHCAT	x	x	--	remote I/O

5.2.3 Technical data (Overview)

Communication module	Field bus	Transmission rate	Field bus connector	Processor	Communication module interface	Current consumption from 24 V DC power supply at the terminal base of the CPU
CM5610-2RS	Serial (ASCII/ Modbus)	9.6 ... 187.5 kBit/s	2 x MC 0.5/9-G-2.5, 9-pin, male	TI ARM Cortex-A9	Dual-port RAM	Typ. 40 mA
CM579-ETHCAT	EtherCAT	10 or 100 MBit/s	2 x RJ45	Hilscher NETX 100	Dual-port RAM, 16 kB	Typ. 85 mA
CM582-DP CM592-DP	PROFIBUS DP	9.6 kBit/s ... 12 MBit/s	D-sub, 9-pin, female, bended	Hilscher NETX 100	Dual-port RAM, 16 kB	Typ. 65 mA
CM598-CN	CANopen	10 ... 1 MBit/s	COMBICON 2x 5-pin, bended	Hilscher NETX 100	Dual-port RAM, 16 kB	Typ. 65 mA
CM579-PNIO	PROFINET	100 MBit/s	2 x RJ45	Hilscher NETX 100	Dual-port RAM, 16 kB	Typ. 85 mA
CM5640-2ETH	2 x Ethernet	10 or 100 MBit/s	2 x RJ45	TI ARM Cortex-A9	Dual-port RAM	Typ. 47 mA

5.2.4 Serial

5.2.4.1 CM5610-2RS with 2 serial interfaces



1 5 LEDs for state display
2 2 rotary switches for address setting
3 Label
4 2 serial interfaces: COM1 and COM2
❄ Sign for XC version

CAUTION!

Risk of injury and damaging the module when using unapproved terminal blocks!

Only use terminal blocks approved by ABB to avoid injury and damage to the module.

The communication modules with 2 serial interfaces are delivered with two 9-pin terminal blocks TA532 (1SAP 182 000 R0001).

The terminal block listed in the ordering data is for spare part only if needed.

5.2.4.1.1 Purpose

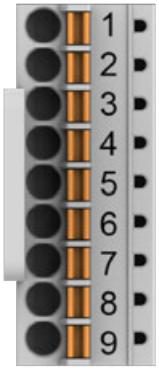
Communication module CM5610-2RS is equipped with 2 serial interfaces (COM1 and COM2) which can be used as serial interface extension of the proocessor module or for communication e.g. for communication via Modbus or ASCII.

Depending on the connection, the physical interface of COM1 and COM2 is either RS-232 or RS-485.

5.2.4.1.2 Connections

Serial interfaces

Pin assignment

Pin		Signal	Interface	Description
	1	Term. P	RS-485	Terminator P
	2	RxD/TxD-P	RS-485	Receive/Transmit, positive
	3	RxD/TxD-N	RS-485	Receive/Transmit, negative
	4	Term. N	RS-485	Terminator N
	5	RTS	RS-232	Request to send (output)
	6	TxD	RS-232	Transmit data (output)
	7	SGND	Signal Ground	Signal Ground
	8	RxD	RS-232	Receive data (input)
	9	CTS	RS-232	Clear to send (input)

Bus cable for RS-485

Bus cable

Bus line	
Construction	2 cores, twisted, with common shield
Conductor cross section	> 0.22 mm² (24 AWG)
Twisting rate	> 10 per meter (symmetrically twisted)
Core insulation	Polyethylene (PE)
Resistance per core	< 100 Ω/km
Characteristic impedance	ca. 120 Ω (100 Ω ... 150 Ω)
Capacitance between the cores	< 55 nF/km (if higher, the max. bus length must be reduced)
Terminating resistors	120 Ω ¼ W at both line ends
Remarks	Commonly used telephone cables with PE insulation and a core diameter of > 0.8 mm are usually sufficient.
	Cables with PVC core insulation and core diameter of 0.8 mm can be used up to a length of approx. 250 m. In this case, the bus terminating resistor is approx. 100 Ω.

Cable lengths

The maximum possible cable length of a serial connection subnet within a segment depends on the transmission rate.

RS-232 (for point-to-point connection):

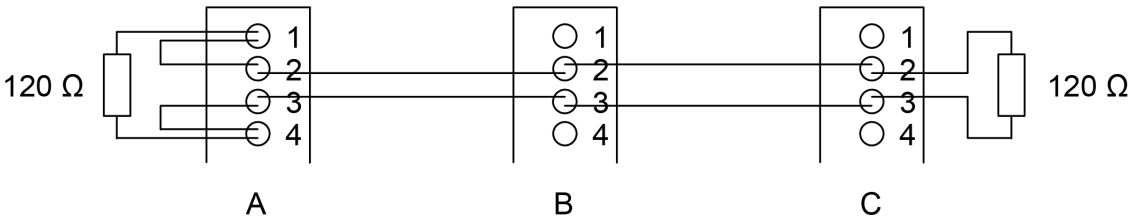
Parameter	Value
Transmission rate	9.6 kbit/s to 115.2 kbit/s
Maximum cable length	On request

RS-485 (for point-to-point or bus connection):

Parameter	Value
Transmission rate	9.6 kbit/s to 115.2 kbit/s
Maximum cable length	On request

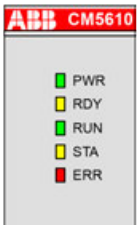
Bus termination (RS-485 only)

The line ends of the bus segment must be equipped with bus terminating resistors. Normally, these resistors are integrated in the interface connectors.



1 Term. P
2 RxD/TxD-P
3 RxD/TxD-N
4 Term. N
A Master at the bus line end, pull-up resistor and pull-down resistor activated, bus terminating resistor 120 Ω
B Slave within the bus line
C Slave at the bus line end, bus terminating resistor 120 Ω

5.2.4.1.3 State LEDs

LED		Color	State	Description
	PWR	Green	ON (light)	Voltage is present
			OFF (dark)	Voltage is missing
	RDY	Yellow	Programmable	Depends on user program
	RUN	Green	Programmable	Depends on user program
	STA	Yellow	Programmable	Depends on user program
	ERR	Red	Programmable	Depends on user program

5.2.4.1.4 Technical data

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

↳ *Chapter 4.3 “System data AC500-XC” on page 38*

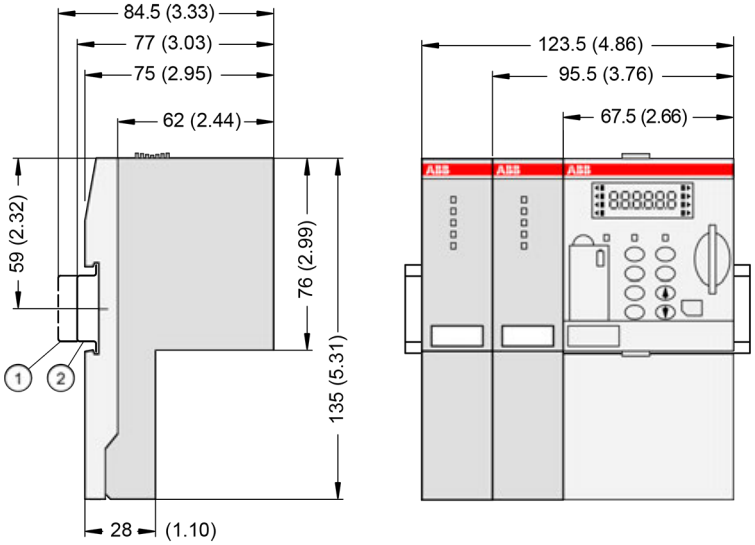
Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter			Value
Protocols			
	Serial COM ASCII		Yes
	Modbus RTU (master and slave)		Yes
State LED			
	PWR		1
	RUN		1
	ERR		1
	RDY		1
	STA		1
Rotary switch			
	ADDR 00...FFhex		2, for station identification
Serial interface 1			
	Physical layer		
		RS232 / RS485 configurable	Isolated
	Connection name		COM input of funktion blocks:11, 21, ... 61 depending on which slot CM5610-2RS is plugged. Counting starts from right to left on left side of CPU.
	Connection type		
		Terminal block	Pluggable spring terminals
	Transmission rate		Configurable from 9.6 kbit/s to 115.2 kbit/s
	Usage		
		Programming	No
		Modbus RTU (master and slave)	Yes
		Serial ASCII communication	Yes
Serial interface 2			
	Physical layer		
		RS232 / RS485 configurable	Isolated
	Connection name		COM input of funktion blocks:12, 22, ... 62 depending on which slot CM5610-2RS is plugged. Counting starts from right to left on left side of CPU.
	Connection type		
		Terminal block	Pluggable spring terminals
	Transmission rate		Configurable from 9.6 kbit/s to 115.2 kbit/s
	Usage		
		Programming	No
		Modbus RTU (master and slave)	Yes
		Serial ASCII communication	Yes
Communication module interface/bus			Dual-port RAM (simulated)

Parameter			Value
Net weight [kg]			0.12 kg
Power supply			
	Nominal supply voltage		
		Supply current at nominal supply voltage (depending on system architecture)	Typ. 40 mA per communication module at 24 V With maximum load to both COM ports: 46 mA
	Internal power supply source		Communication module bus
Hardware			
	Usable CPUs		PM56xx *Chapter 5.1.2.2 “PM5630, PM5650, PM5670, PM5675, PM5680, PM5685” on page 220*
	Usable terminal bases		TB56xx *Chapter 5.3.1 “TB5600, TB5610, TB5620, TB5640, TB5660” on page 284*

5.2.4.1.5 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

> *The dimensions are in mm and in brackets in inch.*

5.2.4.1.6 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 176 000 R0020	CM5610-2RS, communication module, 2 serial RS232/485	Active
1SAP 376 000 R0020	CM5610-2RS-XC, communication module, 2 serial RS232/485, XC version	Active

*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

Table 106: Spare parts for communication modules with 2 serial interfaces

Part no.	Description
1SAP 182 000 R0001	TA532: 9-pin terminal block set for communication module CM5610-2RS(-XC), 10 pieces, spring type terminal

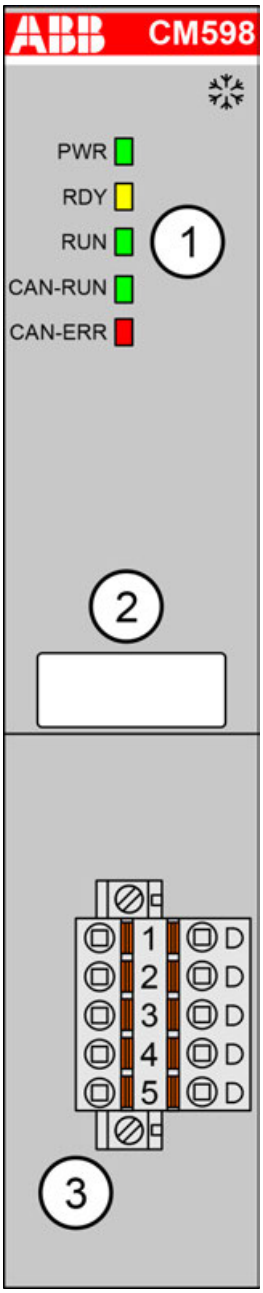
The communication modules with 2 serial interfaces are delivered with two 9-pin terminal blocks TA532 (1SAP 182 000 R0001).

The terminal block listed in the ordering data is for spare part only if needed.

5.2.5 CANopen

5.2.5.1 CM598-CN - CANopen master

- CANopen master 1 Mbit/s
- XC version for use in extreme ambient conditions available



1 5 LEDs for state display
2 Label
3 Communication interface, 5-pin, Combicon, male, removable plug with spring terminals
❄ Sign for XC version

5.2.5.1.1 Purpose

Communication module CM598-CN enables communication over the CANopen field bus.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

Supported protocols	CM598-CN(-XC) *)
CANopen master	X
CAN 2A/2B	X

Remark: *) only for AC500

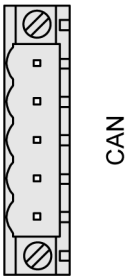
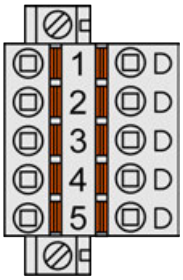
5.2.5.1.2 Connections

Field bus interface

Interface socket	5-pin COMBICON
Transmission standard	ISO 11898, potential-free
Transmission protocol	CANopen (CAN), 1 Mbaud max.
Transfer rate (transmission rate)	10 kbit/s, 20 kbit/s, 50 kbit/s, 100 kbit/s, 125 kbit/s, 250 kbit/s, 500 kbit/s, 800 kbit/s and 1 Mbit/s,

Pin assignment

Table 107: Pin assignment of the CANopen connector

Interface		PIN	Signal	Description
 Terminal block removed	 Terminal block inserted	1	CAN_GND	CAN reference potential
		2	CAN_L	Bus line, receive/transmit line, LOW
		3	CAN_SHLD	Shield of the bus line
		4	CAN_H	Bus line, receive/transmit line, HIGH
		5	NC	Not connected

NOTICE!

Unused connector!

Make sure that the terminal block is always connected to the terminal base or communication module, even if you do not use the interface.

Bus length

The maximum possible bus length of a CAN network depends on bit rate (transmission rate) and cable type. The sum of all bus segments must not exceed the maximum bus length

Bit Rate (speed)	Bus Length
1 Mbit/s	40 m
800 kbit/s	50 m
500 kbit/s	100 m
250 kbit/s	250 m
125 kbit/s	500 m
50 kbit/s	1000 m

Types of bus cables

For CANopen, only bus cables with characteristics as recommended in ISO 11898 are to be used. The requirements for the bus cables depend on the length of the bus segment. Regarding this, the following recommendations are given by ISO 11898:

Length of segment [m]	Bus cable (shielded, twisted pair)			Max. transmission rate [kbit/s]
	Conductor cross section [mm²]	Line resistance [Ω/km]	Wave impedance [Ω]	
0...40	0.25 ... 0.34 / AWG23, AWG22	70	120	1000 at 40 m
40...300	0.34 ... 0.60 / AWG22, AWG20	< 60	120	< 500 at 100 m
300...600	0.50 ... 0.60 / AWG20	< 40	120	< 100 at 500 m
600...1000	0.75 ... 0.80 / AWG18	< 26	120	< 50 at 1000 m

Bus terminating resistors

The ends of the data lines have to be terminated with a 120 Ω bus terminating resistor. The bus terminating resistor is usually installed directly at the bus connector.

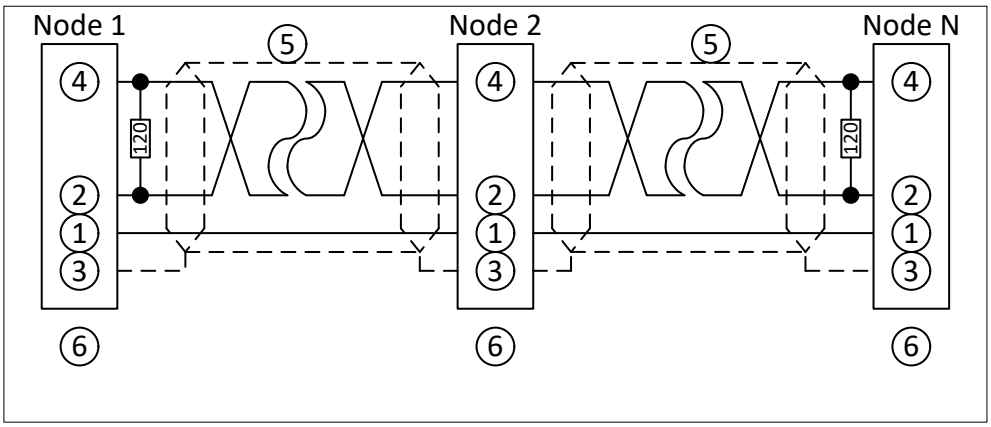


Fig. 21: CANopen interface, bus terminating resistors connected to the line ends

1	CAN_GND
2	CAN_L
3	Shield
4	CAN_H
5	Data line, shielded twisted pair
6	COMBICON connection, CANopen interface

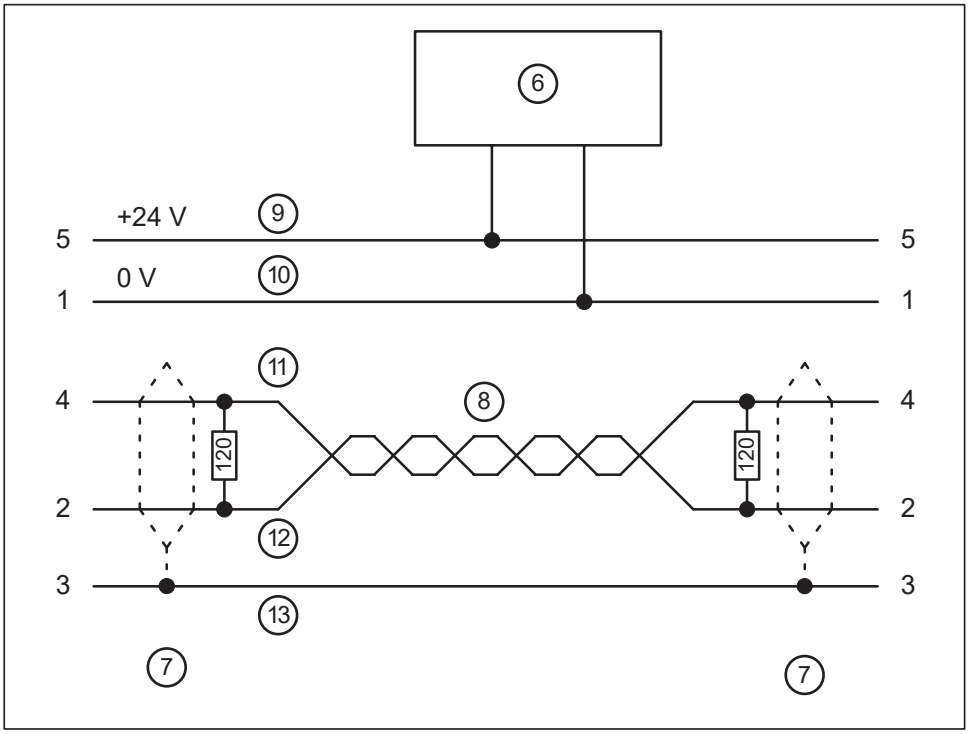


Fig. 22: DeviceNet interface, bus terminating resistors connected to the line ends

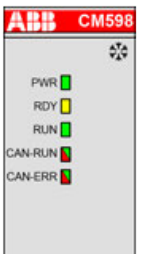
6	DeviceNet power supply
7	COMBICON connection, DeviceNet interface
8	Data lines, twisted pair cables
9	red
10	black
11	white
12	blue
13	bare

The grounding of the shield should take place at the switchgear.

Chapter 4.2 “System data AC500” on page 34

5.2.5.1.3 State LEDs

Table 108: Meaning of the diagnosis LEDs

LED		Color	State	Description
	PWR	Green	ON (light)	Power supply available
			OFF (dark)	Power supply not available or defective hardware
	RDY	Yellow	ON	Boot procedure
			Blinking	Boot failure
			OFF	---
	RUN	Green	ON	Communication module is operational
			Blinking	---
			OFF	Communication module is not operational
	CAN-RUN	Green	ON	Operational: Device is in the OPERATIONAL state
			Single flash	Stopped: Device is in STOPPED state
			Blinking	Pre-operational: Device is in the PREOPERATIONAL state
			OFF	No communication or no power supply
	CAN-ERR	Red	ON	CANopen bus is off
			Single flash	Warning limit reached: At least one of the error counters of the CAN controller has reached or exceeded the warning level (too many error frames)
			Double flash	Error control event: A guard event (NMT Slave or NMTmaster) or a heartbeat event (Heartbeat consumer) has occurred
			OFF	No Error: Device is in working condition
	CAN-RUN	Yellow	Blinking	No production data available,
	CAN-ERR	Yellow	(synchronously)	no bus communication possible.
LED state during firmware update	CAN-RUN	Green	Blinking	Firmware file transfers during communication module firmware update.
	CAN-ERR	Red	(synchronously)	
	CAN-RUN	Green	Blinking	Communication module writes the firmware file to the internal flash. Do not power off the PLC!
	CAN-ERR	Red	(alternately)	

5.2.5.1.4 Technical data

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

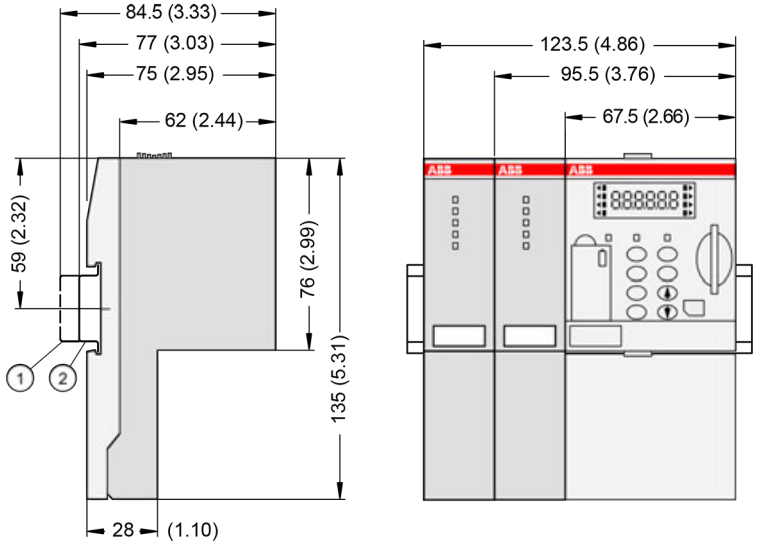
↳ *Chapter 4.3 “System data AC500-XC” on page 38*

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter	Value
Protocol	CANopen master, CAN2A, CAN2B
Transmission rate	10 kbit/s to 1 Mbit/s
Ambient temperature	see: System data AC500 ↳ *Chapter 4.2 “System data AC500” on page 34* System Data AC500-XC ↳ *Chapter 4.3 “System data AC500-XC” on page 38*
Usable terminal bases	All TB5xx
Field bus connector	Pluggable connector COMBICON, 5-pin
Technology	Hilscher NETX 100
Indicators	5 LEDs
Internal power supply	Via the communication module interface of the terminal base
Current consumption from 24 V DC power supply at the terminal base of the CPU	Typ. 65 mA
Number of slaves	Max. 126
Number of receive/transmit PDOs	Max. 512 (respectively for receive and transmit)
Total quantity of input and output data	Max. 3584 byte (respectively for input and output)
Weight	Ca. 150 g

5.2.5.1.5 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

5.2.5.1.6 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 173 800 R0001	CM598-CN, communication module CANopen master	Active
1SAP 373 800 R0001	CM598-CN-XC, communication module CANopen master, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.2.6 EtherCAT

Two alternatives are available for using EtherCAT:

- *Onboard EtherCAT for the AC500-eCo.*
- *EtherCAT for the AC500 with the CM579 communication module.*

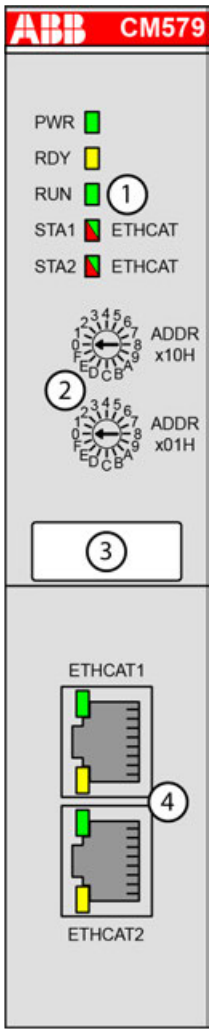
Further information can be found here:

Onboard EtherCAT

EtherCAT

↳ *CM579-ETHCAT*

5.2.6.1 CM579-ETHCAT - EtherCAT master



1 5 LEDs for state display
2 2 rotary switches for address setting (not used)
3 Label
4 2 communication interfaces RJ45 (ETHCAT1 and ETHCAT2)

5.2.6.1.1 Intended purpose

Communication module CM579-ETHCAT is for EtherCAT communication.

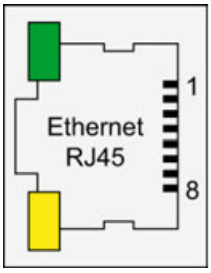
The comunication module is configured via the dual-port memory by means of a system configurator. The configuration is saved on a non-volatile flash EPROM memory.

5.2.6.1.2 Connections

Field bus interfaces

The EtherCAT communication module provides 2 RJ45 interfaces with the following pin assignment. The pin assignment is used for the EtherCAT slaves (communication interface modules CI5xy-ETHCAT) as well.

Pin assignment

Interface	Pin	Signal	Description
	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NC	Not connected
	5	NC	Not connected
	6	RxD-	Receive data -
	7	NC	Not connected
	8	NC	Not connected
	Shield	Cable shield	Functional earth

In corrosive environment, please protect unused connectors using the TA535 accessory.

Not supplied with this device.

The EtherCAT network differentiates between input-connectors (IN) and output-connectors (OUT):

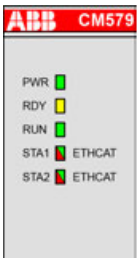
At the EtherCAT slaves (communication interface modules), the ETH1-connector is IN and the ETH2-connector is OUT.

At the EtherCAT master (communication module), the ETHCAT1 connector has to be used. The ETHCAT2 connector is reserved for future extensions.

5.2.6.1.3 State LEDs

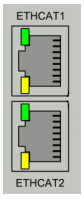
The EtherCAT state is shown by the EtherCAT communication module's LEDs. Some LEDs are two-colored.

Table 109: Meaning of the diagnosis LEDs

LED		Color	State	Description
	PWR	Green	On	Power supply available
			Blinking	---
			Off	Power supply not available or defective hardware
	RDY	Yellow	On	Boot procedure
			Blinking	Boot failure
			Off	---
	RUN	Green	On	Communication module is operational
			Blinking	---
			Off	Communication module is not operational
	STA1	Green	On	No bus error, communication running
			Blinking	Establishing communication
			Off	System error
	STA2	Red	On	Configuration error
			Blinking	---
			Off	No error
	STA1	Yellow	Blinking	No production data available,
	STA2	Yellow	(synchronously)	no bus communication possible.
LED state during firmware update	STA1	Green	Blinking	Firmware file transfers during communication module firmware update.
	STA2	Red	(synchronously)	
	STA1	Green	Blinking	Communication module writes the firmware file to the internal flash. Do not power off the PLC!
	STA2	Red	(alternately)	

The RJ45 Ethernet connector contains two LEDs showing the current Ethernet port connection state.

Table 110: Meaning of the diagnosis LEDs

LED		Color	State	Description
	ETHCAT1 LED "Link"	Green	On	Ethernet connection established
			Off	No Ethernet connection
	ETHCAT1 LED "RX/TX"	Yellow	On	Device sends/receives frames
			Off	No Ethernet connection
	ETHCAT2 LED "Link"	Green		Connector ETHCAT2 is not used
	ETHCAT2 LED "RX/TX"	Yellow		

5.2.6.1.4 Technical data

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

↳ *Chapter 4.3 “System data AC500-XC” on page 38*

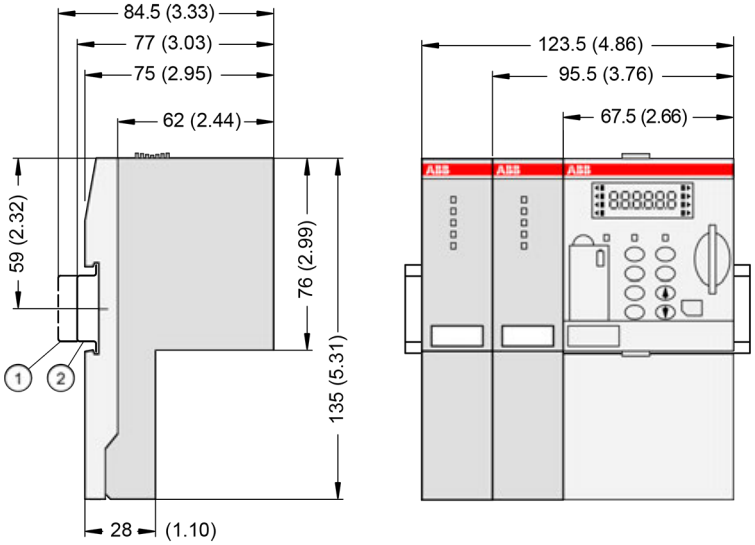
Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter	Value
Internal Supply	Via the communication module interface of the terminal base
Protocol	EtherCAT
Field bus connector	2 x RJ45 (ETHCAT1 and ETHCAT2)
Technology	Hilscher NETX 100
Transfer rate	10/100 Mbit/s (full-duplex)
Transfer method	According to Ethernet II, IEEE 802.3
Ethernet	100 base-TX, internal switch, 2x RJ45 socket
Bus length (segment length max.)	100 m at 100 Mbit/s
Indicators	5 LEDs
Usable CPUs	PM56xx ↳ *Chapter 5.1.2.2 “PM5630, PM5650, PM5670, PM5675, PM5680, PM5685” on page 220*
Usable terminal bases	All TB56xx (not TB5600) ↳ *Chapter 5.3.1 “TB5600, TB5610, TB5620, TB5640, TB5660” on page 284*
Ambient temperature	System data AC500 ↳ *Chapter 4.2 “System data AC500” on page 34* System Data AC500 XC ↳ *Chapter 4.3 “System data AC500-XC” on page 38*
Current consumption from 24 V DC power supply at the terminal base of the CPU	Typ. 85 mA
Internal supply	Via the communication module interface of the terminal base
Number of slaves	Limited to 200
Quantity of input and output data for a single slave	Max. 5760 bytes (respectively for input and output)
Total quantity of input and output data	Max. 5760 bytes (only valid for asynchronous operation, for synchronous operation the reachable values depends on the additional load of SoE, CoE and EoE, typical reachable values are 1024 bytes).
Supported protocols	RTC - Real-time cyclic protocol, class 1 RTA - Real-time acyclic protocol
Acyclic services	● CoE upload ● CoE download (1500 bytes max.) ● Emergency
Min. bus cycle	1 ms

Parameter	Value
Max. size of the bus configuration file	2 MB
Weight	Ca. 170 g

5.2.6.1.5 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

5.2.6.1.6 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 170 902 R0101	CM579-ETHCAT, EtherCAT communication module	Active

*) *Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.2.7 Ethernet

5.2.7.1 CM5640-2ETH - Communication module Ethernet

- TCP/IP with 2 independent channels
- XC version for use in extreme ambient conditions available



1 5 LEDs for state display
2 2 rotary switches for station identification
3 Label
4 2 communication interfaces Ethernet RJ45
❄ Sign for XC version

5.2.7.1.1 Purpose

The communication module provides additional communication ports for the CPU. The Ethernet communication module is a port extender that provides two additional, separate, non-programmable Ethernet interfaces for the CPU processor module used.

Each communication module and port used results in a slightly higher CPU load on the CPU compared to using the same protocol via the onboard port, since the communication module and the transmission of the communication packets must be additionally processed by the CPU. The complete TCP/IP protocol and the application layers are supported.

- *Each communication module port must be addressed via its IP address (not slot no.) and must be in a different subnet than the port(s) of the CPU.*
- *Each used communication module and port causes a slightly higher CPU load compared to using the same protocol onboard.*

It is not possible to close a RSTP ring by using the two ports of the communication module.

Applications:

- TCP/IP for PC/Automation Builder (programming)
- UDP functions using SysSocket or NetBaseServices libraries
- Modbus on TCP/IP (Modbus on TCP/IP, client and server and all standard protocols from the PLC)

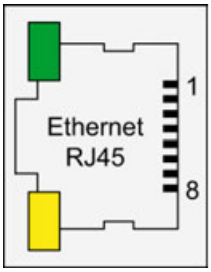
For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

5.2.7.1.2 Connections

Field bus interfaces

The Ethernet communication module has 2 RJ45 interfaces:

Pin assignment

Interface	Pin	Signal	Description
	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NC	Not connected
	5	NC	Not connected
	6	RxD-	Receive data -
	7	NC	Not connected
	8	NC	Not connected
	Shield	Cable shield	Functional earth

In corrosive environment, please protect unused connectors using the TA535 accessory.

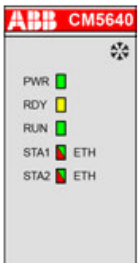
Not supplied with this device.

Direct connection of two CM5640 modules through their ETH2 ports is not recommended and should be avoided.

5.2.7.1.3 State LEDs

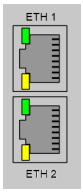
The Ethernet state is shown by the Ethernet communication module's LEDs.

Table 111: Meaning of the diagnosis LEDs

LED		Color	State	Description
	PWR	Green	On	Power supply available
			Off	Power supply not available or defective module
	RDY	Yellow	On	Boot procedure
			Off	Awaiting boot
			Blinking	Boot failure
	RUN	Green	On	Communication module is operational
			Off	Communication module is not operational
	STA1	Green	On	Communication module is activated
			Off	Communication module awaiting activation
	STA2	Red	On	Diagnosis available not fetched by PLC
			Off	No error
LED state during firmware update	STA1	Green	Blinking (alternately)	Communication module is in firmware update state. Do not power off the PLC!
	STA2	Red		

The RJ45 Ethernet connector contains two LEDs showing the current Ethernet port connection state.

Table 112: Meaning of the diagnosis LEDs

LED		Color	State	Description
	ETH1 LED "Link"	Green	On	Ethernet connection established
			Off	No Ethernet connection
	ETH1 LED "RX/TX"	Yellow	On	---
			Blinking	Device sends/receives frames
			Off	---
	ETH2 LED "Link"	Green	On	Ethernet connection established
			Off	No Ethernet connection
	ETH2 LED "RX/TX"	Yellow	On	---
			Blinking	Device sends/receives frames
			Off	---

5.2.7.1.4 Technical data

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

↳ *Chapter 4.3 “System data AC500-XC” on page 38*

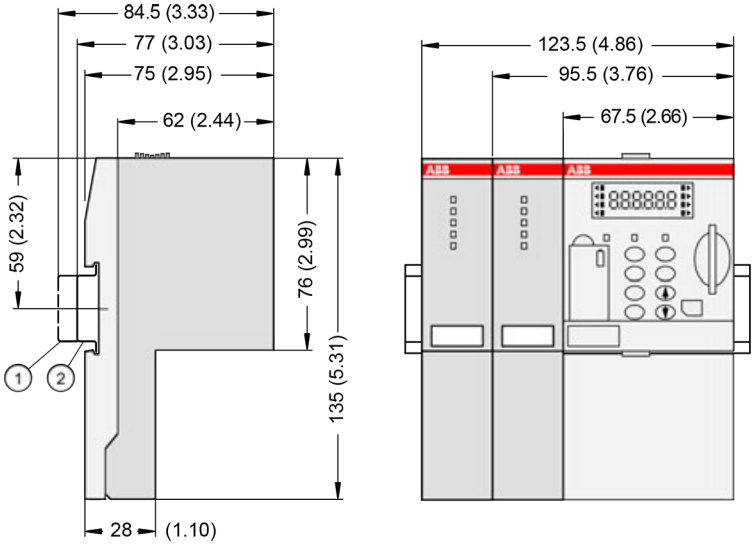
Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter			Value
Protocols			
	Ethernet		
		TCP/IP	Yes
		UPD/IP	Yes
	Modbus TCP		Yes
	ICMP (Ping)		Yes
	DNS		Yes
	SMTP (email)		Yes
	DHCP		Yes
	PRP		Yes
State LED			
	PWR		1
	RUN		1
	RDY		1
	STA		2
Rotary switch			
	ADDR 00...FFhex		2, for station identification
Ethernet interfaces			
	Physical layer		10/100Base-TX
	Connection name		ETH <Slot>1, ETH <Slot>2
	Connection type		
		Independent channels	Yes, 2
		Internal switch	No
	Auto negotiation		Yes, not adjustable/changeable
	MAC address		Not configurable
	Transmission rate		10/100 Mbit/s
	Max. cable length		100 m at 100 Mbit/s
	Usage		
		Programming	3S Online Protocol
		TCP/IP	Yes
		Modbus TCP	Yes
		Online access	3S Online Protocol
Communication module interface/bus			Dual-port RAM
Net weight			0.12 kg
Power supply			
	Nominal supply voltage		
		Supply current at nominal supply voltage (depending on system architecture)	47 mA per communication module at 24 V
	Internal power supply source		Communication module bus
Hardware			

Parameter		Value
	Usable CPUs	PM56xx *Chapter 5.1.2.2 “PM5630, PM5650, PM5670, PM5675, PM5680, PM5685” on page 220*
	Usable terminal bases	TB56xx *Chapter 5.3.1 “TB5600, TB5610, TB5620, TB5640, TB5660” on page 284*

5.2.7.1.5 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

5.2.7.1.6 Ordering data

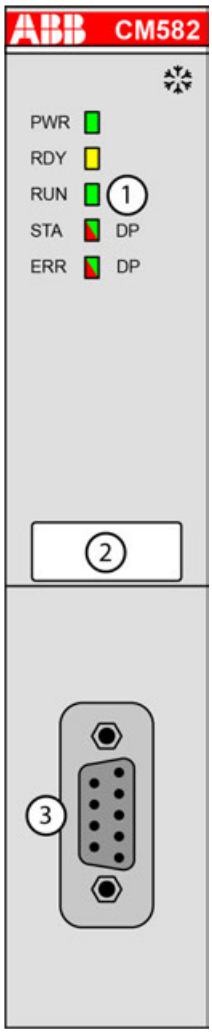
Part no.	Description	Product life cycle phase *)
1SAP 176 000 R0080	CM5640-2ETH, communication module Ethernet TCP/IP with 2 RJ45 CPU port extensions	Active
1SAP 376 000 R0080	CM5640-2ETH-XC, communication module Ethernet TCP/IP with 2 RJ45 CPU port extensions, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.2.8 PROFIBUS

5.2.8.1 CM582-DP - PROFIBUS DP slave

- PROFIBUS DP slave 12 Mbit/s
- Compatible with Automation Builder version starting from V2.0.2, and with CPU firmware version starting from V2.6
- XC version for use in extreme ambient conditions available



1 5 LEDs for state display
2 Label
3 Communication interface PROFIBUS DP D-sub, 9-pin, female
❄ Sign for XC version

5.2.8.1.1 Purpose

Communication module CM582-DP enables communication over the PROFIBUS DP field bus.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

5.2.8.1.2 Connections

Field bus interface

The PROFIBUS DP connector (9-pin, female) has the following pin assignment:

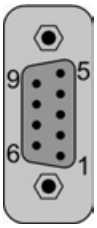
Pin		Signal	Description
	1	NC	Not connected
	2	NC	Not connected
	3	RxD/TxD-P	Receive/Transmit positive
	4	CNTR-P	Control signal for repeater, positive
	5	DGND	Reference potential for data exchange and +5 VI
	6	VP	+5 V (power supply for the bus terminating resistors)
	7	NC	Not connected
	8	RxD/TxD-N	Receive/Transmit negative
	9	NC	Not connected

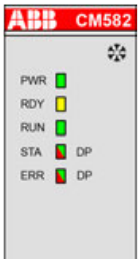
Table 113: Correlation of transmission rate, bit time and cable length:

Tranmission rate in [kbit/s]	Bit time [tBit]	Max. cable length in [m]
9.6	104.2 µs	1200
19.2	52.1 µs	1200
31.25	32 µs	1200
45.45	22 µs	1200
93.75	10.7 µs	1200
187.5	5.3 µs	1000
500	2 µs	400
1500	666.7 ns	200
3000	333.3 ns	100
6000	166.7 ns	100
12000	83.3 ns	100

5.2.8.1.3 State LEDs

The PROFIBUS state is shown by state LEDs.

Table 114: Meaning of the diagnosis LEDs

LED		Color	State	Description
	PWR	Green	ON (light)	Power supply available.
			OFF (dark)	Power supply not available or defective hardware
	RDY	Yellow	ON	Boot procedure
			Blinking	Boot failure
			OFF	---
	RUN	Green	ON	Communication module is operational
			Blinking	---
			OFF	Communication module is not operational
	STA	Green	ON	Communication to all slaves is established
			Flashes cyclic	---
			Flashes non-cyclic	No configuration or stack error
			OFF	No communication
	ERR	Red	Blinking	No data exchange to the master module or the cable is disconnected
			OFF	No error
	STA	Yellow	Blinking (synchronously)	No production data available, no bus communication possible.
	ERR	Yellow		
LED state during firmware update	STA	Green	Blinking (synchronously)	Firmware file transfers during communication module firmware update.
	ERR	Red		
	STA	Green	Blinking (alternately)	Communication module writes the firmware file to the internal flash. Do not power off the PLC!
	ERR	Red		

5.2.8.1.4 Technical data

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

↳ *Chapter 4.3 “System data AC500-XC” on page 38*

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

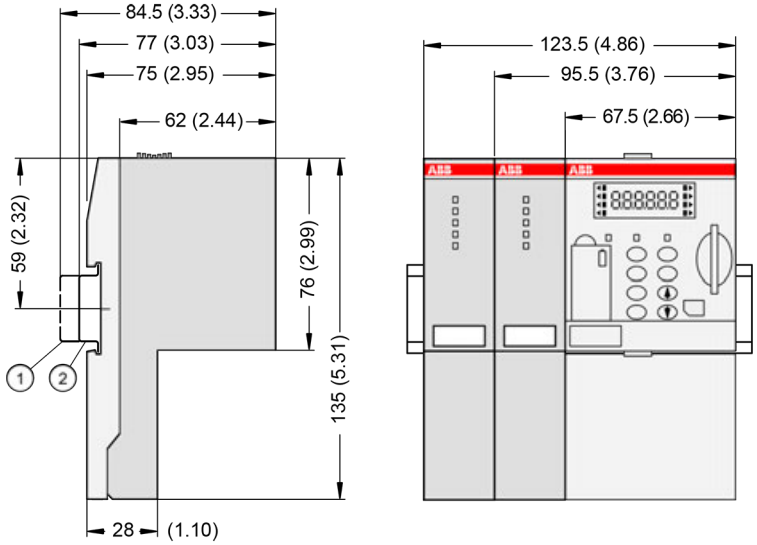
Parameter	Value
State indication	By 5 LEDs PWR, RDY, RUN, STA, ERR
Usable CPUs	PM57x, PM58x, PM59x

Parameter	Value
Usable terminal bases	All TB5xx
Current consumption from 24 V DC power supply at the terminal base of the CPU	Typ. 65 mA
Internal power supply	Through the communication module interface of the terminal base
Maximum number of cyclic input data	244 bytes
Maximum number of cyclic output data	244 bytes
Maximum number of acyclic read/write	240 bytes
Configuration data	max. 244 bytes
Parameter data	237 bytes application specific parameters
Processor	Hilscher NETX 100
Internal RAM memory	8 MB
External flash memory	8 MB
Weight	Ca. 150 g

Technical data of the interface

Parameter	Value
Interface socket	9-pin, D-sub socket
Transmission standard	EIA RS-485 acc. to IEC 61158/61784, potential-free
Transmission protocol	PROFIBUS DP
Transmission rate	9.6 kbit/s up to 12 Mbit/s

5.2.8.1.5 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

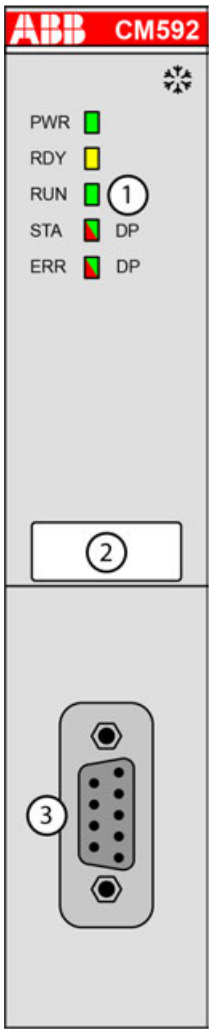
5.2.8.1.6 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 172 200 R0001	CM582-DP, communication module PROFIBUS DP slave, 12 MBit/s	Active
1SAP 372 200 R0001	CM582-DP-XC, communication module PROFIBUS DP slave, 12 MBit/s, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.2.8.2 CM592-DP - PROFIBUS DP master

- Master 12 Mbit/s
- XC version for use in extreme ambient conditions available



1 5 LEDs for state display
2 Label
3 Communication interface PROFIBUS DP D-sub, 9-pin, female
❄ Sign for XC version

5.2.8.2.1 Purpose

Communication module CM592-DP enables communication over the PROFIBUS DP field bus.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

5.2.8.2.2 Connections

Field bus interface

The PROFIBUS DP connector (9-pin, female) has the following pin assignment:

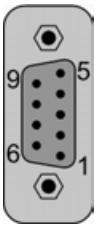
Pin		Signal	Description
	1	NC	Not connected
	2	NC	Not connected
	3	RxD/TxD-P	Receive/Transmit positive
	4	CNTR-P	Control signal for repeater, positive
	5	DGND	Reference potential for data exchange and +5 VI
	6	VP	+5 V (power supply for the bus terminating resistors)
	7	NC	Not connected
	8	RxD/TxD-N	Receive/Transmit negative
	9	NC	Not connected

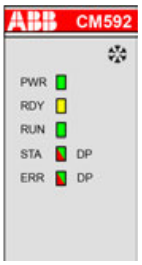
Table 115: Correlation of transmission rate, bit time and cable length:

Tranmission rate in [kbit/s]	Bit time [tBit]	Max. cable length in [m]
9.6	104.2 µs	1200
19.2	52.1 µs	1200
31.25	32 µs	1200
45.45	22 µs	1200
93.75	10.7 µs	1200
187.5	5.3 µs	1000
500	2 µs	400
1500	666.7 ns	200
3000	333.3 ns	100
6000	166.7 ns	100
12000	83.3 ns	100

5.2.8.2.3 State LEDs

The PROFIBUS state is shown by state LEDs.

Table 116: Meaning of the diagnosis LEDs

LED		Color	State	Description
	PWR	Green	ON (light)	Power supply available
			OFF (dark)	Power supply not available or defective hardware
	RDY	Yellow	ON	Boot procedure
			Blinking	Boot failure
			OFF	---
	RUN	Green	ON	Communication module is operational
			Blinking	---
			OFF	Communication module is not operational
	STA	Green	ON	Communication to all slaves is established
			Flashes cyclic	---
			Flashes non-cyclic	No configuration or stack error
			OFF	No communication
	ERR	Red	ON	Communication to one/all slaves is disconnected
			Flashes cyclic	Communication to at least one slave is disconnected
			OFF	No error
	STA	Yellow	Blinking (synchronously)	No production data available, no bus communication possible.
	ERR	Yellow		
LED state during firmware update	STA	Green	Blinking (synchronously)	Firmware file transfers during communication module firmware update.
	ERR	Red		
	STA	Green	Blinking (alternately)	Communication module writes the firmware file to the user flash memory. Do not power off the PLC!
	ERR	Red		

5.2.8.2.4 Technical data

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

↳ *Chapter 4.3 “System data AC500-XC” on page 38*

Only deviating specifications are therefore described here.

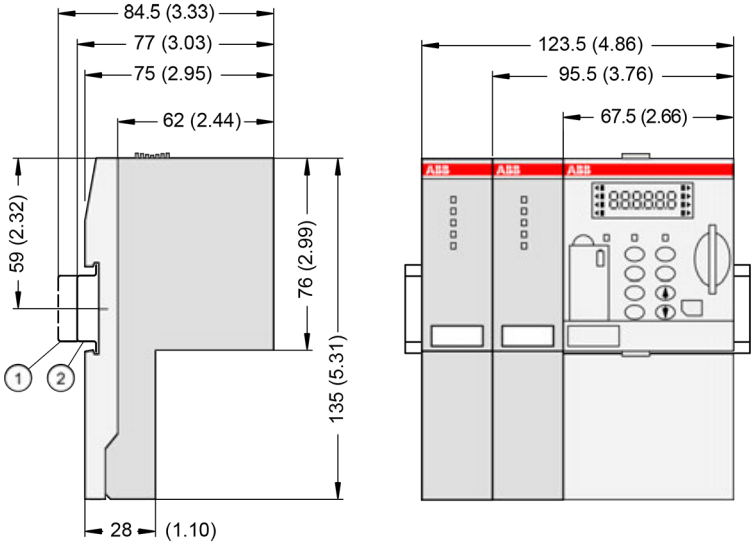
The technical data is also applicable to the XC version.

Parameter	Value
State indication	By 5 LEDs PWR, RDY, RUN, STA, ERR
Usable CPUs	PM57x, PM58x, PM59x
Usable terminal bases	All TB5xx
Current consumption from 24 V DC power supply at the terminal base of the CPU	Typ. 65 mA
Internal power supply	Through the communication module interface of the terminal base
Maximum number of supported slaves	125 (DPV0/DPV1)
Maximum number of total cyclic input data	5712 bytes (Status information is separately managed)
Maximum number of total cyclic output data	5760 bytes
Maximum number of cyclic intput data	244 bytes/slave
Maximum number of cyclic output data	244 bytes/slave
Configuration data	max. 244 bytes per slave
Parameterization data per slave	7 bytes/slave standard parameters 237 bytes/slave application specific parameters
Maximum number of acyclic read/write	240 bytes per slave and telegram
Processor	Hilscher NETX 100
Internal RAM memory	8 MB
External user flash memory	8 MB
Weight	Ca. 150 g

Technical data of the interface

Parameter	Value
Interface socket	9-pin, D-sub socket
Transmission standard	EIA RS-485 acc. to IEC 61158/61784, potential-free
Transmission protocol	PROFIBUS DP
Transmission rate	9.6 kbit/s up to 12 Mbit/s

5.2.8.2.5 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

> *The dimensions are in mm and in brackets in inch.*

5.2.8.2.6 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 173 200 R0001	CM592-DP, communication module PROFIBUS DP master, 12 MBit/s	Active
1SAP 373 200 R0001	CM592-DP-XC, communication module PROFIBUS DP master, 12 MBit/s, XC version	Active

> **) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.2.8.3 PROFIBUS connection details

Attachment plug for the bus cable 9-pin D-sub connector, male

Parameter	Value
Fastening torque	0.4 Nm

Assignment

Pin	Signal	Description
1	Shield	Shielding, protective ground
2	not used	-
3	RxD/TxD-P	Reception / transmission line, positive
4	CBTR-P	Control signal for repeater, positive (optional)
5	DGND	Reference potential for data lines and +5 V
6	VP	+5 V, supply voltage for bus terminating resistors
7	not used	-
8	RxD/TxD-N	Reception / transmission line, negative
9	CNTR-N	Control signal for repeater, negative (optional)

Bus cable

Parameter	Value
Type	Twisted pair (shielded)
Characteristic impedance	135 Ω ... 165 Ω
Cable capacitance	< 30 pF/m
Conductor diameter of the cores	≥ 0.64 mm
Conductor cross section of the cores	≥ 0.34 mm²
Cable resistance per core	≤ 55 Ω/km
Loop resistance (resistance of two cores)	≤ 110 Ω/km

Cable lengths

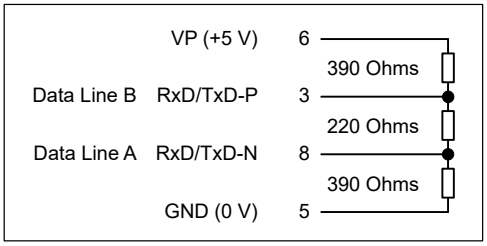
The maximum possible cable length of a PROFIBUS subnet within a segment depends on the tranmission rate (baud rate).

Transmission Rate	Maximum Cable Length
9.6 / 19.2 / 93.75 kBaud	1200 m
187.5 kBaud	1000 m
500 kBaud	400 m
1.5 MBaud	200 m
3 MBaud to 12 MBaud	100 m

Branch lines are generally permissible for transmission rates of up to 1500 kbit/s. But in fact they should be avoided for transmission rates higher than 500 kbit/s.

Bus terminating resistors

The line ends (of the bus segments) have to be terminated using bus terminating resistors according to the drawing below. The bus terminating resistors are usually placed inside the bus connector.



Repeaters

One bus segment can have up to 32 subscribers. Using repeaters a system can be expanded to up to 126 subscribers. Repeaters are also required for longer transfer lines. Please note that a repeater's load to the bus segment is the same as the load of a normal bus subscriber. The sum of normal bus subscribers and repeaters in one bus segment must not exceed 32.

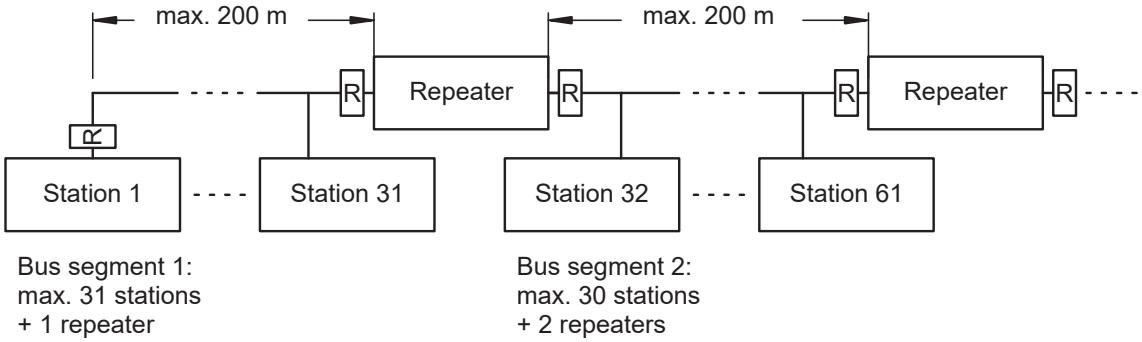
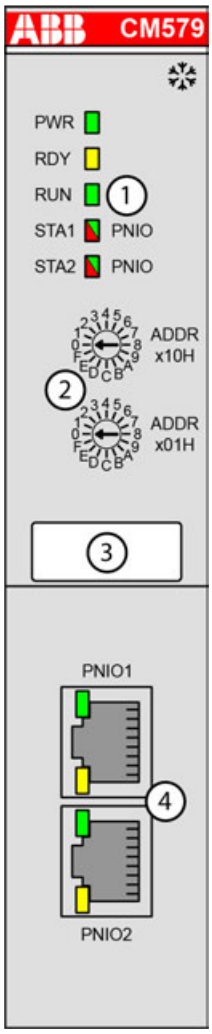


Fig. 23: Principle example for a PROFIBUS-DP system with repeaters (1500 kbit/s baud rate)

5.2.9 PROFINET

5.2.9.1 CM579-PNIO - PROFINET IO RT controller

- PROFINET IO controller
- Integrated 2-port switch
- XC version for use in extreme ambient conditions available



1 5 LEDs for state display
2 2 rotary switches for address setting (not used)
3 Label
4 2 communication interfaces RJ45 (PNIO1 and PNIO2)
❄ Sign for XC version

5.2.9.1.1 Intended purpose

The communication module is for PROFINET RT communication.

The PROFINET communication module includes an internal Ethernet switch. The connection to the Ethernet can be established directly to the communication module. An additional switch is not necessary.

The communication module is configured via the dual-port memory by means of a system configurator. The configuration is saved on a non-volatile flash EPROM memory.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

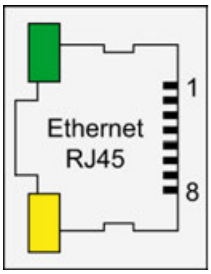
5.2.9.1.2 Functionality

Parameter	Value
Protocol	PROFINET IO RT
Usable CPUs	PM57x, PM58x, PM59x *Chapter 5.1.2.2 "PM5630, PM5650, PM5670, PM5675, PM5680, PM5685" on page 220*
Usable terminal bases	All TB56xx (not TB5600) *Chapter 5.3.1 "TB5600, TB5610, TB5620, TB5640, TB5660" on page 284*
Field bus connector	2 RJ45 (PNIO1 and PNIO2), with integrated 2-port switch
Internal supply	Via the communication module interface of the terminal base

5.2.9.1.3 Connections

Field bus interfaces The communication module provides 2 RJ45 interfaces.

Pin assignment

Interface	Pin	Signal	Description
	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NC	Not connected
	5	NC	Not connected
	6	RxD-	Receive data -
	7	NC	Not connected
	8	NC	Not connected
	Shield	Cable shield	Functional earth

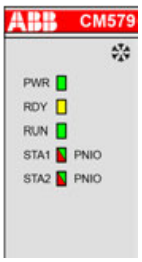
In corrosive environment, please protect unused connectors using the TA535 accessory.

Not supplied with this device.

5.2.9.1.4 State LEDs

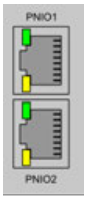
The PROFINET state is shown by the state LEDs.

Table 117: Meaning of the diagnosis LEDs

LED		Color	State	Description
	PWR	Green	On	Power supply available
			Blinking	---
			Off	Power supply not available or defective hardware
	RDY	Yellow	On	Boot procedure
			Blinking	Boot failure
			Off	---
	RUN	Green	On	Communication module is operational
			Blinking	---
			Off	Communication module is not operational
	STA1	Red	On	Diagnosis alarm reported. At least one device is having a diagnosis alarm. In incorporation with STA2 PNIO: License fault.
			Blinking	System error
			Off	No system error
	STA2	Red	On	No connection; in incorporation with STA1 PNIO: license fault
			Blinking	Configuration fault: some configured I/O modules are not connected
			Off	No bus error, communication is running
	STA1	Yellow	Blinking	No production data available,
	STA2	Yellow	(synchronously)	no bus communication possible.
LED state during firmware update	STA1	Green	Blinking	Firmware file transfers during communication module firmware update.
	STA2	Red	(synchronously)	
	STA1	Green	Blinking	Communication module writes the firmware file to the internal flash. Do not power off the PLC!
	STA2	Red	(alternately)	

The RJ45 Ethernet connector contains two LEDs showing the current Ethernet port connection state.

Table 118: Meaning of the diagnosis LEDs

LED		Color	State	Description
	PNIO1 LED "Link"	Green	On	Ethernet connection established
			Off	No Ethernet connection
	PNIO1 LED "RX/TX"	Yellow	On	---
			Blinking	PROFINET device sends/receives frames
			Off	---
	PNIO2 LED "Link"	Green	On	Ethernet connection established

LED		Color	State	Description
			Off	No Ethernet connection
	PNIO2 LED "RX/TX"	Yellow	On	---
			Blinking	PROFINET device sends/receives frames
			Off	---

5.2.9.1.5 Technical data

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

↳ *Chapter 4.3 “System data AC500-XC” on page 38*

Only deviating specifications are therefore described here.

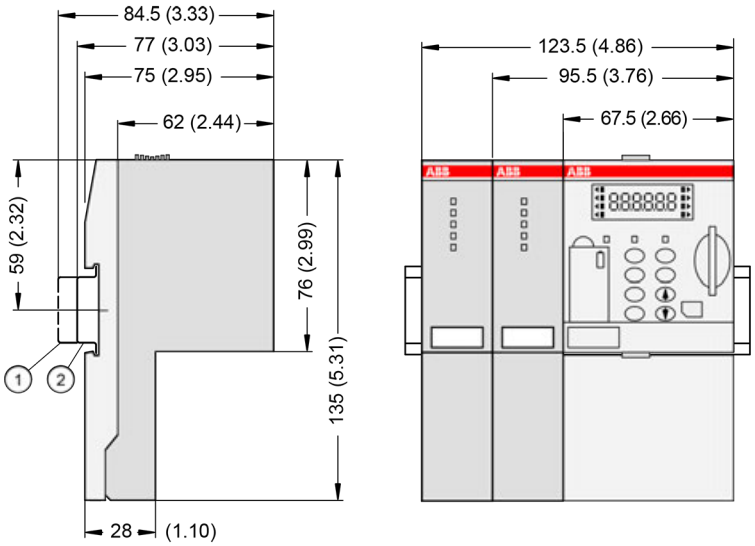
The technical data is also applicable to the XC version.

Parameter	Value
Protocol	PROFINET IO RT
Bus connection	2 RJ45 (PNIO1 and PNIO2), with integrated 2-port switch
Switch	Integrated
Technology	Hilscher NETX 100
Transfer rate	100 Mbit/s (full-duplex)
Transfer method	According to Ethernet II, IEEE 802.3
Ethernet	100 base-TX, internal switch, 2x RJ45 socket
Bus length (segment length max.)	100 m
Indicators	5 LEDs
Usable terminal bases	All TB56xx (not TB5600) ↳ *Chapter 5.3.1 “TB5600, TB5610, TB5620, TB5640, TB5660” on page 284*
Supported alarm types	Process alarm, diagnostic alarm, return of Sub-Module, plug alarm, pull alarm
Alarm processing	Requires handling in application program
Current consumption from 24 V DC power supply at the terminal base of the CPU	Typ. 85 mA
Internal supply	Via the communication module interface of the terminal base
Weight	Ca. 170 g
Maximum number of remote I/O stations connected	128

Parameter		Value
Supported protocols		RTC - real-time cyclic protocol, class 1 RTA - real-time acyclic protocol DCP - discovery and configuration protocol *) CL-RPC - connectionless remote procedure call Since revision FW 2.4.8.0 additionally LLDP - link layer discovery protocol SNMP - simply network management protocol (SNMP v1)
Acyclic services		PNIO read / write (max. 1392 bytes per telegram, max. 4096 bytes per service request)
Total quantity of input and output data		
	CM579-PNIO < FW 2.4.8.0	1024 bytes per I/O module 3072 bytes in total
	CM579-PNIO = FW 2.4.8.0	1024 bytes per I/O module 4096 bytes in total
	CM579-PNIO > FW 2.4.8.0	1440 bytes per I/O module PM5630, PM5650: 4096 bytes in total PM567x: 5120 bytes in total
Min. bus cycle		1 ms
Conformance class		CC A

*) CM579-PNIO does not allow setting "Station name" by using PROFINET service "DCP SET NameOfStation".

5.2.9.1.6 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

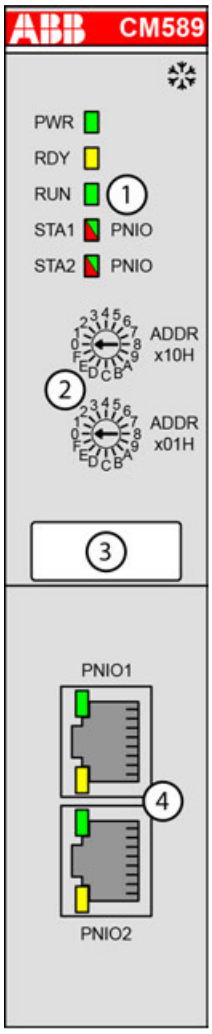
5.2.9.1.7 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 170 901 R0101	CM579-PNIO, PROFINET communication module	Active
1SAP 370 901 R0101	CM579-PNIO-XC, PROFINET communication module, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.2.9.2 CM589-PNIO(-4) - PROFINET IO RT with 4 devices

- PROFINET IO device
- Integrated 2-port switch
- XC version for use in extreme ambient conditions available



1 5 LEDs for state display
2 2 rotary switches for setting the IO device identifier
3 Label
4 2 communication interfaces RJ45 (PNIO1 and PNIO2)
❄ Sign for XC version

The communication module is for PROFINET RT communication.

The PROFINET communication module includes an internal Ethernet switch. The connection to the Ethernet can be established directly to the communication module. An additional switch is not necessary.

The communication module is configured via the dual-port memory by means of a system configurator. The configuration is saved on a non-volatile flash EPROM memory.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

CM589-PNIO(-4)

CM589-PNIO supports one application relation to communicate to one single PROFINET IO controller.

CM589-PNIO-4 supports 4 application relations to communicate to up to 4 PROFINET IO controllers in parallel using PROFINET Shared Device technology.

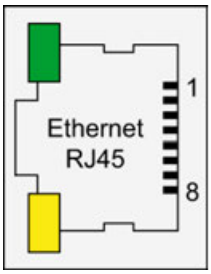
5.2.9.2.1 Functionality

Parameter	Value
Protocol	PROFINET IO RT
Usable CPUs	PM57x, PM58x, PM59x *Chapter 5.1.2.2 "PM5630, PM5650, PM5670, PM5675, PM5680, PM5685" on page 220*
Usable terminal bases	All TB56xx (not TB5600) *Chapter 5.3.1 "TB5600, TB5610, TB5620, TB5640, TB5660" on page 284*
Field bus connector	2 RJ45 (PNIO1 and PNIO2), with integrated 2-port switch
Internal supply	Via the communication module interface of the terminal base

5.2.9.2.2 Connections

Field bus interfaces The PROFINET communication module provides 2 RJ45 interfaces:

Pin assignment

Interface	Pin	Signal	Description
	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NC	Not connected
	5	NC	Not connected
	6	RxD-	Receive data -
	7	NC	Not connected
	8	NC	Not connected
	Shield	Cable shield	Functional earth

In corrosive environment, please protect unused connectors using the TA535 accessory.

Not supplied with this device.

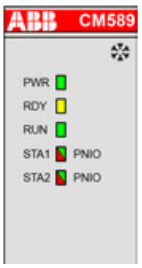
5.2.9.2.3 Addressing

The module reads the position of the rotary switches only during power-up, i.e. changes of the switch position during operation will have no effect until the next module initialization.

5.2.9.2.4 State LEDs

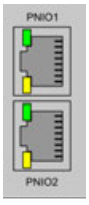
The PROFINET state is shown by the state LEDs.

Table 119: Meaning of the diagnosis LEDs

LED		Color	State	Description
	PWR	Green	On	Power supply available
			Blinking	---
			Off	Power supply not available or defective hardware
	RDY	Yellow	On	Boot procedure
			Blinking	Boot failure
			Off	---
	RUN	Green	On	Communication module is operational
			Blinking	---
			Off	Communication module is not operational
	STA1	Red	On	System error; watchdog timeout
			Blinking	
			Off	No system error
	STA2	Red	On	No connection; no configuration
			Blinking	No data exchange
			Off	No bus error, communication is running
	STA1	Yellow	Blinking (synchronously)	No production data available, no bus communication possible.
	STA2	Yellow		
LED state during firmware update	STA1	Green	Blinking (synchronously)	Firmware file transfers during communication module firmware update.
	STA2	Red		
	STA1	Green	Blinking (alternately)	Communication module writes the firmware file to the internal flash. Do not power off the PLC!
	STA2	Red		

The RJ45 Ethernet connector contains two LEDs showing the current Ethernet port connection state.

Table 120: Meaning of the diagnosis LEDs

LED		Color	State	Description
	PNIO1 LED "Link"	Green	On	Ethernet connection established
			Off	No Ethernet connection
	PNIO1 LED "RX/TX"	Yellow	On	PROFINET device sends/receives frames
			Blinking	PROFINET device sends/receives frames
			Off	---
	PNIO2 LED "Link"	Green	On	Ethernet connection established
			Off	No Ethernet connection
	PNIO2 LED "RX/TX"	Yellow	On	PROFINET device sends/receives frames

LED		Color	State	Description
			Blinking	PROFINET device sends/receives frames
			Off	---

5.2.9.2.5 Technical data

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

↳ *Chapter 4.3 “System data AC500-XC” on page 38*

Only deviating specifications are therefore described here.

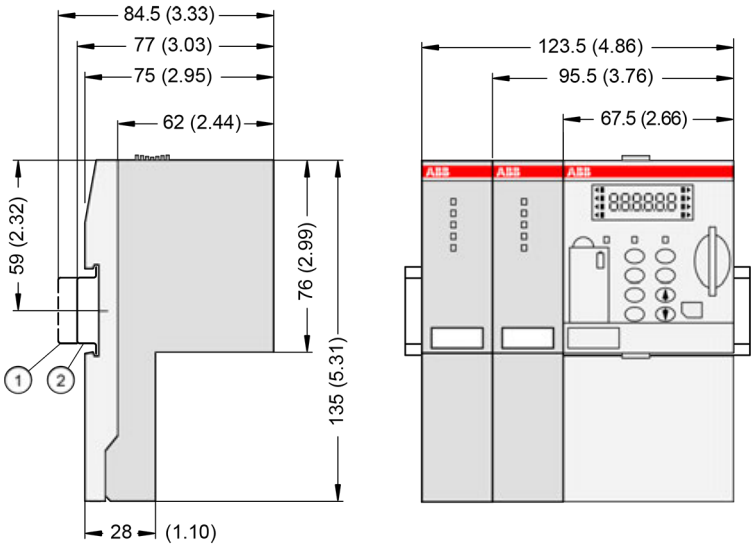
The technical data is also applicable to the XC version.

Parameter	Value
Protocol	PROFINET IO RT
Bus connection	2 RJ45 (PNIO1 and PNIO2), with integrated 2-port switch
Switch	Integrated
Technology	Hilscher NETX 100
Transfer rate	100 Mbit/s (full-duplex)
Transfer method	According to Ethernet II, IEEE 802.3
Ethernet	100 base-TX, internal switch, 2x RJ45 socket
Bus length (segment length max.)	100 m
Indicators	5 LEDs
Usable terminal bases	All TB56xx (not TB5600) ↳ *Chapter 5.3.1 “TB5600, TB5610, TB5620, TB5640, TB5660” on page 284*
Supported alarm types	Process alarm, diagnostic alarm, return of SubModule, plug alarm, pull alarm
Current consumption from 24 V DC power supply at the terminal base of the CPU	Typ. 85 mA
Internal supply	Via the communication module interface of the terminal base
Setting of the I/O device identifier	With 2 rotary switches at the front side of the module
Weight	Ca. 170 g

Parameter	Value
Supported protocols	RTC - real-time cyclic protocol, class 1 RTA - real-time acyclic protocol DCP - discovery and configuration protocol *) CL-RPC - connectionless remote procedure call LLDP - link layer discovery protocol SNMP - simply network management protocol MRP - MRP Client
Acyclic services	PNIO read / write CM589-PNIO < FW 1.4.0: max. 1024 bytes CM589-PNIO ≥ FW 1.4.0: max. 8096 bytes CM589-PNIO-4: max. 8096 bytes
Total quantity of input and output data	CM589-PNIO < FW 1.4.0 (respectively for input and output): max. 1024 byte CM589-PNIO ≥ FW 1.4.0 (respectively for input and output): max. 1440 byte CM589-PNIO-4 (respectively for input and output): max. 1440 byte
Min. bus cycle	1 ms
Conformance class	CC B

*) Setting NameOfStation via service "DCP SET NameOfStation" is enabled only if rotary switches are adjusted to position "00".

5.2.9.2.6 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

5.2.9.2.7 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 172 900 R0011	CM589-PNIO, PROFINET communication module	Active
1SAP 372 900 R0011	CM589-PNIO-XC, PROFINET communication module, XC version	Active
1SAP 172 900 R0111	CM589-PNIO-4, PROFINET communication module	Active
1SAP 372 900 R0111	CM589-PNIO-4-XC, PROFINET communication module, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.3 Terminal bases for AC500(-XC) processor modules and communication modules

5.3.1 TB5600, TB5610, TB5620, TB5640, TB5660

- TB5600-2ETH: 1 processor module, with network interface 2 Ethernet RJ45, 1 CAN and 1 COM1
- TB5610-2ETH: 1 processor module, 1 communication module, with network interface 2 Ethernet RJ45, 1 CAN and 1 COM1
- TB5620-2ETH: 1 processor module, 2 communication modules, with network interface 2 Ethernet RJ45, 1 CAN and 1 COM1
- TB5640-2ETH: 1 processor module, 4 communication modules, with network interface 2 Ethernet RJ45, 1 CAN and 1 COM1
- TB5660-2ETH: 1 processor module, 6 communication modules, with network interface 2 Ethernet RJ45, 1 CAN and 1 COM1
- XC version for use in extreme ambient conditions available

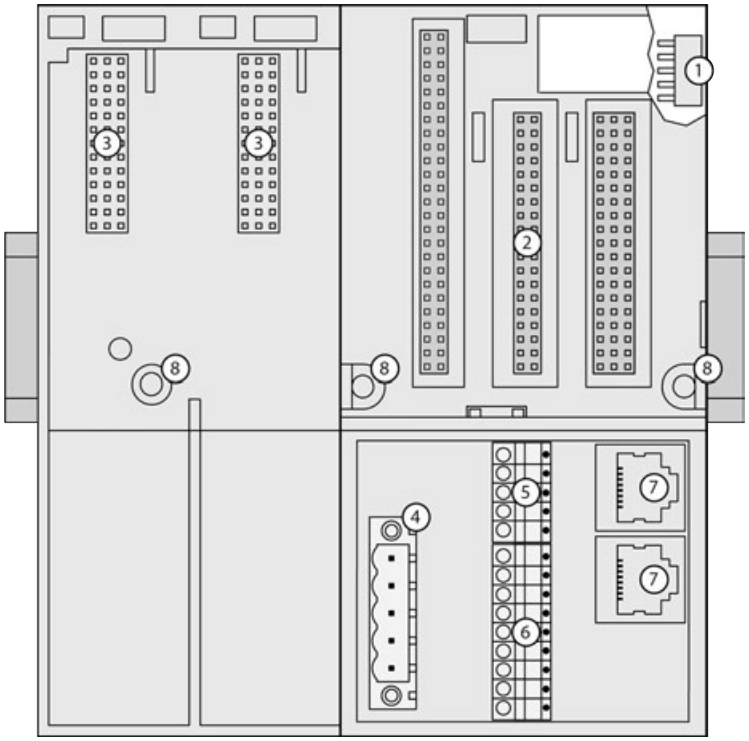
Terminal bases TB56xx-2ETH can only be used with processor modules PM56xx-2ETH.

Table 121: Combination of TB56xx-2ETH(-XC) and PM56xx(-XC)

Processor module	PM5630	PM5650	PM5670	PM5675	PM5680 [2)]	PM5685 [2)]
TB5600-2ETH	0 slot	0 slot	0 slot	0 slot	0 slot	0 slot
TB5610-2ETH	1 slot	1 slot	1 slot	1 slot	1 slot	1 slot
TB5620-2ETH	2 slots	2 slots	2 slots	2 slots	2 slots	2 slots
TB5640-2ETH	-	4 slots	4 slots	4 slots	4 slots	4 slots

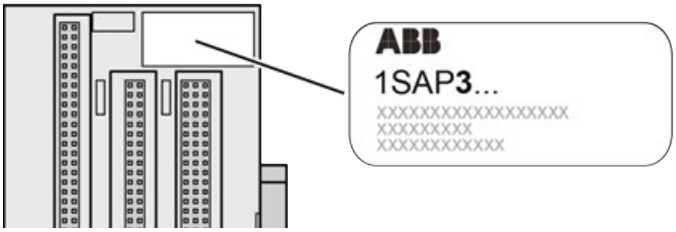
Processor module	PM5630	PM5650	PM5670	PM5675	PM5680 [2)]	PM5685 [2)]
TB5660-2ETH	-	-	6 slots [1)]	6 slots [1)]	-	6 slots
Remarks: The slots can be used for connecting communication modules or AC500-S modules. Note that only one AC500-S module can be connected at one terminal base. [1)] PM567x must have the order numbers 1SAP151000R0378, 1SAP151500R0378 or a production index ≥ C0. [2)] XC variant is not applicable.						

The following figure shows the TB5620-2ETH as example.



1 I/O bus (10-pin, female) to connect the I/O terminal units
2 One available slot for the processor module
3 Slots for communication modules
4 Interface for CAN (5-pin terminal block, removable)
5 Power supply (5-pin terminal block, removable)
6 Serial interface COM1 (9-pin terminal block, removable)
7 RJ45 female connector for Ethernet connection
8 Holes for screw mounting

XC version **XC** = e**X**treme **C**onditions



Extreme conditions

Terminal bases for use in extreme ambient conditions have no ❄ sign for XC version.

*The figure **3** in the Part no. 1SAP**3**... (label) identifies the XC version.*

5.3.1.1 Short description

Terminal bases TB56xx are used as sockets for processor modules PM56xx and communication modules.

Up to 10 I/O terminal units for I/O expansion modules can be added to these terminal bases.

The terminal bases have slots for one processor module and for communication modules as well as terminals and interfaces for power supply, expansion and networking.

Table 122: Combination of TB56xx-2ETH(-XC) and PM56xx(-XC)

Processor module	PM5630	PM5650	PM5670	PM5675	PM5680 [2]	PM5685 [2]
TB5600-2ETH	0 slot	0 slot	0 slot	0 slot	0 slot	0 slot
TB5610-2ETH	1 slot	1 slot	1 slot	1 slot	1 slot	1 slot
TB5620-2ETH	2 slots	2 slots	2 slots	2 slots	2 slots	2 slots
TB5640-2ETH	-	4 slots	4 slots	4 slots	4 slots	4 slots
TB5660-2ETH	-	-	6 slots [1]	6 slots [1]	-	6 slots

Remarks:

The slots can be used for connecting communication modules or AC500-S modules. Note that only one AC500-S module can be connected at one terminal base.

[1] PM567x must have the order numbers 1SAP151000R0378, 1SAP151500R0378 or a production index ≥ C0.

[2] XC variant is not applicable.

NOTICE!

Risk of malfunctions!

Unused slots for communication modules are not protected against accidental physical contact.

- Unused slots for communication modules must be covered with dummy communication modules to achieve IP20 rating ↳ *Chapter 5.8.2.5 “TA524 - Dummy communication module” on page 1409*.
- I/O bus connectors must not be touched during operation.

5.3.1.2 Connections

5.3.1.2.1 I/O bus

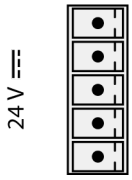
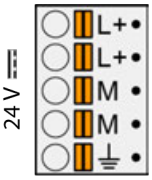
The I/O bus is the I/O data bus for the I/O modules. Through this bus, I/O and diagnosis data are transferred between the processor module and the I/O modules. Up to 10 I/O modules can be added.

↪ *Chapter 5.4.2 “I/O bus - Data transfer” on page 295*

5.3.1.2.2 Power supply

The supply voltage of 24 V DC is connected to a removable 5-pin terminal block. L+/M exist twice. It is therefore possible to feed e.g. external sensors (up to 8 A max. with 1.5 mm^2 conductor) via these terminals, when the ambient temperature never exceeds +60 °C.

Pin assignment

Pin Assignment		Label	Function	Description
 Terminal block removed	 Terminal block inserted	L+	+24 V DC	Positive pin of the power supply voltage
		L+	+24 V DC	Positive pin of the power supply voltage
		M	0 V	Negative pin of the power supply voltage
		M	0 V	Negative pin of the power supply voltage
		⏚	FE	Functional earth

Faulty wiring on power supply terminals

NOTICE!

Risk of damaging the PLC due to improper voltage levels!

– Never exceed the maximum tolerance values for process and supply voltages.
– Never fall below the minimum tolerance values for process and supply voltages.

Observe the **system data** ↪ *Chapter 4.2 “System data AC500” on page 34* and the **technical data** of the module used.

NOTICE!

Risk of malfunction!

To ensure reliability and proper functionality of processor modules below index C0, the supply voltage must ramp-up from 0 V to 24 V within max. 2.5 s.

NOTICE!

Risk of damaging the terminal base and power supply!

Short circuits might damage the terminal base and power supply.

Make sure that the four clamps L+ and M (two of each) are not wrongly connected (e. g. +/- of power supply is connected to both L+/L+ or both M/M).

NOTICE!

Risk of damaging the terminal base!

Terminal base can be damaged by connecting the power supply terminal block (L+/M) to COM1.

Make sure that the COM1 terminal block is always connected to the terminal base even if you do not use COM1 to prevent this.

NOTICE!

Risk of damaging the terminal base!

Excessive current might damage the clamp and terminal base.

Make sure that the current flowing through the removable clamps never exceeds 8 A (with 1.5 mm^2 conductor).

NOTICE!

For applications using XC versions!

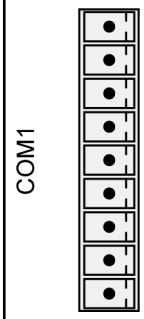
To ensure reliability and proper function, make sure the ambient temperature never exceeds +60 °C when the current flowing through the removable clamps is 8 A (with 1.5 mm^2 conductor).

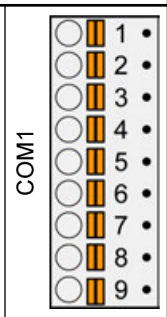
5.3.1.2.3 Serial interface COM1

The serial interface COM1 is connected to a removable 9-pin terminal block.

From firmware version V3.1 it is configurable for RS-232 or RS-485 (V3.0 RS-232 only).

Pin assignment (RS-485 / RS-232)





Pin	Signal	Interface	Description
1	Terminator P	RS-485	Terminator P
2	RxD/TxD-P	RS-485	Receive/Transmit, positive
3	RxD/TxD-N	RS-485	Receive/Transmit, negative
4	Terminator N	RS-485	Terminator N
5	RTS	RS-232	Request to send (output)
6	TxD	RS-232	Transmit data (output)
7	SGND	Signal Ground	Signal Ground
8	RxD	RS-232	Receive data (input)
9	CTS	RS-232	Clear to send (input)

NOTICE!

Unused connector!

Make sure that the terminal block is always connected to the terminal base or communication module, even if you do not use the interface.

5.3.1.2.4 Ethernet interface

This interface is the connection to a processor module with onboard Ethernet e.g. PM56xx-2ETH.

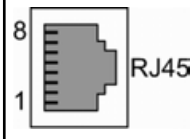
TB56xx-2ETH for processor modules PM56xx-2ETH provide 2 independent Ethernet interfaces.

The two Ethernet interfaces can be configured as independent interfaces or with switch functionality.

In case of two independent interfaces they must be configured to different subnets.

For structured Ethernet cabling only use cables according to TIA/EIA-568-A, ISO/IEC 11801 or EN 50173.

Pin assignment



Interface	Pin	Signal	Description
	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NU	Not used
	5	NU	Not used

Interface	Pin	Signal	Description
	6	RxD-	Receive data -
	7	NU	Not used
	8	NU	Not used
	Shield	Cable shield	Functional earth

NOTICE!

Risk of corrosion!

Unused connectors and slots may corrode if XC devices are used in salt-mist environments.

Protect unused connectors and slots with TA535 protective caps for XC devices
↳ *Chapter 5.8.3.6 “TA535 - Protective caps for XC devices” on page 1418*.

↳ *Supported protocols and used Ethernet ports*

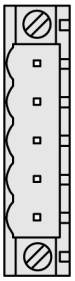
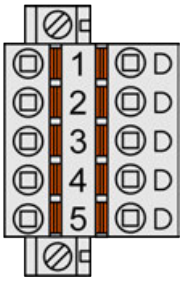
5.3.1.2.5 CAN interface

This interface is the connection to a processor module with onboard CAN e.g. PM56xx-2ETH.

Interface socket	COMBICON, 5-pin, female, removable plug with spring terminals
Transmission standard	ISO 11898, potential-free
Transmission protocol	CANopen (CAN), 1 Mbaud max.
Transfer rate (transmission rate)	50 kbit/s, 100 kbit/s, 125 kbit/s, 250 kbit/s, 500 kbit/s, 800 kbit/s and 1 Mbit/s,

Pin assignment

Table 123: Pin assignment of the CANopen connector

Interface		PIN	Signal	Description
 Terminal block removed	 Terminal block inserted	1	CAN_GND	CAN reference potential
		2	CAN_L	Bus line, receive/transmit line, LOW
		3	CAN_SHLD	Shield of the bus line
		4	CAN_H	Bus line, receive/transmit line, HIGH
		5	NC	Not connected

NOTICE!

Unused connector!

Make sure that the terminal block is always connected to the terminal base or communication module, even if you do not use the interface.

Bus length

The maximum possible bus length of a CAN network depends on bit rate (transmission rate) and cable type. The sum of all bus segments must not exceed the maximum bus length

Bit Rate (speed)	Bus Length
1 Mbit/s	40 m
800 kbit/s	50 m
500 kbit/s	100 m
250 kbit/s	250 m
125 kbit/s	500 m
50 kbit/s	1000 m

Types of bus cables

Only bus cables with characteristics as recommended in ISO 11898 are to be used. The requirements for the bus cables depend on the length of the bus segment.

Bus terminating resistors

Both ends of the CAN bus have to be terminated with a 120 Ω (≥ 1/4 W, ≤ 5 %) bus terminating resistor, to minimize signal reflection. The bus terminating resistor should be connected directly at the bus connector between the CAN signals (CAN_H and CAN_L).

5.3.1.3 Technical data

The system data of AC500 and S500 is applicable to the standard version. *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version. *Chapter 4.3 “System data AC500-XC” on page 38*

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter	Value
Connection of the supply voltage 24 V DC at the terminal base of the processor module	Removable 5-pin terminal block spring type
Max. current consumption from 24 V DC	TB5600: 0.3 A [1]) TB5610: 0.4 A [1]) TB5620: 0.5 A [1]) TB5640: 0.65 A [1]) TB5660: 0.8 A [1])
Melting integral of a fuse at 24 V DC	Min. 1 A^2s [2])
Peak inrush current from 24 V DC	55 A [2])
Number of slots for processor modules	1 (on all terminal bases)
Processor module interfaces at TB56xx	I/O bus, ETH1, ETH2, CAN, COM1

Parameter	Value
Net weight (terminal base without processor module)	TB5600: 155 g TB5610: 180 g TB5620: 210 g TB5640: 260 g TB5660: 310 g
Mounting position	Horizontal or vertical

[1]) Including processor modules, communication modules and I/O bus supply.

[2]) The inrush current and the melting integral depends on the internal power supply of the processor module and the number and type of communication modules and I/O modules connected to the I/O bus.

Table 124: Combination of TB56xx-2ETH(-XC) and PM56xx(-XC)

Processor module	PM5630	PM5650	PM5670	PM5675	PM5680 [2)]	PM5685 [2)]
TB5600-2ETH	0 slot	0 slot	0 slot	0 slot	0 slot	0 slot
TB5610-2ETH	1 slot	1 slot	1 slot	1 slot	1 slot	1 slot
TB5620-2ETH	2 slots	2 slots	2 slots	2 slots	2 slots	2 slots
TB5640-2ETH	-	4 slots	4 slots	4 slots	4 slots	4 slots
TB5660-2ETH	-	-	6 slots [1)]	6 slots [1)]	-	6 slots

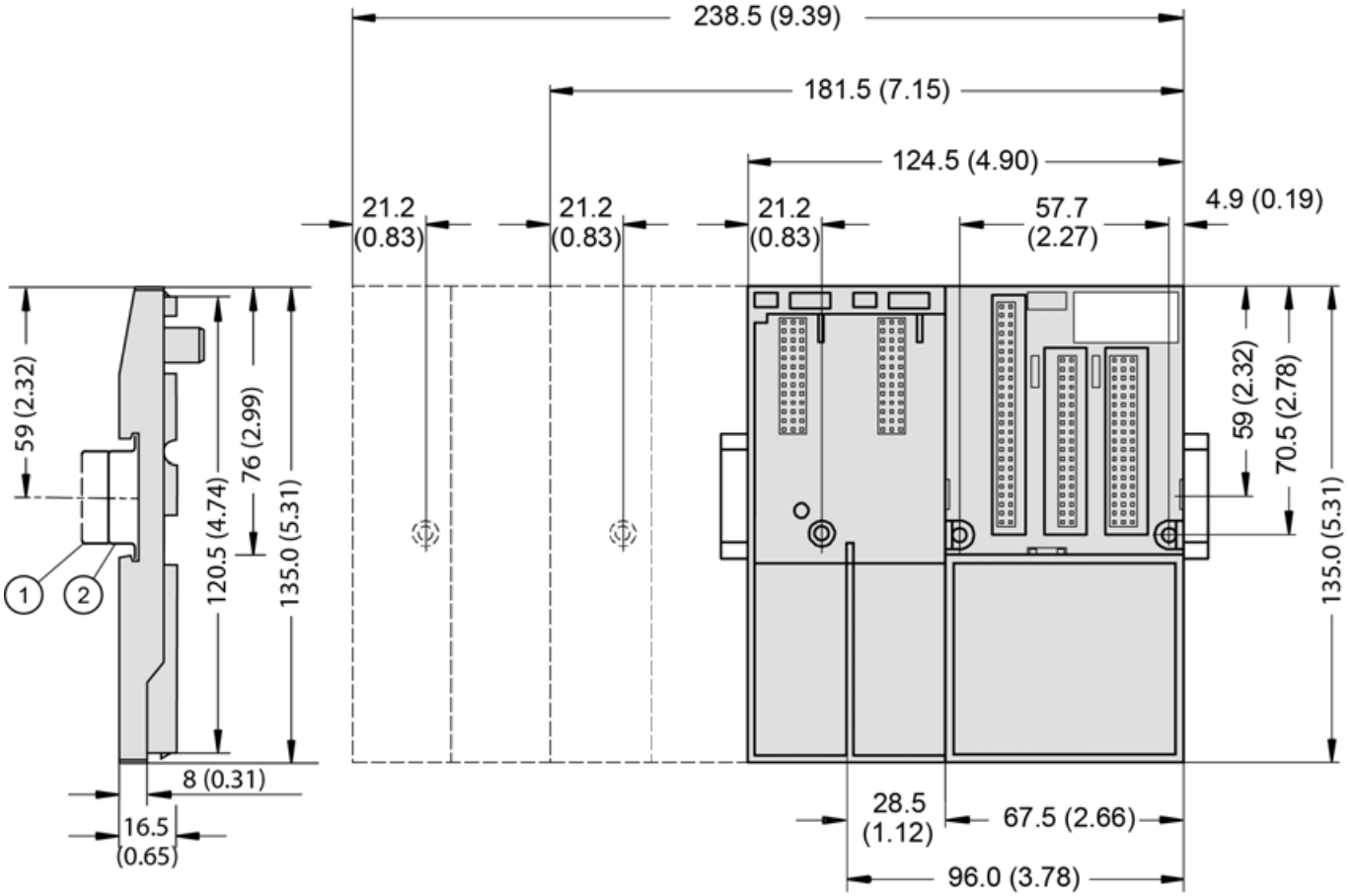
Remarks:

The slots can be used for connecting communication modules or AC500-S modules. Note that only one AC500-S module can be connected at one terminal base.

[1)] PM567x must have the order numbers 1SAP151000R0378, 1SAP151500R0378 or a production index ≥ C0.

[2)] XC variant is not applicable.

5.3.1.4 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

5.3.1.5 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 110 300 R0278	TB5600-2ETH, terminal base AC500, slots: 1 processor module, 2 Ethernet RJ45, 1 CAN connector	Active
1SAP 310 300 R0278	TB5600-2ETH-XC, terminal base AC500, slots: 1 processor module, 2 Ethernet RJ45, 1 CAN connector, XC version	Active
1SAP 111 300 R0278	TB5610-2ETH, terminal base AC500, slots: 1 processor module, 1 communication module, 2 Ethernet RJ45, 1 CAN connector	Active
1SAP 311 300 R0278	TB5610-2ETH-XC, terminal base AC500, slots: 1 processor module, 1 communication module, 2 Ethernet RJ45, 1 CAN connector, XC version	Active

Part no.	Description	Product life cycle phase *)
1SAP 112 300 R0278	TB5620-2ETH, terminal base AC500, slots: 1 processor module, 2 communication modules, 2 Ethernet RJ45, 1 CAN connector	Active
1SAP 312 300 R0278	TB5620-2ETH-XC, terminal base AC500, slots: 1 processor module, 2 communication modules, 2 Ethernet RJ45, 1 CAN connector, XC version	Active
1SAP 114 300 R0278	TB5640-2ETH, terminal base AC500, slots: 1 processor module, 4 communication modules, 2 Ethernet RJ45, 1 CAN connector	Active
1SAP 314 300 R0278	TB5640-2ETH-XC, terminal base AC500, slots: 1 processor module, 4 communication modules, 2 Ethernet RJ45, 1 CAN connector, XC version	Active
1SAP 116 300 R0278	TB5660-2ETH, terminal base AC500, slots: 1 processor module, 6 communication modules, 2 Ethernet RJ45, 1 CAN connector	Active
1SAP 316 300 R0278	TB5660-2ETH-XC, terminal base AC500, slots: 1 processor module, 6 communication modules, 2 Ethernet RJ45, 1 CAN connector, XC version	Active



**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

Table 125: Combination of TB56xx-2ETH(-XC) and PM56xx(-XC)

Processor module	PM5630	PM5650	PM5670	PM5675	PM5680 [2)]	PM5685 [2)]
TB5600-2ETH	0 slot	0 slot	0 slot	0 slot	0 slot	0 slot
TB5610-2ETH	1 slot	1 slot	1 slot	1 slot	1 slot	1 slot
TB5620-2ETH	2 slots	2 slots	2 slots	2 slots	2 slots	2 slots
TB5640-2ETH	-	4 slots	4 slots	4 slots	4 slots	4 slots
TB5660-2ETH	-	-	6 slots [1)]	6 slots [1)]	-	6 slots

Remarks:

The slots can be used for connecting communication modules or AC500-S modules. Note that only one AC500-S module can be connected at one terminal base.

[1)] PM567x must have the order numbers 1SAP151000R0378, 1SAP151500R0378 or a production index ≥ C0.

[2)] XC variant is not applicable.

Table 126: Accessories

Part no.	Description
1SAP 180 800 R0001	TA526, wall mounting accessory

5.4 I/O modules

5.4.1 Safety instructions

NOTICE!

Risk of device damage!

– I/O modules with a device index **above** F0 can be hot-swapped. When I/O modules **below** F0 are inserted or removed from the terminal unit in a powered system the I/O modules can be damaged.

  Before hot swapping a device, check the device index and ensure that the modules meet the requirements. *Table 297 “Allowed device indexes for I/O modules for hot swapping” on page 950*

– Terminal units that support hot swapping of I/O modules have the appendix TU5xx**-H**.
– Hot swap is not supported by AC500-eCo CPU!

The following I/O bus masters support hot swapping of attached I/O modules:

– Communication interface modules CI5xx as of index F0.
– Processor modules PM56xx-2ETH with firmware version as of V3.2.0.

NOTICE!

Risk of damage to I/O modules!

Hot swapping is only allowed for I/O modules.

Processor modules and communication interface modules must not be removed or inserted during operation.

Conditions for hot swapping

– *Digital outputs are not under load.*
– *Input/output voltages above safety extra low voltage/ protective extra low voltages (SELV/PELV) are switched off.*
– *Modules are completely plugged on the terminal unit with both snap fit engaged before switching on loads or input/output voltage.*

.

5.4.2 I/O bus - Data transfer

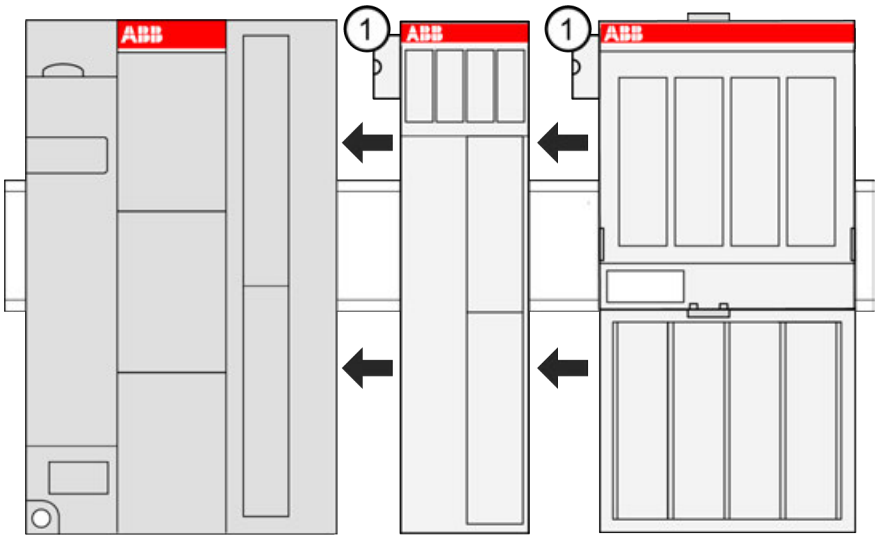
The I/O bus is the I/O data bus for the I/O modules. Through this bus, I/O and diagnosis data are transferred between the processor module and the I/O modules. Up to 10 I/O modules can be added.

Chapter 5.4.2 “I/O bus - Data transfer” on page 295

The synchronized I/O bus is the I/O data bus for the I/O modules connected with the processor modules or communication interface modules. Through this bus, I/O and diagnosis data are transferred.

With its fast data transmission, the I/O bus obtains very low reaction times.

Up to 10 I/O terminal units (for one I/O module each) can be added to one terminal base or to one AC500-eCo processor module. The I/O terminal units and the AC500-eCo I/O modules, have a bus input at the left side and a bus output at the right side. Thus the length of the I/O bus increases with the number of attached I/O modules *Table 127 “Maximum number of I/O devices which can be connected to the I/O bus” on page 297*.



1 I/O bus connection

The connection of the I/O bus is performed automatically by telescoping the modules on the DIN rail.

The I/O bus provides the following signals:

- Supply voltage of 3.3 V DC for feeding the electronic interface components.
- 3 data lines for the synchronized serial data exchange.
- Several control signals.

NOTICE!

Except when using hot swap terminal units, the I/O bus is not designed for pulling and plugging modules during operation.

If a module is pulled or plugged on a terminal unit that is **not** hot swap capable while the bus is running, the following consequences are possible.

– Reset of the station or of the processor module.
– System lockup.
– Damage of the module.

WARNING!

Removal/Insertion under power

Removal or insertion under power is permissible only if all conditions for hot swapping are fullfilled.

“Conditions for hot swap” on page 12

The devices are not designed for removal or insertion under power when the conditions for hot swap do not apply. Because of unforeseeable consequences, it is not allowed to plug in or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing any of the following actions:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while they are energized in a hazardous location could result in an electric arc, which could create an ignition source resulting in fire or explosion.

Prior to proceeding, make sure that power is been disconnected and that the area has been thoroughly checked to ensure that flammable materials or ignitable concentrations are not present.

The devices must not be opened when in operation. The same applies to the network interfaces.

Profibus (master and slave) and CM589-PNIO are available since version 2.5.0 of the Automation Builder.

Table 127: Maximum number of I/O devices which can be connected to the I/O bus

Device	Version Automation Builder	Version firmware	Max. number of I/O devices
CANopen bus modules CI581-CN and CI582-CN	As of V2.1.0	All	0
PROFINET bus modules CI501-PNIO and CI502-PNIO	As of V2.1.0	all	10
EtherCAT communication interface module CI511-ETHCAT and CI512-ETHCAT	As of V2.1.0	As of V2.0.x	10
Modbus communication interface module CI521 and CI522	Independent from Automation Builder version	all	10

Profibus (master and slave) and CM589-PNIO are available since version 2.5.0 of the Automation Builder.

Table 128: General data of the I/O bus

Parameter	Value
Supply voltage, signal level	3.3 V DC ± 10 %
Max. supply current	On request
Type of the data interface	Synchronized serial data exchange

Parameter	Value
Bus data transmission speed	1.8 Mb/s
Minimum bus cycle time	500 µs This value is valid for all module combinations (from 1 to 10 I/O modules)
Galvanic isolation	I/O bus is galvanic connected to CPU and communication interface logic ciruits. Galvanic isolation of I/O bus is I/O module specific. See each module specification for details.
Protection against electrostatic discharge (ESD)	TB5xx, TB56xx: with protection diodes, no ESD discharge allowed on the port.

Table 129: Wiring (bus connection)

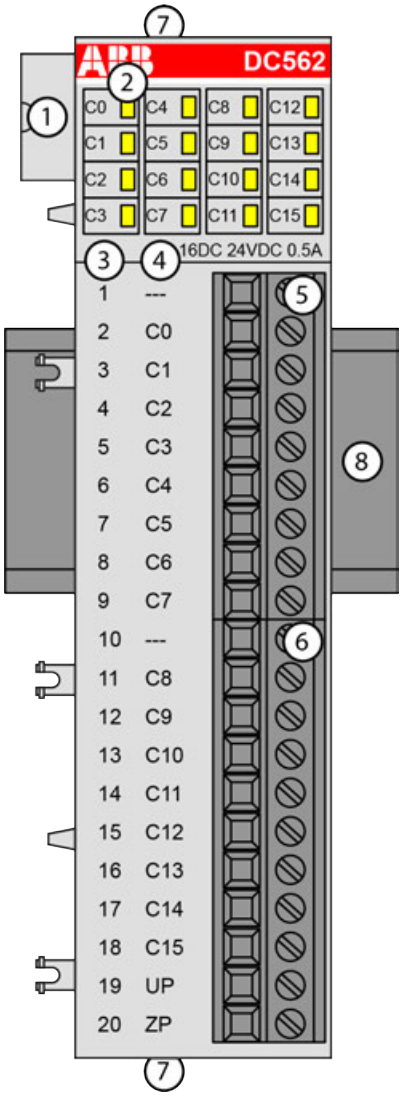
Parameter	Value
Bus connection	Left-side and right-side connection from module to module via a 10-pole HE plug (male at the left side, female at the right side)
Mechanical connection	Established by the terminal units
Max. bus length	1 m

5.4.3 Digital I/O modules

5.4.3.1 S500-eCo

5.4.3.1.1 DC562 - Digital input/output module

- 16 configurable digital inputs/outputs in 1 group, 24 V DC
- Module-wise galvanically isolated



1 I/O bus
2 16 yellow LEDs to display the states of the inputs/outputs C0 ... C15
3 Terminal number
4 Allocation of signal name
5 Terminal block for input and output signals (9-pin)
6 Terminal block for input and output signals (11-pin)
7 2 holes for wall-mounting with screws
8 DIN rail

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The inputs/outputs are group-wise galvanically isolated from each other.

All other circuitry of the module is galvanically isolated from the inputs/outputs.

The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA communication interface modules.

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Via the terminals ZP and UP (process voltage 24 V DC)

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection is carried out by using a removable 9-pin and 11-pin terminal block. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

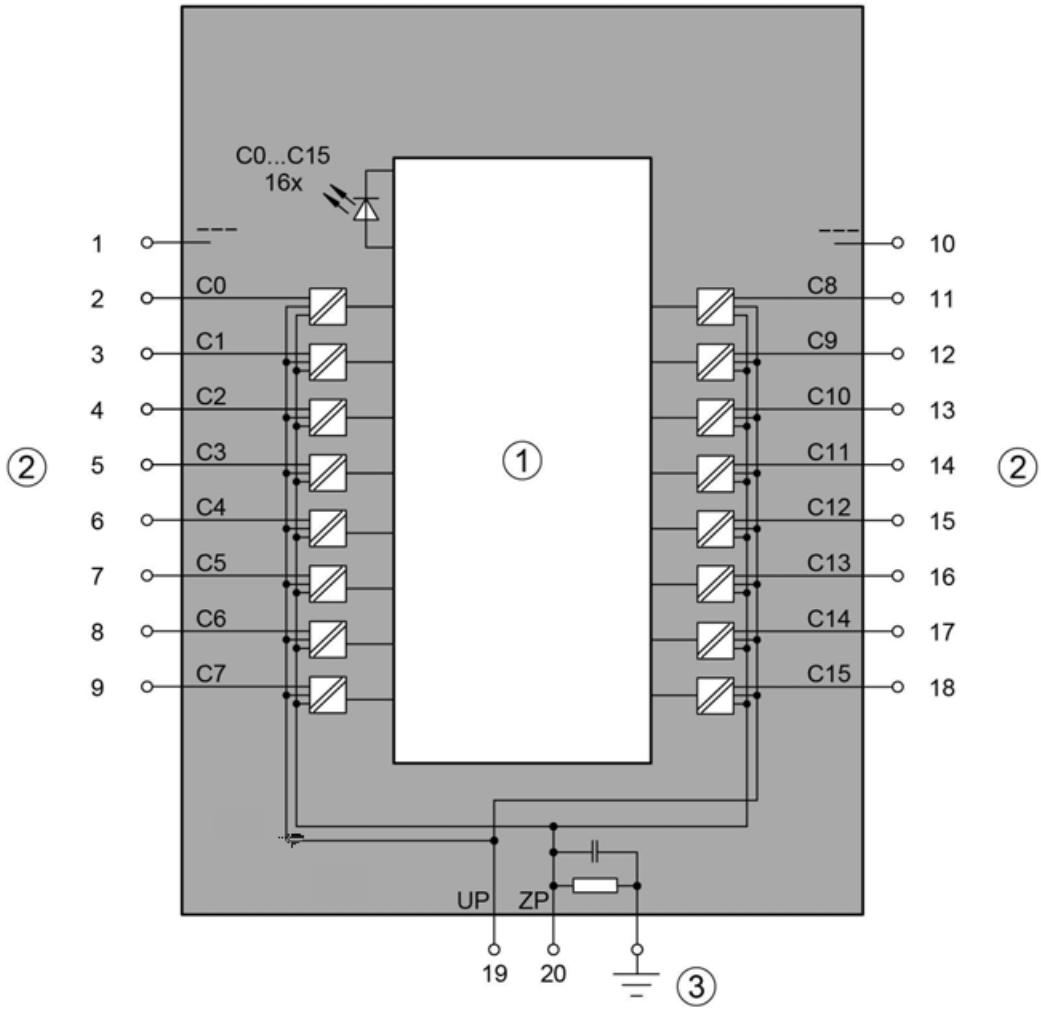


Fig. 24: Internal construction of the digital inputs and outputs

1 Logic - I/O bus interface
2 Digital inputs/outputs
3 Functional earth connection

Table 130: Assignment of the terminals:

Terminal	Signal	Description
1	---	Reserved
2	C0	Input/output signal C0
3	C1	Input/output signal C1
4	C2	Input/output signal C2
5	C3	Input/output signal C3
6	C4	Input/output signal C4
7	C5	Input/output signal C5
8	C6	Input/output signal C6
9	C7	Input/output signal C7
10	---	Reserved
11	C8	Input/output signal C8
12	C9	Input/output signal C9
13	C10	Input/output signal C10
14	C11	Input/output signal C11
15	C12	Input/output signal C12
16	C13	Input/output signal C13
17	C14	Input/output signal C14
18	C15	Input/output signal C15
19	UP	Process voltage UP +24 V DC
20	ZP	Process voltage ZP 0 V DC

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 10 mA per DC562.

The external power supply connection is carried out via the UP (+24 V DC) and ZP (0 V DC) terminals.



WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing the following:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

Process supply voltage must be connected to UP/ZP of the module. The inputs and UP/ZP must use the same power supply.

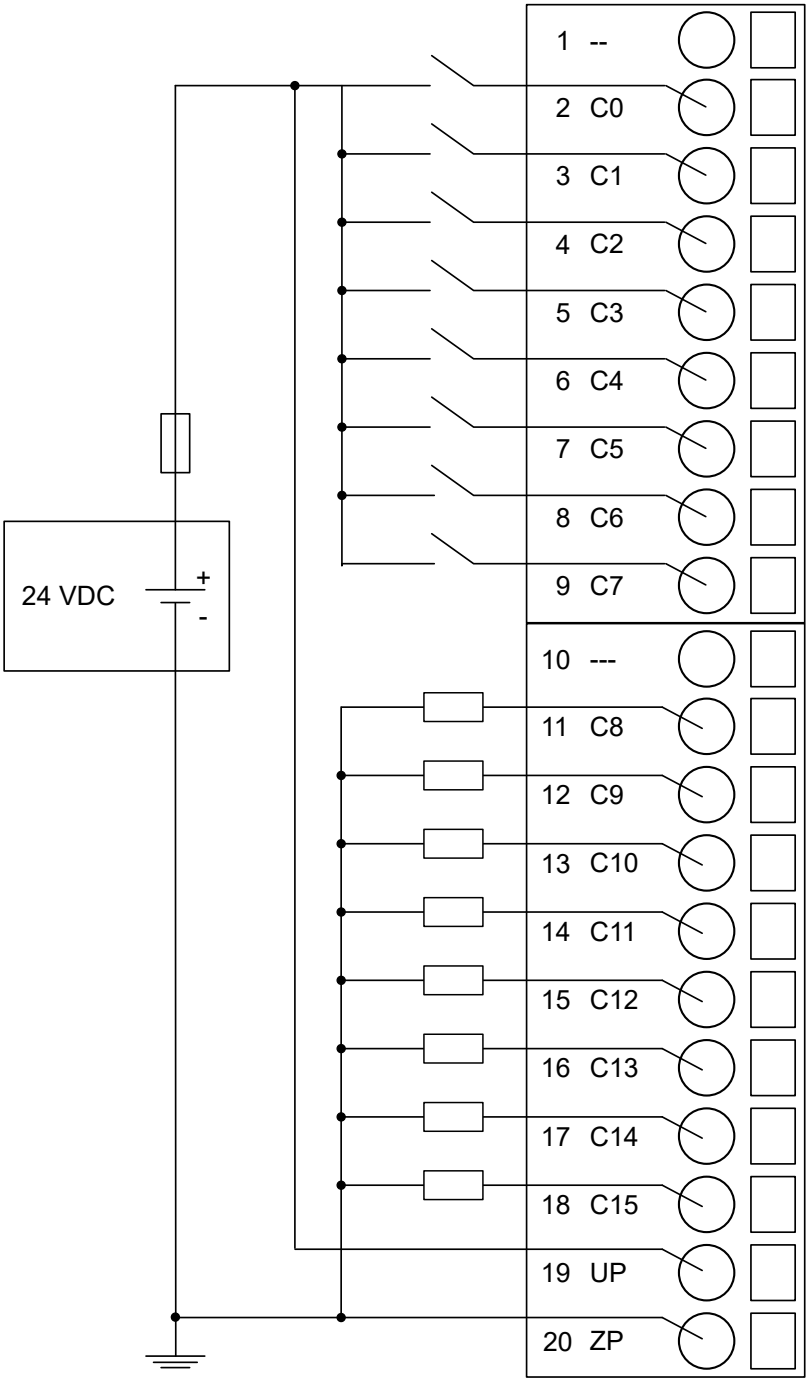


Fig. 25: Connection of the digital input/output module DC562

In this connection example, the inputs/outputs C0 ... C7 are connected as inputs and the inputs/outputs C8 ... C15 are connected as outputs.

The module provides several diagnosis functions *Chapter 5.4.3.1.1.6 “Diagnosis” on page 305*.

The meaning of the LEDs is described in the section State LEDs *Chapter 5.4.3.1.1.7 “State LEDs” on page 305*.

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.



If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6155 [1])	WORD	6155 0x180B	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No (0x00)			
Parameter length [2])	Internal	1 - CPU	BYTE	0	0	255	xx02 [3])

[1]) with CS31 and addresses less than 70, the value is increased by 1

[2]) the module has no additional user-configurable parameters

[3]) Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n)

GSD file:

Ext_User_Prm_Data_Len =	0x06
Ext_User_Prm_Data_Const(0) =	0x18, 0x0C, 0x00, 0x02, 0x00, 0x00;

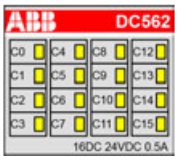
Diagnosis

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000 ... 063**	**AC500-Display**	**<– Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**PNIO diagnosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-Identifier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])			
Module error DC562							
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				

Remarks:

[1])	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31-Bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = Module itself, 1...10 = expansion module 1 ... 10, ADR = hardware address (e. g. of the DC551-CS31)
[3])	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or PNIO = module type (4 = DC); COM1/COM2: 1 ... 10 = expansion 1 ... 10
[4])	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		**State**	**Color**	**LED = OFF**	**LED = ON**
	Inputs/outputs C0 ... C15	Digital input or digital output	Yellow	Input/output is OFF	Input/output is ON (the LEDs are only operating if the module's circuitry is supplied via the I/O bus)

Technical data

Technical data of the module

The system data of AC500-eCo apply.

↳ *Chapter 4.1 “System data AC500-eCo” on page 25*

Only additional details are therefore documented below.

Parameter		Value
Process voltage UP		
	Connections	Terminal 19 for UP (+24 V DC) and terminal 20 for ZP (0 V)
	Rated value	24 V DC
	Current consumption via UP terminal	90 mA + 0.5 A per output (max.)
	Max. ripple	5 %
	Inrush current	0.000001 A^2s
	Protection against reversed voltage	Yes
Current consumption from 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module		Ca. 10 mA
Galvanic isolation		Yes, between the input/output group and the rest of the module
	Isolated groups	1 group for 16 channels
Surge voltage (max.)		35 V DC for 0.5 s
Max. power dissipation within the module		4.8 W
Input data length		2 bytes
Output data length		2 bytes
Weight		Ca. 125 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

No effects of multiple overloads

No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

Technical data of the digital inputs/outputs if used as inputs

Parameter	Value
Number of channels per module	16 configurable inputs (24 V DC)
Distribution of the channels into groups	1 (16 channels per group)
Connections of the channels C0 to C15	Terminals 1 to 16
Reference potential for the channels C0 to C15	Terminal 20 (negative pole of the process voltage, name ZP)

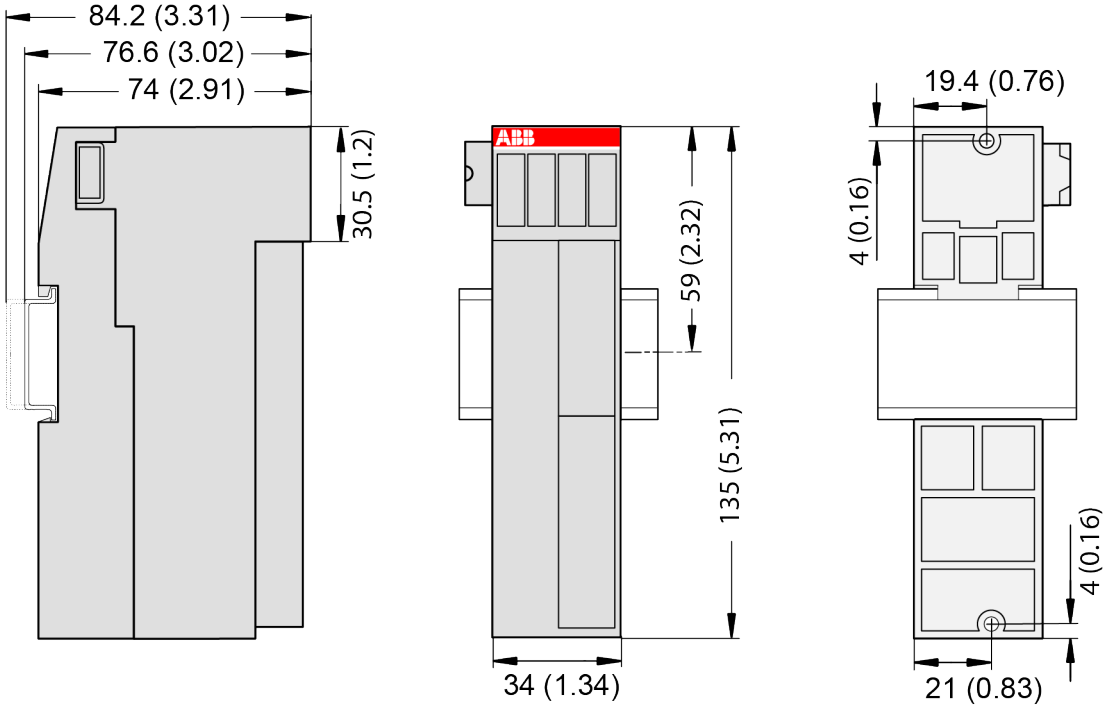
Parameter		Value
Indication of the input signals		1 yellow LED per channel; the LED is ON when the input signal is high (signal 1). The module is powered through the I/O bus.
Input type according to EN 61131-2		Type 1 sink
Input signal range		+24 V DC
	Signal 0	-3 V ... +5 V
	Undefined signal	+5 V ... +15 V
	Signal 1	+15 V ... +30 V
Ripple with signal 0		-3 V ... +5 V
Ripple with signal 1		+15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	Typ. 1 mA
	Input voltage +15 V	> 2.5 mA
	Input voltage +30 V	< 8 mA
Max. permissible leakage current (at 2-wire proximity switches)		1 mA
Input delay (0->1 or 1->0)		Typ. 8 ms
Max. cable length		
	Shielded	500 m
	Unshielded	300 m

Technical data of the digital inputs/outputs if used as outputs

Parameter		Value
Number of channels per module		16 configurable transistor outputs
Distribution of the channels into groups		1 (16 channels per group)
Connections of the channels C0 to C15		Terminals 1 to 16
Reference potential for the channels C0 to C15		Terminal 20 (negative pole of the process voltage, signal name ZP)
Common power supply voltage		Terminal 19 (positive pole of the process voltage, signal name UP)
Indication of the input signals		1 yellow LED per channel; the LED is ON when the input signal is high (signal 1). The module is powered through the I/O bus.
Way of operation		Non-latching type
Output voltage at signal 1		UP -0.3 V at max. current
Output delay (max. at rated load)		
	0 to 1	50 µs
	1 to 0	200 µs
Output current		
	Rated current per channel (max.)	0.5 A at UP 24 V DC
	Rated current per group (max.)	8 A

Parameter		Value
	Rated current (all channels together, max.)	8 A
	Lamp load (max.)	5 W
	Max. leakage current with signal 0	< 0.5 mA
Output type		Non-protected
Protection type		External fuse on each channel
Rated protection fuse (for each channel)		3 A fast
Demagnetization when inductive loads are switched off		Must be performed externally according to driven load specification
Switching frequency		
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 11 Hz at max. 5 W
Short-circuit-proof / Overload-proof		No
	Overload message	No
	Output current limitation	No
	Resistance to feedback against 24 V DC signals	Yes
Connection of 2 outputs in parallel		Not possible
Max. cable length		
	Shielded	500 m
	Unshielded	150 m

Dimensions



The dimensions are in mm and in brackets in inch.

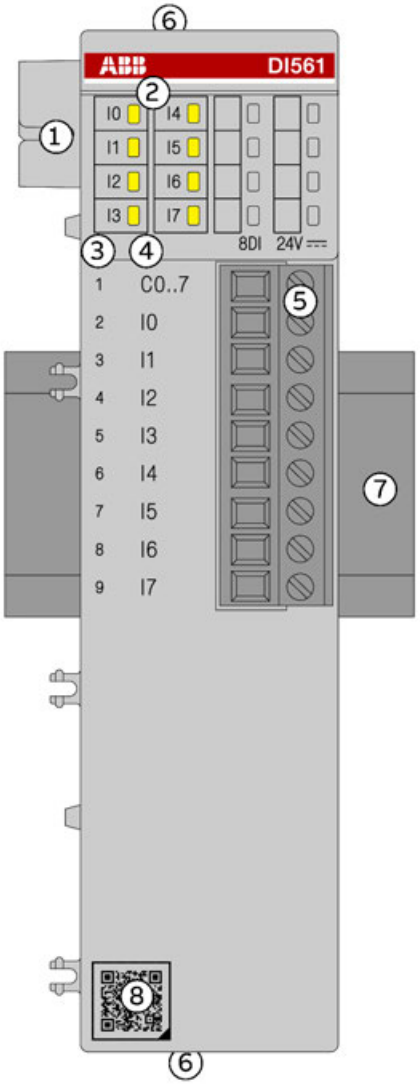
Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 231 900 R0000	DC562, digital input/output module, 16 configurable inputs/outputs, transistor output	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

5.4.3.1.2 DI561 - Digital input module

- 8 digital inputs 24 V DC / 24 V AC (I0 ... I7) in 1 group
- Module-wise galvanically isolated



1 I/O bus
2 8 yellow LEDs to display the signal states of the inputs I0 to I7
3 Terminal number
4 Allocation of signal name
5 Terminal block for input signals (9-pin)
6 2 holes for wall-mounting with screws
7 DIN rail
8 QR code for datasheet

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The inputs are group-wise galvanically isolated from each other.

All other circuitry of the module is galvanically isolated from the inputs.



The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA communication interface modules.

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Not necessary

Connections



For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection is carried out by using a removable 9-pin terminal block. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

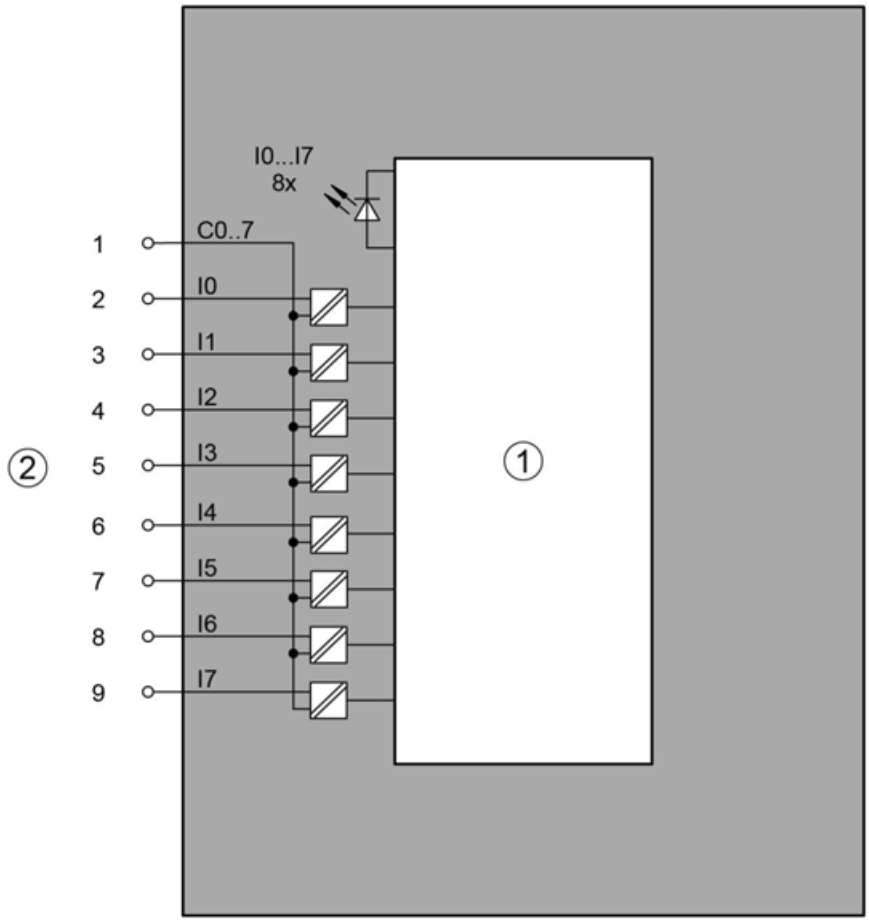


Fig. 26: Internal construction of the digital inputs

1 Logic - I/O bus interface
2 Digital inputs

Table 131: Assignment of the terminals:

Terminal	Signal	Description
1	C0 ... 7	Input common for signals I0 to I7
2	I0	Input signal I0
3	I1	Input signal I1
4	I2	Input signal I2
5	I3	Input signal I3
6	I4	Input signal I4
7	I5	Input signal I5
8	I6	Input signal I6
9	I7	Input signal I7

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 5 mA per DI561.

An external power supply connection is not needed.



WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing the following:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The digital inputs can be used as source inputs or as sink inputs.

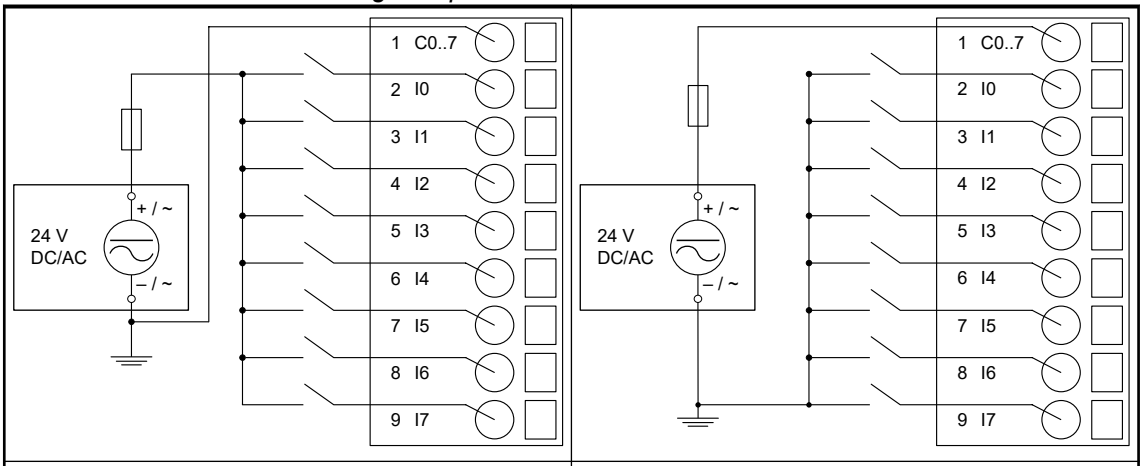
NOTICE!

Risk of malfunctions in the plant!

A ground fault, e. g. caused by a damaged cable insulation, can bridge switches accidentally.

Use sink inputs when possible or make sure that, in case of error, there will be no risks to persons or plant.

Table 132: Connection of the digital input module DI561



Connection of DI561 - sink inputs	Connection of DI561 - source inputs

The module provides several diagnosis functions *Chapter 5.4.3.1.2.6 “Diagnosis” on page 315*.

The meaning of the LEDs is described in the section State LEDs *Chapter 5.4.3.1.2.7 “State LEDs” on page 316*.

I/O Configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6105 [1])	WORD	6105 0x17D9	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No (0x00)			
Parameter length [2])	Internal	1 - CPU	BYTE	0	0	255	xx02 [3])

[1]) with CS31 and addresses smaller than 70, the value is increased by 1

[2]) the module has no additional user-configurable parameters

[3]) Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n)

GSD file:

Ext_User_Prm_Data_Len =	0x03
Ext_User_Prm_Data_Const(0) =	0xDA, 0x17, 0x00;

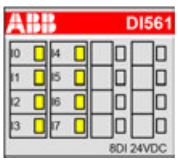
Diagnosis

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000 ... 063**	**AC500-Display**	**<− Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**AB SW**		
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**PNIO diagnosis block**		
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**		**Remedy**
	[1])	**[2])**	**[3])**	**[4])**				
Module error								
3	14	1 ... 10	31	31	19	Checksum error in the I/O module		Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	43	Internal error in the module		Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer		Restart
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	26	Parameter error		Check master
	11 / 12	ADR	1 ... 10					

Remarks:

[1])	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = decentralized communication interface module 1 ... 10, ADR = hardware address (e. g. of the DC551-CS31)
[3])	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10
[4])	In case of module errors, with channel "31 = module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON
	Inputs I0...I7	Digital input	Yellow	Input is OFF	Input is ON

In the undefined signal range, the state LED for the inputs can be ON although the input state detected by the module is OFF.

Technical data

Technical data of the module

The system data of AC500-eCo apply.

Chapter 4.1 “System data AC500-eCo” on page 25

Only additional details are therefore documented below.

Parameter	Value
Galvanic isolation	Yes, between the input group and the rest of the module
Isolated groups	1 (8 channels per group)
Current consumption from 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module	Ca. 5 mA
Max. power dissipation within the module	1.6 W
Weight	Ca. 110 g
Mounting position	Horizontal or vertical
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

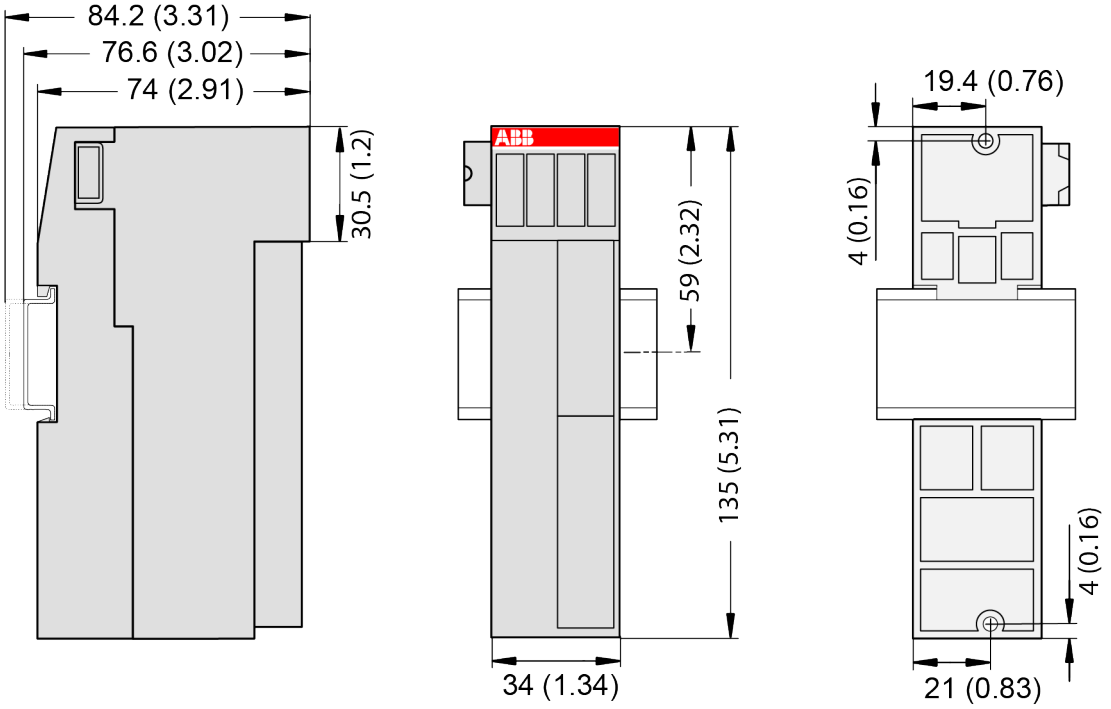
Technical data of the digital inputs

Parameter	Value
Number of channels per module	8 inputs (24 V DC / 24 V AC)
Distribution of the channels into groups	1 (8 channels per group)
Connections of the channels I0 to I7	Terminals 2 ... 9
Reference potential for the channels I0 to I7	Terminal 1 (plus or negative pole of the process supply voltage, signal name C0 .. 7)
Indication of the input signals	1 yellow LED per channel; the LED is ON when the input signal is high (signal 1). The module is powered through the I/O bus.

Parameter		Value		
Monitoring point of input indicator		LED is part of the input circuitry		
Input type according to EN 61131-2		Type 1 source	Type 1 sink	Type 1 AC [1])
Input signal range		-24 V DC	+24 V DC	24 V AC 50/60 Hz
	Signal 0	-5 V ... +3 V	-3 V ... +5 V	0 V AC ... 5 V AC
	Undefined signal	-15 V ... -5 V	+5 V ... +15 V	5 V AC ... 14 V AC
	Signal 1	-30 V ... -15 V	+15 V ... +30 V	14 V AC ... 27 V AC
Input current per channel				
	Input voltage 24 V	Typ. 5 mA		Typ. 5 mA r.m.s.
	Input voltage 5 V	Typ. 1 mA		Typ. 1 mA r.m.s.
	Input voltage 14 V			Typ. 2.7 mA r.m.s.
	Input voltage 15 V	> 2.5 mA		
	Input voltage 27 V			Typ. 5.5 mA r.m.s.
	Input voltage 30 V	< 8 mA		
Max. permissible leakage current (at 2-wire proximity switches)		1 mA		Typ. 1 mA r.m.s.
Input delay (0->1 or 1->0)		Typ. 8 ms		
Input data length		1 byte		
Max. cable length				
	Shielded	500 m		
	Unshielded	300 m		

[1]) For version before E0, when inputs are used with 24 V AC, external surge limiting filters are required.

Dimensions



The dimensions are in mm and in brackets in inch.

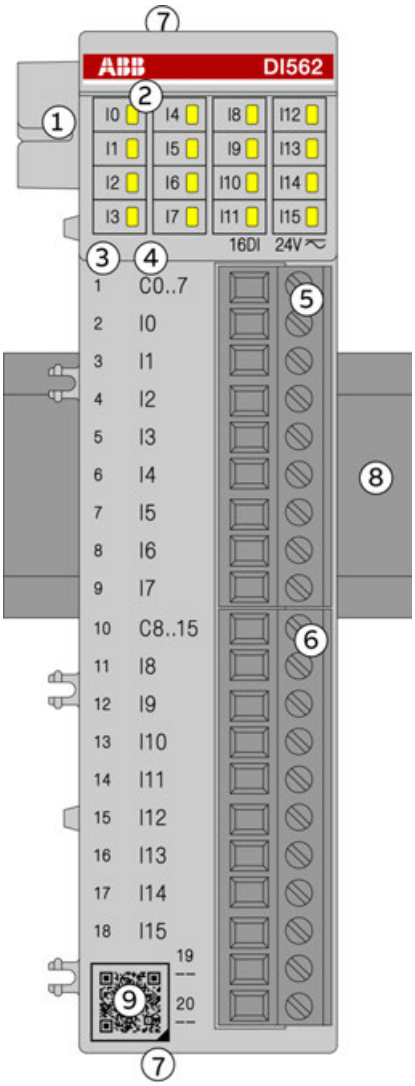
Ordering data

Part no.	Description	Product life cycle phase *)
1TNE 968 902 R2101	DI561, digital input module, 8 DI, 24 V DC / 24 V AC	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.4.3.1.3 DI562 - Digital input module

- 16 digital inputs 24 V DC / 24 V AC (I0 ... I15) in 2 groups
- Group-wise galvanically isolated



1 I/O bus
2 16 yellow LEDs to display the signal states of the inputs I0 ... I15
3 Terminal number
4 Allocation of signal name
5 Terminal block for input signals (9-pin)
6 Terminal block for input signals (11-pin)
7 2 holes for wall-mounting with screws
8 DIN rail
9 QR code for datasheet

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The inputs are group-wise galvanically isolated from each other.

The other electronic circuitry of the module is galvanically isolated from the inputs.

> *The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA communication interface modules.*

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Not necessary

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection is carried out by using removable 9-pin and 11-pin terminal blocks. These terminal blocks differ in their connection system (spring terminals or screw-type terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

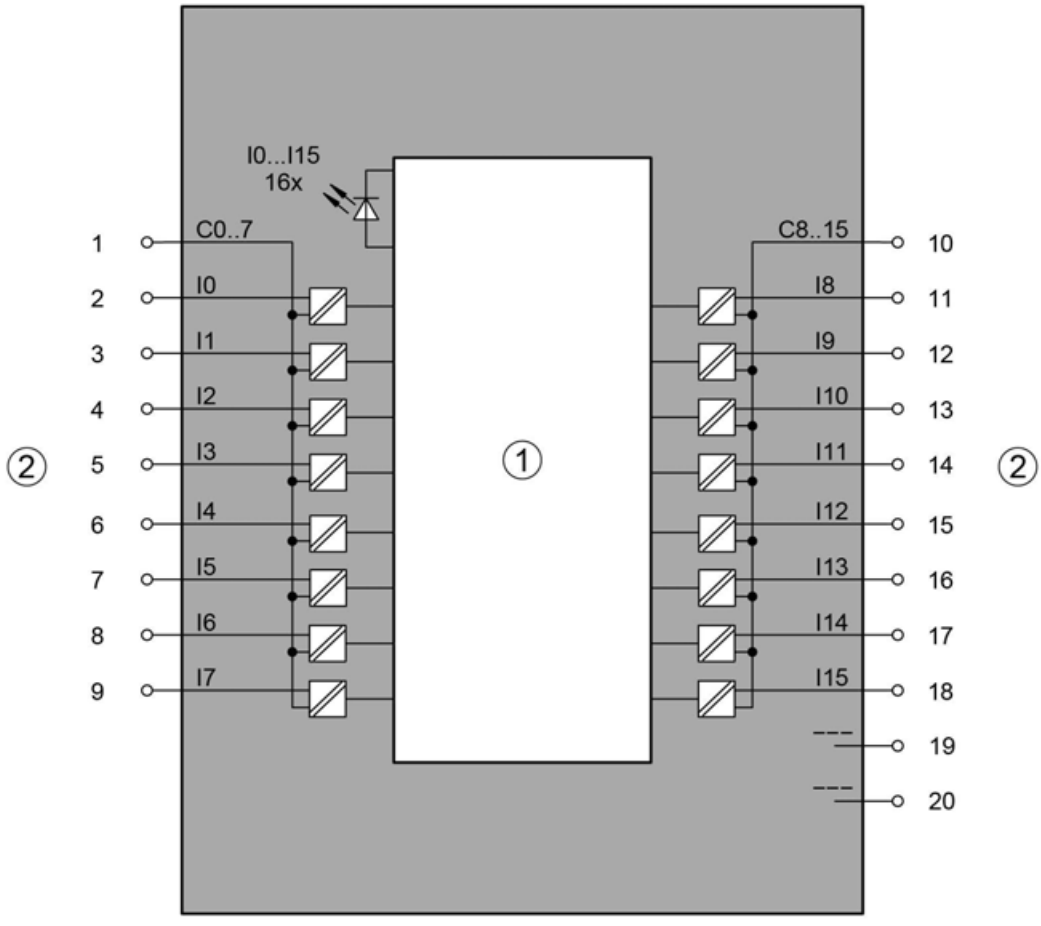


Fig. 27: Internal construction of the digital inputs

1 Logic - I/O bus interface
2 Digital inputs

Table 133: Assignments of the terminal

Terminal	Signal	Description
1	C0 ... C7	Input common for signals I0 to I7
2	I0	Input signal I0
3	I1	Input signal I1
4	I2	Input signal I2
5	I3	Input signal I3
6	I4	Input signal I4
7	I5	Input signal I5
8	I6	Input signal I6
9	I7	Input signal I7
10	C8 ... C15	Input common for signals I8 ... I15
11	I8	Input signal I8
12	I9	Input signal I9
13	I10	Input signal I10
14	I11	Input signal I11
15	I12	Input signal I12
16	I13	Input signal I13
17	I14	Input signal I14
18	I15	Input signal I15
19	---	Reserved
20	---	Reserved

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 5mA per DI562.

An external power supply connection is not needed.



WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing the following:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The module provides several diagnosis functions *Chapter 5.4.3.1.3.6 “Diagnosis” on page 324*.

The digital inputs can be used as source inputs or as sink inputs.

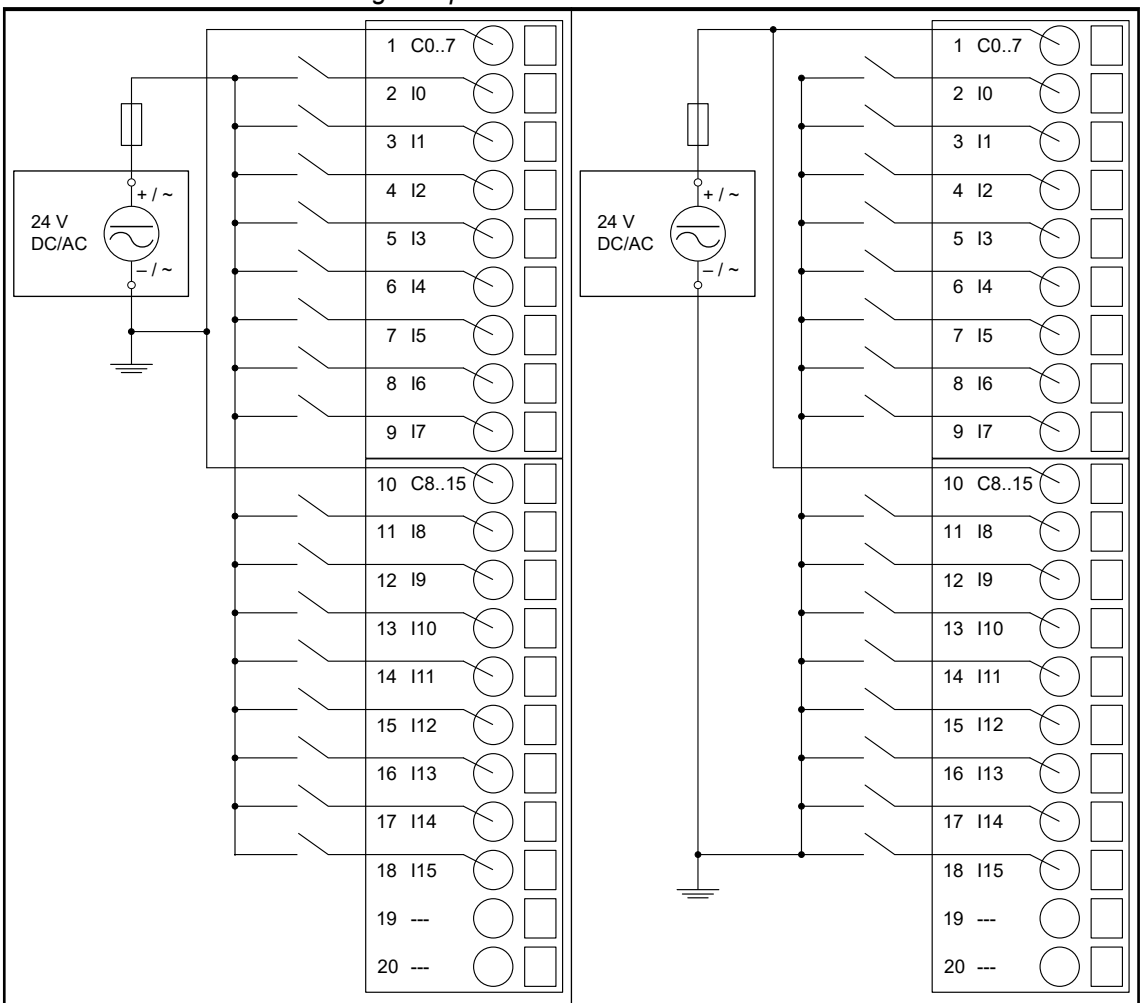
NOTICE!

Risk of malfunctions in the plant!

A ground fault, e. g. caused by a damaged cable insulation, can bridge switches accidentally.

Use sink inputs when possible or make sure that, in case of error, there will be no risks to persons or plant.

Table 134: Connection of the digital input module DI562



Connection of DI562 - sink inputs	Connection of DI562 - source inputs

The meaning of the LEDs is described in section State LEDs *Chapter 5.4.3.1.3.7 “State LEDs” on page 324*.

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.



If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6110 [1])	WORD	6110 0x17DE	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No (0x00)			
Parameter length [2])	Internal	1 - CPU	BYTE	0	0	255	xx02 [3])

Remarks:

[1])	With CS31 and addresses less than 70, the value is increased by 1
[2])	The module has no additional user-configurable parameters
[3])	Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n)

GSD file:

Ext_User_Prm_Data_Len =	0x03
Ext_User_Prm_Data_Const(0) =	0xDF, 0x17, 0x00;

Diagnosis

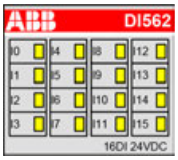
E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500-Display	<– Display in
Class	Comp	Dev	Mod	Ch	Err	AB SW	
Byte 6 Bit 6 ... 7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0 ... 5	PNIO diagnosis block	

Class	Interface	Device	Module	Channel	Error Identifier	Error message	Remedy
	[1])	[2])	[3])	[4])			
Module error DI562							
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				

Remarks:

[1])	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = decentralized communication interface module 1 ... 10, ADR = hardware address (e. g. of the DC551-CS31)
[3])	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10
[4])	In case of module errors, with channel "31 = module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON
	Inputs I0 ... I15	Digital input	Yellow	Input is OFF	Input is ON

In the undefined signal range, the state LED for the inputs can be ON although the input state detected by the module is OFF.

Technical data

Technical data of the module

The system data of AC500-eCo apply.

Chapter 4.1 “System data AC500-eCo” on page 25

Only additional details are therefore documented below.

Parameter	Value
Galvanic isolation	Yes, between the input groups and the rest of the module
Isolated groups	2 (8 channels per group)
Current consumption from 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module	Ca. 5 mA
Max. power dissipation within the module	3.2 W
Weight	Ca. 115 g
Mounting position	Horizontal or vertical
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

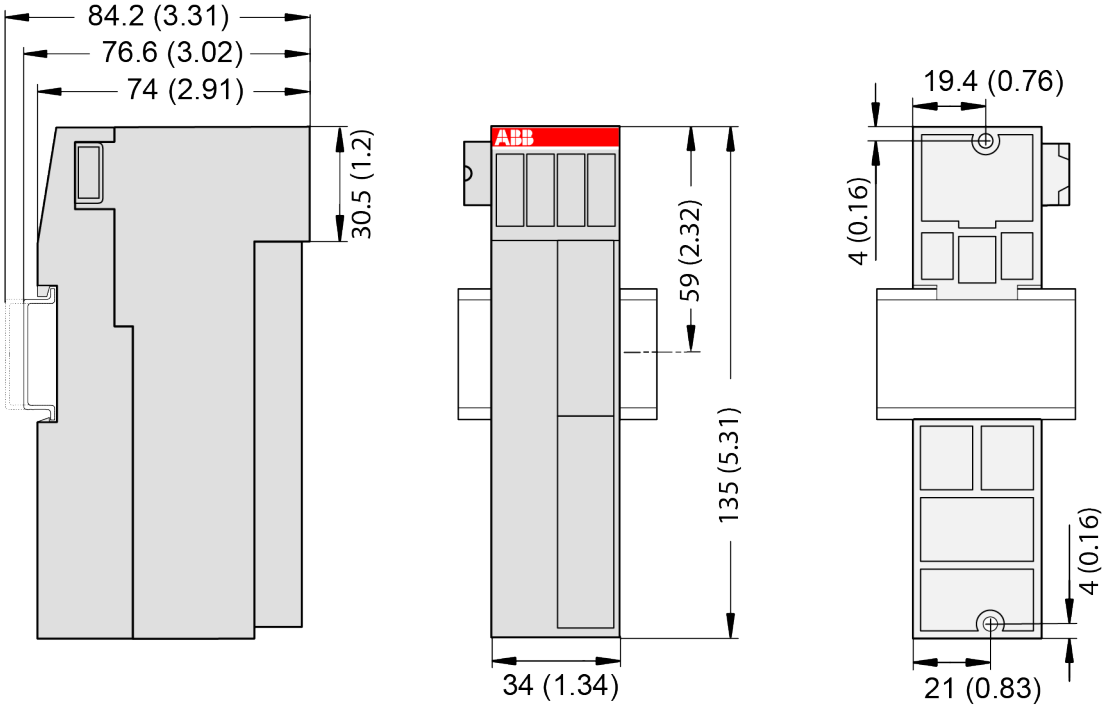
Technical data of the digital inputs

Parameter	Value		
Number of channels per module	16 inputs (24 V DC / 24 V AC)		
Distribution of the channels into groups	2 (8 channels per group)		
Connections of the channels I0 to I7	Terminals 2 ... 9		
Connections of the channels I8 to I15	Terminals 11 ... 18		
Reference potential for the channels I0 to I7	Terminal 1 (positive or negative pole of the process supply voltage, signal name I0 ... I7)		
Reference potential for the channels I8 to I15	Terminal 10 (positive or negative pole of the process supply voltage, signal name I8 ... I15)		
Indication of the input signals	1 yellow LED per channel; the LED is ON when the input signal is high (signal 1). The module is powered through the I/O bus.		
Monitoring point of input indicator	LED is part of the input circuitry		
Input type according to EN 61131-2	Type 1 source	Type 1 sink	Type 1 AC [1])
Input signal range	-24 V DC	+24 V DC	24 V AC 50/60 Hz
Signal 0	-5 V ... +3 V	-3 V ... +5 V	0 V AC ... 5 V AC

Parameter		Value		
	Undefined signal	-15 V ... -5 V	+5 V ... +15 V	5 V AC ... 14 V AC
	Signal 1	-30 V ... -15 V	+15 V ... +30 V	14 V AC ... 27 V AC
Input current per channel				
	Input voltage 24 V	Typ. 5 mA		Typ. 5 mA r.m.s.
	Input voltage 5 V	Typ. 1 mA		Typ. 1 mA r.m.s.
	Input voltage 14 V			Typ. 2.7 mA r.m.s.
	Input voltage 15 V	> 2.5 mA		
	Input voltage 27 V			Typ. 5.5 mA r.m.s.
	Input voltage 30 V	< 8 mA		
Max. permissible leakage current (at 2-wire proximity switches)		1 mA		Typ. 1 mA r.m.s.
Input delay (0->1 or 1->0)		Typ. 8 ms		
Input data length		2 bytes		
Max. cable length				
	Shielded	500 m		
	Unshielded	300 m		

[1])For version before E0, when inputs are used with 24 V AC, external surge limiting filters are required.

Dimensions



The dimensions are in mm and in brackets in inch.

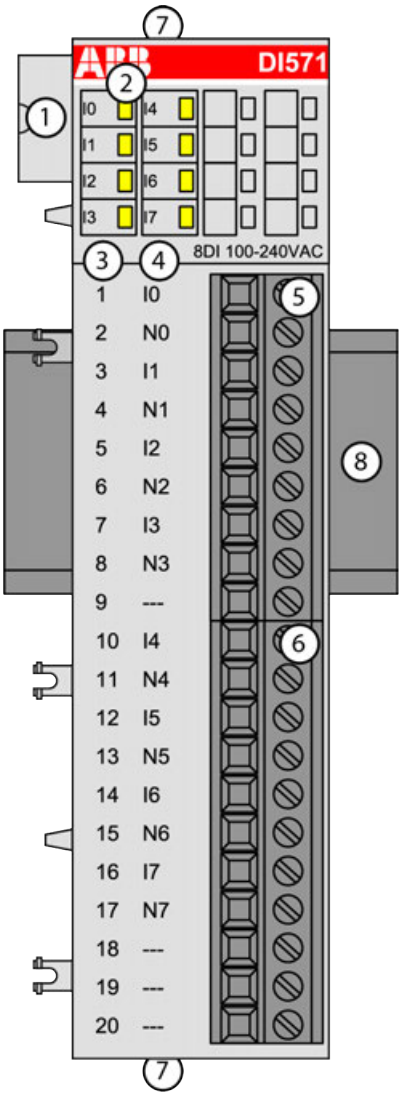
Ordering data

Part no.	Description	Product life cycle phase *)
1TNE 968 902 R2102	DI562, digital input module, 16 DI, 24 V DC / 24 V AC	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

5.4.3.1.4 DI571 - Digital input module

- 8 digital inputs 100 ... 240 V AC (I0 ... I7) in 8 groups
- Module-wise galvanically isolated



1 I/O bus
2 8 yellow LEDs to display the signal states of the inputs I0 ... I7
3 Terminal number
4 Allocation of signal name
5 Terminal block for input signals (9-pin)
6 Terminal block for input signals (11-pin)
7 2 holes for wall-mounting with screws
8 DIN rail

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The inputs are group-wise galvanically isolated from each other.

All other circuitry of the module is galvanically isolated from the inputs.



The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA communication interface modules.

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Not necessary

Connections



For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection is carried out by using removable 9-pin and 11-pin terminal blocks. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

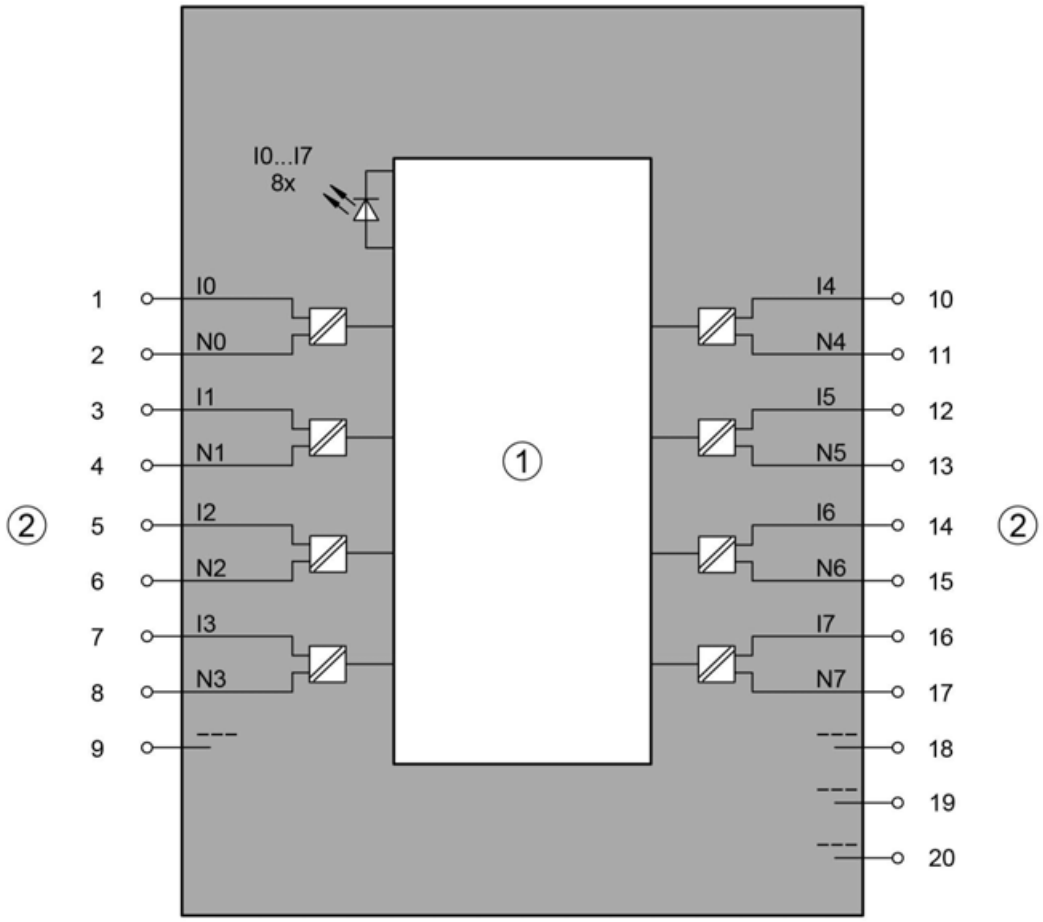


Fig. 28: Internal construction of the digital inputs

1 Logic - I/O bus interface
2 Digital inputs

Table 135: Assignment of the terminals:

Terminal	Signal	Description
1	I0	Input signal I0
2	N0	Neutral conductor for the input signal I0
3	I1	Input signal I1
4	N1	Neutral conductor for the input signal I1
5	I2	Input signal I2
6	N2	Neutral conductor for the input signal I2
7	I3	Input signal I3
8	N3	Neutral conductor for the input signal I3
9	---	Reserved
10	I4	Input signal I4
11	N4	Neutral conductor for the input signal I4
12	I5	Input signal I5
13	N5	Neutral conductor for the input signal I5

Terminal	Signal	Description
14	I6	Input signal I6
15	N6	Neutral conductor for the input signal I6
16	I7	Input signal I7
17	N7	Neutral conductor for the input signal I7
18	---	Reserved
19	---	Reserved
20	---	Reserved

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 10 mA per DI571.

An external power supply connection is not needed.



WARNING!

Risk of death by electric shock!

Hazardous voltages can be present at the terminals of the module.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.



WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing the following:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.



NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

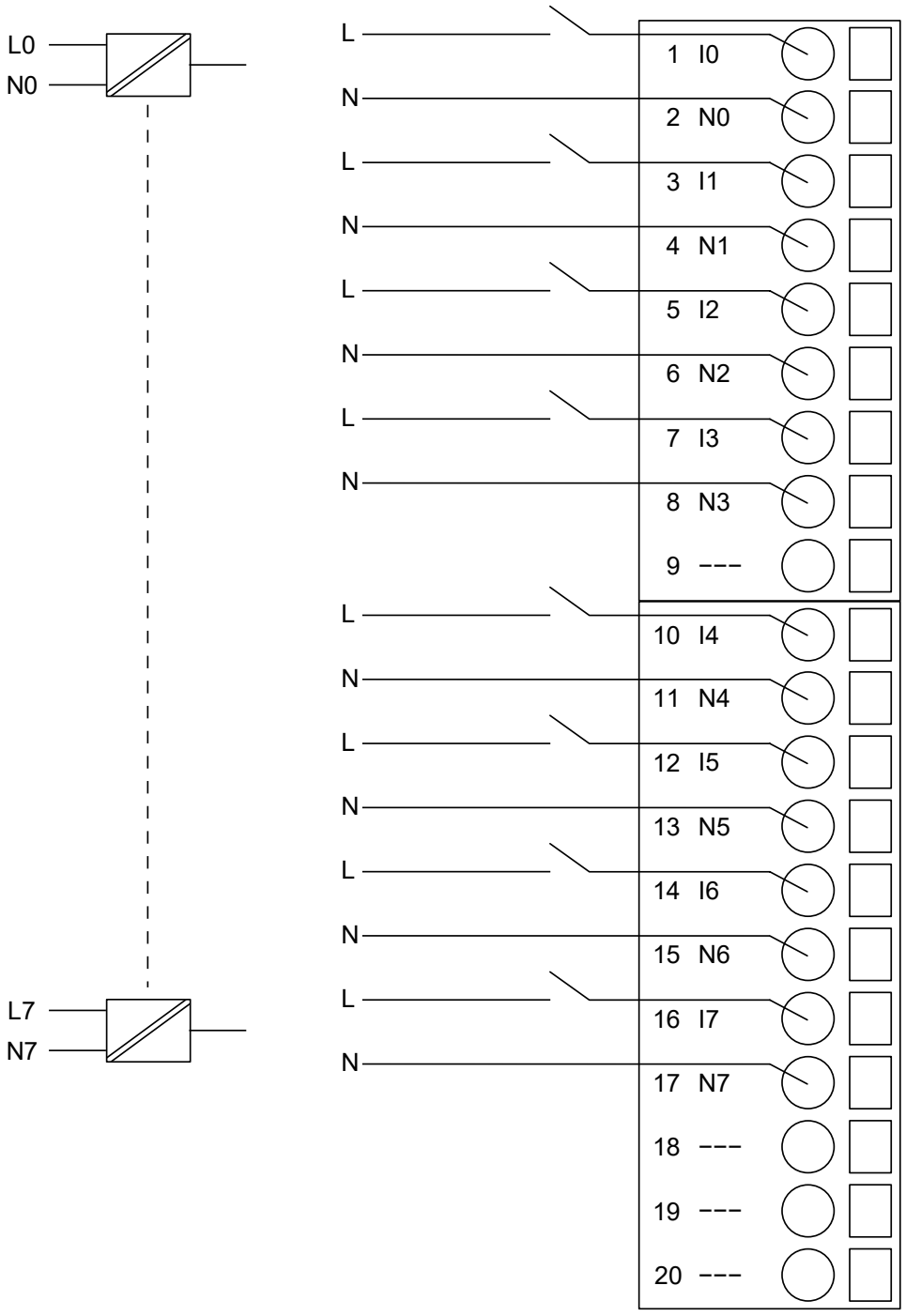


Fig. 29: Connection of the digital input module DI571

NOTICE!

Risk of damaging the PLC modules!

The PLC modules will be irreparably damaged if a voltage > 240 V is connected.

Make sure that all inputs are fed from the same phase. The module must not be connected to a 400 V voltage.

The module provides several diagnosis functions *Chapter 5.4.3.1.4.7 “Diagnosis” on page 334*.

The meaning of the LEDs is described in the section State LEDs *Chapter 5.4.3.1.4.8 “State LEDs” on page 334*.

Internal data exchange

Parameter	Value
Digital inputs (bytes)	1
Digital outputs (bytes)	0

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.



If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of the modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6115 [1])	WORD	6115 0x17E3	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No (0x00)			
Parameter length [2])	Internal	1 - CPU	BYTE	0	0	255	xx02 [3])

[1]) with CS31 and addresses less than 70, the value is increased by 1

[2]) the module has no additional user-configurable parameters

[3]) Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n)

GSD file:

Ext_User_Prm_Data_Len =	0x03
Ext_User_Prm_Data_Const(0) =	0xDF, 0x17, 0x00;

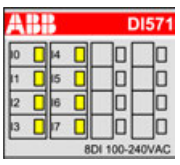
Diagnosis

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000 ... 063**	**AC500-Display**	**<– Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])			
Module error							
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				

Remarks:

[1])	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = decentralized communication interface module 1 ... 10, ADR = hardware address (e. g. of the DC551-CS31)
[3])	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10
[4])	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		**State**	**Color**	**LED = OFF**	**LED = ON**
	Inputs I0 ... I7	Digital input	Yellow	Input is OFF	Input is ON (the input voltage is only displayed if the supply voltage of the module is ON)

Technical data

Technical data of the module

The system data of AC500-eCo apply.

Chapter 4.1 “System data AC500-eCo” on page 25

Only additional details are therefore documented below.

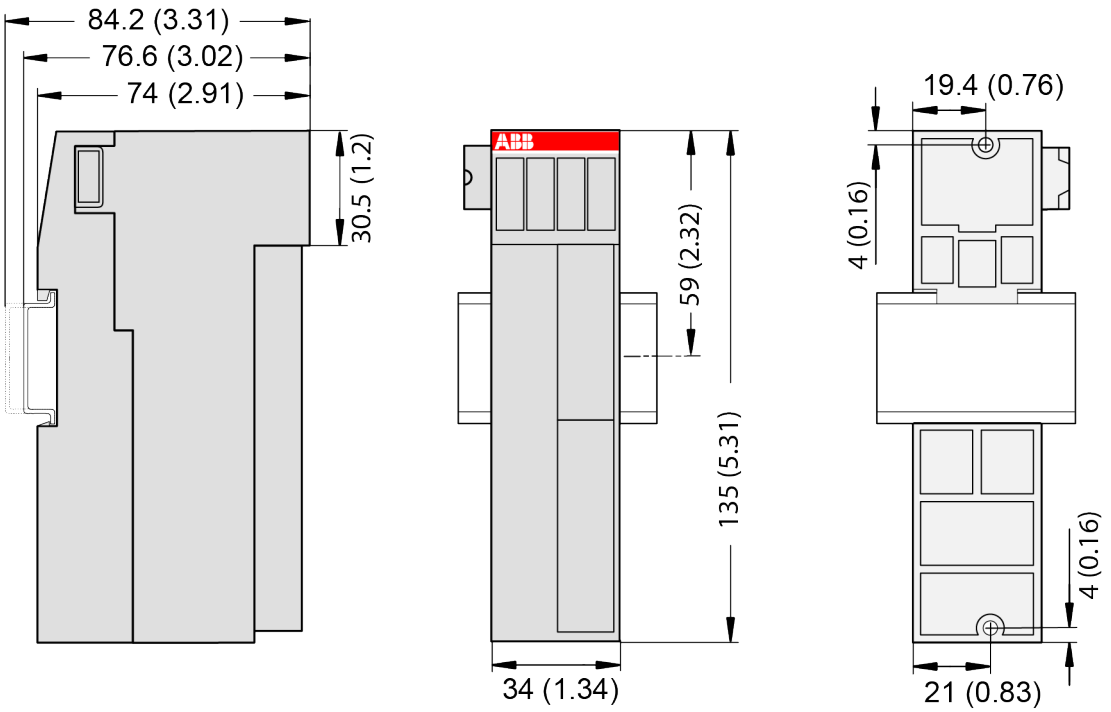
Parameter		Value
Galvanic isolation		Yes, between the channels and the rest of the module
	Isolated groups	8 (1 channel per group)
Current consumption from 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module		Ca. 10 mA
Max. power dissipation within the module		On request
Weight		Ca. 135 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

Technical data of the digital inputs

Parameter		Value
Number of channels per module		8 AC inputs (100-240 V AC)
Distribution of the channels into groups		8 (1 channel per group)
Input voltage range		0 V AC ... 264 V AC (47 Hz ... 63 Hz)
Input current per channel (typically at +25 °C)		<5 mA (at 40 V AC) >6 mA (at 159 V AC, 50 Hz) >7 mA (at 159 V AC, 60 Hz)
Connections of the channels I0 to I7		Terminals 1, 3, 5, 7, 10, 12, 14, 16
Reference potential for the channels I0 to I7		Terminals 2, 4, 6, 8, 11, 13, 15, 17
Indication of the input signals		1 yellow LED per channel; the LED is ON when the input signal is high (signal 1)
Input type according to EN 61131-2		Type 1
Input signal range		
	Signal 0 (max.)	20 V AC
	Undefined signal	20 V AC < U < 79 V AC
	Signal 1 (min.)	79 V AC
Input delay		
	Signal 0 -> 1	Typ. 15 ms
	Signal 1 -> 0	Typ. 30 ms
Input data length		1 byte

Parameter		Value
Max. permissible leakage current (at 2-wire proximity switches)		1 mA
Max. cable length		
	Shielded	500 m
	Unshielded	300 m

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

Part no.	Description	Product life cycle phase *)
1TNE 968 902 R2103	DI571, digital input module, 8 DI, 100 V AC ... 240 V AC	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active

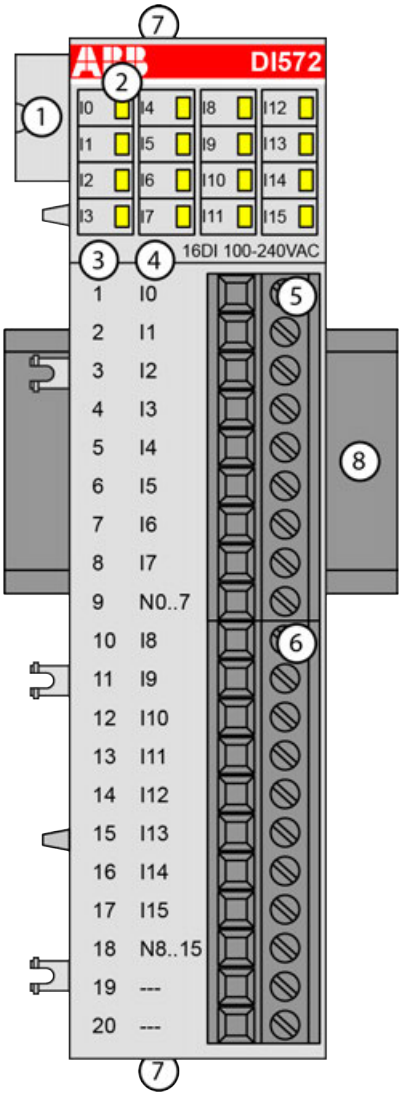
Part no.	Description	Product life cycle phase *)
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active



**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.4.3.1.5 DI572 - Digital input module

- 16 digital inputs 100 ... 240 V AC (I0 ... I15) in 2 groups
- Module-wise galvanically isolated



1 I/O bus
2 16 yellow LEDs to display the signal states of the inputs I0 ... I15
3 Terminal number
4 Allocation of signal name
5 Terminal block for input signals (9-pin)
6 Terminal block for input signals (11-pin)
7 2 holes for wall-mounting with screws
8 DIN rail

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The inputs are group-wise galvanically isolated from each other.

All other circuitry of the module is galvanically isolated from the inputs.

The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA communication interface modules.

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Not necessary

Connections



For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection is carried out by using removable 9-pin and 11-pin terminal blocks. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

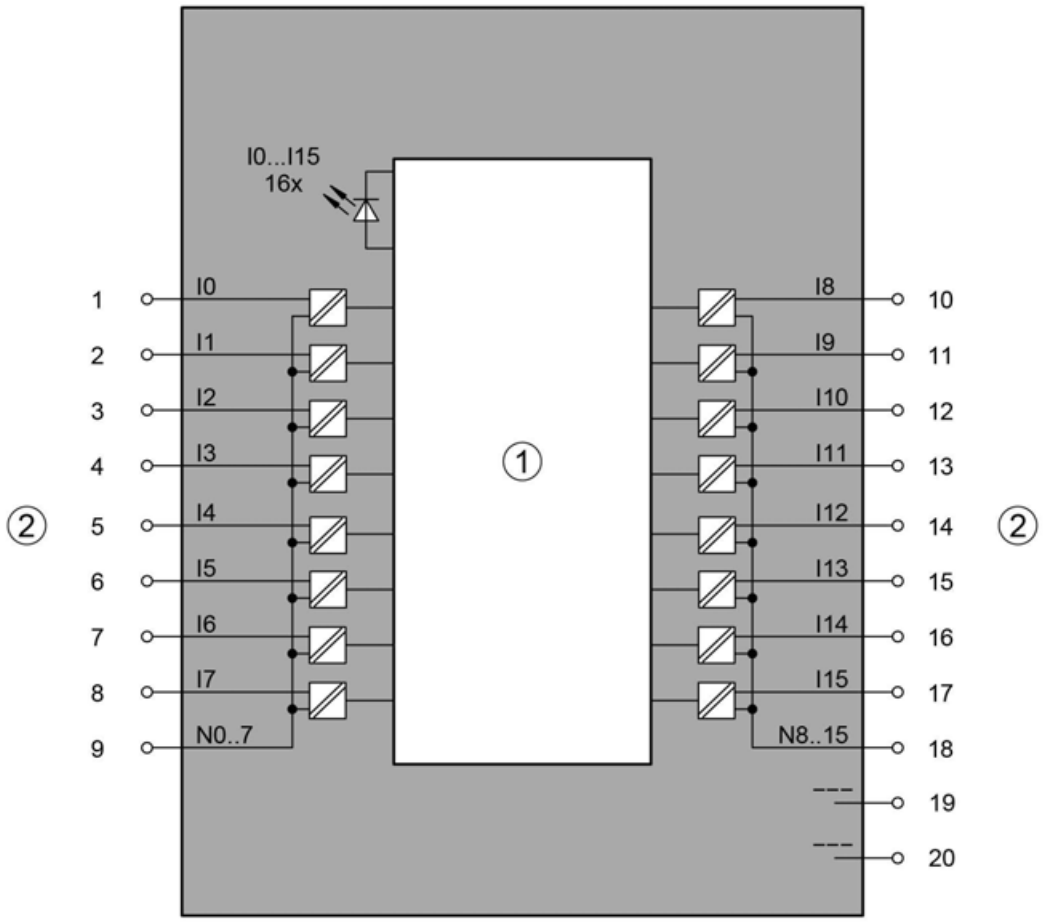


Fig. 30: Block diagram for the internal construction of the digital inputs.

1 Logic - I/O bus interface
2 Digital inputs

Table 136: Assignment of the terminals

Terminal	Signal	Description
1	I0	Input signal I0
2	I1	Input signal I1
3	I2	Input signal I2
4	I3	Input signal I3
5	I4	Input signal I4
6	I5	Input signal I5
7	I6	Input signal I6
8	I7	Input signal I7
9	N0 ... 7	Neutral conductor for the input signals I0 ... I7
10	I8	Input signal I8
11	I9	Input signal I9
12	I10	Input signal I10
13	I11	Input signal I11

Terminal	Signal	Description
14	I12	Input signal I12
15	I13	Input signal I13
16	I14	Input signal I14
17	I15	Input signal I15
18	N8 ... 15	Neutral conductor for the input signals I8 ... I15
19	---	Reserved
20	---	Reserved

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 10 mA per DI572.

An external power supply connection is not needed.



WARNING!

Risk of death by electric shock!

Hazardous voltages can be present at the terminals of the module.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.



WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing the following:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

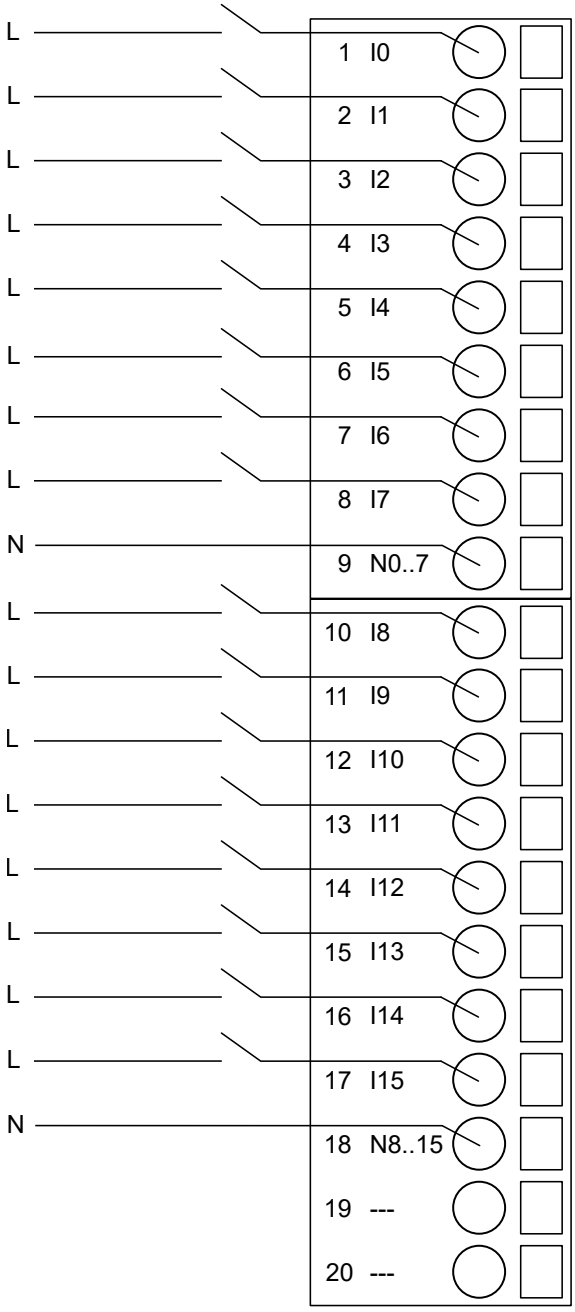


NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.



NOTICE!

Risk of damaging the PLC modules!

The PLC modules will be irreparably damaged if a voltage > 240 V is connected.

Make sure that all inputs are fed from the same phase. The module must not be connected to a 400 V voltage.

The module provides several diagnosis functions ↬ *Chapter 5.4.3.1.5.6 “Diagnosis” on page 344*.

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.



If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Parameter name	**Value**	**Internal value**	**Data type of internal value**	**Default value**	**Min.**	**Max.**	**EDS Slot Index**
Module ID	Internal	6160 [1])	WORD	6160 0x1810	0	65535	xx01 [2])
Ignore module	No	0	BYTE	No 0x00	-	-	-
	Yes	1					
Parameter length	Internal	3	BYTE	3	0	255	xx02 [2])
Input delay	20 ms	0	BYTE	20 ms 0x00	0	1	-
	100 ms	1					

[1]) With CS31 and addresses less than 70, the value is increased by 1.

[2]) Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n).

GSD file:

Ext_Module_Prm_Data_Len =	7
Ext_User_Prm_Data_Const(0) =	0x18, 0x11, 0x00, 0x03, 0x00, 0x00, 0x00;

Diagnosis

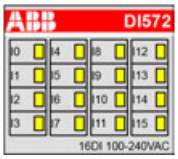
E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500-Display	<– Display in
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC Browser	
Byte 6 Bit 6 ... 7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0 ... 5	PNIO diagnosis block	

Class	Interface	Device	Module	Channel	Error Identifier	Error message	Remedy
	[1])	[2])	[3])	[4])			
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				

Remarks:

Parameter	Remark
[1])	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31-Bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = decentralized communication interface module 1 ... 10, ADR = hardware address (e.g. of the DC551-CS31)
[3])	With "Module" the following allocation applies depending on the master: module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10
[4])	In case of module errors, with channel "31 = module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON
	Inputs I0 ... I15	Digital input	Yellow	Input is OFF	Input is ON (the input voltage is only displayed if the supply voltage of the module is ON)

Technical data

Technical data of the module

The system data of AC500-eCo apply.

Chapter 4.1 “System data AC500-eCo” on page 25

Only additional details are therefore documented below.

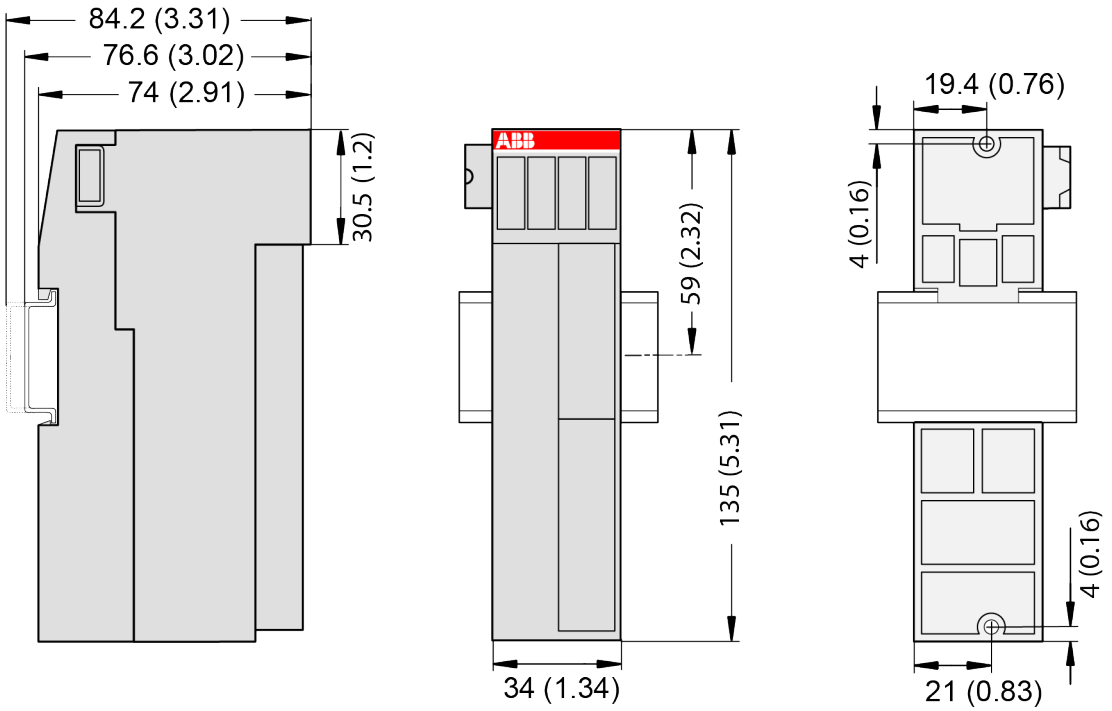
Parameter	Value
Galvanic isolation	Yes, between the input groups and the rest of the module
Isolated groups	2 (8 channels per group)
Current consumption from 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module	Ca. 10 mA
Max. power dissipation within the module	6 W
Weight	Ca. 222 g
Mounting position	Horizontal or vertical
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

Technical data of the digital inputs

Parameter		Value
Number of channels per module		16 AC inputs (100-240 V AC)
Distribution of the channels into groups		2 (8 channels per group)
Input voltage range		0 V AC ... 264 V AC (47 Hz ... 63 Hz)
Input current per channel (typically at +25 °C)		< 3 mA (at 40 V AC) > 6 mA (at 164 V AC) > 8 mA (at 240 V AC)
Connections of the channels I0..I7		Terminals 1... 8
Connections of the channels I8...I15		Terminals 10 ... 17
Reference potential for the channels I0...I7		Terminal 9
Reference potential for the channels I8...I15		Terminal 18
Indication of the input signals		1 yellow LED per channel. The LED is on when the input signal is high (signal 1).
Input type according to EN 61131-2		Type 1
Input signal range		
	Signal 0 (max.)	40 V AC
	Undefined signal	40 V AC < U < 79 V AC
	Signal 1 (min.)	79 V AC
Input delay		
	Signal 0 -> 1	Typ. 24 ms
	Signal 1 -> 0	Typ. 24 ms

Parameter		Value
Input data length		2 bytes
Max. permissible leakage current (at 2-wire proximity switches)		1 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 230 500 R0000	DI572, digital input module, 16 DI, 100 V AC ... 240 V AC	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active

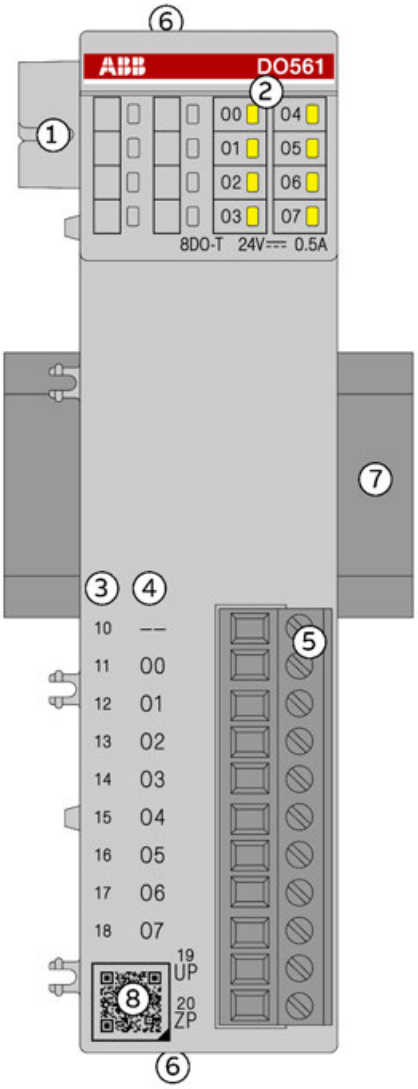
Part no.	Description	Product life cycle phase *)
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active



**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.4.3.1.6 DO561 - Digital output module

- 8 digital outputs 24 V DC (O0 ... O7) in 1 group
- Module-wise galvanically isolated



1 I/O bus
2 8 yellow LEDs to display the signal states of the outputs O0 ... O7
3 Terminal number
4 Allocation of signal name
5 Terminal block for output signals (11-pin)
6 2 holes for wall-mounting with screws
7 DIN rail
8 QR code for datasheet

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The outputs are group-wise galvanically isolated from each other.

All other circuitry of the module is galvanically isolated from the outputs.

The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA communication interface modules.

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Via the terminals ZP and UP (process supply voltage 24 V DC)

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection is carried out by using a removable 9-pin terminal block. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

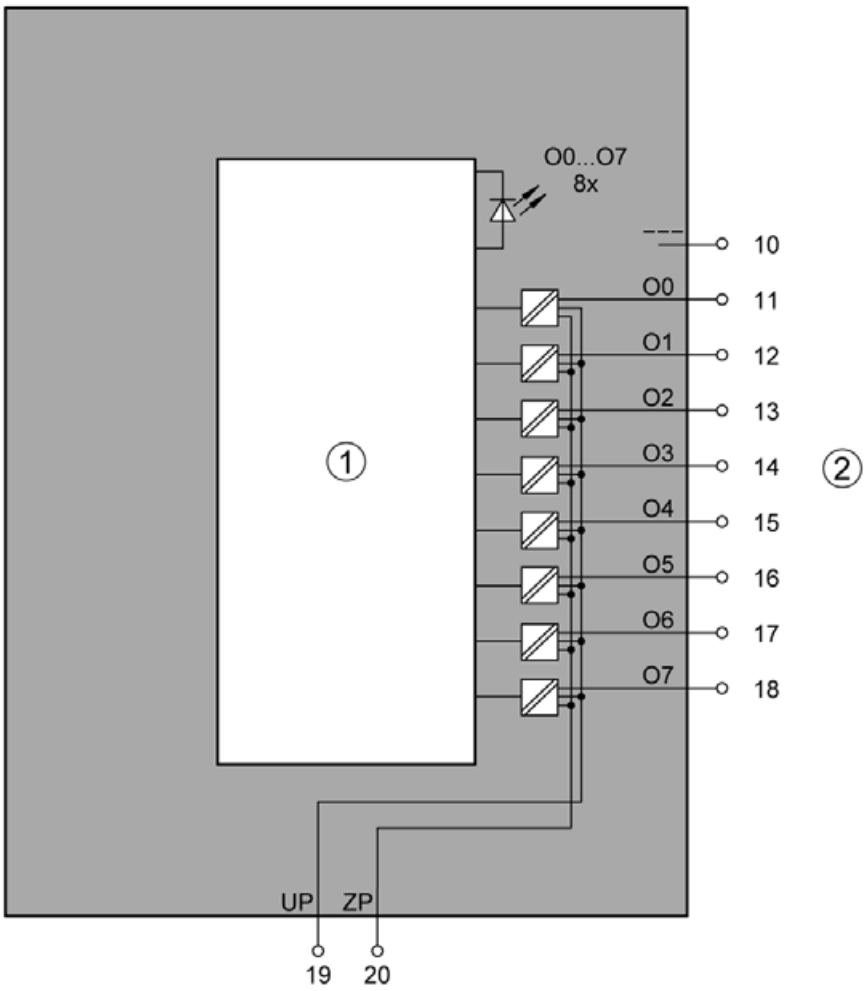


Fig. 31: Internal construction of the digital outputs

1 Logic - I/O interface
2 Digital outputs

Table 137: Assignment of the terminals:

Terminals	Signal	Description
10	---	Reserved
11	O0	Output signal O0
12	O1	Output signal O1
13	O2	Output signal O2
14	O3	Output signal O3
15	O4	Output signal O4
16	O5	Output signal O5
17	O6	Output signal O6
18	O7	Output signal O7
19	UP	Process supply voltage UP +24 V DC
20	ZP	Process supply voltage ZP 0 V

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 5 mA per DO561.

The external power supply connection is carried out via the UP (+24 V DC) and ZP (0 V DC) terminals.



WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing the following:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.



NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

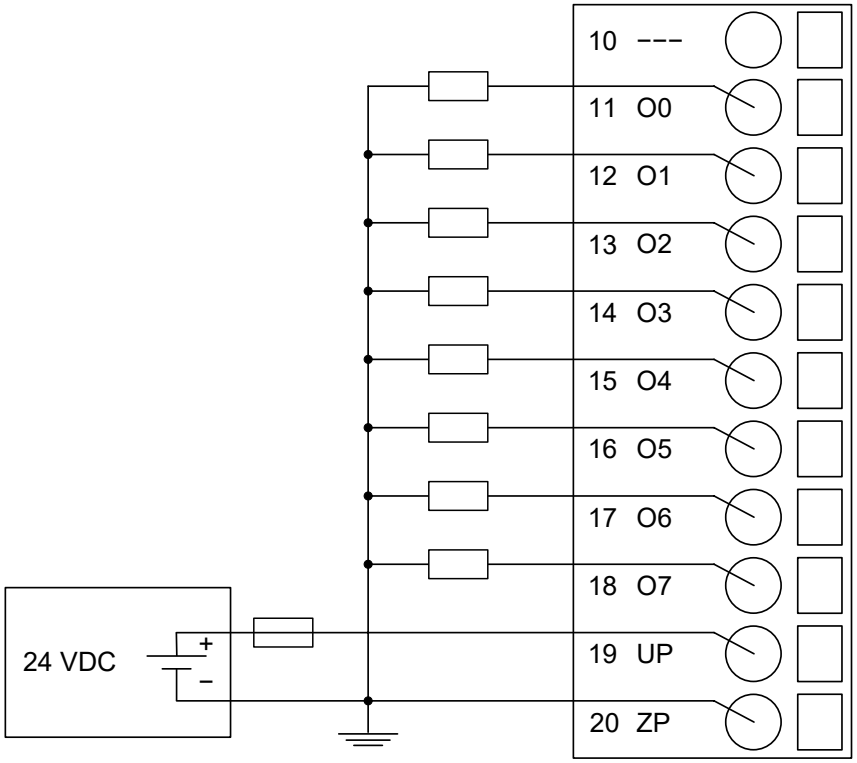


Fig. 32: Connection of the digital output module DO561

NOTICE!

Risk of malfunctions in the plant!

The outputs may switch on for a period of 10 to 50 µs if the process supply voltage UP/ZP is switched on.

This must be considered in the planning of the application.

NOTICE!

Risk of damaging the I/O module!

The outputs are not protected against short circuits and overload.

- Never short-circuit or overload the outputs.
- Never connect the outputs to other voltages.
- Use an external 3 A fast-protection fuse for the outputs.

The module provides several diagnosis functions *Chapter 5.4.3.1.6.6 “Diagnosis” on page 353*.

The meaning of the LEDs is described in the section State LEDs *Chapter 5.4.3.1.6.7 “State LEDs” on page 354*.

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6120 [1])	WORD	6120 0x17E8	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No (0x00)			
Parameter length	Internal	1	BYTE	0	0	255	xx02 [2])

[1]) with CS31 and addresses smaller than 70, the value is increased by 1

[2]) Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n)

GSD file:

Ext_User_Prm_Data_Len =	0x03
Ext_User_Prm_Data_Const(0) =	0xE9, 0x17, 0x00;

Diagnosis

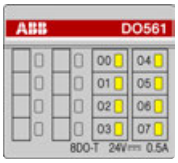
E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000 ... 063**	**AC500-Display**	**<− Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**AB SW**		
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**PNIO diagnosis block**		
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**		**Remedy**
	[1])	**[2])**	**[3])**	**[4])**				
Module error DO561								
3	14	1 ... 10	31	31	19	Checksum error in the I/O module		Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	43	Internal error in the module		Replace I/O module

E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500-Display	<– Display in	
Class	Comp	Dev	Mod	Ch	Err	AB SW		
Byte 6 Bit 6 ... 7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0 ... 5	PNIO diagnosis block		
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**		**Remedy**
	[1])	[2])	[3])	[4])				
Module error DO561								
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer		Restart
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	26	Parameter error		Check master
	11 / 12	ADR	1 ... 10					

Remarks:

[1])	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31-Bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = decentralized communication interface module 1 ... 10, ADR = hardware address (e. g. of the DC551-CS31)
[3])	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or PNIO = module type (2 = DO); COM1/COM2: 1 ... 10 = expansion 1 ... 10
[4])	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON
	Outputs O0 ... O7	Digital output	Yellow	Output is OFF	Output is ON (the output voltage is only displayed if the supply voltage of the module is ON)

Technical data

Technical data of the module

The system data of AC500-eCo apply.

↳ *Chapter 4.1 “System data AC500-eCo” on page 25*

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage UP		
	Connections	Terminal 19 for UP (+24 V DC) and terminal 20 for ZP (0 V DC)
	Rated value	24 V DC
	Current consumption via UP terminal	8 mA + max. 0.5 A per output
	Max. ripple	5 %
	Inrush current	0.000002 A^2s
	Protection against reversed voltage	Yes
	Rated protection fuse for UP	Recommended; the outputs must be protected by an 3 A fast-acting fuse
Current consumption from 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module		Ca. 5 mA
Galvanic isolation		Yes, between the output group and the rest of the module
Isolated groups		1 (8 channels per group)
Surge-voltage (max.)		35 V DC for 0.5 s
Power dissipation within the module (max.)		1 W
Weight		Ca. 115 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

No effects of multiple overloads

No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

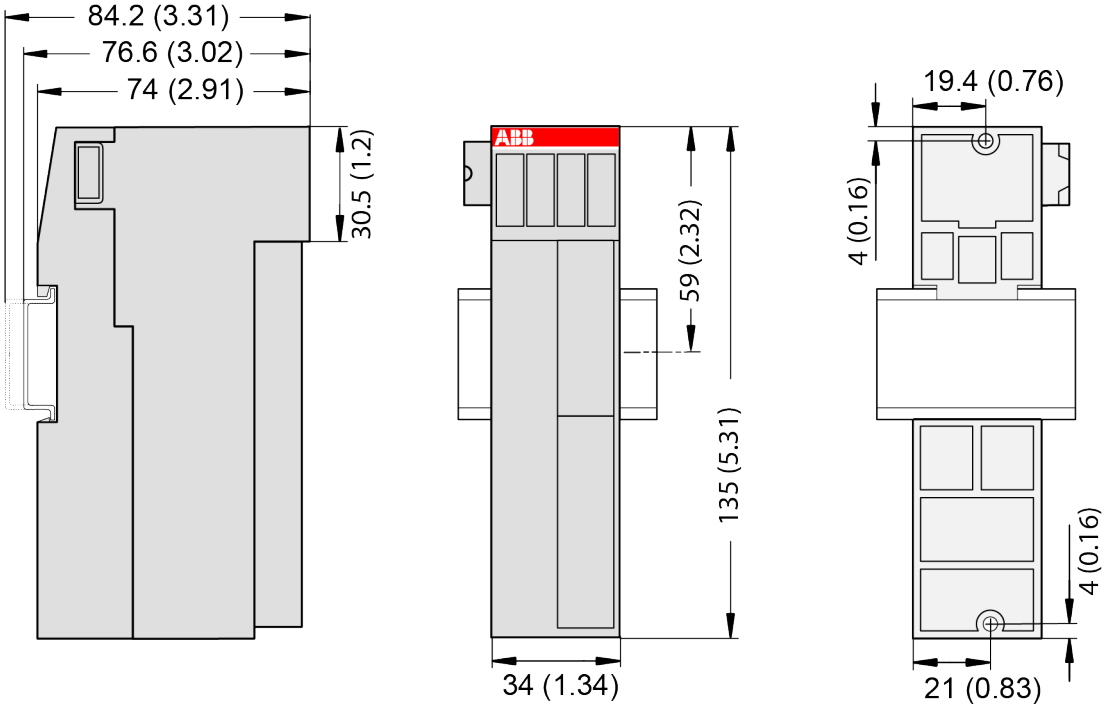
Technical data of the digital outputs

Parameter	Value
Number of channels per module	8 transistor outputs (24 V DC, 0.5 A max.)
Distribution of the channels into groups	1 (8 channels per group)
Connection of the channels O0 to O7	Terminals 11 to 18
Common power supply voltage	Terminal 19 (positive pole of the process voltage, signal name UP)
Reference potential for the channels O0 to O7	Terminal 20 (negative pole of the process voltage, signal name ZP)
Indication of the output signals	1 yellow LED per channel; the LED is on when the output signal is high (signal 1) and the module is powered via the I/O bus
Way of operation	Non-latching type
Min. output voltage at signal 1	20 V DC at max. current consumption

Parameter		Value
Output delay (max. at rated load)		
	0 to 1	50 µs
	1 to 0	200 µs
Output data length		1 byte
Output current		
	Rated current per channel (max.) (Resistive load)	0.5 A
	Rated current per point (max.) (Pilot duty)	0.5 A
	Rated current per group (max.)	4 A
	Lamp load (Tungsten)*	5 W
Max. leakage current with signal 0		0.5 mA
Output type		Non-protected
Protection type		External fuse on each channel
Rated protection fuse (for each channel)		3 A fast
Demagnetization when inductive loads are switched off		Must be performed externally according to driven load specification
Switching Frequencies		
	With inductive loads	Max. 0.5 Hz
	With lamp loads*	Max. 11 Hz at max. 5 W
Short-circuit-proof / Overload-proof		No
	Overload message	No
	Output current limitation	No
	Resistance to feedback against 24 V DC	No
Connection of 2 outputs in parallel		Not possible
Max. cable length		
	Shielded	500 m
	Unshielded	150 m

*.

Dimensions



The dimensions are in mm and in brackets in inch.

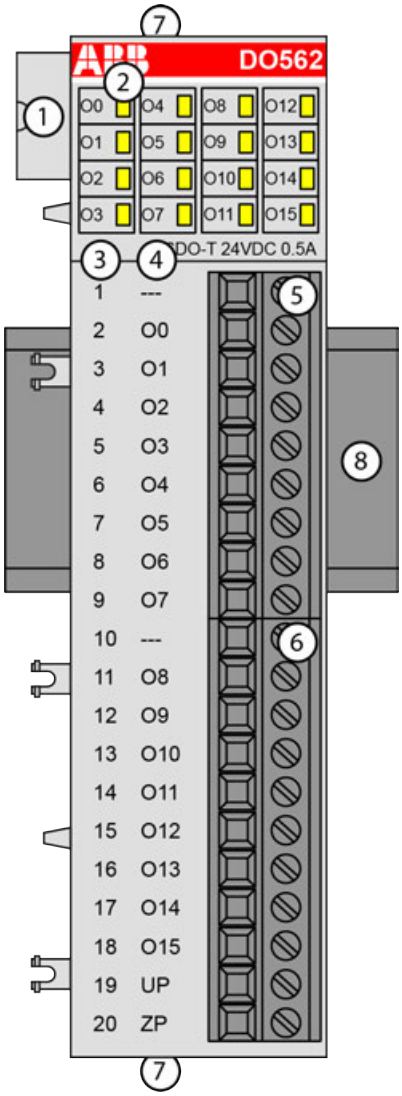
Ordering data

Part no.	Description	Product life cycle phase *)
1TNE 968 902 R2201	DO561, digital output module, 8 DO, transistor output	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.4.3.1.7 DO562 - Digital output module

- 16 digital outputs 24 V DC (O0 ... O15) in 1 group
- Module-wise galvanically isolated



1 I/O bus
2 16 yellow LEDs to display the signal states of the outputs O0 ... O15
3 Terminal number
4 Allocation of signal name
5 Terminal block for output signals (9-pin)
6 Terminal block for output signals (11-pin)
7 2 holes for wall-mounting with screws
8 DIN rail

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The outputs are group-wise galvanically isolated from each other.

All other circuitry of the module is galvanically isolated from the outputs.

The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA communication interface modules.

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Via the terminals ZP and UP (process supply voltage 24 V DC)

Connections



For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection is carried out by using removable 9-pin and 11-pin terminal blocks. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

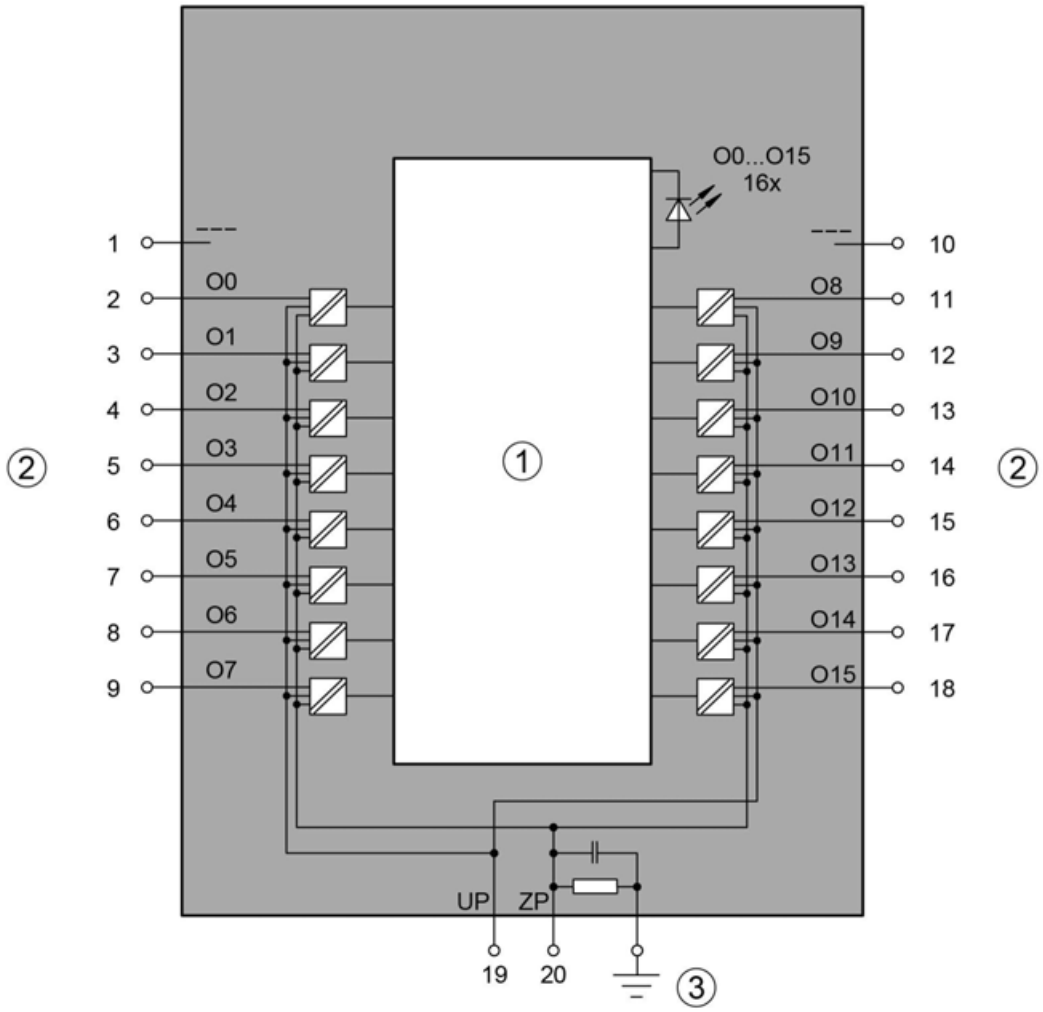


Fig. 33: Internal construction of the digital outputs

1 Logic - I/O interface
2 Digital outputs
3 Functional earth connection

Table 138: Assignment of the terminals:

Terminal	Signal	Description
1	---	Reserved
2	O0	Output signal O0
3	O1	Output signal O1
4	O2	Output signal O2
5	O3	Output signal O3
6	O4	Output signal O4
7	O5	Output signal O5
8	O6	Output signal O6
9	O7	Output signal O7
10	---	Reserved
11	O8	Output signal O8
12	O9	Output signal O9

Terminal	Signal	Description
13	O10	Output signal O10
14	O11	Output signal O11
15	O12	Output signal O12
16	O13	Output signal O13
17	O14	Output signal O14
18	O15	Output signal O15
19	UP	Process voltage UP (24 V DC)
20	ZP	Process voltage ZP (0 V DC)

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 10 mA per DO562.

The external power supply connection is carried out via the UP (+24 V DC) and ZP (0 V DC) terminals.



WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing the following:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

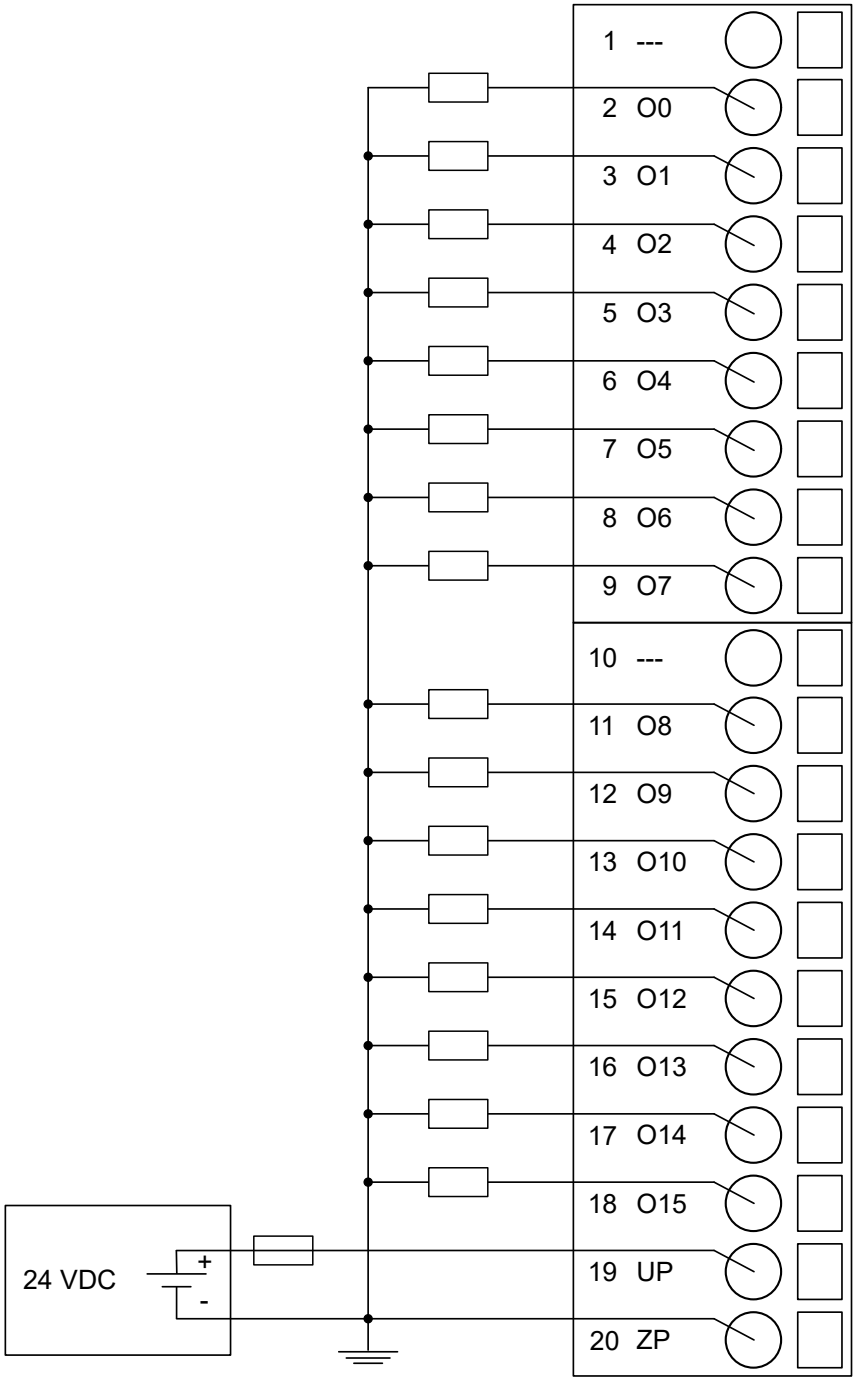


Fig. 34: Connection of the digital output module DO562

NOTICE!

Risk of malfunctions in the plant!

The outputs may switch on for a period of 10 to 50 µs if the process supply voltage UP/ZP is switched on.

This must be considered in the planning of the application.

NOTICE!

Risk of damaging the I/O module!

The outputs are not protected against short circuits and overload.

– Never short-circuit or overload the outputs.
– Never connect the outputs to other voltages.
– Use an external 3 A fast-protection fuse for the outputs.

The module provides several diagnosis functions *Chapter 5.4.3.1.7.6 “Diagnosis” on page 364*.

The meaning of the LEDs is described in the section Status LEDs *Chapter 5.4.3.1.7.7 “State LEDs” on page 364*.

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6145 [1])	WORD	6145 0x1801	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No (0x00)			
Parameter length	Internal	1	BYTE	0	0	255	xx02 [2])

[1]) with CS31 and addresses less than 70, the value is increased by 1

[2]) Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n)

GSD file:

Ext_User_Prm_Data_Len =	0x06
Ext_User_Prm_Data_Const(0) =	0x18, 0x02, 0x00, 0x02, 0x00, 0x00;

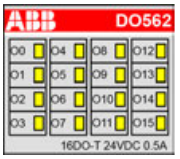
Diagnosis

E1...E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500-Display	<– Display in	
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC Browser		
Byte 6 Bit 6 ... 7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0 ... 5	PNIO diagnosis block		
Class	Inter- face	Device	Module	Channel	Error-Identifier	Error message		Remedy
	[1])	[2])	[3])	[4])				
Module error								
3	14	1 ... 10	31	31	19	Checksum error in the I/O module		Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	43	Internal error in the module		Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer		Restart
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	26	Parameter error		Check master
	11 / 12	ADR	1 ... 10					

Remarks:

[1])	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = decentralized communication interface module 1 ... 10, ADR = hardware address (e. g. of the DC551-CS31)
[3])	With "Module" the following allocation applies dependent of the master: Module error: I/O bus or PNIO: 31 = Module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or PNIO = module type (2 = DO); COM1/COM2: 1 ... 10 = expansion 1 ... 10
[4])	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON
	Outputs O0 ... O15	Digital output	Yellow	Output is OFF	Output is ON (the output voltage is only displayed if the supply voltage of the module is ON)

Technical data

Technical data of the module

The system data of AC500-eCo apply.

Chapter 4.1 “System data AC500-eCo” on page 25

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage UP		
	Connections	Terminal 19 for UP (+24 V DC) and terminal 20 for ZP (0 V DC)
	Rated value	24 V DC
	Current consumption via UP terminal	20 mA + max. 0.5 A per output
	Max. ripple	5 %
	Inrush current	0.000002 A^2s
	Protection against reversed voltage	Yes
	Rated protection fuse for UP	Recommended; the outputs must be protected by an 3 A fast-acting fuse
Current consumption from 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module		Ca. 10 mA
Galvanic isolation		Yes, between the output group and the rest of the module
Isolated groups		1 (16 channels per group)
Surge-voltage (max.)		35 V DC for 0.5 s
Max. power dissipation within the module		1.4 W
Weight		Ca. 125 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

No effects of multiple overloads

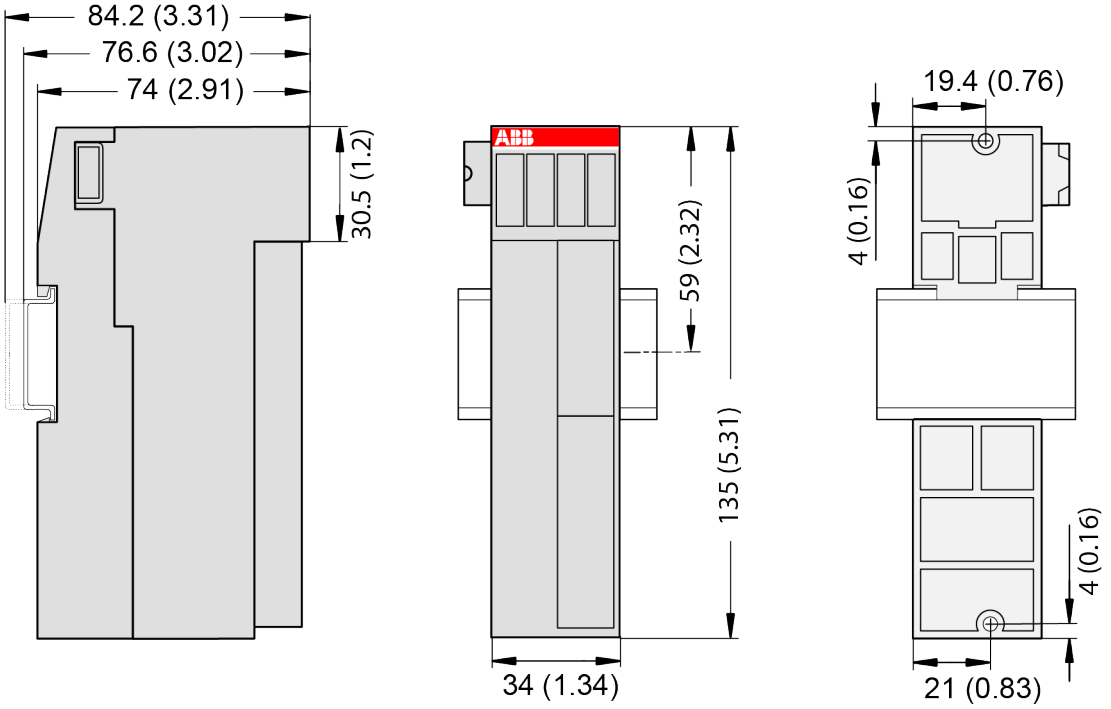
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

Technical data of the digital outputs

Parameter	Value
Number of channels per module	16 transistor outputs (24 V DC, 0.5 A max.)
Distribution of the channels into groups	1 (16 channels per group)
Connection of the channels O0 ... O7	Terminals 1 ... 9
Connection of the channels O8 ... O15	Terminals 11 ... 18
Common power supply voltage	Terminal 19 (positive pole of the process voltage, signal name UP)

Parameter		Value
Reference potential for the channels O0 ... O15		Terminal 20 (negative pole of the process voltage, signal name ZP)
Indication of the output signals		1 yellow LED per channel; the LED is on when the output signal is high (signal 1) and the module is powered via the I/O bus
Way of operation		Non-latching type
Min. output voltage at signal 1		UP -0.3 V at max. current consumption
Output delay (max. at rated load)		
	0 to 1	50 µs
	1 to 0	200 µs
Output data length		2 bytes
Output current		
	Rated current per channel (max.)	0.5 A at UP 24 V DC
	Rated current per group (max.)	8 A
	Lamp load (max.)	5 W
Max. leakage current with signal 0		0.5 mA
Output type		Non-protected
Protection type		External fuse on each channel
Rated protection fuse (for each channel)		3 A fast
Demagnetization when inductive loads are switched off		Must be performed externally according to driven load specification
Switching Frequencies		
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 11 Hz at max. 5 W
Short-circuit-proof / Overload-proof		No
	Overload message	No
	Output current limitation	No
	Resistance to feedback against 24 V DC	No
Connection of 2 outputs in parallel		Not possible
Max. cable length		
	Shielded	500 m
	Unshielded	150 m

Dimensions



The dimensions are in mm and in brackets in inch.

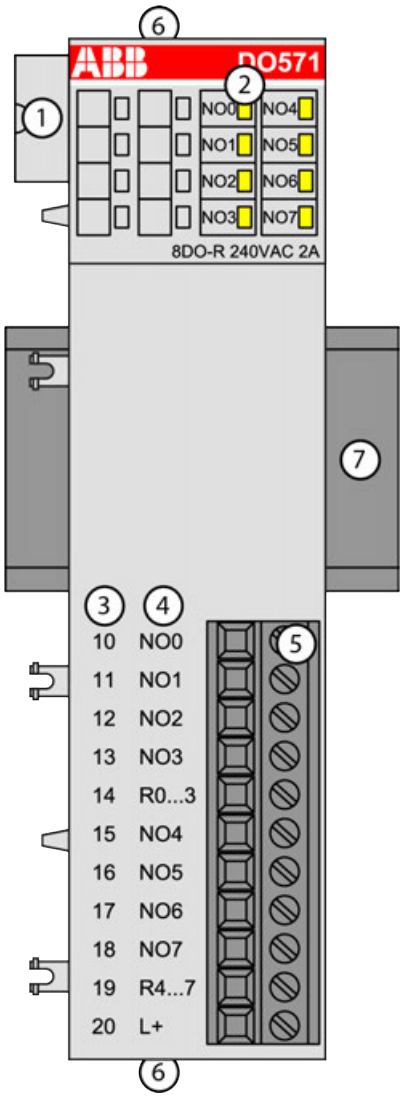
Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 230 900 R0000	DO562, digital output module, 16 DO, transistor output	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

5.4.3.1.8 DO571 - Digital output module

- 8 digital normally open relay outputs 24 V DC / 24 V AC or 100 V AC ... 240 V AC, 2 A max. (NO0 ... NO7) in 2 groups
- Group-wise galvanically isolated



1 I/O bus
2 8 yellow LEDs to display the signal states of the outputs O0 ... O7
3 Terminal number
4 Allocation of signal name
5 Terminal block for output signals (11-pin)
6 2 holes for wall-mounting with screws
7 DIN rail

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The outputs are group-wise galvanically isolated from each other.

All other circuitry of the module is galvanically isolated from the outputs.



The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA communication interface modules.

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Via the terminal L+ (process voltage 24 V DC). The negative pole is provided by the I/O bus.

Connections



For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection is carried out by using removable 9-pin and 11-pin terminal blocks. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

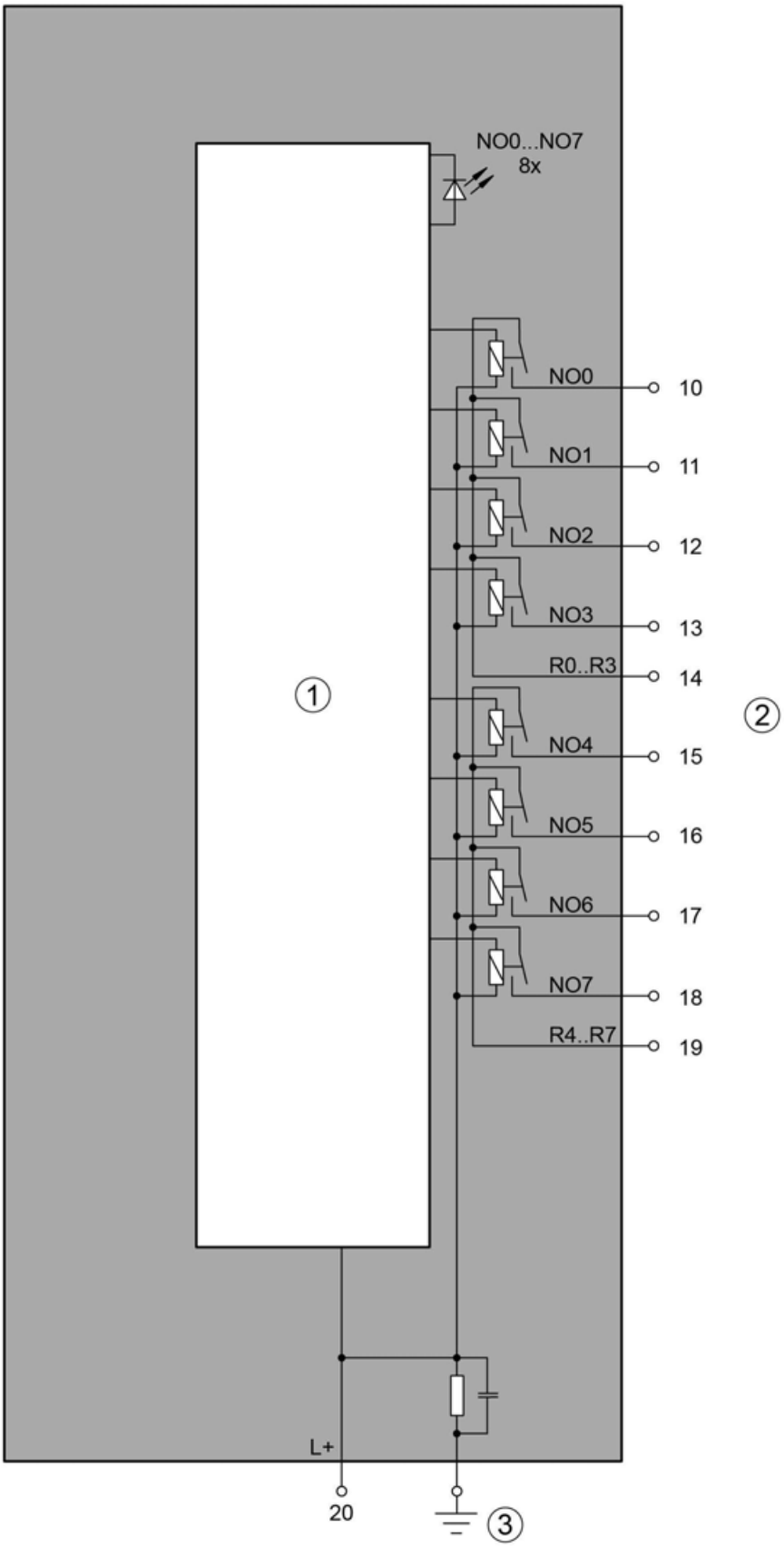


Fig. 35: Internal construction of the digital outputs

1 Logic - I/O interface
2 Digital outputs
3 Functional earth connection

Table 139: Assignment of the terminals:

Terminal	Signal	Description
10	NO0	Normally-open contact of the output NO0
11	NO1	Normally-open contact of the output NO1
12	NO2	Normally-open contact of the output NO2
13	NO3	Normally-open contact of the output NO3
14	R0..3	Output common for signals NO0 to NO3
15	NO4	Normally-open contact of the output NO4
16	NO5	Normally-open contact of the output NO5
17	NO6	Normally-open contact of the output NO6
18	NO7	Normally-open contact of the output NO7
19	R4..7	Output common for signals NO4 to NO7
20	L+	Process voltage L+ +24 V DC

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 5 mA per DO571.

The external power supply connection is carried out via the L+ (+24 V DC) terminal. The negative pole of the external power supply is realized via the I/O bus. Therefore, the CPU/ communication interface module and the DO571 must have a common power supply.



WARNING!

Risk of death by electric shock!

Hazardous voltages can be present at the terminals of the module.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.

For screw-type terminals only:



WARNING!

For screw terminals only: Danger of death by electric shock!

The IP 20 protection degree is only provided if all terminal screws are tightened.

Tighten all screws of unused load terminals of relay outputs if voltages > 24 V are connected to the relay group.

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing the following:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

NOTICE!

Risk of damaging the PLC module!

The PLC module can be damaged by overload.

Make sure that the total current of each output common terminal (R0 ... R3 and R4 ... R7) does not exceed 8 A.

Never connect total currents > 8 A per group.

If the group fuse protection is not sufficient, then individual fuse protection of the outputs should be used.

Connection of the module:

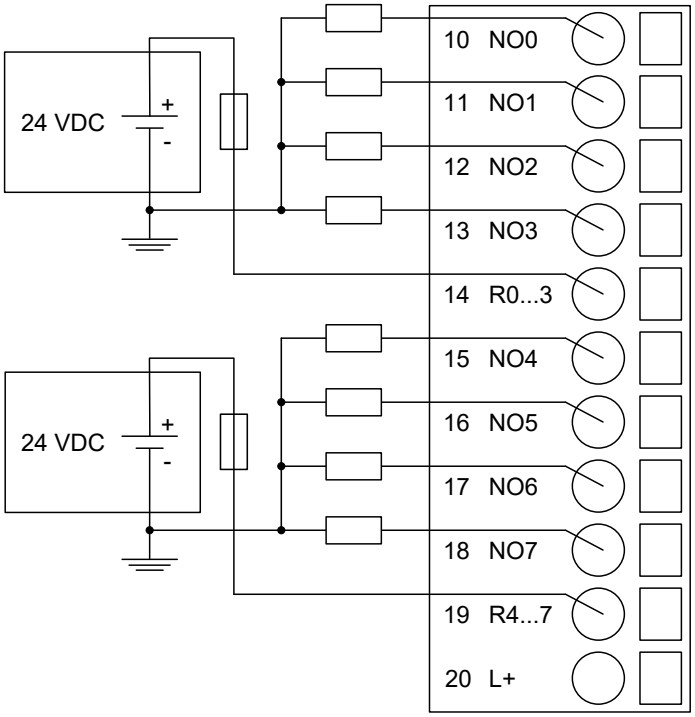


Fig. 36: Connection of 24 V DC actuators

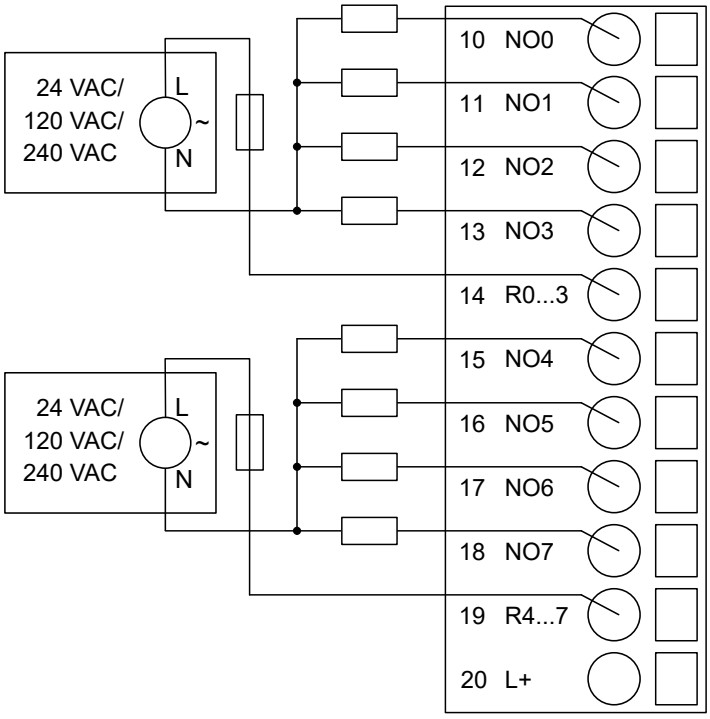


Fig. 37: Connection of 24 V AC or 100 V AC ... 240 V AC actuators

NOTICE!

Risk of damaging the I/O module!

The outputs are not protected against short circuit and overload.

- Never short-circuit or overload the outputs.
- Never connect inductive loads without an external suppression against voltage peaks due to inductive kickback.
- Never connect voltages > 240 V. All outputs must be supplied from the same phase.
- Use an external 5 A fast protection fuse for the outputs.

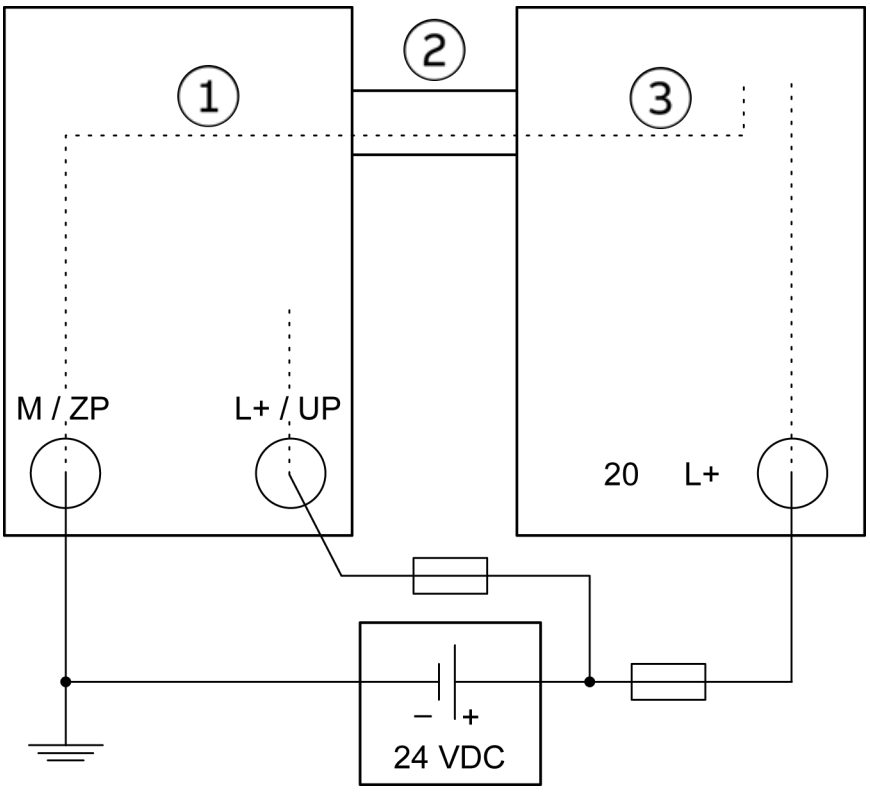


Fig. 38: Power supply - the negative connection is realized via the I/O bus

1 CPU or communication interface module
2 I/O bus
3 DO571

The L+ connection of the DO571 and the 24 V supply of the CPU/communication interface module must be connected to the same 24 V power supply.

The module provides several diagnosis functions *Chapter 5.4.3.1.8.6 “Diagnosis” on page 376*.

The meaning of the LEDs is described in the section Status LEDs *Chapter 5.4.3.1.8.7 “State LEDs” on page 377*.

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.



If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6125 [1])	WORD	6125 0x17ED	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No (0x00)			
Parameter length	Internal	1	BYTE	0	0	255	xx02 [2])
Check supply	Off On	0 1	BYTE	On 0x01			

[1]) with CS31 and addresses smaller than 70, the value is increased by 1

[2]) Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n)

GSD file:

Ext_User_Prm_Data_Len =	0x04
Ext_User_Prm_Data_Const(0) =	0xEF, 0x17, 0x00,\ 0x01;

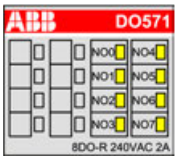
Diagnosis

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<– Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**		
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**PNIO diag-nosis block**		
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error Identi-fier**	**Error message**		**Remedy**
	[1])	[2])	[3])	[4])				
Module error								
3	14	1 ... 10	31	31	19	Checksum error in the I/O module		Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	43	Internal error in the module		Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer		Restart
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	31	31	26	Parameter error		Check master
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	11	Process voltage too low		Check process voltage
	11 / 12	ADR	1 ... 10					

Remarks:

[1])	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = decentralized communication interface module 1 ... 10, ADR = Hardware address (e. g. of the DC551-CS31)
[3])	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or PNIO = module type (2 = DO); COM1/COM2: 1 ... 10 = expansion 1 ... 10
[4])	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON
	Outputs O0 ... O7	Digital output	Yellow	Output is OFF	Output is ON (the output voltage is only displayed if the supply voltage of the module is ON)

Technical data

Technical data of the module

The system data of AC500-eCo apply.

↳ *Chapter 4.1 “System data AC500-eCo” on page 25*

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage L+		
	Connections	Terminal 20 for L+ (+24 V DC). The negative pole is provided by the I/O bus.
	Rated value	24 V DC
	Current consumption via L+	50 mA
	Inrush current (at power-up)	0.0035 A^2s
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse for UP	Recommended; the outputs must be protected by a 3 A fast-acting fuse
Current consumption from 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module		Ca. 5 mA
Galvanic isolation		Yes, between the output group and the rest of the module
Isolated groups		2 (4 channels per group)
Surge-voltage (max.)		35 V DC for 0.5 s
Max. power dissipation within the module		2.0 W
Weight		Ca. 150 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

No effects of multiple overloads

No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

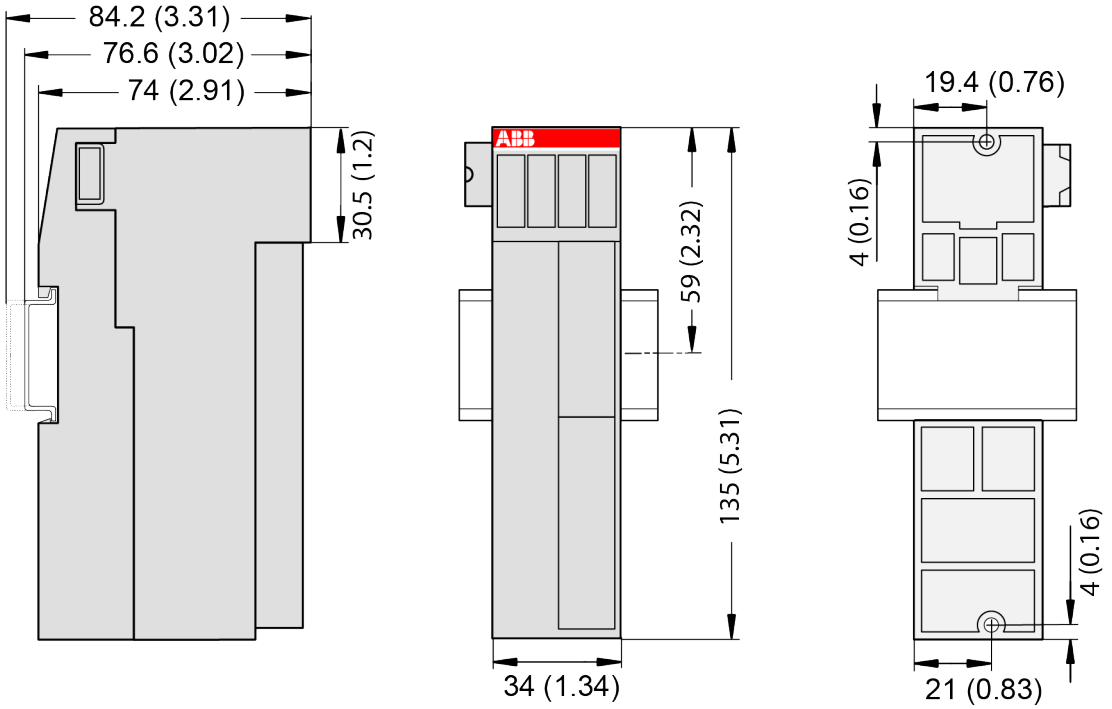
Technical data of the digital outputs

Parameter		Value
Number of channels per module		8 normally-open relay outputs
Distribution of the channels into groups		2 (4 channels per group)
Connection of the channels O0 ... O3		Terminals 10 ... 13
Connection of the channels O4 ... O7		Terminals 15 ... 18
Reference potential for the channels O0 ... O3		Terminal 14 (signal name R0 ... R3)
Reference potential for the channels O4 ... O7		Terminal 19 (signal name R4 ... R7)
Relay coil power supply		Terminal 20 (positive pole of the process supply voltage, signal name L+). The negative pole is provided by the I/O bus.
Indication of the output signals		1 yellow LED per channel; the LED is on when the output signal is high (signal 1) and the module is powered via the I/O bus
Way of operation		Non-latching type
Relay output voltage		
	Rated value	24 V DC / 24 V AC or 120/240 V AC
Output delay		
	Switching 0 to 1 (max.)	Typ. 10 ms
	Switching 1 to 0 (max.)	Typ. 10 ms
Output data length		1 byte
Output current		
	Rated current per channel (max.)	2.0 A (24 V DC / 24 V AC / 48 V AC / 120 V AC / 240 V AC, only resistive loads) 2.0 A (24 V AC / 48 V AC / 120 V AC, only pilot duty) 1.5 A (240 V AC, only pilot duty)
	Rated current per group (max.)	8 A
	Lamp load (max.)	200 W (230 V AC), 30 W (24 V DC)
Spark suppression with inductive AC loads		Must be performed externally according to driven load specification
Switching Frequencies		
	With resistive loads	Max. 1 Hz
	With inductive loads	On Request
	With lamp loads	Max. 1 Hz
Output type		Non-protected
Protection type		External fuse [1])
Rated protection fuse		5 A fast
Short-circuit-proof / Overload-proof		No, should be provided by an external fuse or circuit breaker
	Overload message	No
	Output current limitation	No
Connection of 2 outputs in parallel		Not possible
Lifetime of relay contacts (cycles)		100.000 at rated load

Parameter		Value
Max. cable length		
	Shielded	500 m
	Unshielded	150 m

[1]) Per group in case of group fuse protection. For each channel in case of channel-by-channel fuse protection. The maximum current per group must not be exceeded.

Dimensions



The dimensions are in mm and in brackets in inch.

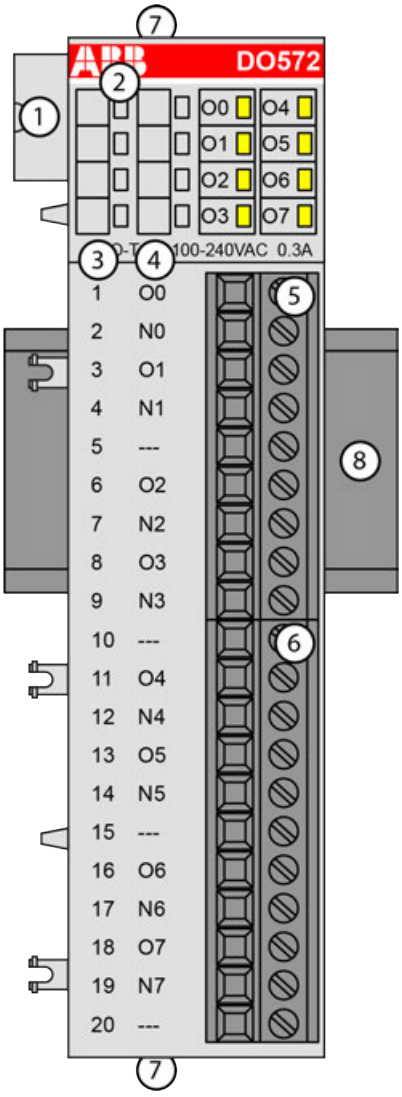
Ordering data

Part no.	Description	Product life cycle phase *)
1TNE 968 902 R2202	DO571, digital output module, 8 DO, relay output	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

5.4.3.1.9 DO572 - Digital output module

- 8 digital triac outputs (O0 ... O7) in 8 groups
- 120/240 V AC
- Module-wise galvanically isolated



1 I/O bus
2 8 yellow LEDs to display the signal states of the outputs O0 ... O7
3 Terminal number
4 Allocation of signal name
5 Terminal block for output signals (9-pin)
6 Terminal block for output signals (11-pin)
7 2 holes for wall-mounting with screws
8 DIN rail

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The outputs are group-wise galvanically isolated from each other.

All other circuitry of the module is galvanically isolated from the outputs.



The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA communication interface modules.

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Not necessary

Connections



For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection is carried out by using removable 9-pin and 11-pin terminal blocks. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

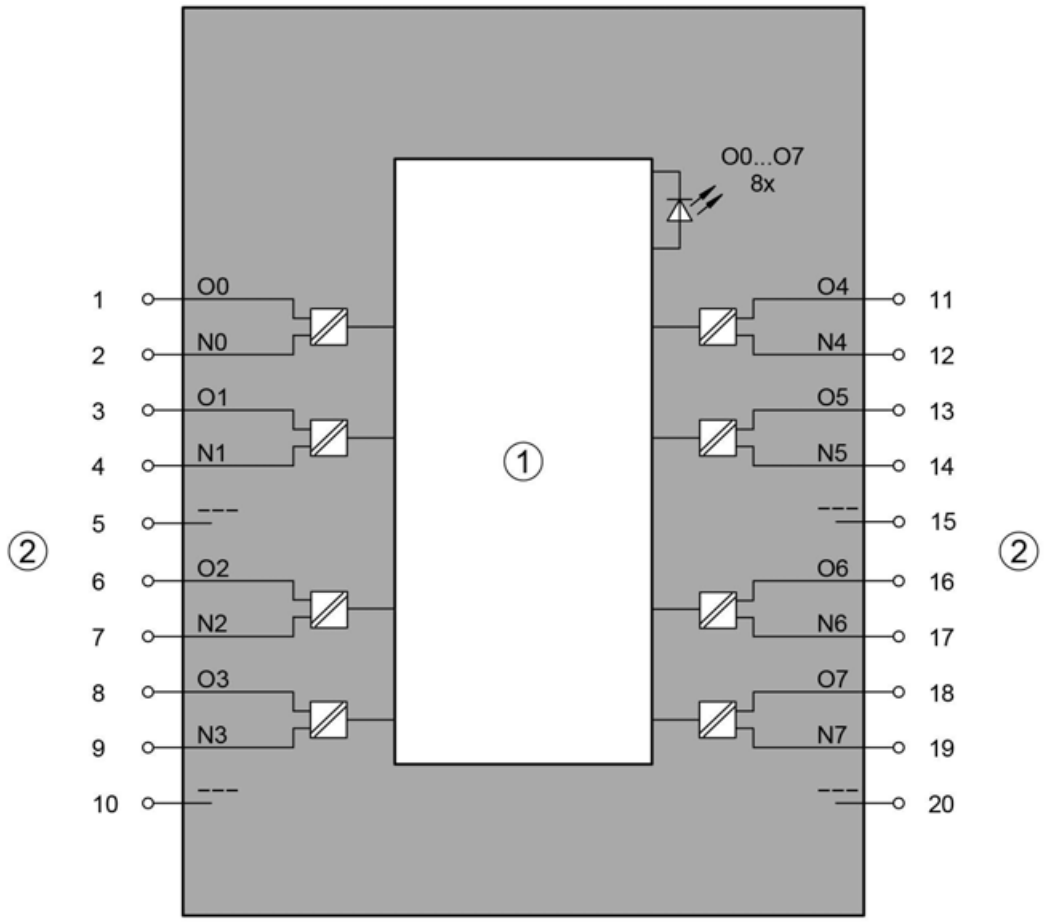


Fig. 39: Internal construction of the digital outputs

1 Logic - I/O interface
2 Digital outputs

Table 140: Assignment of the terminals:

Terminal	Signal	Description
1	O0	Output signal O0
2	N0	Neutral conductor for the output signal O0
3	O1	Output signal O1
4	N1	Neutral conductor for the output signal O1
5	---	Reserved
6	O2	Output signal O2
7	N2	Neutral conductor for the output signal O2
8	O3	Output signal O3
9	N3	Neutral conductor for the output signal O3
10	---	Reserved

Terminal	Signal	Description
11	O4	Output signal O4
12	N4	Neutral conductor for the output signal O4
13	O5	Output signal O5
14	N5	Neutral conductor for the output signal O5
15	---	Reserved
16	O6	Output signal O6
17	N6	Neutral conductor for the output signal O6
18	O7	Output signal O7
19	N7	Neutral conductor for the output signal O7
20	---	Reserved

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 10 mA per DO572.

An external power supply connection is not needed.



WARNING!

Risk of death by electric shock!

Hazardous voltages can be present at the terminals of the module.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.



WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing the following:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

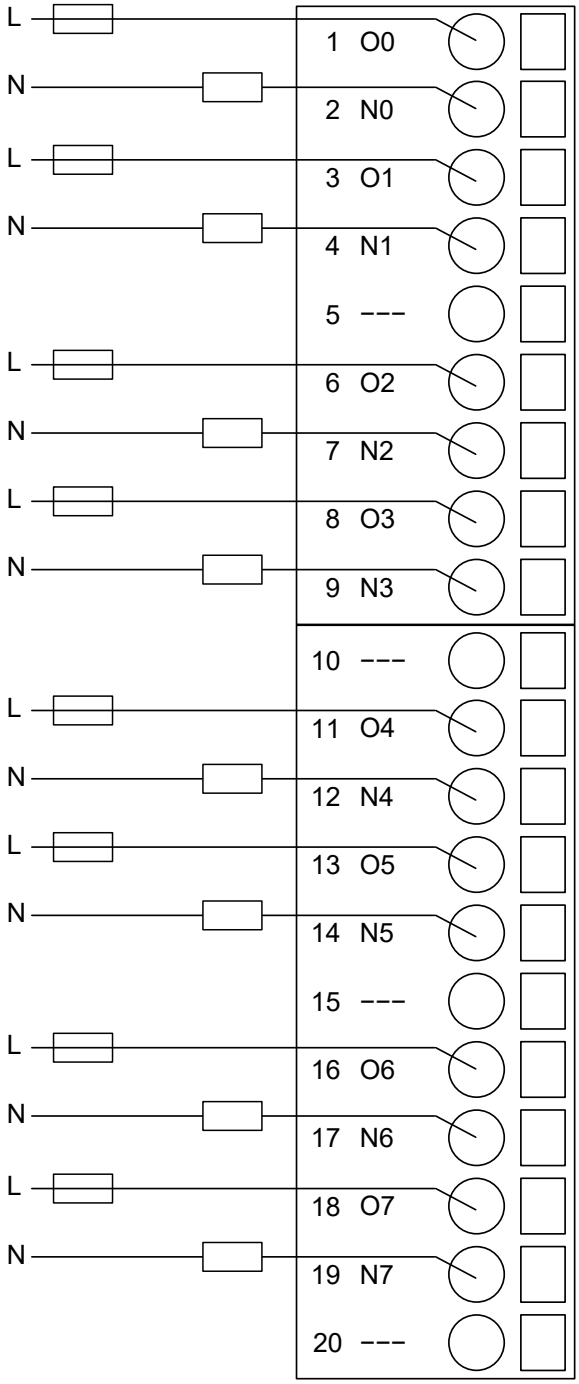


Fig. 40: Connection of the module

NOTICE!

Risk of damaging the PLC modules!

The PLC modules will be irreparably damaged if a voltage > 240 V is connected.

Make sure that all inputs are fed from the same phase. The module must not be connected to a 400 V voltage.

The module provides several diagnosis functions *Chapter 5.4.3.1.9.6 “Diagnosis” on page 386*.

The meaning of the LEDs is described in the section State LEDs *Chapter 5.4.3.1.9.7 “State LEDs” on page 387*.

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6130 [1])	WORD	6130 0x17F2	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No (0x00)			
Parameter length [2])	Internal	1 - CPU	BYTE	0	0	255	xx02 [3])

[1])	With CS31 and addresses smaller than 70, the value is increased by 1
[2])	The module has no additional user-configurable parameters
[3])	Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n)

GSD file:

Ext_User_Prm_Data_Len =	0x03
Ext_User_Prm_Data_Const(0) =	0xF3, 0x17, 0x00;

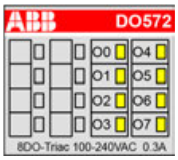
Diagnosis

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000 ... 063**	**AC500-Display**	**<− Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**		
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**PNIO diagnosis block**		
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**		**Remedy**
	[1])	[2])	[3])	[4])				
Module error								
3	14	1 ... 10	31	31	19	Checksum error in the I/O module		Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	43	Internal error in the module		Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer		Restart
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	31	31	26	Parameter error		Check master
	11 / 12	ADR	1 ... 10					

Remarks:

[1])	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31-Bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = decentralized communication interface module 1 ... 10, ADR = hardware address (e. g. of the DC551-CS31)
[3])	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or PNIO = module type (2 = DO); COM1/COM2: 1 ... 10 = expansion 1 ... 10
[4])	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON
	Outputs O0 ... O7	Digital output	Yellow	Output is OFF	Output is ON

Technical data

Technical data of the module

The system data of AC500-eCo apply.

↳ *Chapter 4.1 “System data AC500-eCo” on page 25*

Only additional details are therefore documented below.

Parameter	Value
Galvanic isolation	Yes, between the channels and the rest of the module
Isolated groups	8 (1 channel per group)
Current consumption from 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module	Ca. 10 mA
Max. power dissipation within the module	On Request
Weight	ca. 120 g
Mounting position	Horizontal or vertical
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

No effects of multiple overloads

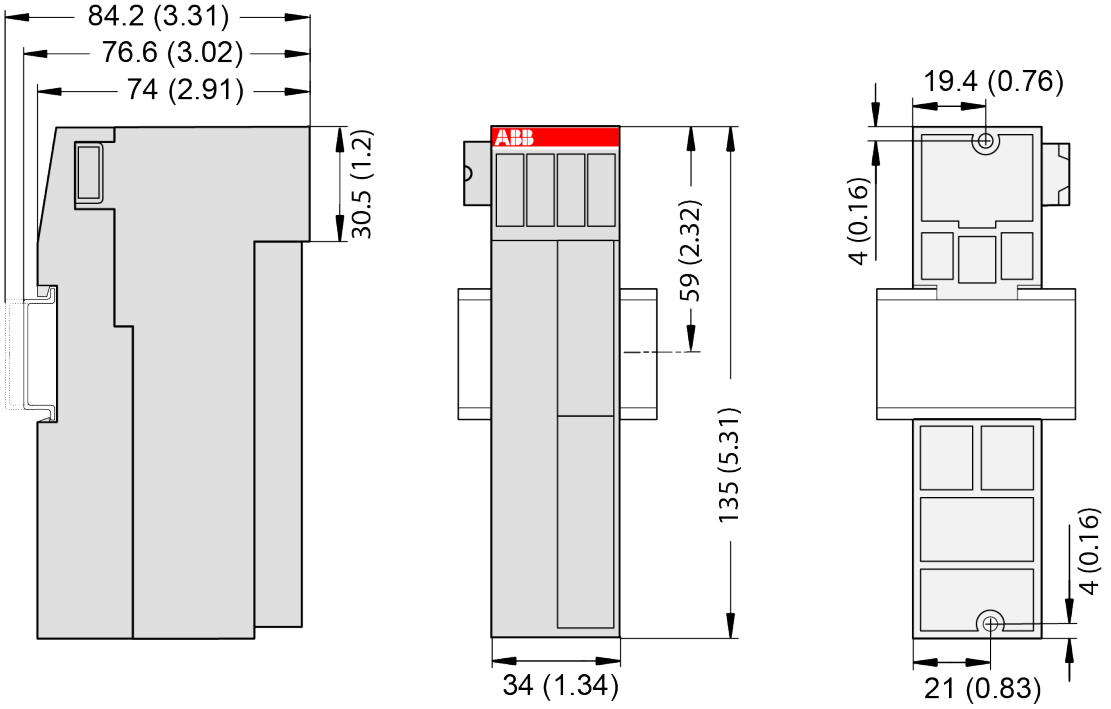
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

Technical data of the digital outputs

Parameter		Value
Number of channels per module		8 triac outputs
Distribution of the channels into groups		8 groups (1 channel per group)
Connection of the channels O0 to O7		Terminals 1, 3, 5, 7, 10, 12, 14, 16
Reference potential for the channels O0 to O7		Terminals 2, 4, 6, 8, 11, 13, 15, 17
Output voltage for signal 1		On Request
Max. leakage current with signal 0		1.1 mA root mean square at 132 V AC and 1.8 mA root mean square at 264 V AC
Output voltage		
	Rated value	120 V AC or 240 V AC

Parameter		Value
Indication of the output signals		1 yellow LED per channel; the LED is on when the output signal is high (signal 1) and the module is powered via the I/O bus
Way of operation		Non-latching type
Output delay		On Request
Output data length		1 byte
Output current		
	Rated current per channel (max.)	0.3 A
	Rated current per group (max.)	0.3 A
Surge current (max.)		On request
Lamp load (max.)		On request
Spark suppression with inductive AC loads		Must be performed externally according to driven load specification
Switching Frequencies		
	With resistive loads	Max. 10 Hz
	With inductive loads	Not applicable
	With lamp loads	Max. 10 Hz
Output type		Non-protected
Protection type		External fuse on each channel
Rated protection fuse		2 A fast
Short-circuit-proof / Overload-proof		No, should be provided by an external fuse or circuit breaker
	Overload message	No
	Output current limitation	No
Resistance to feedback against 230 V AC		No
Connection of 2 outputs in parallel		Not applicable
Max. cable length		
	Shielded	500 m
	Unshielded	150 m

Dimensions



The dimensions are in mm and in brackets in inch.

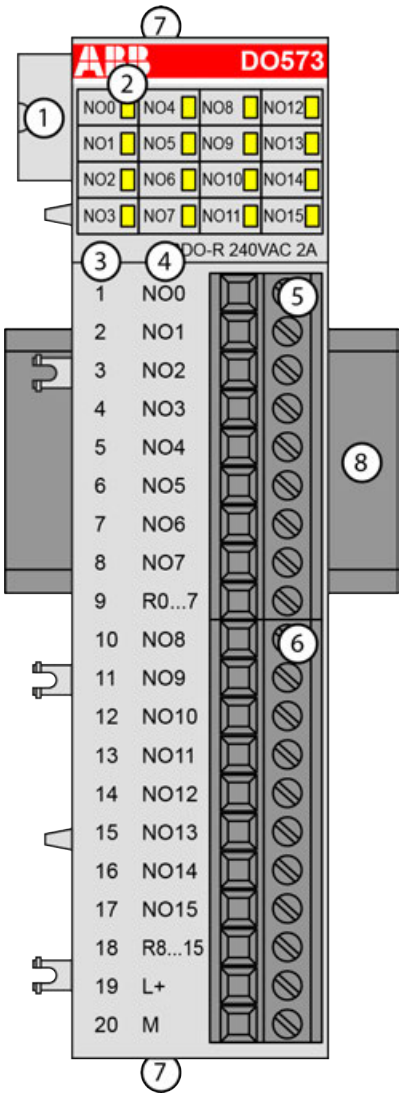
Ordering data

Part no.	Description	Product life cycle phase *)
1TNE 968 902 R2203	DO572, digital output module, 8 DO, triac output	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

5.4.3.1.10 DO573 - Digital output module

- 16 digital normally open relay outputs 24 V DC or 100 V AC ... 240 V AC (NO0 ... NO15) in 2 groups, 2 A max.
- Group-wise galvanically isolated



1 I/O bus
2 16 yellow LEDs to display the signal states of the outputs O0 ... O15
3 Terminal number
4 Allocation of signal name
5 Terminal block for output signals (9-pin)
6 Terminal block for output signals (11-pin)
7 2 holes for wall-mounting with screws
8 DIN rail

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The outputs are group-wise galvanically isolated from each other.

All other circuitry of the module is galvanically isolated from the outputs.



The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA communication interface modules.

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Via the terminals L+ (process voltage 24 V DC) and M (0 V DC); the M terminal is connected to the M terminal of the CPU via the I/O bus

Connections



For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection is carried out by using removable 9-pin and 11-pin terminal blocks. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

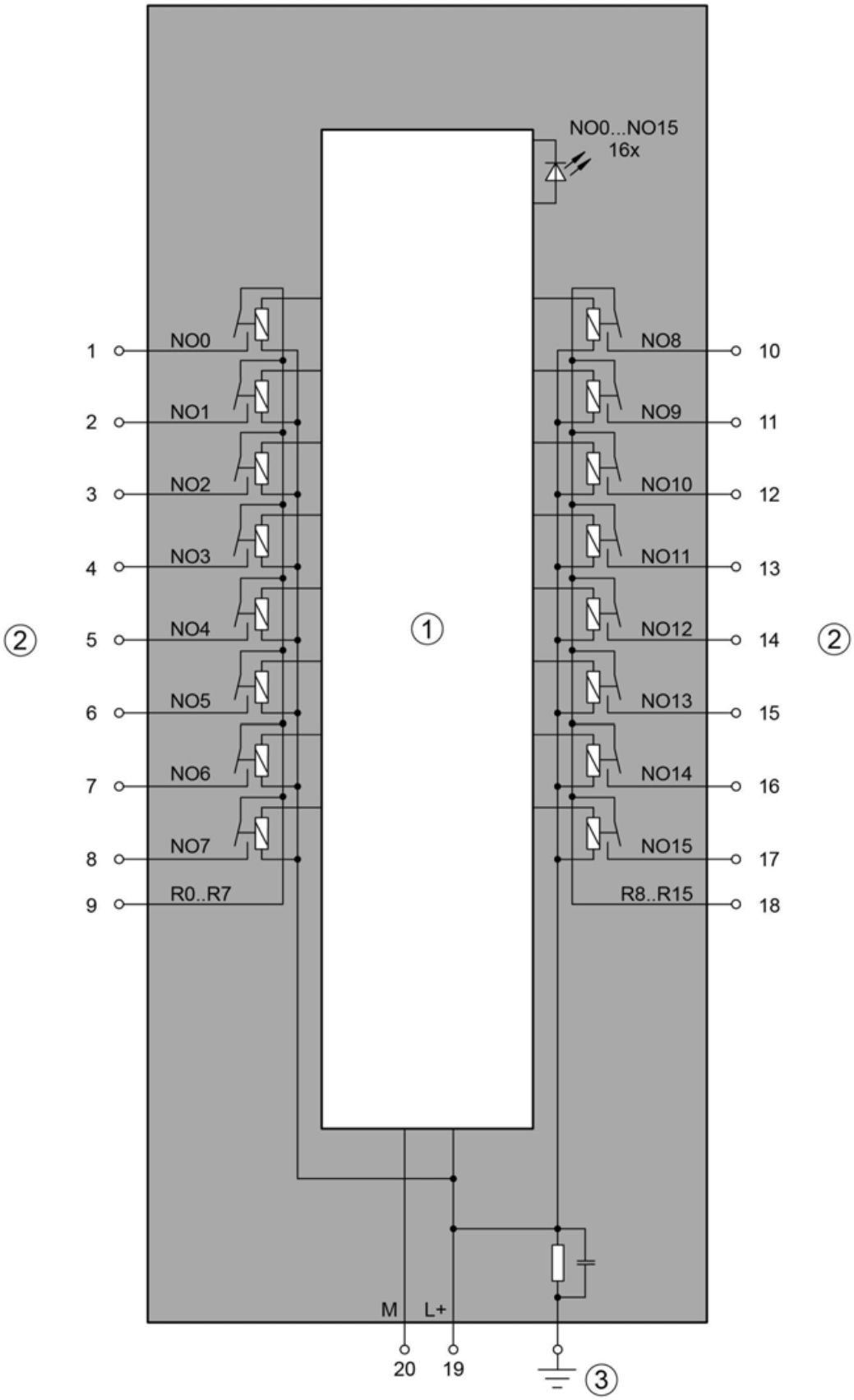


Fig. 41: Internal construction of the digital outputs

1 Logic - I/O bus interface
2 Digital outputs
3 Functional earth connection

Table 141: Assignment of the terminals:

Terminal	Signal	Description
1	NO0	Normally-open contact of the output NO0
2	NO1	Normally-open contact of the output NO1
3	NO2	Normally-open contact of the output NO2
4	NO3	Normally-open contact of the output NO3
5	NO4	Normally-open contact of the output NO4
6	NO5	Normally-open contact of the output NO5
7	NO6	Normally-open contact of the output NO6
8	NO7	Normally-open contact of the output NO7
9	R0..7	Output common for signals NO0 to NO7
10	NO8	Normally-open contact of the output NO8
11	NO9	Normally-open contact of the output NO9
12	NO10	Normally-open contact of the output NO10
13	NO11	Normally-open contact of the output NO11
14	NO12	Normally-open contact of the output NO12
15	NO13	Normally-open contact of the output NO13
16	NO14	Normally-open contact of the output NO14
17	NO15	Normally-open contact of the output NO15
18	R8 ... 15	Output common for signals NO8 to NO15
19	L+	Process voltage L+ (24 V DC)
20	M	Process voltage M (0 V DC)

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 5 mA per DO573.

The external power supply connection is carried out via the L+ (+24 V DC) and the M (0 V DC) terminals. The M terminal is electrically interconnected to the M/ZP terminal of the CPU/ communication interface module.



WARNING!
Risk of death by electric shock!
Hazardous voltages can be present at the terminals of the module.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.

For screw-type terminals only:



WARNING!
For screw terminals only: Danger of death by electric shock!
The IP 20 protection degree is only provided if all terminal screws are tightened.

Tighten all screws of unused load terminals of relay outputs if voltages > 24 V are connected to the relay group.

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing the following:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the I/O module!

The outputs are not protected against short circuit and overload.

– Never short-circuit or overload the outputs.
– Never connect inductive loads without an external suppression against voltage peaks due to inductive kickback.
– Never connect voltages > 240 V. All outputs must be supplied from the same phase.
– Use an external 5 A fast protection fuse for the outputs.

NOTICE!

Risk of damaging the PLC module!

The PLC module can be damaged by overload.

Make sure that the total current of each output common terminal (R0 ... R7 and R8 ... R15) does not exceed 10 A.

Never connect total currents > 10 A per group.

If the group fuse protection is not sufficient, then individual fuse protection of the outputs should be used.

The following figure shows the connection of the module:

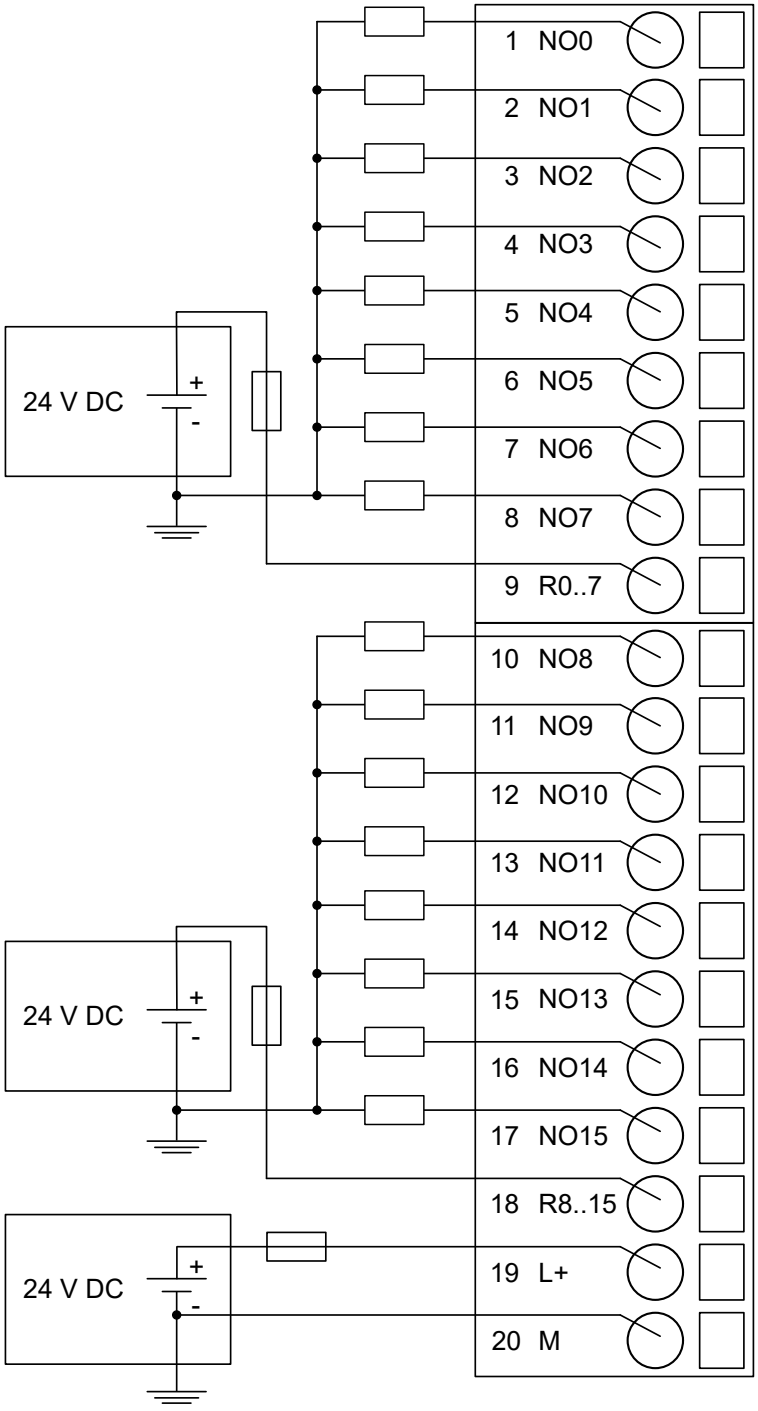


Fig. 42: Connection of 24 V DC actuators

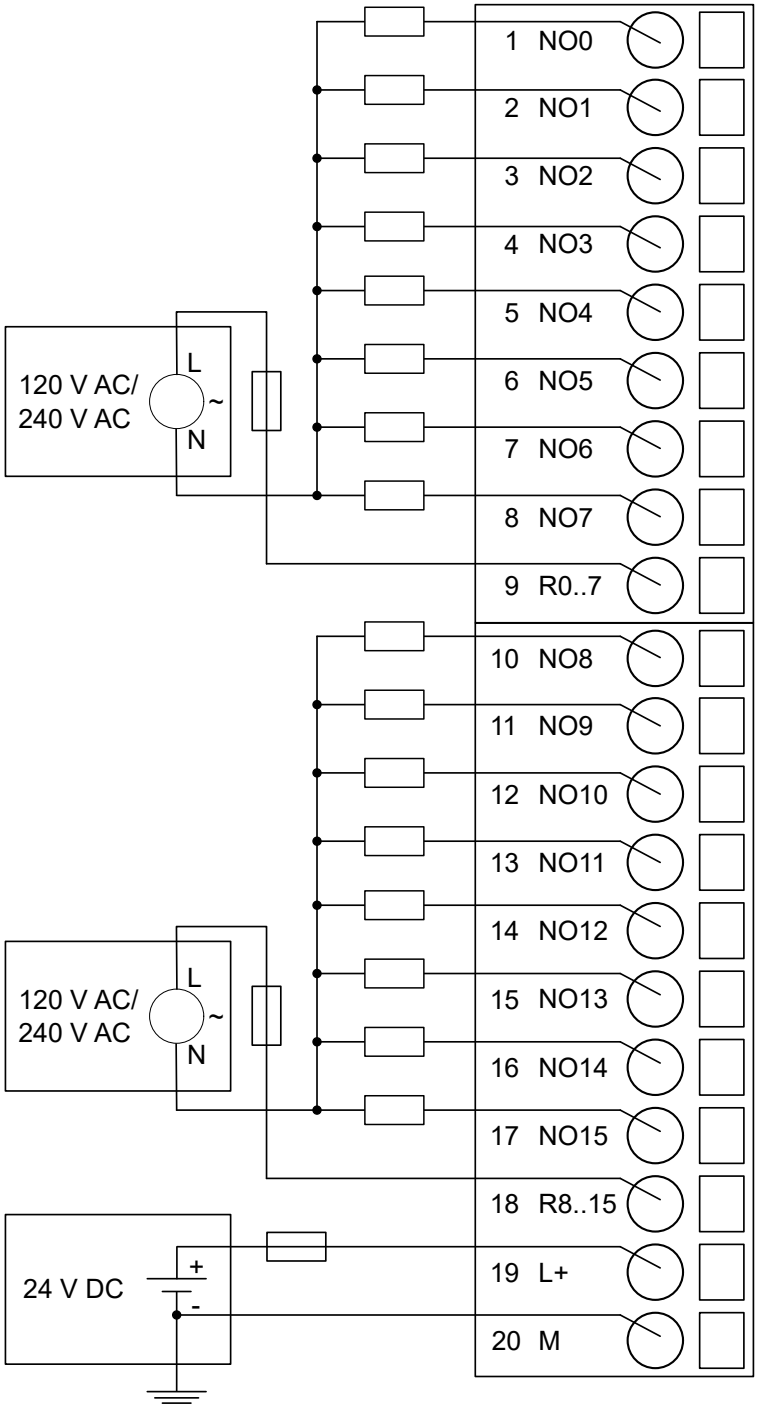


Fig. 43: Connection of 100-240 V AC actuators

The module provides several diagnosis functions.

The meaning of the LEDs is described in the section State LEDs ↳ *Chapter 5.4.3.1.9.7 “State LEDs” on page 387*.

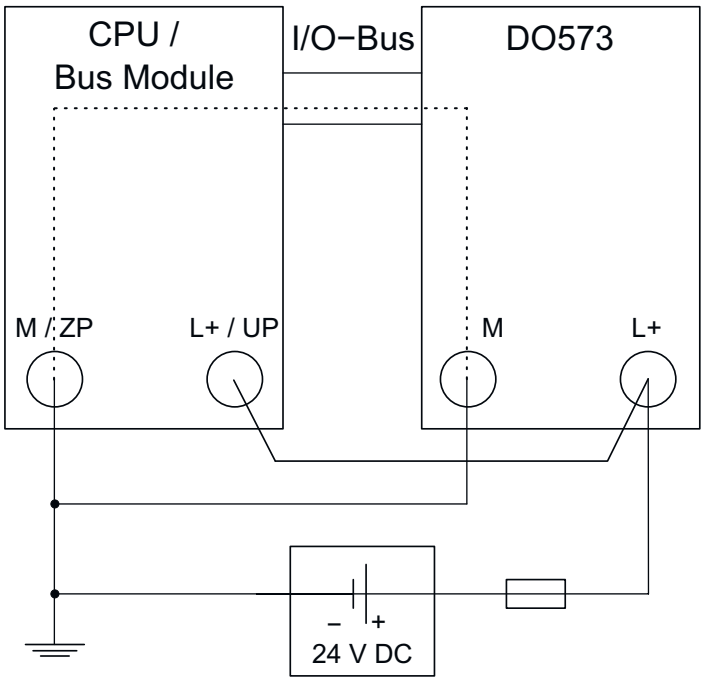


Fig. 44: Power supply - the negative connection is realized via the I/O bus

The L+ connection of the DO573 and the 24 V supply of the CPU/communication interface module must be connected to the same 24 V power supply .

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6150 [1])	WORD	6150 0x1806	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No (0x00)			
Parameter length	Internal	1	BYTE	0	0	255	xx02 [2])
Check supply	Off On	0 1	BYTE	On 0x01			

[1]) with CS31 and addresses less than 70, the value is increased by 1

[2]) Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n)

GSD file:

Ext_User_Prm_Data_Len = Ext_User_Prm_Data_Const(0) =	0x07 0x18, 0x07, 0x00, 0x03, 0x01, 0x00, 0x00;

Diagnosis

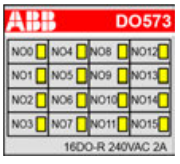
E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<– Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**		
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**PNIO diag-nosis block**		
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-Identi-fier**	**Error message**		**Remedy**
	[1])	**[2])**	**[3])**	**[4])**				
Module error								
3	14	1 ... 10	31	31	19	Checksum error in the I/O module		Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	43	Internal error in the module		Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer		Restart
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	31	31	26	Parameter error		Check master
	11 / 12	ADR	1 ... 10					

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<– Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-Identi-fier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])			
Module error							
3	14	1 ... 10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1 ... 10				

Remarks:

[1])	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31-Bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = Module itself, 1 ... 10 = decentralized communication interface module 1 ... 10, ADR = Hardware address (e. g. of the DC551-CS31)
[3])	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or PNIO = module type (2 = DO); COM1/COM2: 1 ... 10 = expansion 1 ... 10
[4])	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		**State**	**Color**	**LED = OFF**	**LED = ON**
	Outputs NO0 ... NO15	Digital output	Yellow	Output is OFF	Output is ON (the output voltage is only displayed if the supply voltage of the module is ON)

Technical data

Technical data of the module

The system data of AC500-eCo apply.

↳ *Chapter 4.1 “System data AC500-eCo” on page 25*

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage L+		
	Connections	Terminals 19 for L+ (+24 V DC) and 20 for M (0 V DC)
	Rated value	24 V DC
	Current consumption via L+	50 mA
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse for L+	Recommended; the outputs must be protected by an 5 A fast-acting fuse
Current consumption from 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module		Ca. 5 mA
Galvanic isolation		Yes, between the output groups and the rest of the module
Isolated groups		2 (8 channels per group)
Surge-voltage (max.)		35 V DC for 0.5 s
Max. power dissipation within the module		2.0 W
Weight		Ca. 160 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

No effects of multiple overloads

No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

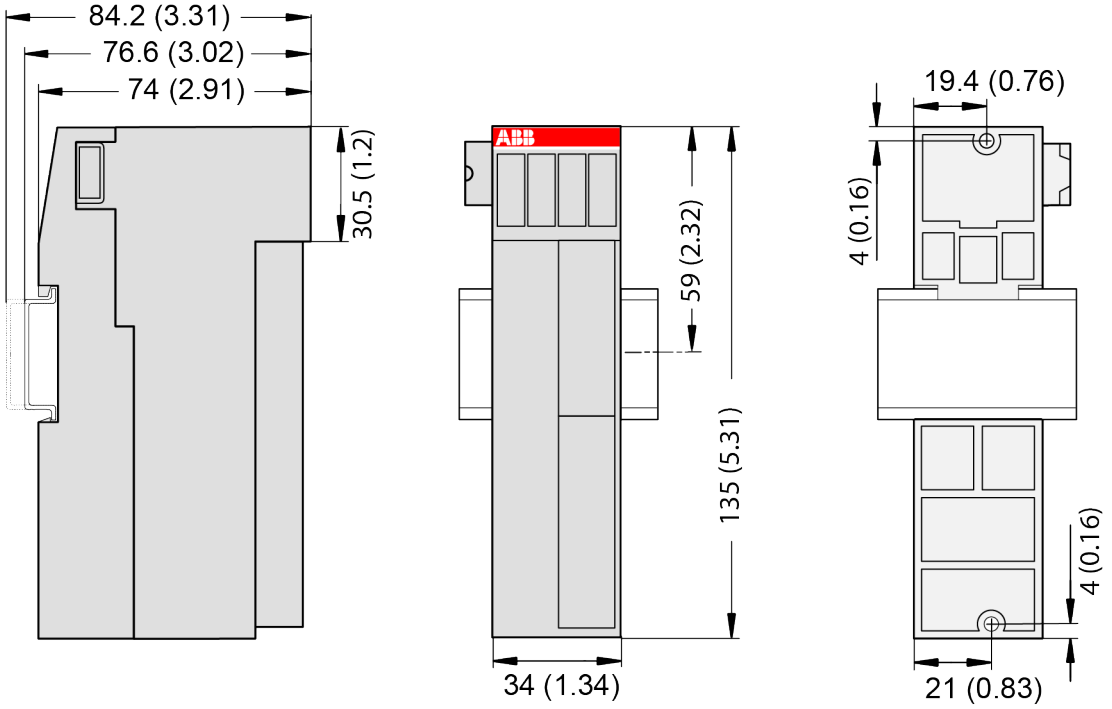
Technical data of the digital outputs

Parameter	Value
Number of channels per module	16 normally-open relay outputs
Distribution of the channels into groups	2 (8 channels per group)
Connection of the channels NO0 ... NO7	Terminals 1 ... 8
Connection of the channels NO8 ... NO15	Terminals 10 ... 17
Reference potential for the channels NO0 ... NO7	Terminal 9 (signal name R0 ... 7)
Reference potential for the channels NO8 ... NO15	Terminal 18 (signal name R8 ... 15)
Relay coil power supply	Terminals 19 and 20 (signal names L+ and M)
Indication of the output signals	1 yellow LED per channel; the LED is on when the output signal is high (signal 1) and the module is powered via the I/O bus

Parameter		Value
Way of operation		Non-latching type
Relay output voltage		
	Rated value	24 V DC or 120/240 V AC
Output delay		
	Switching 0 to 1 (max.)	Typ. 10 ms
	Switching 1 to 0 (max.)	Typ. 10 ms
Output data length		2 bytes
Output current		
	Rated current per channel (max.)	2.0 A (24 V DC / 24 V AC / 48 V AC / 120 V AC / 240 V AC, only resistive loads) 2.0 A (24 V AC / 48 V AC / 120 V AC, only pilot duty) 1.5 A (240 V AC, only pilot duty)
	Rated current per group (max.)	10 A
Lamp load (max.)		200 W (230 V AC), 30 W (24 V DC)
Spark suppression with inductive AC loads		Must be performed externally according to driven load specification
Switching Frequencies		
	With resistive loads	Max. 1 Hz
	With inductive loads	On Request
	With lamp loads	Max. 1 Hz
Output type		Non-protected
Protection type		External fuse [1])
Rated protection fuse		5 A fast
Short-circuit-proof / Overload-proof		No, should be provided by an external fuse or circuit breaker
	Overload message	No
	Output current limitation	No
Connection of 2 outputs in parallel		Not possible
Lifetime of relay contacts (cycles)		100.000 at rated load
Max. cable length		
	Shielded	500 m
	Unshielded	150 m

[1]) Per group in case of group fuse protection. For each channel in case of channel-by-channel fuse protection. The maximum current per group must not be exceeded.

Dimensions



The dimensions are in mm and in brackets in inch.

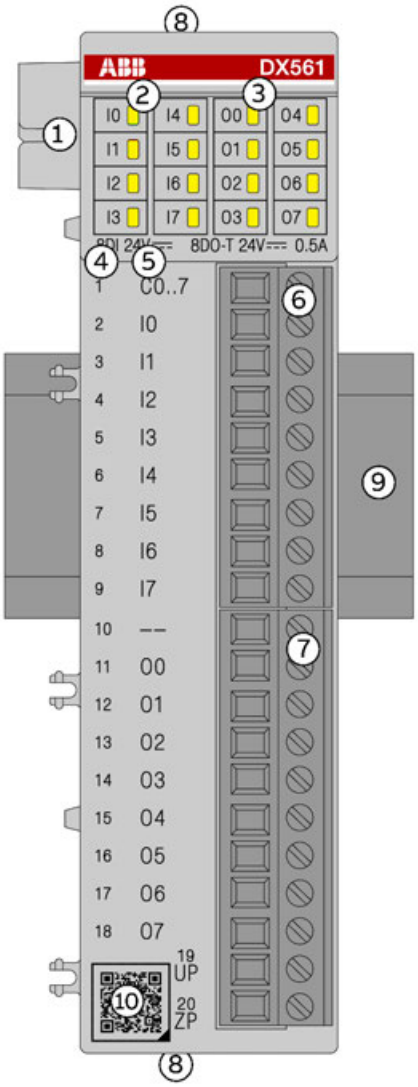
Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 231 300 R0000	DO573, digital output module, 16 DO, relay output	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

5.4.3.1.11 DX561 - Digital input/output module

- 8 digital inputs 24 V DC (I0 ... I7) in 1 group
- 8 digital transistor outputs 24 V DC (O0 ... O7) in 1 group
- Group-wise galvanically isolated



1 I/O bus
2 8 yellow LEDs to display the signal states of the inputs I0 ... I7
3 8 yellow LEDs to display the signal states of the outputs O0 ... O7
4 Terminal number
5 Allocation of signal name
6 Terminal block for input signals (9-pin)
7 Terminal block for output signals (11-pin)
8 2 holes for wall-mounting with screws
9 DIN rail
10 QR code for datasheet

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The inputs and outputs are group-wise galvanically isolated from each other.

All other circuitry of the module is galvanically isolated from the inputs.



The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA communication interface modules.

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Via the terminals ZP and UP (process voltage 24 V DC)

Connections



For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection is carried out by using removable 9-pin and 11-pin terminal blocks. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

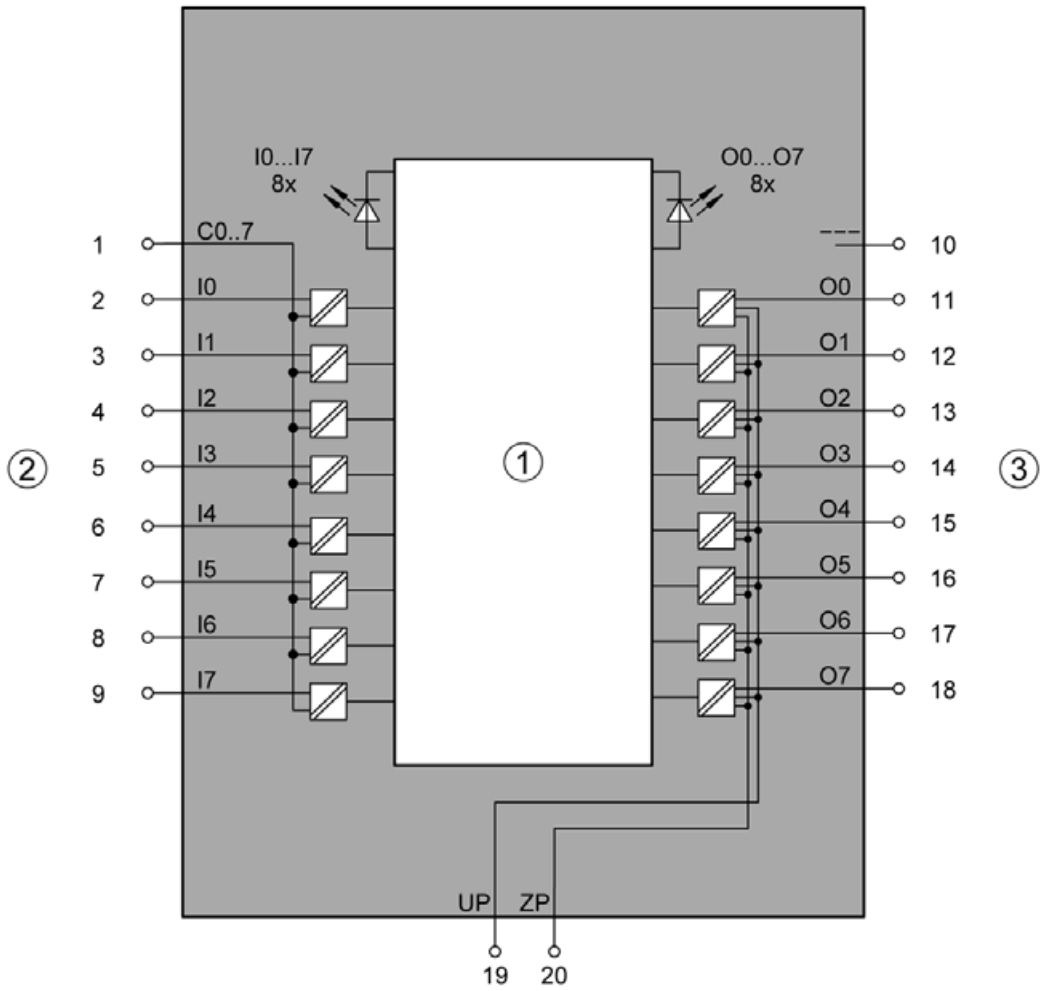


Fig. 45: Internal construction of the digital inputs and outputs

1 Logic - I/O interface
2 Digital inputs
3 Digital outputs

Table 142: Assignment of the terminals:

Terminal	Signal	Description
1	C0 ... 7	Input common for signals I0 ... I7
2	I0	Input signal I0
3	I1	Input signal I1
4	I2	Input signal I2
5	I3	Input signal I3
6	I4	Input signal I4
7	I5	Input signal I5
8	I6	Input signal I6
9	I7	Input signal I7
10	---	Reserved
11	O0	Output signal O0
12	O1	Output signal O1

Terminal	Signal	Description
13	O2	Output signal O2
14	O3	Output signal O3
15	O4	Output signal O4
16	O5	Output signal O5
17	O6	Output signal O6
18	O7	Output signal O7
19	UP	Process voltage UP +24 V DC
20	ZP	Process voltage ZP 0 V DC

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 5 mA per DX561.

The external power supply connection is carried out via the UP (+24 V DC) and ZP (0 V DC) terminals.



WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing the following:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The digital inputs can be used as source inputs or as sink inputs.

NOTICE!

Risk of malfunctions in the plant!

A ground fault, e. g. caused by a damaged cable insulation, can bridge switches accidentally.

Use sink inputs when possible or make sure that, in case of error, there will be no risks to persons or plant.

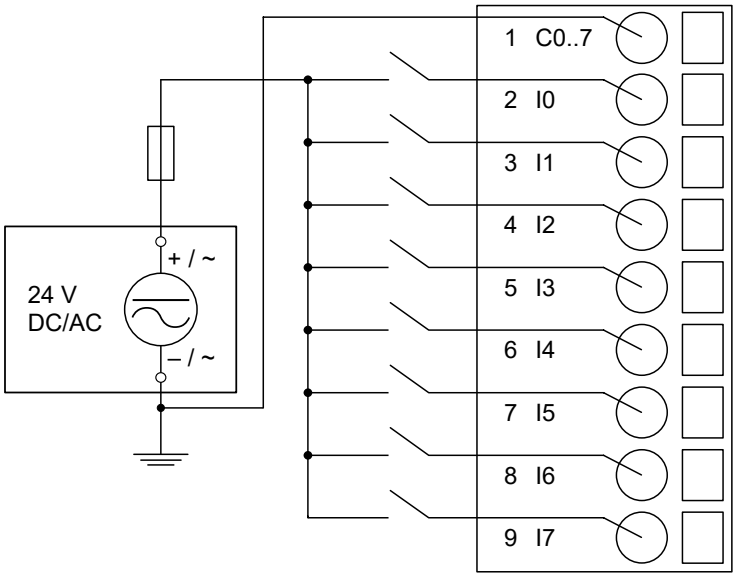


Fig. 46: Connection of inputs to the digital input/output module - sink inputs

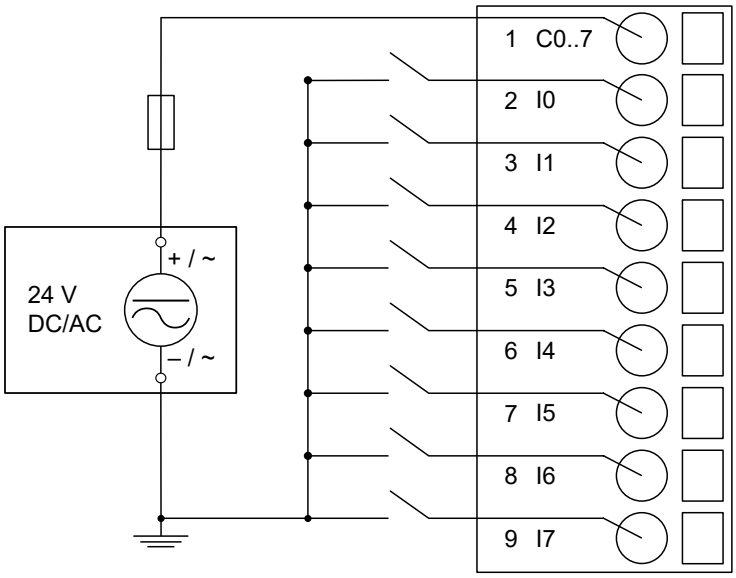


Fig. 47: Connection of inputs to the digital input/output module - source inputs

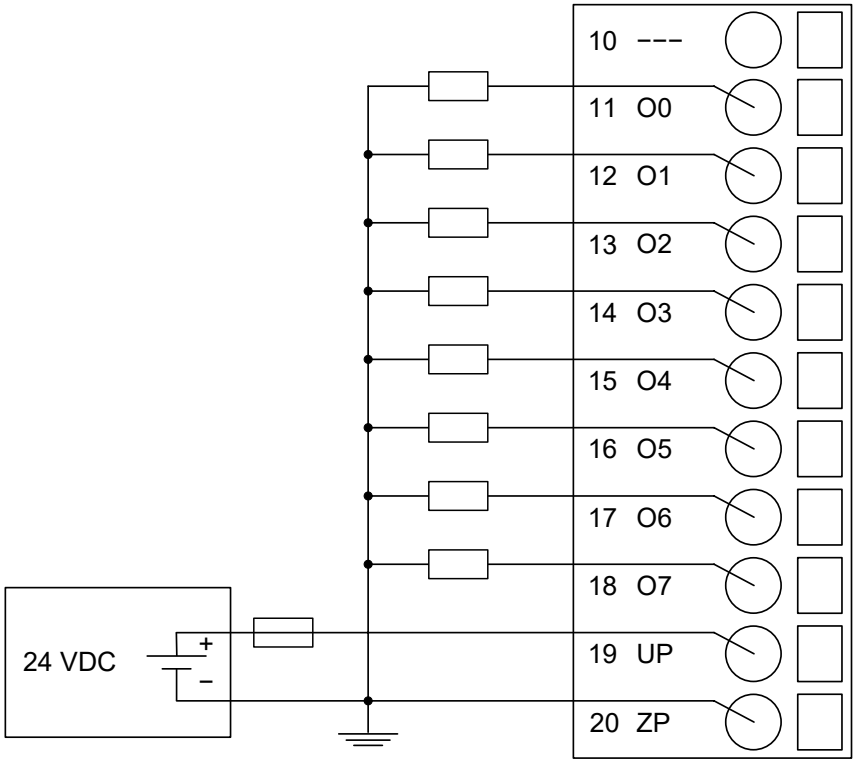


Fig. 48: Connection of the outputs to the module

NOTICE!

Risk of malfunctions in the plant!

The outputs may switch on for a period of 10 to 50 µs if the process supply voltage UP/ZP is switched on.

This must be considered in the planning of the application.

NOTICE!

Risk of damaging the I/O module!

The outputs are not protected against short circuits and overload.

- Never short-circuit or overload the outputs.
- Never connect the outputs to other voltages.
- Use an external 3 A fast-protection fuse for the outputs.

The module provides several diagnosis functions *Chapter 5.4.3.1.11.6 “Diagnosis” on page 409*.

The meaning of the LEDs is described in the Displays section *Chapter 5.4.3.1.11.7 “State LEDs” on page 410* chapter.

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6135 [1])	WORD	6135 0x17F7	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No (0x00)			
Parameter length	Internal	1	BYTE	0	0	255	xx02 [2])

[1]) with CS31 and addresses smaller than 70, the value is increased by 1

[2]) Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n)

GSD file:

Ext_User_Prm_Data_Len =	0x03
Ext_User_Prm_Data_Const(0) =	0xF8, 0x17, 0x00,\
(0) =	0x01;

Diagnosis

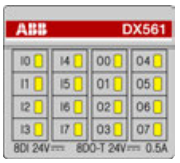
E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500-Display	<− Display in	
Class	Comp	Dev	Mod	Ch	Err	AB SW		
Byte 6 Bit 6 ... 7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0 ... 5	PNIO diagnosis block		
Class	Interface	Device	Module	Channel	Error Identifier	Error message		Remedy
	[1])	[2])	[3])	[4])				
Module error								
3	14	1 ... 10	31	31	19	Checksum error in the I/O module		Replace I/O module
	11 / 12	ADR	1 ... 10					

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000 ... 063**	**AC500-Display**	**<− Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**AB SW**		
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**PNIO diagnosis block**		
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**		**Remedy**
	[1])	[2])	[3])	[4])				
Module error								
3	14	1 ... 10	31	31	43	Internal error in the module		Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer		Restart
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	31	31	26	Parameter error		Check master
	11 / 12	ADR	1 ... 10					

Remarks:

[1])	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = decentralized communication interface module 1 ... 10, ADR = hardware address (e. g. of the DC551-CS31)
[3])	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or PNIO = module type (2 = DO); COM1/COM2: 1 ... 10 = expansion 1 ... 10
[4])	In case of module errors, with channel "31 = module itself" is output.

State LEDs

LED		**State**	**Color**	**LED = OFF**	**LED = ON**
	Inputs I0 ... I7	Digital input	Yellow	Input is OFF	Input is ON
	Outputs O0 ... O7	Digital output	Yellow	Output is OFF	Output is ON (the output voltage is only displayed if the supply voltage of the module is ON)

Technical data

Technical data of the module

The system data of AC500-eCo apply.

Chapter 4.1 “System data AC500-eCo” on page 25

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage UP		
	Connections	Terminal 19 for UP (+24 V DC) and terminal 20 for ZP (0 V DC)
	Rated value	24 V DC
	Current consumption via UP terminal	8 mA + max. 0.5 A per output
	Max. ripple	5 %
	Inrush current	0.000002 A^2s
	Protection against reversed voltage	Yes
	Rated protection fuse for UP	Recommended: the outputs must be protected by an 3 A fast-acting fuse
Current consumption from 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module		Ca. 5 mA
Galvanic isolation		Yes, between the input group and the output group and the rest of the module
Isolated groups		2 groups (1 group for 8 input channels, 1 group for 8 output channels)
Surge-voltage (max.)		35 V DC for 0.5 s
Max. power dissipation within the module		2.3 W
Weight		ca. 120 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

No effects of multiple overloads

No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

Technical data of the digital inputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group for 8 channels
Connections of the channels I0 ... I7	Terminals 2 ... 9
Reference potential for the channels I0 ... I7	Terminal 1
Indication of the input signals	1 yellow LED per channel; the LED is ON when the input signal is high (signal 1)

Parameter		Value	
Monitoring point of input indicator		LED is part of the input circuitry	
Input type according to EN 61131-2		Type 1 source	Type 1 sink
Input signal range		-24 V DC	+24 V DC
Signal 0		-5 V ... +3 V	-3 V ... +5 V
Undefined signal		-15 V ... + 5 V	+5 V ... +15 V
Signal 1		-30 V ... -15 V	+15 V ... +30 V
Ripple with signal 0		-5 V ... +3 V	-3 V ... +5 V
Ripple with signal 1		-30 V ... -15 V	+15 V ... +30 V
Input current per channel			
	Input voltage +24 V	Typ. 5 mA	
	Input voltage +5 V	Typ. 1 mA	
	Input voltage +15 V	> 2.5 mA	
	Input voltage +30 V	< 8 mA	
Max. permissible leakage current (at 2-wire proximity switches)		1 mA	
Input delay (0->1 or 1->0)		Typ. 8 ms	
Input data length		1 byte	
Max. cable length			
	Shielded	500 m	
	Unshielded	300 m	

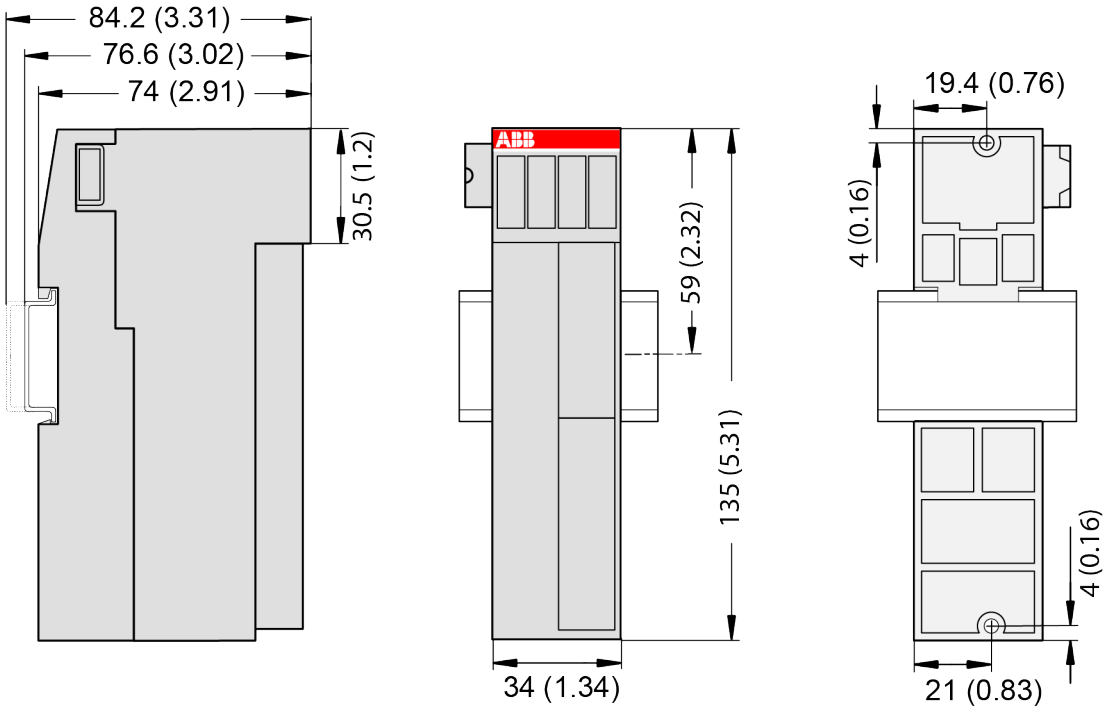
Technical data of the digital outputs

Parameter		Value
Number of channels per module		8 transistor outputs (24 V DC, 0.5 A max.)
Distribution of the channels into groups		1 group of 8 channels
Connection of the channels O0 ... O7		Terminals 11 ... 18
Reference potential for the channels O0 ... O7		Terminal 20 (negative pole of the process voltage, name ZP)
Common power supply voltage		Terminal 19 (positive pole of the process voltage, name UP)
Indication of the output signals		1 yellow LED per channel; the LED is on when the output signal is high (signal 1) and the module is powered via the I/O bus
Monitoring point of output indicator		Controlled together with transistor
Way of operation		Non-latching type
Max. output voltage at signal 1		20 V DC at max. current consumption
Output delay		
	0 to 1	50 µs
	1 to 0	200 µs
Output data length		1 byte
Output current		

Parameter		Value
	Rated current per channel (max.) (Resistive load)	0.5 A
	Rated current per point (max.) (pilot duty)	0.5 A
	Rated current per group (max.)	4 A
	Rated current (all channels together, max.)	4 A
	Lamp load (Tungsten)*	5 W
	Max. leakage current with signal 0	0.5 mA
Output type		Non-protected
Protection type		External fuse on each channel
Rated protection fuse (for each channel)		3 A fast
Demagnetization when inductive loads are switched off		Must be performed externally according to driven load specification
Switching Frequencies		
	With inductive loads	Max. 0.5 Hz
	With lamp loads*	Max. 11 Hz at max. 5 W
Short-circuit-proof / Overload-proof		No
	Overload message	No
	Output current limitation	No
	Resistance to feedback against 24 V DC	No
Connection of 2 outputs in parallel		Not possible
Max. cable length		
	Shielded	500 m
	Unshielded	150 m

*.

Dimensions



The dimensions are in mm and in brackets in inch.

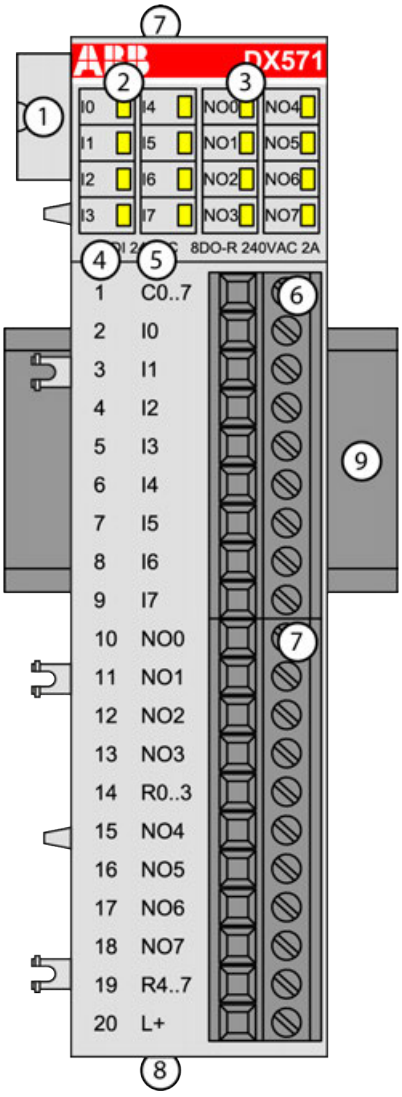
Ordering data

Part no.	Description	Product life cycle phase *)
1TNE 968 902 R2301	DX561, digital input/output module, 8 DI 24 V DC, 8 DO 24 V DC, transistor output	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

5.4.3.1.12 DX571 - Digital input/output module

- 8 digital inputs 24 V DC / 24 V AC (I0 ... I7) in 1 group
- 8 digital normally open relay outputs 24 V DC / 24 V AC or 100 V AC ... 240 V AC, 2 A max. (NO0 ... NO7) in 2 groups
- Group-wise galvanically isolated



1 I/O bus
2 8 yellow LEDs to display the signal states of the inputs I0 ... I7
3 8 yellow LEDs to display the signal states of the outputs NO0 ... NO7
4 Terminal number
5 Allocation of signal name
6 Terminal block for input signals (9-pin)
7 Terminal block for output signals (11-pin)
8 2 holes for wall-mounting with screws
9 DIN rail

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The inputs and outputs are group-wise galvanically isolated from each other.

All other circuitry of the module is galvanically isolated from the inputs.



The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA communication interface modules.

Functionality

Parameter	Value
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Via the terminal L+ (process voltage 24 V DC). The negative pole is provided by the I/O bus.

Connections



For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection is carried out by using removable 9-pin and 11-pin terminal blocks. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

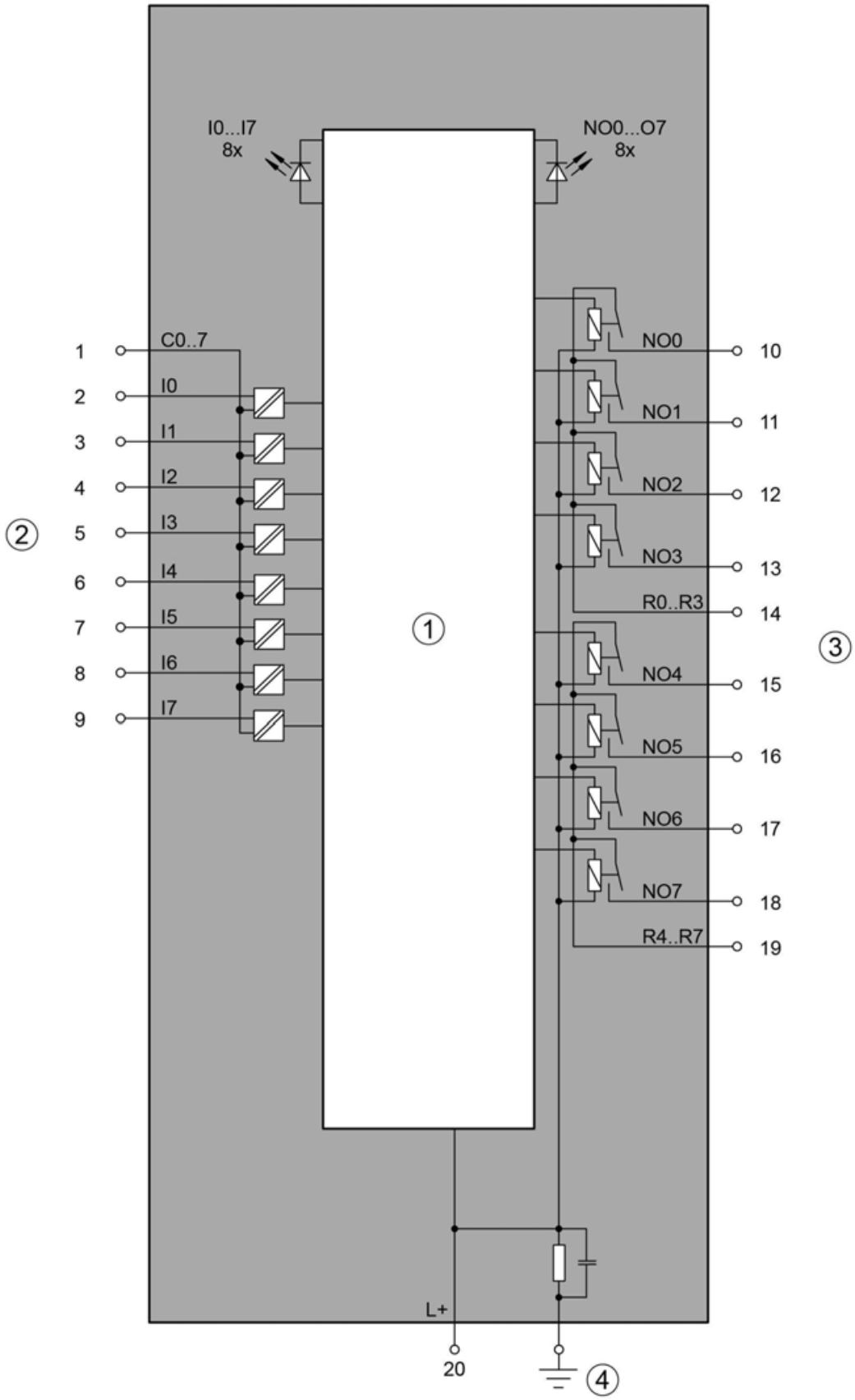


Fig. 49: Internal construction of the digital inputs and outputs

1 Logic - I/O inteface
2 Digital inputs
3 Digital outputs
4 Functional earth connection

Table 143: Assignment of the terminals:

Terminal	Signal	Description
1	C0 ... 7	Input common for signals I0 ... I7
2	I0	Input signal I0
3	I1	Input signal I1
4	I2	Input signal I2
5	I3	Input signal I3
6	I4	Input signal I4
7	I5	Input signal I5
8	I6	Input signal I6
9	I7	Input signal I7
10	NO0	Normally-open contact of the output 0
11	NO1	Normally-open contact of the output 1
12	NO2	Normally-open contact of the output 2
13	NO3	Normally-open contact of the output 3
14	R0 ... 3	Output common for signals O0 ... O3
15	NO4	Normally-open contact of the output 4
16	NO5	Normally-open contact of the output 5
17	NO6	Normally-open contact of the output 6
18	NO7	Normally-open contact of the output 7
19	R4 ... 7	Output common for signals O4 ... O7
20	L+	Process voltage +24 V DC

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 5 mA per DX571.

The external power supply connection is carried out via the L+ (+24 V DC) terminal. The negative pole of the external power supply is realized via the I/O bus. Therefore, the CPU/ communication interface module and the DX571 must have a common power supply.

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing the following:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

NOTICE!

Risk of damaging the PLC module!

The PLC module can be damaged by overload.

Make sure that the total current of each output common terminal (R0 ... R3 and R4 ... R7) does not exceed 8 A.

Never connect total currents > 8 A per group.

If the group fuse protection is not sufficient, then individual fuse protection of the outputs should be used.

The module provides several diagnosis functions.

↳ *Chapter 5.4.3.1.12.6 “Diagnosis” on page 424*

The digital inputs can be used as source inputs or as sink inputs.

NOTICE!

Risk of malfunctions in the plant!

A ground fault, e. g. caused by a damaged cable insulation, can bridge switches accidentally.

Use sink inputs when possible or make sure that, in case of error, there will be no risks to persons or plant.

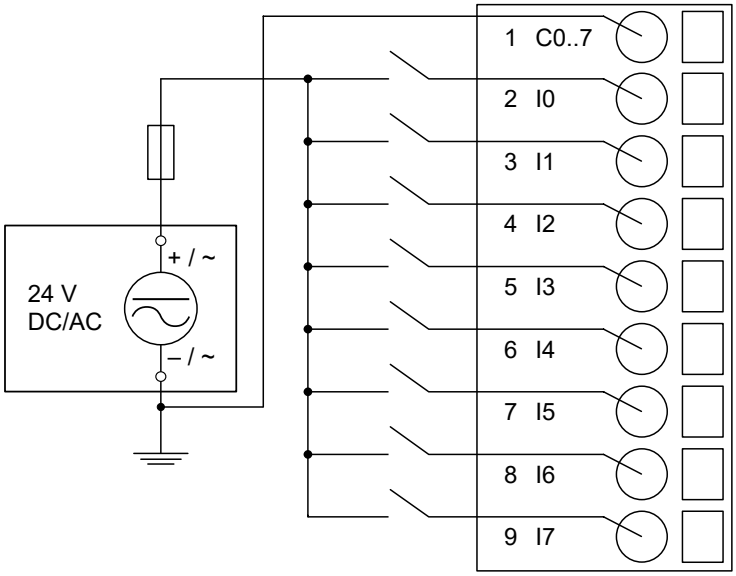


Fig. 50: Connection of inputs to the digital input/output module DX571 - sink inputs

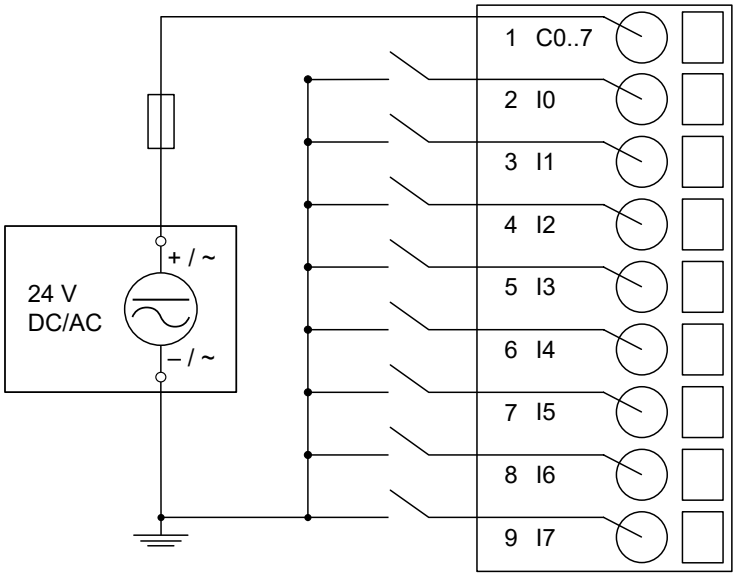


Fig. 51: Connection of inputs to the digital input/output module DX571 - source inputs

The following figures show the connection of the outputs to the module:

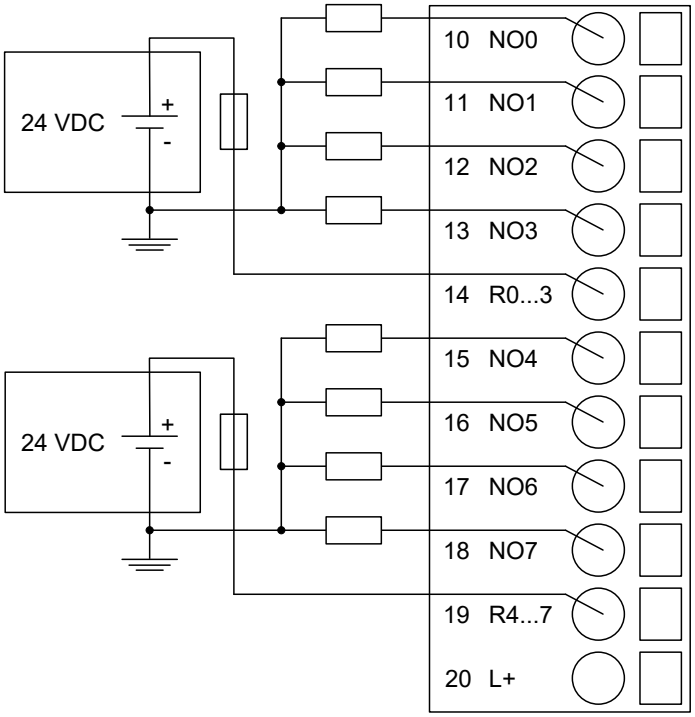


Fig. 52: Connection of 24 V DC actuators

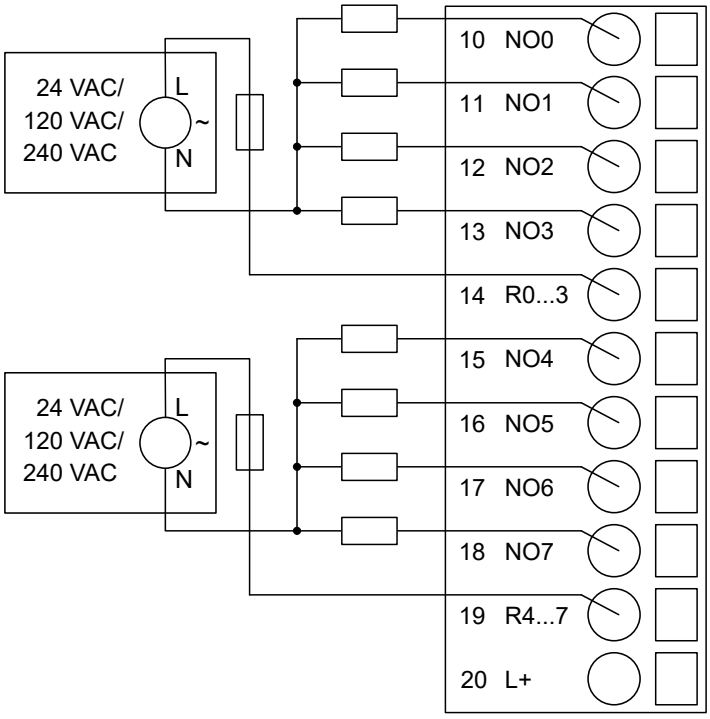


Fig. 53: Connection of 24 V AC or 100 ... 240 V AC actuators

The L+ connection of the DX571 and the 24 V supply of the CPU/communication interface module must be connected to the same 24 V power supply.

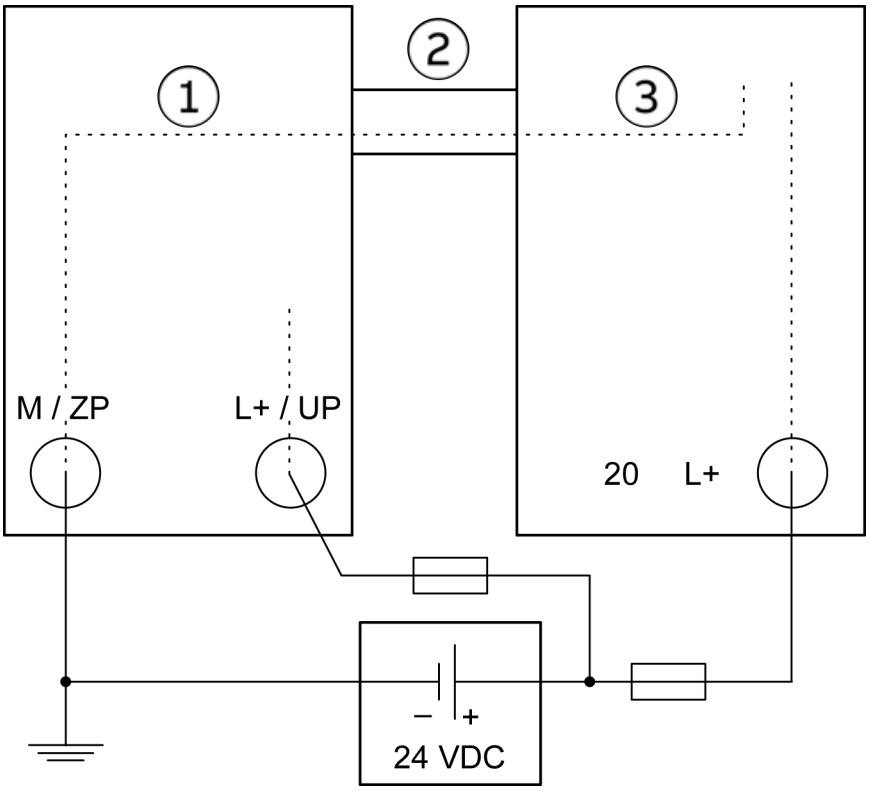


Fig. 54: Power supply - the minus connection is realized via the I/O bus

1 CPU or communication interface module
2 I/O bus
3 DX571

WARNING!
Risk of death by electric shock!
Hazardous voltages can be present at the terminals of the module.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.

For screw-type terminals only:

WARNING!
For screw terminals only: Danger of death by electric shock!
The IP 20 protection degree is only provided if all terminal screws are tightened.

Tighten all screws of unused load terminals of relay outputs if voltages > 24 V are connected to the relay group.

NOTICE!
Risk of damaging the I/O module!
The outputs are not protected against short circuit and overload.

- Never short-circuit or overload the outputs.
- Never connect inductive loads without an external suppression against voltage peaks due to inductive kickback.
- Never connect voltages > 240 V. All outputs must be supplied from the same phase.
- Use an external 5 A fast protection fuse for the outputs.

↳ *Meaning of the LEDs*

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.



If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6140 [1])	WORD	6140 0x17FC	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No (0x00)			
Parameter length	Internal	1	BYTE	0	0	255	xx02 [2])
Check supply	Off On	0 1	BYTE	On 0x01			
[1]) with CS31 and addresses smaller than 70, the value is increased by 1							
[2]) Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1...n)							

GSD file:

Ext_User_Prm_Data_Len =	0x04
Ext_User_Prm_Data_Const(0) =	0xFD, 0x17, 0x00,\
(0) =	0x01;

Diagnosis

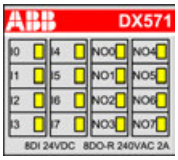
E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500-Display	<– Display in
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC Browser	
Byte 6 Bit 6 ... 7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0 ... 5	PNIO diagnosis block	

Class	Inter face	Device	Module	Channel	Error Identifier	Error message	Remedy
	[1])	[2])	[3])	[4])			
Module error							
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1 ... 10				

Remarks:

[1])	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = Module itself, 1 ... 10 = decentralized communication interface module 1 ... 10, ADR = hardware address (e. g. of the DC551-CS31)
[3])	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = Module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or PNIO = Module type (2 = DO); COM1/COM2: 1 ... 10 = expansion 1 ... 10
[4])	In case of module errors, with channel "31 = module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON
	Inputs I0 ... I7	Digital input	Yellow	Input is OFF	Input is ON
	Outputs NO0 ... NO7	Digital output	Yellow	Output is OFF	Output is ON

In the undefined signal range, the state LED for the inputs can be ON although the input state detected by the module is OFF.

Technical data

Technical data of the module

The system data of AC500-eCo apply.

Chapter 4.1 “System data AC500-eCo” on page 25

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage L+		
	Connections	Terminal 20 for L+ (+24 V DC). The negative pole is provided by the I/O bus.
	Rated value	24 V DC
	Current consumption via L+	50 mA
	Inrush current (at power-up)	0.0035 A^2s
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse for L+	Recommended; the outputs must be protected by a 3 A fast-acting fuse
Current consumption from 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module		Ca. 5 mA
Galvanic isolation		Yes, between the input group and the output group and the rest of the module
Isolated groups		3 groups (1 group for 8 input channels, 2 groups for 8 output channels)
Surge-voltage (max.)		35 V DC for 0.5 s
Max. power dissipation within the module		2.3 W
Weight		Ca. 150 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

No effects of multiple overloads

No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

Technical data of the digital inputs

Parameter		Value		
Number of channels per module		8		
Distribution of the channels into groups		1 group for 8 channels		
Connections of the channels I0 ... I7		Terminals 2 ... 9		
Reference potential for the channels I0 ... I7		Terminal 1		
Indication of the input signals		1 yellow LED per channel; the LED is ON when the input signal is high (signal 1)		
Monitoring point of input indicator		LED is part of the input circuitry		
Input type according to EN 61131-2		Type 1 source	Type 1 sink	Type 1 AC [1])
Input signal range		-24 V DC	+24 V DC	24 V AC 50/60 Hz
Signal 0		-5 V ... +3 V	-3 V ... +5 V	0 V AC ... 5 V AC
Undefined signal		-15 V ... + 5 V	+5 V ... +15 V	5 V AC ... 14 V AC
Signal 1		-30 V ... -15 V	+15 V ... +30 V	14 V AC ... 27 V AC
Input current per channel				
	Input voltage 24 V	Typ. 5 mA		Typ. 5 mA r.m.s.
	Input voltage 5 V	Typ. 1 mA		Typ. 1 mA r.m.s.
	Input voltage 14 V			Typ. 2.7 mA r.m.s.
	Input voltage 15 V	> 2.5 mA		
	Input voltage 27 V			Typ. 5.5 mA r.m.s.
	Input voltage 30 V	< 8 mA		
Max. permissible leakage current (at 2-wire proximity switches)		1 mA		Typ. 1 mA r.m.s.
Input delay (0->1 or 1->0)		Typ. 8 ms		
Input data length		1 byte		
Max. cable length				
	Shielded	500 m		
	Unshielded	300 m		

[1]) When inputs are used with 24 V AC, external surge limiting filters are required.

Technical data of the digital outputs

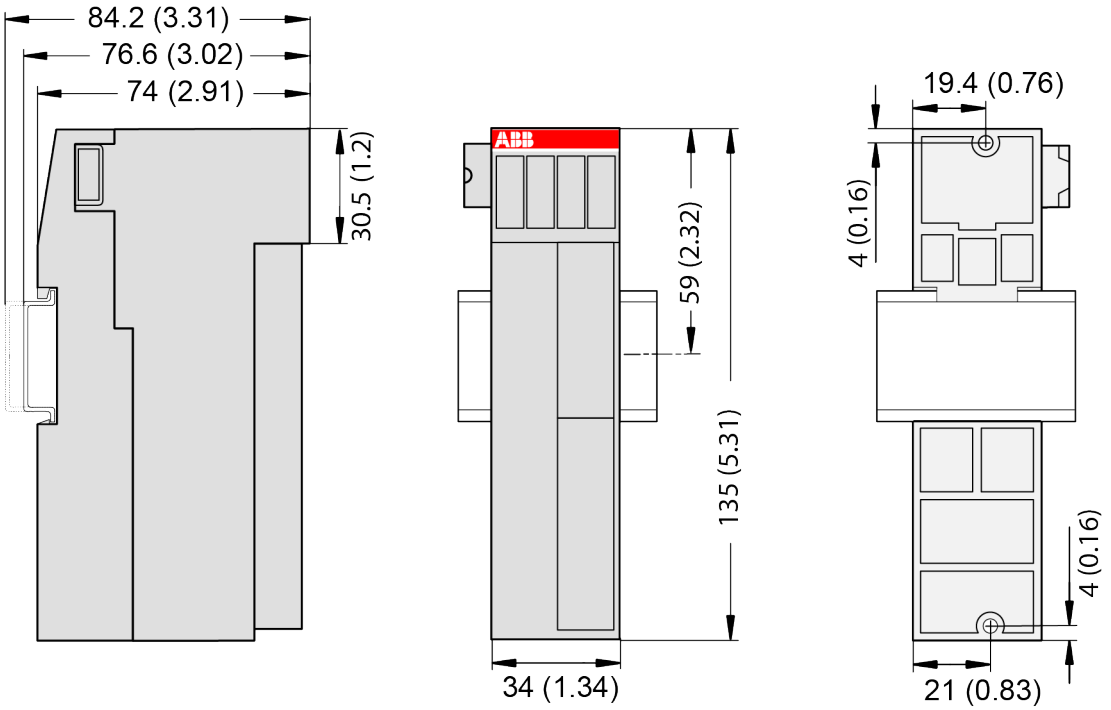
Parameter	Value
Number of channels per module	8 normally-open relay outputs
Distribution of the channels into groups	2 (4 channels per group)
Connection of the channels O0 ... O3	Terminals 10 ... 13

Parameter		Value
Connection of the channels O4 ... O7		Terminals 15 ... 18
Reference potential for the channels O0 ... O3		Terminal 14 (signal name R0 ... 3)
Reference potential for the channels O4 ... O7		Terminal 19 (signal name R4 ... 7)
Relay coil power supply		Terminal 20 (positive pole of the process supply voltage, signal name L+). The negative pole is provided by the I/O bus.
Indication of the output signals		1 yellow LED per channel; the LED is on when the output signal is high (signal 1) and the module is powered through the I/O bus
Monitoring point of output indicator		Controlled together with relay
Way of operation		Non-latching type
Relay output voltage		
	Rated value	24 V DC / 24 V AC or 120/240 V AC
Output delay		
	Switching 0 to 1 (max.)	Typ. 10 ms
	Switching 1 to 0 (max.)	Typ. 10 ms
Output data length		1 byte
Output current		
	Rated current per channel (max.)	2.0 A (24 V DC / 24 V AC / 48 V AC / 120 V AC / 240 V AC, only resistive loads) 2.0 A (24 V AC / 48 V AC / 120 V AC, only pilot duty) 1.5 A (240 V AC, only pilot duty)
	Rated current per group (max.)	8 A
Lamp load (max.)		200 W (230 V AC), 30 W (24 V DC)
Spark suppression with inductive AC loads		Must be performed externally according to driven load specification
Switching Frequencies		
	With resistive loads	Max. 1 Hz
	With inductive loads	On Request
	With lamp loads	Max. 1 Hz
Output type		Non-protected
Protection type		External fuse [1])
Rated protection fuse		5 A fast
Short-circuit-proof / Overload-proof		No, should be provided by an external fuse or circuit breaker
	Overload message	No
	Output current limitation	No
Connection of 2 outputs in parallel		Not possible
Lifetime of relay contacts (cycles)		100.000 at rated load
Max. cable length		

Parameter		Value
	Shielded	500 m
	Unshielded	150 m

[1]) Per group in case of group fuse protection. For each channel in case of channel-by-channel fuse protection. The maximum current per group must not be exceeded.

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

Part no.	Description	Product life cycle phase *)
1TNE 968 902 R2302	DX571, digital input/output module, 8 DI 24 V DC / 24 V AC, 8 DO, relay output	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active

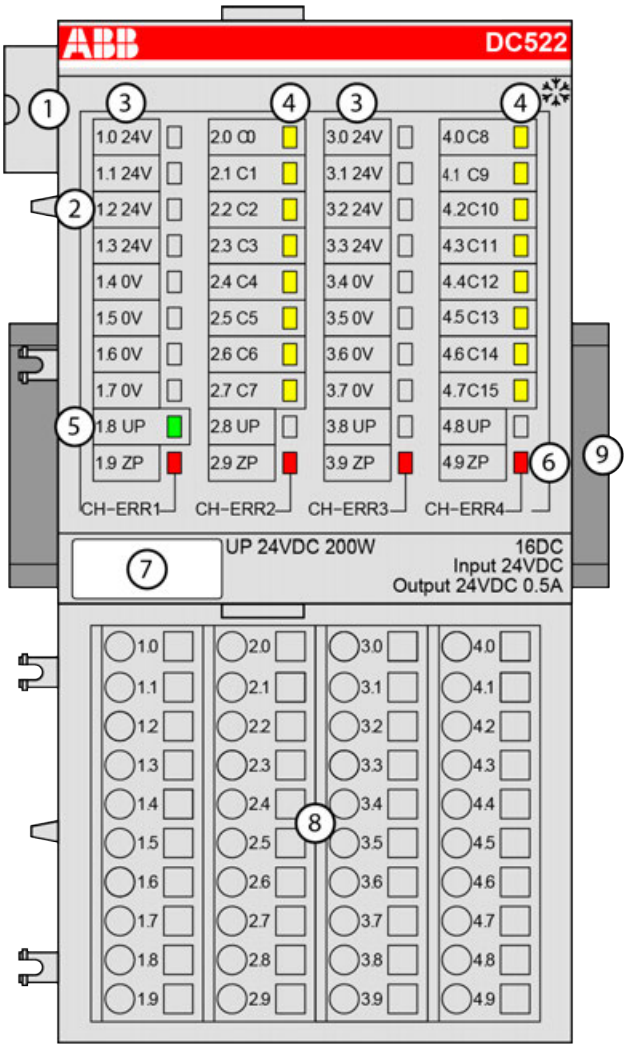
Part no.	Description	Product life cycle phase *)
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

*) *Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.4.3.2 S500 and S500-XC

5.4.3.2.1 DC522 - Digital input/output module

- 16 configurable digital inputs/outputs
- Module-wise galvanically isolated
- Fast counter
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name

3 Sensor power supply 24 V DC / 0.5 A
4 16 yellow LEDs to display the signal states at the digital inputs/outputs (C0 ... C15)
5 1 green LED to display the state of the process supply voltage UP
6 4 red LEDs to display errors
7 Label
8 Terminal unit
9 DIN rail
❄ Sign for XC version

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

Digital configurable input/output unit.

- 2 sensor supply voltages 24 V DC, 0.5 A, with short-circuit and overload protection
- 16 digital configurable inputs/outputs 24 V DC (C0 ... C15) in 1 group (2.0 ... 2.7 and 4.0 ... 4.7), each of which can be used
  – as an input,
  – as a transistor output with short-circuit and overload protection, 0.5 A rated current or
  – as a re-readable output (combined input/output) with the technical data of the digital inputs and outputs.
- Optional with fast counter

The configuration is performed by software. The modules are supplied with a process supply voltage of 24 V DC.

All available inputs/outputs are galvanically isolated from all other circuitry of the module. There is no potential separation between the channels within the same group.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

Functionality

Parameter	Value
Fast counter	Integrated, many configurable operating modes (only with AC500)
LED displays	For signal states, errors and supply voltage
Internal power supply	Through the I/O bus interface (I/O bus)
External power supply	Via the terminals ZP and UP (process voltage 24 V DC)
Required terminal unit	TU515 or TU516 ↳ *TU515, TU516*
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V

The device is plugged on a terminal unit.

↳ *Chapter 5.5.2 “TU515, TU516, TU541 and TU542 for I/O modules” on page 946*

Position the module properly and press until it locks in place. The terminal unit is either mounted on a DIN rail or to the wall using 2 screws plus the additional accessory for wall mounting.

Chapter 5.8.2.6 “TA526 - Wall mounting accessory” on page 1410

Connections

The connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8... 4.8 and 1.9 ... 4.9 are electrically interconnected within the I/O terminal unit and always have the same assignment, irrespective of the inserted module:

Terminals 1.8 ... 4.8: process voltage UP = +24 V DC

Terminals 1.9 ... 4.9: process voltage ZP = 0 V DC

The assignment of the other terminals:

Terminals	Signal	Description
1.0 ... 1.3	+24 V	4 x sensor power supply sources (loadable with 0.5 A in total)
1.4 ... 1.7	0 V	0 V (reference potential)
2.0 ... 2.7	C0 ... C7	8 digital inputs/outputs
3.0 ... 3.3	+24 V	4 x sensor power supply sources (loadable with 0.5 A in total)
3.4 ... 3.7	0 V	0 V (reference potential)
4.0 ... 4.7	C8 ... C15	8 digital inputs/outputs

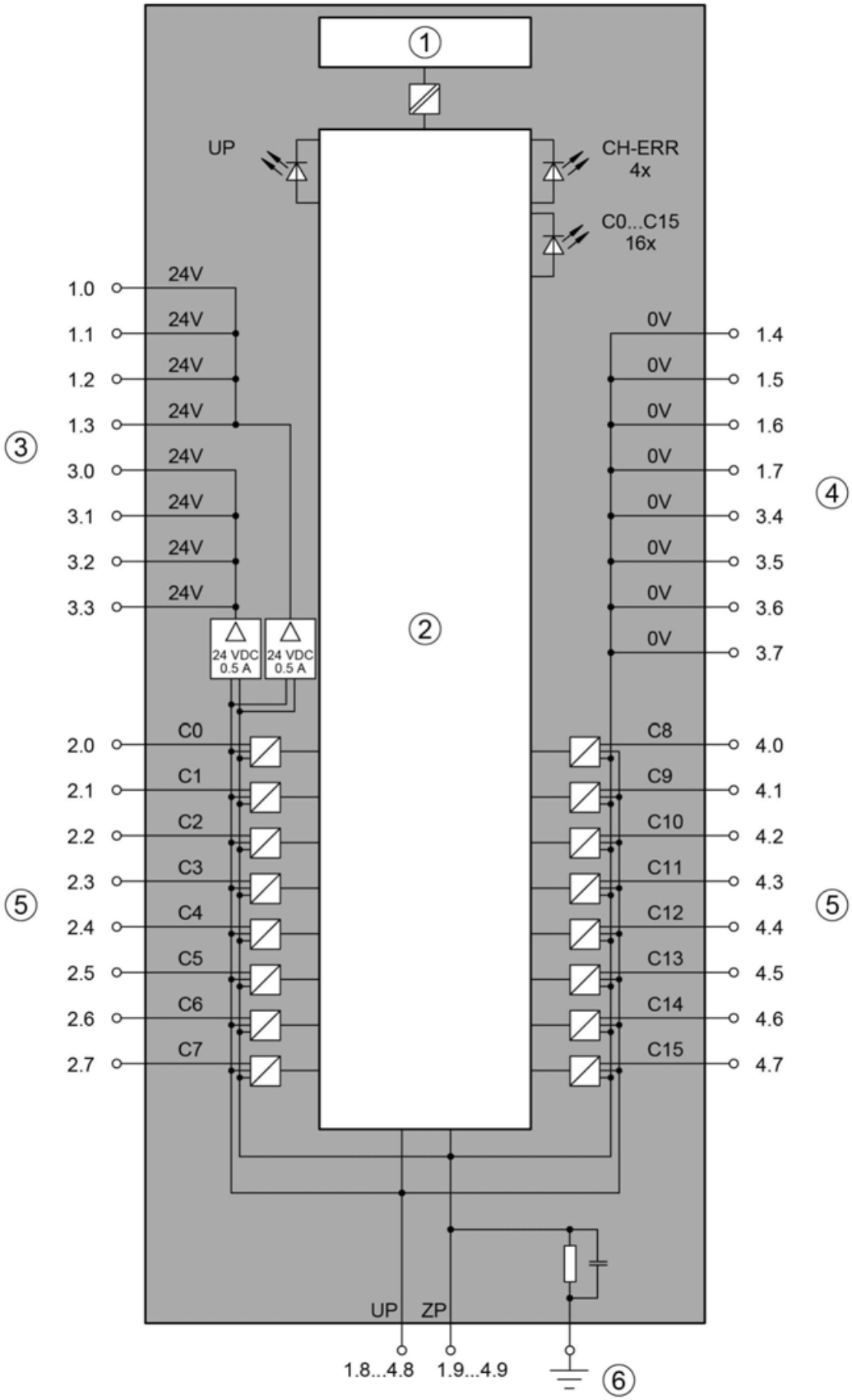


Fig. 55: Input/output channels

1 I/O bus interface
2 Logic
3 Sensor power supply sources

4 0 V
5 Digital inputs/outputs
6 Functional earth connection

CAUTION!
The process supply voltage must be included in the grounding concept (e. g. grounding of the negative terminal).

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 2 mA per DC522.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.

WARNING!
Removal/Insertion under power
Removal or insertion under power is permissible only if all conditions for hot swapping are fullfilled.

“Conditions for hot swap” on page 12

The devices are not designed for removal or insertion under power when the conditions for hot swap do not apply. Because of unforeseeable consequences, it is not allowed to plug in or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing any of the following actions:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while they are energized in a hazardous location could result in an electric arc, which could create an ignition source resulting in fire or explosion.

Prior to proceeding, make sure that power is been disconnected and that the area has been thoroughly checked to ensure that flammable materials or ignitable concentrations are not present.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

NOTICE!
Risk of influences to the connected sensors!
Some sensors may be influenced by the deactivated module outputs of DC522.

Connect a 470 Ω / 1 W resistor in series to inputs C8/C9 if they are used as fast counter inputs to avoid any influences.

The modules provide several diagnosis functions.

Internal data exchange

	Without the fast counter	With the fast counter (only with AC500)
Digital inputs (bytes)	2	4
Digital outputs (bytes)	2	4
Counter input data (words)	0	4
Counter output data (words)	0	8

I/O Configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.



If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1 ... 10

Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
Module ID	Internal	1220 [1])	Word	1220 0x04C4	0	65535	0x0Y01
Ignore module [2])	No Yes	0 1	Byte	No 0x00			Not for FBP
Parameter length	Internal	7	Byte	7-CPU 6-FBP	0	255	0x0Y02

Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
Check supply	Off On	0 1	Byte	On 0x01	0	1	0x0Y03
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	Byte	8 ms 0x02	0	3	0x0Y04
Fast counter [4])	0 : 10 [3])	0 : 10	Byte	Mode 0 0x00			Not for FBP
Short-circuit detection of output or sensor supply	Off On	0 1	Byte	On 0x01	0	1	0x0Y05
Behaviour of outputs at communication errors	Off Last value Substitute value	0 1+(n*5) 2+(n*5), n ≤ 2	Byte	Off 0x00	0	2	0x0Y06
Substitute value at outputs Bit 15 = Output 15 Bit 0 = Output 0	0 ... 65535	0 ... 0xffff	Word	0 0x0000	0	65535	0x0Y07

Remarks:

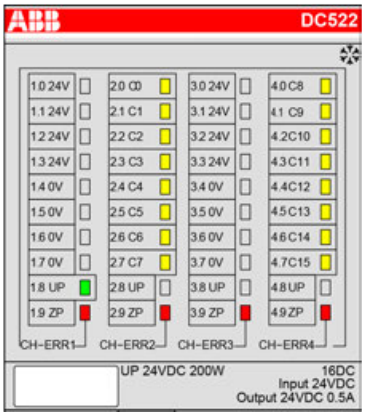
[1])	With CS31 and addresses smaller than 70 and FBP, the value is increased by 1
[2])	Not with FBP
[3])	For a description of the counter operating modes, please refer to the 'Fast Counter' section ↯ *Chapter 5.4.3.2.9 “Fast counter” on page 522*
[4])	With FBP or CS31 without the parameter Fast Counter

GSD file:

Ext_User_Prm_Data_Len =	9
Ext_User_Prm_Data_Const(0) =	0x04, 0xc5, 0x06, \ 0x01, 0x02, 0x01, 0x00, 0x00, 0x00;

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Inputs/ outputs C0 ... C15	Digital input or digital output	Yellow	Input/output = OFF	Input/output = ON [1])	--
	UP	Process supply voltage 24 V DC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
	CH-ERR1	Channel Error, error messages in groups (digital inputs/ outputs combined into the groups 1, 2, 3, 4)	Red	No error or process supply voltage is missing	Severe error within the corresponding group	Error on one channel of the corresponding group (e.g. short circuit at an output)
	CH-ERR2		Red			
	CH-ERR3		Red			
	CH-ERR4		Red			
	CH-ERR [2])	Module error	Red	--	Internal error	--
	[1]) Indication LED is ON even if an input signal is applied to the channel and the supply voltage is off. In this case the module is not operating and does not generate an input signal.					
	[2]) All of the LEDs CH-ERR1 to CH-ERR4 light up together					

Technical data

Technical data of the module

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

↳ *Chapter 4.3 “System data AC500-XC” on page 38*

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter		Value
Process supply voltage UP		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 V DC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module

Parameter		Value
Current consumption		
	From 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module	Ca. 2 mA
	From UP at normal operation / with outputs	0.15 A + max. 0.5 A per output
	Inrush current from UP (at power up)	0.005 A^2s
Max. power dissipation within the module		6 W (outputs unloaded)
Sensor power supply		
	Connections	Terminals 1.0 ... 1.3 = +24 V, 1.4 ... 1.7 = 0 V Terminals 3.0 ... 3.3 = +24 V, 3.4 ... 3.7 = 0 V
	Voltage	24 V DC with short-circuit and overload protection
	Loadability	Terminals 1.0 ... 1.3, in total max. 0.5 A Terminals 3.0 ... 3.3, in total max. 0.5 A
Weight (without terminal unit)		Ca. 125 g
Mounting position		Horizontal mounting or Vertical mounting with derating (output load reduced to 50 % at +40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Multiple overloads
With multi-channel modules, there are no effects of multiple overloads as each digital output channel is individually protected by an internal intelligent high-side switch.

Technical data of the configurable digital inputs/outputs

Each of the configurable I/O channels is defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter	Value
Number of channels per module	16 inputs/outputs (with transistors)
Distribution of the channels into groups	1 group of 16 channels
If the channels are used as inputs	

Parameter		Value
	Channels C0 ... C7	Terminals 2.0 ... 2.7
	Channels C8 ... C15	Terminals 4.0 ... 4.7
If the channels are used as outputs		
	Channels C0 ... C7	Terminals 2.0 ... 2.7
	Channels C8 ... C15	Terminals 4.0 ... 4.7
Indication of the input/output signals		1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Monitoring point of input/output indicator		LED is part of the input circuitry
Galvanic isolation		From the rest of the module

Technical data of the digital inputs/outputs if used as inputs

Parameter		Value
Number of channels per module		Max. 16 digital inputs
Reference potential for all inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (negative pole of the process supply voltage, signal name ZP)
Galvanic isolation		From the rest of the module
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Monitoring point of input/output indicator		LED is part of the input circuitry
Input type acc. to EN 61131-2		Type 1
Input delay (0->1 or 1->0)		Typ. 8 ms, configurable from 0.1 ... 32 ms
Input signal voltage		24 V DC
	Signal 0	-3 V ... +5 V *)
	Undefined signal	> +5 V ... < +15 V
	Signal 1	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V *)
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 5 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

*) Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal may not exceed the clamp voltage of the varistor. The varistor limits the voltage to approx. 36 V. Consequently the input voltage must be within the following range.

- If UPx = 24 V, the input voltage must range from -12 V ... +30 V.
- If UPx = 30 V, the input voltage must range from -6 V ... +30 V.

Technical data of the digital inputs/outputs if used as outputs

Parameter		Value
Number of channels per module		Max. 16 transistor outputs
Reference potential for all outputs		Terminals 1.9, 2.9, 3.9 and 4.9 (negative pole of the process supply voltage, signal name ZP)
Common power supply voltage		For all outputs: terminals 1.8, 2.8, 3.8 and 4.8 (positive pole of the process supply voltage, signal name UP)
Output voltage for signal 1		UP (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value, per channel	500 mA at UP = 24 V
	Maximum value (all channels together)	8 A
Leakage current with signal 0		< 0.5 mA
Rated protection fuse on UP		10 A fast
Demagnetization when inductive loads are switched off		With varistors integrated in the module (see figure below)
Switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 11 Hz with max. 5 W
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals		Yes
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

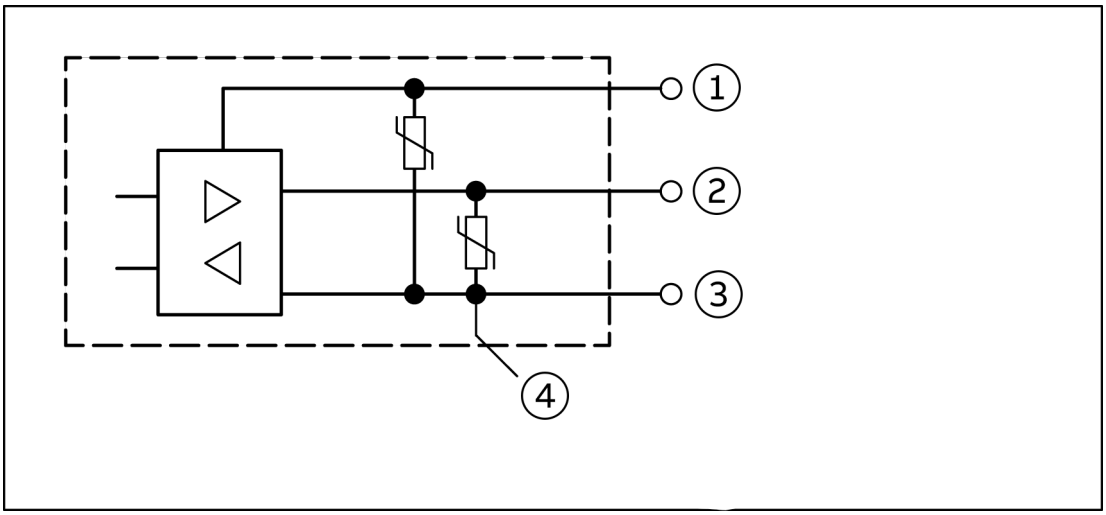


Fig. 56: Digital input/output (circuit diagram)

1 UPx (+ 24 V)
2 Digital input/output
3 ZPx (0 V)
4 For demagnization when inductive loads are switched off

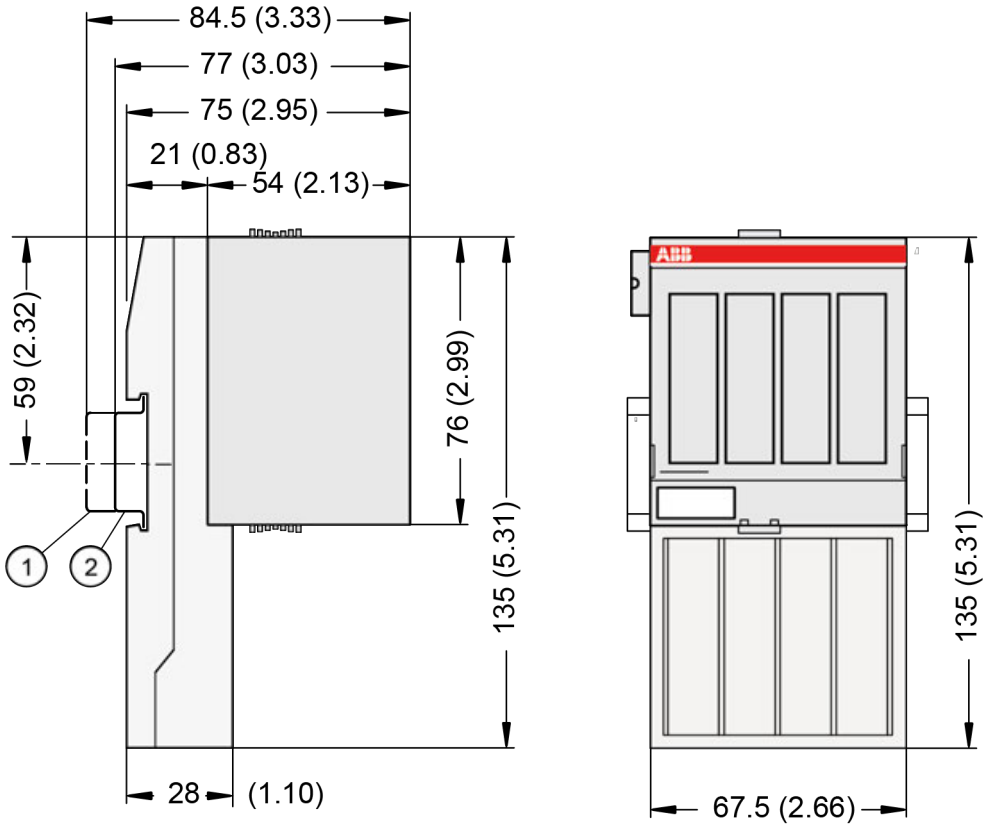
Technical data of the fast counter

The fast counter of the module does not work if the module is connected to one of following devices:

- *FBP interface module*
- *CS31 bus module*
- *CANopen communication interface module*

Parameter	Value
Used inputs	C8 / C9
Used outputs	C10
Counting frequency	Max. 50 kHz

Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

> *The dimensions are in mm and in brackets in inch.*

Ordering data

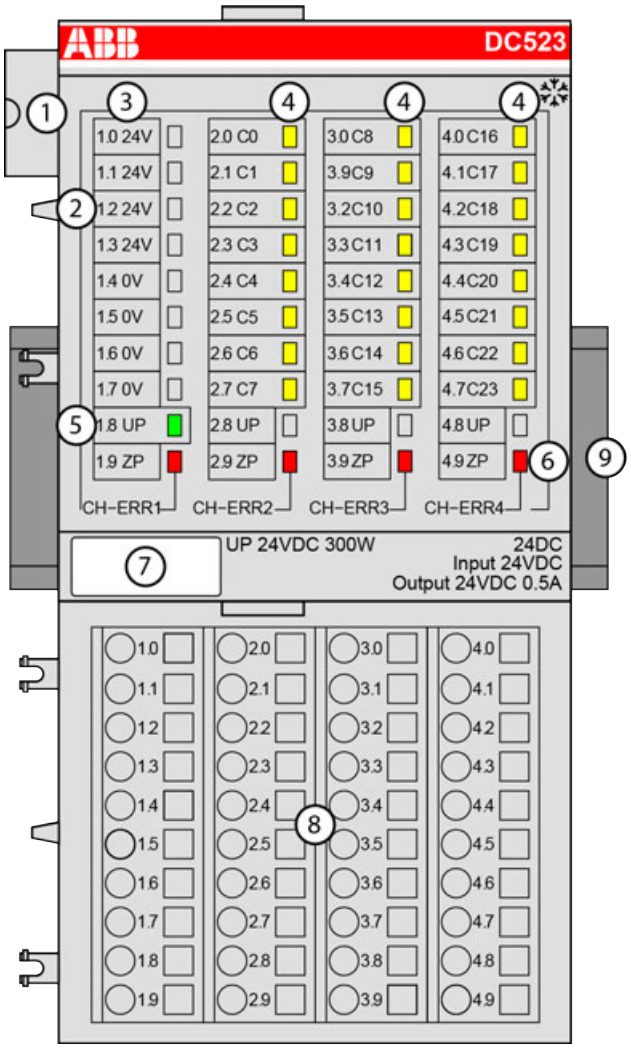
Part no.	Description	Product life cycle phase *)
1SAP 240 600 R0001	DC522, digital input/output module, 16 DC, 24 V DC / 0.5 A, 2-wires	Active
1SAP 440 600 R0001	DC522-XC, digital input/output module, 16 DC, 24 V DC / 0.5 A, 2-wires, XC version	Active

> **) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.4.3.2.2 DC523 - Digital input/output module

- 24 configurable digital inputs/outputs
- Module-wise galvanically isolated

- Fast counter
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 Sensor power supply 24 V DC / 0.5 A
4 24 yellow LEDs to display the signal states at the digital inputs/outputs (C0 ... C23)
5 1 green LED to display the status of the process supply voltage UP
6 4 red LEDs to display errors
7 Label
8 Terminal unit
9 DIN rail
❄ Sign for XC version

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

Digital configurable input/output unit.

- 1 sensor supply voltage 24 V DC, 0.5 A, with short circuit and overload protection
- 24 digital configurable inputs/outputs 24 V DC (C0 ... C23) in 1 group (2.0 ... 2.7, 3.0 ... 3.7 and 4.0 ... 4.7), of which each can be used
  - as an input,
  - as a transistor output with short circuit and overload protection, 0.5 A rated current or
  - as a re-readable output (combined input/output) with the technical data of the digital inputs and outputs.
- Optional with fast counter

The configuration is performed by software. The modules are supplied with a process supply voltage of 24 V DC.

All available inputs/outputs are galvanically isolated from all other circuitry of the module. There is no potential separation between the channels within the same group.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

Functionality

Parameter	Value
Fast counter	Integrated, many configurable operating modes (only with AC500)
LED displays	For signal states, errors and supply voltage
Internal power supply	Through the I/O bus interface (I/O bus)
External power supply	Via the terminals ZP and UP (process voltage 24 V DC)
Required terminal unit	TU515 or TU516 ↳ *TU515, TU516*
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

The device is plugged on a terminal unit.

↳ *Chapter 5.5.2 “TU515, TU516, TU541 and TU542 for I/O modules” on page 946*

Position the module properly and press until it locks in place. The terminal unit is either mounted on a DIN rail or to the wall using 2 screws plus the additional accessory for wall mounting.

↳ *Chapter 5.8.2.6 “TA526 - Wall mounting accessory” on page 1410*

Connections

The connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8 ... 4.8 and 1.9 ... 4.9 are electrically interconnected within the I/O terminal unit and always have the same assignment, irrespective of the inserted module:

Terminals 1.8 ... 4.8: process voltage UP = +24 V DC

Terminals 1.9 ... 4.9: process voltage ZP = 0 V DC

The assignment of the other terminals:

Terminals	Signal	Description
1.0 ... 1.3	+24 V	4 x sensor power supply sources (loadable with 0.5 A in total)
1.4 ... 1.7	0 V	0 V (reference potential)
2.0 ... 2.7	C0 ... C7	8 digital inputs/outputs
3.0 ... 3.7	C8 ... C15	8 digital inputs/outputs
4.0 ... 4.7	C16 ... C23	8 digital inputs/outputs

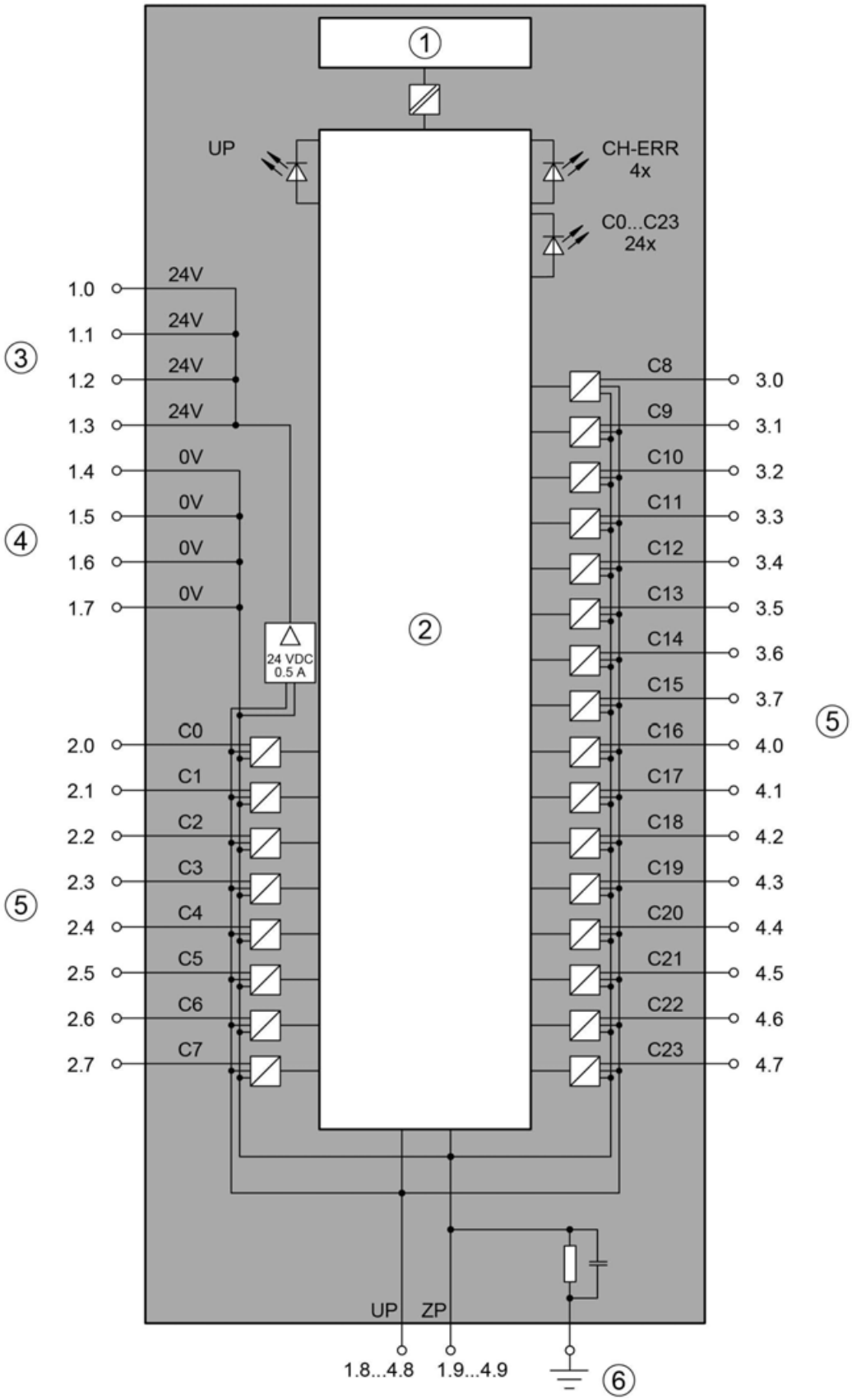


Fig. 57: Internal construction of the digital inputs and outputs

1 I/O bus interface
2 Logic
3 Sensor power supply sources

4 0 V
5 Digital inputs/outputs
6 Functional earth connection

CAUTION!
The process supply voltage must be included in the grounding concept (e. g. grounding of the negative terminal).

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 2 mA per DC523.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.

WARNING!
Removal/Insertion under power
Removal or insertion under power is permissible only if all conditions for hot swapping are fullfilled.

“Conditions for hot swap” on page 12

The devices are not designed for removal or insertion under power when the conditions for hot swap do not apply. Because of unforeseeable consequences, it is not allowed to plug in or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing any of the following actions:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while they are energized in a hazardous location could result in an electric arc, which could create an ignition source resulting in fire or explosion.

Prior to proceeding, make sure that power is been disconnected and that the area has been thoroughly checked to ensure that flammable materials or ignitable concentrations are not present.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

NOTICE!
Risk of influences to the connected sensors!
Some sensors may be influenced by the deactivated module outputs of DC523.

Connect a 470 Ω / 1 W resistor in series to inputs C16/C17 if they are used as fast counter inputs to avoid any influences.

The modules provide several diagnosis functions.

Internal data exchange

	Without the fast counter	With the fast counter (only with AC500)
Digital inputs (bytes)	3	5
Digital outputs (bytes)	3	5
Counter input data (words)	0	4
Counter output data (words)	0	8

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1 ... 10

Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
Module ID	Internal	1215 [1])	Word	1215 0x04BF	0	65535	0x0Y01
Ignore module [2])	No Yes	0 1	Byte	No 0x00			Not for FBP
Parameter length	Internal	9	Byte	9-CPU 8-FBP	0	255	0x0Y02

Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
Check supply	Off on	0 1	Byte	On 0x01	0	1	0x=Y03
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	Byte	8 ms 0x02	0	3	0x0Y04
Fast counter [4)]	0 : 10 [3)]	0 : 10	Byte	Mode 0 0x00			Not for FBP
Short circuit detection of output or sensor supply	Off On	0 1	Byte	On 0x01	0	1	0x0Y05
Behaviour of outputs at communication errors	Off Last value Substitute value	0 1+(n*5) 2+(n*5), n ≤ 2	Byte	Off 0x00	0	2	0x0Y06
Substitute value at outputs B23 = Output 23 Bit 0 = Output 0	0 ... 16777215	0 ... 0x00ff-ffff	DWord	0 0x0000 -0000	0	224−1	0x0Y07

Remarks:

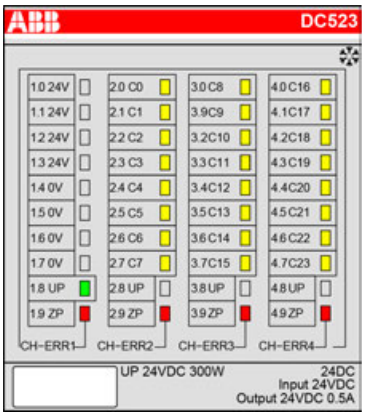
[1)]	With CS31 and addresses smaller than 70 and FBP, the value is increased by 1
[2)]	Not with FBP
[3)]	For a description of the counter operating modes, please refer to the 'Fast Counter' section *Chapter 5.4.3.2.9 “Fast counter” on page 522*
[4)]	With FBP or CS31 without the parameter Fast Counter

GSD file:

Ext_User_Prm_Data_Len = Ext_User_Prm_Data_Const(0) =	11 0x04, 0xc0, 0x08, \ 0x01, 0x02, 0x01, 0x00, 0x00, 0x00, 0x00, 0x00;

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Inputs/ outputs C0 ... C23	Digital input or digital output	Yellow	Input/output = OFF	Input/output = ON [1])	--
	UP	Process supply voltage 24 V DC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
	CH-ERR1	Channel error, error messages in groups (digital inputs/ outputs combined into the groups 1, 2, 3, 4)	Red	No error or process supply voltage is missing	Severe error within the corresponding group	Error on one channel of the corresponding group (e.g. short circuit at an output)
	CH-ERR2		Red			
	CH-ERR3		Red			
	CH-ERR4		Red			
	CH-ERR [2])	Module error	Red	--	Internal error or module not configured	--
	[1]) Indication LED is ON even if an input signal is applied to the channel and the supply voltage is off. In this case the module is not operating and does not generate an input signal.					
	[2]) All of the LEDs CH-ERR1 to CH-ERR4 light up together					

Technical data

Technical data of the module

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

↳ *Chapter 4.3 “System data AC500-XC” on page 38*

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter		Value
Process supply voltage UP		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 V DC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast

Parameter		Value
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/ communication interface module	Ca. 2 mA
	From UP at normal operation / with outputs	0.1 A + max. 0.5 A per output
	Inrush current from UP (at power up)	0.008 A^2s
Max. power dissipation within the module		6 W (outputs unloaded)
Sensor power supply		
	Connections	Terminals 1.0 ... 1.3 = +24 V, 1.4 ... 1.7 = 0 V
	Voltage	24 V DC with short circuit and overload protection
	Loadability	Terminals 1.0 ... 1.3, in total max. 0.5 A
Weight (without terminal unit)		Ca. 125 g
Mounting position		Horizontal mounting or Vertical mounting with derating (output load reduced to 50 % at +40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Multiple overloads
With multi-channel modules, there are no effects of multiple overloads as each digital output channel is individually protected by an internal intelligent high-side switch.

Technical data of the configurable digital inputs/outputs

Each of the configurable I/O channels is defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter		Value
Number of channels per module		24 inputs/outputs (with transistors)
Distribution of the channels into groups		1 group of 24 channels
If the channels are used as inputs		
	Channels C0 ... C7	Terminals 2.0 ... 2.7
	Channels C8 ... C15	Terminals 3.0 ... 3.7

Parameter		Value
	Channels C16 ... C23	Terminals 4.0 ... 4.7
If the channels are used as outputs		
	Channels C0 ... C7	Terminals 2.0 ... 2.7
	Channels C8 ... C15	Terminals 3.0 ... 3.7
	Channels C16 ... C23	Terminals 4.0 ... 4.7
Indication of the input/output signals		1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Monitoring point of input/output indicator		LED is part of the input circuitry
Galvanic isolation		From the rest of the module

Technical data of the digital inputs/outputs if used as inputs

Parameter		Value
Number of channels per module		Max. 24 digital inputs
Reference potential for all inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (negative pole of the process supply voltage, signal name ZP)
Galvanic isolation		From the rest of the module
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Monitoring point of input/output indicator		LED is part of the input circuitry
Input type acc. to EN 61131-2		Type 1
Input delay (0->1 or 1->0)		Typ. 8 ms, configurable from 0.1 to 32 ms
Input signal voltage		24 V DC
	Signal 0	-3 V ... +5 V *)
	Undefined signal	> +5 V ... < +15 V
	Signal 1	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V *)
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 5 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

*) Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal must not exceed the clamp voltage of the varistor. The varistor limits the clamp voltage to approx. 36 V. Consequently the input voltage must be within the following range.

- If UPx = 24 V, the input voltage must range from -12 V ... +30 V.
- If UPx = 30 V, the input voltage must range from -6 V ... +30 V.

Technical data of the digital inputs/outputs if used as outputs

Parameter		Value
Number of channels per module		Max. 24 transistor outputs
Reference potential for all outputs		Terminals 1.9, 2.9, 3.9 and 4.9 (negative pole of the process supply voltage, signal name ZP)
Common power supply voltage		For all outputs: terminals 1.8, 2.8, 3.8 and 4.8 (positive pole of the process supply voltage, signal name UP)
Output voltage for signal 1		UP (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value, per channel	500 mA at UP = 24 V
	Maximum value (all channels together)	8 A
Leakage current with signal 0		< 0.5 mA
Rated protection fuse on UP		10 A fast
Demagnetization when inductive loads are switched off		With varistors integrated in the module (see figure below)
Switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 11 Hz with max. 5 W
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals		Yes
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

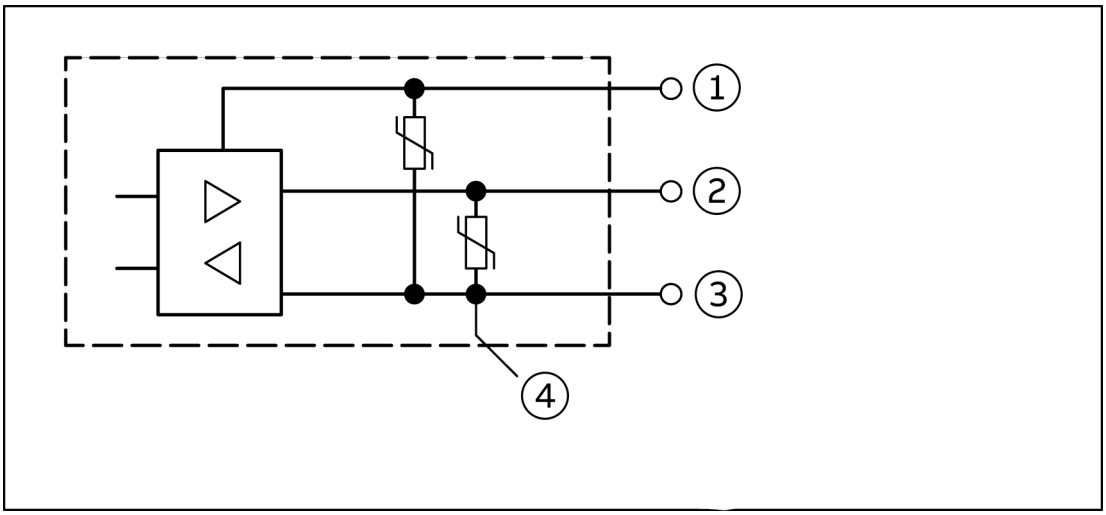


Fig. 58: Digital input/output (circuit diagram)

1 UPx (+ 24 V)
2 Digital input/output
3 ZPx (0 V)
4 For demagnization when inductive loads are switched off

Technical data of the fast counter

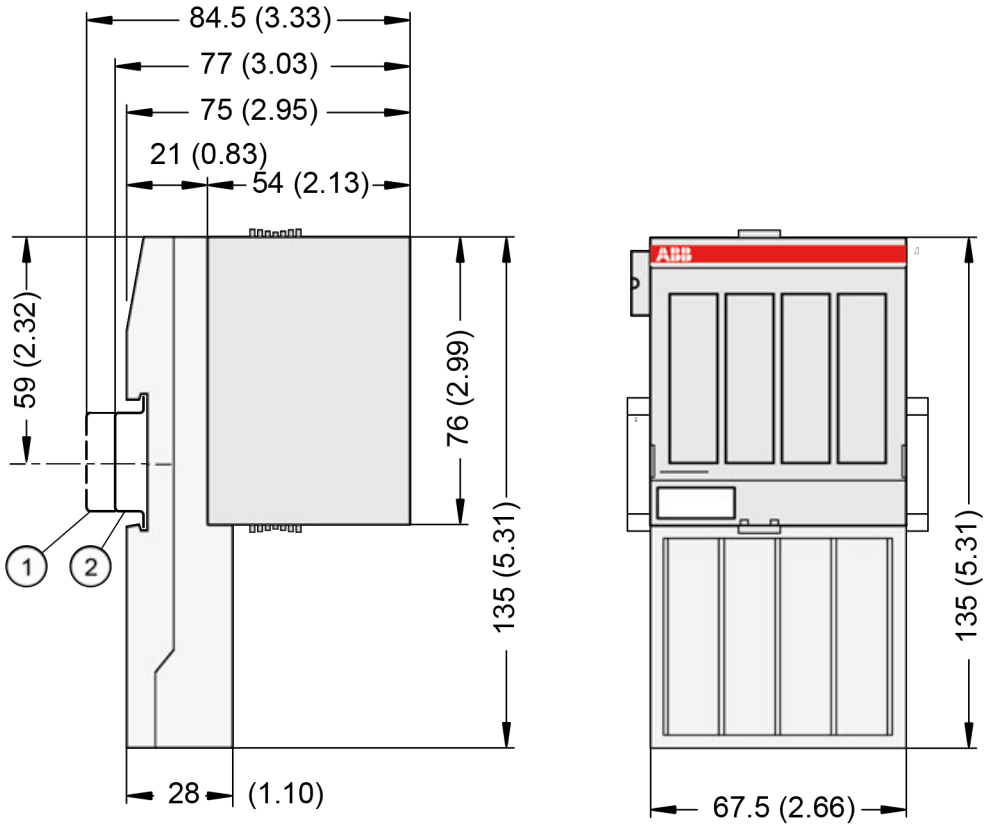
The fast counter of the module does not work if the module is connected to one of following devices:

- *FBP interface module*
- *CS31 bus module*
- *CANopen communication interface module*

Parameter	Value
Used inputs	C16 / C17
Used outputs	C18
Counting frequency	Max. 50 kHz

How to prepare a device as fast counter and how to connect it to the PLC is described in an *application example*.

Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

> *The dimensions are in mm and in brackets in inch.*

Ordering data

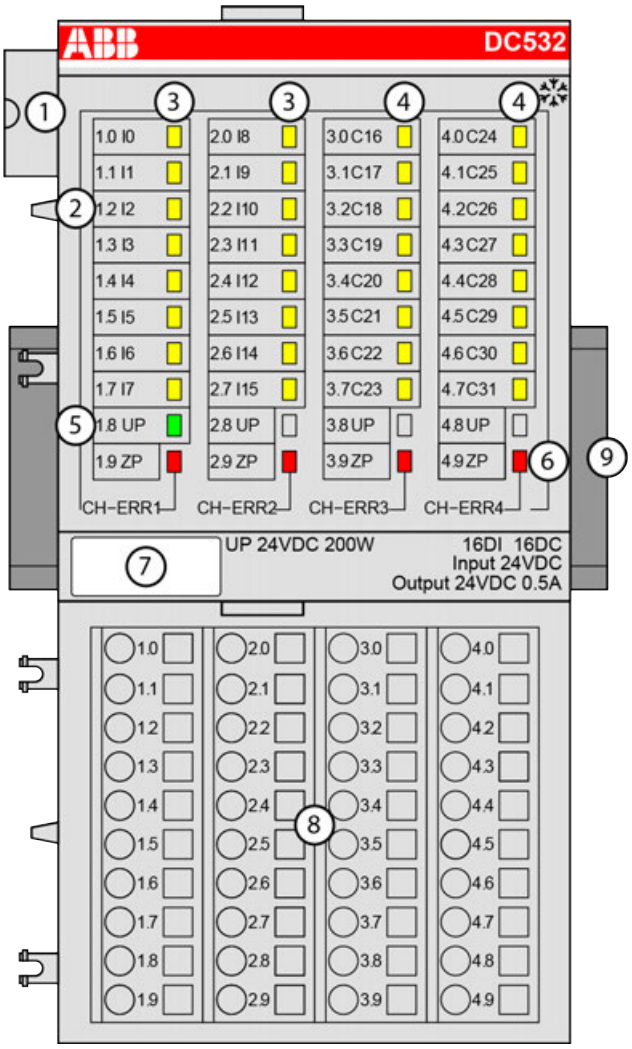
Part no.	Description	Product life cycle phase *)
1SAP 240 500 R0001	DC523, digital input/output module, 24 DC, 24 V DC / 0.5 A, 1-wire	Active
1SAP 440 500 R0001	DC523-XC, digital input/output module, 24 DC, 24 V DC / 0.5 A, 1-wire, XC version	Active

> **) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.4.3.2.3 DC532 - Digital input/output module

- 16 digital inputs 24 V DC, 16 configurable digital inputs/outputs
- Module-wise galvanically isolated

- Fast counter
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 16 yellow LEDs to display the signal states at the digital inputs (I0 ... I15)
4 16 yellow LEDs to display the signal states at the digital inputs/outputs (C16 ... C31)
5 1 green LED to display the state of the process supply voltage UP
6 4 red LEDs to display errors
7 Label
8 Terminal unit
9 DIN rail
❄ Sign for XC version

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

Digital configurable input / output unit.

- 16 digital inputs 24 V DC in 2 groups (1.0 ... 1.7 and 2.0 ... 2.7)
- 16 digital configurable inputs/outputs 24 V DC (C16 ... C31) in 1 group (3.0 ... 3.7 and 4.0 ... 4.7), of which each can be used
  - as an input,
  - as a transistor output with short circuit and overload protection, 0.5 A rated current or
  - as a re-readable output (combined input/output) with the technical data of the digital inputs and outputs.
- Optional with fast counter

The configuration is performed by software. The modules are supplied with a process supply voltage of 24 V DC.

All available inputs/outputs are galvanically isolated from all other circuitry of the module. There is no potential separation between the channels within the same group.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

Functionality

Parameter	Value
Digital inputs	16 (24 V DC)
Digital inputs/outputs	16 (24 V DC)
Fast counter	Integrated, many configurable operating modes (only with AC500)
LED displays	For signal states, errors and supply voltage
Internal power supply	Through the I/O bus interface (I/O bus)
External power supply	Via the terminals ZP and UP (process voltage 24 V DC)
Required terminal unit	TU515 or TU516 ↳ *TU515, TU516*
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V

The device is plugged on a terminal unit.

↳ *Chapter 5.5.2 “TU515, TU516, TU541 and TU542 for I/O modules” on page 946*

Position the module properly and press until it locks in place. The terminal unit is either mounted on a DIN rail or to the wall using 2 screws plus the additional accessory for wall mounting.

↳ *Chapter 5.8.2.6 “TA526 - Wall mounting accessory” on page 1410*



For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

Connections

The connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8 ... 4.8 and 1.9 ... 4.9 are electrically interconnected within the I/O terminal unit and always have the same assignment, irrespective of the inserted module:

Terminals 1.8 ... 4.8: process voltage UP = +24 V DC

Terminals 1.9 ... 4.9: process voltage ZP = 0 V DC

The assignment of the other terminals:

Terminals	Signal	Description
1.0 ... 1.7	I0 ... I7	8 digital inputs
2.0 ... 2.7	I8 ... I15	8 digital inputs
3.0 ... 3.7	C16 ... C23	8 digital inputs/outputs
4.0 ... 4.7	C24 ... C31	8 digital inputs/outputs

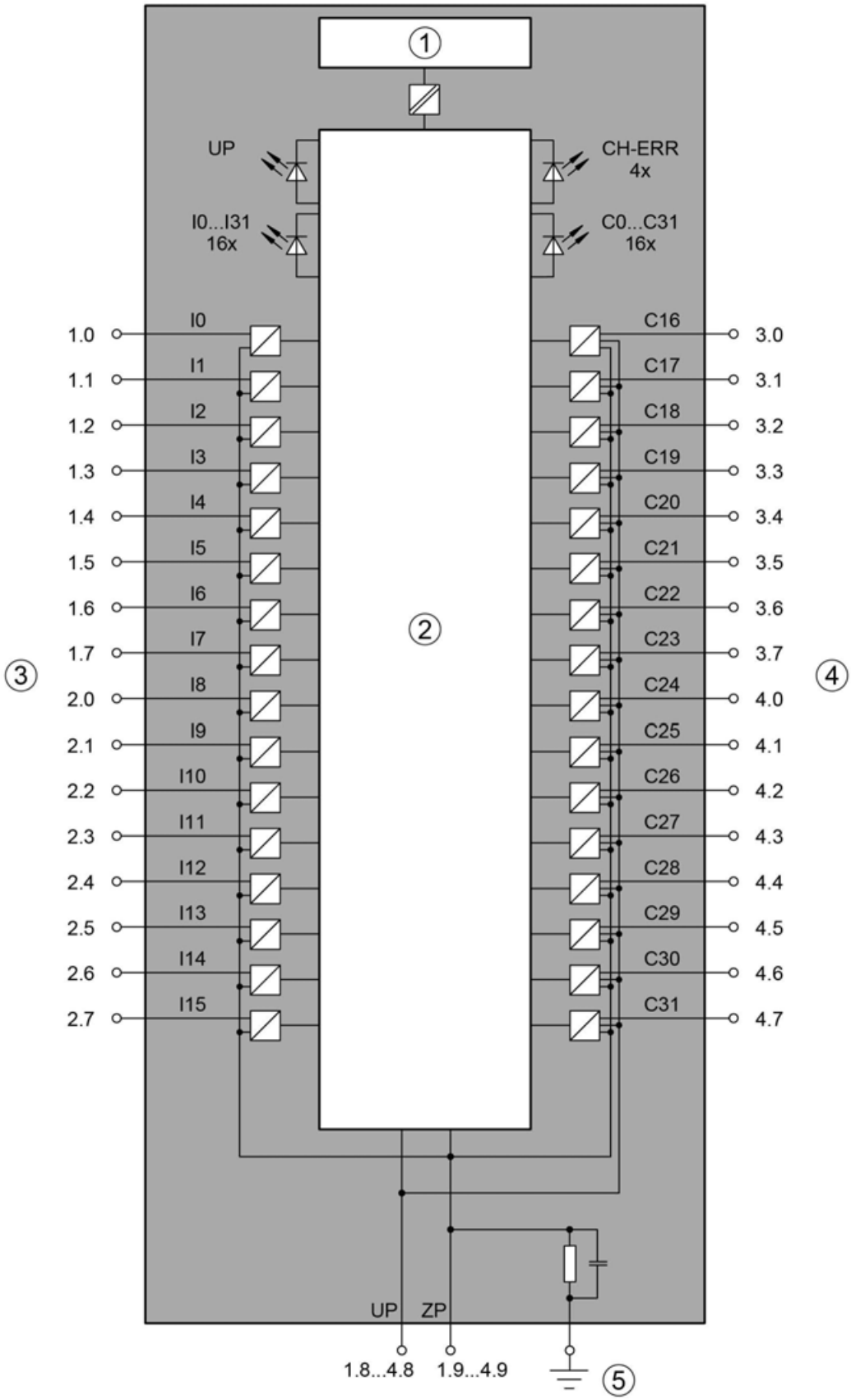


Fig. 59: Input/output channels

1 I/O bus interface
2 Logic

3 Digital inputs
4 Digital inputs/outputs
5 Functional earth connection

CAUTION!
The process supply voltage must be included in the grounding concept (e. g. grounding of the negative terminal).

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 2 mA per DC532.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.

WARNING!
Removal/Insertion under power
Removal or insertion under power is permissible only if all conditions for hot swapping are fullfilled.

“Conditions for hot swap” on page 12

The devices are not designed for removal or insertion under power when the conditions for hot swap do not apply. Because of unforeseeable consequences, it is not allowed to plug in or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing any of the following actions:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while they are energized in a hazardous location could result in an electric arc, which could create an ignition source resulting in fire or explosion.

Prior to proceeding, make sure that power is been disconnected and that the area has been thoroughly checked to ensure that flammable materials or ignitable concentrations are not present.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

NOTICE!
Risk of influences to the connected sensors!
Some sensors may be influenced by the deactivated module outputs of DC532.

Connect a 470 Ω / 1 W resistor in series to inputs C24/C25 if using them as fast counter inputs to avoid any influences.

The module provides several diagnosis functions.

Internal data exchange

	Without the fast counter	With the fast counter (only with AC500)
Digital inputs (bytes)	4	6
Digital outputs (bytes)	2	4
Counter input data (words)	0	4
Counter output data (words)	0	8

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.



If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1 ... 10

Name	Value	Internal value	Internal value, type	Default	Min.	Max.	
Module ID	Internal	1200 [1])	Word	1200 0x04B0	0	65535	0x0Y01
Ignore module [2])	No Yes	0 1	Byte	No 0x00			Not for FBP
Parameter length	Internal	7	Byte	7-CPU 6-FBP	0	255	0x0Y02

Name	Value	Internal value	Internal value, type	Default	Min.	Max.	
Check supply	Off on	0 1	Byte	On 0x01	0	1	0x0Y03
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	Byte	8 ms 0x02	0	3	0x0Y04
Fast counter [4])	0 : 10 [3])	0 : 10	Byte	Mode 0 0x00			Not for FBP
Output short circuit detection	Off On	0 1	Byte	On 0x01	0	1	0x0Y05
Behaviour of outputs at communication errors	Off Last value Substitute value	0 1+(n*5) 2+(n*5), n ≤ 2	Byte	Off 0x00	0	2	0x0Y06
Substitute value at outputs Bit 15 = Output 15 Bit 0 = Output 0	0 ... 65535	0 ... 0xffff	Word	0 0x0000	0	65535	0x0Y07

Remarks:

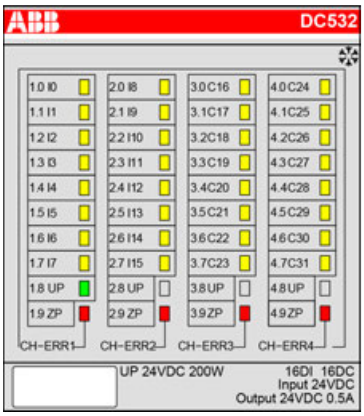
[1])	With CS31 and addresses smaller than 70 and FBP, the value is increased by 1
[2])	Not with FBP
[3])	For a description of the counter operating modes, please refer to the 'Fast Counter' section *Chapter 5.4.3.2.9 “Fast counter” on page 522*
[4])	With FBP or CS31 without the parameter Fast Counter

GSD file:

Ext_User_Prm_Data_Len =	9
Ext_User_Prm_Data_Const(0) =	0x04, 0xb1, 0x06, \ 0x01, 0x02, 0x01, 0x00, 0x00, 0x00;

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Inputs I0 ... I15	Digital input	Yellow	Input = OFF	Input = ON [1])	--
	Inputs/ outputs C16 ... C31	Digital input/ output	Yellow	Input/output = OFF	Input/output = ON [1])	--
	UP	Process supply voltage 24 V DC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
	CH-ERR1	Channel Error, error messages in groups (digital inputs/ outputs combined into the groups 1, 2, 3, 4)	Red	No error or process supply voltage is missing	Severe error within the corresponding group	Error on one channel of the corresponding group (e.g. short circuit at an output)
	CH-ERR2		Red			
	CH-ERR3		Red			
	CH-ERR4		Red			
	CH-ERR [2])	Module Error	Red	--	Internal error or module not configured	--
	[1]) Indication LED is ON even if an input signal is applied to the channel and the supply voltage is off. In this case the module is not operating and does not generate an input signal.					
	[2]) All of the LEDs CH-ERR1 to CH-ERR4 light up together					

Technical data

Technical data of the module

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

↳ *Chapter 4.3 “System data AC500-XC” on page 38*

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter		Value
Process supply voltage UP		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 V DC
	Max. ripple	5 %

Parameter		Value
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module	Ca. 2 mA
	From UP at normal operation / with outputs	0.15 A + max. 0.5 A per output
	Inrush current from UP (at power up)	0.007 A^2s
Max. power dissipation within the module		6 W (outputs unloaded)
Weight (without terminal unit)		ca. 125 g
Mounting position		Horizontal mounting or Vertical mounting with derating (output load reduced to 50 % at +40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Multiple overloads
With multi-channel modules, there are no effects of multiple overloads as each digital output channel is individually protected by an internal intelligent high-side switch.

Technical data of the digital inputs

Parameter	Value
Number of channels per module	16
Distribution of the channels into groups	1 group of 16 channels
Terminals of the channels I0 ... I7	1.0 ... 1.7
Terminals of the channels I8 ... I15	2.0 ... 2.7
Reference potential for all inputs	Terminals 1.9, 2.8, 3.8 and 4.9 (negative pole of the process supply voltage, signal name ZP)
Galvanic isolation	From the rest of the module (I/O bus)
Indication of the input signals	1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Monitoring point of input indicator	LED is part of the input circuitry
Input type acc. to EN 61131-2	Type 1

Parameter		Value
Input delay (0->1 or 1->0)		Typ. 8 ms, configurable from 0.1 to 32 ms
Input signal voltage		24 V DC
	Signal 0	-3 V ... +5 V
	Undefined signal	> +5 V ... < +15 V Parameter
	Signal 1	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 5 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical data of the configurable digital inputs/outputs

Each of the configurable I/O channels is defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter		Value
Number of channels per module		16 inputs/outputs (with transistors)
Distribution of the channels into groups		1 group of 16 channels
If the channels are used as inputs		
	Channels I16 ... I23	Terminals 3.0 ... 3.7
	Channels I24 ... I31	Terminals 4.0 ... 4.7
If the channels are used as outputs		
	Channels Q16 ... Q23	Terminals 3.0 ... 3.7
	Channels Q24 ... Q31	Terminals 4.0 ... 4.7
Indication of the input/output signals		1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Monitoring point of input/output indicator		LED is part of the input circuitry
Galvanic isolation		From the rest of the module

Technical data of the digital inputs/outputs if used as inputs

Parameter		Value
Number of channels per module		Max. 16 digital inputs
Reference potential for all inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (negative pole of the process supply voltage, signal name ZP)
Input current, per channel		See 'Technical Data of the Digital Inputs' ↳ *Chapter 5.4.3.2.3.8.2 “Technical data of the digital inputs” on page 463*
Input type acc. to EN 61131-2		Type 1
Input delay (0->1 or 1->0)		Typ. 8 ms, configurable from 0.1 to 32 ms
Input signal voltage		24 V DC
Signal 0		-3 V ... +5 V *)
undefined signal		> +5 V ... < +15 V
Signal 1		+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V *)
Ripple with signal 1		Within +15 V ... +30 V
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

*) Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal must not exceed the clamp voltage of the varistor. The varistor limits the clamp voltage to approx. 36 V. Consequently the input voltage must be within the following range.

- If UPx = 24 V, the input voltage must range from -12 V ... +30 V.
- If UPx = 30 V, the input voltage must range from -6 V ... +30 V.

Technical data of the digital inputs/outputs if used as outputs

Parameter		Value
Number of channels per module		Max. 16 transistor outputs
Reference potential for all outputs		Terminals 1.9, 2.9, 3.9 and 4.9 (negative pole of the process supply voltage, signal name ZP)
Common power supply voltage		For all outputs: terminals 1.8, 2.8, 3.8 and 4.8 (positive pole of the process supply voltage, signal name UP)
Output voltage for signal 1		UP (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value, per channel	500 mA at UP = 24 V
	Maximum value (all channels together)	8 A
Leakage current with signal 0		< 0.5 mA
Rated protection fuse on UP		10 A fast
Demagnetization when inductive loads are switched off		With varistors integrated in the module (see figure below)
Switching frequency		

Parameter		Value
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 11 Hz with max. 5 W
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals		Yes
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

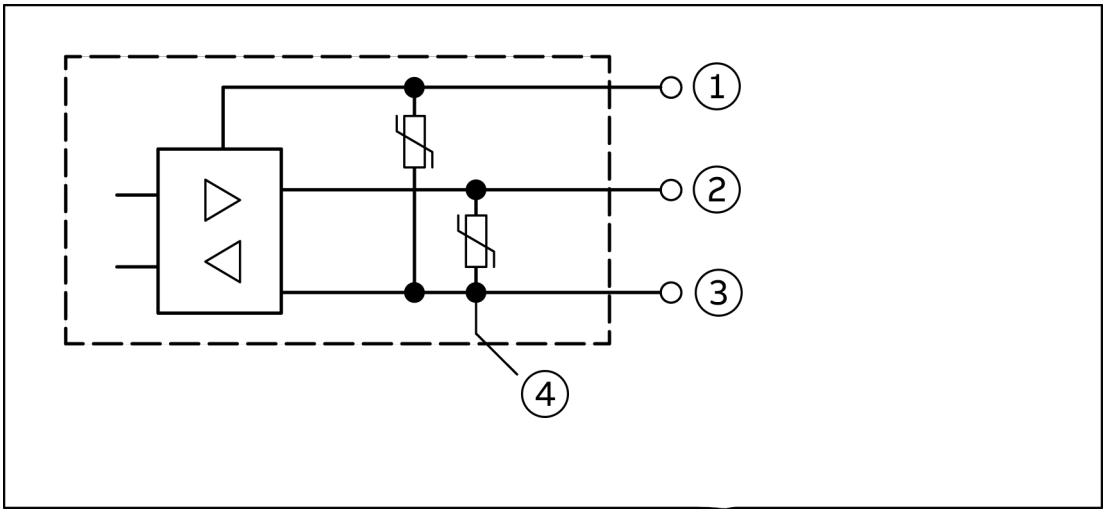


Fig. 60: Digital input/output (circuit diagram)

1 UPx (+ 24 V)
2 Digital input/output
3 ZPx (0 V)
4 For demagnization when inductive loads are switched off

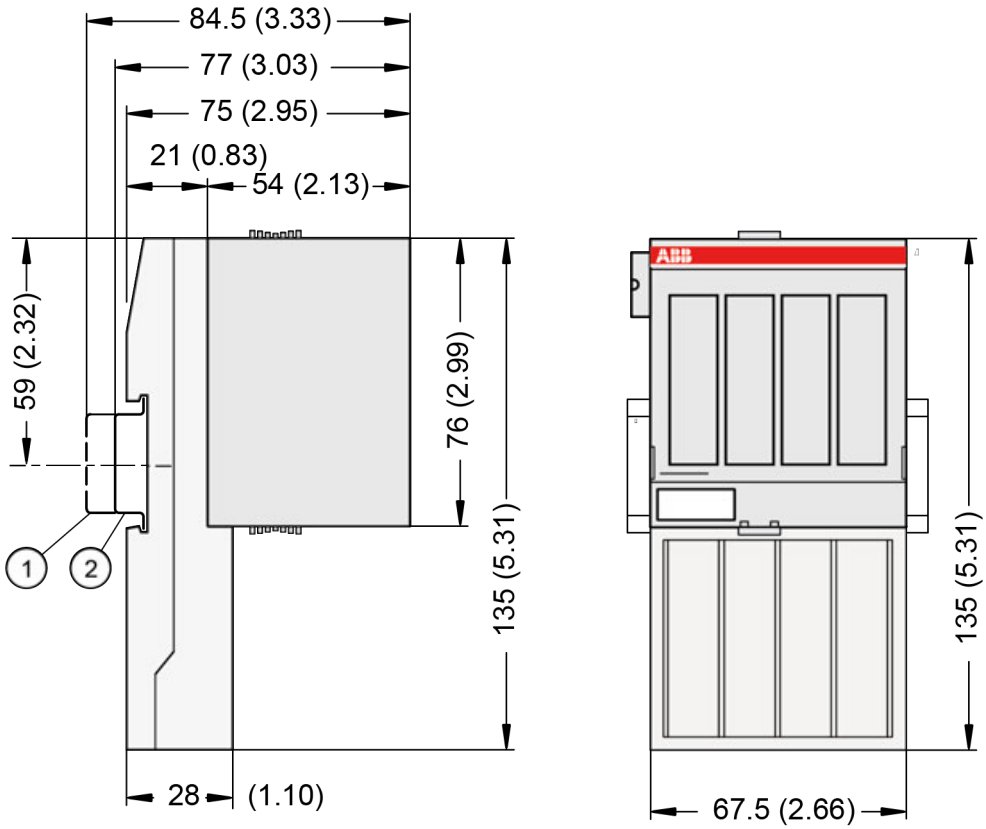
Technical data of the fast counter

The fast counter of the module does not work if the module is connected to one of following devices:

- *FBP interface module*
- *CS31 bus module*
- *CANopen communication interface module*

Parameter	Value
Used inputs	C24 / C25
Used outputs	C26
Counting frequency	Max. 50 kHz

Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

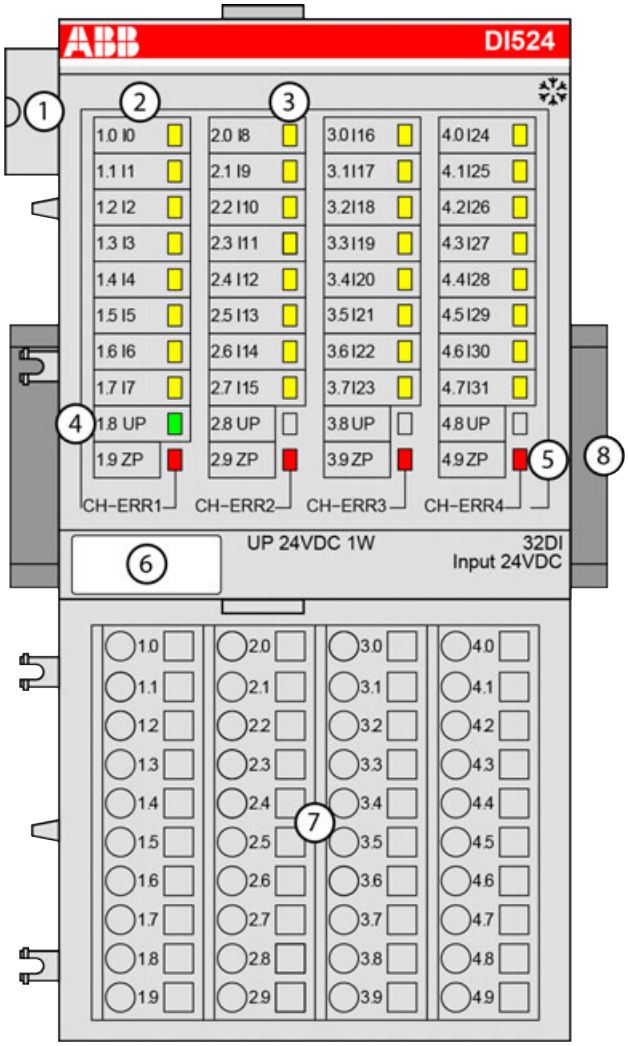
Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 240 100 R0001	DC532, digital input/output module, 16 DI, 16 DC, 24 V DC / 0.5 A, 1-wire	Active
1SAP 440 100 R0001	DC532-XC, digital input/output module, 16 DI, 16 DC, 24 V DC / 0.5 A, 1-wire, XC version	Active

*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

5.4.3.2.4 DI524 - Digital input module

- 32 digital inputs 24 V DC in 4 groups (1.0 ... 1.7, 2.0 ... 2.7, 3.0 ... 3.7 and 4.0 ... 4.7)
- Fast counter
- Module-wise galvanically isolated
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 32 yellow LEDs to display the signal states at the digital inputs (I0 ... I31)
4 1 green LED to display the state of the process supply voltage UP
5 4 red LEDs to display errors
6 Label
7 Terminal unit
8 DIN rail
❄ Sign for XC version

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The configuration is performed by software. The modules are supplied with a process supply voltage of 24 V DC.

All available inputs/outputs are galvanically isolated from all other circuitry of the module. There is no potential separation between the channels within the same group.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

Functionality

Parameter	Value
Fast counter	Integrated, many configurable operating modes (only with AC500)
LED displays	For signal states, errors and supply voltage
Internal power supply	Via the I/O bus interface (I/O bus)
External power supply	Via the terminals ZP and UP (process voltage 24 V DC)
Required terminal units	TU515 or TU516 ↳ *TU515, TU516*
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V

The device is plugged on a terminal unit.

↳ *Chapter 5.5.2 “TU515, TU516, TU541 and TU542 for I/O modules” on page 946*

Position the module properly and press until it locks in place. The terminal unit is either mounted on a DIN rail or to the wall using 2 screws plus the additional accessory for wall mounting.

↳ *Chapter 5.8.2.6 “TA526 - Wall mounting accessory” on page 1410*

Connections



For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8 ... 4.8 and 1.9 ... 4.9 are electrically interconnected within the I/O terminal unit and have always the same assignment, irrespective of the inserted module:

Terminals 1.8 ... 4.8: process voltage UP = +24 V DC

Terminals 1.9 ... 4.9: process voltage ZP = 0 V DC

Table 144: Assignment of the other terminals:

Terminals	Signal	Description
1.0 ... 1.7	I0 ... I7	8 digital inputs
2.0 ... 2.7	I8 ... I15	8 digital inputs
3.0 ... 3.7	I16 ... I23	8 digital inputs
4.0 ... 4.7	I24 ... I31	8 digital inputs

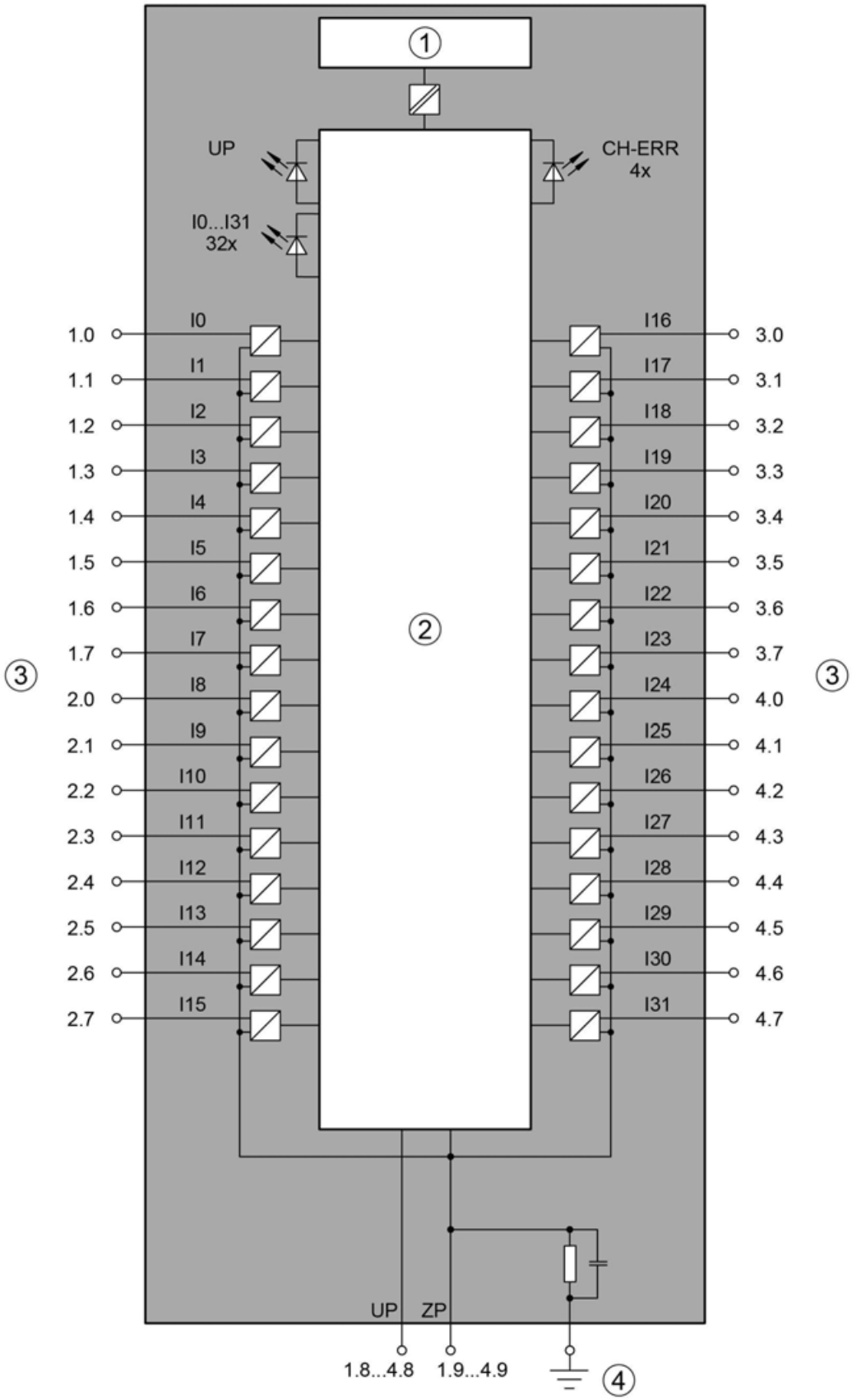


Fig. 61: Internal construction of the digital inputs

1 I/O bus interface
2 Logic
3 Digital inputs
4 Functional earth connection

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 2 mA per DI524.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.



WARNING!

Removal/Insertion under power

Removal or insertion under power is permissible only if all conditions for hot swapping are fullfilled.

↳ *“Conditions for hot swap” on page 12*

The devices are not designed for removal or insertion under power when the conditions for hot swap do not apply. Because of unforeseeable consequences, it is not allowed to plug in or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing any of the following actions:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while they are energized in a hazardous location could result in an electric arc, which could create an ignition source resulting in fire or explosion.

Prior to proceeding, make sure that power is been disconnected and that the area has been thoroughly checked to ensure that flammable materials or ignitable concentrations are not present.

The devices must not be opened when in operation. The same applies to the network interfaces.

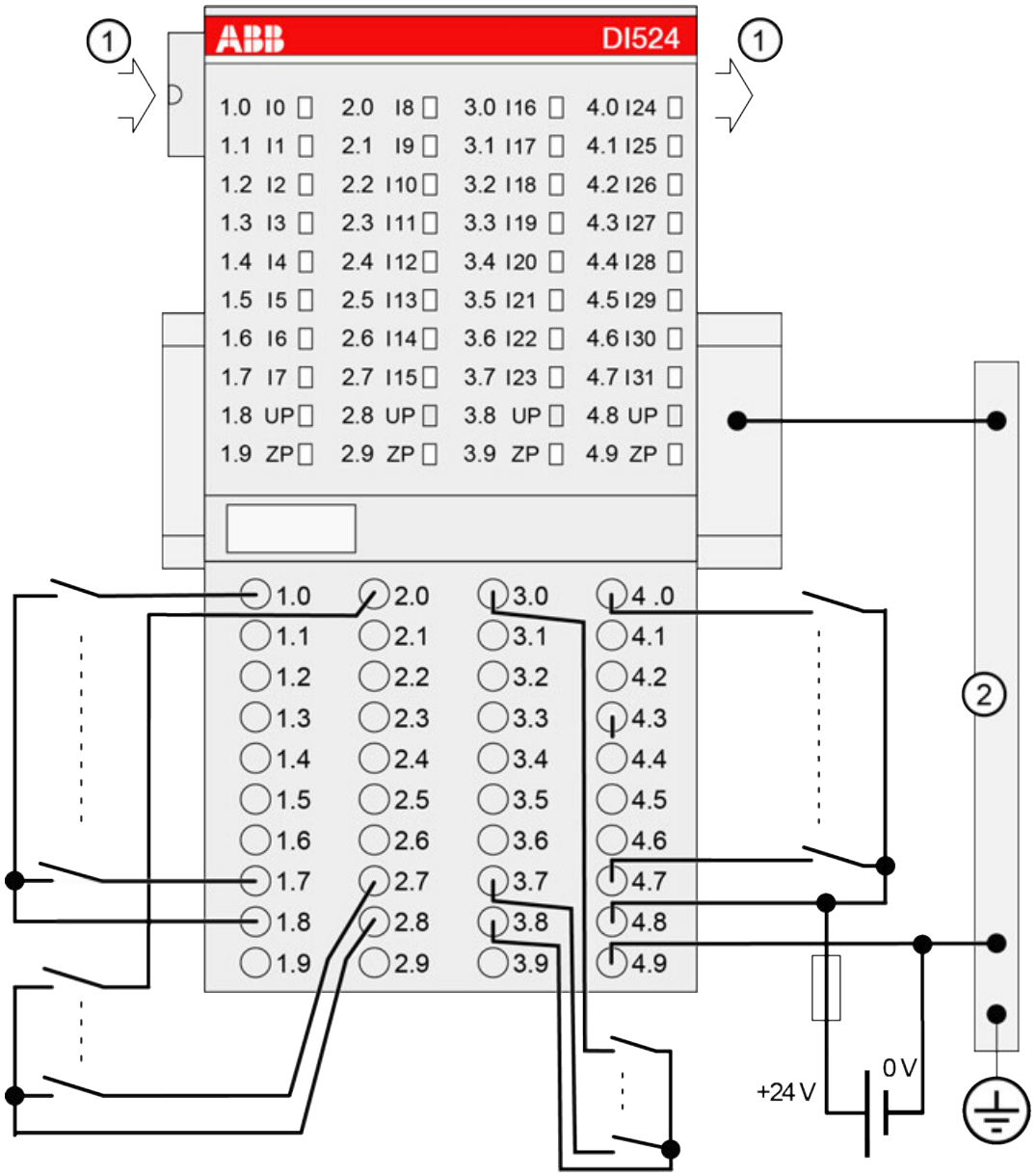


NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.



1 I/O bus
2 Control cabinet earth

CAUTION!
The process supply voltage must be included in the grounding concept (e. g. grounding of the negative terminal).

The module provides several diagnosis functions.

Internal data exchange

	Without the fast counter	With the fast counter (only with AC500)
Digital inputs (bytes)	4	6
Digital outputs (bytes)	0	2

	Without the fast counter	With the fast counter (only with AC500)
Counter input data (words)	0	4
Counter output data (words)	0	8

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.



If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1 ... 10

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
1	Module ID	Internal	1000 [1])	Word	1000 0x03E8	0	65535	0x0Y01
2	Ignore module [2])	No Yes	0 1	Byte	No 0x00			Not for FBP
3	Parameter length	Internal	3-CPU 2-FBP	Byte	3 2	0	255	0x0Y02
4	Check supply	Off On	0 1	Byte	On 0x01	0	1	0x0Y03

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
5	Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	Byte	8 ms 0x02	0	3	0x0Y04
6	Fast counter [4)]	0 : 10 [3)]	0 : 10	Byte	Mode 0 0x00			Not for FBP

Remarks:

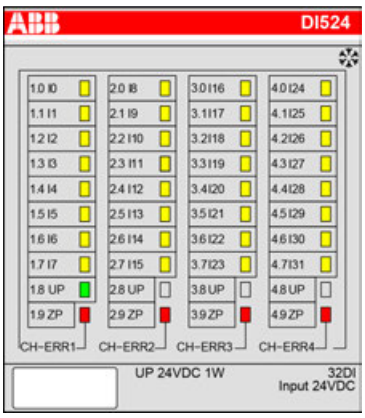
[1)]	With CS31 and addresses smaller than 70 and FBP, the value is increased by 1
[2)]	Not with FBP
[3)]	For a description of the counter operating modes, please refer to the 'Fast Counter' section *Chapter 5.4.3.2.9 “Fast counter” on page 522*
[4)]	With FBP or CS31 without the parameter Fast counter

GSD file:

Ext_User_Prm_Data_Len = Ext_User_Prm_Data_Const(0) =	5 0x03, 0xe9, 0x02, \ 0x01, 0x02;

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Inputs I0 ... I31	Digital input	Yellow	Input = OFF	Input = ON [1)]	--
	UP	Process supply voltage 24 V DC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--

LED		State	Color	LED = OFF	LED = ON	LED flashes
	CH-ERR1	Channel error, error messages in groups (digital inputs combined into the groups 1, 2, 3, 4)	Red	No error or process supply voltage is missing	Severe error within the corresponding group	Error on one channel of the corresponding group
	CH-ERR2		Red			
	CH-ERR3		Red			
	CH-ERR4		Red			
	CH-ERR [2])	Module error	Red	--	Internal error or module not configured	--
	[1]) Indication LED is ON even if an input signal is applied to the channel and the supply voltage is off. In this case the module is not operating and does not generate an input signal.					
	[2]) All of the LEDs CH-ERR1 to CH-ERR4 light up together					

Technical data

Technical data of the module

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

↳ *Chapter 4.3 “System data AC500-XC” on page 38*

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter		Value
Process supply voltage UP		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 V DC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse for UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/ communication interface module	ca. 2 mA
	From UP at normal operation	0.15 A
	Inrush current from UP (at power up)	0.008 A^2s
Weight (without terminal unit)		ca. 105 g

Parameter	Value
Mounting position	Horizontal mounting or Vertical mounting with derating (output load reduced to 50 % at +40 °C per group)
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Technical data of the digital inputs

Parameter		Value
Number of channels per module		32
Distribution of the channels into groups		1 group of 32 channels
Terminals of the channels I0 ... I7		1.0 ... 1.7
Terminals of the channels I8 ... I15		2.0 ... 2.7
Terminals of the channels I16 ... I23		3.0 ... 3.7
Terminals of the channels I24 ... I31		4.0 ... 4.7
Reference potential for all inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (negative pole of the process supply voltage, signal name ZP)
Galvanic isolation		From the rest of the module (I/O bus)
Indication of the input signals		One yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Monitoring point of input indicator		LED is part of the input circuitry
Input type acc. to EN 61131-2		Type 1
Input delay (0 -> 1 or 1 -> 0)		Typ. 8 ms, configurable from 0.1 ... 32 ms
Input signal voltage		24 V DC
	Signal 0	-3 V ... +5 V
	Undefined signal	> +5 V ... < +15 V
	Signal 1	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 5 mA
	Input voltage +30 V	< 8 mA
Max. cable length		

Parameter		Value
	Shielded	1000 m
	Unshielded	600 m

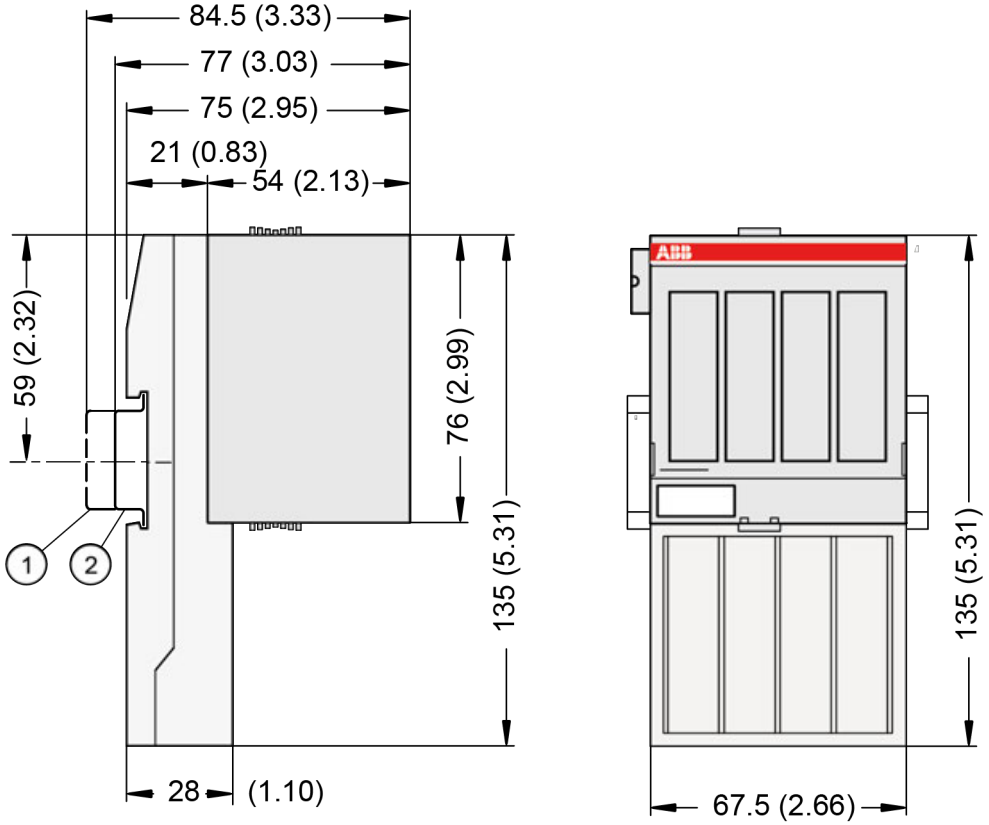
Technical data of the fast counter

The fast counter of the module does not work if the module is connected to one of following devices:

- *FBP interface module*
- *CS31 bus module*
- *CANopen communication interface module*

Parameter	Value
Used inputs	I24 / I25
Used outputs	None
Counting frequency	Max. 50 kHz

Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

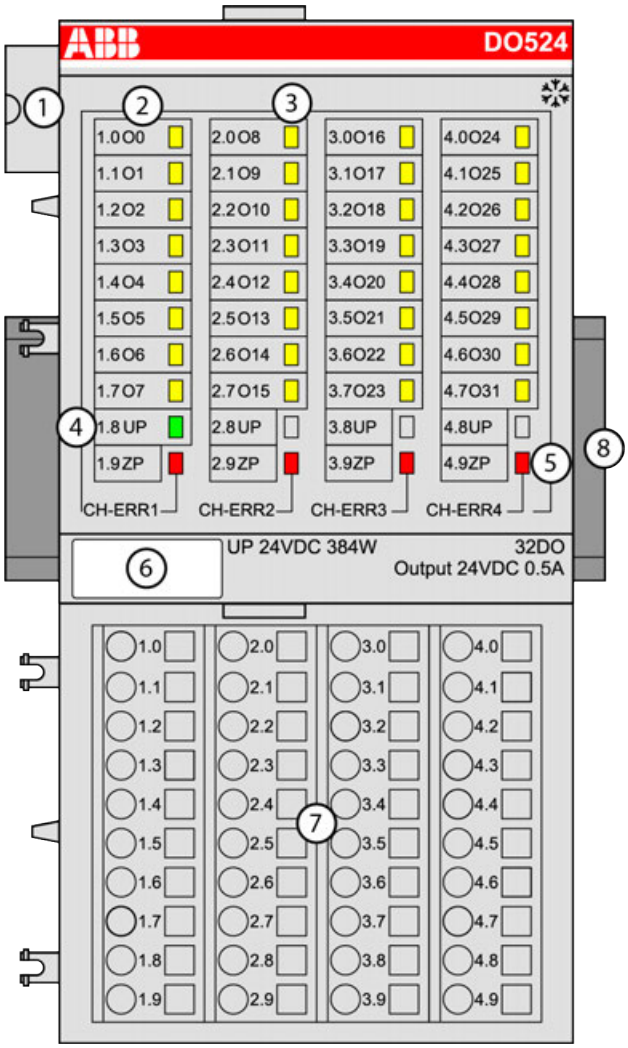
Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 240 000 R0001	DI524, digital input module, 32 DI, 24 V DC, 1-wire	Active
1SAP 440 000 R0001	DI524-XC, digital input module, 32 DI, 24 V DC, 1-wire, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.4.3.2.5 DO524 - Digital output module

- 32 digital outputs 24 V DC / 0.5 A in 4 groups (1.0 ... 4.7) with short circuit and overload protection
- Module-wise galvanically isolated
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 32 yellow LEDs to display the signal states at the digital outputs (O0 ... O31)
4 1 green LED to display the state of the process supply voltage UP
5 4 red LEDs to display errors
6 Label
7 Terminal unit
8 DIN rail
❄ Sign for XC version

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The outputs are galvanically isolated from all other circuitry of the module. There is no potential separation between the channels.

Functionality

Parameter	Value
LED displays	For signal states, errors and supply voltage
Internal power supply	Via the I/O bus interface (I/O bus)
External power supply	Via the terminals ZP and UP (process voltage 24 V DC)
Required terminal unit	TU515 or TU516 ↳ *TU515, TU516*

The device is plugged on a terminal unit.

↳ *Chapter 5.5.2 “TU515, TU516, TU541 and TU542 for I/O modules” on page 946*

Position the module properly and press until it locks in place. The terminal unit is either mounted on a DIN rail or to the wall using 2 screws plus the additional accessory for wall mounting.

↳ *Chapter 5.8.2.6 “TA526 - Wall mounting accessory” on page 1410*



Multiple overloads

No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Connections



For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8 ... 4.8 and 1.9 ... 4.9 are electrically interconnected within the I/O terminal unit and have always the same assignment, independent of the inserted module:

Terminals 1.8 ... 4.8: process voltage UP = +24 V DC

Terminals 1.9 ... 4.9: process voltage ZP = 0 V DC

The assignment of the other terminals:

Terminals	Signal	Description
1.0 ... 1.7	O0 ... O7	8 digital outputs
2.0 ... 2.7	O8 ... O15	8 digital outputs
3.0 ... 3.7	O16 ... O23	8 digital outputs
4.0 ... 4.7	O24 ... O31	8 digital outputs

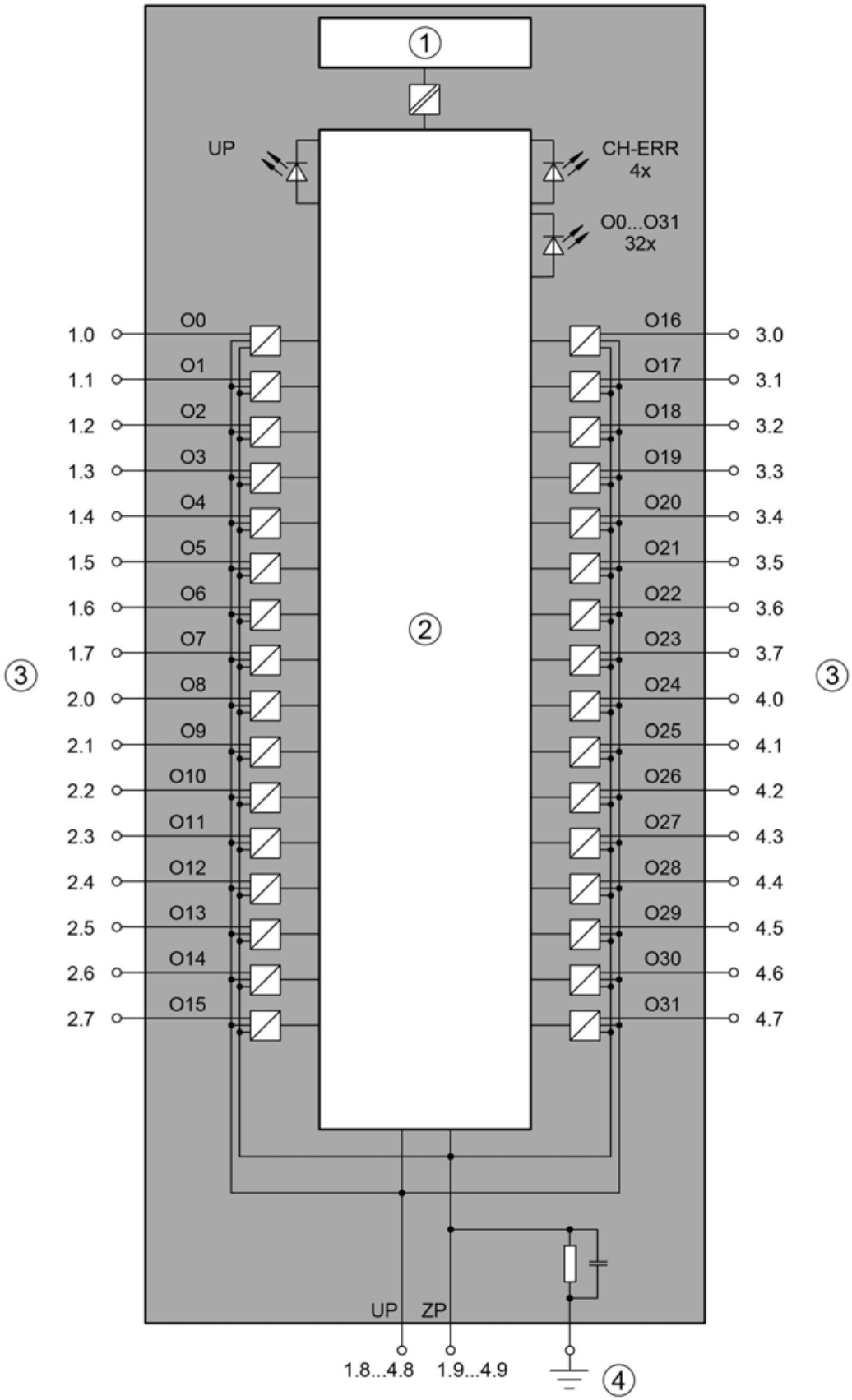


Fig. 62: Internal construction of the digital outputs

1 I/O bus interface
2 Logic
3 Digital outputs
4 Functional earth connection

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 2 mA per DO524.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.



WARNING!

Removal/Insertion under power

Removal or insertion under power is permissible only if all conditions for hot swapping are fullfilled.

“Conditions for hot swap” on page 12

The devices are not designed for removal or insertion under power when the conditions for hot swap do not apply. Because of unforeseeable consequences, it is not allowed to plug in or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing any of the following actions:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while they are energized in a hazardous location could result in an electric arc, which could create an ignition source resulting in fire or explosion.

Prior to proceeding, make sure that power is been disconnected and that the area has been thoroughly checked to ensure that flammable materials or ignitable concentrations are not present.

The devices must not be opened when in operation. The same applies to the network interfaces.



NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The module provides several diagnosis functions.

Internal data exchange

Digital inputs (bytes)	0
Digital outputs (bytes)	4

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.



If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1 ... 10

Name	Value	Internal value	Internal value, type	Default	Min.	Max.	Max.
Module ID	Internal	1101 [1])	WORD	1101 0x044D	0	65535	0x0Y01
Ignore module [2])	No Yes	0 1	BYTE	No 0x00			not for FBP
Parameter length	Internal	7	BYTE	7-CPU 7-FBP	0	255	0x0Y02
Check supply	Off on	0 1	BYTE	On 0x01	0	1	0x0Y03
Output short circuit detection	Off On	0 1	BYTE	On 0x01	0	1	0x0Y04
Behaviour of outputs at communication errors	Off Last value Substitute value	0 1+(n*5) 2+(n*5), n ≤ 2	BYTE	Off 0x00	0	2	0x0Y05
Substitute value at outputs Bit 31 = Output 31 Bit 0 = Output 0	0 ... 4294967295	0 ... 0xffffffff	DWORD	0 0x00000000	0	4294967295	0x0Y06

[1]) With CS31 and addresses smaller than 70 and FBP, the value is increased by 1

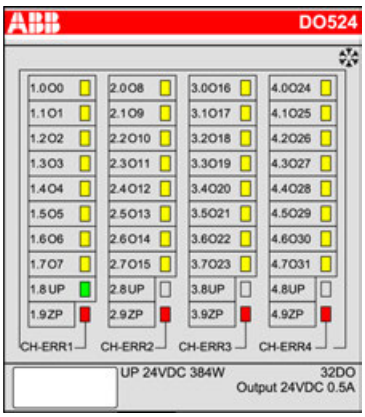
[2]) Not with FBP

GSD file:

Ext_User_Prm_Data_Len =	10
Ext_User_Prm_Data_Const(0) =	0x04, 0x4d, 0x07, \ 0x01, 0x01, 0x00, 0x00, 0x00, 0x00, 0x00;

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Outputs O0 ... O31	Digital output	Yellow	Output = OFF	Output = ON	--
	UP	Process supply voltage 24 V DC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
	CH-ERR1	Channel error, error messages in groups (digital outputs combined into the groups 1, 2, 3, 4)	Red	No error or process supply voltage is missing	Severe error within the corresponding group	Error on one channel of the corresponding group (e.g. short circuit at an output)
	CH-ERR2		Red			
	CH-ERR3		Red			
	CH-ERR4		Red			
	CH-ERR *)	Module error	Red	--	Internal error	--
	*) All of the LEDs CH-ERR1 to CH-ERR4 light up together					

Technical data

Technical data of the module

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

↳ *Chapter 4.3 “System data AC500-XC” on page 38*

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter		Value
Process supply voltage UP		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 V DC

Parameter		Value
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module	Ca. 2 mA
	From UP at normal operation / with outputs	0.10 A + max. 0.5 A per output
	Inrush current from UP (at power up)	0.005 A^2s
Max. power dissipation within the module		6 W (outputs unloaded)
Weight (without terminal unit)		Ca. 100 g
Mounting position		Horizontal mounting or Vertical mounting with derating (output load reduced to 50 % at +40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

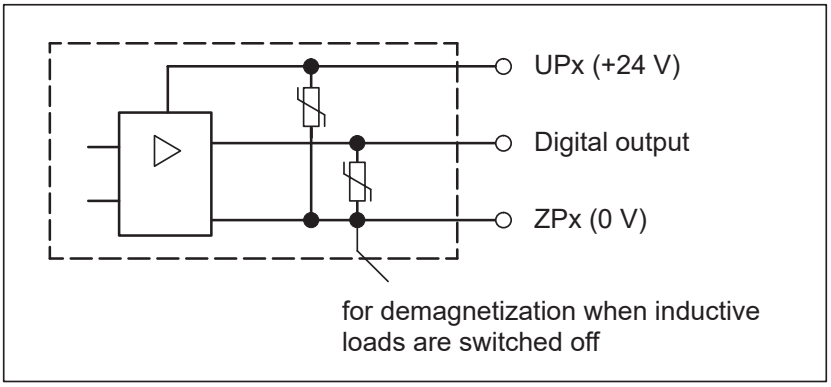
Multiple overloads
With multi-channel modules, there are no effects of multiple overloads as each digital output channel is individually protected by an internal intelligent high-side switch.

Technical data of the digital outputs

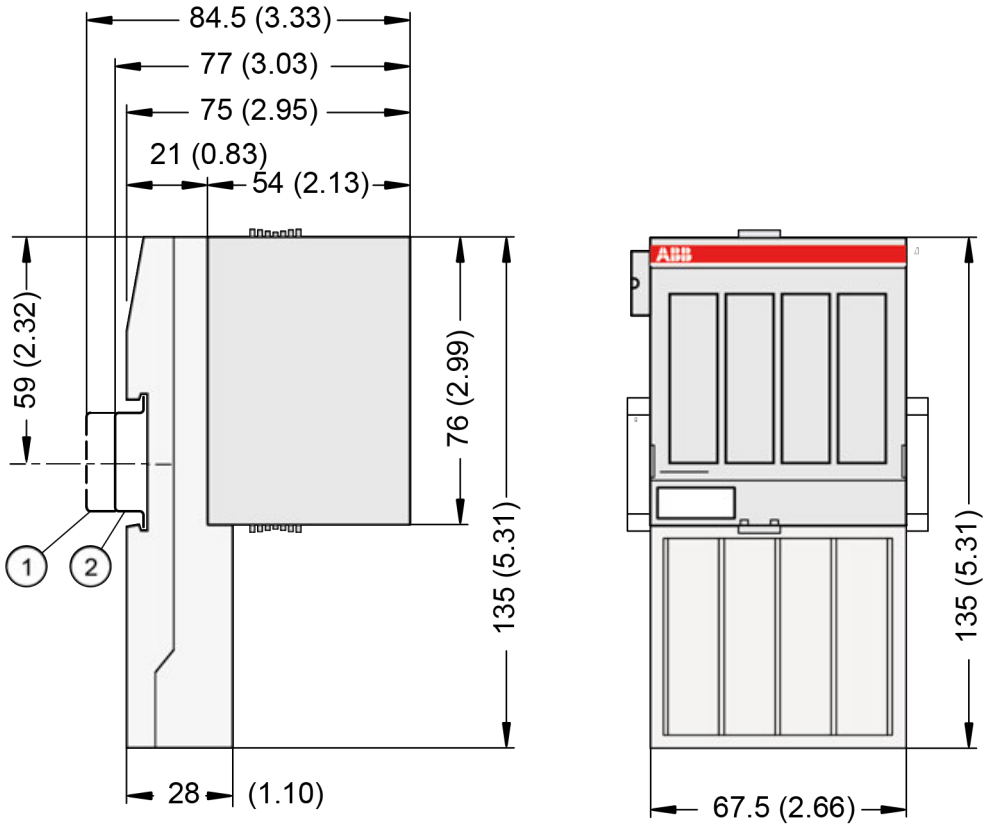
Parameter		Value
Number of channels per module		32 outputs (with transistors)
Distribution of the channels into groups		1 group of 32 channels
Connection of the channels		
	O0 ... O7	Terminals 1.0 ... 1.7
	O8 ... O15	Terminals 2.0 ... 2.7
	O16 ... O23	Terminals 3.0 ... 3.7
	O24 ... O31	Terminals 4.0 ... 4.7
Indication of the output signals		1 yellow LED per channel, the LED is ON if the output signal is high (signal 1)

Parameter		Value
Reference potential for all outputs		Terminals 1.9, 2.9, 3.9 and 4.9 (negative pole of the process supply voltage, signal name ZP)
Common power supply voltage		For all outputs: terminals 1.8, 2.8, 3.8 and 4.8 (positive pole of the process supply voltage, signal name UP)
Output voltage for signal 1		UP (-0.8 V)
Output delay (0 -> 1 or 1 -> 0)		On request
Output current		
	Rated value, per channel	500 mA at UP = 24 V
	Maximum value (channels O0 ... O15)	4 A
	Maximum value (channels O16 ... O31)	4 A
	Maximum value (all channels together)	8 A
Max. leakage current with signal 0		< 0.5 mA
Rated protection fuse on UP		10 A fast
Demagnetization when inductive loads are switched off		With varistors integrated in the module (see figure below)
Switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 11 Hz with max. 5 W
Short-circuit proof / overload proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short-circuit/overload
Resistance to feedback against 24 V signals		Yes
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital output with the varistors for demagnetization when inductive loads are switched off.



Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

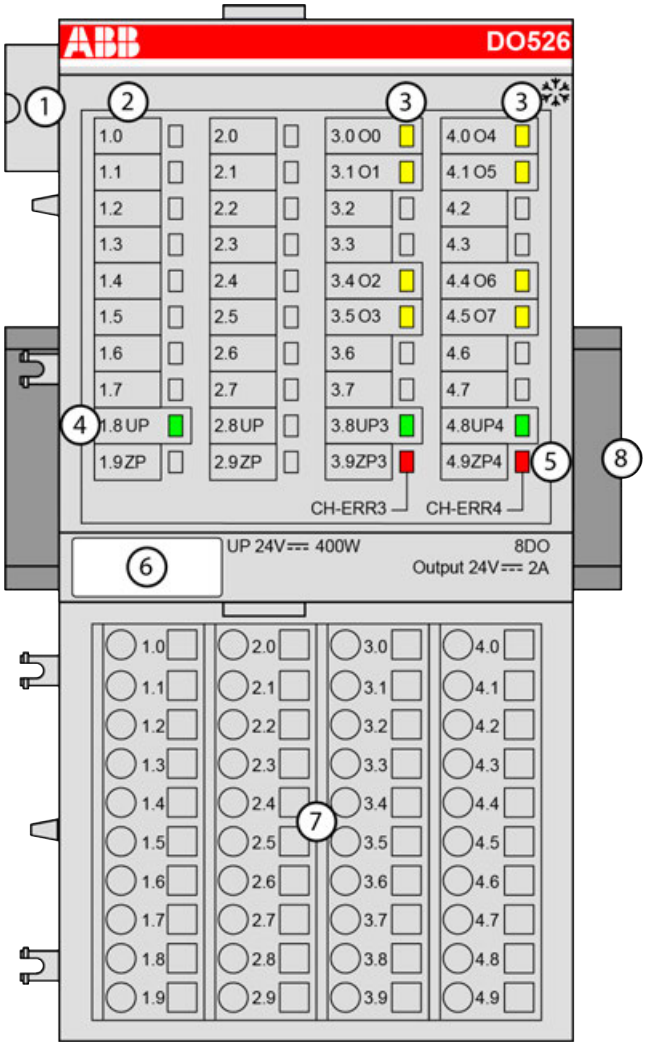
Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 240 700 R0001	DO524, digital output module, 32 DO, 24 V DC / 0.5 A, 1-wire	Active
1SAP 440 700 R0001	DO524-XC, digital output module, 32 DO, 24 V DC / 0.5 A, 1-wire, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.4.3.2.6 DO526 - Digital output module

- 8 digital outputs 24 V DC (O0 ... O7) in 2 groups without short circuit and without overload protection.
- Module and group-wise galvanically isolated
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 8 yellow LEDs to display the signal states of the outputs O0 ... O7
4 3 green LEDs to display the states of the process supply voltage UP, UP3 and UP4
5 2 red LEDs to display errors
6 Label
7 Terminal unit
8 DIN-rail
❄ Sign for XC version

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The outputs are group-wise galvanically isolated from each other.

All other circuitry of the module is galvanically isolated from the outputs.

Potential separation between the channel groups.

Functionality

Parameter	Value
LED displays	For signal states, errors and supply voltages
Internal power supply	Via I/O bus
External power supply	Via the terminals ZP, ZP3, ZP4, UP, UP3 and UP4 (process voltage 24 V DC)
Required terminal unit	TU542 ↳ *TU542*

The output module is plugged on the terminal unit TU542. Properly position the module and press until it locks in place. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting ↳ *Chapter 5.8.2.6 “TA526 - Wall mounting accessory” on page 1410*.

Connections



For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8 ... 2.8 and 1.9 ... 2.9 are electrically interconnected within the I/O terminal unit and always have the same assignment, irrespective of the inserted module:

Terminals 1.8 ... 2.8:	Process voltage UP = +24 V DC
Terminals 1.9 ... 2.9:	Process voltage ZP = 0 V
Terminal 3.8:	Process voltage UP3 = +24 V DC
Terminal 3.9:	Process voltage ZP3 = 0 V
Terminal 4.8:	Process voltage UP4 = +24 V DC
Terminal 4.9:	Process voltage ZP4 = 0 V

Terminals	Signal	Description
3.0, 3.1, 3.4, 3.5	O0 ... O3	4 digital outputs
4.0, 4.1, 4.4, 4.5	O4 ... O7	4 digital outputs

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 2 mA per DO526.

The external power supply connection is carried out via the UP, UP3, UP4 (+24 V DC) and the ZP, ZP3, ZP4 (0 V DC) terminals.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

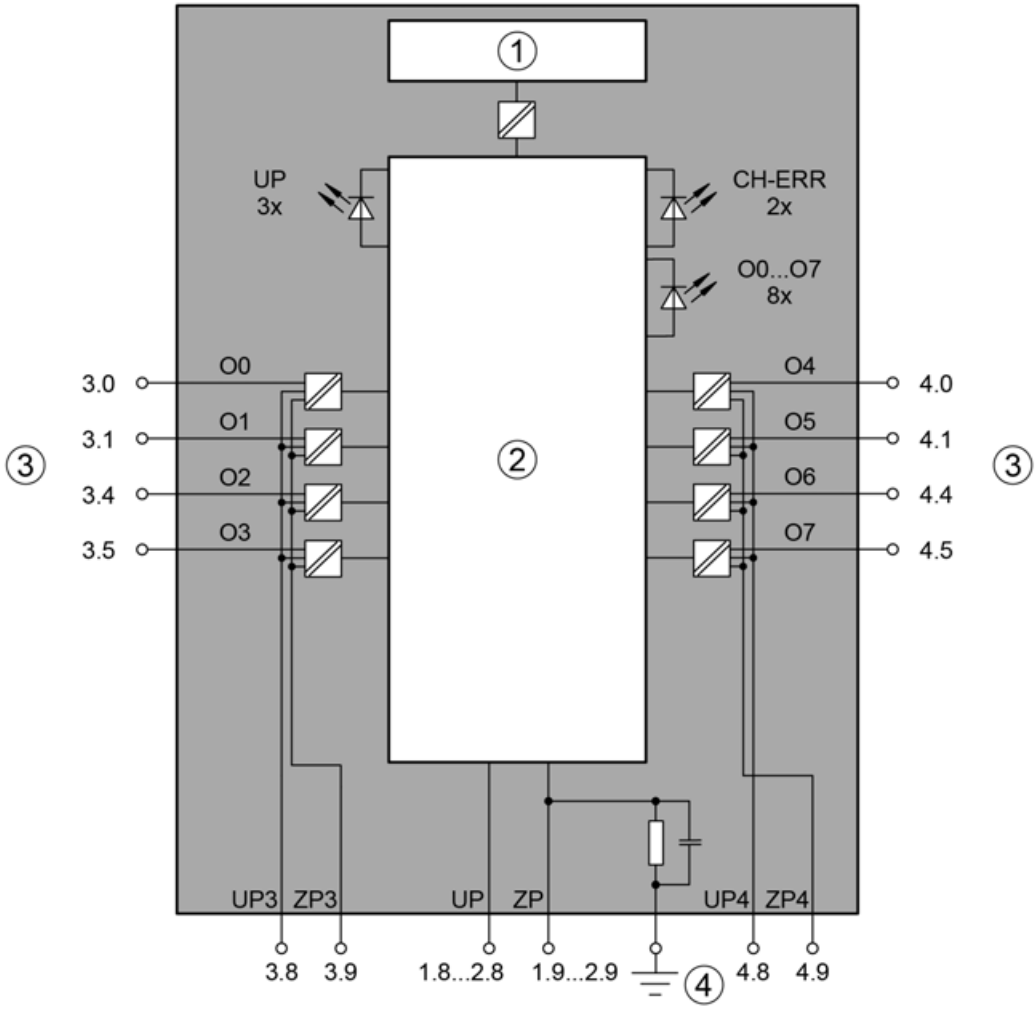


Fig. 63: Internal construction of the digital outputs

1 I/O bus
2 Logic
3 Digital outputs
4 Functional earth connection

CAUTION!

The process supply voltage must be included in the grounding concept (e. g. grounding of the negative terminal).

The module provides several diagnosis functions.

Internal data exchange

Digital inputs (bytes)	0
Digital outputs (bytes)	1

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.



If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software, versions ≥ 1.2.3.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1 ... 7

Name	Value	Internal value	Internal value, type	Default	Min.	Max.	Max.
Module ID	Internal	1105 [1])	WORD	1105 0x0451	0	65535	0x0Y01
Ignore module [2])	No Yes	0 1	BYTE	No 0x00			not for FBP
Parameter length	Internal	6	BYTE	6-CPU 6-FBP	0	6	0x0Y02
Check supply	Off on	0 1	BYTE	On 0x01	0	1	0x0Y03
Reserve	0 ... 255	0 ... 0xff	BYTE	On 0x01	0	1	0x0Y04
Behaviour of outputs at communication errors	Off Last value Substitute value	0 1+(n*5) 2+(n*5), n ≤ 2	BYTE	Off 0x00	0	2	0x0Y05

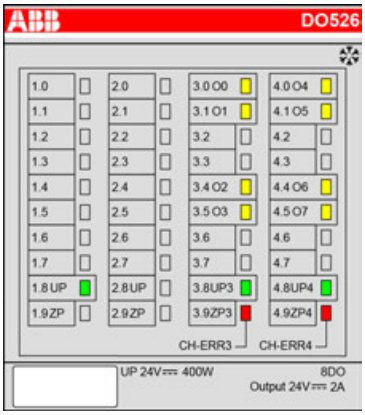
Name	Value	Internal value	Internal value, type	Default	Min.	Max.	Max.
Substitute value at outputs Bit 7 = Output 7 Bit 0 = Output 0	0...255	0 ... 0xff	BYTE	0x00	0	255	0x0Y06
Reserve	0 ... 255	0 ... 0xff	BYTE	0x00	0	255	0x0Y07
Reserve	0 ... 255	0 ... 0xff	BYTE	0x00	0	255	0x0Y08
[1]) With CS31 and addresses smaller than 70 and FBP, the value is increased by 1 [2]) Not with FBP							

GSD file:

Ext_User_Prm_Data_Len =	10
Ext_User_Prm_Data_Const(0) =	0x04, 0x51, 0x00, 0x06, 0x01, 0x01, 0x00, 0x00, 0x00, 0x00

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Outputs O0 ... O7	Digital output	Yellow	Output = OFF	Output = ON [2])	--
	UP	Process supply voltage 24 V DC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
	UP3	Process supply voltage outputs 0 ... 3 24 V DC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
	UP4	Process supply voltage outputs 4 ... 7 24 V DC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--

LED		State	Color	LED = OFF	LED = ON	LED flashes
	CH-ERR3	Channel Error, error messages in groups (digital outputs combined into the groups 3, 4)	Red	No error or process supply voltage is missing	Severe error within the corresponding group	Error on in the corresponding group
	CH-ERR4		Red			
	CH-ERR [1])	Module Error	Red	--	Internal error	--
	[1]) All of the LEDs CH-ERR3 to CH-ERR4 light up together [2]) The state of the LEDs corresponds to the logic state of the output. In case of missing or low process supply voltage UP3 or UP4, the signal on the output terminal is off even though the LED is on.					

Technical data

Technical data of the module

The system data of AC500 and S500 is applicable to the standard version.

Chapter 4.2 “System data AC500” on page 34

The system data of AC500-XC is applicable to the XC version.

Chapter 4.3 “System data AC500-XC” on page 38

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter		Value
Process supply voltage UP, UP3 and UP4		
	Connections	Terminals 1.8 and 2.8 for +24 V (UP) as well as 1.9 and 2.9 0 V (ZP) Terminals 3.8 for +24 V (UP3) as well as 3.9 for 0 V (ZP3) Terminals 4.8 for +24 V (UP4) as well as 4.9 for 0 V (ZP4)
	Rated value	24 V DC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP, UP3 and UP4	10 A fast (for each process supply voltage)
	Galvanic isolation	Yes, per module and per output channel groups
Current consumption		
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module	Ca. 2 mA
	From UP at normal operation / with outputs	Ca. 20 mA + 1.5 mA per output
	From UP3 or UP4 at normal operation / with outputs	Ca. 0.01 A + max. 2 A per output

Parameter		Value
	Inrush current from UP (at power up)	0.015 A^2s
	Inrush current from UP3 or UP4 (at power up)	0.005 A^2s (without output load)
Max. power dissipation within the module		6 W
Weight (without terminal unit)		Ca. 135 g
Mounting position		Horizontal mounting or Vertical mounting with derating (output load reduced to 50 % at +40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!

Attention:

All I/O channels (digital and analog) are protected against reverse polarity, reverse supply and continuous overvoltage up to 30 V DC.

No effects of multiple overloads

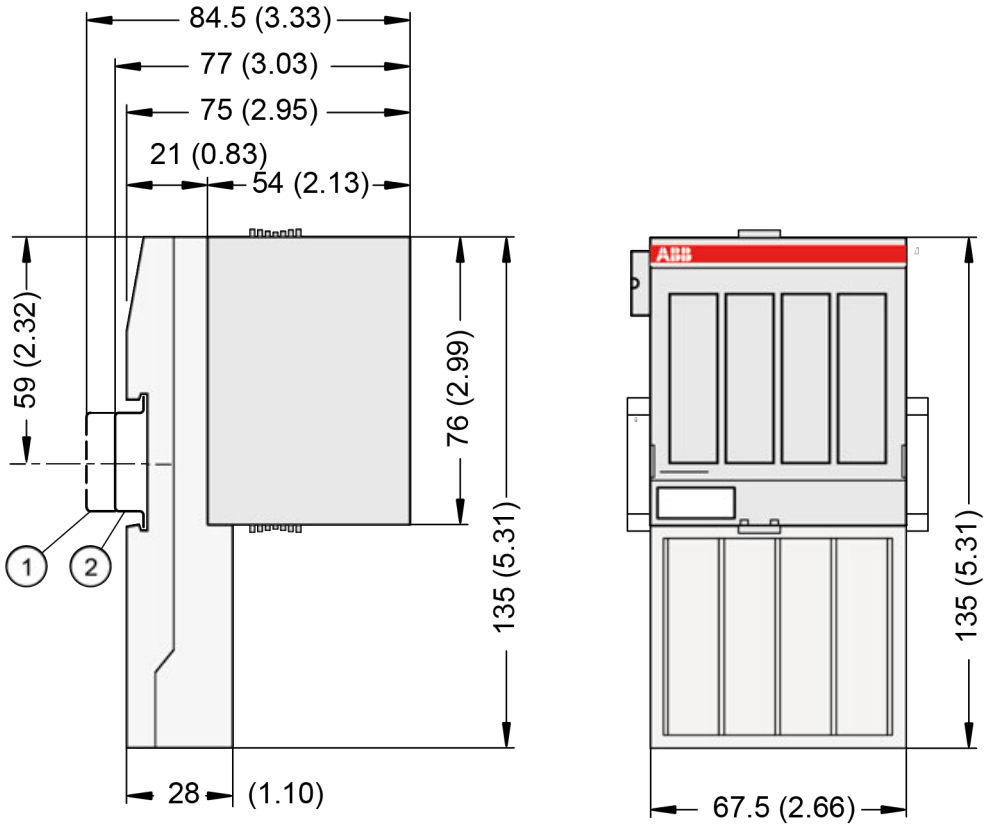
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

Technical data of the digital outputs

Parameter		Value
Number of channels per module		8 outputs (with transistors, non-latching type)
Distribution of the channels into groups		2 groups of 4 channels
Connection of the channels		
	O0 ... O3	Terminals 3.0, 3.1, 3.4, 3.5
	O4 ... O7	Terminals 4.0, 4.1, 4.4, 4.5
Indication of the output signals		1 yellow LED per channel, the LED is ON if the output signal is high (signal 1)
Power supply voltage for the module		Terminals 1.8 and 2.8 (positive pole of the process supply voltage, signal name UP)
Reference potential for module power supply		Terminals 1.9 and 2.9 (negative pole of the process supply voltage, signal name ZP)
Power supply voltage for the outputs O0 to O3		Terminal 3.8 (positive pole of the process supply voltage, signal name UP3)
Reference potential for the outputs O0 to O3		Terminal 3.9 (negative pole of the process supply voltage, signal name ZP3)
Power supply voltage for the outputs O4 to O7		Terminal 4.8 (positive pole of the process supply voltage, signal name UP4)
Reference potential for the outputs O4 to O7		Terminal 4.9 (negative pole of the process supply voltage, signal name ZP4)
Output voltage for signal 1		UP (-0.4 V)
Output delay (0->1 or 1->0)		On request
Output current		

Parameter		Value
	Rated value, per channel	2 A at UP3 or UP4 = 24 V
	Maximum value (channels O0 ... O3)	8 A
	Maximum value (channels O4 ... O7)	8 A
Leakage current with signal 0		< 0.1 mA
Rated protection fuse on UP		10 A fast
Demagnetization when inductive loads are switched off		With clamp diode in output high side driver
Switching frequency		
	With resistive load	On request
	With inductive loads	Max. 2 Hz
	With lamp loads	Max. 11 Hz with max. 48 W
Short-circuit proof / overload proof		No (should be done externally)
Overload message		No
Output current limitation		No (should be done externally)
Resistance to feedback against 24 V signals		Yes to UP3 or UP4. No to outputs in same group.
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

> *The dimensions are in mm and in brackets in inch.*

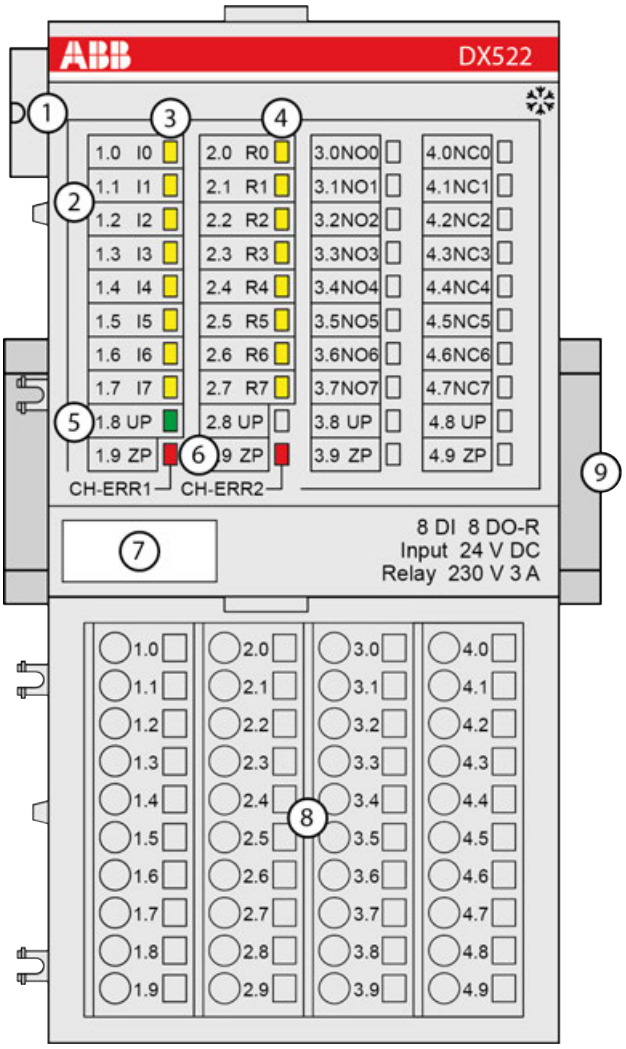
Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 240 800 R0001	DO526, digital output module, 8 DO, 24 V DC / 2 A, 1-wire	Active
1SAP 440 800 R0001	DO526-XC, digital output module, 8 DO, 24 V DC / 2 A, 1-wire, XC version	Active
1SAP 213 200 R0001	TU542, I/O terminal unit, 24 V DC, spring terminals	Active
1SAP 413 200 R0001	TU542-XC, I/O terminal unit, 24 V DC, spring terminals, XC version	Active

5.4.3.2.7 DX522 - Digital input/output module

- 8 digital inputs 24 V DC, module-wise galvanically isolated
- 8 relay outputs

- Fast counter
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 8 yellow LEDs to display the signal states at the digital inputs (I0 ... I7)
4 8 yellow LEDs to display the signal states at the digital relay outputs (R0 ... R7)
5 1 green LED to display the state of the process supply voltage UP
6 2 red LEDs to display errors
7 Label
8 Terminal unit
9 DIN rail
❄ Sign for XC version

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

Digital configurable input/output unit.

- 8 digital inputs 24 V DC in 1 group (1.0...1.7)
- 8 digital relay outputs with one change-over contact each (R0...R7). All output channels are galvanically isolated from each other.
- Fast counter

The configuration is performed by software. The modules are supplied with a process supply voltage of 24 V DC.

All available inputs/outputs are galvanically isolated from all other circuitry of the module. There is no potential separation between the channels within the same group.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

Functionality

Parameter	Value
Fast counter	Integrated, many configurable operating modes (only with AC500)
LED displays	For signal states, errors and supply voltage
Internal power supply	Through the I/O bus interface (I/O bus)
External power supply	Via the terminals ZP and UP (process supply voltage 24 V DC)
Required terminal units	TU531 or TU532 ↳ *TU531, TU532*

The device is plugged on a terminal unit.

↳ *Chapter 5.5.3 “TU531 and TU532 for I/O modules” on page 953*

Position the module properly and press until it locks in place. The terminal unit is either mounted on a DIN rail or to the wall using 2 screws plus the additional accessory for wall mounting.

↳ *Chapter 5.8.2.6 “TA526 - Wall mounting accessory” on page 1410*

Connections



WARNING!

Risk of death by electric shock!

Hazardous voltages can be present at the terminals of the module.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.



For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8 ... 4.8 and 1.9 ... 4.9 are electrically interconnected within the I/O terminal unit.

The terminals have always the same assignment, irrespective of the inserted module:

- Terminals 1.8 ... 4.8: process supply voltage UP = +24 V DC
- Terminals 1.9 ... 4.9: process supply voltage ZP = 0 V DC

Table 145: Assignment of the other terminals:

Terminals	Signal	Description
1.0 ... 1.7	I0 ... I7	Input signals of the 8 digital inputs
1.8 ... 4.8	UP	Process supply voltage +24 V DC
1.9 ... 4.9	ZP	Reference potential for the 8 digital inputs and the process supply voltage
2.0	R0	Common contact of the first relay output
3.0	NO 0	Normally-open contact of the first relay output
4.0	NC 0	Normally-closed contact of the first relay output
2.1	R1	Common contact of the second relay output
3.1	NO 1	Normally-open contact of the second relay output
4.1	NC 1	Normally-closed contact of the second relay output
:	:	:
2.7	R7	Common contact of the eighth relay output
3.7	NO 7	Normally-open contact of the eighth relay output
4.7	NC 7	Normally-closed contact of the eighth relay output

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 2 mA per DX522.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.

WARNING!

Removal/Insertion under power

Removal or insertion under power is permissible only if all conditions for hot swapping are fullfilled.

“Conditions for hot swap” on page 12

The devices are not designed for removal or insertion under power when the conditions for hot swap do not apply. Because of unforeseeable consequences, it is not allowed to plug in or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing any of the following actions:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while they are energized in a hazardous location could result in an electric arc, which could create an ignition source resulting in fire or explosion.

Prior to proceeding, make sure that power is been disconnected and that the area has been thoroughly checked to ensure that flammable materials or ignitable concentrations are not present.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The module provides several diagnosis functions.

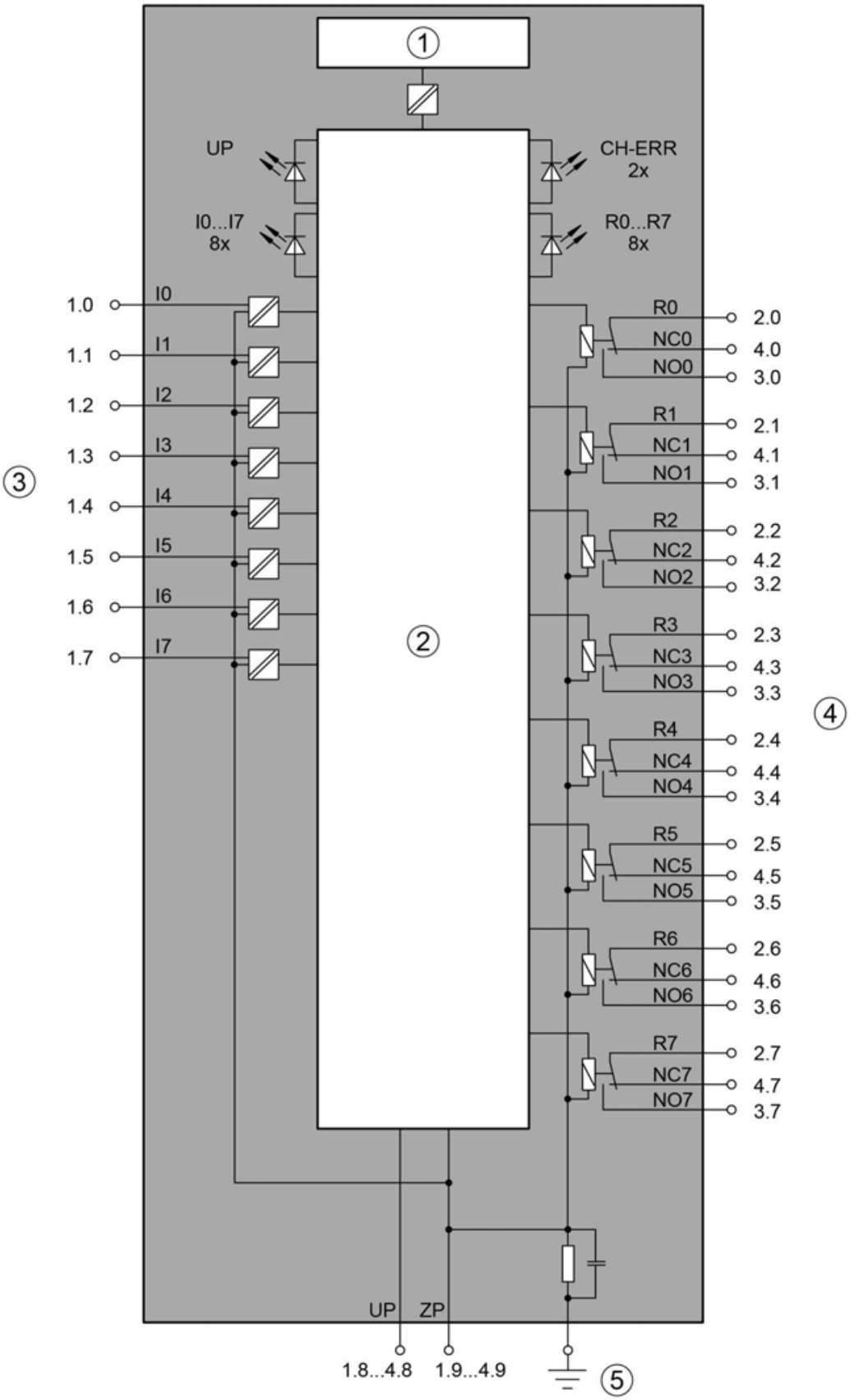


Fig. 64: Connection of the digital inputs/outputs

1 I/O bus
2 Logic

3 Digital inputs
4 Digital outputs
5 Functional earth connection

NOTICE!

– If the relay outputs have to switch inductive **DC loads**, free-wheeling diodes must be circuited in parallel to these loads.
– If the relay outputs have to switch inductive **AC loads**, spark suppressors are required.

CAUTION!

The process supply voltage must be included in the grounding concept (e. g. grounding of the negative terminal).

NOTICE!

Risk of damaging the PLC module!

The following has to be considered when connecting input and output voltages to the module:

– All 230 V AC feeds must be single-phase from the same supply system.
– Connection of 2 or more relay contacts in series is possible; however, voltages above 230 V AC and 3-phase loads are not allowed.
– The 8 change-over contacts of the relays are galvanically isolated from channel to channel. This allows to connect loads of 24 V DC and 120/230 V AC to relay outputs of the same module. In such cases it is necessary that both supply voltages are grounded to prevent unsafe floating grounds.

NOTICE!

Risk of damaging the PLC module!

There is no internal short-circuit or overload protection for the relay outputs.

Protect the relay contacts by back-up fuses of 6 A max. (characteristic gG/gL). Depending on the application, fuses can be used for single channels or module-wise.

Internal data exchange

	Without the fast counter	With the fast counter (only with AC500)
Digital inputs (bytes)	1	3
Digital outputs (bytes)	1	3
Counter input data (words)	0	4
Counter output data (words)	0	8

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.



If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1 ... 10

Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
Module ID	Internal	1210 [1])	Word	1210 0x04BA	0	65535	0x0Y01
Ignore module [2])	No Yes	0 1	Byte	No 0x00			Not for FBP
Parameter length	Internal	5	Byte	5-CPU 4-FBP	0	255	0x0Y02
Check supply	Off On	0 1	Byte	On 0x01	0	1	0x0Y03
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	Byte	8 ms 0x02	0	3	0x0Y04
Fast Counter [4])	0 : 10 [3])	0 : 10	Byte	Mode 0 0x00			Not for FBP

Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
Behaviour of outputs at communication errors	Off Last value Substitute value	0 1+(n*5) 2+(n*5), n ≤ 2	Byte	Off 0x00	0	2	0x0Y05
Substitute value at outputs) Bit 7 = Output 7 Bit 0 = Output 0	0 ... 255	0 ... 0xff	Byte	0 0x00	0	255	0x0Y06

Remarks:

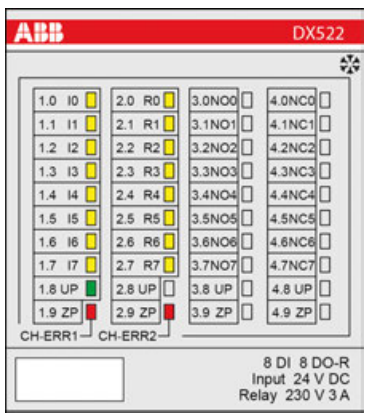
[1])	With CS31 and addresses smaller than 70 and FBP, the value is increased by 1
[2])	Not with FBP
[3])	For a description of the counter operating modes, please refer to the 'Fast Counter' section ↬ *Chapter 5.4.3.2.9 “Fast counter” on page 522*
[4])	With FBP and without the parameter Fast Counter

GSD file:

Ext_User_Prm_Data_Len = Ext_User_Prm_Data_Const (0) =	7 0x04, 0xbb, 0x04, \ 0x01, 0x02, 0x00, 0x00;

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Inputs I0 ... I7	Digital input	Yellow	Input = OFF	Input = ON [1])	--
	Outputs R0 ... R7 (relays)	Digital output	Yellow	Relay output = OFF	Relay output = ON	--
	UP	Process supply voltage 24 V DC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--

LED		State	Color	LED = OFF	LED = ON	LED flashes
	CH-ERR1	Channel Error, error messages in groups (digital inputs/ outputs combined into the groups 1 and 2)	Red	No error or process supply voltage is missing	Severe error within the corresponding group	Error on one channel of the corresponding group
	CH-ERR2		Red			
	CH-ERR [2])	Module Error	Red	--	Internal error	--
	[1]) Indication LED is ON even if an input signal is applied to the channel and the supply voltage is off. In this case the module is not operating and does not generate an input signal.					
	[2]) All of the LEDs CH-ERR1 to CH-ERR2 light up together					

Technical data

Technical data of the module

The system data of AC500 and S500 is applicable to the standard version.

Chapter 4.2 “System data AC500” on page 34

The system data of AC500-XC is applicable to the XC version.

Chapter 4.3 “System data AC500-XC” on page 38

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter		Value
Process supply voltage UP		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 V DC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/ communication interface module	ca. 2 mA
	From UP at normal operation / with outputs	0.05 A + output loads
	Inrush current from UP (at power up)	0.010 A^2s
Max. power dissipation within the module		6 W (outputs OFF)
Weight (without terminal unit)		ca. 300 g

Parameter	Value
Mounting position	Horizontal mounting or Vertical mounting with derating (output load reduced to 50 % at +40 °C per group)
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

No effects of multiple overloads

No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

Technical data of the digital inputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels I0 ... I7		1.0 ... 1.7
Reference potential for all inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (negative pole of the process supply voltage, signal name ZP)
Galvanic isolation		From the rest of the module (I/O bus)
Indication of the input signals		One yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Monitoring point of input indicator		LED is part of the input circuitry
Input type acc. to EN 61131-2		Type 1
Input delay (0->1 or 1->0)		Typ. 8 ms, configurable 0.1 ... 32 ms
Input signal voltage		24 V DC
Signal 0		-3 V ... +5 V
Undefined signal		> +5 V ... < +15 V
Signal 1		+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V
Ripple with signal 1		Within +15 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 5 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical data of the relay outputs

Parameter		Value
Number of channels per module		8 relay outputs
Distribution of channels into groups		8 groups of 1 channel each
Connection of the channel R0		Terminal 2.0 (common), 3.0 (NO) and 4.0 (NC)
Connection of the channel R1		Terminal 2.1 (common), 3.1 (NO) and 4.1 (NC)
Connection of the channel R6		Terminal 2.6 (common), 3.6 (NO) and 4.6 (NC)
Connection of the channel R7		Terminal 2.7 (common), 3.7 (NO) and 4.7 (NC)
Galvanic isolation		Between the channels and from the rest of the module
Indication of the output signals		One yellow LED per channel, the LED is ON when the relay coil is energized
Monitoring point of output indicator		LED is controlled by process CPU
Way of operation		Non-latching type
Output delay (0->1 or 1->0)		On request
Relay power supply		By UP process supply voltage
Relay outputs		
	Output short circuit protection	Should be provided externally with a fuse or circuit breaker
Rated protection fuse		6 A gL/gG per channel
Min. switching current		10 mA
Output switching capacity		
	Resistive load, max.	3 A; 3 A (230 V AC), 2 A (24 V DC)
	Inductive load, max.	1.5 A; 1.5 A (230 V AC), 1.5 A (24 V DC)
	Lamp load	60 W (230 V AC), 10 W (24 V DC)
Output switching capacity (XC version above +60 °C)		On request
Lifetime (cycles)		Mechanical: 300 000; Under load: 300 000 (24 V DC at 2 A), 200 000 (120 V AC at 2 A), 100 000 (230 V AC at 3 A)
Spark suppression with inductive AC load		Must be performed externally according to driven load specifications
Demagnetization with inductive DC load		A free-wheeling diode must be circuited in parallel to the inductive load
Switching frequency		
	With resistive load	Max. 10 Hz
	With inductive load	Max. 2 Hz
	With lamp load	On request
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

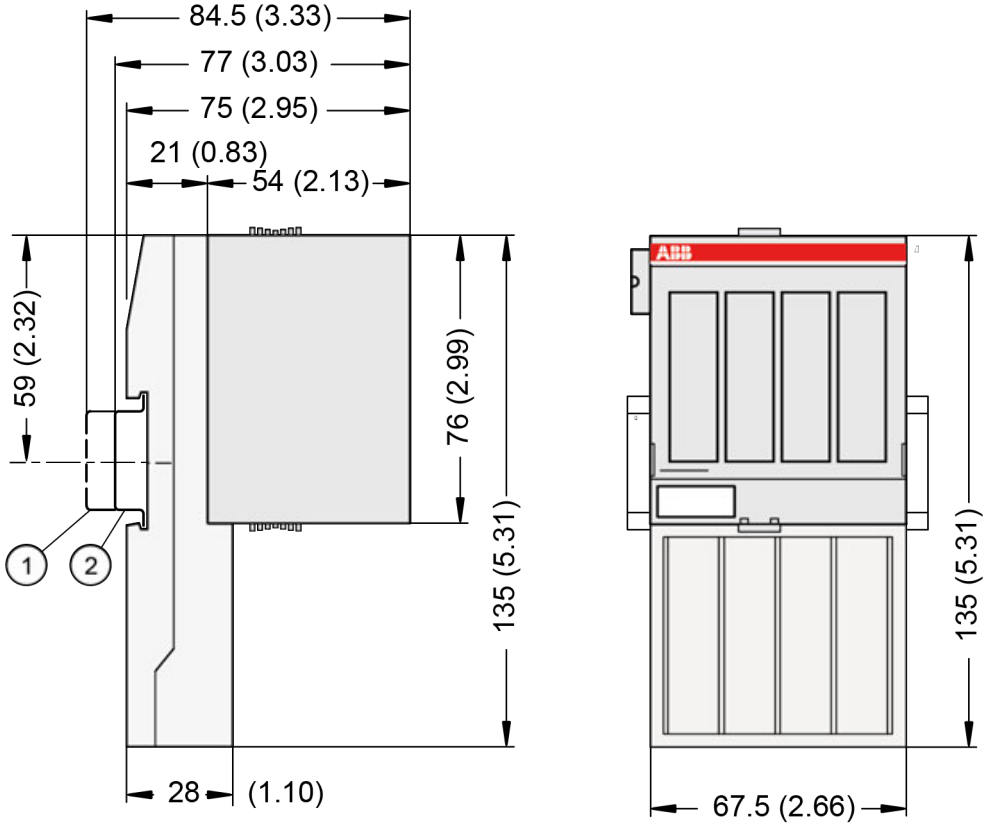
Technical data of the fast counter

The fast counter of the module does not work if the module is connected to one of following devices:

- *FBP interface module*
- *CS31 bus module*
- *CANopen communication interface module*

Parameter	Value
Used inputs	I0 / I1
Used outputs	None
Counting frequency	50 kHz max.

Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

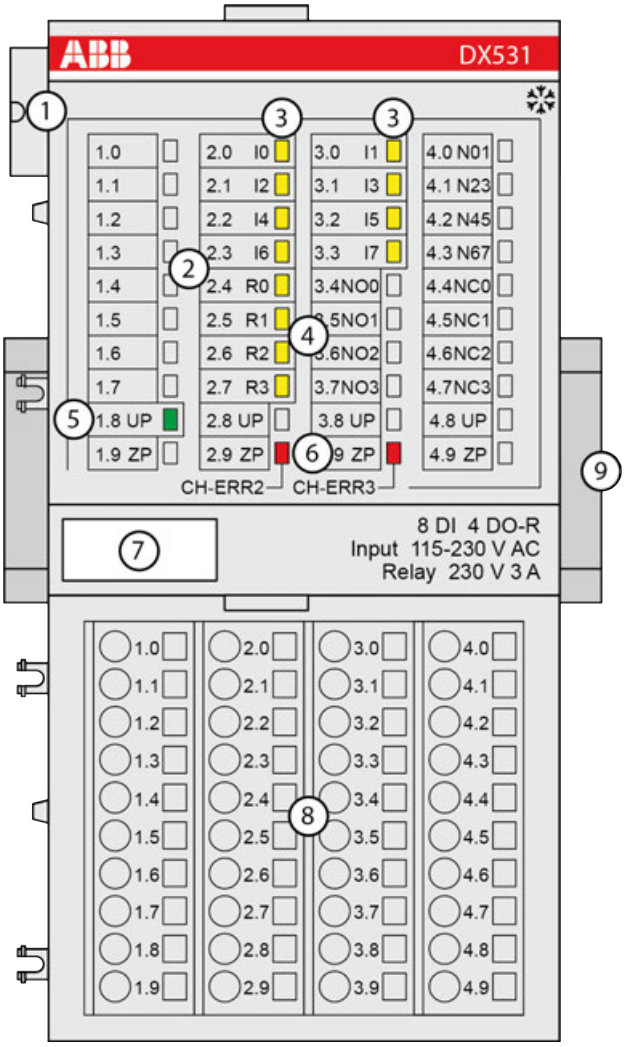
Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 245 200 R0001	DX522, digital input/output module, 8 DI, 24 V DC, 8 DO relays	Active
1SAP 445 200 R0001	DX522-XC, digital input/output module, 8 DI, 24 V DC, 8 DO relays, XC version	Active

*) *Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.4.3.2.8 DX531 - Digital input/output module

- 8 digital inputs 120/230 V AC
- 4 relay outputs with one change-over contacts each
- Module-wise galvanically isolated



1 I/O bus
2 Allocation between terminal number and signal name
3 8 yellow LEDs to display the signal states at the digital inputs (I0 ... I7)

4 4 yellow LEDs to display the signal states at the digital relay outputs (R0 ... R3)
5 1 green LED to display the state of the process supply voltage UP
6 2 red LEDs to display errors
7 Label
8 Terminal unit
9 DIN rail
❄ Sign for XC version

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

Digital configurable input / output unit.

- 8 digital inputs 120/230 V AC in 1 group (2.0 ... 2.3 and 3.0 ... 3.3)
- 4 digital relay outputs with one change-over contact each (R0 ... R3). All output channels are galvanically isolated from each other.

The configuration is performed by software. The modules are supplied with a process supply voltage of 24 V DC.

All available inputs/outputs are galvanically isolated from all other circuitry of the module. There is no potential separation between the channels within the same group.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

Functionality

Parameter	Value
LED displays	For signal states, errors and supply voltage
Internal power supply	Through the I/O bus interface (I/O bus)
External power supply	Via the terminals ZP and UP (process supply voltage 24 V DC)
Required terminal units	TU531 or TU532 ↳ *TU531, TU532*

The device is plugged on a terminal unit.

↳ *Chapter 5.5.3 “TU531 and TU532 for I/O modules” on page 953*

Position the module properly and press until it locks in place. The terminal unit is either mounted on a DIN rail or to the wall using 2 screws plus the additional accessory for wall mounting.

↳ *Chapter 5.8.2.6 “TA526 - Wall mounting accessory” on page 1410*

Connections

WARNING!

Risk of death by electric shock!

Hazardous voltages can be present at the terminals of the module.

Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8 ... 4.8 and 1.9 ... 4.9 are electrically interconnected within the I/O terminal unit.

The terminals always have the same assignment, irrespective of the inserted module:

- Terminals 1.8 ... 4.8: process supply voltage UP = +24 V DC
- Terminals 1.9 ... 4.9: process supply voltage ZP = 0 V DC

Table 146: Assignment of the other terminals

Terminals	Signal	Description
1.0 ... 1.7	unused	
2.0 and 3.0	I0 and I1	Input signals for the digital inputs I0 and I1
4.0	N01	Neutral conductor for the digital inputs I0 and I1
2.1 and 3.1	I2 and I3	Input signals for the digital inputs I2 and I3
4.1	N23	Neutral conductor for the digital inputs I2 and I3
2.2 and 3.2	I4 and I5	Input signals for the digital inputs I4 and I5
4.2	N45	Neutral conductor for the digital inputs I4 and I5
2.3 and 3.3	I6 and I7	Input signals for the digital inputs I6 and I7
4.3	N67	Neutral conductor for the digital inputs I6 and I7
2.4	R0	Common contact of the first relay output
3.4 and 4.4	NO0 and NC0	NO and NC contacts of the first relay output
2.5	R1	Common contact of the second relay output
3.5 and 4.5	NO1 and NC1	NO and NC contacts of the second relay output

Terminals	Signal	Description
2.6	R2	Common contact of the third relay output
3.6 and 4.6	NO2 and NC2	NO and NC contacts of the third relay output
2.7	R3	Common contact of the fourth relay output
3.7 and 4.7	NO3 and NC3	NO and NC contacts of the fourth relay output

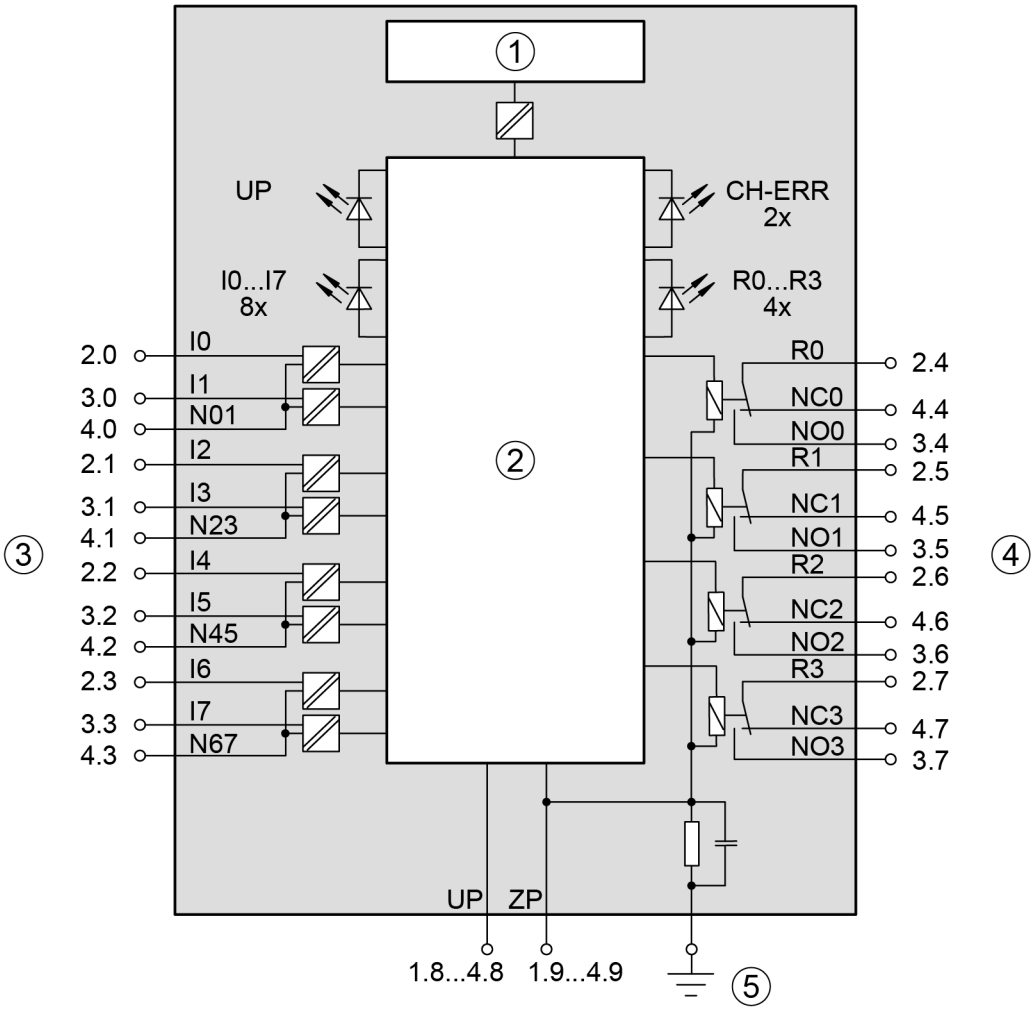


Fig. 65: Internal construction

1 I/O bus interface
2 Logic
3 Digital inputs
4 Relay output
5 Functional earth connection

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 2 mA per DX531. The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.

WARNING!

Removal/Insertion under power

Removal or insertion under power is permissible only if all conditions for hot swapping are fullfilled.

“Conditions for hot swap” on page 12

The devices are not designed for removal or insertion under power when the conditions for hot swap do not apply. Because of unforeseeable consequences, it is not allowed to plug in or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing any of the following actions:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while they are energized in a hazardous location could result in an electric arc, which could create an ignition source resulting in fire or explosion.

Prior to proceeding, make sure that power is been disconnected and that the area has been thoroughly checked to ensure that flammable materials or ignitable concentrations are not present.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

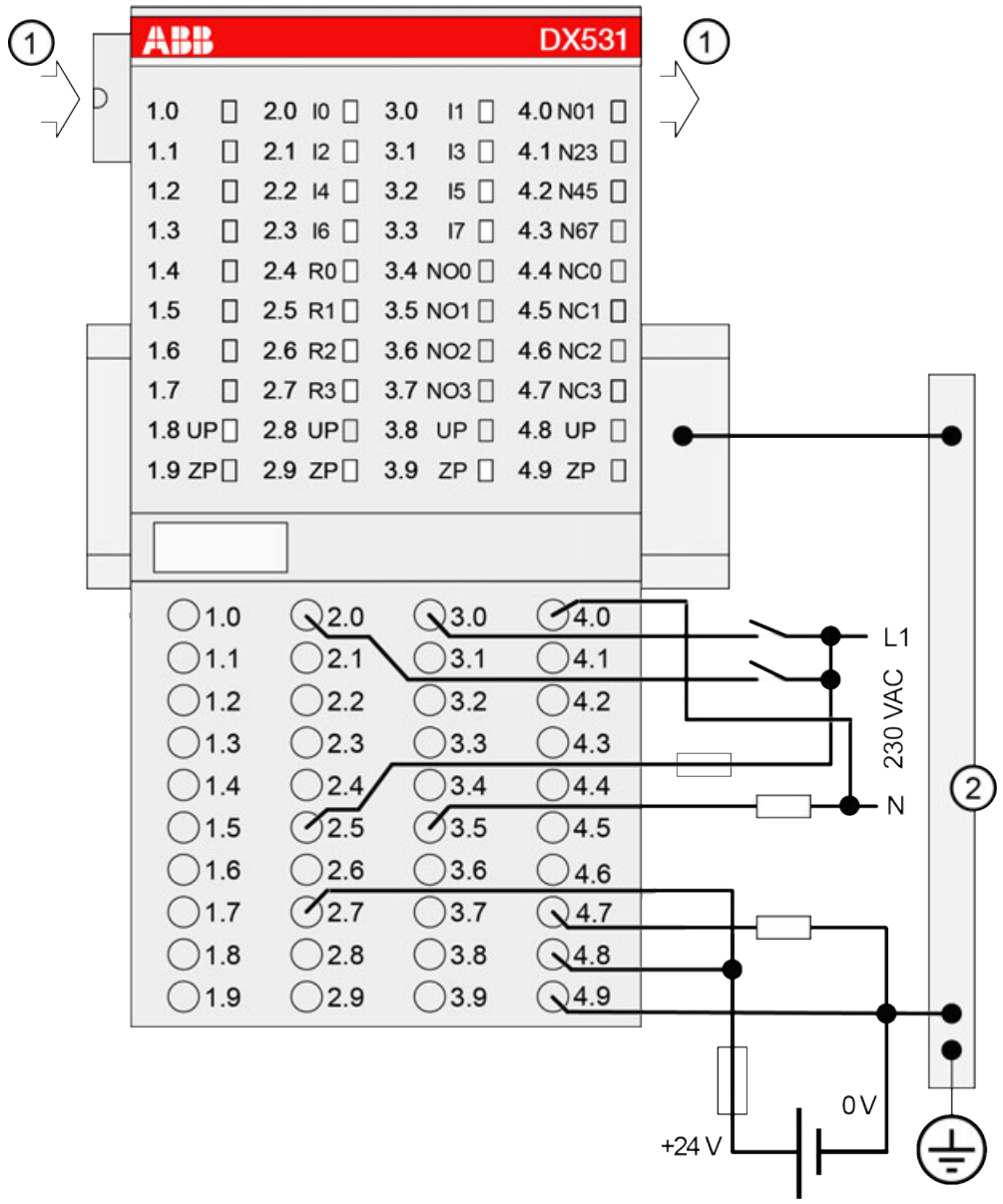


Fig. 66: Connection of the module

1 I/O bus
2 Control cabinet earth

NOTICE!

- If the relay outputs have to switch inductive **DC loads**, free-wheeling diodes must be circuited in parallel to these loads.
- If the relay outputs have to switch inductive **AC loads**, spark suppressors are required.

CAUTION!

The process supply voltage must be included in the grounding concept (e. g. grounding of the negative terminal).

NOTICE!

Risk of damaging the PLC module!

The following has to be considered when connecting input and output voltages to the module:

- All 230 V AC feeds must be single phase from the same supply system.
- Connection of 2 or more relay contacts in series is possible; however, voltages above 230 V AC and 3-phase loads are not allowed.
- The 4 change-over contacts of the relays are galvanically isolated from channel to channel. This allows to connect loads of 24 V DC and 120/230 V AC to relay outputs of the same module. In such cases it is necessary that both supply voltages are grounded to prevent unsafe floating grounds.
- All input signals must come from the same phase of the same supply system (together with the used neutral conductor). The module is designed for 120/230 V AC max., not for 400 V AC, not even between two input terminals.
- All neutral conductor connections must be common to the same supply system, since the terminals 4.0 ... 4.3 are interconnected within the module. Otherwise, accidental energization could occur.

NOTICE!

Risk of damaging the PLC module!

There is no internal short-circuit or overload protection for the relay outputs.

Protect the relay contacts by back-up fuses of 6 A max. (characteristic gG/gL). Depending on the application, fuses can be used for single channels or module-wise.

The module provides several diagnosis functions.

Internal data exchange

Digital inputs (bytes)	1
Digital outputs (bytes)	1
Counter input data (words)	0
Counter output data (words)	0

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1 ... 10

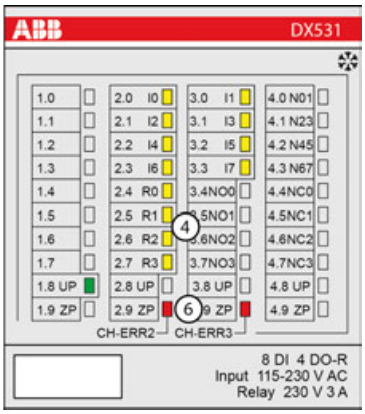
Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
Module ID	Internal	1205 [1])	Word	1205 0x04B5	0	65535	0x0Y01
Ignore module [2])	No Yes	0 1	Byte	No 0x00			not for FBP
Parameter length	Internal	4	Byte	4-CPU 4-FBP	0	255	0x0Y02
Check supply	Off on	0 1	Byte	On 0x01	0	1	0x0Y03
Input delay	20 ms 100 ms	0 1	Byte	20 ms 0x00	0	1	0x0Y04
Behaviour of outputs at communication errors	Off Last value Substitute value	0 1+(n*5) 2+(n*5), n ≤ 2	Byte	Off 0x00	0	2	0x0Y05
Substitute value at outputs Bit 3 = Output 3 Bit 0 = Output 0	0 ... 15	0 ... 0x0f	Byte	0 0x00	0	15	0x0Y06
[1]) With CS31 and addresses smaller than 70 and FBP, the value is increased by 1 [2]) Not with FBP							

GSD file:

Ext_User_Prm_Data_Len =	7
Ext_User_Prm_Data_Const	0x04, 0xb6, 0x04, \
(0) =	0x01, 0x00, 0x00, 0x00;

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Inputs I0 ... I7	Digital input	Yellow	Input = OFF	Input = ON	--
	Outputs R0 ... R3 (relays)	Digital output	Yellow	Relay output = OFF	Relay output = ON	--
	UP	Process supply voltage 24 V DC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
	CH-ERR2	Channel error, error messages in groups (digital inputs/ outputs combined into the groups 2 and 3)	Red	No error or process supply voltage is missing	Severe error within the corresponding group	Error on one channel of the corresponding group
	CH-ERR3		Red			
	CH-ERR *)	Module Error	Red	--	Internal error	--
	*) All of the LEDs CH-ERR2 to CH-ERR3 light up together					

Technical data

Technical data of the module

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

↳ *Chapter 4.3 “System data AC500-XC” on page 38*

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter		Value
Process supply voltage UP		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V DC (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V DC (ZP)
	Rated value	24 V DC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module

Parameter		Value
Current consumption		
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module	ca. 2 mA
	From UP at normal operation / with outputs	0.15 A + output loads
Inrush current from UP (at power up)		0.004 A^2s
Max. power dissipation within the module		6 W (outputs OFF)
Weight (without terminal unit)		Ca. 300 g
Mounting position		Horizontal mounting or Vertical mounting with derating (output load reduced to 50 % at +40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

No effects of multiple overloads

No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

Technical data of the digital inputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	4 groups of 2 channels each
Terminals of the channels I0 to I7	*Chapter 5.4.3.2.8.3 “Connections” on page 512*
Galvanic isolation	2500 V AC from the rest of the module (I/O bus)
Indication of the input signals	1 yellow LED per channel The LEDs are only operating if the module is initialized
Monitoring point of input indicator	LED is controlled by process CPU
Input type acc. to EN 61131-2	Type 2
Input delay (0->1 or 1->0)	Typ. 20 ms
Input signal voltage	230 V AC or 120 V AC
Input signal range	0 V AC ... 265 V AC
Input signal frequency	47 Hz ... 63 Hz
Input characteristic	According EN 61132-2 Type 2
Signal 0	0 V AC ... 40 V AC

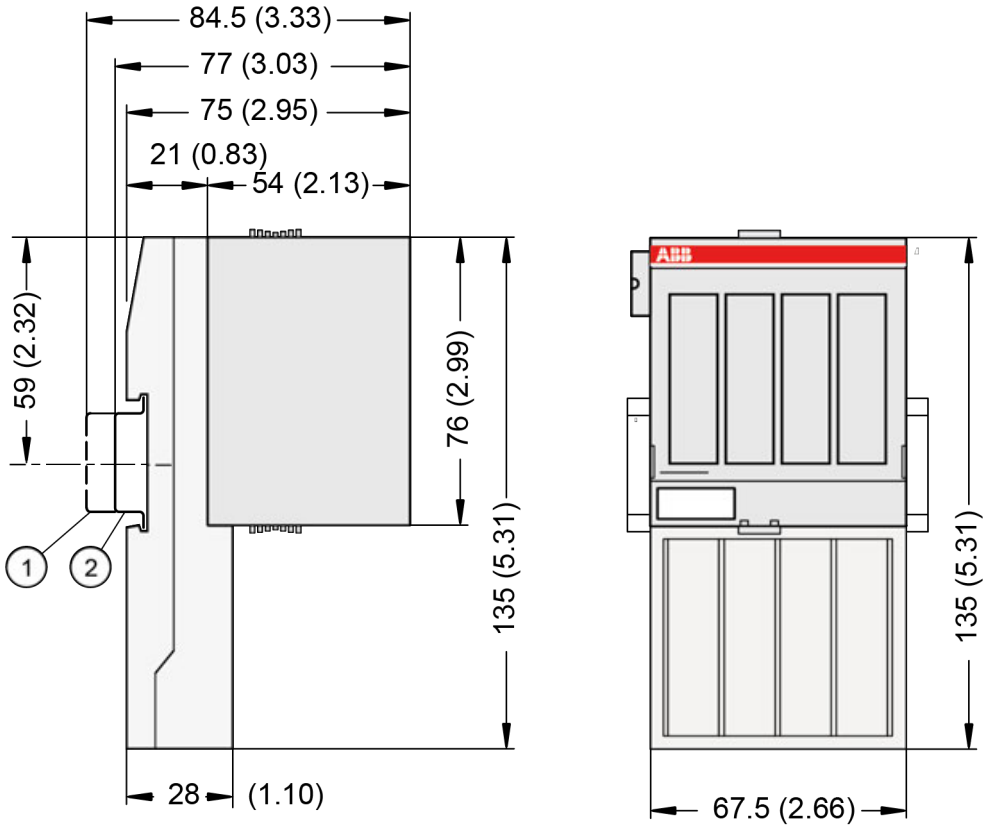
Parameter		Value
Undefined signal		> 40 V AC ... < 74 V AC
Signal 1		74 V AC ... 265 V AC
Input current per channel		
	Input voltage = 159 V AC	> 7 mA
	Input voltage = 40 V AC	< 5 mA
Overvoltage protection		Yes
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical data of the relay outputs

Parameter		Value
Number of channels per module		4 relay outputs
Distribution of channels into groups		4 groups of 1 channel each
Connection of the four relays		↳ *Chapter 5.4.3.2.8.3 “Connections” on page 512*
Galvanic isolation		Between the channels and from the rest of the module
Indication of the output signals		1 yellow LED per channel, the LED is ON when the relay coil is energized
Monitoring point of output indicator		LED is controlled by process CPU
Way of operation		Non-latching type
Output delay (0->1 or 1->0)		On request
Relay power supply		By UP process supply voltage
Relay outputs		
	Output short circuit protection	Must be provided externally with a fuse or circuit breaker
	Rated protection fuse	6 A gL/gG per channel
Output switching capacity		
	Resistive load, max.	3 A; 3 A (230 V AC), 2 A (24 V DC)
	Inductive load, max.	1.5 A; 1.5 A (230 V AC), 1.5 A (24 V DC)
	Lamp load	60 W (230 V AC), 10 W (24 V DC)
Lifetime (cycles)		Mechanical: 300 000; Under load: 300 000 (24 V DC at 2 A), 200 000 (120 V AC at 2 A), 100 000 (230 V AC at 3 A)
Spark suppression with inductive AC load		Must be performed externally according to driven load specifications
Demagnetization with inductive DC load		A free-wheeling diode must be circuited in parallel to the inductive load
Switching frequency		
	With resistive load	Max. 10 Hz
	With inductive load	Max. 2 Hz

Parameter		Value
	With lamp load	On request
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 245 000 R0001	DX531, digital input/output module, 8 DI, 120 / 230 V AC, 4 DO relays, 2-wires	Active

> *) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

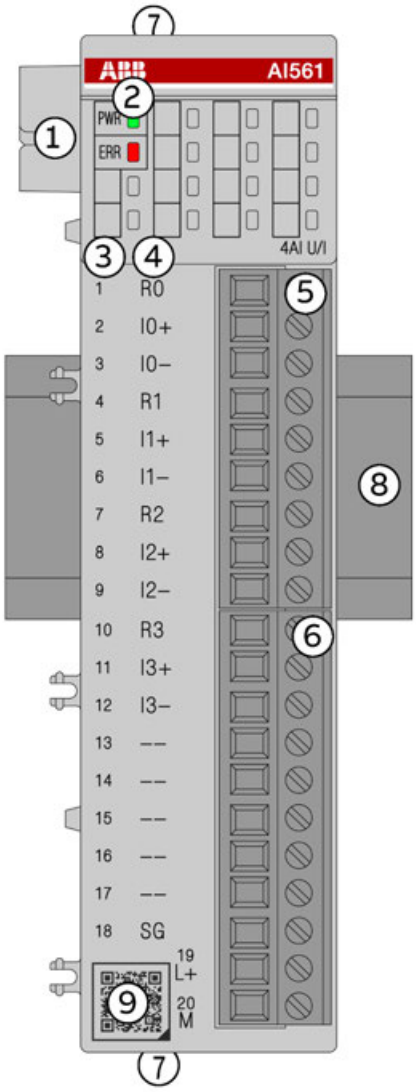
5.4.3.2.9 Fast counter

5.4.4 Analog I/O modules

5.4.4.1 S500-eCo

5.4.4.1.1 AI561 - Analog input module

- 4 configurable analog inputs (I0 ... I3) in 1 group
- Resolution: 12 bits including sign (13 bits including sign for version E0 or later)



1 I/O bus
2 1 green LED to display power supply, 1 red LED to display error
3 Terminal number
4 Allocation of signal name

5 Terminal block for input signals (9-pin)
6 Terminal block for input signals (11-pin)
7 2 holes for wall-mounting with screws
8 DIN rail
9 QR code for datasheet

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The inputs are not galvanically isolated from each other.

All other circuitry of the module is not galvanically isolated from the inputs or from the I/O bus.



The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA communication interface modules.

Functionality

4 analog inputs, individually configurable:

- Not used (default setting)
- -2.5 V ... +2.5 V
- -5 V ... +5 V
- 0 V ... +5 V
- 0 V ... +10 V
- 0 mA ... 20 mA
- 4 mA ... 20 mA

Parameter		Value
Resolution of the analog channels		
	Voltage bipolar (-2.5 V ... +2.5 V; -5 V ... +5 V)	12 bits including sign; 13 bits including sign for version E0 or later
	Voltage unipolar (0 V ... 5 V; 0 V ... 10 V)	12 bits
	Current (0 mA ... 20 mA; 4 mA ... 20 mA)	12 bits
LED displays		2 LEDs for process voltage and error messages
Internal supply		Via I/O bus
External supply		Via the terminals L+ (process voltage 24 V DC) and M (0 V DC); the M terminal is connected to the M terminal of the CPU via the I/O bus

Connections

> *For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.*

The connection is carried out by using a removable 9-pin and 11-pin terminal block. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

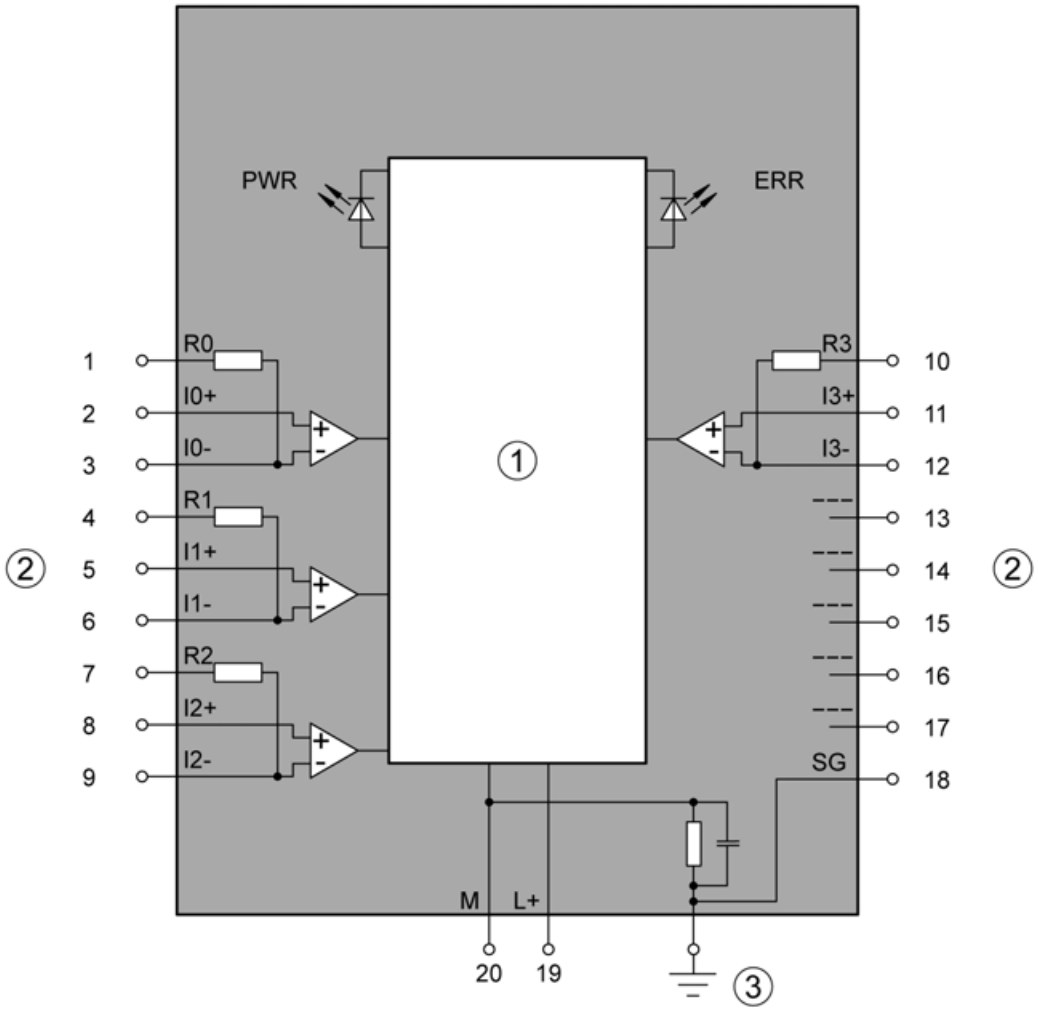


Fig. 67: Internal construction of the analog inputs

1 Logic - I/O bus interface
2 Analog inputs
3 Functional earth connection

Table 147: Assignment of the terminals

Terminal	Signal	Description
1	R0	Burden resistor for input signal 0 for current sensing
2	I0+	Positive pole of input signal 0
3	I0-	Negative pole of input signal 0

Terminal	Signal	Description
4	R1	Burden resistor for input signal 1 for current sensing
5	I1+	Positive pole of input signal 1
6	I1-	Negative pole of input signal 1
7	R2	Burden resistor for input signal 2 for current sensing
8	I2+	Positive pole of input signal 2
9	I2-	Negative pole of input signal 2
10	R3	Burden resistor for input signal 3 for current sensing
11	I3+	Positive pole of input signal 3
12	I3-	Negative pole of input signal 3
13	---	Reserved
14	---	Reserved
15	---	Reserved
16	---	Reserved
17	---	Reserved
18	SG	Shield grounding
19	L+	Process voltage L+ (24 V DC)
20	M	Process voltage M (0 V DC)

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 5 mA per AI561.

The external power supply connection is carried out via the L+ (+24 V DC) and the M (0 V DC) terminals. The M terminal is interconnected to the M/ZP terminal of the CPU/communication interface module.

NOTICE!

Risk of imprecise and faulty measurements!

Analog signals may be severely distorted due to external electromagnetic interference.

When the length of the connection cable exceeds 20 m, a shielded and grounded cable must be used. When the shield is grounded at both ends, an independent low-impedance equipotential connection should be provided to avoid high potential differences between interconnected devices.

NOTICE!

Risk of damaging the PLC modules!

The PLC modules must not be removed while the plant is connected to a power supply.

Make sure that all voltage sources (supply and process voltage) are switched off before you do the following:

– Connect or disconnect any signal or terminal block.
– Remove or replace a module.

NOTICE!

Risk of damaging the PLC modules!

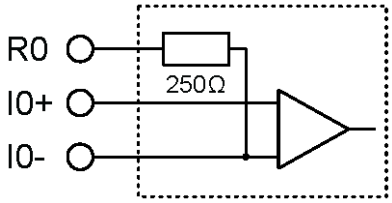
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The module provides several diagnosis functions.

Chapter 5.4.4.1.1.6 “Diagnosis” on page 528

The following figure is an example of the internal construction of the analog input AI0. The analog inputs AI1 ... AI3 are designed in the same way.



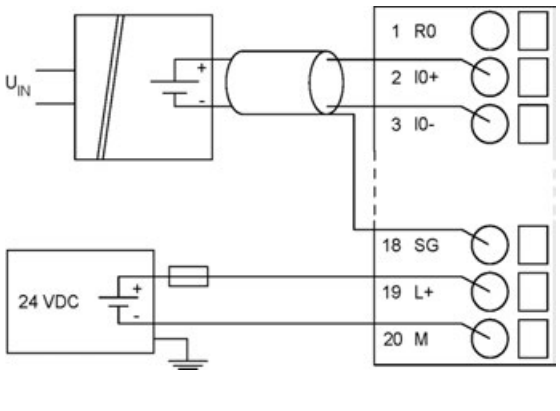
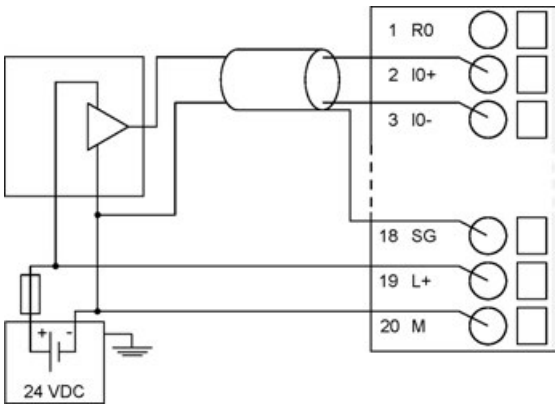
CAUTION!

Risk of damaging the analog input!

The 250 Ω input resistor can be damaged by overcurrent.

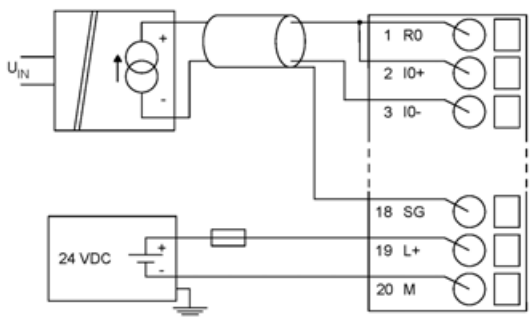
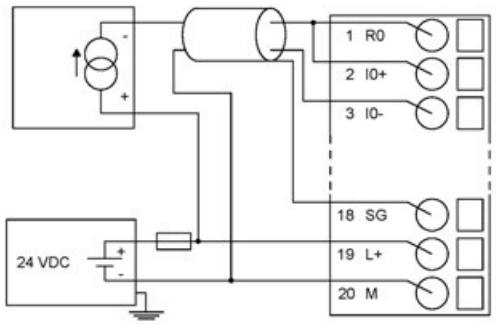
Make sure that the current through the resistor never exceeds 30 mA.

Table 148: Example of the connection of analog sensors (voltage) to the input I0 of the analog input module AI561 (Proceed with the inputs I1 ... I3 in the same way)

	
Connection of active-type analog sensors (voltage)	Connection of passive-type analog sensors (voltage)

Connection of active-type analog sensors (voltage)	Connection of passive-type analog sensors (voltage)
-2.5 V ... 2.5 V	-2.5 V ... 2.5 V
-5 V ... 5 V	-5 V ... 5 V
0 V ... 5 V	0 V ... 5 V
0 V ... 10 V	0 V ... 10 V

Table 149: Example of the connection of analog sensors to the Input I0 of the analog input module AI561 (Proceed with the inputs I1 ... I3 in the same way.)

	
Connection of active-type analog sensors (current)	Connection of passive-type analog sensors (current)

Connection of active-type analog sensors (voltage)	**Connection of passive-type analog sensors (voltage)**
4 mA ... 20 mA	4 mA ... 20 mA
0 mA ... 20 mA	

Meaning of the LEDs

I/O configuration

The analog input module AI561 does not store configuration data itself.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	**Value**	**Internal Value**	**Internal value, Type**	**Default**	**Min.**	**Max.**	**EDS Slot Index**
Module ID	Intern	6500 [1])	WORD	0x1964	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No 0x00			
Parameter length	Internal	6	BYTE	0	0	255	xx02 [2])
Check Supply	Off On	0 1	BYTE	On 0x01			
Analog Data Format	Default	0	BYTE	Default 0x00		255	

[1]) with CS31 and addresses smaller than 70, the value is increased by 1

[2]) Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n)

GSD file:	Ext_User_Prm_Data_Len = Ext_User_Prm_Data_Const(0) =	0x09 0x65, 0x19, 0x06, \ 0x01, 0x00, \ 0x00, 0x00, 0x00, 0x00;

Input channel (4x)

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.
Channel configura-tion	see table [2])	see table [2])	BYTE	0 0x00	0	65535

Table 150: Channel configuration [2])

Internal value	Operating modes for the analog inputs, individu-ally configurable
0	Not used (default)
1	0 V ... 10 V
3	0 mA ... 20 mA
4	4 mA ... 20 mA
6	0 V ... 5 V
7	-5 V ... +5 V
20	-2,5 V ... +2,5 V

Diagnosis

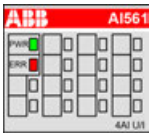
E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500 display	<− Display in	
Class	Comp	Dev	Mod	Ch	Err	AB SW		
Byte 6 Bit 6 ... 7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0 ... 5	PNIO diagnosis block		
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**		**Remedy**
	[1])	[2])	[3])	[4])				
Module error								
3	14	1 ... 10	31	31	19	Checksum error in the I/O module		Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer		Restart
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	26	Parameter error		Check master

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier** **000 ... 063**	**AC500 display**	**<− Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**AB SW**		
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**PNIO diagnosis block**		
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**		**Remedy**
	[1])	**[2])**	**[3])**	**[4])**				
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	11	Process voltage too low		Check process voltage
	11 / 12	ADR	1 ... 10					
Channel error								
4	14	1 ... 10	1	0 ... 3	48	Analog value overflow at an analog input		Check input value or terminal
	11 / 12	ADR	1 ... 0					
4	14	1 ... 10	1	0...3	7	Analog value underflow at an analog input		Check input value
	11 / 12	ADR	1 ... 0					

Remarks:

[1])	In AC500, the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = expansion module 1 ... 10, ADR = hardware address (e. g. of the DC551-CS31)
[3])	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or PNIO = module type (1 = AI); COM1/COM2: 1 ... 10 = expansion 1 ... 10
[4])	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON	LED flashes
	PWR	Process voltage 24 V DC via terminal	Green	CPU module voltage or external 24 V DC supply voltage is missing	3.3 V system voltage (I/O bus) and external 24 V DC supply voltage are present	---
	ERR	Channel or module error	Red	No error or process voltage is missing	Severe error in the module	Error on 1 or more channels of the module

Measuring ranges

Risk of invalid analog input values!

The analog input values may be invalid if the measuring range of the inputs is exceeded.

Make sure that the analog signal at the connection terminals is always within the signal range.

Range	-2.5 ... +2.5 V	-5 ... +5 V	0 ... 5 V	0 ... 10 V	0 ... 20 mA	4 ... 20 mA	Digital value	
							Decimal	Hex.
Overflow	>2.9397	>5.8795	>5.8795	>11.7589	>23.5178	>22.8142	32767	7FFF
Measured value too high	2.9397	5.8795	5.8795	11.7589	23.5178	22.8142	32511	7EFF
	:	:	:	:	:	:	:	:
	2.5014	5.0029	:	:	:	:	27664	6C10
			:	:	:	20.0058	27658	6C0A
			5.0015	10.0029	20.0058		27656	6C08
Normal range Normal range or measured value too low	2.5000	5.0000	5.0000	10.0000	20.0000	20.0000	27648	6C00
	:	:	:	:	:	:	:	:
	0.0014	0.0029	:	:	:	:	16	0010
			:	:	:	4.0058	10	000A
			0.0015	0.0029	0.0058		8	0008
	0.0000	0.0000	0.0000	0.0000	0	4	0	0000
	:	:				3.9942	-10	FFF6
	-0.0014	-0.0029				:	-16	FFF0
	:	:				:	-4864	ED00
	:	:				0	-6912	E500
	:	:					:	:
	-2.5000	-5.0000					-27648	9400

Range	-2.5 ... +2.5 V	-5 ... +5 V	0 ... 5 V	0 ... 10 V	0 ... 20 mA	4 ... 20 mA	Digital value	
							Decimal	Hex.
Measured value too low	-2.5014 : -2.9398	-5.0029 : -5.8795					-27664 : -32512	93F0 : 8100
Underflow	<-2.9398	<-5.8795	<-0.0300	<-0.0600	<-0.1200	<-0.1200	-32768	8000

The represented resolution corresponds to 12 bits including sign.

Technical data

Technical data of the module

The system data of AC500-eCo apply.

Chapter 4.1 “System data AC500-eCo” on page 25

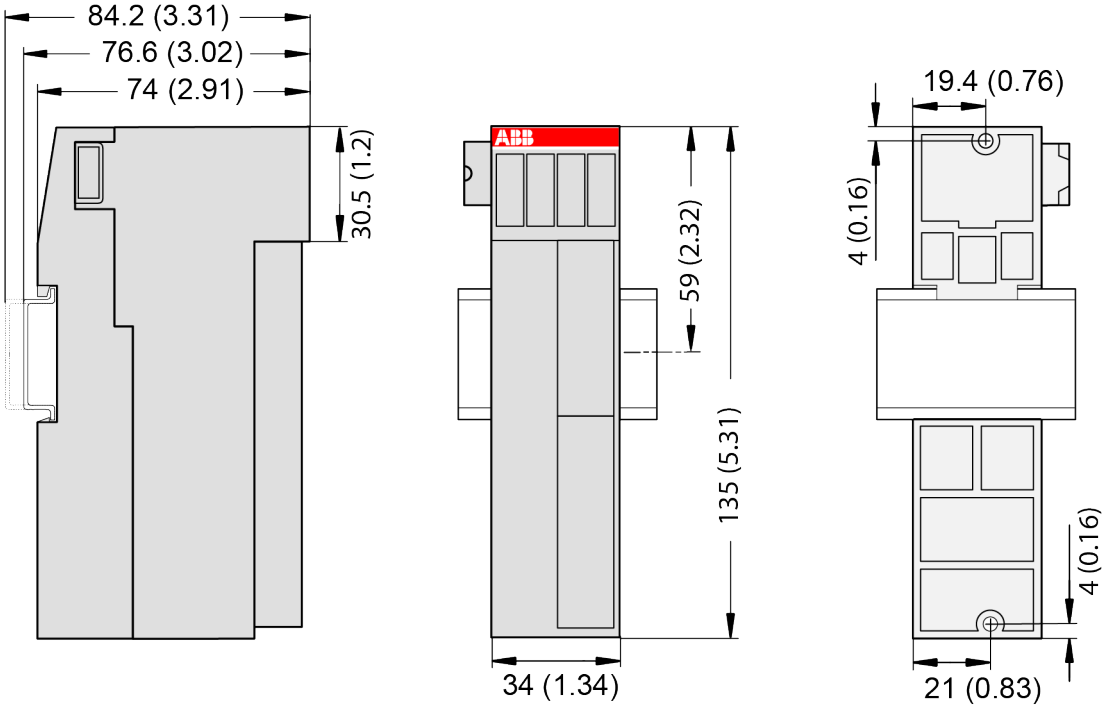
Only additional details are therefore documented below.

Parameter		Value
Process supply voltage L+		
	Connections	Terminal 19 for L+ (+24 V DC) and terminal 20 for M (0 V)
	Rated value	24 V DC
	Current consumption via L+ terminal	0.1 A; 0.02 A (version E0 or later)
	Inrush current (at power up)	Typ. 0.1 A²s; Max. 0.16 A²s
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Protection fuse for L+	Yes, external additional fuse recommended
Current consumption from 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module		Ca. 5 mA
Galvanic isolation		No
Surge-voltage (max.)		35 V DC for 0.5 s
Max. power dissipation within the module		2.7 W 1 W (version E0 or later)
Weight		Ca. 120 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

Technical data of the analog inputs

Parameter		Value	
Number of channels per module		4 individually configurable voltage or current inputs	
Distribution of channels into groups		1 (4 channels per group)	
Resolution			
	Unipolar	Voltage: 0 V ... +5 V; 0 V ... +10 V: 12 bits Current 0 mA ... 20 mA; 4 mA ... 20 mA: 12 bits	
	Bipolar	Voltage -2.5 V ... +2.5 V; -5 V ... +5 V: 12 bits including sign (13 bits including sign for version E0 or later)	
Connection of the signals I0- to I3-		Terminals 3, 6, 9, 12	
Connection of the signals I0+ to I3+		Terminals 2, 5, 8, 11	
Input type		Differential	
Galvanic isolation		No galvanic isolation between the inputs and the I/O bus	
Common mode input range		Signal voltage plus common mode voltage must be within ± 12 V	
Indication of the input signals		No	
Channel input resistance		Voltage: > 1 MΩ Current: ca. 250 Ω	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ.	± 0.5 % of full scale (voltage) ± 0.5 % of full scale (current 0 mA ... 20 mA) ± 0.7 % of full scale (current 4 mA ... 20 mA) at +25 °C
		Max.	± 2 % of full scale (all ranges) at 0 °C ... +60 °C or EMC disturbance
Time constant of the input filter		Voltage: 300 µs Current: 300 µs	
Relationship between input signal and hex code		↳ *Chapter 5.4.4.1.1.8 “Measuring ranges” on page 530*	
Analog to digital conversion time		Typ. 500 µs per channel	
Unused inputs		Can be left open and should be configured as "unused"	
Input data length		8 bytes	
Overvoltage protection		Yes, up to 30 V DC only for voltage input	
Max. cable length (conductor cross section > 0,14 mm²)			
	Unshielded wire	On request	
	Shielded wire	100 m	

Dimensions



The dimensions are in mm and in brackets in inch.

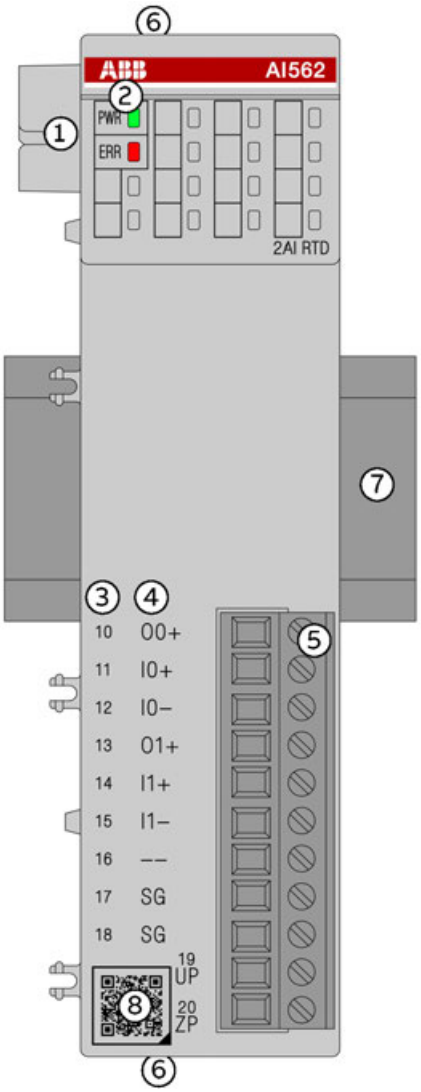
Ordering data

Part no.	Description	Product life cycle phase *)
1TNE 968 902 R1101	AI561, analog input module, 4 AI, U/I	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.4.4.1.2 AI562 - Analog input module

- 2 configurable analog resistance temperature detector (RTD) inputs (I0 and I1) in 1 group
- Resolution: 16 bits including sign



1 I/O bus
2 1 green LED to display power supply, 1 red LED to display error
3 Terminal number
4 Allocation of signal name
5 Terminal block for input signals (11-pin)
6 2 holes for wall-mounting with screws
7 DIN rail
8 QR code for datasheet

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The inputs are not galvanically isolated from each other.

All other circuitry of the module is galvanically isolated from the inputs.

The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA communication interface modules.

Functionality

2 analog RTD-inputs, individually configurable:

- Not used (default)
- Pt100, -50 °C ... +400 °C, 2-wire
- Pt100, -50 °C ... +400 °C, 3-wire
- Pt1000, -50 °C ... +400 °C, 2-wire
- Pt1000, -50 °C ... +400 °C, 3-wire
- Ni1000, -50 °C ... +150 °C, 2-wire
- Ni1000, -50 °C ... +150 °C, 3-wire
- Ni100, -50 °C ... +150 °C, 2-wire
- Ni100, -50 °C ... +150 °C, 3-wire
- Analog input resistance 0 Ω ... 150 Ω
- Analog input resistance 0 Ω ... 300 Ω

Parameter		Value
Resolution of the analog channels		
	Temperature	0.1 °C
	Resistance	150 Ω: 1 LSB (5.4 mΩ); 300 Ω: 1 LSB (10.8 mΩ)
LED displays		2 LEDs for process voltage and error messages
Internal supply		Via I/O bus
External supply		Via the terminals UP (process voltage 24 V DC) and ZP (0 V DC)

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection is carried out by using a removable 11-pin terminal block. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

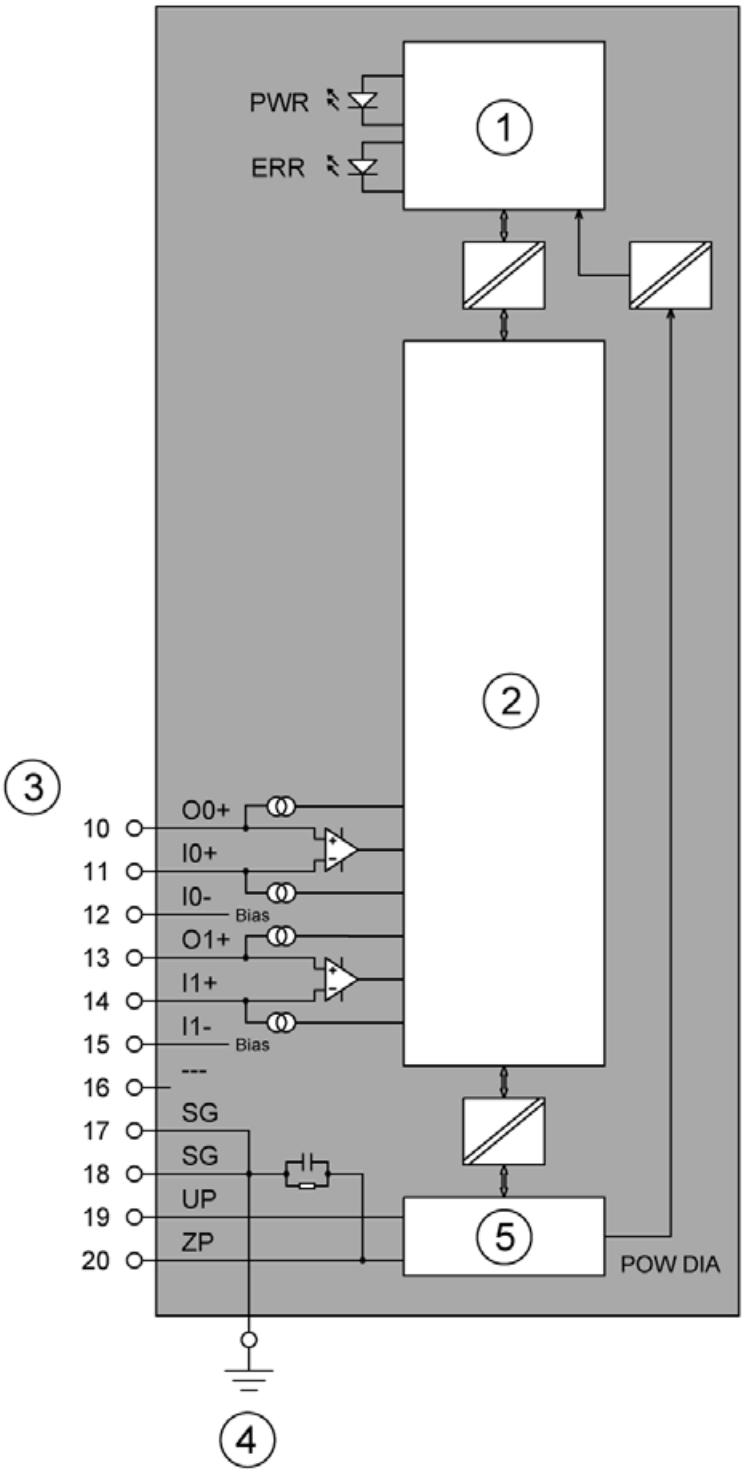


Fig. 68: Internal construction of the analog inputs

1 I/O bus interface and MCU core circuit
2 ADC and logic circuit
3 Analog inputs circuit
4 Functional earth connection
5 Fly-back DC/DC power supply

The assignment of the terminals:

Terminal	Signal	Description
10	O0+	Current source of channel 0
11	I0+	Sense input of channel 0
12	I0-	Return input of channel 0
13	O1+	Current source of channel 1
14	I1+	Sense input of channel 1
15	I1-	Return input of channel 1
16	---	Reserved
17	SG	Shield grounding
18	SG	Shield grounding
19	UP	Process voltage UP (24 V DC)
20	ZP	Process voltage ZP (0 V DC)

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 5 mA per AI562.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.

NOTICE!

Risk of imprecise and faulty measurements!

Analog signals may be severely distorted due to external electromagnetic interference.

When the length of the connection cable exceeds 20 m, a shielded and grounded cable must be used. When the shield is grounded at both ends, an independent low-impedance equipotential connection should be provided to avoid high potential differences between interconnected devices.

NOTICE!

Risk of damaging the PLC modules!

The PLC modules must not be removed while the plant is connected to a power supply.

Make sure that all voltage sources (supply and process voltage) are switched off before you do the following:

– Connect or disconnect any signal or terminal block.
– Remove or replace a module.

NOTICE!

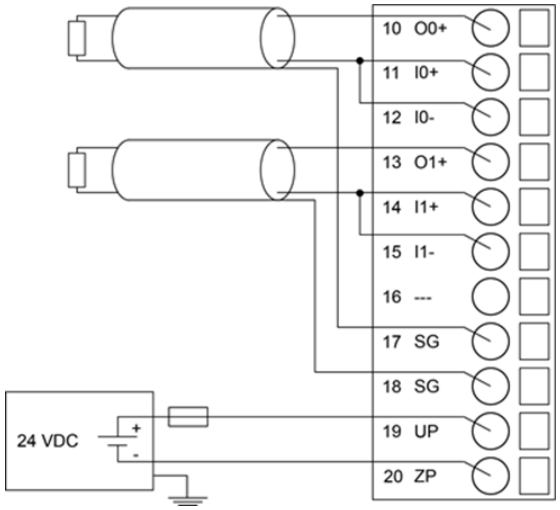
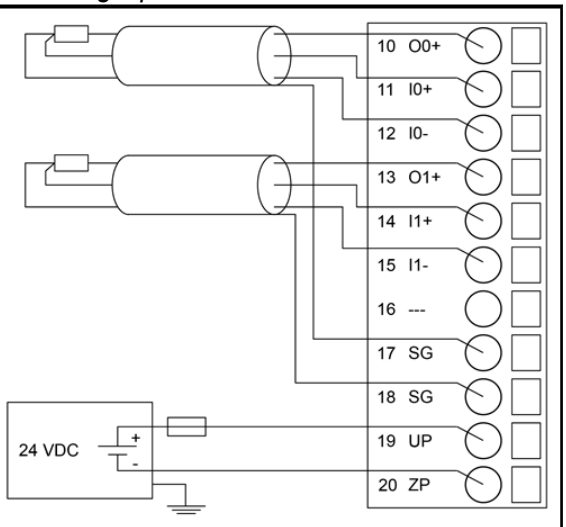
Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The module provides several diagnosis functions ↬ *Chapter 5.4.4.1.2.6 “Diagnosis” on page 540*.

Table 151: Connection of RTDs to the inputs of the analog input module AI562

	
2-wire input	3-wire input

With 2-wire connection, the resistance of the connection wires influences the accuracy of the measured value. Use 3-wire connection to achieve the guaranteed measuring accuracy.

The meaning of the LEDs is described in the Displays section *Chapter 5.4.4.1.2.7 “State LEDs” on page 541*.

I/O configuration

The analog input module AI562 does not store configuration data itself.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Intern	6505[1)]	WORD	0x1969	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No 0x00			
Parameter length	Intern	4	BYTE	0	0	255	xx02[2)]
Check Supply	Off On	0 1	BYTE	On 0x01			
Analog Data Format	Default	0	BYTE	Default 0x00		255	

[1)]with CS31 and addresses less than 70, the value is increased by 1

[2)]Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n)

GSD file:

Ext_User_Prm_Data_Len =	0x07
Ext_User_Prm_Data_Const(0) =	0x6A, 0x19, 0x04, \ 0x01, 0x00, \ 0x00, 0x00;

Input channel (2x)

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.
Channel configuration	*Table 152 “Channel configuration” on page 539*		BYTE	0 0x00	0	65535

Table 152: Channel configuration

Internal value	Operating modes for the analog inputs, individually configurable
0	Not used (default)
8	2-wire Pt100 -50 °C ... +400 °C
9	3-wire Pt100 -50 °C ... +400 °C
16	2-wire Pt1000 -50 °C ... +400 °C
17	3-wire Pt1000 -50 °C ... +400 °C
18	2-wire Ni1000 -50 °C ... +150 °C
19	3-wire Ni1000 -50 °C ... +150 °C
22	2-wire Ni100 -50 °C ... +150 °C
23	3-wire Ni100, -50 °C ... +150 °C
32	Analog input resistance 0 Ω ... 150 Ω
33	Analog input resistance 0 Ω ... 300 Ω

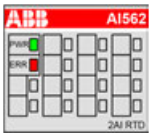
Diagnosis

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000 ... 063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**AB SW**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
Module error							
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1 ... 10				
Channel error							
4	14	1 ... 10	1	0...1	48	Analog value overflow at an analog input	Check input value or terminal
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	1	0...1	7	Analog value underflow at an analog input	Check input value
	11 / 12	ADR	1 ... 10				

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = expansion module 1 ... 10, ADR = hardware address (e.g. of the DC551-CS31)
3)	With "Module" the following allocation applies dependent of the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1...10 Channel error: I/O bus or PNIO = module type (1 = AI); COM1/COM2: 1 ... 10 = expansion 1 ... 10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON	LED flashes
	PWR	Process voltage 24 V DC via terminal	Green	CPU module voltage or external 24 V DC supply voltage is missing	3.3 V system voltage (I/O bus) and external 24 V DC supply voltage are present	---
	ERR	Channel or module error	Red	No error or process voltage is missing	Severe error in the module	Error on 1 or more channels of the module

Measuring ranges

Risk of invalid analog input values!

The analog input values may be invalid if the measuring range of the inputs is exceeded.

Make sure that the analog signal at the connection terminals is always within the signal range.

Resistance temperature detectors

Range	Pt100 / Pt1000 -50 °C ... +400 °C	Ni1000 / Ni100 -50 °C ... +150 °C	Digital value	
			Decimal	Hex.
Overflow	> +450.0 °C	> +160.0 °C	32767	7FFF
Measured value too high	+450.0 °C : +400.1 °C		4500 : 4001	1194 : 0FA1
		+160.0 °C : +150.1 °C	1600 : 1501	0640 : 05DD
Normal range	+400.0 °C : : : : + 0.1 °C	 +150.0 °C : : + 0.1 °C	4000 2000 1500 700 : 1	0FA0 07D0 05DC 02BC : 1
	0,0 °C	0.0 °C	0	0000
	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-1 : -500	FFFF : FE0C

Range	Pt100 / Pt1000 -50 °C ... +400 °C	Ni1000 / Ni100 -50 °C ... +150 °C	Digital value	
			Decimal	Hex.
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-501 : -600	FE0B : FDA8
Underflow	< -60.0 °C	< -60.0 °C	-32768	8000

Resistances

Range	Resistance 0 Ω ... 150 Ω	Resistance 0 Ω ... 300 Ω	Digital value	
			Decimal	Hex.
Overflow	>176.383 Ω	>352.767 Ω	32767	7FFF
Measured value too high	176.383 Ω 150.005 Ω	352.767 Ω 300.011 Ω	32511 27649	7EFF 6C01
Normal range	150.000 Ω : 0.005 Ω	300.000 Ω : 0.011 Ω	27648 : 1	6C00 : 0001
	0 Ω	0 Ω	0	0000

Technical data

Technical data of the module

The system data of AC500-eCo apply.

↳ *Chapter 4.1 “System data AC500-eCo” on page 25*

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage UP		
	Connections	Terminal 19 for UP (+24 V DC) and terminal 20 for ZP (0 V)
	Rated value	24 V DC
	Current consumption	0.04 A; 0.02 A (version E0 or later)
	Inrush current (at power-up)	Typ. 0.1 A^2s; Max. 0.16 A^2s
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Protection fuse for UP	Yes, external additional fuse recommended

Parameter	Value
Current consumption from 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module	Ca. 5 mA
Galvanic isolation	Yes, between the input group and the rest of the module. Isolation voltage 500 V DC.
Isolated groups	1 (2 channels per group)
Surge-voltage (max.)	35 V DC for 0.5 s
Max. power dissipation within the module	1.1 W; 0.6 W (version E0 or later)
Weight	Ca. 120 g
Mounting position	Horizontal or vertical
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

Technical data of the analog inputs

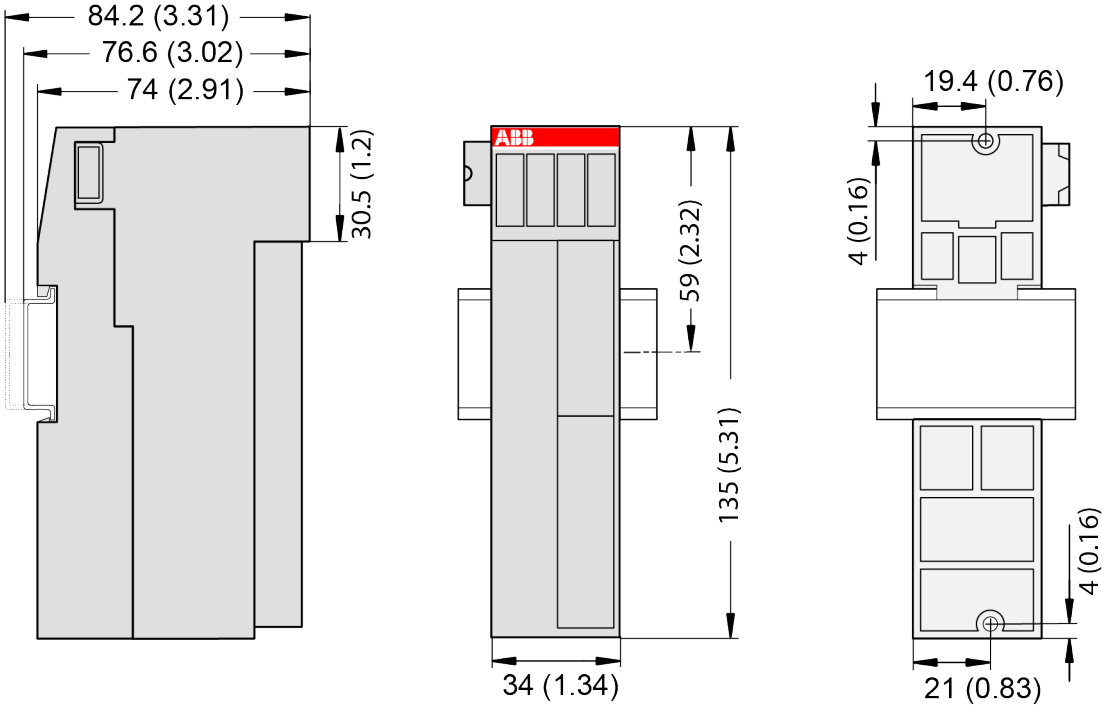
Parameter		Value	
Number of channels per module		2 configurable RTD (resistance temperature detector) inputs	
Distribution of channels into groups		1 (2 channels per group)	
Resolution			
RTD		0.1 °C	
Resistance		150 Ω: 1 LSB (5.4 mΩ); 300 Ω: 1 LSB (10.8 mΩ)	
Connection of the signals O0+ and O1+		Terminals 10 and 13	
Connection of the signals I0+ and I1+		Terminals 11 and 14	
Connection of the signals I0- and I1-		Terminals 12 and 15	
Input type		Module ground referenced RTD for 2-wire and 3-wire resistance temperature detectors	
Galvanic isolation		Against internal power supply and other modules. Isolation voltage 500 V DC.	
Input ranges		Pt100, Pt1000, Ni100, Ni1000	
		150 Ω, 300 Ω	
Indication of the input signals		No	
Module update time		All channels: < 1 s	
Channel input resistance		> 100 kΩ	
Input filter attenuation		-3 dB at 3.6 kHz	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range[1)]			
Before verison E0		Typ.	Depending on RTD max. ±0.6 % of full scale at +25 °C

Parameter		Value	
		Max.	±2 % of full scale at 0 °C ... +60 °C or EMC disturbances
	Version E0 or later	Typ.	Pt100, Pt1000, 300 Ω: ±0.05 % of full scale at +25 °C Ni100, Ni1000, 150 Ω: ±0.1 % of full scale at +25 °C
		Max.	±0.2 % of full scale at -20 °C ... +60 °C; ±0.5 % of full scale at EMC disturbances
Measuring range		*Chapter 5.4.4.1.2.8 “Measuring ranges” on page 541*	
Analog to digital conversion time		Typ. 140 ms per channel	
Unused inputs		Can be left open and should be configured as "unused"	
Input data length		4 bytes	
Power dissipation inside the sensor (max.)		1 mW	
Suppression of interference		On request	
Maximum input voltage		30 V DC (sense), 5 V DC (source)	
Basic error (resistance)		0.1 % of full-scale	
Repeatability		0.05 % of full-scale	
Overvoltage protection		Yes, up to 30 V DC	
Wire loop resistance		< 20 Ω	
Max. cable length (conductor cross section > 0.14 mm²)			
	Unshielded wire	10 m	
	Shielded wire	100 m	

Remarks:

1)	For 2-wire connection, the cable should be as short as possible to reduce error. If the cable is long, use 3-wire connection to achieve the guaranteed measuring accuracy.

Dimensions



The dimensions are in mm and in brackets in inch.

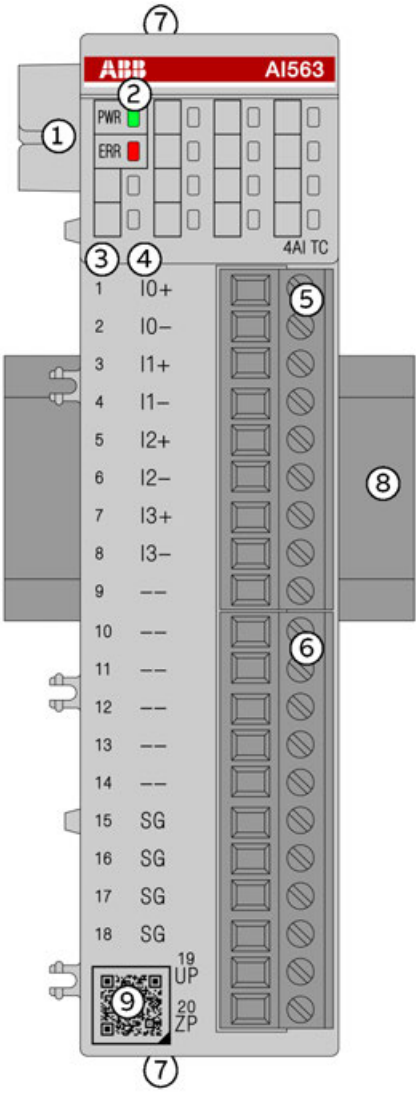
Ordering data

Part no.	Description	Product life cycle phase *)
1TNE 968 902 R1102	AI562, analog input module, 2 AI, RTD	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.4.4.1.3 AI563 - Analog input module

- 4 configurable thermocouple (TC) / -80 mV ... +80 mV inputs (I0 ... I3) in 1 group
- Resolution: 16 bits including sign



1 I/O bus
2 1 green LED to display power supply, 1 red LED to display error
3 Terminal number
4 Allocation of signal name
5 Terminal block for input signals (9-pin)
6 Terminal block for input signals (11-pin)
7 2 holes for wall-mounting with screws
8 DIN rail
9 QR code for datasheet

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The inputs are group-wise galvanically isolated from each other.

The other electronic circuitry of the module is galvanically isolated from the inputs.

The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA communication interface modules.

Functionality

4 analog TC inputs, individually configurable:

- Not used (default)
- Voltage -80 mV ... +80 mV
- Thermocouple J-type -210 °C ... +1200 °C
- Thermocouple K-type -270 °C ... +1372 °C
- Thermocouple R-type -50 °C ... +1768 °C
- Thermocouple S-type -50 °C ... +1768 °C
- Thermocouple T-type -270 °C ... +400 °C
- Thermocouple E-type -270 °C ... +1000 °C
- Thermocouple N-type -270 °C ... +1300 °C

Parameter		Value
Resolution of the analog channels		
	Temperature	0.1 °C
	Voltage	1 LSB (3 µV)
LED displays		2 LEDs for process voltage and error messages
Internal supply		Via I/O bus
External supply		Via the terminals UP (process voltage 24 V DC) and ZP (0 V DC)

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

After powering up the system, input channels, which are configured will have undefined values /diagnosis message for typically 45 seconds, if the wires of all configured channels are broken.

If the AI563 is connected to a PROFINET communication interface module, the firmware version of PROFINET communication interface module must be 1.2 or above.

The connection is carried out by using a removable 9-pin and 11-pin terminal block. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

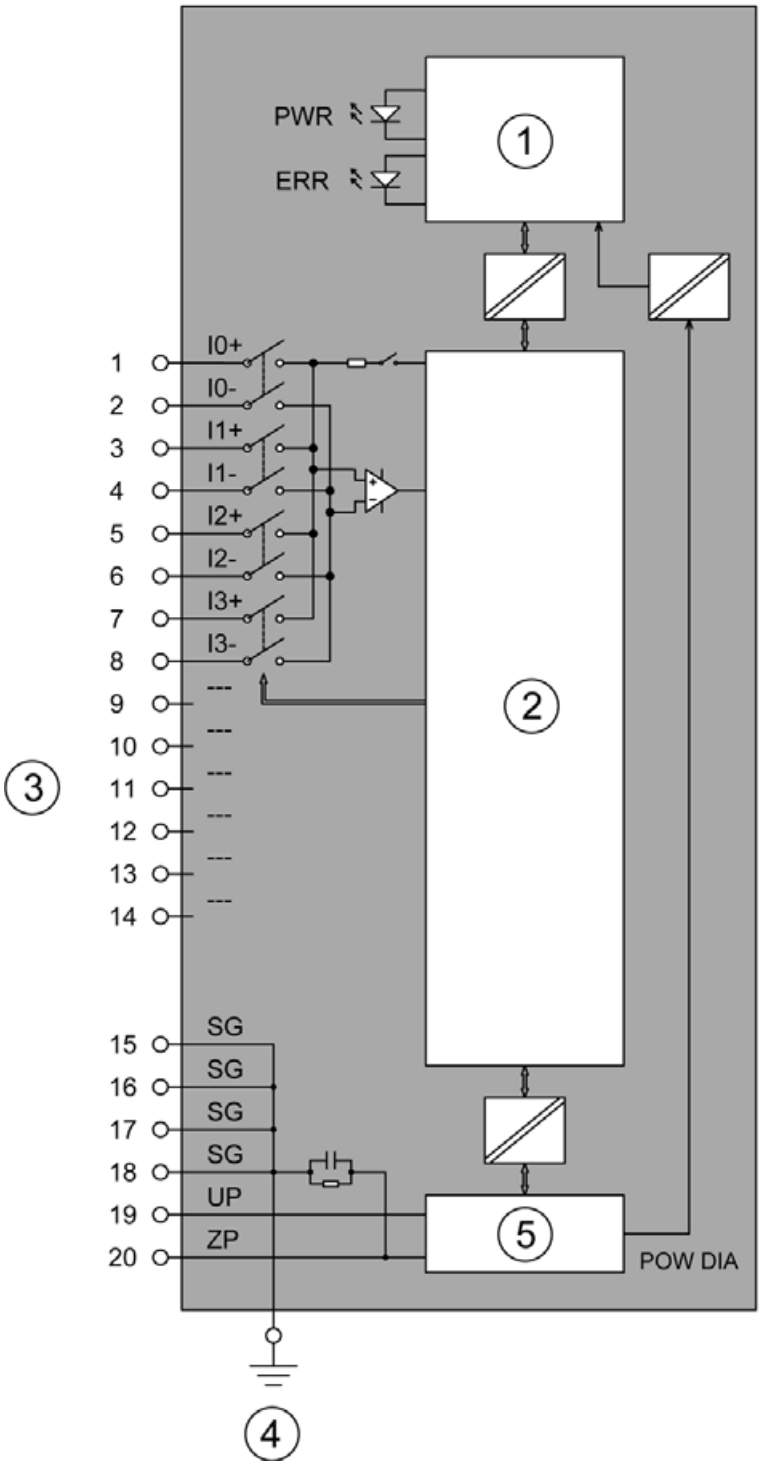


Fig. 69: Internal construction of the analog inputs

1 I/O bus interface and MCU core circuit
2 ADC and logic circuit
3 Analog inputs circuit
4 Functional earth connection
5 Fly-back DC/DC power supply

Table 153: Assignment of the terminals

Terminal	Signal	Description
1	I0+	Positive pole of channel 0
2	I0-	Negative pole of channel 0

Terminal	Signal	Description
3	I1+	Positive pole of channel 1
4	I1-	Negative pole of channel 1
5	I2+	Positive pole of channel 2
6	I2-	Negative pole of channel 2
7	I3+	Positive pole of channel 3
8	I3-	Negative pole of channel 3
9	---	Reserved
10	---	Reserved
11	---	Reserved
12	---	Reserved
13	---	Reserved
14	---	Reserved
15	SG	Shield grounding
16	SG	Shield grounding
17	SG	Shield grounding
18	SG	Shield grounding
19	UP	Process voltage UP (24 V DC)
20	ZP	Process voltage ZP (0 V DC)

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module increases by 5 mA per AI563.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.

NOTICE!

Risk of imprecise and faulty measurements!

Analog signals may be severely distorted due to external electromagnetic interference.

When the length of the connection cable exceeds 20 m, a shielded and grounded cable must be used. When the shield is grounded at both ends, an independent low-impedance equipotential connection should be provided to avoid high potential differences between interconnected devices.

NOTICE!

Risk of damaging the PLC modules!

The PLC modules must not be removed while the plant is connected to a power supply.

Make sure that all voltage sources (supply and process voltage) are switched off before you do the following:

– Connect or disconnect any signal or terminal block.
– Remove or replace a module.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The module provides several diagnosis functions *Chapter 5.4.4.1.3.6 “Diagnosis” on page 552*.

The following figure shows the connection of thermocouple and ±80 mV voltage to the inputs of the module:

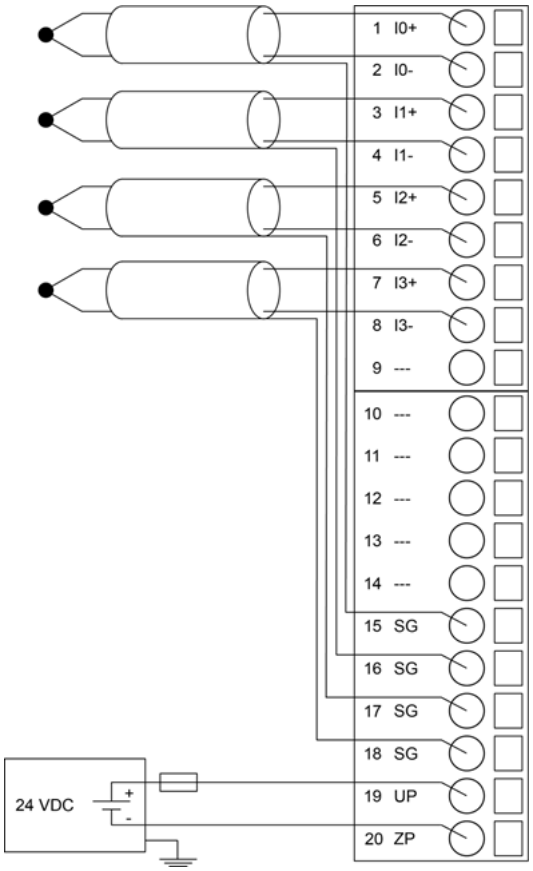


Fig. 70: Connection of thermocouples to the inputs of the module

The meaning of the LEDs is described in Displays chapter *Chapter 5.4.4.1.3.7 “State LEDs” on page 553*.

I/O configuration

The analog input module AI563 does not store configuration data itself.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Intern	6510[1)]	WORD	0x196E	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No 0x00			
Parameter length	Intern	6	BYTE	0	0	255	xx02[2)]
Check Supply	Off On	0 1	BYTE	On 0x01			
Analog Data Format	Default	0	BYTE	Default 0x00		255	
[1)]with CS31 and addresses less than 70, the value is increased by 1 [2)]Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n)							

GSD file:

Ext_User_Prm_Data_Len =	0x09
Ext_User_Prm_Data_Const(0) =	0x6F, 0x19, 0x06, \ 0x01, 0x00, \ 0x00, 0x00, 0x00, 0x00;

Input channel (4x)

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.
Channel configuration	*Table 154 “Channel configuration” on page 551*		BYTE	0 0x00 see table	0	65535

Table 154: Channel configuration

Internal value	Operating modes for the analog inputs, individually configurable
0	Not used (default)
21	Voltage -80 mV ... +80 mV
24	Thermocouple J-type -210 °C ... +1200 °C
25	Thermocouple K-type -270 °C ... +1372 °C
26	Thermocouple R-type -50 °C ... +1768 °C
27	Thermocouple S-type -50 °C ... +1768 °C
28	Thermocouple T-type -270 °C...+400 °C

Internal value	Operating modes for the analog inputs, individually configurable
29	Thermocouple E-type -270 °C ... +1000 °C
30	Thermocouple N-type -270 °C ... +1300 °C

Diagnosis

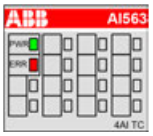
E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500 display	<– Display in	
Class	Comp	Dev	Mod	Ch	Err	AB SW		
Byte 6 Bit 6 ... 7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0 ... 5	PNIO diagnosis block		
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**		**Remedy**
	1)	2)	3)	4)				
Module error								
3	14	1 ... 10	31	31	19	Checksum error in the I/O module		Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer		Restart
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	26	Parameter error		Check master
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	11	Process voltage too low		Check process voltage
	11 / 12	ADR	1 ... 10					
Channel error								
4	14	1 ... 10	1	0 ... 3	48	Analog value overflow or broken wire at an analog input		Check input value or terminal
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	1	0...3	7	Analog value underflow at an analog input		Check input value
	11 / 12	ADR	1 ... 10					

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = expansion module 1...10, ADR = hardware address (e. g. of the DC551-CS31)

3)	With "Module" the following allocation applies dependent of the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or PNIO = module type (1 = AI); COM1/COM2: 1 ... 10 = expansion 1 ... 10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON	LED flashes
	PWR	Process voltage 24 V DC via terminal	Green	CPU module voltage or external 24 V DC supply voltage is missing	3.3 V system voltage (I/O bus) and external 24 V DC supply voltage are present	---
	ERR	Channel or module error	Red	No error or process voltage is missing	Severe error in the module	Error on 1 or more channels of the module

Measuring ranges

AI563 needs typ. 6 to 8 seconds for initialization after applying the process supply voltage to clamp UP/ZP. During this time, the accuracy of the measurement values is not within specification. After that, valid measurement values are provided by the module. After that, valid measurement values are provided by the module.

After an interruption of the process supply voltage > 10 ms, a re-initialization is performed by AI563.

Risk of invalid analog input values!

The analog input values may be invalid if the measuring range of the inputs is exceeded.

Make sure that the analog signal at the connection terminals is always within the signal range.

When a wire break occurs on a sensor wire, the temperature measurement value of the corresponding channel changes to Overflow (Hexadecimal 7FFF).

Range	**Type J** **-210 °C ... +1200 °C**	**Type K** **-270 °C ... +1372 °C**	**Type N** **-270 °C ... +1300 °C**	**Type T** **-270 °C ... +400 °C**	**Digital value**	
					Decimal	**Hex.**
Overflow	> +1200.0 °C	> +1372.0 °C	> +1300.0 °C	> +400.0 °C	32767	7FFF
Normal range		+1372.0 °C			13720	3598
		:	+1300.0 °C		13000	32C8
	+1200.0 °C	:	:		12000	2EE0
	:	:	:	+400.0 °C	4000	0FA0
	:	:	:	:	:	:
	+0.1 °C	+0.1 °C	+0.1 °C	+0.1 °C	1	1
	+0.0 °C	+0.0 °C	+0.0 °C		0	0000
	-0.1 °C	-0.1 °C	-0.1 °C	-0.1 °C	-1	FFFF
	:	:	:	:	:	:
	:	:	:	:	-500	FE0C
	-210.0 °C	:	:	:	-2100	F7CC
		-270.0 °C	-270.0 °C	-270.0 °C	-2700	F574
Underflow	< -210.0 °C	< -270.0 °C	< -270.0 °C	< -270.0 °C	-32768	8000

Range	**-80 mV ... +80 mV**	**Type E** **-270 °C ... +1000 °C**	**Types R, S** **-50 °C ... +1768 °C**	**Digital value**	
				Decimal	**Hex.**
Overflow	> +90 mV	> +1000.0 °C	> +1768.0 °C	32767	7FFF
Normal range	+80 mV			27648	6C00
			+1768.0 °C	17680	4510
		+1000.0 °C		10000	2710
				9000	2328
	:	:	:	:	:
	3 µV	+0.1 °C	+0.1 °C	1	1
	0 µV	0.0 °C	0.0 °C	0	0000
	-3 µV	-0.1 °C	-0.1 °C	-1	FFFF
	:	:	:	:	:
	:	:	-50.0 °C	-500	FE0C
	:	-270.0 °C		-2700	F574
	-80 mV			-27648	9400
Underflow	< -90 mV	< -270.0 °C	< -50.0 °C	-32768	8000

Technical data

Technical data of the module

The system data of AC500-eCo apply.

Chapter 4.1 “System data AC500-eCo” on page 25

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage UP		
	Connections	Terminal 19 for UP (+24 V DC) and terminal 20 for ZP (0 V)
	Rated value	24 V DC
	Current consumption	0.10 A; 0.02 A (version E0 or later)
	Inrush current (at power-up)	Typ. 0.1 A^2s; Max. 0.16 A^2s
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Protection fuse for UP	Yes, between the channels and the rest of the module
Current consumption from 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module		Ca. 5 mA
Galvanic isolation		Yes, between the channels and the rest of the module. Isolation voltage 500 V DC.
	Isolated groups	1 (4 channels per group)
Surge-voltage (max.)		35 V DC for 0.5 s
Max. power dissipation within the module		2.6 W; 0.7 W (version E0 or later)
Weight		Ca. 120 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

Technical data of the analog inputs

Parameter		Value
Number of channels per module		4 configurable thermocouple (TC) inputs
Distribution of channels into groups		1 (4 channels per group)
Resolution		
	Temperature	0.1 °C
	Voltage	16 bits including sign
Connection of the signals I0+ to I3+		Terminals 1, 3, 5 and 7
Connection of the signals I0- to I3-		Terminals 2, 4, 6 and 8

Parameter		Value	
Input type		Floating thermocouple	
Galvanic isolation		Against internal power supply and other modules	
Common mode rejection		> 120 dB at 120 V AC	
Indication of the input signals		No	
Module update time		All channels: < 1.6 s	
Channel input resistance		On request	
Input filter attenuation		-3 dB at 15 kHz (1 kHz, version E0 or later)	
Cold junction error		±0.5 °C (version E0 or later)	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ.	±0.1 % (±0.05 %, version E0 or later) of full-scale at +25 °C (voltage) Depending on thermocouple, see table "Accuracy of thermocouple ranges" at +25 °C *Chapter 5.4.4.1.3.9.2.1 “Accuracy of thermocouple ranges (with cold junction compensation)” on page 556*
		Max.	±2 % of full scale (T-Type: ±3 % for -240 °C ... -270 °C) , at 0 °C ... +60 °C ±0.5 % (version E0 or later) of full scale, at -20 °C ... +60 °C or EMC disturbance (voltage) Depending on thermocouple, see table "Accuracy of thermocouple ranges" at entire temp. *Chapter 5.4.4.1.3.9.2.1 “Accuracy of thermocouple ranges (with cold junction compensation)” on page 556*
Relationship between input signal and hex code		*Chapter 5.4.4.1.3.8 “Measuring ranges” on page 553*	
Analog to digital conversion time		400 ms per channel	
Unused inputs		Can be left open and should be configured as "unused"	
Input data length		8 bytes	
Overvoltage protection		Yes, up to 30 V DC	
Repeatability		On request	
Wire loop resistance		< 100 Ω	
Max. cable length (conductor cross section > 0.14 mm²)			
	Unshielded wire	10 m	
	Shielded wire	100 m	

Accuracy of thermocouple ranges (with cold junction compensation)

Table 155: Before version E0

Thermocouple Type	Range	Accuracy
E	-270 °C ... -220 °C	±2 %
	-220 °C ... +1000 °C	±0.6 %
J	-210 °C ... +1200 °C	±0.6 %

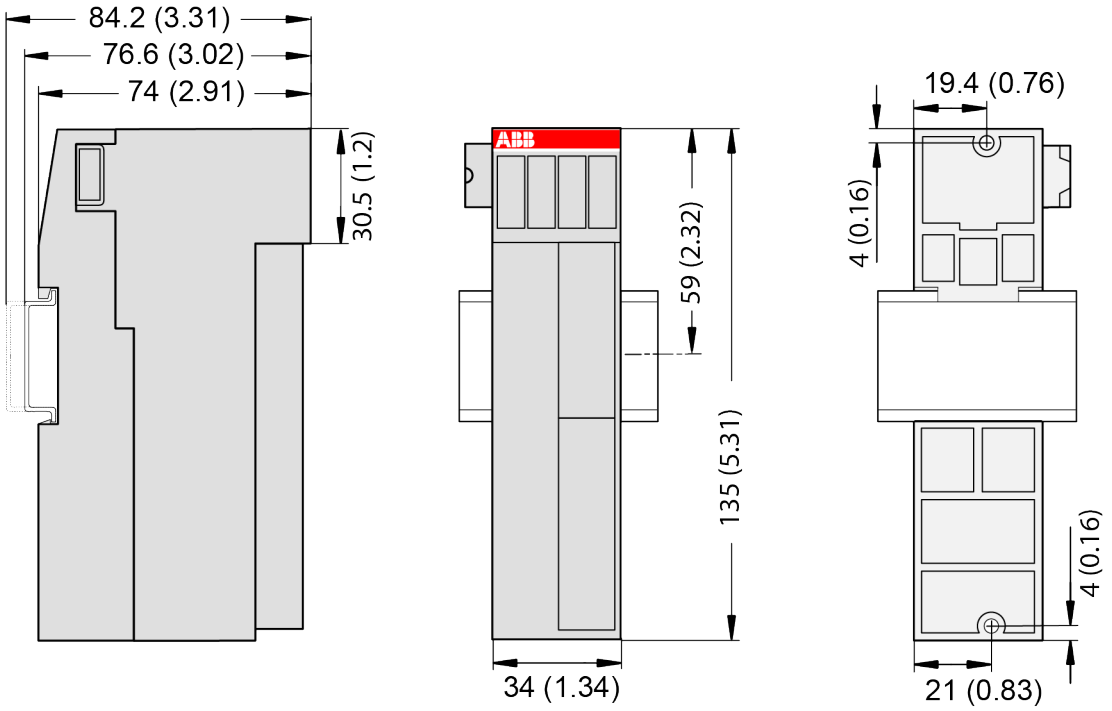
Thermocouple Type	Range	Accuracy
K	-270 °C ... -220 °C	±1.5 %
	-220 °C ... +1372 °C	±0.6 %
N	-270 °C ... -150 °C	±2 %
	-150 °C ... +1300 °C	±0.6 %
R, S	-50 °C ... +150 °C	±1.5 %
	+150 °C ... +1768 °C	±0.6 %
T	-270 °C ... -240 °C	±3 %
	-240 °C ... 0 °C	±2 %
	0 °C ... +400 °C	±0.6 %

Table 156: Version E0 or later

Thermocouple Type	Range	Accuracy	
		25 °C	Entire temp.
E	-270 °C ... -200 °C	±6.5 K	±7.0 K
	-200 °C ... -150 °C	±1.5 K	±2.0 K
	-150 °C ... +1000 °C	±1.0 K	±2.0 K
J	-210 °C ... -100 °C	±1.5 K	±2.0 K
	-100 °C ... +1200 °C	±1.0 K	±2.0 K
K	-270 °C ... -200 °C	±8.5 K	±9.0 K
	-200 °C ... -100 °C	±1.5 K	±2.0 K
	-100 °C ... +1372 °C	±1.0 K	±2.0 K
N	-270 °C ... -200 °C	±16.0 K	±16.5 K
	-200 °C ... -150 °C	±1.5 K	±2.0 K
	-150 °C ... +1300 °C	±1.0 K	±2.0 K
R, S	-50 °C ... 0 °C	±3.5 K	±4.5 K
	0 °C ... +200 °C	±2.0 K	±3.0 K
	+200 °C ... +1768 °C	±1.5 K	±2.5 K
T	-270 °C ... -200 °C	±7.0 K	±7.5 K
	-200 °C ... -100 °C	±1.0 K	±1.5 K
	-100 °C ... +400 °C	±0.7 K	±1.2 K

These accuracy values are valid only for stable module temperatures. The temperature needs to be stable for at least 30 minutes after the module is powered on.

Dimensions



The dimensions are in mm and in brackets in inch.

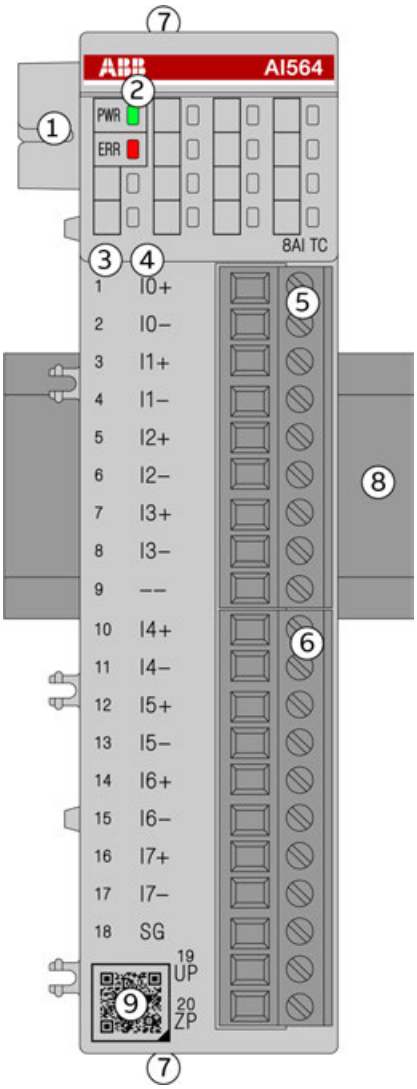
Ordering data

Part no.	Description	Product life cycle phase *)
1TNE 968 902 R1103	AI563, analog input module, 4 AI, thermocouple	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

5.4.4.1.4 AI564 - Analog input module

- 8 configurable thermocouple (TC) / -80 mV ... +80 mV inputs (I0 ... I7) in 1 group
- Resolution: 16 bits including sign



1 I/O bus
2 1 green LED to display power supply, 1 red LED to display error
3 Terminal number
4 Allocation of signal name
5 Terminal block for input signals (9-pin)
6 Terminal block for input signals (11-pin)
7 2 holes for wall-mounting with screws
8 DIN rail
9 QR code for datasheet

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI50x-PNIO, CI51x-ETHCAT, CN52x-MODTCP, CI54x-DP, CI58x-CN) or as a centralized extension module for AC500 CPUs.

The inputs are not galvanically isolated from each other.

The other electronic circuitry of the module is galvanically isolated from the inputs.

Functionality

8 analog TC inputs, individually configurable:

- Not used (default)
- Voltage -80 mV ... +80 mV
- Thermocouple J-type -210 °C ... +1200 °C
- Thermocouple K-type -270 °C ... +1372 °C
- Thermocouple R-type -50 °C ... +1768 °C
- Thermocouple S-type -50 °C ... +1768 °C
- Thermocouple T-type -270 °C ... +400 °C
- Thermocouple E-type -270 °C ... +1000 °C
- Thermocouple N-type -270 °C ... +1300 °C
- Temperature internal reference junction

Parameter		Value
Resolution of the analog channels		
	Temperature	0.1 °C
	Voltage	1 LSB (3 µV)
LED displays		2 LEDs for process voltage and error messages
Internal supply		Via I/O bus
External supply		Via the terminals UP (process voltage 24 V DC) and ZP (0 V DC)

Connections



For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.



After powering up the system, input channels, which are configured will have undefined values /diagnosis message for typically 45 seconds, if the wires of all configured channels are broken.



If the AI564 is connected to a PROFINET communication interface module, the firmware version of PROFINET communication interface module must be 1.2 or above.

The connection is carried out by using a removable 9-pin and a 11-pin terminal block. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

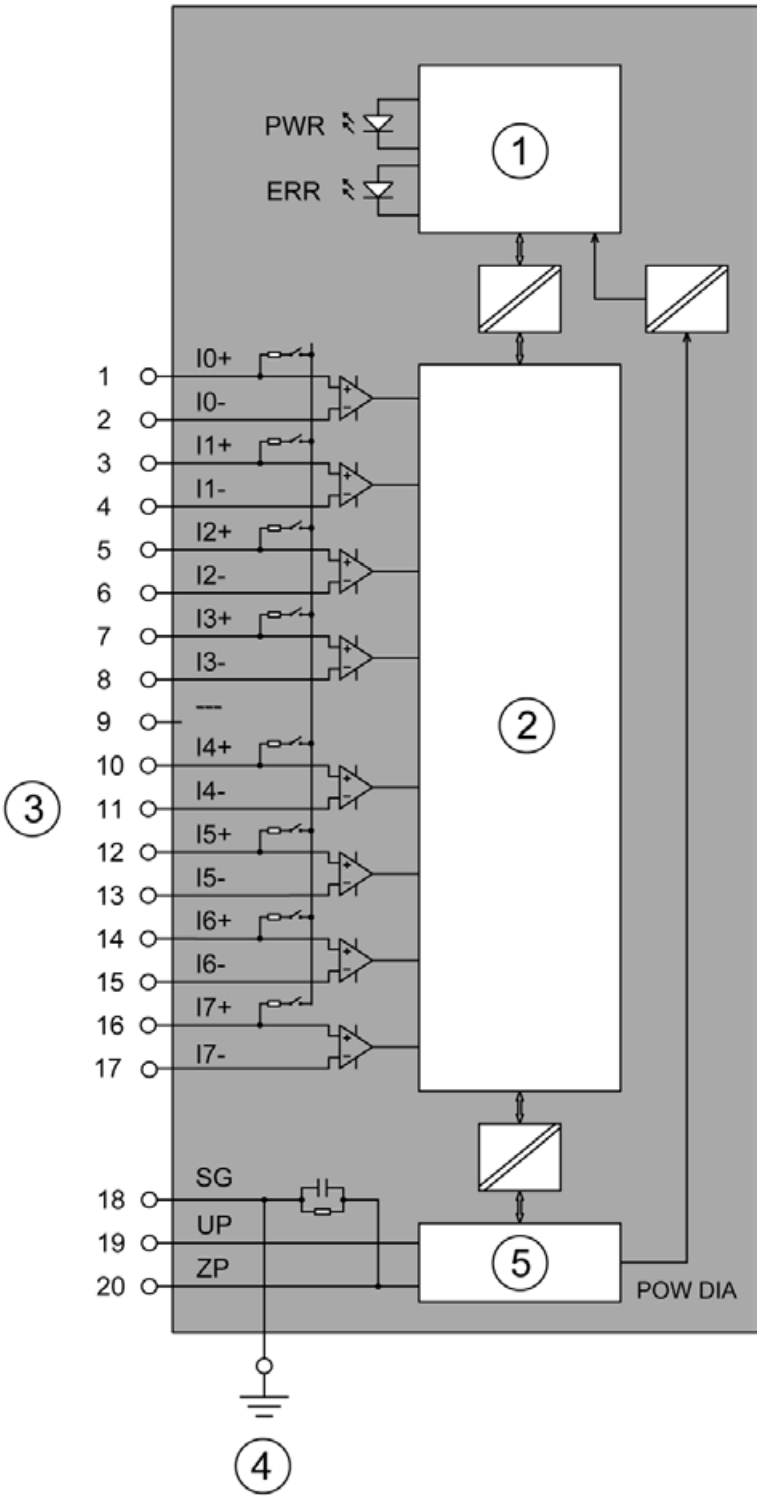


Fig. 71: Internal construction of the analog inputs

1 I/O bus interface and MCU core circuit
2 ADC and logic circuit
3 Analog inputs circuit
4 Functional earth connection
5 Fly-back DC/DC power supply

Table 157: Assignment of the terminals

Terminal	Signal	Description
1	I0+	Positive pole of channel 0
2	I0-	Negative pole of channel 0
3	I1+	Positive pole of channel 1
4	I1-	Negative pole of channel 1
5	I2+	Positive pole of channel 2
6	I2-	Negative pole of channel 2
7	I3+	Positive pole of channel 3
8	I3-	Negative pole of channel 3
9	---	Reserved
10	I4+	Positive pole of channel 4
11	I4-	Negative pole of channel 4
12	I5+	Positive pole of channel 5
13	I5-	Negative pole of channel 5
14	I6+	Positive pole of channel 6
15	I6-	Negative pole of channel 6
16	I7+	Positive pole of channel 7
17	I7-	Negative pole of channel 7
18	SG	Shield grounding
19	UP	Process voltage UP (24 V DC)
20	ZP	Process voltage ZP (0 V DC)

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module increases by 5 mA per AI564.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.

NOTICE!

Risk of imprecise and faulty measurements!

Analog signals may be severely distorted due to external electromagnetic interference.

When the length of the connection cable exceeds 20 m, a shielded and grounded cable must be used. When the shield is grounded at both ends, an independent low-impedance equipotential connection should be provided to avoid high potential differences between interconnected devices.

NOTICE!

Risk of damaging the PLC modules!

The PLC modules must not be removed while the plant is connected to a power supply.

Make sure that all voltage sources (supply and process voltage) are switched off before you do the following:

– Connect or disconnect any signal or terminal block.
– Remove or replace a module.

NOTICE!

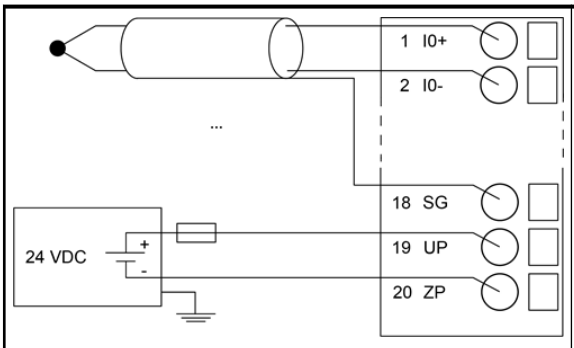
Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

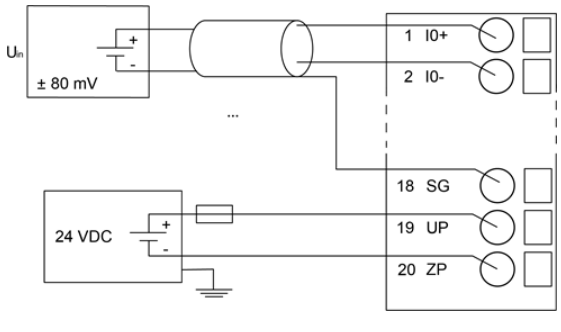
– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The module provides several diagnosis functions *Chapter 5.4.4.1.4.6 “Diagnosis” on page 565*.

The following figures show the connection of thermocouple and ±80 mV voltage to the inputs of the module:



Connection of TC



Connection of ± 80 mV voltage

The meaning of the LEDs is described in Displays chapter *Chapter 5.4.4.1.4.7 “State LEDs” on page 566*.

I/O configuration

The analog input module AI564 does not store configuration data itself.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Intern	6540[1)]	WORD	0x198C	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No 0x00			
Parameter length	Intern	52 (4+48)	BYTE	0	0	255	xx02[2)]
Check Supply	Off On	0 1	BYTE	On 0x01			
Analog Data Format	Default	0	BYTE	Default 0x00		255	
[1)]with CS31 and addresses less than 70, the value is increased by 1 [2)]Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n)							

GSD file:

Ext_User_Prm_Data_Len = Ext_User_Prm_Data_Const(0) =	0x37 0x8D, 0x19, 0x34, \ 0x01, 0x00, \ 48(0);

Input channel (8x)

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.
Channel configuration	*Table 158 “Channel configuration” on page 564*		BYTE	0 0x00 see table	0	65535

Table 158: Channel configuration

Internal value	Operating modes for the analog inputs, individually configurable
0	Not used (default)
21	Voltage -80 mV ... +80 mV
24	Thermocouple J-type -210 °C ... +1200 °C
25	Thermocouple K-type -270 °C ... +1372 °C
26	Thermocouple R-type -50 °C ... +1768 °C
27	Thermocouple S-type -50 °C ... +1768 °C
28	Thermocouple T-type -270 °C...+400 °C
29	Thermocouple E-type -270 °C ... +1000 °C
30	Thermocouple N-type -270 °C ... +1300 °C
52	Temperature internal reference junction

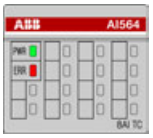
Diagnosis

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000 ... 063**	**AC500 display**	**<− Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**AB SW**		
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**PNIO diagnosis block**		
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**		**Remedy**
	1)	2)	3)	4)				
Module error								
3	14	1 ... 10	31	31	19	Checksum error in the I/O module		Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer		Restart
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	26	Parameter error		Check master
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	11	Process voltage too low		Check process voltage
	11 / 12	ADR	1 ... 10					
Channel error								
4	14	1 ... 10	1	0 ... 7	48	Analog value overflow or broken wire at an analog input		Check input value or terminal
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	1	0...7	7	Analog value underflow at an analog input		Check input value
	11 / 12	ADR	1 ... 10					

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = expansion module 1...10, ADR = hardware address (e. g. of the DC551-CS31)
3)	With "Module" the following allocation applies dependent of the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or PNIO = module type (1 = AI); COM1/COM2: 1 ... 10 = expansion 1 ... 10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON	LED flashes
	PWR	Process voltage 24 V DC via terminal	Green	CPU module voltage or external 24 V DC supply voltage is missing	3.3 V system voltage (I/O bus) and external 24 V DC supply voltage are present	---
	ERR	Channel or module error	Red	No error or process voltage is missing	Severe error in the module	Error on 1 or more channels of the module

Measuring ranges

AI564 needs typ. 6 to 8 seconds for initialization after applying the process supply voltage to clamp UP/ZP. During this time, the accuracy of the measurement values is not within specification. After that, valid measurement values are provided by the module. After that, valid measurement values are provided by the module.

After an interruption of the process supply voltage > 10 ms, a re-initialization is performed by AI564.

Risk of invalid analog input values!

The analog input values may be invalid if the measuring range of the inputs is exceeded.

Make sure that the analog signal at the connection terminals is always within the signal range.

When a wire break occurs on a sensor wire, the temperature measurement value of the corresponding channel changes to Overflow (Hexadecimal 7FFF).

Range	Type J -210 °C ... +1200 °C	Type K -270 °C ... +1372 °C	Type N -270 °C ... +1300 °C	Type T -270 °C ... +400 °C	Digital value	
					Decimal	Hex.
Overflow	> +1200.0 °C	> +1372.0 °C	> +1300.0 °C	> +400.0 °C	32767	7FFF
Normal range		+1372.0 °C			13720	3598
		:	+1300.0 °C		13000	32C8
	+1200.0 °C	:	:		12000	2EE0
	:	:	:	+400.0 °C	4000	0FA0
	:	:	:	:	:	:
	+0.1 °C	+0.1 °C	+0.1 °C	+0.1 °C	1	1

Range	Type J -210 °C ... +1200 °C	Type K -270 °C ... +1372 °C	Type N -270 °C ... +1300 °C	Type T -270 °C ... +400 °C	Digital value	
					Decimal	Hex.
	+0.0 °C	+0.0 °C	+0.0 °C		0	0000
	-0.1 °C	-0.1 °C	-0.1 °C	-0.1 °C	-1	FFFF
	:	:	:	:	:	:
	:	:	:	:	-500	FE0C
	-210.0 °C	:	:	:	-2100	F7CC
		-270.0 °C	-270.0 °C	-270.0 °C	-2700	F574
Underflow	< -210.0 °C	< -270.0 °C	< -270.0 °C	< -270.0 °C	-32768	8000

Range	-80 mV ... +80 mV	Type E -270 °C ... +1000 °C	Types R, S -50 °C ... +1768 °C	Digital value	
				Decimal	Hex.
Overflow	> +90 mV	> +1000.0 °C	> +1768.0 °C	32767	7FFF
Normal range	+80 mV			27648	6C00
			+1768.0 °C	17680	4510
		+1000.0 °C		10000	2710
				9000	2328
	:	:	:	:	:
	3 µV	+0.1 °C	+0.1 °C	1	1
	0 µV	0.0 °C	0.0 °C	0	0000
	-3 µV	-0.1 °C	-0.1 °C	-1	FFFF
	:	:	:	:	:
	:	:	-50.0 °C	-500	FE0C
	:	-270.0 °C		-2700	F574
	-80 mV			-27648	9400
Underflow	< -90 mV	< -270.0 °C	< -50.0 °C	-32768	8000

Technical data

Technical data of the module

The system data of AC500-eCo apply.

↳ *Chapter 4.1 “System data AC500-eCo” on page 25*

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage UP		
	Connections	Terminal 19 for UP (+24 V DC) and terminal 20 for ZP (0 V)
	Rated value	24 V DC
	Current consumption	0.03 A
	Inrush current (at power-up)	Typ. 0.1 A^2s; Max. 0.16 A^2s
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Protection fuse for UP	Yes, external additional fuse recommended
Current consumption from 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module		Ca. 5 mA
Galvanic isolation		Yes, between the input group and the rest of the module. Isolation voltage 500 V DC.
	Isolated groups	1 (8 channels per group)
Surge-voltage (max.)		35 V DC for 0.5 s
Max. power dissipation within the module		0.8 W
Weight		Ca. 120 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

Technical data of the analog inputs

Parameter		Value
Number of channels per module		8 configurable thermocouple (TC) inputs
Distribution of channels into groups		1 (8 channels per group)
Resolution		
	Temperature	0.1 °C
	Voltage	16 bits including sign
Connection of the signals I0+ to I7+		Terminals 1, 3, 5, 7, 10, 12, 14 and 16
Connection of the signals I0- to I7-		Terminals 2, 4, 6, 8, 11, 13, 15 and 17
Input type		Floating thermocouple
Galvanic isolation		Against internal power supply and other modules
Common mode rejection		> 120 dB at 120 V AC
Indication of the input signals		No
Module update time		All channels: < 1.6 s
Channel input resistance		On request
Input filter attenuation		-3 dB at 1 kHz
Cold junction error		±0.5 °C

Parameter		Value	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ.	±0.05 % of full-scale at +25 °C (voltage) Depending on thermocouple, see table "Accuracy of thermocouple ranges" at +25 °C *Chapter 5.4.4.1.4.9.2.1 “Accuracy of thermocouple ranges (with cold junction compensation)” on page 569*
		Max.	±0.5 % of full scale, at -20 °C ... +60 °C or EMC disturbance (voltage) Depending on thermocouple, see table "Accuracy of thermocouple ranges" at entire.temp *Chapter 5.4.4.1.4.9.2.1 “Accuracy of thermocouple ranges (with cold junction compensation)” on page 569*
Relationship between input signal and hex code		*Chapter 5.4.4.1.4.8 “Measuring ranges” on page 566*	
Analog to digital conversion time		170 ms per channel	
Unused inputs		Can be left open and should be configured as "unused"	
Input data length		16 bytes	
Overvoltage protection		Yes, up to 30 V DC	
Repeatability		On request	
Wire loop resistance		< 100 Ω	
Max. cable length (conductor cross section > 0.14 mm²)			
	Unshielded wire	50 m	
	Shielded wire	200 m	

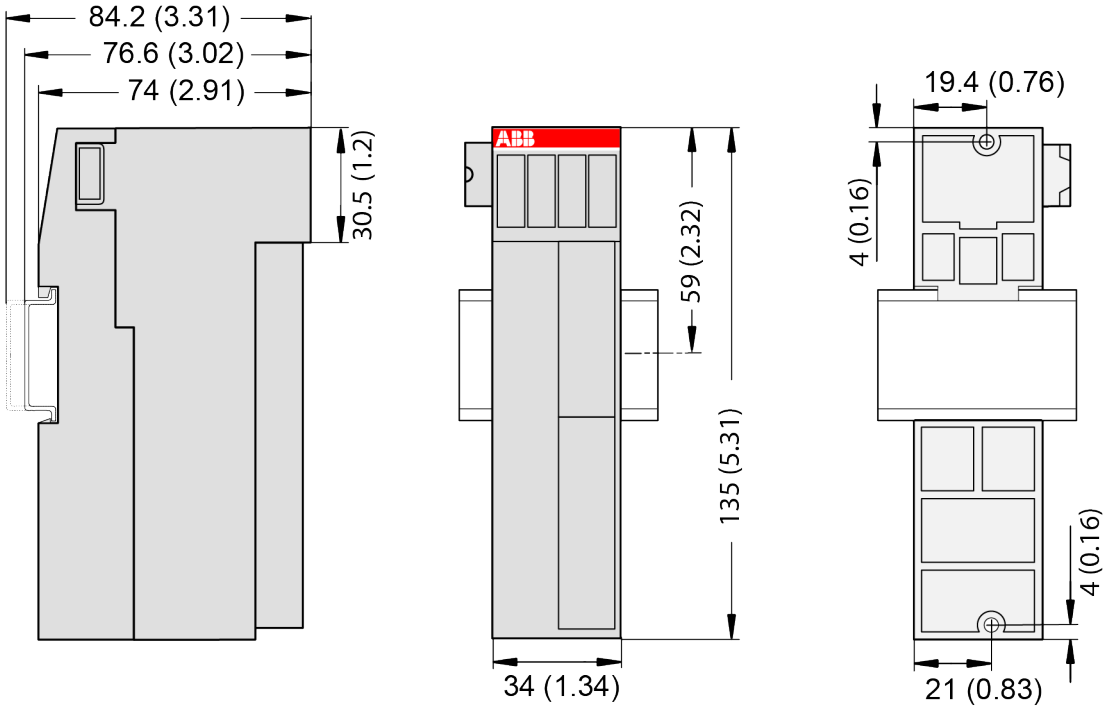
Accuracy of thermocouple ranges (with cold junction compensation)

Thermocouple Type	Range	Accuracy	
		25 °C	Entire temp.
E	-270 °C ... -200 °C	±6.5 K	±7.0 K
	-200 °C ... -150 °C	±1.5 K	±2.0 K
	-150 °C ... +1000 °C	±1.0 K	±2.0 K
J	-210 °C ... -100 °C	±1.5 K	±2.0 K
	-100 °C ... +1200 °C	±1.0 K	±2.0 K
K	-270 °C ... -200 °C	±8.5 K	±9.0 K
	-200 °C ... -100 °C	±1.5 K	±2.0 K
	-100 °C ... +1372 °C	±1.0 K	±2.0 K
N	-270 °C ... -200 °C	±16.0 K	±16.5 K
	-200 °C ... -150 °C	±1.5 K	±2.0 K
	-150 °C ... +1300 °C	±1.0 K	±2.0 K

Thermocouple Type	Range	Accuracy	
R, S	-50 °C ... 0 °C	±3.5 K	±4.5 K
	0 °C ... +200 °C	±2.0 K	±3.0 K
	+200 °C ... +1768 °C	±1.5 K	±2.5 K
T	-270 °C ... -200 °C	±7.0 K	±7.5 K
	-200 °C ... -100 °C	±1.0 K	±1.5 K
	-100 °C ... +400 °C	±0.7 K	±1.2 K

These accuracy values are valid only for stable module temperatures. The temperature needs to be stable for at least 30 minutes after the module is powered on.

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP235000R0000	AI564, analog input module, 8 AI, thermocouple	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active

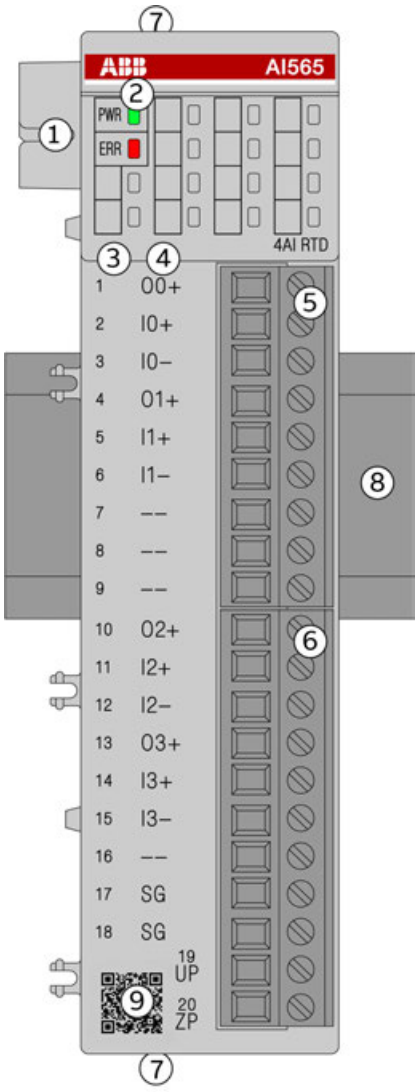
Part no.	Description	Product life cycle phase *)
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active



**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.4.4.1.5 AI565 - Analog input module

- 4 configurable analog resistance temperature detector (RTD) inputs (I0, I1, I2, I3) in 1 group
- Resolution: 16 bits including sign



1 I/O bus
2 1 green LED to display power supply, 1 red LED to display error
3 Terminal number
4 Allocation of signal name
5 Terminal block for input signals (9-pin)
6 Terminal block for input signals (11-pin)
7 2 holes for wall-mounting with screws
8 DIN rail
9 QR code for datasheet

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI50x-PNIO, CI51x-ETHCAT, CN52x-MODTCP, CI54x-DP, CI58x-CN) or as a centralized extension module for AC500 CPUs.

The inputs are not galvanically isolated from each other.

All other circuitry of the module is galvanically isolated from the inputs.

Functionality

4 analog RTD-inputs, individually configurable:

- Not used (default)
- Pt100, -50 °C ... +400 °C, 2-wire
- Pt100, -50 °C ... +400 °C, 3-wire
- Pt1000, -50 °C ... +400 °C, 2-wire
- Pt1000, -50 °C ... +400 °C, 3-wire
- Ni1000, -50 °C ... +150 °C, 2-wire
- Ni1000, -50 °C ... +150 °C, 3-wire
- Ni100, -50 °C ... +150 °C, 2-wire
- Ni100, -50 °C ... +150 °C, 3-wire
- Analog input resistance 0 Ω ... 150 Ω
- Analog input resistance 0 Ω ... 300 Ω
- NTC 2-wire

Parameter		Value
Resolution of the analog channels		
	Temperature	0.1 °C
	Resistance	150 Ω: 1 LSB (5.4 mΩ); 300 Ω: 1 LSB (10.8 mΩ)
LED displays		2 LEDs for process voltage and error messages
Internal supply		Via I/O bus
External supply		Via the terminals UP (process voltage 24 V DC) and ZP (0 V DC)

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection is carried out by using a removable 9-pin and a 11-pin terminal block. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

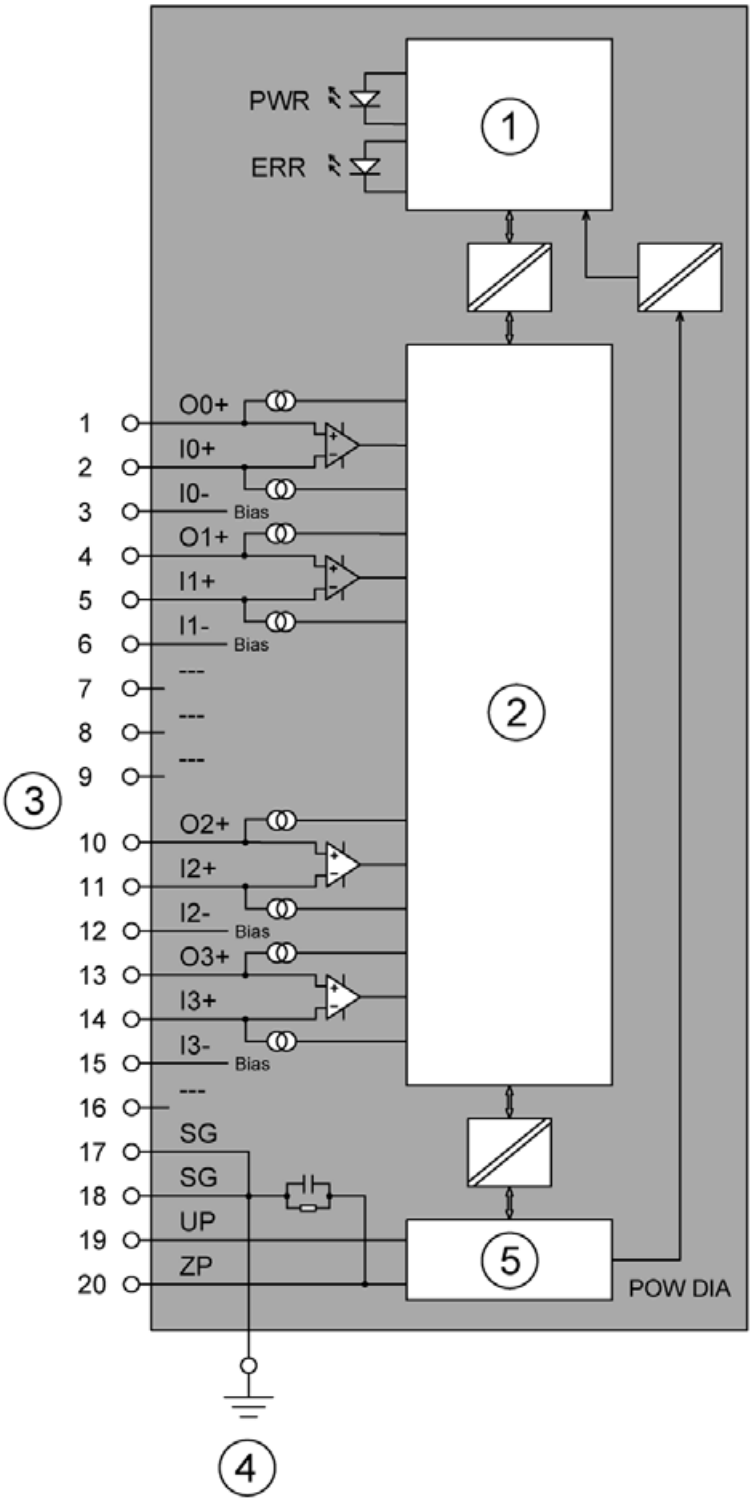


Fig. 72: Internal construction of the analog inputs

1 I/O bus interface and MCU core circuit
2 ADC and logic circuit
3 Analog inputs circuit
4 Functional earth connection
5 Fly-back DC/DC power supply

The assignment of the terminals:

Terminal	Signal	Description
1	O0+	Current source of channel 0
2	I0+	Sense input of channel 0
3	I0-	Return input of channel 0
4	O1+	Current source of channel 1
5	I1+	Sense input of channel 1
6	I1-	Return input of channel 1
7...9	---	Reserved
10	O2+	Current source of channel 2
11	I2+	Sense input of channel 2
12	I2-	Return input of channel 2
13	O3+	Current source of channel 3
14	I3+	Sense input of channel 3
15	I3-	Return input of channel 3
16	---	Reserved
17	SG	Shield grounding
18	SG	Shield grounding
19	UP	Process voltage UP (24 V DC)
20	ZP	Process voltage ZP (0 V DC)

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 5 mA per AI565.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.

NOTICE!

Risk of imprecise and faulty measurements!

Analog signals may be severely distorted due to external electromagnetic interference.

When the length of the connection cable exceeds 20 m, a shielded and grounded cable must be used. When the shield is grounded at both ends, an independent low-impedance equipotential connection should be provided to avoid high potential differences between interconnected devices.

NOTICE!

Risk of damaging the PLC modules!

The PLC modules must not be removed while the plant is connected to a power supply.

Make sure that all voltage sources (supply and process voltage) are switched off before you do the following:

– Connect or disconnect any signal or terminal block.
– Remove or replace a module.

NOTICE!

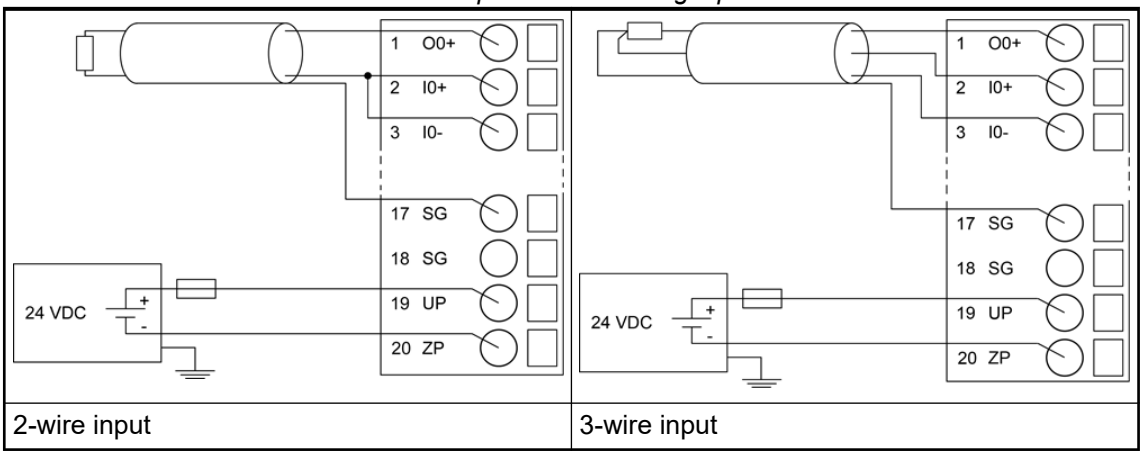
Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The module provides several diagnosis functions *Chapter 5.4.4.1.5.6 “Diagnosis” on page 578*.

Table 159: Connection of RTDs to the inputs of the analog input module AI565



2-wire input	3-wire input

With 2-wire connection, the resistance of the connection wires influences the accuracy of the measured value. Use 3-wire connection to achieve the guaranteed measuring accuracy.

The meaning of the LEDs is described in the Displays section *Chapter 5.4.4.1.5.7 “State LEDs” on page 579*.

I/O configuration

The analog input module AI565 does not store configuration data itself.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Intern	6545[1)]	WORD	0x1991	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No 0x00			
Parameter length	Intern	52 (4+48)	BYTE	0	0	255	xx02[2)]
Check Supply	Off On	0 1	BYTE	On 0x01			
Analog Data Format	Default	0	BYTE	Default 0x00		255	

[1)]with CS31 and addresses less than 70, the value is increased by 1

[2)]Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n)

GSD file:

Ext_User_Prm_Data_Len =	0x37
Ext_User_Prm_Data_Const(0) =	0x92, 0x19, 0x34, \ 0x01, 0x00, \ 48(0x00);

Input channel (4x)

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.
Channel configuration	*Table 160 “Channel configuration” on page 577*		BYTE	0 0x00	0	65535

Table 160: Channel configuration

Internal value	Operating modes for the analog inputs, individually configurable
0	Not used (default)
8	2-wire Pt100 -50 °C ... +400 °C
9	3-wire Pt100 -50 °C ... +400 °C
16	2-wire Pt1000 -50 °C ... +400 °C
17	3-wire Pt1000 -50 °C ... +400 °C
18	2-wire Ni1000 -50 °C ... +150 °C
19	3-wire Ni1000 -50 °C ... +150 °C
22	2-wire Ni100 -50 °C ... +150 °C
23	3-wire Ni100 -50 °C ... +150 °C
32	Analog input resistance 0 Ω ... 150 Ω

Internal value	Operating modes for the analog inputs, individually configurable
33	Analog input resistance 0 Ω ... 300 Ω
70	NTC 2-wire

Diagnosis

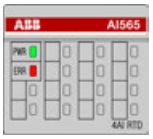
E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500 display	<− Display in	
Class	Comp	Dev	Mod	Ch	Err	AB SW		
Byte 6 Bit 6 ... 7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0 ... 5	PNIO diagnosis block		
Class	Interface	Device	Module	Channel	Error Identifier	Error message		Remedy
	1)	2)	3)	4)				
Module error								
3	14	1 ... 10	31	31	19	Checksum error in the I/O module		Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer		Restart
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	26	Parameter error		Check master
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	11	Process voltage too low		Check process voltage
	11 / 12	ADR	1 ... 10					
Channel error								
4	14	1 ... 10	1	0...3	48	Analog value overflow at an analog input		Check input value or terminal
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	1	0...3	7	Analog value underflow at an analog input		Check input value
	11 / 12	ADR	1 ... 10					

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = expansion module 1 ... 10, ADR = hardware address (e. g. of the DC551-CS31)

3)	With "Module" the following allocation applies dependent of the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1...10 Channel error: I/O bus or PNIO = module type (1 = AI); COM1/COM2: 1 ... 10 = expansion 1 ... 10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON	LED flashes
	PWR	Process voltage 24 V DC via terminal	Green	CPU module voltage or external 24 V DC supply voltage is missing	3.3 V system voltage (I/O bus) and external 24 V DC supply voltage are present	---
	ERR	Channel or module error	Red	No error or process voltage is missing	Severe error in the module	Error on 1 or more channels of the module

Measuring ranges

Risk of invalid analog input values!

The analog input values may be invalid if the measuring range of the inputs is exceeded.

Make sure that the analog signal at the connection terminals is always within the signal range.

Resistance temperature detectors

Range	Pt100 / Pt1000 -50 °C ... +400 °C	Ni1000 / Ni100 -50 °C ... +150 °C	Digital value	
			Decimal	Hex.
Overflow	> +450.0 °C	> +160.0 °C	32767	7FFF
Measured value too high	+450.0 °C : +400.1 °C		4500 : 4001	1194 : 0FA1
		+160.0 °C : +150.1 °C	1600 : 1501	0640 : 05DD

Range	Pt100 / Pt1000 -50 °C ... +400 °C	Ni1000 / Ni100 -50 °C ... +150 °C	Digital value	
			Decimal	Hex.
Normal range	+400.0 °C : : : : + 0.1 °C	 +150.0 °C : : + 0.1 °C	4000 2000 1500 700 : 1	0FA0 07D0 05DC 02BC : 1
	0,0 °C	0.0 °C	0	0000
	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-1 : -500	FFFF : FE0C
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-501 : -600	FE0B : FDA8
Underflow	< -60.0 °C	< -60.0 °C	-32768	8000

Resistances

Range	Resistance 0 Ω ... 150 Ω	Resistance 0 Ω ... 300 Ω	Digital value	
			Decimal	Hex.
Overflow	>176.383 Ω	>352.767 Ω	32767	7FFF
Measured value too high	176.383 Ω 150.005 Ω	352.767 Ω 300.011 Ω	32511 27649	7EFF 6C01
Normal range	150.000 Ω : 0.005 Ω	300.000 Ω : 0.011 Ω	27648 : 1	6C00 : 0001
	0 Ω	0 Ω	0	0000

NTC

Range	Calculated value (°C)	Measured value (Ω)	Digital value	
			Decimal	Hex.
Short circuit	*>> 223.6*	30	32767	7FFF
Overflow	*> 223.6*	< 100	32767	7FFF
Temperature medium accuracy	*223.5* : *108.7*	100 : 801	*2235* : *1087*	*08BB* : *043E*

Range	Calculated value (°C)	Measured value (Ω)	Digital value	
			Decimal	Hex.
Normal range	*108.6* : *25.1*	803.06 : 9961	*1086* : *251*	*043D* : *00FB*
	25.0	10000	*250*	*00FA*
	24.9 : *-24.7*	10039 : 100000	*249* : *-247*	*00F9* : *FF09*
Temperature medium accuracy	*-24.8* : *-36.5*	100558 : 200000	*-248* : *-365*	*FF08* : *FE93*
Underflow	*< -36.6*	> 200000	-32768	8000
Wire break	*<< -36.6*	> 400000	-32768	8000

Variable measuring range

With the NTC, a resistance is measured. Depending on the values R, T and B a temperature value can be calculated, from which the digital values (dec. and hex.) are derived.

The table above shows an example with the default value:

- *R = 10000 Ω*
- *T = 25 °C*
- *B = 3435 K*

Technical data

Technical data of the module

The system data of AC500-eCo apply.

↳ *Chapter 4.1 “System data AC500-eCo” on page 25*

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage UP		
	Connections	Terminal 19 for UP (+24 V DC) and terminal 20 for ZP (0 V)
	Rated value	24 V DC
	Current consumption	0.03 A
	Inrush current (at power-up)	Typ. 0.1 A^2s; Max. 0.16 A^2s
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Protection fuse for UP	Yes, external additional fuse recommended

Parameter	Value
Current consumption from 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module	Ca. 5 mA
Galvanic isolation	Yes, between the input group and the rest of the module. Isolation voltage 500 V DC.
Isolated groups	1 (4 channels per group)
Surge-voltage (max.)	35 V DC for 0.5 s
Max. power dissipation within the module	0.8 W
Weight	Ca. 120 g
Mounting position	Horizontal or vertical
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

Technical data of the analog inputs

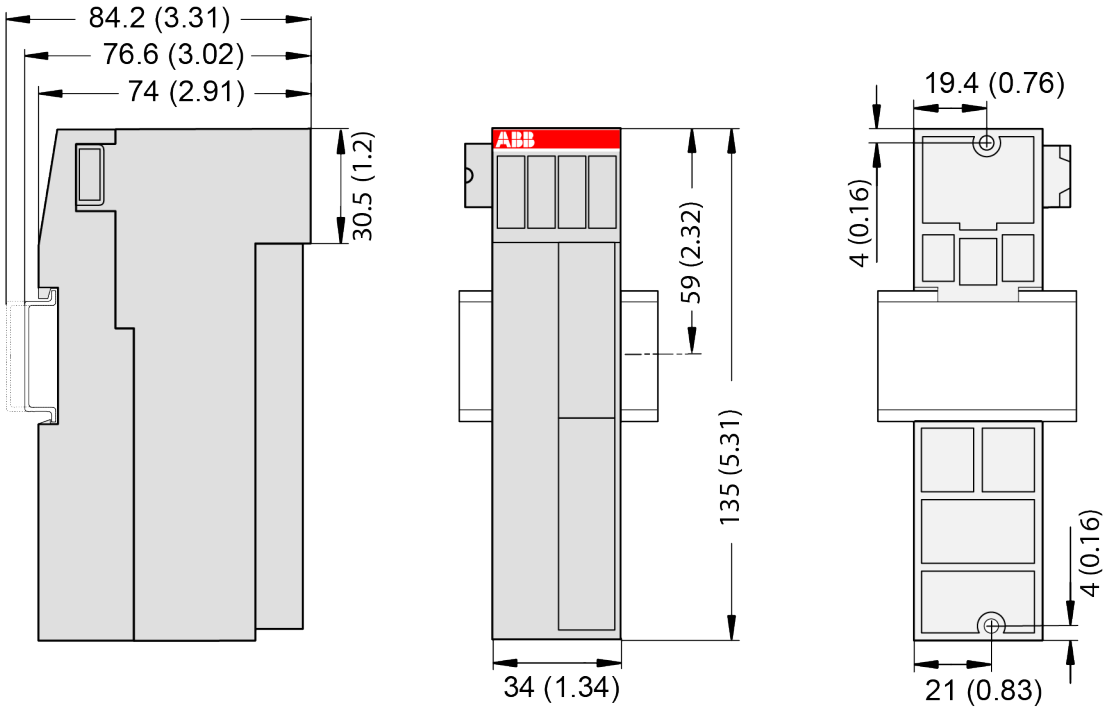
Parameter	Value	
Number of channels per module	4 configurable RTD (resistance temperature detector) inputs	
Distribution of channels into groups	1 (4 channels per group)	
Resolution		
RTD	0.1 °C	
Resistance	150 Ω: 1 LSB (5.4 mΩ); 300 Ω: 1 LSB (10.8 mΩ)	
NTC	0.1 °C	
Connection of the signals O0+ to O3+	Terminals 1, 4, 10 and 13	
Connection of the signals I0+ to I3+	Terminals 2, 5, 11 and 14	
Connection of the signals I0- to I3-	Terminals 3, 6, 12 and 15	
Input type	Module ground referenced RTD for 2-wire and 3-wire resistance temperature detectors	
Galvanic isolation	Against internal power supply and other modules. Isolation voltage 500 V DC.	
Input ranges	Pt100, Pt1000, Ni100, Ni1000	
	150 Ω, 300 Ω	
	NTC	
Indication of the input signals	No	
Module update time	All channels: < 1 s	
Channel input resistance	> 100 kΩ	
Input filter attenuation	-3 dB at 3.6 kHz	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range[1)]	Pt100, Pt1000, 300 Ω	Typ. ±0.05 % of full scale at +25 °C
		Max. ±0.2 % of full scale at -20 °C ... +60 °C; ±0.5 % of full scale at EMC disturbances

Parameter		Value	
		Ni100, Ni1000, 150 Ω	Typ. ±0.1 % of full scale at +25 °C
			Max. ±0.2 % of full scale at -20 °C ... +60 °C; ±0.5 % of full scale at EMC disturbances
		NTC Reference sensor R: 10000 Ω, T: 25 °C B: 3435 K accuracy specified in the range 806 Ω ... 100 kΩ	Typ. ±0.1 % of full scale at 25 °C Max. ±0.2 % of full scale at -20 °C ... +60 °C; ±0.5 % of full scale at EMC disturbances
Measuring range		*Chapter 5.4.4.1.5.8 “Measuring ranges” on page 579*	
Analog to digital conversion time		Typ. 140 ms per channel	
Unused inputs		Can be left open and should be configured as "unused"	
Input data length		8 bytes	
Power dissipation inside the sensor (max.)		1 mW	
Suppression of interference		On request	
Maximum input voltage		30 V DC (sense), 5 V DC (source)	
Basic error (resistance)		0.1 % of full-scale	
Repeatability		0.05 % of full-scale	
Overvoltage protection		Yes, up to 30 V DC	
Wire loop resistance		< 20 Ω	
Max. cable length (conductor cross section > 0.14 mm^2)			
	Unshielded wire	50 m	
	Shielded wire	200 m	

Remarks:

1)	If 2-wire connection is selected, use parameter cable compensation to achieve the guaranteed measuring accuracy.

Dimensions



The dimensions are in mm and in brackets in inch.

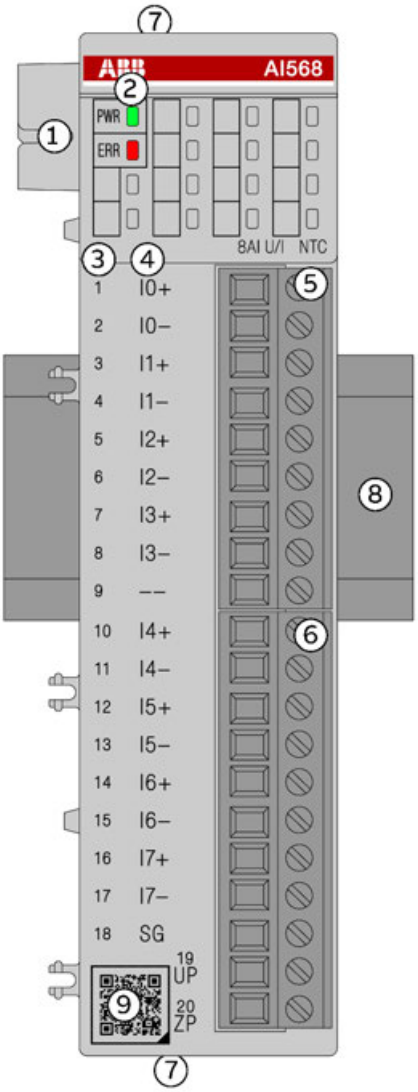
Ordering data

Part no.	Description	Product life cycle phase *)
1SAP235600R0000	AI565, analog input module, 4 AI, RTD	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.4.4.1.6 AI568 - Analog input module

- 8 configurable analog inputs (I0 ... I7) in 1 group
- Resolution: 13 bits including sign



1 I/O bus
2 1 green LED to display power supply, 1 red LED to display error
3 Terminal number
4 Allocation of signal name
5 Terminal block for input signals (9-pin)
6 Terminal block for input signals (11-pin)
7 2 holes for wall-mounting with screws
8 DIN rail
9 QR code for datasheet

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI50x-PNIO, CI51x-ETHCAT, CN52x- MODTCP, CI54x-DP, CI58x-CN) or as a centralized extension module for AC500 CPUs.

The inputs are not galvanically isolated from each other.

The other electronic circuitry including I/O bus of the module is galvanically isolated from the intputs.

Functionality

8 analog inputs, individually configurable:

- Not used (default setting)
- -2.5 V ... +2.5 V
- -5 V ... +5 V
- -10 V … +10 V
- 0 V ... +5 V
- 0 V ... +10 V
- 0 mA ... 20 mA
- 4 mA ... 20 mA
- NTC (2-wires)

Parameter		Value
Resolution of the analog channels		
	Voltage bipolar (-2.5 V ... +2.5 V; -5 V ... +5 V; -10 V … +10 V)	13 bits including sign
	Voltage unipolar (0 V ... 5 V; 0 V ... 10 V)	12 bits
	Current (0 mA ... 20 mA; 4 mA ... 20 mA)	12 bits
	Temperature	0.1 °C
LED displays		2 LEDs for process voltage and error messages
Internal supply		Via I/O bus
External supply		Via the terminals UP (process voltage 24 V DC) and ZP (0 V DC); the ZP terminal is isolated from the M terminal of the CPU via the digital isolator

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection is carried out by using a removable 9-pin and 11-pin terminal block. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

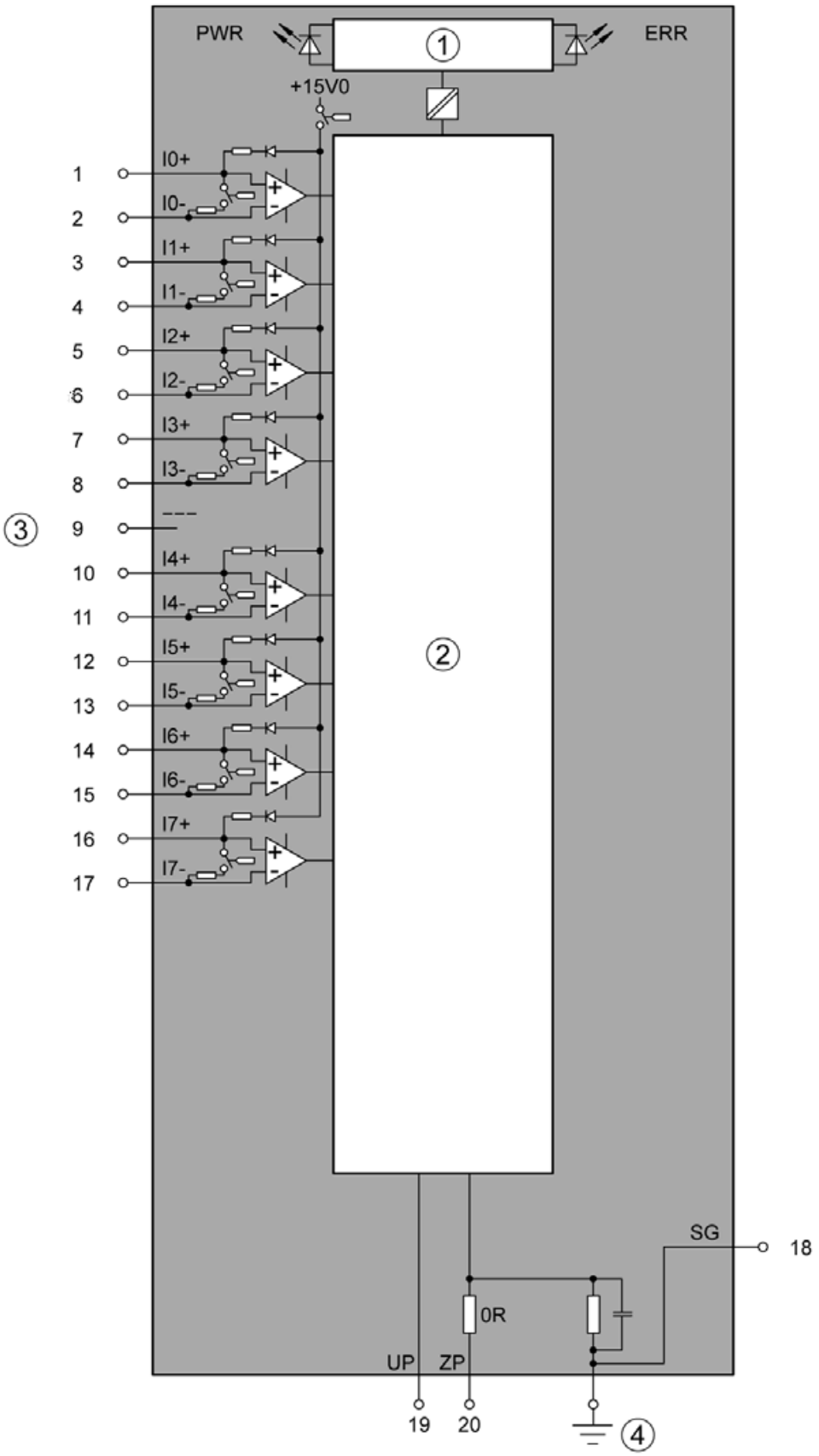


Fig. 73: Internal construction of the analog inputs

1 I/O bus interface and MCU core circuit
2 ADC, logic circuit and DC/DC power
3 Analog inputs
4 Functional earth connection

Table 161: Assignment of the terminals

Terminal	Signal	Description
1	I0+	Positive pole of input signal 0
2	I0-	Negative pole of input signal 0
3	I1+	Positive pole of input signal 1
4	I1-	Negative pole of input signal 1
5	I2+	Positive pole of input signal 2
6	I2-	Negative pole of input signal 2
7	I3+	Positive pole of input signal 3
8	I3-	Negative pole of input signal 3
9	---	Reserved
10	I4+	Positive pole of input signal 4
11	I4-	Negative pole of input signal 4
12	I5+	Positive pole of input signal 5
13	I5-	Negative pole of input signal 5
14	I6+	Positive pole of input signal 6
15	I6-	Negative pole of input signal 6
16	I7+	Positive pole of input signal 7
17	I7-	Negative pole of input signal 7
18	SG	Shield grounding
19	UP	Process voltage UP (24 V DC)
20	ZP	Process voltage ZP (0 V DC)

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 3 mA per AI568.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals. The ZP terminal is isolated from the M/ZP terminal of the CPU/communication interface module.

NOTICE!

Risk of imprecise and faulty measurements!

Analog signals may be severely distorted due to external electromagnetic interference.

When the length of the connection cable exceeds 20 m, a shielded and grounded cable must be used. When the shield is grounded at both ends, an independent low-impedance equipotential connection should be provided to avoid high potential differences between interconnected devices.

NOTICE!

Risk of damaging the PLC modules!

The PLC modules must not be removed while the plant is connected to a power supply.

Make sure that all voltage sources (supply and process voltage) are switched off before you do the following:

– Connect or disconnect any signal or terminal block.
– Remove or replace a module.

NOTICE!

Risk of damaging the PLC modules!

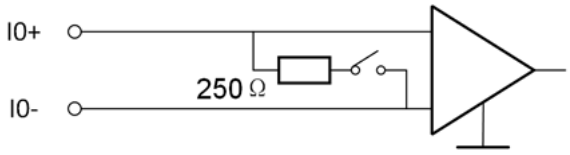
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The module provides several diagnosis functions.

Chapter 5.4.4.1.6.6 “Diagnosis” on page 593

The following figure is an example of the internal construction of the analog input AI0. The analog inputs AI1 ... AI7 are designed in the same way.

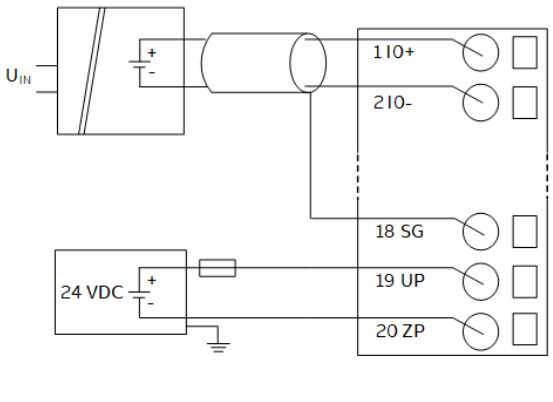
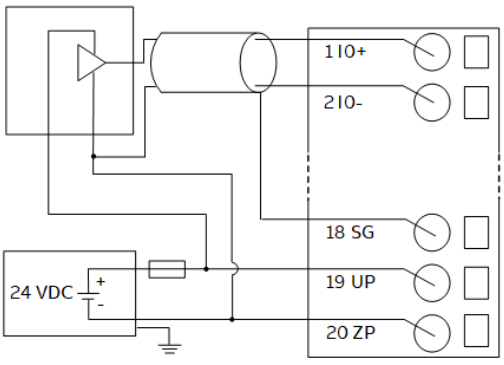


CAUTION!

Risk of damaging the analog input!

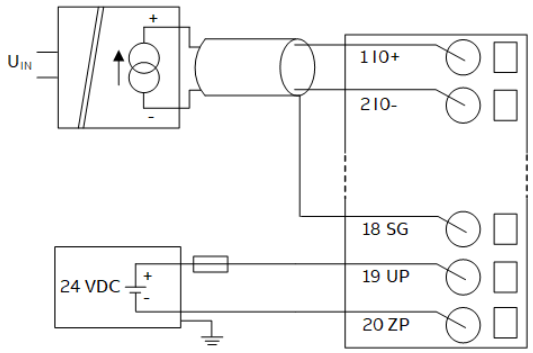
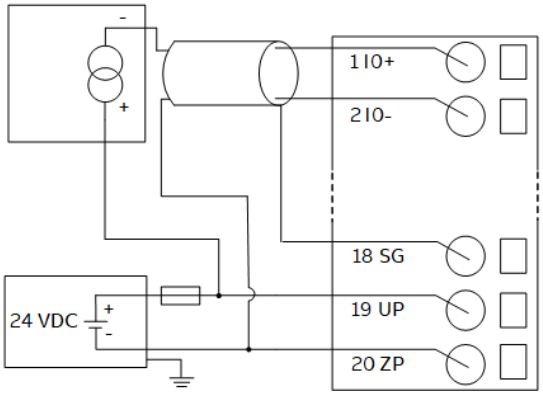
Make sure that the current through the resistor never exceeds 30 mA.

Table 162: Example of the connection of analog sensors (voltage) to the input I0 of the analog input module AI568 (Proceed with the inputs I1 ... I7 in the same way)

	
Connection of active-type analog sensors (voltage)	Connection of passive-type analog sensors (voltage)

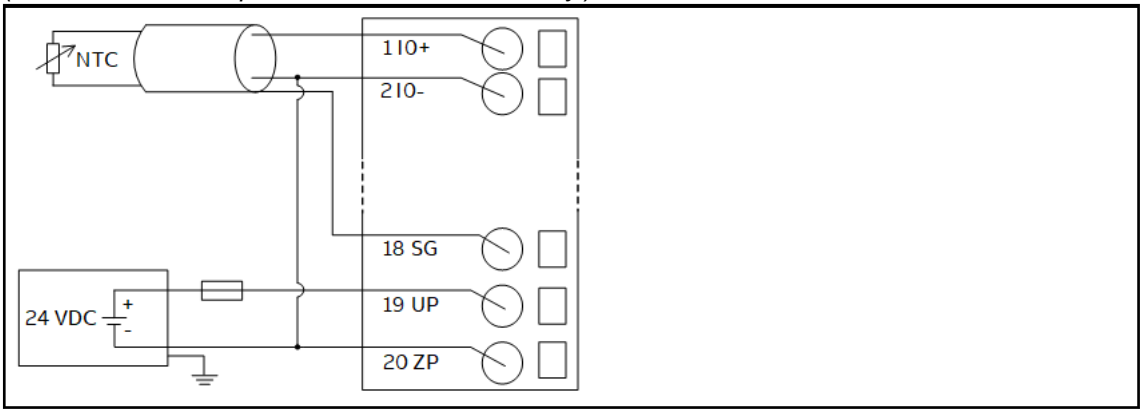
Connection of active-type analog sensors (voltage)	Connection of passive-type analog sensors (voltage)
-2.5 V ... 2.5 V	-2.5 V ... 2.5 V
-5 V ... 5 V	-5 V ... 5 V
-10 V ... 10 V	-10 V ... 10 V
0 V ... 5 V	0 V ... 5 V
0 V ... 10 V	0 V ... 10 V

Table 163: Example of the connection of analog sensors (current) to the Input I0 of the analog input module AI568 (Proceed with the inputs I1 ... I7 in the same way.)

	
Connection of active-type analog sensors (current)	Connection of passive-type analog sensors (current)

Connection of active-type analog sensors (current)	Connection of passive-type analog sensors (current)
4 mA ... 20 mA	4 mA ... 20 mA
0 mA ... 20 mA	

Table 164: Example of the connection of NTC to the Input I0 of the analog input module AI568 (Proceed with the inputs I1 ... I7 in the same way.)



Connection of NTC
803 Ω ... 100 kΩ

Meaning of the LEDs

I/O configuration

The analog input module AI568 does not store configuration data itself.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Intern	6525 [1])	WORD	0x197d	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No 0x00			
Parameter length	Internal	44	BYTE	0	0	255	xx02 [2])
Check Supply	Off On	0 1	BYTE	On 0x01			
Analog Data Format	Default	0	BYTE	Default 0x00		255	

[1]) with CS31 and addresses smaller than 70, the value is increased by 1

[2]) Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n)

Table 165: GSD file

Ext_User_Prm_Data_Len =	0x0C
Ext_User_Prm_Data_Const(0) =	0x7e, 0x19, 0x2c,\ 0x01,0x00,\ 0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00;

Input channel (8x)

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.
Channel configuration	see table [2])	see table [2])	BYTE	0 0x00	0	65535

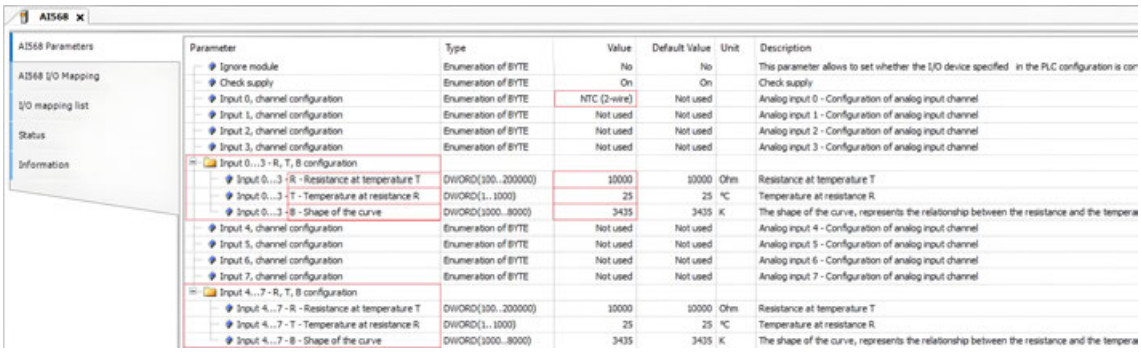
Table 166: Channel configuration [2])

Internal value	Operating modes for the analog inputs, individually configurable
0	Not used (default)
3	0 mA ... 20 mA
4	4 mA ... 20 mA
5	-10 V … +10 V
6	0 V ... 5 V
7	-5 V ... +5 V
10	0 V ... 10 V
20	-2.5 V ... +2.5 V
61	NTC

NTC configuration

The arrangement of the parameter data is performed with Automation Builder software.

1. In the device tree, double-click the desired option board.
2. Select the *“AI568 Parameters”* tab to edit the parameterization of the desired option board.



3. The eight inputs are set to *“Not used”* by default.

   Select your 8 individually configurable analog inputs.

4. **The following steps are only required for the NTC (2-wire) selection.**

   If you have selected NTC (2-wire) on input 0 (1) , a folder Input 0 (1) - R, T, B configuration appears.

> ***Data sheet of used NTC***
>
> *Take the following values from the data sheet of the NTC used.*
>
> – *Resistance at temperature T [Ω]*
> – *Temperature at resistance R [°C] (the reference temperature is usually 25 °C)*
> – *B [K] - The shape of the curve, represents the relationship between the resistance and the temperature of a particular thermistor.*

Diagnosis

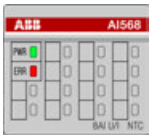
E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000 ... 063**	**AC500 display**	**<− Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**AB SW**		
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**PNIO diagnosis block**		
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**		**Remedy**
	[1])	[2])	[3])	[4])				
Module error								
3	14	1 ... 10	31	31	19	Checksum error in the I/O module		Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer		Restart
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	26	Parameter error		Check master
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	11	Process voltage too low		Check process voltage
	11 / 12	ADR	1 ... 10					
Channel error								
4	14	1 ... 10	1	0 ... 7	4	Analog value overflow at an analog input		Check input value
	11 / 12	ADR	1 ... 0					
4	14	1 ... 10	1	0 ... 7	7	Analog value under-flow at an analog input		Check input value
	11 / 12	ADR	1 ... 0					
4	14	1 ... 10	1	0 ... 7	47	Short circuit at analog input		Check the wiring
	11 / 12	ADR	1 ... 0					
4	14	1 ... 10	1	0 ... 7	48	Broken wire at an analog input		Check input value or ter-minal
	11 / 12	ADR	1 ... 0					

Table 167: Remarks

[1])	In AC500, the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = expansion module 1 ... 10, ADR = hardware address (e. g. of the DC551-CS31)

[3])	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or PNIO = module type (1 = AI); COM1/COM2: 1 ... 10 = expansion 1 ... 10
[4])	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON	LED flashes
	PWR	Process voltage 24 V DC via terminal	Green	CPU module voltage or external 24 V DC supply voltage is missing	3.3 V system voltage (I/O bus) and external 24 V DC supply voltage are present	---
	ERR	Channel or module error	Red	No error or process voltage is missing	Severe error in the module	Error on 1 or more channels of the module

Measuring ranges

Risk of invalid analog input values!

The analog input values may be invalid if the measuring range of the inputs is exceeded.

Make sure that the analog signal at the connection terminals is always within the signal range.

Range	-2.5 ... +2.5 V	-5 ... +5 V	-10 … +10 V	0 ... 5 V	0 ... 10 V	0 ... 20 mA	4 ... 20 mA	Digital value	
								Decimal	Hex.
Overflow	>2.9397	>5.8795	>11.7589	>5.8795	>11.7589	>23.5178	>22.8142	32767	7FFF
Measured value too high	2.9397 : 2.5014	5.8795 : 5.0029	11.7589 : 10.0058 : :	5.8795 : : : 5.0015	11.7589 : : : 10.0029	23.5178 : : : 20.0058	22.8142 : : 20.0058	32511 : 27664 27658 27656	7EFF : 6C10 6C0A 6C08

Range	-2.5 ... +2.5 V	-5 ... +5 V	-10 … +10 V	0 ... 5 V	0 ... 10 V	0 ... 20 mA	4 ... 20 mA	Digital value	
								Dec-imal	Hex.
Normal range Normal range or meas-ured value too low	2.5000 : 0.0014	5.0000 : 0.0029	10.0000 : 0.0058 :	5.0000 : : 0.0015	10.0000 : : 0.0029	20.0000 : : : 0.0058	20.0000 : : 4.0058	27648 : 16 10 8	6C00 : 0010 000A 0008
	0.0000	0.0000	0.0000	0.0000	0.0000	0	4	0	0000
	: -0.0014 : : : -2.5000	: -0.0029 : : : -5.0000	: -0.0058 : : : -10.000 0				3.9994 1.1858	-10 -16 -4864 -6912 : -27648	FFF6 FFF0 ED00 E500 : 9400
Meas-ured value too low	-2.5014 : -2.9398	-5.0029 : -5.8795	-10.005 8 : -11.758 9					-27664 : -32512	93F0 : 8100
Under-flow	<-2.939 8	<-5.879 5	<-11.75 89	<-0.030 0	<-0.060 0	<-0.120 0	<1.185 8	-32768	8000

The represented resolution corresponds to 13 bits including sign.

Variable measuring range

With the NTC, a resistance is measured. Depending on the values R, T and B a temperature value can be calculated, from which the digital values (dec. and hex.) are derived.

The following table shows an example with the default value:

- *R = 10000 Ω*
- *T = 25 °C*
- *B = 3435 K*

Table 168: Measuring range: NTC

Range/	Calculated value	Measured value [Ω]	Digital value	
			Decimal	Hex.
Short circuit	*>> 223.6 °C*	30	32767	7FFF
Overflow	*> 223.6 °C*	< 100	32767	7FFF
Temperature medium accu-racy	*223.5 °C* : *108.7 °C*	100 : 801	*2235* : *1087*	*08BB* : *043E*

Range/	Calculated value	Measured value [Ω]	Digital value	
			Decimal	Hex.
Normal range	*108.6 °C* : *25.1 °C*	803.06 : 9961	*1086* : *251*	*043D* : *00FB*
	25.0	10000	*250*	*00FA*
	24.9 °C : *-24.7 °C*	10039 : 100000	*249* : *-247*	*00F9* : *FF09*
Temperature medium accuracy	*-24.8 °C* : *-36.5 °C*	100558 : 200000	*-248* : *-365*	*FF08* : *FE93*
Underflow	*< -36.6 °C*	> 200000	-32768	8000
Wire break	*<< -36.6 °C*	> 400000	-32768	8000

Technical data

Technical data of the module

The system data of AC500-eCo apply.

↳ *Chapter 4.1 “System data AC500-eCo” on page 25*

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage UP		
	Connections	Terminal 19 for UP (+24 V DC) and terminal 20 for ZP (0 V)
	Rated value	24 V DC
	Current consumption via UP terminal	Max. 50 mA
	Inrush current (at power up)	Typ. 0.1 A^2s; Max. 0.16 A^2s
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Protection fuse for UP	Yes, external additional fuse recommended
Current consumption from 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module		Max. 3 mA
Galvanic isolation		Galvanic isolated from system
Surge-voltage (max.)		35 V DC for 0.5 s
Max. power dissipation within the module*		Max. 2 W
Weight		Ca. 120 g

Parameter	Value
Mounting position	Horizontal or vertical
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

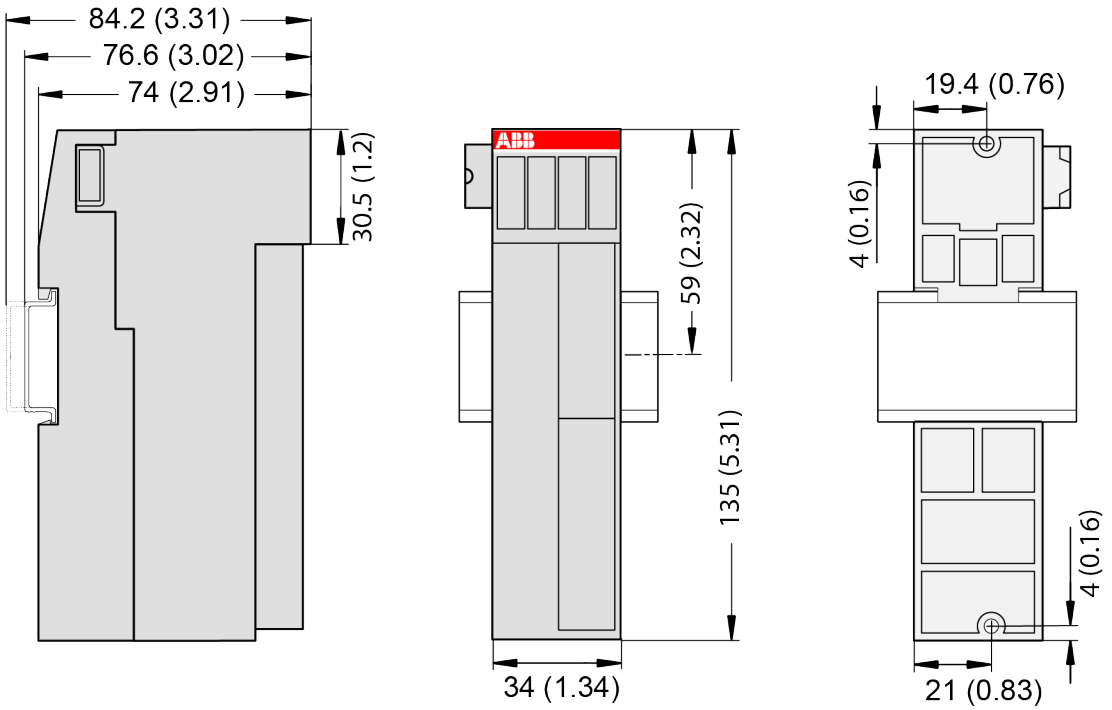
* As a reference to evaluate the temperature rise of the module.

Technical data of the analog inputs

Parameter		Value	
Number of channels per module		8 individually configurable voltage or current inputs	
Distribution of channels into groups		1 (8 channels per group)	
Resolution			
	Unipolar	Voltage 0 V ... +5 V; 0 V ... +10 V: 12 bits Current 0 mA ... 20 mA; 4 mA ... 20 mA: 12 bits	
	Bipolar	Voltage -2.5 V ... +2.5 V; -5 V ... +5 V; -10 V ... +10 V: 13 bits including sign	
	NTC	0.1 °C	
Connection of the signals I0- to I7-		Terminals 2, 4, 6, 8, 11, 13, 15, 17	
Connection of the signals I0+ to I7+		Terminals 1, 3, 5, 7, 10, 12, 14, 16	
Input type		Differential	
Galvanic isolation		500 Vdc	
Common mode input range		Max. ±15 V compared to ZP	
Indication of the input signals		No	
Channel input resistance		Voltage: > 1 MΩ Current: ca. 250 Ω	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ.	± 0.1 % of full scale at +25 °C
		Max.	± 0.3 % of full scale at -20 °C ... + 60 °C or EMC disturbance
		NTC Reference sensor R: 10000 Ω, T: 25 °C B: 3435 K accuracy specified in the range 806 Ω ... 100 kΩ	Typ. ± 0.3 % of full scale at 25 °C Max. ± 0.5 % of full scale at-20 °C ... +60 °C or EMC disturbances
Time constant of the input filter		Voltage: 150 µs Current: 150 µs	
Relationship between input signal and hex code		Unipolar, full-scale range, 0 … 32767 Bipolar, full-scale range, -32768 … 32767	
Analog to digital conversion time		Typ. 500 µs per channel	
Unused inputs		Can be left open and should be configured as "unused"	
Input data length		16 bytes	

Parameter		Value
Overvoltage protection		Yes, up to 30 V DC only for voltage input
Max. cable length (conductor cross section > 0,14 mm²)		
	Unshielded wire	20 m
	Shielded wire	100 m

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP235200R0000	AI568, analog input module, 8 AI U/I, 2-wire NTC	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active

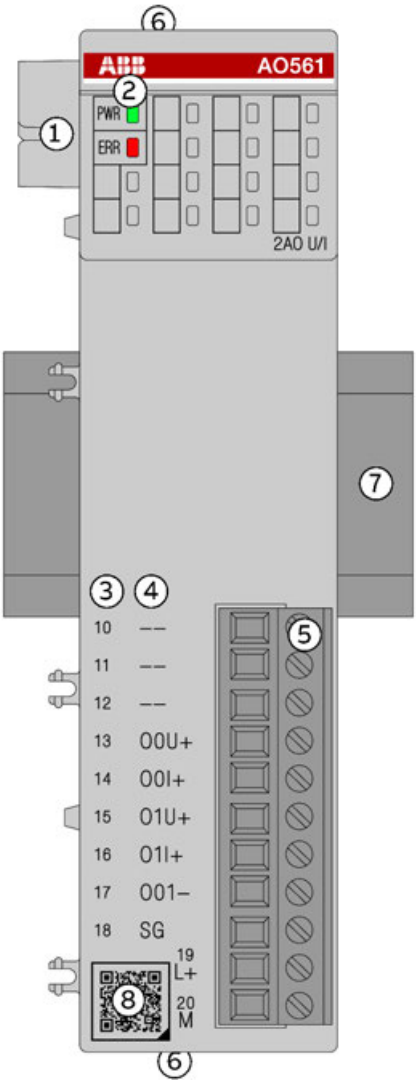
Part no.	Description	Product life cycle phase *)
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active



**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.4.4.1.7 AO561 - Analog output module

- 2 configurable analog outputs (O0 ... O1) in 1 group
- Resolution: 12 bits including sign (13 bits including sign for version E0 or later)



1 I/O bus
2 1 green LED to display power supply, 1 red LED to display error
3 Terminal number
4 Allocation of signal name
5 Terminal block for output signals (11-pin)
6 2 holes for wall-mounting with screws
7 DIN rail
8 QR code for datasheet

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The outputs are not galvanically isolated from each other.

The other electronic circuitry of the module is not galvanically isolated from the outputs or from the I/O bus.

The I/O module must not be used as communication interface module at CI590-CS31-HA bus modules.

Functionality

2 analog outputs, individually configurable for

- Not used (default setting)
- -10 V ... +10 V
- 0 mA ... 20 mA
- 4 mA ... 20 mA

Parameter		Value
Resolution of the analog channels		
	Voltage bipolar (-10 V ... +10 V)	12 bits including sign; 13 bits including sign for version E0 or later
	Current (0 mA ... 20 mA; 4 mA ... 20 mA)	12 bits
LED displays		2 LEDs for process voltage and error messages
Internal supply		Via I/O bus
External supply		Via the terminals L+ (process voltage 24 V DC) and M (0 V DC); the M terminal is connected to the M terminal of the CPU via the I/O bus

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

If the output is configured as not used, the voltage and current output signals are undefined and must not be connected.

The connection is carried out by using a removable 11-pin terminal block. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

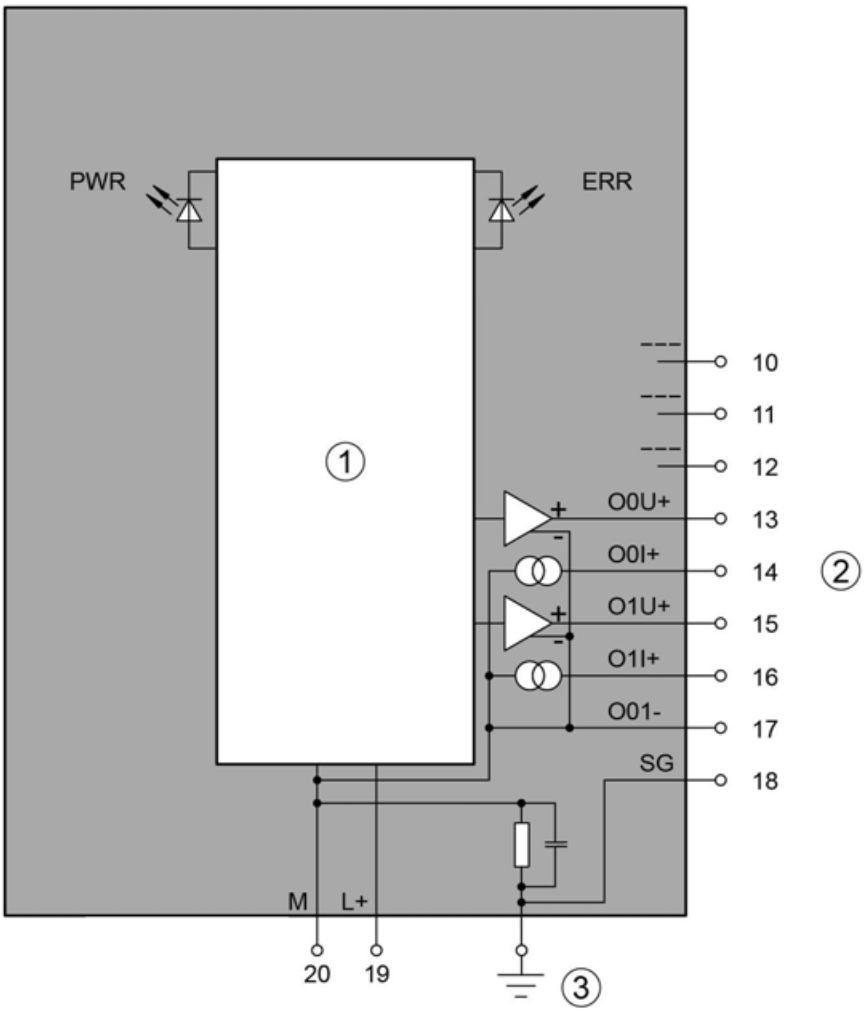


Fig. 74: Internal construction of the analog outputs

1 Logic - I/O bus inteface
2 Analog outputs
3 Functional earth connection

The assignment of the terminals:

Terminal	Signal	Description
10	---	Reserved
11	---	Reserved
12	---	Reserved
13	O0U+	Voltage output of channel 0
14	O0I+	Current output of channel 0
15	O1U+	Voltage output of channel 1
16	O1I+	Current output of channel 1
17	O01-	Negative pole of channels O0 and O1
18	SG	Shield grounding
19	L+	Process voltage L+ (24 V DC)
20	M	Process voltage M (0 V DC)

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module increases by 5 mA per AO561.

The external power supply connection is carried out via the L+ (+24 V DC) and the M (0 V DC) terminals. The M terminal is electrically interconnected to the M/ZP terminal of the CPU/ communication interface module.

NOTICE!

Risk of imprecise and faulty measurements!

Analog signals may be severely distorted due to external electromagnetic interference.

When the length of the connection cable exceeds 20 m, a shielded and grounded cable must be used. When the shield is grounded at both ends, an independent low-impedance equipotential connection should be provided to avoid high potential differences between interconnected devices.

NOTICE!

Risk of damaging the PLC modules!

The PLC modules must not be removed while the plant is connected to a power supply.

Make sure that all voltage sources (supply and process voltage) are switched off before you do the following:

– Connect or disconnect any signal or terminal block.
– Remove or replace a module.

NOTICE!

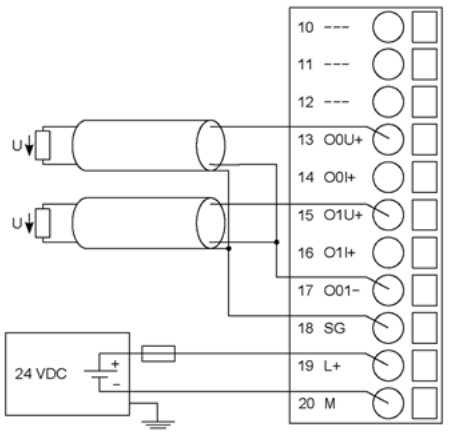
Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

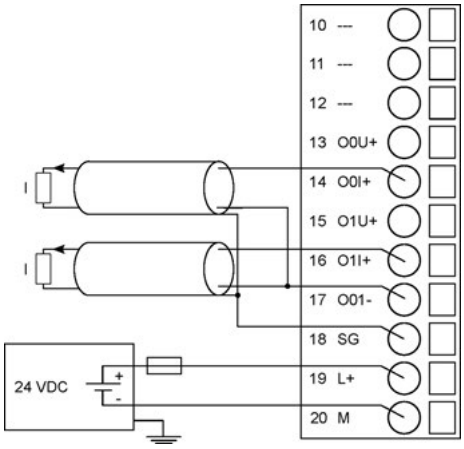
– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The module provides several diagnosis functions ↳ *Chapter 5.4.4.1.7.6 “Diagnosis” on page 606*.

Table 169: Connection of analog actuators to the analog output module AO561



Connection of analog voltage actuators



Connection of analog current actuators

The output signal is undefined if the supply voltage at the L+ terminal is below 10 V. This can, for example, occur if the supply voltage has a slow ramp-up / ramp-down behavior and must be foreseen when planning the installation.

If the output is configured in current mode, the voltage output signal is undefined and must not be connected.

If the output is configured in voltage mode, the current output signal is undefined and must not be connected.

I/O configuration

The analog output module AO561 does not store configuration data itself.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Intern	6515 [1])	WORD	0x1973	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No 0x00			
Parameter length	Intern	4	BYTE	0	0	255	xx02 [2])
Check Supply	Off On	0 1	BYTE	On 0x01			

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
Analog Data Format	Default	0	BYTE	Default 0x00		255	
[1]) with CS31 and addresses less than 70, the value is increased by 1 [2]) Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n)							

GSD file:

Ext_User_Prm_Data_Len =	0x07
Ext_User_Prm_Data_Const(0) =	0x74, 0x19, 0x04, \ 0x01, 0x00, \ 0x00, 0x00, 0x00, 0x00;

Output channel (2x)

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.
Channel configuration	see table [2])	see table [2])	BYTE	0 0x00 see table [2])	0	65535

Table 170: Channel configuration [2])

Internal value	Operating modes for the analog outputs, individually configurable
0	Not used (default)
128	-10 V ... +10 V
129	0 mA ... 20 mA
130	4 mA ... 20 mA

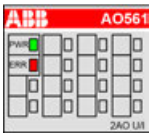
Diagnosis

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000 ... 063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**AB SW**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])			
Module error							
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1 ... 10				
Channel error							
4	14	1 ... 10	3	0 ... 1	48	Analog value overflow at an analog output	Check output value or terminal
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	3	0 ... 1	7	Analog value underflow at an analog output	Check output value
	11 / 12	ADR	1 ... 10				

Remarks:

[1])	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = expansion module 1 ... 10, ADR = hardware address (e. g. of the DC551-CS31)
[3])	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or PNIO = module type (3 = AO); COM1/COM2: 1 ... 10 = expansion 1 ... 10
[4])	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON	LED flashes
	PWR	Process voltage 24 V DC via terminal	Green	CPU module voltage or external 24 V DC supply voltage is missing	3.3 V system voltage (I/O bus) and external 24 V DC supply voltage are present	---
	ERR	Channel or module error	Red	No error or process voltage is missing	Severe error in the module	Error on 1 or more channels of the module

Output ranges

Range	-10 ... +10 V	0 ... 20 mA	4 ... 20 mA	Digital value	
				Decimal	Hex.
Overflow	0	0	0	32767	7FFF
Value too high	11.7589	23.5178	22.8142	32511	7EFF
	:	:	:	:	:
	10.0058	:	:	27664	6C10
	:	:	20.0058	27658	6C0A
	:	20.0058	:	27656	6C08
Normal range	10.0000	20.0000	20.0000	27648	6C00
Normal range or value too low	:	:	:	:	:
	0.0058	:	:	16	0010
	:	:	4.0058	10	000A
	:	0.0058		8	0008
	0.0000	0	4	0	0000
	:		3.9942	-10	FFF6
	-0.0058		:	-16	FFF0
	:		:	-4864	ED00
	:		0	-6912	E500
	:			:	:
	-10.0000			-27648	9400
Value too low	-10.0058			-27664	93F0
	:			:	:
	-11.7589			-32512	8100
Underflow	0		0	<32512	<8100

The represented resolution corresponds to 12 bits including sign.

Technical data

Technical data of the module

The system data of AC500-eCo apply.

↳ *Chapter 4.1 “System data AC500-eCo” on page 25*

Only additional details are therefore documented below.

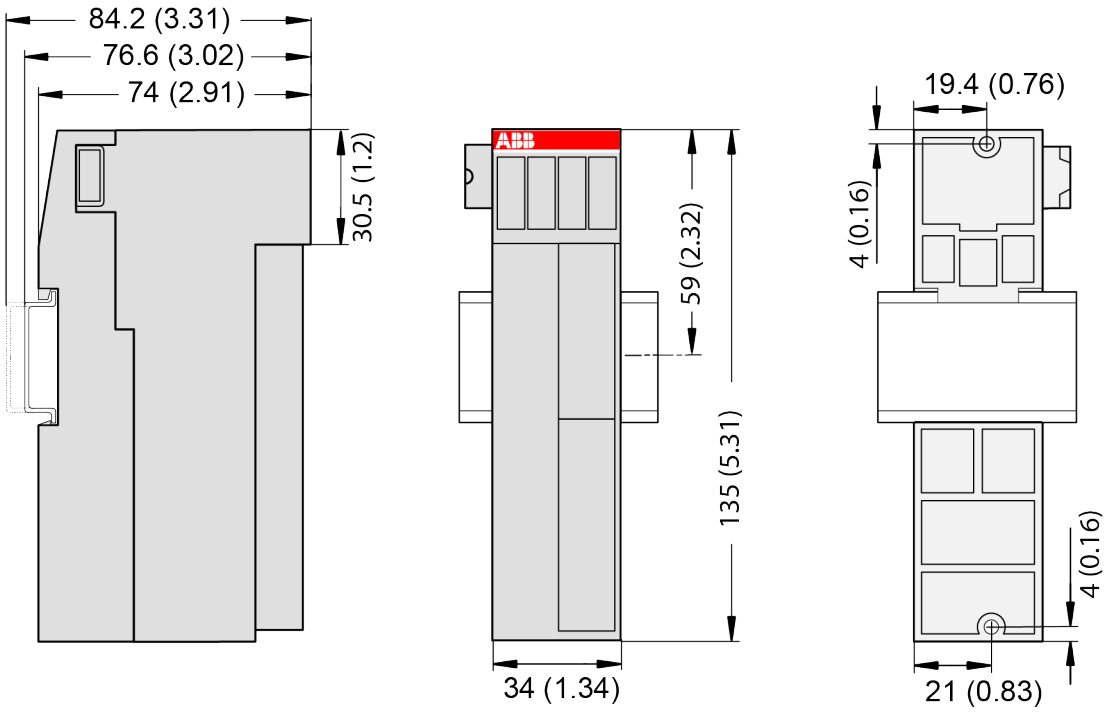
Parameter		Value
Process supply voltage L+		
	Connections	Terminal 19 for L+ (+24 V DC) and terminal 20 for M (0 V)
	Rated value	24 V DC
	Current consumption	0.1 A + output load; 0.01 A + output load (version E0 or later)
	Inrush current (at power-up)	Typ. 0.1 A²s; Max. 0.16 A²s
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Protection fuse for L+	Yes, external additional fuse recommended
Current consumption from 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module		Ca. 5 mA
Galvanic isolation		No
Surge-voltage (max.)		35 V DC for 0.5 s
Max. power dissipation within the module		3.1 W; 1 W (version E0 or later)
Weight		Ca. 120 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

Technical data of the analog outputs

Parameter	Value	
Number of channels per module	2 configurable voltage or current outputs	
Distribution of channels into groups	1 (2 channels per group)	
Connection of the signals O0U+ and O1U+	Terminals 13 and 15	
Connection of the signals O0I+ and O1I+	Terminals 14 and 16	
Output type	Bipolar with voltage, unipolar with current	
Resolution	12 bits including sign; 13 bits including sign (version E0 or later)	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ.	± 0.5 % of full scale at +25 °C

Parameter		Value	
		Max.	± 2 % of full scale at 0 °C ... +60 °C or EMC disturbances
Indication of the output signals		No	
Output Resistance (load) as current output		0 Ω ... 500 Ω	
Output load ability as voltage output		± 2 mA max.	
Output data length		4 bytes	
Relationship between output signal and hex code		*Chapter 5.4.4.1.7.8 "Output ranges" on page 607*	
Unused outputs		Must not be connected and must be configured as "unused"	
Output protection		Voltage: short circuit Current: reverse	
Max. cable length (conductor cross section > 0.14 mm²)			
	Unshielded wire	On request	
	Shielded wire	100 m	

Dimensions



The dimensions are in mm and in brackets in inch.

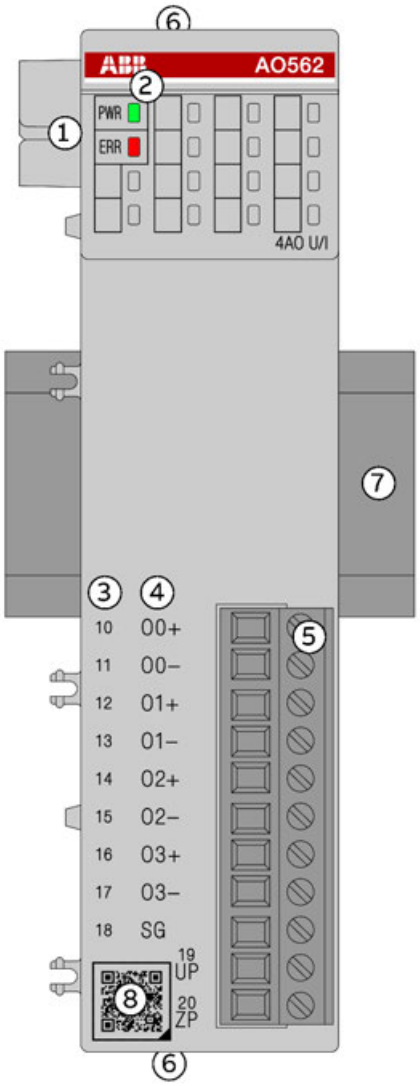
Ordering data

Part no.	Description	Product life cycle phase *)
1TNE 968 902 R1201	AO561, analog output module, 2 AO, U/I	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.4.4.1.8 AO562 - Analog output module

- 4 configurable analog outputs (O0 ... O3) in 1 group
- Resolution: 13 bits including sign



1 I/O bus
2 1 green LED to display power supply, 1 red LED to display error
3 Terminal number
4 Allocation of signal name
5 Terminal block for output signals (11-pin)
6 2 holes for wall-mounting with screws
7 DIN rail
8 QR code for datasheet

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI50x-PNIO, CI51x-ETHCAT, CN52x- MODTCP, CI54x-DP, CI58x-CN) or as a centralized extension module for AC500 CPUs.

The outputs are not galvanically isolated from each other.

The other electronic circuitry including I/O bus of the module is galvanically isolated from the outputs.

Functionality

4 analog outputs, individually configurable

- Not used (default setting)
- 0 V … 10 V
- -10 V ... +10 V
- 0 mA ... 20 mA
- 4 mA ... 20 mA

Parameter		Value
Resolution of the analog channels		
	Voltage unipolar (0 V … 10 V)	12 bits
	Voltage bipolar (-10 V ... +10 V)	13 bits including sign
	Current (0 mA ... 20 mA; 4 mA ... 20 mA)	12 bits
LED displays		2 LEDs for process voltage and error messages
Internal supply		Via I/O bus
External supply		Via the terminals UP (process voltage 24 V DC) and ZP (0 V DC); the ZP terminal is isolated from the M terminal of the CPU via the digital isolator

Connections



For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.



If the output is configured as not used, the voltage and current output signals are undefined and must not be connected.

The connection is carried out by using a removable 11-pin terminal block. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

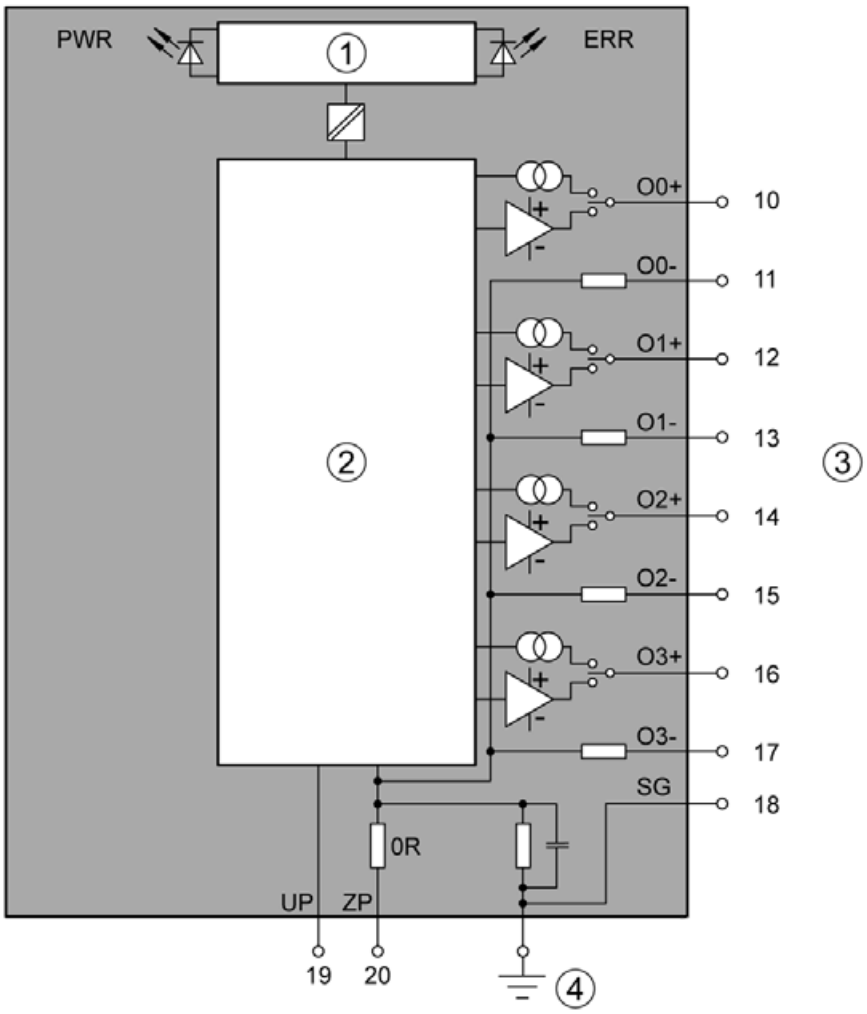


Fig. 75: Internal construction of the analog outputs

1 I/O bus interface and MCU core circuit
2 DAC, logic circuit and DC/DC power
3 Analog outputs
4 Functional earth connection

Table 171: Assignment of the terminasl

Terminal	Signal	Description
10	O0+	Positive pole of the output signal 0
11	O0-	Negative pole of the output signal 0
12	O1+	Positive pole of the output signal 1
13	O1-	Negative pole of the output signal 1
14	O2+	Positive pole of the output signal 2
15	O2-	Negative pole of the output signal 2
16	O3+	Positive pole of the output signal 3
17	O3-	Negative pole of the output signal 3
18	SG	Shield grounding
19	UP	Process voltage UP (24 V DC)
20	ZP	Process voltage ZP (0 V DC)

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module increases by 3 mA per AO562.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals. The ZP terminal is isolated from the M/ZP terminal of the CPU/communication interface module.

NOTICE!

Risk of imprecise and faulty measurements!

Analog signals may be severely distorted due to external electromagnetic interference.

When the length of the connection cable exceeds 20 m, a shielded and grounded cable must be used. When the shield is grounded at both ends, an independent low-impedance equipotential connection should be provided to avoid high potential differences between interconnected devices.

NOTICE!

Risk of damaging the PLC modules!

The PLC modules must not be removed while the plant is connected to a power supply.

Make sure that all voltage sources (supply and process voltage) are switched off before you do the following:

– Connect or disconnect any signal or terminal block.
– Remove or replace a module.

NOTICE!

Risk of damaging the PLC modules!

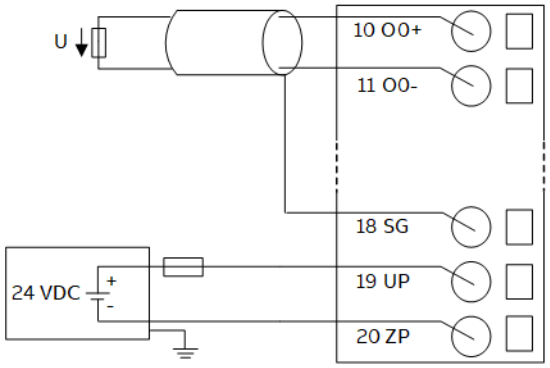
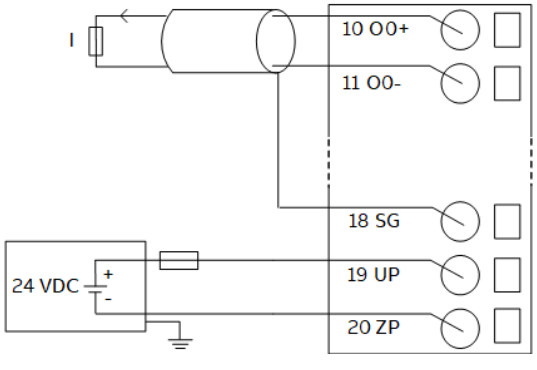
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The module provides several diagnosis functions.

↳ *Chapter 5.4.4.1.8.6 “Diagnosis” on page 616*

Table 172: Example of the connection of analog actuators to the output O0 of the analog output module AO562

	
Connection of analog voltage actuators	Connection of analog current actuators

I/O configuration

The analog output module AO562 does not store configuration data itself.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Intern	6530[1])	WORD	0x1982	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No 0x00			
Parameter length	Intern	15	BYTE	0	0	255	xx02 [2])
Check Supply	Off On	0 1	BYTE	On 0x01			
Analog Data Format	Default	0	BYTE	Default 0x00		255	
[1]) with CS31 and addresses less than 70, the value is increased by 1 [2]) Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n)							

Table 173: GSD file

Ext_User_Prm_Data_Len =	0x09
Ext_User_Prm_Data_Const(0) =	0x83, 0x19, 0x0f,\ 0x01,0x00,\ 0x00,0x00,0x00,0x00;

Output channel (4x)

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.
Channel configuration	see table [2])	see table [2])	BYTE	0 0x00 see table [2])	0	65535

Table 174: Channel configuration [2])

Internal value	Operating modes for the analog outputs, individually configurable
0	Not used (default)
128	-10 V ... +10 V
129	0 mA ... 20 mA
130	4 mA ... 20 mA
132	0 V ... +10 V

Diagnosis

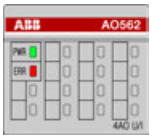
E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500 display	<− Display in	
Class	Comp	Dev	Mod	Ch	Err	AB SW		
Byte 6 Bit 6 ... 7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0 ... 5	PNIO diagnosis block		
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**		**Remedy**
	[1])	[2])	[3])	[4])				
Module error								
3	14	1 ... 10	31	31	19	Checksum error in the I/O module		Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer		Restart
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	26	Parameter error		Check master
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	11	Process voltage too low		Check process voltage
	11 / 12	ADR	1 ... 10					

E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500 display	<– Display in	
Class	Comp	Dev	Mod	Ch	Err	AB SW		
Byte 6 Bit 6 ... 7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0 ... 5	PNIO diagnosis block		
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**		**Remedy**
	[1])	[2])	[3])	[4])				
Channel error								
4	14	1 ... 10	3	0 ... 3	48	Analog value overflow at an analog output		Check output value or terminal
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	3	0 ... 3	7	Analog value underflow at an analog output		Check output value
	11 / 12	ADR	1 ... 10					

Table 175: Remarks

[1])	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = expansion module 1 ... 10, ADR = hardware address (e. g. of the DC551-CS31)
[3])	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or PNIO = module type (3 = AO); COM1/COM2: 1 ... 10 = expansion 1 ... 10
[4])	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON	LED flashes
	PWR	Process voltage 24 V DC via terminal	Green	CPU module voltage or external 24 V DC supply voltage is missing	3.3 V system voltage (I/O bus) and external 24 V DC supply voltage are present	---
	ERR	Channel or module error	Red	No error or process voltage is missing	Severe error in the module	Error on 1 or more channels of the module

Output ranges

Range	0 … 10 V	-10 ... +10 V	0 ... 20 mA	4 ... 20 mA	Digital value	
					Decimal	Hex.
Overflow	0	0	0	0	32767	7FFF
Value too high	11.7589 : 10.0058 : :	11.7589 : 10.0058 : :	23.5178 : : : 20.0058	22.8142 : : 20.0058 :	32511 : 27664 27658 27656	7EFF : 6C10 6C0A 6C08
Normal range Normal range or value too low	10.0000 : 0.0058 : :	10.0000 : 0.0058 : :	20.0000 : : : 0.0058	20.0000 : : 4.0058	27648 : 16 10 8	6C00 : 0010 000A 0008
	0.0000	0.0000	0	4	0	0000
		: -0.0058 : : : -10.0000		3.9942 : : 0	-10 -16 -4864 -6912 : -27648	FFF6 FFF0 ED00 E500 : 9400
Value too low		-10.0058 : -10.7500			-27664 : -29722	93F0 : 8BE6
Underflow	0	0	0	0	<-29722	<8BE6

The represented resolution corresponds to 13 bits including sign.

Technical data

Technical data of the module

The system data of AC500-eCo apply.

Chapter 4.1 “System data AC500-eCo” on page 25

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage UP		
	Connections	Terminal 19 for UP (+24 V DC) and terminal 20 for ZP (0 V)
	Rated value	24 V DC
	Current consumption	0.05 A + output load
	Inrush current (at power-up)	Typ. 0.19 A^2s; Max. 0.32 A^2s

Parameter		Value
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Protection fuse for UP	Yes, external additional fuse recommended
Current consumption from 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module		Ca. 3 mA
Galvanic isolation		Yes
Surge-voltage (max.)		35 V DC for 0.5 s
Max. power dissipation within the module*		2.0 W
Weight		Ca. 120 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

* As a reference to evaluate the temperature rise of the module.

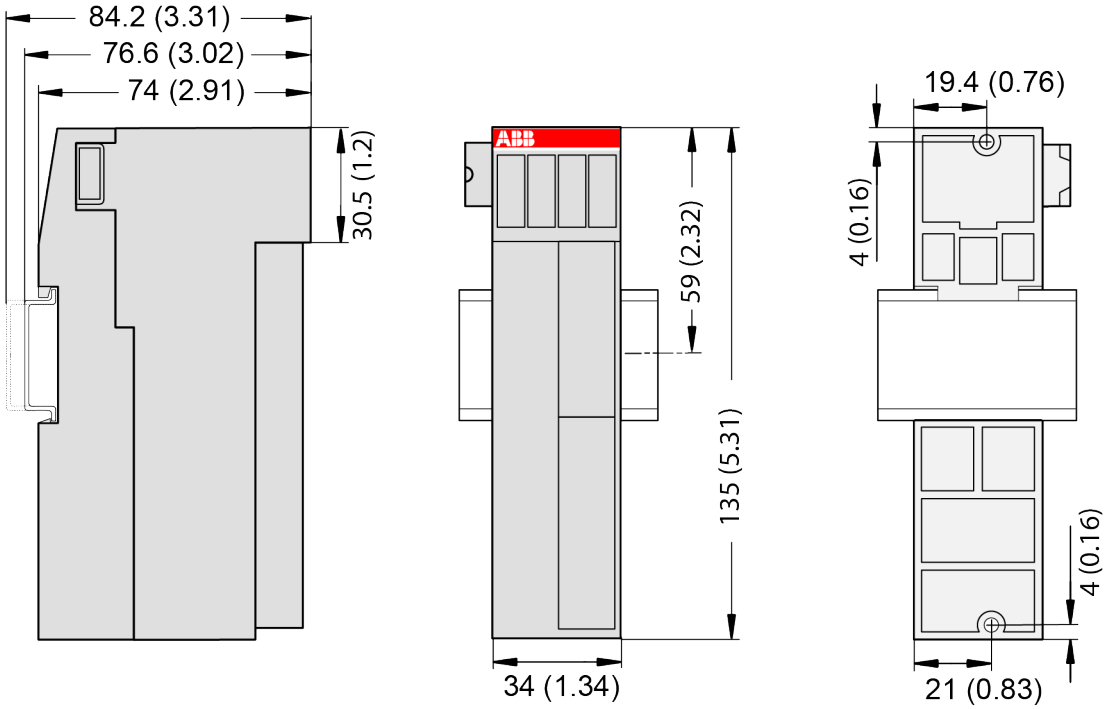
Technical data of the analog outputs

Parameter		Value
Number of channels per module		4 individually configurable voltage or current outputs
Distribution of channels into groups		1 (4 channels per group)
Resolution		
	Unipolar	Voltage 0 V ... 10 V: 12 bits Current 0 mA ... 20 mA; 4 mA ... 20 mA: 12 bits
	Bipolar	Voltage -10 V ... +10 V: 13 bits including sign
Connection of the signals O0- to O3-		Terminals 11, 13, 15, 17
Connection of the signals O0+ to O3+		Terminals 10, 12, 14, 16
Output type		Bipolar with voltage, unipolar with current
Galvanic isolation		500 Vdc
Indication of the output signals		No
Output Resistance (load) as current output		0 Ω ... 500 Ω
Output load ability as voltage output		± 2 mA max.
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		± 0.3 % of full scale at +25 °C (Typ.)
		± 0.5 % of full scale at -20 °C ... +60 °C or EMC disturbance (Max.)
Relationship between output signal and hex code		Unipolar, full-scale range, 0 … 32767 Bipolar, full-scale range, -32768 … 32767
Digital to analog coversion time		Typ. 1ms per channel
Unused outputs		Can be left open and should be configured as "unused"

Parameter		Value
Output data length		total 8 bytes, 2 bytes per channel
Output protection		Voltage: short circuit Current: reverse
Max. cable length *(conductor cross section > 0.14 mm²)		
	Unshielded wire	20 m
	Shielded wire	100 m

*The accuracy of voltage output might be influenced if the cable connection is long. The accuracy error caused by it is equal to "Rcable / (Rcable + Rload) * 100%"

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

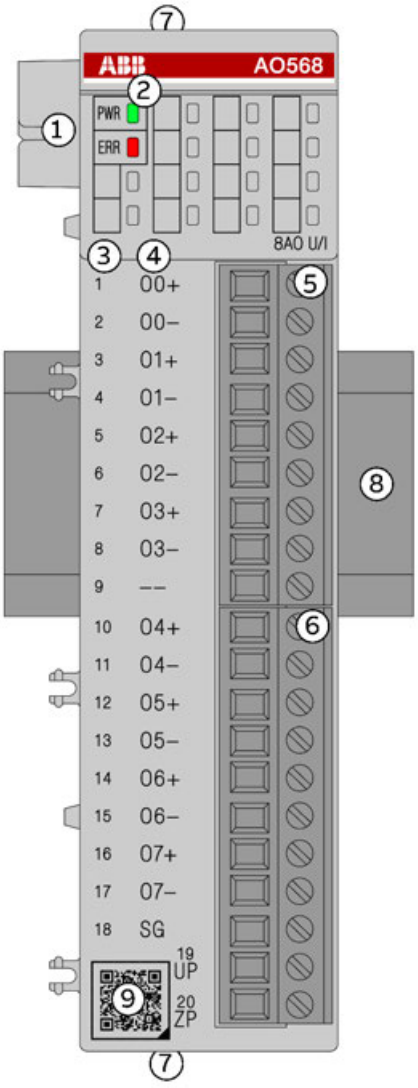
Part no.	Description	Product life cycle phase *)
1SAP235300R0000	AO562, analog output module, 4 AO U, I	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active

Part no.	Description	Product life cycle phase *)
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

*) *Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.4.4.1.9 AO568 - Analog output module

- 8 configurable analog outputs (O0 ... O7) in 1 group
- Resolution: 13 bits including sign



1 I/O bus
2 1 green LED to display power supply, 1 red LED to display error

3 Terminal number
4 Allocation of signal name
5 Terminal block for output signals (9-pin)
6 Terminal block for output signals (11-pin)
7 2 holes for wall-mounting with screws
8 DIN rail
9 QR code for datasheet

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI50x-PNIO, CI51x-ETHCAT, CN52x- MODTCP, CI54x-DP, CI58x-CN) or as a centralized extension module for AC500 CPUs.

The outputs are not galvanically isolated from each other.

The other electronic circuitry including I/O bus of the module is galvanically isolated from the outputs.

Functionality

8 analog outputs, individually configurable for

- Not used (default setting)
- 0 V ... 10 V
- -10 V ... +10 V
- 0 mA ... 20 mA
- 4 mA ... 20 mA

Parameter		Value
Resolution of the analog channels		
	Voltage unipolar (0 V … 10 V)	12 bits
	Voltage bipolar (-10 V ... +10 V)	13 bits including sign
	Current (0 mA ... 20 mA; 4 mA ... 20 mA)	12 bits
LED displays		2 LEDs for process voltage and error messages
Internal supply		Via I/O bus
External supply		Via the terminals UP (process voltage 24 V DC) and ZP (0 V DC); the ZP terminal is isolated from the M terminal of the CPU via the digital isolator

Connections



For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.



If the output is configured as not used, the voltage and current output signals are undefined and must not be connected.

The connection is carried out by using a removable 9-pin and 11-pin terminal block. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

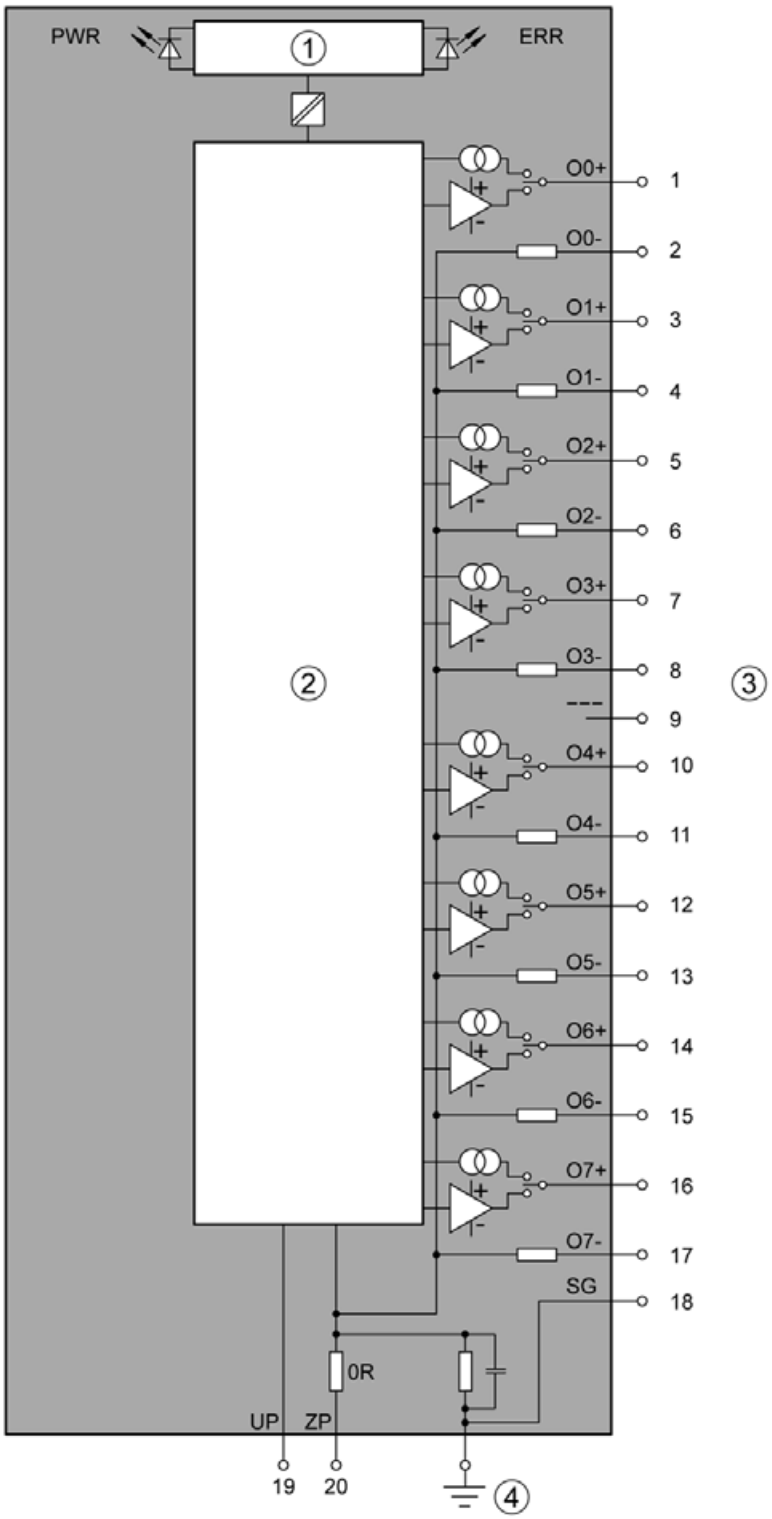


Fig. 76: Internal construction of the analog outputs

1 I/O bus interface and MCU core circuit
2 DAC, logic circuit and DC/DC power
3 Analog outputs
4 Functional earth connection

Table 176: Assignment of the terminals

Terminal	Signal	Description
1	O0+	Positive pole of the output signal 0
2	O0-	Negative pole of the output signal 0
3	O1+	Positive pole of the output signal 1
4	O1-	Negative pole of the output signal 1
5	O2+	Positive pole of the output signal 2
6	O2-	Negative pole of the output signal 2
7	O3+	Positive pole of the output signal 3
8	O3-	Negative pole of the output signal 3
9	---	Reserved
10	O4+	Positive pole of the output signal 4
11	O4-	Negative pole of the output signal 4
12	O5+	Positive pole of the output signal 5
13	O5-	Negative pole of the output signal 5
14	O6+	Positive pole of the output signal 6
15	O6-	Negative pole of the output signal 6
16	O7+	Positive pole of the output signal 7
17	O7-	Negative pole of the output signal 7
18	SG	Shield grounding
19	UP	Process voltage UP (24 V DC)
20	ZP	Process voltage ZP (0 V DC)

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module increases by 3 mA per AO568.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals. The ZP terminal is isolated from the M/ZP terminal of the CPU/communication interface module.

NOTICE!

Risk of imprecise and faulty measurements!

Analog signals may be severely distorted due to external electromagnetic interference.

When the length of the connection cable exceeds 20 m, a shielded and grounded cable must be used. When the shield is grounded at both ends, an independent low-impedance equipotential connection should be provided to avoid high potential differences between interconnected devices.

NOTICE!

Risk of damaging the PLC modules!

The PLC modules must not be removed while the plant is connected to a power supply.

Make sure that all voltage sources (supply and process voltage) are switched off before you do the following:

– Connect or disconnect any signal or terminal block.
– Remove or replace a module.

NOTICE!

Risk of damaging the PLC modules!

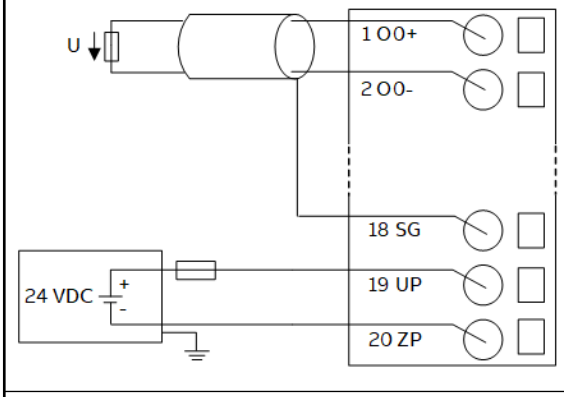
Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

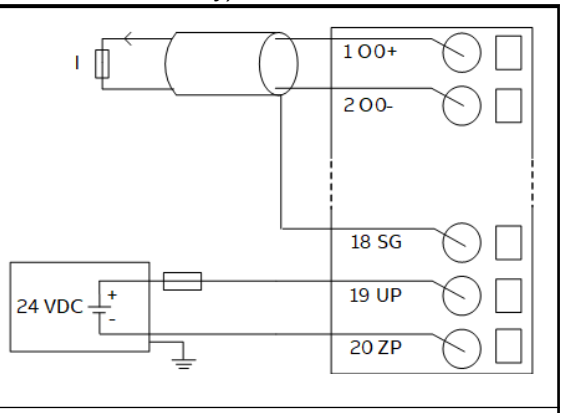
The module provides several diagnosis functions.

Chapter 5.4.4.1.9.6 “Diagnosis” on page 628

Table 177: Example of the connection of analog actuators to the output O0 of the analog output module AO568 (Proceed with the outputs O1 ... O7 in the same way)



Connection of analog voltage actuators



Connection of analog current actuators

I/O configuration

The analog output module AO568 does not store configuration data itself.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Intern	6535 [1])	WORD	0x1987	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No 0x00			
Parameter length	Intern	23	BYTE	0	0	255	xx02 [2])
Check Supply	Off On	0 1	BYTE	On 0x01			
Analog Data Format	Default	0	BYTE	Default 0x00		255	
[1]) with CS31 and addresses less than 70, the value is increased by 1 [2]) Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n)							

Table 178: GSD file

Ext_User_Prm_Data_Len =	0x0D
Ext_User_Prm_Data_Const(0) =	0x88, 0x19, 0x17,\ 0x01,0x00,\ 0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00;

Output channel (8x)

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.
Channel configura-tion	see table [2])	see table [2])	BYTE	0 0x00 see table [2])	0	65535

Table 179: Channel configuration [2])

Internal value	Operating modes for the analog outputs, individually configu-rable
0	Not used (default)
128	-10 V ... +10 V
129	0 mA ... 20 mA
130	4 mA ... 20 mA
132	0 V … 10 V

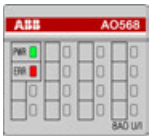
Diagnosis

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000 ... 063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**AB SW**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])			
Module error							
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1 ... 10				
Channel error							
4	14	1 ... 10	3	0 ... 7	48	Analog value overflow at an analog output	Check output value or terminal
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	3	0 ... 7	7	Analog value underflow at an analog output	Check output value
	11 / 12	ADR	1 ... 10				

Table 180: Remarks

[1])	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = expansion module 1 ... 10, ADR = hardware address (e. g. of the DC551-CS31)
[3])	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or PNIO = module type (3 = AO); COM1/COM2: 1 ... 10 = expansion 1 ... 10
[4])	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON	LED flashes
	PWR	Process voltage 24 V DC via terminal	Green	CPU module voltage or external 24 V DC supply voltage is missing	3.3 V system voltage (I/O bus) and external 24 V DC supply voltage are present	---
	ERR	Channel or module error	Red	No error or process voltage is missing	Severe error in the module	Error on 1 or more channels of the module

Output ranges

Range	0 … 10 V	-10 ... +10 V	0 ... 20 mA	4 ... 20 mA	Digital value	
					Decimal	Hex.
Overflow	0	0	0	0	32767	7FFF
Value too high	11.7589 : 10.0058 : :	11.7589 : 10.0058 : :	23.5178 : : : 20.0058	22.8142 : : 20.0058 :	32511 : 27664 27658 27656	7EFF : 6C10 6C0A 6C08
Normal range Normal range or value too low	10.0000 : 0.0058 : :	10.0000 : 0.0058 : :	20.0000 : : : 0.0058	20.0000 : : 4.0058	27648 : 16 10 8	6C00 : 0010 000A 0008
	0.0000	0.0000	0	4	0	0000
		: -0.0058 : : : -10.0000		3.9942 : : 0	-10 -16 -4864 -6912 : -27648	FFF6 FFF0 ED00 E500 : 9400
Value too low		-10.0058 : -10.7500			-27664 : -29722	93F0 : 8BE6
Underflow	0	0	0	0	< -29722	<8BE6

The represented resolution corresponds to 13 bits including sign.

Technical data

Technical data of the module

The system data of AC500-eCo apply.

Chapter 4.1 “System data AC500-eCo” on page 25

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage UP		
	Connections	Terminal 19 for UP (+24 V DC) and terminal 20 for ZP (0 V)
	Rated value	24 V DC
	Current consumption	0.05 A + output load
	Inrush current (at power-up)	Typ. 0.36 A^2s; Max. 0.62 A^2s
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Protection fuse for UP	Yes, external additional fuse recommended
Current consumption from 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module		Ca. 3 mA
Galvanic isolation		Yes
Surge-voltage (max.)		35 V DC for 0.5 s
Max. power dissipation within the module*		3.5 W
Weight		Ca. 120 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

* As a reference to evaluate the temperature rise of the module.

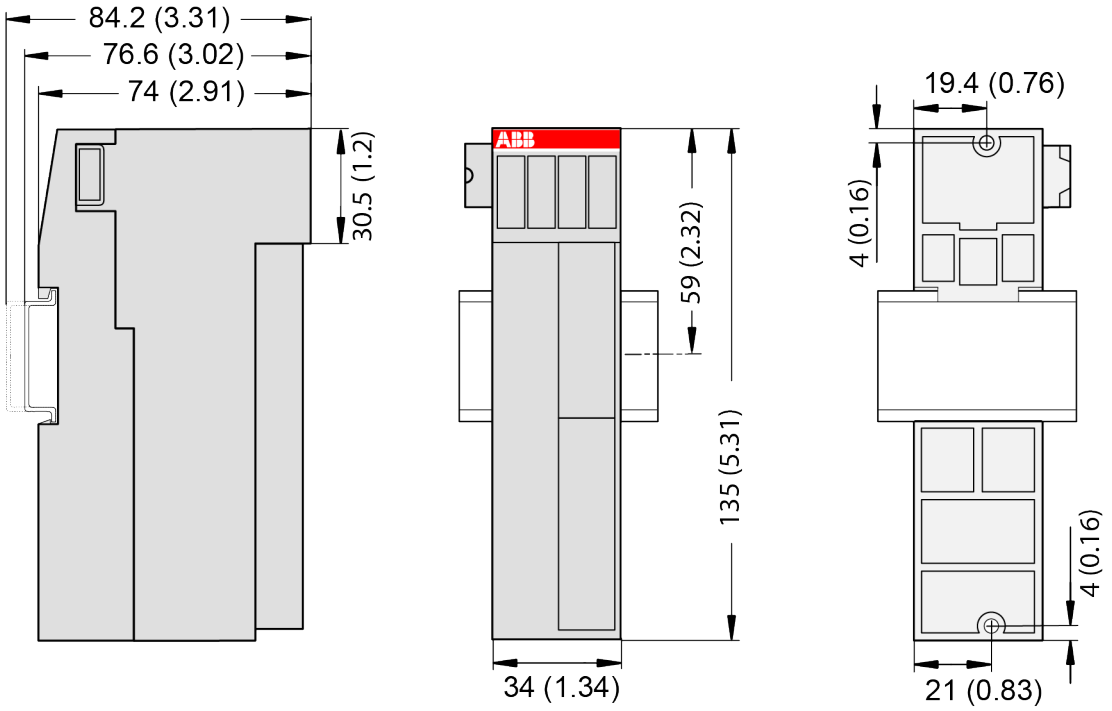
Technical data of the analog outputs

Parameter		Value
Number of channels per module		8 individually configurable voltage or current outputs
Distribution of channels into groups		1 (8 channels per group)
Resolution		
	Unipolar	Voltage 0 V ... 10 V: 12 bits Current 0 mA ... 20 mA; 4 mA ... 20 mA: 12 bits
	Bipolar	Voltage -10 V ... +10 V: 13 bits including sign
Connection of the signals O0- to O7-		Terminals 2, 4, 6, 8, 11, 13, 15, 17
Connection of the signals O0+ to O7+		Terminals 1, 3, 5, 7, 10, 12, 14, 16
Output type		Bipolar with voltage, unipolar with current
Galvanic isolation		500Vdc

Parameter		Value
Indication of the output signals		No
Output Resistance (load) as current output		0 Ω ... 500 Ω
Output load ability as voltage output		± 2 mA max.
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		± 0.3 % of full scale at +25 °C (Typ.)
		± 0.5 % of full scale at -20 °C ... +60 °C or EMC disturbances (Max.)
Relationship between output signal and hex code		Unipolar, full-scale range, 0 … 32767 Bipolar, full-scale range, -32768 … 32767
Digital to analog conversion time		Typ. 1ms per channel
Unused outputs		Can be left open (disconnected) and should be configured as "unused"
Output data length		Total 16 bytes, 2 bytes per channel
Output protection		Voltage: short circuit Current: reverse
Max. cable length* (conductor cross section > 0.14 mm^2)		
	Unshielded wire	20 m
	Shielded wire	100 m

*The accuracy of voltage output might be influenced if the cable connection is long. The accuracy error caused by it is equal to "Rcable / (Rcable + Rload) * 100%"

Dimensions



The dimensions are in mm and in brackets in inch.

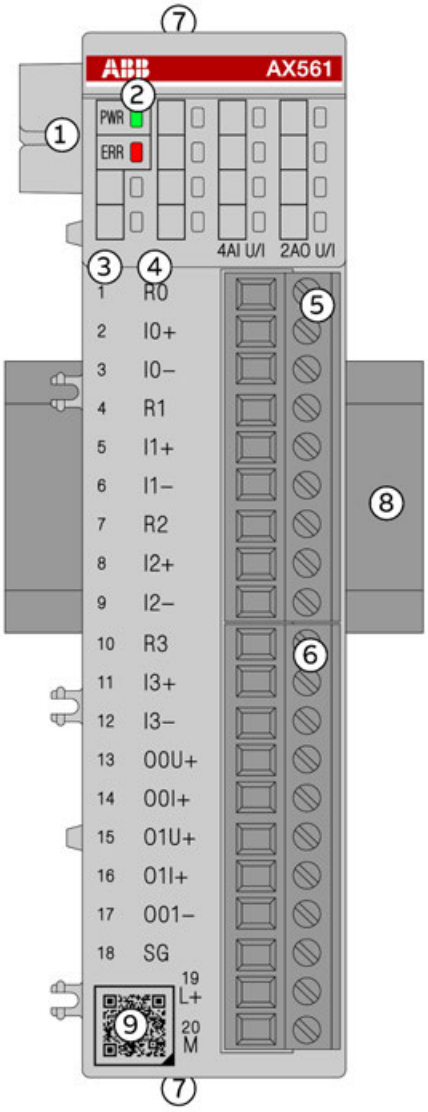
Ordering data

Part no.	Description	Product life cycle phase *)
1SAP235500R0000	AO568, analog output module, 8 AO U, I	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

5.4.4.1.10 AX561 - Analog input/output module

- 4 configurable analog inputs (I0 ... I3) in 1 group
- 2 configurable analog outputs (O0 and O1) in 1 group
- Resolution: 12 bits including sign (13 bits including sign for version E0 or later)



1 I/O bus
2 1 green LED to display power supply, 1 red LED to display error
3 Terminal number
4 Allocation of signal name
5 Terminal block for input signals (9-pin)
6 Terminal block for output signals (11-pin)
7 2 holes for wall-mounting with screws
8 DIN rail
9 QR code for datasheet

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The inputs are not galvanically isolated from each other.

The outputs are not galvanically isolated from each other.

All other circuitry of the module is not galvanically isolated from the inputs/outputs or from the I/O bus.



The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA communication interface modules.

Functionality

4 analog inputs, individually configurable:

- Not used (default)
- -2.5 V ... +2.5 V
- -5 V ... + 5 V
- 0 V ... +5 V
- 0 V ... +10 V
- 0 mA ... 20 mA
- 4 mA ... 20 mA

2 analog outputs, individually configurable:

- Not used (default)
- -10 V ... +10 V
- 0 mA ... 20 mA
- 4 mA ... 20 mA

Parameter		Value
Resolution of the analog channels		
	Voltage bipolar (-2.5 V ... +2.5 V; -5 V ... +5 V)	12 bits including sign; 13 bits including sign (version E0 or later)
	Voltage unipolar (0 V ... 5 V; 0 V ... 10 V)	12 bits
	Current (0 mA ... 20 mA; 4 mA ... 20 mA)	12 bits
LED displays		2 LEDs for process voltage and error messages
Internal supply		Via I/O bus
External supply		Via the terminals L+ (process voltage 24 V DC) and M (0 V DC); the M terminal is connected to the M terminal of the CPU via the I/O bus

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

If the output is configured as not used, the voltage and current output signals are undefined and must not be connected.

The connection is carried out by using a removable 9-pin and 11-pin terminal block. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

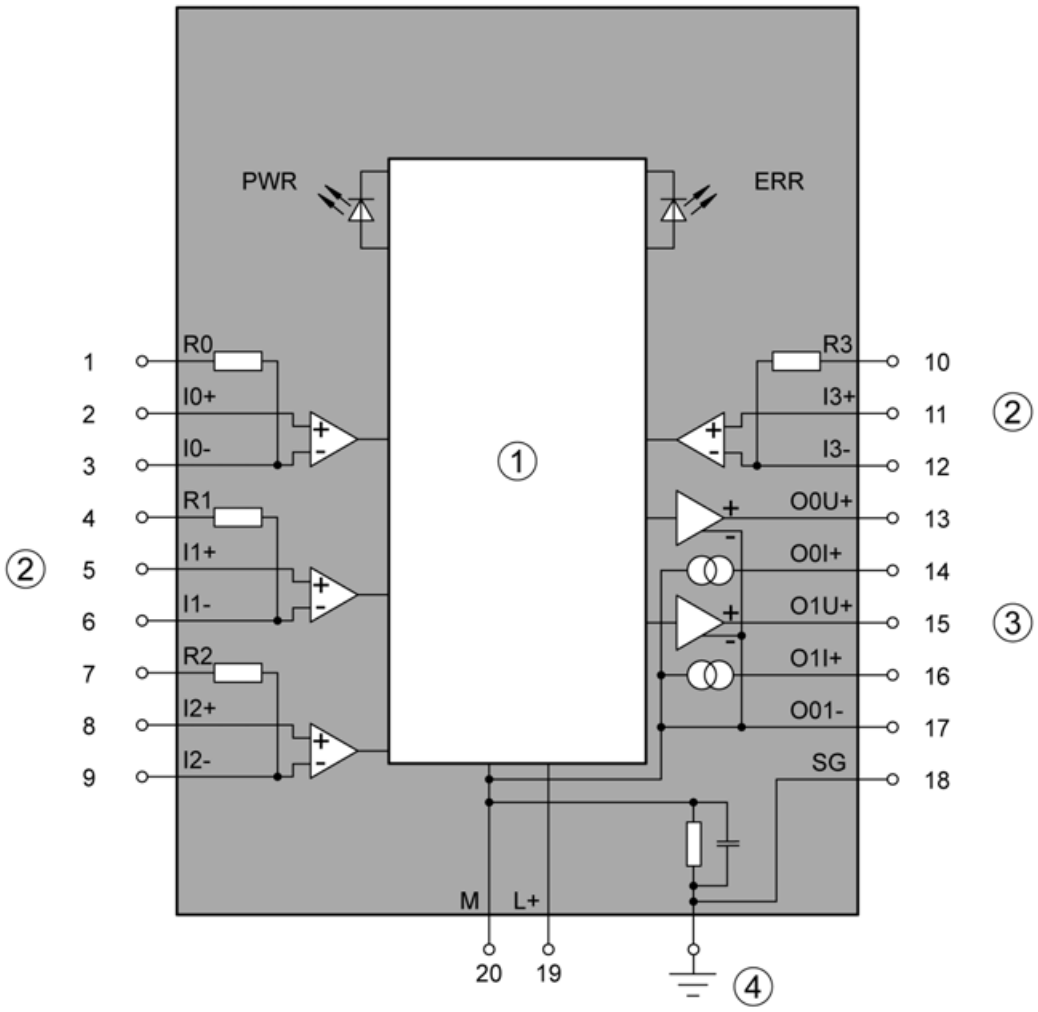


Fig. 77: Internal construction of the analog inputs and outputs

1 Logic - I/O interface
2 Analog inputs
3 Analog outputs
4 Functional earth connection

Table 181: Assignment of the terminals

Terminal	Signal	Description
1	R0	Burden resistor for input signal 0 for current sensing
2	I0+	Positive pole of input signal 0
3	I0-	Negative pole of input signal 0
4	R1	Burden resistor for input signal 1 for current sensing
5	I1+	Positive pole of input signal 1
6	I1-	Negative pole of input signal 1
7	R2	Burden resistor for input signal 2 for current sensing
8	I2+	Positive pole of input signal 2
9	I2-	Negative pole of input signal 2
10	R3	Burden resistor for input signal 3 for current sensing
11	I3+	Positive pole of input signal 3
12	I3-	Negative pole of input signal 3
13	O0U+	Voltage output of channel 0
14	O0I+	Current output of channel 0
15	O1U+	Voltage output of channel 1
16	O1I+	Current output of channel 1
17	O01-	Negative pole of channels O0 and O1
18	SG	Shield grounding
19	L+	Process voltage L+ (24 V DC)
20	M	Process voltage M (0 V DC)

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module increases by 5 mA per AX561.

The external power supply connection is carried out via the L+ (+24 V DC) and the M (0 V DC) terminals. The M terminal is interconnected to the M/ZP terminal of the CPU/communication interface module.

NOTICE!

Risk of imprecise and faulty measurements!

Analog signals may be severely distorted due to external electromagnetic interference.

When the length of the connection cable exceeds 20 m, a shielded and grounded cable must be used. When the shield is grounded at both ends, an independent low-impedance equipotential connection should be provided to avoid high potential differences between interconnected devices.

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing the following:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

The module provides several diagnosis functions.

↳ *Chapter 5.4.4.1.10.6 “Diagnosis” on page 641*

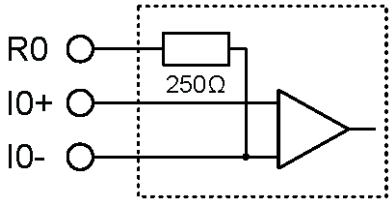


Fig. 78: Example of the internal construction of the analog input AI0 (analog inputs AI1 ... AI3 are designed in the same way)

CAUTION!

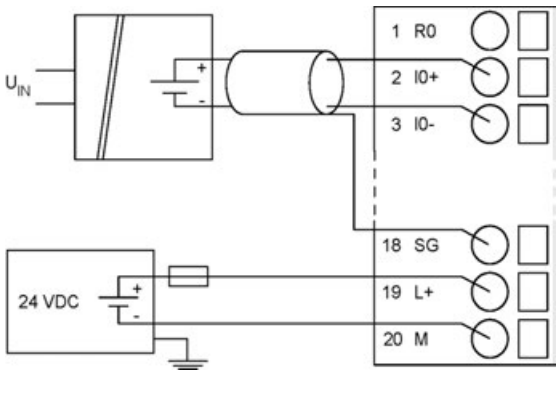
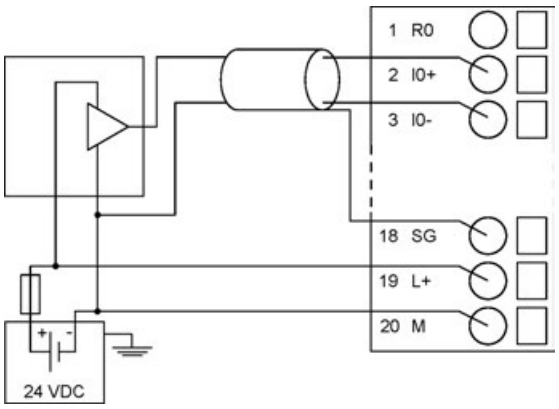
Risk of damaging the analog input!

The 250 Ω input resistor can be damaged by overcurrent.

Make sure that the current through the resistor never exceeds 30 mA.

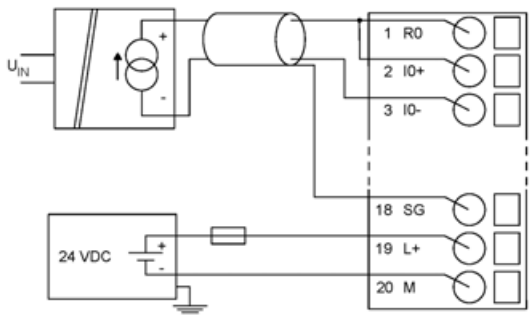
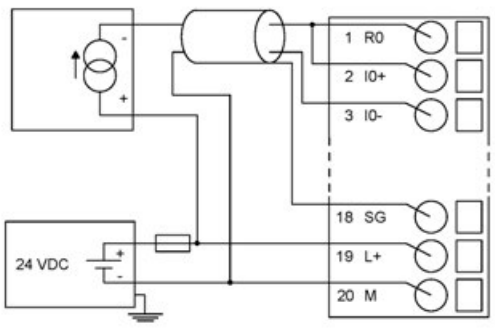
The following figures are an example of the connection of analog sensors (voltage) to the input I0 of the analog input/output module AX561. Proceed with the inputs I1 ... I3 in the same way.

Table 182: Example of the connection of analog sensors (voltage) to the input I0 of the analog input/output module AX561 (Proceed with the inputs I1 to I3 in the same way)

	
Connection of active-type analog sensors (voltage)	Connection of passive-type analog sensors (voltage)

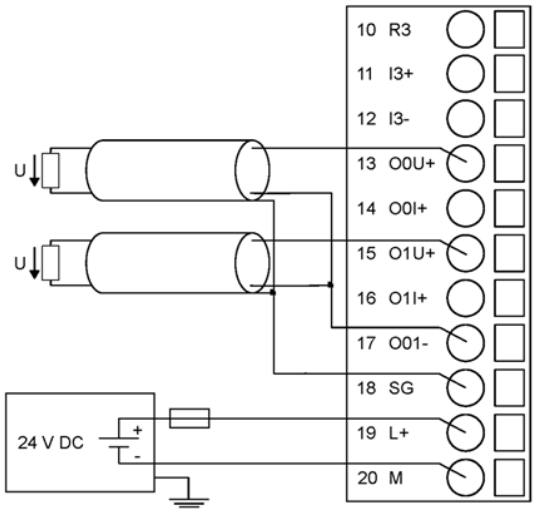
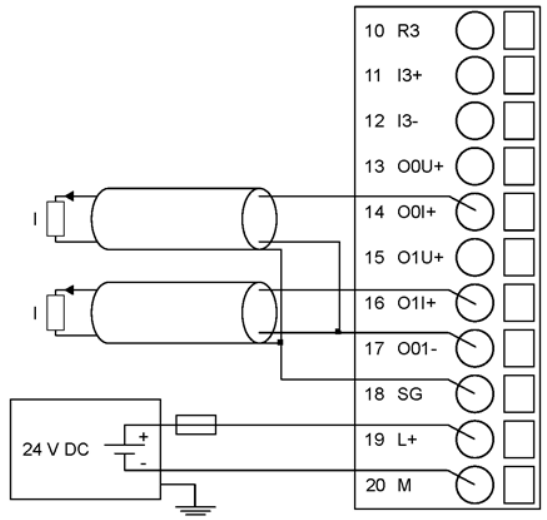
Connection of active-type analog sensors (voltage)	**Connection of passive-type analog sensors (voltage)**
-2.5 V ... 2.5 V	-2.5 V ... 2.5 V
-5 V ... 5 V	-5 V ... 5 V
0 V ... 5 V	0 V ... 5 V
0 V ... 10 V	0 V ... 10 V

Table 183: Example of the connection of analog sensors (current) to the input I0 of the analog input/output module AX561 (Proceed with the inputs I1 ... I3 in the same way)

	
Connection of active-type analog sensors (current)	Connection of passive-type analog sensors (current)

Connection of active-type analog sensors (voltage)	**Connection of passive-type analog sensors (voltage)**
4 mA ... 20 mA	4 mA ... 20 mA
0 mA ... 20 mA	

Table 184: Example of the connection of analog actuators to the analog input/output module AX561

	
Connection of analog voltage actuators	Connection of analog current actuators

The output signal is undefined if the supply voltage at the L+ terminal is below 10 V. This can, for example, occur if the supply voltage has a slow ramp-up / ramp-down behavior and must be foreseen when planning the installation.

If the output is configured in current mode, the voltage output signal is undefined and must not be connected.

If the output is configured in voltage mode, the current output signal is undefined and must not be connected.

Meaning of the LEDs

I/O configuration

The I/O module does not store configuration data itself.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6520 [1])	WORD	0x1978	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No 0x00			

Name	Value	Internal Value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
Parameter length	Internal	8	BYTE	0	0	255	xx02 [2])
Check Supply	Off On	0 1	BYTE	On 0x01			
Analog Data Format	Default	0	BYTE	Default 0x00			

[1]) With CS31 and addresses less than 70, the value is increased by 1

[2]) Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n)

Table 185: GDS file

Ext_User_Prm_Data_Len =	0x0B
Ext_User_Prm_Data_Const(0) =	0x79, 0x19, 0x08, \ 0x01, 0x00, \ 0x00, 0x00, 0x00, 0x00, \ 0x00, 0x00;

Input channel (4x)

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.
Channel configuration	see table [2])	see table [2])	BYTE	0 0x00 see table [2])	0	65535

Table 186: Channel configuration [2])

Internal value	Operating modes for the analog inputs, individually configurable
0	Not used (default)
1	0 V ... +10 V
3	0 mA ... 20 mA
4	4 mA ... 20 mA
6	0 V ... +5 V
7	-5 V ... +5 V
20	-2.5 V ... +2.5 V

Output channel (2x)

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.
Channel configuration	see see table [2])	see see table [2])	BYTE	0 0x00 see table [2])	0	65535

Table 187: Channel configuration [2])

Internal value	Operating modes for the analog outputs, individually configurable
0	Not used (default)
128	-10 V ... + 10 V
129	0 mA ... 20 mA
130	4 mA ... 20 mA

Diagnosis

E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500 display	<− Display in
Class	Comp	Dev	Mod	Ch	Err	AB SW	
Byte 6 Bit 6 ... 7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0 ... 5	PNIO diagnosis block	

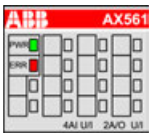
Class	Interface	Device	Module	Channel	Error Identifier	Error message	Remedy
	[1])	[2])	[3])	[4])			
Module error							
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1 ... 10				
Channel error							
4	14	1 ... 10	1	0 ... 3	48	Analog value overflow at an analog input	Check input value or terminal
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	1	0 ... 3	7	Analog value underflow at an analog input	Check input value
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	3	0 ... 1	48	Analog value overflow at an analog output	Check output value or terminal
	11 / 12	ADR	1 ... 10				

E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500 display	<– Display in	
Class	Comp	Dev	Mod	Ch	Err	AB SW		
Byte 6 Bit 6 ... 7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0 ... 5	PNIO diagnosis block		
Class	Interface	Device	Module	Channel	Error Identifier	Error message		Remedy
	[1])	[2])	[3])	[4])				
4	14	1 ... 10	3	0 ... 1	7	Analog value underflow at an analog output		Check output value
	11 / 12	ADR	1 ... 10					

Remarks:

[1])	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = expansion module 1 ... 10, ADR = hardware address (e. g. of the DC551-CS31)
[3])	With "Module" the following allocation applies dependent of the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or PNIO = module type (1 = AI, 3 = AO); COM1/ COM2: 1 ... 10 = expansion 1 ... 10
[4])	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON	LED flashes
	PWR	Process voltage 24 V DC via terminal	Green	CPU module voltage or external 24 V DC supply voltage is missing	3.3 V system voltage (I/O bus) and external 24 V DC supply voltage are present	---
	ERR	Channel or module error	Red	No error or process voltage is missing	Severe error in the module	Error on 1 or more chan-nels of the module

Measuring ranges



CAUTION!

Risk of wrong analog input values!

The analog input values may be wrong if the measuring range of the inputs are exceeded.

Make sure that the analog signal at the connection terminals is always within the signal range.

Range	-2.5 V ... +2.5 V	-5 V ... +5 V	0 V ... 5 V	0 V ... 10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital value	
							Decimal	Hex.
Overflow	>2.9397	>5.8795	>5.8795	>11.7589	>23.5178	>22.8142	32767	7FFF
Measured value too high	2.9397	5.8795	5.8795	11.7589	23.5178	22.8142	32511	7EFF
	:	:	:	:	:	:	:	:
	2.5014	5.0029	:	:	:	:	27664	6C10
			:	:	:	20.0058	27658	6C0A
			5.0015	10.0029	20.0058		27656	6C08
Normal range Normal range or measured value too low	2.5000	5.0000	5.0000	10.0000	20.0000	20.0000	27648	6C00
	:	:	:	:	:	:	:	:
	0.0014	0.0029	:	:	:	:	16	0010
			:	:	:	4.0058	10	000A
			0.0015	0.0029	0.0058		8	0008
	0.0000	0.0000	0.0000	0.0000	0	4	0	0000
	:	:				3.9942	-10	FFF6
	-0.0014	-0.0029				:	-16	FFF0
	:	:				:	-4864	ED00
	:	:				0	-6912	E500
	:	:					:	:
	-2.5000	-5.0000					-27648	9400
Measured value too low	-2.5014	-5.0029					-27664	93F0
	:	:					:	:
	-2.9398	-5.8795					-32512	8100
Underflow	<-2.9398	<-5.8795	<-0.0300	<-0.0600	<-0.1200	<-0.1200	-32768	8000

The represented resolution corresponds to 12 bits including sign.

Output ranges

Range	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital value	
				Decimal	Hex.
Overflow	0	0	0	32767	7FFF
Output value too high	11.7589 : 10.0058 : :	23.5178 : : : 20.0058	22.8142 : : 20.0058 :	32511 : 27664 27658 27656	7EFF : 6C10 6C0A 6C08
Normal range Normal range or output value too low	10.0000 : 0.0058 : :	20,0000 : : : 0.0058	20.0000 : : 4.0058	27648 : 16 10 8	6C00 : 0010 000A 0008
	0.0000	0	4	0	0000
	: -0.0058 : : : -10.0000		3.9942 : : 0	-10 -16 -4864 -6912 : -27648	FFF6 FFF0 ED00 E500 : 9400
Output value too low	-10.0058 : -11.7589			-27664 : -32512	93F0 : 8100
Underflow	0		0	-32768	8000

The represented resolution corresponds to 12 bits including sign.

Technical data

Technical data of the module

The system data of AC500-eCo apply.

Chapter 4.1 “System data AC500-eCo” on page 25

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage L+		
	Connections	Terminal 19 for L+ (+24 V DC) and terminal 20 for M (0 V)
	Rated value	24 V DC
	Current consumption via L+ terminal	0.14 A + output load 0.02 A + output load (version E0 or later)

Parameter		Value
	Inrush current (at power-up)	Typ. 0.1 A²s; Max. 0.16 A²s
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Protection fuse for L+	Recommended
Current consumption from 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module		Ca. 5 mA
Galvanic isolation		No
Surge-voltage (max.)		35 V DC for 0.5 s
Max. power dissipation within the module		4.9 W; 1.8 W (version E0 or later)
Weight		Ca. 120 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

Technical data of the analog inputs

Parameter		Value	
Number of channels per module		4 individually configurable voltage or current inputs	
Distribution of channels into groups		1 (4 channels per group)	
Resolution			
	Unipolar	Voltage: 0 V ... +5 V; 0 V ... +10 V: 12 bits Current 0 mA ... 20 mA; 4 mA ... 20 mA: 12 bits	
	Bipolar	Voltage -2.5 V ... +2.5 V; -5 V ... +5 V: 12 bits including sign (13 bits including sign for version E0 or later)	
Connection of the signals I0- to I3-		Terminals 3, 6, 9, 12	
Connection of the signals I0+ to I3+		Terminals 2, 5, 8, 11	
Input type		Differential	
Galvanic isolation		No galvanic isolation between the inputs and the I/O bus	
Common mode input range		Signal voltage plus common mode voltage must be within ± 12 V	
Indication of the input signals		No	
Channel input resistance		Voltage: >1 MΩ Current: ca. 250 Ω	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ.	± 0.5 % of full scale (voltage) ± 0.5 % of full scale (current 0 mA ... 20 mA) ± 0.7 % of full scale (current 4 mA ... 20 mA) at +25 °C

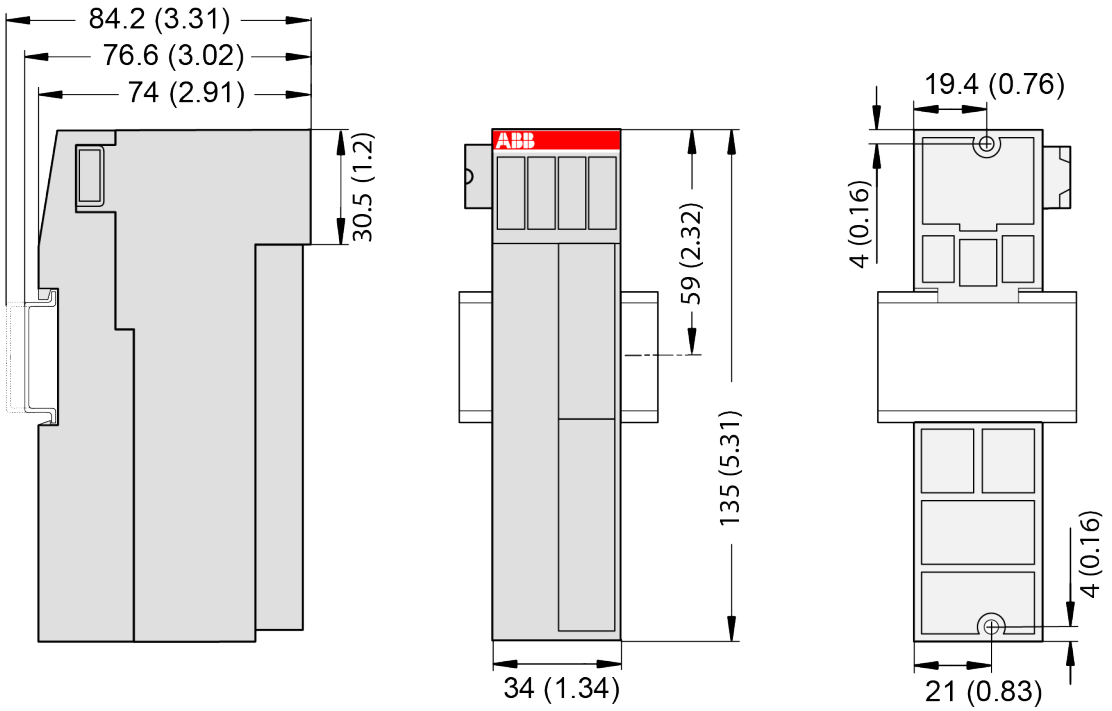
Parameter		Value	
		Max.	± 2 % of full scale (all ranges) at 0 °C ... +60 °C or EMC disturbance
Time constant of the input filter		Voltage: 300 µs Current: 300 µs	
Relationship between input signal and hex code		↳ *Table on page 643*	
Analog to digital conversion time		Typ. 500 µs per channel	
Unused inputs		Can be left open and should be configured as "unused"	
Input data length		8 bytes	
Overvoltage protection		Yes, up to 30 V DC only for voltage input	
Max. cable length (conductor cross section > 0.14 mm^2)			
	Unshielded wire	On request	
	Shielded wire	100 m	

Technical data of the analog outputs

Parameter	Value	
Number of channels per module	2 configurable voltage or current outputs	
Distribution of channels into groups	1 (2 channels per group)	
Connection of the signals O0U- and O1U+	Terminals 13 and 15	
Connection of the signals O0I+ and O1I+	Terminals 14 and 16	
Output type	Bipolar with voltage, unipolar with current	
Resolution	12 bits including sign; 13 bits including sign (version E0 or later)	
Indication of the output signals	No	
Output resistance (load) as current output	0 Ω ... 500 Ω	
Output load ability as voltage output	2 mA max.	
Relationship between input signal and hex code	Table Output Ranges ↳ *Table on page 644*	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ.	± 0.5 % of full scale (voltage) ± 0.5 % of full scale (current 0 mA ... 20 mA) ± 0.7 % of full scale (current 4 mA ... 20 mA) at +25°C
	Max.	± 2 % of full scale (all ranges) at 0 °C ... +60 °C or EMC disturbance
Unused outputs	Can be left open and should be configured as "unused"	
Output data length	4 bytes	

Parameter		Value
Output protection		Voltage: short circuit Current: reverse
Max. cable length (conductor cross section > 0.14 mm²)		
	Unshielded wire	On request
	Shielded wire	100 m

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

Part no.	Description	Product life cycle phase *)
1TNE 968 902 R1301	AX561, analog input/output module, 4 AI, 2 AO, U/I	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active

Part no.	Description	Product life cycle phase *)
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

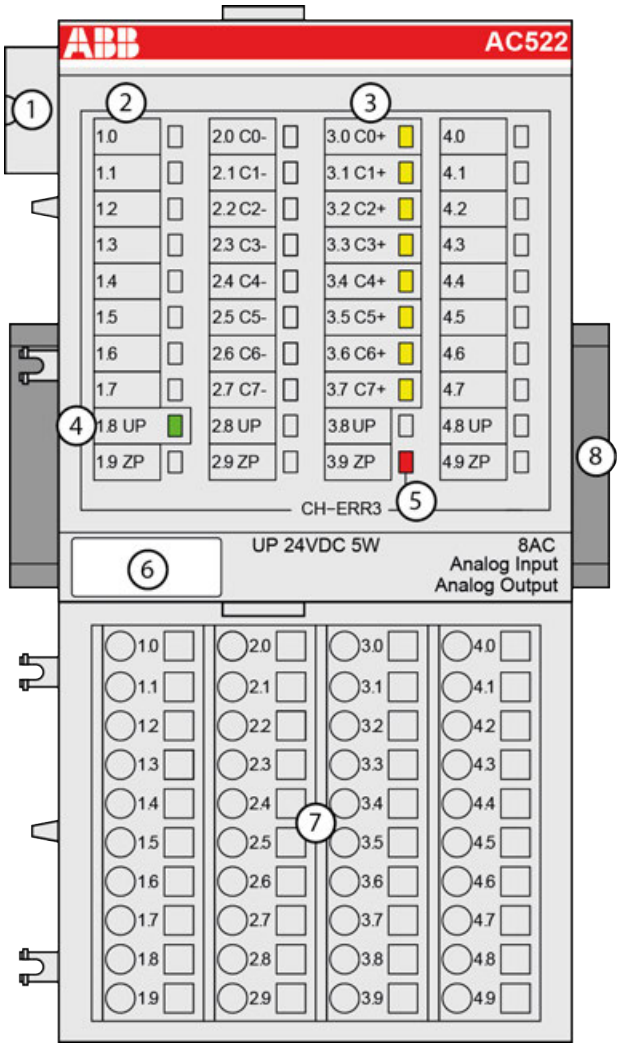


**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.4.4.2 S500 and S500-XC

5.4.4.2.1 AC522 - Analog input/output module

- 8 channels configurable as analog inputs/outputs in one group (2.0 ... 2.7 and 3.0 ... 3.7)
- Resolution 12 bits including sign
- Module-wise galvanically isolated
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 8 yellow LEDs to display the signal states at the analog inputs/outputs (C0 ... C7)
4 1 green LED to display the state of the process supply voltage UP
5 1 red LED to display errors
6 Label
7 Terminal unit
8 DIN rail
❄ Sign for XC version

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

The configuration is performed by software. The modules are supplied with a process voltage of 24 V DC.

The inputs and outputs are galvanically isolated from all other circuitry of the module.

Functionality

8 channels configurable as analog inputs/outputs

If used as inputs, the following signal ranges are individually configurable:

- Unused (default setting)
- 0 V ... 10 V
- -10 V ... +10 V
- 0 mA ... 20 mA
- 4 mA ... 20 mA
- Pt100, -50 °C ... +400 °C (2-wire)
- Pt100, -50 °C ... +400 °C (3-wire), requires 2 channels
- Pt100, -50 °C ... +70 °C (2-wire)
- Pt100, -50 °C ... +70 °C (3-wire), requires 2 channels
- Pt1000, -50 °C ... +400 °C (2-wire)
- Pt1000, -50 °C ... +400 °C (3-wire), requires 2 channels
- Ni1000, -50 °C ... +150 °C (2-wire)
- Ni1000, -50 °C ... +150 °C (3-wire), requires 2 channels
- 0 V ... 10 V with differential inputs, requires 2 channels
- -10 V ... +10 V with differential inputs, requires 2 channels
- Digital signals (digital input)

Parameter		**Value**
Resolution of the analog channels		
	Voltage -10 V ... +10 V	12 bits including sign
	Voltage 0 V ... 10 V	12 bits
	Current 0 mA ... 20 mA, 4 mA ... 20 mA	12 bits
	Temperature	+0.1 °C
LED displays		10 LEDs for signals and error messages
Internal power supply		Via the I/O bus interface (I/O bus)
External power supply		Via the terminals ZP and UP (process voltage 24 V DC)
Required terminal unit		TU515 or TU516 ↳ *TU515, TU516*

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The modules are plugged on an I/O terminal unit.

↳ *TU515, TU516*

Properly position the modules and press until they lock in place. The terminal units are mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting.

↳ *Chapter 5.8.2.6 “TA526 - Wall mounting accessory” on page 1410*

The connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8, 2.8, 3.8 and 4.8 as well as 1.9, 2.9, 3.9 and 4.9 are electrically interconnected within the I/O terminal units and always have the same assignment, independent of the inserted module:

Terminals 1.8, 2.8, 3.8 and 4.8: process voltage UP = +24 V DC

Terminals 1.9, 2.9, 3.9 and 4.9: process voltage ZP = 0 V DC

The assignment of the other terminals:

Terminals	Signal	Description
1.0 ... 1.7	Unused	Unused
2.0 ... 2.7	C0- ... C7-	Negative poles of the 8 analog inputs/outputs
3.0 ... 3.7	C0+ ... C7+	Positive poles of the analog inputs/outputs
4.0 ... 4.7	Unused	Unused

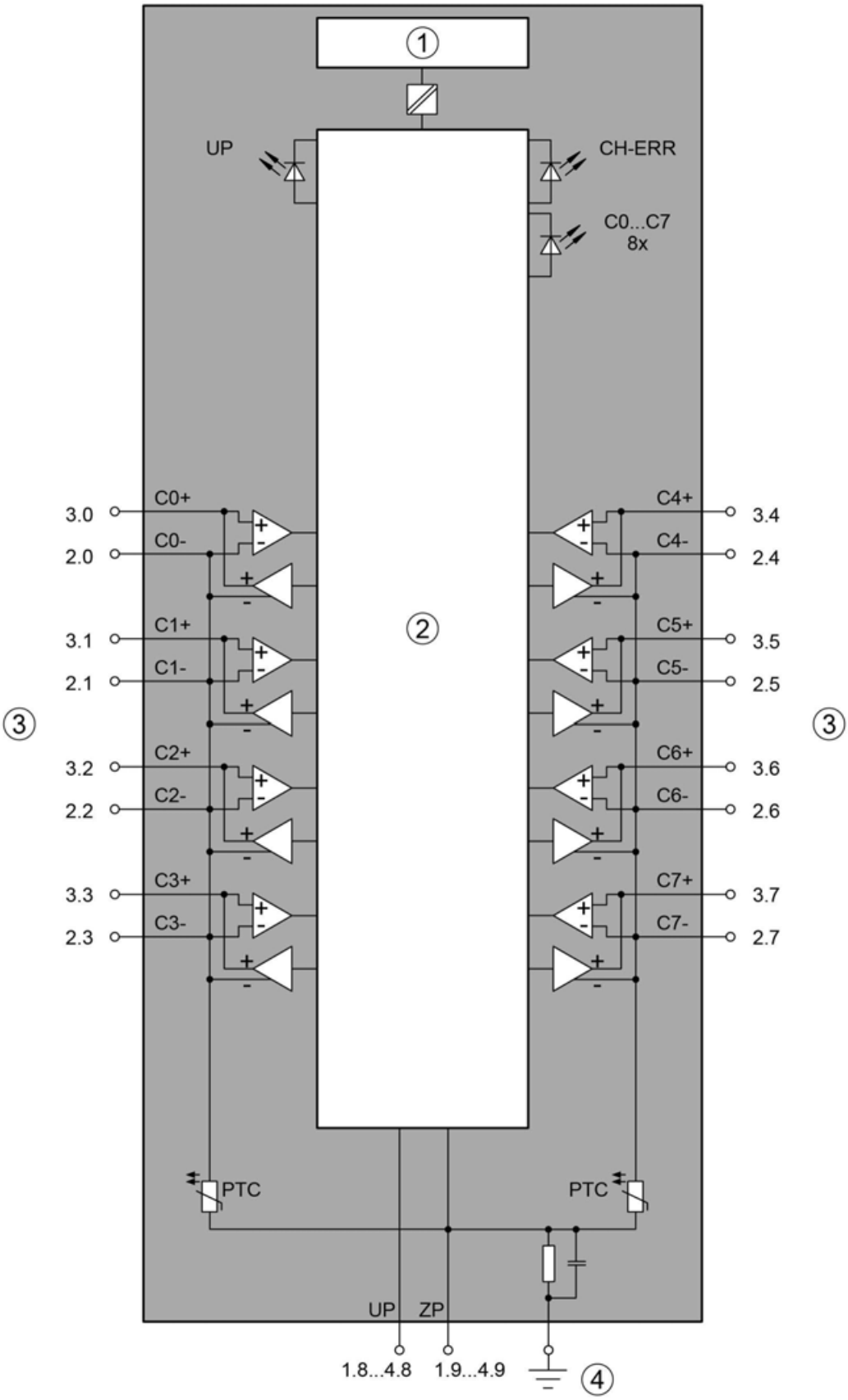


Fig. 79: Connection of the I/O module

1 I/O bus interface
2 Logic
3 Analog input/outputs
4 Functional earth connection

The negative poles of the analog inputs are connected to each other to form an "Analog Ground" signal for the module.

The negative poles of the analog outputs are connected to each other to form an "Analog Ground" signal for the module.

There is no galvanic isolation between the analog circuitry and ZP/UP. Therefore, the analog sensors must be galvanically isolated in order to avoid loops via the ground potential or the supply voltage.

Because of their common reference potential, analog current inputs cannot be circuited in series, neither within the module nor with channels of other modules.

For the open-circuit detection (wire break), each analog input channel is pulled up to "plus" by a high-resistance resistor. If nothing is connected, the maximum voltage will be read in then.

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 2 mA per I/O module. The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.

WARNING!

Removal/Insertion under power

Removal or insertion under power is permissible only if all conditions for hot swapping are fullfilled.

“Conditions for hot swap” on page 12

The devices are not designed for removal or insertion under power when the conditions for hot swap do not apply. Because of unforeseeable consequences, it is not allowed to plug in or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing any of the following actions:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while they are energized in a hazardous location could result in an electric arc, which could create an ignition source resulting in fire or explosion.

Prior to proceeding, make sure that power is been disconnected and that the area has been thoroughly checked to ensure that flammable materials or ignitable concentrations are not present.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

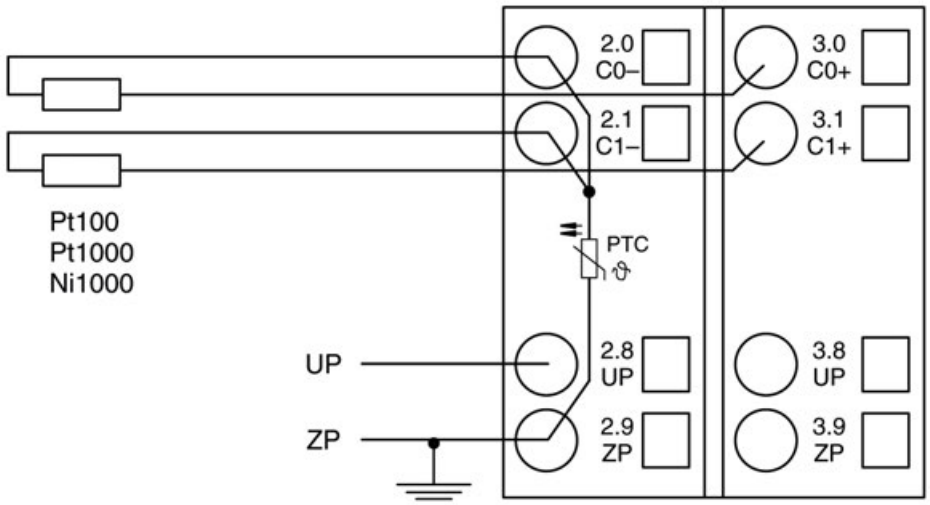
Generally, analog signals must be laid in shielded cables. The cable shields must be grounded at both sides of the cables. To avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

The process voltage must be included in the grounding concept of the control system (e.g. grounding the negative pole).

By installing equipotential bonding conductors between the different parts of the system, it must be made ensured that the potential difference between ZP and AGND never exeeds 1 V.

Connection of resistance thermometers in 2-wire configuration

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the I/O module provides a constant current source which is multiplexed over the 8 analog channels.



Pt100	-50 °C ... +70 °C	2-wire configuration, one channel used
Pt100	-50 °C ... +400 °C	2-wire configuration, one channel used

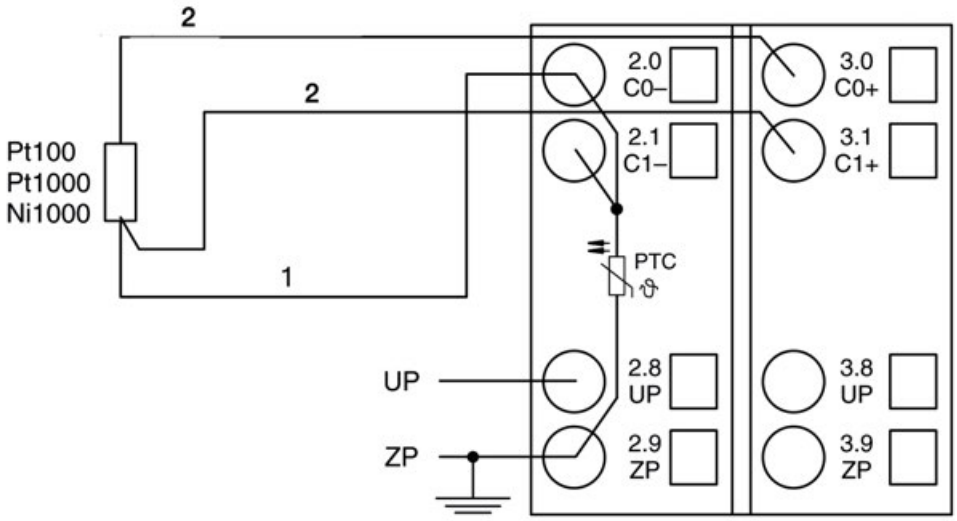
Pt1000	-50 °C ... +400 °C	2-wire configuration, one channel used
Ni1000	-50 °C ... +150 °C	2-wire configuration, one channel used

The I/O module performs a linearization of the resistance characteristic.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of resistance thermometers in 3-wire configuration

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the I/O module provides a constant current source which is multiplexed over the max. 8 (depending on the configuration) analog channels.



1 Return line
2 Twisted pair within the cable

If several measuring points are adjacent to each other, only one return line is necessary. This saves wiring costs.

With the 3-wire configuration, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1).

The constant current of one channel flows through the resistance thermometer. The constant current of the other channel flows through one of the cores. The module calculates the measured value from the two voltage drops and stores it under the input with the higher channel number (e.g. C1).

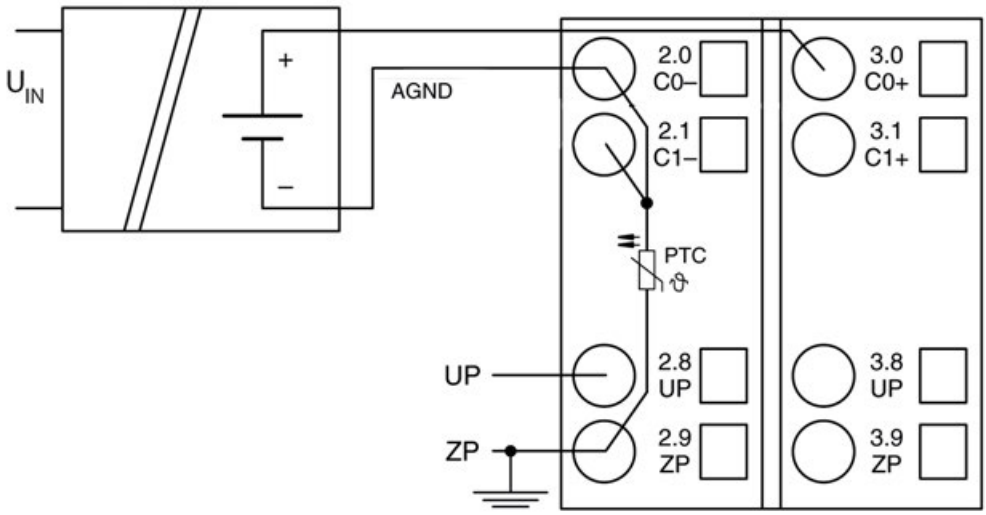
In order to keep measuring errors as small as possible, it is necessary to have all the involved conductors in the same cable. All the conductors must have the same cross section.

Pt100	-50 °C ... +70 °C	3-wire configuration, two channels used
Pt100	-50 °C ... +400 °C	3-wire configuration, two channels used
Pt1000	-50 °C ... +400 °C	3-wire configuration, two channels used
Ni1000	-50 °C ... +150 °C	3-wire configuration, two channels used

The I/O module performs a linearization of the resistance characteristic.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of active-type analog sensors (Voltage) with galvanically isolated power supply



By connecting the sensor's negative pole of the output voltage to AGND, the galvanically isolated voltage source of the sensor is referred to ZP.

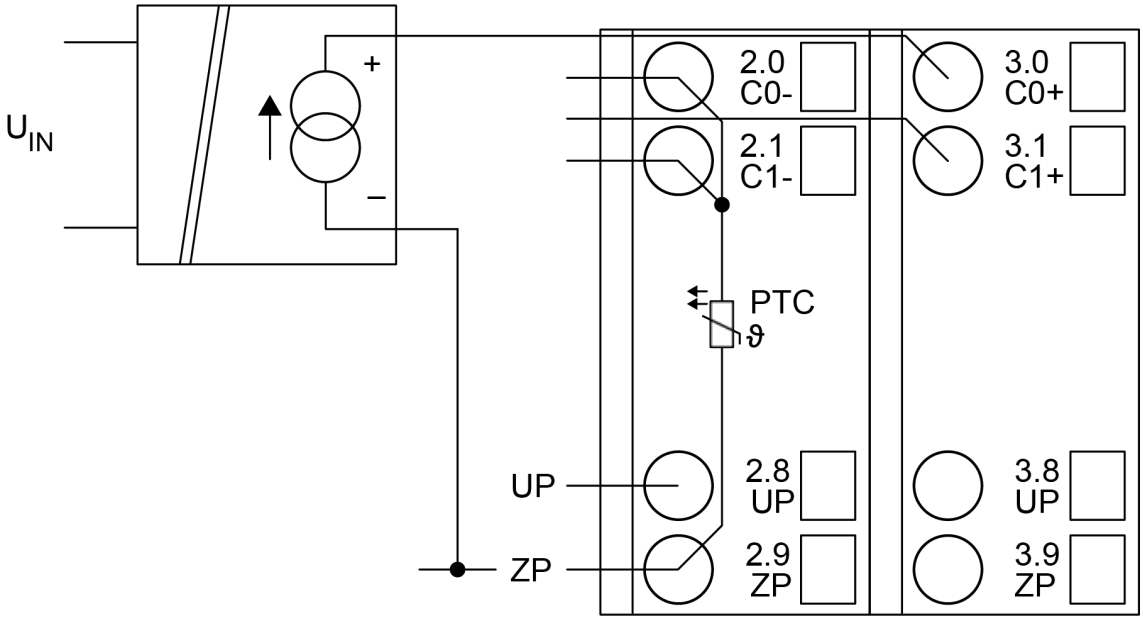
By connecting to AGND the galvanically isolated voltage source of the sensor is referred to ZP.

The following measuring ranges can be configured:

Voltage	0 V ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Connection of active-type analog sensors (Current) with galvanically isolated power supply

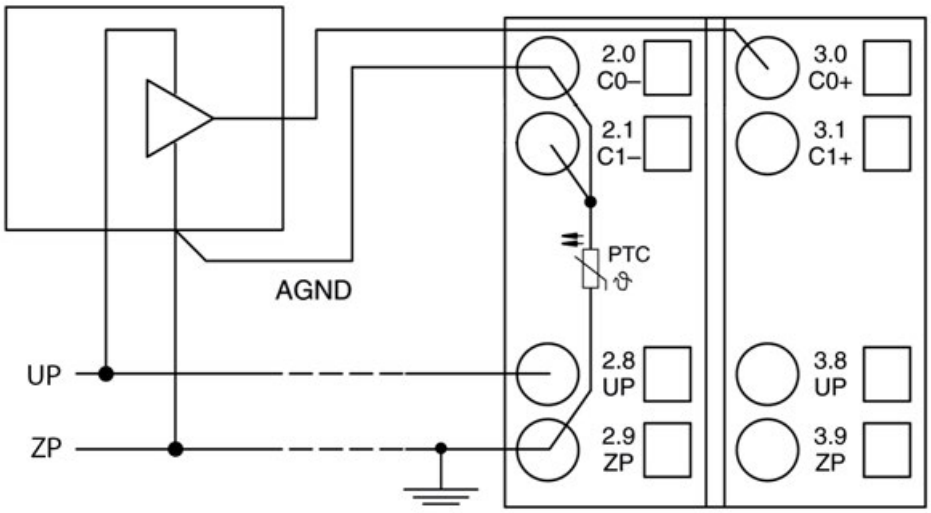


The following measuring ranges can be configured:

Current	0 mA ... 20 mA	1 channel used
Current	4 mA ... 20 mA	1 channel used

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of active-type analog sensors (Voltage) with no galvanically isolated power supply



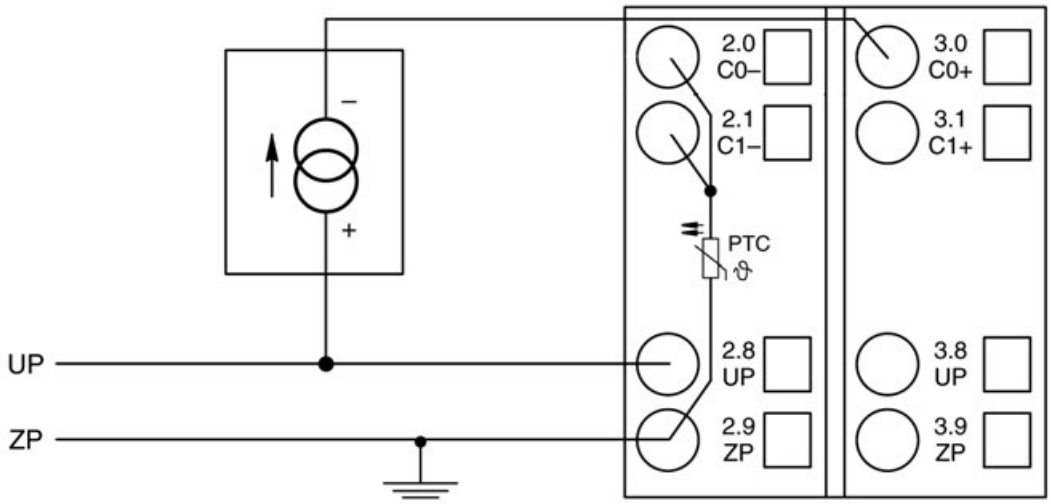
CAUTION!
The potential difference between AGND and ZP at the module must not be greater than 1 V, not even in case of long lines.

If AGND does not get connected to ZP, the sensor current flows to ZP via the AGND line. The measuring signal is distorted, as a very small current flows through the voltage line. The total current through the PTC should not exceed 50 mA. This measuring method is therefore only suitable for short lines and small sensor currents. If there are bigger distances, the difference measuring method should be applied.

Voltage	0 V ... 10 V	1 channel used
Voltage	-10 V ... +10 V *)	1 channel used
*) if the sensor can provide this signal range		

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Connection of passive-type analog sensors (Current)



Current	4 mA ... 20 mA	1 channel used

CAUTION!

Risk of overloading the analog input!

If an analog current sensor supplies more than 25 mA for more than 1 second during initialization, this input is switched off by the module (input protection).

Only use sensors with fast initialization or without current peaks higher than 25 mA. If not possible, connect a 10-volt Zener diode in parallel to I+ and ZP.

Unused input channels can be left open-circuited because they are of low resistance.

Connection of active-type analog sensors (Voltage) to differential inputs

Differential inputs are very useful if analog sensors are used which are remotely non-isolated (e.g. the minus terminal is remotely grounded).

The use of differential inputs helps to considerably increase the measuring accuracy and to avoid ground loops.

With differential input configurations, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

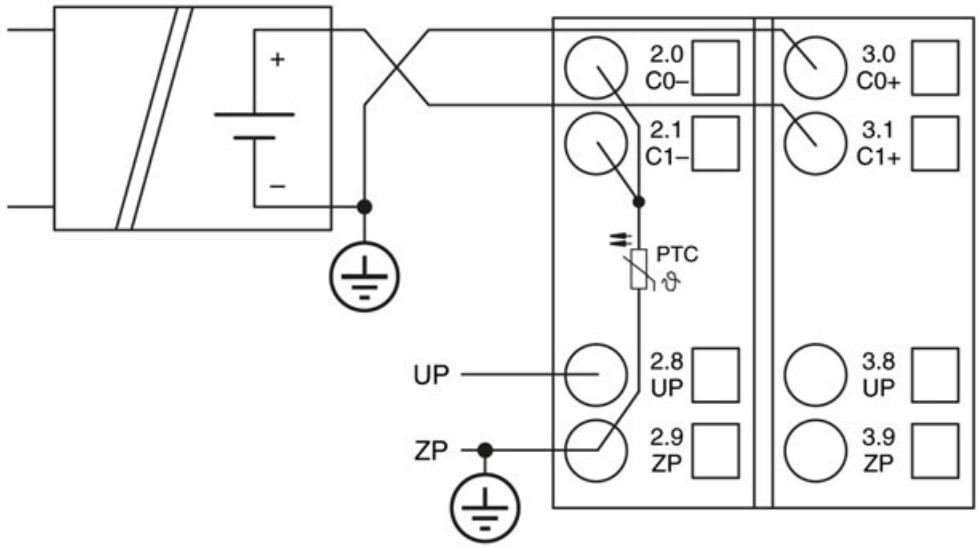
The analog value is calculated by subtraction of the input value with the higher address from the input value of the lower address.

The converted analog value is available at the odd channel (higher address).

CAUTION!

Problems with the common-mode input voltages of the involved analog inputs

The ground potential at the sensors must not have too large a potential difference with respect to ZP (max. ±1 V within the full signal range).



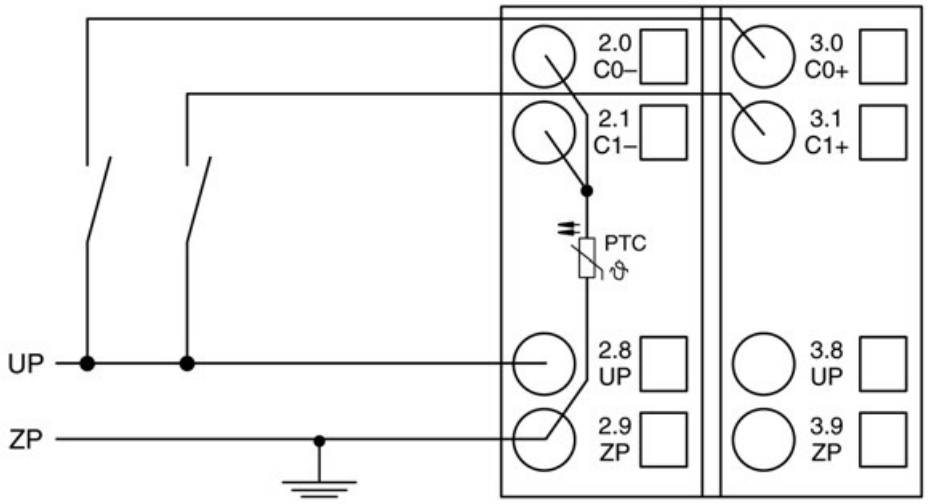
The negative pole of the sensor must be grounded next to the sensor.

Voltage	0 V ... 10 V	with differential inputs, 2 channels used
Voltage	-10 V ... +10 V	with differential inputs, 2 channels used

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

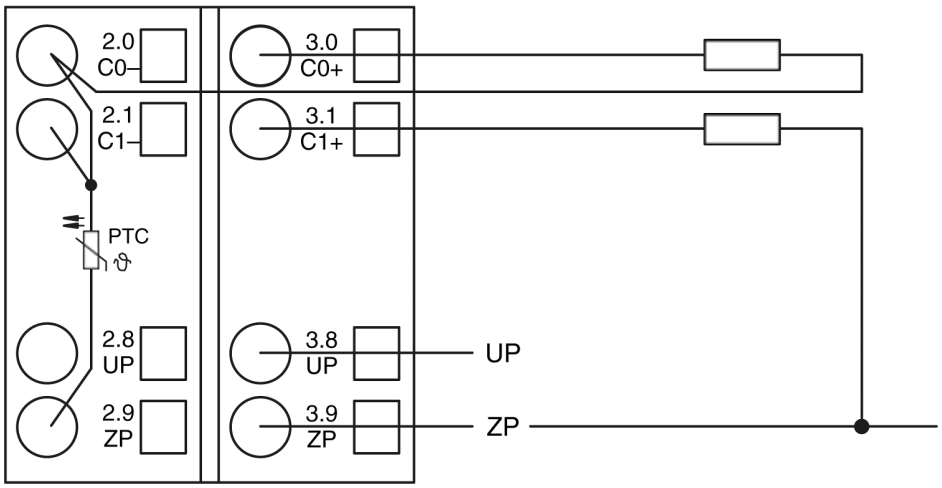
Use of analog inputs as digital inputs

Several (or all) analog inputs can be configured as digital inputs. The inputs are not galvanically isolated against the other analog channels.



Digital input	24 V	1 channel used
Effect of incorrect input terminal connection		Wrong or no signal detected, no damage up to 35 V

Connection of analog output loads (Voltage, current)



Voltage	-10 V ... +10 V	Load max. ± 10 mA	1 channel used
Current	0 mA ... 20 mA	Load 0 Ω ... 500 Ω	1 channel used
Current	4 mA ... 20 mA	Load 0 Ω ... 500 Ω	1 channel used

Only the channels 0 ... 3 can be configured as current output (0 mA ... 20 mA or 4 mA ... 20 mA).

Unused analog outputs can be left open-circuited.

Internal data exchange

Analog inputs (words)	8
Analog outputs (words)	8

I/O configuration

The module does not store configuration data itself. The 8 configurable analog channels are defined as inputs or outputs by the configuration, i.e. each of the configurable channels can used as input or output (or re-readable output in case of voltage input/output).

When a channel is used as input, the corresponding output must be configured unused.

When a channel is used as output, the corresponding input must be configured unused.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1 ... 10

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
1	Module ID	Internal	1520 [1])	Word	1520 0x05f0	0	65535	0x0Y01
2	Ignore module [2])	No Yes	0 1	Byte	No 0x00			not for FBP
3	Parameter length in bytes	Internal	37	Byte	37-CPU 37-FBP	0	255	0x0Y02
4	Check supply	Off On	0 1	Byte	On 0x01	0	1	0x0Y03
5	Analog data format	Default	0	Byte	Default 0x00			0x0Y04
6	Behaviour of outputs at communication errors	Off Last value Substitute value	0 1+(n*5) 2+(n*5), n ≤ 2	Byte	Off 0x00	0	2	0x0Y05

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
7	Channel configuration Input channel 0	see table Channel configuration		Byte	Default 0x00	0	19	0x0Y06
8	Channel monitoring Input channel 0	see table Channel monitoring		Byte	Default 0x00	0	3	0x0Y07
9 to 22	Channel configuration and channel monitoring of the input channels 1 to 7	see tables channel configuration and channel monitoring		Byte Byte	Default 0x00 0x00	0 0	19 3	0x0Y08 to 0x0Y15
23	Channel configuration Output channel 0	see table Channel configuration		Byte	Default 0x00	0	130	0x0Y16
24	Channel monitoring Output channel 0	see table Channel monitoring		Byte	Default 0x00	0	3	0x0Y17
25	Substitute value Output channel 0	only valid for output channel 0	0 ... 0xffff	Word	Default 0x0000	0	65535	0x0Y18
26 to 31	Channel configuration and channel monitoring of the output channels 1 to 3	see tables channel configuration and channel monitoring		Byte Byte	Default 0x00 0x00	0 0	130 3	0x0Y19 to 0x0Y1E

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
32	Channel configuration Output channel 4	see table Channel configuration		Byte	Default 0x00	0	128	0x0Y1F
33	Channel monitoring Output channel 4	see table Channel monitoring		Byte	Default 0x00	0	3	0x0Y20
34 to 39	Channel configuration and channel monitoring of the output channels 5 to 7	see tables channel configuration and channel monitoring		Byte Byte	Default 0x00 0x00	0 0	128 3	0x0Y21 to 0x0Y26

[1]) With CS31 and addresses less than 70 and FBP, the value is increased by 1

[2]) Not with FBP

GSD file:

Ext_User_Prm_Data_Len =	40
Ext_User_Prm_Data_Const(0) =	0x05, 0xf1, 0x25, \ 0x01, 0x00, 0x00, \ 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \ 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \ 0x00, 0x00, 0x00, 0x00, \ 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \ 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00;

Table 188: Input channel (8x)

No.	Name	Internal value, type	Default
1	Channel configuration see table [2])	Byte	0 0x00 see table [2])
2	Channel monitoring see table [3])	Byte	0 0x00 see table [3])

Table 189: Channel configuration [2])

Internal value	Operating modes of the analog inputs, individually configurable
0	Unused (default)
1	Analog input 0 V ... 10 V
2	Digital input
3	Analog input 0 mA ... 20 mA
4	Analog input 4 mA ... 20 mA
5	Analog input -10 V ... +10 V
8	Analog input Pt100, -50 °C ... +400 °C (2-wire)
9	Analog input Pt100, -50 °C ... +400 °C (3-wire), requires 2 channels *)
10	Analog input 0 ... 10 V via differential inputs, requires 2 channels *)
11	Analog input -10 V ... +10 V via differential inputs, requires 2 channels *)
14	Analog input Pt100, -50 °C ... +70 °C (2-wire)
15	Analog input Pt100, -50 °C ... +70 °C (3-wire), requires 2 channels *)
16	Analog input Pt1000, -50 °C ... +400 °C (2-wire)
17	Analog input Pt1000, -50 °C ... +400 °C (3-wire), requires 2 channels *)
18	Analog input Ni1000, -50 °C ... +150 °C (2-wire)
19	Analog input Ni1000, -50 °C ... +150 °C (3-wire), requires 2 channels *)
	*) In the operating modes with 3-wire configuration or with differential inputs, two adjacent analog inputs belong together (e.g. the channels 0 and 1). In these cases, both channels are configured in the desired operating mode. The lower address must be the even address (channel 0). The next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

Table 190: Channel monitoring [3])

Internal value	Monitoring
0	Plausibility, open-circuit (broken wire) and short circuit
1	Open-circuit and short-circuit
2	Plausibility
3	No monitoring

Table 191: Output channel 0 (1 channel)

No.	Name	Value	Internal value	Internal value, type	Default
1	Channel configuration	see table [4])	see table [4])	Byte	see table [4])
2	Channel monitoring	see table [5])	see table [5])	Byte	see table [5])
3	Substitute value see table [6])	0 ... 65535	0 ... 0xffff	Word	0

Table 192: Output channels 1 ... 7 (7x)

No.	Name	Internal value, type	Default
1	Channel configuration see table [4])	Byte	see table [4])
2	Channel monitoring see table [5])	Byte	see table [5])

Table 193: Channel configuration [4])

Internal value	Operating modes of the analog outputs, individually configurable
0	Unused (default)
128	Analog output -10 V ... +10 V
129	Analog output 0 mA ... 20 mA (not with the channels 4 ... 7)
130	Analog output 4 mA ... 20 mA (not with the channels 4 ... 7)

Table 194: Channel monitoring [5])

Internal value	Monitoring
0	Plausibility, open circuit (broken wire) and short circuit (default)
1	Open-circuit (broken wire) and short-circuit
2	Plausibility
3	No monitoring

Table 195: Substitute value [6])

Intended behavior of output channel when the control system stops	Required setting of the module parameter "Behaviour of outputs in case of a communication error"	Required setting of the channel parameter "Substitute value"
Output OFF	Off	0
Last value	Last value	0
Substitute value	Off or last value	1 ... 65535

Diagnosis

Table 196: Possible diagnosis of I/O channels

Output range	Condition	
	Output value in the PLC underflow	Output value in the PLC overflow
0 mA ... 20 mA	Error identifier = 7	Error identifier = 4
4 mA ... 20 mA		
-10 V ... +10 V		

Input range	Condition			
	Short circuit	Wire break	Input value underflow	Input value overflow
0 mA ... 20 mA	no diagnosis possible	no diagnosis possible	no diagnosis possible	Error identifier = 48
4 mA ... 20 mA	Error identifier = 7	Error identifier = 7	Error identifier = 7	Error identifier = 48
-10 V ... +10 V	no diagnosis possible	Error identifier = 48	Error identifier = 7	Error identifier = 48

Table 197: Content of diagnosis messages

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000 ... 063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])			
Module error							
3	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	3	Timeout in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	40	Different hard-/firmware versions in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	36	Internal data exchange failure	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	New start
	11 / 12	ADR	1 ... 10				

E1 ... E4	**d1**	**d2**	**d3**	**d4**		**Identifier** **000 ... 063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**		**Err**	**PS501 PLC browser**	
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**		**Byte 6** **Bit 0 ... 5**	**FBP diag-nosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**		**Error Identifier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])				
3	14	1 ... 10	31	31		26	Parameter error	Check master
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31		11	Process voltage too low	Check process voltage
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	31	31		45	Process voltage is switched off (ON −> OFF)	Process voltage ON
	11 / 12	ADR	1 ... 10					
Channel error								
				AX521	AX522			
4	14	1 ... 10	1	0 ... 3	0 ... 7	48	Analog value over-flow or broken wire at an analog input	Check input value or terminal
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	1	0...3	0 ... 7	7	Analog value under-flow at an analog input	Check input value
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	1	0 ... 3	0 ... 7	47	Short circuit at an analog input	Check terminal
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	3	4 ... 7	8 ... 15	4	Analog value over-flow at an analog output	Check output value
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	3	4 ... 7	8 ... 15	7	Analog value under-flow at an analog output	Check output value
	11 / 12	ADR	1 ... 10					

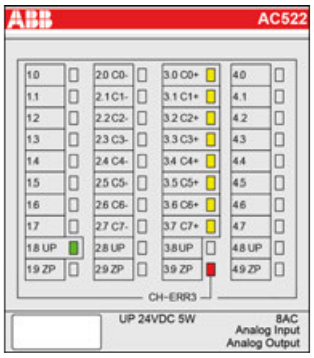
Remarks:

[1])	In AC500, the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = expansion module 1 ... 10, ADR = hardware address (e.g. of the DC551)

[3])	With "Module" the following allocation applies depending on the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or FBP = module type (1 = AI, 3 = AO); COM1/COM2: 1 ... 10 = expansion 1 ... 10
[4])	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Inputs/ outputs 00...07	Analog input/ output	Yellow	Input/output is OFF	Input/output is ON (brightness depends on the value of the analog signal)	--
	UP	Process voltage 24 V DC via terminal	Green	Process voltage is missing	Process voltage OK	--
	CH-ERR3	Channel error, error messages combined into group 3	Red	No error or process voltage is missing	Severe error within the corresponding group	Error on one channel of the group

Measuring ranges

Input ranges of voltage, current and digital input

The represented resolution corresponds to 16 bits.

Range	0 V ... 10 V	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital input	Digital value	
						Decimal	Hex.
Overflow	>11.7589	>11.7589	>23.5178	>22.8142		32767	7FFF
Measured value too high	11.7589 : 10.0004	11.7589 : 10.0004	23.5178 : 20.0007	22.8142 : 20.0006		32511 : 27649	7EFF : 6C01
Normal range	10.0000 : 0.0004	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	ON	27648 : 1	6C00 : 0001
Normal range or measured value too low	0.0000	0.0000	0	4	OFF	0	0000

Range	0 V ... 10 V	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital input	Digital value	
						Decimal	Hex.
	-0.0004 -1.7593	-0.0004 : : : -10.0000		3.9994 : 0		-1 -4864 -6912 : -27648	FFFF ED00 E500 : 9400
Measured value too low		-10.0004 : -11.7589				-27649 : -32512	93FF : 8100
Underflow	<0.0000	<-11.7589	<0.0000	<0.0000		-32768	8000

Input ranges resistance temperature detector

Range	Pt100 -50 °C ... +70 °C	Pt100 / Pt1000 -50 °C ... +400 °C	Ni1000 -50 °C ... +150 °C	Digital value	
				Decimal	Hex.
Overflow	> +80.0 °C	> +450.0 °C	> +160.0 °C	32767	7FFF
Measured value too high		+450.0 °C : + 400.1 °C		4500 : 4001	1194 : 0FA1
			+160.0 °C : +150.1 °C	1600 : 1501	0640 : 05DD
	+80.0 °C : +70.1 °C			800 : 701	0320 : 02BD
Normal range	: : +70.0 °C : + 0.1 °C	+400.0 °C : : : +0.1 °C	: +150.0 °C : : + 0.1 °C	4000 1500 700 : 1	0FA0 05DC 02BC : 0001
	0 °C	0 °C	0 °C	0	0000
	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-1 : -500	FFFF : FE0C

Range	Pt100 -50 °C ... +70 °C	Pt100 / Pt1000 -50 °C ... +400 °C	Ni1000 -50 °C ... +150 °C	Digital value	
				Decimal	Hex.
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-501 : -600	FE0B : FDA8
Underflow	< -60.0 °C	< -60.0 °C	< -60.0 °C	-32768	8000

Output ranges voltage and current

The represented resolution corresponds to 16 bits.

Range	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital value	
				Decimal	Hex.
Overflow	0 V	0 mA	0 mA	> 32511	> 7EFF
Value too high	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA	32511 : 27649	7EFF : 6C01
Normal range	10.0000 V : 0.0004 V	20.0000 mA : 0.0007 mA	20.0000 mA : 4.0006 mA	27648 : 1	6C00 : 0001
	0.0000 V	0.0000 mA	4.0000 mA	0	0000
	-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA	-1 -6912 -27648	FFFF E500 9400
Value too low	-10.0004 V : -11.7589 V	0 mA : 0 mA	0 mA : 0 mA	-27649 : -32512	93FF : 8100
Underflow	0 V	0 mA	0 mA	< -32512	< 8100

Technical data

Technical data of the module

The System Data of AC500 and S500 ↯ *Chapter 4.2 “System data AC500” on page 34* are applicable to the standard version.

Only additional details are therefore documented below.

Parameter		Value
Process voltage		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 V DC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/bus module	Ca. 2 mA
	From UP at normal operation	0.10 A + output loads
Inrush current from UP (at power up)		0.040 A^2s
Max. length of analog cables, conductor cross section > 0.14 mm^2		100 m
Weight		300 g
Mounting position		Horizontal mounting or Vertical mounting with derating (output load reduced to 50 % at +40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Technical data of the analog inputs

Parameter	Value
Number of channels per module	8
Distribution of channels into groups	1 group of 8 channels
Connections of the channels C0- ... C7-	Terminals 2.0 ... 2.7
Connections of the channels C0+ ... C7+	Terminals 3.0 ... 3.7
Input type	Bipolar (not with current or Pt100/Pt1000/Ni1000)
Galvanic isolation	Against internal supply and other modules
Configurability	0 V ... 10 V, -10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA, Pt100/1000, Ni1000 (each input can be configured individually)
Channel input resistance	Voltage: > 100 kΩ Current: ca. 330 Ω

Parameter	Value	
Time constant of the input filter	Voltage: 100 µs Current: 100 µs	
Indication of the input signals	One LED per channel	
Conversion cycle	2 ms (for 8 inputs + 8 outputs), with Pt/Ni... 1 s	
Resolution	Range 0 V ... 10 V: 12 bits Range -10 V ... +10 V: 12 bits including sign Range 0 mA ... 20 mA: 12 bits Range 4 mA ... 20 mA: 12 bits	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ.	±0.5 % of full scale at +25 °C
	Max.	± 1 % of full scale (all ranges) at 0 °C ... +60 °C or EMC disturbance
Relationship between input signal and hex code	See table *Chapter 5.4.4.2.1.9.1 “Input ranges of voltage, current and digital input” on page 668*	
Unused inputs	Must be configured as "unused".	
Overvoltage protection	Yes	

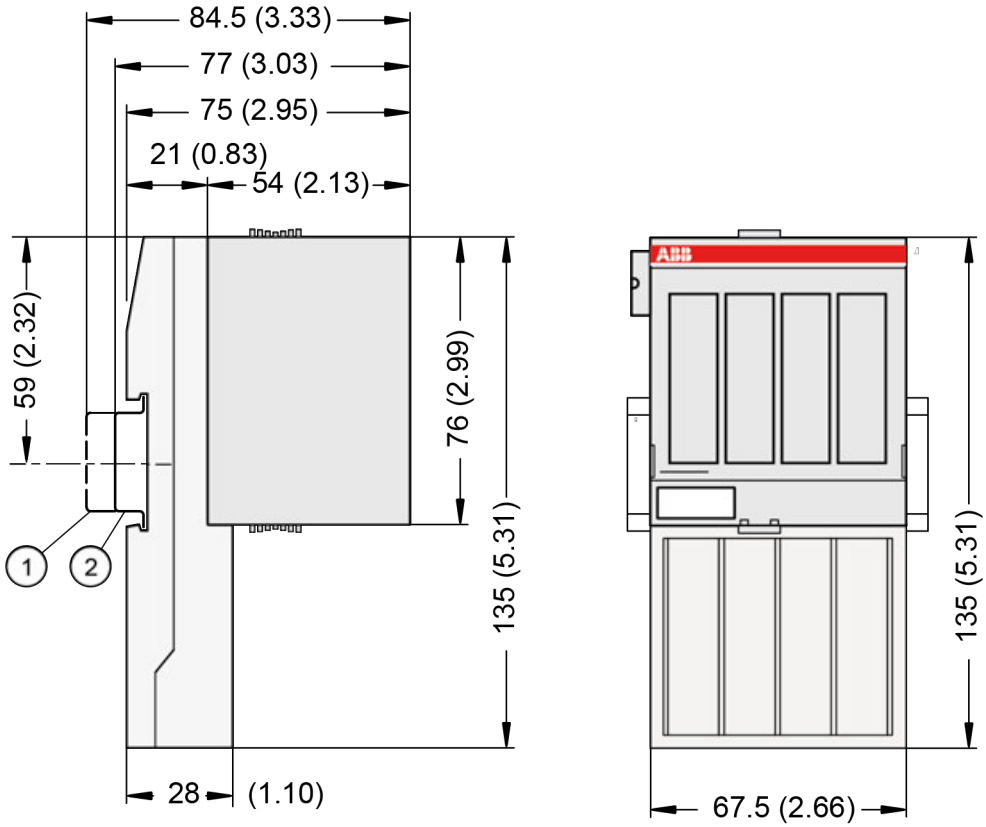
Technical data of the analog inputs, if used as digital inputs

Parameter		Value
Number of channels per module		Max. 8
Distribution of channels into groups		1 group of 8 channels
Connections of the channels C0+ ... C7+		Terminals 3.0 ... 3.7
Reference potential for the inputs		Terminals 1.9 ... 4.9 (ZP)
Input signal delay		Typ. 8 ms, configurable from 0.1 ... 32 ms
Indication of the input signals		1 LED per channel
Input signal voltage		24 V DC
	Signal 0	-30 V ... +5 V
	Undefined signal	+5 V ... +13 V
	Signal 1	+13 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 7 mA
	Input voltage +5 V	Typ. 1.4 mA
	Input voltage +15 V	Typ. 4.3 mA
	Input voltage +30 V	< 9 mA
Input resistance		Ca. 3.5 kΩ

Technical data of the analog outputs

Parameter		Value	
Number of channels per module		8, all channels for voltage, the first 4 channels also for current	
Distribution of channels into groups		1 group of 8 channels	
	Channels C0- ... C7-	Terminals 2.0 ... 2.7	
	Channels C0+ ... C7+	Terminals 3.0 ... 3.7	
Output type		Bipolar with voltage, unipolar with current	
Galvanic isolation		Against internal supply and other modules	
Configurability		-10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA (each output can be configured individually), current outputs only channels 0 ... 3	
Output resistance (load), as current output		0 Ω ... 500 Ω	
Output loadability, as voltage output		Max. ±10 mA	
Indication of the output signals		One LED per channel	
Resolution		12 bits including sign	
Settling time for full range change (resistive load, output signal within specified tolerance)		Typ. 5 ms	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ.	±0.5 % of full scale at +25 °C
		Max.	±1 % of full scale (all ranges) at 0 °C ... +60 °C or EMC disturbance
Relationship between output signal and hex code		See table 'AC522 - Analog input/output module' ↳ *Chapter 5.4.4.2.1.9.3 “Output ranges voltage and current” on page 670*	
Unused outputs		Must be configured as "unused".	

Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

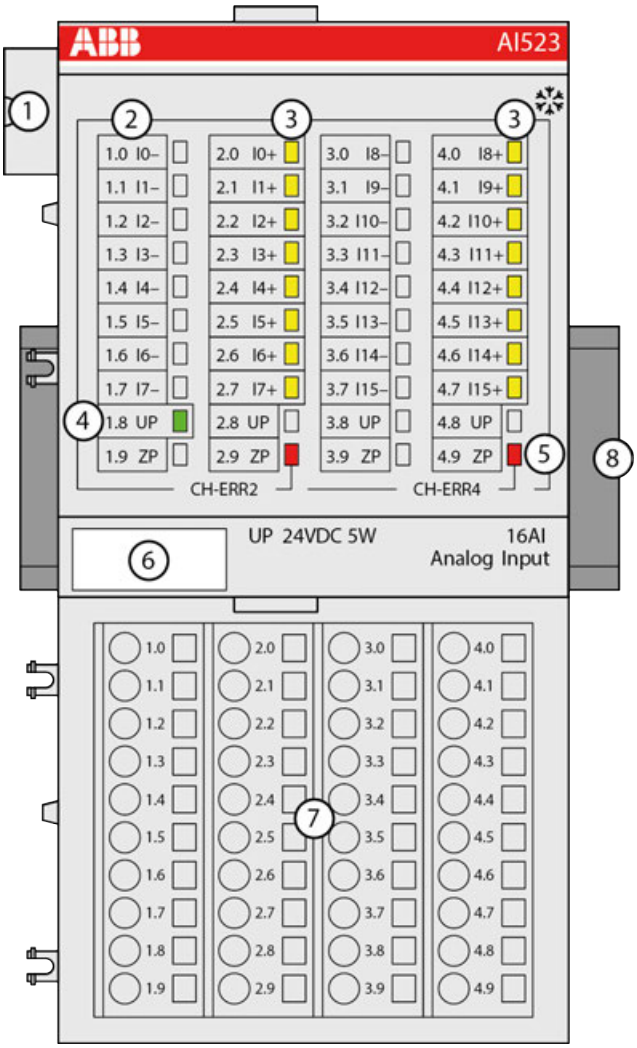
Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 250 500 R0001	AC522, analog input/output module, 8 AC, U/I/RTD, 12 bits including sign, 2-wires	Active
1SAP 450 500 R0001	AC522-XC, analog input/output module, 8 AC, U/I/RTD, 12 bits including sign, 2-wires, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.4.4.2.2 AI523 - Analog input module

- 16 configurable analog inputs (I0 ... I15) in 2 groups (1.0 ... 2.7 and 3.0 ... 4.7)
  Resolution 12 bits including sign
- Module-wise galvanically isolated
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 16 yellow LEDs to display the signal states at the analog inputs (I0 ... I15)
4 1 green LED to display the state of the process supply voltage UP
5 2 red LEDs to display errors
6 Label
7 Terminal unit
8 DIN rail
❄ Sign for XC version

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

Functionality

16 analog inputs, individually configurable:

- Unused (default setting)
- 0 V ... 10 V
- -10 V ... +10 V
- 0 mA ... 20 mA
- 4 mA ... 20 mA
- Pt100, -50 °C ... +400 °C (2-wire)
- Pt100, -50 °C ... +400 °C (3-wire), requires 2 channels
- Pt100, -50 °C ... +70 °C (2-wire)
- Pt100, -50 °C ... +70 °C (3-wire), requires 2 channels
- Pt1000, -50 °C ... +400 °C (2-wire)
- Pt1000, -50 °C ... +400 °C (3-wire), requires 2 channels
- Ni1000, -50 °C ... +150 °C (2-wire)
- Ni1000, -50 °C ... +150 °C (3-wire), requires 2 channels
- 0 V ... 10 V with differential inputs, requires 2 channels
- -10 V ... +10 V with differential inputs, requires 2 channels
- Digital signals (digital input)

Parameter		Value
Resolution of the analog channels		
	Voltage -10 V ... +10 V	12 bits including sign
	Voltage 0 V ... 10 V	12 bits
	Current 0 mA ... 20 mA, 4 mA ... 20 mA	12 bits
	Temperature	0.1 °C
LED displays		19 LEDs for signals and error messages
Internal power supply		Via the I/O bus interface (I/O bus)
External power supply		Via the terminals ZP and UP (process voltage 24 V DC)
Required terminal unit		TU515 or TU516 ↳ *TU515, TU516*

Connections

The modules are plugged on an I/O terminal unit.

↳ *TU515, TU516*

Properly position the modules and press until they lock in place. The terminal units are mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting.

↳ *Chapter 5.8.2.6 “TA526 - Wall mounting accessory” on page 1410*

The connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The terminals 1.8 ... 4.8 and 1.9 ... 4.9 are electrically interconnected within the I/O terminal units and have always the same assignment, independent of the inserted module:

Terminals 1.8 ... 4.8: process voltage UP = +24 V DC

Terminals 1.9 ... 4.9: process voltage ZP = 0 V

The assignment of the other terminals:

Terminals	Signal	Description
1.0 ... 1.7	I0- ... I7-	Negative poles of the first 8 analog inputs
2.0 ... 2.7	I0+ ... I7+	Positive poles of the first 8 analog inputs
3.0 ... 3.7	I8- ... I15-	Negative poles of the following 8 analog inputs
4.0 ... 4.7	I8+ ... I15+	Positive poles of the following 8 analog inputs

CAUTION!
The negative poles of the analog inputs are galvanically connected to each other. They form an "Analog Ground" signal for the module. The negative poles of the analog outputs are also galvanically connected to each other to form an "Analog Ground" signal.

CAUTION!
There is no galvanic isolation between the analog circuitry and ZP/UP. Therefore, the analog sensors must be galvanically isolated in order to avoid loops via the ground potential or the supply voltage.

CAUTION!
Because of their common reference potential, analog current inputs cannot be circuited in series, neither within the module nor with channels of other modules.

For the open-circuit detection (wire break), each analog input channel is pulled up to "plus" by a high-resistance resistor. If nothing is connected, the maximum voltage will be read in then.

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 2 mA per AI523.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.

WARNING!

Removal/Insertion under power

Removal or insertion under power is permissible only if all conditions for hot swapping are fullfilled.

“Conditions for hot swap” on page 12

The devices are not designed for removal or insertion under power when the conditions for hot swap do not apply. Because of unforeseeable consequences, it is not allowed to plug in or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing any of the following actions:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while they are energized in a hazardous location could result in an electric arc, which could create an ignition source resulting in fire or explosion.

Prior to proceeding, make sure that power is been disconnected and that the area has been thoroughly checked to ensure that flammable materials or ignitable concentrations are not present.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

Generally, analog signals must be laid in shielded cables. The cable shields must be grounded at both sides of the cables. To avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

The following figure shows the connection of the module:

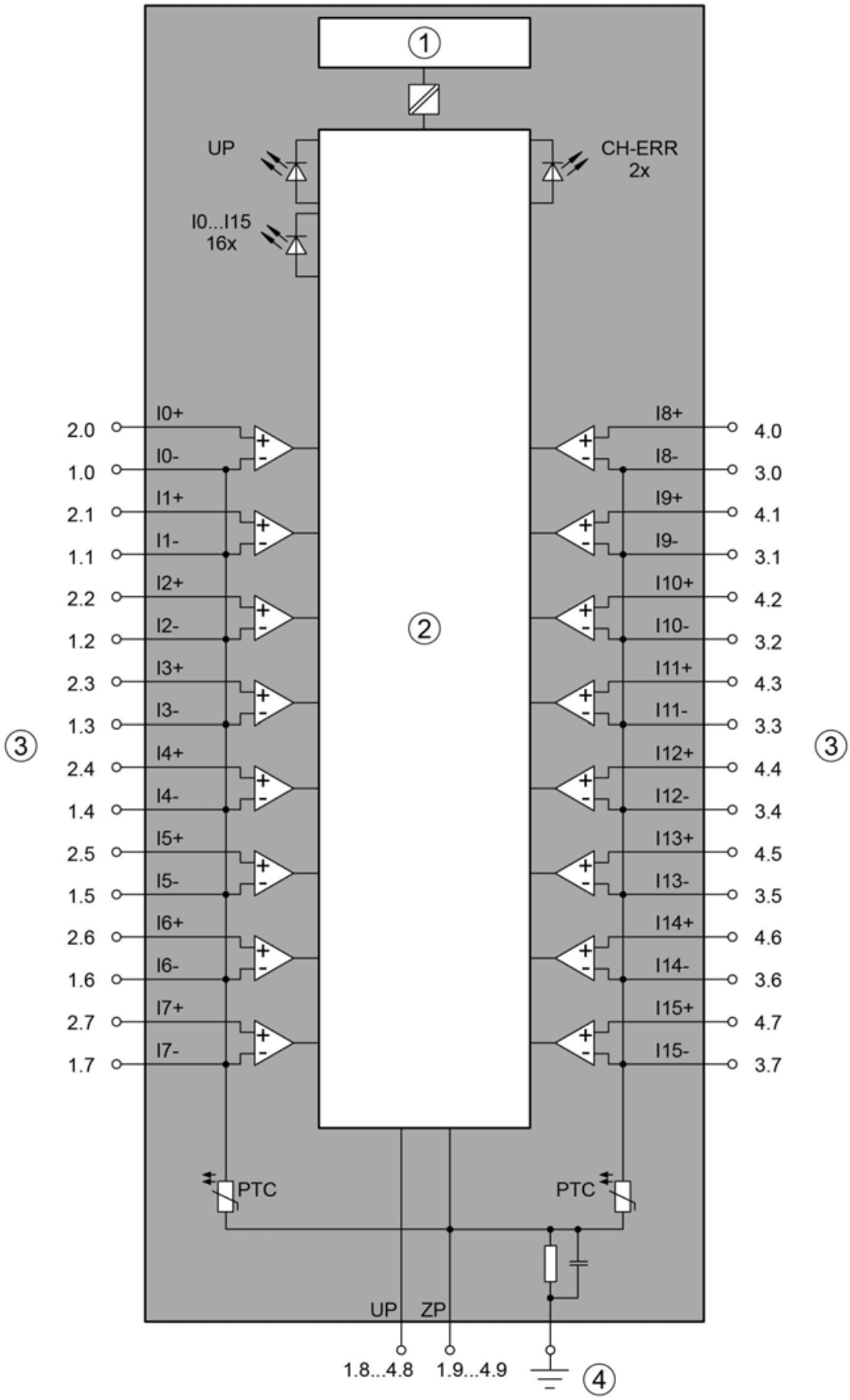


Fig. 80: 16 analog inputs in two groups, individually configurable *Chapter 5.4.4.2.2.2 “Functionality” on page 676*

1 I/O bus interface
2 Logic
3 Analog inputs
4 Functional earth connection

CAUTION!
By installing equipotential bonding conductors between the different parts of the system, it must be ensured that the potential difference between ZP and AGND never can exceed 1 V.

CAUTION!
The process supply voltage must be included in the grounding concept (e. g. grounding of the negative terminal).

The modules provide several diagnosis functions.

↳ *Chapter 5.4.4.2.2.7 “Diagnosis” on page 694*

Connection of resistance thermometers in 2-wire configuration

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module AI523 provides a constant current source which is multiplexed over the 8 analog channels.

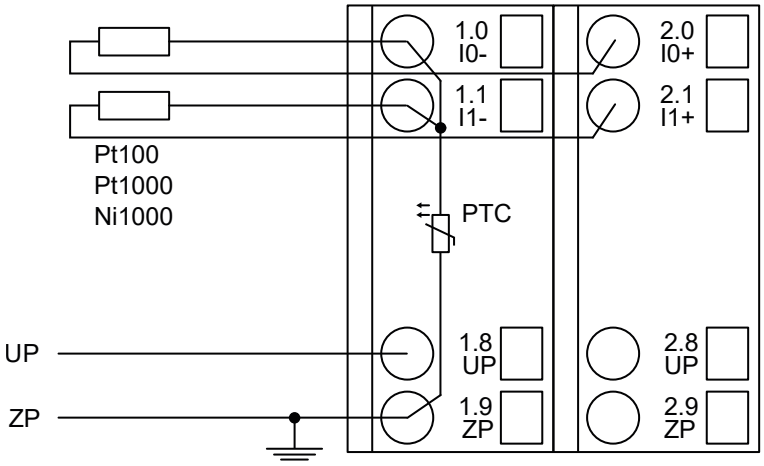


Fig. 81: Connection example

Table 198: Configurable measuring ranges

Pt100	-50 °C ... +70 °C	2-wire configuration, one channel used
Pt100	-50 °C ... +400 °C	2-wire configuration, one channel used
Pt1000	-50 °C ... +400 °C	2-wire configuration, one channel used
Ni1000	-50 °C ... +150 °C	2-wire configuration, one channel used

↳ *Chapter 5.4.4.2.2.6 “Parameterization” on page 691*

↳ *Function of the LEDs*

The module AI523 performs a linearization of the resistance characteristic.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of resistance thermometers in 3-wire configuration

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module AI523 provides a constant current source which is multiplexed over the max. 8 (depending on the configuration) analog channels.

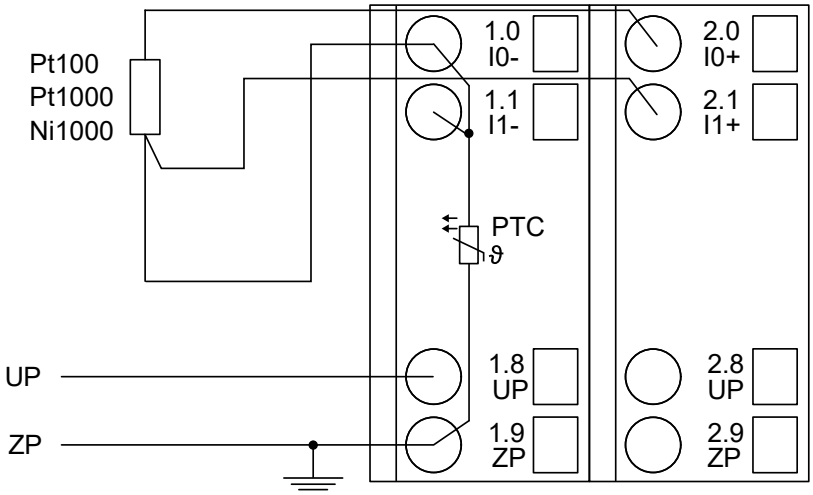


Fig. 82: Connection example

> *If several measuring points are adjacent to each other, the return line is necessary only once. This saves wiring costs.*

With 3-wire configuration, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1).

The constant current of one channel flows through the resistance thermometer. The constant current of the other channel flows through one of the cores. The module calculates the measured value from the two voltage drops and stores it under the input with the higher channel number (e.g. I1).

In order to keep measuring errors as small as possible, it is necessary to have all the involved conductors in the same cable. All the conductors must have the same cross section.

Table 199: Configurable measuring ranges

Pt100	-50 °C ... +70 °C	3-wire configuration, two channels used
Pt100	-50 °C ... +400 °C	3-wire configuration, two channels used
Pt1000	-50 °C ... +400 °C	3-wire configuration, two channels used
Ni1000	-50 °C ... +150 °C	3-wire configuration, two channels used

↳ *Chapter 5.4.4.2.2.6 “Parameterization” on page 691*

↳ *Function of the LEDs*

The module AI523 performs a linearization of the resistance characteristic.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of active-type analog sensors (Voltage) with galvanically isolated power supply

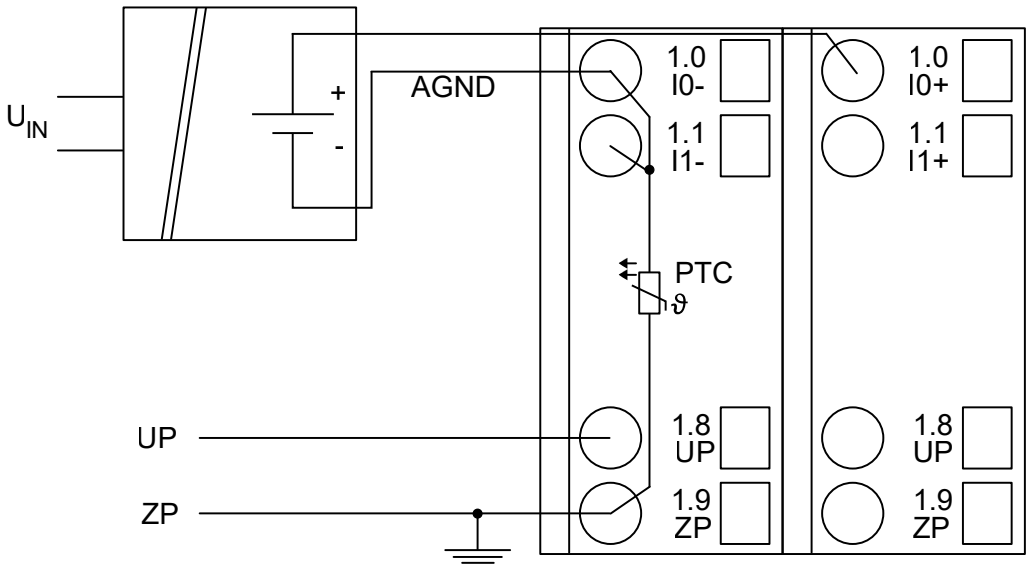


Fig. 83: Connection example

By connecting the sensor's negative pole of the output voltage to AGND, the galvanically isolated voltage source of the sensor is referred to ZP.

Table 200: Configurable measuring ranges

Voltage	0 V ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

↳ *Chapter 5.4.4.2.2.6 “Parameterization” on page 691*

↳ *Chapter 5.4.4.2.2.9 “Measuring ranges” on page 696*

↳ *Function of the LEDs*

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Connection of active-type analog sensors (Current) with galvanically isolated power supply

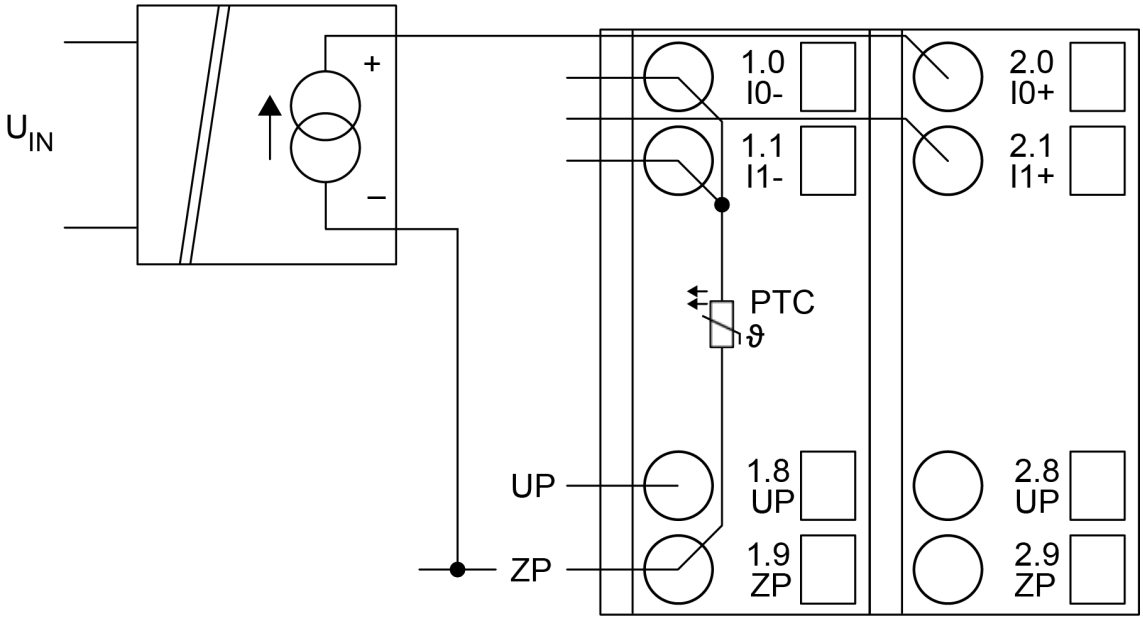


Fig. 84: Connection example

Table 201: Configurable measuring ranges

Current	0 mA ... 20 mA	1 channel used
Current	4 mA ... 20 mA	1 channel used

↳ *Chapter 5.4.4.2.2.6 “Parameterization” on page 691*

↳ *Chapter 5.4.4.2.2.9 “Measuring ranges” on page 696*

↳ *Function of the LEDs*

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of active-type analog sensors (Voltage) with no galvanically isolated power supply

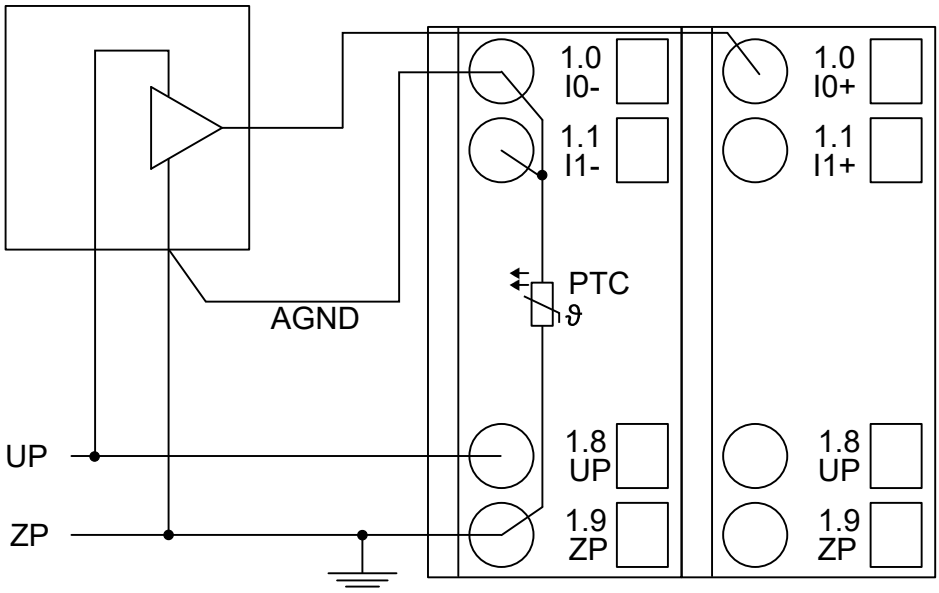


Fig. 85: Connection example

CAUTION!
The potential difference between AGND and ZP at the module must not be greater than 1 V, not even in case of long lines.

↳ *Chapter 5.4.4.2.2 “AI523 - Analog input module” on page 675*

If AGND does not get connected to ZP, the sensor current flows to ZP via the AGND line. The measuring signal is distorted, as a very low current flows over the voltage line. The total current through the PTC should not exceed 50 mA. This measuring method is therefore only suitable for short lines and small sensor currents. If there are bigger distances, the difference measuring method has to be preferred.

Table 202: Configurable measuring ranges

Voltage	0 V ... 10 V	1 channel used
Voltage	-10 V ... +10 V *)	1 channel used
*) if the sensor can provide this signal range		

↳ *Chapter 5.4.4.2.2.9 “Measuring ranges” on page 696*

↳ *Function of the LEDs*

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Connection of passive-type analog sensors (Current)

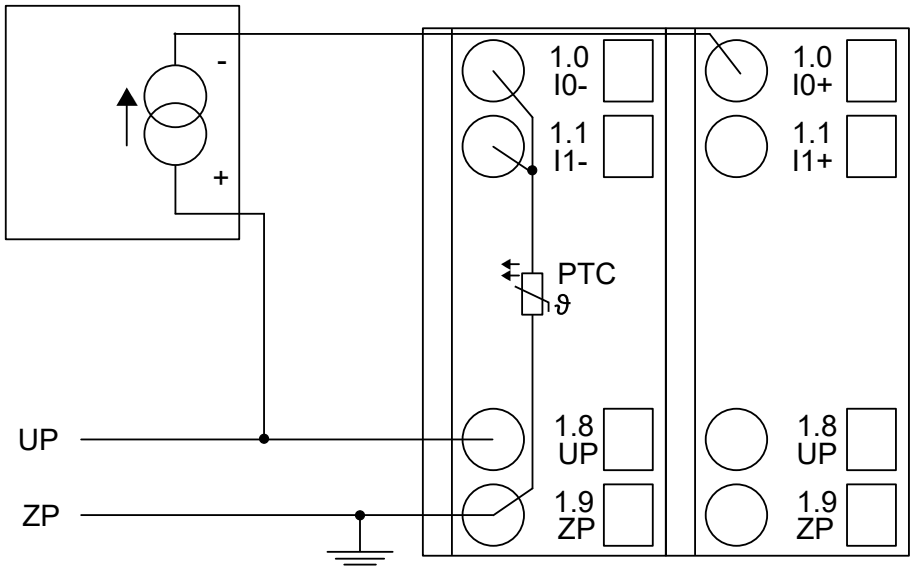


Fig. 86: Connection example

Table 203: Configurable measuring ranges

Current	4 mA ... 20 mA	1 channel used

↳ *Chapter 5.4.4.2.2.6 “Parameterization” on page 691*

↳ *Chapter 5.4.4.2.2.9 “Measuring ranges” on page 696*

↳ *Function of the LEDs*

CAUTION!

Risk of overloading the analog input!

If an analog current sensor supplies more than 25 mA for more than 1 second during initialization, this input is switched off by the module (input protection).

Only use sensors with fast initialization or without current peaks higher than 25 mA. If not possible, connect a 10-volt Zener diode in parallel to I+ and ZP.

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of active-type analog sensors (Voltage) to differential inputs

Differential inputs are very useful if analog sensors which are remotely non-isolated (e.g. the negative terminal is remotely grounded) are used.

The evaluation using differential inputs helps to considerably increase the measuring accuracy and to avoid ground loops.

With differential input configurations, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

The analog value is calculated by subtraction of the input value with the higher address from the input value of the lower address.

The converted analog value is available at the odd channel (higher address).

CAUTION!

Problems with the common-mode input voltages of the involved analog inputs

The ground potential at the sensors must not have too large a potential difference with respect to ZP (max. ±1 V within the full signal range).

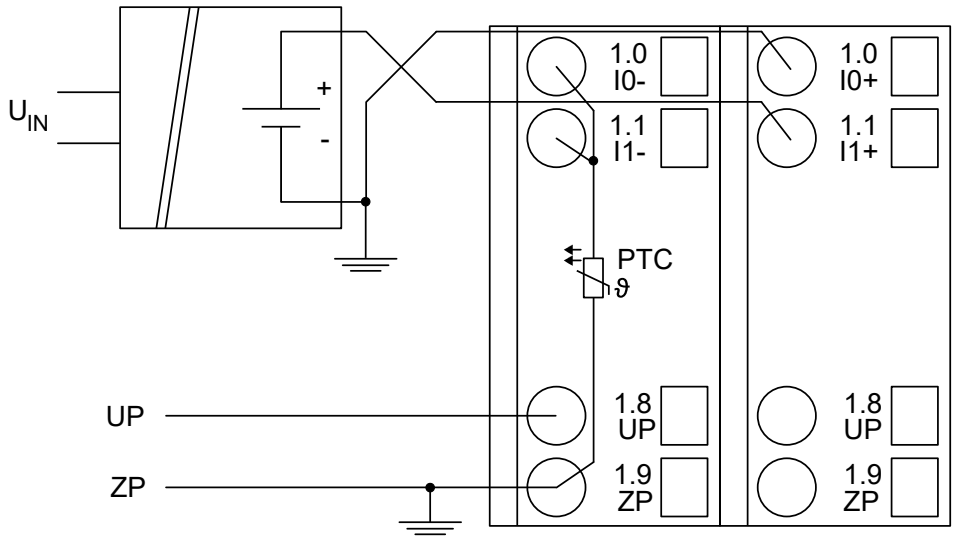


Fig. 87: Connection example

The negative pole of the sensor must be grounded next to the sensor.

Table 204: Configurable measuring ranges

Voltage	0 V ... 10 V	with differential inputs, 2 channels used
Voltage	-10 V ... +10 V	with differential inputs, 2 channels used

↳ *Chapter 5.4.4.2.2.6 “Parameterization” on page 691*

↳ *Chapter 5.4.4.2.2.9 “Measuring ranges” on page 696*

↳ *Function of the LEDs*

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Use of analog inputs as digital inputs

Several (or all) analog inputs can be configured as digital inputs. The inputs are not galvanically isolated against the other analog channels.

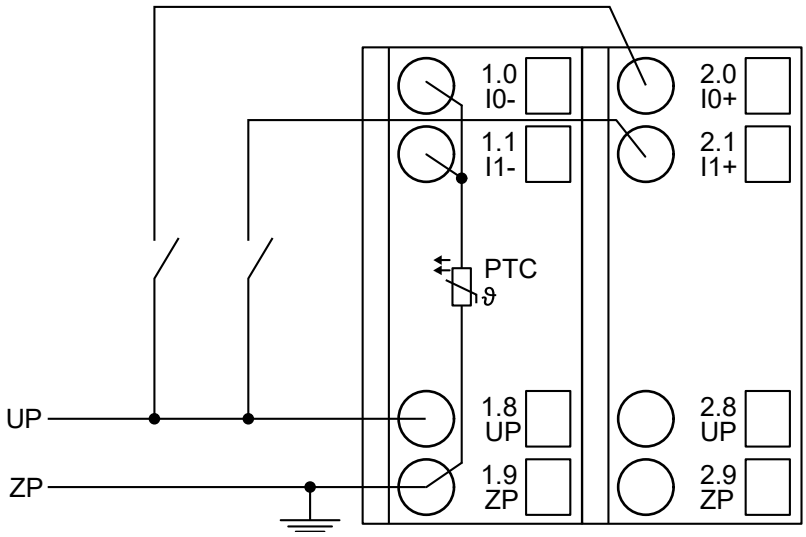


Fig. 88: Connection example

Table 205: Configurable measuring ranges

Digital input	24 V	1 channel used
Effect of incorrect input terminal connection		Wrong or no signal detected, no damage up to 35 V

↳ *Chapter 5.4.4.2.2.6 “Parameterization” on page 691*

↳ *Chapter 5.4.4.2.2.9 “Measuring ranges” on page 696*

↳ *Function of the LEDs*

Internal data exchange

Digital inputs (bytes)	0
Digital outputs (bytes)	0
Counter input data (words)	16
Counter output data (words)	0

I/O configuration

The module does not store configuration data itself. It gets its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

That means replacing I/O modules is possible without any re-parameterization via software.



If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1 ... 10

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
1	Module ID	Internal	1515 [1])	Word	1515 0x05eb	0	65535	0x0Y01
2	Ignore module [2])	No Yes	0 1	Byte	No 0x00			not for FBP
3	Parameter length in bytes	Internal	34	Byte	34-CPU 34-FBP	0	255	0x0Y02
4	Check supply	Off On	0 1	Byte	On 0x01	0	1	0x0Y03
5	Analog data format	Default	0	Byte	Default 0x00			0x0Y04

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
6	Channel configuration Input channel 0	↳ *Table 206 “Channel configuration [2])” on page 693*		Byte	Default 0x00	0	19	0x0Y05
7	Channel monitoring Input channel 0	↳ *Table 207 “Channel monitoring [4])” on page 694*		Byte	Default 0x00	0	3	0x0Y06
8 to 35	Channel configuration and channel monitoring of the input channels 1 ... 14	↳ *Table 206 “Channel configuration [2])” on page 693* ↳ *Table 207 “Channel monitoring [4])” on page 694*		Byte Byte	Default 0x00 0x00	0 0	19 3	0x0Y07 to 0x0Y22
36	Channel configuration Input channel 15	↳ *Table 206 “Channel configuration [2])” on page 693*		Byte	Default 0x00	0	19	0x0Y23
37	Channel monitoring Input channel 15	↳ *Table 207 “Channel monitoring [4])” on page 694*		Byte	Default 0x00	0	3	0x0Y24
[1]) With CS31 and addresses less than 70 and FBP, the value is increased by 1 [2]) Not with FBP								

GSD file:

Ext_User_Prm_Data_Len =	37
Ext_User_Prm_Data_Const(0) =	0x05, 0xec, 0x22, \ 0x01, 0x00, \ 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \ 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \ 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \ 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00;

Input channel (16 x with AI523)

No.	Name	Value	Internal value	Internal value, type	Default
1	Channel configuration	see table [2])	see table [2])	Byte	0 0x00 see [3])
2	Channel monitoring	see table [4])	see table [4])	Byte	0 0x00 see [5])

Table 206: Channel configuration [2])

Internal value	Operating modes of the analog inputs, individually configurable
0	Unused (default) [3])
1	Analog input 0 V ... 10 V
2	Digital input
3	Analog input 0 mA ... 20 mA
4	Analog input 4 mA ... 20 mA
5	Analog input -10 V ... +10 V
8	Analog input Pt100, -50 °C ... +400 °C (2-wire)
9	Analog input Pt100, -50 °C ... +400 °C (3-wire), requires 2 channels *)
10	Analog input 0 ... 10 V via differential inputs, requires 2 channels *)
11	Analog input -10 V ... +10 V via differential inputs, requires 2 channels *)
14	Analog input Pt100, -50 °C ... +70 °C (2-wire)
15	Analog input Pt100, -50 °C ... +70 °C (3-wire), requires 2 channels *)
16	Analog input Pt1000, -50 °C ... +400 °C (2-wire)
17	Analog input Pt1000, -50 °C ... +400 °C (3-wire), requires 2 channels *)
18	Analog input Ni1000, -50 °C ... +150 °C (2-wire)

Internal value	Operating modes of the analog inputs, individually configurable
19	Analog input Ni1000, -50 °C ... +150 °C (3-wire), requires 2 channels *)
	*) In the operating modes with 3-wire configuration or with differential inputs, two adjacent analog inputs belong together (e.g. the channels 0 and 1). In these cases, both channels are configured in the desired operating mode. The lower address must be the even address (channel 0). The next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

Table 207: Channel monitoring [4])

Internal value	Monitoring
0	Plausibility, open-circuit (broken wire) and short circuit [5])
1	Open-circuit and short circuit
2	Plausibility
3	No monitoring

Diagnosis

Table 208: Possible diagnosis of I/O channels

Input range	Condition			
	Short circuit	Wire break	Input value underflow	Input value overflow
0 mA ... 20 mA	no diagnosis possible	no diagnosis possible	no diagnosis possible	Error identifier = 48
4 mA ... 20 mA	Error identifier = 7	Error identifier = 7	Error identifier = 7	Error identifier = 48
-10 V ... +10 V	no diagnosis possible	Error identifier = 48	Error identifier = 7	Error identifier = 48

E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500 display	<− Display in	
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC browser		
Byte 6 Bit 6 ... 7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0 ... 5	FBP diagnosis block		
Class	Interface	Device	Module	Channel	Error identifier	Error message		Remedy
	[1])	[2])	[3])	[4])				
Module error								
3	14	1 ... 10	31	31	19	Checksum error in the I/O module		Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	3	Timeout in the I/O module		Replace I/O module
	11 / 12	ADR	1 ... 10					

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier** **000 ... 063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**FBP diag-nosis block**	

Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])			
3	14	1 ... 10	31	31	40	Different hard-/firmware versions in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	36	Internal data exchange failure	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	New start
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	31	31	45	Process voltage is switched off (ON -> OFF)	Process voltage ON
	11 / 12	ADR	1 ... 10				
Channel error							
4	14	1 ... 10	1	0 ... 15	48	Analog value overflow or broken wire at an analog input	Check input value or terminal
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	1	0 ... 15	7	Analog value underflow at an analog input	Check input value
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	1	0 ... 15	47	Short circuit at an analog input	Check ter-minal
	11 / 12	ADR	1 ... 10				

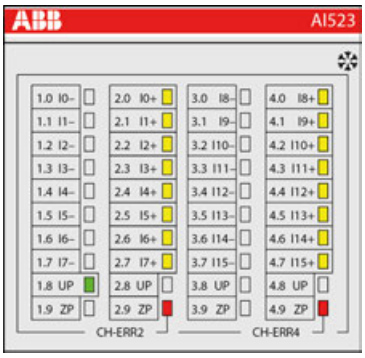
Remarks:

[1])	In AC500, the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = expansion module 1 ... 10, ADR = hardware address (e.g. of the DC551)

[3])	With "Module" the following allocation applies depending on the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or FBP = module type (1 = AI); COM1/COM2: 1 ... 10 = expansion 1 ... 10
[4])	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Inputs I0 ... I7 and I8 ... I15	Analog input	Yellow	Input is OFF	Input is ON (brightness depends on the value of the analog signal)	--
	UP	Process voltage 24 V DC via terminal	Green	Process voltage is missing	Process voltage OK	--
	CH-ERR2	Channel error, error messages in groups (analog inputs or outputs combined into the groups 2 and 4)	Red	No error or process voltage is missing	Severe error within the corresponding group	Error on one channel of the group
	CH-ERR4		Red			
	CH-ERR *)	Module error	Red	--	Internal error	--
	*) Both LEDs (CH-ERR2 and CH-ERR4) light up together					

Measuring ranges

Input ranges of voltage, current and digital input

The represented resolution corresponds to 16 bits.

Range	0 V ... 10 V	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital input	Digital value	
						Decimal	Hex.
Overflow	>11.7589	>11.7589	>23.5178	>22.8142		32767	7FFF
Measured value too high	11.7589 . . 10.0004	11.7589 : 10.0004	23.5178 : 20.0007	22.8142 : 20.0006		32511 : 27649	7EFF : 6C01
Normal range Normal range or measured value too low	10.0000 : 0.0004	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	: : ON	27648 : 1	6C00 : 0001
	0.0000	0.0000	0	4	OFF	0	0000
	-0.0004 -1.7593	-0.0004 : : -10.0000		3.9994 1.1858		-1 -4864 : -27648	FFFF ED00 : 9400
Measured value too low		-10.0004 : -11.7589				-27649 : -32512	93FF : 8100
Underflow	<-1.7593	<-11.7589	<0.0000	<1.1858		-32768	8000

Input ranges resistance temperature detector

The resolution corresponds to 16 bits.

Range	Pt100 -50 °C ... +70 °C	Pt100 / Pt1000 -50 °C ... +400 °C	Ni1000 -50 °C ... +150 °C	Digital value	
				Decimal	Hex.
Overflow	> +80.0 °C	> +450.0 °C	> +160.0 °C	32767	7FFF
Measured value too high		+450.0 °C : + 400.1 °C		4500 : 4001	1194 : 0FA1
			+160.0 °C : +150.1 °C	1600 : 1501	0640 : 05DD
	+80.0 °C : +70.1 °C			800 : 701	0320 : 02BD

Range	Pt100 -50 °C ... +70 °C	Pt100 / Pt1000 -50 °C ... +400 °C	Ni1000 -50 °C ... +150 °C	Digital value	
				Decimal	Hex.
Normal range	: : +70.0 °C : + 0.1 °C	+400.0 °C : : : +0.1 °C	: +150.0 °C : : + 0.1 °C	4000 1500 700 : 1	0FA0 05DC 02BC : 0001
	0.0 °C	0.0 °C	0.0 °C	0	0000
	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-1 : -500	FFFF : FE0C
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-501 : -600	FE0B : FDA8
Underflow	< -60.0 °C	< -60.0 °C	< -60.0 °C	-32768	8000

Technical data

Technical data of the module

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

↳ *Chapter 4.3 “System data AC500-XC” on page 38*

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter		Value
Process voltage		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 V DC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module	Ca. 2 mA

Parameter		Value
	From UP at normal operation / with outputs	0.15 A + output loads
Inrush current from UP (at power up)		0.050 A^2s
Max. length of analog cables, conductor cross section > 0.14 mm^2		100 m
Weight		300 g
Mounting position		Horizontal mounting or Vertical mounting with derating (output load reduced to 50 % at +40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Technical data of the analog inputs

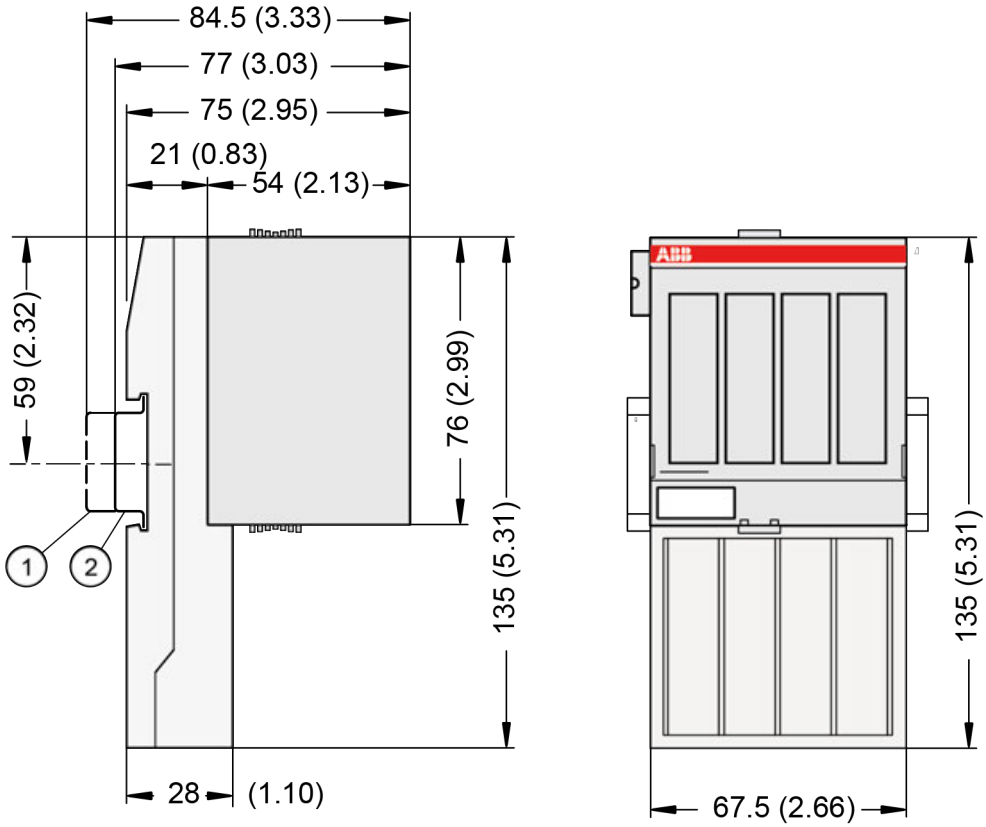
Parameter	Value
Number of channels per module	16
Distribution of channels into groups	1 group of 16 channels
Connections of the channels I0- ... I7- Connections of the channels I0+ ... I7+	Terminals 1.0 ... 1.7 Terminals 2.0 ... 2.7
Connections of the channels I8- ... I15- Connections of the channels I8+ ... I15+	Terminals 3.0 ... 3.7 Terminals 4.0 ... 4.7
Input type	Bipolar (not with current or Pt100/ Pt1000/ Ni1000)
Galvanic isolation	Against internal supply and other modules
Configurability	0 V ... 10 V, -10 V ... +10 V, 0/4 mA ... 20 mA, Pt100/1000, Ni1000 (each input can be configured individually)
Channel input resistance	Voltage: > 100 kΩ Current: ca. 330 Ω
Time constant of the input filter	Voltage: 100 µs Current: 100 µs
Indication of the input signals	1 LED per channel
Conversion cycle	2 ms (for 16 inputs), with Pt/Ni... 1 s
Resolution	Range 0 V ... 10 V: 12 bits
	Range -10 V ... +10 V: 12 bits including sign
	Range 0 mA ... 20 mA: 12 bits
	Range 4 mA ... 20 mA: 12 bits

Parameter	Value	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ.	±0.5 % of full scale at +25 °C
	Max.	±1 % of full scale (all ranges) at 0 °C ... +60 °C or EMC disturbance
Relationship between input signal and hex code	↳ *Chapter 5.4.4.2.2.9.2 “Input ranges resistance temperature detector” on page 697*	
Unused voltage inputs	Are configured as "unused"	
Unused current inputs	Have a low resistance, can be left open-circuited	
Overvoltage protection	Yes	

Technical data of the analog inputs, if used as digital inputs

Parameter		Value
Number of channels per module		Max. 16
Distribution of channels into groups		1 group of 16 channels
Connections of the channels I0+ ... I7+		Terminals 2.0 ... 2.7
Connections of the channels I8+ ... I15+		Terminals 4.0 ... 4.7
Reference potential for the inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (ZP)
Input signal delay		Typ. 8 ms, configurable from 0.1 ... 32 ms
Indication of the input signals		1 LED per channel
Input signal voltage		24 V DC
	Signal 0	-30 V ... +5 V
	Undefined signal	+5 V ... +13 V
	Signal 1	+13 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 7 mA
	Input voltage +5 V	Typ. 1.4 mA
	Input voltage +15 V	Typ. 4.3 mA
	Input voltage +30 V	< 9 mA
Input resistance		Ca. 3.5 kΩ

Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

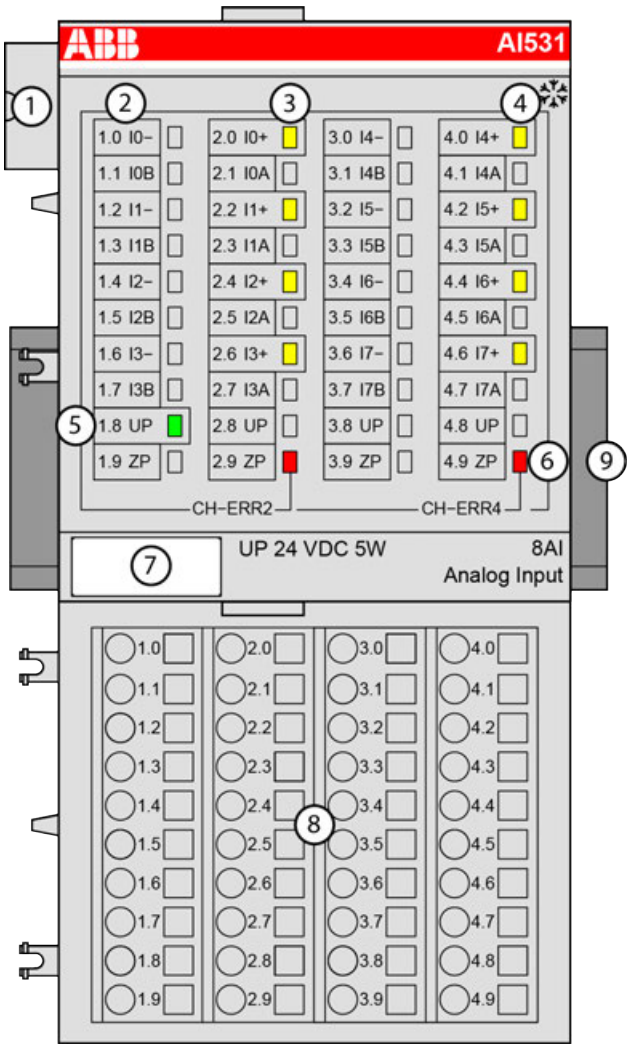
Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 250 300 R0001	AI523, analog input module, 16 AI, U/I/Pt100, 12 bits including sign, 2-wires	Active
1SAP 450 300 R0001	AI523-XC, analog input module, 16 AI, U/I/Pt100, 12 bits including sign, 2-wires, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.4.4.2.3 AI531 - Analog input module

- 8 configurable analog inputs (I0 ... I7) in 2 groups (1.0 ... 1.7 and 2.0 ... 2.7 as well as 3.0 ... 3.7 and 4.0 ... 4.7)
  Resolution 16 bits including sign
- Module-wise galvanically isolated
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal names
3 4 yellow LEDs to display the states at the inputs I0 ... I3
4 4 yellow LEDs to display the states at the inputs I4 ... I7
5 1 green LED to display the process supply voltage UP
6 2 red LEDs to display errors (CH-ERR2 and CH-ERR4)
7 Label
8 Terminal unit
9 DIN rail
❄ Sign for XC version

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

Functionality

8 analog inputs, individually configurable:

- Unused (default setting)
- 0 V ... 5 V, 0 V ... 10 V
- -50 mV ... +50 mV, -500 mV ... +500 mV
- -1 V ... +1 V, -5 V ... +5 V, -10 V ... +10 V
- 0 mA ... 20 mA
- 4 mA ... 20 mA
- -20 mA ... 20 mA
- Pt100, -50 °C ... +70 °C or +400 °C (2-, 3- and 4-wire)
- Pt100, -200 °C ... +850 °C (2-, 3- and 4-wire)
- Pt1000, -50 °C ... +400 °C (2-, 3- and 4-wire)
- Ni1000, -50 °C ... +150 °C (2-, 3- and 4-wire)
- Cu50 (1.426): -50 °C ... +200 °C (2-, 3- and 4-wire)
- Cu50 (1.428): -200 °C ... +200 °C (2-, 3- and 4-wire)
- 0 Ω ... 50 kΩ
- Thermocouples of types J, K, T, N, S
- Resistance measuring bridge
- Digital signals (digital input)

Parameter		Value
Resolution of the analog channels		
	Voltage and current	16 bits including sign
	Temperature	+0.1 °C (0,01°C at Pt100 -50 °C ... +70 °C)
LED displays		11 LEDs for signals and error messages
Internal power supply		through the I/O bus interface (I/O bus)
External power supply		via terminals (process voltage UP = 24 V DC)
Required terminal unit		TU515 or TU516 ↳ *TU515, TU516*

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The modules are plugged on an I/O terminal unit.

↳ *TU515, TU516*

Properly position the modules and press until they lock in place. The terminal units are mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting.

↳ *Chapter 5.8.2.6 “TA526 - Wall mounting accessory” on page 1410*

The connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8, 2.8, 3.8, 4.8, 1.9, 2.9, 3.9 and 4.9 are electrically interconnected within the I/O terminal units and always have the same assignment, independent of the inserted module:

Terminals 1.8, 2.8, 3.8 and 4.8: process voltage UP = +24 V DC

Terminals 1.9, 2.9, 3.9 and 4.9: process voltage ZP = 0 V

Table 209: Assignements of the other terminals

Terminals	Signal	Description
2.0, 2.2, 2.4, 2.6	I0+ ... I3+	Positive poles of the first 4 analog inputs
1.0, 1.2, 1.4, 1.6	I0- ... I3-	Negative poles of the first 4 analog inputs
2.1, 2.3, 2.5, 2.7	I0A ... I3A	Connections A (supply) of the first 4 analog inputs
1.1, 1.3, 1.5, 1.7	I0B ... I3B	Connections B (analog ground) of the first 4 analog inputs
4.0, 4.2, 4.4, 4.6	I4+ ... I7+	Positive poles of the following 4 analog inputs
3.0, 3.2, 3.4, 3.6	I4- ... I7-	Negative poles of the following 4 analog inputs
4.1, 4.3, 4.5, 4.7	I4A ... I7A	Connections A (supply) of the following 4 analog inputs
3.1, 3.3, 3.5, 3.7	I4B ... I7B	Connections B (analog ground) of the following 4 analog inputs



CAUTION!
Analog sensors must be galvanically isolated against the ground. In order to avoid inaccuracy with the measuring results, the analog sensors should also be isolated against the power supply.



CAUTION!
There is no galvanic isolation between the analog circuitry and ZP/UP. Therefore, the analog sensors must be galvanically isolated in order to avoid loops via the ground potential or the supply voltage.



The "IxB" clamps (x=0 ... 7) of the analog inputs are galvanically connected to each other. They form an "Analog Ground Signal" (AGND) for the module.



The negative poles of the analog inputs Ix- may accept a potential difference up to ±20 V DC with regard to the common reference potential IxB (AGND, ZP). Observing this maximum voltage difference, analog current inputs of one module can be switched in series to each other and also with current inputs of other modules.

For the open-circuit detection (wire break), each positive analog input channel Ix+ is pulled up to "plus" by a high-resistance resistor and each negative analog input channel Ix- is pulled down to "minus" by a resistor. If wire break occurs, a maximum voltage (overflow or underflow) will be read in then.

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 2 mA per AI531.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.

WARNING!

Removal/Insertion under power

Removal or insertion under power is permissible only if all conditions for hot swapping are fullfilled.

"Conditions for hot swap" on page 12

The devices are not designed for removal or insertion under power when the conditions for hot swap do not apply. Because of unforeseeable consequences, it is not allowed to plug in or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing any of the following actions:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while they are energized in a hazardous location could result in an electric arc, which could create an ignition source resulting in fire or explosion.

Prior to proceeding, make sure that power is been disconnected and that the area has been thoroughly checked to ensure that flammable materials or ignitable concentrations are not present.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

Generally, analog signals must be laid in shielded cables. The cable shields must be grounded at both sides of the cables. To avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

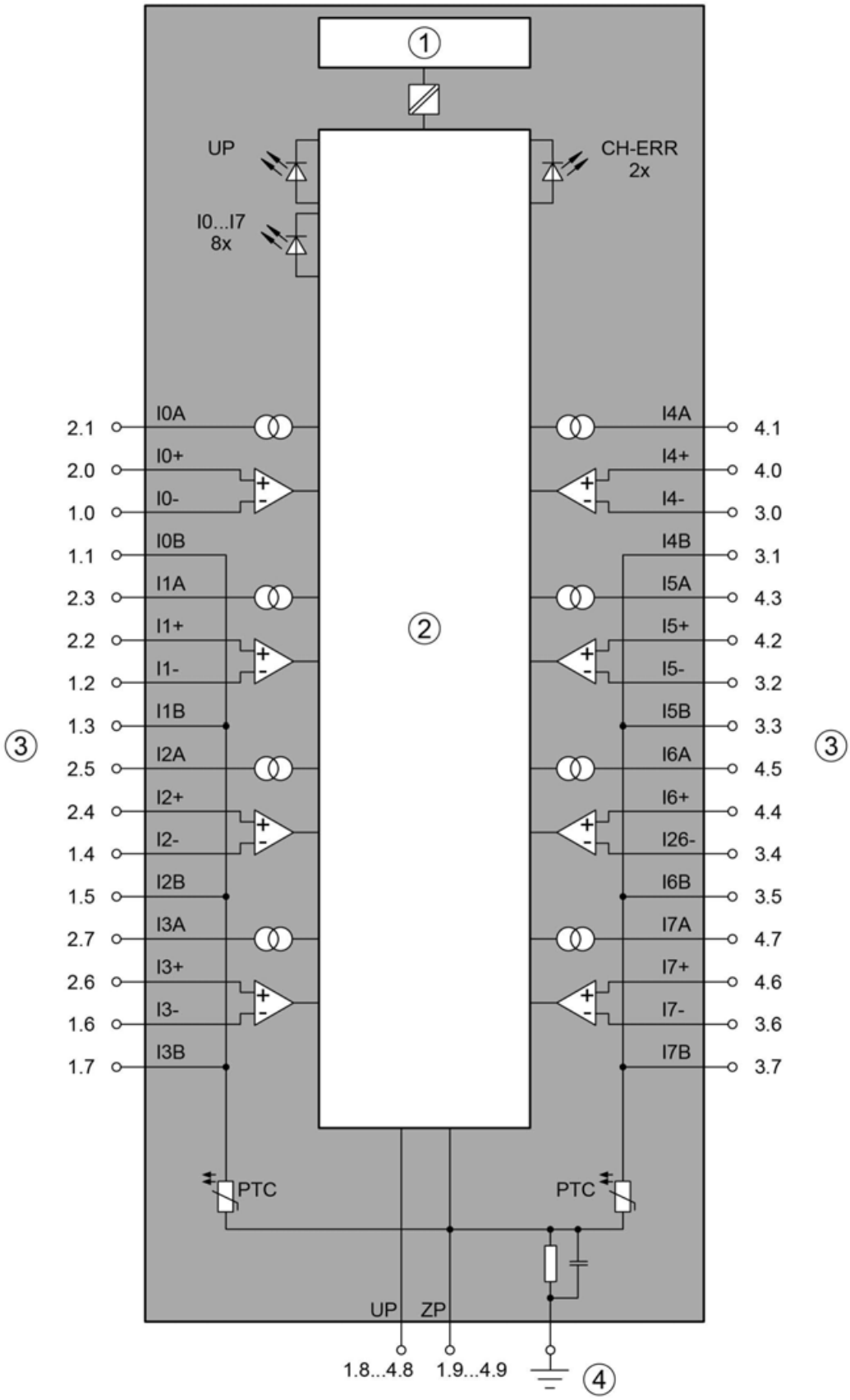


Fig. 89: 8 analog inputs in two groups, individually configurable *Chapter 5.4.4.2.3.2 “Functionality” on page 703*

1 I/O bus interface
2 Logic
3 Analog inputs
4 Functional earth connection

CAUTION!
By installing equipotential bonding conductors between the different parts of the system, it must be ensured that the potential difference between ZP and AGND never can exceed 1 V.

CAUTION!
The process supply voltage must be included in the grounding concept (e. g. grounding of the negative terminal).

The module provides several diagnosis functions.

↳ *Chapter 5.4.4.2.3.7 “Diagnosis” on page 730*

Connection of active-type analog sensors (Voltage) with galvanically isolated power supply

Standard ranges

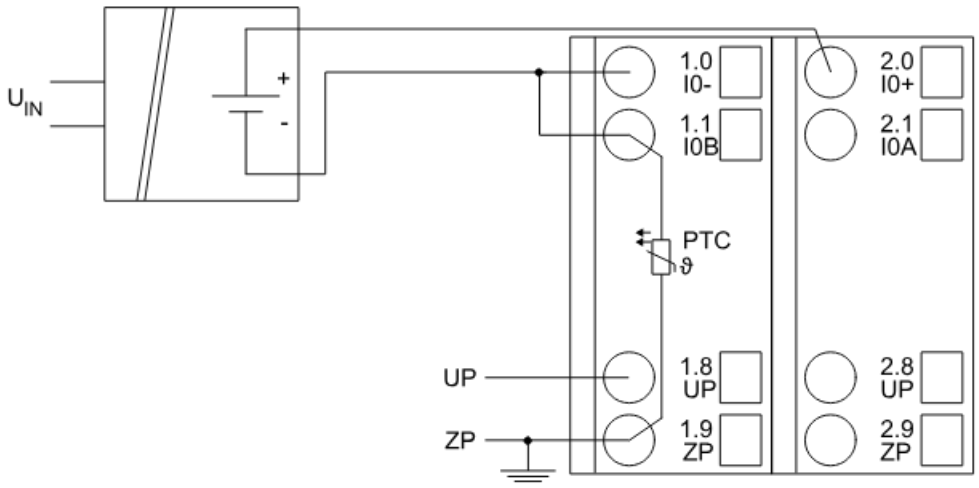


Fig. 90: Connection example

Table 210: Configurable measuring ranges

Voltage	-50 mV ... +50 mV	1 channel used
Voltage	-500 mV ... +500 mV	1 channel used
Voltage	-1 V ... +1 V	1 channel used
Voltage	-5 V ... +5 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used
Voltage	0 V ... +5 V	1 channel used
Voltage	0 V ... +10 V	1 channel used

↳ *Chapter 5.4.4.2.3.6 “Parameterization” on page 727*

Common mode range (+/-20 V)

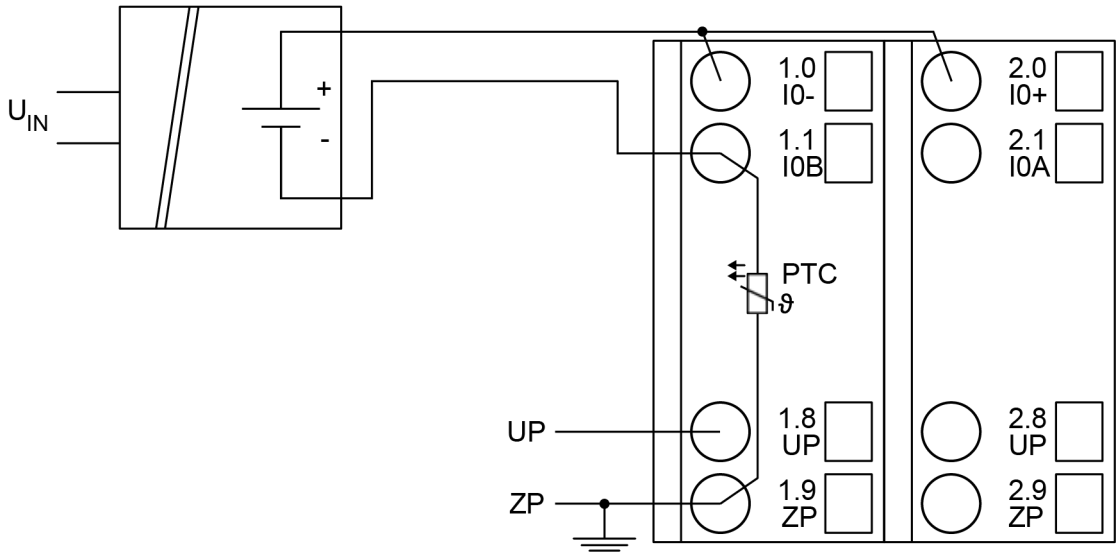


Fig. 91: Connection example

Table 211: Configurable measuring range

Voltage	Common mode voltage	1 channel used

↳ *Chapter 5.4.4.2.3.6 “Parameterization” on page 727*

↳ *Function of the LEDs*

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Connection of active-type analog sensors (Voltage) with no galvanically isolated power supply

Standard ranges

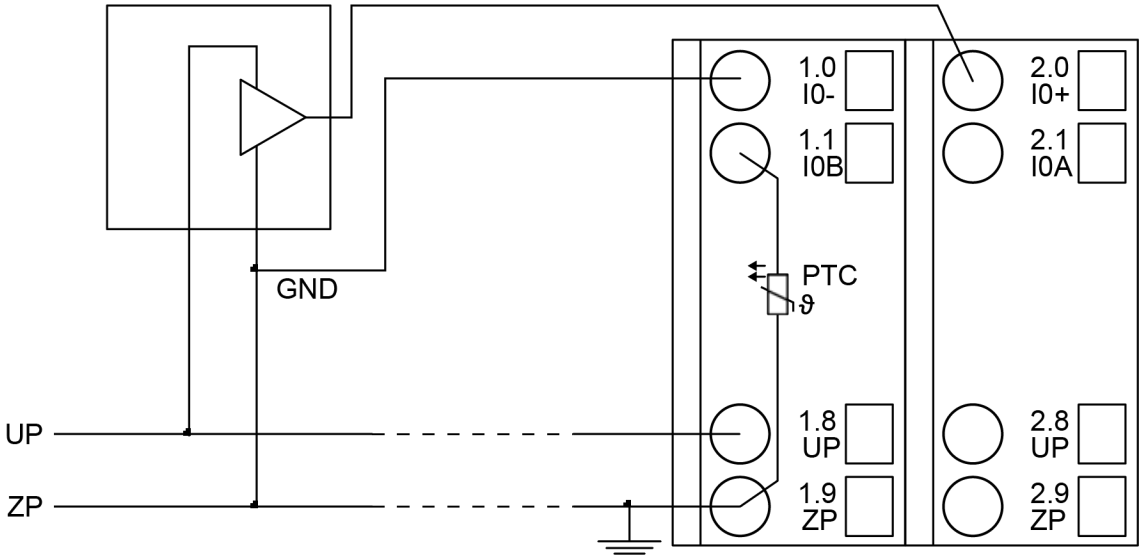


Fig. 92: Connection example

CAUTION!
If GND is not directly connected to ZP at the sensor, the supply current flows via the GND line to ZP. Measuring errors can only occur caused by voltage differences higher than ± 20 V DC between GND and ZP.

Table 212: Configurable measuring ranges

Voltage	-50 mV ... +50 mV	1 channel used
Voltage	-500 mV ... +500 mV	1 channel used
Voltage	-1 V ... +1 V	1 channel used
Voltage	-5 V ... +5 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used
Voltage	0 V ... +5 V	1 channel used
Voltage	0 V ... +10 V	1 channel used

Chapter 5.4.4.2.3.6 “Parameterization” on page 727

Common mode range (+/-20 V)

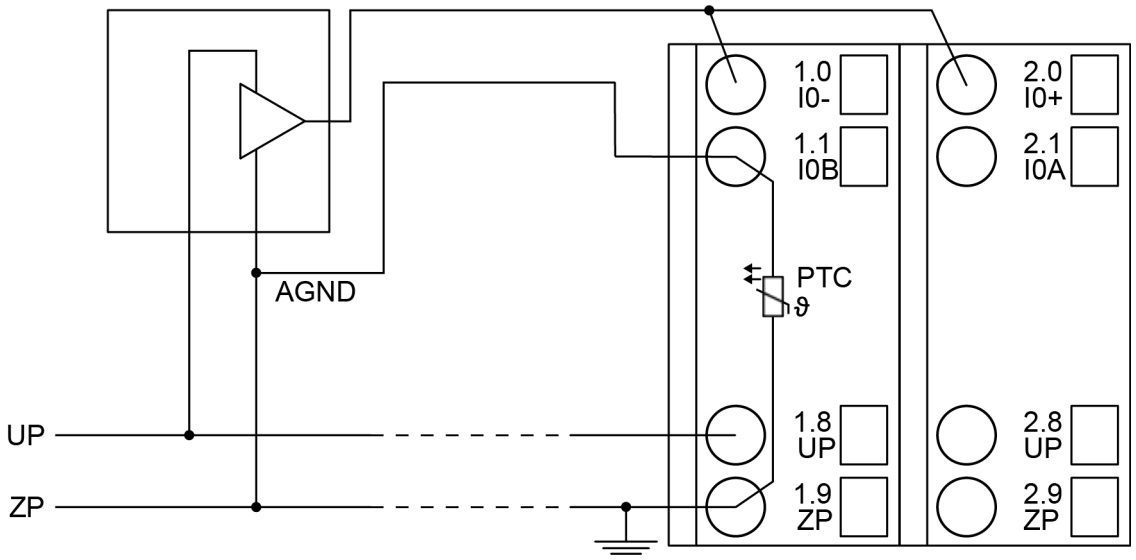


Fig. 93: Connection example

CAUTION!
If GND is not directly connected to ZP at the sensor, the supply current flows via the GND line to ZP. Measuring errors can only occur caused by voltage differences higher than ± 20 V DC between GND and ZP.

Table 213: Configurable measuring range

Voltage	Common mode voltage	1 channel used

↳ *Chapter 5.4.4.2.3.6 “Parameterization” on page 727*

↳ *Function of the LEDs*

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Connection of active-type analog sensors (Current) with galvanically isolated power supply

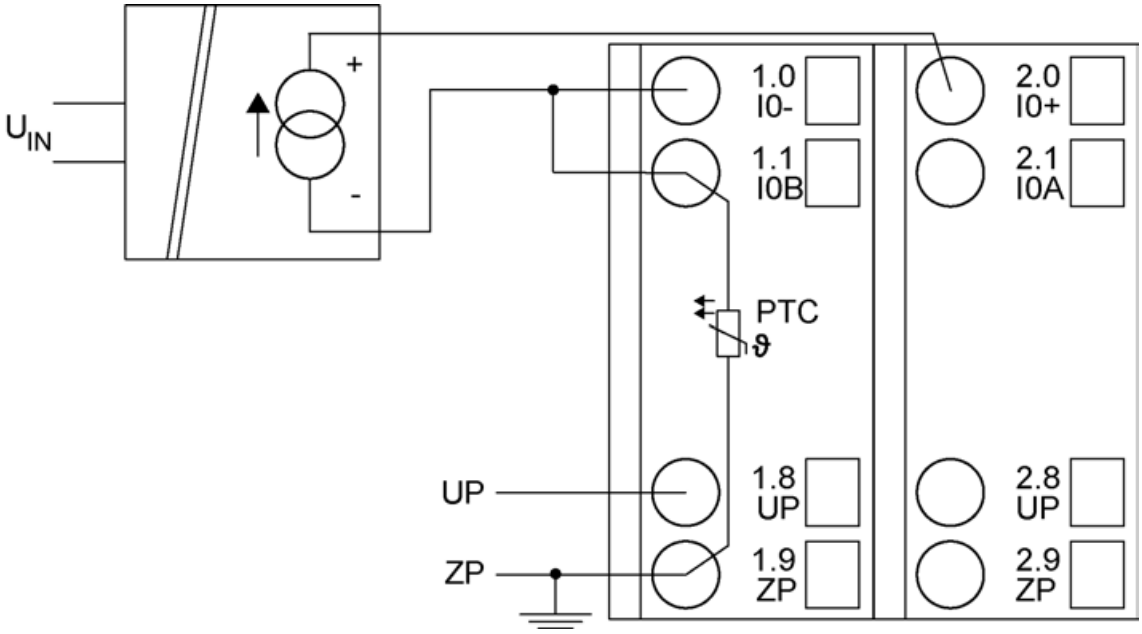


Fig. 94: Connection example

Table 214: Configurable measuring ranges

Current	-20 mA ... 20 mA	1 channel used
Current	0 mA ... 20 mA	1 channel used
Current	4 mA ... 20 mA	1 channel used

↳ *Chapter 5.4.4.2.3.6 “Parameterization” on page 727*

↳ *Function of the LEDs*

Unused input channels can be left open, because they are of low resistance.

Connection of active-type analog sensors (Current) with galvanically isolated power supply and series-connection of an additional input

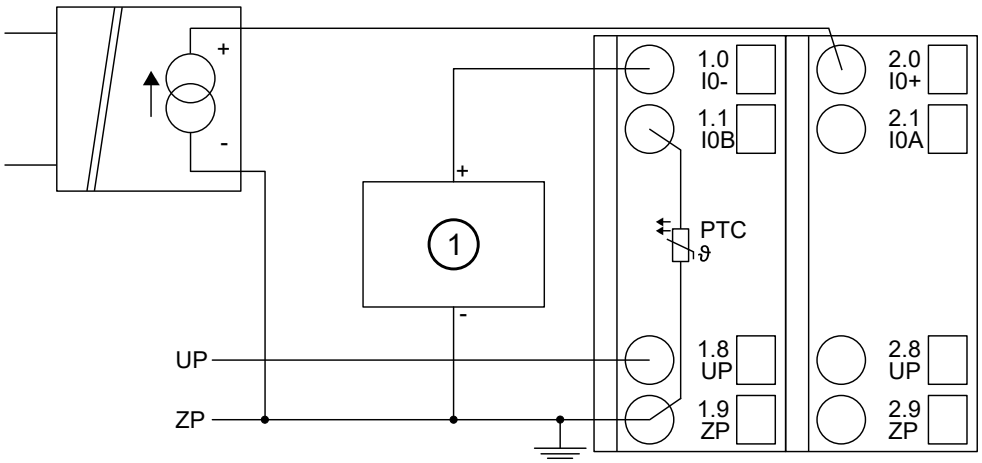


Fig. 95: Connection example

1 Analog input of the second device

If series-connection of an additional input is used, the input resistance of the module (ca. 330 Ω) must be added to the input resistance of the second device. Make sure that the maximum permitted load resistance of the analog sensor is not exceeded (see the data sheet of the analog sensor).

The input of the module is not related to ZP. If the input of the second device is related to ZP, the order of sequence in the series-connection must be observed by all means (from the sensor to the module and then to the input of the second device).

Table 215: Configurable measuring ranges

Current	-20 mA ... 20 mA	1 channel used
Current	0 mA ... 20 mA	1 channel used
Current	4 mA ... 20 mA	1 channel used

↳ *Chapter 5.4.4.2.3.6 “Parameterization” on page 727*

↳ *Function of the LEDs*

Unused input channels can be left open, because they are of low resistance.

Connection of passive-type analog sensors (Current)

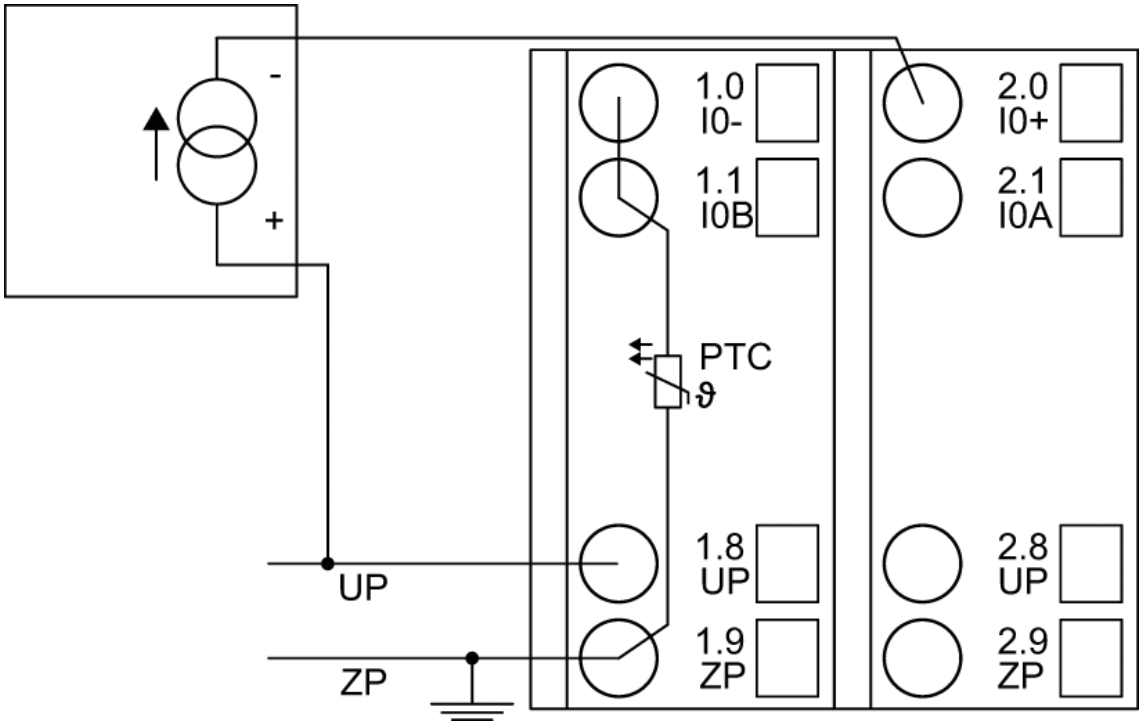


Fig. 96: Connection example

Table 216: Configurable measuring ranges

Current	-20 mA ... 20 mA *)	1 channel used
Current	0 mA ... 20 mA *)	1 channel used

Current	4 mA ... 20 mA	1 channel used
*) This setting is not applicable with passive-type analog sensors (current).		

↳ *Chapter 5.4.4.2.3.6 “Parameterization” on page 727*

↳ *Function of the LEDs*

Unused input channels can be left open, because they are of low resistance.

Connection of passive-type analog sensors (Current) and series-connection of an additional analog sensor

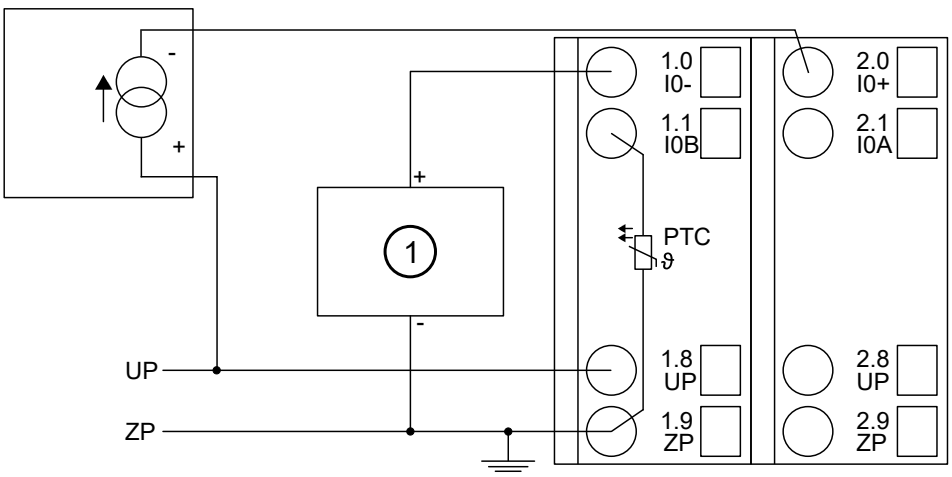


Fig. 97: Connection example

1 Analog input of the second device

If series-connection of an additional input is used, the input resistance of the module (ca. 330 Ω) must be added to the input resistance of the second device. Make sure that the maximum permitted load resistance of the analog sensor is not exceeded (see the data sheet of the analog sensor).

The input of the module is not related to ZP. If the input of the second device is related to ZP, the order of sequence in the series-connection must be observed by all means (from the sensor to the module and then to the input of the second device).

Table 217: Configurable measuring ranges

Current	-20 mA ... 20 mA *)	1 channel used
Current	0 mA ... 20 mA *)	1 channel used
Current	4 mA ... 20 mA	1 channel used
*) This setting is not applicable with passive-type analog sensors (current).		

↳ *Chapter 5.4.4.2.3.6 “Parameterization” on page 727*

↳ *Function of the LEDs*

Unused input channels can be left open, because they are of low resistance.

Connection of digital signal sources at analog inputs

Several (or all) analog inputs can be configured as digital inputs. The inputs are not galvanically isolated against the other analog channels.

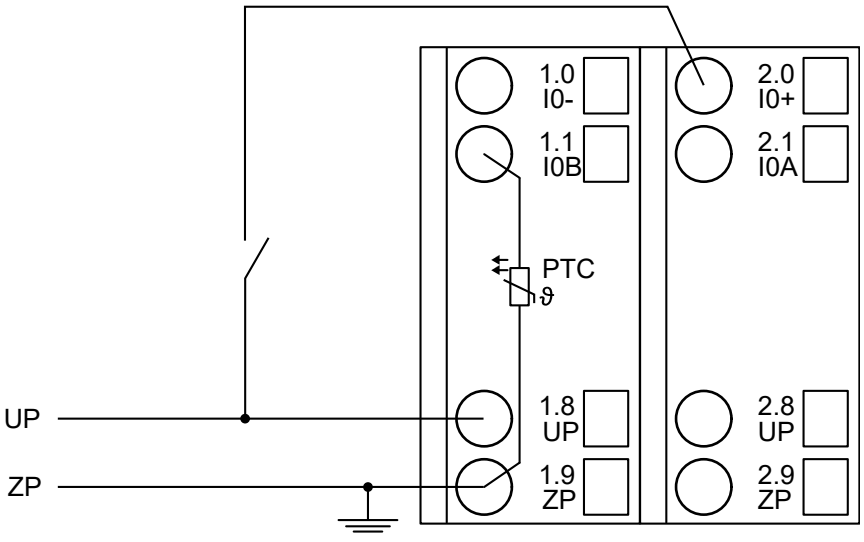


Fig. 98: Connection example

Table 218: Configurable measuring ranges

Digital input	24 V	1 channel used
Effect of incorrect input terminal connection		Wrong or no signal detected, no damage up to 35 V

↳ *Chapter 5.4.4.2.3.6 “Parameterization” on page 727*

↳ *Function of the LEDs*

Connection of resistance thermometers in 2-wire configuration

When resistance thermometers (Pt100, Pt1000, Ni1000, Cu50) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module AI531 provides a constant current source which is multiplexed over the 4 analog channels.

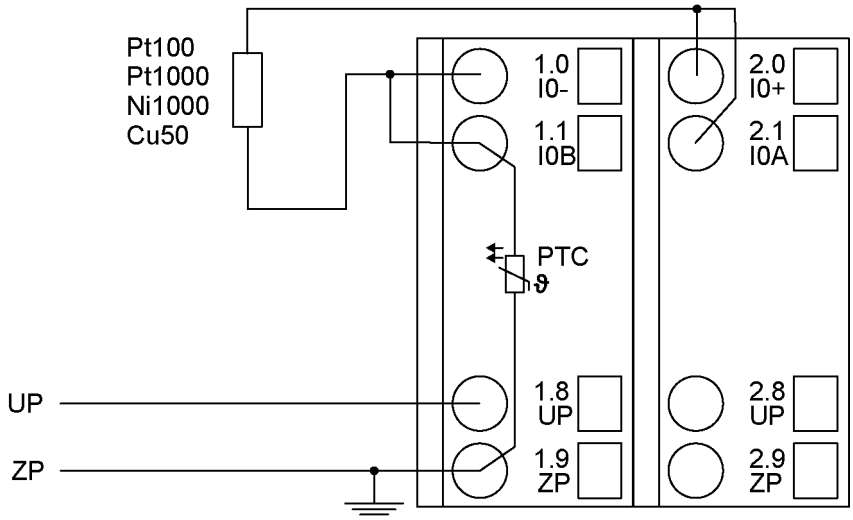


Fig. 99: Connection example

Table 219: Configurable measuring ranges

Pt100	-50 °C ... +70 °C / +400 °C; -200 °C ... +850 °C	1 channel used
Pt1000	-50 °C ... +400 °C	1 channel used
Ni1000	-50 °C ... +150 °C	1 channel used
Cu50	-50 °C ... +200 °C (1.426); -200 °C ... +200 °C (1.428)	1 channel used

↳ *Chapter 5.4.4.2.3.6 “Parameterization” on page 727*

↳ *Function of the LEDs*

The module linearizes the resistance thermometer characteristics.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of resistance thermometers in 3-wire configuration

When resistance thermometers (Pt100, Pt1000, Ni1000, Cu50) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module AI531 provides a constant current source which is multiplexed over the 4 analog channels.

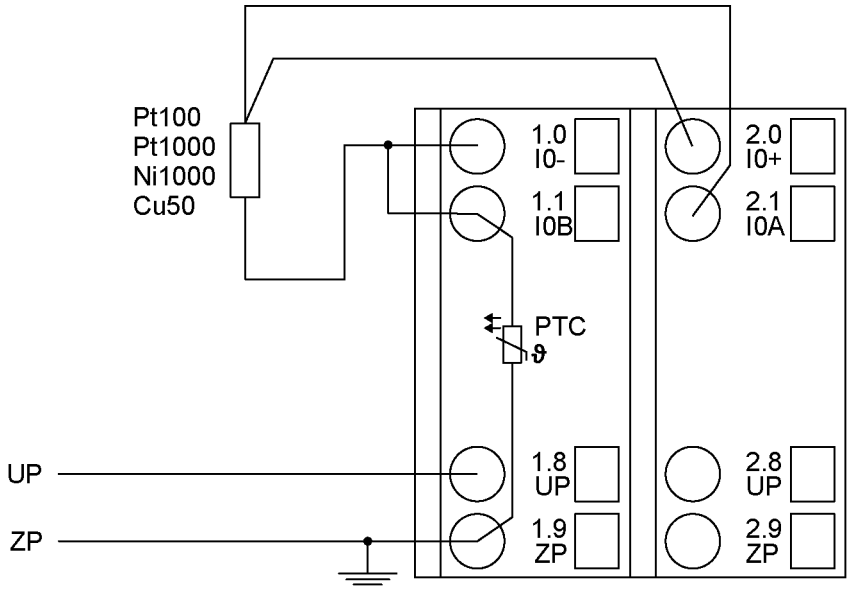


Fig. 100: Connection example

Table 220: Configurable measuring ranges

Pt100	-50 °C ... +70 °C/+400 °C; -200 °C ... +850 °C	1 channel used
Pt1000	-50 °C ... +400 °C	1 channel used
Ni1000	-50 °C ... +150 °C	1 channel used
Cu50	-50 °C ... +200 °C (1.426); -200 °C ... +200 °C (1.428)	1 channel used

↳ *Chapter 5.4.4.2.3.6 “Parameterization” on page 727*

↳ *Function of the LEDs*

The module linearizes the resistance thermometer characteristics. In order to keep measuring errors as small as possible, it is necessary by all means to have all the involved conductors in the same cable. All the conductors must have the same cross section.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of resistance thermometers in 4-wire configuration

When resistance thermometers (Pt100, Pt1000, Ni1000, Cu50) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module AI531 provides a constant current source which is multiplexed over the 4 analog channels.

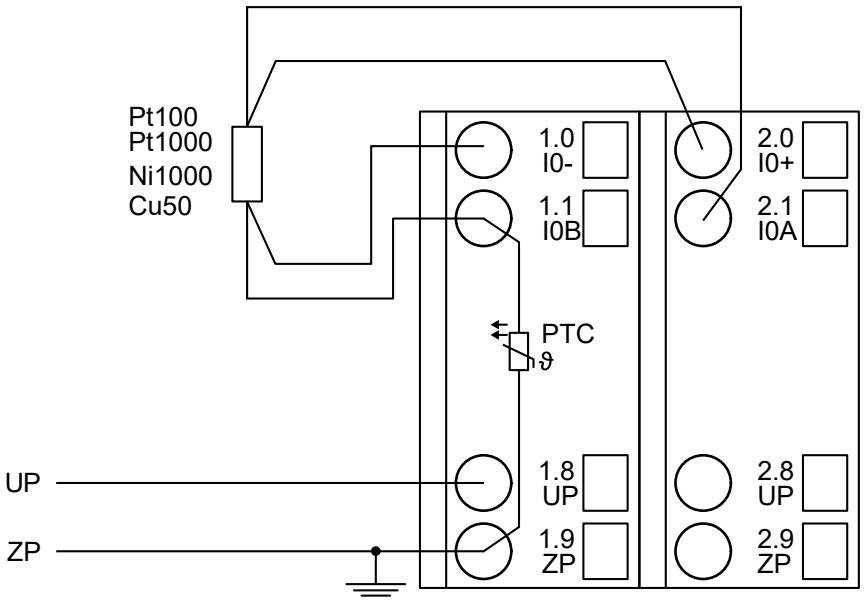


Fig. 101: Connection example

Table 221: Configurable measuring ranges

Pt100	-50 °C ... +70 °C/+400 °C; -200 °C ... +850 °C	1 channel used
Pt1000	-50 °C ... +400 °C	1 channel used
Ni1000	-50 °C ... +150 °C	1 channel used
Cu50	-50 °C ... +200 °C (1.426); -200 °C ... +200 °C (1.428)	1 channel used

Chapter 5.4.4.2.3.6 “Parameterization” on page 727

Function of the LEDs

The module linearizes the resistance thermometer characteristics. In order to keep measuring errors as small as possible, it is necessary by all means, to have all the involved conductors in the same cable.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of resistors in 2-wire configuration

For evaluating resistors, a constant current must flow through them to build the necessary voltage drop. For this, the module AI531 provides a constant current source which is multiplexed over the 4 analog channels.

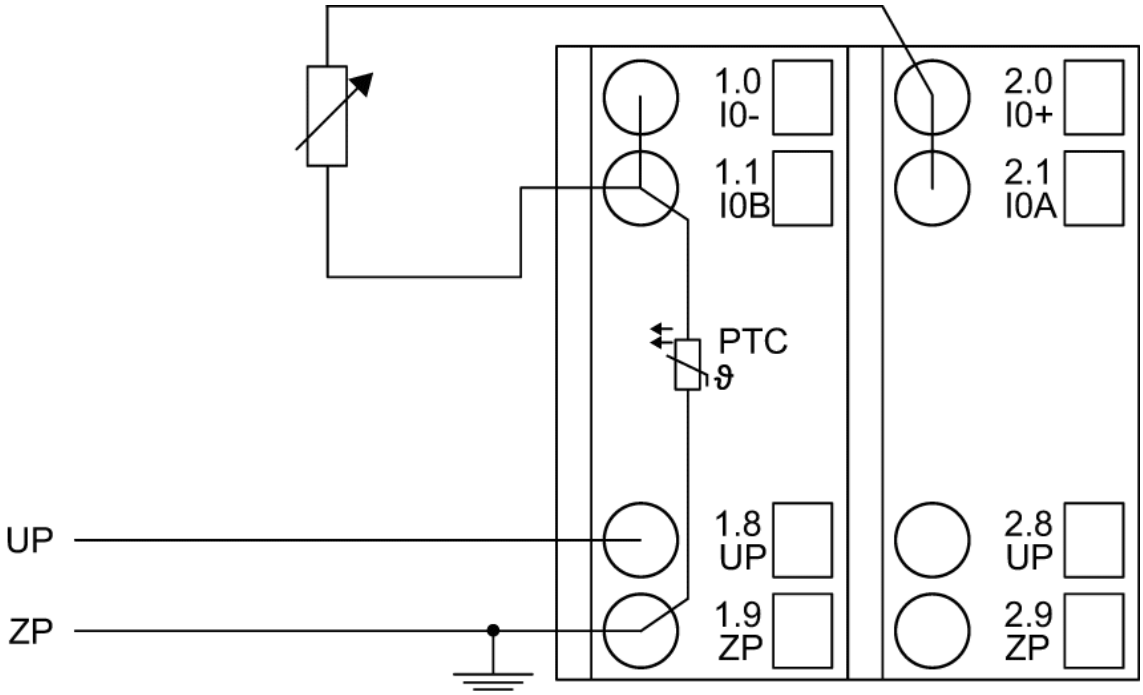


Fig. 102: Connection example

Table 222: Configurable measuring range

Resistor	50 kΩ	1 channel used

↳ *Chapter 5.4.4.2.3.6 “Parameterization” on page 727*

↳ *Function of the LEDs*

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of a resistance measuring bridge with internal supply

When resistance measuring bridges are connected, the short-circuit-proof voltage output (internal supply) at pin I0A (or I2A, I4A, I6A) must be used. This supply voltage is activated as soon as "Voltage Measurement" is configured for the relevant channel.

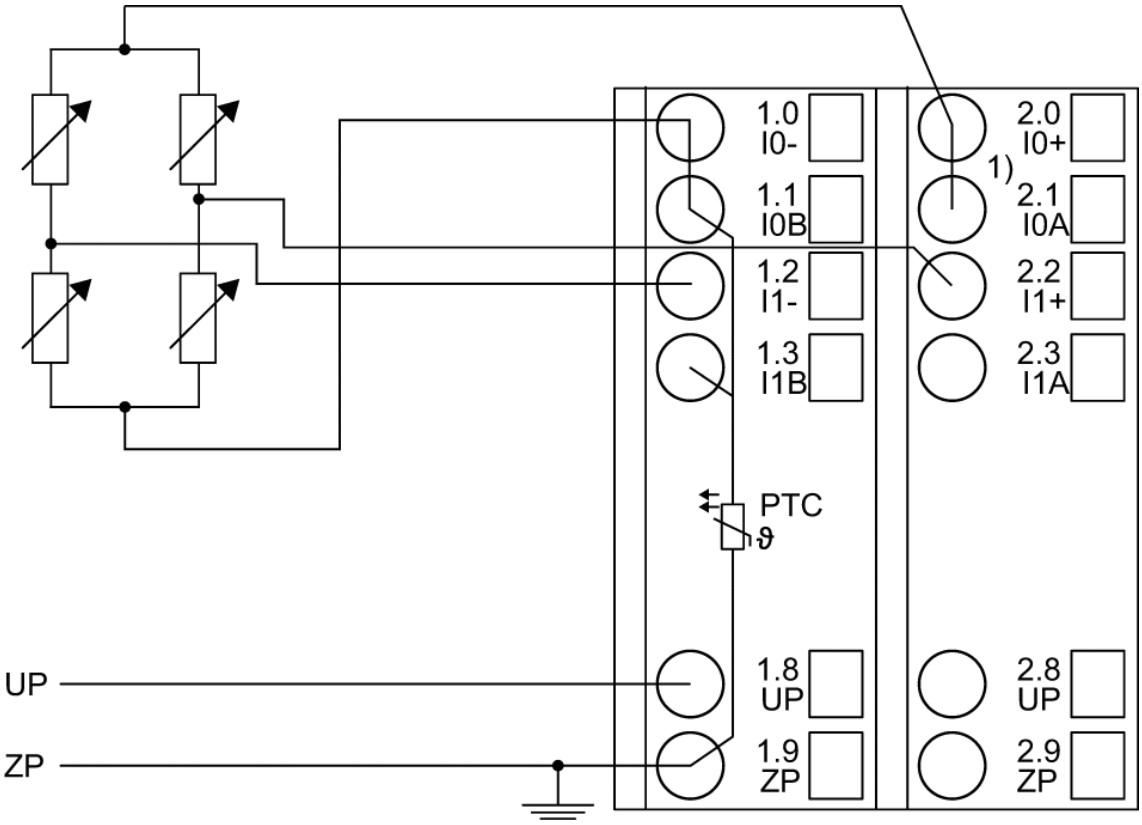


Fig. 103: Connection example

1 Internal supply

Table 223: Configurable measuring ranges

Voltage	-50 mV ... +50 mV	1 channel used
Voltage	-500 mV ... +500 mV	1 channel used
Voltage	-1 V ... +1 V	1 channel used
Voltage	-5 V ... +5 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used
Voltage	0 V ... +5 V	1 channel used
Voltage	0 V ... +10 V	1 channel used

Chapter 5.4.4.2.3.6 “Parameterization” on page 727

The calculation of the resistor deviation must be performed via the bridge voltage by the PLC user program.

Connection of a resistance measuring bridge with external supply

With the connection of a resistance measuring bridge with external supply, the supply voltage is provided separately.

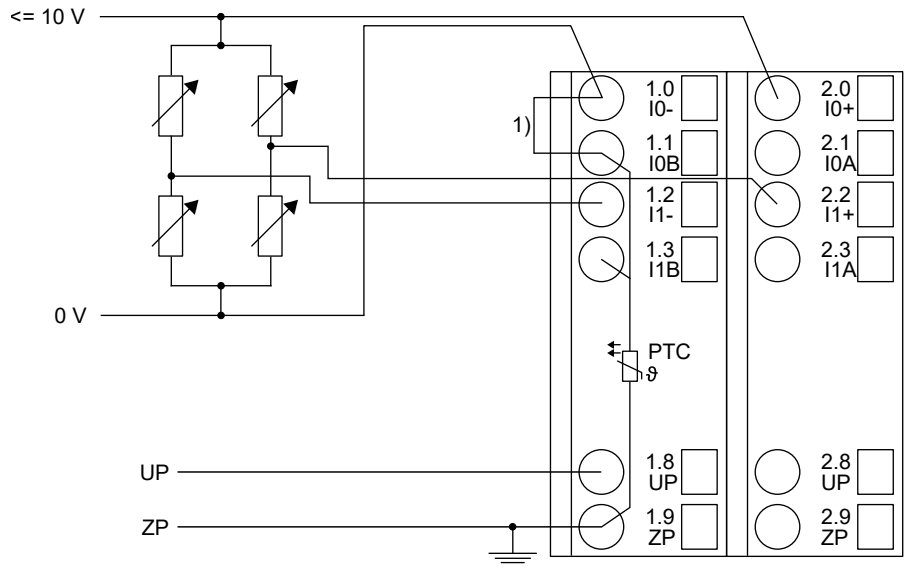


Fig. 104: Connection example

1 Bridge to IxB necessary with galvanically isolated supply

Table 224: Configurable measuring ranges

Voltage	-50 mV ... +50 mV	1 channel used
Voltage	-500 mV ... +500 mV	1 channel used
Voltage	-1 V ... +1 V	1 channel used
Voltage	-5 V ... +5 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used
Voltage	0 V ... +5 V	1 channel used
Voltage	0 V ... +10 V	1 channel used

Chapter 5.4.4.2.3.6 “Parameterization” on page 727

The calculation of the resistor deviation must be performed via the bridge voltage by the PLC user program.

Connection of thermocouples

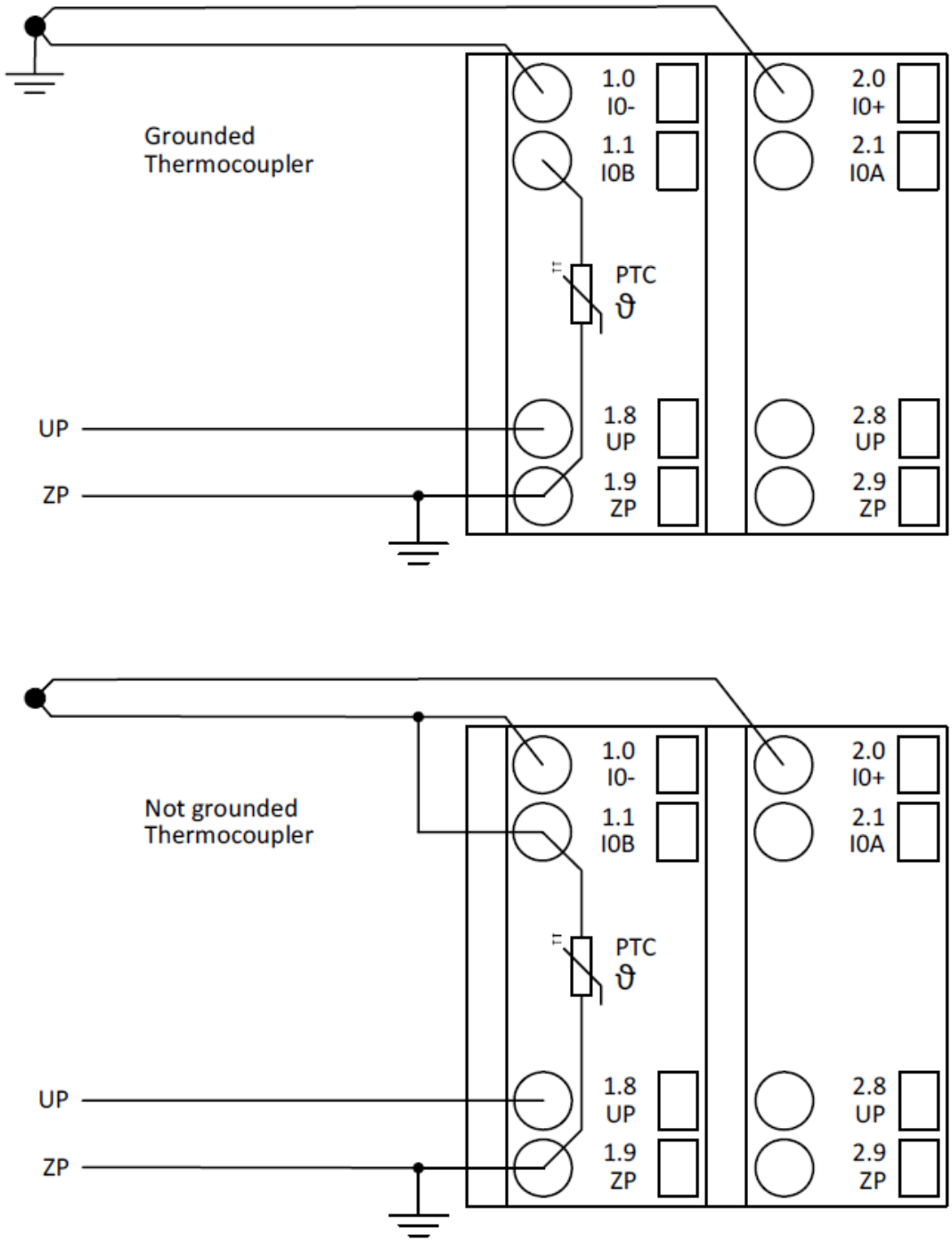


Fig. 105: Connection example

Table 225: Configurable measuring ranges

J type	-210 °C ... +1200 °C	Fe-CuNi	1 channel used
K type	-270 °C ... +1372 °C	Ni-CrNi	1 channel used
N type	-270 °C ... +1300 °C	NiCrSi-NiSi	1 channel used
S type	-50 °C ... +1768 °C	Pt10Rh-Pt	1 channel used
T type	-270 °C ... +400 °C	Cu-CuNi	1 channel used

↳ *Chapter 5.4.4.2.3.6 “Parameterization” on page 727*

↳ *Function of the LEDs*

The module linearizes the thermocouple characteristics. It supports the following possibilities of temperature compensation and handling with cold junctions:

Internal compensation

An internal temperature sensor which is located next to the terminal unit is used to detect the temperature of the cold junction. So the compensating cables must be connected directly to the terminal unit, where the cold junction is located.

The setting *“Internal compensation (default)”* for the parameter *“Compensation channel”* should be selected.



To get more precise temperature measurements, the use of an external compensation method is recommended.

External compensation with temperature input

The temperature for the cold junction can be determinated externally.

A measured or known temperature value (e.g. ambient temperature in the cabinet) is transferred to the module via the output data word to all required channels. The possible temperature range is -25 °C ... +60 °C and is monitored by the AI531.

The setting *“External with temperature value”* for the parameter *“Compensation channel”* should be selected.

External compensation with compensation box

A compensation box balances the temperature difference between the cold junction and the reference temperature by generating a bridge voltage. The reference temperature is transferred via the output data word.

The compensation box must fit to the type of thermocouple and is located at the end of the compensating cables, where the cold junction is located. The cabling to the AI531 can be carried out with normal cables. The operating manual of the compensation box also has to be considered.

The setting *“External with temperature value”* for the parameter *“Compensation channel”* should be selected.

External compensation with flanking channel

A flanking channel of the same input group can be used for compensation, e. g. for channel 3, the channels 0, 1 and 2 can be selected as reference channels. The type of sensor for the reference channel can be selected in the parameters for the flanking channel. For example, a RTD sensor which is located next to the thermocouple terminal can be used as reference point for other channels.

The setting *“Channel x”* for the parameter *“Compensation channel”* should be selected.

↳ *Possible settings*

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Internal data exchange

Digital inputs (bytes)	0
Digital outputs (bytes)	0
Analog inputs (words)	8
Analog outputs (words)	1

I/O configuration

The module does not store configuration data itself. It gets its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

This means that replacing I/O modules is possible without any re-parameterization via software.



If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1 ... 10

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.	EDS Slot/ Index
Module ID	Internal	1535 [1])	Word	1535 0x05ff	0	65535	0x0Y01
Ignore module [2])	No Yes	0 1	Byte	No 0x00			Not for FBP
Parameter length in bytes	Internal	36	Byte	36	0	255	0x0Y02
Check supply	Off On	0 1	Byte	On 0x01			0x0Y03
Analog data format	Default	0	Byte	Default 0x00			0x0Y04

[1]) With CS31 and addresses smaller than 70 and FBP, the value is increased by 1

[2]) Not with FBP

Table 226: GSD file

Ext_User_Prm_Data_Len =	39
Ext_User_Prm_Data_Const(0) =	0x05, 0xff, 0x24, \ 0x01, 0x00, 0x00, 0x00 \ 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \ 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \ 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \ 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00;

Input channel (8x)

No.	Name	Value	Internal value	Internal value, Type	Default	EDS Slot Index
1	Channel configuration	*Table 227 “Channel configuration” on page 728*	*Table 227 “Channel configuration” on page 728*	Byte	0 0x00	0x0Y07
2	Channel monitoring	*Table 228 “Channel monitoring” on page 730*	*Table 228 “Channel monitoring” on page 730*	Byte	0 0x03	
3	Line frequency suppression	*Further information on page 730*	*Further information on page 730*	Byte	0 0x00	
4	Compensation channel	*Further information on page 730*	*Further information on page 730*	Byte	0 0x00	

Table 227: Channel configuration

Internal value	Operating modes for the analog inputs, individually configurable
0	Unused (default)
2	Digital input
34	Analog input -50 mV ... +50 mV
35	Analog input -500 mV ... +500 mV
36	Analog input -1 V ... +1 V
7	Analog input -5 V ... +5 V
5	Analog input -10 V ... +10 V
6	Analog input 0 V ... +5 V
1	Analog input 0 V ... +10 V

Internal value	Operating modes for the analog inputs, individually configurable
37	Analog input -20 mA ... +20 mA
3	Analog input 0 mA ... 20 mA
4	Analog input 4 mA ... 20 mA
14	Analog input Pt100 (2-wire), -50 °C ... +70 °C
15	Analog input Pt100 (3-wire), -50 °C ... +70 °C
48	Analog input Pt100 (4-wire), -50 °C ... +70 °C
57	Analog input Pt100 (2-wire), -50 °C ... +70 °C (resolution: 0,01 K)
58	Analog input Pt100 (3-wire), -50 °C ... +70 °C (resolution: 0,01 K)
59	Analog input Pt100 (4-wire), -50 °C ... +70 °C (resolution: 0,01 K)
8	Analog input Pt100 (2-wire), -50 °C ... +400 °C
9	Analog input Pt100 (3-wire), -50 °C ... +400 °C
49	Analog input Pt100 (4-wire), -50 °C ... +400 °C
45	Analog input Pt100 (2-wire), -200 °C ... +850 °C
46	Analog input Pt100 (3-wire), -200 °C ... +850 °C
47	Analog input Pt100 (4-wire), -200 °C ... +850 °C
16	Analog input Pt1000 (2-wire), -50 °C ... +400 °C
17	Analog input Pt1000 (3-wire), -50 °C ... +400 °C
50	Analog input Pt1000 (4-wire), -50 °C ... +400 °C
18	Analog input Ni1000 (2-wire), -50 °C ... +150 °C
19	Analog input Ni1000 (3-wire), -50 °C ... +150 °C
51	Analog input Ni1000 (4-wire), -50 °C ... +150 °C
39	Analog input Cu50 1.426 (2-wire) -50 °C ... +200 °C
40	Analog input Cu50 1.426 (3-wire) -50 °C ... +200 °C
41	Analog input Cu50 1.426 (4-wire) -50 °C ... +200 °C
42	Analog input Cu50 1.428 (2-wire) -200 °C ... +200 °C
43	Analog input Cu50 1.428 (3-wire) -200 °C ... +200 °C
44	Analog input Cu50 1.428 (4-wire) -200 °C ... +200 °C
24	Analog input J-type thermocouple -210 °C ... +1200 °C
25	Analog input K-type thermocouple -270 °C ... +1372 °C
30	Analog input N-type thermocouple -270 °C ... +1300 °C
27	Analog input S-type thermocouple -50 °C ... +1768 °C
28	Analog input T-type thermocouple -270 °C ... +400 °C
38	Analog input resistor 50 kΩ
52	Temperature-internal reference point
53	Common mode voltage

Table 228: Channel monitoring

Internal value	Monitoring
0	Plausibility, open-circuit (wire break) and short circuit (default)
3	No monitoring

Table 229: Line frequency suppression

Internal value	Line frequency suppression
0	50 Hz
1	60 Hz
2	No line frequency suppression

Table 230: Compensation channel

Internal value	Compensation channel
0	Internal compensation (default)
1	Channel 0 (possible with channels 1, 2, 3)
2	Channel 1 (possible with channels 0, 2, 3)
3	Channel 2 (possible with channels 0, 1, 3)
4	Channel 3 (possible with channels 0, 1, 2)
5	Channel 4 (possible with channels 5, 6, 7)
6	Channel 5 (possible with channels 4, 6, 7)
7	Channel 6 (possible with channels 4, 5, 7)
8	Channel 7 (possible with channels 4, 5, 6)
9	External with temperature value

Diagnosis

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000 ... 063**	**AC500 display**	**<− Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**		
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**FBP diag-nosis block**		
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**		**Remedy**
	[1])	[2])	[3])	[4])				
Module error								
3	14	1 ... 10	31	31	19	Checksum error in the I/O module		Replace I/O module
	11 / 12	ADR	1 ... 10					

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier** **000 ... 063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**FBP diag-nosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])			
3	14	1 ... 10	31	31	3	Timeout in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	40	Different hard-/firmware versions in the module	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	43	Internal error in the module, e.g. internal analog voltage is not correct	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	36	Internal data exchange failure	Replace I/O module
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	31	31	45	Process voltage is switched OFF (ON −> OFF)	Process voltage ON
	11 / 12	ADR	1 ... 10				
Channel error							
4	14	1 ... 10	1	0 ... 7	48	Analog value overflow or broken wire at an analog input	Check input value or terminal
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	1	0 ... 7	7	Analog value underflow at an analog input	Check input value
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	1	0 ... 7	47	Short circuit at an analog input	Check ter-minal
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	1	0 ... 7	1	Possibly wrong meas-ured value caused by inadmissible temper-ature of the compensa-tion channel	Check the tempera-ture com-pensation channel
	11 / 12	ADR	1 ... 10				

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000 ... 063**	**AC500 display**	**<− Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**		
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**FBP diag-nosis block**		
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**		**Remedy**
	[1])	[2])	[3])	[4])				
4	14	1 ... 10	1	0 ... 7	2	Invalid measured value of the channel caused by overly high voltage difference		Check voltage difference; install equalizing conductors if necessary
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	1	0 ... 7	11	Output voltage 10 V faulty		Check output load
	11 / 12	ADR	1 ... 10					

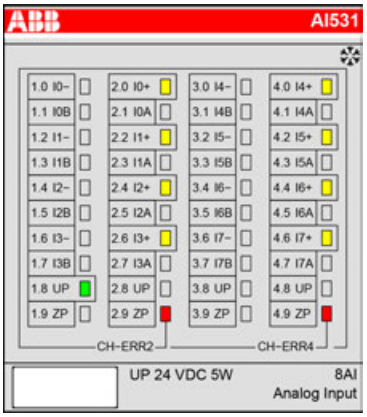
Remarks:

[1])	In AC500, the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 expansion module 1 ... 10, ADR = hardware address (e.g. of the DC551)
[3])	With "Module" the following allocation applies dependent of the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or FBP = module type (1 = AI); COM1/COM2: 1 ... 10 = expansion 1 ... 10
[4])	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

States of the LEDs (see also section diagnosis LEDs in the S500 system data):

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Inputs I0 ... I3 and I4 ... I7	Analog input	Yellow	Input is OFF	Input is ON (brightness depends on the value of the analog signal)	--
	UP	Process voltage 24 V DC via terminal	Green	Process voltage is missing	Process voltage OK	--
	CH-ERR2	Channel error, messages in groups (analog inputs combined into the groups 2 and 4)	Red	No error, or process voltage is missing	Severe error within the corresponding group	Error on one channel of the group
	CH-ERR4		Red			
	CH-ERR *)	Module error	Red	--	Internal error	--
	*) Both LEDs CH-ERR2 and CH-ERR4 light up together					

Measuring ranges

Voltage input ranges

Bipolar voltage input range, measuring bridge

The represented resolution corresponds to 16 bits.

Range	-50 mV ... +50 mV	-500 mV ... +500 mV	-1 V ... +1 V	-5 V ... +5 V	-10 V ... +10 V	Common Mode Voltage	Digital value	
							Decimal	Hex.
Overflow	> 58.7945	> 587.9449	> 1.17589	> 5.8794	> 11.7589	> 20.0000	32767	7FFF
Measured value too high	58.7945 : 50.0018	587.9449 : 500.0181	1.17589 : 1.00004	5.8794 : 5.0002	11.7589 : 10.0004		32511 : 27649	7EFF : 6C01
Normal range	50.0000 : 0.0018	500.0000 : 0.0181	1.00000 : 0.00004	5.0000 : 0.0002	10.0000 : 0.0004	20.0000 : 0.0008	27648 : 1	6C00 : 0001
	0.0000	0.0000	0.0000	0.00000	0.0000	0.0000	0	0000

Range	-50 mV ... +50 mV	-500 mV ... +500 mV	-1 V ... +1 V	-5 V ... +5 V	-10 V ... +10 V	Common Mode Voltage	Digital value	
							Decimal	Hex.
Normal range or Measured value too low	-0.0018 : -50.0000	-0.0181 : -500.0000	-0.00004 : -1.00000	-0.0002 : -5.0000	-0.004 : -10.0000	-0.0008 : -20.0000	-1 : -27648	FFFF : 9400
Measured value too low	-50.0018 : -58.7945	-500.0181 : -587.9449	-1.00004 : -1.17589	-5.0002 : -5.8794	-10.0004 : -11.7589		-27649 : -32512	93FF : 8100
Underflow	< -58.7945	< -587.9449	< -1.17589	< -5.8794	< -11.7589	< -20.0000	-32768	8000

Unipolar voltage input range, measuring bridge, digital input

Range		0 V ... +5 V	0 V ... +10 V	Digital input	Digital value	
					Decimal	Hex.
Measured value too high		5.8794 : 5.0002	11.7589 : 10.0004		32511 : 27649	7EFF : 6C01
Normal range		5.0000 : 0.0002	10.0000 : 0.0004	ON	27648 : 1	6C00 : 0001
		0.0000	0.0000	OFF	0	0000
Measured value too low		-0.0002 : -0.8794	-0.0004 : -1.1759		-1 : -4864	FFFF : ED00
Underflow		< -0.8794	< -1.1759		-32768	8000

Current input ranges

Range	-20 mA ... +20 mA	0 mA ... +20 mA	4 mA ... 20 mA	Digital value	
				Decimal	Hex.
Overflow	> 23.5178	> 23.5178	> 22.8142	32767	7FFF
Measured value too high	23.5178 : 20.0007	23.5178 : 20.0007	22.8142 : 20.0006	32511 : 27649	7EFF : 6C01

Range	-20 mA ... +20 mA	0 mA ... +20 mA	4 mA ... 20 mA	Digital value	
				Decimal	Hex.
Normal range	20.0000 : 0.0007	20.0000 : 0.0007	20.0000 : 4.0006	27648 : 1	6C00 : 0001
	0.0000	0.0000	4.0000	0	0000
	-0.0007 : -20.0000			-1 : -27648	FFFF : 9400
Measured value too low		-0.0007 : -3.5178	3.9994 : 1.1852	-1 : -4864	FFFF : ED00
	-20.0007 : -23.5178			-27649 : -32512	93FF : 8100
Underflow	< -23.5178	< -3.5178	< 1.1852	-32768	8000

Resistance thermometer input ranges

The represented resolution corresponds to 16 bits.

Range	Pt100 -50 °C ... +70 °C [1)]	Pt100 / Pt1000 -50 °C ... +400 °C	Pt100 -200 °C ... +850 °C	Ni1000 -50 °C ... +150 °C	Cu50 -200 °C ... +200 °C	Digital value	
						Decimal	Hex.
Overflow	> +80.0 °C	> +450.0 °C	> +850 °C	> +160.0 °C	> +200 °C	32767	7FFF
Measured value too high		+450.0 °C : +400.1 °C				4500 : 4001	1194 : 0FA1
				+160.0 °C : +150.1 °C		1600 : 1501	0640 : 05DD
	+80.0 °C : +70.1 °C					800 : 701	0320 : 02BD

Range	Pt100 -50 °C ... +70 °C [1])	Pt100 / Pt1000 -50 °C ... +400 °C	Pt100 -200 °C ... +850 °C	Ni1000 -50 °C ... +150 °C	Cu50 -200 °C ... +200 °C	Digital value	
						Decimal	Hex.
Normal range	: : : : +70.0 °C : +0.1 °C	: +400.0 °C : : : : + 0.1 °C	+850.0 °C : : : : +0.1 °C	: : : +150.0 °C : : +0.1 °C	: : +200.0 °C : : : +0.1 °C	8500 4000 2000 1500 700 : 1	2134 0FA0 07D0 05DC 02BC : 1
	0.0 °C	0.0 °C	0.0 °C	0.0 °C		0	0000
	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-0.1 °C : : -200 °C	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C [2]) -200.0 °C [2])	-1 : -500 -2000	FFFF : FE0C F830
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C		-50.1 °C : -60.0 °C		-501 : -600	FE0B : FDA8
Under-flow	< -60.0 °C	< -60.0 °C	< -200 °C	< -60.0 °C	< -200 °C [2])	-32768	8000

[1]) also possible with resolution 0.01 K

[2]) if Cu50 with 1.426, -50 °C is valid; if Cu50 with 1.428, -200.0 °C is valid

Resistor input range

The represented resolution corresponds to 16 bits.

Range	Resistor [Ω]	Digital value	
		Decimal	Hex.
Overflow	> 55000	32767	7FFF
Measured value too high	55000 : 50001	30413 : 27649	76CD : 6C01
Normal range	50000 : 2 1 0	27648 : 1 1 0	6C00 : 0001 0001 0000

Thermocouple input ranges

The represented resolution corresponds to 16 bits.

Range	Typ J -210 °C ... +1200 °C	Typ K -270 °C ... +1372 °C	Typ N -270 °C ... +1300 °C	Typ S -50 °C ... +1768 °C	Typ T -270 °C ... +400 °C	Digital value	
						Decimal	Hex.
Overflow	> +1200.0 °C	> +1372.0 °C	> +1300.0 °C	> +1768.0 °C	> +400.0 °C	32767	7FFF
Normal range				+1768.0 °C		17680	4510
		+1372.0 °C		:		13720	3598
		:	+1300.0 °C	:		13000	32C8
	+1200.0 °C	:	:	:		12000	2EE0
	:	:	:	:	+400.0 °C	4000	0FA0
	:	:	:	:	:	:	:
	+0.1 °C	+0.1 °C	+0.1 °C	+0.1 °C	+0.1 °C	1	1
	0.0 °C	0.0 °C	0.0 °C	0.0 °C		0	0000
	-0.1 °C	-0.1 °C	-0.1 °C	-0.1 °C	-0.1 °C	-1	FFFF
	:	:	:	:	:	:	:
	:	:	:	-50.0 °C	:	-500	FE0C
	-210.0 °C	:	:	:	:	-2100	F7CC
		-270.0 °C	-270.0 °C		-270.0 °C	-2700	F574
Under-flow	< -210.0 °C	< -270.0 °C	< -270.0 °C	< -50.0 °C	< -270.0 °C	-32768	8000

Temperature-internal reference point ranges

Range	Value	Digital value	
		Decimal	Hex.
Overflow	> +85 °C	32767	7FFF
Normal range	+85 °C	850	0352
	0 °C	0	0000
	-40 °C	-400	FE70
Underflow	< -40 °C	-32768	8000

Technical data

Technical data of the module

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

↳ *Chapter 4.3 “System data AC500-XC” on page 38*

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter		**Value**
Process voltage		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 V DC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module	Ca. 2 mA
	Current consumption from UP in normal operation	130 mA
	Inrush current from UP (at power up)	0.056 A^2s
Max. length of analog cables, conductor cross section > 0.14 mm^2 *)		100 m
Weight		130 g
Mounting position		Horizontal mounting or Vertical mounting with derating (max. temperature 40 °C)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.
*) Please note that an additional current of approx. 3µA flows out of the input for the wire break detection. Depending on the internal resistance of the signal source and the wire, this can lead to a higher measured value due to the voltage drop.		

NOTICE!

All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Technical data of the analog inputs

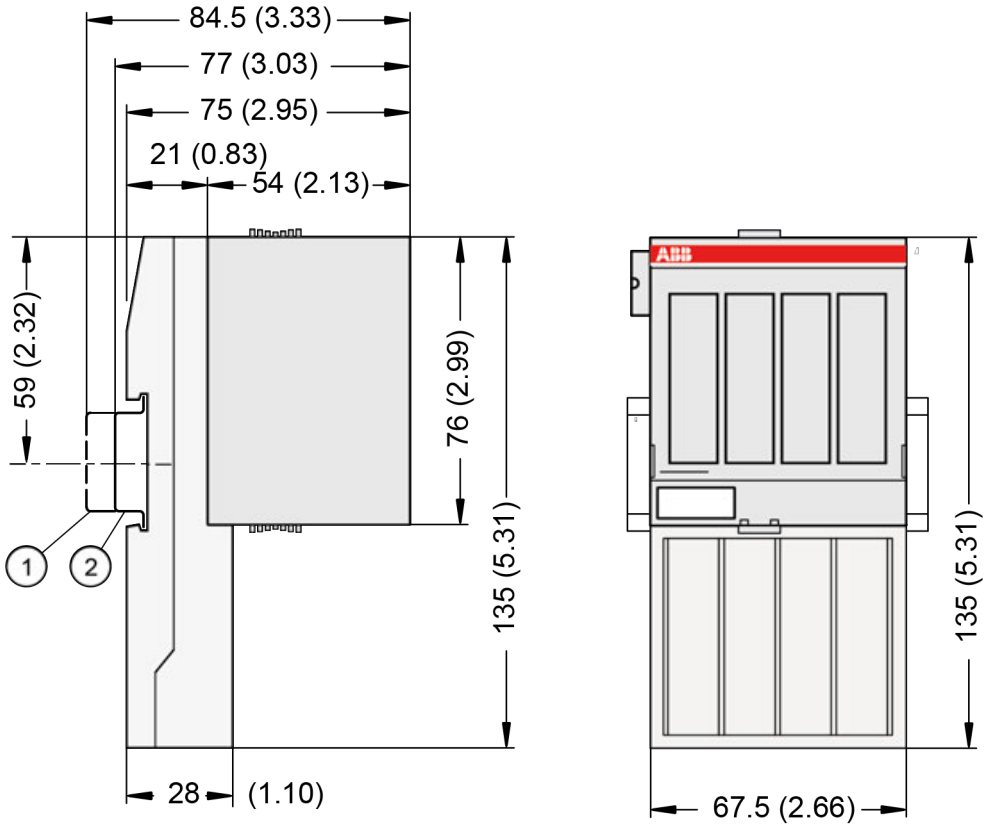
Parameter	Value	
Number of channels per module	8	
Distribution of channels into groups	1 group of 8 channels	
Connections of the channels I0 ... I3	Terminals 1.0 ... 1.7 and terminals 2.0 ... 2.7	
Connections of the channels I4 ... I7	Terminals 3.0 ... 3.7 and terminals 4.0 ... 4.7	
Input type	Bipolar (not with current or Pt100/ Pt1000/ Ni1000/ Cu50/ resistor)	
Galvanic isolation	Against internal supply and other modules	
Common mode input range	± 20 V DC plus signal voltage	
Configurability	Digital input, -50 mV ... +50 mV, -500mV ... +500 mV, -1 V ... +1 V, -5 V ... +5 V, -10 V ... +10 V, 0 V ... +5 V, 0 V ... +10 V, -20 mA ... +20 mA, 0 mA ... 20 mA, 4 mA ... 20 mA, Pt100, Pt1000, Ni1000, Cu50, resistor, thermocouple types J, K, N, S, T (each input can be configured individually)	
Channel input resistance	Voltage: > 100 kΩ, current: ca. 330 Ω	
Time constant of the input filter	Line-frequency suppression 50 Hz, 60 Hz, none	
Indication of the input signals	1 yellow LED per channel, the brightness depends on the value of the analog signal	
Conversion time	1 ms (none), 100 ms (50 Hz / 60 Hz) per channel	
Resolution	16 bits including sign	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ.	± 0.1 % (voltage) ± 0.3 % (current, resistor) at 25 °C
	Max.	± 0.7 % (voltage) ± 0.9 % (current, resistor) ± 0.5 % (thermocouple type J, N, S, T; thermocouple type K > -220 °C) 1.0 K (resistance temperature detectors) at 0 °C ... 60 °C or EMC disturbance
Maximum permanent allowed overload (no damage)		

Parameter		Value
	Current input	When the input current exceeds the overflow value of the measurement range, the input impedance is switched to high impedance for protection. The maximum allowed overload is then 30 V. The digital value corresponds to the overflow value. Periodically, the input impedance is switched to the normal value and the input current is measured. If the input current is within the measurement range, the input impedance remains at the normal level and the digital value corresponds to the measured current.
	Voltage input	30 V
Relationship between input signal and hex code		*Table 228 “Channel monitoring” on page 730*
Unused voltage inputs		Are configured as "unused"
Unused current inputs		Have a low resistance, can be left open-circuited
Overvoltage protection		Yes

Technical data of the analog inputs if used as digital inputs

Parameter		Value
Number of channels per module		Max. 8
Distribution of channels into groups		1 group of 8 channels
Connections of the channels I0+ to I3+		Terminals 2.0, 2.2, 2.4, 2.6
Connections of the channels I4+ to I7+		Terminals 4.0, 4.2, 4.4, 4.6
Reference potential for the inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (ZP)
Input delay		Typ. 2 ms
Indication of the input signals		1 LED per channel
Input signal voltage		24 V DC
	Signal 0	-30 V ... +5 V
	Undefined signal	+5 V ... +13 V
	Signal 1	+13 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	Typ. 1 mA
	Input voltage +15 V	Typ. 3.1 mA
	Input voltage +30 V	< 7 mA
Input resistance		Ca. 4.8 kΩ

Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

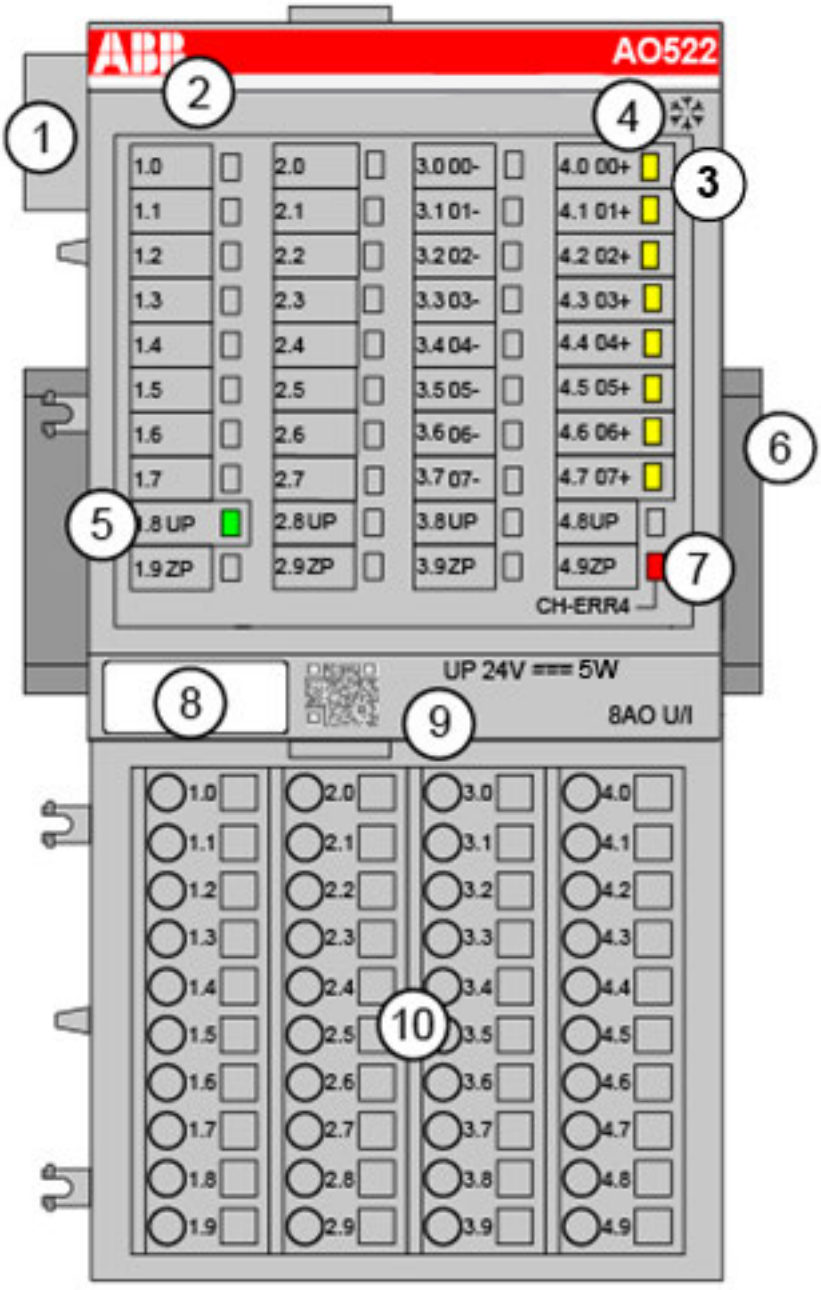
Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 250 600 R0001	AI531, analog input module, 8 AI, U/I/Pt100, TC, 16 bits including sign, 4-wires	Active
1SAP 450 600 R0001	AI531-XC, analog input module, 8 AI, U/I/Pt100, TC, 16 bits including sign, 4-wires, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.4.4.2.4 AO522 - Analog output module

- 8 channels configurable for voltage and current
- Resolution: 16 bit including sign
- Analog output signal ranges:
  - -10 V ... +10 V
  - 0 mA ... 20 mA
  - 4 mA ... 20 mA
- Module-wise galvanically isolated
- XC version available for use in extreme ambient conditions



1 I/O bus
2 Allocation between terminal number and signal name
3 Yellow LEDs to display the signal states of the channels
4 ✲ Sign for XC version
5 1 green LED to display the state of the process supply voltage UP
6 DIN rail
7 1 red LED to display errors

8 Label
9 QR code for ABB access
10 Terminal unit

> ***Consider the safety instructions***
> *In the description, special attention must be paid to designs using galvanic isolation, grounding and EMC measures for the reasons stated. Consider the safety instructions for AC500 product family.*

Intended use

The module can be used both on an AC500 processor module and on a communication interface module.

Unless expressly intended for this purpose, the following applications are prohibited:

- Use in explosion-proof areas
- Use in environments with harmful oils, acids, gases, vapors, dusts and radiation
- Operation under water
- Not to be used as a safety module.

Connections

> *For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.*

The modules are plugged on an I/O terminal unit.

↳ *TU515, TU516*

Properly position the modules and press until they lock in place. The terminal units are mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting.

↳ *Chapter 5.8.2.6 “TA526 - Wall mounting accessory” on page 1410*

The connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The internal logic of the module is supplied by the I/O bus.

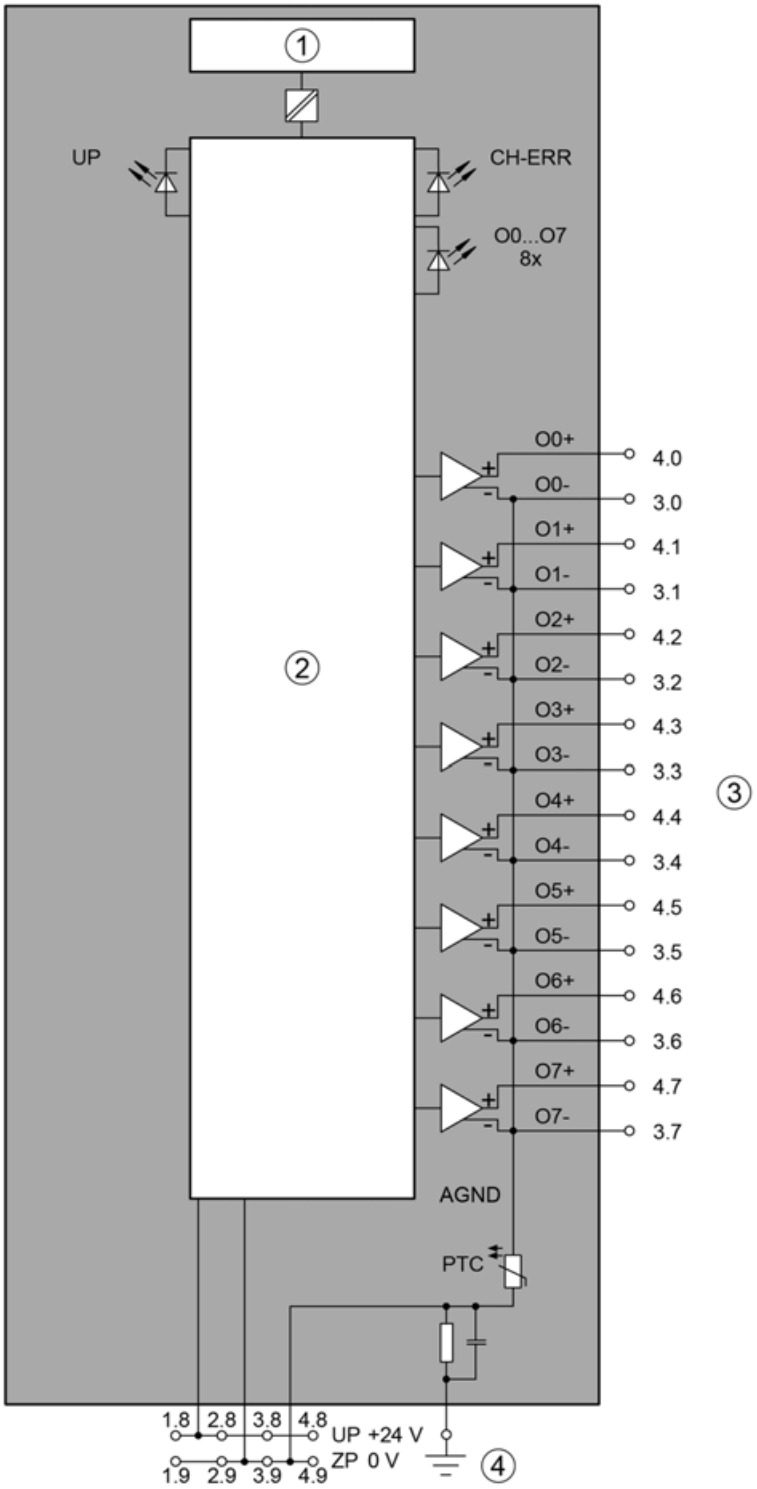
The input/output circuits are powered by the process voltage:

Process voltage UP = +24 V DC. Terminals 1.8 ... 4.8 are internally connected in the terminal unit.

Process voltage ZP = 0 V DC. Terminals 1.9 ... 4.9 are internally connected in the terminal unit.

> *The maximum current load capability of the terminals must be taken into account.*

Block diagram and connections



1 I/O bus interface to the CPU or communication interface module
2 Internal logic and I/O circuits of the module
3 Analog outputs
4 Functional earth connection between terminal unit and DIN rail

WARNING!

Removal/Insertion under power

Removal or insertion under power is permissible only if all conditions for hot swapping are fullfilled.

“Conditions for hot swap” on page 12

The devices are not designed for removal or insertion under power when the conditions for hot swap do not apply. Because of unforeseeable consequences, it is not allowed to plug in or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing any of the following actions:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while they are energized in a hazardous location could result in an electric arc, which could create an ignition source resulting in fire or explosion.

Prior to proceeding, make sure that power is been disconnected and that the area has been thoroughly checked to ensure that flammable materials or ignitable concentrations are not present.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

Generally, analog signals must be laid in shielded cables. The cable shields must be grounded at both sides of the cables. In order to avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

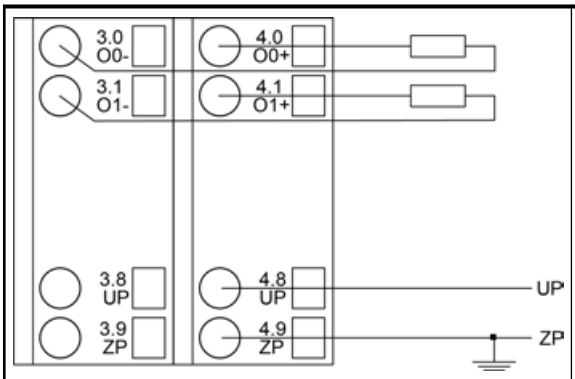
CAUTION!

By installing equipotential bonding conductors between the different parts of the system, it must be ensured that the potential difference between ZP and AGND never can exceed 1 V.

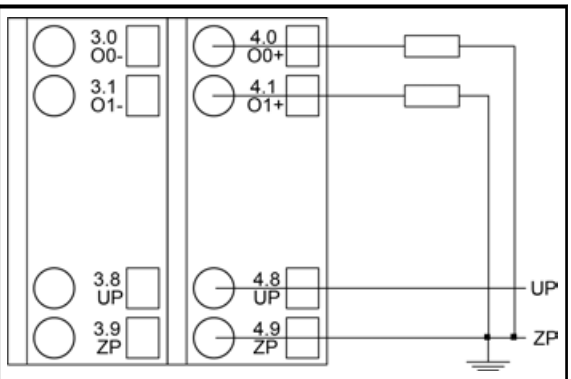
CAUTION!

The process supply voltage must be included in the grounding concept (e. g. grounding of the negative terminal).

Connection of analog output loads (Voltage, current)



Connection of analog voltage actuators



Connection of analog current actuators

Unused analog outputs can be left open-circuited.

Parameterization

The module itself does not save any configuration data. It receives all parameters from the master device of the I/O bus (CPU or communication interface module) when the system is switched on.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. To reconfigure the module, the entire station must be switched off and on again.

Table 231: Module parameters

Name	Default value	Values in menue
Ignore module	Yes	• Yes • No
Check supply	On	• On • Off
Behaviour of outputs at communication errors	Off	• Off • Last value • Substitute value • Last value 5 s • Substitute value 5 s • Last value 10 s • Substitute value 10 s

Table 232: Channel parameters

Name	Default value	Values in menue
Output x, substitute value	0	• 0 ... 65535
Output x, channel configuration	Not used	• Not used • -10 ... +10 V • 0 ... 20 mA • 4 ... 20 mA
Output x, check channel	Diagnosis (Plausib, Cut wire, Short circuit)	• Diagnosis (Plausib, Cut wire, Short circuit) • Not used

Diagnosis

Table 233: Possible diagnosis of I/O channels

Output range	Condition	
	Output value in the PLC underflow	Output value in the PLC overflow
0 mA ... 20 mA	Error identifier = 7	Error identifier = 4
4 mA ... 20 mA		
-10 V ... +10 V		

Table 234: Error severity E3: Warnings

Error severity	Location	Error code	d1	d2	d3	d4	Description	Remedy
								
E3	iob (I/O bus)	3	14	1 ... 10	31	31	Timeout in the I/O module	Replace I/O module
E3	iob (I/O bus)	9	14	1 ... 10	31	31	Overflow diagnosis buffer	New start
E3	iob (I/O bus)	11	14	1 ... 10	31	31	Process voltage too low	Check process voltage
E3	iob (I/O bus)	19	14	1 ... 10	31	31	Checksum error in the I/O module	Replace I/O module
E3	iob (I/O bus)	26	14	1 ... 10	31	31	Parameter error	Check master
E3	iob (I/O bus)	36	14	1 ... 10	31	31	Internal data exchange failure	Replace I/O module
E3	iob (I/O bus)	40	14	1 ... 10	31	31	Different hard-/firm-ware versions in the module	Replace I/O module
E3	iob (I/O bus)	43	14	1 ... 10	31	31	Internal error in the module	Replace I/O module

Table 235: Error severity E4: Warnings

Error severity	Location	Error code	d1	d2	d3	d4	Description	Remedy
								
E4	iob (I/O bus)	7	14	1 ... 10	3	0 ... 7	Analog value < lower limit (Underflow)	Check output value
E4	iob (I/O bus)	45	14	1 ... 10	31	31	Process voltage is switched off (ON -> OFF)	Process voltage ON

Error severity	Location	Error code	d1	d2	d3	d4	Description	Remedy
								
E4	iob (I/O bus)	48	14	1 ... 10	3	0 ... 7	Current: Current output > 0.3 mA: wire break Voltage: Voltage output with signal outside the range -2.5 … +2.5 V: short circuit	Check output value
E4	iob (I/O bus)	4	14	1 ... 10	3	0 ... 7	Analog value > upper limit (Overflow)	Check output value

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Input/output channels	Channel status	Yellow	Channel is OFF	Channel is ON (for analog input/output brightness depends on the value of the signal)	--
	UP	Process voltage 24 V DC via terminal	Green	Process voltage is missing	Process voltage OK	--
	CH-ERR4	Module/ Channel error, error messages in groups (analog inputs or outputs combined into the groups 2 and 4)	Red	No error or process voltage is missing	Severe error within the corresponding group	Error on one channel of the group

Representation of the signal ranges

The represented resolution corresponds to 16 bits.

Range	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital value	
				Decimal	Hex.
Overflow	0 V	0 mA	0 mA	> 32511	> 7EFF
Value too high	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA	32511 : 27649	7EFF : 6C01
Normal range	10.0000 V : 0.0004 V	20.0000 mA : 0.0007 mA	20.0000 mA : 4.0006 mA	27648 : 1	6C00 : 0001
	0.0000 V	0.0000 mA	4.0000 mA	0	0000
	-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA	-1 -6912 -27648	FFFF E500 9400
Value too low	-10.0004 V : -11.7589 V	0 mA : 0 mA	0 mA : 0 mA	-27649 : -32512	93FF : 8100
Underflow	0 V	0 mA	0 mA	< -32512	< 8100

Technical data

Technical data of the module

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

↳ *Chapter 4.3 “System data AC500-XC” on page 38*

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

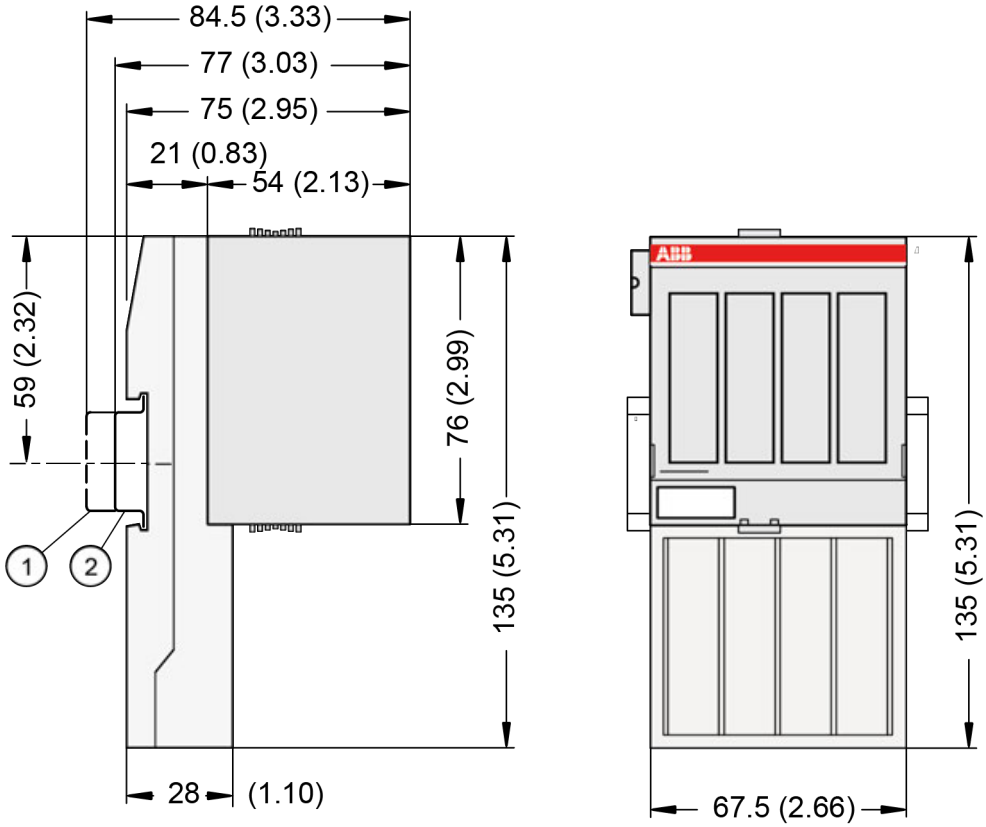
Power supply		
Process voltage (UP)		
	Rated value	24 V DC
	No load current	typ. 0.075 A
	Inrush current (at power up)	typ. 0.06 A^2s
	Protection against reversed voltage	Yes
	Protection against improper voltage level	Up to 30 V DC
	Protection against improper lead connection	Up to ±30 V DC
	Rated protection fuse on UP	↳ *TU515, TU516*
Logic supply		
	Supply current at 24 V DC power supply at the terminals UP/L+ or ZP/M of the CPU or communication interface module	Ca. 2 mA
Power loss		5 W

Technical data of the analog outputs

General data		
Number of analog outputs		8
Distribution of channels into groups		1 group
Resolution		16 bits including sign
Analog output signal ranges		-10 V ... +10 V 0 mA ... 20 mA 4 mA ... 20 mA
Cycle time (all channels)		typ. 250 µs * number of active channels
Settling time for full-range change (Stabilization time) [ABBp attribute ResponseTime]		typ. < 250 µs (residual error of 1 %)
Overshoot		typ. < 3% of full scale for resistive load
Type of protection		All I/O channels are protected against reverse polarity, reverse supply, short circuit, and temporary overvoltage up to 30 V DC.
Voltage output		
	Output impedance in signal range	n.a. (output value is regulated with voltage feedback at terminal)
	Maximum output current	±10 mA
	Short-circuit current	n.a. output is switched off in case of overload
	Type of load	Ground reference is negative pole of output
	Maximum capacitive load	1 µF
Output type		Bipolar with voltage, unipolar with current
Galvanic isolation		Against internal supply and other modules
Current output		
	Load impedance including cable resistance	0…500 Ω
	Type of load	Ground reference is ZP
	Maximum capacitive load	1 mH
Indication of the output signals		One LED per channel
Type, length of cable		Shielded cable. Maximum length so that load is within maximum resistive, capacitive, and inductive load limits
Output response at power up and power down		typ. no output response
Error		
Error at 25 °C		
	Voltage output at 0 ... 60 °C	±0.3 % of full scale
	Voltage output at -40 ... 70 °C	±0.35 % of full scale
	Current output	±0.4 % of full scale
Temperature coefficient		±0.002 % of full scale/K
Maximum error over full temperature range		

General data		
	Voltage output at 0 ... 60 °C	±0.3 % of full scale
	Voltage output at -40 ... 70 °C	±0.35 % of full scale
	Current output	±0.4 % of full scale
Maximum temporary deviation during each specified electrical interference test		-1.55 % of full scale at surge
Crosstalk between channels		< -100 dB for voltage outputs < -75 dB for current outputs
Monotonicity		Usage of monotonic 16 bit digital-to-analog converter
Repeatability at fixed temperature after specified stabilization time		typ. < 0.003 % of full scale at 25 °C
Output ripple		typ. < 0.04 % of full scale (AC RMS, Bandwidth 20 MHz)
Galvanic isolation		
	Between the channels	No
	Between the channels and I/O bus	Yes
	Between the channels and process supply voltage (UP, ZP)	No

Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

Ordering data

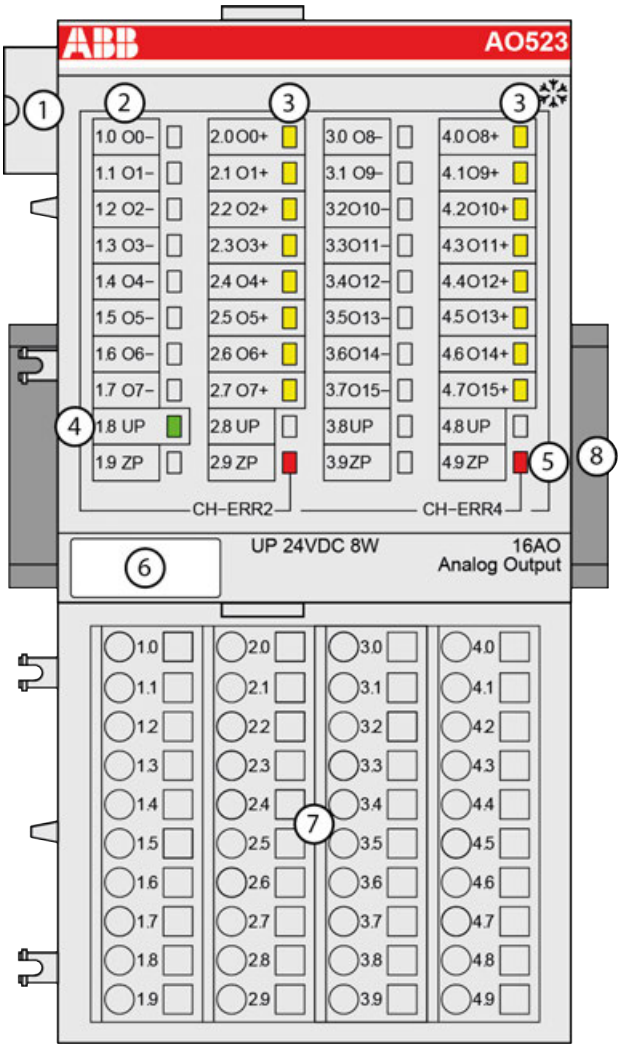
Part no.	Description	Product life cycle phase *)
1SAP 250 900 R0001	AO522: S500 analog output module, 8 AO: U/I,1-wire	Active
1SAP 450 900 R0001	AO522-XC: S500 analog output module, 8 AO: U/I,1-wire, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.4.4.2.5 AO523 - Analog output module

- 16 analog outputs in two groups:
  - 8 channels configurable for voltage or currrent output (O0...O3 / O8...O11)
  - 8 channels for voltage output (O4...O7 / O12...O15)

  Resolution 12 bits including sign
- Module-wise galvanically isolated
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 Yellow LEDs to display the signal states of the channels
4 1 green LED to display the state of the process supply voltage UP
5 2 red LEDs to display errors
6 Label
7 Terminal unit
8 DIN rail
Sign for XC version

Consider the safety instructions

In the description, special attention must be paid to designs using galvanic isolation, grounding and EMC measures for the reasons stated. Consider the safety instructions for AC500 product family.

Intended use

The module can be used both on an AC500 processor module and on a communication interface module.

Unless expressly intended for this purpose, the following applications are prohibited:

- Use in explosion-proof areas
- Use in environments with harmful oils, acids, gases, vapors, dusts and radiation

- Operation under water
- Not to be used as a safety module.

Connections

> *For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.*

The modules are plugged on an I/O terminal unit.

↳ *TU515, TU516*

Properly position the modules and press until they lock in place. The terminal units are mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting.

↳ *Chapter 5.8.2.6 “TA526 - Wall mounting accessory” on page 1410*

The connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The internal logic of the module is supplied by the I/O bus.

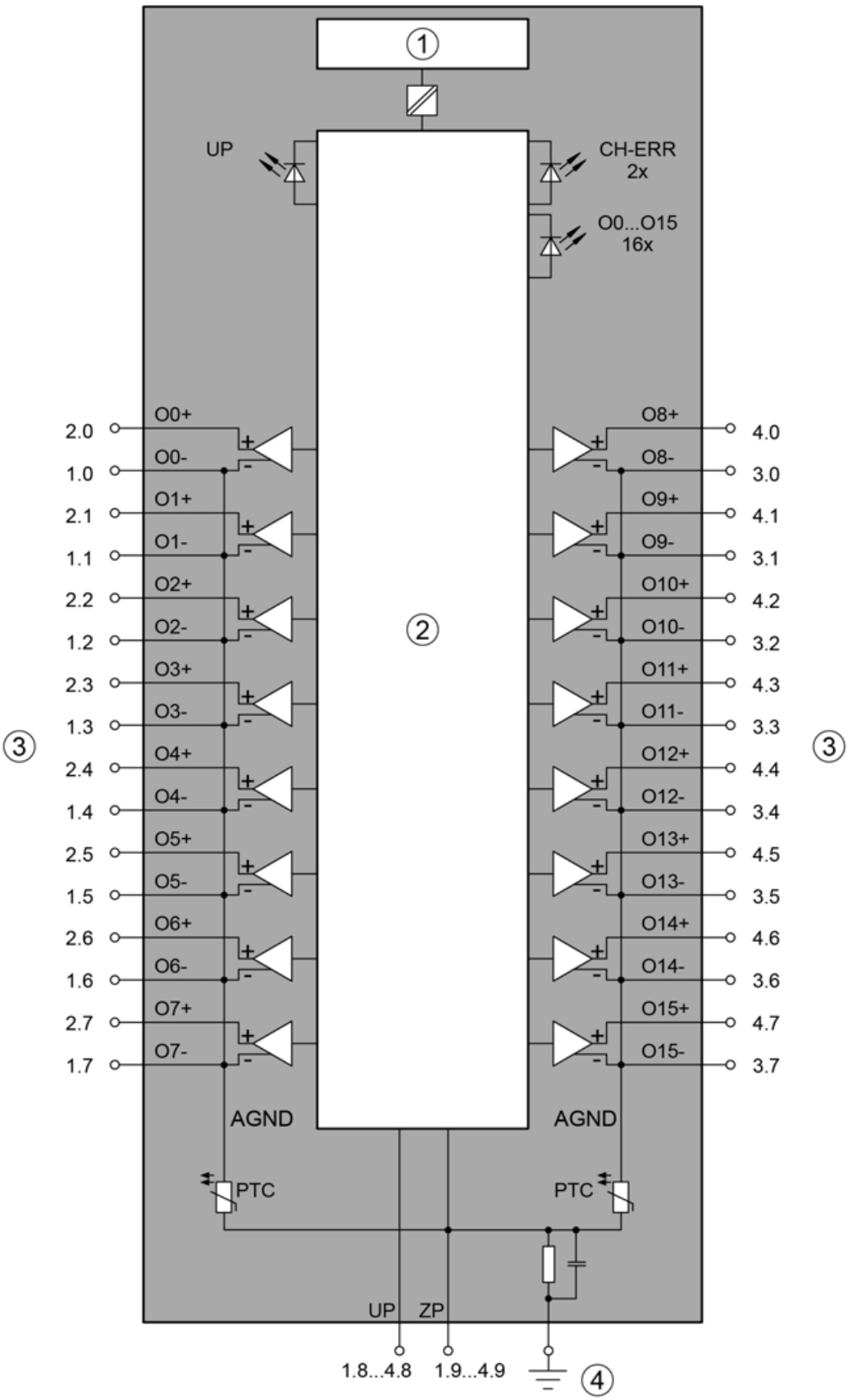
The input/output circuits are powered by the process voltage:

Process voltage UP = +24 V DC. Terminals 1.8 ... 4.8 are internally connected in the terminal unit.

Process voltage ZP = 0 V DC. Terminals 1.9 ... 4.9 are internally connected in the terminal unit.

> *The maximum current load capability of the terminals must be taken into account.*

Block diagram and connections



1 I/O bus interface to the CPU or communication interface module
2 Internal logic and I/O circuits of the module
3 Analog outputs
4 Functional earth connection between terminal unit and DIN rail

WARNING!

Removal/Insertion under power

Removal or insertion under power is permissible only if all conditions for hot swapping are fullfilled.

“Conditions for hot swap” on page 12

The devices are not designed for removal or insertion under power when the conditions for hot swap do not apply. Because of unforeseeable consequences, it is not allowed to plug in or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing any of the following actions:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while they are energized in a hazardous location could result in an electric arc, which could create an ignition source resulting in fire or explosion.

Prior to proceeding, make sure that power is been disconnected and that the area has been thoroughly checked to ensure that flammable materials or ignitable concentrations are not present.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

Generally, analog signals must be laid in shielded cables. The cable shields must be grounded at both sides of the cables. In order to avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

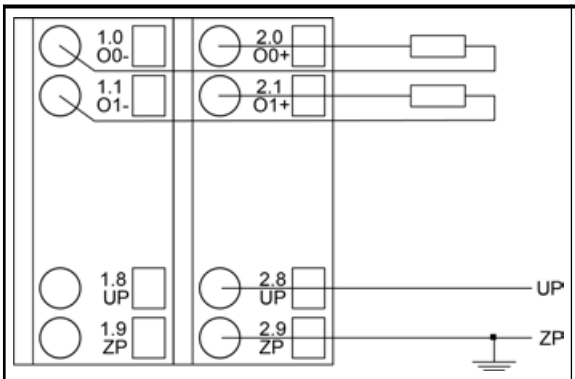
CAUTION!

By installing equipotential bonding conductors between the different parts of the system, it must be ensured that the potential difference between ZP and AGND never can exceed 1 V.

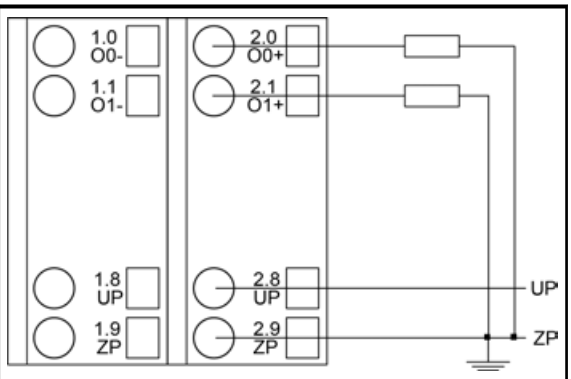
CAUTION!

The process supply voltage must be included in the grounding concept (e. g. grounding of the negative terminal).

Connection of analog output loads (Voltage, current)



Connection of analog voltage actuators



Connection of analog current actuators

Unused analog outputs can be left open-circuited.

Internal data exchange

Digital inputs (bytes)	0
Digital outputs (bytes)	0
Analog inputs (words)	0
Analog outputs (words)	16

Parameterization

The module itself does not save any configuration data. It receives all parameters from the master device of the I/O bus (CPU or communication interface module) when the system is switched on.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. To reconfigure the module, the entire station must be switched off and on again.

Table 236: Module parameters

Name	Default value	Values in menue
Ignore module	Yes	• Yes • No
Check supply	On	• On • Off
Behaviour of outputs at communication errors	Off	• Off • Last value • Substitute value • Last value 5 s • Substitute value 5 s • Last value 10 s • Substitute value 10 s

Table 237: Channel parameters

Name	Default value	Values in menue
Output x, substitute value	0	• 0 ... 65535
Output x, channel configuration	Not used	• Not used • -10 ... +10 V • 0 ... 20 mA • 4 ... 20 mA
Output x, check channel	Diagnosis (Plausib, Cut wire, Short circuit)	• Diagnosis (Plausib, Cut wire, Short circuit) • Not used

Diagnosis

Table 238: Possible diagnosis of I/O channels

Output range	Condition	
	Output value in the PLC underflow	Output value in the PLC overflow
0 mA ... 20 mA	Error identifier = 7	Error identifier = 4
4 mA ... 20 mA		
-10 V ... +10 V		

Table 239: Error severity E3: Warnings

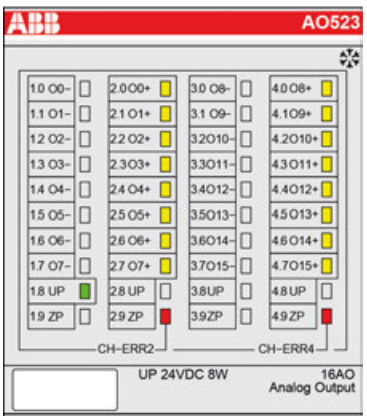
Error severity	Location	Error code	d1	d2	d3	d4	Description	Remedy
								
E3	iob (I/O bus)	3	14	1 ... 10	31	31	Timeout in the I/O module	Replace I/O module
E3	iob (I/O bus)	9	14	1 ... 10	31	31	Overflow diagnosis buffer	New start
E3	iob (I/O bus)	11	14	1 ... 10	31	31	Process voltage too low	Check process voltage
E3	iob (I/O bus)	19	14	1 ... 10	31	31	Checksum error in the I/O module	Replace I/O module
E3	iob (I/O bus)	26	14	1 ... 10	31	31	Parameter error	Check master
E3	iob (I/O bus)	36	14	1 ... 10	31	31	Internal data exchange failure	Replace I/O module
E3	iob (I/O bus)	40	14	1 ... 10	31	31	Different hard-/firmware versions in the module	Replace I/O module
E3	iob (I/O bus)	43	14	1 ... 10	31	31	Internal error in the module	Replace I/O module

Table 240: Error severity E4: Warnings

Error severity	Location	Error code	d1	d2	d3	d4	Description	Remedy
								
E4	iob (I/O bus)	7	14	1 ... 10	3	0 ... 7	Analog value < lower limit (Underflow)	Check output value
E4	iob (I/O bus)	45	14	1 ... 10	31	31	Process voltage is switched off (ON -> OFF)	Process voltage ON
E4	iob (I/O bus)	48	14	1 ... 10	3	0 ... 7	Current: Current output > 0.3 mA: wire break Voltage: Voltage output with signal outside the range -2.5 … +2.5 V: short circuit	Check output value
E4	iob (I/O bus)	4	14	1 ... 10	3	0 ... 7	Analog value > upper limit (Overflow)	Check output value

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Input/output channels	Channel status	Yellow	Channel is OFF	Channel is ON (for analog input/output brightness depends on the value of the signal)	--
	UP	Process voltage 24 V DC via terminal	Green	Process voltage is missing	Process voltage OK	--
	CH-ERR4	Module/ Channel error, error messages in groups (analog inputs or outputs combined into the groups 2 and 4)	Red	No error or process voltage is missing	Severe error within the corresponding group	Error on one channel of the group

Representation of the signal ranges

The represented resolution corresponds to 16 bits.

Range	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital value	
				Decimal	Hex.
Overflow	0 V	0 mA	0 mA	> 32511	> 7EFF
Value too high	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA	32511 : 27649	7EFF : 6C01
Normal range	10.0000 V : 0.0004 V	20.0000 mA : 0.0007 mA	20.0000 mA : 4.0006 mA	27648 : 1	6C00 : 0001
	0.0000 V	0.0000 mA	4.0000 mA	0	0000
	-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA	-1 -6912 -27648	FFFF E500 9400
Value too low	-10.0004 V : -11.7589 V	0 mA : 0 mA	0 mA : 0 mA	-27649 : -32512	93FF : 8100
Underflow	0 V	0 mA	0 mA	< -32512	< 8100

Technical data

Technical data of the module

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

↳ *Chapter 4.3 “System data AC500-XC” on page 38*

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Power supply		
Process voltage (UP)		
	Rated value	24 V DC
	No load current	typ. 0.075 A
	Inrush current (at power up)	typ. 0.06 A^2s
	Protection against reversed voltage	Yes
	Protection against improper voltage level	Up to 30 V DC
	Protection against improper lead connection	Up to ±30 V DC
	Rated protection fuse on UP	↳ *TU515, TU516*
Logic supply		

Power supply		
	Supply current at 24 V DC power supply at the terminals UP/L+ or ZP/M of the CPU or communication interface module	Ca. 2 mA
Power loss		5 W
Weight		300 g

Technical data of the analog outputs

General data		
Number of analog outputs		16
Distribution of channels into groups		2 groups
Resolution		12 bits including sign
Analog output signal ranges		-10 V ... +10 V 0 mA ... 20 mA 4 mA ... 20 mA
Cycle time (all channels)		On request
Settling time for full-range change (resistive load, output signal within specified tolerance)		typ. 5 ms
Overshoot		On request
Type of protection		All I/O channels are protected against reverse polarity, reverse supply, short circuit, and temporary overvoltage up to 30 V DC.
Voltage output		
	Output impedance in signal range	On request
	Maximum output current	±10 mA
	Short-circuit current	On request
	Type of load	On request
	Maximum capacitive load	On request
Output type		Bipolar with voltage, unipolar with current
Galvanic isolation		Yes, per module
Current output		
	Load impedance including cable resistance	0…500 Ω
	Type of load	On request
	Maximum capacitive load	On request
Indication of the output signals		One LED per channel
Type, length of cable		Shielded cable. Maximum length so that load is within maximum resistive, capacitive, and inductive load limits
Output response at power up and power down		On request
Error		
Error at 25 °C		

General data		
	Voltage output at 0 ... 60 °C	±0.5 % of full scale
Temperature coefficient		On request
Maximum error over full temperature range		
	Voltage output at 0 ... 60 °C	±1 % of full scale
Maximum temporary deviation during each specified electrical interference test		On request
Crosstalk between channels		On request
Monotonicity		On request
Repeatability at fixed temperature after specified stabilization time		On request
Output ripple		On request
Galvanic isolation		
	Between the channels	No
	Between the channels and I/O bus	Yes
	Between the channels and process supply voltage (UP, ZP)	No

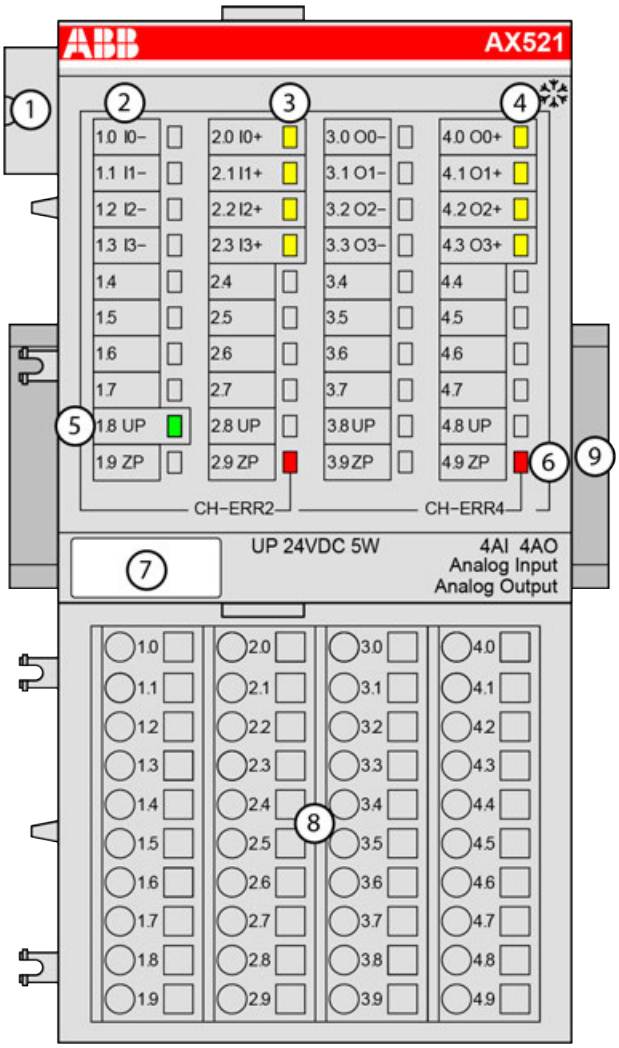
Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 250 200 R0001	AO523, analog output module, 16 AO, U/I, 12 bits including sign, 2-wires	Active
1SAP 450 200 R0001	AO523-XC, analog output module, 16 AO, U/I, 12 bits including sign, 2-wires, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.4.4.2.6 AX521 - Analog input/output module

- 4 configurable analog inputs (I0 ... I3) in 1 group (1.0 ... 2.3)
  Resolution 12 bits including sign
- 4 configurable analog outputs (O0 ... O3) in 1 group (3.0 ... 4.3)
  Resolution 12 bits including sign
- Module-wise galvanically isolated
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 4 yellow LEDs to display the signal states at the analog inputs (I0 ... I3)
4 4 yellow LEDs to display the signal states at the analog outputs (O0 ... O3)
5 1 green LED to display the state of the process supply voltage UP
6 2 red LEDs to display errors
7 Label
8 Terminal unit
9 DIN rail
Sign for XC version

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

Functionality

AX521

4 analog inputs (channel 0... channel 3), individually configurable:

- Unused (default setting)
- 0 V ... 10 V
- -10 V ... +10 V
- 0 mA ... 20 mA

- 4 mA ... 20 mA
- Pt100, -50 °C ... +400 °C (2-wire)
- Pt100, -50 °C ... +400 °C (3-wire), requires 2 channels
- Pt100, -50 °C ... +70 °C (2-wire)
- Pt100, -50 °C ... +70 °C (3-wire), requires 2 channels
- Pt1000, -50 °C ... +400 °C (2-wire)
- Pt1000, -50 °C ... +400 °C (3-wire), requires 2 channels
- Ni1000, -50 °C ... +150 °C (2-wire)
- Ni1000, -50 °C ... +150 °C (3-wire), requires 2 channels
- 0 V ... 10 V with differential inputs, requires 2 channels
- -10 V ... +10 V with differential inputs, requires 2 channels
- Digital signals (digital input)

4 analog outputs (channel 0 ... channel 3), individually configurable:

- Unused (default setting)
- -10 V ... +10 V
- 0 mA ... 20 mA
- 4 mA ... 20 mA

Parameter		Value
Resolution of the analog channels		
	Voltage -10 V ... +10 V	12 bits including sign
	Voltage 0 V ... 10 V	12 bits
	Current 0 mA ... 20 mA, 4 mA ... 20 mA	12 bits
	Temperature	+0.1 °C
LED displays		11 LEDs for signals and error messages
Internal power supply		Via the I/O bus interface (I/O bus)
External power supply		Via the terminals ZP and UP (process voltage 24 V DC)
Required terminal unit		TU515 or TU516 ↳ *TU515, TU516*

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The modules are plugged on an I/O terminal unit.

↳ *TU515, TU516*

Properly position the modules and press until they lock in place. The terminal units are mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting.

↳ *Chapter 5.8.2.6 “TA526 - Wall mounting accessory” on page 1410*

The connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8, 2.8, 3.8 and 4.8 as well as 1.9, 2.9, 3.9 and 4.9 are electrically interconnected within the I/O terminal units and have always the same assignment, irrespective of the inserted module:

Terminals 1.8, 2.8, 3.8 and 4.8: process voltage UP = +24 V DC

Terminals 1.9, 2.9, 3.9 and 4.9: process voltage ZP = 0 V DC

Table 241: Assignment of the other terminals

Terminals	Signal	Description
1.0 ... 1.3	I0- ... I3-	Negative poles of the 4 analog inputs
2.0 ... 2.3	I0+ ... I3+	Positive poles of the 4 analog inputs
3.0 ... 3.3	O0- ... O3-	Negative poles of the 4 analog outputs
4.0 ... 4.3	O0+ ... O3+	Positive poles of the 4 analog outputs



The negative poles of the analog inputs are connected to each other to form an "Analog Ground" signal for the module.



The negative poles of the analog outputs are connected to each other to form an "Analog Ground" signal for the module.



There is no galvanic isolation between the analog circuitry and ZP/UP. Therefore, the analog sensors must be galvanically isolated in order to avoid loops via the ground potential or the supply voltage.



Because of their common reference potential, analog current inputs cannot be circuited in series, neither within the module nor with channels of other modules.



For the open-circuit detection (wire break), each analog input channel is pulled up to "plus" by a high-resistance resistor. If nothing is connected, the maximum voltage will be read in then.

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 2 mA per I/O module.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.

WARNING!

Removal/Insertion under power

Removal or insertion under power is permissible only if all conditions for hot swapping are fullfilled.

“Conditions for hot swap” on page 12

The devices are not designed for removal or insertion under power when the conditions for hot swap do not apply. Because of unforeseeable consequences, it is not allowed to plug in or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing any of the following actions:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while they are energized in a hazardous location could result in an electric arc, which could create an ignition source resulting in fire or explosion.

Prior to proceeding, make sure that power is been disconnected and that the area has been thoroughly checked to ensure that flammable materials or ignitable concentrations are not present.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

Generally, analog signals must be laid in shielded cables. The cable shields must be grounded at both sides of the cables. To avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

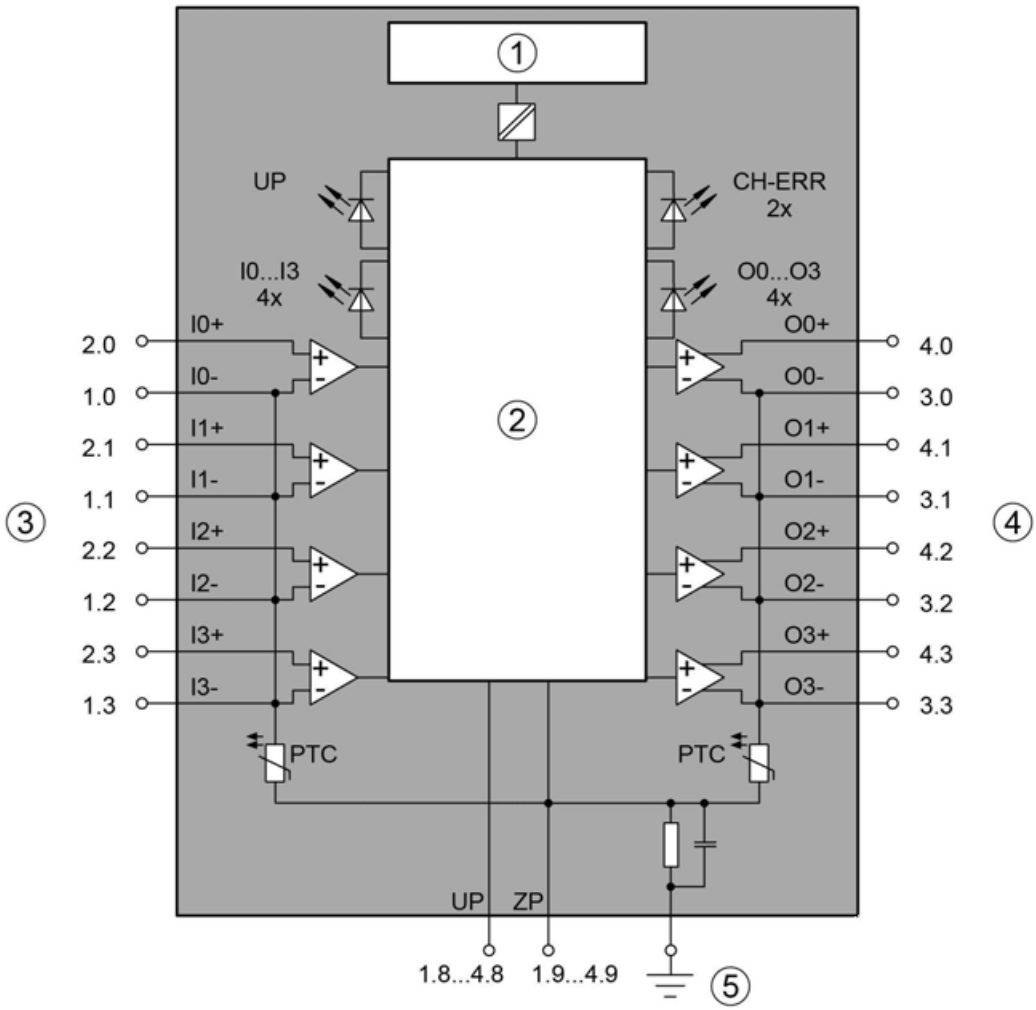


Fig. 106: Connection of the I/O module: 4 analog inputs and 4 analog outputs, individually configurable ↳ *Chapter 5.4.4.2.6.2 “Functionality” on page 763*

1 I/O bus interface
2 Logic
3 Analog inputs
4 Analog outputs
5 Functional earth connection

CAUTION!
By installing equipotential bonding conductors between the different parts of the system, it must be ensured that the potential difference between ZP and AGND never can exceed 1 V.

CAUTION!
The process supply voltage must be included in the grounding concept (e. g. grounding of the negative terminal).

Connection of resistance thermometers in 2-wire configuration

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the I/O module provides a constant current source which is multiplexed over the 8 analog channels.

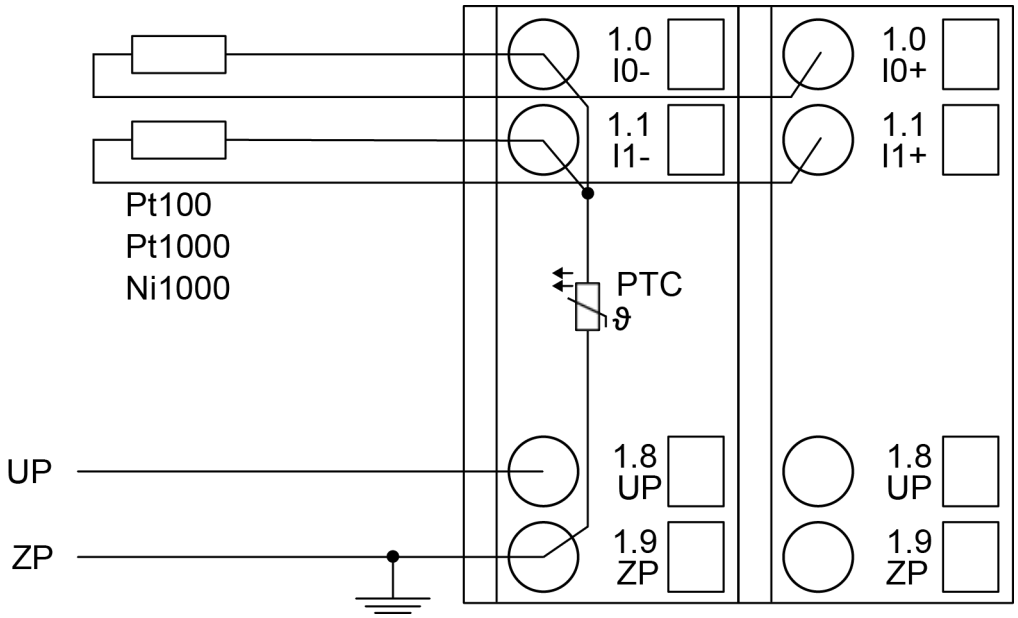


Fig. 107: Connection example

Pt100	-50 °C ... +70 °C	2-wire configuration, one channel used
Pt100	-50 °C ... +400 °C	2-wire configuration, one channel used
Pt1000	-50 °C ... +400 °C	2-wire configuration, one channel used
Ni1000	-50 °C ... +150 °C	2-wire configuration, one channel used

The I/O module performs a linearization of the resistance characteristic.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of resistance thermometers in 3-wire configuration

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the I/O module provides a constant current source which is multiplexed over the max. 8 (depending on the configuration) analog channels.

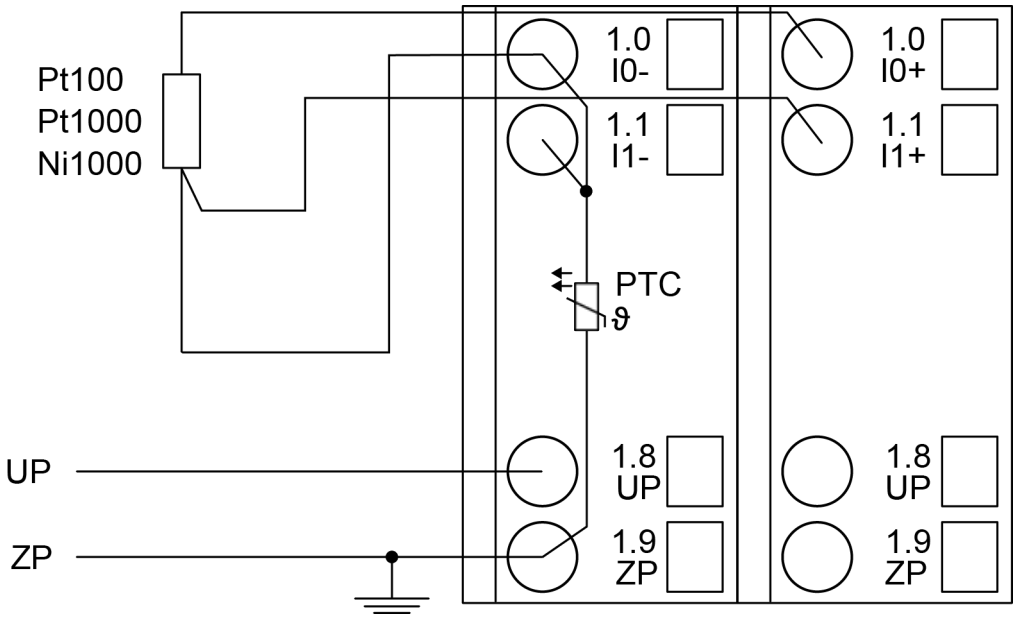


Fig. 108: Connection example

If several measuring points are adjacent to each other, only one return line is necessary. This saves wiring costs.

With the 3-wire configuration, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1).

The constant current of one channel flows through the resistance thermometer. The constant current of the other channel flows through one of the cores. The module calculates the measured value from the two voltage drops and stores it under the input with the higher channel number (e.g. I1).

In order to keep measuring errors as small as possible, it is necessary to have all the involved conductors in the same cable. All the conductors must have the same cross section.

Pt100	-50 °C ... +70 °C	3-wire configuration, two channels used
Pt100	-50 °C ... +400 °C	3-wire configuration, two channels used
Pt1000	-50 °C ... +400 °C	3-wire configuration, two channels used
Ni1000	-50 °C ... +150 °C	3-wire configuration, two channels used

The I/O module performs a linearization of the resistance characteristic.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of active-type analog sensors (Voltage) with galvanically isolated power supply

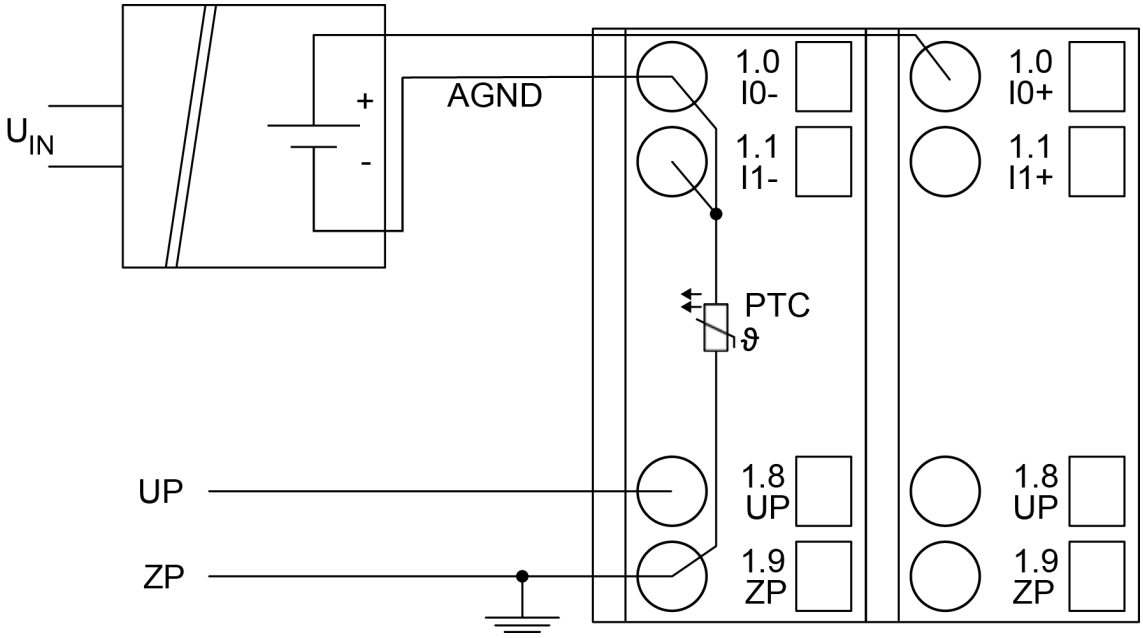


Fig. 109: Connection example

By connecting the sensor's negative pole of the output voltage to AGND, the galvanically isolated voltage source of the sensor is referred to ZP.

The following measuring ranges can be configured for AX521 ↳ *Chapter 5.4.4.2.6.6 “Parameterization” on page 776* and for AX522 ↳ *Chapter 5.4.4.2.7.6 “Parameterization” on page 803*:

Voltage	0 V ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Connection of active-type analog sensors (Current) with galvanically isolated power supply

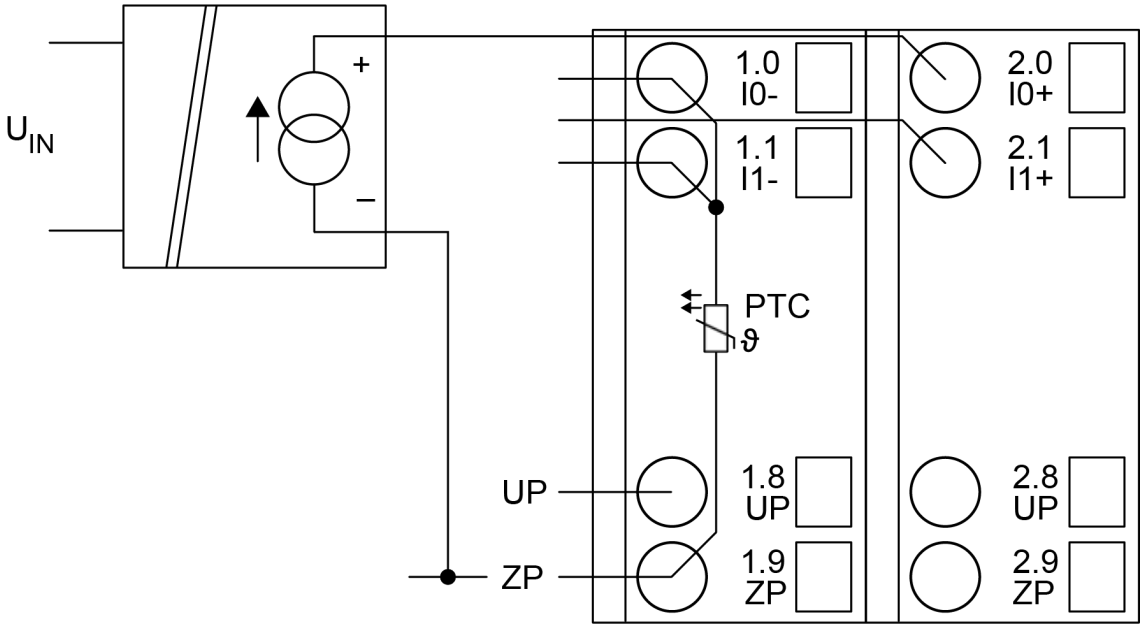


Fig. 110: Connection example

Current	0 mA ... 20 mA	1 channel used
Current	4 mA ... 20 mA	1 channel used

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of active-type analog sensors (Voltage) with no galvanically isolated power supply

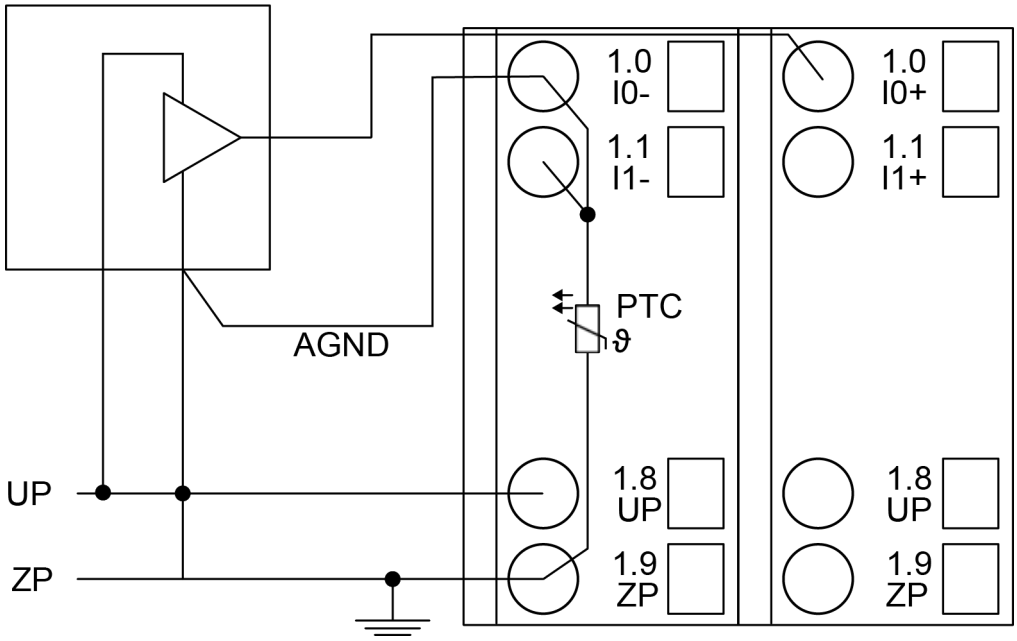


Fig. 111: Connection example

CAUTION!
The potential difference between AGND and ZP at the module must not be greater than 1 V, not even in case of long lines.

If AGND does not get connected to ZP, the sensor current flows to ZP via the AGND line. The measuring signal is distorted, as a very small current flows through the voltage line. The total current through the PTC should not exceed 50 mA. This measuring method is therefore only suitable for short lines and small sensor currents. If there are bigger distances, the difference measuring method should be applied.

Voltage	0 V ... 10 V	1 channel used
Voltage	-10 V ... +10 V *)	1 channel used

*) if the sensor can provide this signal range

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Connection of passive-type analog sensors (Current)

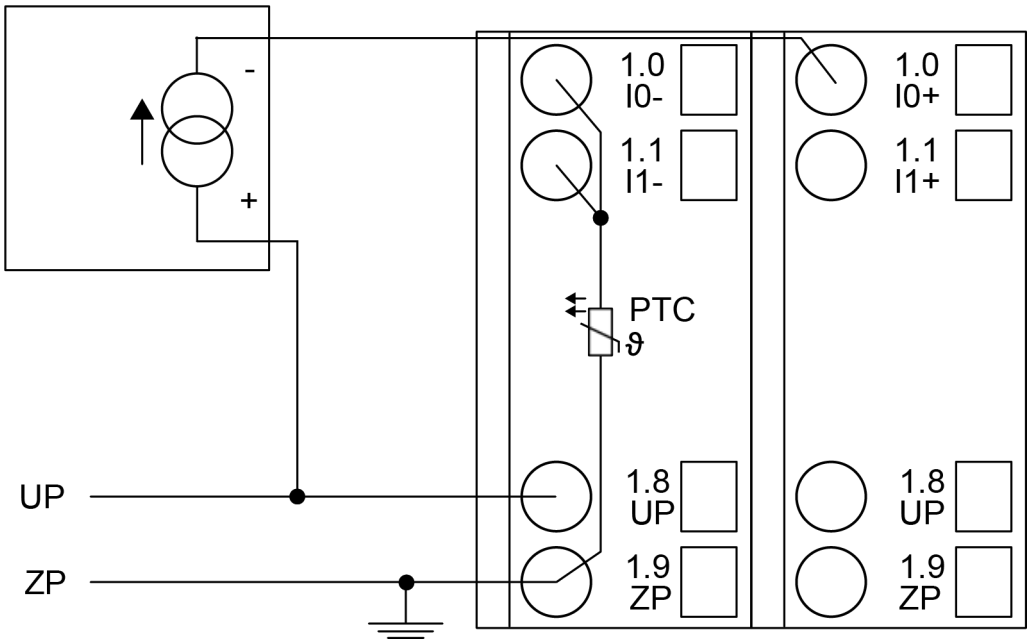


Fig. 112: Connection example

Current	4 mA ... 20 mA	1 channel used

CAUTION!

Risk of overloading the analog input!

If an analog current sensor supplies more than 25 mA for more than 1 second during initialization, this input is switched off by the module (input protection).

Only use sensors with fast initialization or without current peaks higher than 25 mA. If not possible, connect a 10-volt Zener diode in parallel to I+ and ZP.

Unused input channels can be left open-circuited because they are of low resistance.

Connection of active-type analog sensors (Voltage) to differential inputs

Differential inputs are very useful if analog sensors are used which are remotely non-isolated (e.g. the minus terminal is remotely grounded).

The use of differential inputs helps to considerably increase the measuring accuracy and to avoid ground loops.

With differential input configurations, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

The analog value is calculated by subtraction of the input value with the higher address from the input value of the lower address.

The converted analog value is available at the odd channel (higher address).

CAUTION!

Problems with the common-mode input voltages of the involved analog inputs

The ground potential at the sensors must not have too large a potential difference with respect to ZP (max. ±1 V within the full signal range).

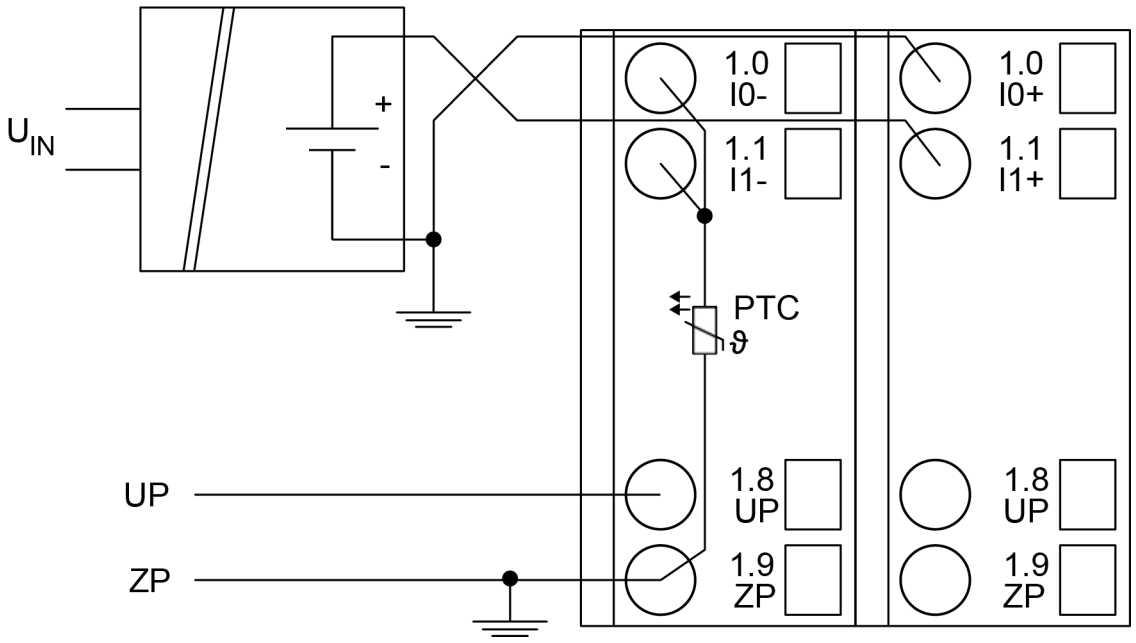


Fig. 113: Connection example

The negative pole of the sensor must be grounded next to the sensor.

Voltage	0 V ... 10 V	with differential inputs, 2 channels used
Voltage	-10 V ... +10 V	with differential inputs, 2 channels used

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Use of analog inputs as digital inputs

Several (or all) analog inputs can be configured as digital inputs. The inputs are not galvanically isolated against the other analog channels.

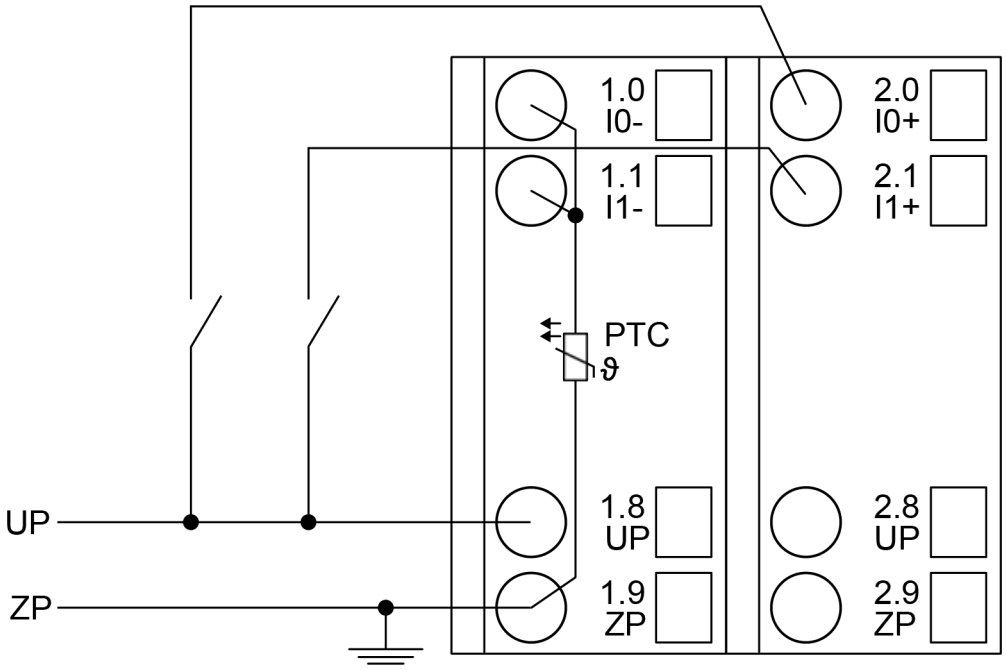


Fig. 114: Connection example

Digital input	24 V	1 channel used
Effect of incorrect input terminal connection		Wrong or no signal detected, no damage up to 35 V

Connection of analog output loads (Voltage, current)

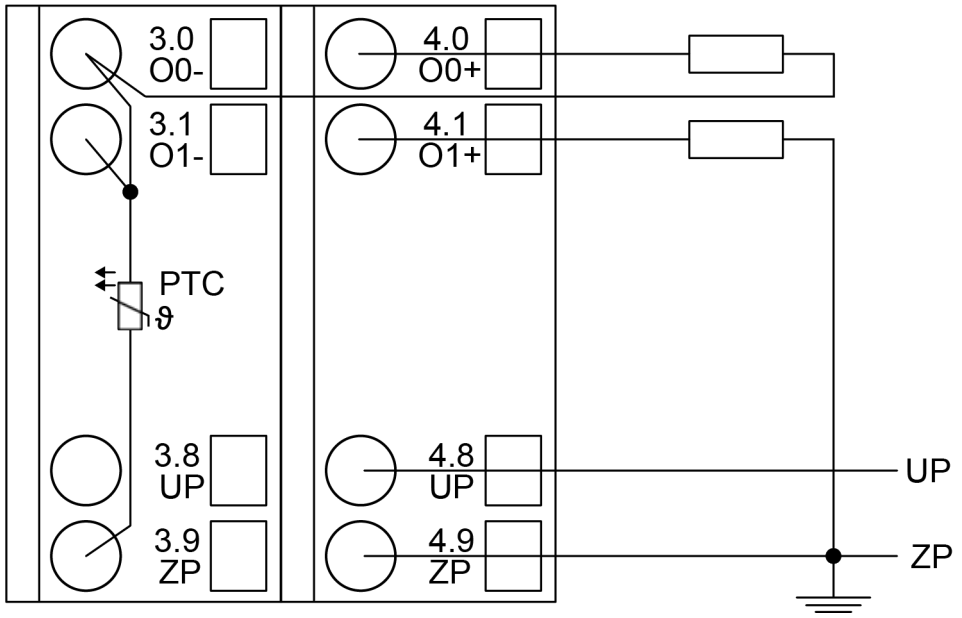


Fig. 115: Connection example

Voltage	-10 V ... +10 V	Load max. ± 10 mA	1 channel used
Current	0 mA ... 20 mA	Load 0 Ω ... 500 Ω	1 channel used
Current	4 mA ... 20 mA	Load 0 Ω ... 500 Ω	1 channel used

Only the channels 0 ... 3 can be configured as current output (0 mA ... 20 mA or 4 mA ... 20 mA).

Unused analog outputs can be left open-circuited.

Internal data exchange

Digital inputs (bytes)	0
Digital outputs (bytes)	0
Counter input data (words)	4
Counter output data (words)	4

I/O configuration

The module does not store configuration data itself. It gets its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1 ... 10

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
1	Module ID	Internal	1505 [1])	Word	1505 0x05E1	0	65535	0x0Y01
2	Ignore module [2])	No Yes	0 1	Byte	No 0x00			Not for FBP
3	Parameter length in bytes	Internal	21	Byte	21-CPU 21-FBP	0	255	0x0Y02
4	Check supply	Off On	0 1	Byte	On 0x01	0	1	0x0Y03
5	Analog data format	Default	0	Byte	Default 0x00			0x0Y04
6	Behaviour of outputs at communication errors	Off Last value Substitute value	0 1+(n*5) 2+(n*5), n ≤ 2	Byte	Off 0x00	0	2	0x0Y05
7	Channel configuration Input channel 0	See table 'Channel configuration' *Table 243 “Channel configuration [2])” on page 778*		Byte	Default 0x00	0	19	0x0Y06
8	Channel monitoring Input channel 0	See table 'Channel monitoring' *Table 244 “Channel monitoring [3])” on page 779*		Byte	Default 0x00	0	3	0x0Y07

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
9 to 14	Channel configuration and channel monitoring of the input channels 1 to 3	See tables 'Channel configuration' *Table 243 “Channel configuration 2)” on page 778* and 'Channel monitoring' *Table 244 “Channel monitoring 3)” on page 779*		Byte Byte	Default 0x00 0x00	0 0	19 3	0x0Y08 to 0x0Y0D
15	Channel configuration Output channel 0	See table 'Channel configuration' *Table 243 “Channel configuration 2)” on page 778*		Byte	Default 0x00	0	130	0x0Y0E
16	Channel monitoring Output channel 0	See table 'Channel monitoring' *Table 244 “Channel monitoring 3)” on page 779*		Byte	Default 0x00	0	3	0x0Y0F
17	Substitute value Output channel 0	only valid for output channel 0	0 ... 0xffff	Word	Default 0x0000	0	65535	0x0Y10
18 to 21	Channel configuration and channel monitoring of the output channels 1 to 2	See tables 'Channel configuration' *Table 243 “Channel configuration 2)” on page 778* and 'Channel monitoring' *Table 244 “Channel monitoring 3)” on page 779*		Byte Byte	Default 0x00 0x00	0 0	130 3	0x0Y11 to 0x0Y14
22	Channel configuration Output channel 3	See table 'Channel monitoring' *Table 243 “Channel configuration 2)” on page 778*		Byte	Default 0x00	0	130	0x0Y15

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
23	Channel monitoring Output channel 3	See table 'Channel monitoring' ↳ *Table 244 “Channel monitoring 3)” on page 779*		Byte	Default 0x00	0	3	0x0Y16
[1]) With CS31 and addresses less than 70 and FBP, the value is increased by 1 [2]) Not with FBP								

GSD file:

Ext_User_Prm_Data_Len =	24
Ext_User_Prm_Data_Const(0) =	0x05, 0xe2, 0x15, \ 0x01, 0x00, 0x00 \ 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \ 0x00, 0x00, 0x00, 0x00, \ 0x00, 0x00, 0x00, 0x00, 0x00, 0x00;

Table 242: Input channel (4x)

No.	Name	Internal value, type	Default
1	Channel configuration see table [2])	Byte	0 0x00 see table [2])
2	Channel monitoring see table [3])	Byte	0 0x00 see table [3])

Table 243: Channel configuration [2])

Internal value	Operating modes of the analog inputs, individually configurable
0	Unused (default)
1	Analog input 0 V ... 10 V
2	Digital input
3	Analog input 0 mA ... 20 mA
4	Analog input 4 mA ... 20 mA
5	Analog input -10 V ... +10 V
8	Analog input Pt100, -50 °C ... +400 °C (2-wire)
9	Analog input Pt100, -50 °C ... +400 °C (3-wire), requires 2 channels *)
10	Analog input 0 ... 10 V via differential inputs, requires 2 channels *)
11	Analog input -10 V ... +10 V via differential inputs, requires 2 channels *)
14	Analog input Pt100, -50 °C ... +70 °C (2-wire)
15	Analog input Pt100, -50 °C ... +70 °C (3-wire), requires 2 channels *)

Internal value	Operating modes of the analog inputs, individually configurable
16	Analog input Pt1000, -50 °C ... +400 °C (2-wire)
17	Analog input Pt1000, -50 °C ... +400 °C (3-wire), requires 2 channels *)
18	Analog input Ni1000, -50 °C ... +150 °C (2-wire)
19	Analog input Ni1000, -50 °C ... +150 °C (3-wire), requires 2 channels *)
	*) In the operating modes with 3-wire configuration or with differential inputs, two adjacent analog inputs belong together (e.g. the channels 0 and 1). In these cases, both channels are configured in the desired operating mode. The lower address must be the even address (channel 0). The next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

Table 244: Channel monitoring [3])

Internal value	Monitoring
0	Plausibility, open-circuit (broken wire) and short circuit
3	No monitoring

Table 245: Output channel 0 (1 channel)

No.	Name	Value	Internal value	Internal value, type	Default
1	Channel configuration	see table [4])	see table [4])	Byte	see table [4])
2	Channel monitoring	see table [5])	see table [5])	Byte	see table [5])
3	Substitute value see table [6])	0 ... 65535	0 ... 0xffff	Word	0

Table 246: Output channels 1 ... 3 (3x)

No.	Name	Internal value, type
1	Channel configuration see table [4])	Byte
2	Channel monitoring see table [6])	Byte

Table 247: Channel configuration [4])

Internal value	Operating modes of the analog outputs, individually configurable
0	Unused (default)
128	Analog output -10 V ... +10 V
129	Analog output 0 mA ... 20 mA (not with the channels 4 ... 7 and 12 ... 15)
130	Analog output 4 mA ... 20 mA (not with the channels 4 ... 7 and 12 ... 15)

Table 248: Channel monitoring [5])

Internal value	Monitoring
0	Plausibility, open circuit (broken wire) and short circuit (default)
3	No monitoring

Table 249: Substitute value [6])

Intended behaviour of output channel when the control system stops	Required setting of the module parameter "Behaviour of outputs in case of a communication error"	Required setting of the channel parameter "Substitute value"
Output OFF	Off	0
Last value infinite	Last value	0
Last value for 5 s and then turn off	Last value 5 sec	0
Last value for 10 s and then turn off	Last value 10 sec	0
Substitute value infinite	Substitute value	Depending on configuration
Substitute value for 5 s and then turn off	Substitute value 5 sec	Depending on configuration
Substitute value for 10 s and then turn off	Substitute value 10 sec	Depending on configuration

Diagnosis

Table 250: Possible diagnosis of I/O channels

Output range	Condition	
	Output value in the PLC underflow	Output value in the PLC overflow
0 mA ... 20 mA	Error identifier = 7	Error identifier = 4
4 mA ... 20 mA		
-10 V ... +10 V		

Input range	Condition			
	Short circuit	Wire break	Input value underflow	Input value overflow
0 mA ... 20 mA	no diagnosis possible	no diagnosis possible	no diagnosis possible	Error identifier = 48
4 mA ... 20 mA	Error identifier = 7	Error identifier = 7	Error identifier = 7	Error identifier = 48
-10 V ... +10 V	no diagnosis possible	Error identifier = 48	Error identifier = 7	Error identifier = 48

Table 251: Content of diagnosis messages

E1 ... E4	**d1**	**d2**	**d3**	**d4**		**Identifier 000 ... 063**	**AC500 display**	**<– Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**		**Err**	**PS501 PLC browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**		**Byte 6 Bit 0 ... 5**	**FBP diag-nosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**		**Error Identifier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])				
Module error								
3	14	1 ... 10	31	31		19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31		3	Timeout in the I/O module	Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31		40	Different hard-/firm-ware versions in the module	Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31		43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31		36	Internal data exchange failure	Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31		9	Overflow diagnosis buffer	New start
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31		26	Parameter error	Check master
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31		11	Process voltage too low	Check process voltage
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	31	31		45	Process voltage is switched off (ON –> OFF)	Process voltage ON
	11 / 12	ADR	1 ... 10					
Channel error								
				AX521	AX522			
4	14	1 ... 10	1	0 ... 3	0 ... 7	48	Analog value over-flow or broken wire at an analog input	Check input value or terminal
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	1	0...3	0 ... 7	7	Analog value under-flow at an analog input	Check input value
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	1	0 ... 3	0 ... 7	47	Short circuit at an analog input	Check terminal
	11 / 12	ADR	1 ... 10					

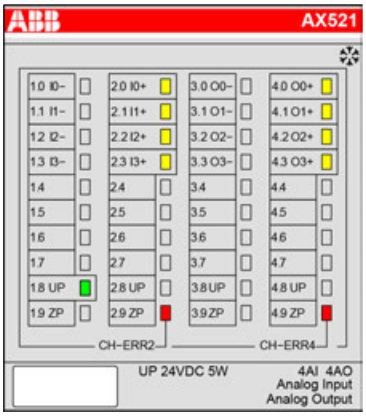
E1 ... E4	**d1**	**d2**	**d3**	**d4**		**Identifier** **000 ... 063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**		**Err**	**PS501 PLC browser**	
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**		**Byte 6** **Bit 0 ... 5**	**FBP diag-nosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**		**Error Identifier**	**Error message**	**Remedy**
	[1])	**[2])**	**[3])**	**[4])**				
4	14	1 ... 10	3	4 ... 7	8 ... 15	4	Analog value over-flow at an analog output	Check output value
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	3	4 ... 7	8 ... 15	7	Analog value under-flow at an analog output	Check output value
	11 / 12	ADR	1 ... 10					

Remarks:

[1])	In AC500, the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = expansion module 1 ... 10, ADR = hardware address (e.g. of the DC551)
[3])	With "Module" the following allocation applies depending on the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or FBP = module type (1 = AI, 3 = AO); COM1/COM2: 1 ... 10 = expansion 1 ... 10
[4])	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Inputs I0 ... I3	Analog input	Yellow	Input is OFF	Input is ON (brightness depends on the value of the analog signal)	--
	Outputs O0 ... O3	Analog output	Yellow	Output is OFF	Output is ON (brightness depends on the value of the analog signal)	--
	UP	Process voltage 24 V DC via terminal	Green	Process voltage is missing	Process voltage OK	--
	CH-ERR2	Channel error, error messages in groups (analog inputs or outputs combined into the groups 2 and 4)	Red	No error or process voltage is missing	Severe error within the corresponding group	Error on one channel of the group
	CH-ERR4		Red			
	CH-ERR *)	Module error	Red	--	Internal error	--
	*) Both LEDs (CH-ERR2 and CH-ERR4) light up together					

Measuring ranges

Input ranges of voltage, current and digital input

The represented resolution corresponds to 16 bits.

Range	0 V ... 10 V	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital input	Digital value	
						Decimal	Hex.
Overflow	>11.7589	>11.7589	>23.5178	>22.8142		32767	7FFF
Measured value too high	11.7589 . . 10.0004	11.7589 : 10.0004	23.5178 : 20.0007	22.8142 : 20.0006		32511 : 27649	7EFF : 6C01
Normal range	10.0000 : 0.0004	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	: : ON	27648 : 1	6C00 : 0001

Range	0 V ... 10 V	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital input	Digital value	
						Decimal	Hex.
Normal range or measured value too low	0.0000	0.0000	0	4	OFF	0	0000
	-0.0004 -1.7593	-0.0004 : : -10.0000		3.9994 1.1858		-1 -4864 : -27648	FFFF ED00 : 9400
Measured value too low		-10.0004 : -11.7589				-27649 : -32512	93FF : 8100
Underflow	<-1.7593	<-11.7589	<0.0000	<1.1858		-32768	8000

Input ranges resistance temperature detector

Range	Pt100 -50 °C ... +70 °C	Pt100 / Pt1000 -50 °C ... +400 °C	Ni1000 -50 °C ... +150 °C	Digital value	
				Decimal	Hex.
Overflow	> +80.0 °C	> +450.0 °C	> +160.0 °C	32767	7FFF
Measured value too high		+450.0 °C : + 400.1 °C		4500 : 4001	1194 : 0FA1
			+160.0 °C : +150.1 °C	1600 : 1501	0640 : 05DD
	+80.0 °C : +70.1 °C			800 : 701	0320 : 02BD
Normal range	: : +70.0 °C : +0.1 °C	+400.0 °C : : : + 0.1 °C	: +150.0 °C : : + 0.1 °C	4000 1500 700 : 1	0FA0 05DC 02BC : 0001
	0.0 °C	0.0 °C	0.0 °C	0	0000
	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-1 : -500	FFFF : FE0C
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-501 : -600	FE0B : FDA8
Underflow	< -60.0 °C	< -60.0 °C	< -60.0 °C	-32768	8000

Output ranges voltage and current

The represented resolution corresponds to 16 bits.

Range	-10 V ...+10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital value	
				Decimal	Hex.
Overflow	0 V	0 mA	0 mA	> 32511	> 7EFF
Value too high	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA	32511 : 27649	7EFF : 6C01
Normal range	10.0000 V : 0.0004 V	20.0000 mA : 0.0007 mA	20.0000 mA : 4.0006 mA	27648 : 1	6C00 : 0001
	0.0000 V	0.0000 mA	4.0000 mA	0	0000
	-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA	-1 -6912 -27648	FFFF E500 9400
Value too low	-10.0004 V : -11.7589 V	0 mA : 0 mA	0 mA : 0 mA	-27649 : -32512	93FF : 8100
Underflow	0 V	0 mA	0 mA	< -32512	< 8100

Technical data

Technical data of the module

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

↳ *Chapter 4.3 “System data AC500-XC” on page 38*

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter		Value
Process voltage		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 V DC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		

Parameter		Value
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module	Ca. 2 mA
	From UP at normal operation	0.15 A + output loads
Inrush current from UP (at power up)		0.020 A^2s
Max. length of analog cables, conductor cross section > 0.14 mm²		100 m
Weight		300 g
Mounting position		Horizontal mounting or Vertical mounting with derating (output load reduced to 50 % at 40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Technical data of the analog inputs

Parameter	Value
Number of channels per module	4
Distribution of channels into groups	1 group of 4 channels
Connections of the channels I0- ... I3-	Terminals 1.0 ... 1.3
Connections of the channels I0+ ... I3+	Terminals 2.0 ... 2.3
Input type	Bipolar (not with current or Pt100/Pt1000/Ni1000)
Galvanic isolation	Against internal supply and other modules
Configurability	0 V ... 10 V, -10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA, Pt100/1000, Ni1000 (each input can be configured individually)
Channel input resistance	Voltage: > 100 kΩ Current: ca. 330 Ω
Time constant of the input filter	Voltage: 100 µs Current: 100 µs
Indication of the input signals	One LED per channel
Conversion cycle	2 ms (for 8 inputs + 8 outputs), with Pt/Ni... 1 s
Resolution	Range 0 V ... 10 V: 12 bits Range -10 V ... +10 V: 12 bits including sign Range 0 mA ... 20 mA: 12 bits Range 4 mA ... 20 mA: 12 bits

Parameter	Value	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ.	± 0.5 % of full scale at 25 °C
	Max.	± 1 % of full scale (all ranges) at 0 °C ... 60 °C or EMC disturbance
Relationship between input signal and hex code	↳ *Chapter 5.4.4.2.6.9.2 “Input ranges resistance temperature detector” on page 784*	
Unused voltage inputs	Are configured as "unused"	
Unused current inputs	Have a low resistance, can be left open-circuited	
Overvoltage protection	Yes	

Technical data of the analog inputs, if used as digital inputs

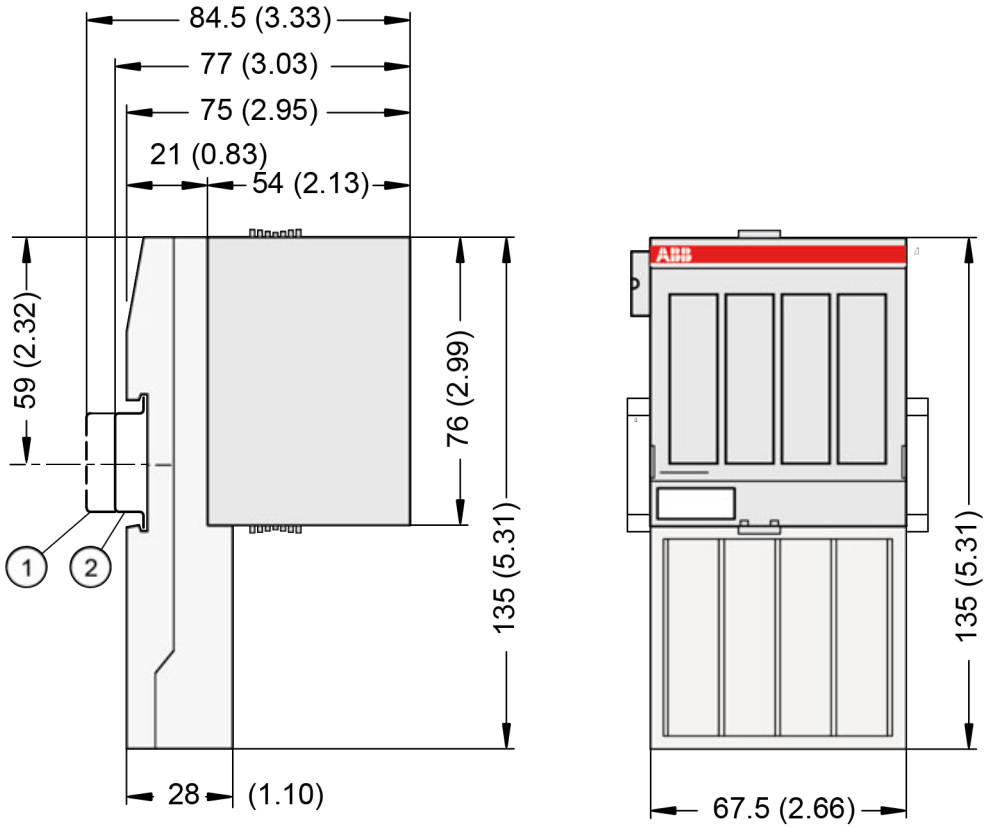
Parameter		Value
Number of channels per module		Max. 4
Distribution of channels into groups		1 group of 4 channels
Connections of the channels I0+ to I3+		Terminals 2.0 to 2.3
Reference potential for the inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (ZP)
Input signal delay		Typ. 8 ms, configurable from 0.1 to 32 ms
Indication of the input signals		1 LED per channel
Input signal voltage		24 V DC
	Signal 0	-30 V ... +5 V
	Undefined signal	+5 V ... +13 V
	Signal 1	+13 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 7 mA
	Input voltage +5 V	Typ. 1.4 mA
	Input voltage +15 V	Typ. 4.3 mA
	Input voltage +30 V	< 9 mA
Input resistance		ca. 3.5 kΩ

Technical data of the analog outputs

Parameter		Value
Number of channels per module		4, all channels for voltage and current
Distribution of channels into groups		1 group of 4 channels
	Channels O0- ... O3-	Terminals 3.0 ... 3.3
	Channels O0+ ... O3+	Terminals 4.0 ... 4.3
Output type		Bipolar with voltage, unipolar with current
Galvanic isolation		Against internal supply and other modules

Parameter	Value	
Configurability	-10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA (each output can be configured individually), current outputs only channels 0 ... 3	
Output resistance (load), as current output	0 Ω ... 500 Ω	
Output loadability, as voltage output	Max. ± 10 mA	
Indication of the output signals	One LED per channel	
Resolution	12 bits including sign	
Settling time for full range change (resistive load, output signal within specified tolerance)	Typ. 5 ms	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ.	± 0.5 % of full scale at 25 °C
	Max.	± 1 % of full scale (all ranges) at 0 °C ... 60 °C or EMC disturbance
Relationship between output signal and hex code		
Unused outputs	Can be left open-circuited	

Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

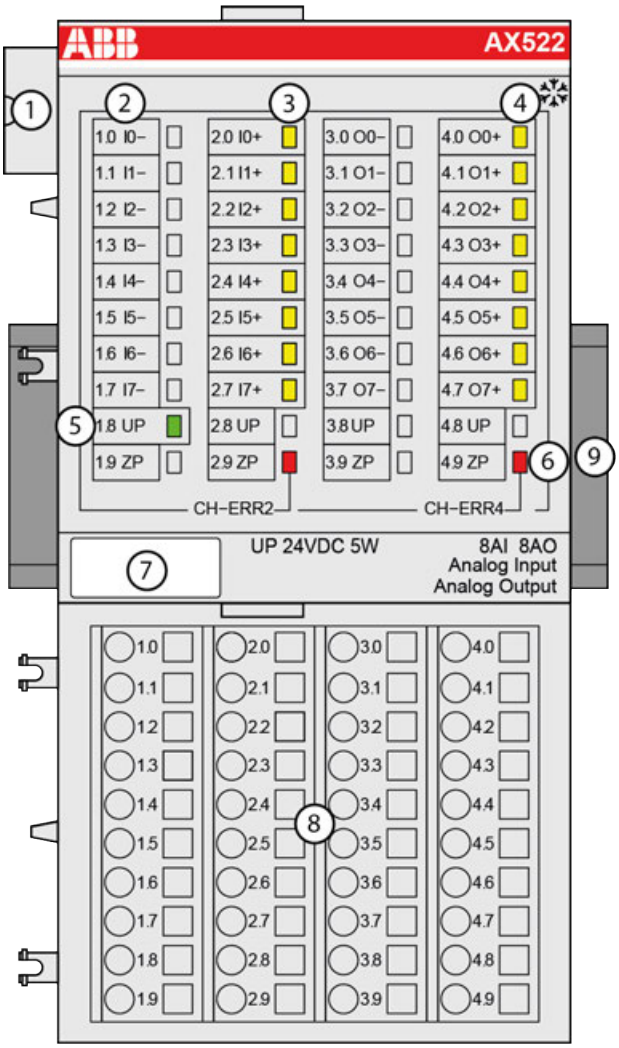
Ordering Data

Part no.	Description	Product life cycle phase *)
1SAP 250 100 R0001	AX521, analog input/output module, 4 AI, 4 AO, U/I/Pt100, 12 bits including sign, 2-wires	Active
1SAP 450 100 R0001	AX521-XC, analog input/output module, 4 AI, 4 AO, U/I/Pt100, 12 bits including sign, 2-wires, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.4.4.2.7 AX522 - Analog input/output module

- 8 configurable analog inputs (I0 ... I7) in 1 group (1.0 ... 2.7)
  Resolution 12 bits including sign
- 8 configurable analog outputs (O0 ... O7) in 1 group (3.0 ... 4.7)
  Resolution 12 bits including sign
- Module-wise galvanically isolated
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 8 yellow LEDs to display the signal states at the analog inputs (I0 ... I7)
4 8 yellow LEDs to display the signal states at the analog outputs (O0 ... O7)
5 1 green LED to display the state of the process supply voltage UP
6 2 red LEDs to display errors
7 Label
8 Terminal unit
9 DIN rail
Sign for XC version

Intended purpose

The device can be used as a decentralized I/O extension module for S500 communication interface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

Functionality

8 analog inputs (channel 0 ... channel 7), individually configurable

- Unused (default setting)
- 0 V ... 10 V

- -10 V ... +10 V
- 0 mA ... 20 mA
- 4 mA ... 20 mA
- Pt100, -50 °C ... +400 °C (2-wire)
- Pt100, -50 °C ... +400 °C (3-wire), requires 2 channels
- Pt100, -50 °C ... +70 °C (2-wire)
- Pt100, -50 °C ... +70 °C (3-wire), requires 2 channels
- Pt1000, -50 °C ... +400 °C (2-wire)
- Pt1000, -50 °C ... +400 °C (3-wire), requires 2 channels
- Ni1000, -50 °C ... +150 °C (2-wire)
- Ni1000, -50 °C ... +150 °C (3-wire), requires 2 channels
- 0 V ... 10 V with differential inputs, requires 2 channels
- -10 V ... +10 V with differential inputs, requires 2 channels
- Digital signals (digital input)

Parameter		Value
Resolution of the analog channels		
	Voltage -10 V ... +10 V	12 bits including sign
	Voltage 0 V ... 10 V	12 bits
	Current 0 mA ... 20 mA, 4 mA ... 20 mA	12 bits
	Temperature	0.1 °C
LED displays		19 LEDs for signals and error messages
Internal power supply		Via the I/O bus interface (I/O bus)
External power supply		Via the terminals ZP and UP (process voltage 24 V DC)
Required terminal unit		TU515 or TU516 ↳ *TU515, TU516*

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The modules are plugged on an I/O terminal unit.

↳ *TU515, TU516*

Properly position the modules and press until they lock in place. The terminal units are mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting.

↳ *Chapter 5.8.2.6 “TA526 - Wall mounting accessory” on page 1410*

The connection of the I/O channels is carried out using the 40 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8, 2.8, 3.8 and 4.8 as well as 1.9, 2.9,3.9 and 4.9 are electrically interconnected within the I/O terminal units and always have the same assignment, independent of the inserted module:

Terminals 1.8, 2.8, 3.8 and 4.8: process voltage UP = +24 V DC

Terminals 1.9, 2.9, 3.9 and 4.9: process voltage ZP = 0 V DC

The assignment of the other terminals:

Terminals	Signal	Description
1.0 ... 1.7	I0- ... I7-	Negative poles of the 8 analog inputs
2.0 ... 2.7	I0+ ... I7+	Positive poles of the 8 analog inputs
3.0 ... 3.7	O0- ... O7-	Negative poles of the 8 analog outputs
4.0 ... 4.7	O0+ ... O7+	Positive poles of the 8 analog outputs



The negative poles of the analog inputs are connected to each other to form an "Analog Ground" signal for the module.



The negative poles of the analog outputs are connected to each other to form an "Analog Ground" signal for the module.



There is no galvanic isolation between the analog circuitry and ZP/UP. Therefore, the analog sensors must be galvanically isolated in order to avoid loops via the ground potential or the supply voltage.



Because of their common reference potential, analog current inputs cannot be circuited in series, neither within the module nor with channels of other modules.



For the open-circuit detection (wire break), each analog input channel is pulled up to "plus" by a high-resistance resistor. If nothing is connected, the maximum voltage will be read in then.

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 2 mA per I/O module.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.

WARNING!

Removal/Insertion under power

Removal or insertion under power is permissible only if all conditions for hot swapping are fullfilled.

“Conditions for hot swap” on page 12

The devices are not designed for removal or insertion under power when the conditions for hot swap do not apply. Because of unforeseeable consequences, it is not allowed to plug in or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing any of the following actions:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while they are energized in a hazardous location could result in an electric arc, which could create an ignition source resulting in fire or explosion.

Prior to proceeding, make sure that power is been disconnected and that the area has been thoroughly checked to ensure that flammable materials or ignitable concentrations are not present.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

Generally, analog signals must be laid in shielded cables. The cable shields must be grounded at both sides of the cables. To avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

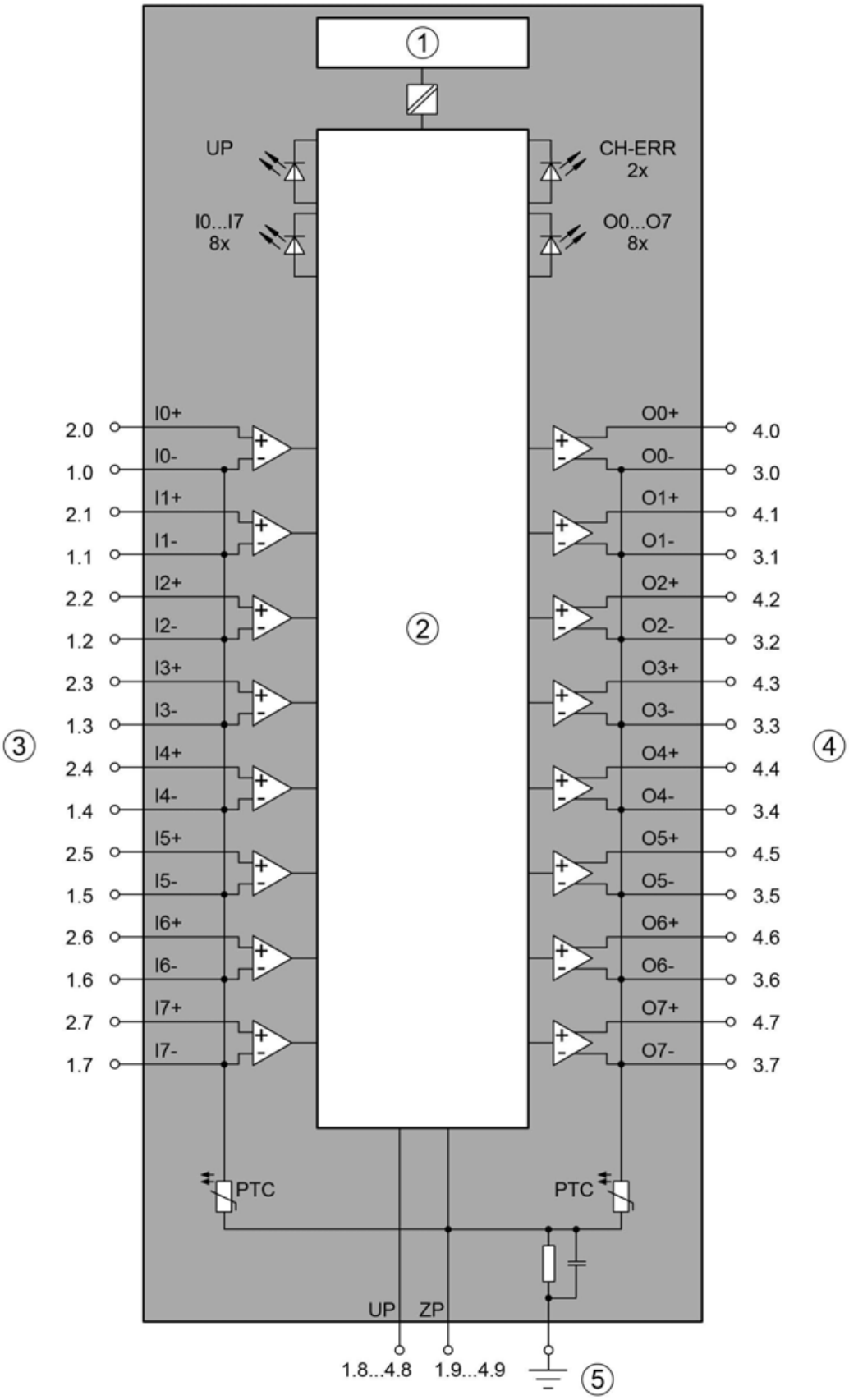


Fig. 116: Connection of the I/O module: 8 analog inputs and 8 analog outputs, individually configurable ↳ *Chapter 5.4.4.2.7.2 “Functionality” on page 790*

1 I/O bus interface
2 Logic

3 Analog inputs
4 Analog outputs
5 Functional earth connection

CAUTION!
By installing equipotential bonding conductors between the different parts of the system, it must be ensured that the potential difference between ZP and AGND never can exceed 1 V.

CAUTION!
The process supply voltage must be included in the grounding concept (e. g. grounding of the negative terminal).

Connection of resistance thermometers in 2-wire configuration

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the I/O module provides a constant current source which is multiplexed over the 8 analog channels.

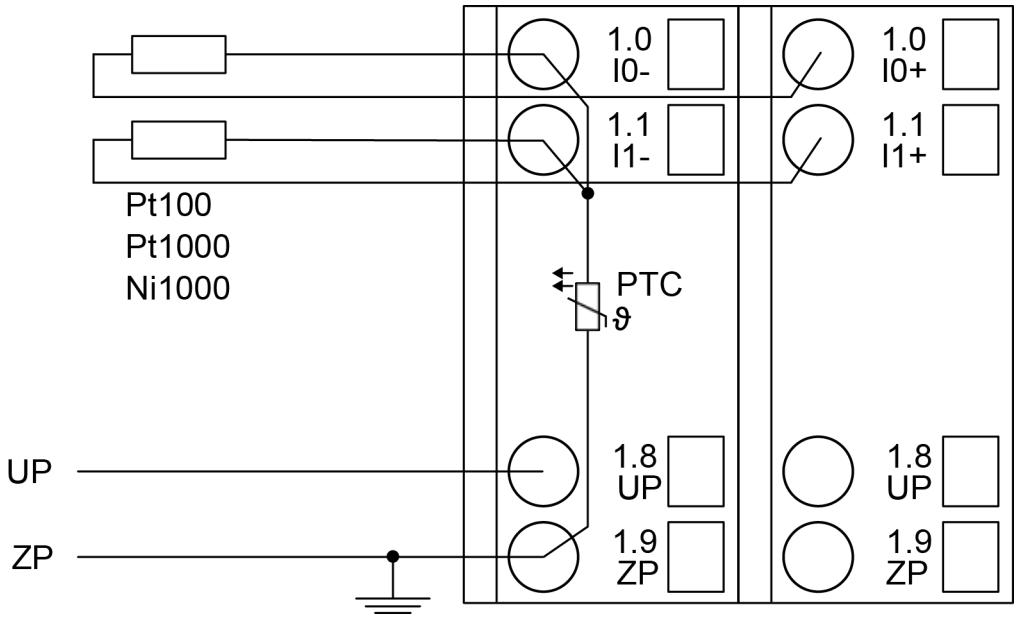


Fig. 117: Connection example

Pt100	-50 °C ... +70 °C	2-wire configuration, one channel used
Pt100	-50 °C ... +400 °C	2-wire configuration, one channel used
Pt1000	-50 °C ... +400 °C	2-wire configuration, one channel used
Ni1000	-50 °C ... +150 °C	2-wire configuration, one channel used

The I/O module performs a linearization of the resistance characteristic.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of resistance thermometers in 3-wire configuration

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the I/O module provides a constant current source which is multiplexed over the max. 8 (depending on the configuration) analog channels.

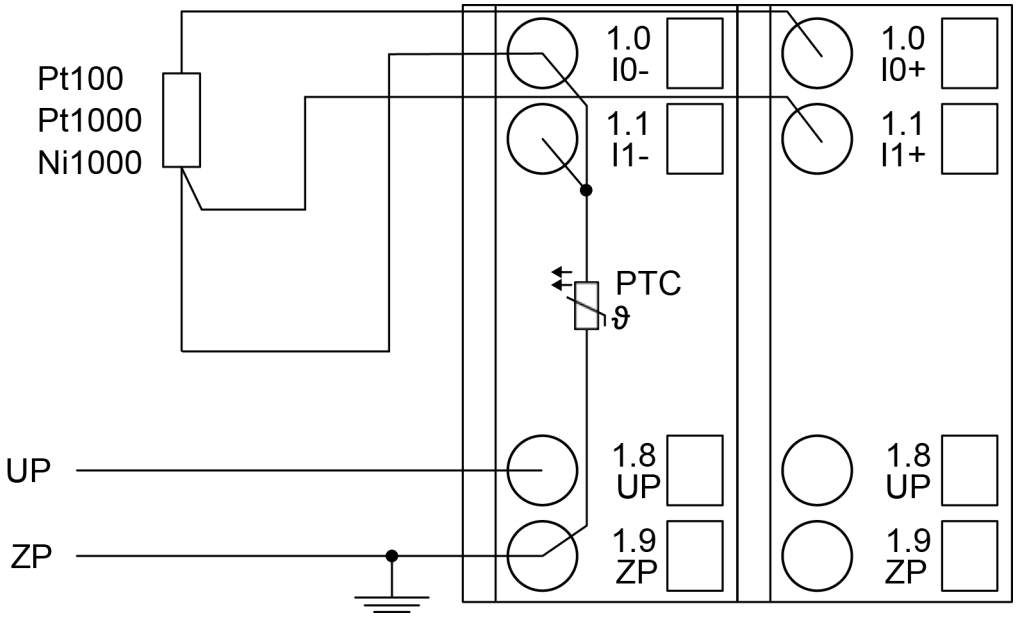


Fig. 118: Connection example

> *If several measuring points are adjacent to each other, only one return line is necessary. This saves wiring costs.*

With the 3-wire configuration, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1).

The constant current of one channel flows through the resistance thermometer. The constant current of the other channel flows through one of the cores. The module calculates the measured value from the two voltage drops and stores it under the input with the higher channel number (e.g. I1).

In order to keep measuring errors as small as possible, it is necessary to have all the involved conductors in the same cable. All the conductors must have the same cross section.

Pt100	-50 °C ... +70 °C	3-wire configuration, two channels used
Pt100	-50 °C ... +400 °C	3-wire configuration, two channels used
Pt1000	-50 °C ... +400 °C	3-wire configuration, two channels used
Ni1000	-50 °C ... +150 °C	3-wire configuration, two channels used

The I/O module performs a linearization of the resistance characteristic.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of active-type analog sensors (Voltage) with galvanically isolated power supply

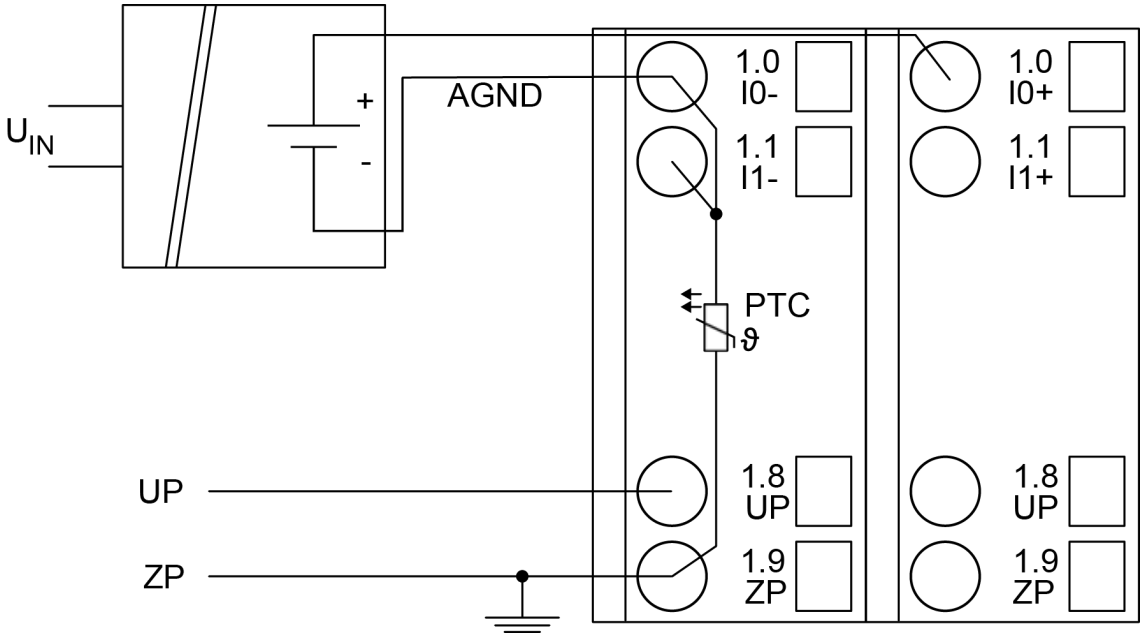


Fig. 119: Connection example

By connecting the sensor's negative pole of the output voltage to AGND, the galvanically isolated voltage source of the sensor is referred to ZP.

The following measuring ranges can be configured for AX521 *Chapter 5.4.4.2.6.6 “Parameterization” on page 776* and for AX522 *Chapter 5.4.4.2.7.6 “Parameterization” on page 803*:

Voltage	0 V ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Connection of active-type analog sensors (Current) with galvanically isolated power supply

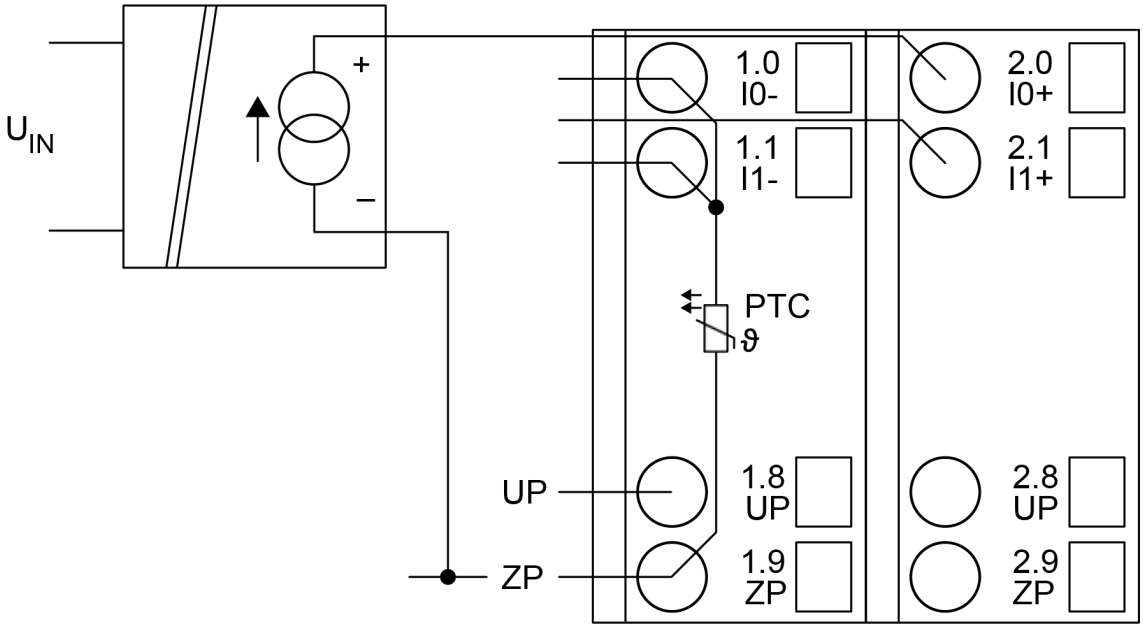


Fig. 120: Connection example

Current	0 mA ... 20 mA	1 channel used
Current	4 mA ... 20 mA	1 channel used

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of active-type analog sensors (Voltage) with no galvanically isolated power supply

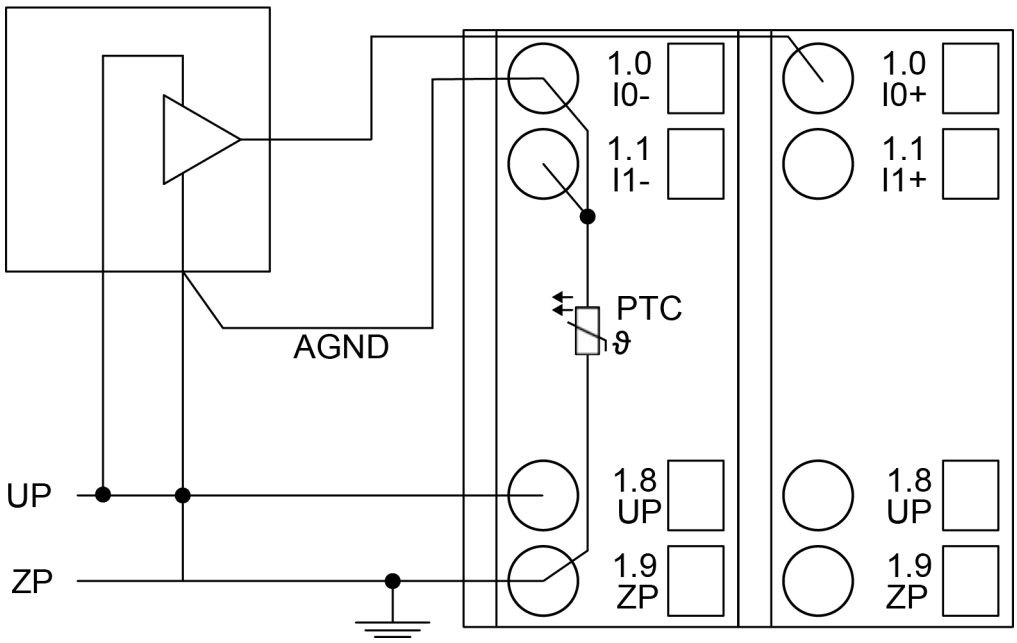


Fig. 121: Connection example

CAUTION!
The potential difference between AGND and ZP at the module must not be greater than 1 V, not even in case of long lines.

If AGND does not get connected to ZP, the sensor current flows to ZP via the AGND line. The measuring signal is distorted, as a very small current flows through the voltage line. The total current through the PTC should not exceed 50 mA. This measuring method is therefore only suitable for short lines and small sensor currents. If there are bigger distances, the difference measuring method should be applied.

Voltage	0 V ... 10 V	1 channel used
Voltage	-10 V ... +10 V *)	1 channel used

*) if the sensor can provide this signal range

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Connection of passive-type analog sensors (Current)

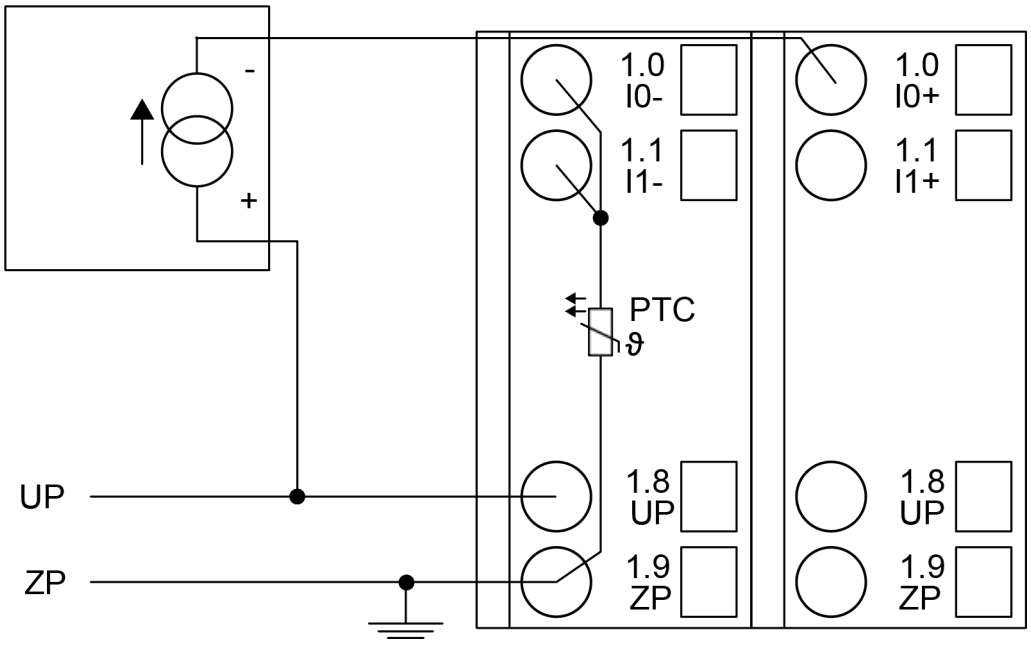


Fig. 122: Connection example

Current	4 mA ... 20 mA	1 channel used

CAUTION!

Risk of overloading the analog input!

If an analog current sensor supplies more than 25 mA for more than 1 second during initialization, this input is switched off by the module (input protection).

Only use sensors with fast initialization or without current peaks higher than 25 mA. If not possible, connect a 10-volt Zener diode in parallel to I+ and ZP.

Unused input channels can be left open-circuited because they are of low resistance.

Connection of active-type analog sensors (Voltage) to differential inputs

Differential inputs are very useful if analog sensors are used which are remotely non-isolated (e.g. the minus terminal is remotely grounded).

The use of differential inputs helps to considerably increase the measuring accuracy and to avoid ground loops.

With differential input configurations, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

The analog value is calculated by subtraction of the input value with the higher address from the input value of the lower address.

The converted analog value is available at the odd channel (higher address).

CAUTION!

Problems with the common-mode input voltages of the involved analog inputs

The ground potential at the sensors must not have too large a potential difference with respect to ZP (max. ±1 V within the full signal range).

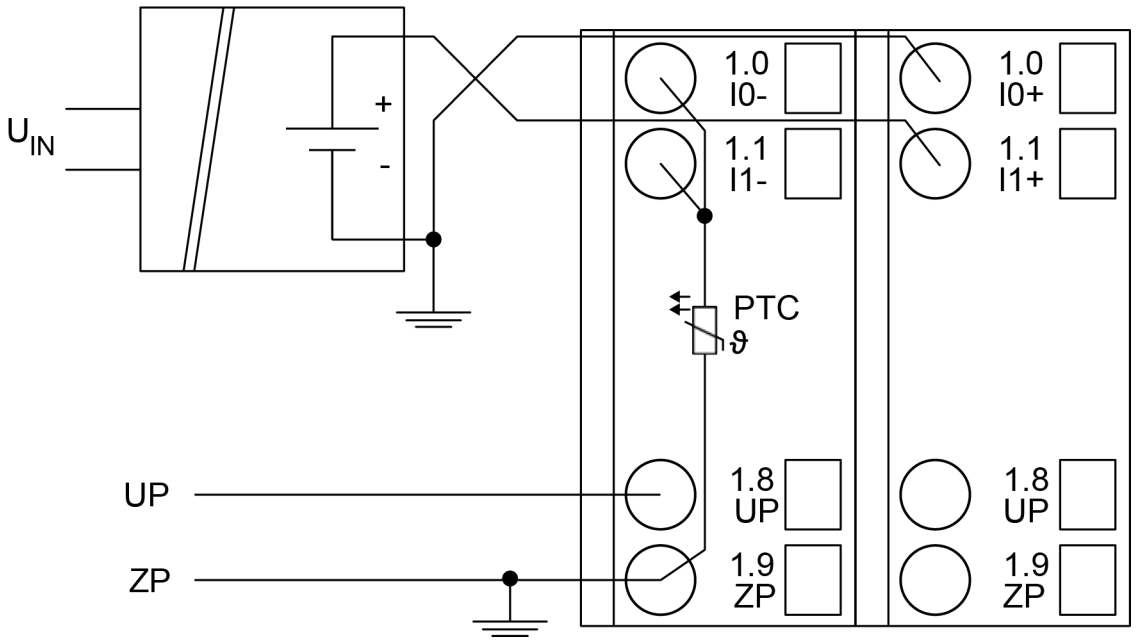


Fig. 123: Connection example

The negative pole of the sensor must be grounded next to the sensor.

Voltage	0 V ... 10 V	with differential inputs, 2 channels used
Voltage	-10 V ... +10 V	with differential inputs, 2 channels used

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Use of analog inputs as digital inputs

Several (or all) analog inputs can be configured as digital inputs. The inputs are not galvanically isolated against the other analog channels.

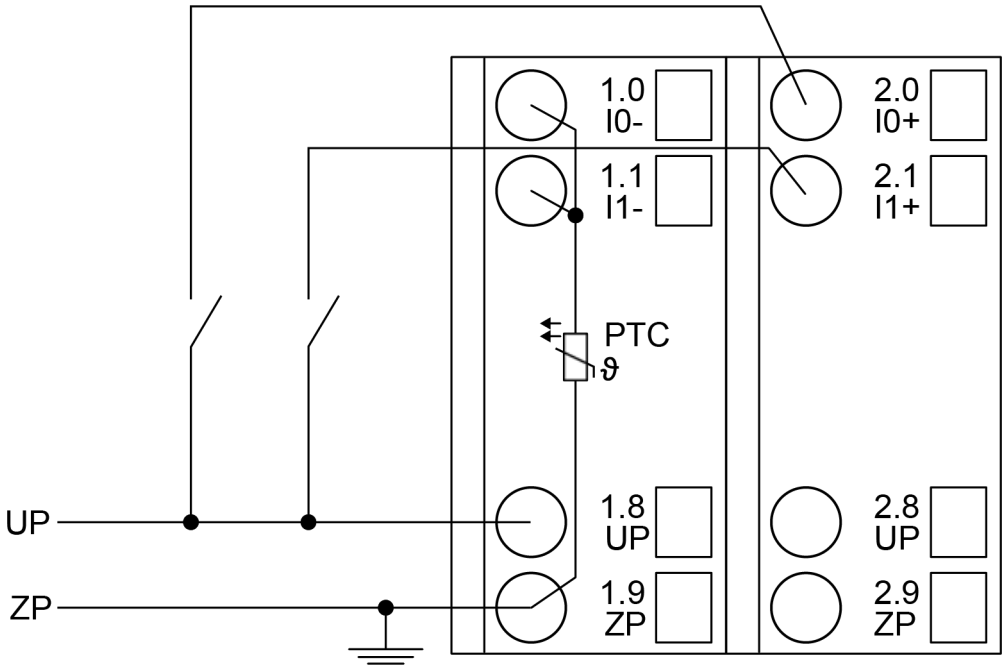


Fig. 124: Connection example

Digital input	24 V	1 channel used
Effect of incorrect input terminal connection		Wrong or no signal detected, no damage up to 35 V

Connection of analog output loads (Voltage, current)

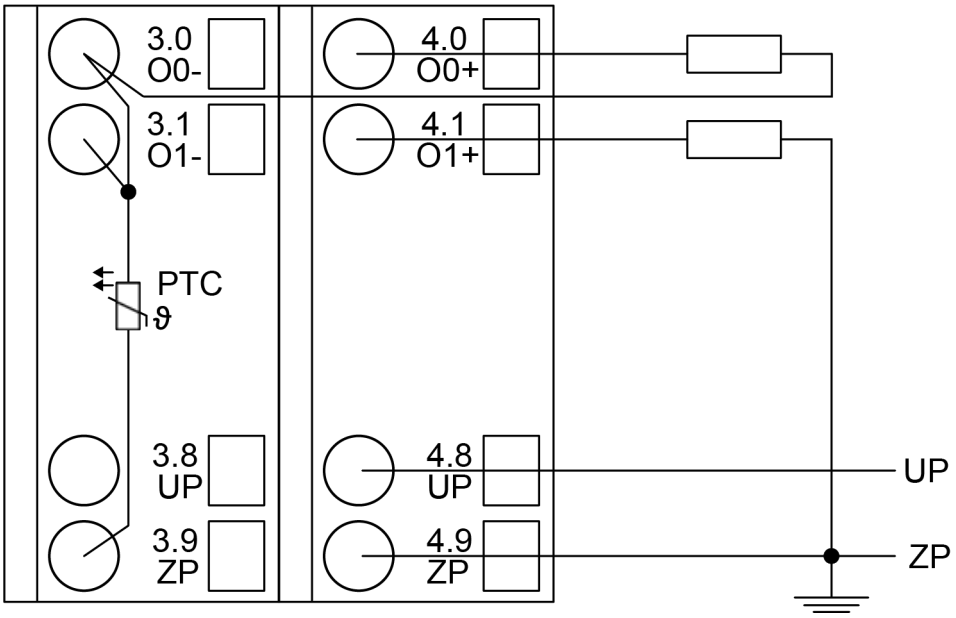


Fig. 125: Connection example

Voltage	-10 V ... +10 V	Load max. ± 10 mA	1 channel used
Current	0 mA ... 20 mA	Load 0 Ω ... 500 Ω	1 channel used
Current	4 mA ... 20 mA	Load 0 Ω ... 500 Ω	1 channel used

Only the channels 0 ... 3 can be configured as current output (0 mA ... 20 mA or 4 mA ... 20 mA).

Unused analog outputs can be left open-circuited.

Internal data exchange

Digital inputs (bytes)	0
Digital outputs (bytes)	0
Counter input data (words)	8
Counter output data (words)	8

I/O configuration

The module does not store configuration data itself. It gets its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1 ... 10

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module slot address: Y = 1 ... 7

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
1	Module ID	Internal	1500 [1)]	Word	1500 0x05dc	0	65535	0x0Y01
2	Ignore module [2)]	No Yes	0 1	Byte	No 0x00			not for FBP
3	Parameter length in bytes	Internal	37	Byte	37-CPU 37-FBP	0	255	0x0Y02
4	Check supply	Off On	0 1	Byte	On 0x01	0	1	0x0Y03
5	Analog data format	Default	0	Byte	Default 0x00			0x0Y04
6	Behaviour of outputs at communication errors	Off Last value Substitute value	0 1+(n*5) 2+(n*5), n ≤ 2	Byte	Off 0x00	0	2	0x0Y05
7	Channel configuration Input channel 0	See table 'Channel configuration' *↳ Table 253 “Channel configuration 2)” on page 805*		Byte	Default 0x00	0	19	0x0Y06
8	Channel monitoring Input channel 0	See table 'Channel monitoring' *↳ Table 254 “Channel monitoring 3)” on page 806*		Byte	Default 0x00	0	3	0x0Y07

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
9 to 22	Channel configuration and channel monitoring of the input channels 1 ... 7	See table 'Channel configuration' *Table 253 “Channel configuration 2)” on page 805* and table 'Channel monitoring' *Table 254 “Channel monitoring 3)” on page 806*		Byte Byte	Default 0x00 0x00	0 0	19 3	0x0Y08 to 0x0Y15
23	Channel configuration Output channel 0	See table 'Channel configuration' *Table 253 “Channel configuration 2)” on page 805*		Byte	Default 0x00	0	130	0x0Y16
24	Channel monitoring Output channel 0	See table 'Channel monitoring' *Table 254 “Channel monitoring 3)” on page 806*		Byte	Default 0x00	0	3	0x0Y17
25	Substitute value Output channel 0	only valid for output channel 0	0 ... 0xffff	Word	Default 0x0000	0	65535	0x0Y18
26 to 31	Channel configuration and channel monitoring of the output channels 1 ... 3	See table 'Channel configuration' *Table 253 “Channel configuration 2)” on page 805* and table 'Channel monitoring' *Table 254 “Channel monitoring 3)” on page 806*		Byte Byte	Default 0x00 0x00	0 0	130 3	0x0Y19 to 0x0Y1E
32	Channel configuration Output channel 4	See table 'Channel configuration' *Table 253 “Channel configuration 2)” on page 805*		Byte	Default 0x00	0	128	0x0Y1F

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
33	Channel monitoring Output channel 4	See table 'Channel monitoring' *Table 254 “Channel monitoring 3)” on page 806*		Byte	Default 0x00	0	3	0x0Y20
34 to 39	Channel configuration and channel monitoring of the output channels 5 ... 7	See table 'Channel configuration' *Table 253 “Channel configuration 2)” on page 805* and table 'Channel monitoring' *Table 254 “Channel monitoring 3)” on page 806*		Byte Byte	Default 0x00 0x00	0 0	128 3	0x0Y21 to 0x0Y26

1) With CS31 and addresses less than 70 and FBP, the value is increased by 1

2) Not with FBP

GSD file:

Ext_User_Prm_Data_Len =	24
Ext_User_Prm_Data_Const(0) =	0x05, 0xe2, 0x15, \ 0x01, 0x00, 0x00 \ 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \ 0x00, 0x00, 0x00, 0x00, \ 0x00, 0x00, 0x00, 0x00, 0x00, 0x00;

Table 252: Input channel (4x)

No.	Name	Internal value, type	Default
1	Channel configuration see table 2)	Byte	0 0x00 see table 2)
2	Channel monitoring see table 3)	Byte	0 0x00 see table 3)

Table 253: Channel configuration 2)

Internal value	Operating modes of the analog inputs, individually configurable
0	Unused (default)
1	Analog input 0 V ... 10 V

Internal value	Operating modes of the analog inputs, individually configurable
2	Digital input
3	Analog input 0 mA ... 20 mA
4	Analog input 4 mA ... 20 mA
5	Analog input -10 V ... +10 V
8	Analog input Pt100, -50 °C ... +400 °C (2-wire)
9	Analog input Pt100, -50 °C ... +400 °C (3-wire), requires 2 channels *)
10	Analog input 0 ... 10 V via differential inputs, requires 2 channels *)
11	Analog input -10 V ... +10 V via differential inputs, requires 2 channels *)
14	Analog input Pt100, -50 °C ... +70 °C (2-wire)
15	Analog input Pt100, -50 °C ... +70 °C (3-wire), requires 2 channels *)
16	Analog input Pt1000, -50 °C ... +400 °C (2-wire)
17	Analog input Pt1000, -50 °C ... +400 °C (3-wire), requires 2 channels *)
18	Analog input Ni1000, -50 °C ... +150 °C (2-wire)
19	Analog input Ni1000, -50 °C ... +150 °C (3-wire), requires 2 channels *)
	*) In the operating modes with 3-wire configuration or with differential inputs, two adjacent analog inputs belong together (e.g. the channels 0 and 1). In these cases, both channels are configured in the desired operating mode. The lower address must be the even address (channel 0). The next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

Table 254: Channel monitoring [3])

Internal value	Monitoring
0	Plausibility, open-circuit (broken wire) and short circuit
3	No monitoring

Table 255: Output channel 0 (1 channel)

No.	Name	Value	Internal value	Internal value, type	Default
1	Channel configuration	see table [4])	see table [4])	Byte	see table [4])
2	Channel monitoring	see table [5])	see table [5])	Byte	see table [5])
3	Substitute value see table [6])	0 ... 65535	0 ... 0xffff	Word	0

Table 256: Output channels 1 ... 3 (3x)

No.	Name	Internal value, type
1	Channel configuration see table [4])	Byte
2	Channel monitoring see table [6])	Byte

Table 257: Channel configuration [4])

Internal value	Operating modes of the analog outputs, individually configurable
0	Unused (default)
128	Analog output -10 V ... +10 V
129	Analog output 0 mA ... 20 mA (not with the channels 4 ... 7 and 12 ... 15)
130	Analog output 4 mA ... 20 mA (not with the channels 4 ... 7 and 12 ... 15)

Table 258: Channel monitoring [5])

Internal value	Monitoring
0	Plausibility, open circuit (broken wire) and short circuit (default)
3	No monitoring

Table 259: Substitute value [6])

Intended behaviour of output channel when the control system stops	Required setting of the module parameter "Behaviour of outputs in case of a communication error"	Required setting of the channel parameter "Substitute value"
Output OFF	Off	0
Last value infinite	Last value	0
Last value for 5 s and then turn off	Last value 5 sec	0
Last value for 10 s and then turn off	Last value 10 sec	0
Substitute value infinite	Substitute value	Depending on configuration
Substitute value for 5 s and then turn off	Substitute value 5 sec	Depending on configuration
Substitute value for 10 s and then turn off	Substitute value 10 sec	Depending on configuration

Diagnosis

Table 260: Possible diagnosis of I/O channels

Output range	Condition	
	Output value in the PLC underflow	Output value in the PLC overflow
0 mA ... 20 mA	Error identifier = 7	Error identifier = 4
4 mA ... 20 mA		
-10 V ... +10 V		

Input range	Condition			
	Short circuit	Wire break	Input value under-flow	Input value over-flow
0 mA ... 20 mA	no diagnosis possible	no diagnosis possible	no diagnosis possible	Error identifier = 48
4 mA ... 20 mA	Error identifier = 7	Error identifier = 7	Error identifier = 7	Error identifier = 48
-10 V ... +10 V	no diagnosis possible	Error identifier = 48	Error identifier = 7	Error identifier = 48

Table 261: Content of diagnosis messages

E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500 display	<– Display in	
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC browser		
Byte 6 Bit 6 ... 7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0 ... 5	FBP diag-nosis block		
Class	Interface	Device	Module	Channel	Error Identifier	Error message		Remedy
	[1])	[2])	[3])	[4])				
Module error								
3	14	1 ... 10	31	31	19	Checksum error in the I/O module		Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	3	Timeout in the I/O module		Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	40	Different hard-/firm-ware versions in the module		Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	43	Internal error in the module		Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	36	Internal data exchange failure		Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer		New start
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	26	Parameter error		Check master
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	11	Process voltage too low		Check process voltage
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	31	31	45	Process voltage is switched off (ON –> OFF)		Process voltage ON
	11 / 12	ADR	1 ... 10					
Channel error								
				AX521	AX522			

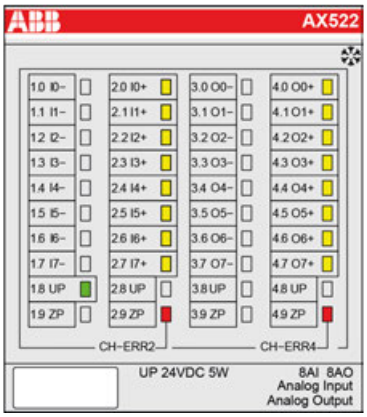
E1 ... E4	**d1**	**d2**	**d3**	**d4**		**Identifier** **000 ... 063**	**AC500 display**	**<– Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**		**Err**	**PS501 PLC browser**	
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**		**Byte 6** **Bit 0 ... 5**	**FBP diag-nosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**		**Error Identifier**	**Error message**	**Remedy**
	[1])	**[2])**	**[3])**	**[4])**				
4	14	1 ... 10	1	0 ... 3	0 ... 7	48	Analog value over-flow or broken wire at an analog input	Check input value or terminal
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	1	0...3	0 ... 7	7	Analog value under-flow at an analog input	Check input value
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	1	0 ... 3	0 ... 7	47	Short circuit at an analog input	Check terminal
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	3	4 ... 7	8 ... 15	4	Analog value over-flow at an analog output	Check output value
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	3	4 ... 7	8 ... 15	7	Analog value under-flow at an analog output	Check output value
	11 / 12	ADR	1 ... 10					

Remarks:

[1])	In AC500, the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = expansion module 1 ... 10, ADR = hardware address (e.g. of the DC551)
[3])	With "Module" the following allocation applies depending on the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or FBP = module type (1 = AI, 3 = AO); COM1/COM2: 1 ... 10 = expansion 1 ... 10
[4])	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Inputs I0 ... I7	Analog input	Yellow	Input is OFF	Input is ON (brightness depends on the value of the analog signal)	--
	Outputs O0 ... O7	Analog output	Yellow	Output is OFF	Output is ON (brightness depends on the value of the analog signal)	--
	UP	Process voltage 24 V DC via terminal	Green	Process voltage is missing	Process voltage OK	--
	CH-ERR2	Channel error, error messages in groups (analog inputs or outputs combined into the groups 2 and 4) Module error	Red	No error or process voltage is missing	Severe error within the corresponding group	Error on one channel of the group
	CH-ERR4		Red			
	CH-ERR *)		Red	--	Internal error	--
	*) Both LEDs (CH-ERR2 and CH-ERR4) light up together					

Measuring ranges

Input ranges of voltage, current and digital input

The represented resolution corresponds to 16 bits.

Range	0 V ... 10 V	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital input	Digital value	
						Decimal	Hex.
Overflow	>11.7589	>11.7589	>23.5178	>22.8142		32767	7FFF
Measured value too high	11.7589 . . 10.0004	11.7589 : 10.0004	23.5178 : 20.0007	22.8142 : 20.0006		32511 : 27649	7EFF : 6C01
Normal range	10.0000 : 0.0004	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	: : ON	27648 : 1	6C00 : 0001
	0.0000	0.0000	0	4	OFF	0	0000

Range	0 V ... 10 V	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital input	Digital value	
						Decimal	Hex.
Normal range or measured value too low	-0.0004 -1.7593	-0.0004 : : -10.0000		3.9994 1.1858		-1 -4864 : -27648	FFFF ED00 : 9400
Measured value too low		-10.0004 : -11.7589				-27649 : -32512	93FF : 8100
Underflow	<-1.7593	<-11.7589	<0.0000	<1.1858		-32768	8000

Input ranges resistance temperature detector

Range	Pt100 -50 °C ... +70 °C	Pt100 / Pt1000 -50 °C ... +400 °C	Ni1000 -50 °C ... +150 °C	Digital value	
				Decimal	Hex.
Overflow	> +80.0 °C	> +450.0 °C	> +160.0 °C	32767	7FFF
Measured value too high		+450.0 °C : + 400.1 °C		4500 : 4001	1194 : 0FA1
			+160.0 °C : +150.1 °C	1600 : 1501	0640 : 05DD
	+80.0 °C : +70.1 °C			800 : 701	0320 : 02BD
Normal range	: : +70.0 °C : +0.1 °C	+400.0 °C : : : + 0.1 °C	: +150.0 °C : : + 0.1 °C	4000 1500 700 : 1	0FA0 05DC 02BC : 0001
	0.0 °C	0.0 °C	0.0 °C	0	0000
	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-1 : -500	FFFF : FE0C
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-501 : -600	FE0B : FDA8
Underflow	< -60.0 °C	< -60.0 °C	< -60.0 °C	-32768	8000

Output ranges voltage and current

The represented resolution corresponds to 16 bits.

Range	-10 V ...+10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital value	
				Decimal	Hex.
Overflow	0 V	0 mA	0 mA	> 32511	> 7EFF
Value too high	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA	32511 : 27649	7EFF : 6C01
Normal range	10.0000 V : 0.0004 V	20.0000 mA : 0.0007 mA	20.0000 mA : 4.0006 mA	27648 : 1	6C00 : 0001
	0.0000 V	0.0000 mA	4.0000 mA	0	0000
	-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA	-1 -6912 -27648	FFFF E500 9400
Value too low	-10.0004 V : -11.7589 V	0 mA : 0 mA	0 mA : 0 mA	-27649 : -32512	93FF : 8100
Underflow	0 V	0 mA	0 mA	< -32512	< 8100

Technical data

Technical data of the module

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

↳ *Chapter 4.3 “System data AC500-XC” on page 38*

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter		Value
Process voltage		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 V DC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		

Parameter		Value
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module	Ca. 2 mA
	From UP at normal operation	0.15 A + output loads
Inrush current from UP (at power up)		0.020 A^2s
Max. length of analog cables, conductor cross section > 0.14 mm²		100 m
Weight		300 g
Mounting position		Horizontal mounting or Vertical mounting with derating (output load reduced to 50 % at 40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Technical data of the analog inputs

Parameter	Value
Number of channels per module	8
Distribution of channels into groups	1 group of 8 channels
Connections of the channels I0- ...I7-	Terminals 1.0 ... 1.7
Connections of the channels I0+ ... I7+	Terminals 2.0 ... 2.3
Input type	Bipolar (not with current or Pt100/Pt1000/Ni1000)
Galvanic isolation	Against internal supply and other modules
Configurability	0 V ... 10 V, -10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA, Pt100/1000, Ni1000 (each input can be configured individually)
Channel input resistance	Voltage: > 100 kΩ Current: ca. 330 Ω
Time constant of the input filter	Voltage: 100 µs current: 100 µs
Indication of the input signals	One LED per channel
Conversion cycle	2 ms (for 8 inputs + 8 outputs), with Pt/Ni... 1 s
Resolution	Range 0 V ... 10 V: 12 bits Range -10 V ... +10 V: 12 bits including sign Range 0 mA ... 20 mA: 12 bits Range 4 mA ... 20 mA: 12 bits

Parameter	Value	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ.	± 0.5 % of full scale at 25 °C
	Max.	± 1 % of full scale (all ranges) at 0 °C ... 60 °C or EMC disturbance
Unused voltage inputs	Are configured as "unused"	
Unused current inputs	Have a low resistance, can be left open-circuited	
Overvoltage protection	Yes	

Technical data of the analog inputs, if used as digital Inputs

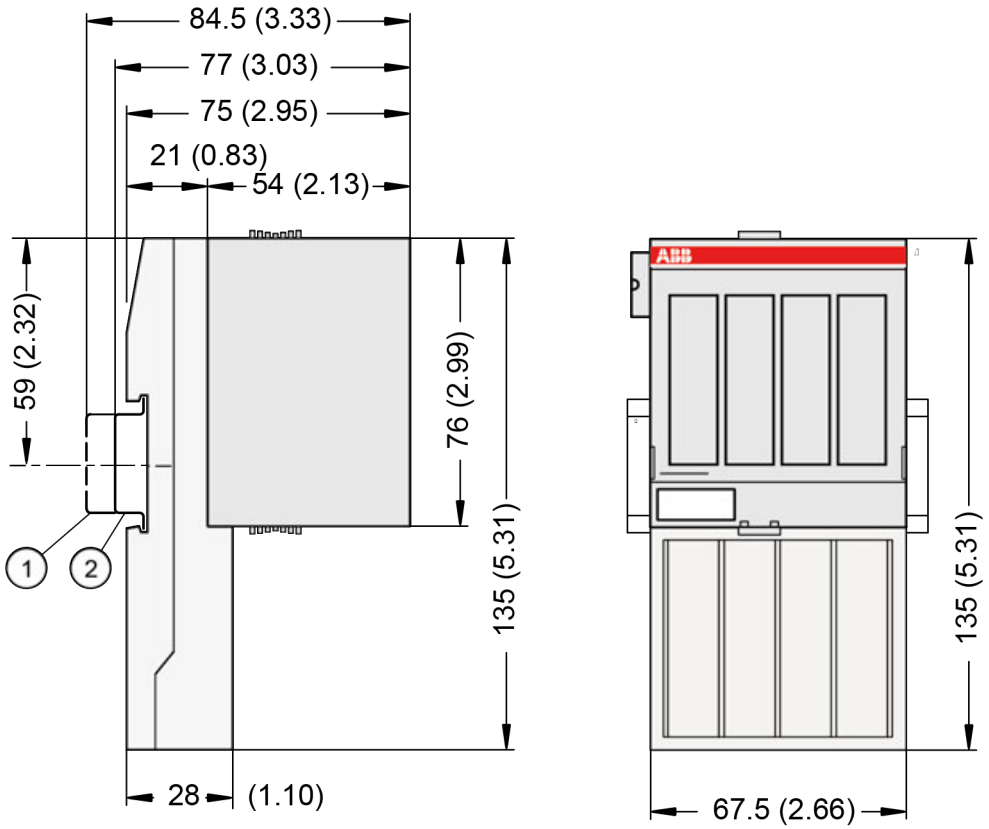
Parameter		Value
Number of channels per module		Max. 8
Distribution of channels into groups		1 group of 8 channels
Connections of the channels I0+ ... I7+		Terminals 2.0 ... 2.7
Reference potential for the inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (ZP)
Input signal delay		Typ. 8 ms, configurable from 0.1 ms ... 32 ms
Indication of the input signals		1 LED per channel
Input signal voltage		24 V DC
	Signal 0	-30 V ... +5 V
	Undefined signal	+5 V ... +13 V
	Signal 1	+13 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 7 mA
	Input voltage +5 V	Typ. 1.4 mA
	Input voltage +15 V	Typ. 4.3 mA
	Input voltage +30 V	< 9 mA
Input resistance		Ca. 3.5 kΩ

Technical data of the analog outputs

Parameter		Value
Number of channels per module		8, all channels for voltage, the first 4 channels also for current
Distribution of channels into groups		1 group of 8 channels
	Channels O0- ... O7-	Terminals 3.0 ... 3.7
	Channels O0+ ... O7+	Terminals 4.0 ... 4.7
Output type		Bipolar with voltage, unipolar with current
Galvanic isolation		Against internal supply and other modules

Parameter	Value	
Configurability	-10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA (each output can be configured individually), current outputs only channels 0 ... 3	
Output resistance (load), as current output	0 Ω ... 500 Ω	
Output loadability, as voltage output	Max. ± 10 mA	
Indication of the output signals	One LED per channel	
Resolution	12 bits including sign	
Settling time for full range change (resistive load, output signal within specified tolerance)	Typ. 5 ms	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ.	± 0.5 % of full scale at 25 °C
	Max.	± 1 % of full scale (all ranges) at 0 °C ... 60 °C or EMC disturbance
Relationship between output signal and hex code		
Unused outputs	Can be left open-circuited	

Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 250 000 R0001	AX522, analog input/output module, 8 AI, 8 AO, U/I/Pt100, 12 bits including sign, 2-wires	Active
1SAP 450 000 R0001	AX522-XC, analog input/output module, 8 AI, 8 AO, U/I/Pt100, 12 bits including sign, 2-wires, XC version	Active

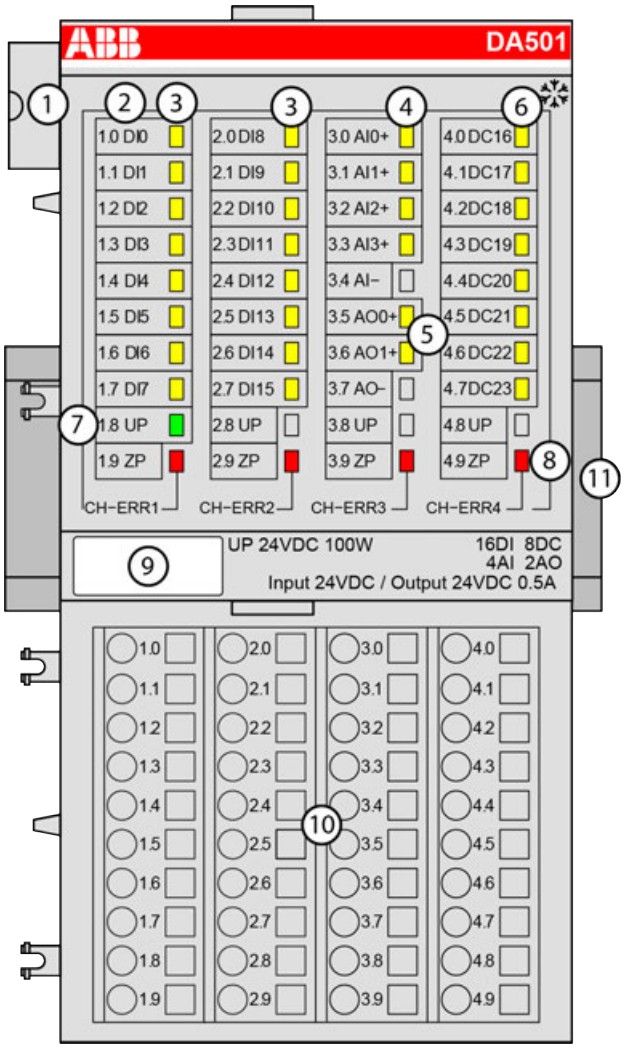
**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.4.5 Digital/Analog I/O modules

5.4.5.1 S500 and S500-XC

5.4.5.1.1 DA501 - Digital/Analog input/output module

- 16 digital inputs 24 V DC
- 8 configurable digital inputs/outputs 24 V DC, 0.5 A max.
- 4 analog inputs, voltage, current and RTD, resolution 12 bits including sign
- 2 analog outputs, voltage and current, resolution 12 bits including sign
- Fast counter
- Module-wise galvanically isolated
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 16 yellow LEDs to display the signal states of the digital inputs DI0 ... DI15
4 4 yellow LEDs to display the signal states of the analog inputs AI0 ... AI3
5 2 yellow LEDs to display the signal states of the analog outputs AO0 ... AO1
6 8 yellow LEDs to display the signal state of the configurable digital inputs/outputs DC16 ... DC23
7 1 green LED to display the state of the process supply voltage UP
8 4 red LEDs to display errors
9 Label
10 Terminal unit
11 DIN rail
❄ Sign for XC version

Intended use

The module can be used both on an AC500 processor module and on a communication interface module.

Unless expressly intended for this purpose, the following applications are prohibited:

- Use in explosion-proof areas
- Use in environments with harmful oils, acids, gases, vapors, dusts and radiation
- Operation under water
- Not to be used as a safety module.

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection is carried out by using the 40 terminals of the terminal unit TU515/TU516.

TU515, TU516

The internal power supply voltage for the circuitry of the module is carried out via the I/O bus (provided by a communication interface module or a CPU). Then, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 2 mA per DA501.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.

WARNING!

Removal/Insertion under power

Removal or insertion under power is permissible only if all conditions for hot swapping are fullfilled.

"Conditions for hot swap" on page 12

The devices are not designed for removal or insertion under power when the conditions for hot swap do not apply. Because of unforeseeable consequences, it is not allowed to plug in or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing any of the following actions:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while they are energized in a hazardous location could result in an electric arc, which could create an ignition source resulting in fire or explosion.

Prior to proceeding, make sure that power is been disconnected and that the area has been thoroughly checked to ensure that flammable materials or ignitable concentrations are not present.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

NOTICE!

Risk of damaging the PLC modules!

The PLC modules must not be removed while the plant is connected to a power supply.

Make sure that all voltage sources (supply and process voltage) are switched off before you do the following:

– Connect or disconnect any signal or terminal block.
– Remove or replace a module.



CAUTION!

Risk of imprecise and faulty measurements!

Analog signals may be distorted seriously by external electromagnetic influences.

Use shielded wires when wiring analog signal sources. The cable shield must be grounded at both ends of the cable. Provide a potential equalization of a low resistance to avoid high potential differences between different parts of the plant.

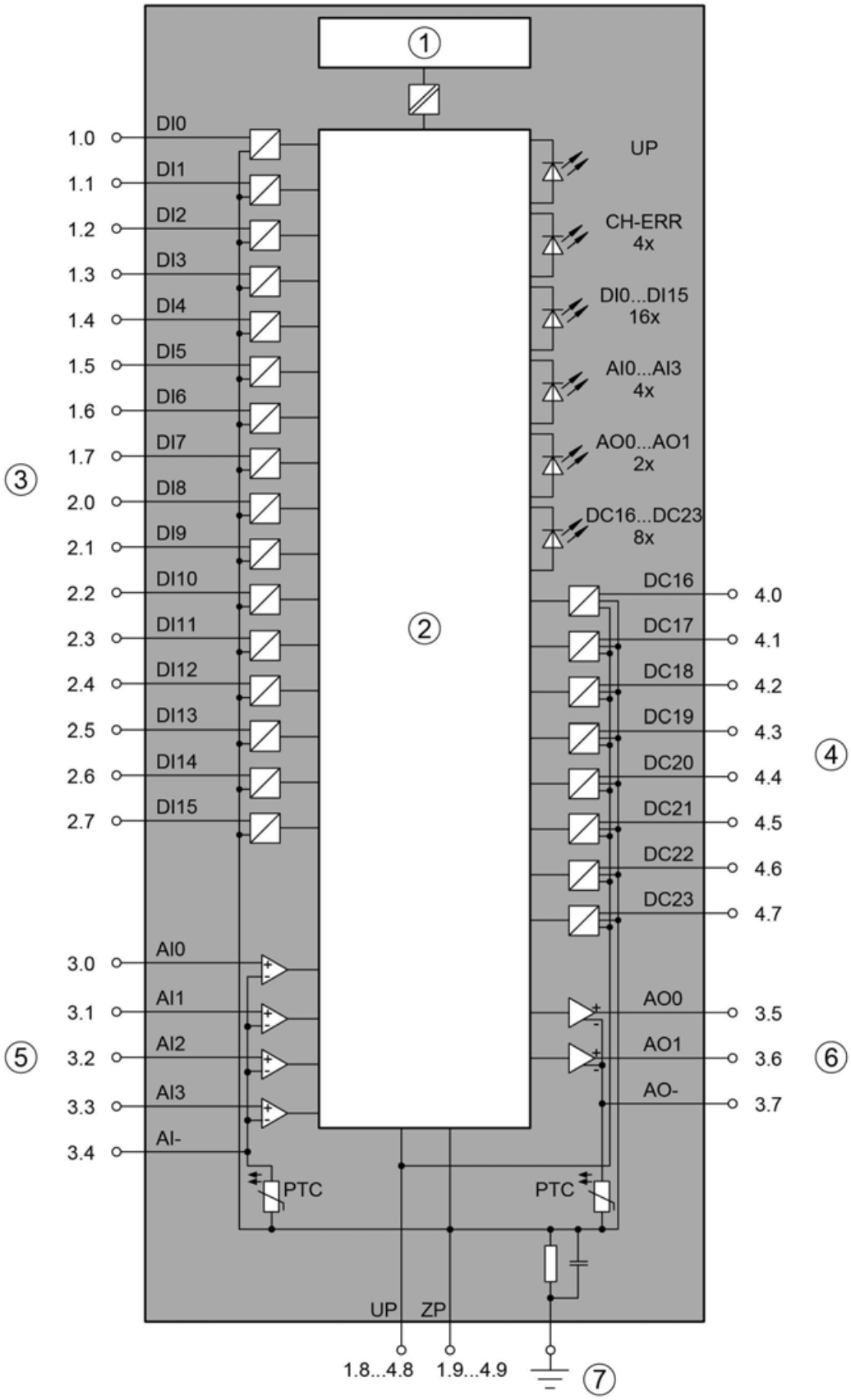


Fig. 126: Terminal assignment of the module

1 I/O bus interface
2 Logic
3 Digital input
4 Digital input/output

5 Pole of analog input signal
6 Pole of analog output signal
7 Functional earth connection

The module provides several diagnosis functions.

Connection of the digital inputs

The following figure shows the connection of the digital input DI0. Proceed with the digital inputs DI1 ... DI15 in the same way.

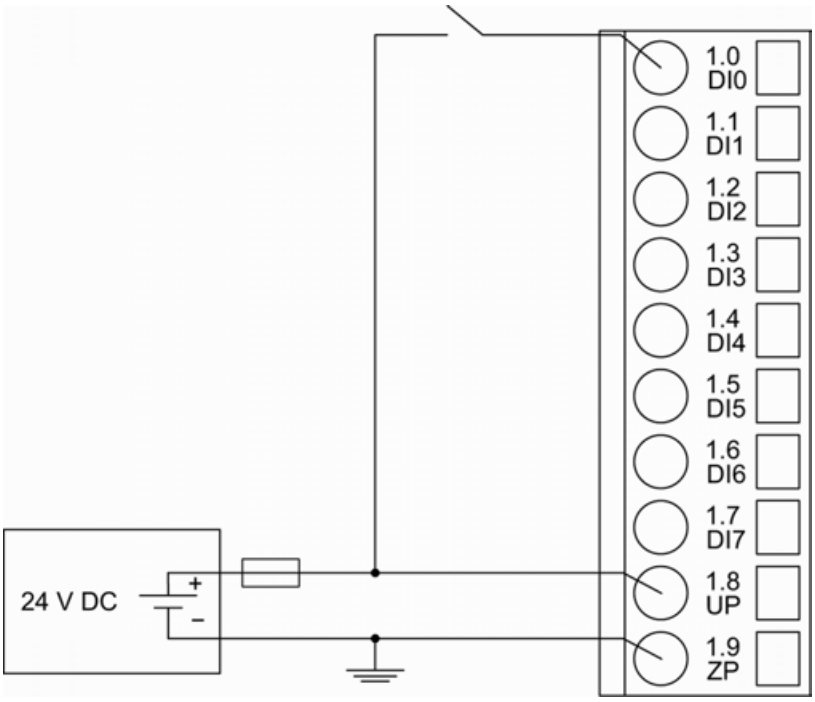


Fig. 127: Connection of the module

The meaning of the LEDs is described in the Displays chapter ↳ *Chapter 5.4.5.1.1.5 “State LEDs” on page 838*.

Connection of the configurable digital inputs/outputs

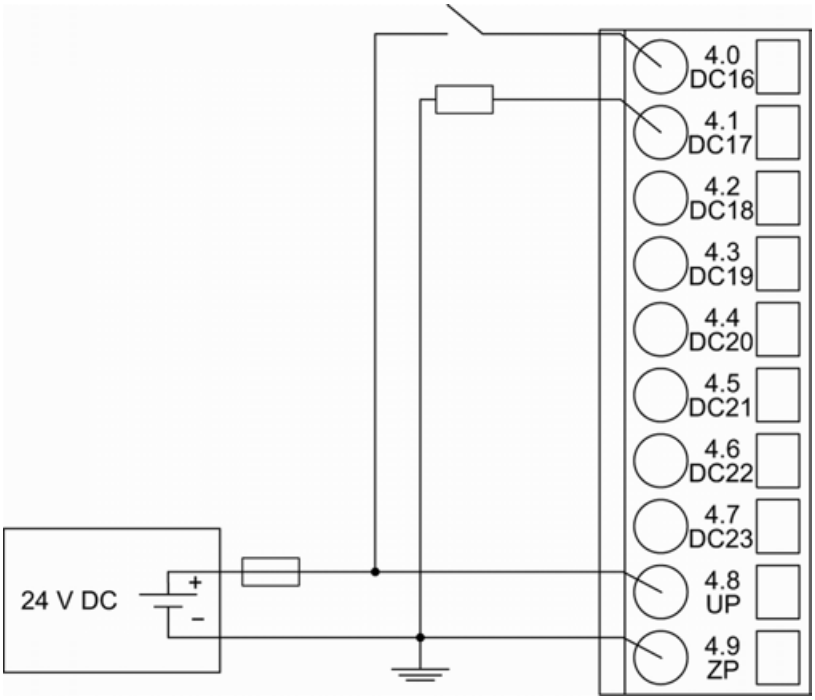


Fig. 128: Connection of configurable digital inputs/outputs to the module (DC16 ... DC23) (DC16 as an input, DC17 as an output)

CAUTION!

Risk of influences to the connected sensors!

Some sensors may be influenced by the deactivated module outputs of DA501.

If the inputs are used as fast counter inputs, connect a 470 Ω / 1 W resistor in series to inputs DC16/DC17.

Connection of resistance thermometers in 2-wire configuration to the analog inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module DA501 provides a constant current source which is multiplexed over the max. 4 analog input channels.

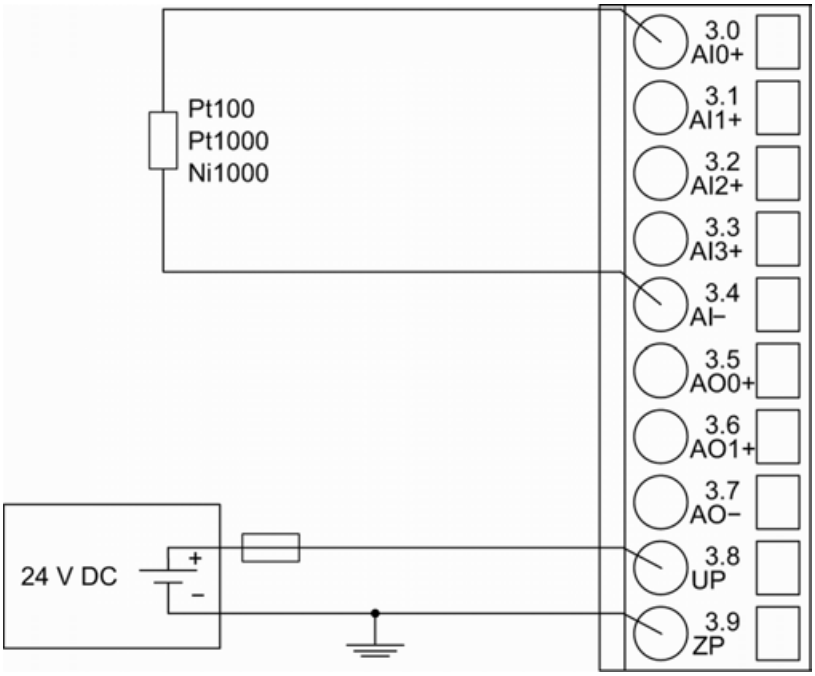


Fig. 129: Connection of resistance thermometers in 2-wire configuration to the analog inputs (AI0 to AI3)

The following measuring ranges can be configured *Chapter 5.4.5.1.1.3 “Parameterization” on page 831*:

Pt100	-50 °C ... +400 °C	2-wire configuration, 1 channel used
Pt1000	-50 °C ... +400 °C	2-wire configuration, 1 channel used
Ni1000	-50 °C ... +150 °C	2-wire configuration, 1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays *Chapter 5.4.5.1.1.5 “State LEDs” on page 838*.

The module DA501 performs a linearization of the resistance characteristic.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of resistance thermometers in 3-wire configuration to the analog inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module DA501 provides a constant current source which is multiplexed over the max. 4 analog input channels.

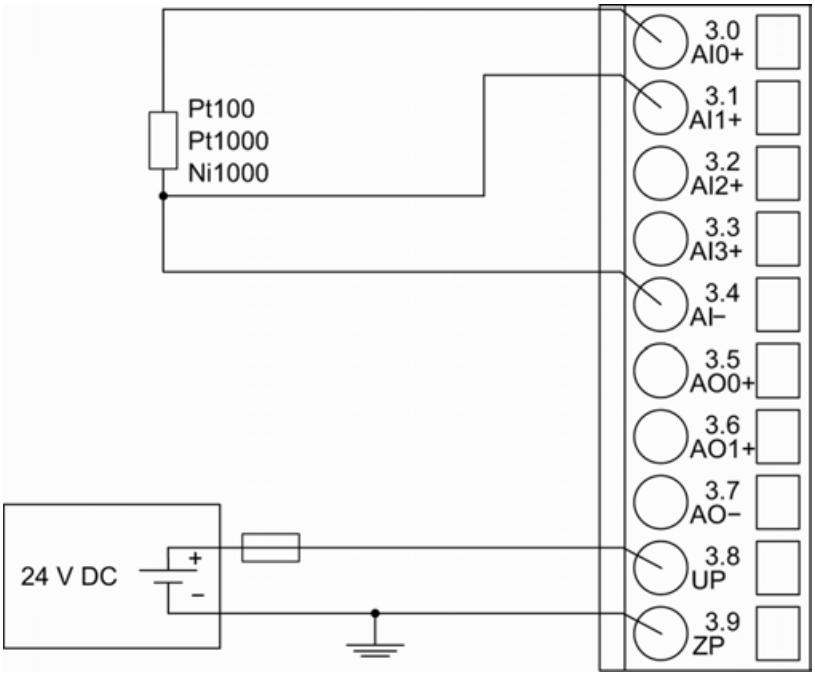


Fig. 130: Connection of resistance thermometers in 3-wire configuration to the analog inputs (AI0 ... AI3)

With 3-wire configuration, 2 adjacent analog channels belong together (e. g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1).

The constant current of one channel flows through the resistance thermometer. The constant current of the other channel flows through one of the cores. The module calculates the measured value from the two voltage drops and stores it under the input with the higher channel number (e. g. I1).

In order to keep measuring errors as small as possible, it is necessary to have all the involved conductors in the same cable. All the conductors must have the same cross section.

The following measuring ranges can be configured ↳ *Chapter 5.4.5.1.1.3 “Parameterization” on page 831*:

Pt100	-50 °C ... +400 °C	3-wire configuration, 2 channels used
Pt1000	-50 °C ... +400 °C	3-wire configuration, 2 channels used
Ni1000	-50 °C ... +150 °C	3-wire configuration, 2 channels used

The function of the LEDs is described under Diagnosis and displays / Displays.

0

The module DA501 performs a linearization of the resistance characteristic.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of active-type analog sensors (Voltage) with galvanically isolated power supply to the analog inputs

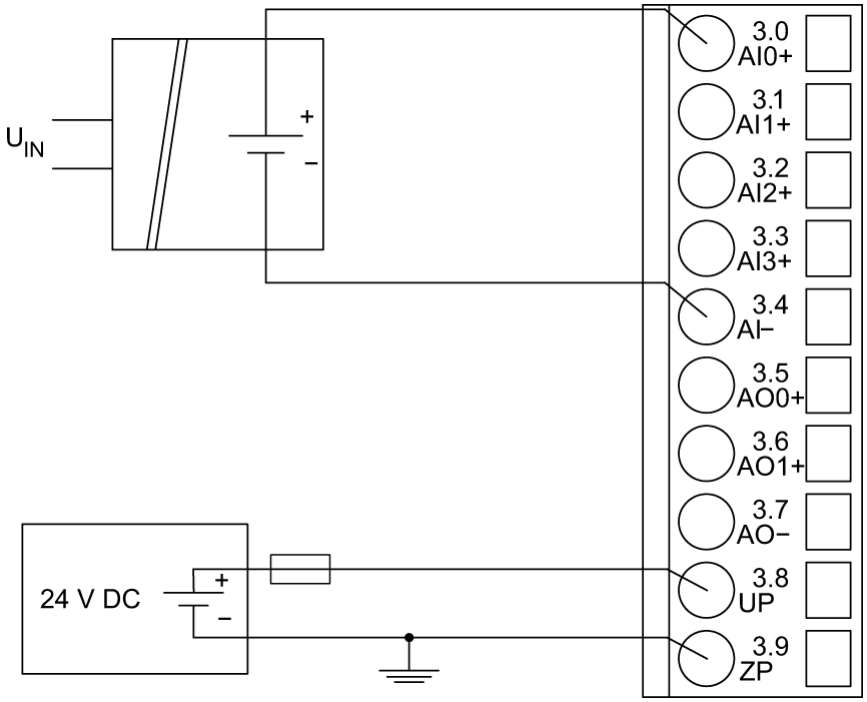


Fig. 131: Connection of active-type analog sensors (voltage) with galvanically isolated power supply to the analog inputs (AI0 ... AI3)

The following measuring ranges can be configured ↬ *Chapter 5.4.5.1.1.3 “Parameterization” on page 831*:

Voltage	0 V ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays ↬ *Chapter 5.4.5.1.1.5 “State LEDs” on page 838*.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of active-type analog sensors (Current) with galvanically isolated power supply to the analog inputs

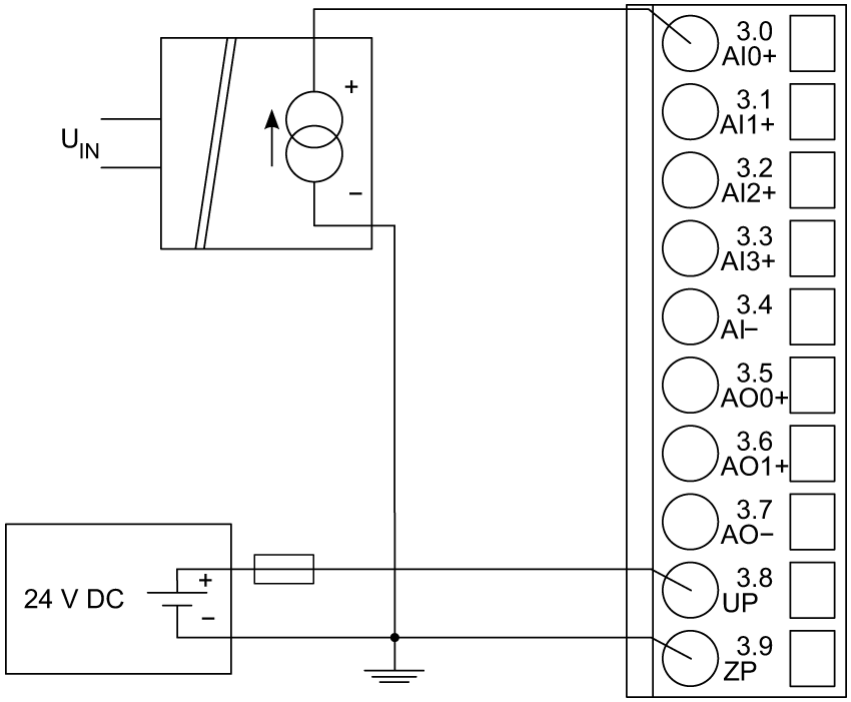


Fig. 132: Connection of active-type analog sensors (current) with galvanically isolated power supply to the analog inputs (AI0 ... AI3)

The following measuring ranges can be configured ↳ *Chapter 5.4.5.1.1.3 “Parameterization” on page 831*:

Current	0 mA ... 20 mA	1 channel used
Current	4 mA ... 20 mA	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays ↳ *Chapter 5.4.5.1.1.5 “State LEDs” on page 838*.

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of active-type analog sensors (Voltage) with no galvanically isolated power supply to the analog inputs

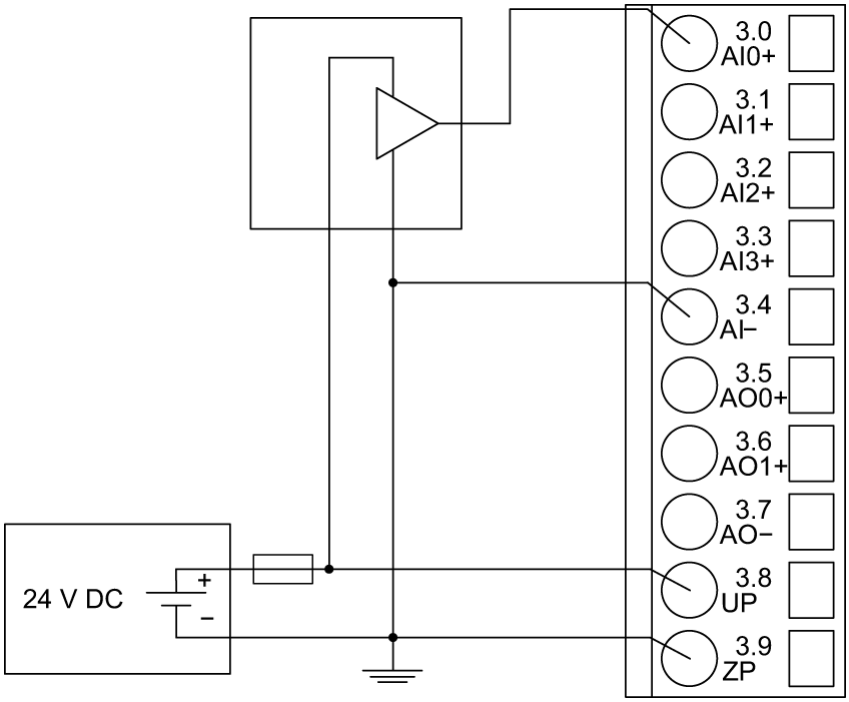


Fig. 133: Connection of active-type sensors (voltage) with no galvanically isolated power supply to the analog inputs (AI0 ... AI3)

CAUTION!

Risk of faulty measurements!

The negative pole at the sensors must not have too big a potential difference with respect to ZP (max. ± 1 V within the full signal range).

Make sure that the potential difference never exceeds ± 1 V.

The following measuring ranges can be configured *Chapter 5.4.5.1.1.3 “Parameterization” on page 831*:

Voltage	0 V ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

For a description of the function of the LEDs, please refer to the Diagnosis and displays / Displays chapter *Chapter 5.4.5.1.1.5 “State LEDs” on page 838*.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of passive-type analog sensors (Current) to the analog inputs

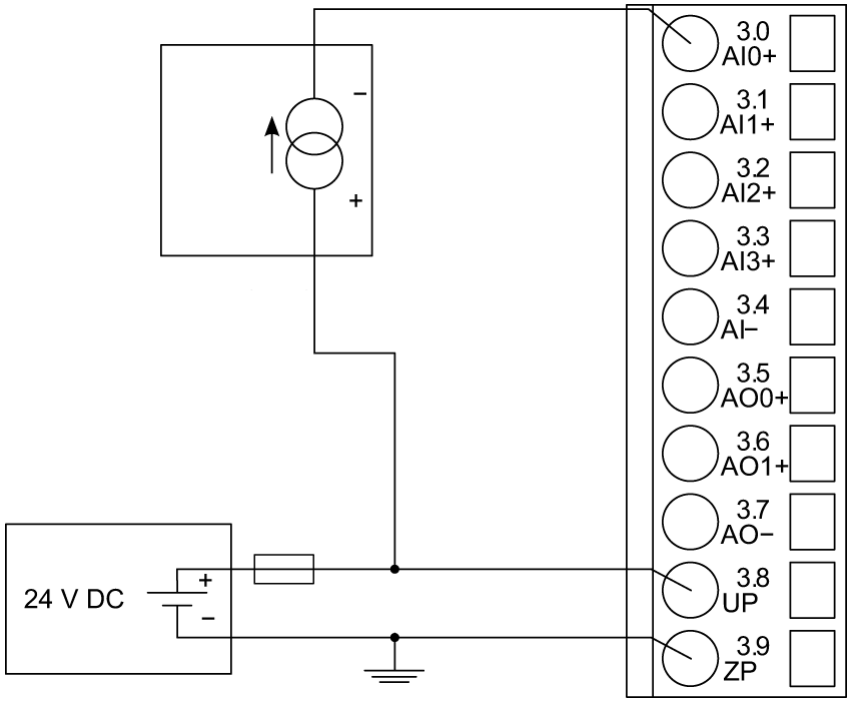


Fig. 134: Connection of passive-type analog sensors (current) to the analog inputs (AI0 to AI3)

The following measuring ranges can be configured ↬ *Chapter 5.4.5.1.1.3 “Parameterization” on page 831*:

Current	4 mA ... 20 mA	1 channel used

For a description of function of the LEDs, please refer to the Diagnosis and displays / Displays chapter ↬ *Chapter 5.4.5.1.1.5 “State LEDs” on page 838*.

CAUTION!

Risk of overloading the analog input!

If an analog current sensor supplies more than 25 mA for more than 1 second during initialization, this input is switched off by the module (input protection).

Only use sensors with fast initialization or without current peaks higher than 25 mA. If not possible, connect a 10-volt Zener diode in parallel to I+ and ZP.

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of active-type analog sensors (Voltage) to differential analog inputs

Differential inputs are very useful if analog sensors which are remotely non-isolated (e.g. the negative terminal is remotely grounded) are used.

Using differential inputs helps to considerably increase the measuring accuracy and to avoid ground loops.

With differential input configurations, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

The analog value is calculated by subtraction of the input value with the higher address from the input value of the lower address.

The converted analog value is available at the odd channel (higher address).

CAUTION!

Risk of faulty measurements!

The negative pole at the sensors must not have too large a potential difference with respect to ZP (max. ± 1 V within the full signal range).

Make sure that the potential difference never exceeds ± 1 V.

The following figure shows the connection of active-type analog sensors (voltage) to differential analog inputs AI0 and AI1. Proceed with AI2 and AI3 in the same way.

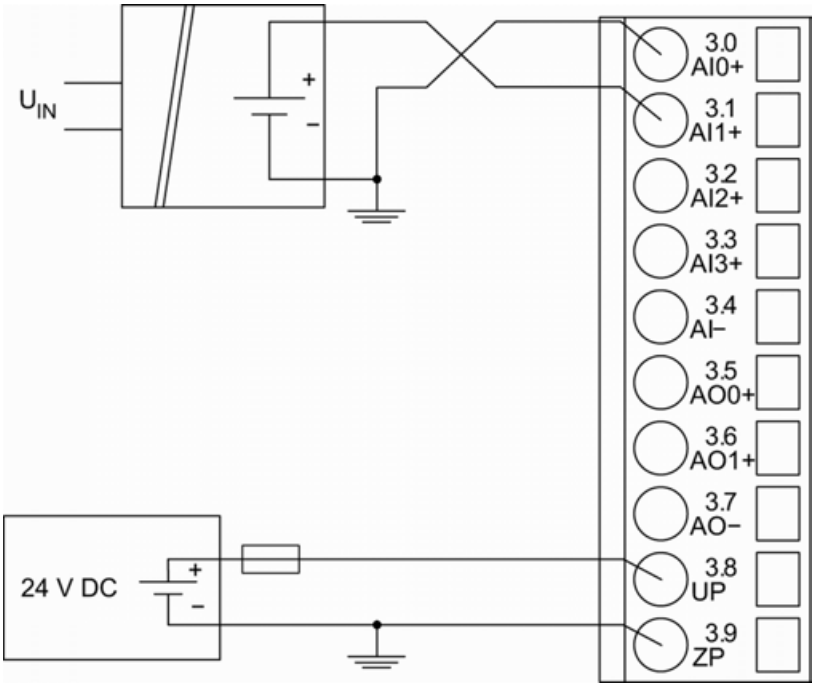


Fig. 135: Connection of active-type analog sensors (voltage) to differential analog inputs (AI0 ... AI3)

The following measuring ranges can be configured ↳ *Chapter 5.4.5.1.1.3 “Parameterization” on page 831*:

Voltage	0 V ... 10 V	with differential inputs, 2 channels used
Voltage	-10 V ... +10 V	with differential inputs, 2 channels used

For a description of the function of the LEDs, please refer to the Diagnosis and displays / Displays chapter ↳ *Chapter 5.4.5.1.1.5 “State LEDs” on page 838*.

To avoid error messages from unused analog input channels, configure them as "unused".

Use of analog inputs as digital inputs

Several (or all) analog inputs can be configured as digital inputs. The inputs are not galvanically isolated against the other analog channels.

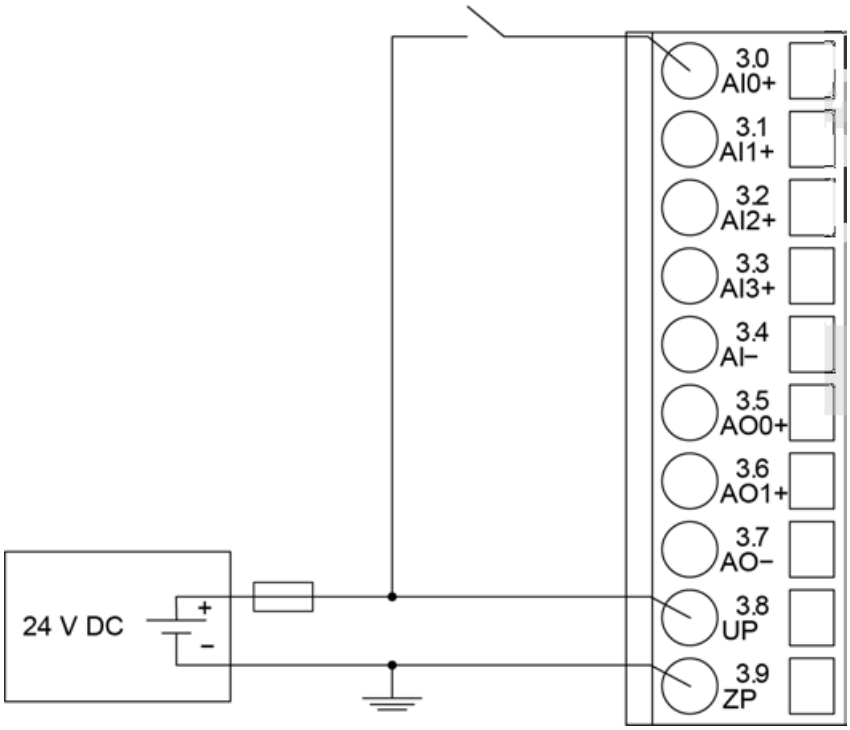


Fig. 136: connection of digital sensors to the analog inputs (AI0 ... AI3)

The following measuring ranges can be configured ↬ *Chapter 5.4.5.1.1.3 “Parameterization” on page 831*:

Digital input	24 V	1 channel used

For a description of the function of the LEDs, please refer to the Diagnosis and displays / Displays chapter ↬ *Chapter 5.4.5.1.1.5 “State LEDs” on page 838*.

Connection of analog output loads (Voltage)

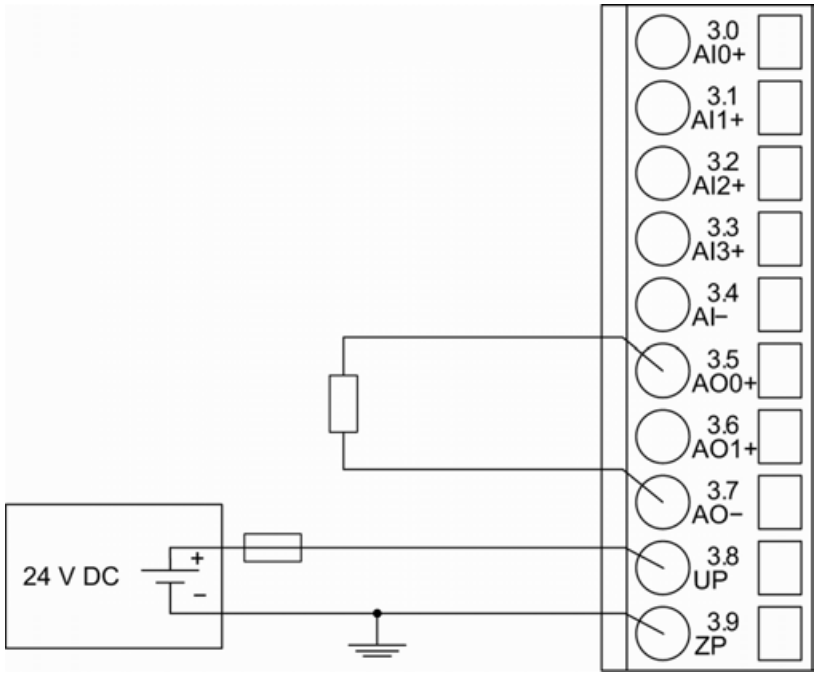


Fig. 137: Connection of analog output loads (voltage) to the analog outputs (AO0 and AO1)

The following measuring ranges can be configured ↳ *Chapter 5.4.5.1.1.3 “Parameterization” on page 831* :

Voltage	-10 V ... +10 V	Load ± 10 mA max.	1 channel used

For a description of the function of the LEDs, please refer to the Diagnosis and displays / Displays chapter ↳ *Chapter 5.4.5.1.1.5 “State LEDs” on page 838*.

Unused analog outputs can be left open-circuited.

Connection of analog output loads (Current)

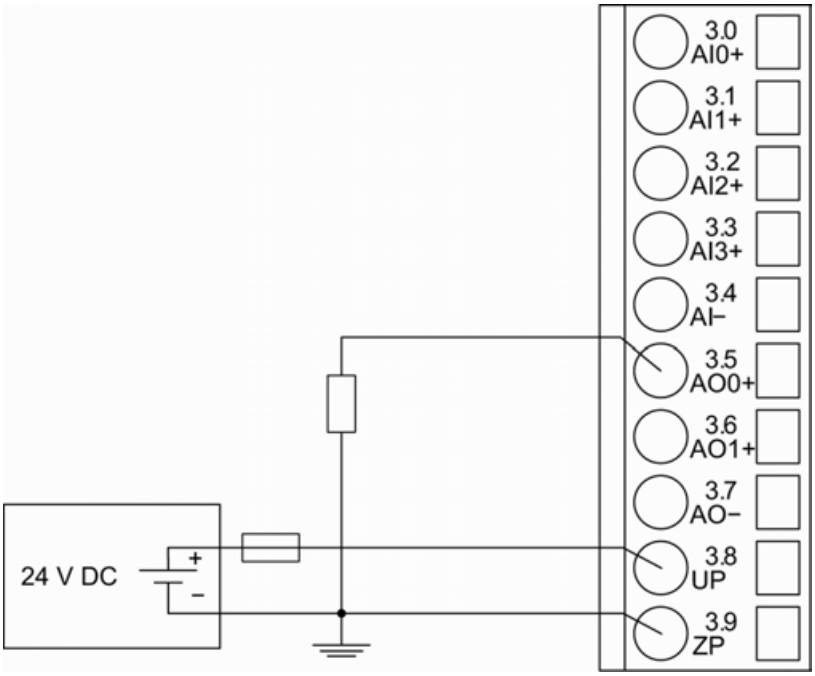


Fig. 138: Connection of analog output loads (current) to the analog outputs (AO0 and AO1)

The following measuring ranges can be configured ↳ *Chapter 5.4.5.1.1.3 “Parameterization” on page 831*:

0

Current	0 mA ... 20 mA	Load 0 Ω ... 500 Ω	1 channel used
Current	4 mA ... 20 mA	Load 0 Ω ... 500 Ω	1 channel used

For a description of the function of the LEDs, please refer to the Diagnosis and displays / Displays chapter ↳ *Chapter 5.4.5.1.1.5 “State LEDs” on page 838*.

Unused analog outputs can be left open-circuited.

Parameterization

The module does not store configuration data itself. It gets its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1 ... 10

Name	Value	Internal value	Internal value, type	Default	EDS Slot / Index
Module ID [1)]	Internal	1810	WORD	1810	0x0Y01
Ignore module see table [2)]	Internal	Yes No	BYTE	No	not for FBP
Parameter length	Internal	8	BYTE	8	0xY02
Check supply	off	0	BYTE	1	0xY03
	on	1			
Fast counter [3)]	0 : 10 [4)]	0 : 10	BYTE	0	not for FBP
Behavior outputs at comm. error [5)]	Off Last value Last value 5 sec Last value 10 sec Substitute value Substitute value 5 sec Substitute value 10 sec	0 1 6 11 2 7 12	BYTE	Off 0x00	0x0Y07

2)	Setting	Description
	On	Error LED lights up at errors of all error classes, Failsafe mode off
	Off by E4	Error LED lights up at errors of error classes E1, E2 and E3, Failsafe mode off
	Off by E3	Error LED lights up at errors of error classes E1 and E2, Failsafe mode off
	On +Failsafe	Error LED lights up at errors of all error classes, Failsafe mode on *)
	Off by E4 + Failsafe	Error LED lights up at errors of error classes E1, E2 and E3, Failsafe mode on *)
	Off by E3 + Failsafe	Error LED lights up at errors of error classes E1 and E2, Failsafe mode on *)

Remarks:

[1] With a faulty ID, the Modules reports a "parameter error" and does not perform cyclic process data transmission

[2] Not for FBP

[3] With FBP or CS31 without the parameter "Fast Counter"



The fast counter of the module does not work if the module is connected to an FBP interface module or CS31 bus module.

[4] For counter operating modes, please refer to the description of the fast counter *Chapter 5.4.3.2.9 “Fast counter” on page 522*

[5] The parameter Behavior outputs at comm. error is only analyzed if the Failsafe-mode is ON.

Group parameters for the digital part

Name	Value	Internal value	Internal value, type	Default	EDS Slot / Index
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.1 ms 0x00	0x0Y05
Detect short circuit at outputs	Off On	0 1	BYTE	On 0x01	0x0Y06
Substitute value at output	0 ... 255	00h ... FFh	BYTE	0 0x0000	0x0Y08

*) The parameters Behavior DO at comm. error is only analyzed if the Failsafe mode is ON.

Group parameters for the analog part

Name	Value	Internal value	Internal value, type	Default	EDS Slot / Index
Analog data format	Standard Reserved	0 255	BYTE	0	0x0Y04

*) The parameter Behavior AO at comm. error is only analyzed if the Failsafe mode is ON.

Channel parameters for the analog inputs (4x)

Name	Value	Internal value	Internal value, type	Default	EDS Slot / Index
Input 0, Channel configuration	see table 'Channel configuration' *Table 262 “ Channel configuration” on page 834*	see table 'Channel configuration' *Table 262 “ Channel configuration” on page 834*	BYTE	0	0x0Y09
Input 0, Check channel	see table 'Channel monitoring' *Table 263 “ Channel monitoring” on page 835*	see table 'Channel monitoring' *Table 263 “ Channel monitoring” on page 835*	BYTE	0	0x0Y0A
:	:	:	:	:	
:	:	:	:	:	
Input 3, Channel configuration	see table 'Channel configuration' *Table 262 “ Channel configuration” on page 834*	see table 'Channel configuration' *Table 262 “ Channel configuration” on page 834*	BYTE	0	0x0Y0F
Input 3, Check channel	see table 'Channel monitoring' *Table 263 “ Channel monitoring” on page 835*	see table 'Channel monitoring' *Table 263 “ Channel monitoring” on page 835*	BYTE	0	0x0Y10

Table 262: Channel configuration

Internal value	Operating modes of the analog inputs, individually configurable
0 (default)	Not used
1	0 V ... 10 V
2	Digital input
3	0 mA ... 20 mA
4	4 mA ... 20 mA
5	-10 V ... +10 V
8	2-wire Pt100 -50 °C ... +400 °C
9	3-wire Pt100 -50 °C ... +400 °C *)
10	0 V ... 10 V (voltage diff.) *)
11	-10 V ... +10 V (voltage diff.) *)
14	2-wire Pt100 -50 °C ... +70 °C
15	3-wire Pt100 -50 °C ... +70 °C *)
16	2-wire Pt1000 -50 °C ... +400 °C
17	3-wire Pt1000 -50 °C ... +400 °C *)

Internal value	Operating modes of the analog inputs, individually configurable
18	2-wire Ni1000 -50 °C ... +150 °C
19	3-wire Ni1000 -50 °C ... +150 °C *)
	*) In the operating modes with 3-wire configuration or with differential inputs, two adjacent analog inputs belong together (e.g. the channels 0 and 1). In these cases, both channels are configured in the desired operating mode. The lower address must be the even address (channel 0). The next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

Table 263: Channel monitoring

Internal Value	Check Channel
0 (default)	Plausibility, wire break, short circuit
3	Not used

Channel parameters for the analog outputs (2x)

Name	Value	Internal value	Internal value, type	Default	EDS Slot / Index
0 Output 0, Channel configuration	see table 'Channel configuration' *Table 264 “Channel configuration” on page 836*	see table 'Channel configuration' *Table 264 “Channel configuration” on page 836*	BYTE	0	0x0Y11
Output 0, Check channel	see table 'Channel monitoring' *Table 265 “Channel monitoring” on page 836*	see table 'Channel monitoring' *Table 265 “Channel monitoring” on page 836*	BYTE	0	0x0Y12
Output 0, Substitute value	see table 'Substitute value' *Table 266 “Substitute value” on page 836*	see table 'Substitute value' *Table 266 “Substitute value” on page 836*	WORD	0	0x0Y13
Output 1, Channel configuration	see table 'Channel configuration' *Table 264 “Channel configuration” on page 836*	see table 'Channel configuration' *Table 264 “Channel configuration” on page 836*	BYTE	0	0x0Y14

Name	Value	Internal value	Internal value, type	Default	EDS Slot / Index
Output 1, Check channel	see table 'Channel monitoring' ↳ *Table 265 “ Channel monitoring” on page 836*	see table 'Channel monitoring' ↳ *Table 265 “ Channel monitoring” on page 836*	BYTE	0	0x0Y15
Output 1, Substitute value	see table 'Substitute value' ↳ *Table 266 “ Substitute value” on page 836*	see table 'Substitute value' ↳ *Table 266 “ Substitute value” on page 836*	WORD	0	0x0Y16

Table 264: Channel configuration

Internal value	Operating modes of the analog outputs, individually configurable
0 (default)	Not used
128	-10 V ... +10 V
129	0 mA ... 20 mA
130	4 mA ... 20 mA

Table 265: Channel monitoring

Internal value	Check channel
0	Plausibility, wire break, short circuit
3	None

Table 266: Substitute value

Intended behavior of output channel when the control system stops	Required setting of the module parameter "Behavior of outputs in case of a communication error"	Required setting of the channel parameter "Substitute value"
Output OFF	Off	0
Last value infinite	Last value	0
Last value for 5 s and then turn off	Last value 5 sec	0
Last value for 10 s and then turn off	Last value 10 sec	0
Substitute value infinite	Substitute value	Depending on configuration
Substitute value for 5 s and then turn off	Substitute value 5 sec	Depending on configuration
Substitute value for 10 s and then turn off	Substitute value 10 sec	Depending on configuration

Diagnosis

In cases of short circuit or overload, the digital outputs are turned off. The module performs reactivation automatically and acknowledgement of the errors is not necessary. The error message is stored via the LED.

Table 267: Error severity E3: Warnings

Error severity	Location	Error code	d1	d2	d3	d4	Description	Remedy
								
E3	iob (I/O bus)	3	14	1 ... 10	31	31	Timeout in the I/O module	Replace I/O module
E3	iob (I/O bus)	9	14	1 ... 10	31	31	Overflow diagnosis buffer	New start
E3	iob (I/O bus)	11	14	1 ... 10	31	31	Process voltage too low	Check process voltage
E3	iob (I/O bus)	19	14	1 ... 10	31	31	Checksum error in the I/O module	Replace I/O module
E3	iob (I/O bus)	26	14	1 ... 10	31	31	Parameter error	Check master
E3	iob (I/O bus)	36	14	1 ... 10	31	31	Internal data exchange failure	Replace I/O module
E3	iob (I/O bus)	40	14	1 ... 10	31	31	Different hard-/firmware versions in the module	Replace I/O module
E3	iob (I/O bus)	43	14	1 ... 10	31	31	Internal error in the module	Replace I/O module

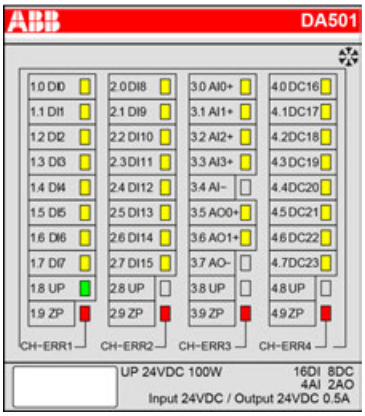
Table 268: Error severity E4: Warnings

Error severity	Location	Error code	d1	d2	d3	d4	Description	Remedy
								
E4	iob (I/O bus)	4	14	1 ... 10	3	20 ... 21[3)]	Analog value overflow at an analog output	Check output value
E4	iob (I/O bus)	4	14	1 ... 10	3	20 ... 21[3)]	Analog value underflow at an analog output	Check output value
E4	iob (I/O bus)	7	14	1 ... 10	3	16 ... 19[2)]	Analog value underflow at an analog input	Check input value
E4	iob (I/O bus)	45	14	1 ... 10	31	31	Process voltage is switched off (ON -> OFF)	Process voltage ON
E4	iob (I/O bus)	47	14	1 ... 10	1	16 ... 19[2)]	Short circuit at an analog input	Check terminal
E4	iob (I/O bus)	47	14	1 ... 10	2	22 ... 29[1)]	Short circuit at a digital output	Check connection
E4	iob (I/O bus)	48	14	1 ... 10	1	16 ... 19[2)]	Analog value overflow or broken wire at an analog input	Check input value or terminal

Remarks:

1)	Ch = 22 ... 29 indicates the digital inputs/outputs DC16 ... DC23
2)	Ch = 16 ... 19 indicates the analog inputs AI0 ... AI3
3)	Ch = 20 ... 21 indicates the analog outputs AO0 ... AO1

State LEDs

LED		State	Color	LED = OFF	LED = ON	LED flashes
	DI0 ... DI15	Digital input	Yellow	Input is OFF	Input is ON 1)	--
	DC16 ... DC23	Digital input/ output	Yellow	Input/output is OFF	Input/output is ON 1)	--
	AI0 ... AI3	Analog input	Yellow	Input is OFF	Input is ON 2)	--
	AO0 ... AO1	Analog output	Yellow	Output is OFF	Output is ON 2)	--
	UP	Process supply voltage 24 V DC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
	CH-ERR1	Channel error, error messages in groups (digital inputs/ outputs combined into the groups 1, 2, 3, 4)	Red	No error or process supply voltage is missing	Severe error within the corresponding group	Severe error within the corresponding group (e.g. short circuit at an output)
	CH-ERR2		Red			
	CH-ERR3		Red			
	CH-ERR4		Red			
	CH-ERR 3)	Module error	Red	--	Internal error	--
	1) Indication LED is ON even if an input signal is applied to the channel and the supply voltage is off. In this case the module is not operating and does not generate an input signal.					
	2) Brightness depends on the value of the analog signal					
	3) All of the LEDs CH-ERR1 to CH-ERR4 light up together					

Representation of the signal ranges

Input ranges voltage, current and digital input

Range	0 V ... +10 V	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital input	Digital value	
						Decimal	Hex.
Overflow	> 11.7589	> 11.7589	> 23.5178	> 22.8142		32767	7FFF
Measured value too high	11.7589 : 10.0004	11.7589 : 10.0004	23.5178 : 20.0007	22.8142 : 20.0006		32511 : 27649	7EFF : 6C01

Range	0 V ... +10 V	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital input	Digital value	
						Decimal	Hex.
Normal range Normal range or measured value too low	10.0000 : 0.0004	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	: : On	27648 : 1	6C00 : 0001
	0.0000	0.0000	0	4	Off	0	0000
	-0.0004 -1.7593	-0.0004 : : -10,0000		3.9994 1.1858		-1 -4864 : -27648	FFFF ED00 : 9400
Measured value too low		-10.0004 : -11.7589				-27649 : -32512	93FF : 8100
Underflow	< 1.7593	< -11.7589	< 0.0000	< 1.1858		-32768	8000

The represented resolution corresponds to 16 bits.

Input ranges resistance temperature detector

Range	Pt100 -50 °C ... +70 °C	Pt100 / Pt1000 -50 °C ... +400 °C	Ni1000 -50 °C ... +150 °C
Overflow	> +80.0 °C	> +450.0 °C	> +160.0 °C
Measured value too high		+450.0 °C : + 400.1 °C	
			+160.0 °C : + 150.1 °C
	+80.0 °C : + 70.1 °C		
Normal range	: : +70.0 °C : + 0.1 °C	+400.0 °C : : : + 0.1 °C	+150.0 °C : : + 0.1 °C
	0.0 °C	0.0 °C	0.0 °C
	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C

Range	Pt100 -50 °C ... +70 °C	Pt100 / Pt1000 -50 °C ... +400 °C	Ni1000 -50 °C ... +150 °C
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C
Underflow	< -60.0 °C	< -60.0 °C	< -60.0 °C

Range	Digital value	
	Decimal	Hex.
Overflow	32767	7FFF
Measured value too high	4500 : 4001	1194 : 0FA1
	1600 : 1501	0640 : 05DD
	800 : 701	0320 : 02BD
Normal range	4000 1500 700 : 1	0FA0 05DC 02BC : 0001
	0	0000
	-1 : -500	FFFF : FE0C
Measured value too low	-501 : -600	FE0B : FDA8
Underflow	-32768	8000

Output ranges voltage and current

Range	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA
Overflow	0 V	0 mA	0 mA
Value too high	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA

Range	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA
Normal range	10.0000 V : 0.0004 V	20.0000 mA : 0.0007 mA	20.0000 mA : 4.0006 mA
	0.0000 V	0.0000 mA	4.0000 mA
	-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA
Value too low	-10.0004 V : -11.7589 V	0 mA : 0 mA	0 mA : 0 mA
Underflow	0 V	0 mA	0 mA

Range	Digital value	
	Decimal	Hex.
Overflow	> 32511	> 7EFF
Value too high	32511 : 27649	7EFF : 6C01
Normal range	27648 : 1	6C00 : 0001
	0	0000
	-1 -6912 -27648	FFFF E500 9400
Value too low	-27649 : -32512	93FF : 8100
Underflow	< -32512	< 8100

The represented resolution corresponds to 16 bits.

Technical data

Technical data of the module

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

↳ *Chapter 4.3 “System data AC500-XC” on page 38*

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter	Value
Fast Counter	Integrated, many configurable operating modes
Power supply	From the process supply voltage UP
LED displays	For system displays, signal states, errors and power supply
Internal supply voltage	Via the I/O bus interface (I/O bus)
External supply voltage	Via terminals UP and ZP (process supply voltage 24 V DC)
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Required terminal unit	TU515 or TU516 ↳ *TU515, TU516*

Parameter		Value
Process supply voltage		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for UP (+24 V DC) and 1.9, 2.9, 3.9 and 4.9 for ZP (0 V DC)
	Protection against reverse voltage	yes
	Rated protection fuse at UP	10 A fast
	Rated value	24 V DC
	Max. ripple	5 %
Current consumption		
	From UP	0.07 A + max. 0.5 A per output
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module	ca. 2 mA
	Inrush current from UP (at power-up)	0.04 A^2s
Galvanic isolation		
	between the channels	No
	between the channels and I/O bus	Yes
	between the channels and process supply voltage (UP, ZP)	No
Max. power dissipation within the module		6 W (outputs unloaded)
Weight (without terminal unit)		ca. 125 g
Mounting position		Horizontal mounting or Vertical mounting with derating (output load reduced to 50 % at +40 °C)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Multiple overloads
With multi-channel modules, there are no effects of multiple overloads as each digital output channel is individually protected by an internal intelligent high-side switch.

Technical data of the digital inputs

Parameter		Value
Number of channels per module		16
Distribution of the channels into groups		2 groups of 8 channels
Terminals of the channels DI0 ... DI7		Terminals 1.0 ... 1.7
Terminals of the channels DI8 ... DI15		Terminals 2.0 ... 2.7
Reference potential for all inputs		Terminals 1.9 ... 3.9 (negative pole of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Monitoring point of input indicator		LED is part of the input circuitry
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1...32 ms
Input signal voltage		24 V DC
	0-Signal	-3 V ... +5 V
	Undefined Signal	> +5 V ... < +15 V
	1-Signal	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical data of the configurable digital inputs/outputs

Each of the configurable digital I/O channels can be defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter	Value
Number of channels per module	8 inputs/outputs (with transistors)
Distribution of the channels into groups	1 group for 8 channels
If the channels are used as inputs	
Channels DC16 ... DC23	Terminals 4.0 ... 4.7
If the channels are used as outputs	
Channels DC16 ... DC23	Terminals 4.0 ... 4.7
Indication of the input/output signals	1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Monitoring point of input/output indicator	LED is part of the input circuitry
Galvanic isolation	Yes, per module

Technical data of the digital inputs/outputs if used as inputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DC16 ... DC23	Terminals 4.0 ... 4.7
Reference potential for all inputs	Terminals 1.9 ... 4.9 (negative pole of the supply voltage, signal name ZP)
Indication of the input signals	1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Monitoring point of input/output indicator	LED is part of the input circuitry
Input type (according EN 61131-2)	Type 1
Input delay (0->1 or 1->0)	Typ. 0.1 ms, configurable 0.1 ... 32 ms
Input signal voltage	24 V DC
0-Signal	-3 V ... +5 V
Undefined Signal	> +5 V ... < +15 V
1-Signal	+15 V ... +30 V
Ripple with signal 0	Within -3 V ... +5 V
Ripple with signal 1	Within +15 V ... +30 V
Input current per channel	
Input voltage +24 V	Typ. 5 mA
Input voltage +5 V	> 1 mA
Input voltage +15 V	> 2 mA
Input voltage +30 V	< 8 mA
Max. cable length	

Parameter		Value
	shielded	1000 m
	unshielded	600 m

* Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal must not exceed the clamp voltage of the varistor. The varistor limits the clamp voltage to approx. 36 V. Consequently the input voltage must be within the following range.

- If UPx = 24 V, the input voltage must range from -12 V ... +30 V.
- If UPx = 30 V, the input voltage must range from -6 V ... +30 V.

Technical data of the digital inputs/outputs if used as outputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DC16 ...DC23		Terminals 4.0 ... 4.7
Reference potential for all outputs		Terminals 1.9 ... 4.9 (negative pole of the supply voltage, signal name ZP)
Common power supply voltage		For all outputs terminals 1.8, 2.8, 3.8 and 4.8 (positive pole of the supply voltage, signal name UP)
Output voltage for signal 1		UP (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	rated value per channel	500 mA at UP = 24 V
	max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA
Fuse for UP		10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)
Output switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

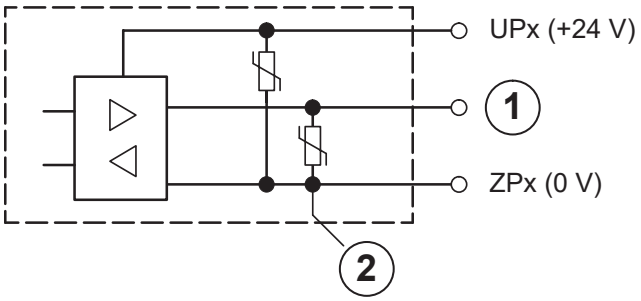


Fig. 139: Digital input/output (circuit diagram)

1 Digital input/output
2 For demagnetization when inductive loads are turned off

Technical data of the fast counter

The fast counter of the module does not work if the module is connected to an FBP interface module or CS31 bus module.

Parameter	Value
Used inputs	DC16 / DC17
Used outputs	DC18
Counting frequency	Max. 50 kHz

Technical data of the analog inputs

Parameter		Value
Number of channels per module		4
Distribution of channels into groups		1 group with 4 channels
Connection if channels AI0+ ... AI3+		Terminals 3.0 ... 3.3
Reference potential for AI0+ ... AI3+		Terminal 3.4 (AI-) for voltage and RTD measurement Terminal 1.9, 2.9, 3.9 and 4.9 for current measurement
Input type		
	Unipolar	Voltage 0 V ... 10 V, current or Pt100/ Pt1000/Ni1000
	Bipolar	Voltage -10 V ... +10 V
Configurability		0 V ... 10 V, -10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA, Pt100/1000, Ni1000 (each input can be configured individually)
Channel input resistance		Voltage: > 100 kΩ Current: ca. 330 Ω

Parameter	Value
Time constant of the input filter	Voltage: 100 µs Current: 100 µs
Indication of the input signals	1 LED per channel (brightness depends on the value of the analog signal)
Conversion cycle	1 ms (for 4 inputs + 2 outputs); with RTDs Pt/Ni... 1 s
Resolution	Range 0 V ... 10 V: 12 bits Range -10 V ... +10 V: 12 bits including sign Range 0 mA ... 20 mA: 12 bits Range 4 mA ... 20 mA: 12 bits Range RTD (Pt100, PT1000, Ni1000): 0.1 °C
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ. 0.5 %, max. 1 % For XC version below 0 °C and above +60 °C: on request
Relationship between input signal and hex code	↬ *Chapter 5.4.5.1.1.6.2 “Input ranges resistance temperature detector” on page 839*
Unused inputs	Are configured as "unused" (default value)
Overvoltage protection	Yes

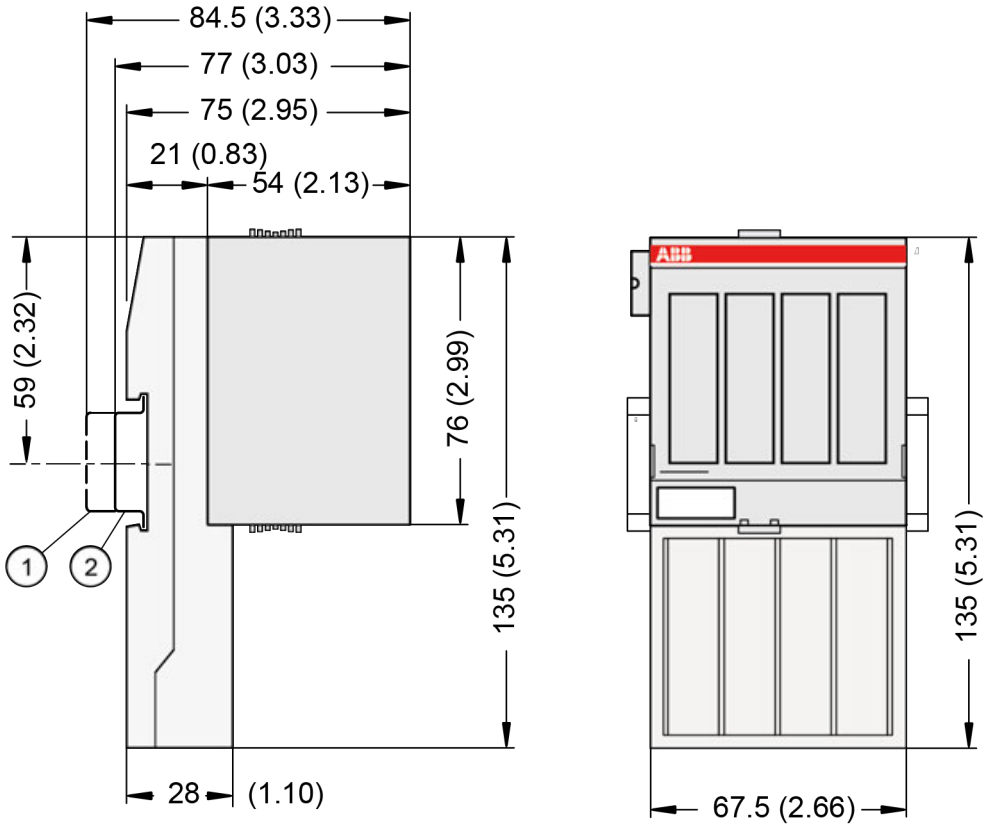
Technical data of the analog inputs, if used as digital inputs

Parameter		Value
Number of channels per module		Max. 4
Distribution of channels into groups		1 group of 4 channels
Connections of the channels AI0+ ... AI3+		Terminals 3.0 ... 3.3
Reference potential for the inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (ZP)
Indication of the input signals		1 LED per channel
Input signal voltage		24 V DC
	Signal 0	-30 V ... +5 V
	Undefined signal	+5 V ... +13 V
	Signal 1	+13 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 7 mA
	Input voltage +5 V	Typ. 1.4 mA
	Input voltage +15 V	Typ. 3.7 mA
	Input voltage +30 V	< 9 mA
Input resistance		ca. 3.5 kΩ

Technical data of the analog outputs

Parameter		Value
Number of channels per module		2
Distribution of channels into groups		1 group for 2 channels
Connection of the channels AO0+ ... AO1+		Terminals 3.5 and 3.6
Reference potential for AO0+ ... AO1+		Terminal 3.7 (AO-) for voltage output Terminals 1.9, 2.9, 3.9 and 4.9 for current output
Output type		
	Unipolar	Current
	Bipolar	Voltage
Galvanic isolation		Against internal supply and other modules
Configurability		-10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA (each output can be configured individually)
Output resistance (load) as current output		0 Ω ... 500 Ω
Output loadability as voltage output		± 10 mA max.
Indication of the output signals		1 LED per channel (brightness depends on the value of the analog signal)
Resolution		12 bits including sign
Settling time for full range change (resistive load, output signal within specified tolerance)		Typ. 5 ms
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code		↳ *Chapter 5.4.5.1.1.6.3 “Output ranges voltage and current” on page 840*
Unused outputs		Are configured as "unused" (default value) and can be left open-circuited

Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

Ordering data

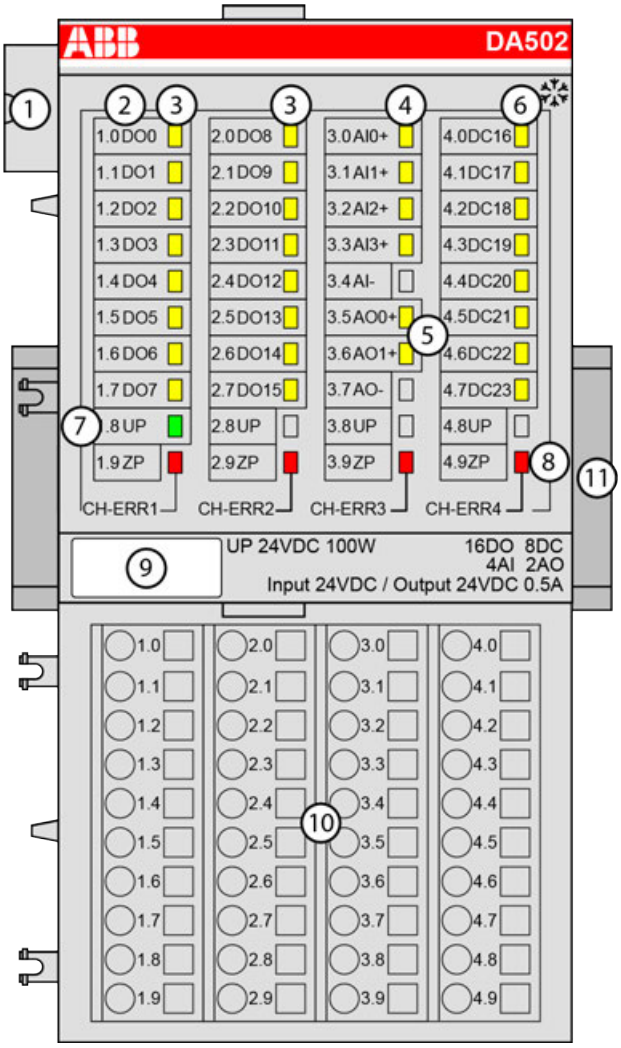
Part no.	Description	Product life cycle phase *)
1SAP 250 700 R0001	DA501, digital/analog input/output module, 16 DI, 8 DC, 4 AI, 2 AO	Active
1SAP 450 700 R0001	DA501-XC, digital/analog input/output module, 16 DI, 8 DC, 4 AI, 2 AO, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.4.5.1.2 DA502 - Digital/Analog input/output module

- 16 digital inputs 24 V DC
- 8 configurable digital inputs/outputs 24 V DC, 0.5 A max.

- 4 analog inputs, voltage, current and RTD, resolution 12 bits including sign
- 2 analog outputs, voltage and current, resolution 12 bits including sign
- Fast counter
- Module-wise galvanically isolated
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 16 yellow LEDs to display the signal states of the digital outputs DO0 ... DO15
4 4 yellow LEDs to display the signal states of the analog inputs AI0 ... AI3
5 2 yellow LEDs to display the signal states of the analog outputs AO0 ... AO1
6 8 yellow LEDs to display the signal states of the configurable digital inputs/outputs DC16 ... DC23
7 1 green LED to display the state of the process supply voltage UP
8 4 red LEDs to display errors
9 Label
10 Terminal unit
11 DIN rail
❄ Sign for XC version

Intended use

The module can be used both on an AC500 processor module and on a communication interface module.

Unless expressly intended for this purpose, the following applications are prohibited:

- Use in explosion-proof areas
- Use in environments with harmful oils, acids, gases, vapors, dusts and radiation
- Operation under water
- Not to be used as a safety module.

Connections



For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection is carried out by using the 40 terminals of the terminal unit TU515/TU516.

Chapter 5.5.2 “TU515, TU516, TU541 and TU542 for I/O modules” on page 946

The internal power supply voltage for the circuitry of the module is carried out via the I/O bus (provided by a communication interface module or a CPU). Then, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 2 mA per DA502.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.



WARNING!

Removal/Insertion under power

Removal or insertion under power is permissible only if all conditions for hot swapping are fullfilled.

“Conditions for hot swap” on page 12

The devices are not designed for removal or insertion under power when the conditions for hot swap do not apply. Because of unforeseeable consequences, it is not allowed to plug in or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing any of the following actions:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while they are energized in a hazardous location could result in an electric arc, which could create an ignition source resulting in fire or explosion.

Prior to proceeding, make sure that power is been disconnected and that the area has been thoroughly checked to ensure that flammable materials or ignitable concentrations are not present.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

NOTICE!

Risk of damaging the PLC modules!

The PLC modules must not be removed while the plant is connected to a power supply.

Make sure that all voltage sources (supply and process voltage) are switched off before you do the following:

– Connect or disconnect any signal or terminal block.
– Remove or replace a module.



CAUTION!

Risk of imprecise and faulty measurements!

Analog signals may be distorted seriously by external electromagnetic influences.

Use shielded wires when wiring analog signal sources. The cable shield must be grounded at both ends of the cable. Provide a potential equalization of a low resistance to avoid high potential differences between different parts of the plant.

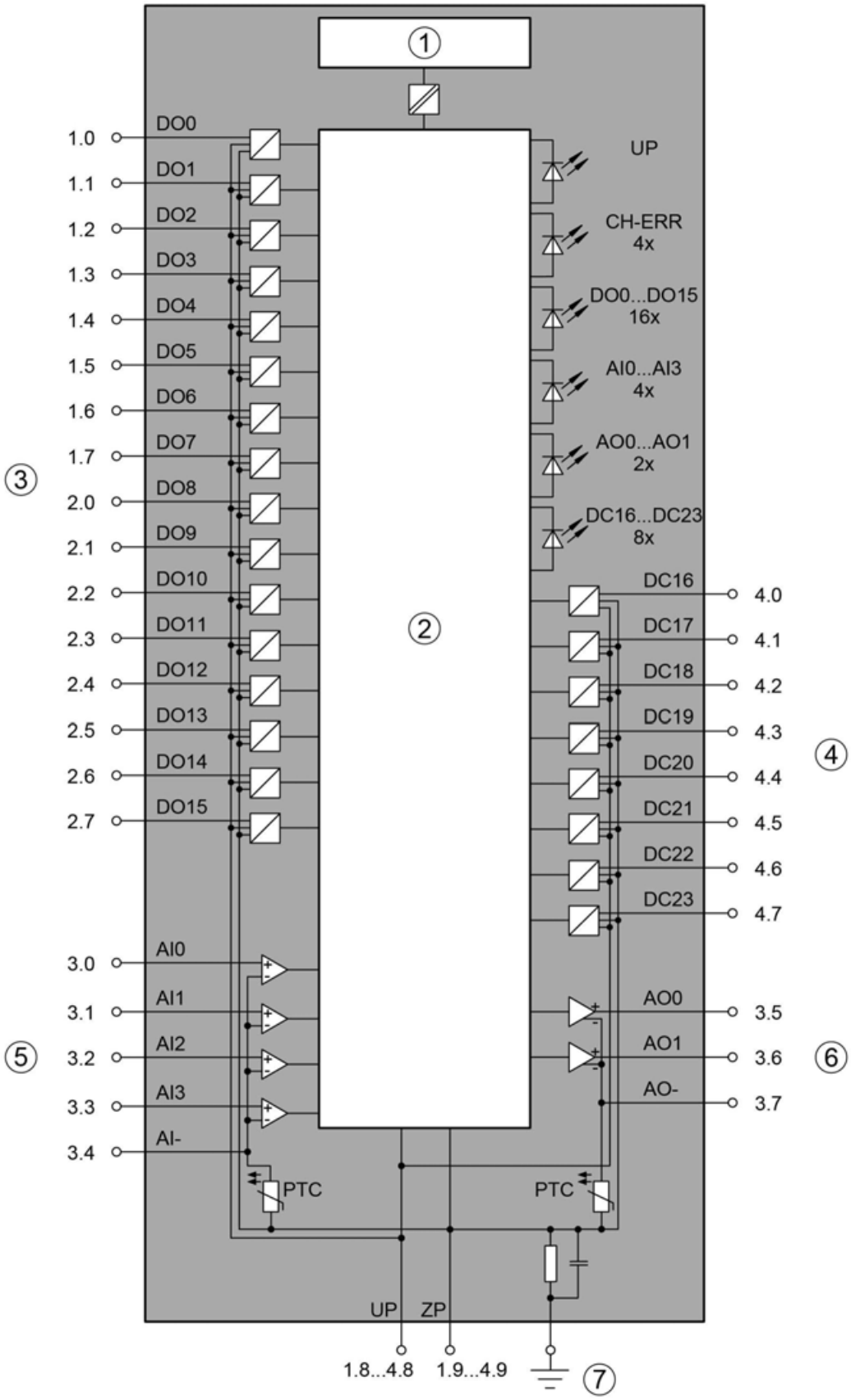


Fig. 140: Terminal assignment of the module

1 I/O bus interface
2 Logic
3 Digital output
4 Digital input/output

5 Pole of analog input signal
6 Pole of analog output signal
7 Functional earth connection

The module provides several diagnosis functions.

Connection of the digital outputs

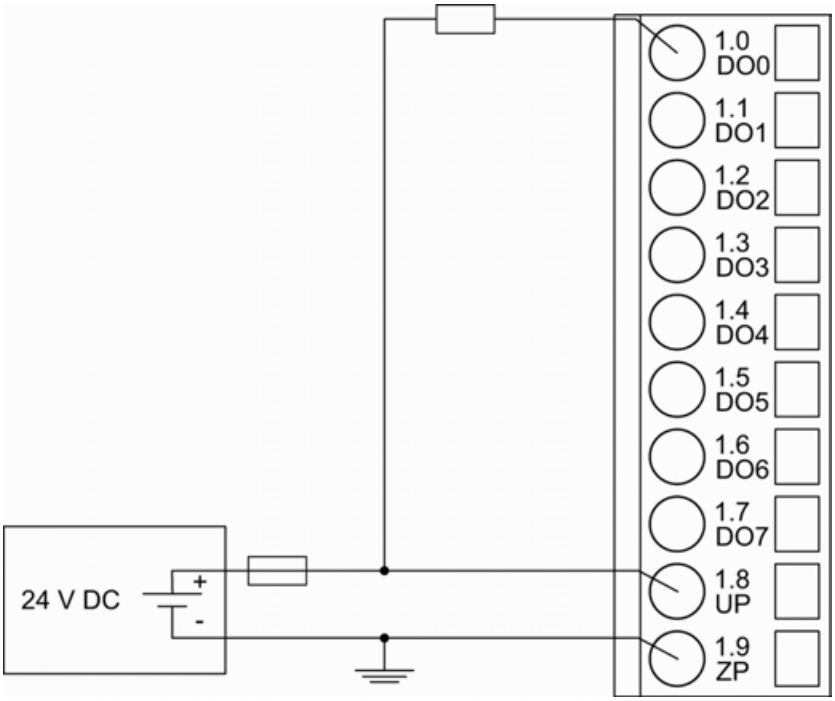


Fig. 141: Connection of the digital outputs (DO0 ... DO15)

↳ *Meaning of the LEDs*

Connection of the configurable digital inputs/outputs

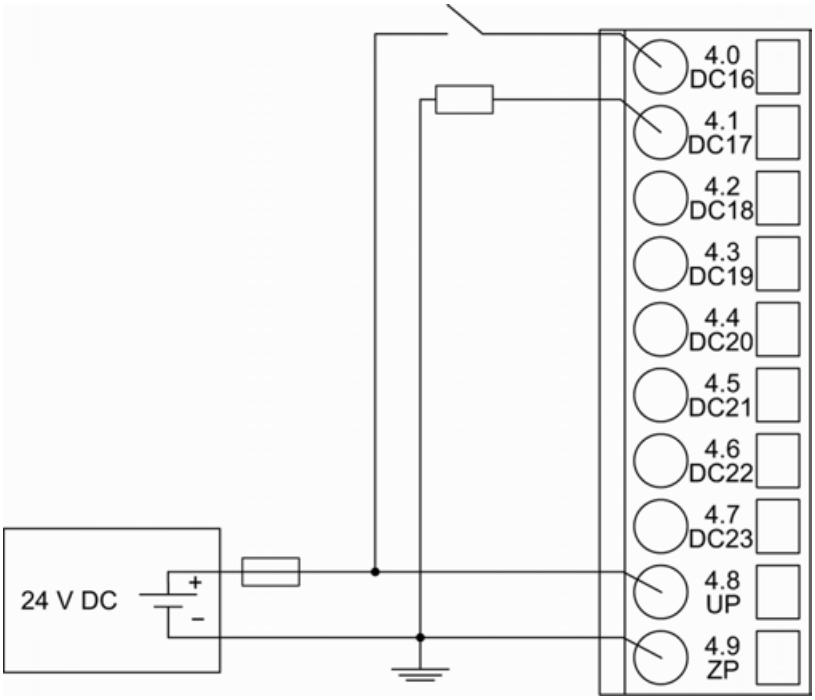


Fig. 142: Connection of the configurable digital input/outputs (DC16 ... DC23) (DC16 as an input, DC17 as an output)

NOTICE!

Risk of influences to the connected sensors!

Some sensors may be influenced by the deactivated module outputs of DA502.

Connect a 470 Ω / 1 W resistor in series to inputs DC16/DC17 if they are used as fast counter inputs to avoid any influences.

↳ *Meaning of the LEDs*

Connection of resistance thermometers in 2-wire configuration to the analog inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module DA502 provides a constant current source which is multiplexed over max. 4 analog input channels.

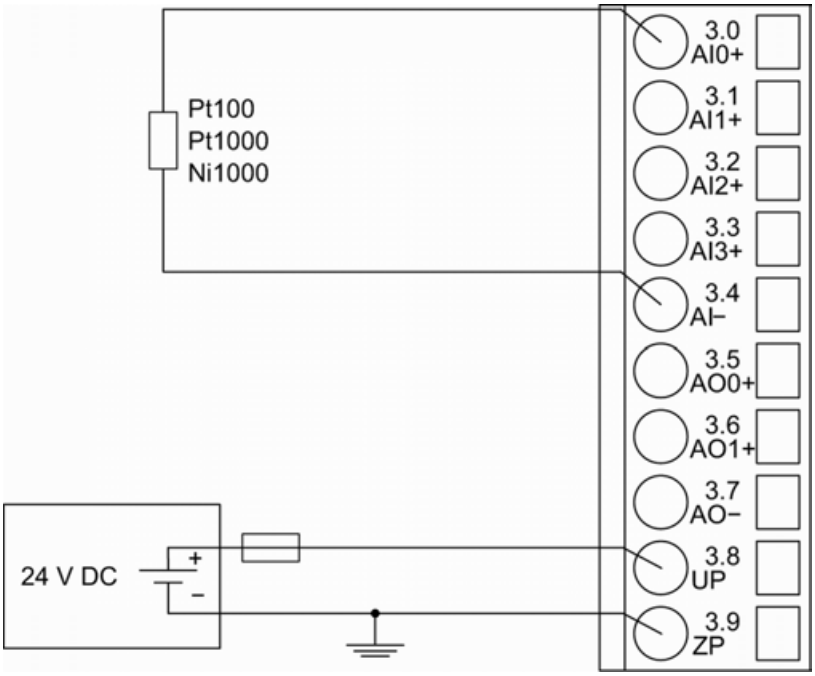


Fig. 143: Connection of resistance thermometers in 2-wire configuration to the analog inputs (AI0 ... AI3)

Table 269: Configurable measuring ranges

Pt100	-50 °C ... +400 °C	2-wire configuration, 1 channel used
Pt1000	-50 °C ... +400 °C	2-wire configuration, 1 channel used
Ni1000	-50 °C ... +150 °C	2-wire configuration, 1 channel used

↳ *Chapter 5.4.5.1.2.6 “Representation of the signal ranges” on page 866*

↳ *Meaning of the LEDs*

The module DA502 performs a linearization of the resistance characteristic.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of resistance thermometers in 3-wire configuration to the analog inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module DA502 provides a constant current source which is multiplexed over max. 4 analog input channels.

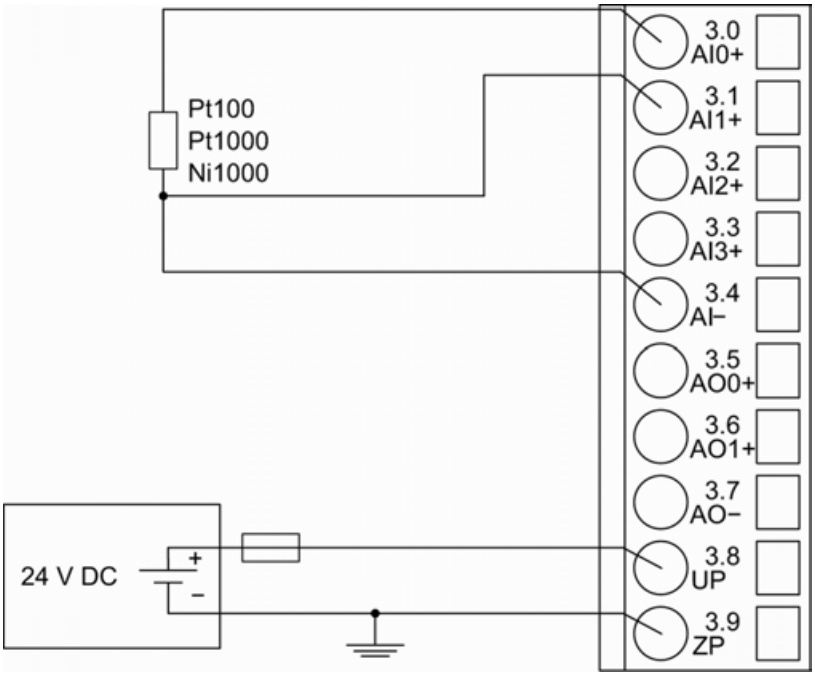


Fig. 144: Connection of resistance thermometers in 3-wire configuration to the analog inputs (AI0 ... AI3)

With 3-wire configuration, 2 adjacent analog channels belong together (e. g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1).

The constant current of one channel flows through the resistance thermometer. The constant current of the other channel flows through one of the cores. The module calculates the measured value from the two voltage drops and stores it under the input with the higher channel number (e. g. I1).

In order to keep measuring errors as small as possible, it is necessary to have all the involved conductors in the same cable. All the conductors must have the same cross section.

Table 270: Configurable measuring ranges

Pt100	-50 °C ... +400 °C	3-wire configuration, 2 channels used
Pt1000	-50 °C ... +400 °C	3-wire configuration, 2 channels used
Ni1000	-50 °C ... +150 °C	3-wire configuration, 2 channels used

↳ *Chapter 5.4.5.1.2.6 “Representation of the signal ranges” on page 866*

↳ *Meaning of the LEDs*

The module DA502 performs a linearization of the resistance characteristic.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of active-type analog sensors (Voltage) with galvanically isolated power supply to the analog inputs

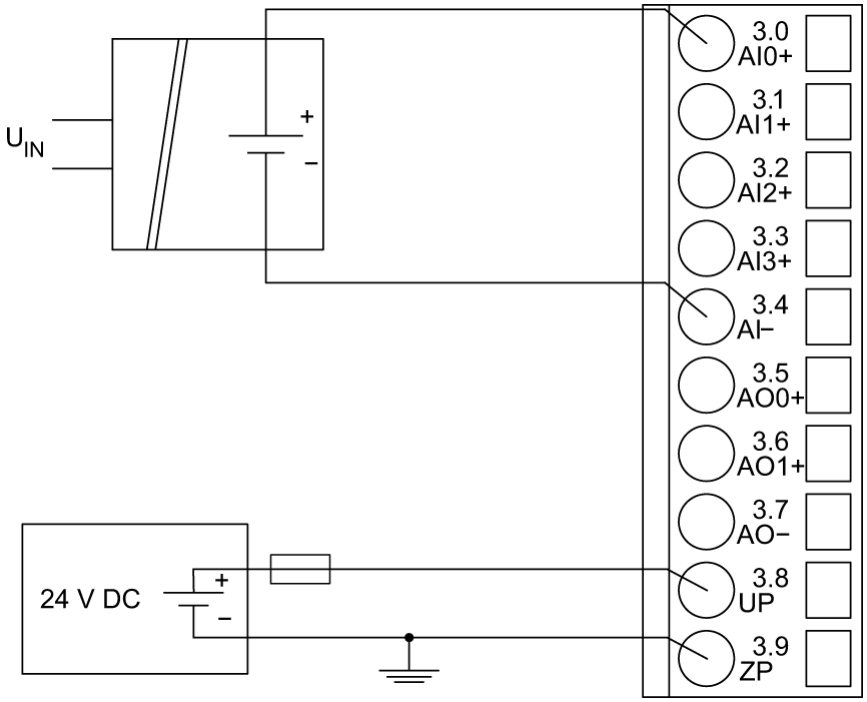


Fig. 145: Connection of active-type analog sensors (voltage) with galvanically isolated power supply to the analog inputs (AI0 ... AI3)

Table 271: Configurable measuring ranges

Voltage	0 V ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

↳ *Chapter 5.4.5.1.2.6 “Representation of the signal ranges” on page 866*

↳ *Meaning of the LEDs*

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of active-type analog sensors (Current) with galvanically isolated power supply to the analog inputs

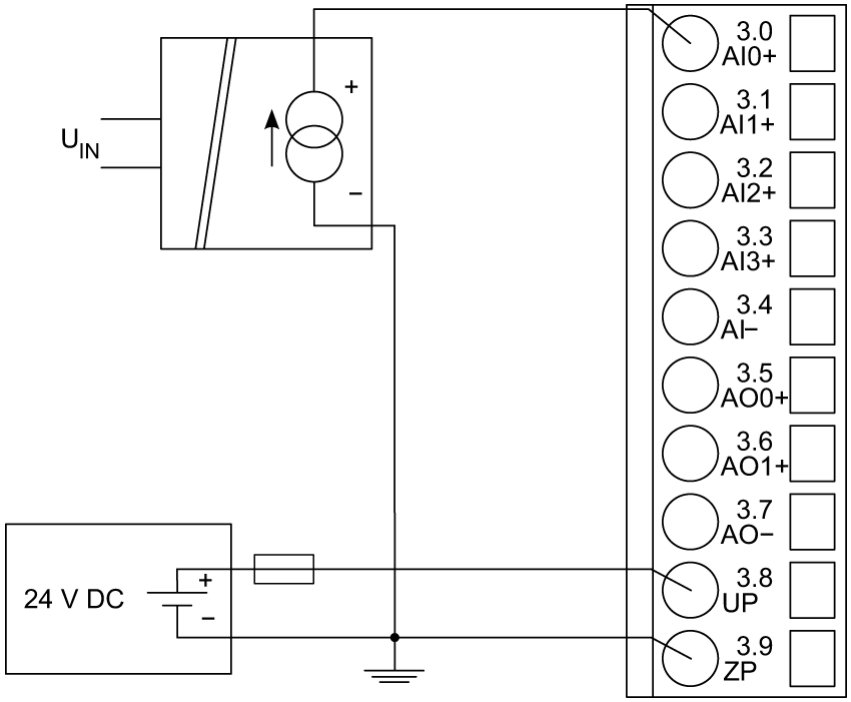


Fig. 146: Connection of active-type analog sensors (current) with galvanically isolated power supply to the analog inputs (AI0 ... AI3)

Table 272: Configurable measuring ranges

Current	0 mA ... 20 mA	1 channel used
Current	4 mA ... 20 mA	1 channel used

↳ *Chapter 5.4.5.1.2.6 “Representation of the signal ranges” on page 866*

↳ *Meaning of the LEDs*

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of active-type analog sensors (Voltage) with no galvanically isolated power supply to the analog inputs

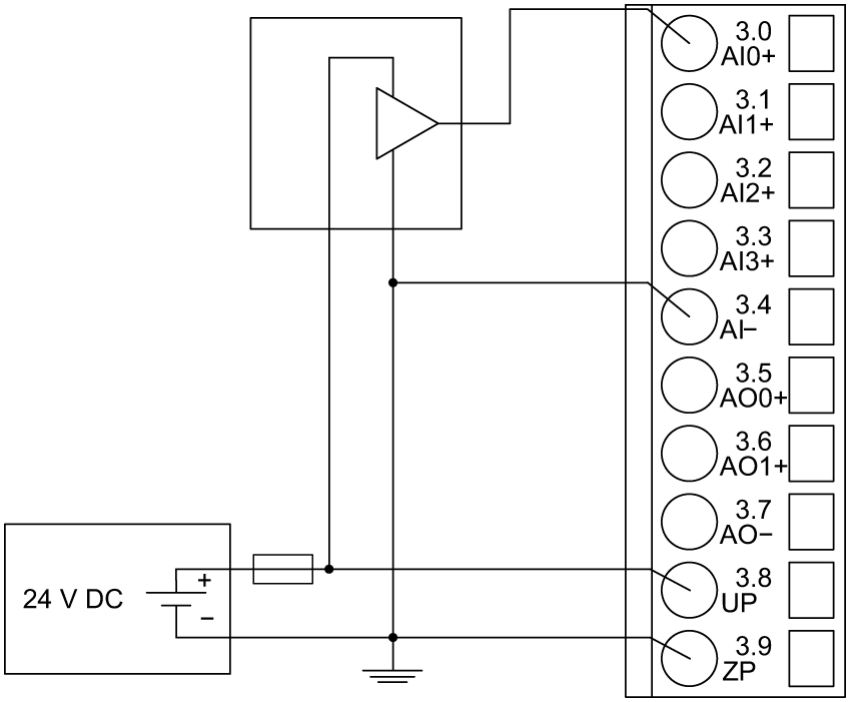


Fig. 147: Connection of active-type sensors (voltage) with no galvanically isolated power supply to the analog inputs (AI0 ... AI3)

CAUTION!

Risk of faulty measurements!

The negative pole at the sensors must not have too big a potential difference with respect to ZP (max. ± 1 V).

Make sure that the potential difference never exceeds ± 1 V.

Table 273: Configurable measuring ranges

Voltage	0 V ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

↳ *Chapter 5.4.5.1.2.6 “Representation of the signal ranges” on page 866*

↳ *Meaning of the LEDs*

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of passive-type analog sensors (Current) to the analog inputs

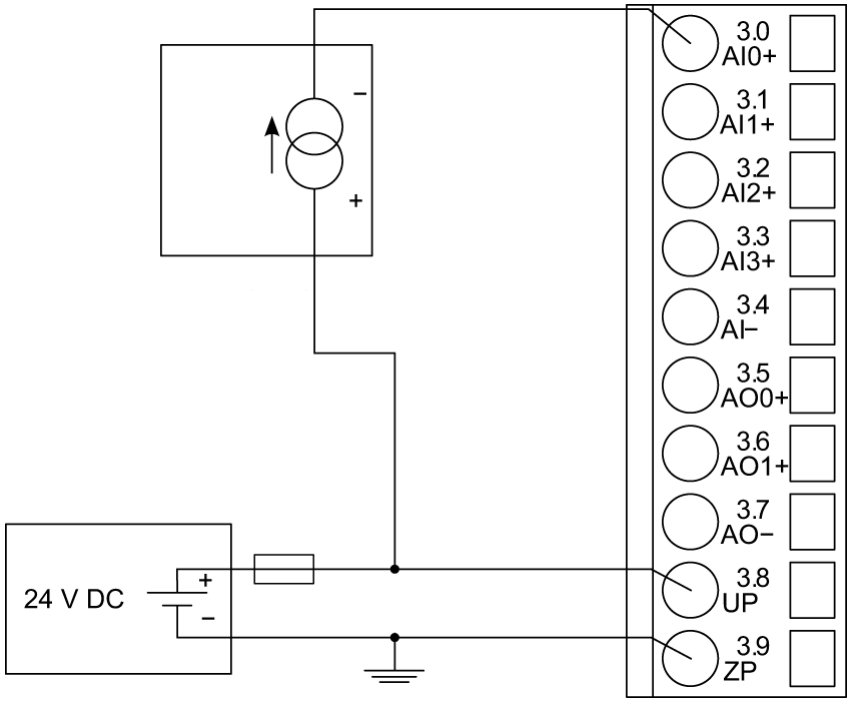


Fig. 148: Connection of passive-type analog sensors (current) to the analog inputs (AI0 ... AI3)

Table 274: Configurable measuring ranges

Current	4 mA ... 20 mA	1 channel used

↳ *Chapter 5.4.5.1.2.6 “Representation of the signal ranges” on page 866*

↳ *Meaning of the LEDs*

CAUTION!

Risk of overloading the analog input!

If an analog current sensor supplies more than 25 mA for more than 1 second during initialization, this input is switched off by the module (input protection).

Only use sensors with fast initialization or without current peaks higher than 25 mA. If not possible, connect a 10-volt Zener diode in parallel to I+ and ZP.

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of active-type analog sensors (Voltage) to differential analog inputs

Differential inputs are very useful if analog sensors which are remotely non-isolated (e.g. the negative terminal is remotely grounded) are used.

Using differential inputs helps to considerably increase the measuring accuracy and to avoid ground loops.

With differential input configurations, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

The analog value is calculated by subtraction of the input value with the higher address from the input value of the lower address.

The converted analog value is available at the odd channel (higher address).

CAUTION!

Risk of faulty measurements!

The negative pole at the sensors must not have too big a potential difference with respect to ZP (max. ± 1 V).

Make sure that the potential difference never exceeds ± 1 V.

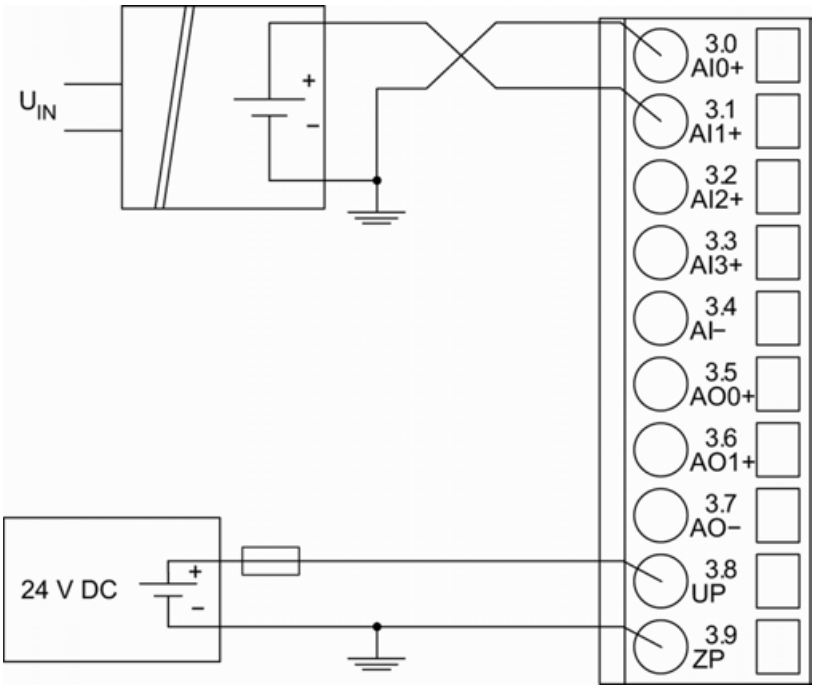


Fig. 149: Connection of active-type analog sensors (voltage) to differential analog inputs (AI0 ... AI3)

Table 275: Configurable measuring ranges

Voltage	0 V ... 10 V	with differential inputs, 2 channels used
Voltage	-10 V ... +10 V	with differential inputs, 2 channels used

Chapter 5.4.5.1.2.6 “Representation of the signal ranges” on page 866

Meaning of the LEDs

To avoid error messages from unused analog input channels, configure them as "unused".

Use of analog inputs as digital inputs

Several (or all) analog inputs can be configured as digital inputs. The inputs are not galvanically isolated against the other analog channels.

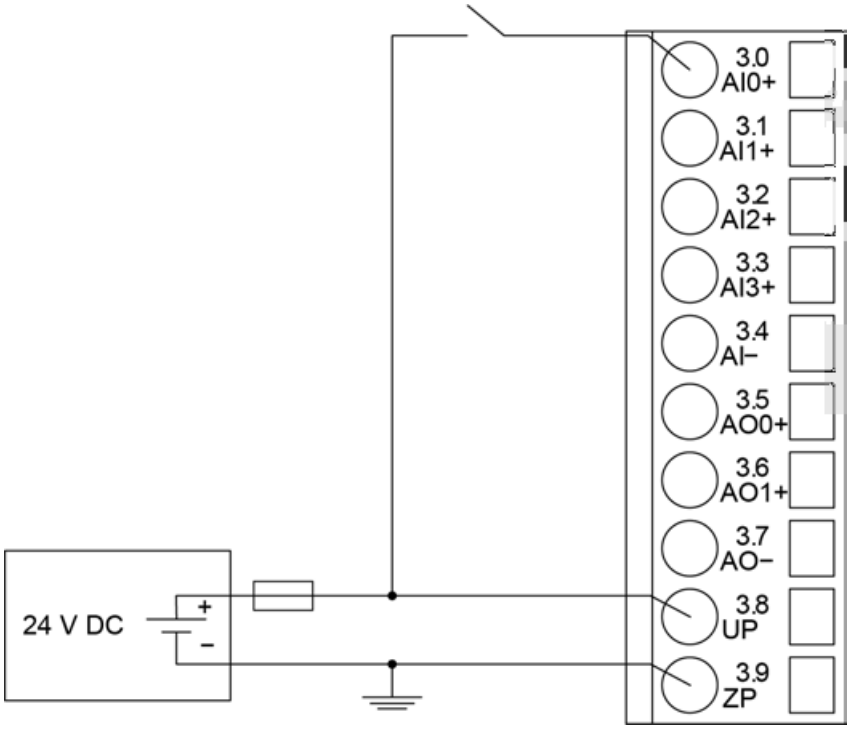


Fig. 150: connection of digital sensors to the analog input (AI0 ... AI3)

Table 276: Configurable measuring ranges

Digital input	24 V	1 channel used

↳ *Chapter 5.4.5.1.2.6 “Representation of the signal ranges” on page 866*

↳ *Meaning of the LEDs*

Connection of analog output loads (Voltage)

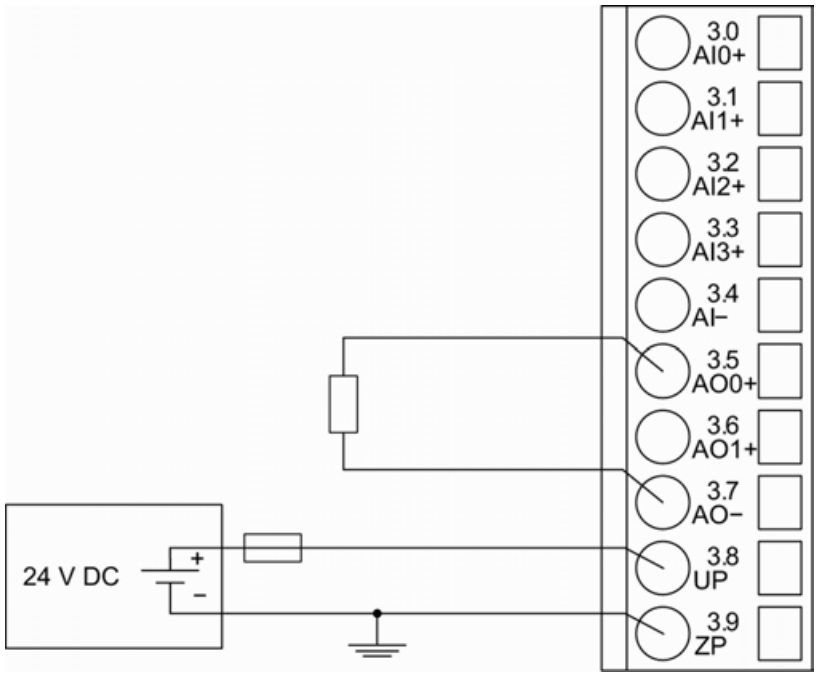


Fig. 151: Connection of analog output loads (voltage) to the analog outputs (AO0 ... AO1)

Table 277: Configurable measuring ranges

Voltage	-10 V ... +10 V	Load ± 10 mA max.	1 channel used

↳ *Chapter 5.4.5.1.2.6 “Representation of the signal ranges” on page 866*

↳ *Meaning of the LEDs*

Unused analog outputs can be left open-circuited.

Connection of analog output loads (Current)

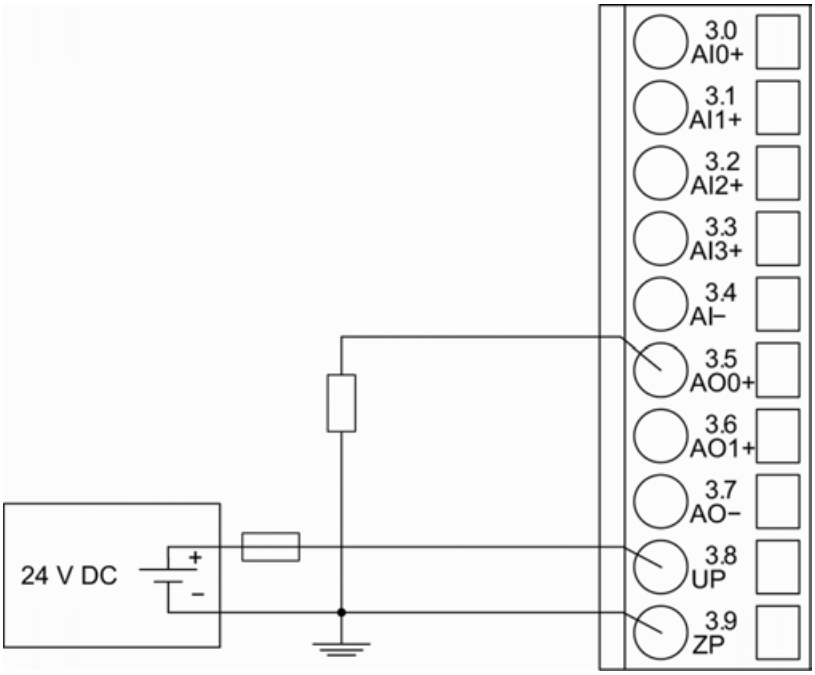


Fig. 152: Connection of analog output loads (current) to the analog outputs (AO0 ... AO1)

Table 278: Configurable measuring ranges

Current	0 mA ... 20 mA	Load 0 Ω ... 500 Ω	1 channel used
Current	4 mA ... 20 mA	Load 0 Ω ... 500 Ω	1 channel used

↳ *Chapter 5.4.5.1.2.6 “Representation of the signal ranges” on page 866*

↳ *Meaning of the LEDs*

Unused analog outputs can be left open-circuited.

I/O configuration

The module itself does not store configuration data. It draws its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Diagnosis

In cases of short circuit or overload, the digital outputs are turned off. The module performs reactivation automatically and acknowledgement of the errors is not necessary. The error message is stored via the LED.

Table 279: Error severity E3: Warnings

Error severity	Location	Error code	d1	d2	d3	d4	Description	Remedy
								
E3	iob (I/O bus)	3	14	1 ... 10	31	31	Timeout in the I/O module	Replace I/O module
E3	iob (I/O bus)	9	14	1 ... 10	31	31	Overflow diagnosis buffer	New start
E3	iob (I/O bus)	11	14	1 ... 10	31	31	Process voltage too low	Check process voltage
E3	iob (I/O bus)	19	14	1 ... 10	31	31	Checksum error in the I/O module	Replace I/O module
E3	iob (I/O bus)	26	14	1 ... 10	31	31	Parameter error	Check master
E3	iob (I/O bus)	36	14	1 ... 10	31	31	Internal data exchange failure	Replace I/O module
E3	iob (I/O bus)	40	14	1 ... 10	31	31	Different hard-/firmware versions in the module	Replace I/O module
E3	iob (I/O bus)	43	14	1 ... 10	31	31	Internal error in the module	Replace I/O module

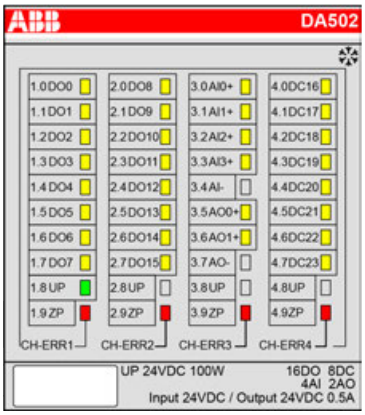
Table 280: Error severity E4: Warnings

Error severity	Location	Error code	d1	d2	d3	d4	Description	Remedy
								
E4	iob (I/O bus)	4	14	1 ... 10	3	20 ... 21[3)]	Analog value overflow at an analog output	Check output value
E4	iob (I/O bus)	4	14	1 ... 10	3	20 ... 21[3)]	Analog value underflow at an analog output	Check output value
E4	iob (I/O bus)	7	14	1 ... 10	3	16 ... 19[2)]	Analog value underflow at an analog input	Check input value
E4	iob (I/O bus)	45	14	1 ... 10	31	31	Process voltage is switched off (ON -> OFF)	Process voltage ON
E4	iob (I/O bus)	47	14	1 ... 10	1	16 ... 19[2)]	Short circuit at an analog input	Check terminal
E4	iob (I/O bus)	47	14	1 ... 10	2	22 ... 29[1)]	Short circuit at a digital output	Check connection
E4	iob (I/O bus)	48	14	1 ... 10	1	16 ... 19[2)]	Analog value overflow or broken wire at an analog input	Check input value or terminal

Remarks:

1)	Ch = 22 ... 29 indicates the digital inputs/outputs DC16 ... DC23
2)	Ch = 16 ... 19 indicates the analog inputs AI0 ... AI3
3)	Ch = 20 ... 21 indicates the analog outputs AO0 ... AO1

State LEDs

LED		State	Color	LED = OFF	LED = ON	LED flashes
	DO0 ... DO15	Digital output	Yellow	Output is OFF	Output is ON	--
	DC16 ...DC23	Digital input/ output	Yellow	Input/output is OFF	Input/output is ON 1)	--
	AI0 ... AI3	Analog input	Yellow	Input is OFF	Input is ON 2)	--
	AO0 ... AO1	Analog output	Yellow	Output is OFF	Output is ON 2)	--
	UP	Process supply voltage 24 V DC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
	CH-ERR1	Channel error, error messages in groups (digital inputs/ outputs combined into the groups 1, 2, 3, 4)	Red	No error or process supply voltage is missing	Severe error within the corresponding group	Severe error within the corresponding group (e.g. short circuit at an output)
	CH-ERR2		Red			
	CH-ERR3		Red			
	CH-ERR4		Red			
	CH-ERR 3)	Module error	Red	--	Internal error	--
	1) Indication LED is ON even if an input signal is applied to the channel and the supply voltage is off. In this case the module is not operating and does not generate an input signal.					
	2) Brightness depends on the value of the analog signal					
	3) All of the LEDs CH-ERR1 to CH-ERR4 light up together					

Representation of the signal ranges

Input ranges voltage, current and digital input

Range	0 V ... +10 V	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital input	Digital value	
						Decimal	Hex.
Overflow	> 11.7589	> 11.7589	> 23.5178	> 22.8142		32767	7FFF
Measured value too high	11.7589 : 10.0004	11.7589 : 10.0004	23.5178 : 20.0007	22.8142 : 20.0006		32511 : 27649	7EFF : 6C01

Range	0 V ... +10 V	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital input	Digital value	
						Decimal	Hex.
Normal range Normal range or measured value too low	10.0000 : 0.0004	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	: : On	27648 : 1	6C00 : 0001
	0.0000	0.0000	0	4	Off	0	0000
	-0.0004 -1.7593	-0.0004 : : -10,0000		3.9994 1.1858		-1 -4864 : -27648	FFFF ED00 : 9400
Measured value too low		-10.0004 : -11.7589				-27649 : -32512	93FF : 8100
Underflow	< 1.7593	< -11.7589	< 0.0000	< 1.1858		-32768	8000

The represented resolution corresponds to 16 bits.

Input ranges resistance temperature detector

Range	Pt100 -50°C ... +70 °C	Pt100 / Pt1000 -50 °C ... +400 °C	Ni1000 -50 °C ... +150 °C	Digital value	
				Decimal	Hex.
Overflow	> +80.0 °C	> +450.0 °C	> +160.0 °C	32767	7FFF
Measured value too high		+450.0 °C : + 400.1 °C		4500 : 4001	1194 : 0FA1
			+160.0 °C : + 150.1 °C	1600 : 1501	0640 : 05DD
	+80.0 °C : +70.1 °C			800 : 701	0320 : 02BD
Normal range	: : +70.0 °C : +0.1 °C	+400.0 °C : : : + 0.1 °C	+150.0 °C : : +0.1 °C	4000 1500 700 : 1	0FA0 05DC 02BC : 0001
	0.0 °C	0.0 °C	0.0 °C	0	0000

Range	Pt100 -50°C ... +70 °C	Pt100 / Pt1000 -50 °C ... +400 °C	Ni1000 -50 °C ... +150 °C	Digital value	
				Decimal	Hex.
	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-0.1 °C : -50,0 °C	-1 : -500	FFFF : FE0C
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-501 : -600	FE0B : FDA8
Underflow	< -60.0 °C	< -60.0 °C	< -60.0 °C	-32768	8000

Output ranges voltage and current

Range	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital value	
				Decimal	Hex.
Overflow	0 V	0 mA	0 mA	> 32511	> 7EFF
Value too high	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA	32511 : 27649	7EFF : 6C01
Normal range	10.0000 V : 0.0004 V	20.0000 mA : 0.0007 mA	20.0000 mA : 4.0006 mA	27648 : 1	6C00 : 0001
	0.0000 V	0.0000 mA	4.0000 mA	0	0000
	-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA	-1 -6912 -27648	FFFF E500 9400
Value too low	-10.0004 V : -11.7589 V	0 mA : 0 mA	0 mA : 0 mA	-27649 : -32512	93FF : 8100
Underflow	0 V	0 mA	0 mA	< -32512	< 8100

The represented resolution corresponds to 16 bits.

Technical data

Technical data of the module

Parameter	Value
Fast counter	Integrated, many configurable operating modes
Power supply	From the process supply voltage UP

Parameter	Value
LED displays	For system displays, signal states, errors and power supply
Internal supply voltage	Via the I/O bus interface (I/O bus)
External supply voltage	Via terminals UP and ZP (process supply voltage 24 V DC)
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Required terminal unit	TU515 or TU516 *Chapter 5.5.2 “TU515, TU516, TU541 and TU542 for I/O modules” on page 946*

The system data of AC500 and S500 is applicable to the standard version.

Chapter 4.2 “System data AC500” on page 34

The system data of AC500-XC is applicable to the XC version.

Chapter 4.3 “System data AC500-XC” on page 38

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter		Value
Process supply voltage		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for UP (+24 V DC) and 1.9, 2.9, 3.9 and 4.9 for ZP (0 V)
	Protection against reverse voltage	yes
	Rated protection fuse at UP	10 A fast
	Rated value	24 V DC
	Max. ripple	5 %
Current consumption		
	From UP	0.07 A + max. 0.5 A per output
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module	ca. 2 mA
	Inrush current from UP (at power-up)	0.04 A^2s
Galvanic isolation		
	between the channels	No
	between the channels and I/O bus	Yes
	between the channels and process supply voltage (UP, ZP)	No
Max. power dissipation within the module		6 W (outputs unloaded)
Weight (without terminal unit)		ca. 125 g

Parameter	Value
Mounting position	Horizontal mounting or Vertical mounting with derating (output load reduced to 50% at +40 °C)
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Multiple overloads
With multi-channel modules, there are no effects of multiple overloads as each digital output channel is individually protected by an internal intelligent high-side switch.

Technical data of the digital outputs

Parameter		Value
Number of channels per module		16 outputs (with transistors)
Distribution of the channels into groups		1 group of 16 channels
Connection of the channels		
	DO0 ... DO7	Terminals 1.0 ... 1.7
	DO8 ... DO15	Terminals 2.0 ... 2.7
Indication of the output signals		1 yellow LED per channel, the LED is ON if the output signal is high (signal 1)
Monitoring point of output indicator		LED is controlled by process CPU
Reference potential for all outputs		Terminals 1.9, 2.9, 3.9 and 4.9 (negative pole of the process supply voltage, signal name ZP)
Common power supply voltage		For all outputs: terminals 1.8, 2.8, 3.8 and 4.8 (positive pole of the process supply voltage, signal name UP)
Output voltage for signal 1		UP (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value, per channel	500 mA at UP = 24 V
	Maximum value (channels O0 to O15)	4 A
Leakage current with signal 0		< 0.5 mA
Rated protection fuse on UP		10 A fast
Demagnetization when inductive loads are switched off		With varistors integrated in the module (see figure below)
Switching frequency		

Parameter		Value
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 11 Hz with max. 5 W
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals		Yes
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical data of the configurable digital inputs/outputs

Each of the configurable digital I/O channels can be defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter		Value
Number of channels per module		8 inputs/outputs (with transistors)
Distribution of the channels into groups		1 group for 8 channels
If the channels are used as inputs		
	Channels DC16 ... DC23	Terminals 4.0 ... 4.7
If the channels are used as outputs		
	Channels DC16 ... DC23	Terminals 4.0 ... 4.7
Indication of the input/output signals		1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Monitoring point of input/output indicator		LED is part of the input circuitry
Galvanic isolation		Yes, per module

Technical data of the digital inputs/outputs if used as inputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DC16 ... DC23	Terminals 4.0 ... 4.7
Reference potential for all inputs	Terminals 1.9 ... 4.9 (Negative pole of the supply voltage, signal name ZP)
Indication of the input signals	1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Monitoring point of input/output indicator	LED is part of the input circuitry
Input type (according EN 61131-2)	Type 1
Input delay (0->1 or 1->0)	Typ. 0.1 ms, configurable from 0.1 ms ... 32 ms

Parameter		Value
Input signal voltage		24 V DC
	0-Signal	-3 V ... +5 V
	Undefined Signal	> +5 V ... < +15 V
	1-Signal	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

* Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal must not exceed the clamp voltage of the varistor. The varistor limits the clamp voltage to approx. 36 V. Consequently the input voltage must be within the following range.

- If UPx = 24 V, the input voltage must range from -12 V ... +30 V.
- If UPx = 30 V, the input voltage must range from -6 V ... +30 V.

Technical data of the digital inputs/outputs if used as outputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DC16 ... DC23		Terminals 4.0 ... 4.7
Reference potential for all outputs		Terminals 1.9 ... 4.9 (negative pole of the supply voltage, signal name ZP)
Common power supply voltage		For all outputs terminals 1.8, 2.8, 3.8 and 4.8 (positive pole of the supply voltage, signal name UP)
Output voltage for signal 1		UP (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	rated value per channel	500 mA at UP = 24 V
	max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA
Fuse for UP		10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)
Output switching frequency		
	With resistive load	On request

Parameter		Value
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

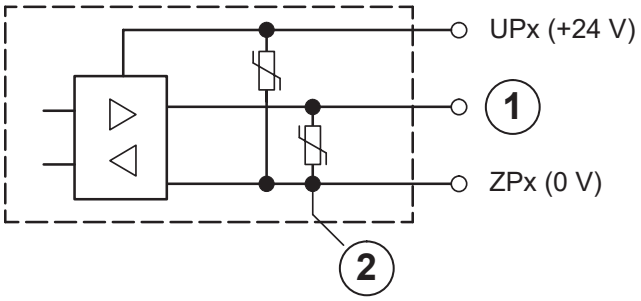


Fig. 153: Digital input/output (circuit diagram)

1 Digital input/output
2 For demagnetization when inductive loads are turned off

Technical data of the fast counter

The fast counter of the module does not work if the module is connected to a CS31 bus module.

Parameter	Value
Counting frequency	Max. 50 kHz

Technical data of the analog inputs

Parameter	Value
Number of channels per module	4
Distribution of channels into groups	1 group with 4 channels
Connection if channels AI0+ ... AI3+	Terminals 3.0 ... 3.3

Parameter		Value
Reference potential for AI0+ ... AI3+		Terminal 3.4 (AI-) for voltage and RTD measurement Terminal 1.9, 2.9, 3.9 and 4.9 for current measurement
Input type		
	Unipolar	Voltage 0 V ... 10 V, current or Pt100/Pt1000/Ni1000
	Bipolar	Voltage -10 V ... +10 V
Configurability		0 V ... 10 V, -10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA, Pt100/1000, Ni1000 (each input can be configured individually)
Channel input resistance		Voltage: > 100 kΩ Current: ca. 330 Ω
Time constant of the input filter		Voltage: 100 µs Current: 100 µs
Indication of the input signals		1 LED per channel (brightness depends on the value of the analog signal)
Conversion cycle		1 ms (for 4 inputs + 2 outputs); with RTDs Pt/Ni... 1 s
Resolution		Range 0 V ... 10 V: 12 bits Range -10 V ... +10 V: 12 bits including sign Range 0 mA ... 20 mA: 12 bits Range 4 mA ... 20 mA: 12 bits Range RTD (Pt100, PT1000, Ni1000): +0.1 °C
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ. 0.5 %, max. 1 % For XC version below 0 °C and above +60 °C: on request
Relationship between input signal and hex code		↳ *Chapter 5.4.5.1.2.6.2 “Input ranges resistance temperature detector” on page 867*
Unused inputs		Are configured as "unused" (default value)
Overvoltage protection		Yes

Technical data of the analog inputs, if used as digital inputs

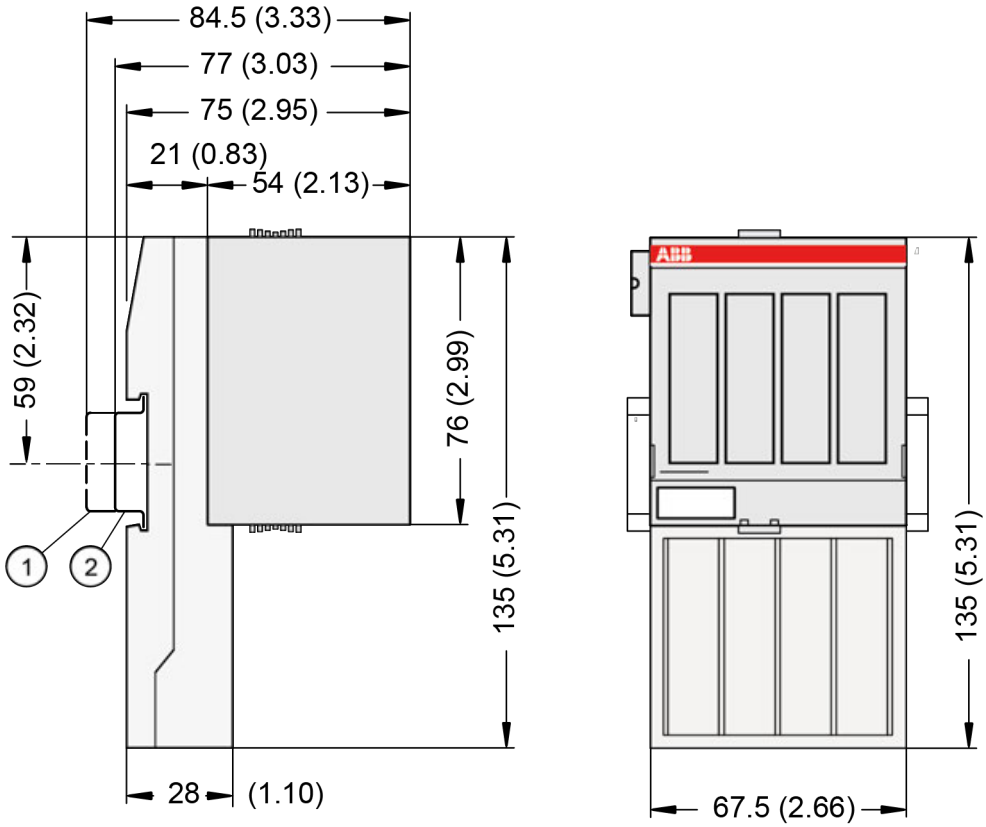
Parameter		Value
Number of channels per module		Max. 4
Distribution of channels into groups		1 group of 4 channels
Connections of the channels AI0+ ... AI3+		Terminals 3.0... 3.3
Reference potential for the inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (ZP)
Indication of the input signals		1 LED per channel
Input signal voltage		24 V DC
	Signal 0	-30 V ... +5 V
	Undefined signal	+5 V ... +13 V

Parameter		Value
	Signal 1	+13 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 7 mA
	Input voltage +5 V	Typ. 1.4 mA
	Input voltage +15 V	Typ. 3.7 mA
	Input voltage +30 V	< 9 mA
Input resistance		ca. 3.5 kΩ

Technical data of the analog outputs

Parameter		Value
Number of channels per module		2
Distribution of channels into groups		1 group for 2 channels
Connection of the channels AO0+ ... AO1+		Terminals 3.5 and 3.6
Reference potential for AO0+ ... AO1+		Terminal 3.7 (AO-) for voltage output Terminals 1.9, 2.9, 3.9 and 4.9 for current output
Output type		
	Unipolar	Current
	Bipolar	Voltage
Galvanic isolation		Against internal supply and other modules
Configurability		-10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA (each output can be configured individually)
Output resistance (load), as current output		0 Ω ... 500 Ω
Output loadability, as voltage output		± 10 mA max.
Indication of the output signals		1 LED per channel (brightness depends on the value of the analog signal)
Resolution		12 bits including sign
Settling time for full range change (resistive load, output signal within specified tolerance)		Typ. 5 ms
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code		↳ *Chapter 5.4.5.1.2.6.3 “Output ranges voltage and current” on page 868*
Unused outputs		Are configured as "unused" (default value) and can be left open-circuited

Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 250 800 R0001	DA502, digital/analog input/output module, 16 DO, 8 DC, 4 AI, 2 AO	Active
1SAP 450 800 R0001	DA502-XC, digital/analog input/output module, 16 DO, 8 DC, 4 AI, 2 AO, XC version	Active

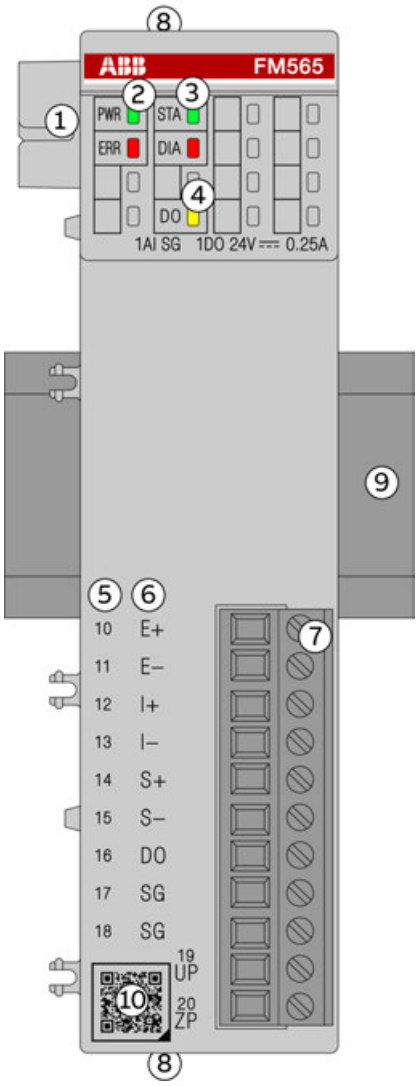
**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.4.6 Function modules

5.4.6.1 S500-eCo

5.4.6.1.1 FM565 - Strain gauge module

- 1 configurable analog SG (strain gauge) input (E, I and S) and 1 digital output (DO) in 1 group
- Resolution: 24/28 bits under normal mode; 16/24 bits under oversampling mode



1 I/O bus
2 1 green LED to display power supply, 1 red LED to display error
3 1 green LED to display the state of input channel, 1 red LED to display the diagnosis of input channel
4 1 yellow LED to display the state of output channel
5 Terminal number
6 Allocation of signal name
7 Terminal block for SG channel signals (11-pin)
8 2 holes for wall-mounting with screws
9 DIN rail
10 QR code for datasheet

Intended purpose

The strain gauge module FM565 provides 1 analog input and 1 digital output. It can be used at the following devices:

- S500 communication interface modules (e.g. CI50x-PNIO, CI51x-ETHCAT, CN52x-MODTCP, CI54x-DP, CI58x-CN)
- AC500 CPUs

FM565 contains the following features:

- Connection type: 4-wire, 4-wire enhanced, 6-wire strain gauges
- 4.2 V DC max supply voltage of full bridge
- Input range: ±1... 255 mV/V, 24 bits (28 bits, library solution); 16 bits/24 bits oversampling
- Galvanically isolated inputs from other electronic circuitry including I/O bus
- Channel status indicated by LEDs
- Digital output 250 mA@24 V, with short-circuit, overtemperature and overvoltage protection

Isolated between system power L+/M and process voltage UP/ZP.

Functionality

1 analog input, configurable:

- Not used (default)
- 4-wire strain gauge
- 4-wire strain gauge enhanced
- 6-wire strain gauge

1 digital output, configurable:

- Not used (default)
- General 24V digital output
- Event - Upper limit trigger
- Event - Lower limit trigger
- Event - Window output
- Event - Sync signal
- Event - Application FB

Parameter		Value
Resolution of the analog channels		
Weight	Normal mode	23 bits plus sign 27 bits plus sign (library solution)
	Oversampling mode - 24 bit	23 bits plus sign
	Oversampling mode - 16 bit	15 bits plus sign
LED displays		5 LEDs: power, error, input state, diagnosis and output state
Internal supply		Via I/O bus
External supply		Via the terminals UP (process voltage 24 V DC) and ZP (0 V DC)

Strain gauge measurement and control functions:

- Sensor calibration
- Parameters read/write
- Weight measurement

- Event capture
- Window monitoring
- Diagnosis

Connections



For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection is carried out by using a removable 11-pin terminal block. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

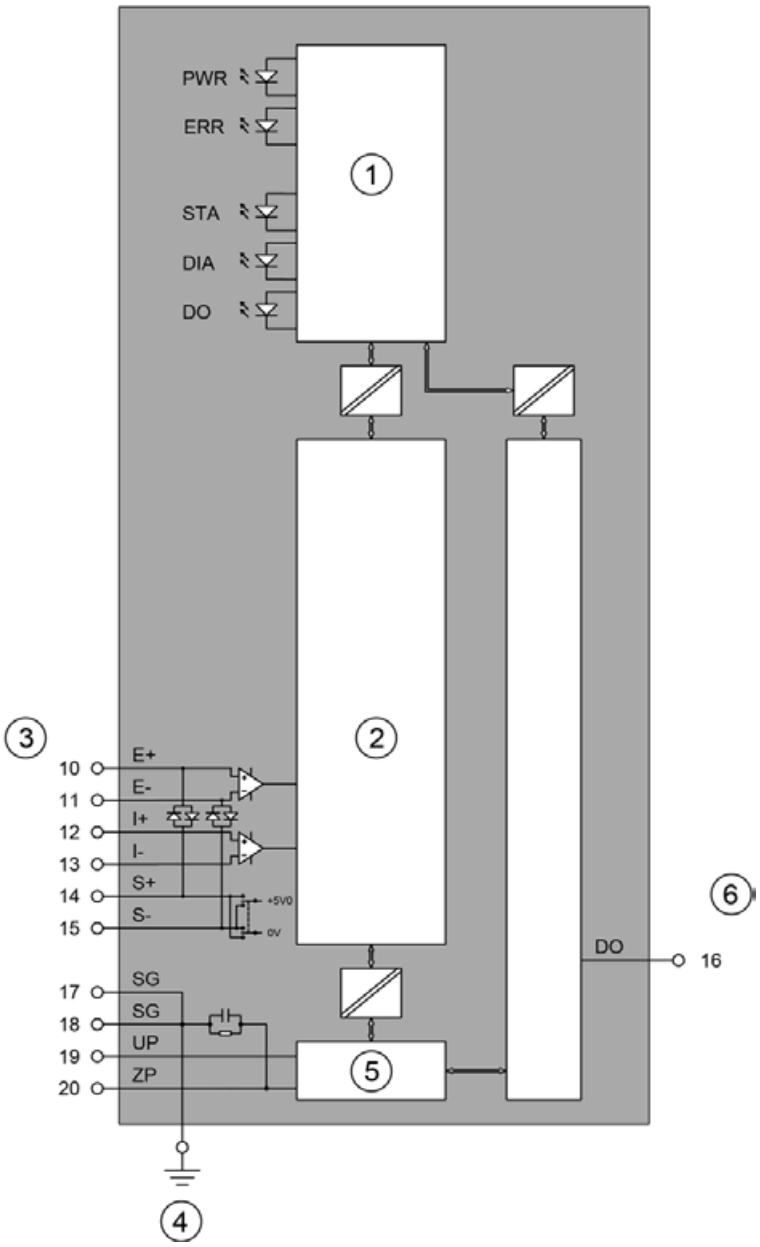


Fig. 154: Internal construction of the analog input and digital output

1 I/O bus interface and MCU core circuit
2 ADC and logic circuit
3 Analog input
4 Functional earth connection
5 Fly-back DC/DC power supply
6 Digital output

Table 281: Assignment of the terminals

Terminal	Signal	Description
10	E+	Positive pole of excitation voltage
11	E-	Negative pole of excitation voltage
12	I+	Positive pole of strain gauge measurement signal
13	I-	Negative pole of strain gauge measurement signal

Terminal	Signal	Description
14	S+	Positive pole of strain gauge sense voltage
15	S-	Negative pole of strain gauge sense voltage
16	DO	Digital output
17	SG	Shield grounding
18	SG	Shield grounding
19	UP	Process voltage UP (24 V DC)
20	ZP	Process voltage ZP (0 V DC)

There is galvanic isolation between the analog circuitry and ZP/UP. Therefore, the analog sensors must be galvanically isolated in order to avoid loops via the ground potential or the supply voltage.

The internal power supply voltage for the module's circuitry is carried out via the connection to CPU. Thus, the current consumption from 24 V DC power supply at the terminals L+ and M of the CPU module increases by 5 mA per FM565.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing the following:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

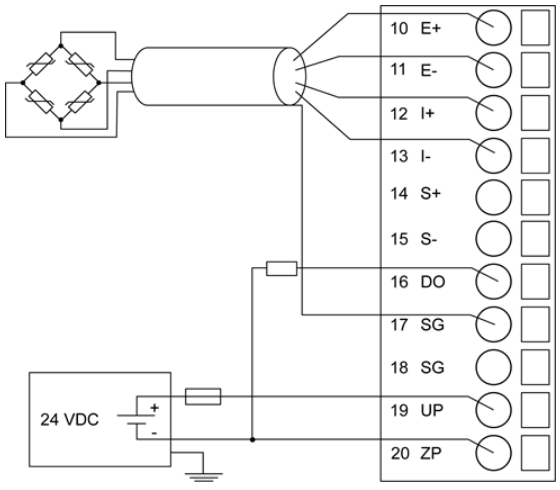
Generally, analog signals must be laid in shielded cables. The cable shields must be grounded at both sides of the cables. To avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

The process voltage must be included in the grounding concept of the control system (e.g. grounding the negative pole).

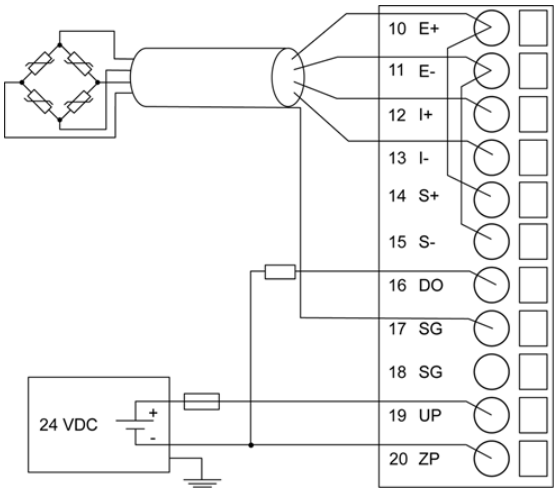
By installing equipotential bonding conductors between the different parts of the system, it must be made ensured that the potential difference between ZP and AGND never exceeds 1 V.

The module provides several diagnosis functions *Chapter 5.4.6.1.1.7 “Diagnosis” on page 889*.

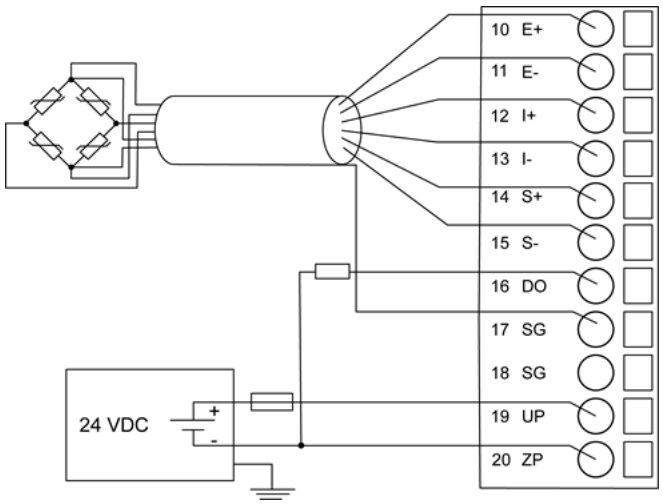
The following figures show the connection of the module:



4-wire connection



4-wire enhanced connection



6-wire connection

With 4-wire or 4-wire enhanced connection, the resistance of the connection wires influences the accuracy of the measured value. Use 6-wire connection to achieve the guaranteed measuring accuracy.

The meaning of the LEDs is described in *Chapter 5.4.6.1.1.8 “State LEDs” on page 891*.

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the CPU module during power-up of the system.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software. Internal parameters are accessed via function blocks.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module parameters

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Intern	1855[1)]	WORD	0x73F	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No 0x00			
Parameter length	Intern	26	BYTE	26	0	255	xx02[2)]
Check Supply	Off On	0 1	BYTE	On 0x01	0	1	

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
Analog Data Format	Default	Default = 0 Factory 1 = 0xFD Factory 2 = 0xFE Factory 3 = 0xFF	BYTE	0x00	0	255	
[1)]with CS31 and addresses less than 70, the value is increased by 1 [2)]Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n)							

Input channel (1x)

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.
Input channel configuration	↳ *Table 282 “Input channel configuration” on page 886*		BYTE	Not used		
Input acquiring mode configuration[1)]	Normal Oversampling - 24 bit Oversampling - 16 bit	0 1 2	BYTE	Normal	0	2
Input range configuration	Intern	1...255	mV/V (BYTE)	2	1	255
Input sampling rate configuration	2.5 SPS 5 SPS 10 SPS 16.6 SPS 20 SPS 50 SPS 60 SPS 100 SPS 400 SPS 1200 SPS 2400 SPS 4800 SPS 7200 SPS 14400 SPS Application	0 1 2 3 4 5 6 7 8 9 10 11 12 13 20	BYTE	20 SPS	2.5 SPS	14400 SPS

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.
Input frequency filter configuration	50 Hz 60 Hz Disable 50 Hz & 60 Hz	0 1 2 3	BYTE	50Hz	0	3
Input check channel	Diagnosis Not used	0 3	BYTE	Diagnosis	0	3
Input unit configuration of weight[2)]	Relative kg lbf t Application	0 1 2 3 4	BYTE	Relative	0	4
Input reference configuration of weight[3)]	Rated weight Weight per nV/V Application - Rated weight Application - Weight per nV/V	0 1 2 3	BYTE	Rated weight	0	3
Input rated weight/stress[4)]	0...100000000	0...100000000	DWORD	100000000		
Input upper limit	1000...1500	1000...1500	‰ (INT)	1500	1000	1500
Input lower limit	-1500...0	-1500...0	‰ (INT)	-1500	-1500	0
Input upper limit hysteresis	0...1500	0...1500	‰ (INT)	1450	0	1500
Input lower limit hysteresis	-1500...0	-1500...0	‰ (INT)	-1450	-1500	0

Remarks:

1)	Set the input sampling rate >= 400 SPS to enable oversampling mode.
2)	"kg", "lbf","t" conversion only supported by normal mode and oversampling - 24bit mode (function blocks: SgxMeasurement24Bit, SgxMeasurement28bit, SgxOversampling24Bit). If "Application" is slected, the unit will be defined in FB input.
3)	If "Application - Rated weight" or "Application - Weight per nV/V" is selected, the actual weight will be calculated based on the value set for internal parameters "Rated weight" and "Weight per nV/V"respectively.
4)	For 24 bit mode, the range is 0...100000000; for 16 bit mode, the range is 0...10000.

Table 282: Input channel configuration

Internal value	Value	Description
0	Not used	
66	4-wire strain gauge	“S+” & “S-“ not connected
67	4-wire strain gauge enhanced	“S+” & “S-“ connected to “E+” & “E-“. Sensor bridge without amplifier, wide operating voltage.
68	6-wire strain gauge	

Output channel (1x)

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.
Output channel configuration	*Table 283 “Output channel configuration” on page 886*		BYTE	Not used	0	105

Table 283: Output channel configuration

Internal value	Value	Description
0	Not used	-
100	General 24V digital output	DO sends a 24 V signal when the "Dout" field in function blocks is set as 1.
101	Event - Upper limit trigger[1)2)]	DO = 1, the measurement is above the input upper limit. DO = 0, the measurement is below the upper limit hysteresis.
102	Event - Lower limit trigger[1)2)]	DO = 1, the measurement is below the input lower limit. DO = 0, the measurement is above the lower limit hysteresis.
103	Event - Window output[1)]	DO = 1, the measurement is above the upper limit or below the lower limit. DO = 0, the measurement is in the normal range.
104	Event - Sync signal[1)]	DO indicates the “done” signal of measurement .
105	Event - Application FB[1)3)]	DO indicates the status of the function block used. ● Function blocks "SgxWindowMonitoring", "SgxMeasurement24Bit", "SgxMeasurement28bit", "SgxOversampling16Bit", "SgxOversampling24Bit": DO = 1, upper/lower limit (internal parameter) reached. ● Function block "SgxEventCapture": DO = 1, upper/lower limit (internal parameter/limit set in "SgxEventCapture") reached.

Remarks:

1)	”Dout” field in the function blocks will be ignored. Change of this field will not influence the DO state.
2)	DO state remians unchanged when the new measurment is between the limit value and the limit hysteresis.
3)	Set "Irq" as TRUE to enable the event trigger of digital output.

GSD file:

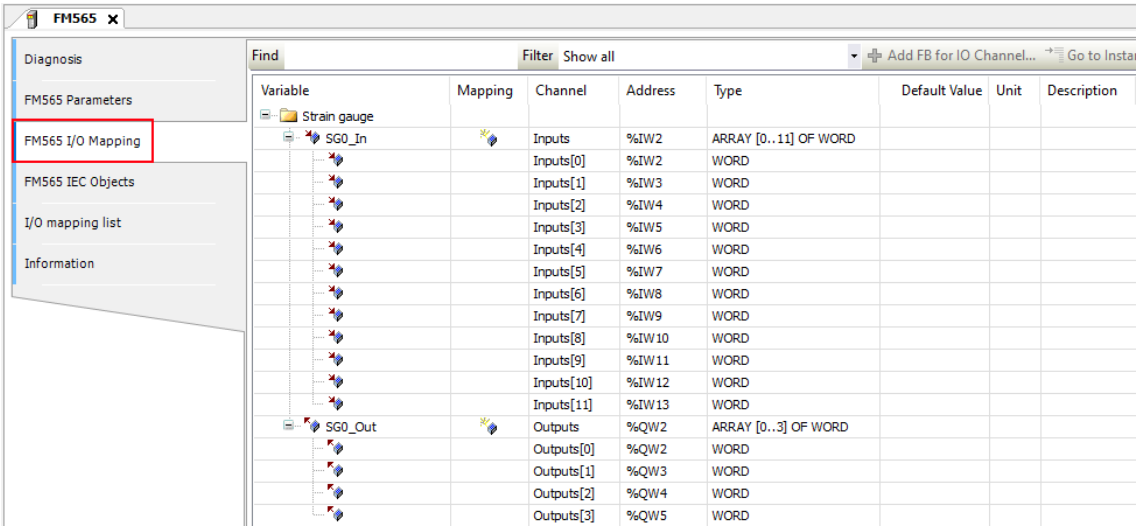
Ext_User_Prm_Data_Len =	0x1D
Ext_User_Prm_Data_Const(0) =	0x40, 0x07, 0x1A, 0x01, 0x00, 24(0x00)

I/O Mapping

I/O mapping is to link the physical I/O channels to the variables used in the program. For SG modules, weight measurement and control functions are realized via function blocks. Two libraries are provided for function block I/O accessing and serve as the foundation for function blocks calling.

I/O Mapping list

Variable names/symbols can be mapped to the channels in the I/O mapping list in Automation Builder. The names created can be called directly in the program.



1. Double click the module in the device tree, and click tab “FM565/FM566 I/O Mapping” to open the editor.

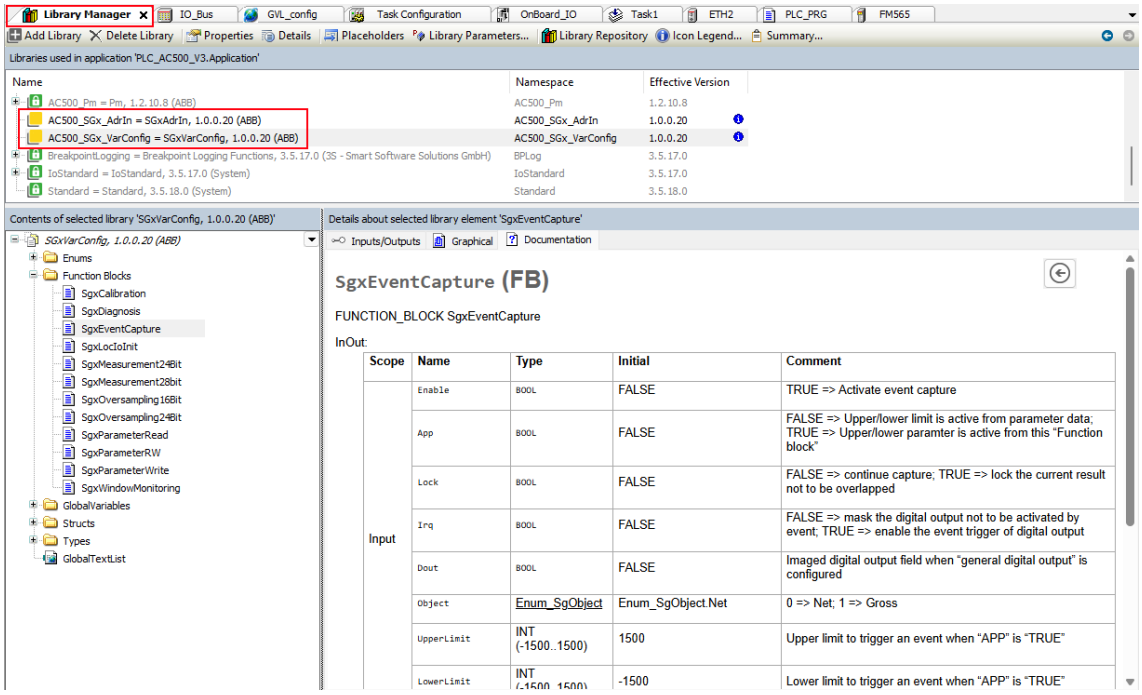
2. Create the variable names/symbols for the SG channel in the variable column.

I/O access library

> *To use the control functions of SG modules, the inputs and outputs image of function blocks must first be connected to the instants by calling function block "SGxLocIoInit" in the library.*

Function block I/O is mapped to the variables via two libraries:

- AC500_SGx_AdrIn_Factory_BigEndian_vxxx
- AC500_SGx_VarConfig_Factory_BigEndian_vxxx



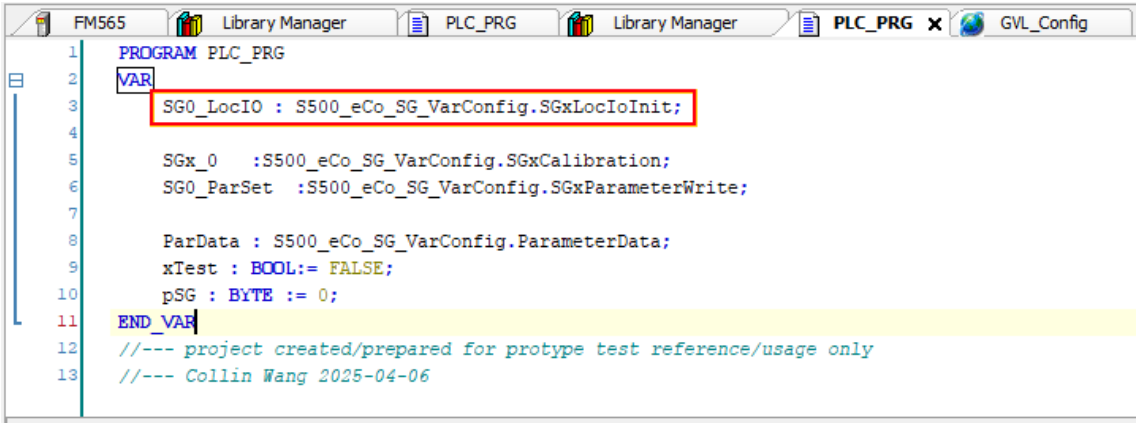
In address based access

TBD

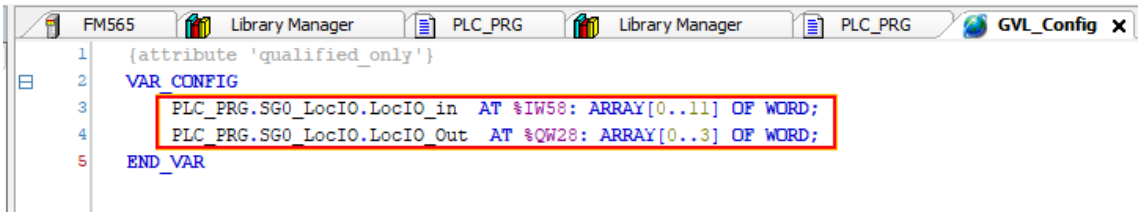
Var_Config based access

Call function block “SGxLocIoInit” in library VarConfig for I/O mapping before calling other function blocks in this library.

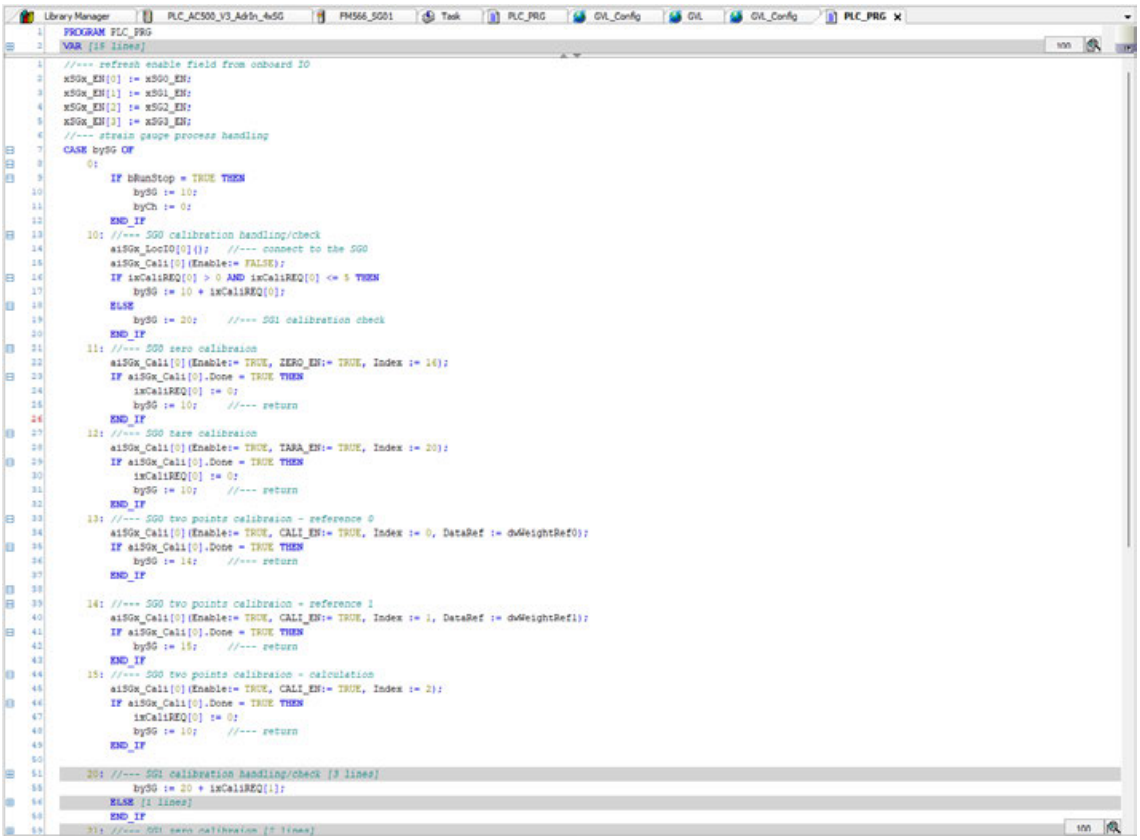
1. Create an instant with function block “SGxLocIoInit” in "PLC_PRG".



2. Create variables with VAR_CONFIG declaration in GVL tab with instant “SG0_LocIO”, and assign the image I/O to address “AT %IWxx” and “AT %QWxx”



3. Call instant “SG0_LocIo()” to map the function block I/O to the address. Once an initialization is called, the mapped I/O is automatically connected to function block of strain gauge library.



Diagnosis

E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500 display	<– Display in	
Class	Comp	Dev	Mod	Ch	Err	AB SW		
Byte 6 Bit 6 ... 7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0 ... 5	PNIO diagnosis block		
Class	Interface	Device	Module	Channel	Error Identifier	Error message		Remedy
	1)	2)	3)	4)				
Module error								
3	14	1 ... 10	31	31	19	Checksum error in the I/O module		Replace I/O module
	11 / 12	ADR	1 ... 10					

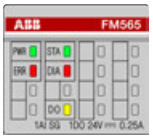
E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier** **000 ... 063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**AB SW**	
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1 ... 10				
Channel error							
4	14	1 ... 10	1	0 ... 7	4	Measurement overflow	Check input value
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	1	0 ... 7	7	Measurement under-flow	Check input value
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	1	0 ... 7	47	Short circuit at the analog input E+/E- or S+/S-	Check output wiring
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	1	0 ... 7	48	Broken wire at an analog input*	Check input value or terminal
	11 / 12	ADR	1 ... 10				

* In development

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = expansion module 1...10, ADR = hard-ware address
3)	With "Module" the following allocation applies dependent of the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or PNIO = module type (1 = AI); COM1/ COM2: 1 ... 10 = expansion 1 ... 10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON	LED flashes
	PWR	Process voltage 24 V DC via terminal	Green	CPU module voltage or external 24 V DC supply voltage is missing	3.3 V system voltage (I/O bus) and external 24 V DC supply voltage are present	—
	ERR	Channel or module error	Red	No error or process voltage is missing	Severe error in the module	Error in 1 channel of the module
	STA	Channel state	Green	Not measuring	Measuring	—
	DIA	Channel error	Red	No error in channel	Error in channel	—
	DO	Digital output	Yellow	DO off	DO on	—

Measuring ranges

FM565/FM566 needs typ. 6 to 8 seconds for initialization after applying the process supply voltage to clamp UP/ZP. During this time, the accuracy of the measurement values is not within specification. After that, valid measurement values are provided by the module.

After an interruption of the process supply voltage > 10 ms, a re-initialization is performed by the module.

Risk of invalid analog input values!

The analog input values may be invalid if the measuring range of the inputs is exceeded.

Make sure that the analog signal at the connection terminals is always within the signal range.

Table 284: Input range for 24 bit/28 bit mode

Range	Measured value (relative)	Digital value (decimal)
Overflow	> +150 %	≥ 150000001
Overshoot	150 %	150000000
	> +100 %	≥ 100000001
Normal	+100 %	+100000000
	0	0
	-100%	-100000000
Underage	< -100%	≤ -100000001
	-150%	-150000000
Underflow	< -150%	≤ -150000001

Table 285: Input range for 16 bit mode

Range	Measured value (relative)	Digital value (decimal)
Overflow	> +150 %	≥ 15001
Overshoot	150 %	15000
	> +100 %	≥ 10001
Normal	+100 %	+10000
	0	0
	-100%	-10000
Underage	< -100%	≤ -10001
	-150%	-15000
Underflow	< -150%	≤ -15001

Technical data

Technical data of the module

The system data of AC500-eCo apply.

↳ *Chapter 4.1 “System data AC500-eCo” on page 25*

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage UP		
	Connections	Terminal 19 for UP (+24 V DC) and terminal 20 for ZP (0 V)
	Rated value	24 V DC
	Current consumption	0.03 A + DO loads
	Inrush current (at power-up)	Typ. 0.1 A^2s; Max. 0.16 A^2s
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Protection fuse for UP	Yes, external additional fuse recommended
Current consumption from 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module		Ca. 5 mA
Galvanic isolation		Yes, between the input group and the rest of the module. Isolation voltage 500 V DC.
	Isolated groups	1 (1 channel per group)
Surge-voltage (max.)		35 V DC for 0.5 s
Max. power dissipation within the module		1.1 W
Weight		Ca. 120 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

Technical data of the analog inputs

Parameter		Value	
Number of channels per module		1 configurable analog input	
Distribution of channels into groups		1 (1 channel per group)	
Resolution			
Weight	Normal	24 bits / 28 bits	
	Oversampling - 24 bit	24 bits	
	Oversampling - 16 bit	16 bits	
Connection of the signals E+, I+ and S+		Terminals 10, 12 and 14	
Connection of the signals E-, I- and S-		Terminals 11, 13 and 15	
Input type		Differential, a full-bridge strain gauge	
Galvanic isolation		500 V DC between input and internal IO bus 500 V DC between input and process voltage	
Configurability		Not used 4-wire strain gauge[1)] 4-wire strain gauge enhanced[2)] 6-wire strain gauge	
Indication of the input signals		2 LEDs per channel, green for state and red for diagnosis	
Channel input resistance		> 100 kΩ	
Input filter attenuation		-3 dB at 14 kHz	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range[3)]		Typ.	0.05 % of full scale at 25 °C
		Max.	±0.5 % of full scale at -20 °C ... +60 °C or EMC disturbance
Analog to digital conversion time		Determined by "sampling rate" and "acquiring mode". Min. 100 µs when function block "Event capture" or "Window monitoring" is applied.	
Input data length		24 bytes	
Protection		Max. 30 V DC overvoltage protection for I+/- Short circuit protection for E+/- or S+/-	
Repeatability		0.05 % of full scale	
Permissible sensor load		80 ... 5000 Ω	
Excitation voltage		Max. 4.2 V DC / Max. 50 mA	
Measurement range		±1 mV/V ... 255 mV/V	
Max. cable length (conductor cross section > 0.14 mm²)			
	Shielded wire	500 m	

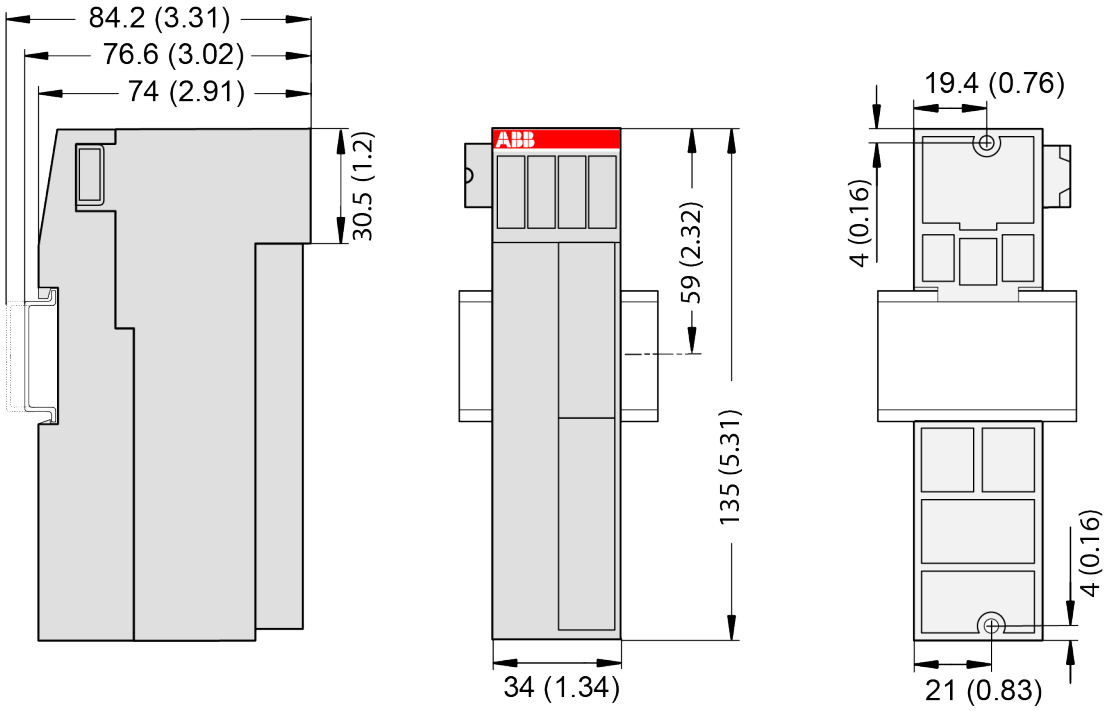
Remarks:

1)	”S+” & “S-“ not connected
2)	”S+” & “S-“ short connected to “E+” & “E-“ respectively
3)	For 4-wire or 4-wire enhanced connection, the cable should be as short as possible to reduce error. If the cable is long, use 6-wire connection to achieve the guaranteed measuring accuracy.

Technical data of the digital outputs

Parameter		**Value**
Number of channels per module		1 configurable digital output (24 V DC)
Distribution of channels into groups		1 (1 cannel per group)
Connection of the signal DO and ZP		Terminals 16 and 20
Output type		Source output
Galvanic isolation		500 V DC
Min. output voltage at signal 1		20 V DC at max. current consumption
Output delay (max. at rated load)		
	0 to 1	150 µs
	1 to 0	200 µs
Output current		
	with resistive load, max.	0.25 A
	with inductive load, max.	0.25 A
	with lamp load, max.	2 W
Max. leakage current with signal 0		0.1 mA
Configurability		Not used General 24 V digital output Event - Upper limit Event - Lower limit Event - Window output Event - Sync signal Event - Application FB
Indication of the output signal		1 yellow LED, the LED is on when the output signal is high (signal 1)
Output data length		8 bytes
Overload or short circuit protection		Yes
Max. cable length		
	Unshielded wire	150 m
	Shielded wire	500 m

Dimensions



The dimensions are in mm and in brackets in inch.

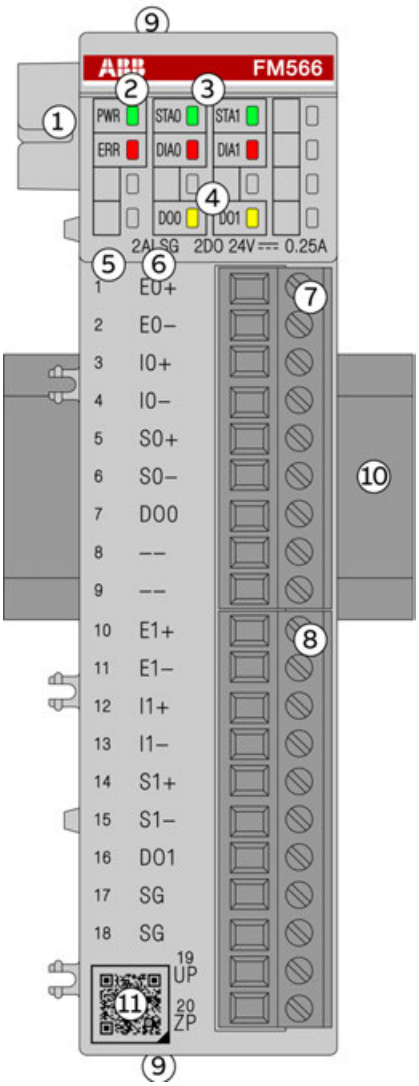
Ordering data

Part no.	Description	Product life cycle phase *)
1SAP238000R0001	FM565, function module, 1 AI, strain gauge input; 1 DO, 24V DC output	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.4.6.1.2 FM566 - Strain gauge module

- 2 configurable analog SG (strain gauge) inputs (E0, I0 and S0; E1, I1 and S1) and 2 digital outputs (DO0, DO1) in 2 groups
- Resolution: 24/28 bits under normal mode; 16/24 bits under oversampling mode



1 I/O bus
2 1 green LED to display power supply, 1 red LED to display error
3 2 green LEDs to display the state of 2 input channels, 2 red LEDs to display the diagnosis of 2 input channels
4 2 yellow LEDs to display the state of 2 output channels
5 Terminal number
6 Allocation of signal name
7 Terminal block for SG channel signals (9-pin)
8 Terminal block for SG channel signals (11-pin)
9 2 holes for wall-mounting with screws
10 DIN rail
11 QR code for datasheet

Intended purpose

The strain gauge module FM566 provides 2 analog inputs and 2 digital outputs. It can be used at the following devices:

- S500 communication interface modules (e.g. CI50x-PNIO, CI51x-ETHCAT, CN52x-MODTCP, CI54x-DP, CI58x-CN)
- AC500 CPUs

FM566 contains the following features:

- Connection type: 4-wire, 4-wire enhanced, 6-wire strain gauges
- 4.2 V DC max supply voltage of full bridge
- Input range: ±1... 255 mV/V, 24 bits (28 bits, library solution); 16 bits/24 bits oversampling
- Galvanically isolated inputs from other electronic circuitry including I/O bus
- Independently configurable per channel
- Channel status indicated by LEDs
- Digital output 250 mA@24 V per channel, with short-circuit, overtemperature and over-voltage protection

The inputs are not galvanically isolated from each other.

Isolated between system power L+/M and process voltage UP/ZP.

Functionality

2 analog inputs, individually configurable:

- Not used (default)
- 4-wire strain gauge
- 4-wire strain gauge enhanced
- 6-wire strain gauge

2 digital outputs, individually configurable:

- Not used (default)
- General 24V digital output
- Event - Upper limit trigger
- Event - Lower limit trigger
- Event - Window output
- Event - Sync signal
- Event - Application FB

Parameter		**Value**
Resolution of the analog channels		
Weight	Normal mode	23 bits plus sign 27 bits plus sign (library solution)
	Oversampling mode - 24 bit	23 bits plus sign
	Oversampling mode - 16 bit	15 bits plus sign
LED displays		8 LEDs: power, error, input state, diagnosis and output state
Internal supply		Via I/O bus
External supply		Via the terminals UP (process voltage 24 V DC) and ZP (0 V DC)

Strain gauge measurement and control functions:

- Sensor calibration
- Parameters read/write
- Weight measurement
- Event capture
- Window monitoring
- Diagnosis *Chapter 5.4.6.1.2.7 “Diagnosis” on page 909*

Connections



For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection is carried out by using a removable 9-pin and a 11-pin terminal block. These terminal blocks differ in their connection system (spring terminals or screw terminals, cable mounting from the front or from the side). The terminal blocks are not included in the module's scope of delivery and must be ordered separately.

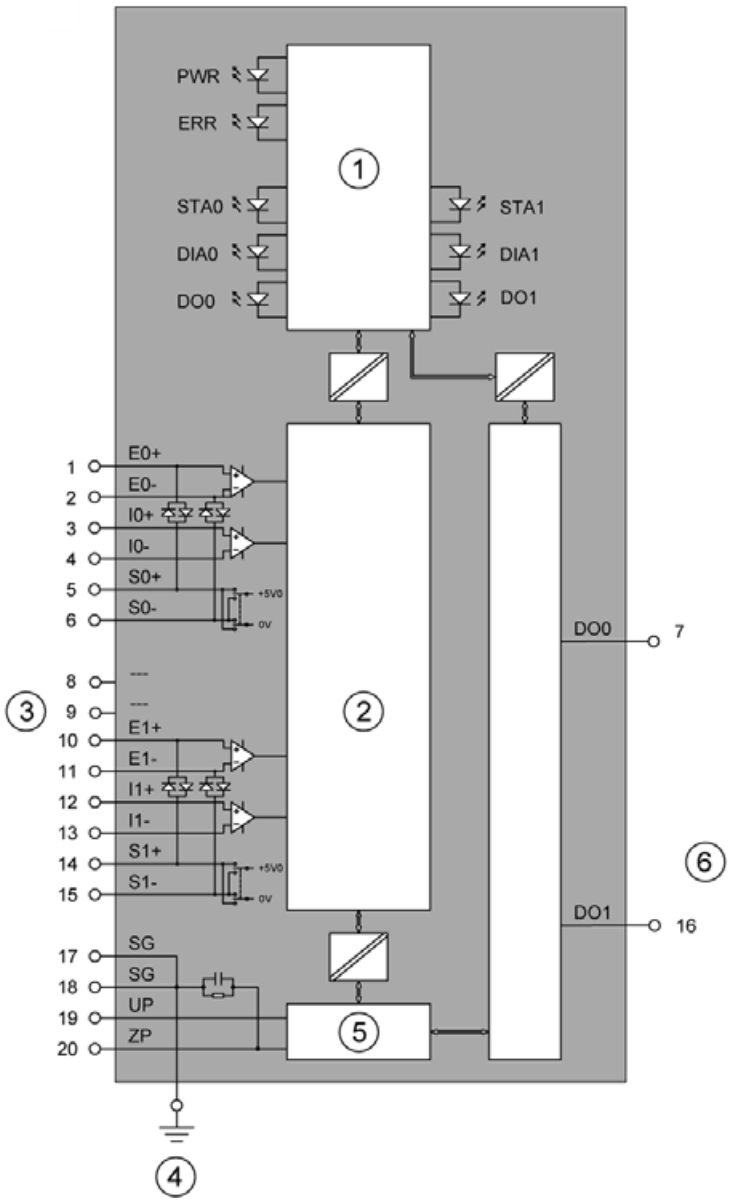


Fig. 155: Internal construction of the analog input and digital output

1 I/O bus interface and MCU core circuit
2 ADC and logic circuit
3 Analog inputs
4 Functional earth connection
5 Fly-back DC/DC power supply
6 Digital outputs

Table 286: Assignment of the terminals

Terminal	Signal	Description
1	E0+	Positive pole of excitation voltage, channel 0
2	E0-	Negative pole of excitation voltage, channel 0
3	I0+	Positive pole of strain gauge measurement signal, channel 0
4	I0-	Negative pole of strain gauge measurement signal, channel 0

Terminal	Signal	Description
5	S0+	Positive pole of strain gauge sense voltage, channel 0
6	S0-	Negative pole of strain gauge sense voltage, channel 0
7	DO0	Digital output, channel 0
8, 9	---	Reserved
10	E1+	Positive pole of excitation voltage, channel 1
11	E1-	Negative pole of excitation voltage, channel 1
12	I1+	Positive pole of strain gauge measurement signal, channel 1
13	I1-	Negative pole of strain gauge measurement signal, channel 1
14	S1+	Positive pole of strain gauge sense voltage, channel 1
15	S1-	Negative pole of strain gauge sense voltage, channel 1
16	DO1	Digital output, channel 1
17	SG	Shield grounding
18	SG	Shield grounding
19	UP	Process voltage UP (24 V DC)
20	ZP	Process voltage ZP (0 V DC)



There is galvanic isolation between the analog circuitry and ZP/UP. Therefore, the analog sensors must be galvanically isolated in order to avoid loops via the ground potential or the supply voltage.

The internal power supply voltage for the module's circuitry is carried out via the connection to CPU. Thus, the current consumption from 24 VDC power supply at the terminals L+ and M of the CPU module increases by 5 mA per FM566.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing the following:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

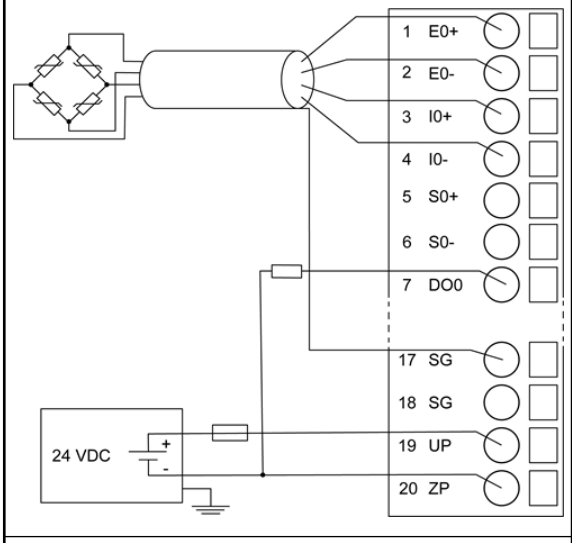
Generally, analog signals must be laid in shielded cables. The cable shields must be grounded at both sides of the cables. To avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

The process voltage must be included in the grounding concept of the control system (e.g. grounding the negative pole).

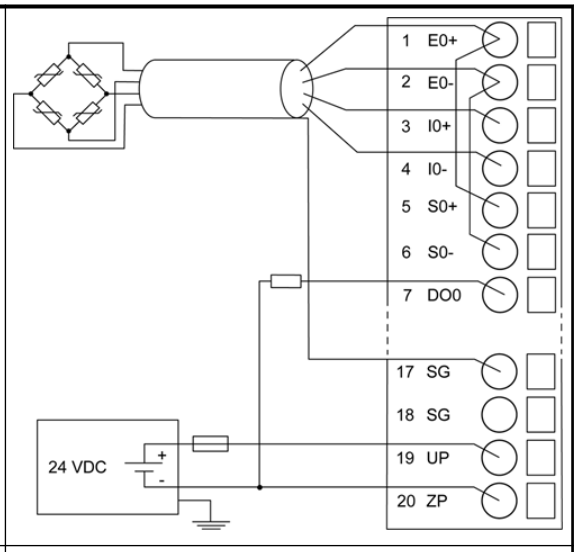
By installing equipotential bonding conductors between the different parts of the system, it must be made ensured that the potential difference between ZP and AGND never exceeds 1 V.

The module provides several diagnosis functions *Chapter 5.4.6.1.2.7 “Diagnosis” on page 909*.

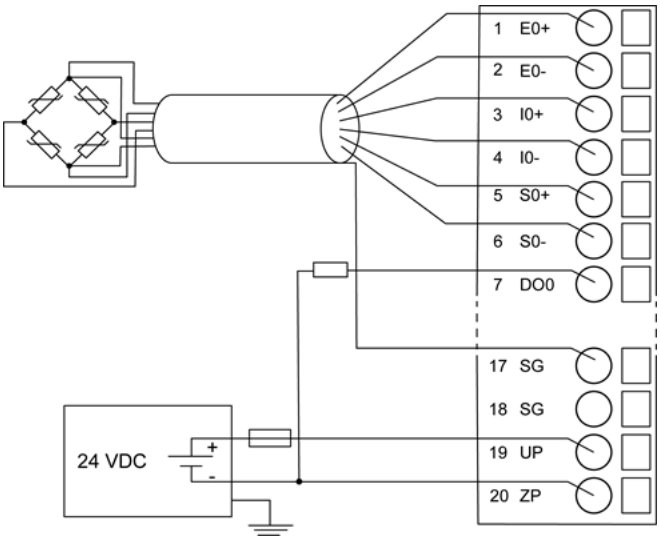
The following figures show the connection of the module:



4-wire connection



4-wire enhanced connection



6-wire connection

With 4-wire or 4-wire enhanced connection, the resistance of the connection wires influences the accuracy of the measured value. Use 6-wire connection to achieve the guaranteed measuring accuracy.

The meaning of the LEDs is described in *Chapter 5.4.6.1.2.8 “State LEDs” on page 910*.

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the CPU module during power-up of the system.

Parameterization

The arrangement of the parameter data is performed with Automation Builder software. Internal parameters are accessed via function blocks .

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module parameters

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Intern	1860[1)]	WORD	0x744	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No 0x00			
Parameter length	Intern	48	BYTE	26	0	255	xx02[2)]
Check Supply	Off On	0 1	BYTE	On 0x01	0	1	
Analog Data Format	Default	Default = 0 Factory 1 = 0xFD Factory 2 = 0xFE Factory 3 = 0xFF	BYTE	0x00	0	255	
[1)]with CS31 and addresses less than 70, the value is increased by 1 [2)]Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1 ... n)							

Input channel (2x)

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.
Input channel configuration	↳ *Table 287 "Input channel configuration" on page 905*		BYTE	Not used		
Input acquiring mode configuration[1)]	Normal Oversampling - 24 bit Oversampling - 16 bit	0 1 2	BYTE	Normal	0	2
Input range configuration	Intern	1...255	mV/V (BYTE)	2	1	255

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.
Input sampling rate configuration	2.5 SPS 5 SPS 10 SPS 16.6 SPS 20 SPS 50 SPS 60 SPS 100 SPS 400 SPS 1200 SPS 2400 SPS 4800 SPS 7200 SPS 14400 SPS Application	0 1 2 3 4 5 6 7 8 9 10 11 12 13 20	BYTE	20 SPS	2.5 SPS	14400 SPS
Input frequency filter configuration	50 Hz 60 Hz Disable 50 Hz & 60 Hz	0 1 2 3	BYTE	50 Hz	0	3
Input check channel	Diagnosis Not used	0 3	BYTE	Diagnosis	0	3
Input unit configuration of weight[2)]	Relative kg lbf t Application	0 1 2 3 4	BYTE	Relative	0	4
Input reference configuration of weight[3)]	Rated weight Weight per nV/V Application - Rated weight Application - Weight per nV/V	0 1 2 3	BYTE	Rated weight	0	3
Input rated weight/stress[4)]	0...100000000	0...100000000	DWORD	100000000		
Input upper limit	1000...1500	1000...1500	‰ (INT)	1500	1000	1500
Input lower limit	-1500...0	-1500...0	‰ (INT)	-1500	-1500	0
Input upper limit hysteresis	0...1500	0...1500	‰ (INT)	1450	0	1500
Input lower limit hysteresis	-1500...0	-1500...0	‰ (INT)	-1450	-1500	0

Remarks:

1)	Set the input sampling rate >= 400 SPS to enable oversampling mode.
2)	"kg", "lbf","t" conversion only supported by normal mode and oversampling - 24bit mode (function blocks: SgxMeasurement24Bit, SgxMeasurement28bit, SgxOversampling24Bit). If "Application" is slected, the unit will be defined in FB input.
3)	If "Application - Rated weight" or "Application - Weight per nV/V" is selected, the actual weight will be calculated based on the value set for internal parameters "Rated weight" and "Weight per nV/V"respectively .
4)	For 24 bit mode, the range is 0...100000000; for 16 bit mode, the range is 0...10000.

Table 287: Input channel configuration

Internal value	Value	Description
0	Not used	
66	4-wire strain gauge	“S0+” & “S0-”, “S1+”& “S1-” not connected
67	4-wire strain gauge enhanced	“S0+” & “S0-” connected to “E0+” & “E0-”, “S1+” & “S1-” connected to “E1+” & “E1-”. Sensor bridge without amplifier, wide operating voltage.
68	6-wire strain gauge	

Output channel (2x)

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.
Output channel configuration	*Table 288 “Output channel configuration” on page 905*		BYTE	Not used	0	105

Table 288: Output channel configuration

Internal value	Value	Description
0	Not used	-
100	General 24V digital output	DO sends a 24 V signal when the "Dout" field in function blocks is set as 1.
101	Event - Upper limit trigger[1)2)]	DO = 1, the measurement is above the input upper limit. DO = 0, the measurement is below the upper limit hysteresis.
102	Event - Lower limit trigger[1)2)]	DO = 1, the measurement is below the input lower limit. DO = 0, the measurement is above the lower limit hysteresis.

Internal value	Value	Description
103	Event - Window output[1)]	DO = 1, the measurement is above the upper limit or below the lower limit. DO = 0, the measurement is in the normal range.
104	Event - Sync signal[1)]	DO indicates the “done” signal of measurement.
105	Event - Application FB[1)3)]	DO indicates the status of the function block used. ● Function blocks "SgxWindowMonitoring", "SgxMeasurement24Bit", "SgxMeasurement28bit", "SgxOversampling16Bit", "SgxOversampling24Bit": DO = 1, upper/lower limit (internal parameter) reached. ● Function block "SgxEventCapture": DO = 1, upper/lower limit (internal parameter/limit set in "SgxEventCapture") reached.

Remarks:

1)	”Dout” field in the function blocks will be ignored. Change of this field will not influence the DO state.
2)	DO state remians unchanged when the new measurment is between the limit value and the limit hysteresis.
3)	Set "Irq" as TRUE to enable the event trigger of digital output.

GSD file:

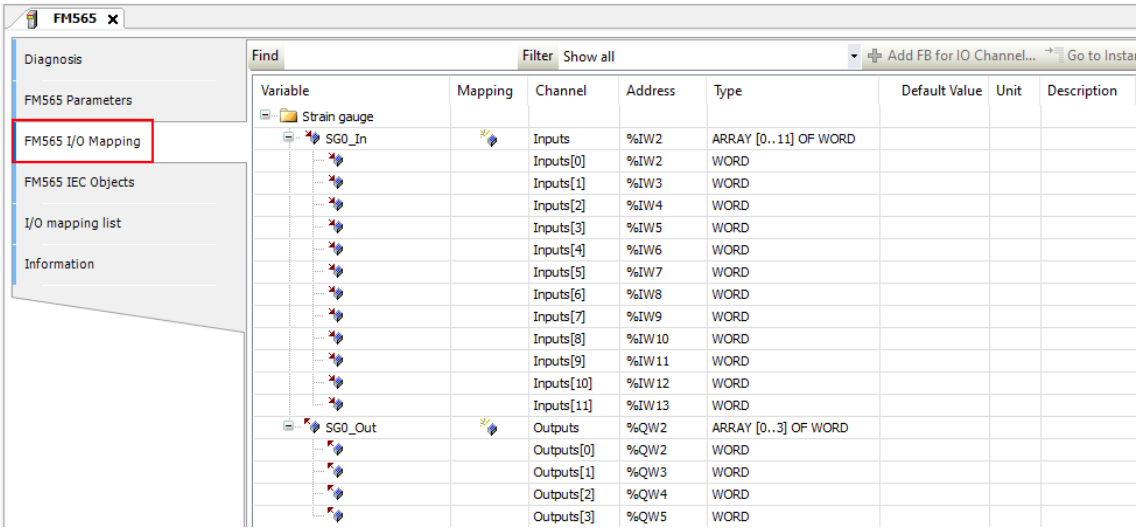
Ext_User_Prm_Data_Len =	0x35
Ext_User_Prm_Data_Const(0) =	0x45, 0x07, 0x1A, 0x01, 0x00, 48(0x00)

I/O Mapping

I/O mapping is to link the physical I/O channels to the variables used in the program. For SG modules, weight measurement and control functions are realized via function blocks. Two libraries are provided for function block I/O accessing and serve as the foundation for function blocks calling.

I/O Mapping list

Variable names/symbols can be mapped to the channels in the I/O mapping list in Automation Builder. The names created can be called directly in the program.



1. Double click the module in the device tree, and click tab “FM565/FM566 I/O Mapping” to open the editor.

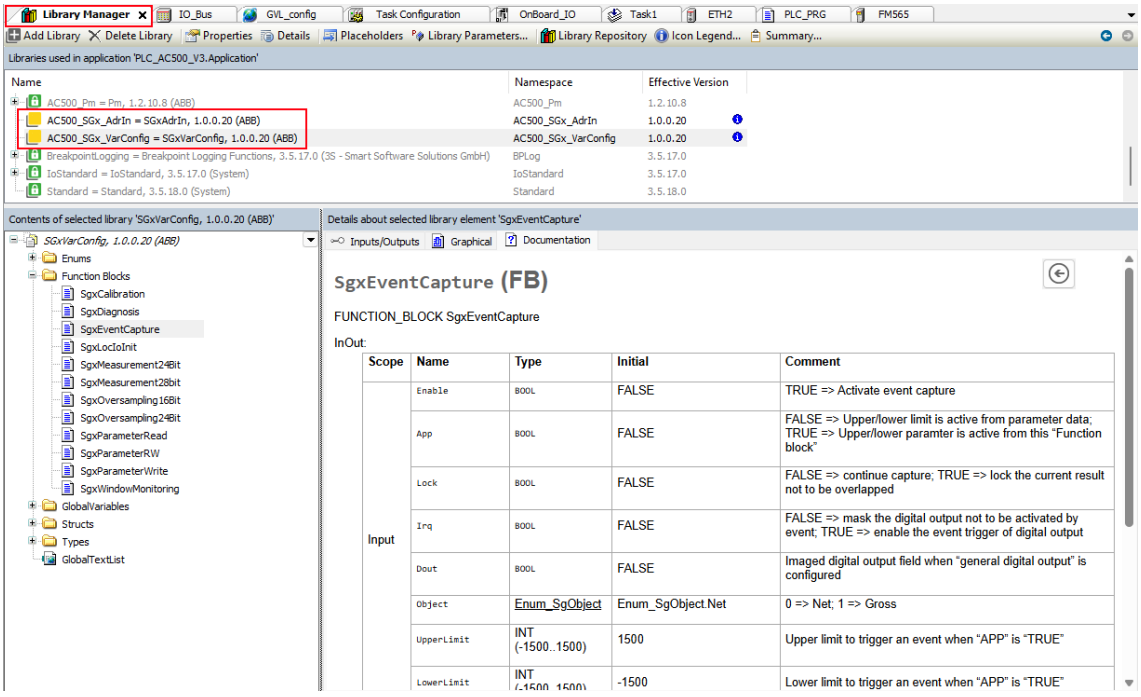
2. Create the variable names/symbols for the SG channel in the variable column.

I/O access library

> *To use the control functions of SG modules, the inputs and outputs image of function blocks must first be connected to the instants by calling function block "SGxLocIoInit" in the library.*

Function block I/O is mapped to the variables via two libraries:

- AC500_SGx_AdrIn_Factory_BigEndian_vxxx
- AC500_SGx_VarConfig_Factory_BigEndian_vxxx



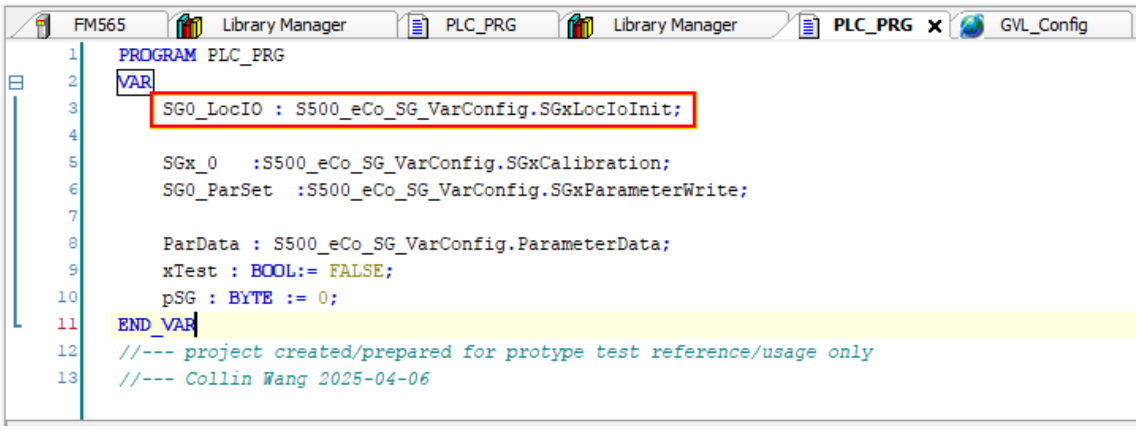
In address based access

TBD

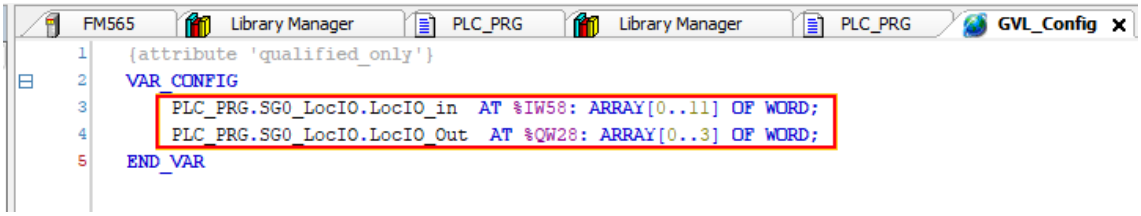
Var_Config based access

Call function block “SGxLocIoInit” in library VarConfig for I/O mapping before calling other function blocks in this library.

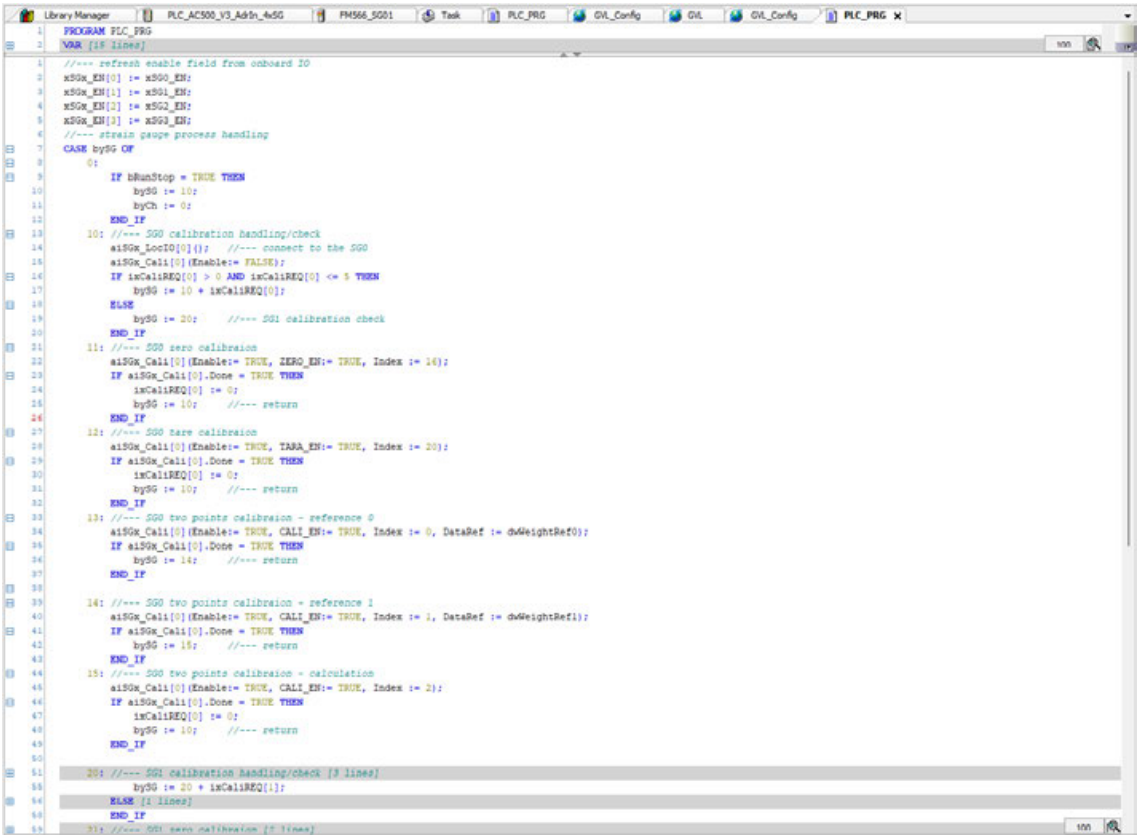
1. Create an instant with function block “SGxLocIoInit” in "PLC_PRG".



2. Create variables with VAR_CONFIG declaration in GVL tab with instant “SG0_LocIO”, and assign the image I/O to address “AT %IWxx” and “AT %QWxx”



3. Call instant “SG0_LocIo()” to map the function block I/O to the address. Once an initialization is called, the mapped I/O is automatically connected to function block of strain gauge library.



Diagnosis

E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500 display	<– Display in	
Class	Comp	Dev	Mod	Ch	Err	AB SW		
Byte 6 Bit 6 ... 7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0 ... 5	PNIO diagnosis block		
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**		**Remedy**
	1)	2)	3)	4)				
Module error								
3	14	1 ... 10	31	31	19	Checksum error in the I/O module		Replace I/O module
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	9	Overflow diagnosis buffer		Restart
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	26	Parameter error		Check master
	11 / 12	ADR	1 ... 10					
3	14	1 ... 10	31	31	11	Process voltage too low		Check process voltage
	11 / 12	ADR	1 ... 10					
Channel error								
4	14	1 ... 10	1	0 ... 7	4	Measurement overflow		Check input value
	11 / 12	ADR	1 ... 10					

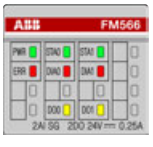
E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500 display	<– Display in	
Class	Comp	Dev	Mod	Ch	Err	AB SW		
Byte 6 Bit 6 ... 7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0 ... 5	PNIO diagnosis block		
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**		**Remedy**
	1)	2)	3)	4)				
4	14	1 ... 10	1	0 ... 7	7	Measurement under-flow		Check input value
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	1	0 ... 7	47	Short circuit at the analog input E0+/E0-, E1+/E1-, S0+/S0- or S1+/S1-		Check output wiring
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	1	0 ... 7	48	Broken wire at an analog input*		Check input value or terminal
	11 / 12	ADR	1 ... 10					

* In development

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = expansion module 1...10, ADR = hard-ware address
3)	With "Module" the following allocation applies dependent of the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus or PNIO = module type (1 = AI); COM1/ COM2: 1 ... 10 = expansion 1 ... 10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON	LED flashes
	PWR	Process voltage 24 V DC via terminal	Green	CPU module voltage or external 24 V DC supply voltage is missing	3.3 V system voltage (I/O bus) and external 24 V DC supply voltage are present	—

LED		State	Color	LED = OFF	LED = ON	LED flashes
	ERR	Channel or module error	Red	No error or process voltage is missing	Severe error in the module	Error in 1 or more channels of the module
	STA0/ STA1	Channel state	Green	Not measuring	Measuring	—
	DIA0/ DIA1	Channel error	Red	No error in channel	Error in channel	—
	DO0/ DO1	Digital output	Yellow	DO off	DO on	—

Measuring ranges

FM565/FM566 needs typ. 6 to 8 seconds for initialization after applying the process supply voltage to clamp UP/ZP. During this time, the accuracy of the measurement values is not within specification. After that, valid measurement values are provided by the module.

After an interruption of the process supply voltage > 10 ms, a re-initialization is performed by the module.

Risk of invalid analog input values!

The analog input values may be invalid if the measuring range of the inputs is exceeded.

Make sure that the analog signal at the connection terminals is always within the signal range.

Table 289: Input range for 24 bit/28 bit mode

Range	Measured value (relative)	Digital value (decimal)
Overflow	> +150 %	≥ 150000001
Overshoot	150 %	150000000
	> +100 %	≥ 100000001
Normal	+100 %	+100000000
	0	0
	-100%	-100000000
Underage	< -100%	≤ -100000001
	-150%	-150000000
Underflow	< -150%	≤ -150000001

Table 290: Input range for 16 bit mode

Range	Measured value (relative)	Digital value (decimal)
Overflow	> +150 %	≥ 15001
Overshoot	150 %	15000
	> +100 %	≥ 10001

Range	Measured value (relative)	Digital value (decimal)
Normal	+100 %	+10000
	0	0
	-100%	-10000
Underage	< -100%	≤ -10001
	-150%	-15000
Underflow	< -150%	≤ -15001

Technical data

The system data of AC500-eCo apply.

Chapter 4.1 “System data AC500-eCo” on page 25

Only additional details are therefore documented below.

Technical data of the module

The system data of AC500-eCo apply.

Chapter 4.1 “System data AC500-eCo” on page 25

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage UP		
	Connections	Terminal 19 for UP (+24 V DC) and terminal 20 for ZP (0 V)
	Rated value	24 V DC
	Current consumption	0.05 A + DO loads
	Inrush current (at power-up)	Typ. 0.1 A^2s; Max. 0.16 A^2s
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Protection fuse for UP	Yes, external additional fuse recommended
Current consumption from 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module		Ca. 5 mA
Galvanic isolation		Yes, between the input group and the rest of the module. Isolation voltage 500 V DC.
	Isolated groups	1 (2 channels per group)
Surge-voltage (max.)		35 V DC for 0.5 s
Max. power dissipation within the module		1.5 W
Weight		Ca. 120 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

Technical data of the analog inputs

Parameter		Value	
Number of channels per module		2 configurable analog inputs	
Distribution of channels into groups		1 (2 channels per group)	
Resolution			
Weight	Normal	24 bits / 28 bits	
	Oversampling - 24 bit	24 bits	
	Oversampling - 16 bit	16 bits	
Connection of the signals E0+, I0+, S0+, E1+, I1+ and S1+		Terminals 1, 3, 5, 10, 12 and 14	
Connection of the signals E0-, I0-, S0-, E1-, I1- and S1-		Terminals 2, 4, 6, 11, 13 and 15	
Input type		Differential, a full-bridge strain gauge	
Galvanic isolation		500 V DC between input and internal IO bus 500 V DC between input and process voltage	
Configurability		Not used 4-wire strain gauge[1)] 4-wire strain gauge enhanced[2)] 6-wire strain gauge	
Indication of the input signals		2 LEDs per channel, green for state and red for diagnosis	
Channel input resistance		> 100 kΩ	
Input filter attenuation		-3 dB at 14 kHz	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range[3)]		Typ.	0.05 % of full scale at 25 °C
		Max.	±0.5 % of full scale at -20 °C ... +60 °C or EMC disturbance
Analog to digital conversion time		Determined by "sampling rate" and "acquiring mode". Min. 100 µs when function block "Event capture" or "Window monitoring" is applied.	
Input data length		48 bytes	
Protection		Max. 30 V DC overvoltage protection for I0+/- or I1+/- Short circuit protection for E0+/-, E1+/-, S0+/- or S1+/-	
Repeatability		0.05 % of full scale	
Permissible sensor load		80 ... 5000 Ω	
Excitation voltage		Max. 4.2 V DC / Max. 50 mA per channel	
Measurement range		±1 mV/V ... 255 mV/V	
Max. cable length (conductor cross section > 0.14 mm²)			
	Shielded wire	500 m	

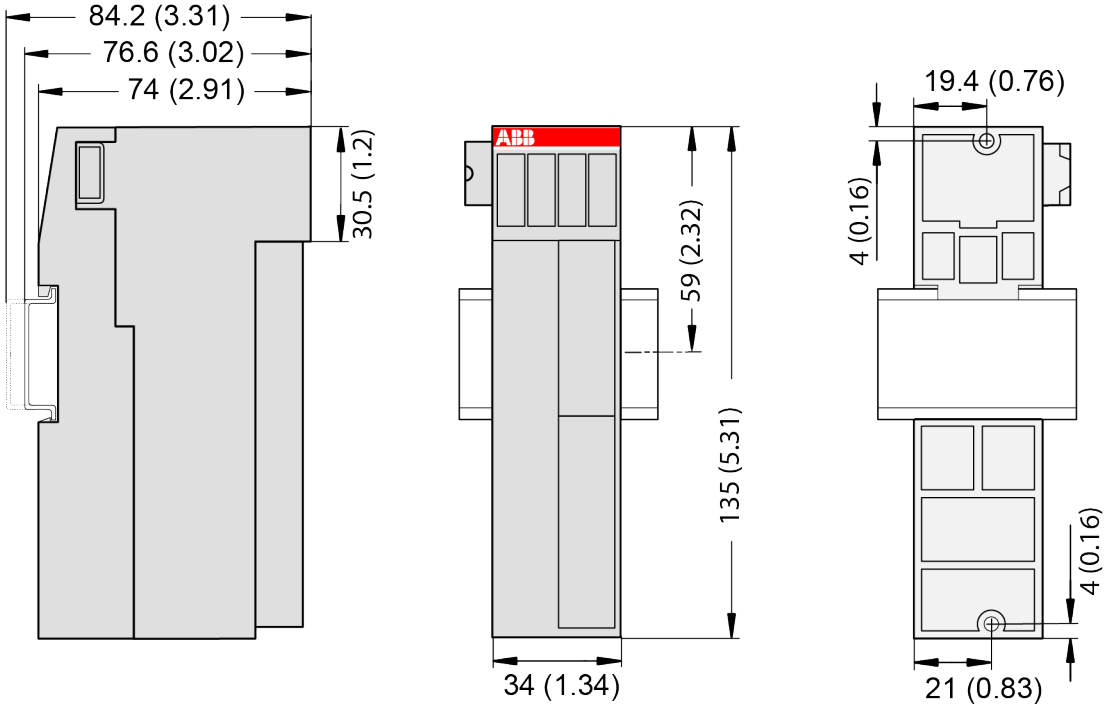
Remarks:

1)	“S0+” & “S0-”; “S1+” & “S1-” not connected
2)	“S0+” & “S0-”; “S1+” & “S1-” short connected to “E0+” & “E0-”; “E1+” & “E1-” respectively
3)	For 4-wire or 4-wire enhanced connection, the cable should be as short as possible to reduce error. If the cable is long, use 6-wire connection to achieve the guaranteed measuring accuracy.

Technical data of the digital outputs

Parameter		Value
Number of channels per module		2 configurable digital outputs (24 V DC)
Distribution of channels into groups		1 (2 channels per group)
Connection of the signal DO0, DO1 and ZP		Terminals 7, 16 and 20
Output type		Source output
Galvanic isolation		500 V DC
Min. output voltage at signal 1		20 V DC at max. current consumption
Output delay (max. at rated load)		
	0 to 1	150 µs
	1 to 0	200 µs
Output current		
	with resistive load, max.	0.25 A
	with inductive load, max.	0.25 A
	with lamp load, max.	2 W
Max. leakage current with signal 0		0.1 mA
Configurability		Not used General 24 V digital output Event - Upper limit Event - Lower limit Event - Window output Event - Sync signal Event - Application FB
Indication of the output signal		1 yellow LED per channel, the LED is on when the output signal is high (signal 1)
Output data length		16 bytes
Overload or short circuit protection		Yes
Max. cable length		
	Unshielded wire	150 m
	Shielded wire	500 m

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

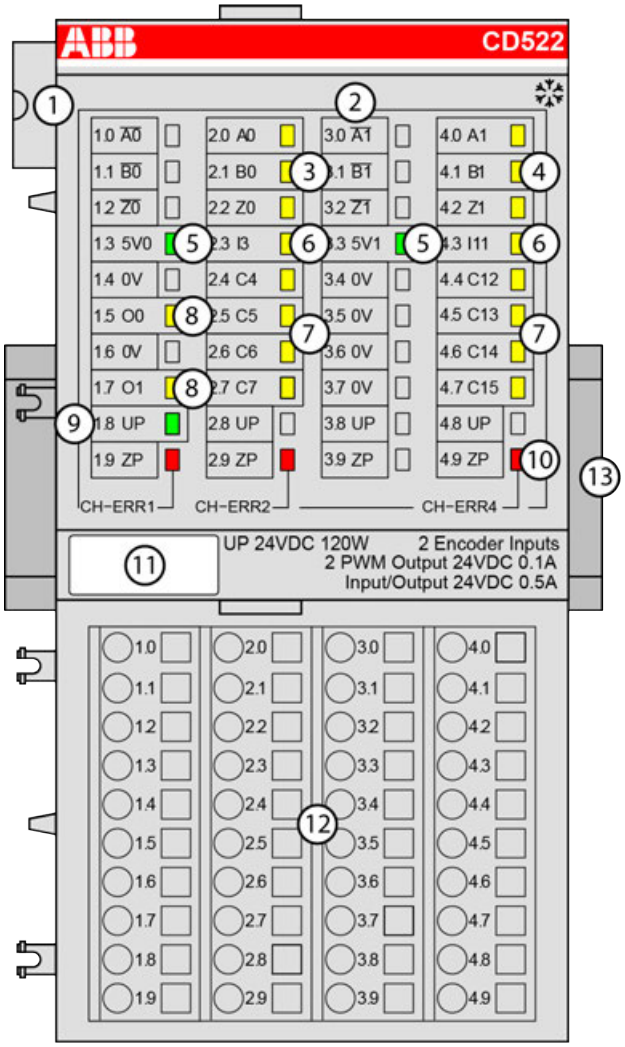
Part no.	Description	Product life cycle phase *)
1SAP238100R0001	FM566, function module, 2 AI, strain gauge input; 2 DO, 24V DC output	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

> *) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

5.4.6.2 S500 and S500-XC

5.4.6.2.1 CD522 - Encoder, counter and PWM module

- 2 encoder inputs with 2 integrated 5-V-power-supplies for the encoders
- 2 PWM outputs - 2 digital inputs 24 V DC
- 8 configurable digital inputs/outputs 24 V DC
- Fast counter
- Module-wise galvanically isolated
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation of terminal No. and signal name
3 3 yellow LEDs to display the signal states of the encoder 0 input
4 3 yellow LEDs to display the signal states of the encoder 1 input
5 2 green LEDs to display the 5-V-power-supply states
6 2 yellow LEDs to display the signal state of the digital input I3 and I11
7 8 yellow LEDs to display the input/output signal states
8 2 yellow LEDs to display the signal states of the PWM/pulse outputs

9 1 green LED to display the process voltage UP
10 3 red LEDs to display errors
11 Label
12 Terminal unit
13 DIN rail
❄ Sign for XC version

Intended purpose

The encoder and PWM module CD522 can be used at the following devices:

- Communication interface modules (e. g. CI501-PNIO, CI541-DP)
- Processor modules

Features:

- 2 independent counting functions with up to 12 configurable modes (including incremental position encoder and frequency input up to 300 kHz).
- 2 independent PWM (pulse-width modulator) or pulse outputs with push-pull driver.
- Dedicated inputs/outputs for specific counting functions (e.g. touch, set, reset).
- All unused inputs/outputs can be used with the specifications of standard inputs/outputs range.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

Depending on the configuration used, some inputs and outputs are dedicated to specific counting functions (touch, set, reset…). All unused inputs and outputs can be used with the specification of standard inputs/outputs range.

Functionality

Digital inputs/outputs	24 V DC, dedicated inputs/outputs can be used for specific counting functions: - Catch/touch operation, counter value stored in separate variable on external event (rising or falling edge) - Set input to preset counter register with predefined value - Set input to reset counter register - End value output; the output is set when predefined value is reached - Reference point initialization (RPI) input for incremental encoder initialization All unused inputs/outputs can be used with the specification of standard input/output range. Effect of incorrect input terminal connection: Wrong or no signal detected, no damage up to 35 V.
Fast counter/encoder	integrated, 2 counters (hardware interface with +24 V DC, +5 V DC, differential and 1 Vpp sinus input) with up to 12 configurable operation modes: - 32 bits one counter mode - 16 bits two counter mode - Incremental position encoder - Absolute SSI encoder - Time frequency meter - Frequency input up to 300 kHz
PWM/pulse outputs	2 pulse-width-modulators or pulse outputs Output specification - Push-pull output: 24 V DC, 100 mA max. - Current limitation (thermal and over current) PWM specification - Frequency from 1 Hz to 100 kHz - Value from 0 to 100 % Pulse specification - Frequency from 1 Hz to 15 kHz - Pulse emission from 1 to 65535 pulses - Number of pulses emitted indicator (0 to 100 %) Frequency specification - Frequency output = 100 kHz when duty cycle set to 50 %
Power supply for encoders	2 5V power supplies, max. 100 mA
LED displays	For signal states, errors and supply voltage
Internal power supply	Via I/O bus
External power supply	Via the terminals UP (process voltage 24 V DC) and ZP (0 V DC)
Required terminal unit	TU515 or TU516 ↳ *TU515, TU516*

How to prepare a device as fast counter and how to connect it to the PLC is described in an *application example*.

Connections

The function module CD522 can be connected to the following devices via the I/O bus connector:

- CS31 bus module DC551-CS31
- AC500 CPU
- OtherAC500 I/O devices.

The connection is carried out by using the 40 terminals of the terminal unit TU515/TU516.

↳ *Chapter 5.5.2 “TU515, TU516, TU541 and TU542 for I/O modules” on page 946*

Table 291: Assignment of the terminals

Terminal	Signal	Description
1.0	/A0	Inverted input signal A of encoder 0
1.1	/B0	Inverted input signal B of encoder 0
1.2	/Z0	Inverted input signal Z of encoder 0
1.3	5V0	+5 V DC power supply output 0 for sensors
1.4	0V	0 V reference input
1.5	O0	Output signal of the fast output O0
1.6	0V	0 V reference input
1.7	O1	Output signal of the fast output O1
1.8	UP	Process voltage UP (24 V DC)
1.9	ZP	Process voltage ZP (0 V DC)
2.0	A0	Input signal A of encoder 0
2.1	B0	Input signal B of encoder 0
2.2	Z0	Input signal Z of encoder 0
2.3	I3	Input signal I3 (standard input)
2.4 ... 2.7	C4 ... C7	Signal of the configurable digital input/output C4 ... C7
2.8	UP	Process voltage UP (24 V DC)
2.9	ZP	Process voltage ZP (0 V DC)
3.0	/A1	Inverted input signal A of encoder 1
3.1	/B1	Inverted input signal B of encoder 1
3.2	/Z1	Inverted input signal Z of encoder 1
3.3	5V1	+5 V DC power supply output 1 for sensors
3.4...3.7	0V	0 V reference input
3.8	UP	Process voltage UP (24 V DC)
3.9	ZP	Process voltage ZP (0 V DC)
4.0	A1	Input signal A of encoder 1
4.1	B1	Input signal B of encoder 1
4.2	Z1	Input signal Z of encoder 1
4.3	I11	Input signal I11 (standard input)

Terminal	Signal	Description
4.4 ... 4.7	C12 ... C15	Signal of the configurable digital input/output C12 ... C15
4.8	UP	Process voltage UP (24 V DC)
4.9	ZP	Process voltage ZP (0 V DC)

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a processor module). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 2 mA per CD522.

The external power supply connection is carried out via the UP (+24 V DC) and the ZP (0 V DC) terminals.



WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing the following:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

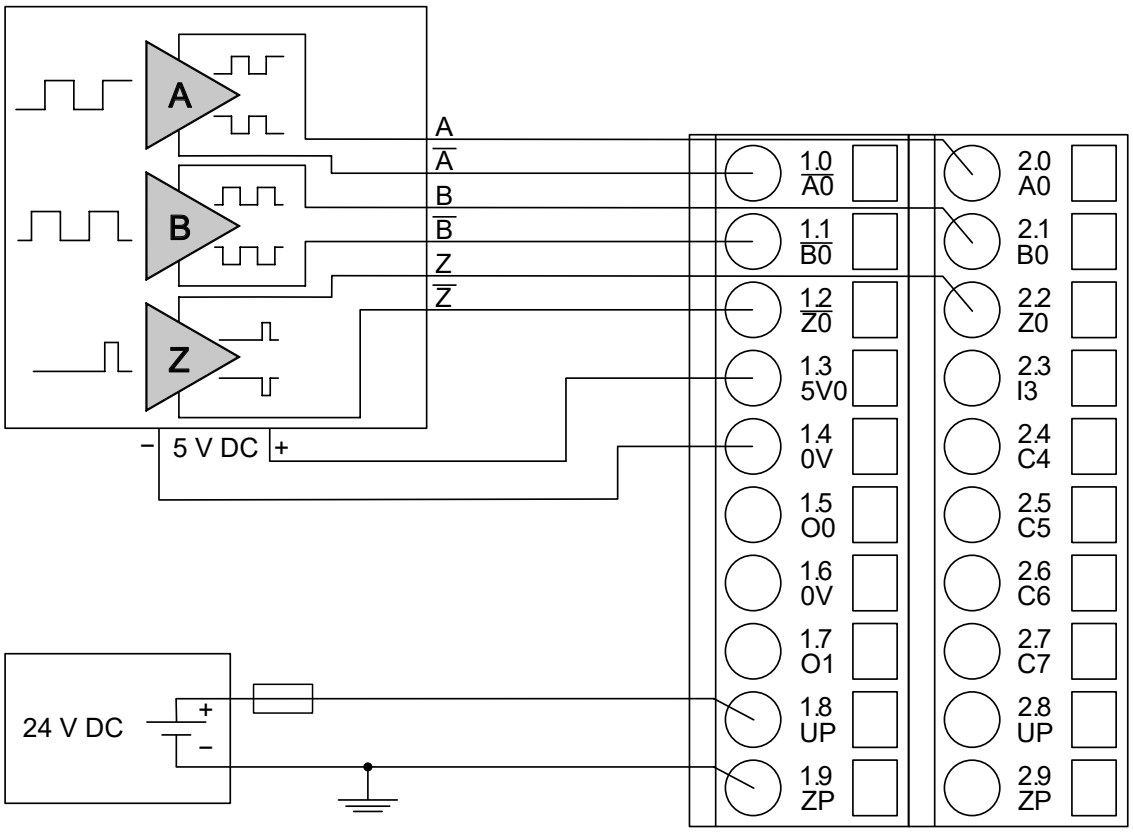
Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

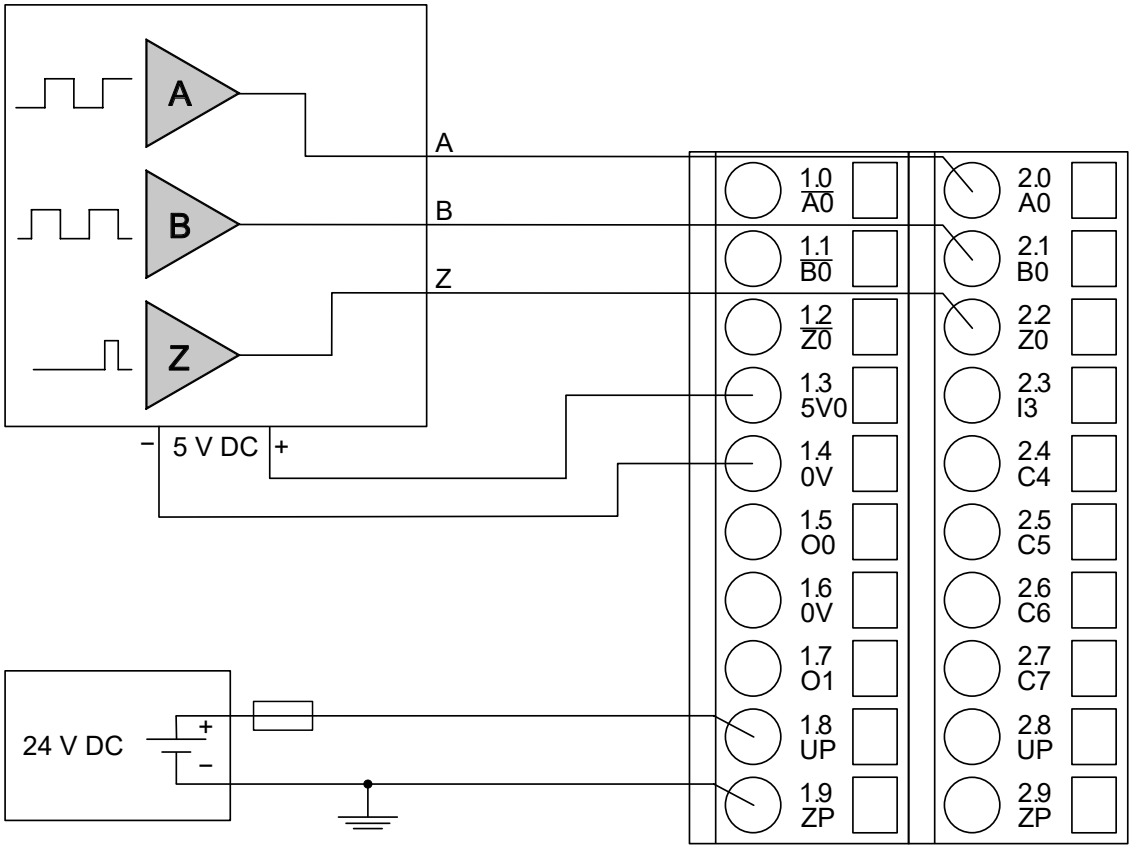
Connection of encoders with differential RS-422 signal

The encoder is powered by the 5 V power supply which is integrated in CD522.

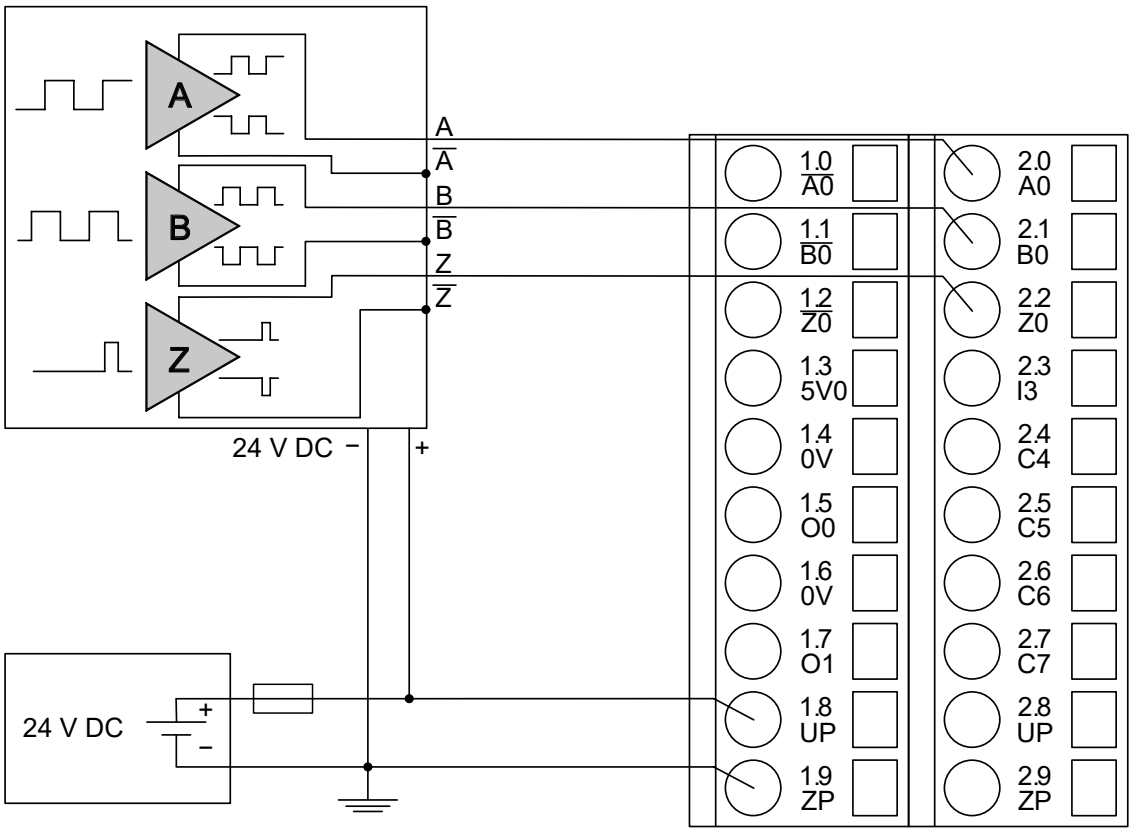


Connection of encoders with 5 V TTL signal

The encoder is powered by the 5 V power supply which is integrated in the CD522.



Connection of encoders with 24 V totem pole signal

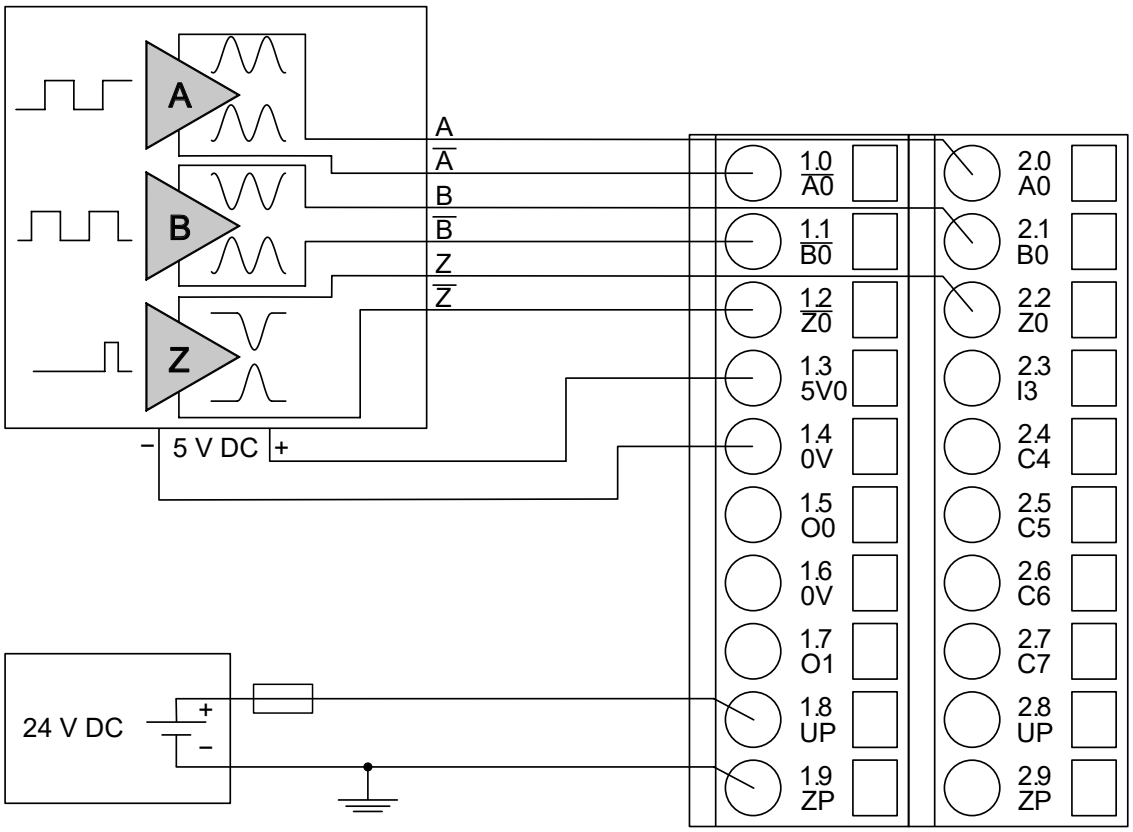


The wires A, B and Z need not to be connected to the module. They are left open.

When using different power supplies for the encoder device and the CD522, make sure that the reference potentials of both power supplies are interconnected.

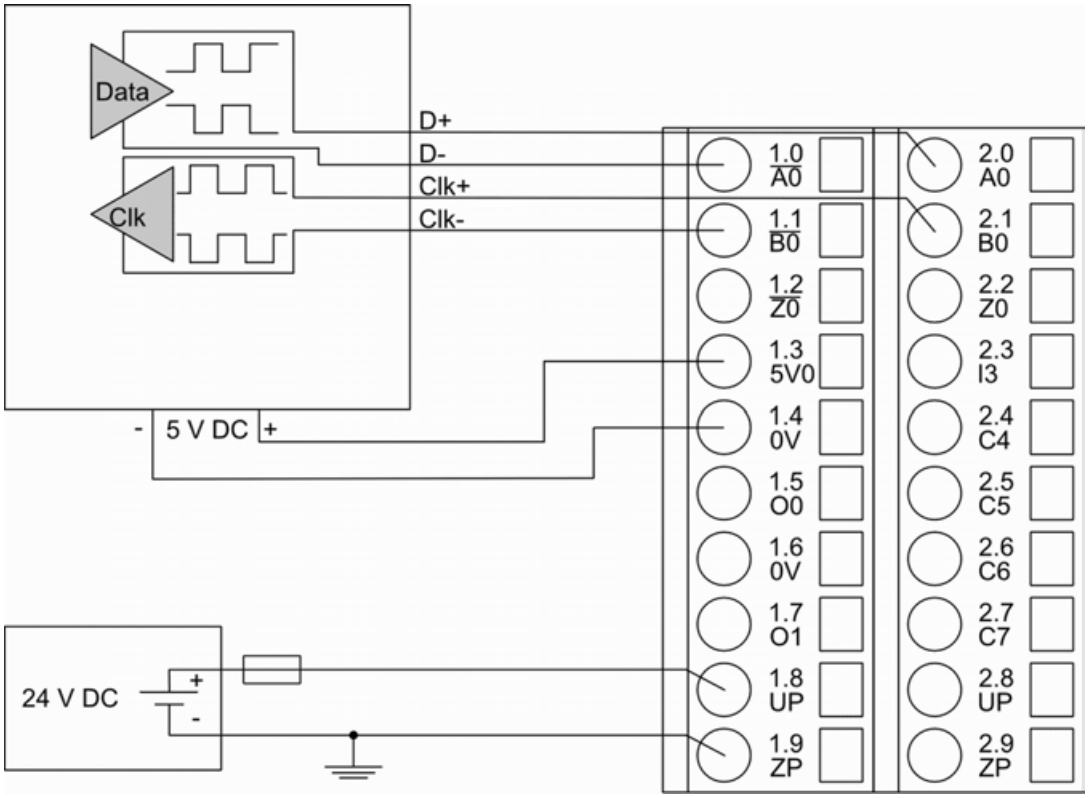
Connection of encoders with 1 Vpp sine signal

The encoder is powered through the 5 V power supply which is integrated in the CD522.



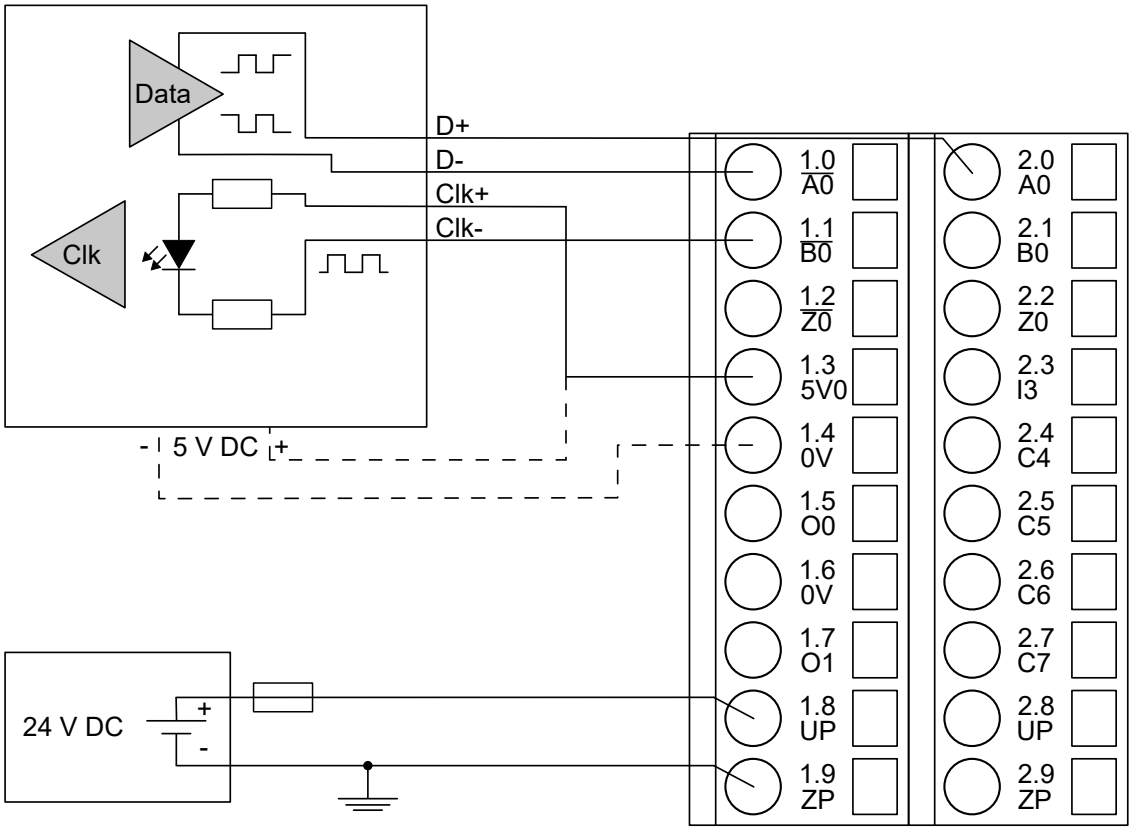
Connection of absolute encoders with SSI interface and differential RS-422 signal

The encoder is powered by the 5 V power supply which is integrated in the CD522.

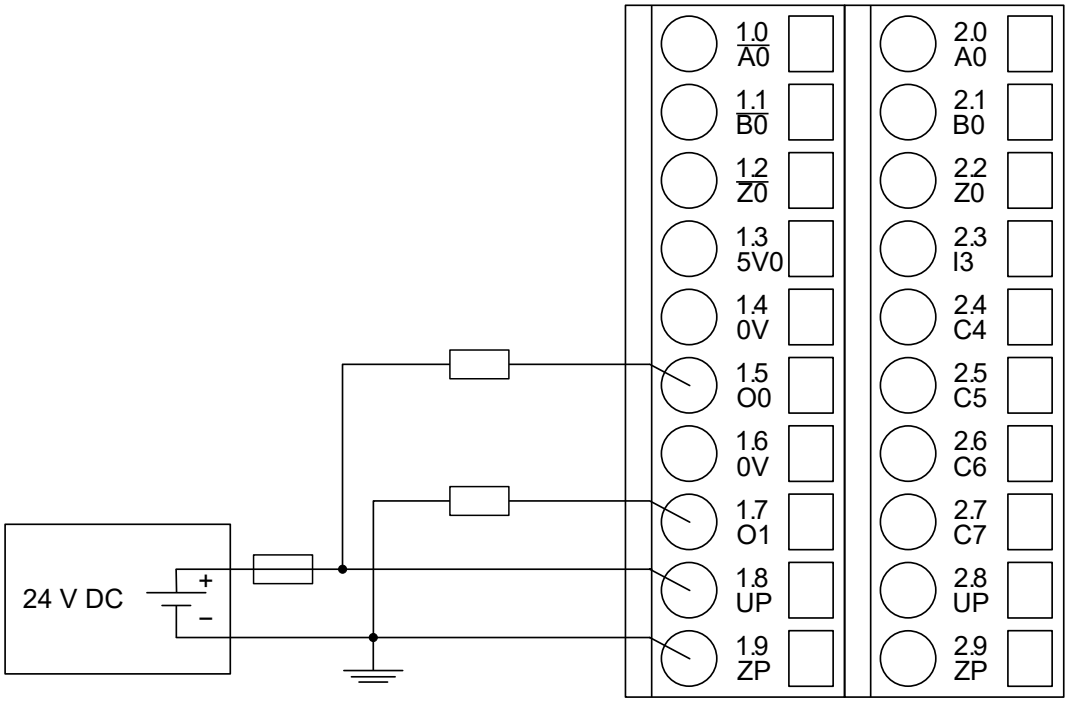


Connection of absolute encoders with an SSI interface and an optocoupler interface at CLK input

The encoder can optionally be powered by the 5 V power supply which is integrated in the CD522.



Connection of output loads to the PWM/Pulse putputs



NOTICE!

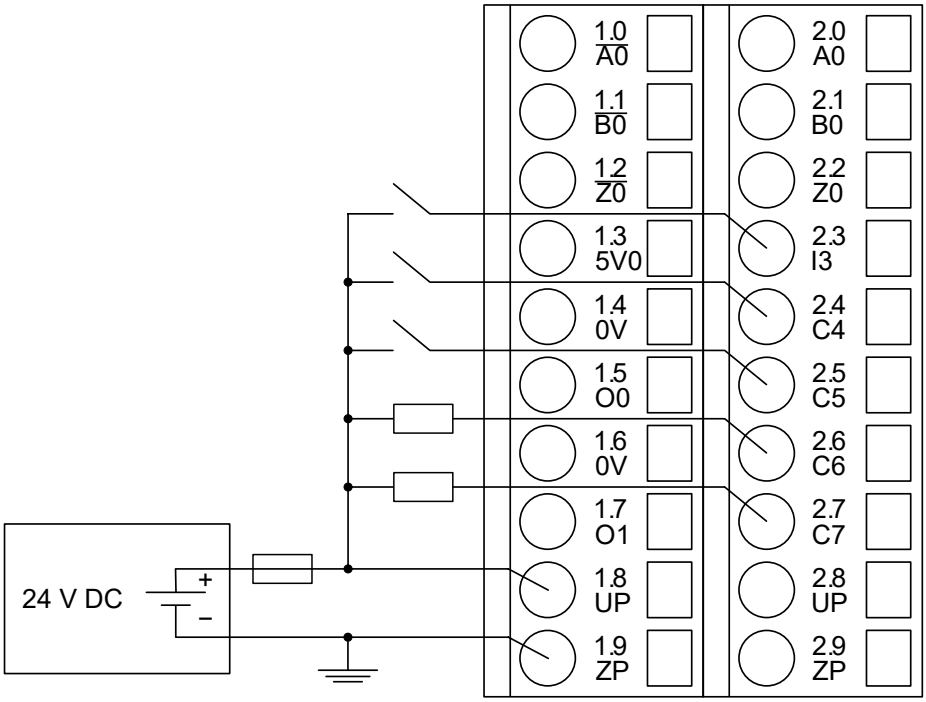
Risk of damaging the module

The PWM outputs have no protection against reverse polarity.

NOTICE!
Risk of damaging the module
The two 5 V outputs have no protection against reverse polarity.

Connection of standard inputs/ outputs

Proceed with the inputs/outputs I11 and C12 ... C15 in the same way.



Connection of sensors with frequency outputs

Proceed with the A0, B0, A1, B1 and Z1 in the same way.

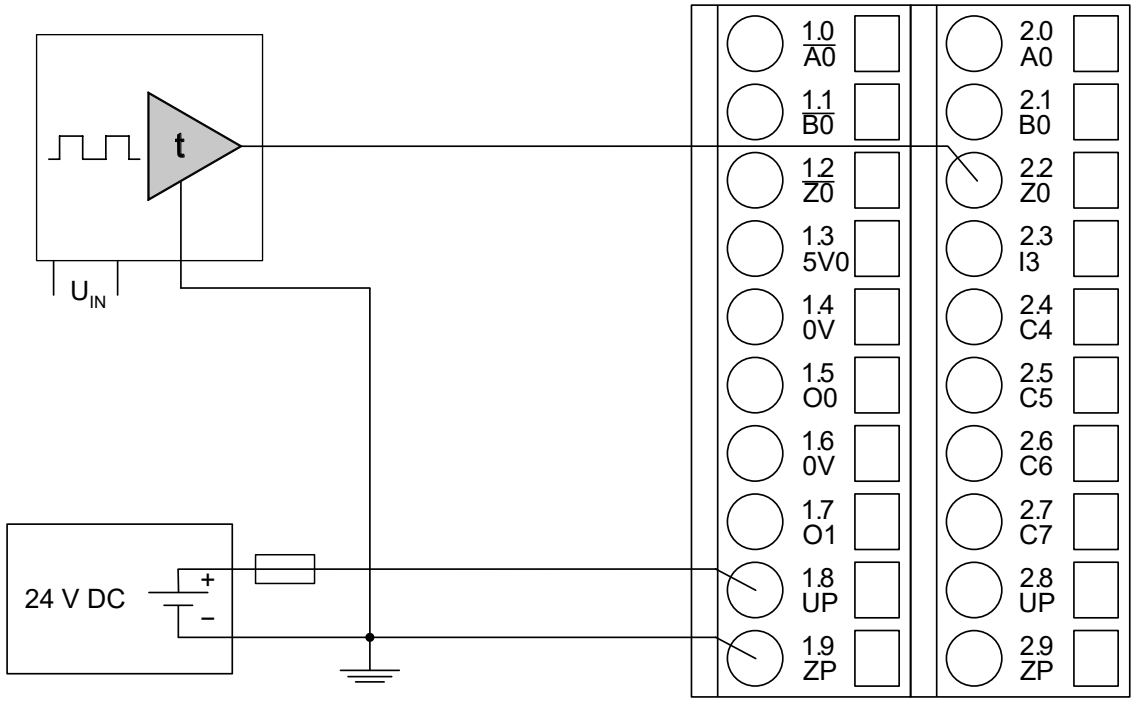


Fig. 156: Example of the connection of sensors with frequency outputs to the input Z0 of the CD522

NOTICE!

Risk of malfunctions!

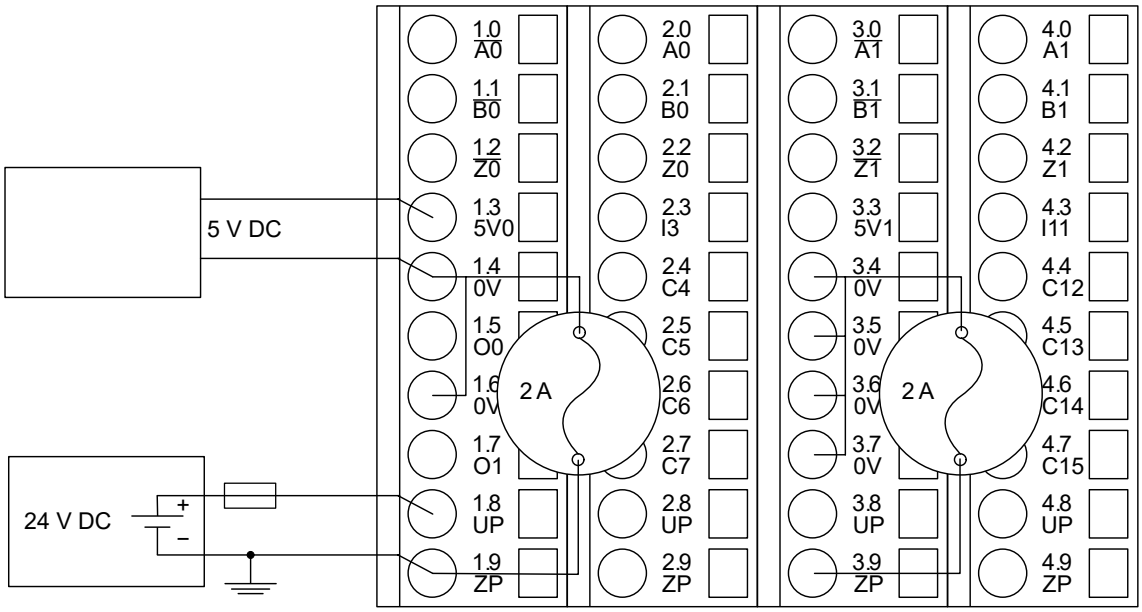
The edges of a signal must be strong enough (0.4 V/µs) to be recognized correctly by the module.

Put a 1 kΩ resistor between 0 V and the Z terminal when using a standard output as time generator.

Connection of sensors to the 5 V power supply

Proceed with the 5 V power supply 1 in the same way.

Each 5-V-power supply provides a current of 100 mA max. It is possible to parallel both integrated power supplies. In this case, the max. current is 200 mA.



NOTICE!

Risk of damaging the module

The integrated 2 A fuse cannot be replaced. If it blows, the module must be replaced.

Ensure that the current per 0 V connection does not exceed 0.5 A.

NOTICE!

Risk of damaging the module

The two 5 V outputs have no protection against reverse polarity.

Internal data exchange

Parameter	Value
Digital inputs (bytes)	0
Digital outputs (bytes)	0
Analog inputs (words)	12
Analog outputs (words)	16



The data will be transferred in 16-bit words and not in bytes. Two bytes are packed into one 16-bit word.

The bit strings are transmitted in big-endian byte order, so the bytes within the word are swapped. If several bytes are considered, the first byte (lowest address) is the largest (High Byte).

If used with AC500 please check the chapter how to configure CD522 within Automation Builder and use the CD522 library.

The types *"structCD522In"* and *"structCD522Out"* can be added in Automation Builder by using the command *"Generate DUT"* via the context menu of the CD522 device.

To use CD522 with CI50x-PNIO or CI54x-DP as unbundled IOs with other PLCs find the meaning of the IO-Data in following tables below:

From CD522 to PLC

TYPE structCD522In					
STRUCT					
StateBytePWM0	High Byte	0..100	Percentage of pulses already sent on channel 0		
StateBytePWM1	Low Byte	0..100	Percentage of pulses already sent on channel 1		
StateByteC0	High Byte		*)		
InputC0	Low Byte		**Name**	**Bitposition**	**Description**
			Input A	0	Digital Input A
			Input B	1	Digital Input B
			Input Z	2	Digital Input C
			Input I3	3	Digital Input I3
			Input I4	4	Digital Input I4
			Input I5	5	Digital Input I5
			Input I6	6	Digital Input I6
			Input I7	7	Digital Input I7
TouchCounterHiC0	WORD				
TouchCounterLoC0	WORD				

TYPE structCD522In					
CounterHiC0	WORD				
CounterLoC0	WORD				
CounterHiC1	WORD				
CounterLoC1	WORD				
ReservedWC1	WORD				
StateByteC1	High Byte		*)		
InputC1	Low Byte		**Name**	**Bitposition**	**Description**
			Input A	0	Digital Input A
			Input B	1	Digital Input B
			Input Z	2	Digital Input C
			Input I3	3	Digital Input I3
			Input I4	4	Digital Input I4
			Input I5	5	Digital Input I5
			Input I6	6	Digital Input I6
			Input I7	7	Digital Input I7
TouchCounterHiC1	WORD				
TouchCounterLoC1	WORD				
END_STRUCT					
END_TYPE					

*Table 292: *) Status Byte C0/C1*

Bit	One Counter Modes (1,2,5,6,11,12,13,14)	Two Counter Modes (3,4)
0	CF0 1=End value 0 reached	not used
1	not used	not used
2	NCATCH 1=New catch available	not used
3	OVRFLW0 1=Counter 0 overflow (see Note 3 below)	OVRFLW0 1=Counter 0 overflow (0x0000 ←→ 0xFFFF)
4	SET0_INPUT Logical OR on all inputs configured as set0 input	OVRFLW1 1=Counter 1 overflow (0x0000 ←→ 0xFFFF)

Bit	One Counter Modes (1,2,5,6,11,12,13,14)	Two Counter Modes (3,4)
5	RESET0_INPUT Logical OR on all inputs configured as reset0 input	RESET0_INPUT Logical OR on all inputs configured as reset0 input
6	not used	not used
7	not used	RESET1_INPUT Logical OR on all inputs configured as reset1 input

Bit	16-bit One Counter Mode (8)	Time frequency meter mode (15)
0	CF0 1=Zero crossover detected	not used
1	not used	not used
2	NCATCH 1=New catch available	not used
3	not used	not used
4	SET0_INPUT Logical OR on all inputs configured as set0 input	not used
5	RESET0_INPUT Logical OR on all inputs configured as reset0 input	not used
6	not used	NEW 1=New timing value available
7	not used	not used

From PLC to CD522

TYPE structCD522Out			
STRUCT			
FreqPWM0	WORD	0…65535	PWM frequency of channel 0 Unit: Hz or 10Hz (depending on control byte in slot 3) Limit: 100kHz
DutyPulsePWM0	WORD	0…1000	PWM mode: PWM duty cycle of channel 0 in 1/10 percentage
		0…65535	Pulse mode: Number of pulses to sent on channel 0
ControlPWM0	High Byte	Bit	Description
		0	FREQU_X10 FREQU_X10 1 = Frequency multiplier x10 enabled
		1	not used
		2	not used

TYPE structCD522Out			
		3	PULSE_START Rising edge = Start pulse emission channel 0
		4	not used
		5	not used
		6	not used
		7	1 = Enable Pulse/PWM channel 0
ReservedBPWM0	Low Byte		
ReservedWPWM0	WORD		
FreqPWM1	WORD	0…65535	PWM frequency of channel 1 Unit: Hz or 10Hz (depending on control byte in slot 3) Limit: 100kHz
DutyPulsePWM1	WORD	0…1000	PWM mode: PWM duty cycle of channel 1 in 1/10 percentage
		0…65535	Pulse mode: Number of pulses to sent on channel 1
ControlPWM1	High Byte	**Bit**	**Description**
		0	FREQU_X10 1 = Frequency multiplier x10 enabled
		1	not used
		2	not used
		3	PULSE_START Rising edge = Start pulse emission channel 1
		4	not used
		5	not used
		6	not used
		7	1 = Enable Pulse/PWM channel 1
OutputPW0PWM1	Low Byte	Bit 0 = Digital output value of channel 0 BIT 4 = Digital output value of channel 1	
ReservedWPWM1	WORD		
CounterSetHiC0	WORD		
CounterSetLoC0	WORD		
CtrlByteC0	High Byte		**)
OutputC0	Low Byte		
ReservedWC0	WORD		
CounterSetHiC1	WORD		

TYPE structCD522Out			
Counter-SetLoC1	WORD		
CtrlByteC1	High Byte		**)
OutputC1	Low Byte		
ReservedWC1	WORD		
END_STRUCT			
END_TYPE			

*Table 293: **) Counter Control Byte C0/C1*

Bit	One Counter Modes (1,2,5,6,8)	Two Counter Modes (3,4)
0	EN 0=counter disabled 1=counter enabled	EN 0=counter disabled 1=counter enabled
1	SET_0 1=set counter 0	not used
2	RESET_0 1=reset counter 0	RESET_0 1=reset counter 0
3	not used	UP_DWN0 0=up counter 0 1=down counter 0
4	not used	RESET_1 1=reset counter 1
5	UPDWN 0=up counter 1=down counter	UP_DWN1 0=up counter 1 1=down counter 1
6	NCATCH 0=no catch operation 1=enable next catch operation	NCATCH 0=no catch operation 1=enable next catch operation
7	EDGECATCH 0=catch on falling edge 1=catch on rising edge	EDGECATCH 0=catch on falling edge 1=catch on rising edge

Bit	Relative encoder modes (Modes 11,12,13)	Time frequency meter (Mode 15)
0	EN 0=counter disabled 1=counter enabled	EN 0=counter disabled 1=counter enabled
1	SET_0 1=set counter 0	EN_1_0 1=enable time capture on falling edge

Bit	Relative encoder modes (Modes 11,12,13)	Time frequency meter (Mode 15)
2	RESET_0 1=reset counter 0	EN_0_1 1=enable time capture on rising edge
3	not used	FREQ_0 0=time measure mode 1=frequency and RPM measure mode
4	RPI, Reference Point Indicator	RESET_NEW 1=time/frequency/RPM measurement is in reset. NEW flag is cleared.
5	not used	not used
6	NCATCH 0=no catch operation 1=enable next catch operation	not used
7	EDGECATCH 0=catch on falling edge 1=catch on rising edge	not used

Bit	SSI, absolute encoder (Mode 14)
0	EN 0=counter disabled 1=counter enabled
1	not used
2	not used
3	not used
4	not used
5	not used
6	NCATCH 0=no catch operation 1=enable next catch operation
7	EDGECATCH 0=catch on falling edge 1=catch on rising edge

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

If the external power supply voltage via UP/ZP terminals fails, the I/O module loses its configuration data. The whole station has to be switched off and on again to re-configure the module.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1 ... 10

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Intern	1805 [1])	WORD	0x070D	0	65535	0x0Y01
Ignore module [2])	No Yes	0 1	BYTE	No 0x00			Not for FBP
Parameter length	Internal	42	BYTE	0	0	255	xx02 [3])
Check supply	Off On	0 1	BYTE	On 0x01			0x0Y03
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	8 ms 0x02	0	3	0x0Y04
Mode Counter 0	see table below	0	BYTE	0x00	0	15	0x0Y05
Counter 0 frequency limit	No filter 50 Hz 500 Hz 5 kHz 20 kHz	0 1 2 3 4	BYTE	No filter 0x00	0	4	0x0Y06
Counter 0 input level	0-24 V DC 0-5 V DC Differential 1 Vpp sinus	0 1 2 3	BYTE	0-24 V DC 0x00	0	3	0X0Y07

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
SSI 0 frequency	200 kHz 500 kHz 1 MHz	2 3 4	BYTE	200 kHz 0x02	0	4	0x0Y08
SSI 0 resolution (in bit)	8 to 32 bit		BYTE	16 bit 16	8	32	0x0Y09
SSI 0 code type	Binary	0	BYTE	Binary 0	0	0	0x0Y0A
SSI 0 polling time	10 ms		BYTE	10	1	255	0x0Y0B
5 V sensor 0 supply	Off On	0	BYTE	Off 0x00	0	1	0x0Y0C
Mode Counter 1	see table below	0	BYTE	0x00	0	15	0x0Y0D
Counter 1 frequency limit	No filter 50 Hz 500 Hz 5 kHz 20 kHz	0 1 2 3 4	BYTE	No filter 0x00	0	4	0x0Y0E
Counter 1 input level	0-24 V DC 0-5 V DC Differential 1 Vpp sinus	0 1 2 3	BYTE	0-24 V DC 0x00	0	3	0X0Y0F
SSI 1 frequency	200 kHz 500 kHz 1 MHz	2 3 4	BYTE	200 kHz 0x02	2	4	0x0Y10
SSI 1 resolution (in bit)	8 to 32 bit		BYTE	16 bit 16	8	32	0x0Y11
SSI 1 code type	Binary	0	BYTE	Binary 0	0	0	0x0Y12
SSI 1 polling time	10 ms		BYTE	10	1	255	0x0Y13
5 V sensor 1 supply	Off On	0	BYTE	Off 0x00	0	1	0x0Y14
Detection SC on sensors	Off On	0	BYTE	Off 0x00	0	1	0x0Y15

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
Output behaviour com fault	Off Last value Substitute Last value 5s Substitute 5s Last value 10s Sub-stitute 10s	0 1 2 3 4 5 6	BYTE	Off 0x00	0	1	0x0Y16
Substitute value	0	0	WORD	Default 0x0000	0	65536	0x0Y17

[1]) With CS31 and addresses smaller than 70 and FBP, the value is increased by 1

[2]) Not with FBP

[3]) Value is hexadecimal: HighByte is slot (xx: 1 ... 10), LowByte is index (1 ... n)

Table 294: Operating modes for counters 0 and 1, configuration table

Internal value	Operating modes of counter
0	No counter / No PWM (default value)
1	1-1 UpDown counter (A)
2	2-1 UpDown with release input
3	3-2 UpDown counters (A, B)
4	4-2 UpDown (A, B on falling edges)
5	5-1 UpDown dynamic set (B) / rising edge
6	6-1 UpDown dynamic set (B) / falling edge
7	Not used
8	8-1 UpDown with release (B), 0 cross detection
9 - 19	Not used
20	11-1 Incremental encoder
21	12-2 Incremental encoder X2
22	13-1 Incremental encoder X4
30	14-1 SSI, absolute encoder
40	15-1 Time frequency meter

Table 295: GSD file

Ext_User_Prm_Data_Len =	25
Ext_User_Prm_Data_Const(0) =	0x07, 0x0E, 0x17, \ 0x01, 0x02, \ 0x00, 0x00, 0x00, 0x02, 0x10, 0x00, 0x0A, 0x00, \ 0x00, 0x00, 0x00, 0x02, 0x10, 0x00, 0x0A, 0x00, \ 0x00, 0x00, 0x00, 0x00;

Diagnosis

E1...E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000 ... 063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])			
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	New start
	11 / 12	ADR	1...10				
3	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				
3	14	1...10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1...10				

Table 296: Channel error CD522

E1...E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000 ... 063**	**AC500display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])			
Channel error							
4	14	1...10	1	0...15	47	Output short circuit	Check output connection or terminal
	11 / 12	ADR	1..10				
4	14	1...10	1	0, 1, 8, 9	10	Input frequency too high	Check frequency filter parameter or sensor
	11 / 12	ADR	1...10				
4	14	1...10	1	0, 1	2	PWM frequency too high	Clamp min/max value in program
	11 / 12	ADR	1...10				
4	14	1...10	1	0, 1	10	PWM duty cycle out of range (0-1000)	Clamp min value to 0 in program
	11 / 12	ADR	1...10				
4	14	1...10	1	0, 1	11	5 V sensor supply too low	Check wiring & sensor power
	11 / 12	ADR	1...10				
4	14	1...10	1	0, 1	18	Internal fuse on 0 V has blown, 0 V not connected to GND	Check wiring, replace module
	11 / 12	ADR	1...10				

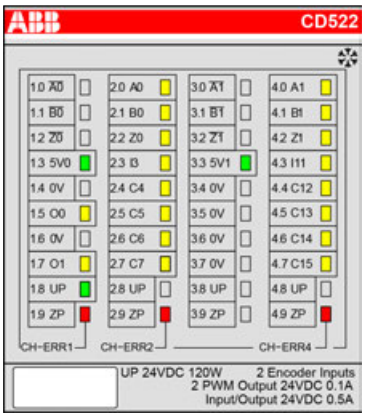
Remarks:

[1])	In AC500, the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1...10 = decentralized communication interface module 1...10, ADR = hardware address (e.g. of the DC551)

[3])	With "Module" the following allocation applies depending on the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1...10 = expansion 1...10 Channel error: I/O bus or FBP = module type (2 = DO); COM1/COM2: 1...10 = expansion 1...10
[4])	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

During the power-on procedure, the module initializes automatically. All LEDs (except the LEDs for the signal states) are on during the initialization.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	A0, B0, Z0	Encoder 0 inputs	Yellow	Input ON	Input OFF	LED follows the state of the inputs, depending on frequency
	A1, B1, Z1	Encoder 1 inputs	Yellow	Input ON	Input OFF	LED follows the state of the inputs, depending on frequency
	I3 and I11	Digital inputs	Yellow	Input = ON (the input voltage is even displayed if the supply voltage is OFF).	Input = OFF	---
	C4 ... C7 and C12 ... C15	Configurable digital inputs/ outputs	Yellow	Input/output = ON (the input voltage is even displayed if the supply voltage is OFF).	Input/output = OFF	---
	O0 and O1	Digital PWM outputs	Yellow	Output = ON	Output = OFF	LED follows the state of the outputs, depending on frequency and operation mode
	5V0 and 5V1	Power supply for encoders	Green	Configuration ON and power 5-V-power ready	Configuration OFF or power failure	Power supply outputs are short-circuited
	UP	Process supply voltage	Green	Process voltage OK	Process voltage is missing	---

LED		State	Color	LED = OFF	LED = ON	LED flashes
	CH-ERR1, CH-ERR2, CH-ERR4		Red	Severe error within the corre-sponding group	No error or process voltage is missing	Error on one channel of the corresponding group (e.g. short circuit at an output)
	CH-ERR *)	Error indica-tion	Red	Internal error or con-figuration is not loaded	--	---
	*) All LEDs CH-ERR1, CH-ERR2 and CH-ERR4 light up simultaneously					

Technical data

The system data of AC500 and S500 is applicable to the standard version.

Chapter 4.2 “System data AC500” on page 34

The system data of AC500-XC is applicable to the XC version.

Chapter 4.3 “System data AC500-XC” on page 38

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter		Value
Process supply voltage		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for UP (+24 V DC) and 1.9, 2.9, 3.9 and 4.9 for ZP (0 V)
	Protection against reverse voltage	Yes
	Rated protection fuse at UP	10 A fast
	Rated value	24 V DC
	Max. ripple	5 %
Current consumption		
	From UP	0.07 A + max. 0.008 A per input + max. 0.5 A per output + 0.01 A for A, B and Z inputs
	Via I/O bus	Ca. 5 mA
	Inrush current from UP (at power-up)	0.04 A^2s
Galvanic isolation		Yes, per module
Max. power dissipation within the module		6 W (outputs unloaded)
Weight (without terminal unit)		Ca. 125 g
Mounting position		Horizontal mounting or Vertical mounting with derating (output load reduced to 50 % at +40 °C)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Multiple overloads
With multi-channel modules, there are no effects of multiple overloads as each digital output channel is individually protected by an internal intelligent high-side switch.

Technical data of the digital inputs/outputs if used as standard inputs

Parameter		Value
Number of channels		2 + 8 configurable digital inputs/outputs
Reference potential for all inputs		Terminals 1.9...4.9 (negative pole of the process supply voltage, signal name ZP)
Galvanic isolation		From the rest of the module
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type acc. to EN 61131-2		Type 1
Input delay (0->1 or 1->0)		Typ. 8 ms, configurable from 0.1 to 32 ms
Input data length		24 bytes
Input signal voltage		24 V DC
	Signal 0	-3 V ... +5 V *
	Undefined signal	> +5 V ... < +15 V
	Signal 1	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V *
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 5 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

* Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal must not exceed the clamp voltage of the varistor. The varistor limits the clamp voltage to approx. 36 V. Consequently the input voltage must be within the following range.

- If UPx = 24 V, the input voltage must range from -12 V ... +30 V.
- If UPx = 30 V, the input voltage must range from -6 V ... +30 V.

Technical data of the digital inputs/outputs if used as standard outputs

Parameter		Value
Number of channels		8 configurable digital inputs/outputs
Reference potential for all outputs		Terminals 1.9 ... 4.9 (negative pole of the process supply voltage, signal name ZP)
Common power supply voltage		For all outputs: terminals 1.8 ... 4.8 (positive pole of the process supply voltage, signal name UP)
Output voltage for signal 1		UP (-0.8 V)
Output delay (0->1 or 1->0)		Typ. 10 µs
Output data length		32 bytes
Output current		
	Rated value, per channel	500 mA at UP = 24 V
	Maximum value (all channels together, PWM included)	8 A
Leakage current with signal 0		< 0.5 mA
Rated protection fuse on UP		10 A fast
Demagnetization when inductive loads are switched off		With varistors integrated in the module (see figure below)
Switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 11 Hz with max. 5 W
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals		Yes
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

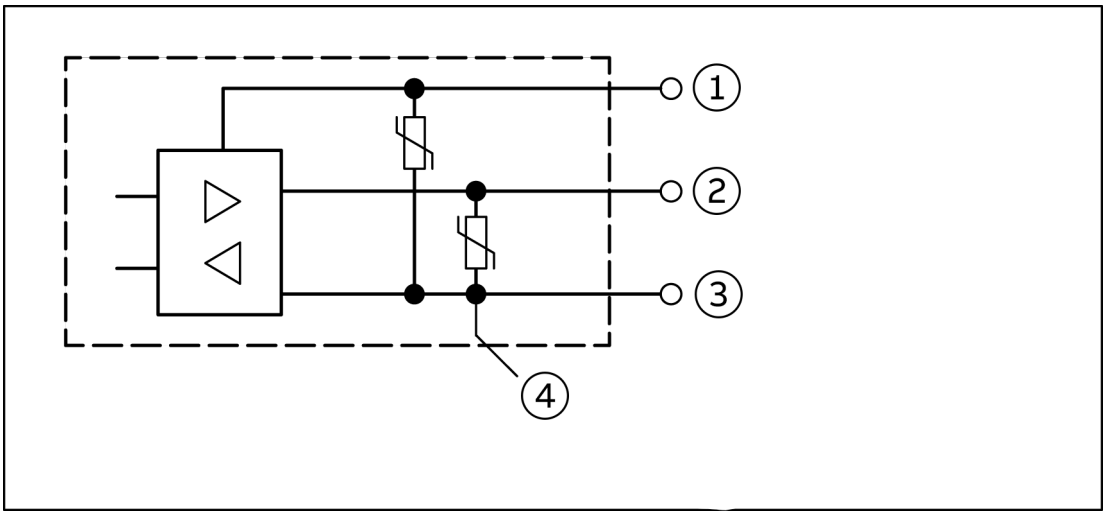


Fig. 157: Digital input/output (circuit diagram)

1 UPx (+ 24 V)
2 Digital input/output
3 ZPx (0 V)
4 For demagnization when inductive loads are switched off

Technical data of the high-speed inputs (A0, B0, Z0; A1, B1, Z1)

Parameter		Value	
Number of channels per module		6	
Reference potential for all inputs		Terminal 1.9, 2.9, 3.9 and 4.9 (negative pole of the process voltage, signal name ZP)	
Input Type		24 V DC	5 V DC / Differential Sinus 1 Vpp
Input current per channel			
	Input voltage +24 V	Typ. 14 mA	
	Input voltage +5 V	> 4.8 mA	
	Input voltage +15 V	> 12 mA	
	Input voltage +30 V	< 15 mA	
Input type acc. to EN 61131-2		Type 1	
Input frequency max. (fast counter)		300 kHz	300 kHz
Input frequency max. (frequency measurement)		5 kHz	5 kHz
Input signal voltage		24 V DC	5 V DC
Signal 0		-3 V ... +5 V	-3 V ... +0,5 V
Undefined signal		> +5 V ... < +15 V	--
Signal 1		+15 V ... +30 V	+0,5 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V	Within -3 V ... +0.5 V
Ripple with signal 1		Within +15 V ... +30 V	Within +0,5 V ... +30 V
Max. cable length			
	Shielded	1000 m	
	Unshielded	600 m	

Technical data of the fast outputs O0 and O1

Parameter		Value
Number of channels		2
Reference potential for all outputs		Terminals 1.9 ... 4.9 (negative pole of the process supply voltage, signal name ZP)
Common power supply voltage		For all outputs: terminals 1.8 ... 4.8 (positive pole of the process supply voltage, signal name UP)
Indication of the output signals		Brightness of the LED depends on the number of pulses emitted (0 % to 100 %) (pulse output mode only)
Output voltage for signal 1		UP (-0.1 V)
Output voltage for signal 0		ZP (+0.3 V)
Output delay (0->1 or 1->0)		Typ. 1 µs
Output current		
	Rated value, per channel	100 mA at UP = 24 V
	Maximum value (all channels together, configurable outputs included))	8 A
Leakage current with signal 0		< 0.5 mA
Rated protection fuse on UP		10 A fast
De-magnetization when inductive loads are switched off		With varistors integrated in the module (see figure above)
Switching frequency		PWM: up to 100 kHz (min. step for PWM value: 2 µs) Pulse: up to 15 kHz
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.1x A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short-circuit/overload
Resistance to feedback against 24 V signals		Yes
Resistance to feedback against reverse polarity		No
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical data of the fast outputs (SSI CLK output B0, B1 for optical interface)

Parameter	Value
Number of channels	2
Reference potential for all outputs	Terminals 1.9...4.9 (negative pole of the process supply voltage, signal name ZP)
Common power supply voltage	For all outputs: terminals 1.8 ... 4.8 (positive pole of the process supply voltage, signal name UP)
Output voltage for signal 0	≤ 1.5 V at 10 mA
Output delay (0->1 or 1->0)	Typ. 0.3 µs
Output current	≤ 10 mA
Switching frequency	< 1 MHz (depending on firmware)

Parameter	Value
Short-circuit-proof / overload-proof	Yes
Output current limitation	Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals	Yes
Resistance to feedback against reverse polarity	No
Max. cable length (shielded)	Typ. 12.5 m at 500 kHz (depending on sensor)

Technical data of the fast outputs (SSI CLK Output Differential)

Parameter	Value
Number of channels	2
Reference potential for all outputs	Terminals 1.9 ... 4.9 (negative pole of the process supply voltage, signal name ZP)
Common power supply voltage	For all outputs: terminals 1.8 ... 4.8 (positive pole of the process supply voltage, signal name UP)
Output voltage for signal 1	$\geq$ 2.9 V at 10 mA
Output voltage for signal 0	$\leq$ 1.3 V at 10 mA
Output delay (0->1 or 1->0)	Typ. 0.3 µs
Output current	$\leq$ 10 mA
Switching frequency	< 1 MHz (depending on firmware)
Short-circuit-proof / overload-proof	Yes
Overload message (I > 0.1x A)	Yes, after ca. 100 ms
Output current limitation	Yes, automatic reactivation after short-circuit/overload
Resistance to feedback against 24V signals	Yes
Resistance to feedback against reverse polarity	No
Max. cable length (shielded)	100 m

Technical data of the 5 V sensor supply

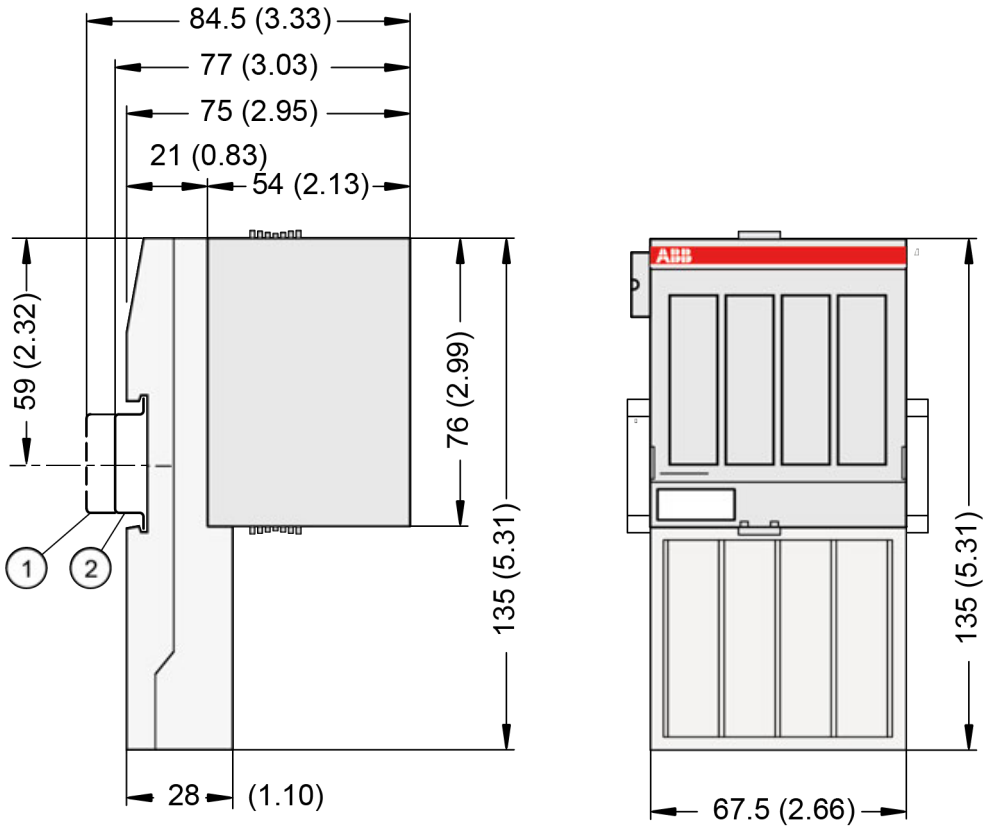
Parameter	Value
Number of supplies	2, independently configuration
Voltage supply (outputs unloaded)	5 V DC +/- 5%
Resistance to feedback against reverse polarity	No
Output current	100 mA max. (independently) 200 mA max. (parallel use)
Output diagnosis	Yes, with diagnosis LED and error message

Technical data of the 0 V reference input

Parameter	Value
Number of reference inputs (internally connected to ZP through internal fuse)	6
Max. current per connection	0.5 A

Parameter		Value
Internal fuse protection		
	Terminals 1.4 and 1.6	2 A
	Terminals 3.4 ... 3.7	2 A

Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 260 300 R0001	CD522, encoder & PWM module, 2 encoder inputs, 2 PWM outputs, 2 digital inputs 24 V DC, 8 digital outputs 24 V DC	Active
1SAP 460 300 R0001	CD522-XC, encoder & PWM module, 2 encoder inputs, 2 PWM outputs, 2 digital inputs 24 V DC, 8 digital outputs 24 V DC, XC version	Active

*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

5.5 Terminal units for S500(-XC) I/O modules

5.5.1 Safety instructions

NOTICE!

Risk of device damage!

– I/O modules with a device index **above** F0 can be hot-swapped. When I/O modules **below** F0 are inserted or removed from the terminal unit in a powered system the I/O modules can be damaged.
  Before hot swapping a device, check the device index and ensure that the modules meet the requirements. *Table 297 “Allowed device indexes for I/O modules for hot swapping” on page 950*
– Terminal units that support hot swapping of I/O modules have the appendix TU5xx**-H**.
– Hot swap is not supported by AC500-eCo CPU!

The following I/O bus masters support hot swapping of attached I/O modules:

– Communication interface modules CI5xx as of index F0.
– Processor modules PM56xx-2ETH with firmware version as of V3.2.0.

NOTICE!

Risk of damage to I/O modules!

Hot swapping is only allowed for I/O modules.

Processor modules and communication interface modules must not be removed or inserted during operation.

Conditions for hot swapping

– *Digital outputs are not under load.*
– *Input/output voltages above safety extra low voltage/ protective extra low voltages (SELV/PELV) are switched off.*
– *Modules are completely plugged on the terminal unit with both snap fit engaged before switching on loads or input/output voltage.*

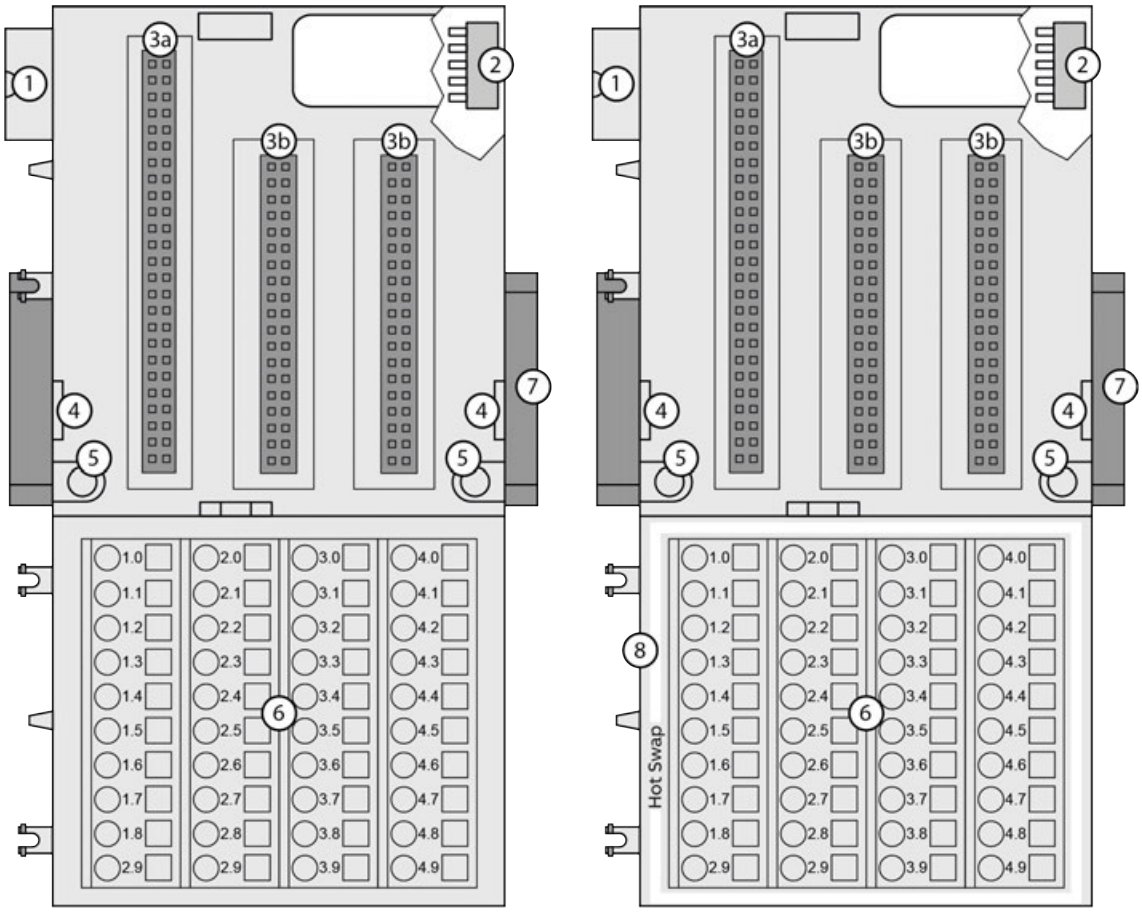
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5.5.2 TU515, TU516, TU541 and TU542 for I/O modules

- TU515, I/O terminal unit, 24 V DC, screw terminals
- TU516, I/O terminal unit, 24 V DC, spring terminals
- TU516-XC, I/O terminal unit, 24 V DC, spring terminals, XC version
- TU516-H, I/O terminal unit, hot swap, 24 V DC, spring terminals
- TU516-H-XC, I/O terminal unit, hot swap, 24 V DC, spring terminals, XC version
- TU541, I/O terminal unit, 24 V DC, screw terminals
- TU542, I/O terminal unit, 24 V DC, spring terminals

- TU542-XC, I/O terminal unit, 24 V DC, spring terminals, XC version
- TU542-H, I/O terminal unit, hot swap, 24 V DC, spring terminals
- TU542-H-XC, I/O terminal unit, hot swap, 24 V DC, spring terminals, XC version

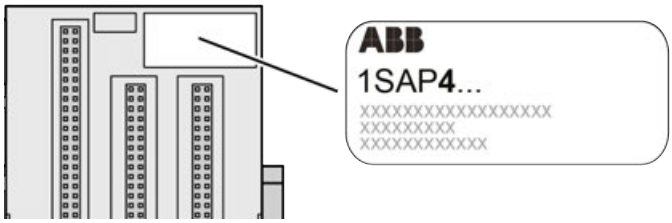
The input/output modules plug into the I/O terminal unit. When properly seated, they are secured with two mechanical locks. All the connections are established via the terminal unit, which allows removal and replacement of the I/O modules without disturbing the wiring at the terminal unit.



1 I/O bus (10 pins, male) to connect the previous terminal unit, the CPU terminal base or the communication interface module to the terminal unit
2 I/O bus (10 pins, female) to connect other terminal units
3a Plug (2 x 25 pins) to connect the inserted I/O modules
3b Plug (2 x 19 pins) to connect the inserted I/O modules
4 With a screwdriver inserted in this place, the terminal unit and the adjacent terminal unit can be shoved from each other
5 Holes for screw mounting
6 40 terminals for signals and process supply voltage
7 DIN rail
8 White border signifies hot swap capability of the terminal unit

XC version

XC = e**X**treme **C**onditions

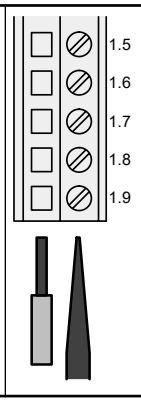
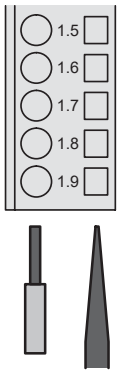


Extreme conditions

Terminal units for use in extreme ambient conditions have no ❄ sign for XC version.

*The figure **4** in the Part no. 1SAP**4**... (lable) identifies the XC version.*

Terminals

Screw terminals			**Spring terminals**		
Conductor		Screwdriver	Conductor		Screwdriver (opens terminal)

The following terminals are used for connection of the process supply voltage.

	Terminals							
Type	1.8	2.8	3.8	4.8	1.9	2.9	3.9	4.9
TU515, TU516 and TU516-H	These terminals are internally connected with assignment: process supply voltage UP = +24 V DC				These terminals are internally connected with assignment: process supply voltage ZP = 0 V			
TU541, TU542 and TU542-H	These terminals are internally connected with assignment: process voltage UP = +24 V DC		Separate process supply voltage UP3 = +24 V DC	Separate process supply voltage UP4 = +24 V DC	These terminals are internally connected with assignment: process supply voltage ZP = 0 V		Separate process supply voltage ZP = 0 V	Separate process supply voltage ZP = 0 V

The assignment of the other terminals depends on the inserted communication interface module (see the description of the respective module used).

Check the given design scheme of your control cabinet.

Check the *terminal unit compatibility*.

5.5.2.1 Technical data

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

↳ *Chapter 4.3 “System data AC500-XC” on page 38*

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter	Value
Number of channels per module	Max. 32
Distribution of the channels into groups	4 groups of 8 channels each (1.0 ... 1.7, 2.0 ... 2.7, 3.0 ... 3.7, 4.0 ... 4.7), the allocation of the channels is given by the inserted I/O module
Rated voltage	24 V DC
Max. permitted total current	10 A, per separated process voltage terminal or for internal connection of process voltages
Grounding	Direct connection to the grounded DIN rail or via the screws with wall mounting
Screw terminals	Front terminal, conductor connection vertically with respect to the printed circuit board
Spring terminals	Front terminal, conductor connection vertically with respect to the printed circuit board
Weight	200 g
Mounting position	Horizontal or vertical

5.5.2.2 Hot swap

NOTICE!

Risk of device damage!

– I/O modules with a device index **above** F0 can be hot-swapped. When I/O modules **below** F0 are inserted or removed from the terminal unit in a powered system the I/O modules can be damaged.
  Before hot swapping a device, check the device index and ensure that the modules meet the requirements. ↳ *Table 297 “Allowed device indexes for I/O modules for hot swapping” on page 950*
– Terminal units that support hot swapping of I/O modules have the appendix TU5xx**-H**.
– Hot swap is not supported by AC500-eCo CPU!

The following I/O bus masters support hot swapping of attached I/O modules:

– Communication interface modules CI5xx as of index F0.
– Processor modules PM56xx-2ETH with firmware version as of V3.2.0.

Table 297: Allowed device indexes for I/O modules for hot swapping

I/O module	Minimum device index for hot swapping on a hot swap terminal unit	Minimum device index for use in a mixed configuration with hot-swappable devices
AC522(-XC)	F0	F0
AI523 (-XC)	F0	D2
AI531	F0	D4
AI531-XC	F0	D2
AI561	hot swap is not supported	B2
AI562	hot swap is not supported	B2
AI563	hot swap is not supported	B3
AI564	hot swap is not supported	A0
AI565	hot swap is not supported	A0
AI568	hot swap is not supported	A0
AI581-S (-XC)	hot swap is not supported	must not be used in a configuration that includes a hot swap terminal unit
AO522 (-XC)	F0	F0
AO523 (-XC)	F0	D2
AO561	hot swap is not supported	B2
AO562	hot swap is not supported	A0
AO568	hot swap is not supported	A0
AX521 (-XC)	F0	D2
AX522 (-XC)	F0	D2
AX561	hot swap is not supported	B2
CD522 (-XC)	hot swap is not supported	D1
DA501 (-XC)	F0	D2
DA502 (-XC)	F0	F0
DC522 (-XC)	F0	D2
DC523 (-XC)	F0	D2
DC532 (-XC)	F0	D2
DC562	hot swap is not supported	A2
DI524 (-XC)	F0	D2
DI561	hot swap is not supported	B2
DI562	hot swap is not supported	B2
DI571	hot swap is not supported	B2
DI572	hot swap is not supported	A1
DI581-S (-XC)	hot swap is not supported	must not be used in a configuration that includes a hot swap terminal unit
DO524 (-XC)	F0	A3
DO526	F0	A2
DO526-XC	F0	A0
DO561	hot swap is not supported	B2

I/O module	Minimum device index for hot swapping on a hot swap terminal unit	Minimum device index for use in a mixed configuration with hot-swappable devices
DO562	hot swap is not supported	A2
DO571	hot swap is not supported	B3
DO572	hot swap is not supported	B2
DO573	hot swap is not supported	A1
DX522 (-XC)	F0	D2
DX531	F0	D2
DX561	hot swap is not supported	B2
DX571	hot swap is not supported	B3
DX581-S (-XC)	hot swap is not supported	must not be used in a configu-ration that includes a hot swap terminal unit
FM562	F0	A1
FM565	hot swap is not supported	A0
FM566	hot swap is not supported	A0

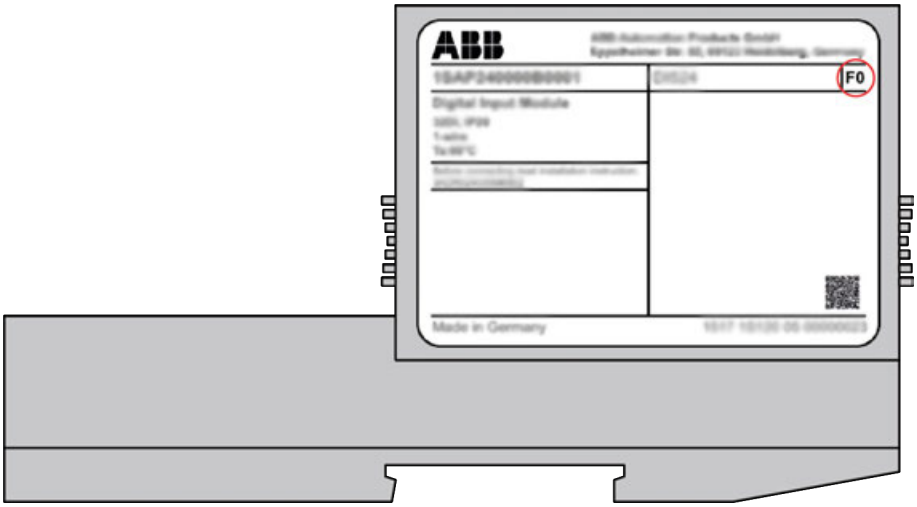


Fig. 158: The index of the module is in the right corner of the label.

WARNING!

Risk of explosion or fire in hazardous environments during hot swapping!

Hot swap must not be performed in flammable environments to avoid life-threatening injury and property damage resulting from fire or explosion.

WARNING!

Electric shock due to negligent behavior during hot swapping!

To avoid electric shock, do the following.

- Make sure the following conditions apply:
  - Digital outputs are not under load.
  - Input/output voltages above safety extra low voltage/ protective extra low voltage (SELV/PELV) are switched off.
  - Modules are fully interlocked with the terminal unit with both snap-fits engaged before switching on loads or input/output voltage.
- Never touch exposed contacts (dangerous voltages).
- Stay away from electrical contacts to avoid arc discharge.
- Do not operate a mechanical installation improperly.

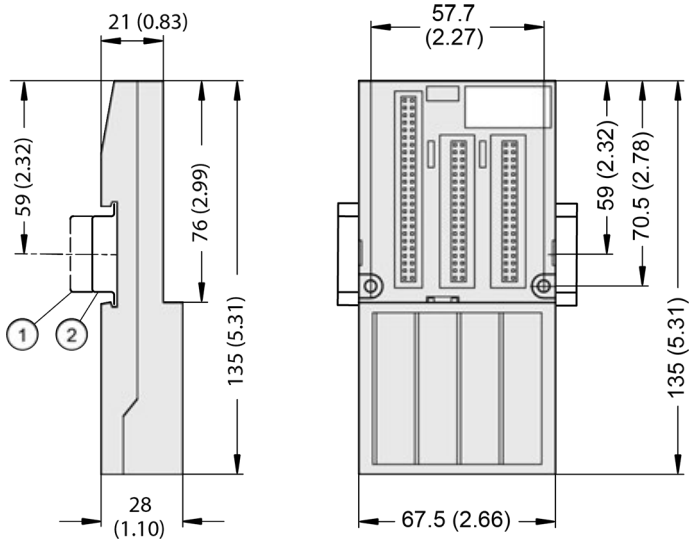
NOTICE!

Risk of damage to I/O modules!

Hot swapping is only allowed for I/O modules.

Processor modules and communication interface modules must not be removed or inserted during operation.

5.5.2.3 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

5.5.2.4 Ordering data

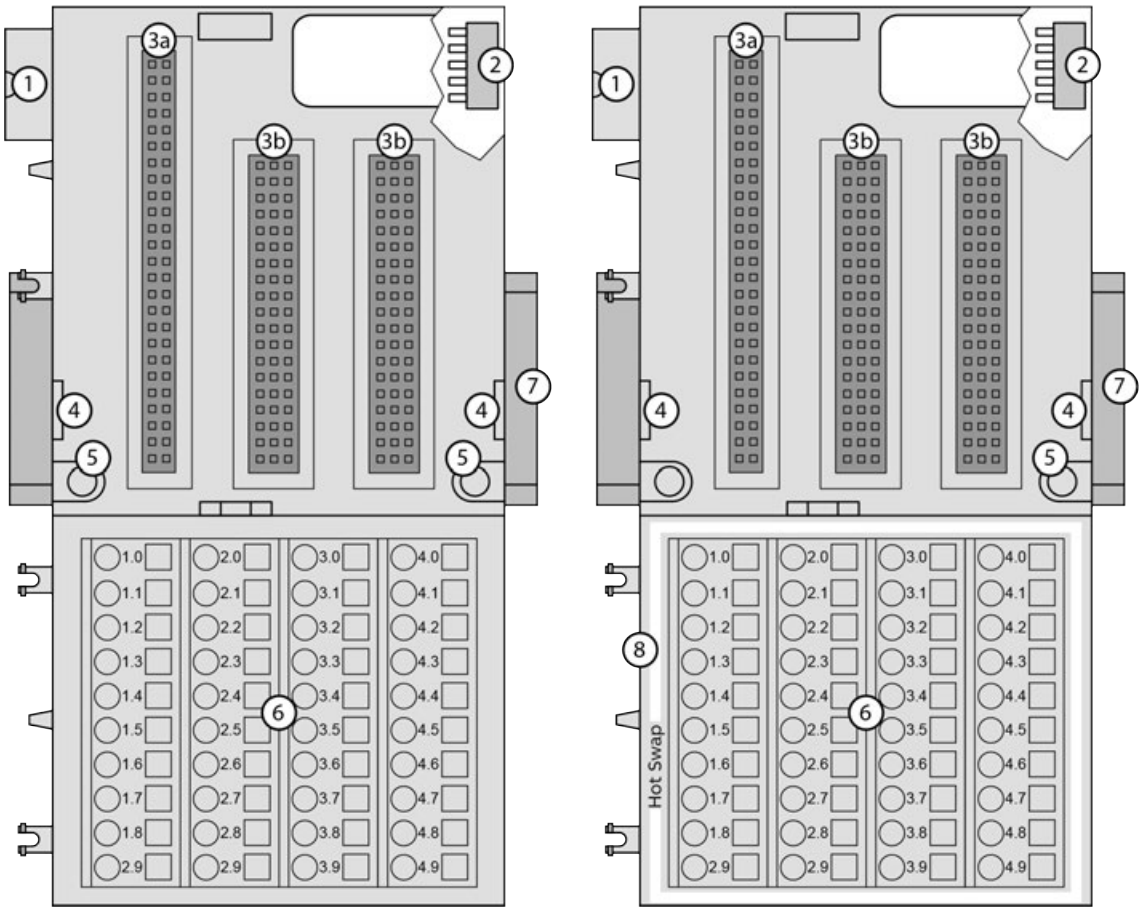
Part no.	Description	Product life cycle phase *)
1SAP 212 200 R0001	TU515, I/O terminal unit, 24 V DC, screw terminals	Active
1SAP 212 000 R0001	TU516, I/O terminal unit, 24 V DC, spring terminals	Active
1SAP 412 000 R0001	TU516-XC, I/O terminal unit, 24 V DC, spring terminals, XC version	Active
1SAP 215 000 R0001	TU516-H, I/O terminal unit, hot swap, 24 V DC, spring terminals, XC version	Active
1SAP 415 000 R0001	TU516-H-XC, I/O terminal unit, hot swap, 24 V DC, spring terminals	Active
1SAP 213 000 R0001	TU541, I/O terminal unit, 24 V DC, screw terminals	Active
1SAP 213 200 R0001	TU542, I/O terminal unit, 24 V DC, spring terminals	Active
1SAP 413 200 R0001	TU542-XC, I/O terminal unit, 24 V DC, spring terminals, XC version	Active
1SAP 215 200 R0001	TU542-H, I/O terminal unit, hot swap, 24 V DC, spring terminals	Active
1SAP 415 200 R0001	TU542-H-XC, I/O terminal unit, hot swap, 24 V DC, spring terminals, XC version	Active



**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.5.3 TU531 and TU532 for I/O modules

- TU531, I/O terminal unit, 120/230 V AC, screw terminals
- TU532, I/O terminal unit, 120/230 V AC, spring terminals
- TU532-XC, I/O terminal unit, 120/230 V AC, spring terminals, XC version
- TU532-H, I/O terminal unit, hot swap, 120/230 V AC, spring terminals
- TU532-H-XC, I/O terminal unit, hot swap, 120/230 V AC, spring terminals, XC version

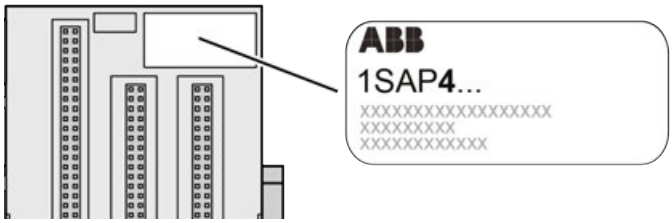


1 I/O bus (10 pins, male) to connect the previous terminal unit, the CPU terminal base or the communication interface module to the terminal unit
2 I/O bus (10 pins, female) to connect other terminal units
3a Plug (2 x 25 pins) to connect the inserted I/O modules
3b Plug (3 x 19 pins) to connect the inserted I/O modules
4 With a screwdriver inserted in this place, the terminal unit and the adjacent I/O terminal unit can be shoved from each other
5 Holes for screw mounting
6 40 terminals for signals and process supply voltage
7 DIN rail
8 White border signifies hot swap capability of the terminal unit

The input/output modules (I/O modules) plug into the I/O terminal unit. When properly plugged-in, they are secured with two mechanical locks. All the connections are established via the terminal unit, which allows removal and replacement of the I/O modules without disturbing the wiring at the terminal unit.

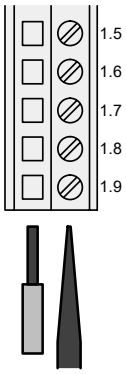
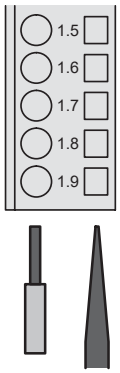
The terminal units TU531 and TU532 are specifically designed for use with AC500/S500 I/O modules that incorporate 115 V AC ... 230 V AC inputs and/or 120/230 V AC relay outputs.

XC version **XC** = e**X**treme **C**onditions



> ***Extreme conditions***
> *Terminal units for use in extreme ambient conditions have no ❄ sign for XC version.*
>
> *The figure **4** in the Part no. 1SAP**4**... (label) identifies the XC version.*

Terminals

Screw terminals			Spring terminals		
Conductor		Screwdriver	Conductor		Screwdriver (opens terminal)

The terminals 1.8 ... 4.8 and 1.9 ... 4.9 are electrically interconnected within the terminal unit.

The terminals always have the same assignment, independent of the inserted module:

- Terminals 1.8 ... 4.8: process supply voltage UP = +24 V DC
- Terminals 1.9 ... 4.9: process supply voltage ZP = 0 V

The assignment of the other terminals depends on the inserted communication interface module (see the description of the respective module used).

The supply voltage of 24 V DC for the module's circuitry comes from the I/O expansion bus (I/O bus).

5.5.3.1 Technical data

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

↳ *Chapter 4.3 “System data AC500-XC” on page 38*

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter		Value
Number of channels per module		32
Distribution of the channels into groups		4 groups of 8 channels each (1.0 ... 1.7, 2.0 ... 2.7, 3.0 ... 3.7, 4.0 ... 4.7), the allocation of the channels is given by the inserted I/O module
Terminals 1.8 ... 4.8 and 1.9 ... 4.9		
	Max. voltage	30 V DC
	Max. permitted total current	10 A
Terminals 1.0 ... 1.7, 2.0 ... 2.7, 3.0 ... 3.7, 4.0 ... 4.7		
	Max. voltage	300 V AC [1])
	Max. permitted current	3 A [2])
Grounding		Direct connection to the grounded DIN rail or via the screws with wall mounting
Screw terminals		Front terminal, conductor connection vertically with respect to the printed circuit board
Spring terminals		Front terminal, conductor connection vertically with respect to the printed circuit board
Weight		200 g
Mounting position		Horizontal or vertical

[1]) Only when the voltage is not limited by the specification of the I/O channel or the supply input which is internally connected to the terminal.

[2]) The terminals are connected to the electronic module via internal connectors (X22 (or 3b), X23 (or 3b), X32, X33 and X34). The current per terminal is limited by the permitted current of these connectors.

5.5.3.2 Hot swap

NOTICE!

Risk of device damage!

– I/O modules with a device index **above** F0 can be hot-swapped. When I/O modules **below** F0 are inserted or removed from the terminal unit in a powered system the I/O modules can be damaged.
  Before hot swapping a device, check the device index and ensure that the modules meet the requirements. ↳ *Table 298 “Allowed device indexes for I/O modules for hot swapping” on page 957*
– Terminal units that support hot swapping of I/O modules have the appendix TU5xx**-H**.
– Hot swap is not supported by AC500-eCo CPU!

The following I/O bus masters support hot swapping of attached I/O modules:

– Communication interface modules CI5xx as of index F0.
– Processor modules PM56xx-2ETH with firmware version as of V3.2.0.

Table 298: Allowed device indexes for I/O modules for hot swapping

I/O module	Minimum device index for hot swapping on a hot swap terminal unit	Minimum device index for use in a mixed configuration with hot-swappable devices
AC522(-XC)	F0	F0
AI523 (-XC)	F0	D2
AI531	F0	D4
AI531-XC	F0	D2
AI561	hot swap is not supported	B2
AI562	hot swap is not supported	B2
AI563	hot swap is not supported	B3
AI564	hot swap is not supported	A0
AI565	hot swap is not supported	A0
AI568	hot swap is not supported	A0
AI581-S (-XC)	hot swap is not supported	must not be used in a configuration that includes a hot swap terminal unit
AO522 (-XC)	F0	F0
AO523 (-XC)	F0	D2
AO561	hot swap is not supported	B2
AO562	hot swap is not supported	A0
AO568	hot swap is not supported	A0
AX521 (-XC)	F0	D2
AX522 (-XC)	F0	D2
AX561	hot swap is not supported	B2
CD522 (-XC)	hot swap is not supported	D1
DA501 (-XC)	F0	D2
DA502 (-XC)	F0	F0
DC522 (-XC)	F0	D2
DC523 (-XC)	F0	D2
DC532 (-XC)	F0	D2
DC562	hot swap is not supported	A2
DI524 (-XC)	F0	D2
DI561	hot swap is not supported	B2
DI562	hot swap is not supported	B2
DI571	hot swap is not supported	B2
DI572	hot swap is not supported	A1
DI581-S (-XC)	hot swap is not supported	must not be used in a configuration that includes a hot swap terminal unit
DO524 (-XC)	F0	A3
DO526	F0	A2
DO526-XC	F0	A0
DO561	hot swap is not supported	B2

I/O module	Minimum device index for hot swapping on a hot swap terminal unit	Minimum device index for use in a mixed configuration with hot-swappable devices
DO562	hot swap is not supported	A2
DO571	hot swap is not supported	B3
DO572	hot swap is not supported	B2
DO573	hot swap is not supported	A1
DX522 (-XC)	F0	D2
DX531	F0	D2
DX561	hot swap is not supported	B2
DX571	hot swap is not supported	B3
DX581-S (-XC)	hot swap is not supported	must not be used in a configuration that includes a hot swap terminal unit
FM562	F0	A1
FM565	hot swap is not supported	A0
FM566	hot swap is not supported	A0

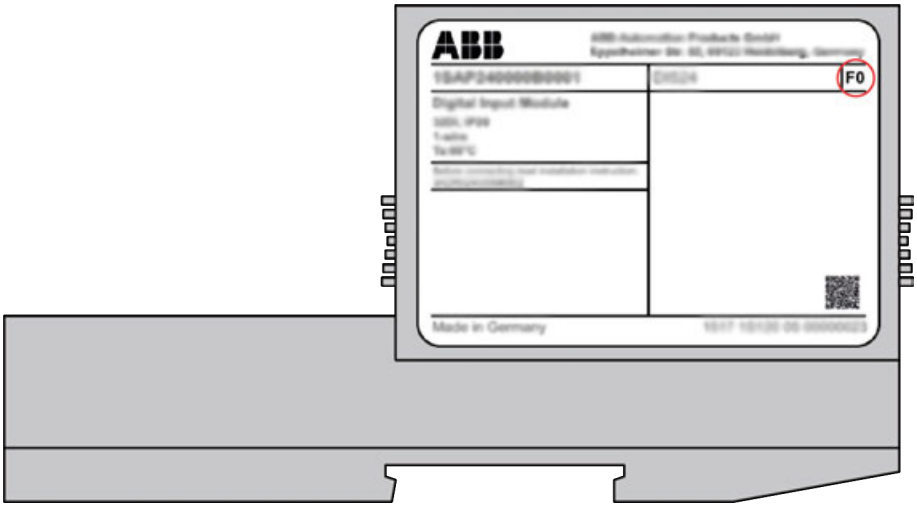


Fig. 159: The index of the module is in the right corner of the label.

WARNING!

Risk of explosion or fire in hazardous environments during hot swapping!

Hot swap must not be performed in flammable environments to avoid life-threatening injury and property damage resulting from fire or explosion.

WARNING!

Electric shock due to negligent behavior during hot swapping!

To avoid electric shock, do the following.

- Make sure the following conditions apply:
  - Digital outputs are not under load.
  - Input/output voltages above safety extra low voltage/ protective extra low voltage (SELV/PELV) are switched off.
  - Modules are fully interlocked with the terminal unit with both snap-fits engaged before switching on loads or input/output voltage.
- Never touch exposed contacts (dangerous voltages).
- Stay away from electrical contacts to avoid arc discharge.
- Do not operate a mechanical installation improperly.

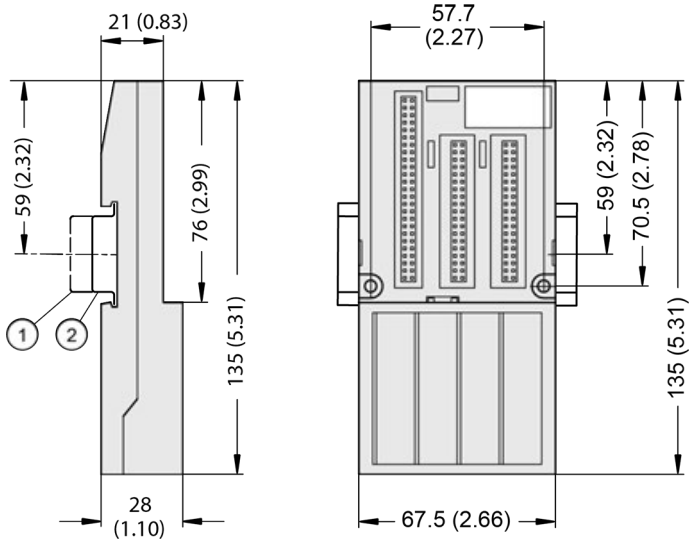
NOTICE!

Risk of damage to I/O modules!

Hot swapping is only allowed for I/O modules.

Processor modules and communication interface modules must not be removed or inserted during operation.

5.5.3.3 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

5.5.3.4 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 217 200 R0001	TU531, terminal unit, 120/230 V AC, relays, screw terminals	Active
1SAP 217 000 R0001	TU532, terminal unit, 120/230 V AC, relays, spring terminals	Active
1SAP 417 000 R0001	TU532-XC, terminal unit, 120/230 V AC, relays, spring terminals, XC version	Active
1SAP 215 100 R0001	TU532-H, terminal unit, hot swap, 120/230 V AC, relays, spring terminals	Active
1SAP 415 100 R0001	TU532-H-XC, terminal unit, hot swap, 120/230 V AC, relays, spring terminals, XC version	Active



**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.6 Communication interface modules

5.6.1 Safety instructions

NOTICE!

Risk of device damage!

– I/O modules with a device index **above** F0 can be hot-swapped. When I/O modules **below** F0 are inserted or removed from the terminal unit in a powered system the I/O modules can be damaged.

  Before hot swapping a device, check the device index and ensure that the modules meet the requirements. *Table 298 “Allowed device indexes for I/O modules for hot swapping” on page 957*

– Terminal units that support hot swapping of I/O modules have the appendix TU5xx**-H**.

– Hot swap is not supported by AC500-eCo CPU!

The following I/O bus masters support hot swapping of attached I/O modules:

– Communication interface modules CI5xx as of index F0.

– Processor modules PM56xx-2ETH with firmware version as of V3.2.0.

NOTICE!

Risk of damage to I/O modules!

Hot swapping is only allowed for I/O modules.

Processor modules and communication interface modules must not be removed or inserted during operation.

Conditions for hot swapping

– *Digital outputs are not under load.*

– *Input/output voltages above safety extra low voltage/ protective extra low voltages (SELV/PELV) are switched off.*

– *Modules are completely plugged on the terminal unit with both snap fit engaged before switching on loads or input/output voltage.*

.

5.6.2 Compatibility of communication modules and communication interface modules

Table 299: Modbus TCP

Communication module	Communication interface module	I/O expansion module S500	I/O expansion module S500-eCo	I/O expansion module S500-S	Applications
Onboard Ethernet interface	CI521-MODTCP CI522-MODTCP	x	x	--	high availability, remote I/O
Onboard Ethernet interface	CI521-MODTCP CI522-MODTCP	x	--	--	hot-swap I/O

Communication module	Communication interface module	I/O expansion module S500	I/O expansion module S500-eCo	I/O expansion module S500-S	Applications
CM5640-2ETH	CI521-MODTCP CI522-MODTCP	x	x	--	high availability, remote I/O
CM5640-2ETH	CI521-MODTCP CI522-MODTCP	x	--	--	hot-swap I/O

Table 300: PROFIBUS DP

Communication module	Communication interface module	I/O expansion module S500	I/O expansion module S500-eCo	I/O expansion module S500-S	Applications
CM592-DP master	CI541-DP CI542-DP	x	x	--	remote I/O
CM592-DP master	CI541-DP CI542-DP	x	--	--	hot-swap I/O

Table 301: PROFINET IO RT

Communication module	Communication interface module	I/O expansion module S500	I/O expansion module S500-eCo	I/O expansion module S500-S	Applications
CM579-PNIO controller	CI501-PNIO CI502-PNIO	x	x	x	remote I/O, safety I/O
CM579-PNIO controller	CI501-PNIO CI502-PNIO	x	--	--	hot-swap I/O

Table 302: CANopen

Communication module	Communication interface module	I/O expansion module S500	I/O expansion module S500-eCo	I/O expansion module S500-S	Applications
Onboard CAN interface	CI581-CN CI582-CN	--	--	--	remote I/O

Table 303: EtherCAT

Communication module	Communication interface module	I/O expansion module S500	I/O expansion module S500-eCo	I/O expansion module S500-S	Applications
CM579-ETHCAT master	CI511-ETHCAT CI512-ETHCAT	x	x	--	remote I/O

5.6.3 CANopen

5.6.3.1 Comparison CI581 and CI582

The devices differ in their input and output characteristics.

CI581-CN: Input/ Output characteristics

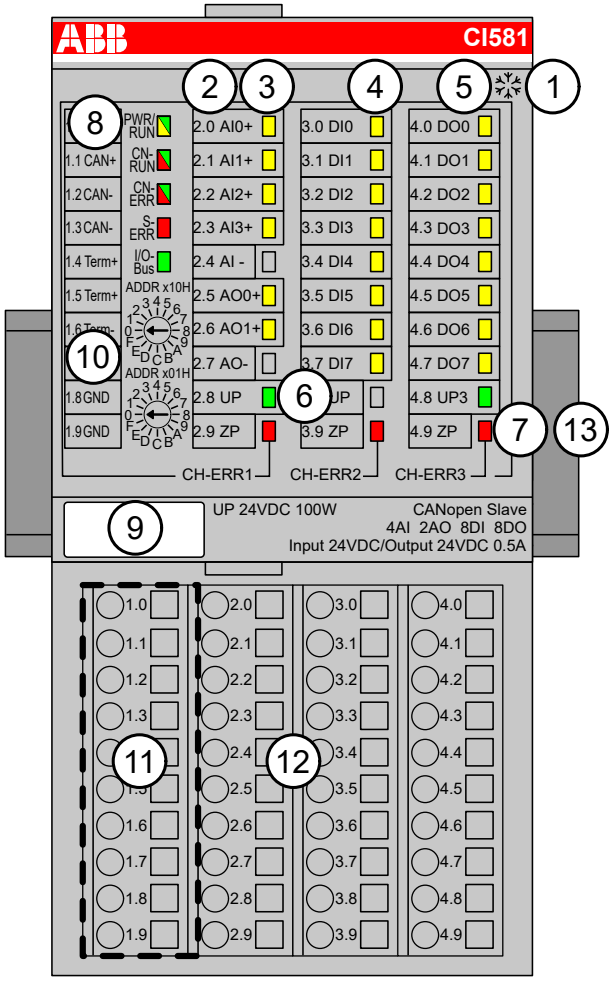
Parameter	Value
Inputs and outputs	8 digital inputs (24 V DC; delay time configurable via software) 8 digital transistor outputs (24 V DC, 0.5 A max.) 4 analog inputs, configurable as: ● -10 V ... +10 V ● 0 V ... +10 V ● -10 V ... +10 V (differential voltage) ● 0 mA ... 20 mA ● 4 mA ... 20 mA ● Pt100 , Pt1000, Ni1000 (for each 2-wire and 3-wire) ● 24 V digital input function 2 analog outputs, configurable as: ● -10 V ... +10 V ● 0 mA ... 20 mA ● 4 mA ... 20 mA
Resolution of the analog channels	12 bits
Fast counter	Integrated, configurable operating modes

CI582-CN: Input/ Output characteristics

Parameter	Value
Inputs and outputs	8 digital inputs (24 V DC) 8 digital transistor outputs (24 V DC, 0.5 A max.) 8 configurable digital inputs/outputs (24 V DC, 0.5 A max.)

5.6.3.2 CI581-CN

- 4 analog inputs (resolution 12 bits including sign)
- 2 analog outputs (resolution 12 bits including sign)
- 8 digital inputs 24 V DC
- 8 digital outputs 24 V DC, 0.5 A max
- Module-wise galvanically isolated
- Fast counter
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal No. and signal name
3 6 yellow LEDs to display the signal states of the analog inputs/outputs (AI0 ... AI3, AO0 ... AO1)
4 8 yellow LEDs to display the signal states of the digital inputs (DI0 ... DI7)
5 8 yellow LEDs to display the signal states of the digital outputs (DO0 ... DO7)
6 2 green LEDs to display the supply voltage UP and UP3
7 3 red LEDs to display errors (CH-ERR1, CH-ERR2, CH-ERR3)
8 5 System LEDs: PWR/RUN, CN-RUN, CN-ERR, S-ERR, I/O-Bus
9 Label
10 2 rotary switches for setting the CANopen Node ID
11 10 terminals to connect the CANopen bus signals
12 Terminal unit
13 DIN rail
❄ Sign for XC version

5.6.3.2.1 Intended purpose

The CANopen communication interface module CI581-CN is used as decentralized I/O module in CANopen networks. Depending on the used terminal unit the network connection is performed either via 9-pin female D-sub or via 10 terminals (screw or spring terminals) which are integrated in the terminal unit.

The communication interface module contains 22 I/O channels with the following properties:

- 4 analog inputs (2.0 ... 2.3)
- 2 analog outputs (2.5 ... 2.6)
- 8 digital inputs 24 V DC in 1 group (3.0 ... 3.7)
- 8 digital outputs 24 V DC in 1 group (4.0 ... 4.7)

The inputs/outputs are galvanically isolated from the CANopen network. There is no potential separation between the channels. The configuration of the analog inputs/outputs is performed by software.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

5.6.3.2.2 Functionality

Parameter		Value
Interface		CAN
Protocol		CANopen
Power supply		From the process supply voltage UP
Supply of the electronic circuitry of the I/O modules attached		Through the I/O bus interface (I/O bus)
Rotary switches		For setting the CANopen Node ID for configuration purposes (00h to FFh)
LED displays		For system displays, signal states, errors and power supply
External supply voltage		Via terminals ZP, UP and UP3 (process supply voltage 24 V DC)
Transmission rates		10 / 20 / 50 / 125 / 250 / 500 / 800 kbit/s 1 Mbit/s Auto transmission rate detection is supported
Bus connection		Depending on used terminal unit TU510: 9-pin D-sub connector TU518: 10-pin terminal block
Processor		Hilscher NETX 100
Expandability		CI58x can only be used on onboard CAN interface and without any I/O expansion module ↳ *Table 302 “CANopen” on page 962*.
State display		Module state: PWR/RUN, CN-RUN, CN-ERR, E-ERR, I/O bus
Adjusting elements		2 rotary switches for generation of the node address
Ambient temperature		System data AC500 ↳ *Chapter 4.2 “System data AC500” on page 34* System data AC500 XC ↳ *Chapter 4.3 “System data AC500-XC” on page 38*
Current consumption		UP: 0.2 A UP3: 0.06 A + 0.5 A max. per output
Weight (without terminal unit)		Ca. 125 g
Process supply voltages UP/UP3		
	Rated value	24 V DC (for inputs and outputs)
	Max. load for the terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse on UP/UP3	10 A fast
	Galvanic isolation	CANopen interface against the rest of the module
	Inrush current from UP (at power up)	On request

Parameter		Value
	Current consumption via UP (normal operation)	0.2 A
	Current consumption via UP3	0.06 A + 0.5 A max. per output
	Connections	Terminals 2.8 and 3.8 for +24 V (UP) Terminal 4.8 for +24 V (UP3) Terminals 2.9, 3.9 and 4.9 for 0 V (ZP)
Max. power dissipation within the module		6 W
Reference potential for all digital inputs and outputs		Negative pole of the supply voltage, signal name ZP
Setting of the CANopen Node ID identifier		With 2 rotary switches at the front side of the module
Mounting position		Horizontal mounting or Vertical mounting with derating (output load reduced to 50 % at +40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.
Effect of incorrect input terminal connection		Wrong or no signal detected, no damage up to 35 V
Required terminal unit		TU509, TU510, TU517 or TU518 ↳ *Chapter 5.7.4 “TU517 and TU518 for communication interface modules” on page 1355*



All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 V DC.

CI581-CN: Input/ Output characteristics

Parameter	Value
Inputs and outputs	8 digital inputs (24 V DC; delay time configurable via software) 8 digital transistor outputs (24 V DC, 0.5 A max.) 4 analog inputs, configurable as: ● -10 V ... +10 V ● 0 V ... +10 V ● -10 V ... +10 V (differential voltage) ● 0 mA ... 20 mA ● 4 mA ... 20 mA ● Pt100 , Pt1000, Ni1000 (for each 2-wire and 3-wire) ● 24 V digital input function 2 analog outputs, configurable as: ● -10 V ... +10 V ● 0 mA ... 20 mA ● 4 mA ... 20 mA
Resolution of the analog channels	12 bits
Fast counter	Integrated, configurable operating modes

5.6.3.2.3 Connections

The CANopen communication interface module is plugged on the I/O terminal units TU517 or TU518 and accordingly TU509 or TU510. Properly position the module and press until it locks in place.

↳ *Chapter 5.7.4 “TU517 and TU518 for communication interface modules” on page 1355*

↳ *Chapter 5.7.3 “TU509 and TU510 for communication interface modules” on page 1351*

The connection of the I/O channels is established using the 30 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 2.8, 3.8, 2.9, 3.9 and 4.9 are electrically interconnected within the terminal unit and always have the same assignment, irrespective of the inserted module:

Terminals 2.8 and 3.8: process supply voltage UP = +24 V DC

Terminal 4.8: process supply voltage UP3 = +24 V DC

Terminals 2.9, 3.9 and 4.9: process supply voltage ZP = 0 V



For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.



With a separate UP3 power supply, the digital outputs can be switched off externally. This way, an emergency-off functionality can be realized.

Do not connect any voltages externally to the digital outputs!

Reason: External voltages at an output or several outputs may cause other outputs to be supplied via that voltage instead of voltage UP3 (reverse voltage). This ist not the intended use.

CAUTION!

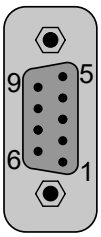
Risk of malfunction by unintended usage!

If the function cut-off of the digital outputs is to be used by deactivation of the supply voltage UP3, be sure that no external voltage is connected at the outputs.

Possibilities of connection

Mounting on terminal units TU509 or TU510

The assignment of the 9-pin female D-sub for the CANopen signals



1	---	Reserved
2	CAN-	Inverted signal of the CAN bus
3	CAN_GND	Ground potential of the CAN bus
4	---	Reserved
5	---	Reserved
6	---	Reserved
7	CAN+	Non-inverted signal of the CAN bus
8	---	Reserved
9	---	Reserved
Shield	Cable shield	Functional earth

Bus terminating resistors

The ends of the data lines have to be terminated with a 120 Ω bus terminating resistor. The bus terminating resistor is usually installed directly at the bus connector.

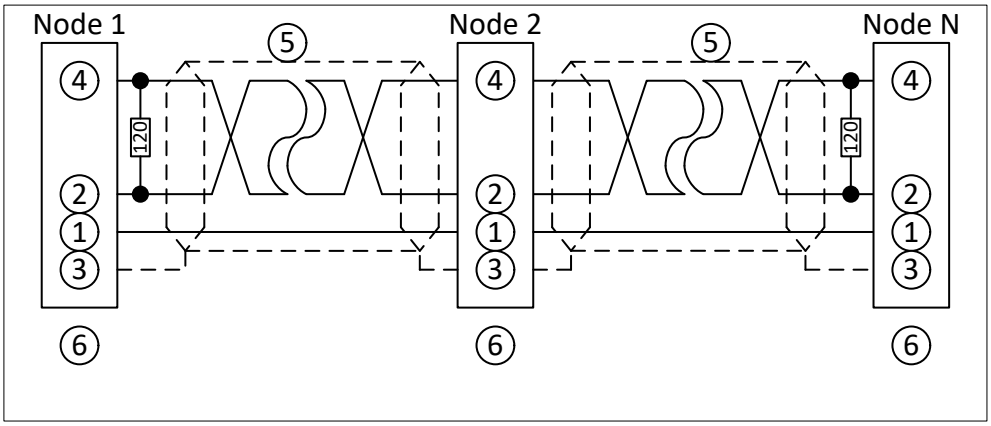


Fig. 160: CANopen interface, bus terminating resistors connected to the line ends

1	CAN_GND
2	CAN_L
3	Shield
4	CAN_H
5	Data line, shielded twisted pair
6	COMBICON connection, CANopen interface

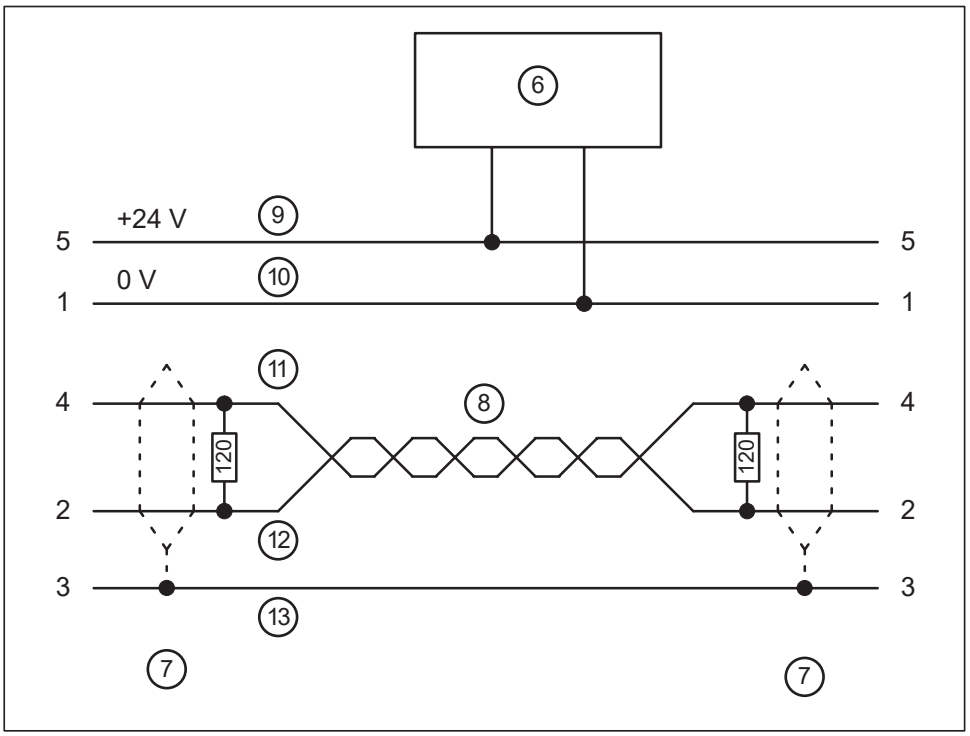


Fig. 161: DeviceNet interface, bus terminating resistors connected to the line ends

6	DeviceNet power supply
7	COMBICON connection, DeviceNet interface
8	Data lines, twisted pair cables
9	red
10	black
11	white
12	blue
13	bare

The grounding of the shield should take place at the switchgear.

Chapter 4.2 “System data AC500” on page 34

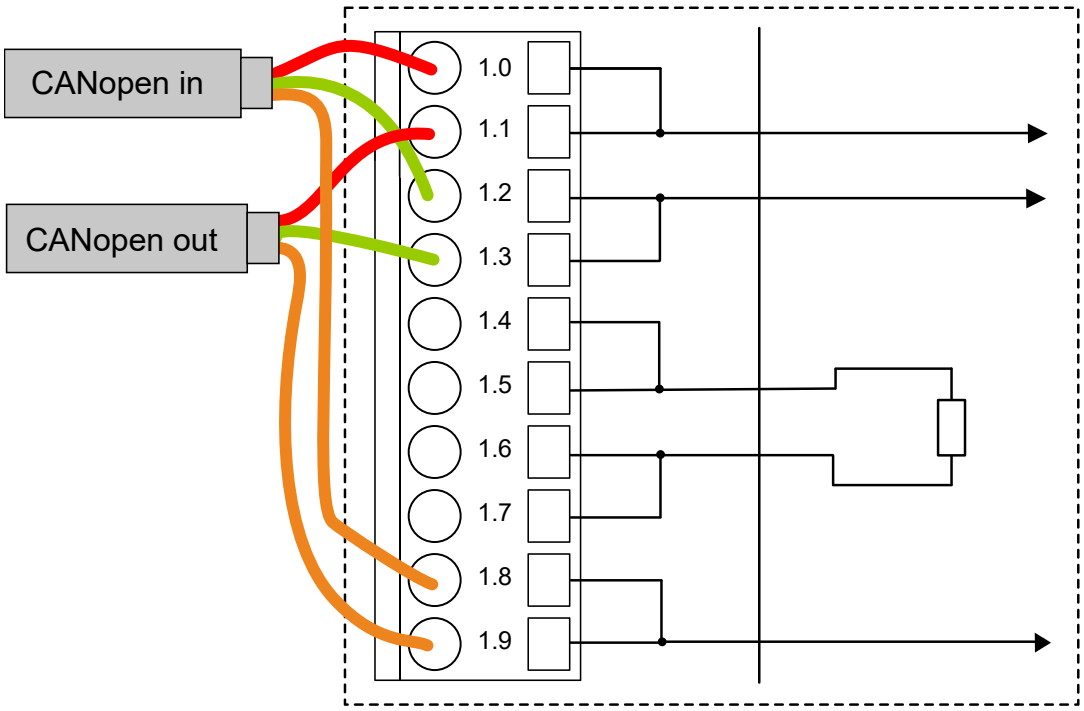
Mounting on terminal units TU517 or TU518

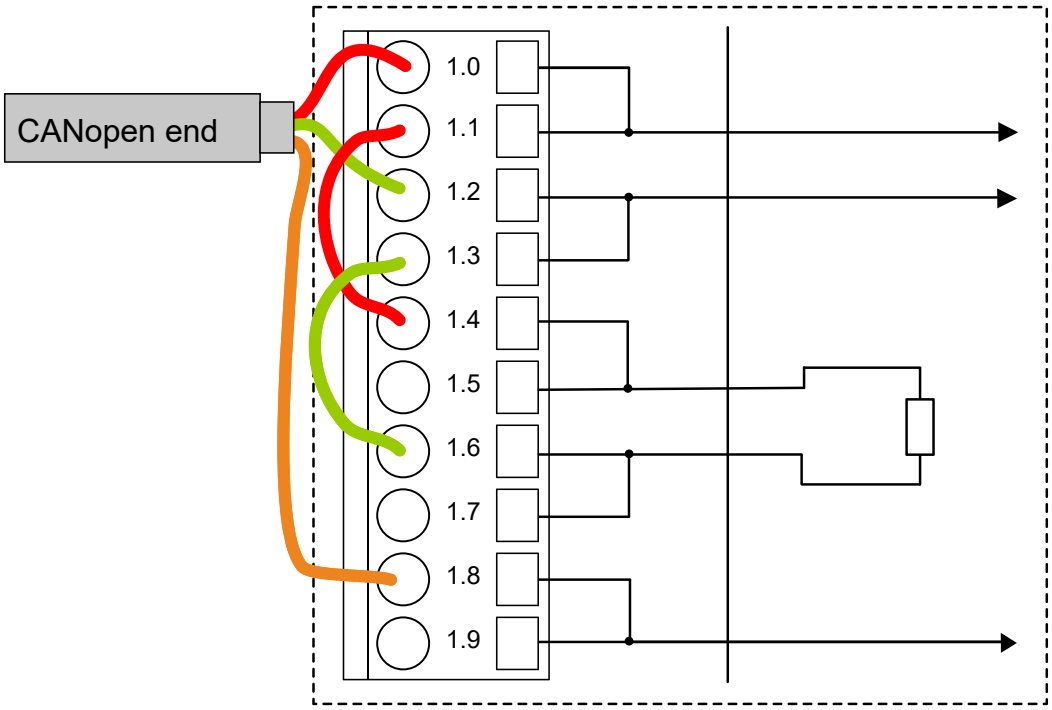
Table 304: Assignment of the terminals

Terminal	Signal	Description
1.0	CAN+	Non-inverted signal of the CAN bus
1.1	CAN+	Non-inverted signal of the CAN bus
1.2	CAN-	Inverted signal of the CAN bus
1.3	CAN-	Inverted signal of the CAN bus
1.4	Term+	CAN bus termination for CAN+ (for bus termination, Term+ must be connected with CAN+)
1.5	Term+	CAN bus termination for CAN+ (connecting alternative for terminal 1.4)
1.6	Term-	CAN bus termination for CAN- (for bus termination, Term- must be connected with CAN-)
1.7	Term-	CAN bus termination for CAN- (connecting alternative for terminal 1.6)
1.8	CAN-GND	Ground potential of the CAN bus
1.9	CAN-GND	Ground potential of the CAN bus

At the line ends of a bus segment, terminating resistors must be connected. If TU517 or TU518 is used, the bus terminating resistors can be enabled by connecting the terminals Term+ and Term- to the data lines CAN+ and CAN- (no external terminating resistors are required, see figure below).

The following figures show the different connection options for the CANopen communication interface module:





In the case of TU517/TU518, the terminating resistors are not located inside the TU but inside the communication interface module CI581-CN. Hence, when removing the device from the TU, the bus terminating resistors are no longer connected to the bus. The bus itself will not be disconnected if a device is removed.

The grounding of the shield should take place at the control cabinet.

↳ *Chapter 4.2 “System data AC500” on page 34*

Table 305: Assignment of the other terminals

Terminal	Signal	Description
2.0	AI0+	Positive pole of analog input signal 0
2.1	AI1+	Positive pole of analog input signal 1
2.2	AI2+	Positive pole of analog input signal 2
2.3	AI3+	Positive pole of analog input signal 3
2.4	AI-	Negative pole of analog input signals 0 to 3
2.5	AO0+	Positive pole of analog output signal 0
2.6	AO1+	Positive pole of analog output signal 1
2.7	AI-	Negative pole of analog output signals 0 and 1
2.8	UP	Process voltage UP (24 V DC)
2.9	ZP	Process voltage ZP (0 V DC)
3.0	DI0	Signal of the digital input DI0
3.1	DI1	Signal of the digital input DI1
3.2	DI2	Signal of the digital input DI2
3.3	DI3	Signal of the digital input DI3

Terminal	Signal	Description
3.4	DI4	Signal of the digital input DI4
3.5	DI5	Signal of the digital input DI5
3.6	DI6	Signal of the digital input DI6
3.7	DI7	Signal of the digital input DI7
3.8	UP	Process voltage UP (24 V DC)
3.9	ZP	Process voltage ZP (0 V DC)
4.0	DO0	Signal of the digital output DO0
4.1	DO1	Signal of the digital output DO1
4.2	DO2	Signal of the digital output DO2
4.3	DO3	Signal of the digital output DO3
4.4	DO4	Signal of the digital output DO4
4.5	DO5	Signal of the digital output DO5
4.6	DO6	Signal of the digital output DO6
4.7	DO7	Signal of the digital output DO7
4.8	UP3	Process voltage UP3 (24 V DC)
4.9	ZP	Process voltage ZP (0 V DC)



WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing the following:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

For the open-circuit detection (wire break), each analog input channel is pulled up to "plus" by a high-resistance resistor. If nothing is connected, the maximum voltage will be read in then.

Generally, analog signals must be laid in shielded cables. The cable shields must be grounded at both sides of the cables. To avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

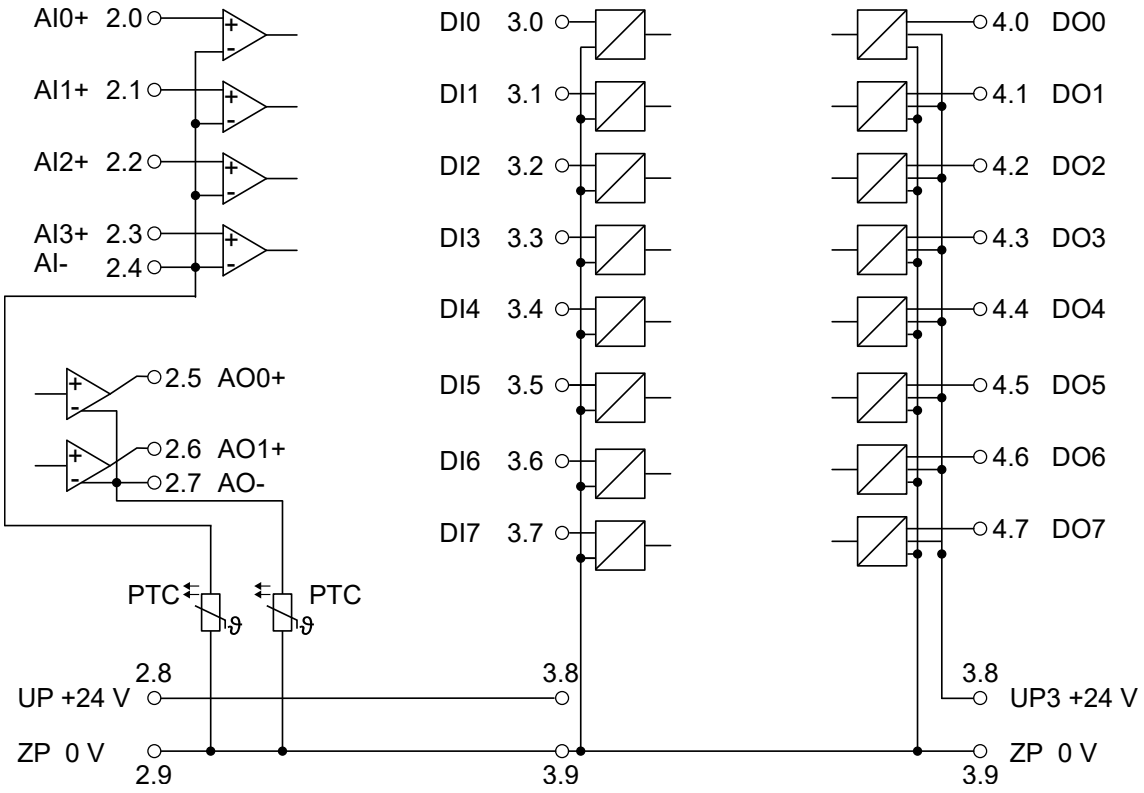


Fig. 162: Connection of the communication interface module CI581-CN

The module provides several diagnosis functions.

Chapter 5.6.3.2.8 “Diagnosis” on page 988

Chapter 5.6.3.2.10 “Measuring ranges” on page 994

Chapter 5.6.3.2.7 “Parameterization” on page 984

Meaning of the LEDs

Bus length

The maximum possible bus length of a CAN network depends on bit rate (transmission rate) and cable type. The sum of all bus segments must not exceed the maximum bus length

Bit Rate (speed)	Bus Length
1 Mbit/s	40 m
800 kbit/s	50 m
500 kbit/s	100 m
250 kbit/s	250 m

Bit Rate (speed)	Bus Length
125 kbit/s	500 m
50 kbit/s	1000 m

Connection of the digital inputs

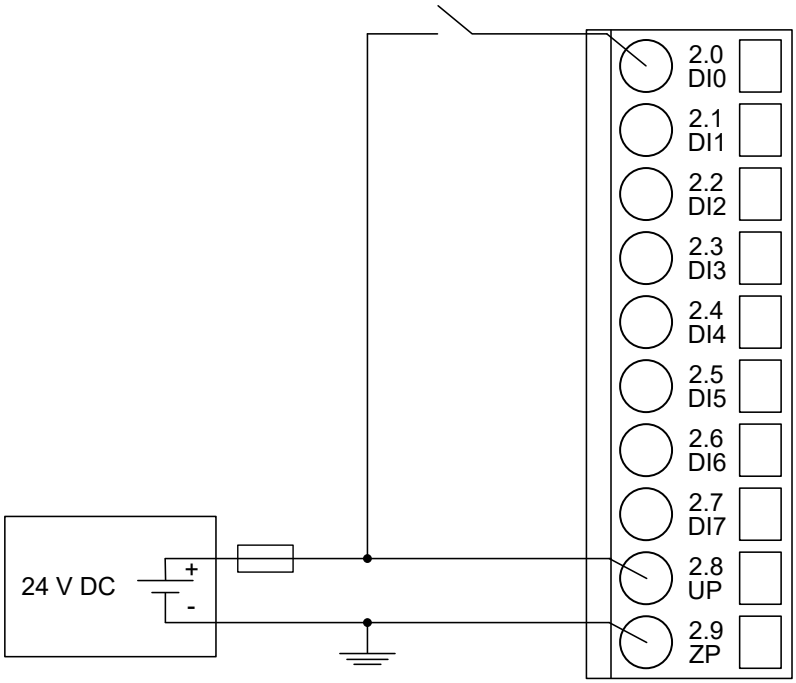


Fig. 163: Connection of the digital inputs to the module CI581-CN

Connection of the digital outputs

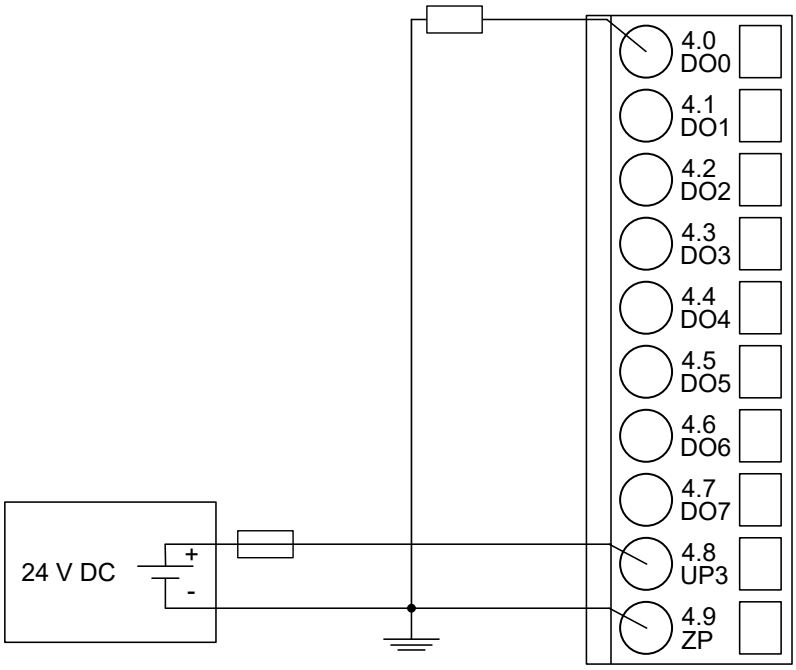


Fig. 164: Connection of configurable digital outputs to the module CI581-CN

Connection of resistance thermometers in 2-wire configuration to the analog inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow to build the necessary voltage drop for the evaluation. For this, the module CI581-CN provides a constant current source which is multiplexed over the max. 4 analog input channels.

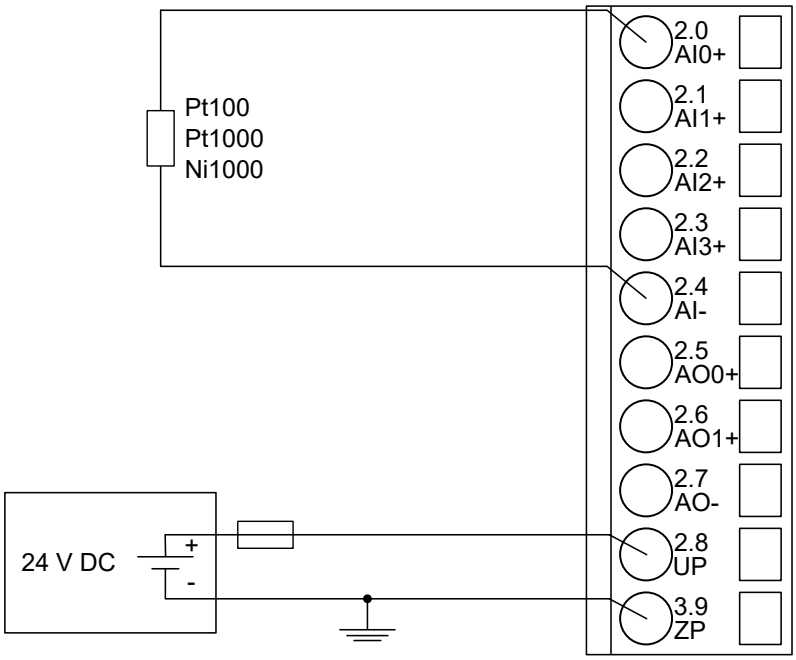


Fig. 165: Connection of resistance thermometers in 2-wire configuration to the analog inputs

Pt100	2-wire configuration, 1 channel used
Pt1000	2-wire configuration, 1 channel used
Ni1000	2-wire configuration, 1 channel used

Chapter 5.6.3.2.10 “Measuring ranges” on page 994

Chapter 5.6.3.2.7 “Parameterization” on page 984

The module CI581-CN performs a linearization of the resistance characteristic.

To avoid error messages, configure unused analog input channels as "unused".

Connection of resistance thermometers in 3-wire configuration to the analog inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module CI581-CN provides a constant current source which is multiplexed over the max. 4 analog input channels.

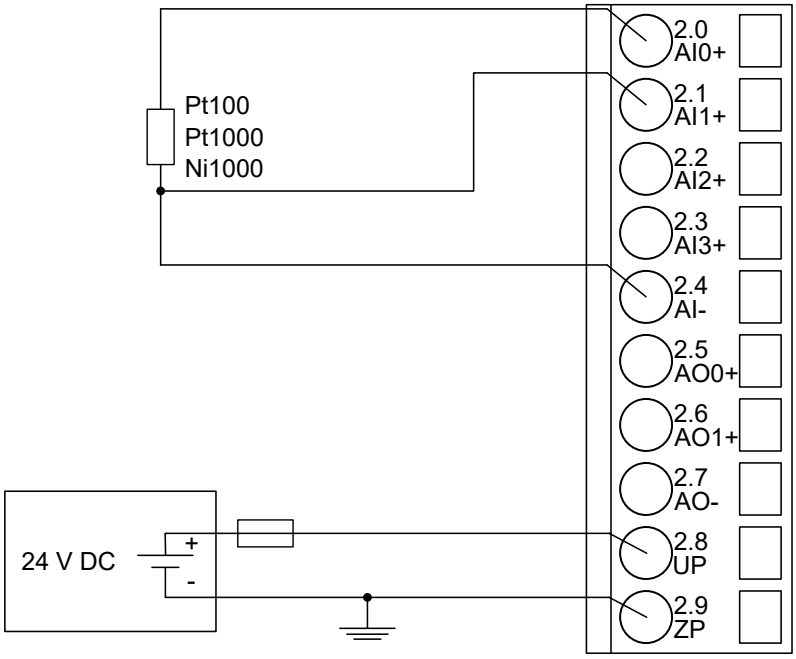


Fig. 166: Connection of resistance thermometers in 3-wire configuration to the analog inputs

With 3-wire configuration, 2 adjacent analog channels belong together (e. g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1).

The constant current of one channel flows through the resistance thermometer. The constant current of the other channel flows through one of the cores. The module calculates the measured value from the two voltage drops and stores it under the input with the higher channel number (e. g. I1).

In order to keep measuring errors as small as possible, it is necessary to have all the involved conductors in the same cable. All the conductors must have the same cross section.

Pt100	3-wire configuration, 2 channels used
Pt1000	3-wire configuration, 2 channels used
Ni1000	3-wire configuration, 2 channels used

↳ *Chapter 5.6.3.2.10 “Measuring ranges” on page 994*

↳ *Chapter 5.6.3.2.7 “Parameterization” on page 984*

The module CI581-CN performs a linearization of the resistance characteristic.

To avoid error messages, configure unused analog input channels as "unused".

Connection of active-type analog sensors (Voltage) with galvanically isolated power supply to the analog inputs

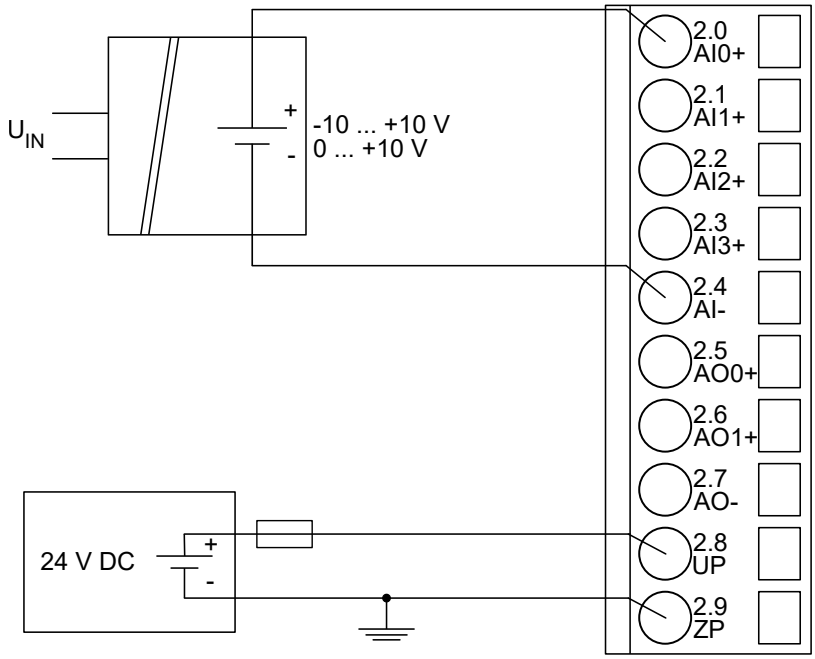


Fig. 167: Connection of active-type analog sensors (voltage) with galvanically isolated power supply to the analog inputs

Voltage	0 ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

↳ *Chapter 5.6.3.2.10 “Measuring ranges” on page 994*

↳ *Chapter 5.6.3.2.7 “Parameterization” on page 984*

To avoid error messages, configure unused analog input channels as "unused".

Connection of active-type analog sensors (Current) with galvanically isolated power supply to the analog inputs

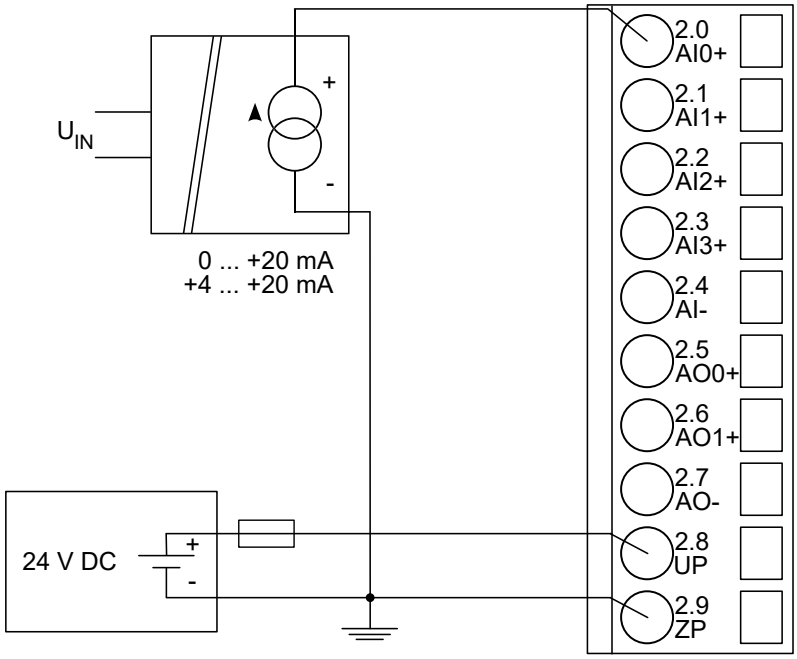


Fig. 168: Connection of active-type analog sensors (current) with galvanically isolated power supply to the analog input AI0 (Proceed with the analog inputs AI1 ... AI3 in the same way)

Current	0 ... 20 mA	1 channel used
Current	4 ... 20 mA	1 channel used

↳ *Chapter 5.6.3.2.10 “Measuring ranges” on page 994*

↳ *Chapter 5.6.3.2.7 “Parameterization” on page 984*

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of active-type analog sensors (Voltage) with no galvanically isolated power supply to the analog inputs

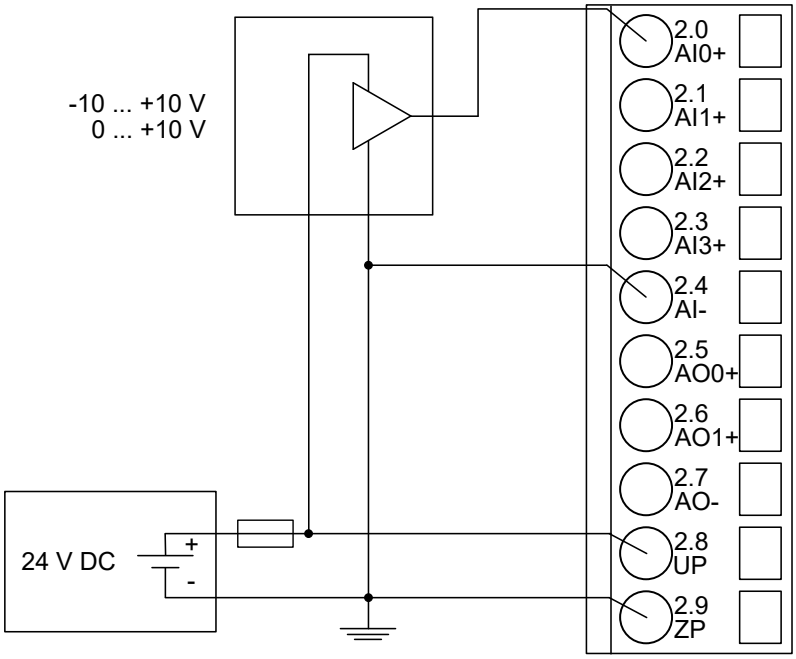


Fig. 169: Connection of active-type sensors (voltage) with no galvanically isolated power supply to the analog inputs (AO ... AI3)

NOTICE!

Risk of faulty measurements!

The negative pole/ground potential at the sensors must not have too large a potential difference with respect to ZP (max. ± 1 V within the full signal range).

Make sure that the potential difference never exceeds ± 1 V.

Voltage	0 ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

↳ *Chapter 5.6.3.2.10 “Measuring ranges” on page 994*

↳ *Chapter 5.6.3.2.7 “Parameterization” on page 984*

To avoid error messages, configure unused analog input channels as "unused".

Connection of passive-type analog sensors (Current) to the analog inputs

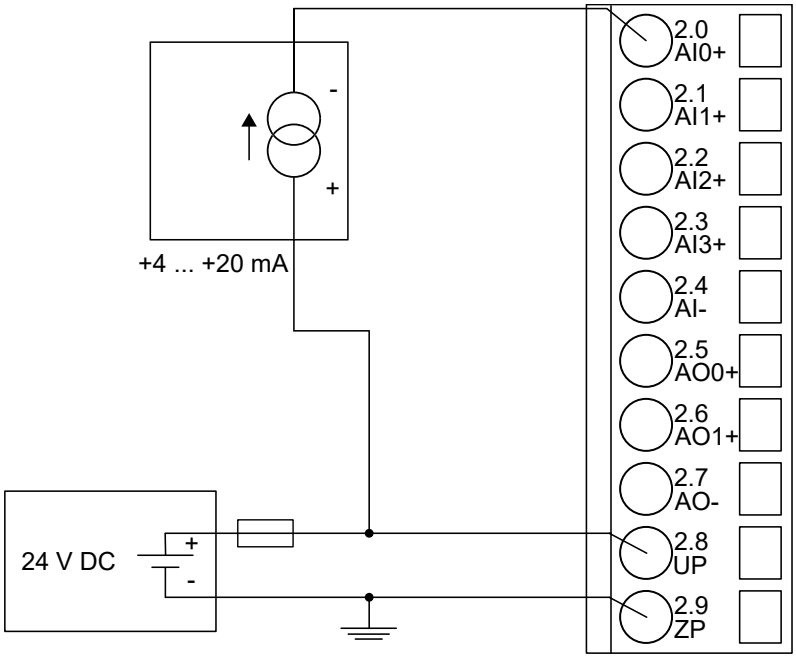


Fig. 170: Connection of passive-type analog sensors (current) to the analog inputs (A0 ... A3)

Current	4 ... 20 mA	1 channel used

CAUTION!

Risk of overloading the analog input!

If an analog current sensor supplies more than 25 mA for more than 1 second during initialization, this input is switched off by the module (input protection).

Use only sensors with fast initialization or without current peaks higher than 25 mA. If not possible, connect a 10-volt Zener diode in parallel to AIx+ and ZP.

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of active-type analog sensors (Voltage) to differential analog inputs

Differential inputs are very useful if analog sensors which are remotely non-isolated (e.g. the negative terminal is remotely grounded) are used.

Using differential inputs helps to considerably increase the measuring accuracy and to avoid ground loops.

With differential input configurations, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

The analog value is calculated by subtraction of the input value with the higher address from the input value of the lower address.

The converted analog value is available at the odd channel (higher address).

NOTICE!

Risk of faulty measurements!

The negative pole/ground potential at the sensors must not have too large a potential difference with respect to ZP (max. ± 1 V within the full signal range).

Make sure that the potential difference never exceeds ± 1 V.

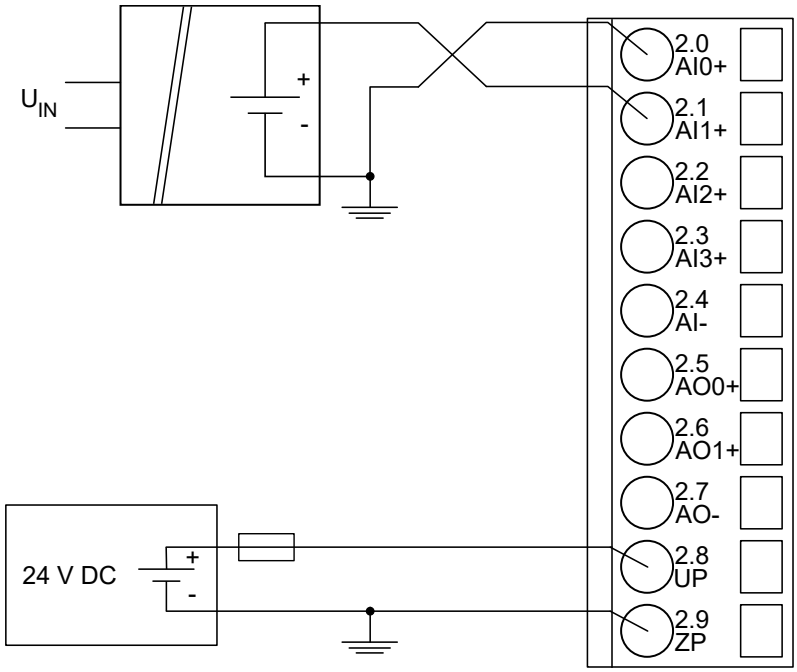


Fig. 171: Connection of active-type analog sensors (voltage) to differential analog inputs (AI0 ... AI3)

Voltage	0 ... 10 V	with differential inputs, 2 channels used
Voltage	-10 V ... +10 V	with differential inputs, 2 channels used

↳ *Chapter 5.6.3.2.10 “Measuring ranges” on page 994*

↳ *Chapter 5.6.3.2.7 “Parameterization” on page 984*

To avoid error messages, configure unused analog input channels as "unused".

Use of analog inputs as digital inputs

Several (or all) analog inputs can be configured as digital inputs. The inputs are not galvanically isolated against the other analog channels.

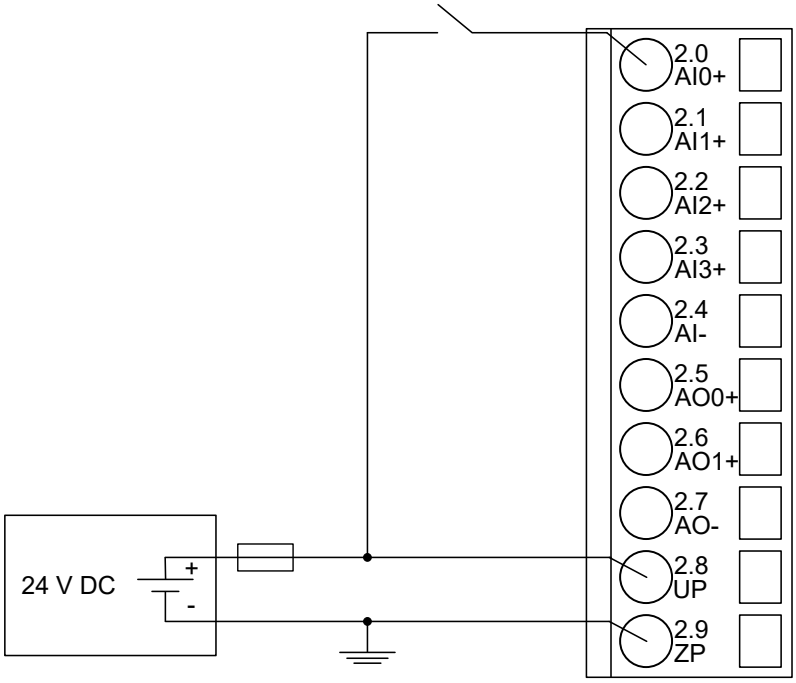


Fig. 172: Connection of digital sensors to the analog input (AI0 ... AI3)

Digital input	24 V	1 channel used

↳ *Chapter 5.6.3.2.10 “Measuring ranges” on page 994*

↳ *Chapter 5.6.3.2.7 “Parameterization” on page 984*

Connection of analog output loads (Voltage)

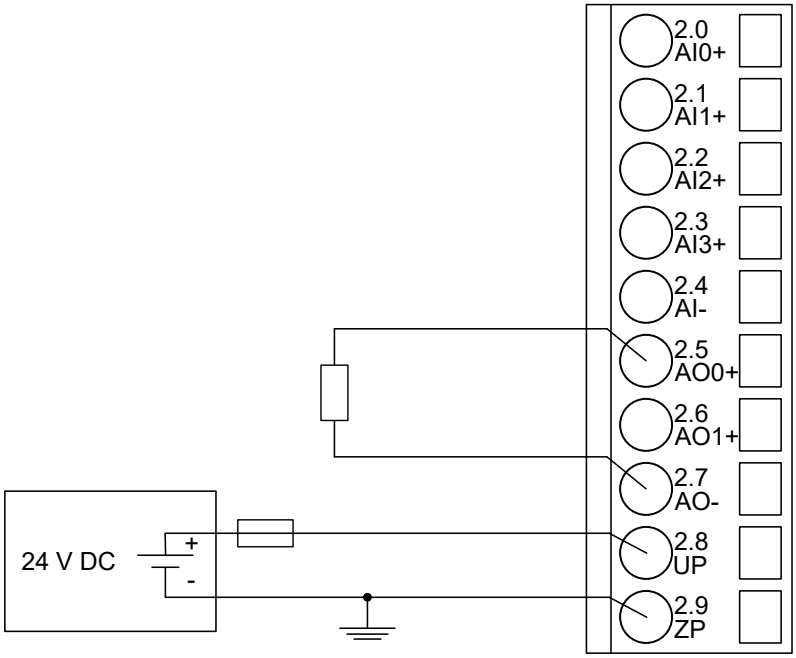


Fig. 173: Connection of analog output loads (voltage) to the analog outputs (AO0 ... AO1)

Voltage	-10 V ... +10 V	Load ± 10 mA max.	1 channel used

↳ *Chapter 5.6.3.2.10 “Measuring ranges” on page 994*
↳ *Chapter 5.6.3.2.7 “Parameterization” on page 984*

Unused analog outputs can be left open-circuited.

Connection of analog output loads (Current)

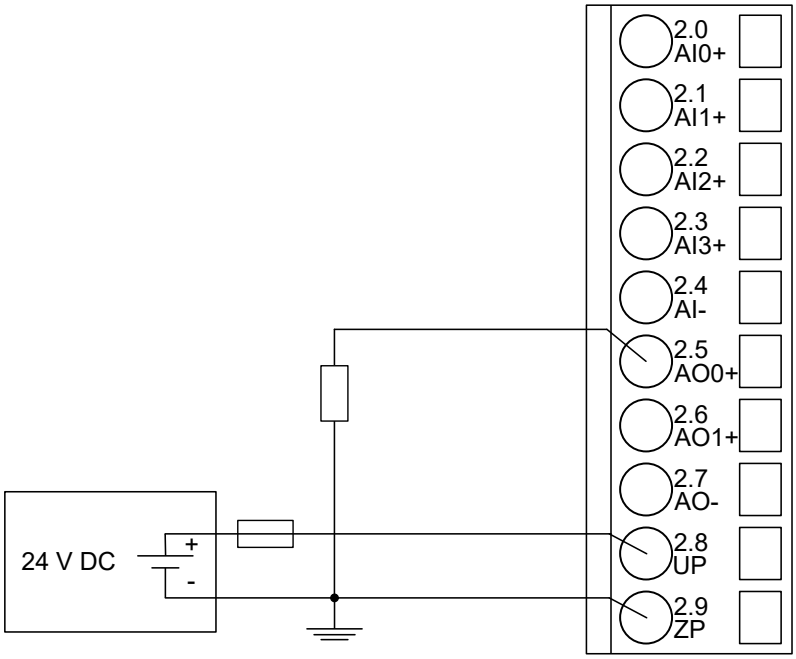


Fig. 174: Connection of analog output loads (current) to the analog outputs (AO0 ... AO1)

Current	0 ... 20 mA	Load 0 ... 500 Ω	1 channel used
Current	4 ... 20 mA	Load 0 ... 500 Ω	1 channel used

↳ *Chapter 5.6.3.2.10 “Measuring ranges” on page 994*
↳ *Chapter 5.6.3.2.7 “Parameterization” on page 984*

Unused analog outputs can be left open-circuited.

5.6.3.2.4 Internal data exchange

Parameter	Value
Digital inputs (bytes)	3
Digital outputs (bytes)	3
Analog inputs (words)	4
Analog outputs (words)	2
Counter input data (words)	4
Counter output data (words)	8

5.6.3.2.5 Addressing

A detailed description concerning addressing can be found in the documentation of ABB Control Builder Plus Software.



The CANopen communication interface module reads the position of the rotary switches only during power-up, i. e. changes of the switch position during operation will have no effect until the next module initialization.

The range of permitted CANopen slave addresses is 1 to 127. Setting a higher address (> 128) does not lead to an error response, but results in a special mode (DS401). In this special mode, the device creates the node address by subtracting the value 128 from the address switch's value.

5.6.3.2.6 I/O configuration

The CI582-CN CANopen bus configuration is handled by CANopen master with the exception of the slave node ID (via rotary switches) and the transmision rate (automatic detection).

The digital I/O channels and the fast counter are configured via software.

5.6.3.2.7 Parameterization

Parameters of the module

Name	Value	Internal value	Internal value, type	Default
Module ID [1])	Internal	0x1C84	WORD	0x1C84
Parameter length	Internal	54	BYTE	54
Error LED / Failsafe function ↳ *Further information on page 984*	On	0	BYTE	0
	Off by E4	1		
	Off by E3	2		
	On + failsafe	16		
	Off by E4 + failsafe	17		
	Off by E3 + failsafe	18		
Reserved	0	0	ARRAY of 24 BYTES	
Check supply (UP and UP3)	On	0	BYTE	
	Off	1		1
Fast counter	0	0	BYTE	0
	:	:		
	10 [2])	10		

[1]) With a faulty ID, the module reports a "parameter error" and does not perform cyclic process data transmission

↳ *2) Description of the counter operating modes*

Table 306: Settings "Error LED / Failsafe function"

Setting	Description
On	Error LED (S-ERR) lights up at errors of all error classes, failsafe mode off
Off by E4	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, failsafe mode off
Off by E3	Error LED (S-ERR) lights up at errors of error classes E1 and E2, failsafe mode off
On +Failsafe	Error LED (S-ERR) lights up at errors of all error classes, failsafe mode on *)
Off by E4 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, failsafe mode on *)
Off by E3 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1 and E2, failsafe mode on *)
*) The parameters Behaviour analog outputs at communication error and Behaviour digital outputs at communication error are only evaluated if the failsafe function is enabled.	

Group parameters for the analog part

Name	Value	Internal value	Internal value, type	Default
Analog data format	Standard Reserved	0 255	BYTE	0
Behavior analog outputs at communication error *)	Off Last value Last value 5 s Last value 10 s Substitute value Substitute value 5 s Substitute value 10 s	0 1 6 11 2 7 12	BYTE	0
*) The parameter Behavior analog outputs at communication error is only analyzed if the failsafe mode is ON.				

Channel parameters for the analog inputs (4x)

Name	Value	Internal value	Internal value, type	Default
Input 0, Channel configuration	Operation modes of analog inputs	Operation modes of analog inputs	BYTE	0
Input 0, Check channel	Settings channel monitoring	Settings channel monitoring	BYTE	0
:	:	:	:	:
:	:	:	:	:

Name	Value	Internal value	Internal value, type	Default
Input 3, Channel configuration	Operation modes of analog inputs	Operation modes of analog inputs	BYTE	0
Input 3, Check channel	Settings channel monitoring	Settings channel monitoring	BYTE	0

Table 307: Channel configuration - Operating modes of the analog inputs

Internal Value	Operating Modes (individually configurable)
0 (default)	Not used
1	0 ... 10 V
2	Digital input
3	0 ... 20 mA
4	4 ... 20 mA
5	-10 V ... +10 V
8	2-wire Pt100 -50 °C ... +400 °C
9	3-wire Pt100 -50 ... +400 °C *)
10	0 ... 10 V (voltage diff.) *)
11	-10 V ... +10 V (voltage diff.) *)
14	2-wire Pt100 -50 °C ... +70 °C
15	3-wire Pt100 -50 °C ... +70 °C *)
16	2-wire Pt1000 -50 °C ... +400 °C
17	3-wire Pt1000 -50 °C ... +400 °C *)
18	2-wire Ni1000 -50 °C ...+150 °C
19	3-wire Ni1000 -50 °C ... +150 °C *)
*) In the operating modes with 3-wire configuration or with differential inputs, two adjacent analog inputs belong together (e.g. the channels 0 and 1). In these cases, both channels are configured in the desired operating mode. The lower address must be the even address (channel 0). The next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).	

Table 308: Channel monitoring

Internal Value	Check Channel
0 (default)	Plausibility, wire break, short circuit
3	Not used

Channel parameters for the analog outputs (2x)

Name	Value	Internal value	Internal value, type	Default
Output 0, Channel configuration	Operation modes of analog outputs	Operation modes of analog outputs	BYTE	0
Output 0, Check channel	Channel monitoring	Channel monitoring	BYTE	0
Output 0, Substitute value	Substitute value	Substitute value	WORD	0
Output 1, Channel configuration	Operation modes of analog outputs	Operation modes of analog outputs	BYTE	0
Output 1, Check channel	Channel monitoring	Channel monitoring	BYTE	0
Output 1, Substitute value	Substitute value	Substitute value	WORD	0

Table 309: Channel configuration - Operating modes of the analog outputs

Internal value	Operating Modes (individually configurable)
0 (default)	Not used
128	-10 V ... +10 V
129	0 mA ... 20 mA
130	4 mA ... 20 mA

Table 310: Channel monitoring

Internal value	Check channel
0	Plausibility, wire break, short circuit
3	None

Table 311: Substitute value

Intended Behavior of Output Channel when the Control System Stops	Required Setting of the Module Parameter "Behavior of Outputs in Case of a Communication Error"	Required Setting of the Channel Parameter "Substitute value"
Output OFF	Off	0
Last value infinite	Last value	0
Last value for 5 s and then turn off	Last value 5 sec	0
Last value for 10 s and then turn off	Last value 10 sec	0
Substitute value infinite	Substitute value	Depending on configuration

Intended Behavior of Output Channel when the Control System Stops	Required Setting of the Module Parameter "Behavior of Outputs in Case of a Communication Error"	Required Setting of the Channel Parameter "Substitute value"
Substitute value for 5 s and then turn off	Substitute value 5 sec	Depending on configuration
Substitute value for 10 s and then turn off	Substitute value 10 sec	Depending on configuration

Group parameters for the digital part

Name	Value	Internal value	Internal value, type	Default
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.1 ms 0x00
Detect short circuit at outputs	Off On	0 1	BYTE	On 0x01
Behavior digital outputs at communcation error [1])	Off Last value Last value 5 sec Last value 10 sec Substitute value Substitute value 5 sec Substitute value 10 sec	0 1 6 11 2 7 12	BYTE	Off 0x00
Substitute value at output	0 ... 255	00h ... FFh	BYTE	0 0x00
Detect voltage overflow at outputs [2])	Off On	0 1	BYTE	Off 0x00

[1]) The parameter Behavior digital outputs at communcation error is only analyzed if the failsafe mode is ON.

[2]) The state "externally voltage detected" appears if the output of a channel DC0 ... DC7 is to be switched on while an external voltage is connected. In this case, the start-up is disabled as long as the external voltage is connected. The monitoring of this state and the resulting diagnosis message can be disabled by setting the parameters to "OFF".

Chapter 5.6.3.2.3 “Connections” on page 967

5.6.3.2.8 Diagnosis

Byte Number	Description	Possible Values
1	Diagnosis byte, slot number	31 = CI581-CN (e. g. error at integrated 8 DI / 8 DO) 1 = 1st connected S500 I/O module ... 10 = 10th connected S500 I/O module
2	Diagnosis byte, module number	According to the I/O bus specification passed on by modules to the fieldbus master
3	Diagnosis byte, channel	According to the I/O bus specification passed on by modules to the fieldbus master
4	Diagnosis byte, error code	According to the I/O bus specification Bit 7 and bit 6, coded error class 0 = E1 1 = E2 2 = E3 3 = E4 Bit 0 to bit 5, coded error description
5	Diagnosis byte, flags	According to the I/O bus specification Bit 7: 1 = coming error Bit 6: 1 = leaving error

In cases of short circuit or overload, the digital outputs are turned off. The module performs reactivation automatically. Thus, an acknowledgement of the errors is not necessary. The error message is stored via the LED.

E1..E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 .. 063**	**AC500-Display**	**<– Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**		
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**CANopen diag-nosis block**		
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**		**Remedy**
	[1])	[2])	[3])	[4])				
Module errors								
3	-	31	31	31	19	Checksum error in the I/O module		Replace I/O module
3	-	31	31	31	3	Timeout in the I/O module		
3	-	31	31	31	40	Different hard-/firm-ware versions in the module		

E1..E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 .. 063**	**AC500-Display**	**<– Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**		
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**CANopen diag-nosis block**		
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**		**Remedy**
	[1])	[2])	[3])	[4])				
3	-	31	31	31	43	Internal error in the module		
3	-	31	31	31	36	Internal data exchange failure		
3	-	31	31	31	9	Overflow diagnosis buffer		Restart
3	-	31	31	31	26	Parameter error		Check Master
3	-	31	31	31	11	Process voltage UP too low		Check process supply voltage
3	-	31	31	31	45	Process voltage UP gone		Check process supply voltage
3	-	31/1...10	31	31	17	No communication with I/O module		Replace I/O module
3	-	1...10	31	31	32	Wrong I/O module type on socket		Replace I/O module / check configu-ration
4	-	1...10	31	31	31	At least one module does not support failsafe function		Check modules and parame-terization
4	-	31	31	31	46	Voltage feedback on activated digital outputs [4])		Check terminals
4	-	31/1...10	31	31	34	No response during initialization of the I/O module		Replace I/O module
4	-	31	31	31	11	Process voltage UP3 too low		Check process supply voltage

E1..E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 .. 063**	**AC500-Display**	**<– Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**CANopen diag-nosis block**	

Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])			
4	-	31	31	31	45	Process voltage UP3 gone	Check process supply voltage
4	-	31	31	31	10	Voltage overflow on outputs (above UP3 level) [5])	Check terminals/ check process supply voltage
Channel error digital							
4	-	31	2	0...7	46	Voltage feedback on deactivated digital output [6])	Check terminals
4	-	31	2	0...7	47	Short circuit at digital output [7])	Check terminals
Channel error analog							
4	-	31	1	0..3	48	Analog value overflow or broken wire at an analog input	Check value or check terminals
4	-	31	1	0..3	7	Analog value underflow at an analog input	Check value
4	-	31	1	0..3	47	Short circuit at an analog input	Check terminals
4	-	31	3	0..1	4	Analog value overflow at an analog output	Check output value
4	-	31	3	0..1	7	Analog value underflow at an analog output	Check output value

Remarks:

[1])	In AC500, the following interface identifier applies: "-" = Diagnosis via bus-specific function blocks; 0 ... 4 or 10 = position of the communication module; 14 = I/O bus; 31 = module itself The identifier is not contained in the CI541-DP diagnosis block.
[2])	With "Device" the following allocation applies: 31 = module itself; 1 ... 10 = decentralized communication interface module
[3])	With "Module" the following allocation applies: 31 = module itself Channel error: module type (1 = AI, 2 = DO, 3 = AO)
[4])	This message appears if external voltages at one or more terminals DO0 ... DO7 cause other digital outputs to be fed by that voltage. All outputs of the digital output groups will be turned off for 5 seconds. The diagnosis message appears for the whole output group. ↳ *Chapter 5.6.3.2.3 “Connections” on page 967*
[5])	The voltage on digital outputs DO0 ... DO7 has overrun the process supply voltage UP3. Diagnosis message appears for the whole module. ↳ *Chapter 5.6.3.2.3 “Connections” on page 967*
[6])	This message appears if the output of a channel DO0 ... DO7 is to be switched on while an external voltage is connected. In this case, start-up is disabled while the external voltage is connected. Otherwise, this could produce reverse voltage flowing from this output to other digital outputs. This diagnosis message appears for each channel.
[7])	Short circuit: After a short circuit has been detected, the output is deactivated for 100 ms seconds. Subsequently, a new start-up will be executed. This diagnosis message appears for each channel.

5.6.3.2.9 State LEDs

The state LEDs are located at the front of module.

There are 2 different groups of LEDs:

- The 5 system LEDs (PWR, CN-RUN, CN-ERR, S-ERR and I/O bus) show the operation states of the module and display possible errors.
- The 27 process LEDs (UP, UP3, inputs, outputs, CH-ERR1 to CH-ERR3) show the process supply voltage and the states of the inputs and outputs and display possible errors.

States of the 5 system LEDs

LED	Color	OFF	ON	Flashing
PWR/RUN	Green	Process supply voltage missing	Internal supply voltage OK, module ready for communication with I/O controller	Start-up / preparing communication
	Yellow	---	---	---

LED	Color	OFF	ON	Flashing
CN-RUN	Green	---	Device configured, CANopen bus in OPERATIONAL state and cyclic data exchange running	Flashing: CANopen bus in PRE-OPERATIONAL state and slave is being configured Single flash: CANopen bus in STOPPED state. Flickering: Autodetect is active
CN-ERR	Red	No system error	CANopen Bus is OFF	Flashing: Configuration error Single flash: error counter overflow due to too many error frames Double flash: A node-guard or a heartbeat event occurred Flickering: Autodetect is active
S-ERR	Red	No error	Internal error	--
I/O bus	Green	No decentralized I/O modules connected or communication error	Decentralized I/O modules connected and operational	---

States of the 27 process LEDs:

LED	Color	OFF	ON	Flashing
AI0 ... AI3	Yellow	Input is OFF	Input is ON (brightness depends on the value of the analog signal)	--
AO0 ... AO1	Yellow	Output is OFF	Output is ON (brightness depends on the value of the analog signal)	--
DI0 ... DI7	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--
DO0 ... DO7	Yellow	Output is OFF	Output is ON	--
UP	Green	Process supply voltage missing	Process supply voltage OK and initialization finished	--

LED	Color	OFF	ON	Flashing
UP3	Green	Process supply voltage missing	Process supply voltage OK	--
CH-ERR1 to CH-ERR3	Red	No error or process supply voltage missing	Internal error	Error on one channel of the corresponding group

5.6.3.2.10 Measuring ranges

Input ranges voltage, current and digital input

Range	0 V ... +10 V	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital input	Digital value	
						Decimal	Hex.
Overflow	> 11.7589	> 11.7589	> 23.5178	> 22.8142		32767	7FFF
Measured value too high	11.7589 : 10.0004	11.7589 : 10.0004	23.5178 : 20.0007	22.8142 : 20.0006		32511 : 27649	7EFF : 6C01
Normal range Normal range or measured value too low	10.0000 : 0.0004	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	: : On	27648 : 1	6C00 : 0001
	0.0000	0.0000	0	4	Off	0	0000
	-0.0004 -1.7593	-0.0004 : : -10,0000		3.9994 1.1858		-1 -4864 : -27648	FFFF ED00 : 9400
Measured value too low		-10.0004 : -11.7589				-27649 : -32512	93FF : 8100
Underflow	< 1.7593	< -11.7589	< 0.0000	< 1.1858		-32768	8000

The represented resolution corresponds to 16 bits.

Input ranges resistance temperature detector

Range	Pt100 / Pt1000 -50 °C ... +400 °C	Ni1000 -50 °C ... +150 °C	Digital value	
			Decimal	Hex.
Overflow	> +450.0 °C	> +160.0 °C	32767	7FFF
Measured value too high	+450.0 °C : + 400.1 °C		4500 : 4001	1194 : 0FA1

Range	Pt100 / Pt1000 -50 °C ... +400 °C	Ni1000 -50 °C ... +150 °C	Digital value	
			Decimal	Hex.
		+160.0 °C : +150.1 °C	1600 : 1501	0640 : 05DD
			800 : 701	0320 : 02BD
Normal range	+400.0 °C : : : + 0.1 °C	+150.0 °C : : +0.1 °C	4000 1500 700 : 1	0FA0 05DC 02BC : 0001
	0 °C	0 °C	0	0000
	-0.1 °C : -50.0 °C	-0.1 °C : -50,0 °C	-1 : -500	FFFF : FE0C
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-501 : -600	FE0B : FDA8
Underflow	< -60.0 °C	< -60.0 °C	-32768	8000

Output ranges voltage and current

Range	-10 V ...+10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital value	
				Decimal	Hex.
Overflow	0 V	0 mA	0 mA	> 32511	> 7EFF
Measured value too high	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA	32511 : 27649	7EFF : 6C01
Normal range	10.0000 V : 0.0004 V	20.0000 mA : 0,0007 mA	20.0000 mA : 4.0006 mA	27648 : 1	6C00 : 0001
	0.0000 V	0.0000 mA	4.0000 mA	0	0000
	-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA	-1 -6912 -27648	FFFF E500 9400

Range	-10 V ...+10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital value	
				Decimal	Hex.
Measured value too low	-10.0004 V : -11.7589 V	0 mA : 0 mA	0 mA : 0 mA	-27649 : -32512	93FF : 8100
Underflow	0 V	0 mA	0 mA	< -32512	< 8100

The represented resolution corresponds to 16 bits.

5.6.3.2.11 Technical data

Technical data of the module

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

↳ *Chapter 4.3 “System data AC500-XC” on page 38*

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.



Multiple overloads

No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Parameter	Value
Interface	CAN
Protocol	CANopen
Power supply	From the process supply voltage UP
Supply of the electronic circuitry of the I/O modules attached	Through the I/O bus interface (I/O bus)
Rotary switches	For setting the CANopen Node ID for configuration purposes (00h to FFh)
LED displays	For system displays, signal states, errors and power supply
External supply voltage	Via terminals ZP, UP and UP3 (process supply voltage 24 V DC)
Transmission rates	10 / 20 / 50 / 125 / 250 / 500 / 800 kbit/s 1 Mbit/s Auto transmission rate detection is supported
Bus connection	Depending on used terminal unit TU510: 9-pin D-sub connector TU518: 10-pin terminal block
Processor	Hilscher NETX 100
Expandability	CI58x can only be used on onboard CAN interface and without any I/O expansion module ↳ *Table 302 “CANopen” on page 962*.

Parameter		Value
State display		Module state: PWR/RUN, CN-RUN, CN-ERR, E-ERR, I/O bus
Adjusting elements		2 rotary switches for generation of the node address
Ambient temperature		System data AC500 *Chapter 4.2 “System data AC500” on page 34* System data AC500 XC *Chapter 4.3 “System data AC500-XC” on page 38*
Current consumption		UP: 0.2 A UP3: 0.06 A + 0.5 A max. per output
Weight (without terminal unit)		Ca. 125 g
Process supply voltages UP/UP3		
	Rated value	24 V DC (for inputs and outputs)
	Max. load for the terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse on UP/UP3	10 A fast
	Galvanic isolation	CANopen interface against the rest of the module
	Inrush current from UP (at power up)	On request
	Current consumption via UP (normal operation)	0.2 A
	Current consumption via UP3	0.06 A + 0.5 A max. per output
	Connections	Terminals 2.8 and 3.8 for +24 V (UP) Terminal 4.8 for +24 V (UP3) Terminals 2.9, 3.9 and 4.9 for 0 V (ZP)
Max. power dissipation within the module		6 W
Reference potential for all digital inputs and outputs		Negative pole of the supply voltage, signal name ZP
Setting of the CANopen Node ID identifier		With 2 rotary switches at the front side of the module
Mounting position		Horizontal mounting or Vertical mounting with derating (output load reduced to 50 % at +40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.
Effect of incorrect input terminal connection		Wrong or no signal detected, no damage up to 35 V
Required terminal unit		TU509, TU510, TU517 or TU518 *Chapter 5.7.4 “TU517 and TU518 for communication interface modules” on page 1355*



All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 V DC.

Technical data of the digital inputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DI0 ... DI7	Terminals 3.0 ... 3.7
Reference potential for all inputs	Terminals 2.9 ... 4.9 (negative pole of the supply voltage, signal name ZP)
Indication of the input signals	1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)	Type 1
Input delay (0->1 or 1->0)	Typ. 0.1 ms, configurable from 0.1 ms ... 32 ms
Input signal voltage	24 V DC
Signal 0	-3 V ... +5 V
Undefined signal	> +5 V ... < +15 V
Signal 1	+15 V ... +30 V
Ripple with signal 0	Within -3 V ... +5 V
Ripple with signal 1	Within +15 V ... +30 V
Input current per channel	
Input voltage +24 V	Typ. 5 mA
Input voltage +5 V	> 1 mA
Input voltage +15 V	> 2 mA
Input voltage +30 V	< 8 mA
Max. cable length	
Shielded	1000 m
Unshielded	600 m

Technical data of the digital outputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DO0 to DO7	Terminals 4.0 to 4.7
Reference potential for all outputs	Terminals 2.9 ... 4.9 (negative pole of the supply voltage, signal name ZP)
Common power supply voltage	For all outputs terminal 4.8 (positive pole of the supply voltage, signal name UP3)
Output voltage for signal 1	UP3 (-0.8 V)
Output delay (0->1 or 1->0)	On request
Output current	
Rated value per channel	500 mA at UP3 = 24 V
Max. value (all channels together)	4 A
Leakage current with signal 0	< 0.5 mA

Parameter	Value
Fuse for UP3	10 A fast
Demagnetization with inductive DC load	Via internal varistors (see figure below this table)
Output switching frequency	
With resistive load	On request
With inductive loads	Max. 0.5 Hz
With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof	Yes
Overload message (I > 0.7 A)	Yes, after ca. 100 ms
Output current limitation	Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals	Yes (software-controlled supervision)
Max. cable length	
Shielded	1000 m
Unshielded	600 m

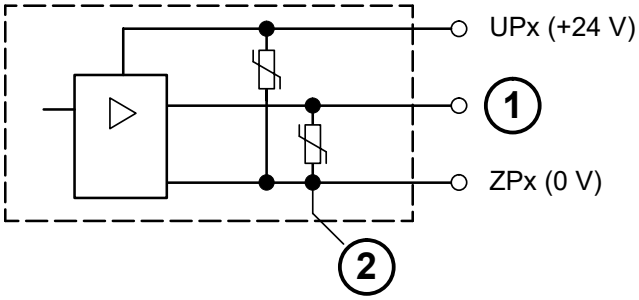


Fig. 175: Circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off

1 Digital output
2 Varistors for demagnetization when inductive loads are turned off

Technical data of the analog inputs

Parameter		Value
Number of channels per module		4
Distribution of channels into groups		1 group with 4 channels
Connection if channels AI0+ to AI3+		Terminals 2.0 to2.3
Reference potential for AI0+ to AI3+		Terminal 2.4 (AI-) for voltage and RTD measurement Terminal 2.9, 3.9 and 4.9 for current measurement
Input type		
	Unipolar	Voltage 0...10 V, current or Pt100/Pt1000/ Ni1000
	Bipolar	Voltage -10...+10 V
Galvanic isolation		Against CANopen Bus

Parameter	Value
Configurability	0...10 V, -10...+10 V, 0/4...20 mA, Pt100/1000, Ni1000 (each input can be configured individually)
Channel input resistance	Voltage: > 100 kΩ Current: ca. 330 Ω
Time constant of the input filter	Voltage: 100 µs Current: 100 µs
Indication of the input signals	1 LED per channel (brightness depends on the value of the analog signal)
Conversion cycle	1 ms (for 4 inputs + 2 outputs); with RTDs Pt/Ni... 1 s
Resolution	Range 0...10 V: 12 bits Range -10...+10 V: 12 bits including sign Range 0...20 mA: 12 bits Range 4...20 mA: 12 bits Range RTD (Pt100, PT1000, Ni1000): +0.1 °C
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code	↬ *Chapter 5.6.3.2.10.2 “Input ranges resistance temperature detector” on page 994*
Unused inputs	Are configured as "unused" (default value)
Overvoltage protection	Yes

Technical data of the analog inputs if used as digital inputs

Parameter		Value
Number of channels per module		Max. 4
Distribution of channels into groups		1 group of 4 channels
Connections of the channels AI0+ to AI3+		Terminals 2.0 to 2.3
Reference potential for the inputs		Terminals 2.9, 3.9 and 4.9 (ZP)
Indication of the input signals		1 LED per channel
Input signal voltage		24 V DC
	Signal 0	-30 V...+5 V
	Undefined signal	+5 V...+15 V
	Signal 1	+15 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 7 mA
	Input voltage +5 V	Typ. 1.4 mA
	Input voltage +15 V	Typ. 3.7 mA
	Input voltage +30 V	< 9 mA
Input resistance		Ca. 3.5 kΩ

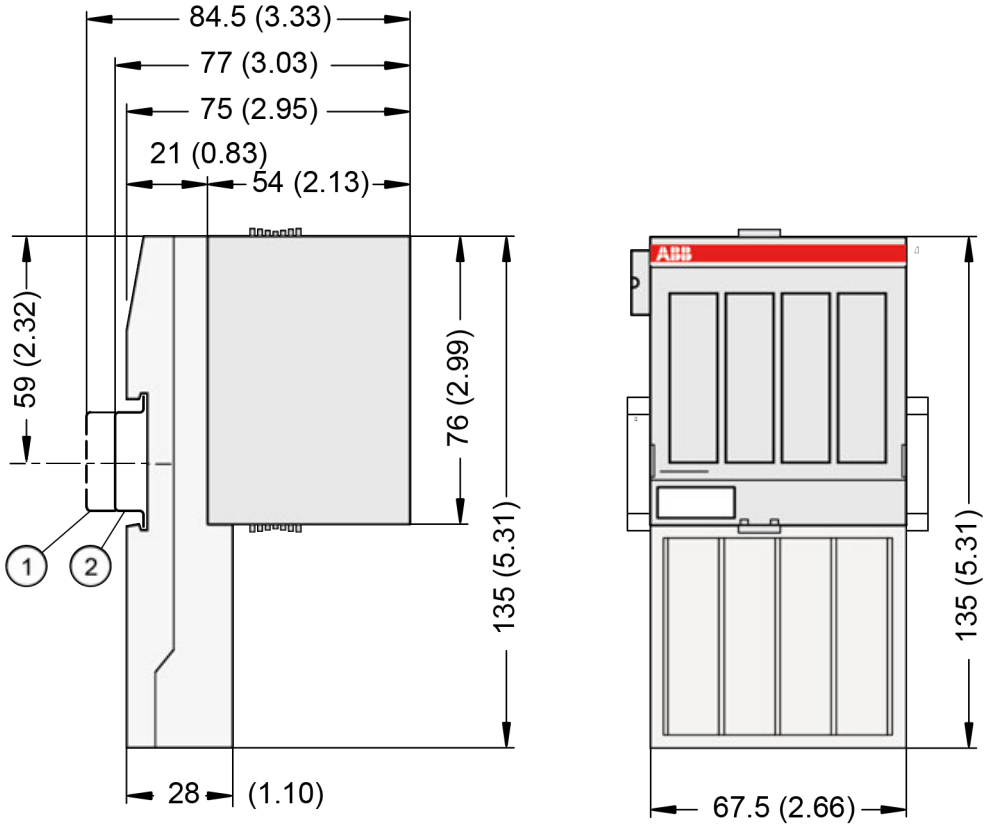
Technical data of the analog outputs

Parameter		Value
Number of channels per module		2
Distribution of channels into groups		1 group for 2 channels
Connection of the channels AO0+...AO1+		Terminals 1.5...1.6
Reference potential for AO0+ to AO1+		Terminal 2.7 (AO-) for voltage output Terminal 2.9, 3.9 and 4.9 for current output
Output type		
	Unipolar	Current
	Bipolar	Voltage
Galvanic isolation		Against internal supply and other modules
Configurability		-10... +10 V, 0... 20 mA, 4... 20 mA (each output can be configured individually)
Output resistance (load), as current output		0...500 Ω
Output loadability, as voltage output		±10 mA max.
Indication of the output signals		1 LED per channel (brightness depends on the value of the analog signal)
Resolution		12 bits including sign
Settling time for full range change (resistive load, output signal within specified tolerance)		Typ. 5 ms
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code		*Chapter 5.6.3.2.10.3 “Output ranges voltage and current” on page 995*
Unused outputs		Are configured as "unused" (default value) and can be left open-circuited

Technical data of the fast counter

Parameter	Value
Used inputs	Terminal 3.0 (DI0), 3.1 (DI1)
Used outputs	Terminal 4.0 (DO0)
Counting frequency	Depending on operation mode: Mode 1 - 6: max. 200 kHz Mode 7: max. 50 kHz Mode 9: max. 35 kHz Mode 10: max. 20 kHz
Detailed description	Fast Counter *Chapter 5.4.3.2.9 “Fast counter” on page 522*
Operating modes	Operating modes *Chapter 5.4.3.2.9 “Fast counter” on page 522*

5.6.3.2.12 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

> *The dimensions are in mm and in brackets in inch.*

5.6.3.2.13 Ordering data

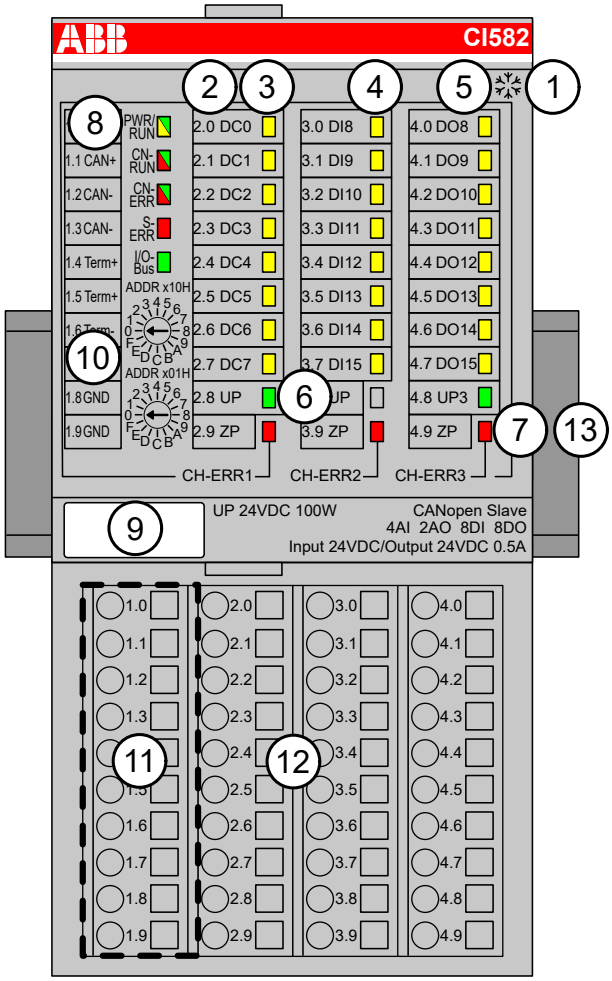
Part no.	Description	Product life cycle phase *)
1SAP 228 100 R0001	CI581-CN, CANopen communication interface module with 8 DI, 8 DO, 4 AI and 2 AO	Active
1SAP 428 100 R0001	CI581-CN-XC, CANopen communication interface module with 8 DI, 8 DO, 4 AI and 2 AO, XC version	Active

> **) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.6.3.3 CI582-CN

- 8 digital inputs 24 V DC
- 8 digital outputs 24 V DC, 0.5 A max.

- 8 configurable digital inputs/outputs 24 V DC, 0.5 A max.
- Module-wise galvanically isolated
- Fast counter
- XC version for use in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 8 yellow LEDs to display the signal states of the configurable digital inputs/outputs (DC0 ... DC7)
4 8 yellow LEDs to display the signal states of the digital inputs (DI8 ... DI15)
5 8 yellow LEDs to display the signal states of the digital outputs (DO8 ... DO15)
6 2 green LEDs to display the supply voltage UP and UP3
7 3 red LEDs to display errors (CH-ERR1, CH-ERR2, CH-ERR3)
8 5 System LEDs: PWR/RUN, CN-RUN, CN-ERR, S-ERR, I/O-Bus
9 Label
10 2 rotary switches for setting the CANopen node ID
11 10 terminals to connect the CANopen bus signals
12 Terminal unit
13 DIN rail
❄ Sign for XC version

5.6.3.3.1 Intended purpose

The CANopen communication interface module CI582-CN is used as decentralized I/O module in CANopen networks. Depending on the terminal unit used, the network connection is performed either via a female 9-pin D-sub connector or via 10 terminals (screw or spring terminals) which are integrated in the terminal unit.

The communication interface module contains 24 I/O channels with the following properties:

- 8 digital configurable inputs/outputs in 1 group (1.0 ... 1.7)
- 8 digital inputs 24 V DC in 1 group (2.0 ... 2.7)
- 8 digital outputs 24 V DC in 1 group (3.0 ... 3.7)

The inputs/outputs are galvanically isolated from the CANopen network. There is no potential separation between the channels. The configuration of the analog inputs/outputs is performed by software.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

5.6.3.3.2 Functionality

Parameter		Value
Interface		CAN
Protocol		CANopen
Power supply		From the process supply voltage UP
Supply of the electronic circuitry of the I/O modules attached		Through the I/O bus interface (I/O bus)
Rotary switches		For setting the CANopen Node ID for configuration purposes (00h to FFh)
LED displays		For system displays, signal states, errors and power supply
External supply voltage		Via terminals ZP, UP and UP3 (process supply voltage 24 V DC)
Transmission rates		10 / 20 / 50 / 125 / 250 / 500 / 800 kbit/s 1 Mbit/s Auto transmission rate detection is supported
Bus connection		Depending on used terminal unit TU510: 9-pin D-sub connector TU518: 10-pin terminal block
Processor		Hilscher NETX 100
Expandability		CI58x can only be used on onboard CAN interface and without any I/O expansion module *Table 302 “CANopen” on page 962*.
State display		Module state: PWR/RUN, CN-RUN, CN-ERR, E-ERR, I/O bus
Adjusting elements		2 rotary switches for generation of the node address
Ambient temperature		System data AC500 *Chapter 4.2 “System data AC500” on page 34* System data AC500 XC *Chapter 4.3 “System data AC500-XC” on page 38*
Current consumption		UP: 0.2 A UP3: 0.06 A + 0.5 A max. per output
Weight (without terminal unit)		Ca. 125 g
Process supply voltages UP/UP3		
	Rated value	24 V DC (for inputs and outputs)
	Max. load for the terminals	10 A
	Protection against reversed voltage	Yes

Parameter		Value
	Rated protection fuse on UP/UP3	10 A fast
	Galvanic isolation	CANopen interface against the rest of the module
	Inrush current from UP (at power up)	On request
	Current consumption via UP (normal operation)	0.2 A
	Current consumption via UP3	0.06 A + 0.5 A max. per output
	Connections	Terminals 2.8 and 3.8 for +24 V (UP) Terminal 4.8 for +24 V (UP3) Terminals 2.9, 3.9 and 4.9 for 0 V (ZP)
Max. power dissipation within the module		6 W
Reference potential for all digital inputs and outputs		Negative pole of the supply voltage, signal name ZP
Setting of the CANopen Node ID identifier		With 2 rotary switches at the front side of the module
Mounting position		Horizontal mounting or Vertical mounting with derating (output load reduced to 50 % at +40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.
Effect of incorrect input terminal connection		Wrong or no signal detected, no damage up to 35 V
Required terminal unit		TU509, TU510, TU517 or TU518 ↳ *Chapter 5.7.4 “TU517 and TU518 for communication interface modules” on page 1355*

All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 V DC.

CI582-CN: Input/ Output characteristics

Parameter	Value
Inputs and outputs	8 digital inputs (24 V DC) 8 digital transistor outputs (24 V DC, 0.5 A max.) 8 configurable digital inputs/outputs (24 V DC, 0.5 A max.)

5.6.3.3.3 Connections

The CANopen communication interface module is plugged on the I/O terminal units TU517 or TU518 and accordingly TU509 or TU510. Properly position the module and press until it locks in place.

↳ *Chapter 5.7.4 “TU517 and TU518 for communication interface modules” on page 1355*

↳ *Chapter 5.7.3 “TU509 and TU510 for communication interface modules” on page 1351*

The connection of the I/O channels is established using the 30 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 2.8, 3.8, 2.9, 3.9 and 4.9 are electrically interconnected within the terminal unit and always have the same assignment, irrespective of the inserted module:

Terminals 2.8 and 3.8: process supply voltage UP = +24 V DC

Terminal 4.8: process supply voltage UP3 = +24 V DC

Terminals 2.9, 3.9 and 4.9: process supply voltage ZP = 0 V

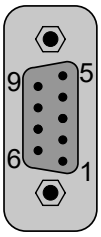
For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

With a separate UP3 power supply, the digital outputs can be switched off externally. This way, an emergency-off functionality can be realized.

Possibilities of connection

Mounting on terminal units TU509 or TU510

The assignment of the 9-pin female D-sub for the CANopen signals



1	---	Reserved
2	CAN-	Inverted signal of the CAN bus
3	CAN_GND	Ground potential of the CAN bus
4	---	Reserved
5	---	Reserved
6	---	Reserved
7	CAN+	Non-inverted signal of the CAN bus
8	---	Reserved
9	---	Reserved
Shield	Cable shield	Functional earth

Bus terminating resistors

The ends of the data lines have to be terminated with a 120 Ω bus terminating resistor. The bus terminating resistor is usually installed directly at the bus connector.

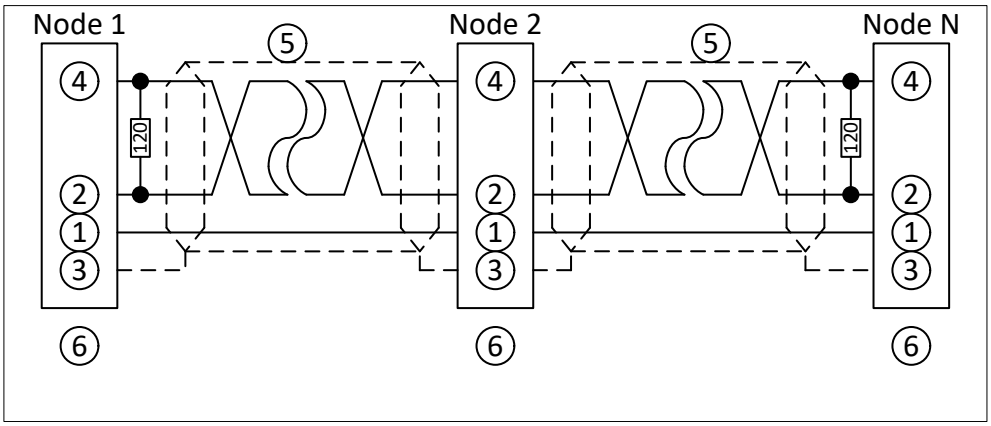


Fig. 176: CANopen interface, bus terminating resistors connected to the line ends

1	CAN_GND
2	CAN_L
3	Shield
4	CAN_H
5	Data line, shielded twisted pair
6	COMBICON connection, CANopen interface

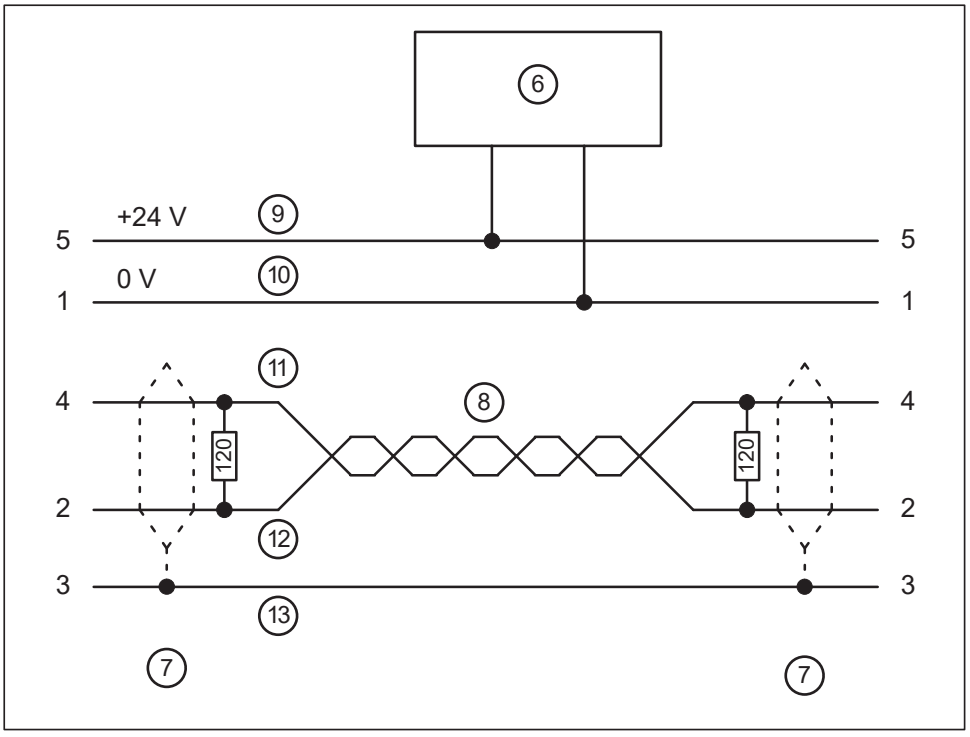


Fig. 177: DeviceNet interface, bus terminating resistors connected to the line ends

6	DeviceNet power supply
7	COMBICON connection, DeviceNet interface
8	Data lines, twisted pair cables
9	red

10	black
11	white
12	blue
13	bare

The grounding of the shield should take place at the switchgear.

Chapter 4.2 “System data AC500” on page 34

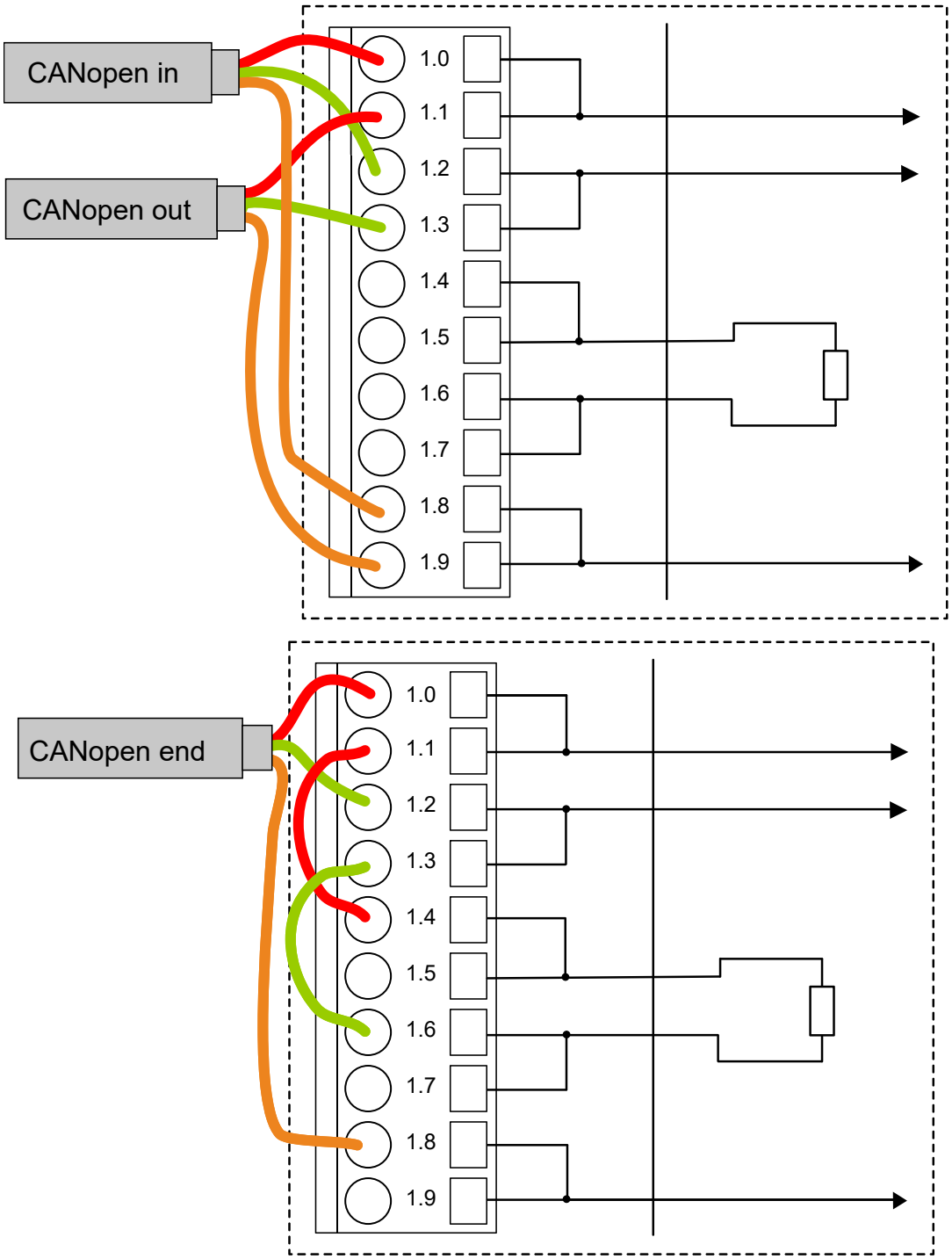
Mounting on terminal units TU517 or TU518

Table 312: Assignment of the terminals

Terminal	Signal	Description
1.0	CAN+	Non-inverted signal of the CAN bus
1.1	CAN+	Non-inverted signal of the CAN bus
1.2	CAN-	Inverted signal of the CAN bus
1.3	CAN-	Inverted signal of the CAN bus
1.4	Term+	CAN bus termination for CAN+ (for bus termination, Term+ must be connected with CAN+)
1.5	Term+	CAN bus termination for CAN+ (connecting alternative for terminal 1.4)
1.6	Term-	CAN bus termination for CAN- (for bus termination, Term- must be connected with CAN-)
1.7	Term-	CAN bus termination for CAN- (connecting alternative for terminal 1.6)
1.8	CAN-GND	Ground potential of the CAN bus
1.9	CAN-GND	Ground potential of the CAN bus

At the line ends of a bus segment, terminating resistors must be connected. If TU517 or TU518 is used, the bus terminating resistors can be enabled by connecting the terminals Term+ and Term- to the data lines CAN+ and CAN- (no external terminating resistors are required, see figure below).

The following figures show the different connection options for the CANopen communication interface module:



In the case of TU517/TU518, the terminating resistors are not located inside the TU but inside the communication interface module CI581-CN. Hence, when removing the device from the TU, the bus terminating resistors are no longer connected to the bus. The bus itself will not be disconnected if a device is removed.

The grounding of the shield should take place at the control cabinet.

Chapter 4.2 “System data AC500” on page 34

Table 313: Assignment of the other terminals

Terminal	Signal	Description
2.0	DC0	Signal of the configurable digital input/output DC0
2.1	DC1	Signal of the configurable digital input/output DC1
2.2	DC2	Signal of the configurable digital input/output DC2
2.3	DC3	Signal of the configurable digital input/output DC3
2.4	DC4	Signal of the configurable digital input/output DC4
2.5	DC5	Signal of the configurable digital input/output DC5
2.6	DC6	Signal of the configurable digital input/output DC6
2.7	DC7	Signal of the configurable digital input/output DC7
2.8	UP	Process voltage UP (24 V DC)
2.9	ZP	Process voltage ZP (0 V DC)
3.0	DI8	Signal of the digital input DI8
3.1	DI9	Signal of the digital input DI9
3.2	DI10	Signal of the digital input DI10
3.3	DI11	Signal of the digital input DI11
3.4	DI12	Signal of the digital input DI12
3.5	DI13	Signal of the digital input DI13
3.6	DI14	Signal of the digital input DI14
3.7	DI15	Signal of the digital input DI15
3.8	UP	Process voltage UP (24 V DC)
3.9	ZP	Process voltage ZP (0 V DC)
4.0	DO8	Signal of the digital output DO8
4.1	DO9	Signal of the digital output DO9
4.2	DO10	Signal of the digital output DO10
4.3	DO11	Signal of the digital output DO11
4.4	DO12	Signal of the digital output DO12
4.5	DO13	Signal of the digital output DO13
4.6	DO14	Signal of the digital output DO14
4.7	DO15	Signal of the digital output DO15
4.8	UP3	Process voltage UP3 (24 V DC)
4.9	ZP	Process voltage ZP (0 V DC)

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing the following:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

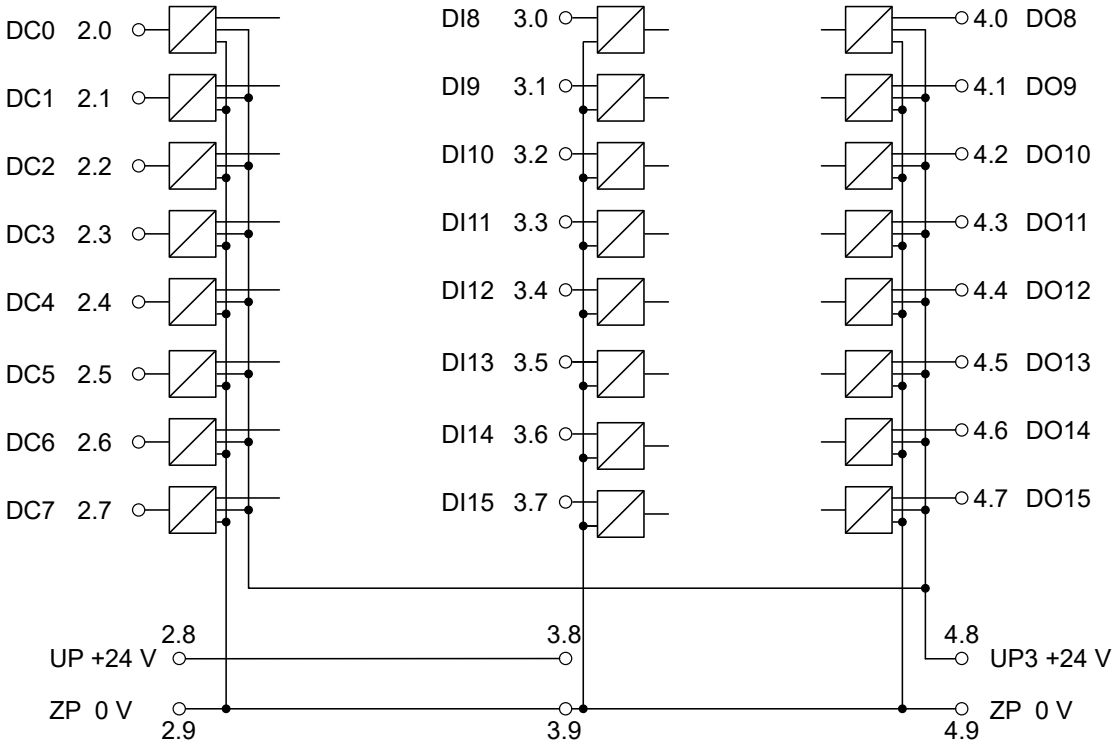


Fig. 178: Connection of the communication interface module CI582-CN

For a description of the meaning of the LEDs, please refer to the section for the state LEDs ↳ *Chapter 5.6.3.3.9 “State LEDs” on page 1020*.

Bus length

The maximum possible bus length of a CAN network depends on bit rate (transmission rate) and cable type. The sum of all bus segments must not exceed the maximum bus length

Bit Rate (speed)	Bus Length
1 Mbit/s	40 m
800 kbit/s	50 m
500 kbit/s	100 m
250 kbit/s	250 m
125 kbit/s	500 m
50 kbit/s	1000 m

Connection of the digital inputs

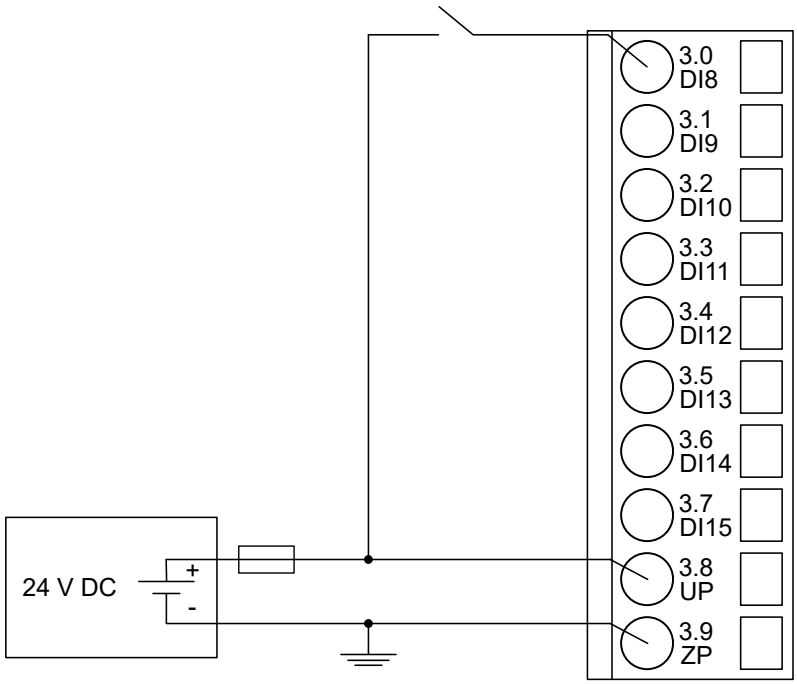


Fig. 179: Connection of the digital inputs (DI8 ... DI15) to the module CI582-CN

Connection of the digital outputs

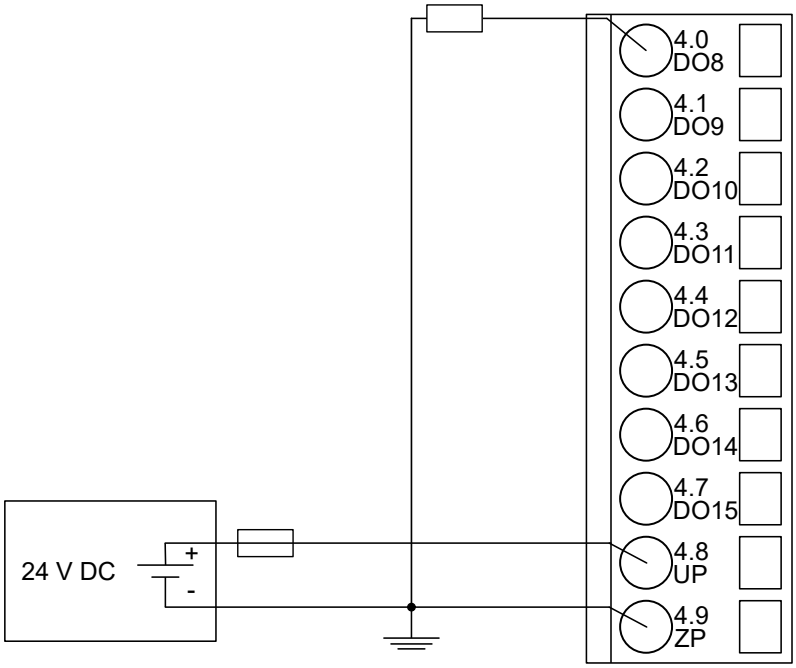


Fig. 180: Connection of configurable digital outputs (DO8 ... DO15) to the module CI582-CN

Connection of the configurable digital inputs/outputs

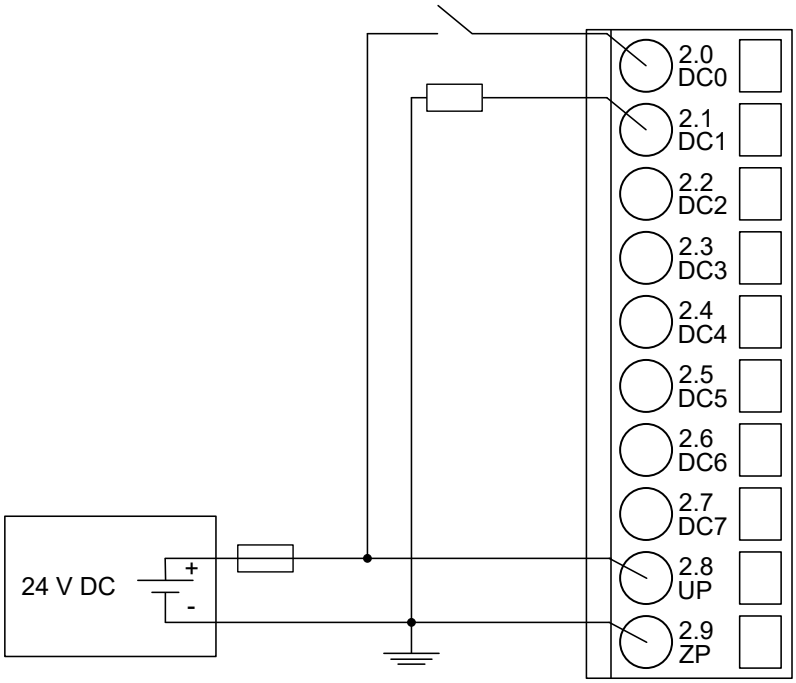


Fig. 181: Connection of configurable digital inputs/outputs (DC0 ... DC7) to the module CI582-CN

5.6.3.3.4 Internal data exchange

Parameter	Value
Digital inputs (bytes)	5
Digital outputs (bytes)	5
Counter input data (words)	4
Counter output data (words)	8

5.6.3.3.5 Addressing

A detailed description concerning addressing can be found in the documentation of ABB Control Builder Plus Software.



The CANopen communication interface module reads the position of the rotary switches only during power-up, i. e. changes of the switch position during operation will have no effect until the next module initialization.

The range of permitted CANopen slave addresses is 1 to 127. Setting a higher address (> 128) does not lead to an error response, but results in a special mode (DS401). In this special mode, the device creates the node address by subtracting the value 128 from the address switch's value.

5.6.3.3.6 I/O configuration

The CI582-CN CANopen bus configuration is handled by CANopen master with the exception of the slave node ID (via rotary switches) and the transmision rate (automatic detection).

The digital I/O channels and the fast counter are configured via software.

5.6.3.3.7 Parameterization

Parameters of the module

Name	Value	Internal value	Internal value, type	Default
Module ID [1])	Internal	0x1C89	WORD	0x1C89
Parameter length	Internal	38	BYTE	38
Error LED / failsafe function table error LED / failsafe function ↳ *Table 314 “Error LED / Failsafe function” on page 1015*)	On	0	BYTE	0
	Off by E4	1		
	Off by E3	2		
	On + failsafe	16		
	Off by E4 + failsafe	17		
	Off by E3 + failsafe	18		
Reserved	0	0	ARRAY of 24 BYTES	
Check supply	On	0	BYTE	
	Off	1		1

Name	Value	Internal value	Internal value, type	Default
Fast counter	0	0	BYTE	0
	:	:		
	10 [2])	10		

[1]) With a faulty ID, the module reports a "parameter error" and does not perform cyclic process data transmission.

[2]) For a description of the counter operating modes, please refer to the 'Fast Counter' section *Chapter 5.4.3.2.9 “Fast counter” on page 522*.

Table 314: Error LED / Failsafe function

Setting	Description
On	Error LED (S-ERR) lights up at errors of all error classes, failsafe mode off
Off by E4	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, failsafe mode off
Off by E3	Error LED (S-ERR) lights up at errors of error classes E1 and E2, failsafe mode off
On + Failsafe	Error LED (S-ERR) lights up at errors of all error classes, failsafe mode on *)
Off by E4 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, failsafe mode on *)
Off by E3 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1 and E2, failsafe mode on *)
*) The parameter Behavior DO at comm. error is only analyzed if the failsafe mode is ON.	

Group parameters for the digital part

Name	Value	Internal value	Internal value, type	Default
Input delay	0.1 ms	0	BYTE	0.1 ms
	1 ms	1		0x00
	8 ms	2		
	32 ms	3		
Detect short circuit at outputs	Off	0	BYTE	On
	On	1		0x01
Behavior DO at comm. error [1])	Off	0	BYTE	Off
	Last value	1		0x00
	Last value 5 sec	6		
	Last value 10 sec	11		
	Substitute value	2		
	Substitute value 5 sec	7		
	Substitute value 10 sec	12		

Name	Value	Internal value	Internal value, type	Default
Substitute value at output	0 ... 65535	0000h ... FFFFh	WORD	0 0x0000
Preventive voltage feedback monitoring for DC0 ... DC7 [2])	Off On	0 1	BYTE	Off 0x00
Detect voltage overflow at outputs [3])	Off On	0 1	BYTE	Off 0x00

Remarks:

[1])	The parameter Behavior DO at comm. error is applied to DC and DO channels and only analyzed if the failsafe mode is ON.
[2])	The state "externally voltage detected" appears if the output of a channel DC0 ... DC7 is to be switched on while an external voltage is connected. In this case, start-up is disabled while the externally voltage is connected. The monitoring of this state and the resulting diagnosis message can be disabled by setting the parameters to "OFF".
[3])	The error state "voltage overflow at outputs" appears if external voltage at digital outputs DC0 ... DC7 and DO0 ... DO7 has exceeded the process supply voltage UP3 ↳ *Chapter 5.6.3.3.3 “Connections” on page 1005*. The according diagnosis message "Voltage overflow on outputs " can be disabled by setting the parameters to "OFF". This parameter should only be disabled in exceptional cases as voltage overflow may produce reverse voltage.

5.6.3.3.8 Diagnosis

Byte Number	Description	Possible Values
1	Diagnosis byte, slot number	31 = CI582-CN (e. g. error at integrated 8 DI / 8 DO) 1 = 1st connected S500 I/O module ... 10 = 10th connected S500 I/O module
2	Diagnosis byte, module number	According to the I/O bus specification passed on by modules to the fieldbus master
3	Diagnosis byte, channel	According to the I/O bus specification passed on by modules to the fieldbus master

Byte Number	Description	Possible Values
4	Diagnosis byte, error code	According to the I/O bus specification Bit 7 and bit 6, coded error class 0 = E1 1 = E2 2 = E3 3 = E4 Bit 0 to Bit 5, coded error description
5	Diagnosis byte, flags	According to the I/O bus specification Bit 7: 1 = coming error Bit 6: 1 = leaving error

In cases of short circuit or overload, the digital outputs are turned off. The module performs reactivation automatically. Thus, an acknowledgement of the errors is not necessary. The error message is stored via the LED.

E1..E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 .. 063**	**AC500 display**	**<– Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**		
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**CANopen diag-nosis block**		
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error message**		**Remedy**
	[1])	[2])	[3])	[4])				
Module errors								
3	-	31	31	31	19	Checksum error in the I/O module		Replace I/O module
3	-	31	31	31	3	Timeout in the I/O module		
3	-	31	31	31	40	Different hard-/firm-ware versions in the module		
3	-	31	31	31	43	Internal error in the module		
3	-	31	31	31	36	Internal data exchange failure		
3	-	31	31	31	9	Overflow diagnosis buffer		Restart
3	-	31	31	31	26	Parameter error		Check Master

E1..E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 .. 063**	**AC500 display**	**<– Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**CANopen diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])			
3	-	31	31	31	11	Process voltage UP too low	Check process supply voltage
3	-	31	31	31	45	Process voltage UP gone	Check process supply voltage
3	-	31/1...10	31	31	17	No communication with I/O module	Replace I/O module
3	-	1...10	31	31	32	Wrong I/O module type on socket	Replace I/O module / check configu-ration
4	-	1...10	31	31	31	At least one module does not support failsafe function	Check modules and parame-terization
4	-	31	31	31	45	Process voltage UP3 too low	Check process voltage
4	-	31	31	31	46	Voltage feedback on activated digital outputs [4])	Check terminals
4	-	31/1...10	31	31	34	No response during initialization of the I/O module	Replace I/O module
4	-	31	31	31	11	Process voltage UP3 too low	Check process supply voltage
4	-	31	31	31	45	Process voltage UP3 gone	Check process supply voltage

E1..E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 .. 063**	**AC500 display**	**<– Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**CANopen diag-nosis block**	

Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])			
4	-	31	31	31	10	Voltage overflow on outputs (above UP3 level) [5])	Check termi-nals/ check process supply voltage
Channel error digital							
4	-	31	2	8...15	46	Externally voltage detected at digital output DO0 ... DO7 [6])	Check terminals
4	-	31	4	0...7	46	Externally voltage detected at digital output DC0 ... DC7 [6])	Check terminals
4	-	31	4	0...7	47	Short circuit at digital output DC0 ... DC7[7])	Check terminals
4	-	31	2	8...15	47	Short circuit at digital output DO0 ... DO7[7])	Check terminals

Remarks:

[1])	In AC500, the following interface identifier applies: "-" = Diagnosis via bus-specific function blocks; 0 ... 4 or 10 = position of the communication module; 14 = I/O bus; 31 = module itself The identifier is not contained in the CI542-DP diagnosis block.
[2])	With "Device" the following allocation applies: 31 = module itself, 1..10 = expansion module
[3])	With "Module" the following allocation applies depending on the master: Module error: 31 = module itself Channel error: module type (1 = AI, 2 = DO, 3 = AO)

[4])	This message appears if external voltages at one or more terminals DC0 ... DC7 or DO0 ... DO7 cause other digital outputs to be supplied by that voltage *Chapter 5.6.3.3.3 “Connections” on page 1005*. All outputs of the digital output groups will be turned off for 5 seconds. The diagnosis message appears for the whole output group.
[5])	The voltage at digital outputs DC0 ... DC7 and DO0 ... DO7 has exceeded the process supply voltage UP3 *Chapter 5.6.3.3.3 “Connections” on page 1005*. A diagnosis message appears for the whole module.
[6])	This message appears if the output of a channel DC0 ... DC7 or DO0 ... DO7 should be switched on while an external voltage is connected. In this case the start-up is disabled while the external voltage is connected. Otherwise, this could produce reverse voltage flowing from this output to other digital outputs. This diagnosis message appears for each channel.
[7])	Short circuit: After a short circuit has been detected, the output is deactivated for 100ms. Subsequently, a new start-up will be executed. This diagnosis message appears for each channel.

5.6.3.3.9 State LEDs

The LEDs are located at the front of the module.

There are 2 different groups of LEDs:

- The 5 system LEDs (PWR, CN-RUN, CN-ERR, S-ERR and I/O bus) show the operation states of the module and display possible errors.
- The 29 process LEDs (UP, UP3, inputs, outputs, CH-ERR1 to CH-ERR3) show the process supply voltage and the states of the inputs and outputs and display possible errors.

States of the 5 system LEDs

LED	Color	OFF	ON	Flashing
PWR/RUN	Green	Process supply voltage missing	Internal supply voltage OK, module ready for communication with I/O controller	Start-up / preparing communication
	Yellow	---	---	---
CN-RUN	Green	---	Device configured, CANopen bus in OPERATIONAL state and cyclic data exchange running	Flashing: CANopen bus in PRE-OPERATIONAL state and slave is being configured Single flash: CANopen bus in STOPPED state. Flickering: Autodetect is active

LED	Color	OFF	ON	Flashing
CN-ERR	Red	No system error	CANopen Bus is OFF	Flashing: Configuration error Single flash: error counter overflow due to too many error frames Double flash: A node-guard or a heartbeat event occurred Flickering: Autodetect is active
S-ERR	Red	No error	Internal error	--
I/O bus	Green	No decentralized I/O modules connected or communication error	Decentralized I/O modules connected and operational	---

States of the 29 process LEDs

LED	Color	OFF	ON	Flashing
DC0 ... DC7	Yellow	Input/output is OFF	Input/output is ON	--
DI8 ...DI15	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--
DO8 ... DO15	Yellow	Output is OFF	Output is ON	--
UP	Green	Process supply voltage missing	Process supply voltage OK and initialization finished	--
UP3	Green	Process supply voltage missing	Process supply voltage OK	--
CH-ERR1 to CH-ERR3	Red	No error or process supply voltage missing	Internal error	Error on one channel of the corresponding group

5.6.3.3.10 Technical data

Technical data of the module

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

↳ *Chapter 4.3 “System data AC500-XC” on page 38*

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Parameter		Value
Interface		CAN
Protocol		CANopen
Power supply		From the process supply voltage UP
Supply of the electronic circuitry of the I/O modules attached		Through the I/O bus interface (I/O bus)
Rotary switches		For setting the CANopen Node ID for configuration purposes (00h to FFh)
LED displays		For system displays, signal states, errors and power supply
External supply voltage		Via terminals ZP, UP and UP3 (process supply voltage 24 V DC)
Transmission rates		10 / 20 / 50 / 125 / 250 / 500 / 800 kbit/s 1 Mbit/s Auto transmission rate detection is supported
Bus connection		Depending on used terminal unit TU510: 9-pin D-sub connector TU518: 10-pin terminal block
Processor		Hilscher NETX 100
Expandability		CI58x can only be used on onboard CAN interface and without any I/O expansion module *Table 302 “CANopen” on page 962*.
State display		Module state: PWR/RUN, CN-RUN, CN-ERR, E-ERR, I/O bus
Adjusting elements		2 rotary switches for generation of the node address
Ambient temperature		System data AC500 *Chapter 4.2 “System data AC500” on page 34* System data AC500 XC *Chapter 4.3 “System data AC500-XC” on page 38*
Current consumption		UP: 0.2 A UP3: 0.06 A + 0.5 A max. per output
Weight (without terminal unit)		Ca. 125 g
Process supply voltages UP/UP3		
	Rated value	24 V DC (for inputs and outputs)
	Max. load for the terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse on UP/UP3	10 A fast
	Galvanic isolation	CANopen interface against the rest of the module
	Inrush current from UP (at power up)	On request
	Current consumption via UP (normal operation)	0.2 A
	Current consumption via UP3	0.06 A + 0.5 A max. per output

Parameter		Value
	Connections	Terminals 2.8 and 3.8 for +24 V (UP) Terminal 4.8 for +24 V (UP3) Terminals 2.9, 3.9 and 4.9 for 0 V (ZP)
Max. power dissipation within the module		6 W
Reference potential for all digital inputs and outputs		Negative pole of the supply voltage, signal name ZP
Setting of the CANopen Node ID identifier		With 2 rotary switches at the front side of the module
Mounting position		Horizontal mounting or Vertical mounting with derating (output load reduced to 50 % at +40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.
Effect of incorrect input terminal connection		Wrong or no signal detected, no damage up to 35 V
Required terminal unit		TU509, TU510, TU517 or TU518 *Chapter 5.7.4 “TU517 and TU518 for communication interface modules” on page 1355*

All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 V DC.

Technical data of the digital inputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DI0 ... DI7	Terminals 3.0 ... 3.7
Reference potential for all inputs	Terminals 2.9 ... 4.9 (negative pole of the supply voltage, signal name ZP)
Indication of the input signals	1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)	Type 1
Input delay (0->1 or 1->0)	Typ. 0.1 ms, configurable from 0.1 ms ... 32 ms
Input signal voltage	24 V DC
Signal 0	-3 V ... +5 V
Undefined signal	> +5 V ... < +15 V
Signal 1	+15 V ... +30 V
Ripple with signal 0	Within -3 V ... +5 V
Ripple with signal 1	Within +15 V ... +30 V
Input current per channel	

Parameter	Value
Input voltage +24 V	Typ. 5 mA
Input voltage +5 V	> 1 mA
Input voltage +15 V	> 2 mA
Input voltage +30 V	< 8 mA
Max. cable length	
Shielded	1000 m
Unshielded	600 m

Technical data of the digital outputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DO0 to DO7	Terminals 4.0 to 4.7
Reference potential for all outputs	Terminals 2.9 ... 4.9 (negative pole of the supply voltage, signal name ZP)
Common power supply voltage	For all outputs terminal 4.8 (positive pole of the supply voltage, signal name UP3)
Output voltage for signal 1	UP3 (-0.8 V)
Output delay (0->1 or 1->0)	On request
Output current	
Rated value per channel	500 mA at UP3 = 24 V
Max. value (all channels together)	4 A
Leakage current with signal 0	< 0.5 mA
Fuse for UP3	10 A fast
Demagnetization with inductive DC load	Via internal varistors (see figure below this table)
Output switching frequency	
With resistive load	On request
With inductive loads	Max. 0.5 Hz
With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof	Yes
Overload message (I > 0.7 A)	Yes, after ca. 100 ms
Output current limitation	Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals	Yes (software-controlled supervision)
Max. cable length	
Shielded	1000 m
Unshielded	600 m

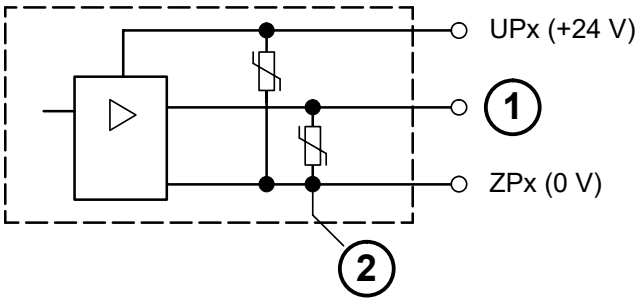


Fig. 182: Circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off

1 Digital output
2 Varistors for demagnetization when inductive loads are turned off

Technical data of the configurable digital inputs/outputs

Each of the configurable I/O channels is defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter	Value
Number of channels per module	8 inputs/outputs (with transistors)
Distribution of the channels into groups	1 group for 8 channels
If the channels are used as inputs	
Channels DC0...DC07	Terminals 2.0...2.7
If the channels are used as outputs	
Channels DC0...DC07	Terminals 2.0...2.7
Indication of the input/output signals	1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Galvanic isolation	From the CANopen network

Technical data of the digital inputs/outputs if used as inputs

Please refer to the Technical Data of the Digital Inputs ↳ *Chapter 5.6.3.3.10 “Technical data” on page 1021*. Deviation:

Terminals of the channels DC0 to DC7: Terminals 2.0 to 2.7

Due to the direct connection to the output, the demagnetizing varistor is also effective at the input. This is why the difference between UPx and the input signal must not exceed the clamp voltage of the varistor. The varistor limits the clamp voltage to approx. 36 V. Consequently the input voltage must be within the following range.

- If UPx = 24 V, the input voltage must range from -12 V ... +30 V.
- If UPx = 30 V, the input voltage must range from -6 V ... +30 V.

Technical data of the digital inputs/outputs if used as outputs

Please refer to the Technical Data of the Digital Outputs ↳ *Chapter 5.6.3.3.10 “Technical data” on page 1021*. Deviation:

Terminals of the channels DC0 to DC7: Terminals 2.0 to 2.7

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

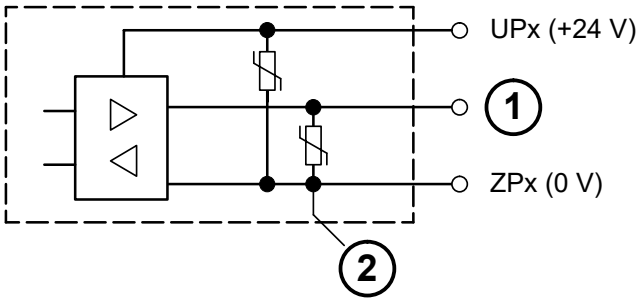


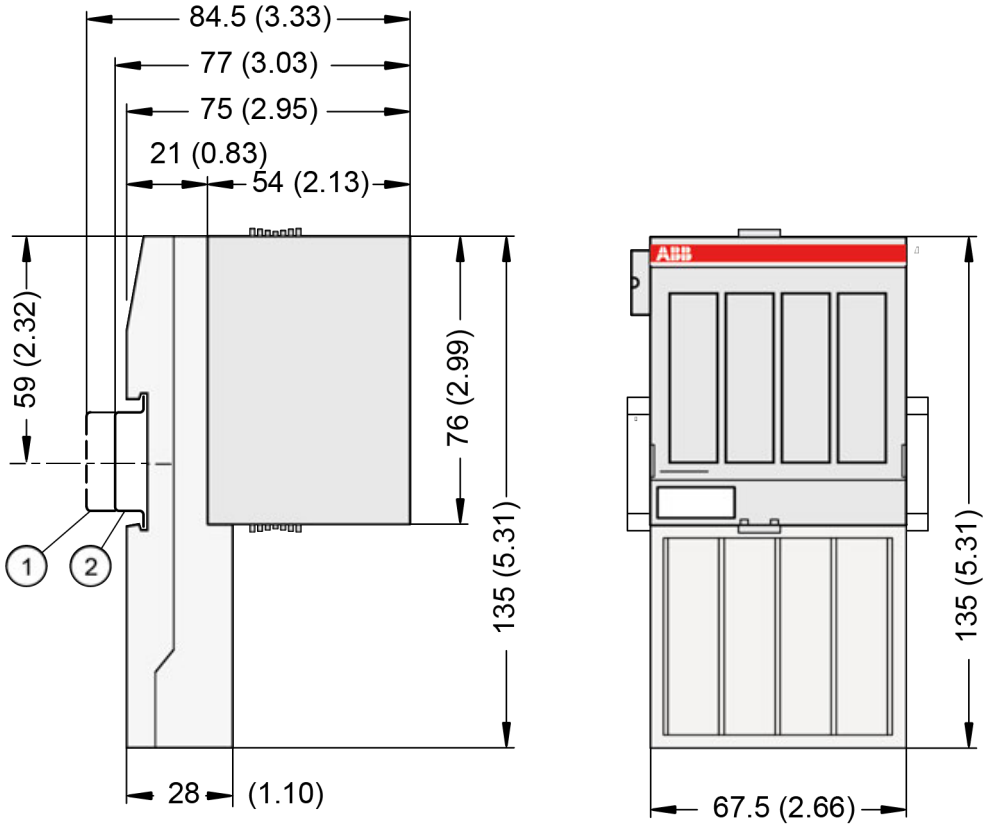
Fig. 183: Digital input/output (circuit diagram)

1	Digital input/output
2	For demagnetization when inductive loads are turned off

Technical data of the fast counter

Parameter	Value
Used inputs	Terminal 3.0 (DI8), 3.1 (DI9)
Used outputs	Terminal 4.0 (DO8)
Counting frequency	Depending on operation mode: Mode 1 - 6: max. 200 kHz Mode 7: max. 50 kHz Mode 9: max. 35 kHz Mode 10: max. 20 kHz
Detailed description	Fast Counter *Chapter 5.4.3.2.9 “Fast counter” on page 522*
Operating modes	Operating modes *Chapter 5.4.3.2.9 “Fast counter” on page 522*

5.6.3.3.11 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

5.6.3.3.12 Ordering data

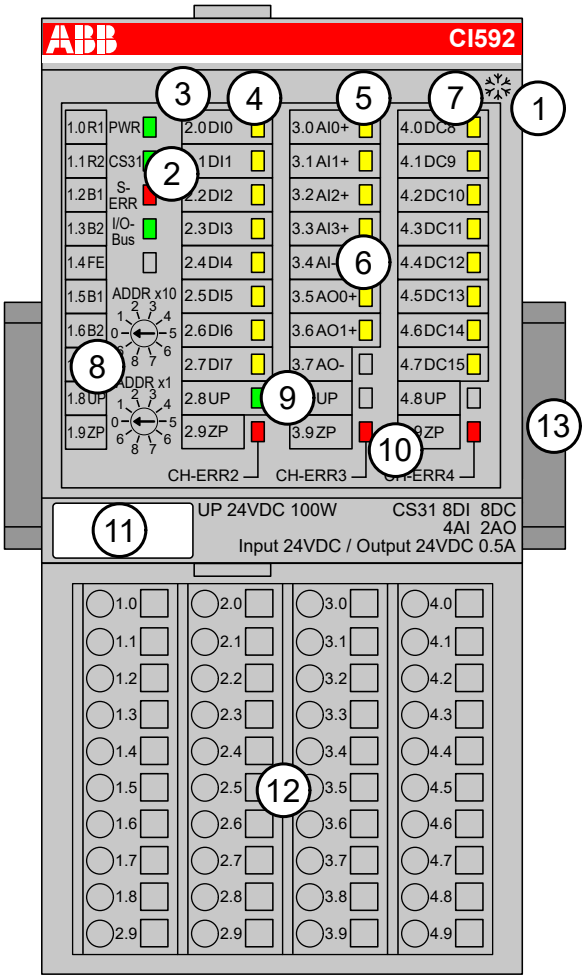
Part no.	Description	Product life cycle phase *)
1SAP 228 200 R0001	CI582-CN, CANopen communication interface module with 8 DI, 8 DO and 8 DC	Active
1SAP 428 200 R0001	CI582-CN-XC, CANopen communication interface module with 8 DI, 8 DO and 8 DC, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.6.4 CS31

5.6.4.1 CI592-CS31 - Digital and analog inputs and outputs

- 8 digital inputs 24 V DC
- 8 configurable digital inputs/outputs 24 V DC
- 4 analog inputs (resolution 12 bits plus sign)
- 2 analog outputs (resolution 12 bits plus sign)
- CS31 bus connection
- Module-wise galvanically isolated
- Fast counter
- XC version for usage in extreme ambient conditions available



1 I/O bus
2 4 system LEDs
3 Allocation between terminal number and signal name
4 8 yellow LEDs to display the signal states of the digital inputs DI0 ... DI7
5 4 yellow LEDs to display the signal states of the analog inputs AI0 ... AI3
6 2 yellow LEDs to display the signal states of the analog outputs AO0 ... AO1
7 8 yellow LEDs to display the signal states of the configurable digital inputs/outputs DC8 ... DC15
8 2 rotary switches to set the module's address (00d ... 99d)
9 1 green LED to display the process voltage UP
10 3 red LEDs to display errors
11 Label
12 Terminal unit
13 DIN rail
❄ Sign for XC version

5.6.4.1.1 Intended purpose

The CS31 bus module is used as a decentralized I/O module on CS31 field buses. The bus connection is performed on a RS-485 serial interface, which allows the connection of this module to all existing CS31 buses.

In addition, the CS31 bus module provides 22 I/O channels with the following properties:

- 8 digital inputs, 24 V DC
- 8 configurable digital inputs/outputs 24 V DC, 0.5 A max.
- 4 analog inputs, voltage, current and RTD, resolution 12 bits plus sign
- 2 analog outputs, voltage and current, resolution 12 bits plus sign

The configuration is performed by software.

For usage in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

5.6.4.1.2 Functionality

Interface	RS-485, CS31 protocol
Address switches	For setting the module's address (00d ... 99d)
Digital inputs	8 (24 V DC; delay time configurable via software)
Configurable digital inputs/outputs	8 (24 V DC, 0.5 A max.)
Analog inputs	4 (configurable via software), resolution 12 bits plus sign, voltage, current and RTD input
Analog outputs	2 (configurable via software), resolution 12 bits plus sign, voltage and current output
Fast counter	Integrated, many configurable operating modes
LED displays	For system displays, signal statuses, errors and power supply
External supply voltage	Via terminals UP and ZP (process supply voltage 24 V DC)
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Required terminal unit	TU551-CS31 or TU552-CS31 ↳ *Chapter 5.7.6 “TU551-CS31 and TU552-CS31 for CS31 communication interface modules” on page 1363*

5.6.4.1.3 Connections

The CS31 communication interface module CI592-CS31 is plugged on the CS31 terminal unit TU551-CS31 or TU552-CS31 ↳ *Chapter 5.7.6 “TU551-CS31 and TU552-CS31 for CS31 communication interface modules” on page 1363*. Hereby, it clicks in with two mechanical locks. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting ↳ *Chapter 5.8.2.6 “TA526 - Wall mounting accessory” on page 1410*.



For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection is carried out by using the 40 terminals of the terminal unit TU551-CS31/TU552-CS31. It is possible to replace the CI592-CS31 without loosening the wiring.

Table 315: Assignment of the terminals

Terminal	Signal	Description
1.0	R1	Integrated terminating resistors for CS31 bus, Terminal 1
1.1	R2	Integrated terminating resistors for CS31 bus, Terminal 2
1.2	B1	CS31 bus, bus line 1
1.3	B2	CS31 bus, bus line 2
1.4	FE	Functional earth
1.5	B1	CS31 bus, bus line 1
1.6	B2	CS31 bus, bus line 2
1.7	FE	Functional earth
1.8	UP	Process voltage UP (24 V DC)
1.9	ZP	Process voltage ZP (0 V DC)
2.0	DI0	Signal of the digital input DI0
2.1	DI1	Signal of the digital input DI1
2.2	DI2	Signal of the digital input DI2
2.3	DI3	Signal of the digital input DI3
2.4	DI4	Signal of the digital input DI4
2.5	DI5	Signal of the digital input DI5
2.6	DI6	Signal of the digital input DI6
2.7	DI7	Signal of the digital input DI7
2.8	UP	Process voltage UP (24 V DC)
2.9	ZP	Process voltage ZP (0 V DC)
3.0	AI0+	Positive pole of analog input signal 0
3.1	AI1+	Positive pole of analog input signal 1
3.2	AI2+	Positive pole of analog input signal 2
3.3	AI3+	Positive pole of analog input signal 3
3.4	AI-	Negative pole of analog input signals 0 ... 3
3.5	AO0+	Positive pole of analog output signal 0
3.6	AO1+	Positive pole of analog output signal 1
3.7	AO-	Negative pole of analog output signals 0 and 1
3.8	UP	Process voltage UP (24 V DC)
3.9	ZP	Process voltage ZP (0 V DC)
4.0	C8	Signal of the configurable digital input/output C8
4.1	C9	Signal of the configurable digital input/output C9
4.2	C10	Signal of the configurable digital input/output C10

Terminal	Signal	Description
4.3	C11	Signal of the configurable digital input/output C11
4.4	C12	Signal of the configurable digital input/output C12
4.5	C13	Signal of the configurable digital input/output C13
4.6	C14	Signal of the configurable digital input/output C14
4.7	C15	Signal of the configurable digital input/output C15
4.8	UP	Process voltage UP (24 V DC)
4.9	ZP	Process voltage ZP (0 V DC)



WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing the following:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

NOTICE!

Risk of imprecise and faulty measurements!

Analog signals may be severely distorted due to external electromagnetic interference.

When the length of the connection cable exceeds 20 m, a shielded and grounded cable must be used. When the shield is grounded at both ends, an independent low-impedance equipotential connection should be provided to avoid high potential differences between interconnected devices.

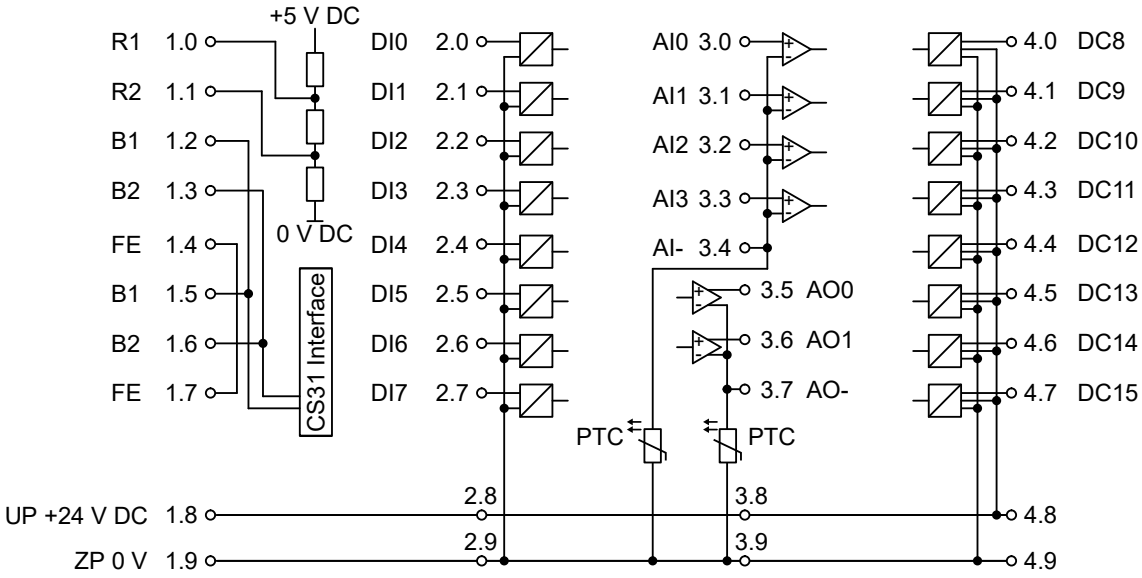


Fig. 184: Terminal assignment of the CS31 communication interface module CI592-CS31

The module provides several diagnosis functions *Chapter 5.6.4.1.9 “Diagnosis” on page 1049*.

The measuring ranges are described in the section Measuring Ranges *Chapter 5.6.4.1.8 “Parameterization” on page 1043* *Chapter 5.6.4.1.11 “Measuring ranges” on page 1050*:

The meaning of the LEDs is described in the section Status LEDs *Chapter 5.6.4.1.10 “State LEDs” on page 1049*.

Connection of the digital inputs

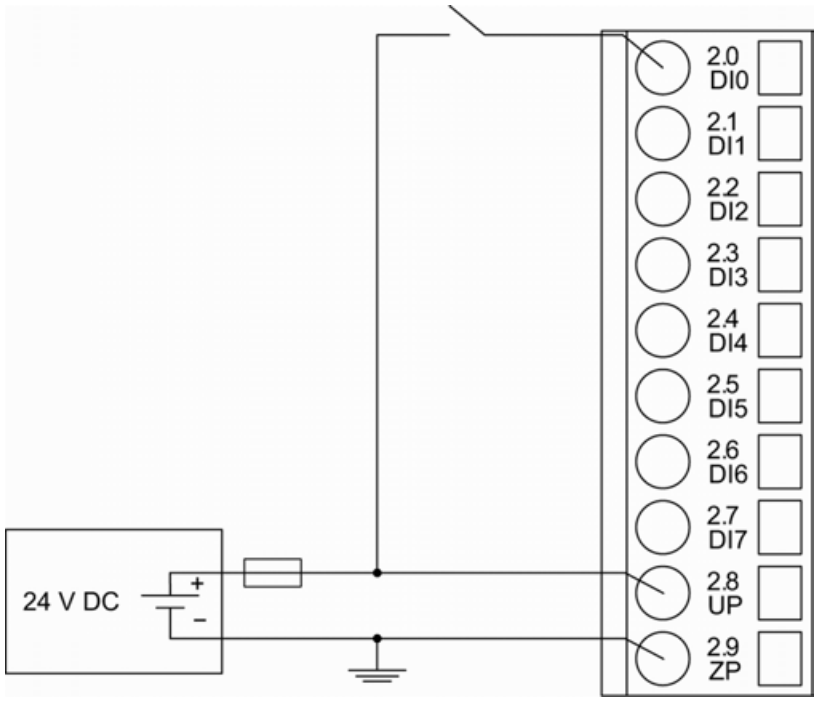


Fig. 185: Connection of the digital inputs (DI0 ... DI7)

Connection of the configurable digital inputs/outputs

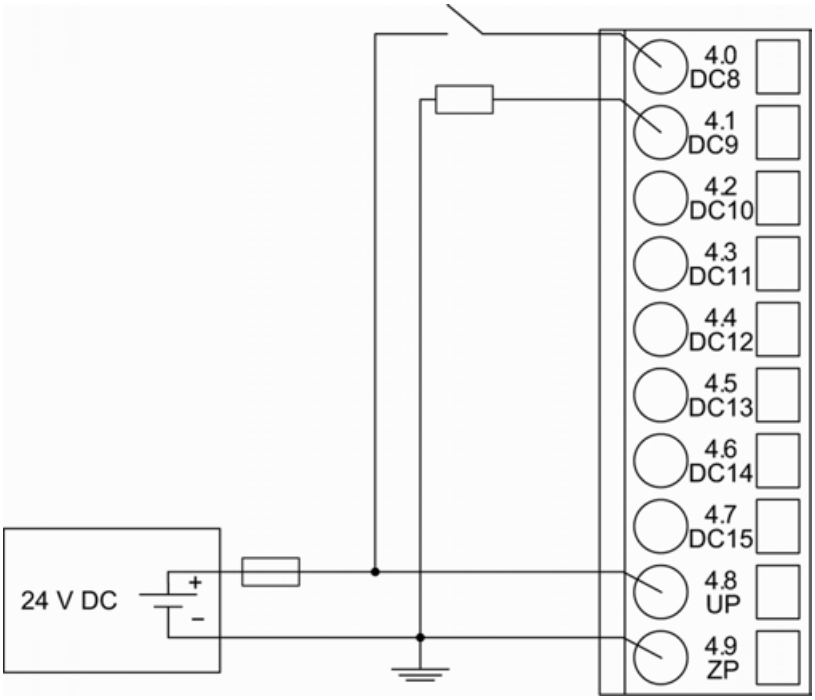


Fig. 186: Connection of configurable digital inputs/outputs (DC8 ... DC15)(DC8 as an input, DC9 as an output)

CAUTION!

Risk of influences to the connected sensors!

Some sensors may be influenced by the deactivated module outputs of CI592-CS31.

If using inputs as fast counter inputs, connect a 470 Ω / 1 W resistor in series to configurable inputs/outputs DC8/DC9.

Connection of resistance thermometers in 2-wire configuration to the analog inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow to build the necessary voltage drop for the evaluation. For this, the module CI592-CS31 provides a constant current source which is multiplexed over the max. 4 analog input channels.

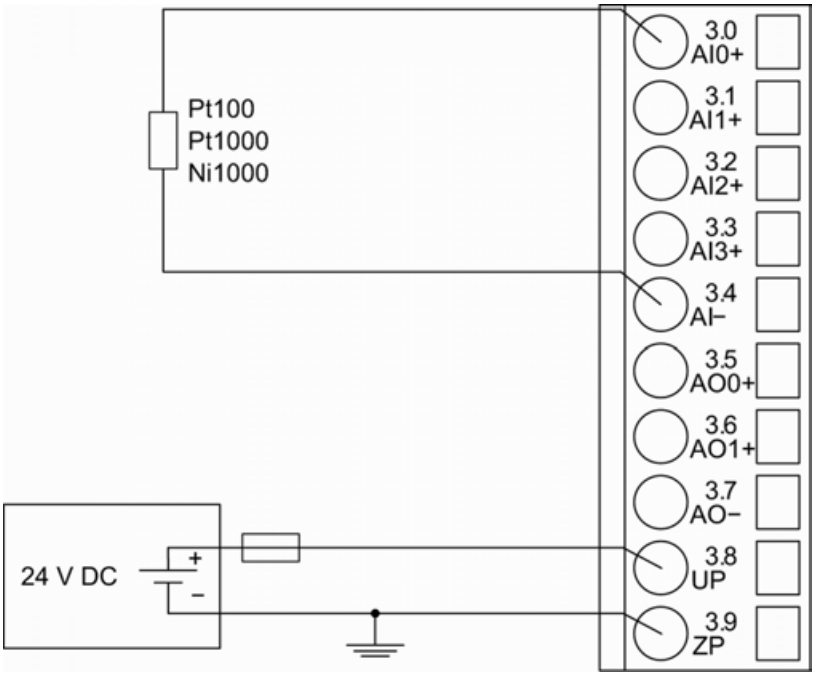


Fig. 187: Connection of resistance thermometers in 2-wire configuration to the analog inputs (AI0 ... AI3)

Pt100	-50 °C ... +400 °C	2-wire configuration, 1 channel used
Pt1000	-50 °C ... +400 °C	2-wire configuration, 1 channel used
Ni1000	-50 °C ... +150 °C	2-wire configuration, 1 channel used

The measuring ranges are described in the section Measuring Ranges ↬ *Chapter 5.6.4.1.8 “Parameterization” on page 1043* ↬ *Chapter 5.6.4.1.11 “Measuring ranges” on page 1050*:

The module CI592-CS31 performs a linearization of the resistance characteristic.

Configure unused analog input channels as "unused".

Connection of resistance thermometers in 3-wire configuration to the analog inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow to build the necessary voltage drop for the evaluation. For this, the module CI592-CS31 provides a constant current source which is multiplexed over the max. 4 analog input channels.

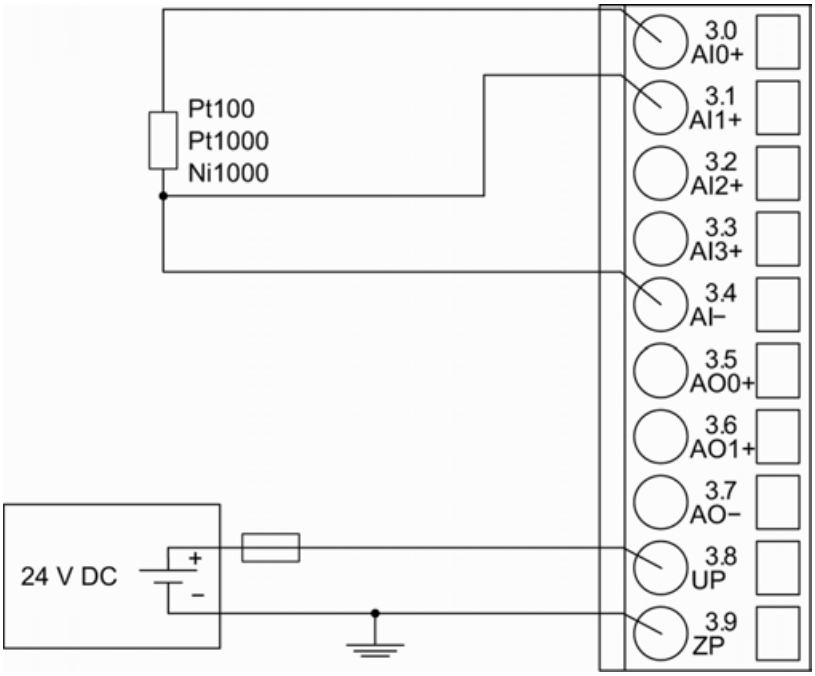


Fig. 188: Connection of resistance thermometers in 3-wire configuration to the analog inputs (AI0 ... AI3)

With 3-wire configuration, 2 adjacent analog channels belong together (e. g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1).

The constant current of one channel flows through the resistance thermometer. The constant current of the other channel flows through one of the cores. The module calculates the measured value from the two voltage drops and stores it under the input with the higher channel number (e. g. I1).

In order to keep measuring errors as small as possible, it is necessary to have all the involved conductors in the same cable. All the conductors must have the same cross section.

Pt100	3-wire configuration, 2 channels used
Pt1000	3-wire configuration, 2 channels used
Ni1000	3-wire configuration, 2 channels used

The measuring ranges are described in the section Measuring Ranges ↬ *Chapter 5.6.4.1.8 “Parameterization” on page 1043* ↬ *Chapter 5.6.4.1.11 “Measuring ranges” on page 1050*:

The module CI592-CS31 performs a linearization of the resistance characteristic.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of active-type analog sensors (Voltage) with galvanically power supply to the analog inputs

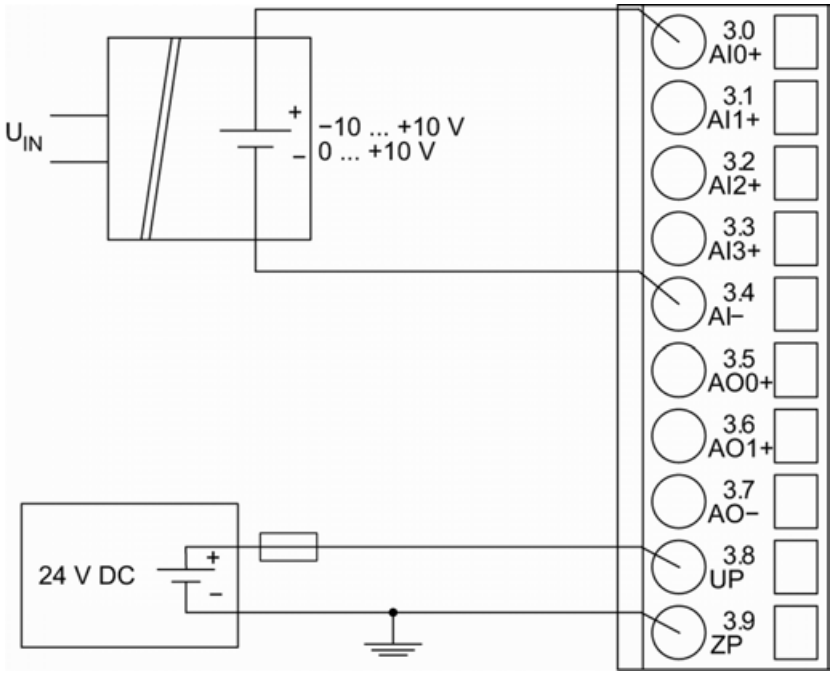


Fig. 189: Connection of active-type analog sensors (voltage) with galvanically power supply to the analog inputs (AI0 ... AI3)

Voltage	0 ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

The measuring ranges are described in the section Measuring Ranges ↳ *Chapter 5.6.4.1.8 “Parameterization” on page 1043* ↳ *Chapter 5.6.4.1.11 “Measuring ranges” on page 1050*:

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of active-type analog sensors (Current) with galvanically isolated power supply to the analog inputs

The following figure shows the connection of active-type analog sensors (current) with galvanically isolated power supply to the analog input AI0. Proceed with the analog inputs AI1 ... AI3 in the same way.

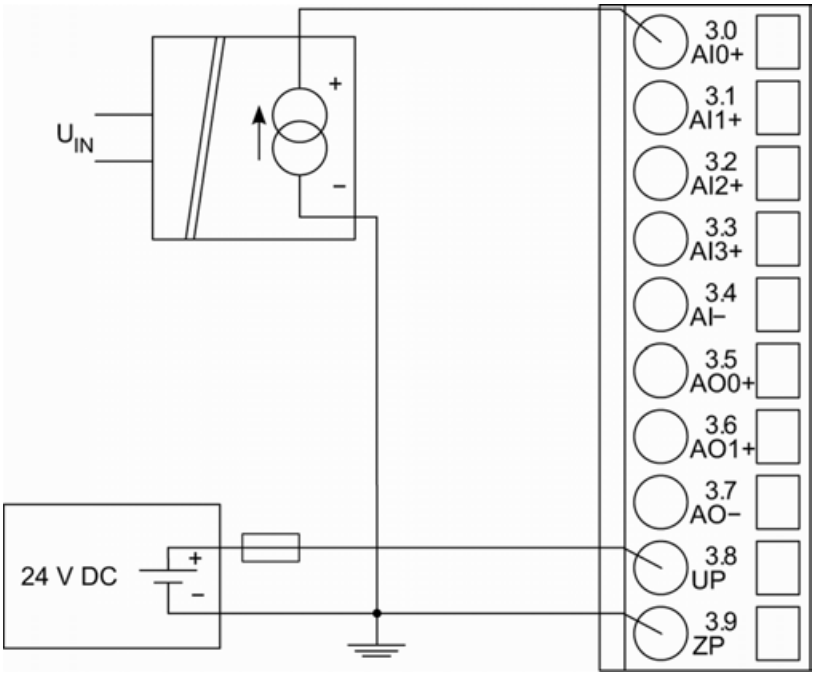


Fig. 190: Connection of active-type analog sensors (current) with galvanically isolated power supply to the analog inputs (AI0 ... AI3)

Current	0 ... 20 mA	1 channel used
Current	4 ... 20 mA	1 channel used

The measuring ranges are described in the section Measuring Ranges ↳ *Chapter 5.6.4.1.8 “Parameterization” on page 1043* ↳ *Chapter 5.6.4.1.11 “Measuring ranges” on page 1050*:

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of active-type analog sensors (Voltage) with no galvanically isolated power supply to the analog inputs

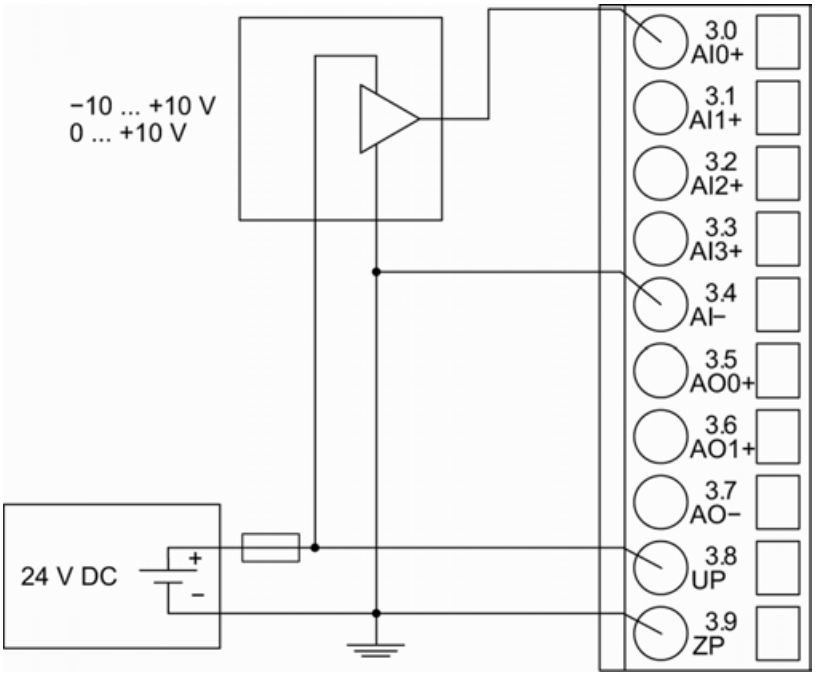


Fig. 191: Connection of active-type sensors (voltage) with no galvanically isolated power supply to the analog inputs (AI0 ... AI3)

NOTICE!

Risk of faulty measurements!

The negative pole/ground potential at the sensors must not have too large a potential difference with respect to ZP (max. ± 1 V within the full signal range).

Make sure that the potential difference never exceeds ± 1 V.

Voltage	0 ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

The measuring ranges are described in the section Measuring Ranges ↳ *Chapter 5.6.4.1.8 “Parameterization” on page 1043* ↳ *Chapter 5.6.4.1.11 “Measuring ranges” on page 1050*:

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of passive-type analog sensors (current) to the analog inputs

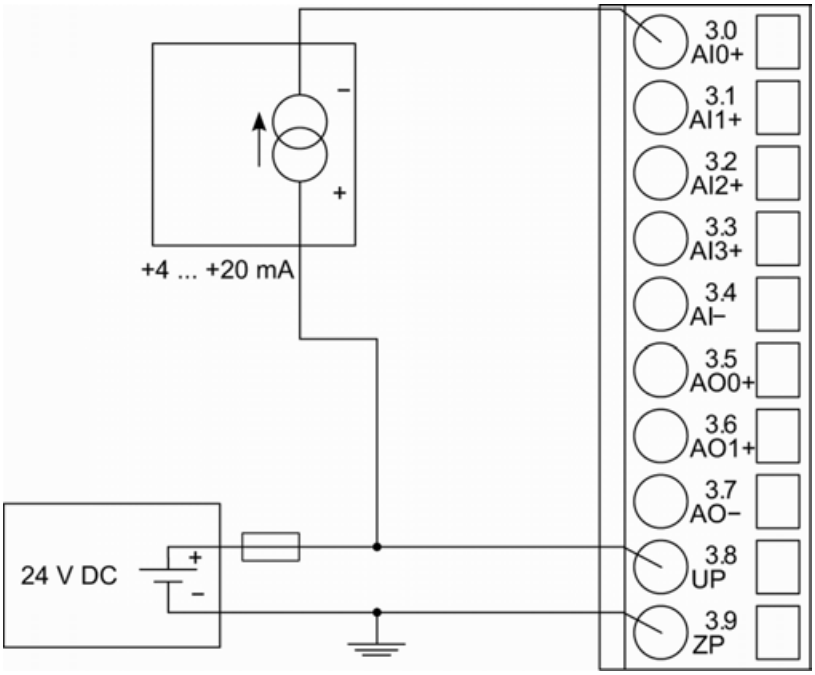


Fig. 192: Connection of passive-type analog sensors (current) to the analog inputs (AI0 ... AI3)

Current	4 ... 20 mA	1 channel used

The measuring ranges are described in the section Measuring Ranges ↳ *Chapter 5.6.4.1.8 “Parameterization” on page 1043* ↳ *Chapter 5.6.4.1.11 “Measuring ranges” on page 1050*:

CAUTION!

Risk of overloading the analog input!

If an analog current sensor supplies more than 25 mA for more than 1 second during initialization, this input is switched off by the module (input protection).

Use only sensors with fast initialization or without current peaks higher than 25 mA. If not possible, connect a 10-volt zener diode in parallel to I+ and I-.

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of active-type analog sensors (Voltage) to differential analog inputs

Differential inputs are very useful, if analog sensors are used which are remotely non-isolated (e.g. the minus terminal is remotely grounded).

The evaluation using differential inputs helps to considerably increase the measuring accuracy and to avoid ground loops.

With differential input configurations, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

The analog value is calculated by subtraction of the input value with the higher address from the input value of the lower address.

The converted analog value is available at the odd channel (higher address).

NOTICE!

Risk of faulty measurements!

The negative pole/ground potential at the sensors must not have too large a potential difference with respect to ZP (max. ± 1 V within the full signal range).

Make sure that the potential difference never exceeds ± 1 V.

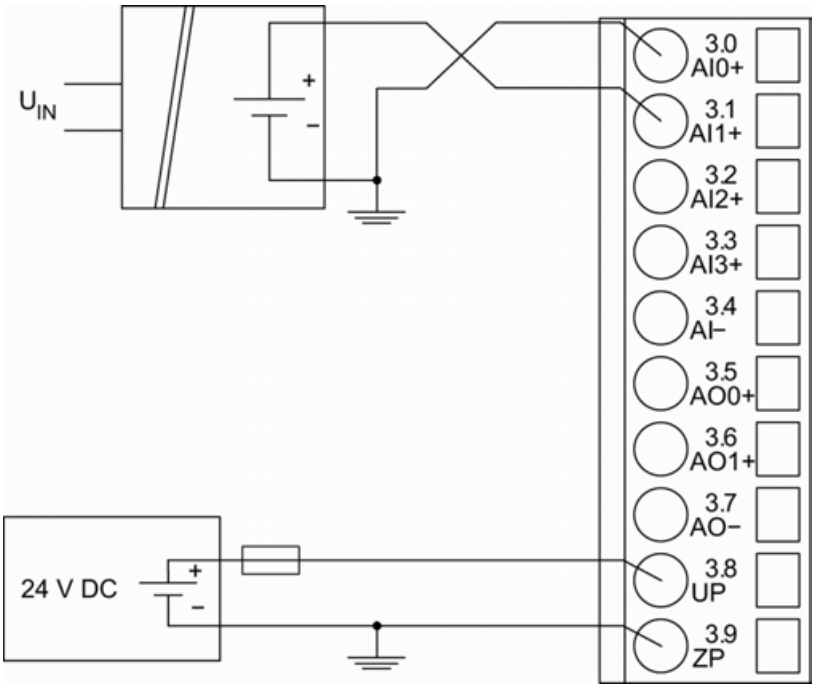


Fig. 193: Connection of active-type analog sensors (voltage) to differential analog inputs (AI0 ... AI3)

Voltage	0 ... 10 V	with differential inputs, 2 channels used
Voltage	-10 V ... +10 V	with differential inputs, 2 channels used

The measuring ranges are described in the section Measuring Ranges ↳ *Chapter 5.6.4.1.8 “Parameterization” on page 1043* ↳ *Chapter 5.6.4.1.11 “Measuring ranges” on page 1050*:

To avoid error messages from unused analog input channels, configure them as "unused".

Use of analog inputs as digital inputs

Several (or all) analog inputs can be configured as digital inputs. The inputs are not galvanically isolated against the other analog channels.

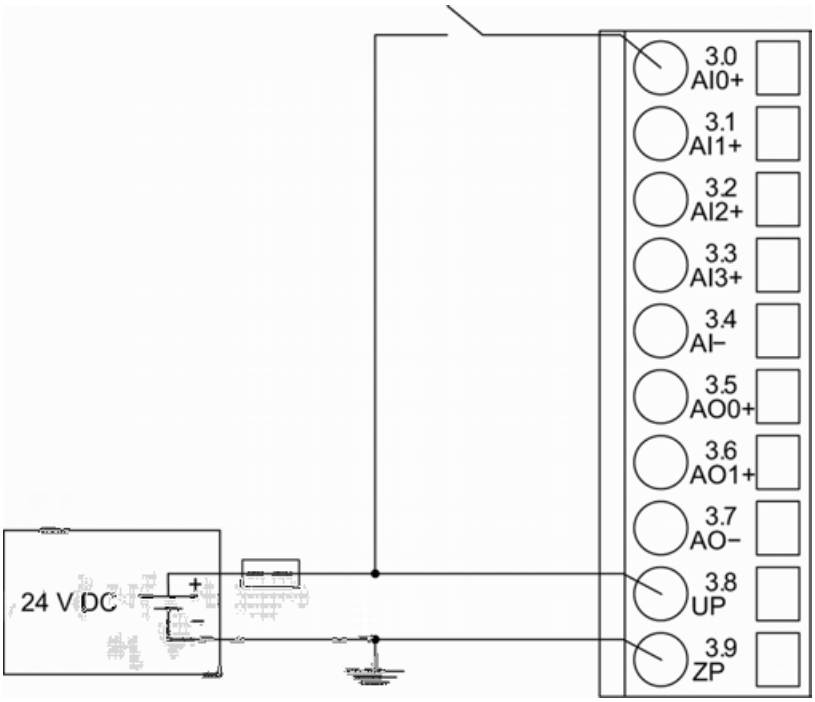


Fig. 194: Connection of digital sensors to the analog inputs (AI0 ... AI3)

Digital input	24 V	1 channel used

The measuring ranges are described in the section Measuring Ranges ↳ *Chapter 5.6.4.1.8 “Parameterization” on page 1043* ↳ *Chapter 5.6.4.1.11 “Measuring ranges” on page 1050*:

Connection of analog output loads (Voltage)

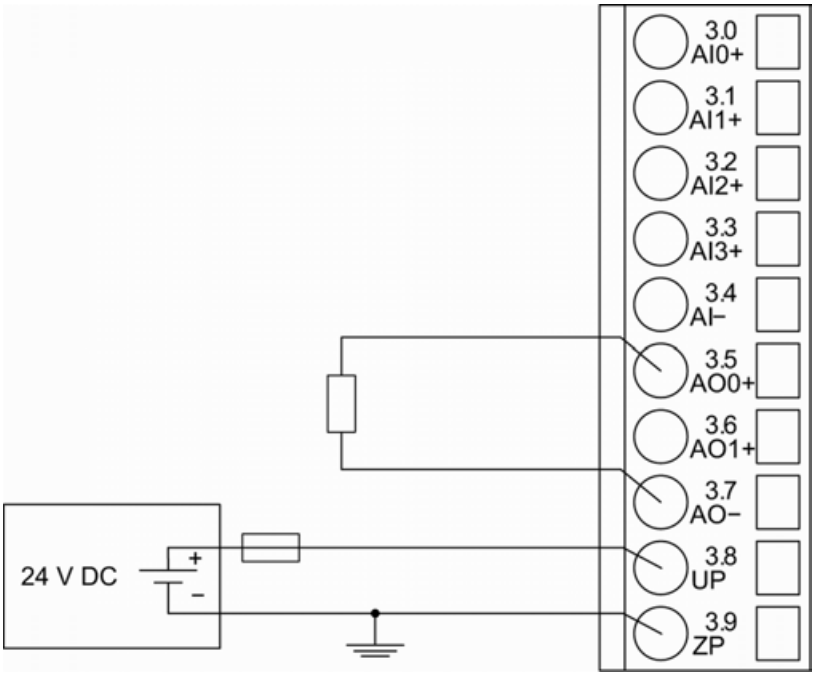


Fig. 195: Connection of analog output loads (voltage) to the analog outputs (AO0 and AO1)

Voltage	-10 V ... +10 V	Load ± 10 mA max.	1 channel used

The measuring ranges are described in the section Measuring Ranges ↳ *Chapter 5.6.4.1.8 “Parameterization” on page 1043* ↳ *Chapter 5.6.4.1.11 “Measuring ranges” on page 1050*:

Unused analog outputs can be left open-circuited.

Connection of analog output loads (Current)

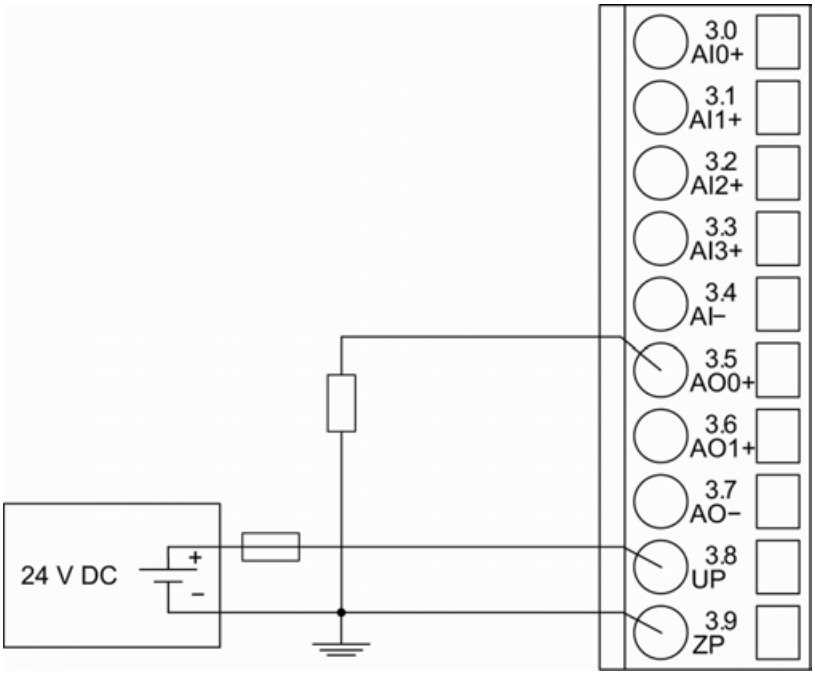


Fig. 196: Connection of analog output loads (current) to the analog outputs (AO0 and AO1)

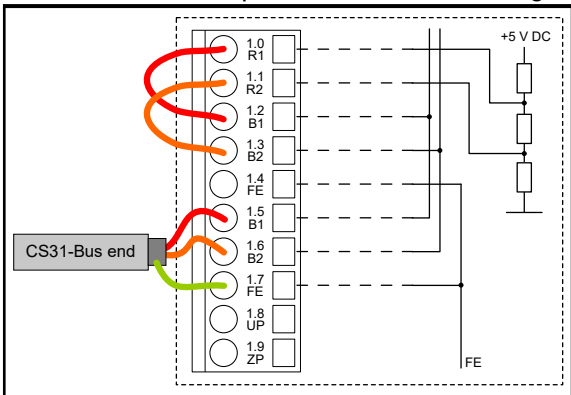
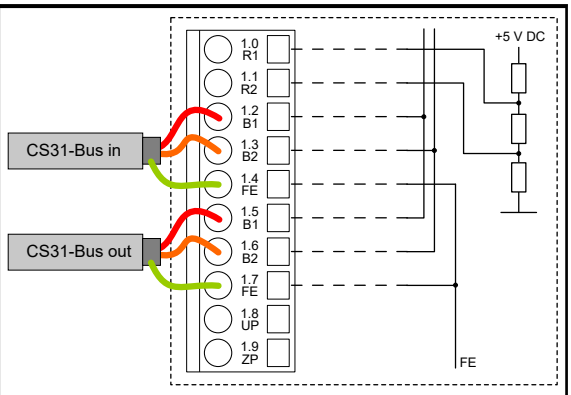
Current	0 ... 20 mA	Load 0 ... 500 Ω	1 channel used
Current	4 ... 20 mA	Load 0 ... 500 Ω	1 channel used

The measuring ranges are described in the section Measuring Ranges ↳ *Chapter 5.6.4.1.8 “Parameterization” on page 1043* ↳ *Chapter 5.6.4.1.11 “Measuring ranges” on page 1050*:

Unused analog outputs can be left open-circuited.

5.6.4.1.4 CS31 bus connections

Table 316: Different possibilities of connecting the CS31 buses to the CI592-CS31

	
Connection of CS31 bus - the CI592-CS31 is located at the bus end	Connection of CS31 bus - the CI592-CS31 is located at the middle of the bus

Details on CS31 wiring is described seperately .

5.6.4.1.5 Internal data exchange

	without the fast counter	with the fast counter (only with AC500)
Digital inputs (bytes)	2 + communication interface modules	4 + communication interface modules
Digital outputs (bytes)	1 + communication interface modules	3 + communication interface modules
Analog inputs (words)	4 + communication interface modules	4 + communication interface modules
Analog outputs (words)	2 + communication interface modules	2 + communication interface modules
Counter input data (words)	0	4
Counter output data (words)	0	8

5.6.4.1.6 I/O configuration

The CI592-CS31 module does not store configuration data itself. The configurable channels are defined as inputs or outputs by the user program, i.e. each of the configurable channels can be used as input or output (or re-readable output) by interrogation or allocation by the user program.

5.6.4.1.7 Addressing

An address must be set at every module so that the field bus communication module can access the specific inputs and outputs.

A detailed description concerning "addressing" can be found in the chapters "Addressing" of the CPUs and communication modules.

The address (00d ... 99d) is set with two rotary switches on the front panel of the module.



The CS31 bus module reads the position of the address switches only during the initialization after power ON, i.e. changes of the setting during operation remain ineffective.

5.6.4.1.8 Parameterization

Parameters of the module - if used with fast counter

Name	Value	Internal value	Internal value, type	Default
Module ID [1])	Internal	2725	WORD	2725
Parameter length	Internal	22	BYTE	22
Error LED / Fail-safe function [2])	On	0	BYTE	0
	Off by E4	1		
	Off by E3	3		

Name	Value	Internal value	Internal value, type	Default
	On + failsafe	16		
	Off by E4 + failsafe	17		
	Off by E3 + failsafe	19		
Check supply	off	0	BYTE	
	on	1		1



If the communication interface module is configured as a fast counter module and '0 - no Counter' in Automation Builder is selected the channel ERR LEDs stays on and the module does not start up. The address was adjusted with '71'.

Only the '0- no Counter' mode does not operate. If any other counter is selected e.g. '1-1 Up counter' the module starts up and can be utilized.

Parameters of the module - if used without fast counter

Name	Value	Internal value	Internal value, type	Default
Module ID [1])	Internal	2726	WORD	2726
Parameter length	Internal	23	BYTE	23
Error LED / Failsafe function [2])	On	0	BYTE	0
	Off by E4	1		
	Off by E3	3		
	On + failsafe	16		
	Off by E4 + failsafe	17		
	Off by E3 + failsafe	19		
Check supply	Off	0	BYTE	
	On	1		1

Remarks:

[1]) With a faulty Module ID, the Modules reports a "parameter error" and does not perform cyclic process data transmission

[2]) Error LED/Failsafe function:

Setting	Description
On	Error-LED lights up at errors of all error classes, Failsafe mode off
Off by E4	Error LED lights up at errors of error classes E1, E2 and E3, Failsafe mode off
Off by E3	Error LED lights up at errors of error classes E1 and E2, Failsafe mode off

Setting	Description
On +Failsafe	Error-LED lights up at errors of all error classes, Failsafe mode on *)
Off by E4 + Failsafe	Error LED lights up at errors of error classes E1, E2 and E3, Failsafe mode on *)
Off by E3 + Failsafe	Error LED lights up at errors of error classes E1 and E2, Failsafe mode on *)

*) The parameters behaviourAOatCommunicationFault and behaviourDOatCommunicationFault are only analyzed if the Failsafe mode is ON.

Group parameters for the digital part

Name	Value	Internal value	Internal value, type	Default
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.1 ms 0x00
Fast counter	No counter 1 Up counter 1 Up counter with release input 2 UpDown counters 2 UpDown (2. On falling edges) 1 Updown dynamic set/ rising edge 1 Updown dynamic set/ falling edge 1 UpDown directional discriminator Reserved 1 UpDown directional discriminator x2 1 UpDown directional discriminator x4	0 1 2 3 4 5 6 7 8 9 10	BYTE	0
Detect short circuit at outputs	Off On	0 1	BYTE	On 0x01

Name	Value	Internal value	Internal value, type	Default
Behaviour DO at comm. error *)	Off Last value Last value 5 sec Last value 10 sec Substitute value Substitute value 5 sec Substitute value 10 sec	0 1 6 11 2 7 12	BYTE	Off 0x00
Substitute value at output	0 ... 255	00h ... FFh	BYTE	0 0x0000

*) The parameter Behaviour DO at comm. error is only analyzed if the Failsafe-mode is ON.

Group parameters for the analog part

Name	Value	Internal value	Internal value, type	Default
Analog data format	Standard Reserved	0 255	BYTE	0
Behaviour AO at comm. error *)	Off Last value Last value 5 s Last value 10 s Substitute value Substitute value 5 s Substitute value 10 s	0 1 6 11 2 7 12	BYTE	0

*) The parameter Behaviour AO at comm. error is only analyzed if the Failsafe-mode is ON.

Channel parameters for the analog inputs (4x)

Name	Value	Internal value	Internal value, type	Default
Input 0, Channel configuration	see table [1])	see table [1])	BYTE	0
Input 0, Check channel	see table [2])	see table [2])	BYTE	0
:	:	:	:	:
:	:	:	:	:

Name	Value	Internal value	Internal value, type	Default
Input 3, Channel configuration	see table [1])	see table [1])	BYTE	0
Input 3, Check channel	see table [2])	see table [2])	BYTE	0

Table 317: Channel configuration [1])

Internal value	Operating modes of the analog inputs, individually configurable
0 (default)	Not used
1	0 V ... 10 V
2	Digital input
3	0 mA ... 20 mA
4	4 mA ... 20 mA
5	-10 V ... +10 V
8	2-wire Pt100 -50 °C ... +400 °C
9	3-wire Pt100 -50 ... +400 °C *)
10	0 ... 10 V (voltage diff.) *)
11	-10 V ... +10 V (voltage diff.) *)
14	2-wire Pt100 -50 °C ... +70 °C
15	3-wire Pt100 -50 °C ... +70 °C *)
16	2-wire Pt1000 -50 °C ... +400 °C
17	3-wire Pt1000 -50 °C ... +400 °C *)
18	2-wire Ni1000 -50 °C ... +150 °C
19	3-wire Ni1000 -50 °C ...+150 °C *)
	*) In the operating modes with 3-wire configuration or with differential inputs, two adjacent analog inputs belong together (e.g. the channels 0 and 1). In these cases, both channels are configured in the desired operating mode. The lower address must be the even address (channel 0). The next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

Table 318: Channel monitoring [2])

Internal Value	Check Channel
0 (default)	Plausib(ility), cut wire, short circuit
3	Not used

Channel parameters for the analog outputs (2x)

Name	Value	Internal value	Internal value, type	Default
Output 0, Channel configuration	see table [3])	see table [3])	BYTE	0
Output 0, Check channel	see table [4])	see table [4])	BYTE	0
Output 0, Substitute value	see table [5])	see table [5])	WORD	0
Output 1, Channel configuration	see table [3])	see table [3])	BYTE	0
Output 1, Check channel	see table [4])	see table [4])	BYTE	0
Output 1, Substitute value	see table [5])	see table [5])	WORD	0

Table 319: Channel configuration [3])

Internal value	Operating modes of the analog outputs, individually configurable
0 (default)	Not used
128	-10 V ... +10 V
129	0 ... 20 mA
130	4 ... 20 mA

Table 320: Channel monitoring [4])

Internal value	Check channel
0	Plausib(ility), cut wire, short circuit
3	None

Table 321: Substitute value [5])

Intended behavior of output channel when the control system stops	Required setting of the module parameter "Behaviour of outputs in case of a communication error"	Required setting of the channel parameter "Substitute value"
Output OFF	Off	0
Last value infinite	Last value	0
Last value for 5 s and then turn off	Last value 5 sec	0
Last value for 10 s and then turn off	Last value 10 sec	0
Substitute value infinite	Substitute value	Depending on configuration
Substitute value for 5 s and then turn off	Substitute value 5 sec	Depending on configuration
Substitute value for 10 s and then turn off	Substitute value 10 sec	Depending on configuration

5.6.4.1.9 Diagnosis

In cases of short circuit or overload, the digital outputs are turned off. The modules performs reactivation automatically. Thus an acknowledgement of the errors is not necessary. The error message is stored via the LED.

5.6.4.1.10 State LEDs

The LEDs are located at the front of module.

There are 2 different groups of LEDs:

- The 4 system LEDs (PWR, CS31, S-ERR and I/O-Bus) show the operation state of the module and display possible errors.
- The 26 process LEDs (UP, inputs, outputs, CH-ERR2 to CH-ERR4) show the process supply voltage and the states of the inputs and outputs and display possible errors.

Table 322: State of the 4 system-LEDs:

LED	State	Color	OFF	ON	Flashing
PWR/RUN	System voltage	Green	Process supply voltage missing	Internal supply voltage OK, module ready for communication with I/O Controller	Start-up / preparing communication
CS31	CS31 communication	Green	No communication at the CS31 bus module	Communication at the CS31 bus OK	Diagnosis mode
S-ERR	Sum Error	Red	No error	Internal error	--
I/O-Bus	Communication via the I/O bus	Green	No communication interface module connected or communication error	Communication interface module connected and operational	---

Table 323: State of the 27 process LEDs:

LED	State	Color	OFF	ON	Flashing
DI0 ... DI7	Digital input	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--
DC8 ... DC15	Digital input/ output	Yellow	Input/output is OFF	Input/output is ON (the input voltage is even displayed if the supply voltage is OFF)	--

LED	State	Color	OFF	ON	Flashing
AI0 ... AI3	Analog input	Yellow	Input is OFF	Input is ON (brightness depends on the value of the analog signal)	--
AO0 ... AO1	Analog output	Yellow	Output is OFF	Output is ON (brightness depends on the value of the analog signal)	--
UP	Process supply voltage 24 V DC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
CH-ERR2	Channel Error, error messages in groups (digital inputs/outputs combined into the groups 1, 2, 3, 4)	Red	No error or process supply voltage is missing	Severe error within the corresponding group	Severe error within the corresponding group (e.g. short-circuit at an output)
CH-ERR3		Red			
CH-ERR4		Red			
CH-ERR *)	Module Error	Red	--	Internal error	--
*) All of the LEDs CH-ERR2 to CH-ERR4 light up together					

5.6.4.1.11 Measuring ranges

Input ranges voltage, current and digital input

Range	0 V ... 10 V	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital input	Digital value	
						Decimal	Hex.
Overflow	>11.7589	>11.7589	>23.5178	>22.8142		32767	7FFF
Measured value too high	11.7589 : 10.0004	11.7589 : 10.0004	23.5178 : 20.0007	22.8142 : 20.0006		32511 : 27649	7EFF : 6C01
Normal range Normal range or measured value too low	10.0000 : 0.0004	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	: : On	27648 : 1	6C00 : 0001
	0.0000	0.0000	0	4	Off	0	0000
	-0.0004 -1.7593	-0.0004 : : : -10,0000		3.9994 : 0		-1 -4864 -6912 : -27648	FFFF ED00 E500 : 9400

Range	0 V ... 10 V	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital input	Digital value	
						Decimal	Hex.
Measured value too low		-10.0004 : -11.7589				-27649 : -32512	93FF : 8100
Underflow	<0.0000	<-11.7589	<0.0000	<0.0000		-32768	8000

The represented resolution corresponds to 16 bits.

Input range resistor

Range	Pt100 / Pt1000 -50 °C ... +400 °C	Ni1000 -50 °C ... +150 °C	Digital value	
			Decimal	Hex.
Overflow	> +450.0 °C	> +160.0 °C	32767	7FFF
Measured value too high	+450.0 °C : +400.1 °C		4500 : 4001	1194 : 0FA1
		+160.0 °C : + 150.1 °C	1600 : 1501	0640 : 05DD
			800 : 701	0320 : 02BD
Normal range	+400.0 °C : : : +0.1 °C	+150.0 °C : : +0.1 °C	4000 1500 700 : 1	0FA0 05DC 02BC : 0001
	0.0 °C	0.0 °C	0	0000
	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-1 : -500	FFFF : FE0C
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-501 : -600	FE0B : FDA8
Underflow	< -60.0 °C	< -60.0 °C	-32768	8000

Output ranges voltage and current

Range	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital value	
				Decimal	Hex.
Overflow	0 V	0 mA	0 mA	> 32511	> 7EFF
Measured value too high	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA	32511 : 27649	7EFF : 6C01
Normal range	10.0000 V : 0.0004 V	20.0000 mA : 0,0007 mA	20.0000 mA : 4.0006 mA	27648 : 1	6C00 : 0001
	0.0000 V	0.0000 mA	4.0000 mA	0	0000
	-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA	-1 -6912 -27648	FFFF E500 9400
Measured value too low	-10.0004 V : -11.7589 V	0 mA : 0 mA	0 mA : 0 mA	-27649 : -32512	93FF : 8100
Underflow	0 V	0 mA	0 mA	< -32512	< 8100

The represented resolution corresponds to 16 bits.

5.6.4.1.12 Technical data

Technical data of the module

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

↳ *Chapter 4.3 “System data AC500-XC” on page 38*

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.



Multiple overloads

With multi-channel modules, there are no effects of multiple overloads as each digital output channel is individually protected by an internal intelligent high-side switch.

Parameter		Value
Process supply voltage UP:		
	Rated value	24 V DC
	Protection against reverse voltage	Yes
	Rated protection fuse at UP	10 A fast
Current consumption		

Parameter		Value
	From UP	0.07 A + max. 0.5 A per output
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/ communication interface module (depending on system architecture)	5 mA
	Inrush current from UP (power-up)	0.040 A^2s
Interface		RS-485
Protocol		CS31
Galvanic isolation		Yes, CS31 bus from the rest of the module
Max. power dissipation within the module		6 W (outputs unloaded)
Rotary switch		2 rotary switches on the front panel for setting the module's address
Operating and error displays		30 LEDs (totally)
Weight (without terminal unit)		Approx. 125 g

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Technical data of the digital inputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DI0 ... DI7		Terminals 1.0 ... 1.7
Reference potential for all inputs		Terminals 1.9 ... 3.9 (negative pole of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1ms ... 32 ms
Input signal voltage		24 V DC
	Signal 0	-3 V ... +5 V
	Undefined Signal	> +5 V ... < +15 V
	Signal 1	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA

Parameter		Value
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical data of the configurable digital inputs/outputs

Each of the configurable digital I/O channels can be defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter		Value
Number of channels per module		8 inputs/outputs (with transistors)
Distribution of the channels into groups		1 group for 8 channels
If the channels are used as inputs		
	Channels DC8 ... DC15	Terminals 4.0 ... 4.7
If the channels are used as outputs		
	Channels DC8 ... DC15	Terminals 4.0 ... 4.7
Indication of the input/output signals		1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Galvanic isolation		Yes, per module

Technical data of the digital inputs/outputs if used as inputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DC8 ... DC15		Terminals 4.0 ... 4.7
Reference potential for all inputs		Terminals 1.9 ... 4.9 (negative pole of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1...32 ms
Input signal voltage		24 V DC
	0-Signal	-3 V ... +5 V *)
	Undefined Signal	> +5 V ... < +15 V
	1-Signal	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V *)
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA

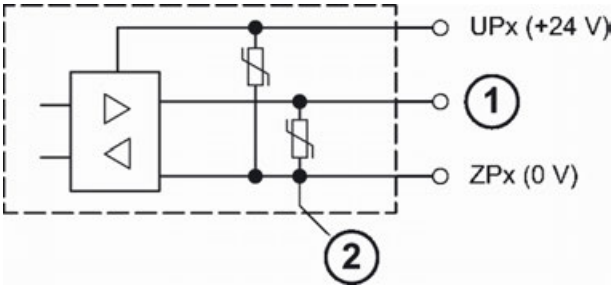
Parameter		Value
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

*) Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal may not exceed the clamp voltage of the varistor. The varistor limits the voltage to approx. 36 V. Following this, the input voltage must range from -12 V ... +30 V when UPx = 24 V and from -6 V ... +30 V when UPx = 30 V.

Technical data of the digital inputs/outputs if used as outputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DC8 ... DC15		Terminals 4.0 ... 4.7
Reference potential for all outputs		Terminals 1.9 ... 4.9 (negative pole of the supply voltage, signal name ZP)
Common power supply voltage		For all outputs terminals 1.8, 2.8, 3.8 and 4.8 (positive pole of the supply voltage, signal name UP)
Output voltage for signal 1		UP (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value per channel	500 mA at UP = 24 V
	Max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA
Fuse for UP		10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)
Output switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.



1 Digital input/output
2 For demagnetization when inductive loads are turned off

Technical data of the fast counter

Parameter	Value
Used inputs	DC8 / DC9
Used outputs	DC10
Counting frequency	Max. 50 kHz

Technical data of the analog inputs

Parameter		Value
Number of channels per module		4
Distribution of channels into groups		1 group with 4 channels
Connection if channels AI0+ ... AI3+		Terminals 3.0 ... 3.3
Reference potential for AI0+ ... AI3+		Terminal 3.4 (AI-) for voltage and RTD measurement Terminal 1.9, 2.9, 3.9 and 4.9 for current measurement
Input type		
	Unipolar	Voltage 0 V ... 10 V, current or Pt100/Pt1000/Ni1000
	Bipolar	Voltage -10 V ... +10 V
Configurability		0 V ... 10 V, -10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20mA, Pt100/1000, Ni1000 (each input can be configured individually)
Channel input resistance		Voltage: > 100 kΩ Current: ca. 330 Ω
Time constant of the input filter		Voltage: 100 µs Current: 100 µs
Indication of the input signals		1 LED per channel (brightness depends on the value of the analog signal)
Conversion cycle		1 ms (for 4 inputs + 2 outputs); with RTDs Pt/Ni... 1 s

Parameter	Value
Resolution	Range 0 V ... 10 V: 12 bits Range -10 V ... +10 V: 12 bits + sign Range 0 mA ... 20 mA: 12 bits Range 4 mA ... 20 mA: 12 bits Range RTD (Pt100, PT1000, Ni1000): +0.1 °C
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code	Tables Input Ranges Voltage, Current and Digital Input ↳ *Chapter 5.6.4.1.11.1 “Input ranges voltage, current and digital input” on page 1050* and Input Range Resistor ↳ *Chapter 5.6.4.1.11.2 “Input range resistor” on page 1051*
Unused inputs	Are configured as "unused" (default value)
Overvoltage protection	Yes

Technical data of the analog inputs, if used as digital inputs

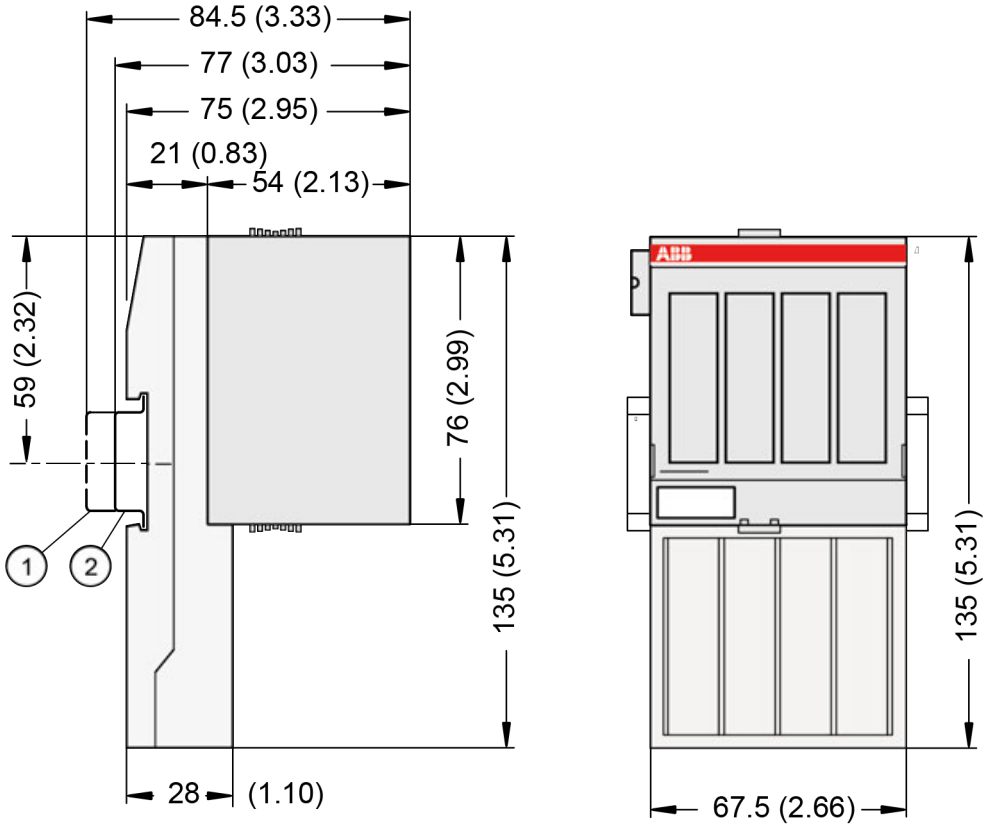
Parameter		Value
Number of channels per module		Max. 4
Distribution of channels into groups		1 group of 4 channels
Connections of the channels AI0+ ... AI3+		Terminals 3.0 ... 3.3
Reference potential for the inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (ZP)
Indication of the input signals		1 LED per channel
Input signal voltage		24 V DC
	Signal 0	-30 V ... +5 V
	Undefined signal	+5 V ... +13 V
	Signal 1	+13 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 7 mA
	Input voltage +5 V	Typ. 1.4 mA
	Input voltage +15 V	Typ. 3.7 mA
	Input voltage +30 V	< 9 mA
Input resistance		ca. 3.5 kΩ

Technical data of the analog outputs

Parameter	Value
Number of channels per module	2
Distribution of channels into groups	1 group for 2 channels
Connection of the channels AO0+ ... AO1+	Terminals 3.5 and 3.6

Parameter		Value
Reference potential for AO0+ ... AO1+		Terminal 3.7 (AO-) for voltage output Terminals 1.9, 2.9, 3.9 and 4.9 for current output
Output type		
	Unipolar	Current
	Bipolar	Voltage
Galvanic isolation		Against internal supply and other modules
Configurability		-10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA (each output can be configured individually)
Output resistance (load), as current output		0 Ω ... 500 Ω
Output loadability, as voltage output		± 10 mA max.
Indication of the output signals		1 LED per channel (brightness depends on the value of the analog signal)
Resolution		12 bits (+ sign)
Settling time for full range change (resistive load, output signal within specified tolerance)		Typ. 5 ms
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code		Table Output Ranges Voltage and Current ↬ *Chapter 5.6.4.1.11.3 “Output ranges voltage and current” on page 1052*
Unused outputs		Are configured as "unused" (default value) and can be left open-circuited

5.6.4.1.13 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

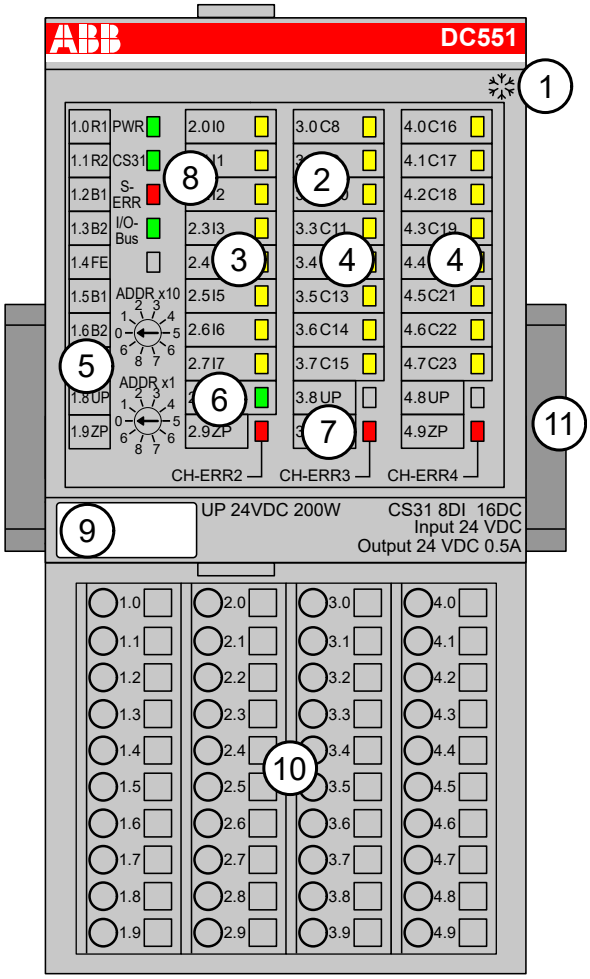
5.6.4.1.14 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 221 200 R0001	CI592-CS31, CS31 communication interface module with 8 DI, 8 DC, 4 AI, 2 AO	Active
1SAP 421 200 R0001	CI592-CS31-XC, CS31 communication interface module with 8 DI, 8 DC, 4 AI, 2 AO, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.6.4.2 DC551-CS31 - Digital inputs and outputs

- 8 digital inputs 24 V DC, 16 configurable digital inputs/outputs
- Module-wise galvanically isolated
- Fast counter
- XC version for usage in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 8 yellow LEDs to display the signal states of the digital inputs I0 ... I7
4 16 yellow LEDs to display the signal states of the digital inputs/outputs C8 ... C23
5 2 rotary switches to set the module's address (00d ... 99d)
6 1 green LED to display the process voltage UP
7 3 red LEDs to display errors
8 4 system LEDs
9 Label
10 Terminal unit
11 DIN rail
Sign for XC version

5.6.4.2.1 Intended purpose

The CS31 communication interface module DC551-CS31 can only be used together with the AC500 CPUs and dedicated PS501 control builder.

The CS31 communication interface module is used as a decentralized I/O module on CS31 field buses. The bus connection is performed on a RS-485 serial interface, which allows the connection of this module to all existing CS31 buses.

In addition, the CS31 communication interface module provides 24 I/O channels with the following properties:

- 8 digital inputs 24 V DC in one group (2.0 ... 2.7)
- 16 digital inputs/outputs in one group (3.0 ... 4.7), of which each can be used
- as an input,
- as a transistor output with short circuit and overload protection, 0.5 A rated current or
- as a re-readable output (combined input/output) with the technical data of the digital inputs and outputs.

The inputs and output are galvanically isolated from the other electronic circuitry of the module.

For usage in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

5.6.4.2.2 Functionality

Interface	RS-485, CS31 protocol
Supply of the module's electronic circuitry	From UP and ZP (power supply)
Supply of the electronic circuitry of the I/O modules attached	Through the bus interface (I/O bus)
Address switches	For setting the CS31 field bus address (0 ... 99)
Digital inputs	8 (24 V DC)
Digital inputs/outputs	16 (24 V DC)
Fast Counter	Integrated, many configurable operating modes
LED displays	For system displays, signal statuses, errors and power supply
External supply voltage	Via the terminals ZP and UP (process voltage 24 V DC)
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Required terminal unit	TU551-CS31 or TU552-CS31 ↳ *Chapter 5.7.6 “TU551-CS31 and TU552-CS31 for CS31 communication interface modules” on page 1363*

5.6.4.2.3 Connections

The CS31 communication interface module is plugged on the CS31 terminal unit TU551 or TU552 ↳ *Chapter 5.7.6 “TU551-CS31 and TU552-CS31 for CS31 communication interface modules” on page 1363*. Hereby, it clicks in with two mechanical locks. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting (TA526 ↳ *Chapter 5.8.2.6 “TA526 - Wall mounting accessory” on page 1410*).

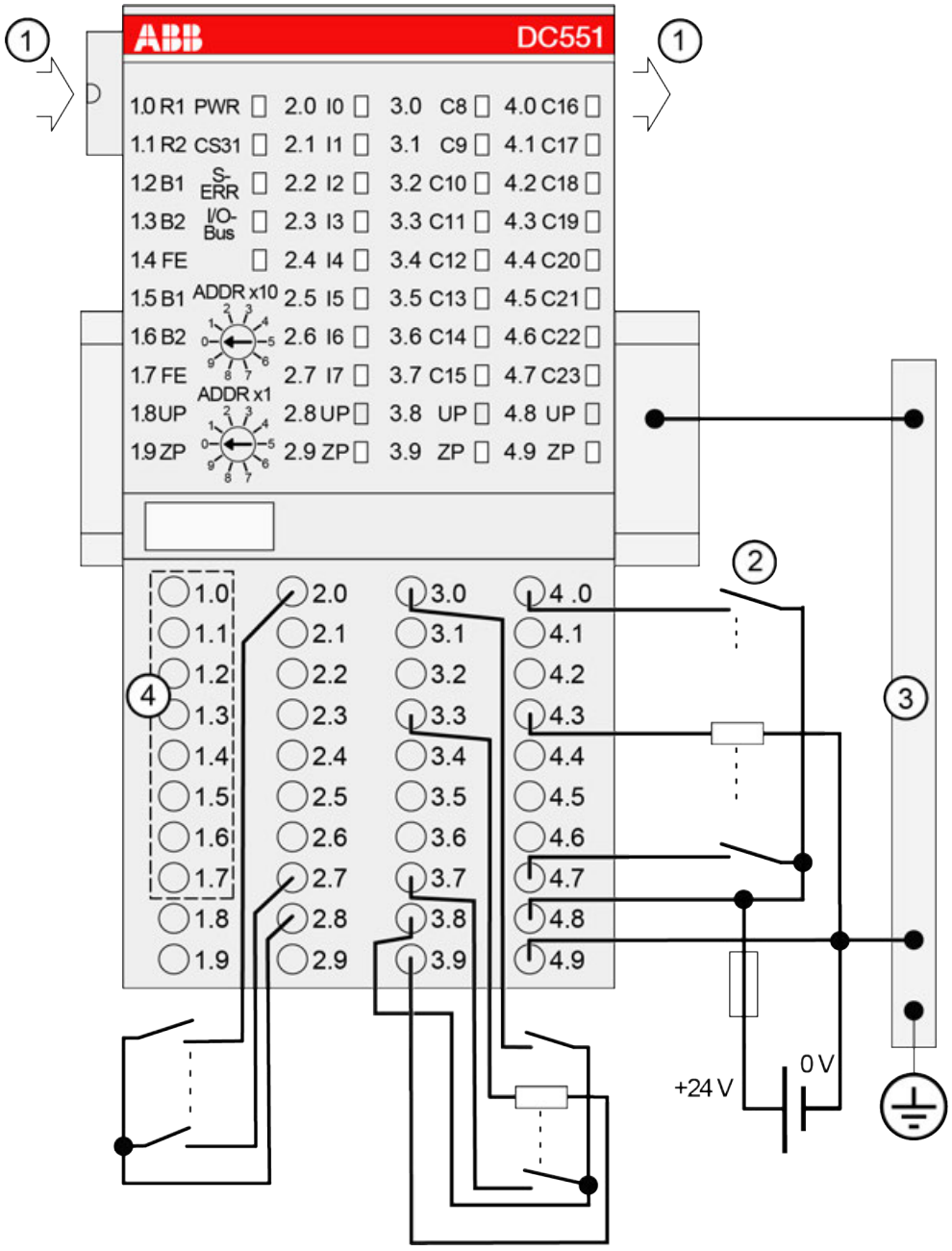
The connection of the I/O channels is carried out using the 40 terminals of the CS31 terminal unit. It is possible, to replace CS31 bus modules and I/O modules without loosening the wiring.

The terminals 1.8 ... 4.8 and 1.9 ... 4.9 are electrically interconnected within the terminal unit.

The terminals always have the same assignment, irrespective of the inserted module:

- Terminals 1.8 ... 4.8: process voltage UP = +24 V DC
- Terminals 1.9 ... 4.9: process voltage ZP = 0 V

The assignment of the other terminals depends on the inserted CS31 bus module.



1 I/O bus
2 4.0 ... 4.7: Connected with UP (switch) -> Input;
Connected with ZP (load) -> Output
3 Control cabinet earth
4 1.0 ... 1.7: *Chapter 5.6.4.2.4 “CS31 bus connections” on page 1063*

Table 324: Assignment of the other terminals

Terminals	Signal	Description
1.0 ... 1.7	RS-485	CS31 bus interface
2.0 ... 2.7	I0 ... I7	8 digital inputs
3.0 ... 4.7	C8 ... C23	16 digital inputs/outputs

CAUTION!
The process supply voltage must be included in the grounding concept (e. g. grounding of the negative terminal).

The supply voltage 24 V DC for the module's electronic circuitry comes from the ZP/UP terminals.

The module provides several diagnosis functions *Chapter 5.6.4.2.11 “Diagnosis” on page 1069*.

WARNING!
Removal/Insertion under power
The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing the following:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

CAUTION!
Risk of influences to the connected sensors!
Some sensors may be influenced by the deactivated module outputs of DC551-CS31.

Connect a 470 Ω / 1 W resistor in series to inputs C16/C17 if using them as fast counter inputs to safely avoid any influences.

5.6.4.2.4 CS31 bus connections

The CS31 bus is connected through the terminal unit with the terminals 1.0 ... 1.7. The end-of-line resistor can also be activated by using external wire jumpers.

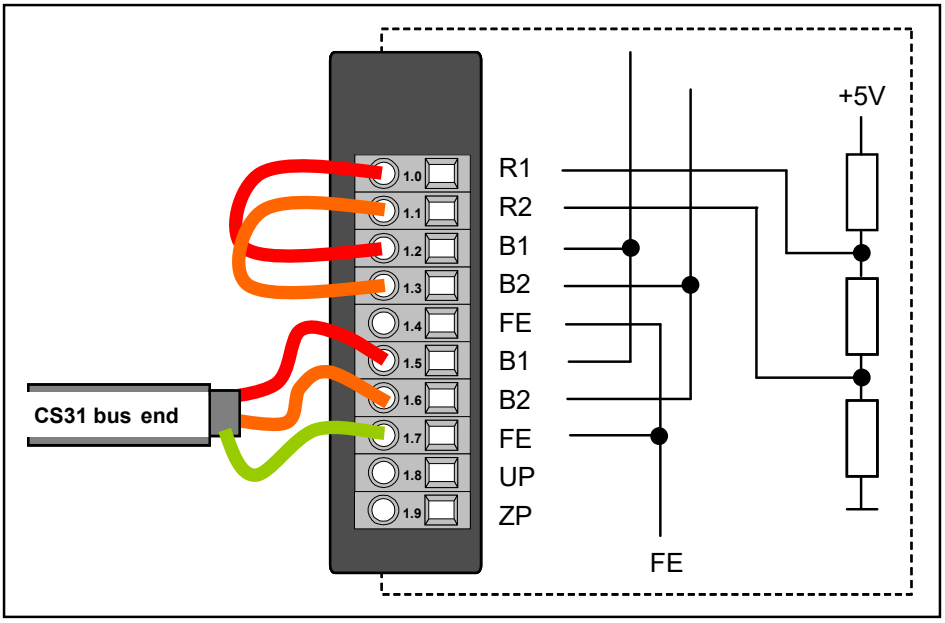


Fig. 197: CS31 communication interface module at the end of the CS31 bus (end-of-line resistor activated)

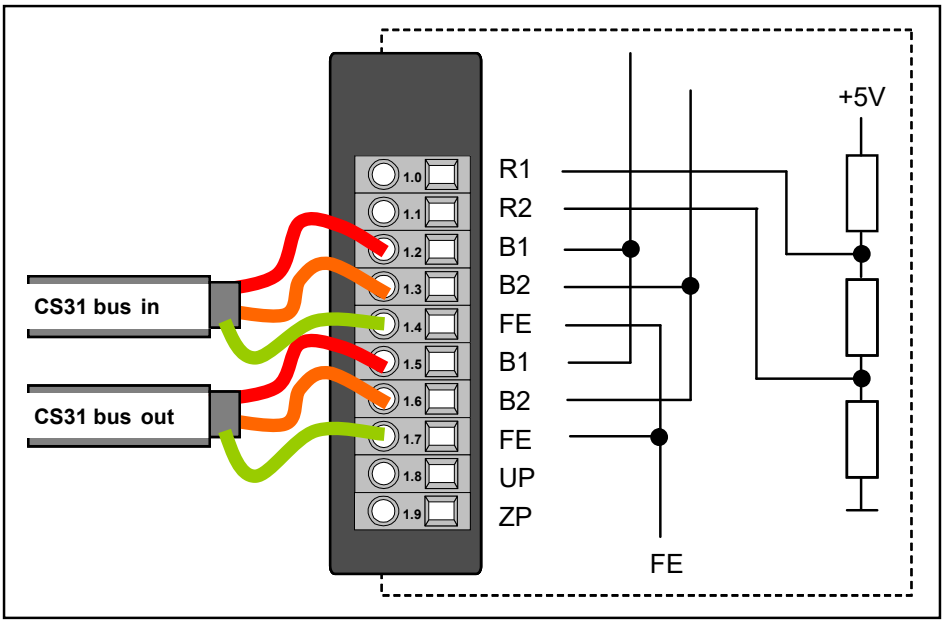


Fig. 198: CS31 communication interface module in the middle of the CS31 bus (end-of-line resistor not activated)

Details on CS31 wiring is described seperately .

5.6.4.2.5 Internal data exchange

	without the fast counter	**with the fast counter (only with AC500)**
Digital inputs (bytes)	3 + expansion modules (see above)	5 + expansion modules (see above)
Digital outputs (bytes)	2 + expansion modules (see above)	4 + expansion modules (see above)
Counter input data (words)	0	5 (16 DI + 4 AI)
Counter output data (words)	0	9 (16 DO + 8 AO)

5.6.4.2.6 Addressing

An address must be set at every module so that the field bus communication module can access the specific inputs and outputs.

The address (00 ... 99) is set with two rotary switches on the front panel of the module.

CS31 communication interface module reads the position of the address switches only during the initialization after power ON, i.e. changes of the setting during operation remain ineffective.

5.6.4.2.7 DC551-CS31 limitations

Digital I/O

DC551-CS31 is able to manage up to 240 digital I/O channels. It uses 2 digital bus addresses in this case.

The physical address to identify the I/O is	address n (switch address) for the 1st module (120 I/O)
	address n + 7 + bit 8/15 = 1 for the 2nd module

Analog I/O

Analog limitation to 40 AI/AO with 4 bus addresses used.

Case of DC551-CS31 with fast counter

An additional bus address is used for "double word" values of the fast counter.

Table 325: Maximum configuration

DC551-CS31 8DI + 16 DC + counter	16 AI	16 AI	DC532	DC532	DC532	DC532	DC532

The following configuration uses 7 bus addresses (the fast counter needs 16 DI + 16 DO + 4 AI + 8 AO):

2 bus addresses for digital I/O (24 + 16 + 5x32)DI + (16 + 16 + 5x16)DO = 200 DI (>120) + 112 DO

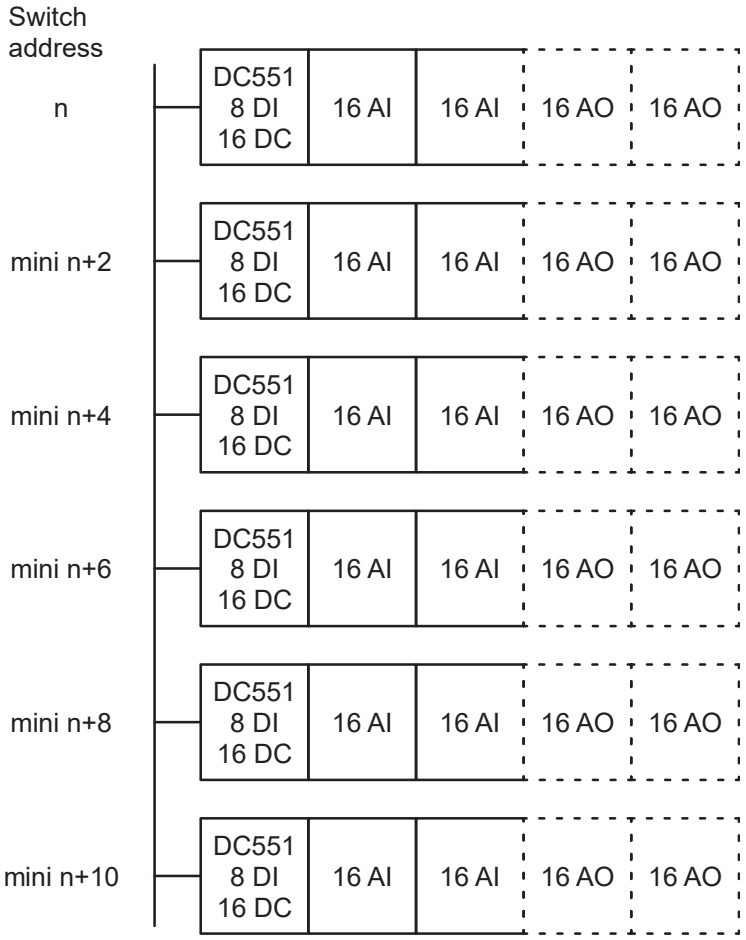
5 bus addresses for analog I/O (4 + 2x16)AI + 8 AO = 36 AI + 8 AO

If the communication interface module is configured as a fast counter module and '0 - no Counter' in Automation Builder is selected the channel ERR LEDs stays on and the module does not start up. The address was adjusted with '71'.

Only the '0- no Counter' mode does not operate. If any other counter is selected e.g. '1-1 Up counter' the module starts up and can be utilized.

Small overview of the addressing possibilities

Configuration example with 32 analog inputs with or without 32 analog outputs (fast counter not used) = 5 bus addresses by the communication interface module



If there are fewer analog outputs than analog inputs, no additional address is necessary. Change the type from "analog in" to "analog I/O".

- 30 bus addresses used, 1 bus address free
- 192 analog inputs (+ 192 analog outputs)
- 48DI / 96DC (144 DI / 96 DO for CS31 and user program)
- Switch address incremented to avoid control overlap.

In CPU table module switch address n will be seen as (idem for AC500 or old CPU):

- Address n, type digital I/O, 8 DI/16 DC
- Address n, type analog I or I/O, 8 AI (+ 8 AO)
- Address n + bit 8/15=1, type analog I or I/O, 8 AI (+ 8 AO)
- Address n+1, type analog I or I/O, 8 AI (+ 8 AO)
- Address n+1 + bit 8/15=1, type analog I or I/O, 8 AI (+ 8 AO)

5.6.4.2.8 I/O configuration

The DC551-CS31 module does not store configuration data itself. The 16 configurable channels are defined as inputs or outputs by the user program, i.e. each of the configurable channels can be used as input or output (or re-readable output) by interrogation or allocation by the user program.

5.6.4.2.9 Parameterization

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.
1	Module ID	Internal	2715 [1])	Word	2715 0x0a9b	0	65535
2	Ignore module	No Yes	0 1	Byte	No 0x00		
14	Parameter length	Internal	8 (7 [4])	Byte	8 (7 [4])	0	255
16	Check supply	Off On	0 1	Byte	On 0x01		
17	Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	Byte	8 ms 0x02		
18	Fast counter	0 : 10 [3])	0 : 10	Byte	Mode 0 0x00		
Nr.+1	Detection short-circuit at outputs	Off On	0 1	Byte	On 0x01		
Nr.+1	Behaviour outputs at communication errors	Off Last value Substitute value	0 1 2	Byte	Off 0x00		
Nr.+1	Substitute value outputs Bit 15 = Output 15 Bit 0 = Output 0	0...65535	0...0xffff	Word	0		

[1]) With CS31 and addresses less than 70, the value is increased by 1

[3]) Counter operating modes ↳ *Chapter 5.4.3.2.9 “Fast counter” on page 522*, description of the fast counter ↳ *Chapter 5.4.3.2.9 “Fast counter” on page 522*

[4]) With CS31 and addresses less than 70, without the parameter Fast Counter

5.6.4.2.10 Structure of the diagnosis block of the DC551-CS31

If a DC551-CS31 module is connected via a CS31 bus, then the field bus master receives diagnosis information by an extended diagnosis block.

Table 326: Structure of the diagnosis block

Byte number	Description	Possible values
1	Data length (header included)	18
2	Diagnosis byte	0 = Communication with DC551-CS31 OK 1 = Communication with DC551-CS31 failed
3	DC551-CS31 diagnosis byte, module number	0 = DC551 (e.g. error at the integrated 8DI/16DC) 1 = 1st attached S500 I/O module ... 7 = 7th attached S500 I/O module
4	DC551-CS31 diagnosis byte, slot	According to the I/O bus specification passed on by modules to the fieldbus master
5	DC551-CS31 diagnosis byte, channel	According to the I/O bus specification passed on by modules to the fieldbus master
6	DC551-CS31 diagnosis byte, error code	According to the I/O bus specification Bit 7 and bit 6, coded error class 0 = E1 1 = E2 2 = E3 3 = E4 Bit 0 to bit 5, coded error description passed on by modules to the fieldbus master
7	DC551-CS31 diagnosis byte, flags	According to the I/O bus specification Bit 7: 1 = coming error Bit 6: 1 = leaving error Bit 5: 1 = Diag reset Bit 2 to bit 4: reserved Bit 1: 1 = explicit acknowledgement Bit 0: 1 = static error Passed on by modules to the fieldbus master Value = 0: static message for other systems, which do not have a coming/ leaving evaluation
8ff	Reserved	

5.6.4.2.11 Diagnosis

In case of overload or short-circuit, the outputs switch off automatically and try to switch on again cyclically. Therefore an acknowledgement of the outputs is not necessary. The LED error message, however, is stored.

5.6.4.2.12 Status LEDs

The LEDs are on the front panels of the modules.

There are two different groups of LEDs:

- The 4 system LEDs (PWR, S-ERR, CS31 and I/O-Bus) show the operating status of the module and indicate possible errors.
- The 28 process LEDs (UP, inputs, outputs, CH-ERR2 to CH-ERR4) display the supply voltage and signal statuses of the inputs and outputs and indicate possible errors.

All of the S500 modules have LEDs to display operating statuses and errors.

LED	Status	Color	LED = OFF	LED = ON	LED flashes
PWR	System voltage	Green	Missing internal system voltage or field bus supply is missing	Internal system voltage is OK	--
CS31	CS31 communication	Green	No communication at the CS31 bus module	Communication at the CS31 bus OK	Diagnosis mode
S-ERR	Sum Error	Red	No error or system voltage is missing	Internal error (storing can be parameterized)	--
I/O-Bus	Communication via the I/O bus	Green	No I/O modules connected or data error	I/O modules connected	Error I/O bus
Reserved	Not defined	-	-	-	-
I0 ... I7	Digital inputs	Yellow	Input = OFF	Input = ON (the input voltage is even displayed if the supply voltage is OFF)	-
C8 ... C23	Digital inputs/ outputs	Yellow	Input/output = OFF	Input/output = ON (the input voltage is even displayed if the supply voltage is OFF)	-
UP	Process supply voltage and initialization	Green	Process voltage is missing	Process voltage OK	--

LED	Status	Color	LED = OFF	LED = ON	LED flashes
CH-ERR2	Channel Error, error messages in groups (digital inputs/outputs combined into the groups 2 to 4)	Red	No error	Severe error within the corresponding group	Error on one channel of the corresponding group (e.g. short-circuit at an output)
CH-ERR3		Red			
CH-ERR4		Red			
CH-ERR *)	Module Error	Red	No error or process voltage is missing	Internal error	--
*) All LEDs CH-ERR2 to CH-ERR4 light up together					

The status of the LEDs concerning the CS31 communication interface module in connection with the I/O modules is described in detail in the S500 system data.

5.6.4.2.13 Technical data

Technical data of the module

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

↳ *Chapter 4.3 “System data AC500-XC” on page 38*

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter		Value
Rated supply voltage of the module		24 V DC (UP/ZP)
Current consumption of the module (UP)		15 mA
Process voltage UP		
	Rated value	24 V DC (for inputs and outputs)
	Max. electric charge for the supply terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse at UP	10 A fast
	Galvanic isolation	CS31 bus interface from the rest of the module
	Inrush current from UP (at power-up)	0.040 A^2s
	Current consumption from UP at normal operation / with outputs	0.1 A + max. 0.008 A per input + max. 0.5 A per output
	Connections	Terminals 1.8 ... 4.8 for +24 V (UP) and 1.9 ... 4.9 for 0 V (ZP)
Max. power dissipation within the module		6 W (outputs unloaded)
Number of digital inputs		8
Number of configurable digital inputs/outputs		16
Reference potential for all digital inputs and outputs		Negative pole of the supply voltage, signal name ZP

Parameter	Value
Address setting	With 2 rotary switches on the front panel
Diagnosis	Diagnosis and Displays *Chapter 5.6.4.2.11 “Diagnosis” on page 1069*
Operating and error displays	32 LEDs altogether
Weight (without terminal unit)	Ca. 125 g
Mounting position	Horizontal Or vertical with derating (output load reduced to 50 % at +40°C per group)
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Technical data of the digital inputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels I0 ... I7		2.0 ... 2.7
Terminals of the channels C8 ... C23		3.0 ... 4.7
Reference potential for all inputs		Terminals 1.9 ... 4.9 (negative pole of the process supply voltage, signal name ZP)
Galvanic isolation		From the CS31 bus
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type acc. to EN 61131-2		Type 1
Input delay (0->1 or 1-> 0)		Typ. 8 ms, configurable 0.1 ms ... 32 ms
Input signal voltage		24 V DC
	Signal 0	-3 V ... +5 V
	Undefined signal	> +5 V ... < +15 V
	Signal 1	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		

Parameter		Value
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical data of the configurable digital inputs/outputs

Each of the configurable I/O channels is defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter		Value
Number of channels per module		16 inputs/outputs (with transistors)
Distribution of the channels into groups		1 group of 16 channels
If the channels are used as inputs		
	Channels I8 ... I23	Terminals 3.0 ... 4.7
If the channels are used as outputs		
	Channels Q8 ... Q23	Terminals 3.0 ... 4.7
Indication of the input/output signals		1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Galvanic isolation		From the CS31 bus

Technical data of the digital inputs/outputs if used as outputs

Parameter		Value
Number of channels per module		Max. 16 transistor outputs
Reference potential for all outputs		Terminals 1.9 ... 4.9 (negative pole of the process supply voltage, signal name ZP)
Common power supply voltage		For all outputs: terminals 1.8 ... 4.8 (positive pole of the process supply voltage, signal name UP)
Output voltage for signal 1		UP (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value, per channel	500 mA at UP = 24 V
	Maximum value (all channels together)	10 A
Leakage current with signal 0		< 0.5 mA
Rated protection fuse on UP		10 A fast
Demagnetization when inductive loads are switched off		With varistors integrated in the module (see figure below)

Parameter		Value
Switching frequency		
	With resistive loads	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 11 Hz with max. 5 W
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals		Yes
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

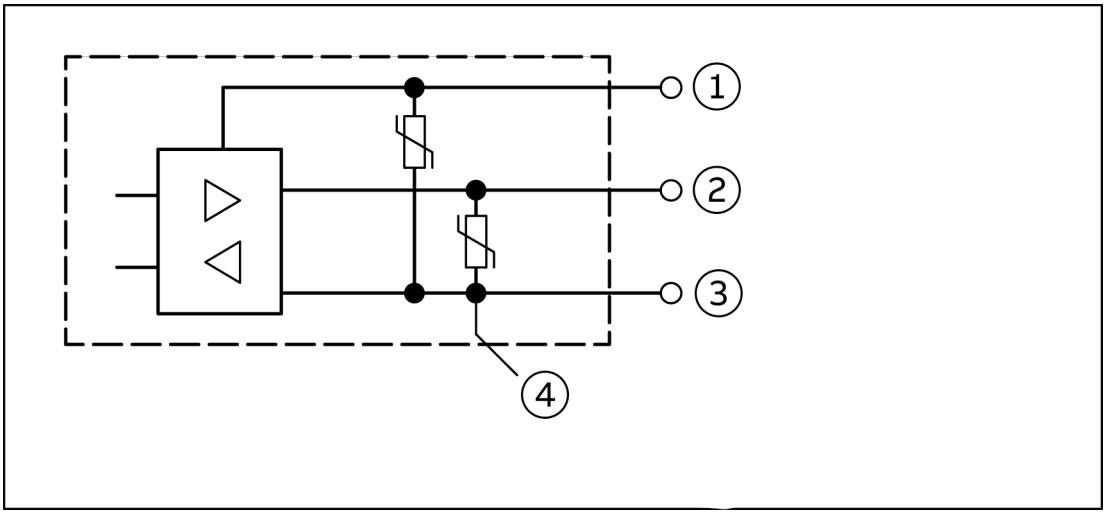


Fig. 199: Digital input/output (circuit diagram)

1 UPx (+ 24 V)
2 Digital input/output
3 ZPx (0 V)
4 For demagnization when inductive loads are switched off

Technical data of the digital inputs/outputs if used as inputs

Parameter		Value
Number of channels per module		Max. 16 digital inputs
Reference potential for all inputs		Terminals 1.9 ... 4.9 (negative pole of the process supply voltage, signal name ZP)
Input current, per channel		Technical Data of the Digital Inputs
Input type acc. to EN 61131-2		Type 1
Input delay (0->1 or 1->0)		Typ. 8 ms, configurable 0.1 ms ...32 ms
Input signal voltage		24 V DC
	Signal 0	-3 V ... +5 V *)

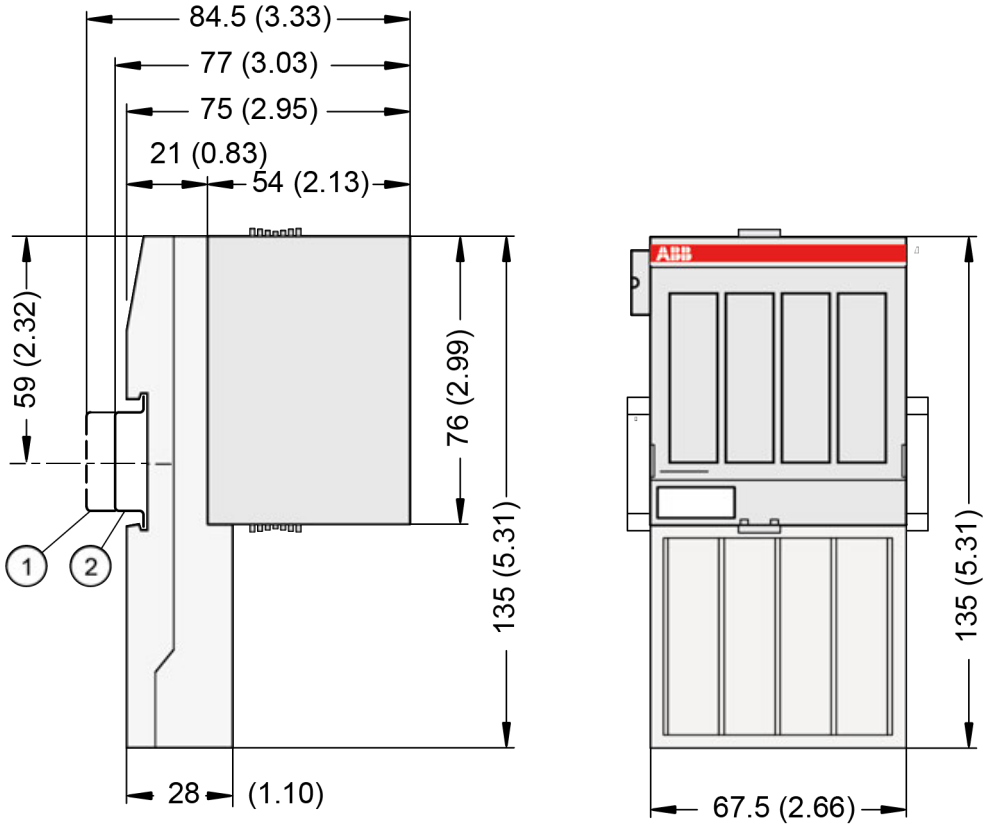
Parameter		Value
	Undefined signal	> +5 V ... < +15 V
	Signal 1	+15 V ... +30 V
Ripple with signal 0		within -3 V ... +5 V *)
Ripple with signal 1		within +15 V ... +30 V
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

*) Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal may not exceed the clamp voltage of the varistor. The varistor limits the voltage to approx. 36 V. Following this, the input voltage must range from -12 V ... +30 V when UPx = 24 V and from -6 V ... +30 V when UPx = 30 V.

Technical data of the fast counter

Parameter	Value
Used inputs	C16 / C17
Used outputs	C18
Counting frequency	Max. 50 kHz

5.6.4.2.14 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

5.6.4.2.15 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 220 500 R0001	DC551-CS31, CS31 communication interface module, 8 DI and 16 DC	Active
1SAP 420 500 R0001	DC551-CS31-XC, CS31 communication interface module, 8 DI and 16 DC, XC version	Active

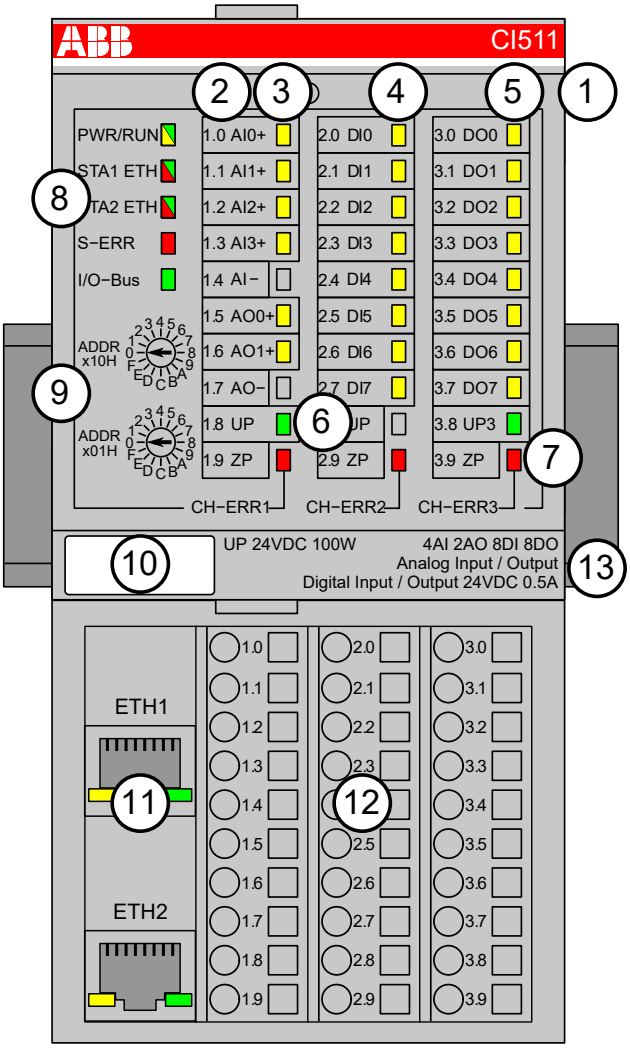
**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.6.5 EtherCAT

5.6.5.1 CI511-ETHCAT

- 4 analog inputs (resolution 12 bits including sign)
- 2 analog outputs (resolution 12 bits including sign)
- 8 digital inputs 24 V DC
- 8 digital outputs 24 V DC, 0.5 A max.
- Cam switch functionality (see also Extended Cam Switch Library)
- Extended Cam switch functionality *) (see also Extended Cam Switch Library)
- Module-wise galvanically isolated - Expandability with up to 10 S500 I/O Modules *)

*) Applicable for device index C0 and above.



1 I/O bus
2 Allocation between terminal number and signal name
3 6 yellow LEDs to display the signal states of the analog inputs/outputs (AI0 ... AI3, AO0 ... AO1)
4 8 yellow LEDs to display the signal states of the digital inputs (DI0 ... DI7)
5 8 yellow LEDs to display the signal states of the digital outputs (DO0 ... DO7)
6 2 green LEDs to display the supply voltage UP and UP3
7 3 red LEDs to display errors (CH-ERR1, CH-ERR2, CH-ERR3)
8 5 system LEDs: PWR/RUN, NET, DC, S-ERR, I/O-Bus
9 2 rotary switches (reserved for future extensions)
10 Label
11 Ethernet interfaces (ETH1, ETH2) on the terminal unit
12 Terminal unit
13 DIN rail

5.6.5.1.1 Intended purpose

The EtherCAT communication interface module CI511-ETHCAT is used as decentralized I/O module in EtherCAT networks. The network connection is performed via 2 RJ45 connectors which are integrated in the terminal unit. The communication interface module contains 22 I/O channels with the following properties:

- 4 analog inputs (1.0 ... 1.3)
- 2 analog outputs (1.5 ... 1.6)
- 8 digital inputs 24 V DC in 1 group (2.0 ... 2.7)
- 8 digital outputs 24 V DC in 1 group (3.0 ... 3.7)
- Cam switch functionality

The inputs/outputs are galvanically isolated from the Ethernet network. There is no potential separation between the channels. The configuration of the analog inputs/outputs is performed by software.

5.6.5.1.2 Functionality

Parameter	Value
Interface	Ethernet
Protocol	EtherCAT
Power supply	From the process supply voltage UP
Supply of the electronic circuitry of the I/O expansion modules attached	Through the I/O bus interface (I/O bus)
Rotary switches	Not used; reserved for future extensions
Analog inputs	4 (configurable via software)
Analog outputs	2 (configurable via software)
Digital inputs	8 (24 V DC; delay time configurable via software)
Digital outputs	8 (24 V DC, 0.5 A max.)
LED displays	For system displays, signal states, errors and power supply
External supply voltage	Via terminals ZP, UP and UP3 (process supply voltage 24 V DC)
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Required terminal unit	TU507 or TU508 ↳ *Chapter 5.7.2 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 1348*

5.6.5.1.3 Connections

The Ethernet communication interface module CI511-ETHCAT is plugged on the I/O terminal unit TU507-ETH or TU508-ETH. Properly seat the module and press until it locks in place. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting (TA526).



For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The connection of the I/O channels is carried out using the 30 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 1.8 and 2.8 as well as 1.9, 2.9 and 3.9 are electrically interconnected within the terminal unit and have always the same assignment, independent of the inserted module:

Terminals 1.8 and 2.8: Process supply voltage UP = +24 V DC

Terminal 3.8: Process supply voltage UP3 = +24 V DC

Terminals 1.9, 2.9 and 3.9: Process supply voltage ZP = 0 V



With a separate UP3 power supply, the digital outputs can be switched off externally. This way, an emergency-off functionality can be realized.

The assignment of the other terminals:

Terminal	Signal	Description
1.0 ... 1.3	AI0 ... AI3	Positive pole of the 4 analog inputs
1.4	AI-	Negative pole of the analog inputs
1.5 ... 1.6	AO0 ... AO1	Positive pole of the 2 analog outputs
1.7	AO-	Negative pole of the analog outputs
2.0 ... 2.7	DI0 ... DI7	8 digital inputs
3.0 ... 3.7	DO0 ... DO7	8 digital outputs



WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing the following:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.



CAUTION!

There is no galvanic isolation between the analog circuitry and ZP/UP. Therefore, the analog sensors must be galvanically isolated in order to avoid loops via the ground potential or the supply voltage.



CAUTION!

Because of their common reference potential, analog current inputs cannot be circuited in series, neither within the module nor with channels of other modules.



For the open-circuit detection (wire break), each channel is pulled up to "plus" by a high-resistance resistor. If nothing is connected, the maximum voltage will be read in then.

Analog signals are always laid in shielded cables. The cable shields are grounded at both ends of the cables. In order to avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

For simple applications (low disturbances, no high requirement on precision), the shielding can also be omitted.

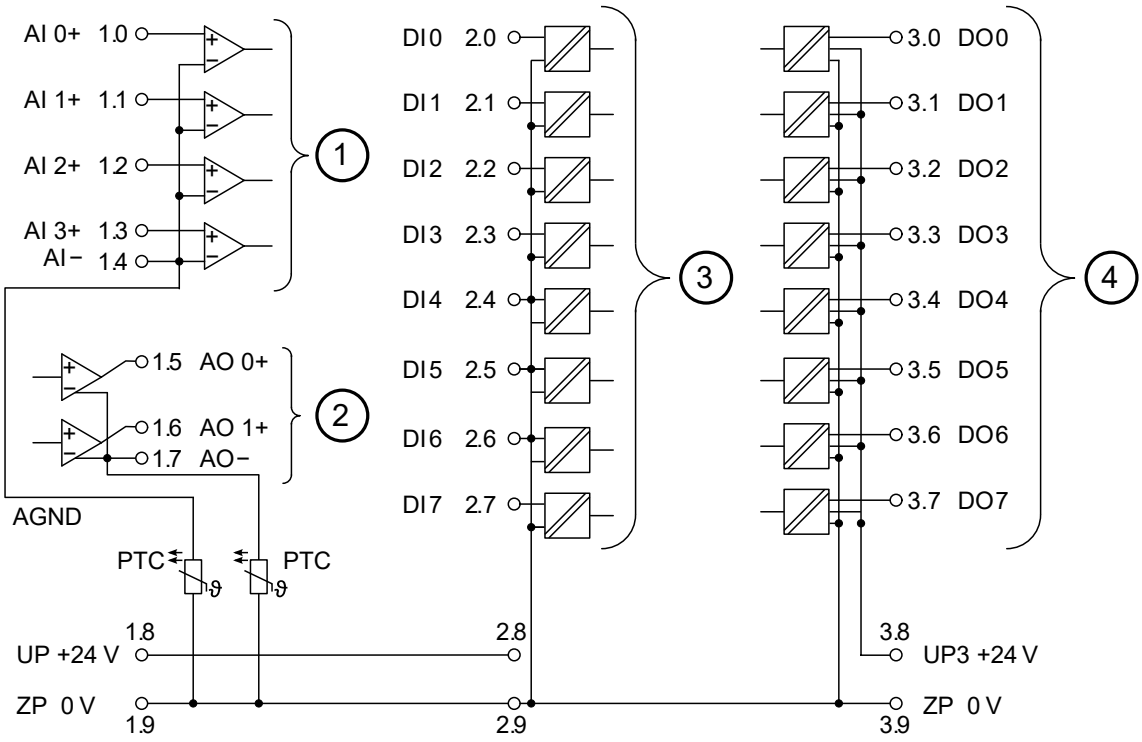


Fig. 200: Connection of the communication interface module CI511-ETHCAT

1 4 analog inputs, configurable for 0 ... 10 V, -10 ... +10 V, 0/4 ... 20 mA, Pt100/Pt1000, Ni1000 and digital signals
2 2 analog outputs, configurable for -10 ... +10 V, 0/4 ... 20 mA
3 8 digital inputs 24 V DC
4 8 digital outputs 24 V DC, 0.5 A max.

In case of voltage feedback, 2 cases are distinguished:

1. The outputs are already active

The output group will be switched off. A diagnosis message will appear. After 5 seconds, the module tries automatic reactivation.

2. The outputs are not active

Only the output with voltage feedback will not be set to active. A diagnosis message will appear.

NOTICE!

Risk of faulty measurements!

The negative pole/ground potential at the sensors must not have too large a potential difference with respect to ZP (max. ± 1 V within the full signal range).

Make sure that the potential difference never exceeds ± 1 V.

CAUTION!

The process supply voltage must be included in the grounding concept (e. g. grounding of the negative terminal).

The module provide several diagnosis functions

Chapter 5.6.5.1.8 “Diagnosis” on page 1097

Chapter 5.6.5.1.7 “Parameterization” on page 1091

↳ *Chapter 5.6.5.1.10 “Measuring ranges” on page 1100*

↳ *Meaning of the LEDs*

Connection of resistance thermometers in 2-wire configuration

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module CI511-ETHCAT provides a constant current source which is multiplexed over the max. 4 analog input channels.

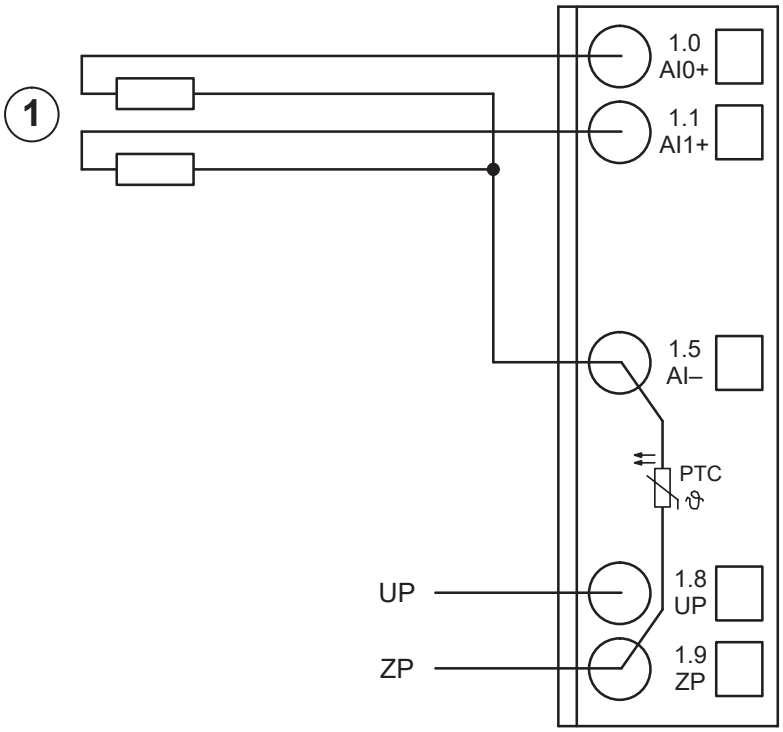


Fig. 201: Connection of resistance thermometers in 2-wire configuration

1 Pt100 (2-wire), Pt1000 (2-wire), Ni1000 (2-wire); 1 analog sensor requires 1 channel

Pt100	-50 °C ... +400 °C	2-wire configuration, 1 channel used
Pt1000	-50 °C ... +400 °C	2-wire configuration, 1 channel used
Ni1000	-50 °C ... +150 °C	2-wire configuration, 1 channel used

↳ *Chapter 5.6.5.1.7 “Parameterization” on page 1091*

↳ *Chapter 5.6.5.1.10 “Measuring ranges” on page 1100*

The module CI511-ETHCAT performs a linearization of the resistance characteristic.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of resistance thermometers in 3-wire configuration

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module CI511-ETHCAT provides a constant current source which is multiplexed over the max. 4 analog input channels.

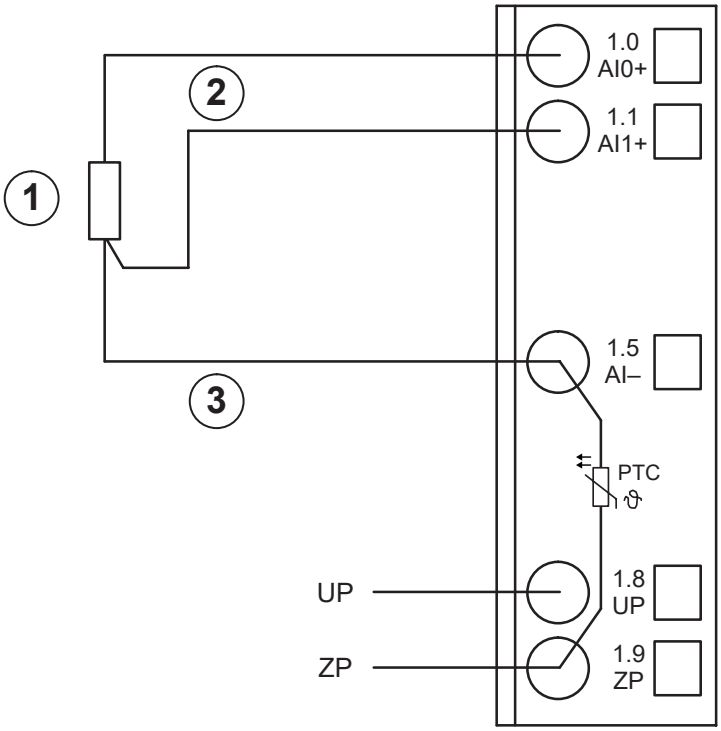


Fig. 202: Connection of resistance thermometers in 3-wire configuration

1 Pt100 (3-wire), Pt1000 (3-wire), Ni1000 (3-wire); 1 analog sensor requires 2 channels
2 Twisted pair within the cable
3 Return line: The return line is only needed once if measuring points are adjacent to each other. This saves wiring costs.

With 3-wire configuration, two adjacent analog channels belong together (e. g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1).

The constant current of one channel flows through the resistance thermometer. The constant current of the other channel flows through one of the cores. The module calculates the measured value from the two voltage drops and stores it under the input with the higher channel number (e. g. I1).

In order to keep measuring errors as small as possible, it is necessary, to have all the involved conductors in the same cable. All the conductors must have the same cross section.

Pt100	-50 °C ... +400 °C	3-wire configuration, 2 channels used
Pt1000	-50 °C ... +400 °C	3-wire configuration, 2 channels used
Ni1000	-50 °C ... +150 °C	3-wire configuration, 2 channels used

↳ *Chapter 5.6.5.1.7 “Parameterization” on page 1091*

↳ *Chapter 5.6.5.1.10 “Measuring ranges” on page 1100*

The module CI511-ETHCAT performs a linearization of the resistance characteristic.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Connection of active-type analog sensors (Voltage) with galvanically isolated power supply

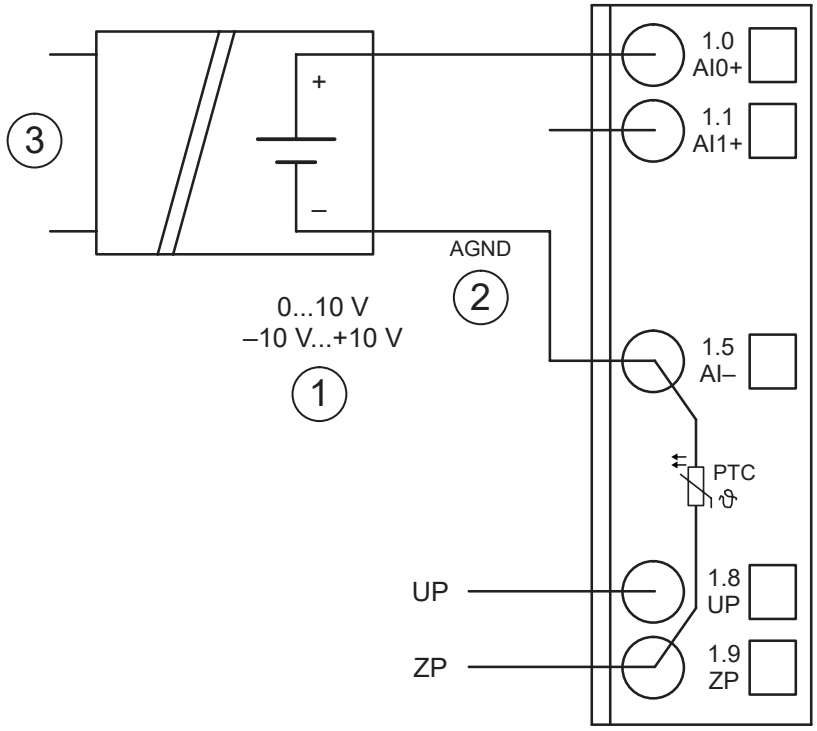


Fig. 203: Connection of active-type analog sensors (voltage) with galvanically isolated power supply

1 1 analog sensor requires 1 channel
2 By connecting to AI-, the galvanically isolated voltage source of the sensor is referred to ZP
3 Galvanically isolated power supply for the analog sensor

Voltage	0 ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

Chapter 5.6.5.1.7 “Parameterization” on page 1091

Chapter 5.6.5.1.10 “Measuring ranges” on page 1100

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Connection of active-type analog sensors (Current) with galvanically isolated power supply

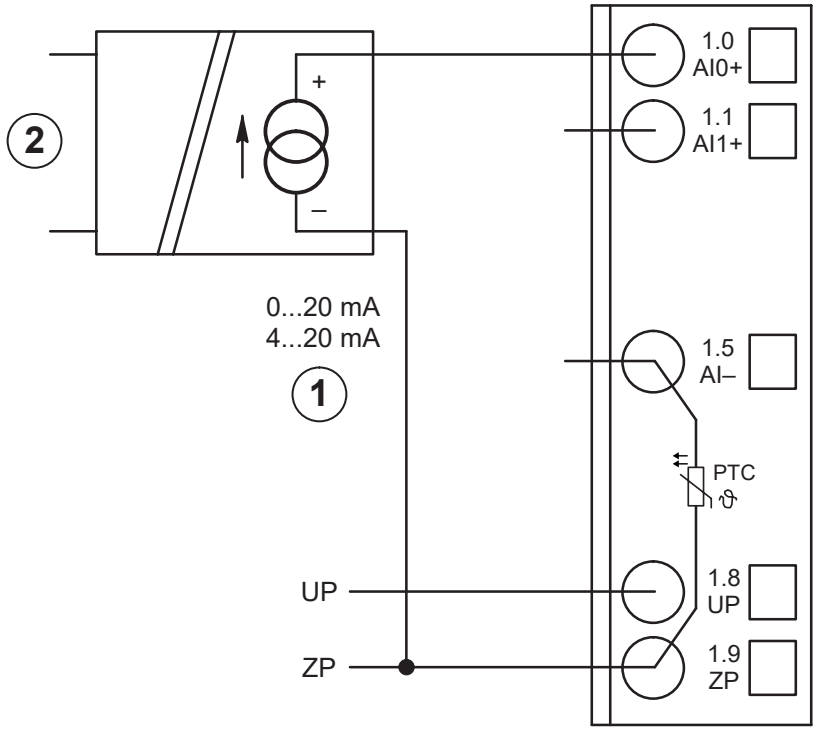


Fig. 204: Connection of active-type analog sensors (current) with galvanically isolated power supply

1 1 analog sensor requires 1 channel
2 Galvanically isolated power supply for the analog sensor

Current	0 ... 20 mA	1 channel used
Current	4 ... 20 mA	1 channel used

Chapter 5.6.5.1.7 “Parameterization” on page 1091

Chapter 5.6.5.1.10 “Measuring ranges” on page 1100

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of active-type analog sensors (Voltage) with no galvanically isolated power supply

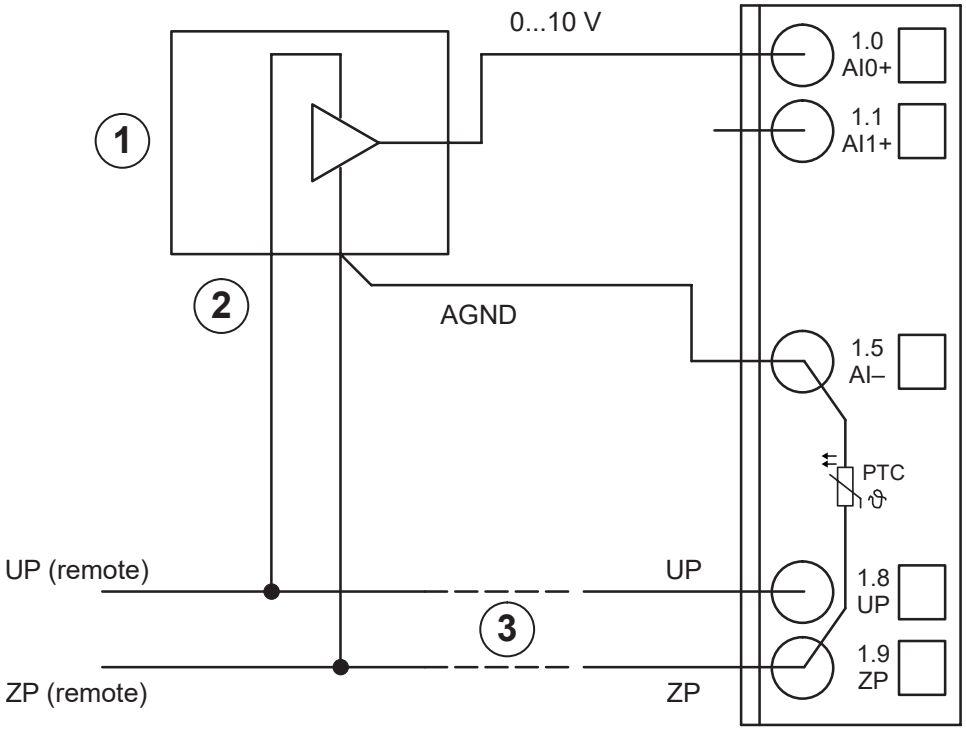


Fig. 205: Connection of active-type sensors (voltage) with no galvanically isolated power supply

1 1 analog sensor requires 1 channel
2 Power supply not galvanically isolated
3 The connection between the negative pole of the sensor and ZP has to be performed
4 Long cable

NOTICE!

Risk of faulty measurements!

The negative pole/ground potential at the sensors must not have too large a potential difference with respect to ZP (max. ± 1 V within the full signal range).

Make sure that the potential difference never exceeds ± 1 V.

Voltage	0 ... 10 V	1 channel used
Voltage	-10 V ... +10 V *)	1 channel used

*) if the sensor can provide this signal range

↳ *Chapter 5.6.5.1.7 “Parameterization” on page 1091*

↳ *Chapter 5.6.5.1.10 “Measuring ranges” on page 1100*

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Connection of passive-type analog sensors (Current)

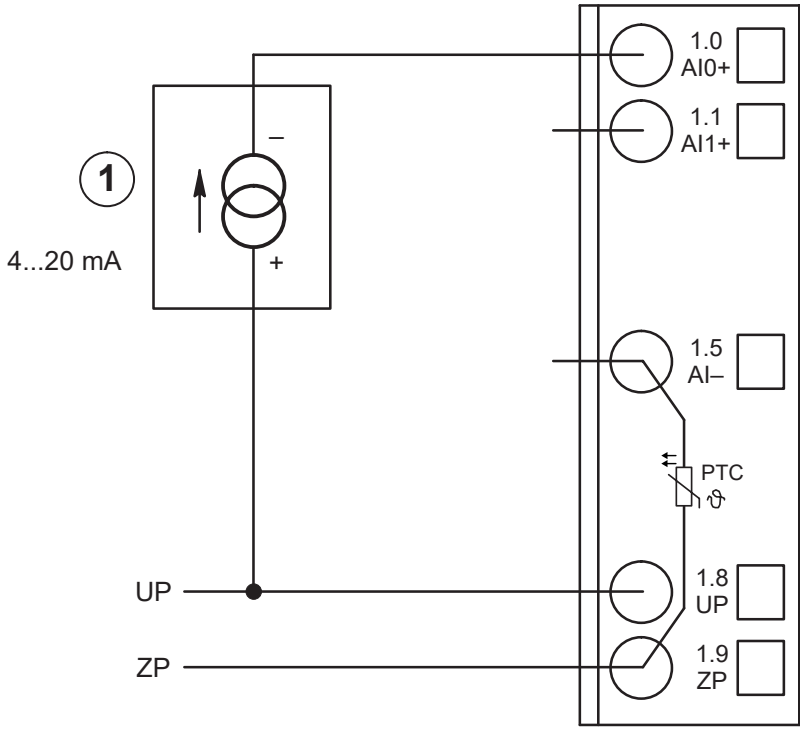


Fig. 206: Connection of passive-type analog sensors (current)

1 1 analog sensor requires 1 channel

Current	4 ... 20 mA	1 channel used

Chapter 5.6.5.1.7 “Parameterization” on page 1091

Chapter 5.6.5.1.10 “Measuring ranges” on page 1100

CAUTION!

Risk of overloading the analog input!

If an analog current sensor supplies more than 25 mA for more than 1 second during initialization, this input is switched off by the module (input protection).

Use only sensors with fast initialization or without current peaks higher than 25 mA. If not possible, connect a 10-volt Zener diode in parallel to AIx+ and ZP.

Unused input channels can be left open-circuited, because they are of low resistance.

Connection of active-type analog sensors (Voltage) to differential inputs

Differential inputs are very useful, if analog sensors are used which are remotely non-isolated (e.g. the minus terminal is remotely grounded).

The evaluation using differential inputs helps to considerably increase the measuring accuracy and to avoid ground loops.

With differential input configurations, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

The analog value is calculated by subtraction of the input value with the higher address from the input value of the lower address.

The converted analog value is available at the odd channel (higher address).

CAUTION!

Problems with the common-mode input voltages of the involved analog inputs

The ground potential at the sensors must not have too large a potential difference with respect to ZP (max. ±1 V within the full signal range).

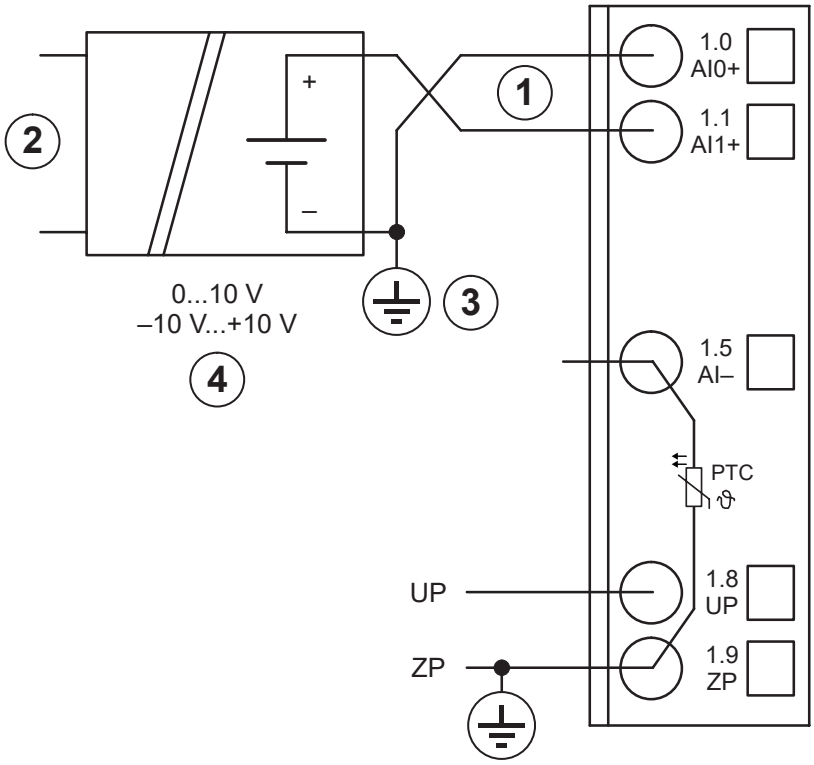


Fig. 207: Connection of active-type analog sensors (voltage) to differential inputs

1 1 analog sensor requires 2 channels
2 Galvanically isolated power supply for the analog sensor
3 Grounding at the sensor
4 0 V ... 10 V / -10 V ... +10 V connected to differential inputs

Voltage	0 V ... 10 V	with differential inputs, 2 channels used
Voltage	-10 V ... +10 V	with differential inputs, 2 channels used

Chapter 5.6.5.1.7 “Parameterization” on page 1091

Chapter 5.6.5.1.10 “Measuring ranges” on page 1100

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

Use of analog inputs as digital inputs

Several (or all) analog inputs can be configured as digital input. The inputs are not galvanically isolated against the other analog channels.

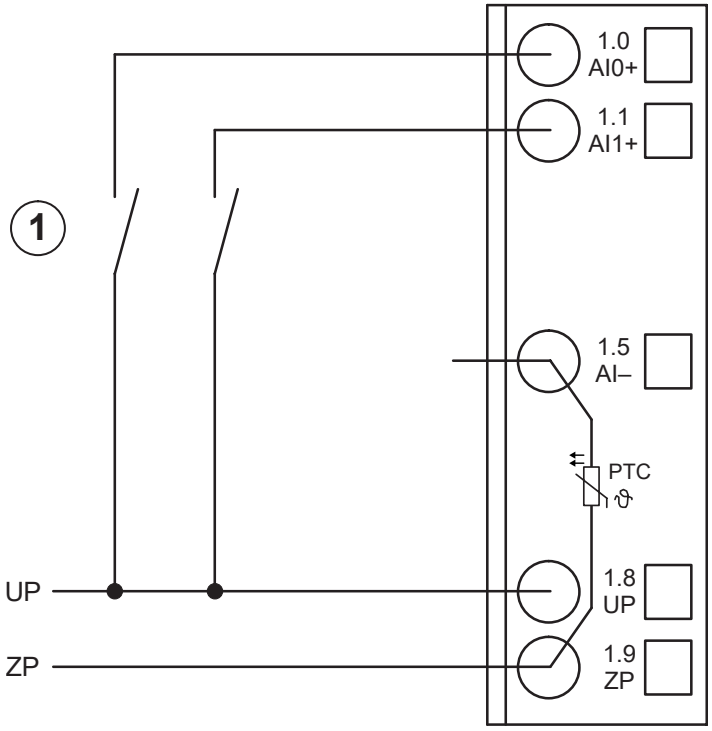


Fig. 208: Use of analog inputs as digital inputs

1 1 digital signal requires 1 channel

Digital input	24 V	1 channel used

↳ *Chapter 5.6.5.1.7 “Parameterization” on page 1091*

↳ *Chapter 5.6.5.1.10 “Measuring ranges” on page 1100*

Connection of analog output loads (Voltage, current)

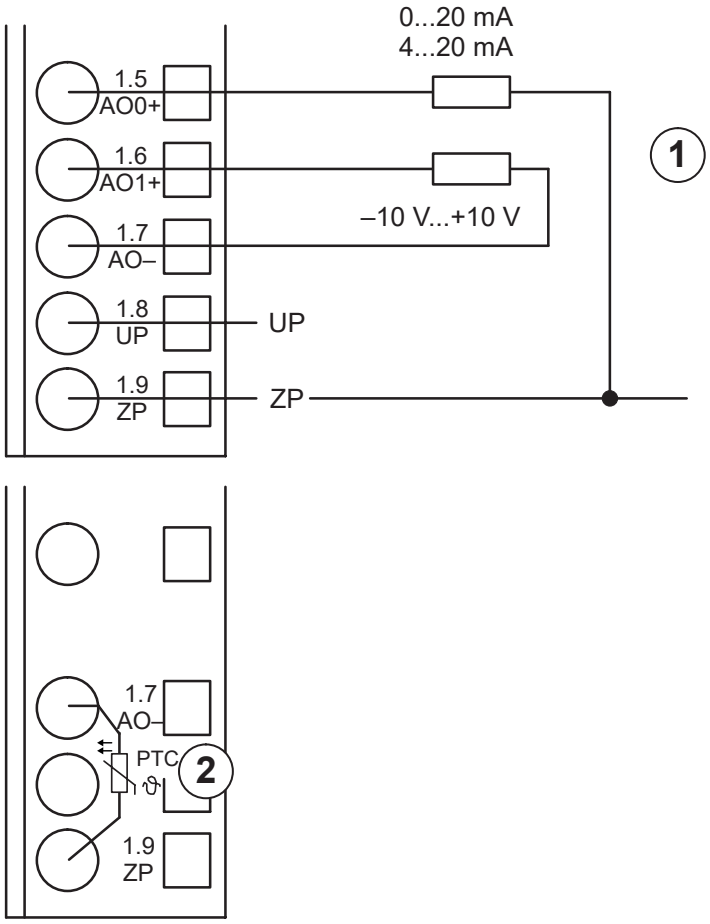


Fig. 209: Connection of analog output loads (voltage, current)

1 1 analog load requires 1 channel

Voltage	-10 V ... +10 V	Load ± 10 mA max.	1 channel used
Current	0 ... 20 mA	Load 0 Ω ... 500 Ω	1 channel used
Current	4 ... 20 mA	Load 0 Ω ... 500 Ω	1 channel used

Chapter 5.6.5.1.7 “Parameterization” on page 1091

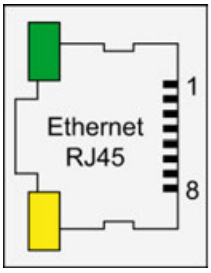
Chapter 5.6.5.1.10 “Measuring ranges” on page 1100

Unused analog outputs can be left open-circuited.

Assignment of the Ethernet ports

The terminal unit for the communication interface module provides two Ethernet interfaces with the following pin assignment. The pin assignment is used for the EtherCAT master (communication module CM5xy-ETHCAT) as well.

Pin assignment

Interface	Pin	Signal	Description
	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NC	Not connected
	5	NC	Not connected
	6	RxD-	Receive data -
	7	NC	Not connected
	8	NC	Not connected
	Shield	Cable shield	Functional earth

In corrosive environment, please protect unused connectors using the TA535 accessory.

Not supplied with this device.

The EtherCAT network differentiates between input-connectors (IN) and output-connectors (OUT):

At the EtherCAT slaves (communication interface modules), the ETH1-connector is IN and the ETH2-connector is OUT.

At the EtherCAT master (communication module), the ETHCAT1 connector has to be used. The ETHCAT2 connector is reserved for future extensions.

5.6.5.1.4 Internal data exchange

Parameter	Value
Digital inputs (bytes)	1
Digital outputs (bytes)	1
Analog inputs (words)	4
Analog outputs (words)	2

5.6.5.1.5 Addressing

The Ethernet bus module CI511-ETHCAT does not consider the position of the rotary switches at the front side of the module. The function of the rotary switches is reserved for future expansions.

5.6.5.1.6 I/O configuration

In order to be able to use the CI51X-ETHCAT with device index C0 or above properly, please download the corresponding device description (.xml-)files from http://www.abb.com/plc and install them to the device repository of your Automation Builder. This will allow you to use up to 10 Expandable S500 I/O modules as well as the Extended Cam Switch Library with your CI51X-ETHCAT device.

The CI511-ETHCAT does not store configuration data itself.

The analog I/O channels are configured via software.

5.6.5.1.7 Parameterization

Module parameter

Name	Value	Internal value	Internal value, type	Default
Module ID	Internal	48155	WORD	48155
Parameter length	Internal	28	BYTE	28
Error LED / Fail-safe function [1])	On Off by E4 Off by E3 On + failsafe Off by E4 + failsafe Off by E3 + failsafe	0 1 3 16 17 19	BYTE	0
Check Supply	Off On	0 1	BYTE	1

Table 327: Error LED / Failsafe function [1])

Setting	Description
On	Error LED lights up at errors of all error classes, Failsafemode off
Off by E4	Error LED lights up at errors of error classes E1, E2 and E3, Failsafemode off
Off by E3	Error LED lights up at errors of error classes E1 and E2 auf, Failsafemode off
On + failsafe	Error LED lights up at errors of all error classes, Failsafemode on *)
Off by E4 + failsafe	Error LED lights up at errors of error classes E1, E2 and E3, Failsafemode on *)
Off by E3 + failsafe	Error LED lights up at errors of error classes E1 and E2, Failsafemode on *)

*) The parameters behaviourAOatCommunicationFault and behaviourDOatCommunicationFault are only analyzed if the Failsafe-mode is ON.

Group parameters of the cam switch

Name	Value	Internal value	Internal value, type	Default
numOfUsed-Cams [1])	0 ... 32 128 ... 160	0 ... 32 218 ... 160	WORD	0
resolution [2])	0 ... 2 -1	0 ... 2 -1	DWORD	36000
zeroShift [3])	0 ... 2 -1	0 ... 2 -1	DWORD	0
EncoderBitReso-lution [4])	8 ... 32	8 ... 32	WORD	18
Reserve	-	-	WORD	-

[1]) The parameter numOfUsedCams defines the interrupt cycle time (Therefore, it takes effect to the accuracy of the track) and the behavior of the module if the DC information is lost.

Parameter setting for numOfUsed-Cams	Number of cams used	Interrupt cycle time	Behavior if DC information is lost
0	0	50 µs	Module changes to "safe-operational" state; the outputs are activated trough the user program
1...8	1...8	80 µs	
9...16	9...16	100 µs	
17...32	17...32	200 µs	
128	0	50 µs	Module keeps in "operational" state; the outputs are activated trough the user program
129 ... 136	1 ... 8	80 µs	Module keeps in "operational" state; the cam switch outputs are activated according to an interpolated timing information
137 ... 144	9 ... 16	100 µs	
145 ... 170	17 ... 32	200 µs	

[2]) The parameter resolution defines the angle resolution of the track. The value gives the number of increments related to 360°; e. g. the value 36,000 corresponds to an angle resolution of 0.01°.

[3]) The parameter zeroShift defines the zero shift. With it the encoder can be adjusted to the mounting position. The value of zeroShift is set in encoder-increments. It is not assigned to the parameter resolution of the cam switch.

[4]) The parameter EncoderBitResolution defines the resolution of the used encoder (in bits), e. g. with the default setting 18 bits the encoder has 196,608 divisions.

Channel parameters for the cam switch (max. 32x)

Name	Value	Internal value	Internal value, type	Default
camToTrack0 *)	Digital Output 0 ... 7, none	0 ... 7, FF	BYTE	FF
:	:	:	:	:
camToTrack31	Digital Output 0 ...7, none	0 ... 7, FF	BYTE	FF

*) The value of the parameter camToTrack# defines which DO (digital output) is assigned to the track. camToTrack0 = 3 for example means that track 0 is assigned to the digital output 3. If the value FFh is set to a track, no digital output is assigned to it.

Name	Value	Referred FB from extended Cam Switch Library [2])	Internal value	Internal value, type	Default
cam-Type[0] [1]) ...	Common	MCX_CamSwitchSimple_c	0	BYTE	0
	Pulsed	MCX_CamSwitchSimple_dc			
	Timed	MCX_PulseSwitch_dc	1		
	Comfort	MCX_CamSwitchTimed_dc	2		
	Cam shift	MCX_CamSwitchCom-fort_dc	3		
	Binary shift		4		
	Multiturn cam	MCX_CamShift_dc	5		
	Time timed	MCX_BinaryShift_dc	6		
	Reference	MCX_CamSwitchMulti_dc	7		
	Multiturn timed	MCX_SwitchTimeTimed_dc	8		
		MCX_BinaryReference_dc	9		
		MCX_CamSwitchMulti-Timed_dc			

[1]) camType additionally to camToTrack identifies the type of each cam switch and enables the use of a specific function block from the Extended Cam Switch Library.

[2]) camType parameters and the Extended Camswitch Library are only available for CI511-ETHCAT and CI512-ETHCAT with device index C0 and above.

Group parameters for the analog part

Name	Value	Internal value	Internal value, type	Default
Analog data format	Standard	0	BYTE	0
Behaviour AO at comm. error *)	Off Last value Last value 5 s Last value 10 s Substitute value Substitute value 5 s Substitute value 10 s	0 1 6 11 2 7 12	BYTE	0

*) The parameter Behaviour AO at comm. error is only analyzed if the Failsafe-mode is ON.

Channel parameters for the analog inputs (4x)

Name	Value	Internal value	Internal value, type	Default
Input 0, channel configuration	see [1])	see [1])	BYTE	0
Input 0, check channel	see [2])	see [2])	BYTE	0
:	:	:	:	:
:	:	:	:	:
Input 3, channel configuration	see [1])	see [1])	BYTE	0
Input 3, channel configuration	see [2])	see [2])	BYTE	0

Channel configuration [1])

Internal value	Operating modes of the analog inputs, individually configurable
0 (default)	Not used
1	0 ... 10 V
2	Digital input
3	0 ... 20 mA
4	4 ... 20 mA
5	-10 V ... +10 V
8	2-wire Pt100 -50 °C ... +400 °C
9	3-wire Pt100 -50 °C ...+400 °C *)
10	0 V ... 10 V (voltage diff.) *)
11	-10 V ... +10 V (voltage diff.) *)
14	2-wire Pt100 -50 °C ... +70 °C
15	3-wire Pt100 -50 °C ... +70 °C *)

Internal value	Operating modes of the analog inputs, individually configurable
16	2-wire Pt1000 -50 °C ...+400 °C
17	3-wire Pt1000 -50 °C ...+400 °C *)
18	2-wire Ni1000 -50 °C ...+150 °C
19	3-wire Ni1000 -50 °C ...+150 °C *)
	*) In the operating modes with 3-wire configuration or with differential inputs, two adjacent analog inputs belong together (e.g. the channels 0 and 1). In these cases, both channels are configured in the desired operating mode. The lower address must be the even address (channel 0). The next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

Table 328: Channel monitoring [2])

Internal Value	Check channel
0	Plausibility, wire break, short circuit
3	not used

Channel parameters for the analog outputs (2x)

Name	Value	Internal value	Internal value, type	Default
Output 0, channel configuration	see [3])	see [3])	BYTE	0
Output 0, check channel	see [4])	see [4])	BYTE	0
Output 0, substitute value	see [5])	see [5])	WORD	0
Output 1, channel configuration	see [3])	see [3])	BYTE	0
Output 1, check channel	see [4])	see [4])	BYTE	0
Output 1, substitute value	see [5])	see [5])	WORD	0

Table 329: Channel configuration [3])

Internal value	Operating modes of the analog outputs, individually configurable
0	Not used (default)
128	-10 V ... +10 V
129	0 ... 20 mA
130	4 ... 20 mA

Table 330: Channel monitoring [4])

Internal value	Check channel
0	Plausibility, wire break, short circuit
3	None

Table 331: Substitute value [5])

Intended behavior of output channel when the control system stops	Required setting of the module parameter "Behaviour of outputs in case of a communication error"	Required setting of the channel parameter "Substitute value"
Output OFF	Off	0
Last value infinite	Last value	0
Last value for 5 s	Last value 5 s	0
Last value for 10 s	Last value 10 s	0
Substitute value infinite	Substitute value	Depending on configuration
Substitute value for 5 s	Substitute value 5 s	Depending on configuration
Substitute value for 10 s	Substitute value 10 s	Depending on configuration

Group parameters for the digital part

Name	Value	Internal value	Internal value, type	Default
Input delay	0.01 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.01 ms 0x00
Detect short circuits at outputs	Off On	0 1	BYTE	On 0x01
Behaviour DO at comm. error *)	Off Last value Last value 5 sec Last value 10 sec Substitute value Substitute 5 sec Substitute 10 sec	0 1 6 11 2 7 12	BYTE	Off 0x00
Substitute value at output	0 ... 255	00h ... FFh	BYTE	0 0x0000

*) The parameter behaviourDOatCommunicationFault is only analyzed if the Failsafe-mode is ON.

5.6.5.1.8 Diagnosis

In cases of short circuit or overload, the digital outputs are turned off. The modules performs reactivation automatically. Thus an acknowledgement of the errors is not necessary. The error message is stored via the LED.

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<– Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**ETHCAT Diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])			
Module error							
3	-	31	31	31	19	Checksum error in the I/O module	Replace I/O module
3	-	31	31	31	3	Timeout in the I/O module	
3	-	31	31	31	40	Different hard-/firm-ware versions in the module	
3	-	31	31	31	43	Internal error in the module	
3	-	31	31	31	36	Internal data exchange failure	
3	-	31	31	31	20	Slave-to-Slave mal-function	Check configu-ration
3	-	31	31	31	41	Distributed Clock malfunction	Check configu-ration
3	-	31	31	31	9	Overflow diagnosis buffer	Restart
3	-	31	31	31	26	Parameter error	Check master
3	-	31	31	31	11	Process voltage UP too low	Check process supply voltage UP
4	-	31	31	31	45	Process voltage UP3 too low	Check process voltage
4	-	31	31	31	34	No response during initialization of the I/O module	Replace I/O module

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<– Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**ETHCAT Diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])			
4	-	31	31	31	46	Voltage feedback on activated digital outputs [4])	Check terminals
Channel error digital							
4	-	31	2	0..7	46	Voltage feedback on deactivated dig-ital output [5])	Check terminals
4	-	31	2	0..7	47	Short circuit at dig-ital output	Check terminals
Channel error analog							
4	-	31	1	0..3	48	Analog value over-flow or broken wire at an analog input	Check value or check terminals
4	-	31	1	0..3	7	Analog value underflow at an analog input	Check value
4	-	31	1	0..3	47	Short circuit at an analog input	Check terminals
4	-	31	3	0..1	48	Analog value over-flow at an analog output	Check output value
4	-	31	3	0..1	7	Analog value underflow at an analog output	Check output value

Remarks:

[1])	In AC500 the following interface identifier applies: "-" = Diagnosis via bus-specific function blocks; 0 ... 4 or 10 = Position of the Communication Module;14 = I/O bus; 31 = Module itself The identifier is not contained in the CI511-ETHCAT diagnosis block.
[2])	With "Device" the following allocation applies: 31 = Module itself or ADR = Hardware address (e. g. of the DC551)

[3])	With "Module" the following allocation applies dependent of the master: 31 = Module itself (Module error) or Module type (1=AI, 2=DO, 3=AO; channel error)
[4])	Diagnosis message appears for the whole output group and not per channel. The message occurs if the output channel is already active.
[5])	Diagnosis message appears per channel. The message occurs if the output channel is not active.

5.6.5.1.9 State LEDs

The LEDs are located at the front of module.

There are 2 different groups of LEDs:

- The 5 system LEDs (PWR, NET, DC, S-ERR and I/O-Bus) show the operation state of the module and display possible errors.
- The 27 process LEDs (UP, UP3, inputs, outputs, CH-ERR1 to CH-ERR3) show the process supply voltage and the states of the inputs and outputs and display possible errors.

Table 332: States of the 5 system LEDs

LED	Color	Off	On	Flashing	1x flash	2x flash
PWR/RUN	Green	Error in the internal supply voltage or process voltage missing	Internal supply voltage OK	Module is not configured	--	--
	Yellow	--	--	--	--	--
NET	Green	Init	Operational	Pre-operational	Safe-operational	--
	Red	No error	PDI Watchdog Timeout	Invalid Configuration	Unsolicited State Change	Application time out
DC *)	Green	Distributed Clock not active	Distributed Clock active	--	--	--
	Red	--	--	--	--	--
S-ERR	Red	No error	Internal error	--	--	--
I/O-Bus	Green	No communication interface modules connected or communication error	---	---	--	--
ETH1	Green	No EtherCAT connection	Link OK No data transfer	Link OK Data transfer OK	--	--
	Yellow	--	--	--	--	--

LED	Color	Off	On	Flashing	1x flash	2x flash
ETH2	Green	No EtherCAT connection	Link OK No data transfer	Link OK Data transfer OK	--	--
	Yellow	--	--	--	--	--

*) The state of this LED is only significant if the cam switch functionality is enabled

Table 333: States of the 27 process LEDs

LED	Color	OFF	ON	Flashing
AI0 ... AI3	Yellow	Input is OFF	Input is ON (brightness depends on the value of the analog signal)	--
AO0 ... AO1	Yellow	Output is OFF	Output is ON (brightness depends on the value of the analog signal)	--
DI0 ... DI7	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--
DO0 ... DO7	Yellow	Output is OFF	Output is ON	--
UP	Green	Process supply voltage missing	Process supply voltage OK and initialization finished	--
UP3	Green	Process supply voltage missing	Process supply voltage OK	--
CH-ERR1 to CH-ERR3	Red	No error or process supply voltage missing	Internal error	Error on one channel of the corresponding group

5.6.5.1.10 Measuring ranges

Input ranges voltage, current and digital input

Range	0 V ... +10 V	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital input	Digital value	
						Decimal	Hex.
Overflow	> 11.7589	> 11.7589	> 23.5178	> 22.8142		32767	7FFF
Measured value too high	11.7589 : 10.0004	11.7589 : 10.0004	23.5178 : 20.0007	22.8142 : 20.0006		32511 : 27649	7EFF : 6C01
Normal range	10.0000 : 0.0004	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	: : On	27648 : 1	6C00 : 0001

Range	0 V ... +10 V	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital input	Digital value	
						Decimal	Hex.
Normal range or measured value too low	0.0000	0.0000	0	4	Off	0	0000
	-0.0004 -1.7593	-0.0004 : : -10,0000		3.9994 1.1858		-1 -4864 : -27648	FFFF ED00 : 9400
Measured value too low		-10.0004 : -11.7589				-27649 : -32512	93FF : 8100
Underflow	< 1.7593	< -11.7589	< 0.0000	< 1.1858		-32768	8000

The represented resolution corresponds to 16 bits.

Input ranges resistance temperature detector

Range	Pt100 / Pt1000 -50 °C ... +400 °C	Ni1000 -50 °C ... +150 °C	Digital value	
			Decimal	Hex.
Overflow	> +450.0 °C	> +160.0 °C	32767	7FFF
Measured value too high	+450.0 °C : +400.1 °C		4500 : 4001	1194 : 0FA1
		+160.0 °C : +150.1 °C	1600 : 1501	0640 : 05DD
			800 : 701	0320 : 02BD
Normal range	+400.0 °C : : : +0.1 °C	+150.0 °C : : + 0.1 °C	4000 1500 700 : 1	0FA0 05DC 02BC : 0001
	0.0 °C	0.0 °C	0	0000
	-0.1 °C : -50.0 °C	-0.1 °C : -50,0 °C	-1 : -500	FFFF : FE0C
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-501 : -600	FE0B : FDA8
Underflow	< -60.0 °C	< -60.0 °C	-32768	8000

Output ranges voltage and current

Range	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital value	
				Decimal	Hex.
Overflow	0 V	0 mA	0 mA	> 32511	> 7EFF
Measured value too high	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA	32511 : 27649	7EFF : 6C01
Normal range	10.0000 V : 0.0004 V	20.0000 mA : 0,0007 mA	20.0000 mA : 4.0006 mA	27648 : 1	6C00 : 0001
	0.0000 V	0.0000 mA	4.0000 mA	0	0000
	-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA	-1 -6912 -27648	FFFF E500 9400
Measured value too low	-10.0004 V : -11.7589 V	0 mA : 0 mA	0 mA : 0 mA	-27649 : -32512	93FF : 8100
Underflow	0 V	0 mA	0 mA	< -32512	< 8100

The represented resolution corresponds to 16 bits.

5.6.5.1.11 Technical data

Technical data of the module

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

↳ *Chapter 4.3 “System data AC500-XC” on page 38*

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter	Value
Bus connection	2 x RJ45
Technology	Hilscher NETX 100
Transfer rate	10/100 Mbit/s (full-duplex)
Transfer method	According to Ethernet II, IEEE 802.3
Ethernet	100 base-TX, internal switch, 2x RJ45 socket
Expandability (S500 I/O modules)	Up to 10 S500 I/O modules (Index C0 and above), not available (Index below C0)
Indicators	5 LEDs for state indication
Adjusting elements	2 rotary switches (used for future topology extensions)

Parameter	Value
Quantity of input/output data	CI512-ETHCAT: 10 bytes input and 14 bytes output CI511-ETHCAT: 18 bytes input and 18 bytes output
Limit of data for input and output	144 byte
Acyclic services	SDO (1500 bytes max.) Emergency ECAT_SLV_DIAG
Protective functions (according to CODESYS)	Protected against: ● short circuit ● reverse supply ● overvoltage ● reverse polarity Galvanic isolation to network

Parameter		Value
Process supply voltage UP/UP3		
	Rated value	24 V DC (for inputs and outputs)
	Max. load for the terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse on UP/UP3	10 A fast
	Galvanic isolation	Ethernet interface against the rest of the module
	Inrush current from UP (at power up)	On request
	Current consumption via UP (normal operation)	0.2 A
	Current consumption via UP3	0.06 A + 0.5 A max. per output
	Connections	Terminals 1.8 and 2.8 for +24 V (UP) Terminal 3.8 for +24 V (UP3) Terminals 1.9, 2.9 and 3.9 for 0 V (ZP)
Max. power dissipation within the module		6 W
Number of digital inputs		8
Number of digital outputs		8
Number of analog inputs		4
Number of analog outputs		2
Reference potential for all digital inputs and outputs		Negative pole of the supply voltage, signal name ZP
Diagnosis		See Diagnosis and Displays *Chapter 5.6.5.1.8 “Diagnosis” on page 1097*
Operation and error displays		32 LEDs (totally)
Weight (without terminal unit)		ca. 125 g

Parameter	Value
Mounting position	Horizontal mounting or Vertical mounting with derating (output load reduced to 50 % at +40 °C per group)
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Multiple overloads
With multi-channel modules, there are no effects of multiple overloads as each digital output channel is individually protected by an internal intelligent high-side switch.

Technical data of the digital inputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DI0 ... DI7		Terminals 2.0 ... 2.7
Reference potential for all inputs		Terminals 1.9 ... 3.9 (Negative pole of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1 ms ... 32 ms
Input signal voltage		24 V DC
	0-Signal	-3 V ... +5 V
	Undefined Signal	> +5 V ... < +15 V
	1-Signal	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		

Parameter		Value
	Shielded	1000 m
	Unshielded	600 m

Technical data of the digital outputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DO0 ... DO7		Terminals 3.0 ... 3.7
Reference potential for all outputs		Terminals 1.9 ... 3.9 (Negative pole of the supply voltage, signal name ZP)
Common power supply voltage		For all outputs terminal 3.8 (positive pole of the supply voltage, signal name UP3)
Output voltage for signal 1		UP3 (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value per channel	500 mA at UP3 = 24 V
	Max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA
	Fuse for UP3	10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)
Output switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

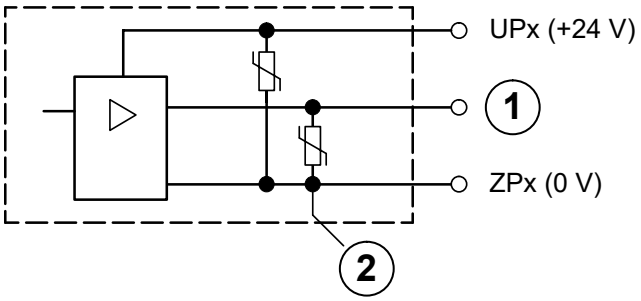


Fig. 210: Digital input/output (circuit diagram)

1 Digital output
2 Varistors for demagnetization when inductive loads are turned off

Technical data of the analog inputs

Parameter		Value
Number of channels per module		4
Distribution of channels into groups		1 group with 4 channels
Connection if channels AI0+ ... AI3+		Terminals 1.0 ... 1.3
Reference potential for AI0+ ... AI3+		Terminal 1.4 (AI-) for voltage and RTD measurement Terminals 1.9, 2.9 and 3.9 for current measurement
Input type		
	Unipolar	Voltage 0 V ... 10 V, current or Pt100/Pt1000/ Ni1000
	Bipolar	Voltage -10 V ... +10 V
Galvanic isolation		Against Ethernet network
Configurability		0 V ... 10 V, -10 V ... +10 V, 0/4 mA ... 20 mA, Pt100/1000, Ni1000 (each input can be configured individually)
Channel input resistance		Voltage: > 100 kΩ Current: ca. 330 Ω
Time constant of the input filter		Voltage: 100 µs Current: 100 µs
Indication of the input signals		1 LED per channel (brightness depends on the value of the analog signal)
Conversion cycle		1 ms (for 4 inputs + 2 outputs); with RTDs Pt/ Ni... 1 s
Resolution		Range 0 ... 10 V: 12 bits Range -10 ... +10 V: 12 bits including sign Range 0 ... 20 mA: 12 bits Range 4 ... 20 mA: 12 bits Range RTD (Pt100, PT1000, Ni1000): +0.1 °C
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ. 0.5 %, max. 1 %

Parameter	Value
Relationship between input signal and hex code	↳ *Chapter 5.6.5.1.10.2 “Input ranges resistance temperature detector” on page 1101*
Unused inputs	Are configured as "unused" (default value)
Overvoltage protection	Yes

Technical data of the analog inputs, if used as digital inputs

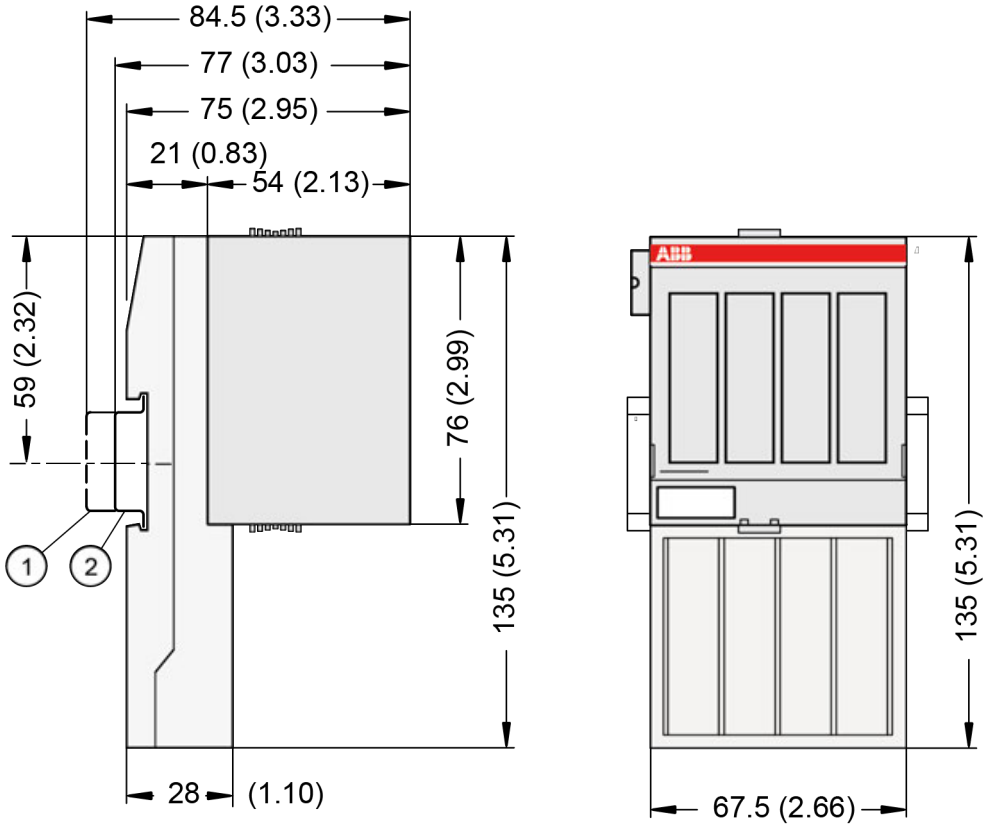
Parameter		Value
Number of channels per module		Max. 4
Distribution of channels into groups		1 group of 4 channels
Connections of the channels AI0+ ... AI3+		Terminals 1.0 ... 1.3
Reference potential for the inputs		Terminals 1.9, 2.9 and 3.9 (ZP)
Indication of the input signals		1 LED per channel
Input signal voltage		24 V DC
	Signal 0	-30 V ... +5 V
	Undefined signal	+5 V ... +13 V
	Signal 1	+13 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 7 mA
	Input voltage +5 V	Typ. 1.4 mA
	Input voltage +15 V	Typ. 3.7 mA
	Input voltage +30 V	< 9 mA
Input resistance		Ca. 3.5 kΩ

Technical data of the analog outputs

Parameter		Value
Number of channels per module		2
Distribution of channels into groups		1 group for 2 channels
Connection of the channels AO0+...AO1+		Terminals 1.5 ... 1.6
Reference potential for AO0+ ... AO1+		Terminal 1.7 (AO-) for voltage outputTerminals 1.9, 2.9 and 3.9 (ZP) for current output
Output type		
	Unipolar	Current
	Bipolar	Voltage
Galvanic isolation		Against Ethernet network
Configurability		-10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA (each output can be configured individually)
Output resistance (load), as current output		0 Ω ... 500 Ω

Parameter	Value
Output loadability, as voltage output	± 10 mA max.
Indication of the output signals	1 LED per channel (brightness depends on the value of the analog signal)
Resolution	12 bits including sign
Settling time for full range change (resistive load, output signal within specified tolerance)	Typ. 5 ms
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code	Table Output Ranges Voltage and Current ↬ *Chapter 5.6.5.1.10.3 "Output ranges voltage and current" on page 1102*
Unused outputs	Are configured as unused (default value) and can be left open-circuited

5.6.5.1.12 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

5.6.5.1.13 Ordering data

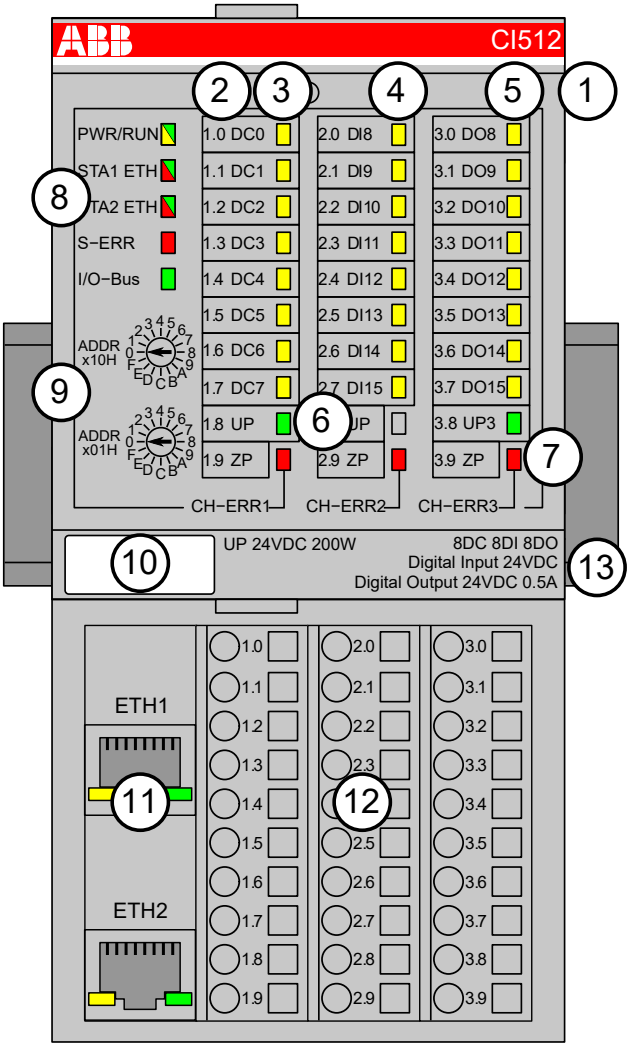
Part no.	Description	Product life cycle phase *)
1SAP 220 900 R0001	CI511-ETHCAT, EtherCAT communication interface module, 8 DI, 8 DO, 4 AI and 2 AO	Active

*) *Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.6.5.2 CI512-ETHCAT

- 8 digital inputs 24 V DC
- 8 digital outputs 24 V DC, 0.5 A max.
- 8 configurable digital inputs/outputs 24 V DC, 0.5 A max.
- Cam switch functionality (see also Extended Cam Switch Library)
- Extended Cam switch functionality *)
  (see also Extended Cam Switch Library)
- Module-wise galvanically isolated
- Expandability with up to 10 S500 I/O modules *)

*) Applicable for device index C0 and above.



1 I/O bus
2 Allocation between terminal number and signal name
3 8 yellow LEDs to display the signal states of the digital configurable inputs/outputs (DC0 ... DC7)
4 8 yellow LEDs to display the signal states of the digital inputs (DI0 ... DI7)
5 8 yellow LEDs to display the signal states of the digital outputs (DO0 ... DO7)
6 2 green LEDs to display the supply voltage UP and UP3
7 3 red LEDs to display errors (CH-ERR1, CH-ERR2, CH-ERR3)
8 5 System LEDs: PWR/RUN, NET, DC, S-ERR, I/O-Bus
9 2 rotary switches (reserved for future extensions)
10 Label
11 Ethernet interfaces (ETH1, ETH2) on the terminal unit
12 Terminal unit
13 DIN rail

5.6.5.2.1 Intended purpose

The EtherCAT communication interface module CI512-ETHCAT is used as decentralized I/O module in EtherCAT networks. The network connection is performed via 2 RJ45 connectors which are integrated in the terminal unit.

The communication interface module contains 24 I/O channels with the following properties:

- 8 digital configurable inputs/outputs in 1 group (1.0 ... 1.7)
- 8 digital inputs 24 V DC in 1 group (2.0 ... 2.7)
- 8 digital outputs 24 V DC in 1 group (3.0 ... 3.7)
- Cam switch functionality

The inputs/outputs are galvanically isolated from the Ethernet network. There is no potential separation between the channels. The configuration of the configurable digital inputs/outputs is performed by software.

5.6.5.2.2 Functionality

Parameter	Value
Interface	Ethernet
Protocol	EtherCAT
Power supply	From the process supply voltage UP
Supply of the electronic circuitry of the I/O expansion modules attached	Through the I/O bus interface (I/O bus)
Rotary switches	Not used; reserved for future extensions
Configurable digital inputs/outputs	8 (configurable via software)
Digital inputs	8 (24 V DC; delay time configurable via software)
Digital outputs	8 (24 V DC, 0.5 A max.)
LED displays	For system displays, signal states, errors and power supply
External supply voltage	Via terminals ZP, UP and UP3 (process supply voltage 24 V DC)
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Required terminal unit	TU507 or TU508 *Chapter 5.7.2 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 1348*

5.6.5.2.3 Connections

The Ethernet communication interface module CI512-ETHCAT is plugged on the I/O terminal unit TU507-ETH or TU508-ETH. Properly seat the module and press until it locks in place. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting (TA526).

The connection of the I/O channels is carried out using the 30 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.



For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The terminals 1.8 and 2.8 as well as 1.9, 2.9 and 3.9 are electrically interconnected within the terminal unit and have always the same assignment, independent of the inserted module:

Terminals 1.8 and 2.8: Process supply voltage UP = +24 V DC

Terminal 3.8: Process supply voltage UP3 = +24 V DC

Terminals 1.9, 2.9 and 3.9: Process supply voltage ZP = 0 V

With a separate UP3 power supply, the digital outputs can be switched off externally. This way, an emergency-off functionality can be realized.

The assignment of the other terminals:

Terminals	Signal	Description
1.0 ... 1.7	DC0 ... DC7	8 digital inputs/outputs (configurable via software)
2.0 ... 2.7	DI0 ... DI7	8 digital inputs (delay time configurable via software)
3.0 ... 3.7	DO0 ... DO7	8 digital outputs

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing the following:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

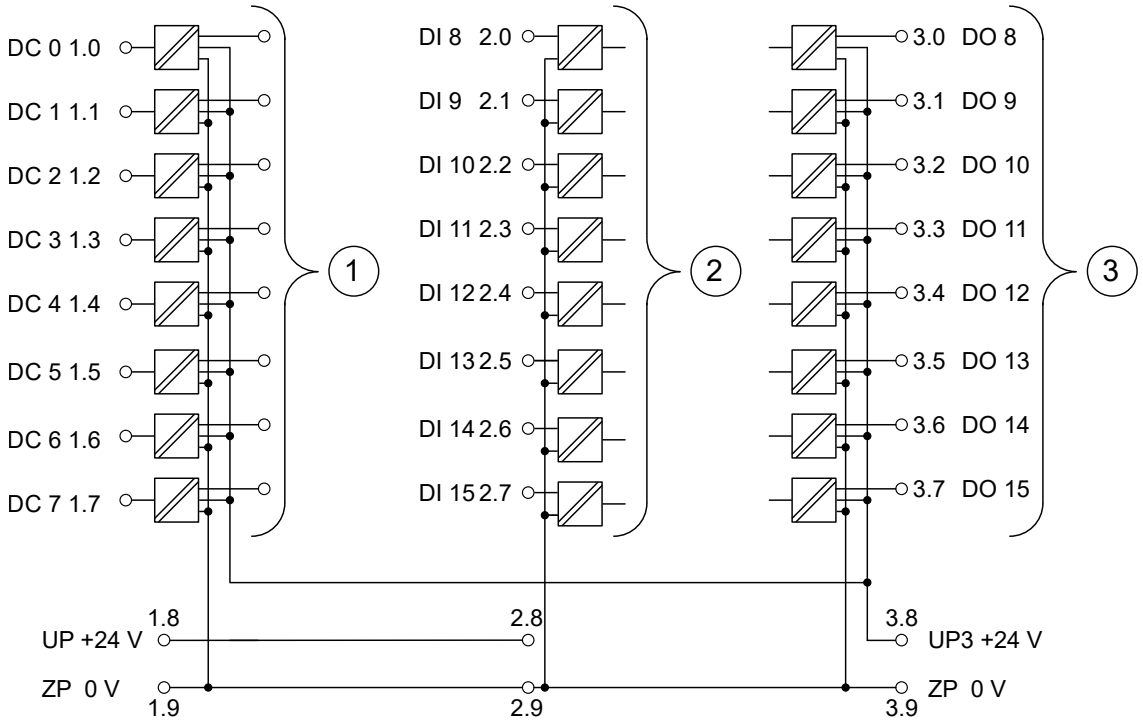


Fig. 211: Connection of the communication interface module CI512-ETHCAT

1 8 digital configurable inputs/outputs 24 V DC
2 8 digital inputs 24 V DC
3 8 digital outputs 24 V DC

In case of voltage feedback, 2 cases are distinguished:

1. The outputs are already active

The output group will be switched off. A diagnosis message will appear. After 5 seconds, the module tries automatic reactivation.

2. The outputs are not active

Only the output with voltage feedback will not be set to active. A diagnosis message will appear.

CAUTION!
The process supply voltage must be included within the grounding concept of the plant (e. g. grounding of the negative pole).

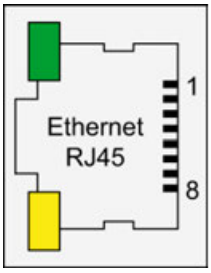
The module provides several diagnosis functions.

Chapter 5.6.5.2.9 “Diagnosis” on page 1118

5.6.5.2.4 Assignment of the Ethernet ports

The terminal unit for the communication interface module provides two Ethernet interfaces with the following pin assignment. The pin assignment is used for the EtherCAT master (communication module CM5xy-ETHCAT) as well.

Pin assignment

Interface	Pin	Signal	Description
	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NC	Not connected
	5	NC	Not connected
	6	RxD-	Receive data -
	7	NC	Not connected
	8	NC	Not connected
	Shield	Cable shield	Functional earth

In corrosive environment, please protect unused connectors using the TA535 accessory.

Not supplied with this device.

The EtherCAT network differentiates between input-connectors (IN) and output-connectors (OUT):

At the EtherCAT slaves (communication interface modules), the ETH1-connector is IN and the ETH2-connector is OUT.

At the EtherCAT master (communication module), the ETHCAT1 connector has to be used. The ETHCAT2 connector is reserved for future extensions.

5.6.5.2.5 Internal data exchange

Parameter	Value
Digital inputs (bytes)	1
Digital outputs (bytes)	1
Configurable digital inputs/outputs (bytes)	1 + 1

5.6.5.2.6 Addressing

The Ethernet communication interface module CI512-ETHCAT does not consider the position of the rotary switches at the front side of the module. The function of the rotary switches is reserved for future expansions.

5.6.5.2.7 I/O configuration

In order to be able to use the CI51X-ETHCAT with device index C0 or above properly, please download the corresponding device description (.xml-)files from http://www.abb.com/plc and install them to the device repository of your Automation Builder. This will allow you to use up to 10 Expandable S500 I/O modules as well as the Extended Cam Switch Library with your CI51X-ETHCAT device.

The CI512-ETHCAT does not store configuration data itself.

The analog I/O channels are configured via software.

5.6.5.2.8 Parameterization

Module parameter

Name	Value	Internal value	Internal value, type	Default
Module ID	Internal	49435	WORD	49435
Parameter length	Internal	10	BYTE	10
Error LED / Fail-safe function [1])	On Off by E4 Off by E3 On + failsafe Off by E4 + failsafe Off by E3 + failsafe	0 1 3 16 17 19	BYTE	0
Check Supply	Off On	0 1	BYTE	1

Table 334: Error LED / Failsafe function [1])

Setting	Description
On	Error LED lights up at errors of all error classes, Failsafe mode off
Off by E4	Error LED lights up at errors of error classes E1, E2 and E3, Failsafe mode off
Off by E3	Error LED lights up at errors of error classes E1 and E2 auf, Failsafe mode off
On + failsafe	Error LED lights up at errors of all error classes, Failsafe mode on *)
Off by E4 + failsafe	Error LED lights up at errors of error classes E1, E2 and E3, Failsafe mode on *)
Off by E3 + failsafe	Error LED lights up at errors of error classes E1 and E2, Failsafe mode on *)

*) The parameter behaviourDOatCommunicationFault is only analyzed if the Failsafe-mode is ON.

Group parameters of the cam switch

Name	Value	Internal value	Internal value, type	Default
numOfUsed-Cams [1])	0 ... 32 128 ... 160	0 ... 32 218 ... 160	WORD	0
resolution [2])	0 ... 2 -1	0 ... 2 -1	DWORD	36000
zeroShift [3])	0 ... 2 -1	0 ... 2 -1	DWORD	0
EncoderBitReso-lution [4])	8 ... 32	8 ... 32	WORD	18
Reserve	-	-	WORD	-

Remarks:

[1]) The parameter numOfUsedCams defines the interrupt cycle time (Therefore, it takes effect to the accuracy of the track) and the behavior of the module if the DC information is lost.

Parameter setting for numOfUsed-Cams	Number of cams used	Interrupt cycle time	Behavior if DC information is lost
0	0	50 µs	Module changes to "safe-operational" state; the outputs are activated trough the user program
1 ... 8	1 ... 8	80 µs	
9 ... 16	9 ... 16	100 µs	
17 ... 32	17 ... 32	200 µs	
128	0	50 µs	Module keeps in "operational" state; the outputs are activated trough the user program
129 ... 136	1 ... 8	80 µs	Module keeps in "operational" state; the cam switch outputs are activated according to an interpolated timing information
137 ... 144	9 ... 16	100 µs	
145 ... 170	17 ... 32	200 µs	

[2]) The parameter resolution defines the angle resolution of the track. The value gives the number of increments related to 360°; e. g. the value 36,000 corresponds to an angle resolution of 0.01°.

[3]) The parameter zeroShift defines the zero shift. With it the encoder can be adjusted to the mounting position. The value of zeroShift is set in encoder-increments. It is not assigned to the parameter resolution of the cam switch.

[4]) The parameter EncoderBitResolution defines the resolution of the used encoder (in bits), e. g. with the default setting 18 bits the encoder has 196,608 divisions.

Channel parameters for the cam switch (max. 32x)

Name	Value	Internal value	Internal value, type	Default
camToTrack0 [1])	Digital Output 0 ... 15, none	0 ... 15, FF	BYTE	FF
:	:	:	:	:
camToTrack31	Digital Output 0 ... 15, none	0 ... 15, FF	BYTE	FF

[1]) The value of the parameter camToTrack# defines which DO (digital output) is assigned to the track. camToTrack0 = 3 for example means that track 0 is assigned to the digital output 3. If the value FFh is set to a track, no digital output is assigned to it.

Name	Value	Referred FB from extended Cam Switch Library [2])	Internal value	Internal value, type	Default
cam-Type[0] [1]) ...	Common	MCX_CamSwitchSimple_c	0	BYTE	0
	Pulsed	MCX_CamSwitchSimple_dc			
	Timed	MCX_PulseSwitch_dc	1		
	Comfort	MCX_CamSwitchTimed_dc	2		
	Cam shift	MCX_CamSwitchComfort_dc	3		
	Binary shift	MCX_CamShift_dc	4		
	Multiturn cam	MCX_BinaryShift_dc	5		
	Time timed	MCX_CamSwitchMulti_dc	6		
	Reference	MCX_SwitchTimeTimed_dc	7		
	Multiturn timed	MCX_BinaryReference_dc	8		
		MCX_CamSwitchMulti-Timed_dc	9		

[1]) camType additionally to camToTrack identifies the type of each cam switch and enables the use of a specific function block from the Extended Cam Switch Library.

[2]) camType parameters and the Extended Camswitch Library are only available for CI511-ETHCAT and CI512-ETHCAT with device index C0 and above.

Group parameters for the digital part

Name	Value	Internal value	Internal value, type	Default
Input delay	0.01 ms	0	BYTE	0.01 ms
	1 ms	1		0x00
	8 ms	2		
	32 ms	3		
Detect short circuit at outputs	Off	0	BYTE	On
	On	1		0x01

Name	Value	Internal value	Internal value, type	Default
Behaviour DO at comm. error *)	Off Last value Last value 5 sec Last value 10 sec Substitute value Substitute value 5 sec Substitute value 10 sec	0 1 6 11 2 7 12	BYTE	Off 0x00
Substitute values DO	0 ... 65535	0000h ... FFFFh	WORD	0 0x0000
*) The parameter behaviourDOatCommunicationFault is only analyzed if the Failsafe-mode is ON.				

5.6.5.2.9 Diagnosis

In cases of short circuit or overload, the digital outputs are turned off. The modules performs reactivation automatically. Thus an acknowledgement of the errors is not necessary. The error message is stored via the LED.

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000 ... 063**	**AC500-Display**	**<− Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**		
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**ETHCAT Diagnosis block**		
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**		**Remedy**
	[1])	**[2])**	**[3])**					
Module error								
3	-	31	31	31	43	Internal error in the module		Replace I/O module
3	-	31	31	31	20	Slave-to-Slave malfunction		Check configuration
3	-	31	31	31	41	Distributed Clock malfunction		Check configuration
3	-	31	31	31	26	Parameter error		Check master
3	-	31	31	31	11	Process voltage UP too low		Check process supply voltage

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000 ... 063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**ETHCAT Diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**	**Remedy**
	[1])	[2])	[3])				
4	-	31	31	31	45	Process voltage UP3 too low	Check process voltage
4	-	31	31	31	34	No response during initialization of the I/O module	Replace I/O module
4	-	31	31	31	46	Voltage feedback on activated digital outputs [4])	Check terminals
Channel error digital							
4	-	31	2	0 ... 15	46	Voltage feedback on deactivated digital output [5])	Check terminals
4	-	31	4	0 ... 7	47	Short circuit at digital output	Check terminals
4	-	31	2	8 ... 15	47	Short circuit at digital output	Check terminals

Remarks:

[1])	In AC500 the following interface identifier applies: "-" = Diagnosis via bus-specific function blocks; 0 ... 4 or 10 = Position of the Communication Module; 14 = I/O bus; 31 = Module itself The identifier is not contained in the CI512-ETHCAT diagnosis block.
[2])	With "Device" the following allocation applies: 31 = Module itself or ADR = Hardware address (e. g. of the DC551)
[3])	With "Module" the following allocation applies dependent of the master: 31 = Module itself (Module error) or Module type (1=AI, 2=DO, 3=AO; channel error)
[4])	Diagnosis message appears for the whole output group and not per channel. The message occurs if the output channel is already active.
[5]	Diagnosis message appears per channel. The message occurs if the output channel is not active.

5.6.5.2.10 State LEDs

The LEDs are located at the front of module.

There are 2 different groups of LEDs:

- The 5 system LEDs (PWR, NET, DC, S-ERR and I/O-Bus) show the operation state of the module and display possible errors.
- The 29 process LEDs (UP, UP3, inputs, outputs, CH-ERR1 to CH-ERR3) show the process supply voltage and the states of the inputs and outputs and display possible errors.

Table 335: States of the 5 system LEDs

LED	Color	Off	On	Flashing	1x flash	2x flash
PWR/RUN	Green	Error in the internal supply voltage or process voltage missing	Internal supply voltage OK	Module is not configured	--	--
	Yellow	--	--	--	--	--
NET	Green	Init	Operational	Pre-operational	Safe-operational	--
	Red	No error	PDI Watchdog Timeout	Invalid Configuration	Unsolicited State Change	Application time out
DC *)	Green	Distributed Clock not active	Distributed Clock active	--	--	--
	Red	--	--	--	--	--
S-ERR	Red	No error	Internal error	--	--	--
I/O-Bus	Green	No communication interface modules connected or communication error	---	---	--	--
ETH1	Green	No EtherCAT connection	Link OK No data transfer	Link OK Data transfer OK	--	--
	Yellow	--	--	--	--	--
ETH2	Green	No EtherCAT connection	Link OK No data transfer	Link OK Data transfer OK	--	--
	Yellow	--	--	--	--	--
*) The state of this LED is only significant if the camswitch functionality is enabled						

Table 336: States of the 29 process LEDs

LED	Color	OFF	ON	Flashing
DC0 ... DC7	Yellow	Input/Output is OFF	Input/Output is ON	--
DI8 ... DI15	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--
DO8 ... DO15	Yellow	Output is OFF	Output is ON	--
UP	Green	Process supply voltage missing	Process supply voltage OK and initialization finished	--
UP3	Green	Process supply voltage missing	Process supply voltage OK	--
CH-ERR1 to CH-ERR3	Red	No error or process supply voltage missing	Internal error	Error on one channel of the corresponding group

5.6.5.2.11 Technical data

Technical data of the module

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

↳ *Chapter 4.3 “System data AC500-XC” on page 38*

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter	Value
Bus connection	2 x RJ45
Technology	Hilscher NETX 100
Transfer rate	10/100 Mbit/s (full-duplex)
Transfer method	According to Ethernet II, IEEE 802.3
Ethernet	100 base-TX, internal switch, 2x RJ45 socket
Expandability (S500 I/O modules)	Up to 10 S500 I/O modules (Index C0 and above), not available (Index below C0)
Indicators	5 LEDs for state indication
Adjusting elements	2 rotary switches (used for future topology extensions)
Quantity of input/output data	CI512-ETHCAT: 10 bytes input and 14 bytes output CI511-ETHCAT: 18 bytes input and 18 bytes output
Limit of data for input and output	144 byte

Parameter	Value
Acyclic services	SDO (1500 bytes max.) Emergency ECAT_SLV_DIAG
Protective functions (according to CODESYS)	Protected against: ● short circuit ● reverse supply ● overvoltage ● reverse polarity Galvanic isolation to network

Parameter		Value
Process supply voltages UP/UP3		
	Rated value	24 V DC (for inputs and outputs)
	Max. load for the terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse on UP/UP3	10 A fast
	Galvanic isolation	Ethernet interface against the rest of the module
	Inrush current from UP (at power up)	On request
	Current consumption via UP (normal operation)	0.15 A
	Current consumption via UP3	0.06 A + 0.5 A max. per output
	Connections	Terminals 1.8 and 2.8 for +24 V (UP) Terminal 3.8 for +24 V (UP3) Terminals 1.9, 2.9 and 3.9 for 0 V (ZP)
Max. power dissipation within the module		6 W
Number of digital inputs		8
Number of digital outputs		8
Number of configurable digital inputs/outputs		8
Reference potential for all digital inputs and outputs		Negative pole of the supply voltage, signal name ZP
Operation and error displays		34 LEDs (totally)
Weight (without terminal unit)		Ca. 125 g
Mounting position		Horizontal mounting or Vertical mounting with derating (output load reduced to 50 % at +40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.



Multiple overloads
With multi-channel modules, there are no effects of multiple overloads as each digital output channel is individually protected by an internal intelligent high-side switch.

Technical data of the digital inputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DI0 ... DI7		Terminals 2.0 ... 2.7
Reference potential for all inputs		Terminals 1.9 ... 3.9 (negative pole of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1 ms ... 32 ms
Input signal voltage		24 V DC
	0-Signal	-3 V ... +5 V
	undefined Signal	> +5 V ... < +15 V
	1-Signal	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical data of the digital outputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DO0 ... DO7	Terminals 3.0 ... 3.7
Reference potential for all outputs	Terminals 1.9 ... 3.9 (negative pole of the supply voltage, signal name ZP)
Common power supply voltage	For all outputs terminal 3.8 (positive pole of the supply voltage, signal name UP3)

Parameter		Value
Output voltage for signal 1		UP3 (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value per channel	500 mA at UP3 = 24 V
	Max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA
	Fuse for UP3	10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)
Output switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

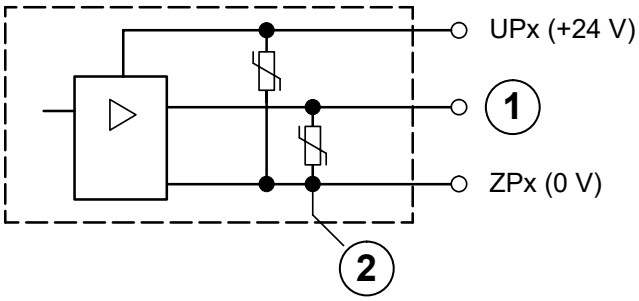


Fig. 212: Digital input/output (circuit diagram)

1 Digital output
2 Varistors for demagnetization when inductive loads are turned off

Figure:

Technical data of the configurable digital inputs/outputs

Each of the configurable I/O channels is defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter		Value
Number of channels per module		8 inputs/outputs (with transistors)
Distribution of the channels into groups		1 group for 8 channels
If the channels are used as inputs		
	Channels DC0 ... DC07	Terminals 1.0 ... 1.7
If the channels are used as outputs		
	Channels DC0 ... DC07	Terminals 1.0 ... 1.7
Indication of the input/output signals		1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Galvanic isolation		From the Ethernet network

Technical data of the digital inputs/outputs if used as inputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DC0 ... DC7		Terminals 1.0 ... 1.7
Reference potential for all inputs		Terminals 1.9 ... 3.9 (negative pole of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1 ms ... 32 ms
Input signal voltage		24 V DC
	0-Signal	-3 V ... +5 V *)
	Undefined Signal	> +5 V ... < +15 V
	1-Signal	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V *)
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

*) Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal may not exceed the clamp voltage of the varistor. The varistor limits the voltage to approx. 36 V. Following this, the input voltage must range from -12 V ... +30 V when UPx = 24 V and from -6 V ... +30 V when UPx = 30 V.

Technical data of the digital inputs/outputs if used as outputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DC0 ... DC7		Terminals 1.0 ... 1.7
Reference potential for all outputs		Terminals 1.9 ... 3.9 (negative pole of the supply voltage, signal name ZP)
Common power supply voltage		For all outputs terminal 3.8 (positive pole of the supply voltage, signal name UP3)
Output voltage for signal 1		UP3 (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value per channel	500 mA at UP3 = 24 V
	Max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA
	Fuse for UP3	10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)
Output switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

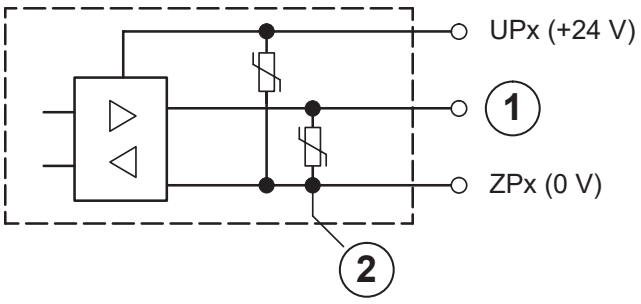
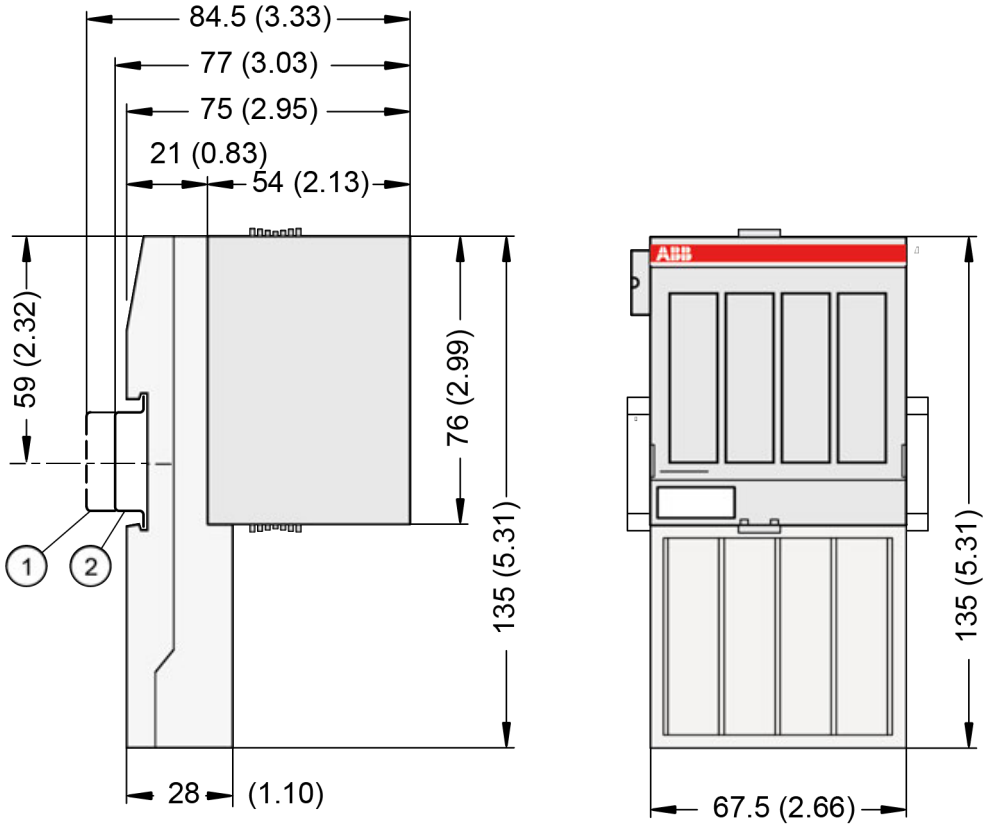


Fig. 213: Digital input/output (circuit diagram)

1 Digital input/output
2 For demagnetization when inductive loads are turned off

5.6.5.2.12 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

5.6.5.2.13 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 221 000 R0001	CI512-ETHCAT, EtherCAT communication interface module, 8 DI, 8 DO and 8 DC	Active

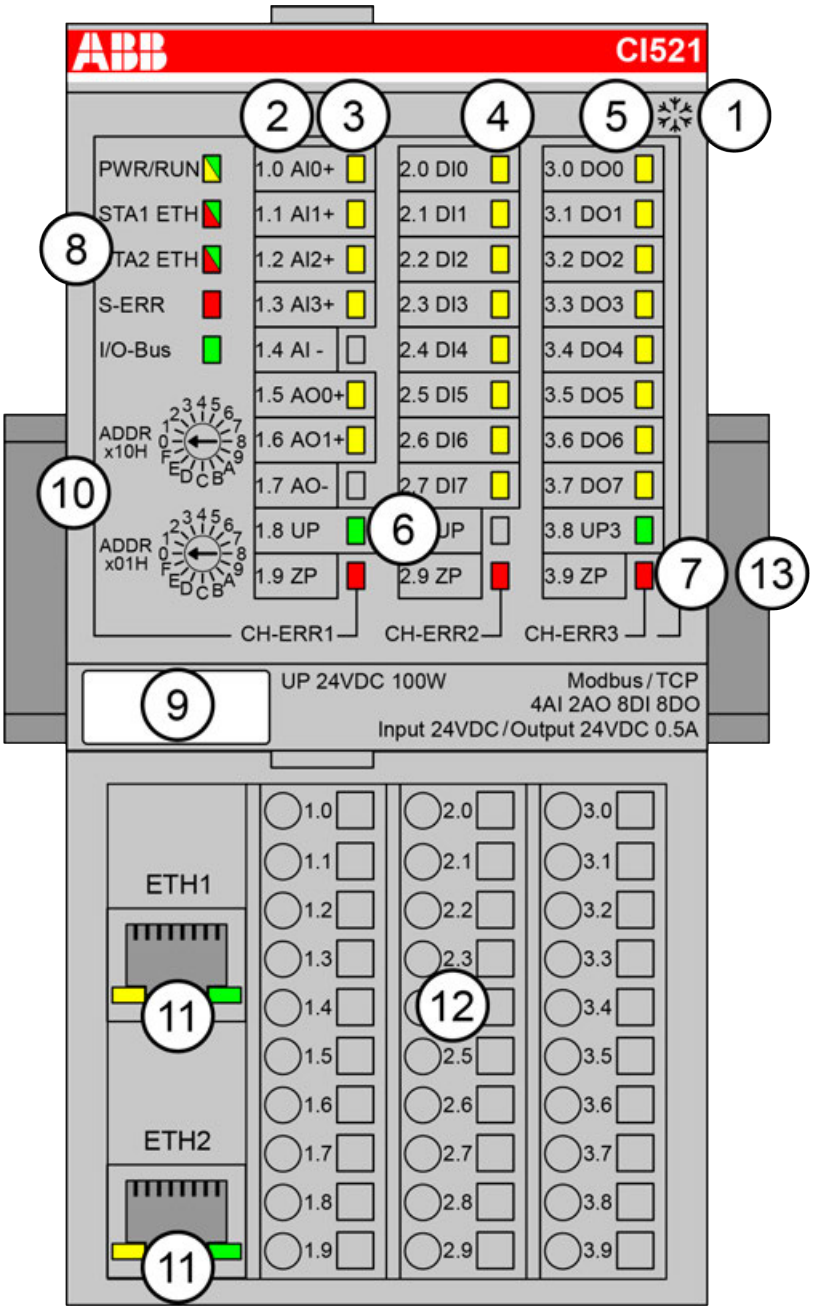
*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

5.6.6 Modbus

5.6.6.1 CI521-MODTCP

- 4 analog inputs (resolution 12 bits including sign)
- 2 analog outputs (resolution 12 bits including sign)
- 8 digital inputs 24 V DC

- 8 digital outputs 24 V DC, 0.5 A max.
- Module-wise galvanically isolated
- Fast counter
- XC version for usage in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 6 yellow LEDs to display the signal states of the analog inputs/outputs (AI0 ... AI3, AO0 ... AO1)
4 8 yellow LEDs to display the signal states of the digital inputs (DI0 ... DI7)
5 8 yellow LEDs to display the signal states of the digital outputs (DO0 ... DO7)
6 2 green LEDs to display the process supply voltage UP and UP3
7 3 red LEDs to display errors (CH-ERR1, CH-ERR2, CH-ERR3)
8 5 system LEDs: PWR/RUN, STA1 ETH, STA2 ETH, S-ERR, I/O-Bus
9 Label
10 2 rotary switches for setting the IP address
11 Ethernet interfaces (ETH1, ETH2) on the terminal unit

12 Terminal unit
13 DIN rail
❄ Sign for XC version

5.6.6.1.1 Intended purpose

The Modbus TCP communication interface module CI521-MODTCP is used as decentralized I/O module in Modbus TCP networks. The network connection is performed via 2 RJ45 connectors which are integrated in the terminal unit.

The communication interface module contains 22 I/O channels with the following properties:

- 4 analog inputs (1.0 ... 1.3)
- 2 analog outputs (1.5 ... 1.6)
- 8 digital inputs 24 V DC in 1 group (2.0 ... 2.7)
- 8 digital outputs 24 V DC in 1 group (3.0 ... 3.7)

The inputs/outputs are galvanically isolated from the Ethernet network. There is no potential separation between the channels. The configuration of the analog inputs/outputs is performed by software.

For usage in enhanced ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

5.6.6.1.2 Functionality

Parameter	Value
Interface	Ethernet
Protocol	Modbus TCP
Power supply	From the process supply voltage UP
Supply of the electronic circuitry of the I/O expansion modules attached	Through the I/O bus interface (I/O bus)
Rotary switches	for setting the last BYTE of the IP (00h to FFh)
Analog inputs	4 (configurable via software)
Analog outputs	2 (configurable via software)
Digital inputs	8 (24 V DC; delay time configurable via software)
Digital outputs	8 (24 V DC, 0.5 A max.)
LED displays	For system displays, signal states, errors and power supply
External supply voltage	Via terminals ZP, UP and UP3 (process supply voltage 24 V DC)
Required terminal unit	TU507 or TU508 ↳ *Chapter 5.7.2 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 1348*

5.6.6.1.3 Connections

The Ethernet communication interface module CI521-MODTCP is plugged on the I/O terminal unit TU507-ETH or TU508-ETH. Properly seat the module and press until it locks in place. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting.

↳ *Chapter 5.7.2 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 1348*

↳ *Chapter 5.8.2.6 “TA526 - Wall mounting accessory” on page 1410*

The connection of the I/O channels is carried out using the 30 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.



For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The terminals 1.8 and 2.8 as well as 1.9, 2.9 and 3.9 are electrically interconnected within the terminal unit and have always the same assignment, independent of the inserted module:

Terminals 1.8 and 2.8: Process supply voltage UP = +24 V DC

Terminal 3.8: Process supply voltage UP3 = +24 V DC

Terminals 1.9, 2.9 and 3.9: Process supply voltage ZP = 0 V



With a separate UP3 power supply, the digital outputs can be switched off externally. This way, an emergency-off functionality can be realized.



Conditions for undisturbed operating with older I/O expansion modules

All I/O expansion modules that are attached to the CI52x-MODTCP must be powered up together with the CI52x-MODTCP if the firmware version of these I/O expansion modules is V1.9 or lower.

The firmware version is related to the index. The index is printed on the module type label on the right side.

Modules as of index listed in the following table can be powered up independently.

S500 I/O module type	First index with firmware version above 1.9
AI523	D0
AI523-XC	D0
AI531	A3
AI531-XC	A0
AO523	D0
AO523-XC	D0
AX521	D0
AX521-XC	D0
AX522	D0
AX522-XC	D0
CD522	A2
CD522-XC	A0
DA501	A2
DA501-XC	A0
DA502	A1

S500 I/O module type	First index with firmware version above 1.9
DA502-XC	A1
DC522	D0
DC522-XC	D0
DC523	D0
DC523-XC	D0
DC532	D0
DC532-XC	D0
DI524	D0
DI524-XC	D0
DO524	A2
DO524-XC	A2
DX522	D0
DX522-XC	D0
DX531	D0
AC522	D0
PD501	D0

Do not connect any voltages externally to digital outputs!

Reason: Externally voltages at an output or several outputs may cause that other outputs are supplied through that voltage instead of voltage UP3 (reverse voltage). This ist not intended usage.

CAUTION!

Risk of malfunction by unintended usage!

If the function cut-off of the digital outputs is to be used by deactivation of the supply voltage UP3, be sure that no external voltage is connected at the outputs.

Table 337: Assignment of the other terminals

Terminal	Signal	Description
1.0	AI0+	Positive pole of analog input signal 0
1.1	AI1+	Positive pole of analog input signal 1
1.2	AI2+	Positive pole of analog input signal 2
1.3	AI3+	Positive pole of analog input signal 3
1.4	AI-	Negative pole of analog input signals 0 to 3
1.5	AO0+	Positive pole of analog output signal 0
1.6	AO1+	Positive pole of analog output signal 1
1.7	AI-	Negative pole of analog output signals 0 and 1
1.8	UP	Process voltage UP (24 V DC)
1.9	ZP	Process voltage ZP (0 V DC)
2.0	DI0	Signal of the digital input DI0

Terminal	Signal	Description
2.1	DI1	Signal of the digital input DI1
2.2	DI2	Signal of the digital input DI2
2.3	DI3	Signal of the digital input DI3
2.4	DI4	Signal of the digital input DI4
2.5	DI5	Signal of the digital input DI5
2.6	DI6	Signal of the digital input DI6
2.7	DI7	Signal of the digital input DI7
2.8	UP	Process voltage UP (24 V DC)
2.9	ZP	Process voltage ZP (0 V DC)
3.0	DO0	Signal of the digital output DO0
3.1	DO1	Signal of the digital output DO1
3.2	DO2	Signal of the digital output DO2
3.3	DO3	Signal of the digital output DO3
3.4	DO4	Signal of the digital output DO4
3.5	DO5	Signal of the digital output DO5
3.6	DO6	Signal of the digital output DO6
3.7	DO7	Signal of the digital output DO7
3.8	UP3	Process voltage UP3 (24 V DC)
3.9	ZP	Process voltage ZP (0 V DC)



WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing the following:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.



NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

For the open-circuit detection (wire break), each analog input channel is pulled up to "plus" by a high-resistance resistor. If nothing is connected, the maximum voltage will be read in then.

Generally, analog signals must be laid in shielded cables. The cable shields must be grounded at both sides of the cables. To avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

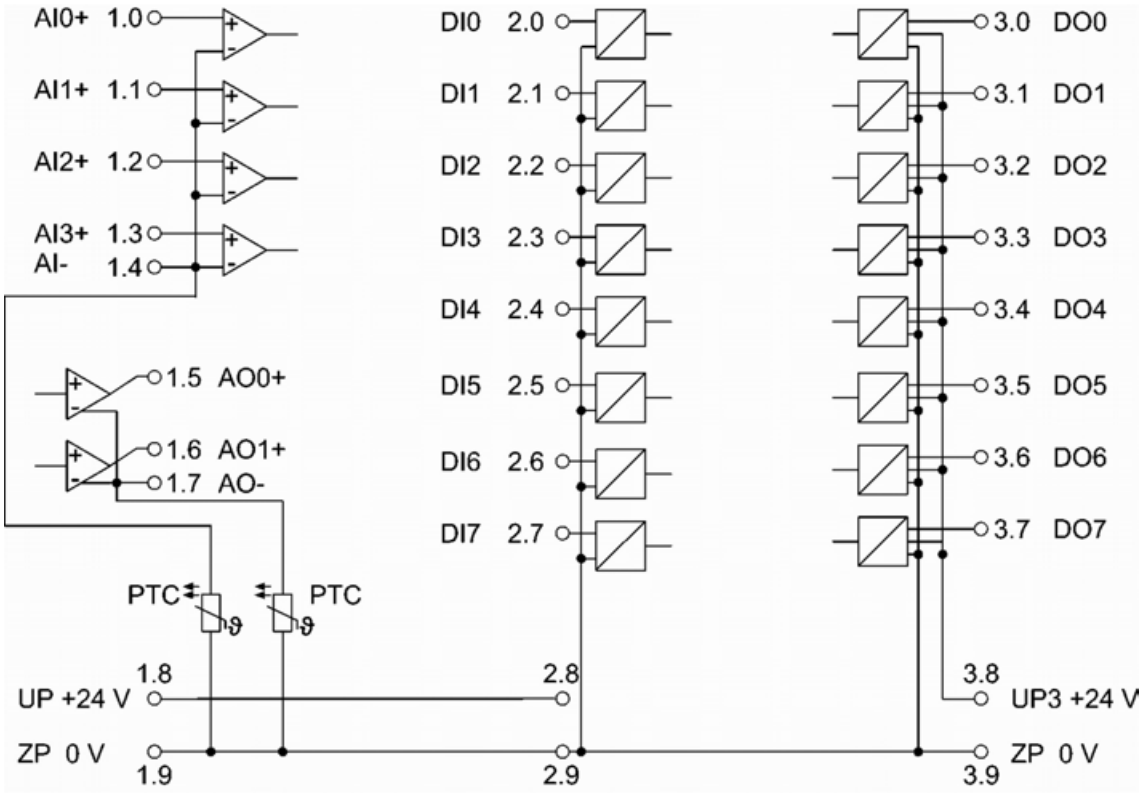


Fig. 214: Connection of the communication interface module CI521-MODTCP

Connection of the digital inputs

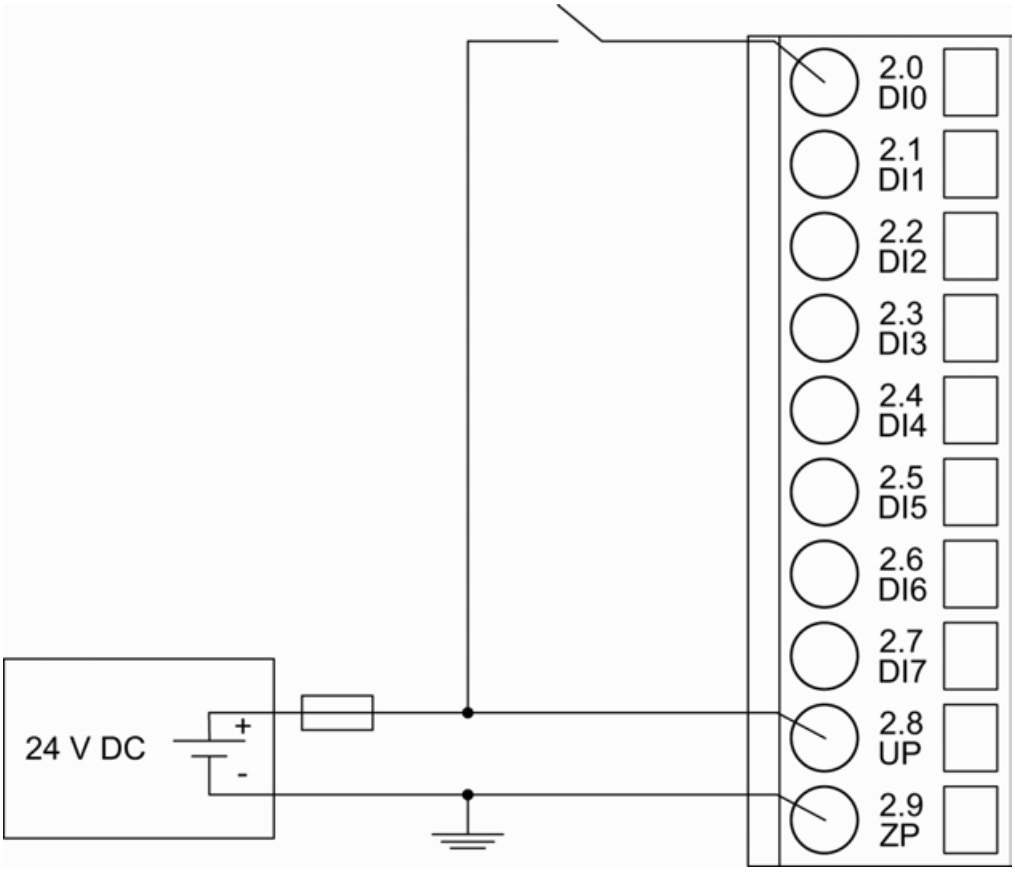


Fig. 215: Connection of the digital inputs (DO0 ... DO7) to the module CI521-MODTCP

↳ Meaning of the LEDs

Connection of the digital outputs

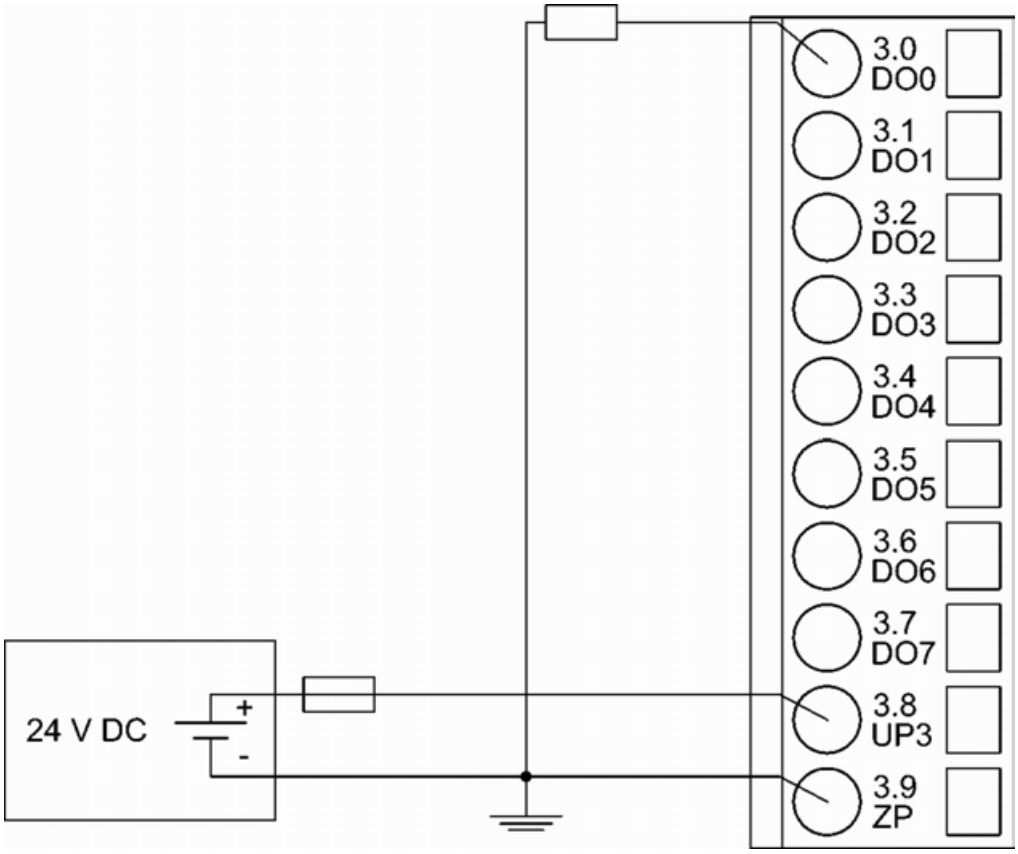


Fig. 216: Connection of configurable digital inputs/outputs (DO0 ... DO7) to the module CI521-MODTCP

↳ *Meaning of the LEDs*

Connection of resistance thermometers in 2-wire configuration to the analog inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module CI521-MODTCP provides a constant current source which is multiplexed over the max. 4 analog input channels.

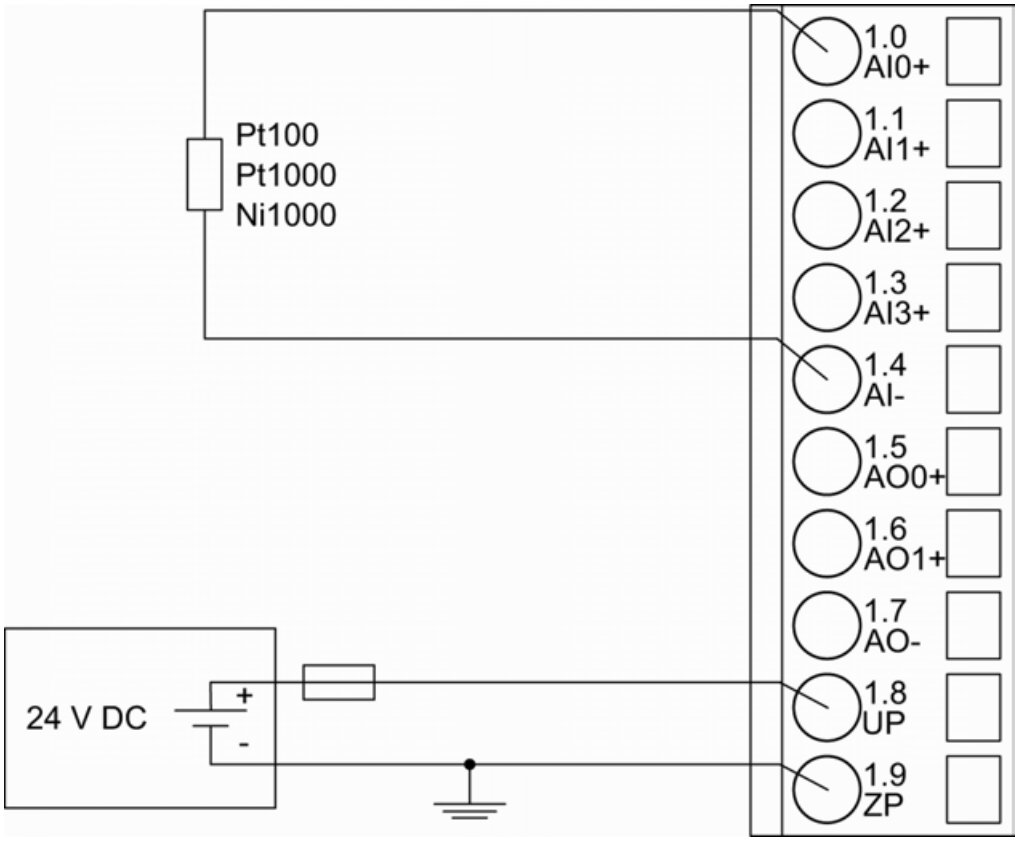


Fig. 217: Connection of resistance thermometers in 2-wire configuration to the analog inputs (AI0 ... AI3)

Table 338: Configurable measuring ranges

Pt100	-50 °C ... +70 °C	2-wire configuration, 1 channel used
Pt100	-50 °C ... +400 °C	2-wire configuration, 1 channel used
Pt1000	-50 °C ... +400 °C	2-wire configuration, 1 channel used
Ni1000	-50 °C ... +150 °C	2-wire configuration, 1 channel used

↳ *Chapter 5.6.6.1.7 “Parameterization” on page 1147*

↳ *Chapter 5.6.6.1.10 “Measuring ranges” on page 1159*

↳ *Meaning of the LEDs*

The module CI521-MODTCP performs a linearization of the resistance characteristic.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of resistance thermometers in 3-wire configuration to the analog inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module CI521-MODTCP provides a constant current source which is multiplexed over the max. 4 analog input channels.

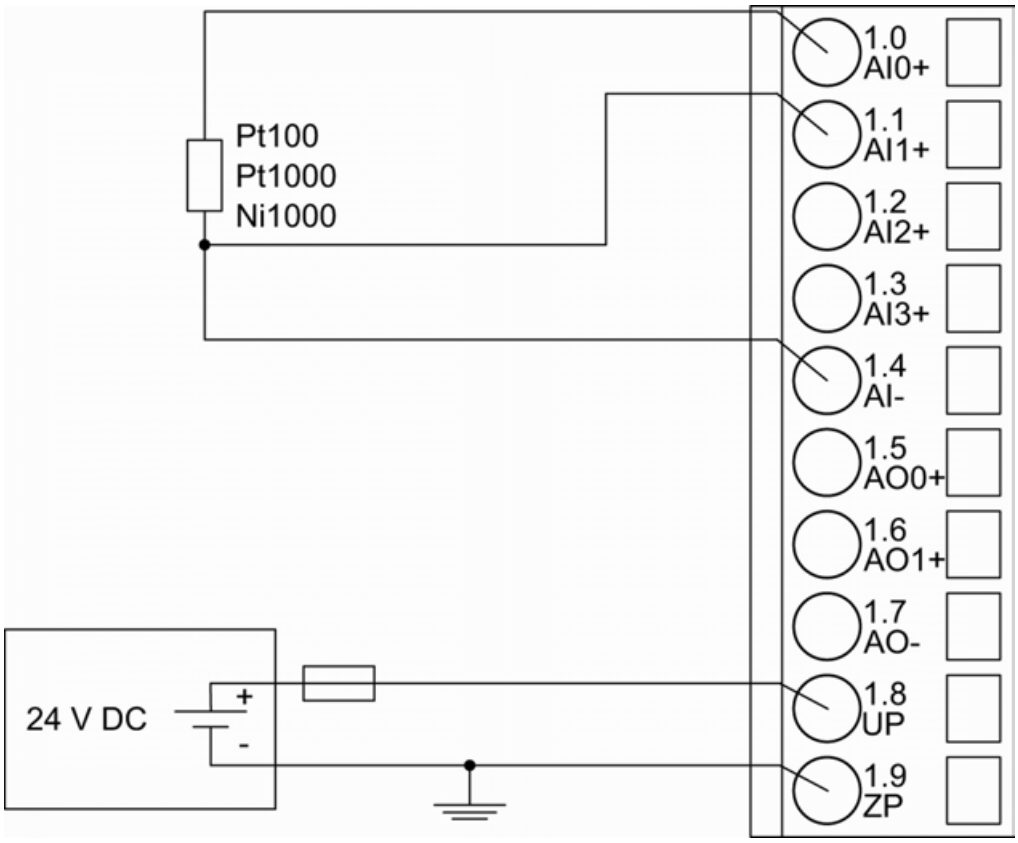


Fig. 218: Connection of resistance thermometers in 3-wire configuration to the analog inputs (AI0 ... AI3)

With 3-wire configuration, 2 adjacent analog channels belong together (e. g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1).

The constant current of one channel flows through the resistance thermometer. The constant current of the other channel flows through one of the cores. The module calculates the measured value from the two voltage drops and stores it under the input with the higher channel number (e. g. I1).

In order to keep measuring errors as small as possible, it is necessary to have all the involved conductors in the same cable. All the conductors must have the same cross section.

Table 339: Configurable measuring ranges

Pt100	-50 °C ... +70 °C	3-wire configuration, 2 channels used
Pt100	-50 °C ... +400 °C	3-wire configuration, 2 channels used
Pt1000	-50 °C ... +400 °C	3-wire configuration, 2 channels used
Ni1000	-50 °C ... +150 °C	3-wire configuration, 2 channels used

↳ *Chapter 5.6.6.1.7 “Parameterization” on page 1147*

↳ *Chapter 5.6.6.1.10 “Measuring ranges” on page 1159*

↳ *Meaning of the LEDs*

The module CI521-MODTCP performs a linearization of the resistance characteristic.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of active-type analog sensors (voltage) with galvanically isolated power supply to the analog inputs

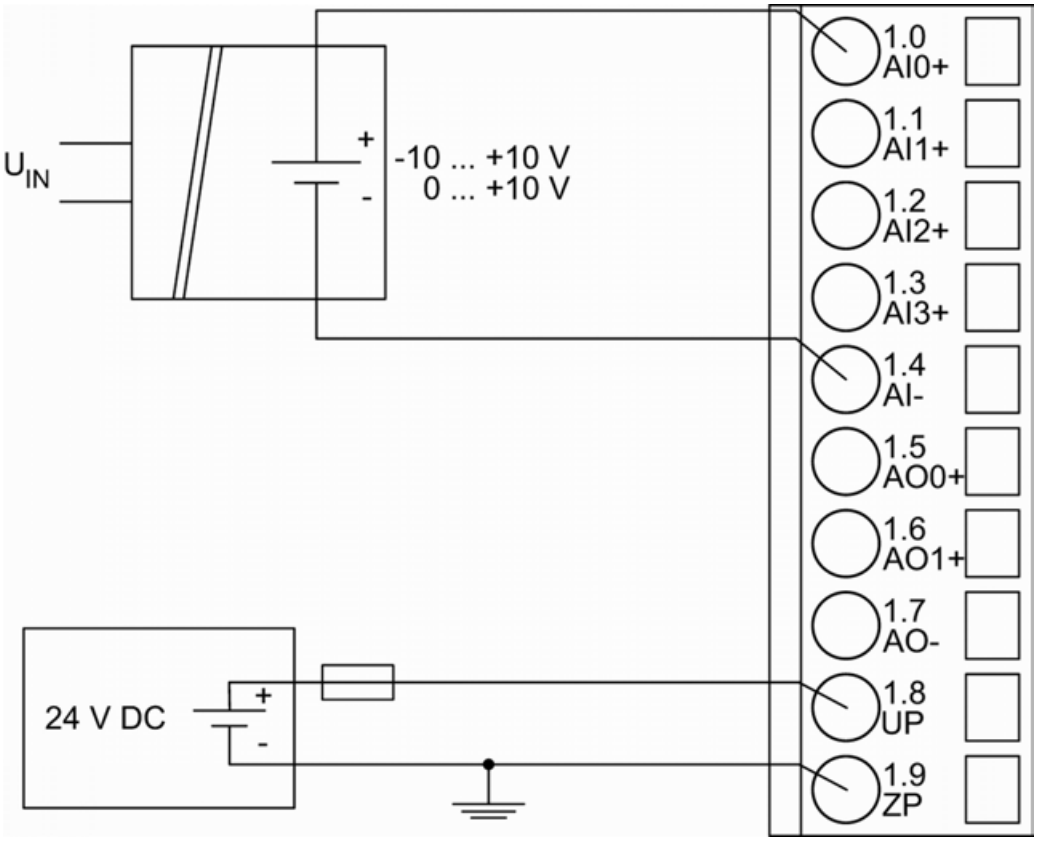


Fig. 219: Connection of active-type analog sensors (voltage) with galvanically isolated power supply to the analog inputs (AI0 ... AI3)

Table 340: Configurable measuring ranges

Voltage	0 ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

↳ *Chapter 5.6.6.1.7 “Parameterization” on page 1147*

↳ *Chapter 5.6.6.1.10 “Measuring ranges” on page 1159*

↳ *Meaning of the LEDs*

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of active-type analog sensors (Current) with galvanically isolated power supply to the analog inputs

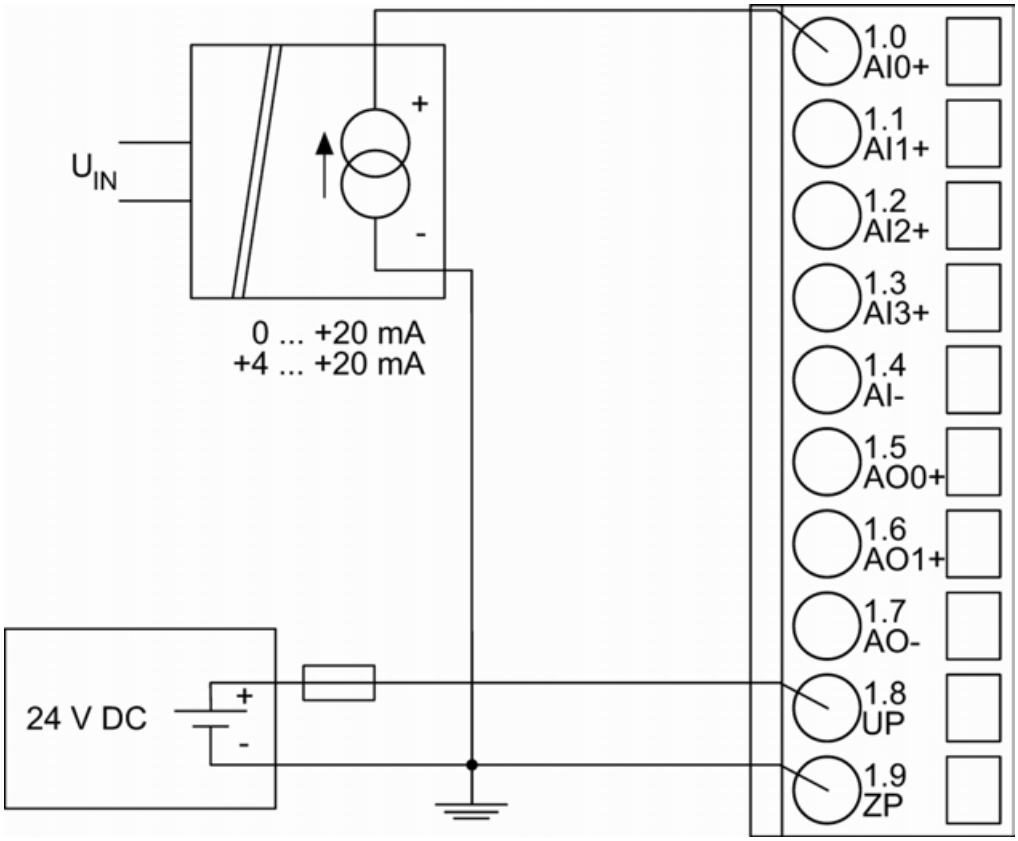


Fig. 220: Connection of active-type analog sensors (current) with galvanically isolated power supply to the analog inputs (AI0 ... AI3)

Table 341: Configurable measuring ranges

Current	0 mA ... 20 mA	1 channel used
Current	4 mA ...20 mA	1 channel used

Chapter 5.6.6.1.7 “Parameterization” on page 1147

Chapter 5.6.6.1.10 “Measuring ranges” on page 1159

Meaning of the LEDs

Unused input channels can be left open-circuited, because they are of low resistance.

To avoid error messages through unused analog input channels in measuring range 4 mA ... 20 mA, these channels should be configured as "Not used".

Connection of active-type analog sensors (Voltage) with no galvanically isolated power supply to the analog inputs

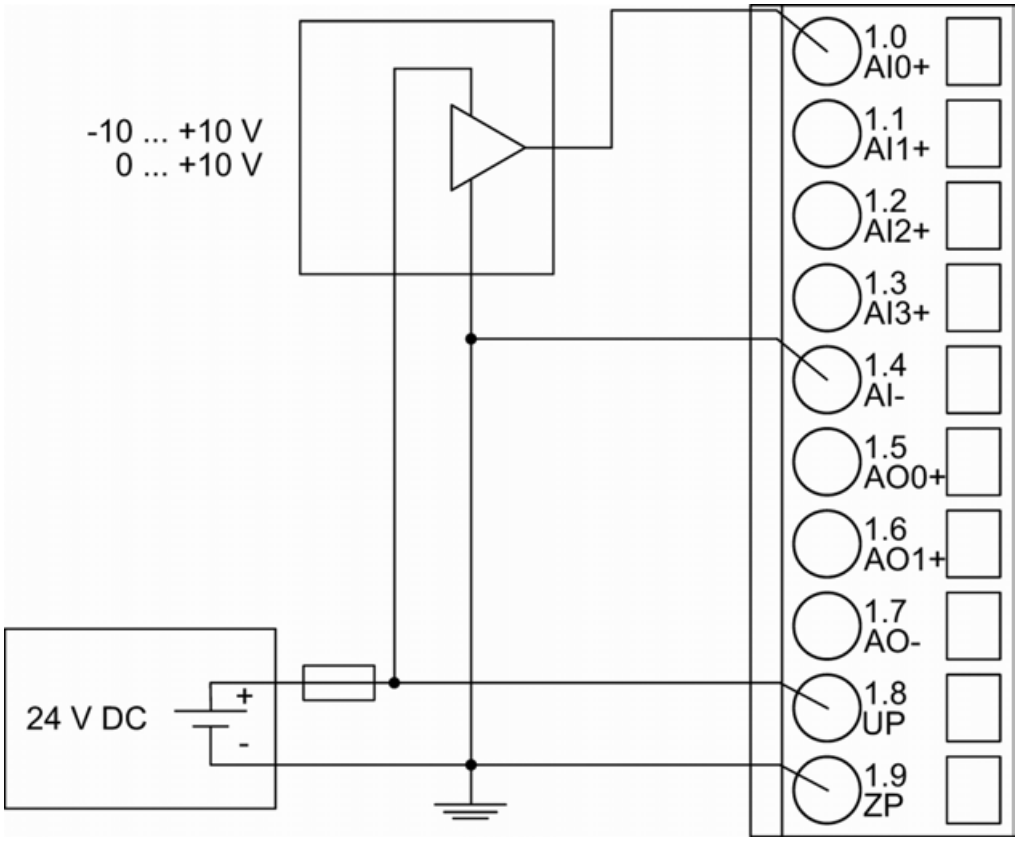


Fig. 221: Connection of active-type sensors (voltage) with no galvanically isolated power supply to the analog inputs (AI0 ... AI3)

CAUTION!
Risk of faulty measurements!
The negative pole at the sensors must not have too big a potential difference with respect to ZP (max. ± 1 V).

Make sure that the potential difference never exceeds ± 1 V (also not with long cable lengths).

Table 342: Configurable measuring ranges

Voltage	0 ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

↳ *Chapter 5.6.6.1.7 “Parameterization” on page 1147*

↳ *Chapter 5.6.6.1.10 “Measuring ranges” on page 1159*

↳ *Meaning of the LEDs*

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of passive-type analog sensors (Current) to the analog inputs

The following figure shows the connection of passive-type analog sensors (current) to the analog input AI0. Proceed with the analog inputs AI1 ... AI3 in the same way.

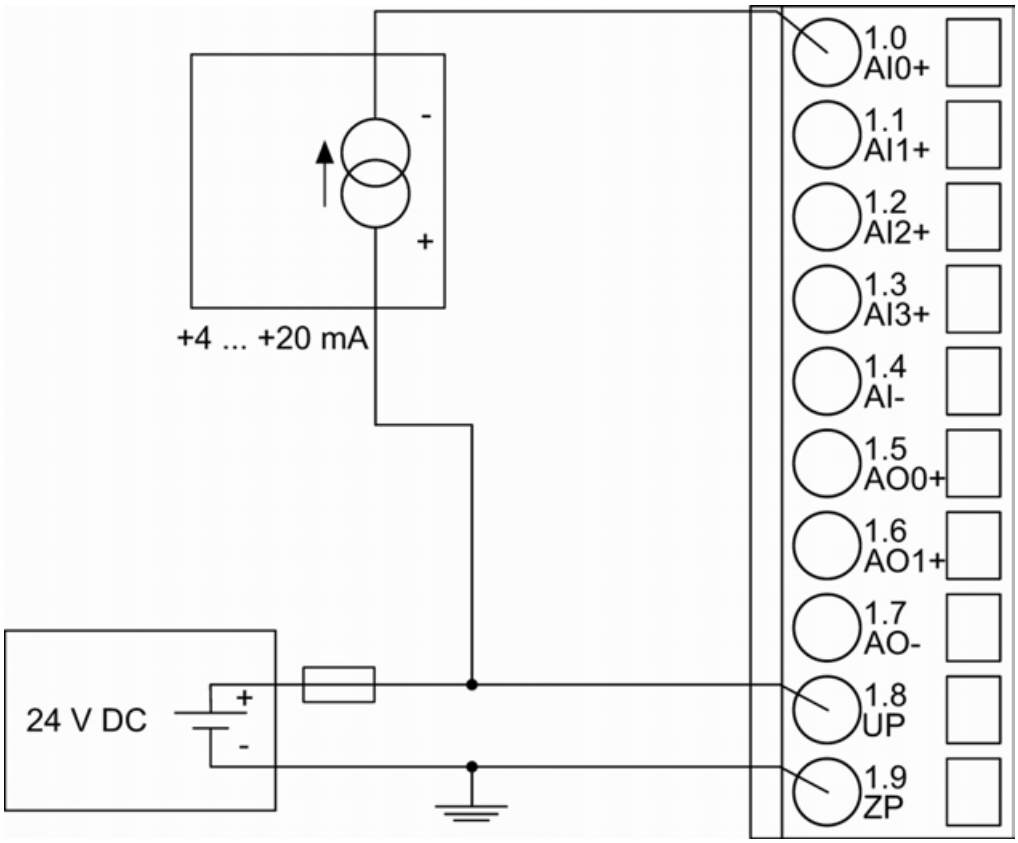


Fig. 222: Connection of passive-type analog sensors (current) to the analog inputs (AI0 ... AI3)

Table 343: Configurable measuring ranges

Current	4 mA ... 20 mA	1 channel used

↳ *Chapter 5.6.6.1.7 “Parameterization” on page 1147*

↳ *Chapter 5.6.6.1.10 “Measuring ranges” on page 1159*

↳ *Meaning of the LEDs*

CAUTION!

Risk of overloading the analog input!

If an analog current sensor supplies more than 25 mA for more than 1 second during initialization, this input is switched off by the module (input protection).

Use only sensors with fast initialization or without current peaks higher than 25 mA. If not possible, connect a 10-volt Zener diode in parallel to AIx+ and ZP.

Unused input channels can be left open-circuited, because they are of low resistance.

To avoid error messages through unused analog input channels in measuring range 4 mA ... 20 mA, these channels should be configured as "Not used".

Connection of active-type analog sensors (Voltage) to differential analog inputs

Differential inputs are very useful, if analog sensors are used which are remotely non-isolated (e.g. the minus terminal is remotely grounded).

The evaluation using differential inputs helps to considerably increase the measuring accuracy and to avoid ground loops.

With differential input configurations, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

The analog value is calculated by subtraction of the input value with the higher address from the input value of the lower address.

The converted analog value is available at the odd channel (higher address).

CAUTION!

Risk of faulty measurements!

The negative pole at the sensors must not have too big a potential difference with respect to ZP (max. ± 1 V).

Make sure that the potential difference never exceeds ± 1 V.

The following figure shows the connection of active-type analog sensors (voltage) to differential analog inputs AI0 and AI1. Proceed with AI2 and AI3 in the same way.

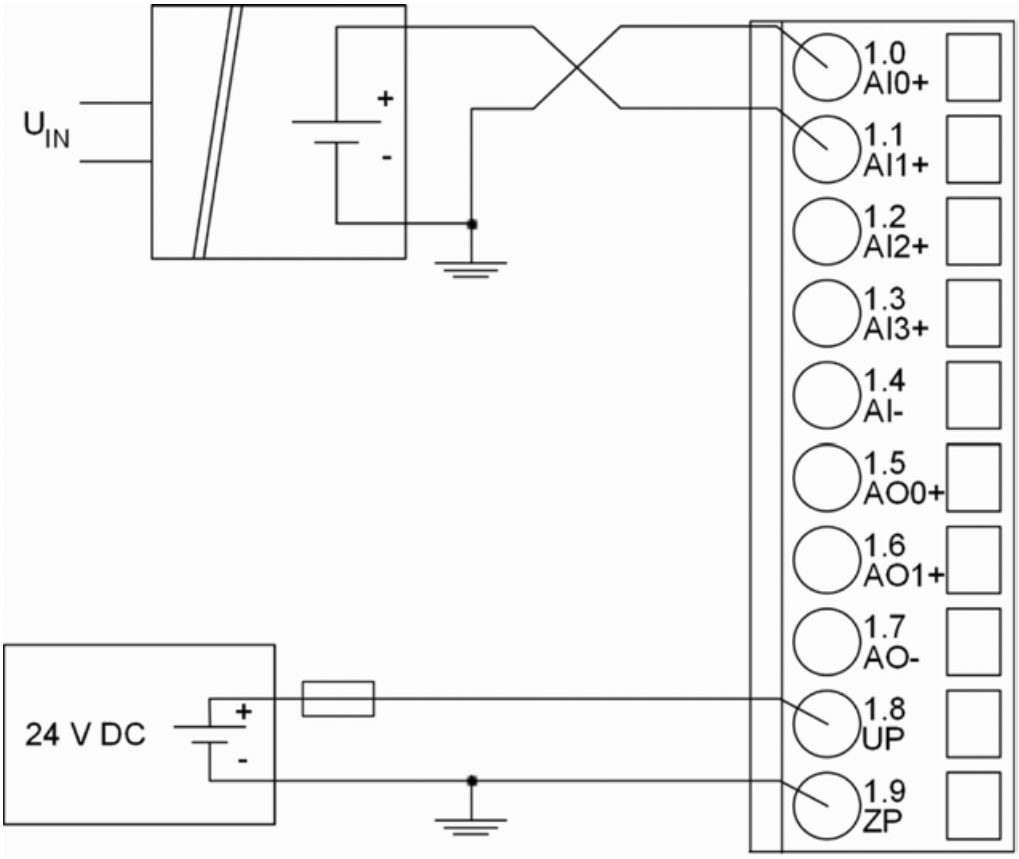


Fig. 223: Connection of active-type analog sensors (voltage) to differential analog inputs (AI0 ... AI3)

Table 344: Configurable measuring ranges

Voltage	0 V ... 10 V	With differential inputs, 2 channels used
Voltage	-10 V ... +10 V	With differential inputs, 2 channels used

↳ *Chapter 5.6.6.1.7 “Parameterization” on page 1147*

↳ *Chapter 5.6.6.1.10 “Measuring ranges” on page 1159*

Meaning of the LEDs

To avoid error messages from unused analog input channels, configure them as "unused".

Use of analog inputs as digital inputs

Several (or all) analog inputs can be configured as digital inputs. The inputs are not galvanically isolated against the other analog channels.

Chapter 5.6.6.1.11.5 “Technical data of the analog inputs if used as digital inputs” on page 1165

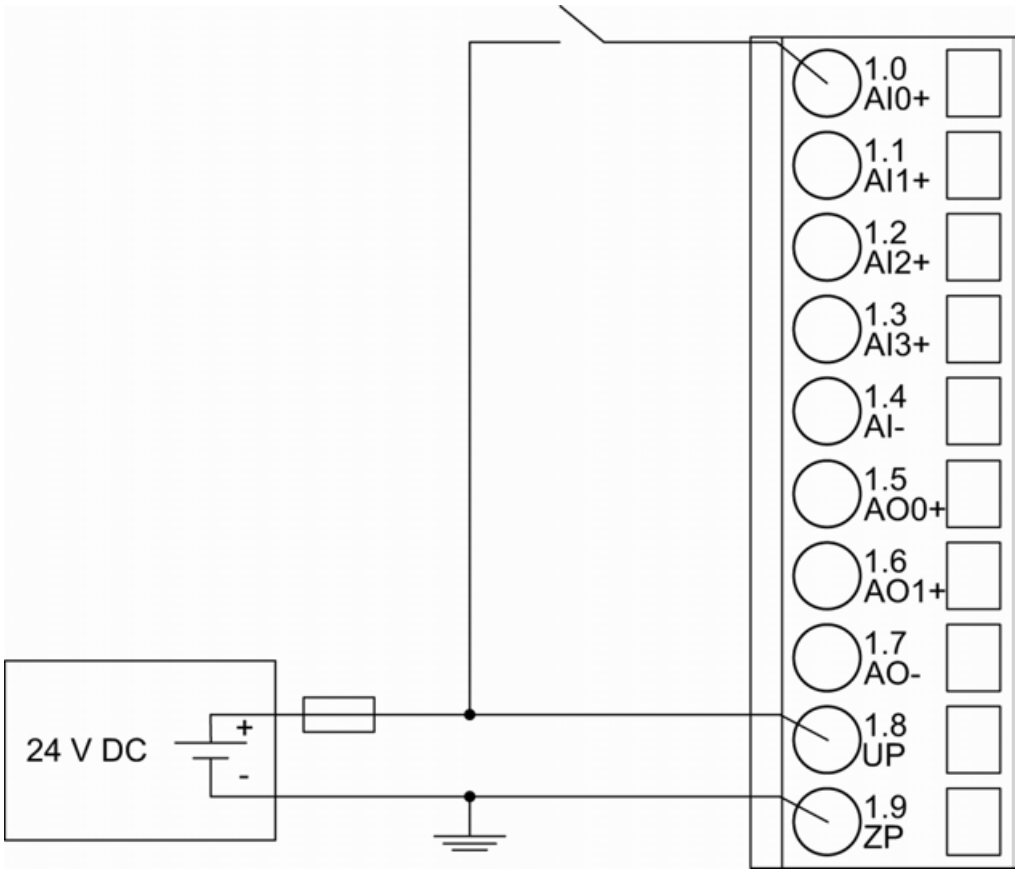


Fig. 224: Connection of digital sensors to the analog inputs (AI0 ... AI3)

Table 345: Configurable measuring ranges

Digital input	24 V	1 channel used

Chapter 5.6.6.1.7 “Parameterization” on page 1147

Chapter 5.6.6.1.10 “Measuring ranges” on page 1159

Meaning of the LEDs

Connection of analog output loads (Voltage)

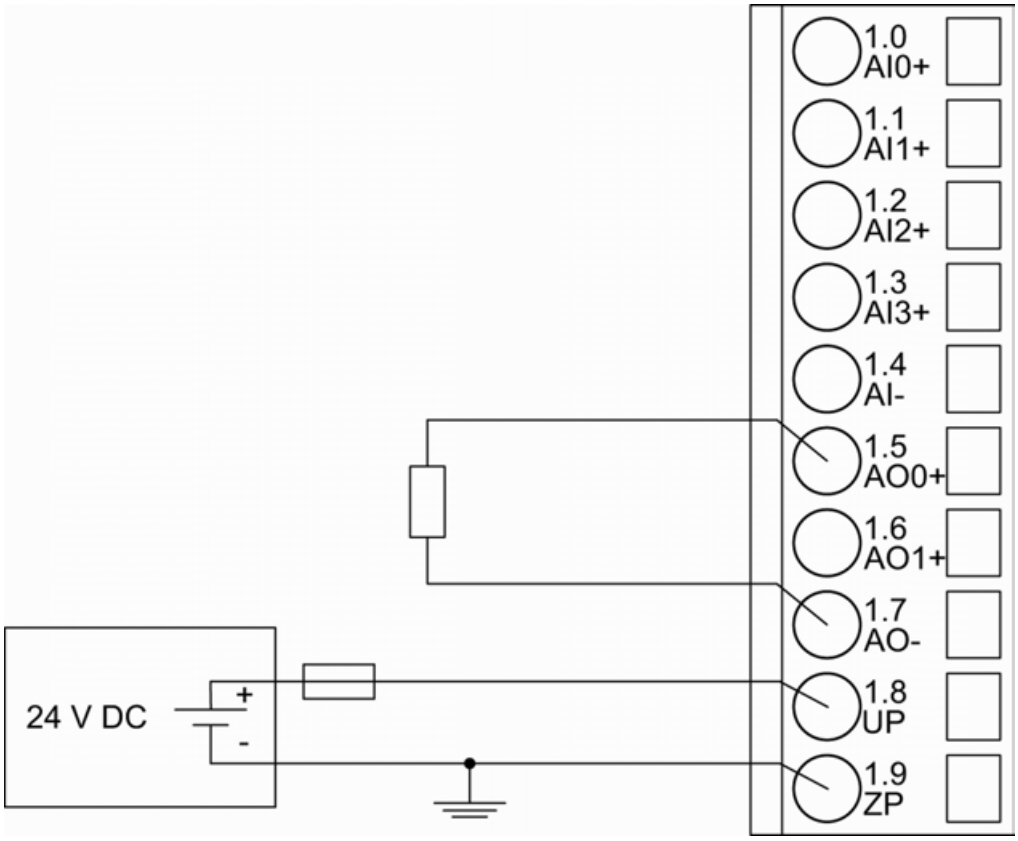


Fig. 225: Connection of analog output loads (voltage) to the analog outputs (AO0 ... AO1)

Table 346: Configurable measuring ranges

Voltage	-10 V ... +10 V	Load ± 10 mA max.	1 channel used

↳ *Chapter 5.6.6.1.7 “Parameterization” on page 1147*

↳ *Chapter 5.6.6.1.10 “Measuring ranges” on page 1159*

↳ *Meaning of the LEDs*

Unused analog outputs can be left open-circuited.

Connection of analog output loads (Current)

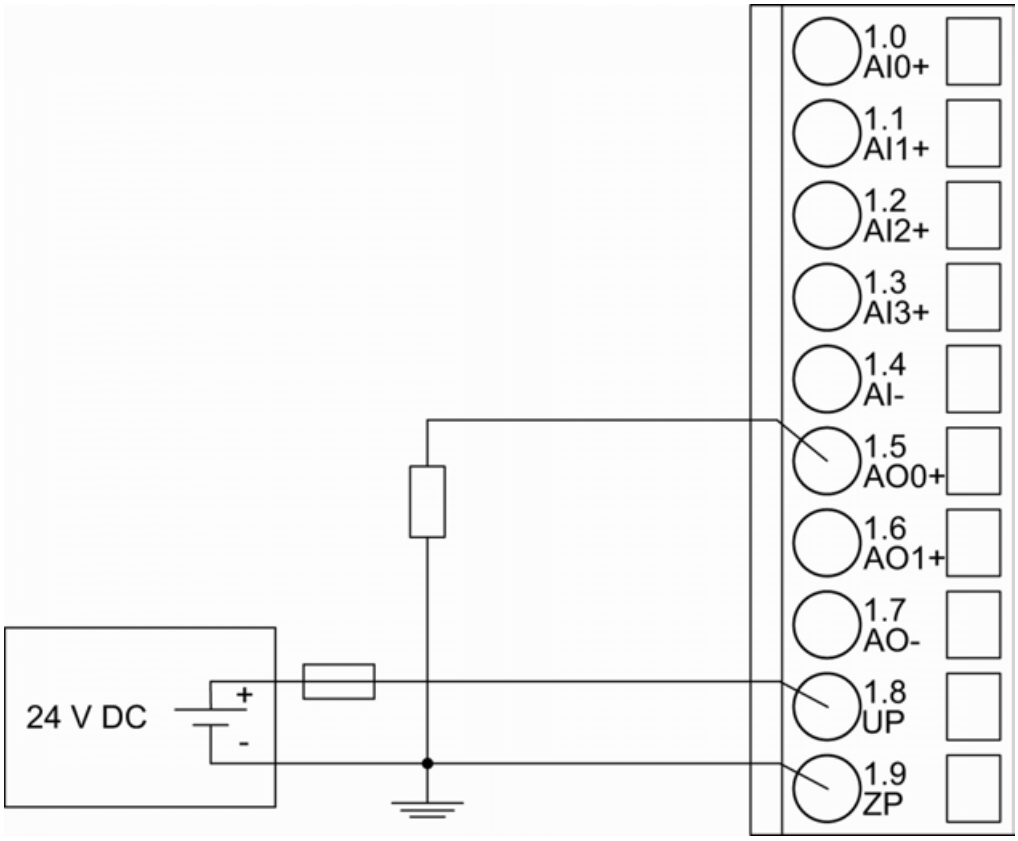


Fig. 226: Connection of analog output loads (current) to the analog outputs (AO0 and AO1)

Table 347: Configurable measuring ranges

Current	0 mA ... 20 mA	Load 0 ... 500 Ω	1 channel used
Current	4 ... 20 mA	Load 0 ... 500 Ω	1 channel used

↳ *Chapter 5.6.6.1.7 “Parameterization” on page 1147*

↳ *Chapter 5.6.6.1.10 “Measuring ranges” on page 1159*

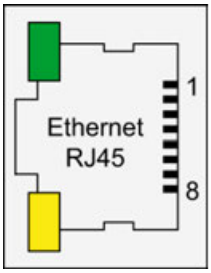
↳ *Meaning of the LEDs*

Unused analog outputs can be left open-circuited.

Assignment of the Ethernet ports

The terminal unit for the communication interface module provides two Ethernet interfaces with the following pin assignment:

Pin assignment

Interface	Pin	Signal	Description
	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NC	Not connected
	5	NC	Not connected
	6	RxD-	Receive data -

Interface	Pin	Signal	Description
	7	NC	Not connected
	8	NC	Not connected
	Shield	Cable shield	Functional earth

In corrosive environment, please protect unused connectors using the TA535 accessory.

Not supplied with this device.

5.6.6.1.4 Internal data exchange

Parameter	Value
Digital inputs (bytes)	3
Digital outputs (bytes)	3
Analog inputs (words)	4
Analog outputs (words)	2
Counter input data (words)	4
Counter output data (words)	8

Replacement of a Modbus TCP communication interface module:

The module must be powered off before it is replaced. If the configuration data is stored in the module, then the configuration data must be downloaded into the new module, either by using Modbus communication or by using the Modbus configurator which is contained in the Automation Builder distribution.

5.6.6.1.5 Addressing

The module reads the position of the rotary switches only during power-up, i.e. changes of the switch position during operation will have no effect until the next module initialization.

The IP address of the CI521-MODTCP Module can be set with the "ABB IP Configuration Tool".

If the last byte of the IP is set to 0, the address switch will be used instead.

Address switch position 255 is mapped to fixed IP 192.168.0.254 independent of other stored settings. This is a backup so the module can always get a valid IP address and can be configured by the “ABB IP Configuration Tool”.

Address switch position 0 is mapped to last byte equal 1 and DHCP enabled.

The factory setting for the IP is 192.168.0.x (last byte is address switch).

5.6.6.1.6 I/O configuration

The CI521-MODTCP stores configuration parameters (IP address configuration, module parameters).

The analog/digital I/O channels are configured via software.

Details about configuration

5.6.6.1.7 Parameterization

Parameters of the module

Name	Value	Internal value	Internal value, type	Default
Module ID [1])	Internal	7400	WORD	7000
Ignore Module	Internal	0	BYTE	0
Parameter length	Internal	63	BYTE	63
Error LED / Failsafe function see table Error LED / Failsafe function *Table 348 “Error LED / Failsafe function” on page 1148*	On	0	BYTE	0
	Off by E4	1		
	Off by E3	3		
	On + failsafe	16		
	Off by E4 + failsafe	17		
	Off by E3 + failsafe	19		
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0

Name	Value	Internal value	Internal value, type	Default
Timeout for Bus supervision	No supervision 10 ms timeout 20 ms timeout	0 1 2	BYTE	No supervision
IO Mapping Structure [3])	Fixed Mapping Dynamic Mapping	0 1	BYTE	0
Reserved	Internal	0	ARRAY[0..2] OF BYTE	0,0,0
Check supply	off on	0 1	BYTE	1
Fast counter	0 : 10 [3])	0 : 10	BYTE	0

[1]) With a faulty ID, the Modules reports a "parameter error" and does not perform cyclic process data transmission.

[2]) Counter operating modes

[3]) Fixed Mapping means each module has its own Modbus registers for data transfer independent of the IO bus constellation

Dynamic mapping means the structure of the IO Date is dependent on the I/O bus constellation. Each I/O bus expansion module starts directly after the module before on the next Word address.

[4]) If none of the parameters is set all masters / clients in the network have read and write rights on the CI52x-MODTCP device and its connected expansion modules.

If at least one parameter is set only the configured masters / clients have write rights on the CI52x-MODTCP device, all other masters / clients still have read access to the CI52x-MODTCP device.

Table 348: Error LED / Failsafe function

Setting	Description
On	Error LED (S-ERR) lights up at errors of all error classes, Failsafe-mode off
Off by E4	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, Failsafe-mode off
Off by E3	Error LED (S-ERR) lights up at errors of error classes E1 and E2, Failsafe-mode off
On +Failsafe	Error LED (S-ERR) lights up at errors of all error classes, Failsafe-mode on *)
Off by E4 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, Failsafe-mode on *)
Off by E3 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1 and E2, Failsafe-mode on *)

*) The parameters Behaviour AO at comm. error and Behaviour DO at comm. error are only analyzed if the Failsafe-mode is ON.

Group parameters for the analog part

Name	Value	Internal value	Internal value, type	Default
Analog data format	Standard Reserved	0 255	BYTE	0
Behaviour AO at comm. error *)	Off Last value Last value 5 s Last value 10 s Substitute value Substitute value 5 s Substitute value 10 s	0 1 6 11 2 7 12	BYTE	0
*) The parameter Behaviour AO at comm. error is only analyzed if the Failsafe-mode is ON.				

Channel parameters for the analog inputs (4x)

Name	Value	Internal value	Internal value, type	Default
Input 0, Channel configuration	*Table 349 “Channel configuration” on page 1149*	*Table 349 “Channel configuration” on page 1149*	BYTE	0
Input 0, Check channel	*Table 350 “Channel monitoring” on page 1150*	*Table 350 “Channel monitoring” on page 1150*	BYTE	0
:	:	:	:	:
:	:	:	:	:
Input 3, Channel configuration	*Table 349 “Channel configuration” on page 1149*	*Table 349 “Channel configuration” on page 1149*	BYTE	0
Input 3, Check channel	*Table 350 “Channel monitoring” on page 1150*	*Table 350 “Channel monitoring” on page 1150*	BYTE	0

Table 349: Channel configuration

Internal value	Operating modes of the analog inputs, individually configurable
0 (default)	Not used
1	0 ... 10 V
2	Digital input
3	0 ... 20 mA
4	4 ... 20 mA
5	-10 V ... +10 V
8	2-wire Pt100 -50 ... +400 °C

Internal value	Operating modes of the analog inputs, individually configurable
9	3-wire Pt100 -50 ... +400 °C *)
10	0 ... 10 V (voltage diff.) *)
11	-10 V ... +10 V (voltage diff.) *)
14	2-wire Pt100 -50 ... +70 °C
15	3-wire Pt100 -50 ... +70 °C *)
16	2-wire Pt1000 -50 ... +400 °C
17	3-wire Pt1000 -50 ... +400 °C *)
18	2-wire Ni1000 -50 ... +150 °C
19	3-wire Ni1000 -50 ... +150 °C *)
*) In the operating modes with 3-wire configuration or with differential inputs, two adjacent analog inputs belong together (e.g. the channels 0 and 1). In these cases, both channels are configured in the desired operating mode. The lower address must be the even address (channel 0). The next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).	

Table 350: Channel monitoring

Internal Value	Check Channel
0 (default)	Plausibility, wire break, short circuit
3	Not used

Channel parameters for the analog outputs (2x)

Name	Value	Internal value	Internal value, type	Default
Output 0, Channel configuration	*Table 351 “Channel configuration” on page 1151*	*Table 351 “Channel configuration” on page 1151*	BYTE	0
Output 0, Check channel	*Table 352 “Channel monitoring” on page 1151*	*Table 352 “Channel monitoring” on page 1151*	BYTE	0
Output 0, Substitute value	*Table 353 “Substitute value” on page 1151*	*Table 353 “Substitute value” on page 1151*	WORD	0
Output 1, Channel configuration	*Table 351 “Channel configuration” on page 1151*	*Table 351 “Channel configuration” on page 1151*	BYTE	0
Output 1, Check channel	*Table 352 “Channel monitoring” on page 1151*	*Table 352 “Channel monitoring” on page 1151*	BYTE	0
Output 1, Substitute value	*Table 353 “Substitute value” on page 1151*	*Table 353 “Substitute value” on page 1151*	WORD	0

Table 351: Channel configuration

Internal value	Operating modes of the analog outputs, individually configurable
0 (default)	Not used
128	-10 V ... +10 V
129	0 ... 20 mA
130	4 ... 20 mA

Table 352: Channel monitoring

Internal value	Check channel
0	Plausibility, wire break, short circuit
3	None

Table 353: Substitute value

Intended behavior of output channel when the control system stops	Required setting of the module parameter "Behaviour of outputs in case of a communication error"	Required setting of the channel parameter "Substitute value"
Output OFF	Off	0
Last value infinite	Last value	0
Last value for 5 s and then turn off	Last value 5 sec	0
Last value for 10 s and then turn off	Last value 10 sec	0
Substitute value infinite	Substitute value	Depending on configuration
Substitute value for 5 s and then turn off	Substitute value 5 sec	Depending on configuration
Substitute value for 10 s and then turn off	Substitute value 10 sec	Depending on configuration

Group parameters for the digital part

Name	Value	Internal value	Internal value, type	Default
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.1 ms 0x00
Detect short circuit at outputs	Off On	0 1	BYTE	On 0x01

Name	Value	Internal value	Internal value, type	Default
Behaviour DO at comm. error [1])	Off Last value Last value 5 sec Last value 10 sec Substitute value Substitute value 5 sec Substitute value 10 sec	0 1 6 11 2 7 12	BYTE	Off 0x00
Substitute value at output	0 ... 255	00h ... FFh	BYTE	0 0x0000
Detect voltage overflow at outputs [2])	Off On	0 1	BYTE	On 0x01

[1]) The parameters Behaviour DO at comm. error is only analyzed if the Failsafe-mode is ON.

[2]) The state "externally voltage detected" appears, if the output of a channel DC0 ... DC7 should be switched on while an externally voltage is connected. In this case the start up is disabled, as long as the externally voltage is connected. The monitoring of this state and the resulting diagnosis message can be disabled by setting the parameters to "OFF".

Chapter 5.6.6.1.3 “Connections” on page 1129

5.6.6.1.8 Diagnosis

Table 354: Structure of the diagnosis block

Byte Number	Description	Possible Values
1	Diagnosis Byte, slot number	31 = CI521-MODTCP (e. g. error at integrated 8 DI / 8 DO) 1 = 1st connected S500 I/O Module ... 10 = 10th connected S500 I/O Module
2	Diagnosis Byte, module number	According to the I/O bus specification passed on by modules to the fieldbus master
3	Diagnosis Byte, channel	According to the I/O bus specification passed on by modules to the fieldbus master

Byte Number	Description	Possible Values
4	Diagnosis Byte, error code	According to the I/O bus specification Bit 7 and bit 6, coded error class 0 = E1 1 = E2 2 = E3 3 = E4 Bit 0 to bit 5, coded error description
5	Diagnosis Byte, flags	According to the I/O bus specification Bit 7: 1 = coming error Bit 6: 1 = leaving error

In cases of short circuit or overload, the digital outputs are turned off. The modules performs reactivation automatically. Thus an acknowledgement of the errors is not necessary. The error message is stored via the LED.



For diagnosis firmware version ≥ 3.2.6 is required.

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<– Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**		
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**PNIO diag-nosis block**		
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-Identi-fier**	**Error message**		**Remedy**
	[1])	[2])	[3])					
Module errors								
3	-	31	31	31	19	Checksum error in the I/O module		Replace I/O module
3	-	31	31	31	3	Timeout in the I/O module		
3	-	31	31	31	40	Different hard-/firm-ware versions in the module		
3	-	31	31	31	43	Internal error in the module		
3	-	31	31	31	36	Internal data exchange failure		
3	-	31	31	31	9	Overflow diagnosis buffer		Restart

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<– Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**		
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**PNIO diag-nosis block**		
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**		**Remedy**
	[1])	**[2])**	**[3])**					
3	-	31	31	31	26	Parameter error		Check Master
3	-	31	31	31	11	Process voltage UP too low		Check process supply voltage
3	-	31	31	31	45	No process voltage UP		Check process supply voltage
3	-	31/1...10	31	31	17	No communication with I/O module		Replace I/O module
3	-	1...10	31	31	32	Wrong I/O module type on socket		Replace I/O module / Check configu-ration
4	-	1...10	31	31	31	At least one module does not support failsafe function		Check modules and parame-terization
4	-	1...10	31	5	8	I/O module removed from hot swap terminal unit or defective module on hot swap ter-minal unit [9])		Plug I/O module, replace I/O module
4	-	1...10	31	5	28	Wrong I/O module plugged on hot swap terminal unit [9])		Remove wrong I/O module and plug pro-jected I/O module

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<– Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**		
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**PNIO diag-nosis block**		
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**		**Remedy**
	[1])	**[2])**	**[3])**					
4	-	1...10	31	5	42	No communication with I/O module on hot swap terminal unit [9])		Replace I/O module
4	-	1...10	31	5	54	I/O module does not support hot swap [8]) [9])		Power off system and replace I/O module
4	-	1...10	31	6	8	Hot swap terminal unit configured but not found		Replace terminal unit by hot swap terminal unit
4	-	1...10	31	6	42	No communication with hot swap terminal unit [9])		Restart, if error persists replace terminal unit
4	-	31	31	31	46	Voltage feedback on activated digital outputs DO0...DO7 on UP3 [4])		Check terminals
4	-	31/1...10	31	31	34	No response during initialization of the I/O module		Replace I/O module
4	-	31	31	31	11	Process voltage UP3 too low		Check process supply voltage
4	-	31	31	31	45	No process voltage UP3		Check process supply voltage

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<– Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**		
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**PNIO diag-nosis block**		
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**		**Remedy**
	[1])	[2])	[3])					
4	-	31	31	31	10	Voltage overflow on outputs (above UP3 level) [5])		Check terminals/ check process supply voltage
Channel error digital								
4	-	31	2	0...7	46	Externally voltage detected at digital output DO0...DO7 [6])		Check terminals
4	-	31	2	0...7	47	Short circuit at digital output [7])		Check terminals
Channel error analog								
4	-	31	1	0..3	48	Analog value overflow or broken wire at an analog input		Check value or check terminals
4	-	31	1	0..3	7	Analog value underflow at an analog input		Check value
4	-	31	1	0..3	47	Short circuit at an analog input		Check terminals
4	-	31	3	0..1	4	Analog value overflow at an analog output		Check output value
4	-	31	3	0..1	7	Analog value underflow at an analog output		Check output value

Remarks:

[1])	In AC500 the following interface identifier applies: "-" = Diagnosis via bus-specific function blocks; 0 ... 4 or 10 = Position of the Communication Module;14 = I/O bus; 31 = Module itself The identifier is not contained in the CI521-MODTCP diagnosis block.
[2])	With "Device" the following allocation applies: 31 = Module itself; 1..10 = Expansion module
[3])	With "Module" the following allocation applies: 31 = Module itself Module type (1 = AI, 2 = DO, 3 = AO)
[4])	This message appears, if externally voltages at one or more terminals DO0...DO7 cause that other digital outputs are supplied through that voltage. All outputs of the apply digital output groups will be turned off for 5 seconds. The diagnosis message appears for the whole output group. *Chapter 5.6.6.1.3 “Connections” on page 1129*
[5])	The voltage on digital outputs DO0...DO7 has overrun the process supply voltage UP3. Diagnosis message appears for the whole module. *Chapter 5.6.6.1.3 “Connections” on page 1129*
[6])	This message appears, if the output of a channel DO0...DO7 should be switched on while an externally voltage is connected. In this case the start up is disabled, as long as the externally voltage is connected. Otherwise this could produce reverse voltage from this output to other digital outputs. This diagnosis message appears per channel.
[7])	Short circuit: After a detected short circuit, the output is deactivated for 100ms. Then a new start up will be executed. This diagnosis message appears per channel.
[8])	In case of an I/O module doesn’t support hot swapping, do not perform any hot swap operations (also not on any other terminal units (slots)) as modules may be damaged or I/O bus communication may be disturbed.
[9])	Diagnosis for hot swap available as of version index F0.

5.6.6.1.9 State LEDs

The LEDs are located at the front of module.

There are 2 different groups of LEDs:

- The 5 system LEDs (PWR, STA1 ETH, STA2 ETH, S-ERR and I/O-Bus) show the operation state of the module and display possible errors.
- The 27 process LEDs (UP, UP3, inputs, outputs, CH-ERR1 to CH-ERR3) show the process supply voltage and the states of the inputs and outputs and display possible errors.

Table 355: States of the 5 system LEDs

LED	Color	OFF	ON	Flashing
PWR/RUN	Green	Process supply voltage missing	Internal supply voltage OK, module ready for communication with IO Controller	Start-up / preparing communication
	Yellow	---	---	---

LED	Color	OFF	ON	Flashing
STA1 ETH (System LED "BF")	Green	---	Device configured, cyclic data exchange running	Device configured, acyclic data exchange running
	Red	---	Communication error (timeout) appeared	IP address error
STA2 ETH (System LED "SF")	Green	Device has valid parameters	Device is running parameterization sequenze	Device has no parameters
	Red	---	---	Device has invalid parameters
S-ERR	Red	No error	Internal error	--
I/O-Bus	Green	No expansion modules connected or communication error	Expansion modules connected and operational	---
ETH1	Green	No connection at Ethernet interface	Connected to Ethernet interface	---
	Yellow	---	Device is transmitting telegrams	Device is transmitting telegrams
ETH2	Green	No connection at Ethernet interface	Connected to Ethernet interface	---
	Yellow	---	Device is transmitting telegrams	Device is transmitting telegrams

Table 356: States of the 27 process LEDs

LED	Color	OFF	ON	Flashing
AI0 ... AI3	Yellow	Input is OFF	Input is ON (brightness depends on the value of the analog signal)	--
AO0 ... AO1	Yellow	Output is OFF	Output is ON (brightness depends on the value of the analog signal)	--
DI0 ... DI7	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--
DO0 ... DO7	Yellow	Output is OFF	Output is ON	--
UP	Green	Process supply voltage missing	Process supply voltage OK and initialization finished	--

LED	Color	OFF	ON	Flashing
UP3	Green	Process supply voltage missing	Process supply voltage OK	--
CH-ERR1 to CH-ERR3	Red	No error or process supply voltage missing	Internal error	Error on one channel of the corresponding group

5.6.6.1.10 Measuring ranges

Input ranges voltage, current and digital input

Range	0 V ... +10 V	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital input	Digital value	
						Decimal	Hex.
Overflow	> 11.7589	> 11.7589	> 23.5178	> 22.8142		32767	7FFF
Measured value too high	11.7589 : 10.0004	11.7589 : 10.0004	23.5178 : 20.0007	22.8142 : 20.0006		32511 : 27649	7EFF : 6C01
Normal range Normal range or measured value too low	10.0000 : 0.0004	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	: : On	27648 : 1	6C00 : 0001
	0.0000	0.0000	0	4	Off	0	0000
	-0.0004 -1.7593	-0.0004 : : -10,0000		3.9994 1.1858		-1 -4864 : -27648	FFFF ED00 : 9400
Measured value too low		-10.0004 : -11.7589				-27649 : -32512	93FF : 8100
Underflow	< 1.7593	< -11.7589	< 0.0000	< 1.1858		-32768	8000

The represented resolution corresponds to 16 bits.

Input ranges resistance temperature detector

Range	Pt100 / Pt1000 -50 °C ... +70 °C	Pt100 / Pt1000 -50 °C ... +400 °C	Ni1000 -50 °C ... +150 °C	Digital value	
				Decimal	Hex.
Overflow	> +80.0 °C	> +450.0 °C	> +160.0 °C	32767	7FFF
Measured value too high		+450.0 °C : +400.1 °C		4500 : 4001	1194 : 0FA1

Range	Pt100 / Pt1000 -50 °C ... +70 °C	Pt100 / Pt1000 -50 °C ... +400 °C	Ni1000 -50 °C ... +150 °C	Digital value	
				Decimal	Hex.
			+160.0 °C : +150.1 °C	1600 : 1501	0640 : 05DD
	+80.0 °C : +70.1 °C			800 : 701	0320 : 02BD
Normal range	+70.0 °C : +0.1 °C	+400.0 °C : : : +0.1 °C	+150.0 °C : : + 0.1 °C	4000 1500 700 : 1	0FA0 05DC 02BC : 0001
	0.0 °C	0.0 °C	0.0 °C	0	0000
Normal range	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-0.1 °C : -50,0 °C	-1 : -500	FFFF : FE0C
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-501 : -600	FE0B : FDA8
Underflow	< -60.0 °C	< -60.0 °C	< -60.0 °C	-32768	8000

Output ranges voltage and current

Range	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital value	
				Decimal	Hex.
Overflow	0 V	0 mA	0 mA	> 32511	> 7EFF
Measured value too high	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA	32511 : 27649	7EFF : 6C01
Normal range	10.0000 V : 0.0004 V	20.0000 mA : 0,0007 mA	20.0000 mA : 4.0006 mA	27648 : 1	6C00 : 0001
	0.0000 V	0.0000 mA	4.0000 mA	0	0000
	-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA	-1 -6912 -27648	FFFF E500 9400

Range	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital value	
				Decimal	Hex.
Measured value too low	-10.0004 V : -11.7589 V	0 mA : 0 mA	0 mA : 0 mA	-27649 : -32512	93FF : 8100
Underflow	0 V	0 mA	0 mA	< -32512	< 8100

The represented resolution corresponds to 16 bits.

5.6.6.1.11 Technical data

Technical data of the module

The system data of AC500 and S500 is applicable to the standard version.

Chapter 4.2 “System data AC500” on page 34

The system data of AC500-XC is applicable to the XC version.

Chapter 4.3 “System data AC500-XC” on page 38

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter		Value
Process supply voltages UP/UP3		
	Rated value	24 V DC (for inputs and outputs)
	Max. load for the terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse on UP/UP3	10 A fast
	Galvanic isolation	Ethernet interface against the rest of the module
	Inrush current from UP (at power up)	On request
	Current consumption via UP (normal operation)	0.2 A
	Current consumption via UP3	0.06 A + 0.5 A max. per output
	Connections	Terminals 1.8 and 2.8 for +24 V (UP) Terminal 3.8 for +24 V (UP3) Terminals 1.9, 2.9 and 3.9 for 0 V (ZP)
Max. power dissipation within the module		6 W
Number of digital inputs		8
Number of digital outputs		8
Number of analog inputs		4
Number of analog outputs		2
Reference potential for all digital inputs and outputs		Negative pole of the supply voltage, signal name ZP
Ethernet		10/100 base-TX, internal switch, 2 x RJ45 socket

Parameter	Value
Setting of the IP address	With ABB IP config tool and 2 rotary switches at the front side of the module
Operation and error displays	32 LEDs (totally)
Weight (without terminal unit)	Ca. 125 g
Mounting position	Horizontal mounting or Vertical mounting with derating (output load reduced to 50 % at +40 °C per group)
Extended ambient temperature (XC version)	> +60 °C on request
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Multiple overloads
With multi-channel modules, there are no effects of multiple overloads as each digital output channel is individually protected by an internal intelligent high-side switch.

Technical data of the digital inputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DI0 ... DI7		Terminals 2.0 ... 2.7
Reference potential for all inputs		Terminals 1.9 ... 3.9 (negative pole of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1...32 ms
Input signal voltage		24 V DC
	0-Signal	-3 V ... +5 V
	Undefined Signal	> +5 V ... < +15 V
	1-Signal	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA

Parameter		Value
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical data of the digital outputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DO0 ... DO7		Terminals 3.0 ... 3.7
Reference potential for all outputs		Terminals 1.9 ... 3.9 (negative pole of the supply voltage, signal name ZP)
Common power supply voltage		For all outputs terminal 3.8 (positive pole of the supply voltage, signal name UP3)
Output voltage for signal 1		UP3 (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value per channel	500 mA at UP3 = 24 V
	Max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA
	Fuse for UP3	10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)
Output switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

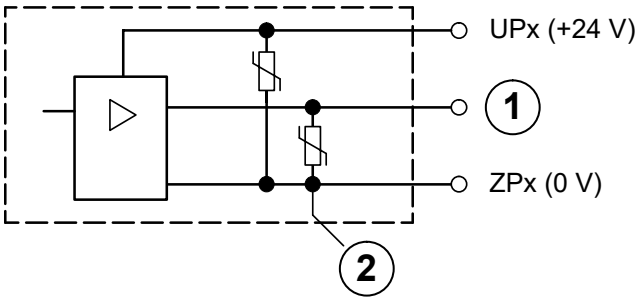


Fig. 227: Digital input/output (circuit diagram)

1 Digital Output
2 Varistors for demagnetization when inductive loads are turned off

Technical data of the analog inputs

Parameter		Value
Number of channels per module		4
Distribution of channels into groups		1 group with 4 channels
Connection if channels AI0+ ... AI3+		Terminals 1.0 ... 1.3
Reference potential for AI0+ ... AI3+		Terminal 1.4 (AI-) for voltage and RTD measurement Terminal 1.9, 2.9 and 3.9 for current measurement
Input type		
	Unipolar	Voltage 0 V ... 10 V, current or Pt100/Pt1000/ Ni1000
	Bipolar	Voltage -10 V ... +10 V
Galvanic isolation		Against Ethernet network
Configurability		0 V ... 10 V, -10 V ... +10 V, 0/4 mA ... 20 mA, Pt100/1000, Ni1000 (each input can be configured individually)
Channel input resistance		Voltage: > 100 kΩ Current: ca. 330 Ω
Time constant of the input filter		Voltage: 100 µs Current: 100 µs
Indication of the input signals		1 LED per channel (brightness depends on the value of the analog signal)
Conversion cycle		1 ms (for 4 inputs + 2 outputs); with RTDs Pt/Ni ... 1 s
Resolution		Range 0 V ... 10 V: 12 bits Range -10 V ... +10 V: 12 bits including sign Range 0 mA ... 20 mA: 12 bits Range 4 mA ... 20 mA: 12 bits Range RTD (Pt100, PT1000, Ni1000): +0.1 °C
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ. 0.5 %, max. 1 %

Parameter	Value
Relationship between input signal and hex code	↳ *Chapter 5.6.6.1.10.2 “Input ranges resistance temperature detector” on page 1159*
Unused inputs	Are configured as "unused" (default value)
Overvoltage protection	Yes

Technical data of the analog inputs if used as digital inputs

Parameter		Value
Number of channels per module		Max. 4
Distribution of channels into groups		1 group of 4 channels
Connections of the channels AI0+ ... AI3+		Terminals 1.0 ... 1.3
Reference potential for the inputs		Terminals 1.9, 2.9 and 3.9 (ZP)
Indication of the input signals		1 LED per channel
Input signal voltage		24 V DC
	Signal 0	-30 V ... +5 V
	Undefined signal	+5 V ... +13 V
	Signal 1	+13 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 7 mA
	Input voltage +5 V	Typ. 1.4 mA
	Input voltage +15 V	Typ. 3.7 mA
	Input voltage +30 V	< 9 mA
Input resistance		Ca. 3.5 kΩ

Technical data of the analog outputs

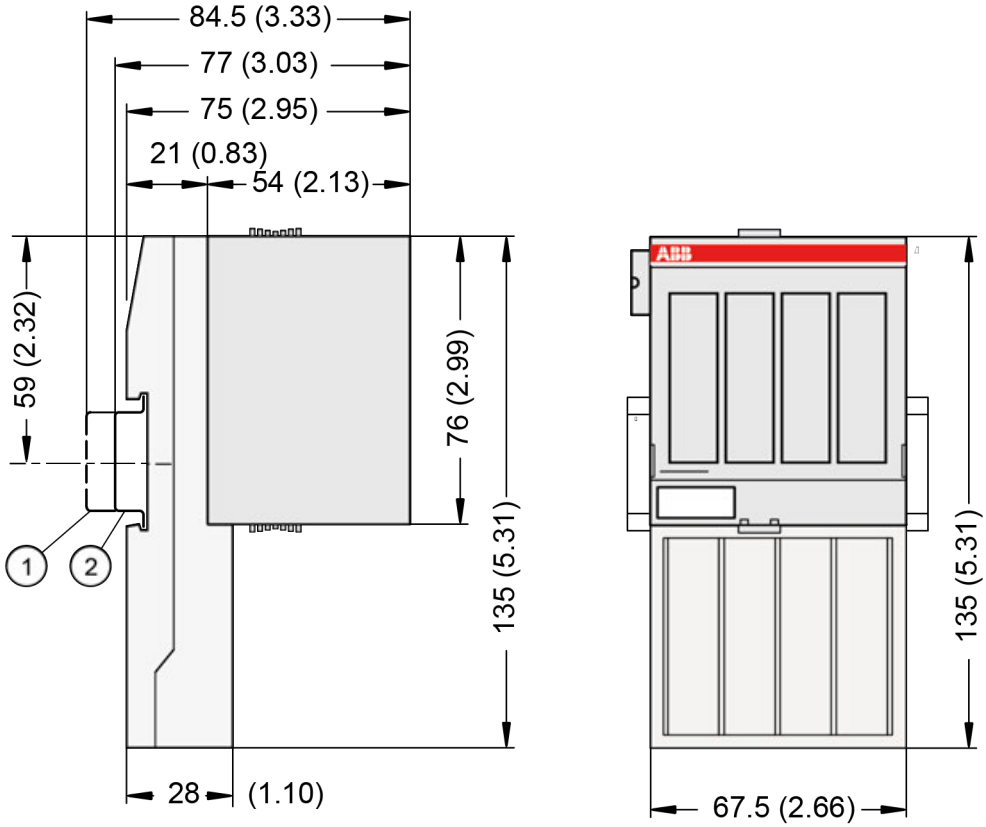
Parameter		Value
Number of channels per module		2
Distribution of channels into groups		1 group for 2 channels
Connection of the channels AO0+ ... AO1+		Terminals 1.5 ... 1.6
Reference potential for AO0+ ... AO1+		Terminal 1.7 (AO-) for voltage outputTerminal 1.9, 2.9 and 3.9 for current output
Output type		
	Unipolar	Current
	Bipolar	Voltage
Galvanic isolation		Against internal supply and other modules
Configurability		-10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA (each output can be configured individually)
Output resistance (load), as current output		0 Ω ... 500 Ω
Output loadability, as voltage output		± 10 mA max.

Parameter	Value
Indication of the output signals	1 LED per channel (brightness depends on the value of the analog signal)
Resolution	12 bits including sign
Settling time for full range change (resistive load, output signal within specified tolerance)	Typ. 5 ms
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code	↳ *Chapter 5.6.6.1.10.3 “Output ranges voltage and current” on page 1160*
Unused outputs	Are configured as "unused" (default value) and can be left open-circuited

Technical data of the fast counter

Parameter	Value
Used inputs	Terminal 2.0 (DI0), 2.1 (DI1)
Used outputs	Terminal 3.0 (DO0)
Counting frequency	Depending on operation mode: Mode 1 - 6: max. 200 kHz Mode 7: max. 50 kHz Mode 9: max. 35 kHz Mode 10: max. 20 kHz

5.6.6.1.12 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

5.6.6.1.13 Ordering data

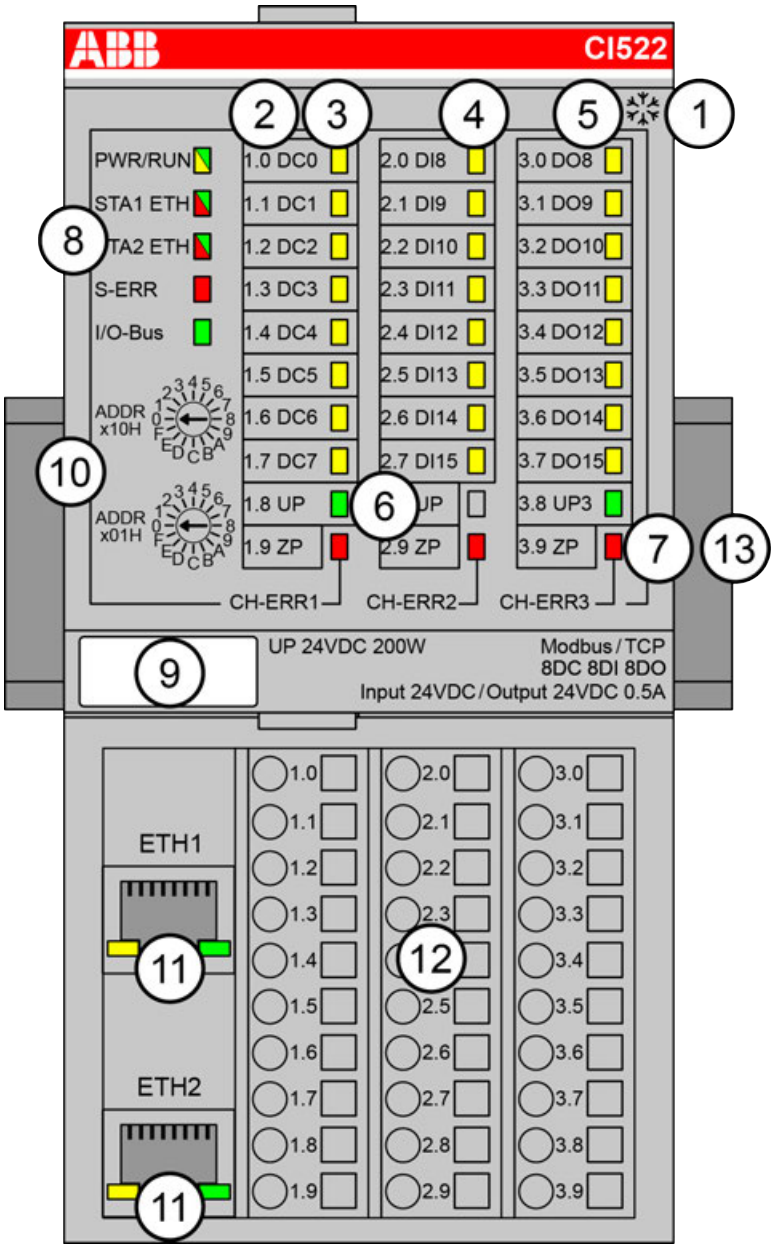
Part no.	Description	Product life cycle phase *)
1SAP 222 100 R0001	CI521-MODTCP, Modbus TCP communication interface module, 4 AI, 2 AO, 8 DI and 8 DO	Active
1SAP 422 100 R0001	CI521-MODTCP-XC, Modbus TCP communication interface module, 4 AI, 2 AO, 8 DI and 8 DO, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.6.6.2 CI522-MODTCP

- 8 digital inputs 24 V DC
- 8 digital outputs 24 V DC, 0.5 A max.

- 8 configurable digital inputs/outputs 24 V DC, 0.5 A max.
- Module-wise galvanically isolated
- Fast counter
- XC version for usage in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 8 yellow LEDs to display the signal states of the digital configurable inputs/outputs (DC0 ... DC7)
4 8 yellow LEDs to display the signal states of the digital inputs (DI8 ... DI15)
5 8 yellow LEDs to display the signal states of the digital outputs (DO8 ... DO15)
6 2 green LEDs to display the process supply voltage UP and UP3
7 3 red LEDs to display errors (CH-ERR1, CH-ERR2, CH-ERR3)
8 5 system LEDs: PWR/RUN, STA1 ETH, STA2 ETH, S-ERR, I/O-Bus
9 Label
10 2 rotary switches for setting the IP address
11 Ethernet interfaces (ETH1, ETH2) on the terminal unit
12 Terminal unit
13 DIN rail
❄ Sign for XC version

5.6.6.2.1 Intended purpose

Modbus TCP communication interface module CI522-MODTCP is used as decentralized I/O module in Modbus TCP networks. The network connection is performed via 2 RJ45 connectors which are integrated in the terminal unit. The communication interface module contains 24 I/O channels with the following properties:

- 8 digital configurable inputs/outputs in 1 group (1.0 ... 1.7)
- 8 digital inputs 24 V DC in 1 group (2.0 ... 2.7)
- 8 digital outputs 24 V DC in 1 group (3.0 ... 3.7)

The inputs/outputs are galvanically isolated from the Ethernet network. There is no potential separation between the channels. The configuration of the configurable digital inputs/outputs is performed by software.

For usage in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

5.6.6.2.2 Functionality

Interface	Ethernet
Protocol	Modbus TCP
Power supply	From the process supply voltage UP
Supply of the electronic circuitry of the I/O expansion modules attached	Through the I/O bus interface (I/O bus)
Rotary switches	for setting the last BYTE of the IP ADDRESS (00h ... FFh)
Configurable digital inputs/outputs	8 (configurable via software)
Digital inputs	8 (24 V DC; delay time configurable via software)
Digital outputs	8 (24 V DC, 0.5 A max.)
LED displays	For system displays, signal states, errors and power supply
External supply voltage	Via terminals ZP, UP and UP3 (process supply voltage 24 V DC)
Required terminal unit	TU507 or TU508 ↳ *Chapter 5.7.2 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 1348*

5.6.6.2.3 Connections

The Ethernet communication interface module CI522-MODTCP is plugged on the I/O terminal unit TU507-ETH or TU508-ETH. Properly seat the module and press until it locks in place. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting .

↳ *Chapter 5.7.2 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 1348*

↳ *Chapter 5.8.2.6 “TA526 - Wall mounting accessory” on page 1410*

The connection of the I/O channels is carried out using the 30 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The terminals 1.8 and 2.8 as well as 1.9, 2.9 and 3.9 are electrically interconnected within the terminal unit and have always the same assignment, independent of the inserted module:

Terminals 1.8 and 2.8: Process supply voltage UP = +24 V DC

Terminal 3.8: Process supply voltage UP3 = +24 V DC

Terminals 1.9, 2.9 and 3.9: Process supply voltage ZP = 0 V

With a separate UP3 power supply, the digital outputs can be switched off externally. This way, an emergency-off functionality can be realized.

Conditions for undisturbed operating with older I/O expansion modules

All I/O expansion modules that are attached to the CI52x-MODTCP must be powered up together with the CI52x-MODTCP if the firmware version of these I/O expansion modules is V1.9 or lower.

The firmware version is related to the index. The index is printed on the module type label on the right side.

Modules as of index listed in the following table can be powered up independently.

S500 I/O module type	First index with firmware version above 1.9
AI523	D0
AI523-XC	D0
AI531	A3
AI531-XC	A0
AO523	D0
AO523-XC	D0
AX521	D0
AX521-XC	D0
AX522	D0
AX522-XC	D0
CD522	A2
CD522-XC	A0
DA501	A2
DA501-XC	A0
DA502	A1
DA502-XC	A1
DC522	D0
DC522-XC	D0
DC523	D0

S500 I/O module type	First index with firmware version above 1.9
DC523-XC	D0
DC532	D0
DC532-XC	D0
DI524	D0
DI524-XC	D0
DO524	A2
DO524-XC	A2
DX522	D0
DX522-XC	D0
DX531	D0
AC522	D0
PD501	D0

Do not connect any voltages externally to digital outputs!

This ist not intended usage.

Reason: Externally voltages at one or more terminals DC0 ... DC7 or DO8 ... DO15 may cause that other digital outputs are supplied through that voltage instead of voltage UP3 (reverse voltage).

This is also possible, if DC channels are used as inputs. For this, the source for the input signals should be the impressed UP3 of the device.

This limitation does not apply for the input channels DI0 ... DI7.

CAUTION!

Risk of malfunction by unintended usage!

If the function cut-off of the digital outputs is to be used by deactivation of the supply voltage UP3, be sure that no external voltage is connected at the outputs.

Table 357: The assignment of the other terminals

Terminal	Signal	Description
1.0	DC0	Signal of the configurable digital input/output DC0
1.1	DC1	Signal of the configurable digital input/output DC1
1.2	DC2	Signal of the configurable digital input/output DC2
1.3	DC3	Signal of the configurable digital input/output DC3
1.4	DC4	Signal of the configurable digital input/output DC4
1.5	DC5	Signal of the configurable digital input/output DC5
1.6	DC6	Signal of the configurable digital input/output DC6

Terminal	Signal	Description
1.7	DC7	Signal of the configurable digital input/output DC7
1.8	UP	Process voltage UP (24 V DC)
1.9	ZP	Process voltage ZP (0 V DC)
2.0	DI8	Signal of the digital input DI8
2.1	DI9	Signal of the digital input DI9
2.2	DI10	Signal of the digital input DI10
2.3	DI11	Signal of the digital input DI11
2.4	DI12	Signal of the digital input DI12
2.5	DI13	Signal of the digital input DI13
2.6	DI14	Signal of the digital input DI14
2.7	DI15	Signal of the digital input DI15
2.8	UP	Process voltage UP (24 V DC)
2.9	ZP	Process voltage ZP (0 V DC)
3.0	DO8	Signal of the digital output DO8
3.1	DO9	Signal of the digital output DO9
3.2	DO10	Signal of the digital output DO10
3.3	DO11	Signal of the digital output DO11
3.4	DO12	Signal of the digital output DO12
3.5	DO13	Signal of the digital output DO13
3.6	DO14	Signal of the digital output DO14
3.7	DO15	Signal of the digital output DO15
3.8	UP3	Process voltage UP3 (24 V DC)
3.9	ZP	Process voltage ZP (0 V DC)



WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing the following:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

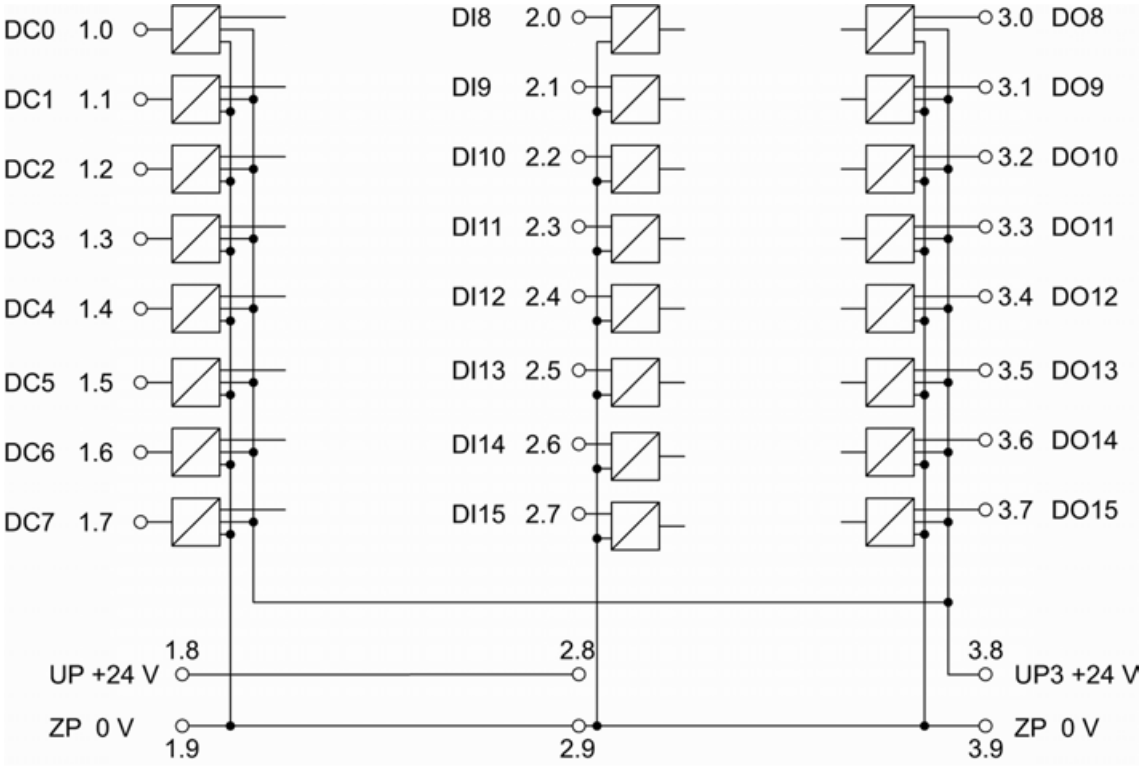


Fig. 228: Connection of the communication interface module CI522-MODTCP

Connection of the digital inputs

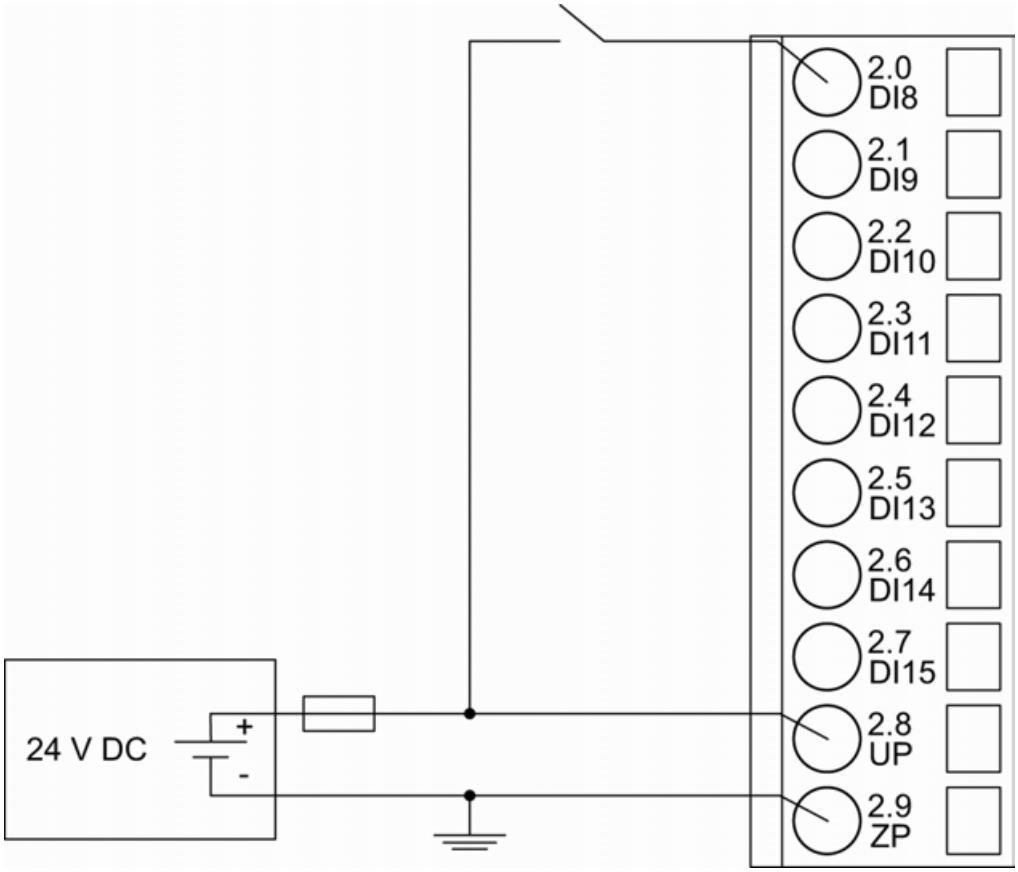


Fig. 229: Connection of the digital inputs (DI8 ... DI15) to the module CI522-MODTCP

↳ Meaning of the LEDs

Connection of the digital outputs

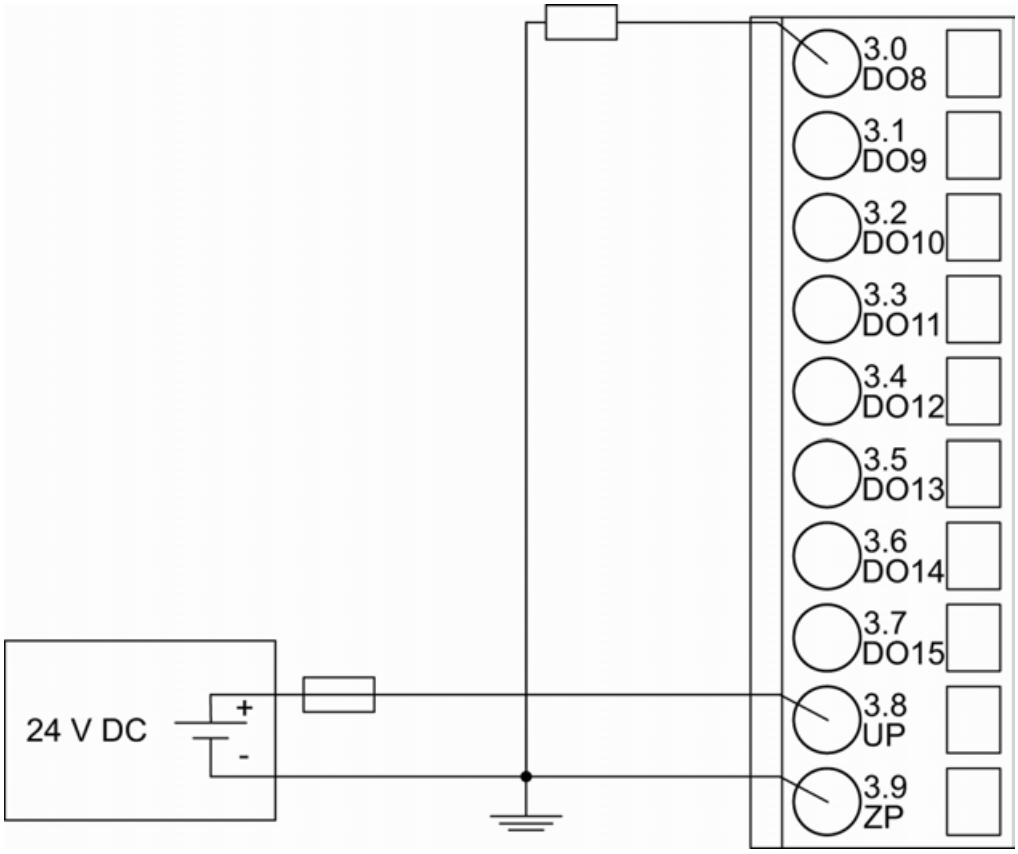


Fig. 230: Connection of the digital output DO8. Proceed with the digital outputs DO9 ... DO15 in the same way

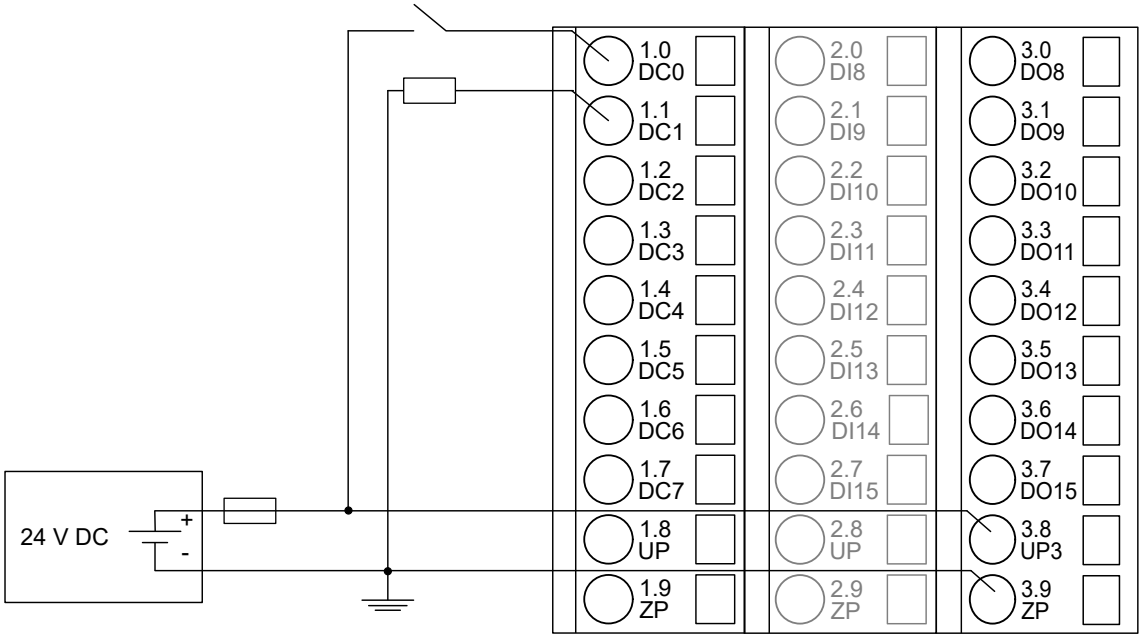
↳ *Meaning of the LEDs*

Connection of the configurable digital inputs/outputs

The following figure shows the connection of the configurable digital input/output DC0 and DC1. DC0 is connected as an input and DC1 is connected as an output. Proceed with the configurable digital inputs/outputs DC2 ... DC7 in the same way.

CAUTION!
If a DC channel is used as input, the source for the input signals should be the impressed UP3 of the device.

↳ *Chapter 5.6.6.2.3 “Connections” on page 1169*

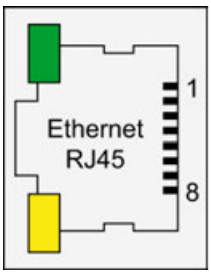


Meaning of the LEDs

Assignment of the Ethernet ports

The terminal unit for the communication interface module provides two Ethernet interfaces with the following pin assignment:

Pin assignment

Interface	Pin	Signal	Description
	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NC	Not connected
	5	NC	Not connected
	6	RxD-	Receive data -
	7	NC	Not connected
	8	NC	Not connected
	Shield	Cable shield	Functional earth

In corrosive environment, please protect unused connectors using the TA535 accessory.

Not supplied with this device.

5.6.6.2.4 Internal data exchange

Digital inputs (bytes)	5
Digital outputs (bytes)	5

Counter input data (words)	4
Counter output data (words)	8

Replacement of a Modbus TCP communication interface module:

The module must be powered off before it is replaced. If the configuration data is stored in the module, then the configuration data must be downloaded into the new module, either by using Modbus communication or by using the Modbus configurator which is contained in the Automation Builder distribution.

5.6.6.2.5 Addressing

The IP address of the CI5221-MODTCP Module can be set with the “ABB IP Configuration Tool”

If the last byte of the IP is set to 0, the address switch will be used instead.

Address switch position 255 is mapped to fixed IP 192.168.0.254 independent of other stored settings. This is a backup so the module can always get a valid IP address and can be configured by the “ABB IP Configuration Tool”.

Address switch position 0 is mapped to last byte equal 1 and DHCP enabled.

The factory setting for the IP is 192.168.0.x (last byte is address switch).

The module reads the position of the rotary switches only during power-up, i.e. changes of the switch position during operation will have no effect until the next module initialization.

5.6.6.2.6 I/O configuration

The CI522-MODTCP stores configuration parameters (IP address configuration, module parameters).

The digital I/O channels are configured via software.

↳ *Details about the configuration*

5.6.6.2.7 Parameterization

Parameters of the module

Name	Value	Internal value	Internal value, type	Default
Module ID [1])	Internal	7405	WORD	7405
Ignore Module	Internal	0	BYTE	0
Parameter length	Internal	47	BYTE	47
Error LED / Failsafe function ↳ *Table 358 “ Table Error LED / Failsafe function” on page 1179*	On	0	BYTE	0
	Off by E4	1		
	Off by E3	3		
	On + failsafe	16		
	Off by E4 + failsafe	17		

Name	Value	Internal value	Internal value, type	Default
	Off by E3 + fail-safe	19		
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Timeout for Bus supervision	No supervision 10 ms timeout 20 ms timeout	0 1 2	BYTE	No supervision
IO Mapping Structure [3])	Fixed Mapping Dynamic Mapping	0 1	BYTE	0
Reserved	Internal	0	ARRAY[0..2] OF BYTE	0,0,0
Check supply	off on	0 1	BYTE	1
Fast counter	0 : 10 [2])	0 : 10	BYTE	0

Remarks:

[1])	With a faulty ID, the module reports a "parameter error" and does not perform cyclic process data transmission.
[2])	Counter operating modes ↳ *Chapter 5.4.3.2.9 “Fast counter” on page 522*

[3])	Fixed Mapping means each module has its own Modbus registers for data transfer independent of the I/O bus constellation description. Dynamic mapping means the structure of the IO Date is dependent on the I/O bus constellation. Each I/O bus expansion module starts directly after the module before on the next Word address.
[4])	If none of the parameters is set all masters / clients in the network have read and write rights on the CI52x-MODTCP device and its connected expansion modules. If at least one parameter is set only the configured masters / clients have write rights on the CI52x-MODTCP device, all other masters / clients still have read access to the CI52x-MODTCP device.

Table 358: Table Error LED / Failsafe function

Setting	Description
On	Error LED (S-ERR) lights up at errors of all error classes, Failsafe-mode off
Off by E4	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, Failsafe-mode off
Off by E3	Error LED (S-ERR) lights up at errors of error classes E1 and E2, Failsafe-mode off
On + Failsafe	Error LED (S-ERR) lights up at errors of all error classes, Failsafe-mode on *)
Off by E4 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, Failsafe-mode on *)
Off by E3 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1 and E2, Failsafe-mode on *)
*) The parameter Behaviour DO at comm. error is only analyzed if the Failsafe-mode is ON.	

Group parameters for the digital part

Name	Value	Internal value	Internal value, type	Default
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.1 ms 0x00
Detect short circuit at outputs	Off On	0 1	BYTE	On 0x01

Name	Value	Internal value	Internal value, type	Default
Behaviour DO at comm. error [1])	Off Last value Last value 5 sec Last value 10 sec Substitute value Substitute value 5 sec Substitute value 10 sec	0 1 6 11 2 7 12	BYTE	Off 0x00
Substitute value at output	0 ... 65535	0000h ... FFFFh	WORD	0 0x0000
Preventive voltage feedback monitoring for DC0 ... DC7 [2])	Off On	0 1	BYTE	Off 0x00
Detect voltage overflow at outputs [3])	Off On	0 1	BYTE	Off 0x00

Remarks:

[1])	The parameter Behaviour DO at comm. error is apply to DC and DO channels and only analyzed if the Failsafe-mode is ON.
[2])	The state "externally voltage detected" appears, if the output of a channel DC0 ... DC7 should be switched on while an externally voltage is connected. In this case the start up is disabled, as long as the externally voltage is connected. The monitoring of this state and the resulting diagnosis message can be disabled by setting the parameters to "OFF".
[3])	The error state "voltage overflow at outputs" appears, if externally voltage at digital outputs DC0 ... DC7 and accordingly DO8 ... DO15 has exceeded the process supply voltage UP3. The according diagnosis message "Voltage overflow on outputs " can be disabled by setting the parameters on "OFF". This parameter should only be disabled in exceptional cases for voltage overflow may produce reverse voltage. *Chapter 5.6.6.2.3 “Connections” on page 1169*

5.6.6.2.8 Diagnosis

Table 359: Structure of the Diagnosis Block

Byte Number	Description	Possible Values
1	Diagnosis Byte, slot number	31 = CI502-PNIO (e. g. error at integrated 8 DI / 8 DO) 1 = 1st connected S500 I/O Module ... 10 = 10th connected S500 I/O Module
2	Diagnosis Byte, module number	According to the I/O bus specification passed on by modules to the fieldbus master

Byte Number	Description	Possible Values
3	Diagnosis Byte, channel	According to the I/O bus specification passed on by modules to the fieldbus master
4	Diagnosis Byte, error code	According to the I/O bus specification Bit 7 and bit 6, coded error class 0 = E1 1 = E2 2 = E3 3 = E4 Bit 0 to bit 5, coded error description
5	Diagnosis Byte, flags	According to the I/O bus specification Bit 7: 1 = coming error Bit 6: 1 = leaving error
6	Reserved	0

In cases of short circuit or overload, the digital outputs are turned off. The modules performs reactivation automatically. Thus an acknowledgement of the errors is not necessary. The error message is stored via the LED.



For diagnosis firmware version ≥ 3.2.6 is required.

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<– Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**		
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**PNIO diag-nosis block**		
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**		**Remedy**
	[1])	[2])	[3])					
Module errors								
3	-	31	31	31	19	Checksum error in the I/O module		Replace I/O module
3	-	31	31	31	3	Timeout in the I/O module		
3	-	31	31	31	40	Different hard-/firm-ware versions in the module		
3	-	31	31	31	43	Internal error in the module		

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<– Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**		
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**PNIO diag-nosis block**		
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**		**Remedy**
	[1])	[2])	[3])					
3	-	31	31	31	36	Internal data exchange failure		
3	-	31	31	31	9	Overflow diagnosis buffer		Restart
3	-	31	31	31	26	Parameter error		Check Master
3	-	31	31	31	11	Process voltage UP too low		Check process supply voltage
3	-	31	31	31	45	Process voltage UP gone		Check process supply voltage
3	-	31/1...10	31	31	17	No communication with I/O module		Replace I/O module
3	-	1...10	31	31	32	Wrong I/O module type on socket		Replace I/O module / Check configu-ration
4	-	1...10	31	31	31	At least one module does not support failsafe function		Check modules and parame-terization
4	-	1...10	31	5	8	I/O module removed from hot swap terminal unit or defective module on hot swap ter-minal unit [9])		Plug I/O module, replace I/O module

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<– Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**		
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**PNIO diag-nosis block**		
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**		**Remedy**
	[1])	**[2])**	**[3])**					
4	-	1...10	31	5	28	Wrong I/O module plugged on hot swap terminal unit [9])		Remove wrong I/O module and plug pro-jected I/O module
4	-	1...10	31	5	42	No communication with I/O module on hot swap terminal unit [9])		Replace I/O module
4	-	1...10	31	5	54	I/O module does not support hot swap [8]) [9])		Power off system and replace I/O module
4	-	1...10	31	6	8	Hot swap terminal unit configured but not found		Replace terminal unit by hot swap terminal unit
4	-	1...10	31	6	42	No communication with hot swap ter-minal unit [9])		Restart, if error persists replace terminal unit
4	1...6	255	2	0	45	The connected Communication Module has no con-nection to the net-work		Check cabeling
4	-	31	31	31	45	Process voltage UP3 too low		Check process voltage

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<– Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**		
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**PNIO diag-nosis block**		
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**		**Remedy**
	[1])	[2])	[3])					
4	-	31	31	31	46	Reverse voltage from digital out-puts DO8...DO15 to UP3 [4])		Check terminals
4	-	31/1...10	31	31	34	No response during initialization of the I/O module		Replace I/O module
4	-	31	31	31	11	Process voltage UP3 too low		Check process supply voltage
4	-	31	31	31	45	Process voltage UP3 gone		Check process supply voltage
4	-	31	31	31	10	Voltage overflow at outputs (above UP3 level) [5])		Check termi-nals/ check process supply voltage
Channel error digital								
4	-	31	2	8..15	46	Externally voltage detected at digital output DO8...DO15 [6])		Check terminals
4	-	31	4	0...7	46	Externally voltage detected at digital output DC0...DC7 [6])		Check terminals
4	-	31	4	0...7	47	Short circuit at digital output DC0...DC7[7])		Check terminals
4	-	31	2	8...15	47	Short circuit at digital output DO8...DO15[7])		Check terminals

Remarks:

[1])	In AC500 the following interface identifier applies: "-" = Diagnosis via bus-specific function blocks; 0 ... 4 or 10 = Position of the Communication Module; 14 = I/O bus; 31 = Module itself The identifier is not contained in the CI502-PNIO diagnosis block.
[2])	With "Device" the following allocation applies: 31 = Module itself, 1..10 = Expansion module
[3])	With "Module" the following allocation applies dependent of the master: Module error: 31 = Module itself Channel error: Module type (1 = AI, 2 = DO, 3 = AO)
[4])	This message appears, if externally voltages at one or more terminals DC0 ... DC7 oder DO8 ... DO15 cause that other digital outputs are supplied through that voltage (voltage feedback). All outputs of the apply digital output groups will be turned off for 5 seconds. The diagnosis message appears for the whole output group. *Chapter 5.6.6.2.3 “Connections” on page 1169*
[5])	The voltage at digital outputs DC0 ... DC7 and accordingly DO8 ... DO15 has exceeded the process supply voltage UP3. Diagnosis message appears for the whole module. *Chapter 5.6.6.2.3 “Connections” on page 1169*
[6])	This message appears, if the output of a channel DC0 ... DC7 or DO8 ... DO15 should be switched on while an externally voltage is connected. In this case the start up is disabled, as long as the externally voltage is connected. Otherwise this could produce reverse voltage from this output to other digital outputs. This diagnosis message appears per channel.
[7])	Short circuit: After a detected short circuit, the output is deactivated for 2000ms. Then a new start up will be executed. This diagnosis message appears per channel.
[8])	In case of an I/O module doesn’t support hot swapping, do not perform any hot swap operations (also not on any other terminal units (slots)) as modules may be damaged or I/O bus communication may be disturbed.
[9])	Diagnosis for hot swap available as of version index F0.

5.6.6.2.9 State LEDs

The LEDs are located at the front of module.

There are 2 different groups of LEDs:

- The 5 system LEDs (PWR, STA1 ETH, STA2 ETH, S-ERR and I/O-Bus) show the operation state of the module and display possible errors.
- The 29 process LEDs (UP, UP3, inputs, outputs, CH-ERR1 to CH-ERR3) show the process supply voltage and the states of the inputs and outputs and display possible errors.

Table 360: States of the 5 system LEDs

LED	Color	OFF	ON	Flashing
PWR/RUN	Green	Process supply voltage missing	Internal supply voltage OK, module ready for communication with I/O Controller	Start-up / preparing communication
	Yellow	---	---	---

LED	Color	OFF	ON	Flashing
STA1 ETH (System LED "BF")	Green	---	Device configured, cyclic data exchange running	Device configured, acyclic data exchange running
	Red	---	Communication error (timeout) appeared	IP address error
STA2 ETH (System LED "SF")	Green	Device has valid parameters	Device is running parameterization sequenze	Device has no parameters
	Red	---	---	Device has invalid parameters
S-ERR	Red	No error	Internal error	--
I/O-Bus	Green	No expansion modules connected or communication error	Expansion modules connected and operational	---
ETH1	Green	No connection at Ethernet interface	Connected to Ethernet interface	---
	Yellow	---	Device is transmitting telegrams	Device is transmitting telegrams
ETH2	Green	No connection at Ethernet interface	Connected to Ethernet interface	---
	Yellow	---	Device is transmitting telegrams	Device is transmitting telegrams

Table 361: States of the 29 process LEDs

LED	Color	OFF	ON	Flashing
DC0 ... DC7	Yellow	Input/Output is OFF	Input/Output is ON	--
DI8 ... DI15	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--
DO8 ... DO15	Yellow	Output is OFF	Output is ON	--
UP	Green	Process supply voltage missing	Process supply voltage OK and initialization finished	--
UP3	Green	Process supply voltage missing	Process supply voltage OK	--
CH-ERR1 to CH-ERR3	Red	No error or process supply voltage missing	Internal error	Error on one channel of the corresponding group

5.6.6.2.10 Technical data

Technical data of the module

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

↳ *Chapter 4.3 “System data AC500-XC” on page 38*

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter		Value
Process supply voltages UP/UP3		
	Rated value	24 V DC (for inputs and outputs)
	Max. load for the terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse on UP/UP3	10 A fast
	Galvanic isolation	Ethernet interface against the rest of the module
	Inrush current from UP (at power up)	On request
	Current consumption via UP (normal operation)	0.15 A
	Current consumption via UP3	0.06 A + 0.5 A max. per output
	Connections	Terminals 1.8 and 2.8 for +24 V (UP) Terminal 3.8 for +24 V (UP3) Terminals 1.9, 2.9 and 3.9 for 0 V (ZP)
Max. power dissipation within the module		6 W
Number of digital inputs		8
Number of digital outputs		8
Number of configurable digital inputs/outputs		8
Reference potential for all digital inputs and outputs		Negative pole of the supply voltage, signal name ZP
Ethernet		10/100 base-TX, internal switch, 2 x RJ45 socket
Setting of the I/O device identifier		With 2 rotary switches at the front side of the module
Operation and error displays		34 LEDs (totally)
Weight (without terminal unit)		Ca. 125 g
Mounting position		Horizontal mounting or Vertical mounting with derating (output load reduced to 50 % at +40°C per group)
Extended ambient temperature (XC version)		> +60 °C on request
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Multiple overloads
With multi-channel modules, there are no effects of multiple overloads as each digital output channel is individually protected by an internal intelligent high-side switch.

Technical data of the digital inputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DI8 ... DI15		Terminals 2.0 ... 2.7
Reference potential for all inputs		Terminals 1.9 ... 3.9 (negative pole of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1 ms ... 32 ms
Input signal voltage		24 V DC
	Signal 0	-3 V ... +5 V
	Undefined Signal	> +5 V ... < +15 V
	Signal 1	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical data of the digital outputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DO8 ... DO15		Terminals 3.0 ... 3.7
Reference potential for all outputs		Terminals 1.9 ... 3.9 (negative pole of the supply voltage, signal name ZP)
Common power supply voltage		For all outputs terminal 3.8 (positive pole of the supply voltage, signal name UP3)
Output voltage for signal 1		UP3 (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value per channel	500 mA at UP3 = 24 V
	Max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA
	Fuse for UP3	10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)
Output switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

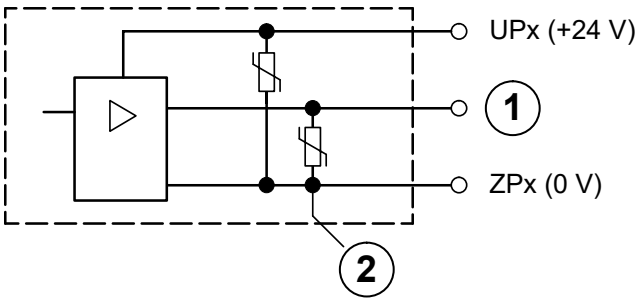


Fig. 231: Digital input/output (circuit diagram)

1 Digital output
2 Varistors for demagnetization when inductive loads are turned off

Technical data of the configurable digital inputs/outputs

Each of the configurable I/O channels is defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter		Value
Number of channels per module		8 inputs/outputs (with transistors)
Distribution of the channels into groups		1 group for 8 channels
If the channels are used as inputs		
	Channels DC0 ... DC7	Terminals 1.0 ... 1.7
If the channels are used as outputs		
	Channels DC0 ... DC7	Terminals 1.0 ... 1.7
Indication of the input/output signals		1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Galvanic isolation		From the Ethernet network

Technical data of the digital inputs/outputs if used as inputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DC0 ... DC7		Terminals 1.0 ... 1.7
Reference potential for all inputs		Terminals 1.9 ... 3.9 (negative pole of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1 ms ... 32 ms
Input signal voltage		24 V DC
	Signal 0	-3 V ... +5 V *)
	Undefined Signal	> +5 V ... < +15 V
	Signal 1	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V *)
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

*) Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal may not exceed the clamp voltage of the varistor. The varistor limits the voltage to approx. 36 V. Following this, the input voltage must range from -12 V ... +30 V when UPx = 24 V and from -6 V ... +30 V when UPx = 30 V.

Technical data of the digital inputs/outputs if used as outputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DC0 ... DC7		Terminals 1.0 ... 1.7
Reference potential for all outputs		Terminals 1.9 ... 3.9 (negative pole of the supply voltage, signal name ZP)
Common power supply voltage		For all outputs terminal 3.8 (positive pole of the supply voltage, signal name UP3)
Output voltage for signal 1		UP3 (-0,8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value per channel	500 mA at UP3 = 24 V
	Max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA
	Fuse for UP3	10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)
Output switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

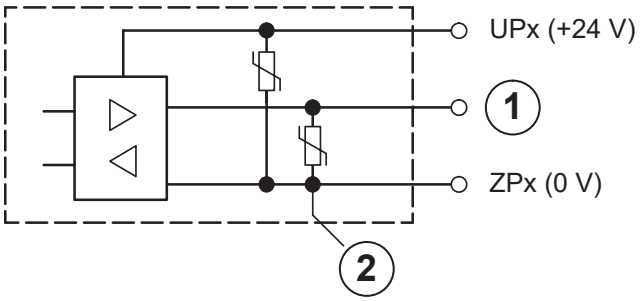


Fig. 232: Digital input/output (circuit diagram)

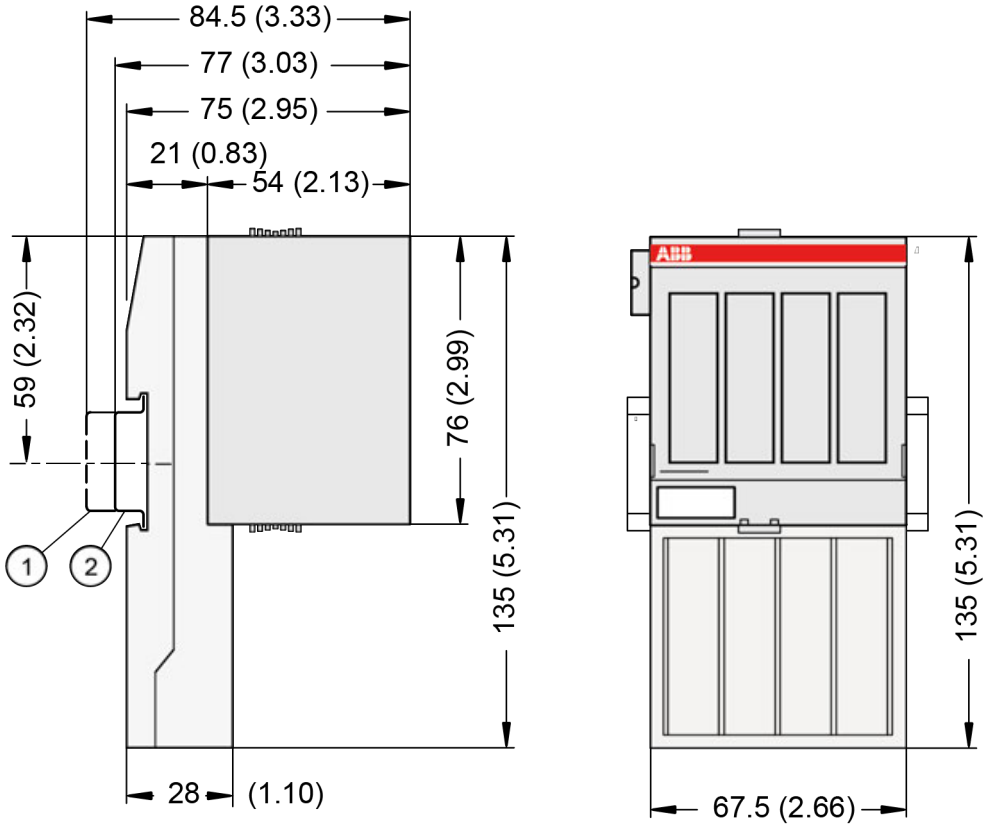
1 Digital input/output
2 For demagnetization when inductive loads are turned off

Technical data of the fast counter

Parameter	Value
Used inputs	Terminal 2.0 (DI8),Terminal 2.1 (DI9)
Used outputs	Terminal 3.0 (DO8)
Counting frequency	Depending on operation mode: Mode 1- 6: max. 200 kHz Mode 7: max. 50 kHz Mode 9: max. 35 kHz Mode 10: max. 20 kHz

How to prepare a device as fast counter and how to connect it to the PLC is described in an *application example*.

5.6.6.2.11 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

5.6.6.2.12 Ordering data

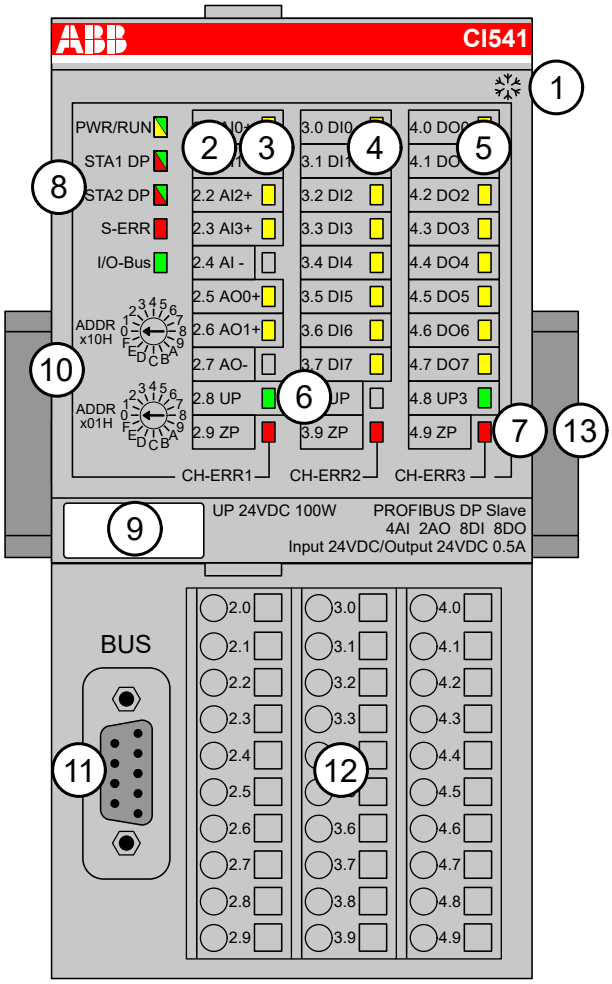
Ordering No.	Scope of delivery	Product life cycle phase *)
1SAP 222 200 R0001	CI522-MODTCP, Modbus TCP communication interface module, 8 DC, 8 DI and 8 DO	Active
1SAP 422 200 R0001	CI522-MODTCP-XC, Modbus TCP communication interface module, 8 DC, 8 DI and 8 DO, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.6.7 PROFIBUS

5.6.7.1 CI541-DP

- 4 configurable analog inputs (2-wire/single-ended) or 2 configurable analog inputs (3-wire/ differential)
  Resolution 12 bits including sign
- 2 analog outputs
  Resolution 12 bits including sign
- 8 digital inputs 24 V DC in 1 group
- 8 digital outputs 24 V DC in 1 group, 0.5 A max.
- Fast counter
- Module-wise galvanically isolated
- XC version for usage in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 6 yellow LEDs to display the signal states of the analog inputs/outputs (AI0 ... AI3, AO0 ... AO1)
4 8 yellow LEDs to display the signal states of the digital inputs (DI0 ... DI7)
5 8 yellow LEDs to display the signal states of the digital outputs (DO0 ... DO7)
6 2 green LEDs to display the process supply voltage UP and UP3
7 3 red LEDs to display errors (CH-ERR1, CH-ERR2, CH-ERR3)
8 5 system LEDs: PWR/RUN, STA1 DP, STA2 DP, S-ERR, I/O-Bus
9 Label
10 2 rotary switches for setting the PROFIBUS ID
11 9-pin D-SUB connector to connect the PROFIBUS DP signals

12 Terminal unit
13 DIN rail
Sign for XC version

5.6.7.1.1 Intended purpose

The PROFIBUS DP communication interface module is used as decentralized I/O module in PROFIBUS DP networks. Depending on the used terminal unit the network connection is performed either via 9-pole female D-sub or via 10 terminals (screw-type or spring terminals) which are integrated in the terminal unit. The communication interface module contains 22 I/O channels.

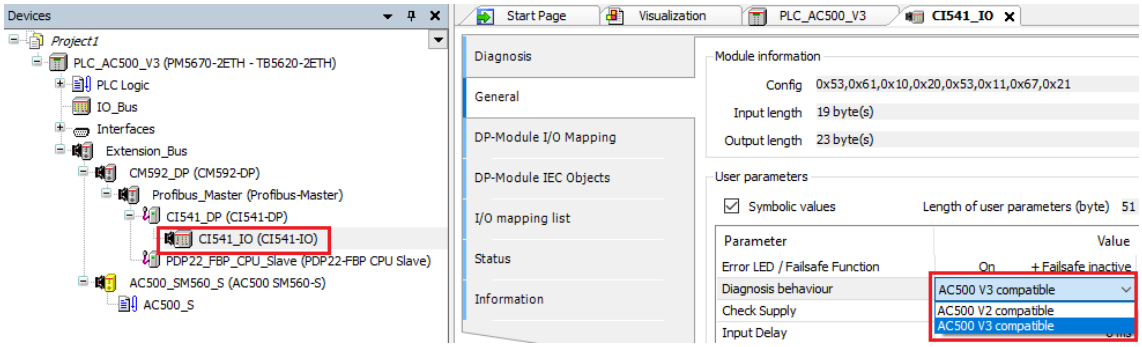
The inputs/outputs are galvanically isolated from the PROFIBUS DP network. There is no potential separation between the channels. The configuration of the analog inputs/outputs is performed by software.

For usage in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

- 4 configurable analog inputs (2-wire/single-ended) or 2 configurable analog inputs (3-wire/ differential)
  Resolution 12 bits including sign
- 2 analog outputs
  Resolution 12 bits including sign
- 8 digital inputs 24 V DC in 1 group
- 8 digital outputs 24 V DC in 1 group, 0.5 A max.
- Fast counter
- Module-wise galvanically isolated
- XC version for usage in extreme ambient conditions available

5.6.7.1.2 Diagnosis settings

The current CI54x does not run in combination with a PLC if in the *“General”* tab the parameter *“Diagnosis behavior”* is set to *“AC500 V3 compatible”*. How to change the setting in your AB project is described below.



1. Double click in the *“Device”* tree on *“CI541_IO”*.
   ⇨ The tab for the various settings opens.
2. Double click on the *“General”* tab.
3. Double click on the *“Value”* of the parameter *“Diagnosis behavior”*.
4. Click on the small arrow.
   ⇨ A submenu with two values opens.
5. Click on *“AC500 V2 compatible”* as setting.
6. Close the tab.

After changing the parameter to *“AC500 V2 compatible”* the CI54x get in *“RUN”*.

If the CI54x indicates a S500 diagnosis message, following AC500 diagnosis entry (*“655374 CI54x communication interface module is sending not supported diagnosis format - Check configuration and FW revision of communication interface module”*) is shown in the diagnosis editor and history. This diagnosis message does not have impact to cyclic data exchange between the master and the CI54x.

In case of a parameter change from V2 to V3 the parameter at the CI54x of V3 has the same value than at the CI54x below V2 (that means compatible to AC500 V2).

5.6.7.1.3 Functionality

Parameter	Value
Interface	PROFIBUS
Protocol	PROFIBUS DP (DP-V0 and DP-V1)
Power supply	From the process supply voltage UP
Supply of the electronic circuitry of the I/O expansion modules attached	Through the I/O bus interface (I/O bus)
Rotary switches	For setting the PROFIBUS ID for configuration purposes (00h to FFh)
Expandability	Max. 10 S500 I/O modules
Fast counter	Integrated, configurable operating modes
LED displays	For system displays, signal states, errors and power supply
External supply voltage	Via terminals ZP, UP and UP3 (process supply voltage 24 V DC)
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Required terminal unit	TU509, TU510, TU517 or TU518 ↳ *Chapter 5.7.3 “TU509 and TU510 for communication interface modules” on page 1351* ↳ *Chapter 5.7.4 “TU517 and TU518 for communication interface modules” on page 1355*

5.6.7.1.4 Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The PROFIBUS DP communication interface module CI541-DP is plugged on the I/O terminal units TU509 or TU510 and accordingly TU517 or TU518. Properly seat the module and press until it locks in place. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting.

↳ *Chapter 5.7.3 “TU509 and TU510 for communication interface modules” on page 1351*

↳ *Chapter 5.7.4 “TU517 and TU518 for communication interface modules” on page 1355*

↳ *Chapter 5.8.2.6 “TA526 - Wall mounting accessory” on page 1410*

The connection of the I/O channels is carried out using the 30 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 2.8 and 3.8 as well as 2.9, 3.9 and 4.9 are interconnected within the terminal unit and have always the same assignment, independent of the inserted module:

Terminals 2.8 and 3.8: Process supply voltage UP = +24 V DC

Terminal 4.8: Process supply voltage UP3 = +24 V DC

Terminals 2.9, 3.9 and 4.9: Process supply voltage ZP = 0 V

With a separate UP3 power supply, the digital outputs can be switched off externally. This way, an emergency-off functionality can be realized.

Do not connect any voltages externally to digital outputs!

Reason: Externally voltages at an output or several outputs may cause that other outputs are supplied through that voltage instead of voltage UP3 (reverse voltage). This ist not intended usage.

CAUTION!

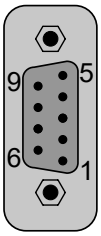
Risk of malfunction by unintended usage!

If the function cut-off of the digital outputs is to be used by deactivation of the supply voltage UP3, be sure that no external voltage is connected at the outputs.

Possibilities of connection

Connection on terminal units TU509 or TU510

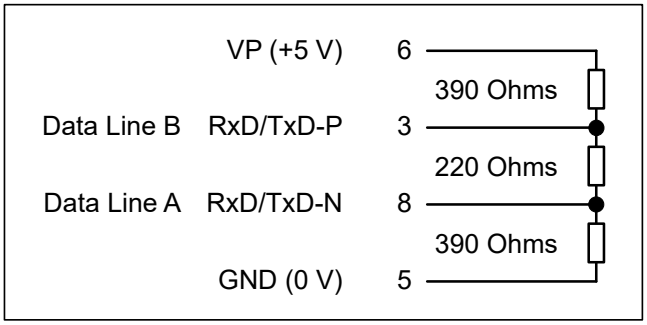
The assignment of the 9-pole female D-sub for the PROFIBUS signals:



1	---	Reserved
2	---	Reserved
3	B	Data line B (receive and send line, positive)
4	---	Reserved
5	DGND	Reference potential for data transmissions and +5 V
6	VP (5 V)	+5 V (Power supply voltage for terminating resistors)
7	---	Reserved
8	A	Data line A (receive and send line, negative)
9	---	Reserved
Shield	Shield	Shield, functional earth

Bus termination

The line ends of the bus segment must be equipped with bus terminating resistors. Normally, these resistors are integrated in the interface connectors.



The grounding of the shield should take place at the control cabinet

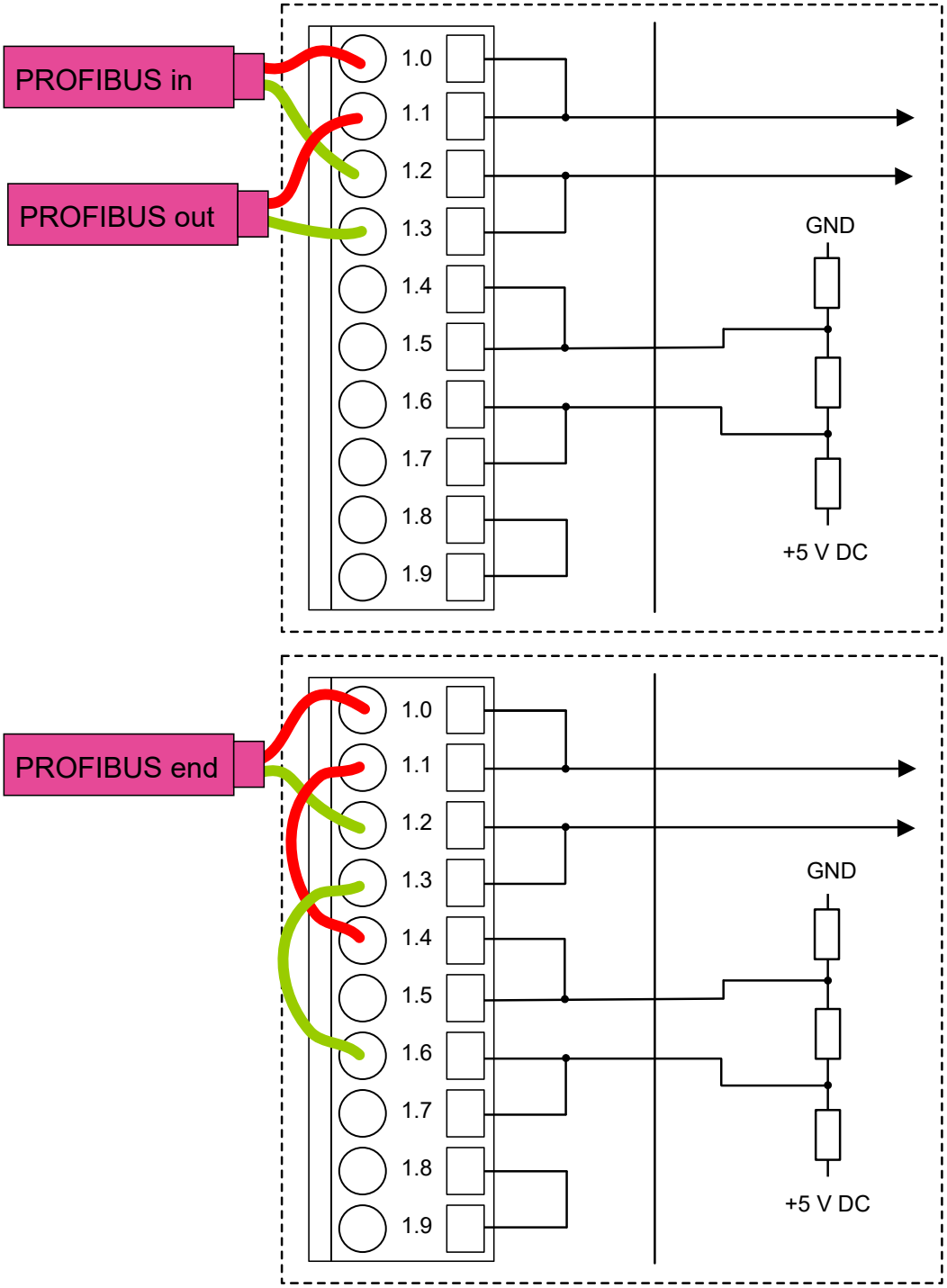
Chapter 4.2 “System data AC500” on page 34

Mounting on terminal units TU517 or TU518

The assignment of the terminals 1.0 ... 1.9:

Terminal	Signal	Description
1.0	B	Data line B (receive and send line, positive)
1.1	B	Data line B (receive and send line, positive)
1.2	A	Data line A (receive and send line, negative)
1.3	A	Data line A (receive and send line, negative)
1.4	TermB	Bus termination data line B
1.5	TermB	Bus termination data line B
1.6	TermA	Bus termination data line A
1.7	TermA	Bus termination data line A
1.8	DGND	Reference potential for data transmission
1.9	DGND	Reference potential for data transmission

At the line ends of a bus segment, terminating resistors must be connected. If using TU517/ TU518, the bus terminating resistors can be enabled by connecting the terminals TermA and TermB to the data lines A and B (no external terminating resistors are required, see figure below).



If using TU517/TU518, note that the terminating resistors are not located inside the TU, but inside the communication interface module CI541-DP. I. e. when removing the device from the TU, the bus terminating resistors are not connected to the bus any more. The bus itself will not be disconnected if a device is removed.

If using TU517/TU518 the max. permitted transmission rate is limited to 1.5 MBaud.



The grounding of the shield should take place at the control cabinet.

Chapter 4.2 “System data AC500” on page 34

Technical data bus cable

Parameter	Value
Type	Twisted pair (shielded)
Characteristic impedance	135...165 Ω
Cable capacitance	< 30 pF/m
Conductor diameter of the cores	≥ 0.64 mm
Conductor cross section of the cores	≥ 0.34 mm²
Cable resistance per core	≤ 55 Ω/km
Loop resistance (resistance of two cores)	≤ 110 Ω/km

Cable length

The maximum possible cable length of a PROFIBUS subnet within a segment depends on the transmission rate (baud rate).

Transmission rate	Maximum cable length
9.6 kBaud to 93.75 kBaud	1200 m
187.5 kBaud	1000 m
500 kBaud	400 m
1.5 MBaud	200 m
3 MBaud to 12 MBaud	100 m

The assignment of the other terminals:

Terminal	Signal	Description
2.0	AI0+	Positive pole of analog input signal 0
2.1	AI1+	Positive pole of analog input signal 1
2.2	AI2+	Positive pole of analog input signal 2
2.3	AI3+	Positive pole of analog input signal 3
2.4	AI-	Negative pole of analog input signals 0 to 3
2.5	AO0+	Positive pole of analog output signal 0
2.6	AO1+	Positive pole of analog output signal 1
2.7	AI-	Negative pole of analog output signals 0 and 1
2.8	UP	Process voltage UP (24 V DC)
2.9	ZP	Process voltage ZP (0 V DC)

Terminal	Signal	Description
3.0	DI0	Signal of the digital input DI0
3.1	DI1	Signal of the digital input DI1
3.2	DI2	Signal of the digital input DI2
3.3	DI3	Signal of the digital input DI3
3.4	DI4	Signal of the digital input DI4
3.5	DI5	Signal of the digital input DI5
3.6	DI6	Signal of the digital input DI6
3.7	DI7	Signal of the digital input DI7
3.8	UP	Process voltage UP (24 V DC)
3.9	ZP	Process voltage ZP (0 V DC)
4.0	DO0	Signal of the digital output DO0
4.1	DO1	Signal of the digital output DO1
4.2	DO2	Signal of the digital output DO2
4.3	DO3	Signal of the digital output DO3
4.4	DO4	Signal of the digital output DO4
4.5	DO5	Signal of the digital output DO5
4.6	DO6	Signal of the digital output DO6
4.7	DO7	Signal of the digital output DO7
4.8	UP3	Process voltage UP3 (24 V DC)
4.9	ZP	Process voltage ZP (0 V DC)



WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing the following:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

For the open-circuit detection (cut wire), each channel is pulled up to "plus" by a high-resistance resistor. If nothing is connected, the maximum voltage will be read in then.

Analog signals are always laid in shielded cables. The cable shields are grounded at both ends of the cables. In order to avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

For simple applications (low electromagnetic disturbances, no high requirement on precision), the shielding can also be omitted.

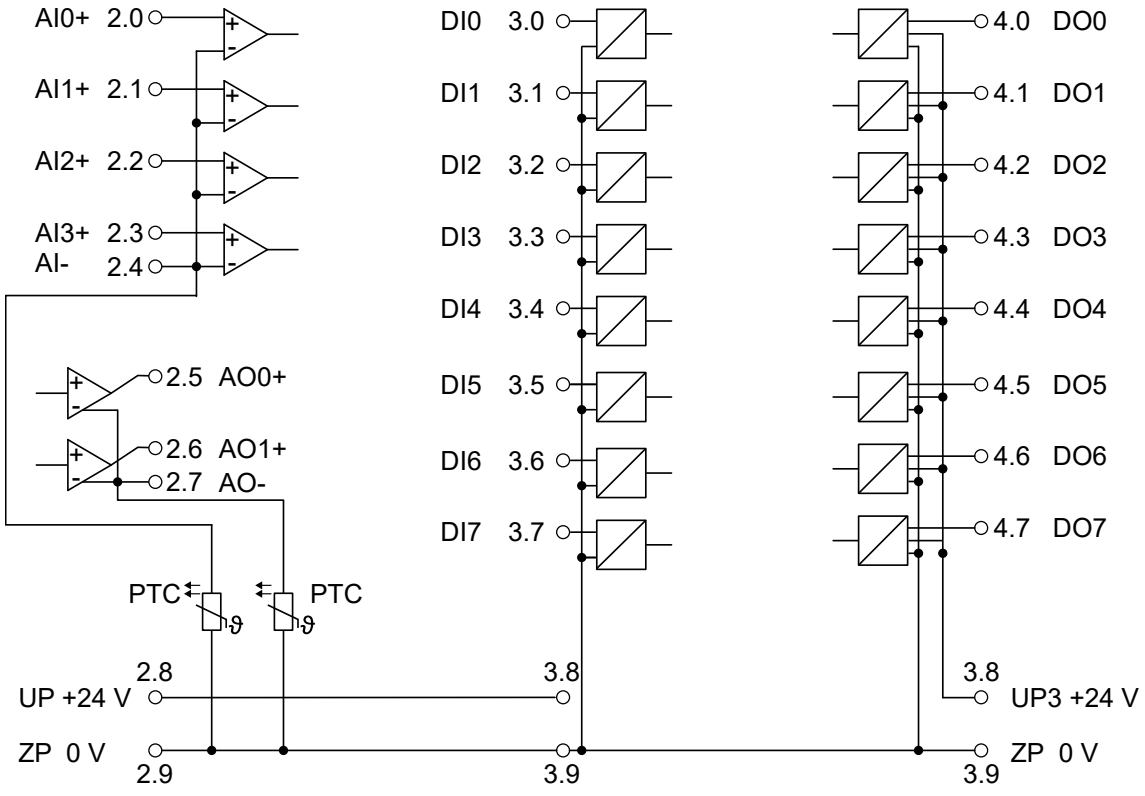


Fig. 233: Connection of the PROFIBUS DP communication interface module CI541-DP

Connection of the digital inputs

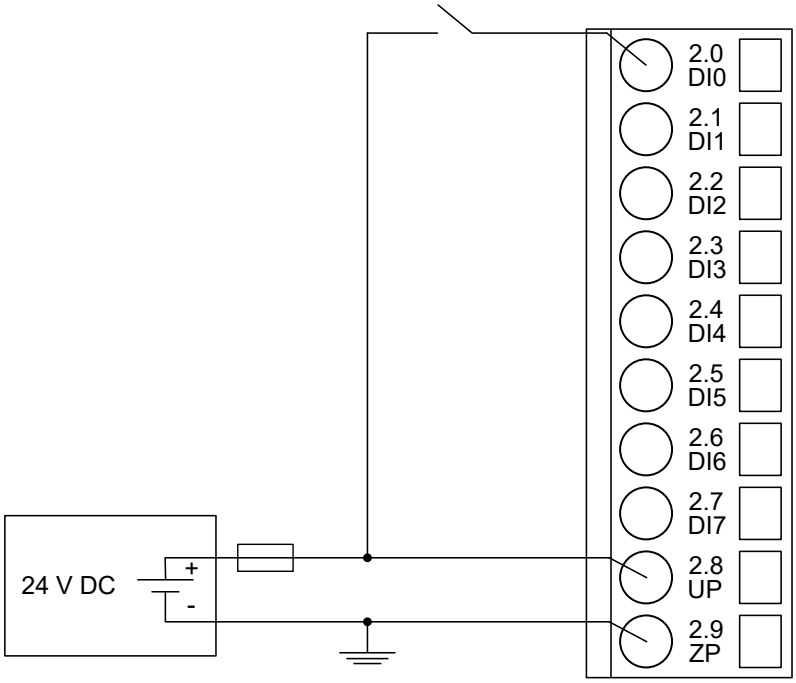


Fig. 234: Connection of the digital input DI0 (Proceed with the digital inputs DI1 ... DI7 in the same way)

Meaning of the LEDs

Connection of the digital outputs

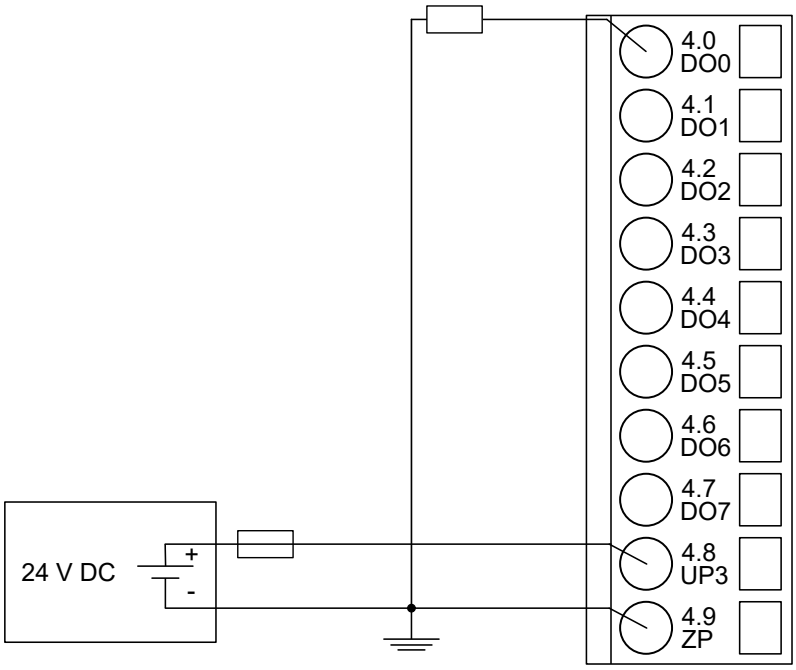


Fig. 235: Connection of the digital output DO0 (Proceed with the digital outputs DO1 ... DO7 in the same way)

Meaning of the LEDs

Connection of resistance thermometers in 2-wire configuration to the analog inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module CI541-DP provides a constant current source which is multiplexed over the max. 4 analog input channels.

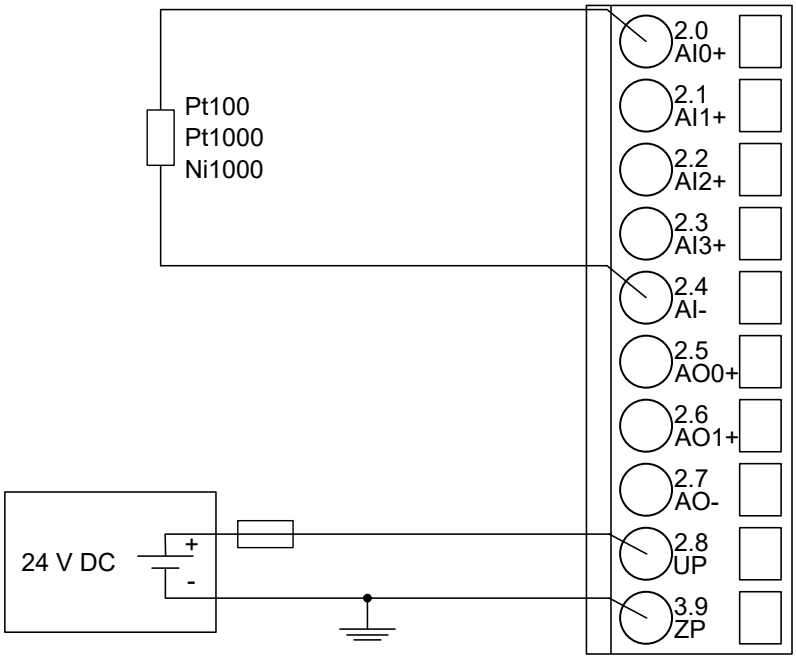


Fig. 236: Connection of resistance thermometers in 2-wire configuration to the analog input AI0 (Proceed with the analog inputs AI1 ... AI3 in the same way)

The following measuring ranges can be configured.

↳ *Chapter 5.6.7.1.8 “Parameterization” on page 1214*

↳ *Chapter 5.6.7.1.11 “Measuring ranges” on page 1226*

Table 362: Configurable measuring ranges

Pt100	-50 °C ... +400 °C	2-wire configuration, 1 channel used
Pt1000	-50 °C ... +400 °C	2-wire configuration, 1 channel used
Ni1000	-50 °C ... +150 °C	2-wire configuration, 1 channel used

↳ *Meaning of the LEDs*

The module CI541-DP performs a linearization of the resistance characteristic.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of resistance thermometers in 3-wire configuration to the analog inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module CI541-DP provides a constant current source which is multiplexed over the max. 4 analog input channels.

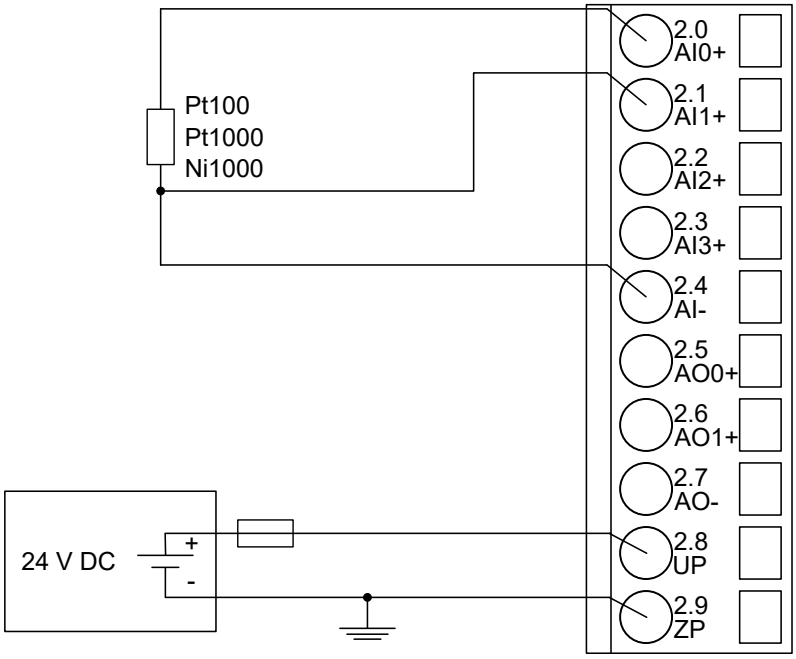


Fig. 237: Connection of resistance thermometers in 3-wire configuration to the analog inputs AI0 and AI1 (Proceed with the analog inputs AI2 and AI3 in the same way)

With 3-wire configuration, 2 adjacent analog channels belong together (e. g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1).

The constant current of one channel flows through the resistance thermometer. The constant current of the other channel flows through one of the cores. The module calculates the measured value from the two voltage drops and stores it under the input with the higher channel number (e. g. I1).

In order to keep measuring errors as small as possible, it is necessary to have all the involved conductors in the same cable. All the conductors must have the same cross section.

The following measuring ranges can be configured.

↳ *Chapter 5.6.7.1.8 “Parameterization” on page 1214*

↳ *Chapter 5.6.7.1.11 “Measuring ranges” on page 1226*

Table 363: Configurable measuring ranges

Pt100	-50 °C ... +400 °C	3-wire configuration, 2 channels used
Pt1000	-50 °C ... +400 °C	3-wire configuration, 2 channels used
Ni1000	-50 °C ... +150 °C	3-wire configuration, 2 channels used

↳ *Meaning of the LEDs*

The module CI541-DP performs a linearization of the resistance characteristic.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of active-type analog sensors (Voltage) with galvanically isolated power supply to the analog inputs

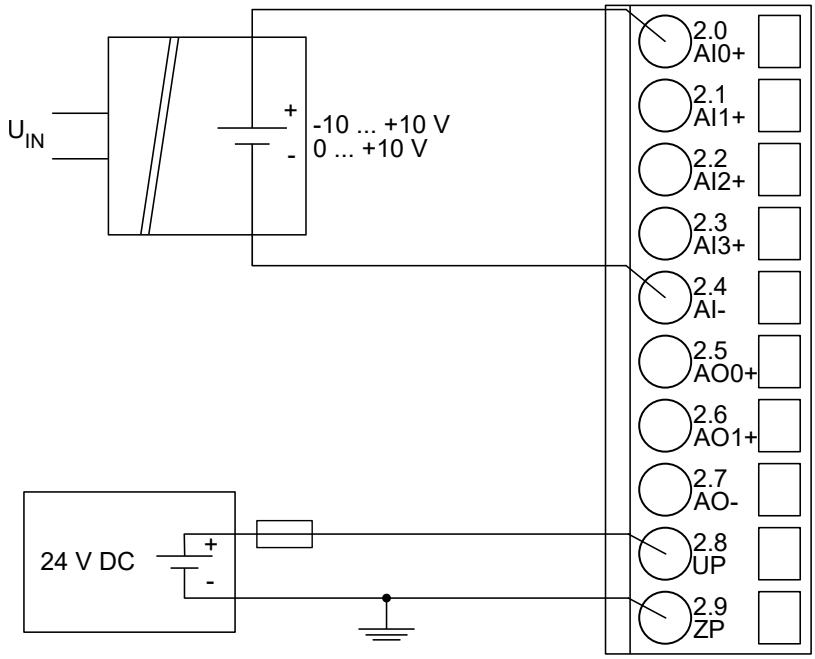


Fig. 238: Connection of active-type analog sensors (voltage) with galvanically isolated power supply to the analog input AI0 (Proceed with the analog inputs AI1 ... AI3 in the same way)

The following measuring ranges can be configured.

↳ *Chapter 5.6.7.1.8 “Parameterization” on page 1214*

↳ *Chapter 5.6.7.1.11 “Measuring ranges” on page 1226*

Table 364: Configurable measuring ranges

Voltage	0 V ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

↳ *Meaning of the LEDs*

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of active-type analog sensors (Current) with galvanically isolated power supply to the analog inputs

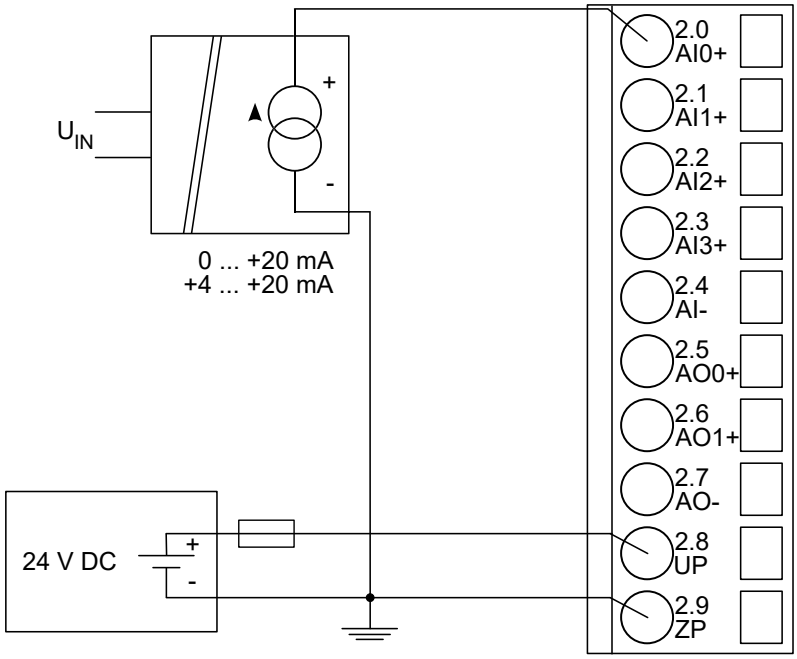


Fig. 239: Connection of active-type analog sensors (current) with galvanically isolated power supply to the analog input AI0 (Proceed with the analog inputs AI1 ... AI3 in the same way)

The following measuring ranges can be configured.

↳ *Chapter 5.6.7.1.8 “Parameterization” on page 1214*

↳ *Chapter 5.6.7.1.11 “Measuring ranges” on page 1226*

Table 365: Configurable measuring ranges

Current	0 mA ... 20 mA	1 channel used
Current	4 mA ... 20 mA	1 channel used

↳ *Meaning of the LEDs*

Unused input channels can be left open-circuited, because they are of low resistance.

To avoid error messages through unused analog input channels in measuring range 4 ... 20 mA, these channels should be configured as "Not used".

Connection of active-type analog sensors (Voltage) with no galvanically isolated power supply to the analog inputs

The following figure shows the connection of active-type analog sensors (voltage) with no galvanically isolated power supply to the analog input AI0. Proceed with the analog inputs AI1 ... AI3 in the same way.

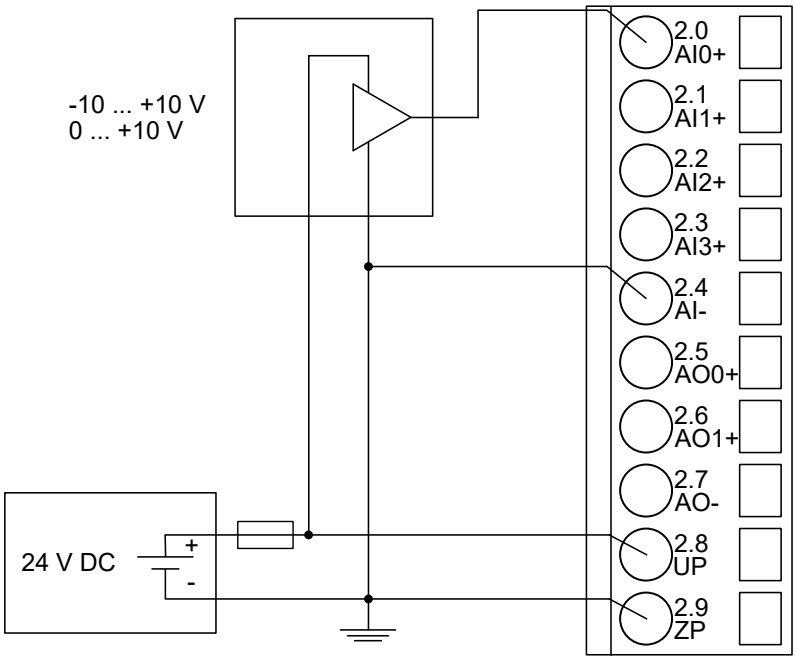


Fig. 240: Connection of active-type analog sensors (voltage) with no galvanically isolated power supply to the analog input AI0 (Proceed with the analog inputs AI1 ... AI3 in the same way)

CAUTION!

Risk of faulty measurements!

The negative pole at the sensors must not have too big a potential difference with respect to ZP (max. ± 1 V).

Make sure that the potential difference never exceeds ± 1 V (also not with long cable lengths).

The following measuring ranges can be configured.

↳ *Chapter 5.6.7.1.8 “Parameterization” on page 1214*

↳ *Chapter 5.6.7.1.11 “Measuring ranges” on page 1226*

Table 366: Configurable measuring ranges

Voltage	0 V ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

↳ *Meaning of the LEDs*

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of passive-type analog sensors (Current) to the analog inputs

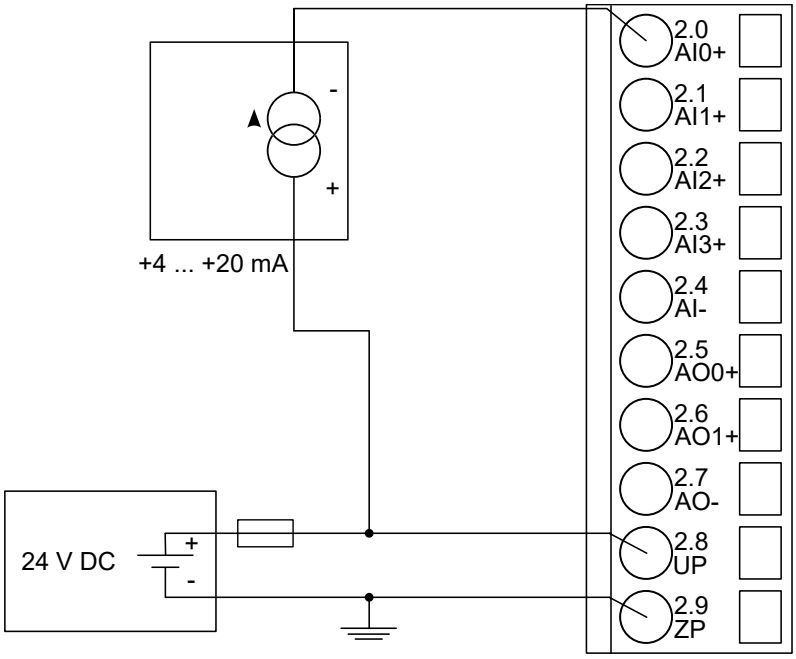


Fig. 241: Connection of passive-type analog sensors (current) to the analog input AI0 (Proceed with the analog inputs AI1 ... AI3 in the same way)

The following measuring ranges can be configured.

↳ *Chapter 5.6.7.1.8 “Parameterization” on page 1214*

↳ *Chapter 5.6.7.1.8 “Parameterization” on page 1214*

Table 367: Configurable measuring ranges

Current	4 mA ... 20 mA	1 channel used

↳ *Meaning of the LEDs*

CAUTION!

Risk of overloading the analog input!

If an analog current sensor supplies more than 25 mA for more than 1 second during initialization, this input is switched off by the module (input protection).

Use only sensors with fast initialization or without current peaks higher than 25 mA. If not possible, connect a 10-volt Zener diode in parallel to AIx+ and ZP.

Unused input channels can be left open-circuited, because they are of low resistance.

To avoid error messages through unused analog input channels in measuring range 4 mA ... 20 mA, these channels should be configured as "Not used".

Connection of active-type analog sensors (Voltage) to differential analog inputs

Differential inputs are very useful, if analog sensors are used which are remotely non-isolated (e.g. the minus terminal is remotely grounded).

The evaluation using differential inputs helps to considerably increase the measuring accuracy and to avoid ground loops.

With differential input configurations, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

The analog value is calculated by subtraction of the input value with the higher address from the input value of the lower address.

The converted analog value is available at the odd channel (higher address).

CAUTION!

Risk of faulty measurements!

The negative pole at the sensors must not have too big a potential difference with respect to ZP (max. ± 1 V).

Make sure that the potential difference never exceeds ± 1 V.

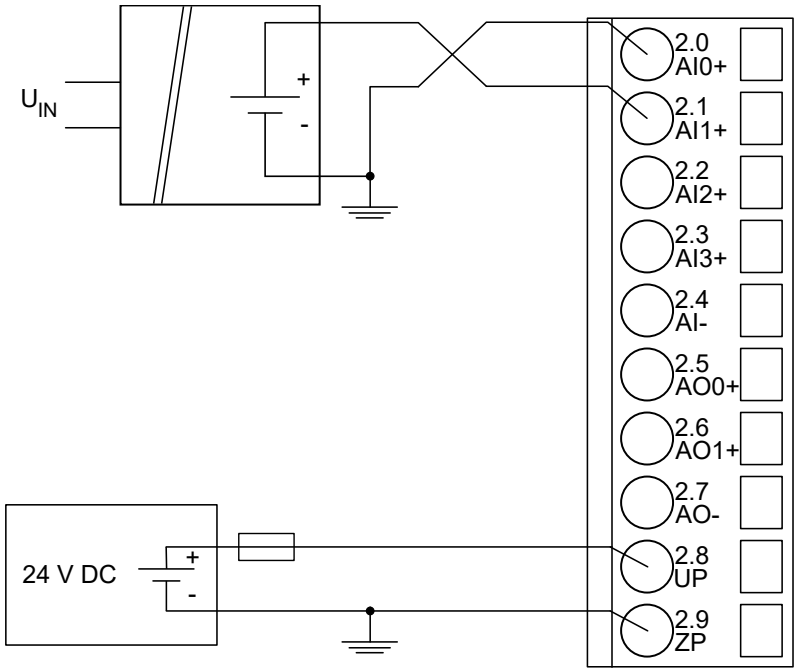


Fig. 242: Connection of active-type analog sensors (voltage) to differential analog inputs AI0 and AI1 (Proceed with AI2 and AI3 in the same way)

The following measuring ranges can be configured.

Chapter 5.6.7.1.8 “Parameterization” on page 1214

Chapter 5.6.7.1.11 “Measuring ranges” on page 1226

Table 368: Configurable measuring ranges

Voltage	0 V ... 10 V	with differential inputs, 2 channels used
Voltage	-10 V ... +10 V	with differential inputs, 2 channels used

Meaning of the LEDs

To avoid error messages from unused analog input channels, configure them as "unused".

Use of analog inputs as digital inputs

Several (or all) analog inputs can be configured as digital inputs. The inputs are not galvanically isolated against the other analog channels.

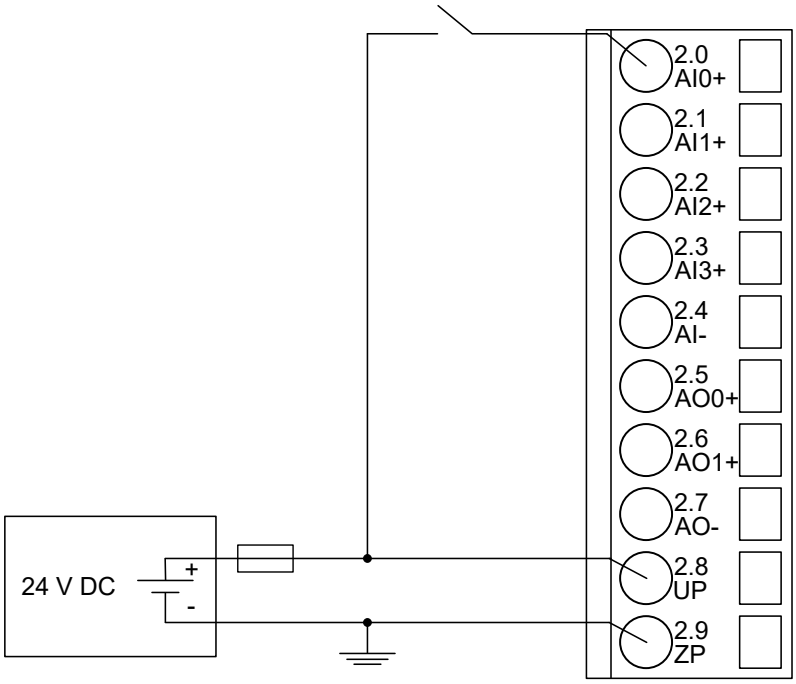


Fig. 243: Connection of digital sensors to the analog input AI0 (Proceed with the analog inputs AI1 ... AI3 in the same way)

The following measuring ranges can be configured.

↳ *Chapter 5.6.7.1.8 “Parameterization” on page 1214*

↳ *Chapter 5.6.7.1.11 “Measuring ranges” on page 1226*

Table 369: Configurable measuring ranges

Digital input	24 V	1 channel used

↳ *Meaning of the LEDs*

Connection of analog output loads (Voltage)

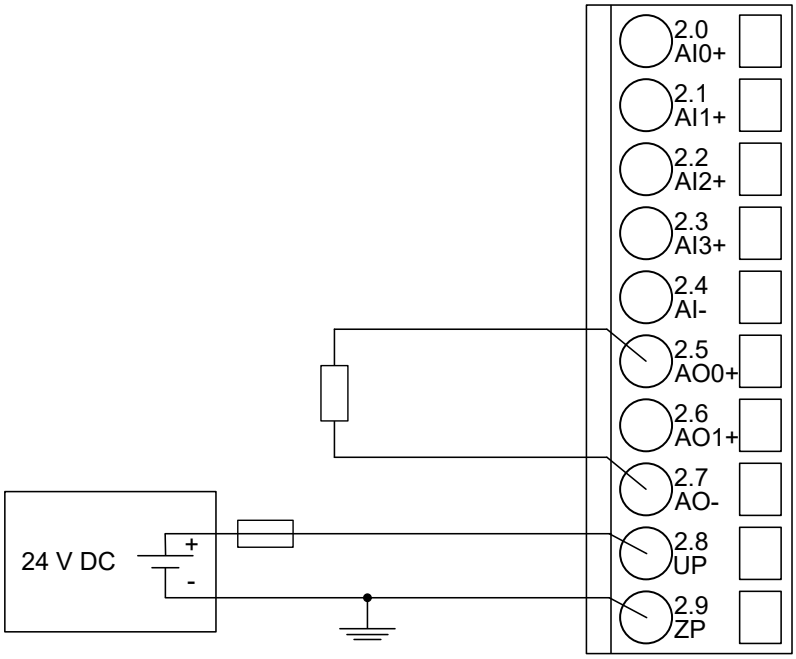


Fig. 244: Connection of analog output loads (voltage) to the analog output AO0 (Proceed with the analog output AO1 in the same way)

The following measuring ranges can be configured.

↳ *Chapter 5.6.7.1.8 “Parameterization” on page 1214*

↳ *Chapter 5.6.7.1.11 “Measuring ranges” on page 1226*

Table 370: Configurable measuring ranges

Voltage	-10 V ... +10 V	Load ± 10 mA max.	1 channel used

↳ *Meaning of the LEDs*

Unused analog outputs can be left open-circuited.

Connection of analog output loads (Current)

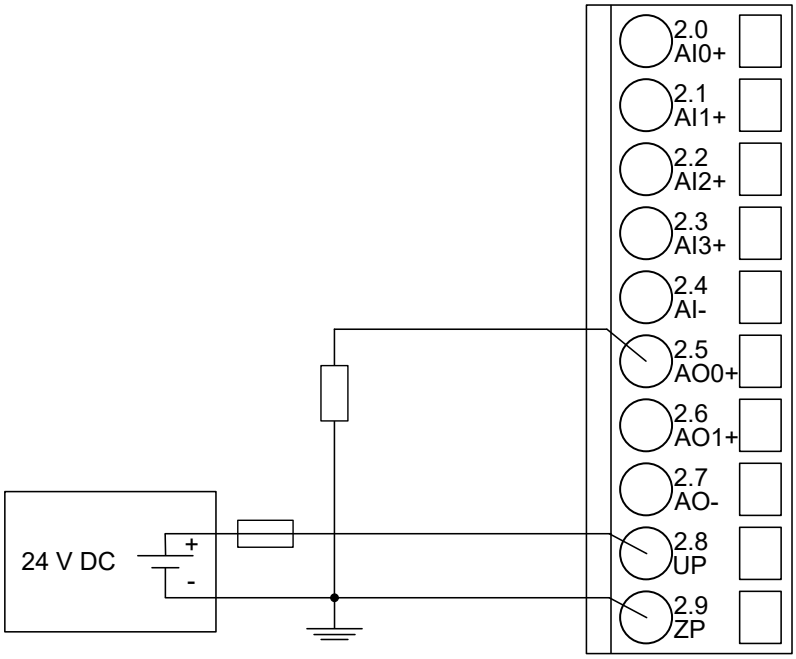


Fig. 245: Connection of analog output loads (current) to the analog output AO0 (Proceed with the analog output AO1 in the same way)

The following measuring ranges can be configured.

↳ *Chapter 5.6.7.1.8 “Parameterization” on page 1214*

↳ *Chapter 5.6.7.1.11 “Measuring ranges” on page 1226*

Table 371: Configurable measuring ranges

Current	0 mA ... 20 mA	Load 0 Ω ... 500 Ω	1 channel used
Current	4 mA ... 20 mA	Load 0 Ω ... 500 Ω	1 channel used

↳ *Meaning of the LEDs*

Unused analog outputs can be left open-circuited.

5.6.7.1.5 Internal data exchange

Parameter	Value
Digital inputs (bytes)	3
Digital outputs (bytes)	3
Analog inputs (words)	4
Analog outputs (words)	2
Counter input data (words)	4
Counter output data (words)	8

5.6.7.1.6 Addressing

The module reads the position of the rotary switches only during power-up, i.e. changes of the switch position during operation will have no effect until the next module initialization.

5.6.7.1.7 I/O configuration

The CI541-DP PROFIBUS DP bus configuration is handled by PROFIBUS DP master with the exception of the slave bus ID (via rotary switches) and the transmission rate (automatic detection).

The analog/digital I/O channels and the fast counter are configured via software.

↳ *Details about configuration*

5.6.7.1.8 Parameterization

Parameters of the module

Table 372: Parameters of the module:

Name	Value	Internal value	Internal value, type	Default
Module ID [1])	Internal	0x1C20	WORD	0x1C20
Parameter length	Internal	47	BYTE	47
Reserved (1 byte)	0	0	BYTE	0
Error LED / Fail-safe function ↳ *Table 373 “Settings "Error LED / Failsafe function"” on page 1215*	On	0	BYTE	0
	Off by E4	1		
	Off by E3	2		
	On + failsafe	16		
	Off by E4 + failsafe	17		
	Off by E3 + failsafe	18		
Reserved (20 bytes)	0	0	BYTE	0
Check supply (UP and UP3)	On	0	BYTE	
	Off	1		1
Fast counter	0	0	BYTE	0
	:	:		
	10 [2])	10		

[1]) With a faulty ID, the Modules reports a "parameter error" and does not perform cyclic process data transmission

[2]) Counter operating modes ↳ *Chapter 5.4.3.2.9 “Fast counter” on page 522*

Table 373: Settings "Error LED / Failsafe function"

Setting	Description
On	Error LED (S-ERR) lights up at errors of all error classes, Failsafe mode off
Off by E4	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, Failsafe mode off
Off by E3	Error LED (S-ERR) lights up at errors of error classes E1 and E2, Failsafe mode off
On +Failsafe	Error LED (S-ERR) lights up at errors of all error classes, Failsafe mode on *)
Off by E4 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, Failsafe mode on *)
Off by E3 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1 and E2, Failsafe mode on *)
*) The parameters Behaviour analog outputs at communication error and Behaviour digital outputs at communication error are only evaluated if failsafe function is enabled.	

Group parameters for the analog part

Name	Value	Internal value	Internal value, type	Default
Analog data format	Standard Reserved	0 255	BYTE	0
Behaviour analog outputs at communication error *)	Off Last value Last value 5 s Last value 10 s Substitute value Substitute value 5 s Substitute value 10 s	0 1 6 11 2 7 12	BYTE	0
*) The parameter Behaviour analog outputs at communication error is only analyzed if the Failsafe mode is ON.				

Channel parameters for the analog inputs (4x)

General

Name	Value	Internal value	Internal value, type	Default
Input 0, Channel configuration	Operation modes of analog inputs *Table 374 “Operation modes of analog inputs:” on page 1216*	Operation modes of analog inputs *Table 374 “Operation modes of analog inputs:” on page 1216*	BYTE	0
Input 0, Check channel	Settings channel monitoring *Further information on page 1217*	Settings channel monitoring *Further information on page 1217*	BYTE	0
:	:	:	:	:
:	:	:	:	:
Input 3, Channel configuration	Operation modes of analog inputs *Table 374 “Operation modes of analog inputs:” on page 1216*	Operation modes of analog inputs *Table 374 “Operation modes of analog inputs:” on page 1216*	BYTE	0
Input 3, Check channel	Settings channel monitoring *Further information on page 1217*	Settings channel monitoring *Further information on page 1217*	BYTE	0

Channel configuration

Table 374: Operation modes of analog inputs:

Internal value	Operating modes of the analog inputs, individually configurable
0 (default)	Not used
1	0 ... 10 V
2	Digital input
3	0 mA ... 20 mA
4	4 mA ... 20 mA
5	-10 V ... +10 V
8	2-wire Pt100 -50 °C ... +400 °C
9	3-wire Pt100 -50 °C ... +400 °C *)
10	0 V ... 10 V (voltage diff.) *)
11	-10 V ... +10 V (voltage diff.) *)
14	2-wire Pt100 -50 °C ... +70 °C
15	3-wire Pt100 -50 °C ... +70 °C *)
16	2-wire Pt1000 -50 °C ... +400 °C
17	3-wire Pt1000 -50 °C ... +400 °C *)

18	2-wire Ni1000 -50 °C ... +150 °C
19	3-wire Ni1000 -50 °C ... +150 °C *)
*) In the operating modes with 3-wire configuration or with differential inputs, two adjacent analog inputs belong together (e.g. the channels 0 and 1). In these cases, both channels are configured in the desired operating mode. The lower address must be the even address (channel 0). The next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).	

Channel monitoring

Table 375: Table settings channel monitoring:

Internal Value	Check Channel
0 (default)	Plausib(ility), cut wire, short circuit
3	Not used

Channel parameters for the analog outputs (2x)

Name	Value	Internal value	Internal value, type	Default
Output 0, Channel configuration	Operation modes of analog outputs ↳ *Table 376 “Table operation modes of analog outputs:” on page 1218*	Operation modes of analog outputs ↳ *Table 376 “Table operation modes of analog outputs:” on page 1218*	BYTE	0
Output 0, Check channel	Channel monitoring ↳ *Table 377 “ Table channel monitoring:” on page 1218*	Channel monitoring ↳ *Table 377 “ Table channel monitoring:” on page 1218*	BYTE	0
Output 0, Substitute value	Substitute value ↳ *Table 378 “ Table substitute value:” on page 1218*	Substitute value ↳ *Table 378 “ Table substitute value:” on page 1218*	WORD	0
Output 1, Channel configuration	Operation modes of analog outputs ↳ *Table 376 “Table operation modes of analog outputs:” on page 1218*	Operation modes of analog outputs ↳ *Table 376 “Table operation modes of analog outputs:” on page 1218*	BYTE	0

Name	Value	Internal value	Internal value, type	Default
Output 1, Check channel	Channel monitoring *Table 377 “ Table channel monitoring:” on page 1218*	Channel monitoring *Table 377 “ Table channel monitoring:” on page 1218*	BYTE	0
Output 1, Substitute value	Substitute value *Table 378 “ Table substitute value:” on page 1218*	Substitute value *Table 378 “ Table substitute value:” on page 1218*	WORD	0

Channel configuration

Table 376: Table operation modes of analog outputs:

Internal value	Operating modes of the analog outputs, individually configurable
0 (default)	Not used
128	-10 V ... +10 V
129	0 mA ... 20 mA
130	4 mA ... 20 mA

Channel monitoring

Table 377: Table channel monitoring:

Internal value	Check channel
0	Plausib(ility), cut wire, short circuit
3	None

Substitute value

Table 378: Table substitute value:

Intended behavior of output channel when the control system stops	Required setting of the module parameter "Behaviour of outputs in case of a communication error"	Required setting of the channel parameter "Substitute value"
Output OFF	Off	0
Last value infinite	Last value	0
Last value for 5 s and then turn off	Last value 5 sec	0
Last value for 10 s and then turn off	Last value 10 sec	0
Substitute value infinite	Substitute value	depending on configuration
Substitute value for 5 s and then turn off	Substitute value 5 sec	depending on configuration
Substitute value for 10 s and then turn off	Substitute value 10 sec	depending on configuration

Group parameters for the digital part

Name	Value	Internal value	Internal value, type	Default
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.1 ms 0x00
Detect short circuit at outputs	Off On	0 1	BYTE	On 0x01
Behaviour digital outputs at communcation error [1])	Off Last value Last value 5 sec Last value 10 sec Substitute value Substitute value 5 sec Substitute value 10 sec	0 1 6 11 2 7 12	BYTE	Off 0x00
Substitute value at output	0 ... 255	00h ... FFh	BYTE	0 0x00
Detect voltage overflow at outputs [2])	Off On	0 1	BYTE	Off 0x00

[1]) The parameters Behaviour digital outputs at communcation error is only analyzed if the Failsafe-mode is ON.

[2]) The state "externally voltage detected" appears, if the output of a channel DC0 ... DC7 should be switched on while an externally voltage is connected. In this case the start up is disabled, as long as the externally voltage is connected. The monitoring of this state and the resulting diagnosis message can be disabled by setting the parameters to "OFF".

Chapter 5.6.7.1.4 “Connections” on page 1196

5.6.7.1.9 Diagnosis

Structure of the diagnosis block via DPM_SLV_DIAG function block.

Byte Number	Description	Possible Values
1	Data length (header included)	7
2	PROFIBUS DP V1 coding: Vendor specific	129
3	Diagnosis Byte, slot number	31 = CI541-DP (e. g. error at integrated 8 DI / 8 DO) 1 = 1st connected S500 I/O Module ... 10 = 10th connected S500 I/O Module

Byte Number	Description	Possible Values
4	Diagnosis Byte, module number	According to the I/O bus specification passed on by modules to the fieldbus master
5	Diagnosis Byte, channel	According to the I/O bus specification passed on by modules to the fieldbus master
6	Diagnosis Byte, error code	According to the I/O bus specification Bit 7 and bit 6, coded error class 0 = E1 1 = E2 2 = E3 3 = E4 Bit 0 to bit 5, coded error description
7	Diagnosis Byte, flags	According to the I/O bus specification Bit 7: 1 = coming error Bit 6: 1 = leaving error

In cases of short circuit or overload, the digital outputs are turned off. The modules performs reactivation automatically. Thus an acknowledgement of the errors is not necessary. The error message is stored via the LED.

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<– Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**		
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**PROFIBUS DP diag-nosis block**		
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-Identi-fier**	**Error message**		**Remedy**
	[1])	[2])	[3])					
Module errors								
3	-	31	31	31	19	Checksum error in the I/O module		Replace I/O module
3	-	31	31	31	3	Timeout in the I/O module		
3	-	31	31	31	40	Different hard-/firm-ware versions in the module		
3	-	31	31	31	43	Internal error in the module		
3	-	31	31	31	36	Internal data exchange failure		

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<– Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**PROFIBUS DP diag-nosis block**	

Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-Identi-fier**	**Error message**	**Remedy**
	[1])	[2])	[3])				
3	-	31	31	31	9	Overflow diagnosis buffer	Restart
3	-	31	31	31	26	Parameter error	Check master
3	-	31	31	31	11	Process voltage UP too low	Check process supply voltage
3	-	31	31	31	45	Process voltage UP gone	Check process supply voltage
3	-	31/1...10	31	31	17	No communication with I/O device	Replace I/O module
3	-	1...10	31	31	32	Wrong I/O module type on socket	Replace I/O module / Check configu-ration
4	-	1...10	31	31	31	At least one module does not support failsafe function	Check modules and parame-terization
4	-	1...10	31	5	8	I/O module removed from hot swap terminal unit or defective module on hot swap ter-minal unit [9])	Plug I/O module, replace I/O module
4	-	1...10	31	5	28	Wrong I/O module plugged on hot swap terminal unit [9])	Remove wrong I/O module and plug pro-jected I/O module

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<– Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**		
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**PROFIBUS DP diag-nosis block**		
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-Identi-fier**	**Error message**		**Remedy**
	[1])	[2])	[3])					
4	-	1...10	31	5	42	No communication with I/O module on hot swap terminal unit [9])		Replace I/O module
4	-	1...10	31	5	54	I/O module does not support hot swap [8]) [9])		Power off system and replace I/O module
4	-	1...10	31	6	8	Hot swap terminal unit configured but not found		Replace terminal unit by hot swap terminal unit
4	-	1...10	31	6	42	No communication with hot swap terminal unit [9])		Restart, if error persists replace terminal unit
4	-	31	31	31	46	Reverse voltage from digital outputs DO0...DO7 to UP3 [4])		Check connection
4	-	31/1...10	31	31	34	No response during initialization of the I/O module		Replace I/O module
4	-	31	31	31	11	Process voltage UP3 too low		Check process supply voltage
4	-	31	31	31	45	Process voltage UP3 gone		Check process supply voltage

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<– Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**PROFIBUS DP diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-Identi-fier**	**Error message**	**Remedy**
	[1])	[2])	[3])				
4	-	31	31	31	10	Voltage overflow on outputs (above UP3 level) [5])	Check terminals/ check process supply voltage
Channel error digital							
4	-	31	2	0...7	46	Externally voltage detected on digital output DO0...DO7 [6])	Check terminals
4	-	31	2	0...7	47	Short circuit at digital output [7])	Check terminals
Channel error analog							
4	-	31	1	0...3	48	Analog value overflow or broken wire at an analog input	Check value or check terminals
4	-	31	1	0...3	7	Analog value underflow at an analog input	Check value
4	-	31	1	0...3	47	Short-circuit at an analog input	Check terminals
4	-	31	3	0...1	4	Analog value overflow at an analog output	Check output value
4	-	31	3	0...1	7	Analog value underflow at an analog output	Check output value

Remarks:

[1])	In AC500 the following interface identifier applies: "-" = Diagnosis via bus-specific function blocks; 0...4 or 10 = Position of the Communication Module; 14 = I/O bus; 31 = Module itself The identifier is not contained in the CI541-DP diagnosis block.
[2])	With "Device" the following allocation applies: 31 = Module itself; 1...10 = Expansion module
[3])	With "Module" the following allocation applies: 31 = Module itself Channel error: Module type (1 = AI, 2 = DO, 3 = AO)
[4])	This message appears, if externally voltages at one or more terminals DO0...DO7 cause that other digital outputs are supplied through that voltage (voltage feedback). All outputs of the apply digital output groups will be turned off for 5 seconds. The diagnosis message appears for the whole output group. *Chapter 5.6.7.1.4 “Connections” on page 1196*
[5])	The voltage on digital outputs DO0 ... DO7 has overrun the process supply voltage UP3. Diagnosis message appears for the whole module. *Chapter 5.6.7.1.4 “Connections” on page 1196*
[6])	This message appears, if the output of a channel DO0 ... DO7 should be switched on while an externally voltage is connected. In this case the start up is disabled, as long as the externally voltage is connected. Otherwise this could produce reverse voltage from this output to other digital outputs. This diagnosis message appears per channel.
[7])	Short circuit: After a detected short circuit, the output is deactivated for 100ms. Then a new start up will be executed. This diagnosis message appears per channel.
[8])	In case of an I/O module doesn’t support hot swapping, do not perform any hot swap operations (also not on any other terminal units (slots)) as modules may be damaged or I/O bus communication may be disturbed.
[9])	Diagnosis for hot swap available as of version index F0.

5.6.7.1.10 State LEDs

The LEDs are located at the front of module.

There are 2 different groups of LEDs:

- The 5 system LEDs (PWR, STA1-DP, STA2-DP, S-ERR and I/O-Bus) show the operation state of the module and display possible errors.
- The 27 process LEDs (UP, UP3, inputs, outputs, CH-ERR1 to CH-ERR3) show the process supply voltage and the states of the inputs and outputs and display possible errors.

Table 379: States of the 5 system LEDs:

LED	Color	OFF	ON	Flashing
PWR/RUN	Green	Process supply voltage missing	Internal supply voltage OK, module ready for communication with I/O Controller	Start-up / preparing communication
	Yellow	---	---	---

LED	Color	OFF	ON	Flashing
STA1-DP	Green	---	PROFIBUS running	Invalid device parameters
STA2-DP	Red	No error	Bus timeout	No communication to master
S-ERR	Red	No error	Internal error	--
I/O-Bus	Green	No communication interface modules connected or communication error	Communication interface modules connected and operational	---

Table 380: States of the 27 process LEDs:

LED	Color	OFF	ON	Flashing
AI0 to AI3	Yellow	Input is OFF	Input is ON (brightness depends on the value of the analog signal)	--
AO0 to AO1	Yellow	Output is OFF	Output is ON (brightness depends on the value of the analog signal)	--
DI0 to DI7	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--
DO0 toDO7	Yellow	Output is OFF	Output is ON	--
UP	Green	Process supply voltage missing	Process supply voltage OK and initialization finished	--
UP3	Green	Process supply voltage missing	Process supply voltage OK	--
CH-ERR1 to CH-ERR3	Red	No error or process supply voltage missing	Internal error	Error on one channel of the corresponding group

5.6.7.1.11 Measuring ranges

Input ranges voltage, current and digital input

Range	0 V ... +10 V	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital input	Digital value	
						Decimal	Hex.
Overflow	> 11.7589	> 11.7589	> 23.5178	> 22.8142		32767	7FFF
Measured value too high	11.7589 : 10.0004	11.7589 : 10.0004	23.5178 : 20.0007	22.8142 : 20.0006		32511 : 27649	7EFF : 6C01
Normal range Normal range or measured value too low	10.0000 : 0.0004	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	: : On	27648 : 1	6C00 : 0001
	0.0000	0.0000	0	4	Off	0	0000
	-0.0004 -1.7593	-0.0004 : : -10,0000		3.9994 1.1858		-1 -4864 : -27648	FFFF ED00 : 9400
Measured value too low		-10.0004 : -11.7589				-27649 : -32512	93FF : 8100
Underflow	< 1.7593	< -11.7589	< 0.0000	< 1.1858		-32768	8000

The represented resolution corresponds to 16 bits.

Input ranges resistance temperature detector

Range	Pt100 / Pt1000 -50 ... +70 °C	Pt100 / Pt1000 -50 ... +400 °C	Ni1000 -50 ... +150 °C
Overflow	> +80.0 °C	> +450.0 °C	> +160.0 °C
Measured value too high		+450.0 °C : + 400.1 °C	
			+160.0 °C : +150.1 °C
Normal range		+400.0 °C : : : + 0.1 °C	+150.0 °C : : +0.1 °C
		0.0 °C	0.0 °C

Range	**Pt100 / Pt1000** **-50 ... +70 °C**	**Pt100 / Pt1000** **-50 ... +400 °C**	**Ni1000** **-50 ... +150 °C**
		-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C
Measured value too low		-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C
Underflow	< -60.0 °C	< -60.0 °C	< -60.0 °C

Range	**Digital value**	
	Decimal	**Hex.**
Overflow	32767	7FFF
Measured value too high	4500 : 4001	1194 : 0FA1
	1600 : 1501	0640 : 05DD
	800 : 701	0320 : 02BD
Normal range	4000 1500 700 : 1	0FA0 05DC 02BC : 0001
	0	0000
	-1 : -500	FFFF : FE0C
Measured value too low	-501 : -600	FE0B : FDA8
Underflow	-32768	8000

Output ranges voltage and current

Range	-10...+10 V	0...20 mA	4...20 mA
Overflow	0 V	0 mA	0 mA
Measured value too high	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA
Normal range	10.0000 V : 0.0004 V	20.0000 mA : 0.0007 mA	20.0000 mA : 4.0006 mA
	0.0000 V	0.0000 mA	4.0000 mA
	-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA
Measured value too low	-10.0004 V : -11.7589 V	0 mA : 0 mA	0 mA : 0 mA
Underflow	0 V	0 mA	0 mA

Range	Digital value	
	Decimal	**Hex.**
Overflow	> 32511	> 7EFF
Measured value too high	32511 : 27649	7EFF : 6C01
Normal range	27648 : 1	6C00 : 0001
	0	0000
	-1 -6912 -27648	FFFF E500 9400
Measured value too low	-27649 : -32512	93FF : 8100
Underflow	< -32512	< 8100

The represented resolution corresponds to 16 bits.

5.6.7.1.12 Technical data

Technical data of the module

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

↳ *Chapter 4.3 “System data AC500-XC” on page 38*

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter		Value
Process supply voltages UP/UP3		
	Rated value	24 V DC (for inputs and outputs)
	Max. load for the terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse on UP/UP3	10 A fast
	Galvanic isolation	PROFIBUS interface against the rest of the module
	Inrush current from UP (at power up)	On request
	Current consumption via UP (normal operation)	0.2 A
	Current consumption via UP3	0.06 A + 0.5 A max. per output
	Connections	Terminals 2.8 and 3.8 for +24 V (UP) Terminal 4.8 for +24 V (UP3) Terminals 2.9, 3.9 and 4.9 for 0 V (ZP)
Max. power dissipation within the module		6 W
Configurable digital inputs/outputs		8
Number of digital inputs		8
Number of digital outputs		8
Reference potential for all digital inputs and outputs		Negative pole of the supply voltage, signal name ZP
Setting of the PROFIBUS DP identifier		With 2 rotary switches at the front side of the module
Operation and error displays		32 LEDs (totally)
Weight (without terminal unit)		Ca. 125 g
Mounting position		Horizontal Or vertical with derating (output load reduced to 50 % at +40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!

All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.



Multiple overloads
With multi-channel modules, there are no effects of multiple overloads as each digital output channel is individually protected by an internal intelligent high-side switch.

Technical data of the digital inputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DI0 ... DI7		Terminals 3.0 ... 3.7
Reference potential for all inputs		Terminals 2.9 ... 4.9 (negative pole of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1 ms ... 32 ms
Input signal voltage		24 V DC
	0-Signal	-3 V ... +5 V
	Undefined Signal	> +5 V ... < +15 V
	1-Signal	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical data of the digital outputs

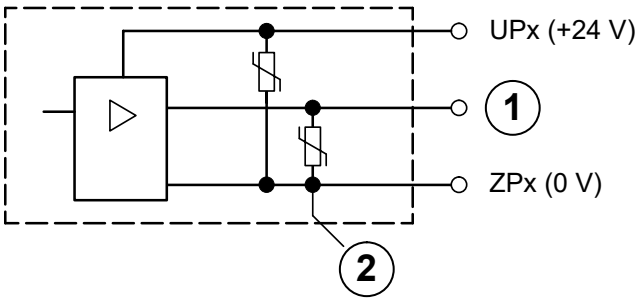
Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DO0 ... DO7	Terminals 4.0 ... 4.7
Reference potential for all outputs	Terminals 2.9 ... 4.9 (negative pole of the supply voltage, signal name ZP)
Common power supply voltage	For all outputs terminal 4.8 (positive pole of the supply voltage, signal name UP3)

Parameter		Value
Output voltage for signal 1		UP3 (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value per channel	500 mA at UP3 = 24 V
	Max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA
	Fuse for UP3	10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)
Output switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The module provides several diagnosis functions.

↳ *Chapter 5.6.7.1.9 “Diagnosis” on page 1219*

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.



1 Digital output
2 Varistors for demagnetization when inductive loads are turned off

Technical data of the analog inputs

Parameter	Value
Number of channels per module	4
Distribution of channels into groups	1 group with 4 channels
Connection if channels AI0+ ... AI3+	Terminals 2.0 ... 2.3

Parameter		Value
Reference potential for AI0+ ... AI3+		Terminal 2.4 (AI-) for voltage and RTD measurement Terminal 2.9, 3.9 and 4.9 for current measurement
Input type		
	Unipolar	Voltage 0 V ... 10 V, current or Pt100/Pt1000/ Ni1000
	Bipolar	Voltage -10 V ... +10 V
Galvanic isolation		Against PROFIBUS
Configurability		0 V ... 10 V, -10 V ... +10 V, 0/4 mA ... 20 mA, Pt100/1000, Ni1000 (each input can be configured individually)
Channel input resistance		Voltage: > 100 kΩ Current: ca. 330 Ω
Time constant of the input filter		Voltage: 100 µs Current: 100 µs
Indication of the input signals		1 LED per channel (brightness depends on the value of the analog signal)
Conversion cycle		1 ms (for 4 inputs + 2 outputs); with RTDs Pt/ Ni... 1 s
Resolution		Range 0 V ... 10 V: 12 bits Range -10 V ... +10 V: 12 bits including sign Range 0 mA ... 20 mA: 12 bits Range 4 mA ... 20 mA: 12 bits Range RTD (Pt100, PT1000, Ni1000): +0.1 °C
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code		↳ *Chapter 5.6.7.1.11 “Measuring ranges” on page 1226*
Unused inputs		Are configured as "unused" (default value)
Overvoltage protection		Yes

Technical data of the analog inputs if used as digital inputs

Parameter		Value
Number of channels per module		Max. 4
Distribution of channels into groups		1 group of 4 channels
Connections of the channels AI0+ ... AI3+		Terminals 2.0 ... 2.3
Reference potential for the inputs		Terminals 2.9, 3.9 and 4.9 (ZP)
Indication of the input signals		1 LED per channel
Input signal voltage		24 V DC
	Signal 0	-30 V ... +5 V

Parameter		Value
	Undefined signal	+5 V ... +15 V
	Signal 1	+15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 7 mA
	Input voltage +5 V	Typ. 1.4 mA
	Input voltage +15 V	Typ. 3.7 mA
	Input voltage +30 V	< 9 mA
Input resistance		Ca. 3.5 kΩ

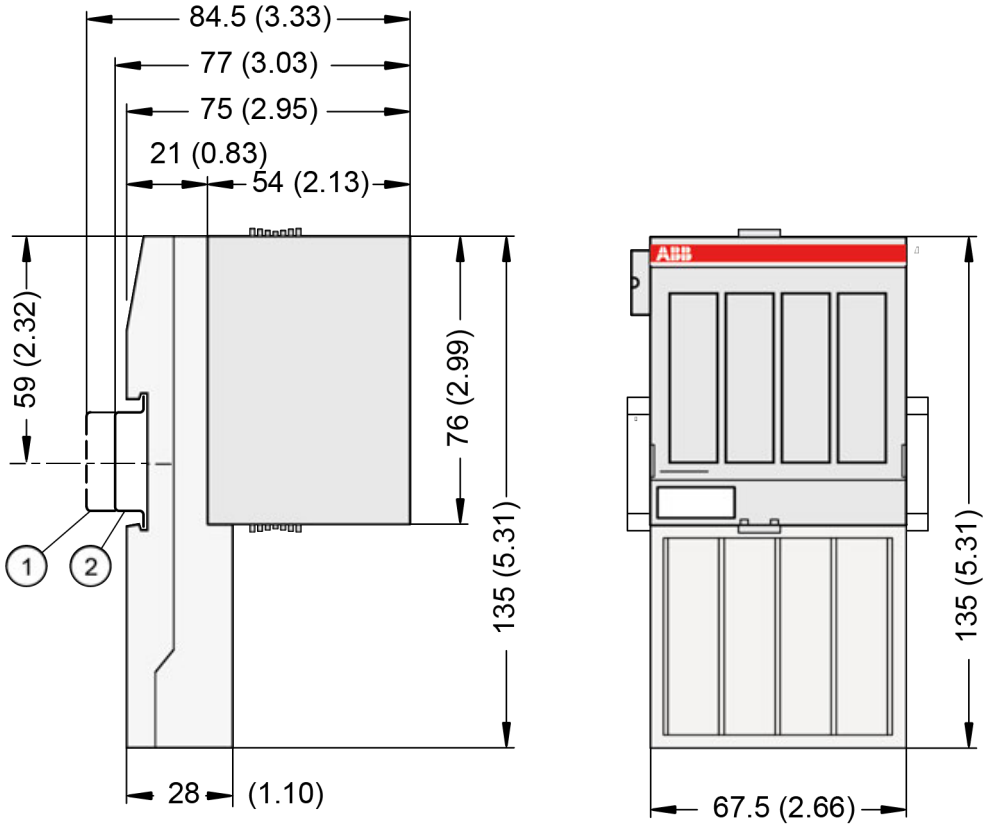
Technical data of the analog outputs

Parameter		Value
Number of channels per module		2
Distribution of channels into groups		1 group for 2 channels
Connection of the channels AO0+ ... AO1+		Terminals 2.5 ... 2.6
Reference potential for AO0+ ... AO1+		Terminal 2.7 (AO-) for voltage output Terminal 2.9, 3.9 and 4.9 for current output
Output type		
	Unipolar	Current
	Bipolar	Voltage
Galvanic isolation		Against PROFIBUS
Configurability		-10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA (each output can be configured individually)
Output resistance (load), as current output		0 Ω ... 500 Ω
Output loadability, as voltage output		± 10 mA max.
Indication of the output signals		1 LED per channel (brightness depends on the value of the analog signal)
Resolution		12 bits including sign
Settling time for full range change (resistive load, output signal within specified tolerance)		Typ. 5 ms
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code		*Chapter 5.6.7.1.11.3 “Output ranges voltage and current” on page 1228*
Unused outputs		Are configured as "unused" (default value) and can be left open-circuited

Technical data of the fast counter

Parameter	Value
Used inputs	Terminal 3.0 (DI0), 3.1 (DI1)
Used outputs	Terminal 4.0 (DO0)
Counting frequency	Depending on operation mode: Mode 1 - 6: max. 200 kHz Mode 7: max. 50 kHz Mode 9: max. 35 kHz Mode 10: max. 20 kHz

5.6.7.1.13 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

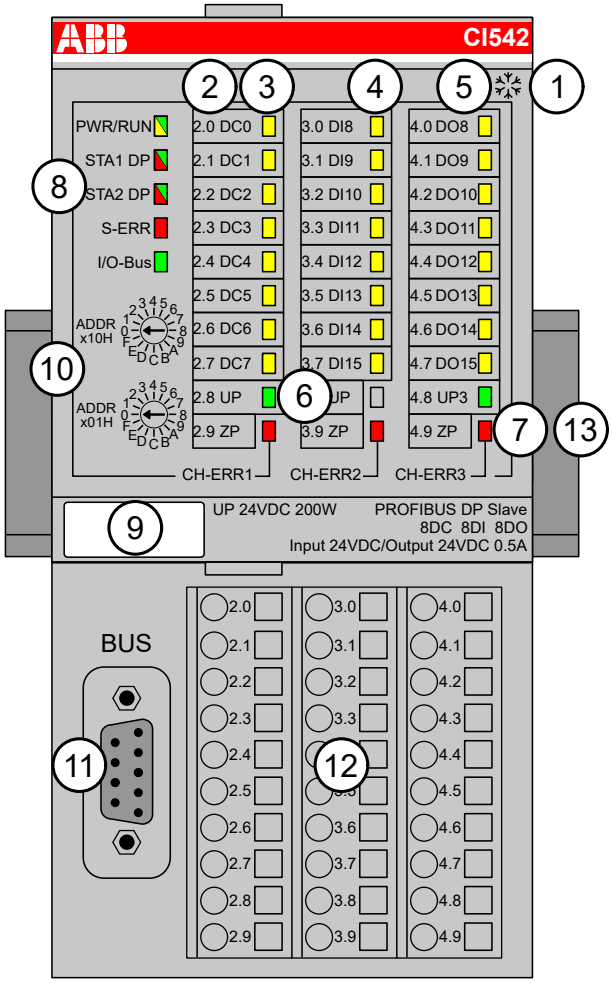
5.6.7.1.14 Ordering data

Ordering No.	Scope of delivery	Product life cycle phase *)
1SAP 224 100 R0001	CI541-DP, PROFIBUS DP communication interface module, 8 DI, 8 DO, 4 AI and 2 AO	Active
1SAP 424 100 R0001	CI541-DP-XC, PROFIBUS DP communication interface module, 8 DI, 8 DO, 4 AI and 2 AO, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.6.7.2 CI542-DP

- 8 digital inputs 24 V DC
- 8 digital outputs 24 V DC, 0.5 A max.
- 8 configurable digital inputs/outputs 24 V DC, 0.5 A max.
- Module-wise galvanically isolated
- Fast counter
- XC version for usage in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 8 yellow LEDs to display the signal states of the configurable digital inputs/outputs (DC0 ... DC7)
4 8 yellow LEDs to display the signal states of the digital inputs (DI8 ... DI15)
5 8 yellow LEDs to display the signal states of the digital outputs (DO8 ... DO15)
6 2 green LEDs to display the process supply voltage UP and UP3
7 3 red LEDs to display errors (CH-ERR1, CH-ERR2, CH-ERR3)
8 5 system LEDs: PWR/RUN, STA1 DP, STA2 DP, S-ERR, I/O-Bus
9 Label
10 2 rotary switches for setting the PROFIBUS ID
11 9-pin D-SUB connector to connect the PROFIBUS DP signals
12 Terminal unit
13 DIN rail
❄ Sign for XC version

5.6.7.2.1 Intended purpose

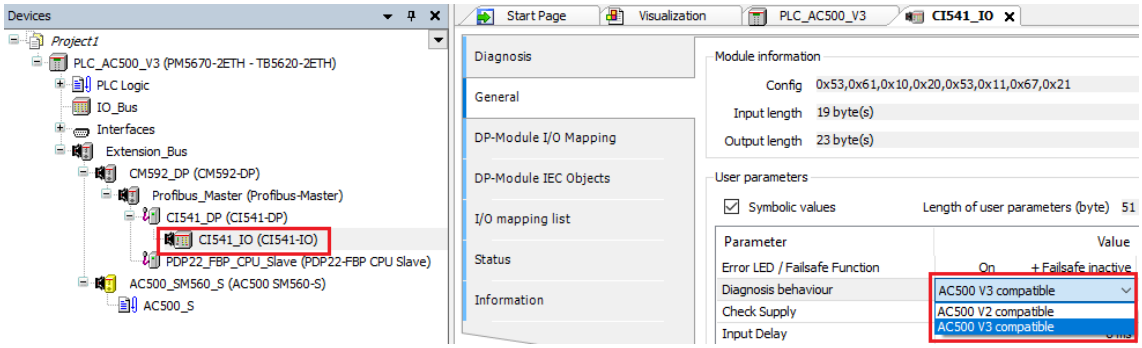
The PROFIBUS DP communication interface module is used as decentralized I/O module in PROFIBUS networks. Depending on the used terminal unit the network connection is performed either via 9-pole female D-sub or via 10 terminals (screw-type or spring terminals) which are integrated in the terminal unit.

The inputs/outputs are galvanically isolated from the PROFIBUS network. There is no potential separation between the channels. The configuration of the configurable digital inputs/outputs is performed by software.

For usage in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

5.6.7.2.2 Diagnosis settings

The current CI54x does not run in combination with a PLC if in the *“General”* tab the parameter *“Diagnosis behavior”* is set to *“AC500 V3 compatible”*. How to change the setting in your AB project is described below.



1. Double click in the *“Device”* tree on *“CI541_IO”*.
   ⇨ The tab for the various settings opens.
2. Double click on the *“General”* tab.
3. Double click on the *“Value”* of the parameter *“Diagnosis behavior”*.
4. Click on the small arrow.
   ⇨ A submenu with two values opens.
5. Click on *“AC500 V2 compatible”* as setting.
6. Close the tab.

After changing the parameter to *“AC500 V2 compatible”* the CI54x get in *“RUN”*.

If the CI54x indicates a S500 diagnosis message, following AC500 diagnosis entry (*“655374 CI54x communication interface module is sending not supported diagnosis format - Check configuration and FW revision of communication interface module”*) is shown in the diagnosis editor and history. This diagnosis message does not have impact to cyclic data exchange between the master and the CI54x.

In case of a parameter change from V2 to V3 the parameter at the CI54x of V3 has the same value than at the CI54x below V2 (that means compatible to AC500 V2).

5.6.7.2.3 Connections

> *For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.*

The PROFIBUS DP communication interface module CI542-DP is plugged on the I/O terminal units TU509 or TU510 and accordingly TU517 or TU518. Properly seat the module and press until it locks in place. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting.

Chapter 5.7.3 “TU509 and TU510 for communication interface modules” on page 1351

Chapter 5.7.4 “TU517 and TU518 for communication interface modules” on page 1355

Chapter 5.8.2.6 “TA526 - Wall mounting accessory” on page 1410

The connection of the I/O channels is carried out using the 30 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

The terminals 2.8 and 3.8 as well as 2.9, 3.9 and 4.9 are electrically interconnected within the terminal unit and have always the same assignment, independent of the inserted module:

Terminals 2.8 and 3.8: Process supply voltage UP = +24 V DC

Terminal 4.8: Process supply voltage UP3 = +24 V DC

Terminals 2.9, 3.9 and 4.9: Process supply voltage ZP = 0 V

With a separate UP3 power supply, the digital outputs can be switched off externally. This way, an emergency-off functionality can be realized.

Do not connect any voltages externally to digital outputs!

This ist not intended usage.

Reason: Externally voltages at one or more terminals DC0...DC7 or DO0...DO7 may cause that other digital outputs are supplied through that voltage instead of voltage UP3 (reverse voltage).

This is also possible, if DC channels are used as inputs. For this, the source for the input signals should be the impressed UP3 of the device.

This limitation does not apply for the input channels DI0...DI7.

CAUTION!

Risk of malfunction by unintended usage!

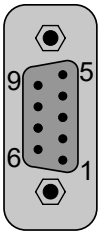
If the function cut-off of the digital outputs is to be used by deactivation of the supply voltage UP3, be sure that no external voltage is connected at the outputs.

Possibilities of connection

Assignment

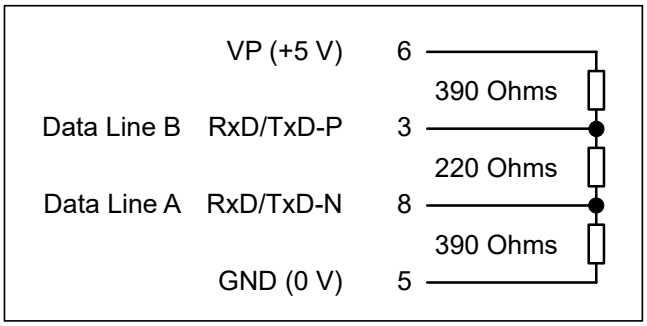
Mounting on terminal units TU509 or TU510:

The assignment of the 9-pole female D-sub for the PROFIBUS DP signals.

Serial Interface	Pin	Signal	Description
	1	---	Reserved
	2	---	Reserved
	3	B	PROFIBUS DP signal B
	4	---	Reserved
	5	DGND	Ground for 5 V power supply
	6	VP (5 V)	5 V power supply
	7	---	Reserved
	8	A	PROFIBUS DP signal A
	9	---	Reserved
	Shield	Cable shield	Functional earth

Bus termination

The line ends of the bus segment must be equipped with bus terminating resistors. Normally, these resistors are integrated in the interface connectors.



The grounding of the shield should take place at the control cabinet.

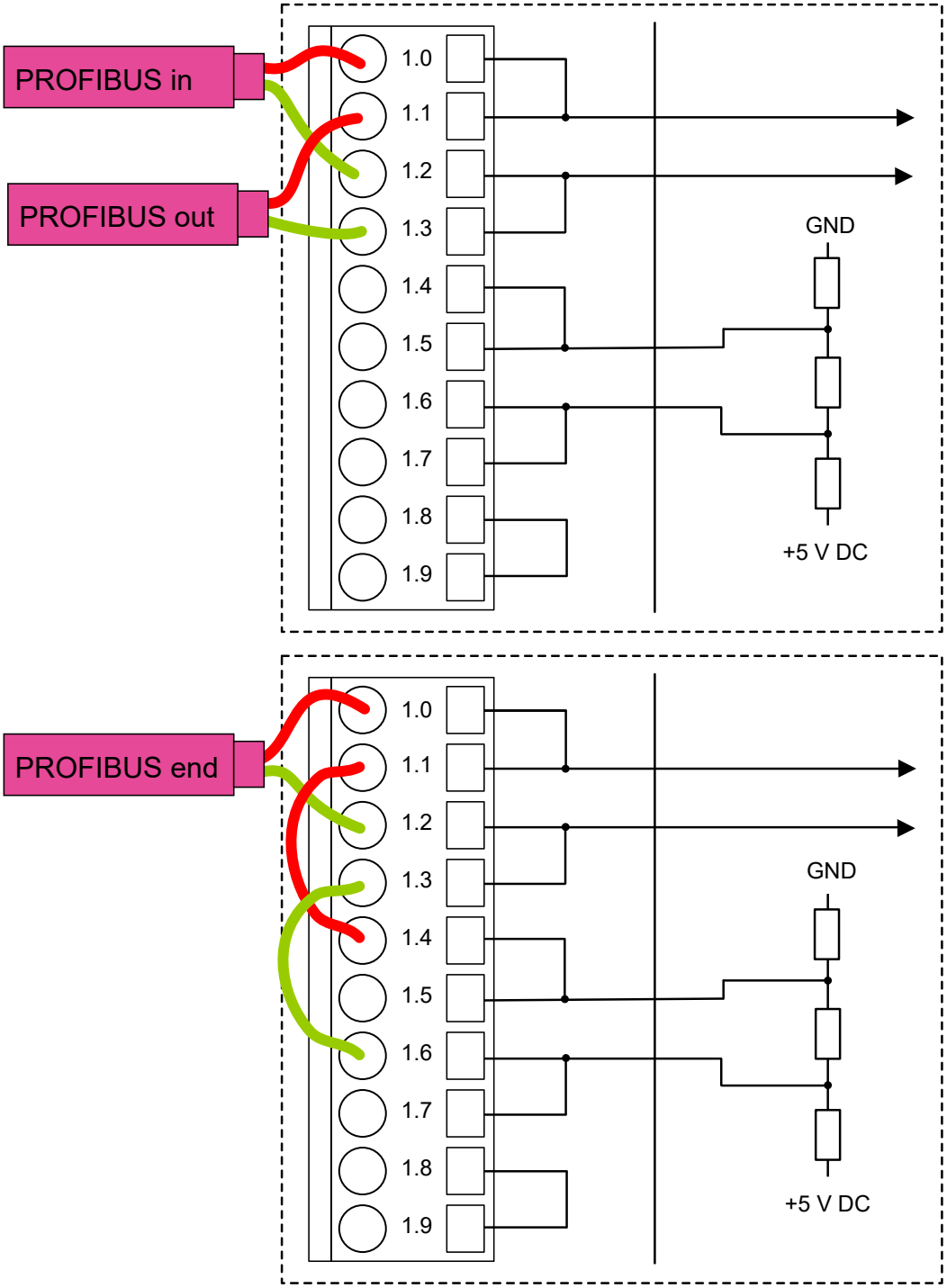
Chapter 4.2 “System data AC500” on page 34

Mounting on terminal units TU517 or TU518:

The assignment of the terminals 1.0 - 1.9:

Terminal	Signal	Description
1.0	B	Data line B (receive and send line, positive)
1.1	B	Data line B (receive and send line, positive)
1.2	A	Data line A (receive and send line, negative)
1.3	A	Data line A (receive and send line, negative)
1.4	TermB	Bus termination data line B
1.5	TermB	Bus termination data line B
1.6	TermA	Bus termination data line A
1.7	TermA	Bus termination data line A
1.8	DGND	Reference potential for data transmission
1.9	DGND	Reference potential for data transmission

At the line ends of a bus segment, terminating resistors must be connected. If using TU517/ TU518, the bus terminating resistors can be enabled by connecting the terminals TermA and TermB to the data lines A and B (no external terminating resistors are required, see figure below).



If using TU517/TU518, note that the terminating resistors are not located inside the TU, but inside the communication interface module CI541-DP. I. e. when removing the device from the TU, the bus terminating resistors are not connected to the bus any more. The bus itself will not be disconnected if a device is removed.

If using TU517/TU518 the max. permitted transmission rate is limited to 1.5 MBaud.

Technical data bus cable

Parameter	Value
Type	Twisted pair (shielded)
Characteristic impedance	135 Ω...165 Ω
Cable capacitance	< 30 pF/m
Conductor diameter of the cores	≥ 0.64 mm
Conductor cross section of the cores	≥ 0.34 mm^2
Cable resistance per core	≤ 55 Ω/km
Loop resistance (resistance of two cores)	≤ 110 Ω/km

Cable length

The maximum possible cable length of a PROFIBUS subnet within a segment depends on the transmission rate (baud rate).

Transmission rate	Maximum cable length
9.6 kBaud to 93.75 kBaud	1200 m
187.5 kBaud	1000 m
500 kBaud	400 m
1.5 MBaud	200 m
3 MBaud to 12 MBaud	100 m

The assignment of the other terminals:

Terminal	Signal	Description
2.0	DC0	Signal of the configurable digital input/output DC0
2.1	DC1	Signal of the configurable digital input/output DC1
2.2	DC2	Signal of the configurable digital input/output DC2
2.3	DC3	Signal of the configurable digital input/output DC3
2.4	DC4	Signal of the configurable digital input/output DC4
2.5	DC5	Signal of the configurable digital input/output DC5
2.6	DC6	Signal of the configurable digital input/output DC6
2.7	DC7	Signal of the configurable digital input/output DC7
2.8	UP	Process voltage UP (24 V DC)
2.9	ZP	Process voltage ZP (0 V DC)
3.0	DI8	Signal of the digital input DI8
3.1	DI9	Signal of the digital input DI9
3.2	DI10	Signal of the digital input DI10
3.3	DI11	Signal of the digital input DI11
3.4	DI12	Signal of the digital input DI12
3.5	DI13	Signal of the digital input DI13
3.6	DI14	Signal of the digital input DI14

Terminal	Signal	Description
3.7	DI15	Signal of the digital input DI15
3.8	UP	Process voltage UP (24 V DC)
3.9	ZP	Process voltage ZP (0 V DC)
4.0	DO8	Signal of the digital output DO8
4.1	DO9	Signal of the digital output DO9
4.2	DO10	Signal of the digital output DO10
4.3	DO11	Signal of the digital output DO11
4.4	DO12	Signal of the digital output DO12
4.5	DO13	Signal of the digital output DO13
4.6	DO14	Signal of the digital output DO14
4.7	DO15	Signal of the digital output DO15
4.8	UP3	Process voltage UP3 (24 V DC)
4.9	ZP	Process voltage ZP (0 V DC)



WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing the following:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.



NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

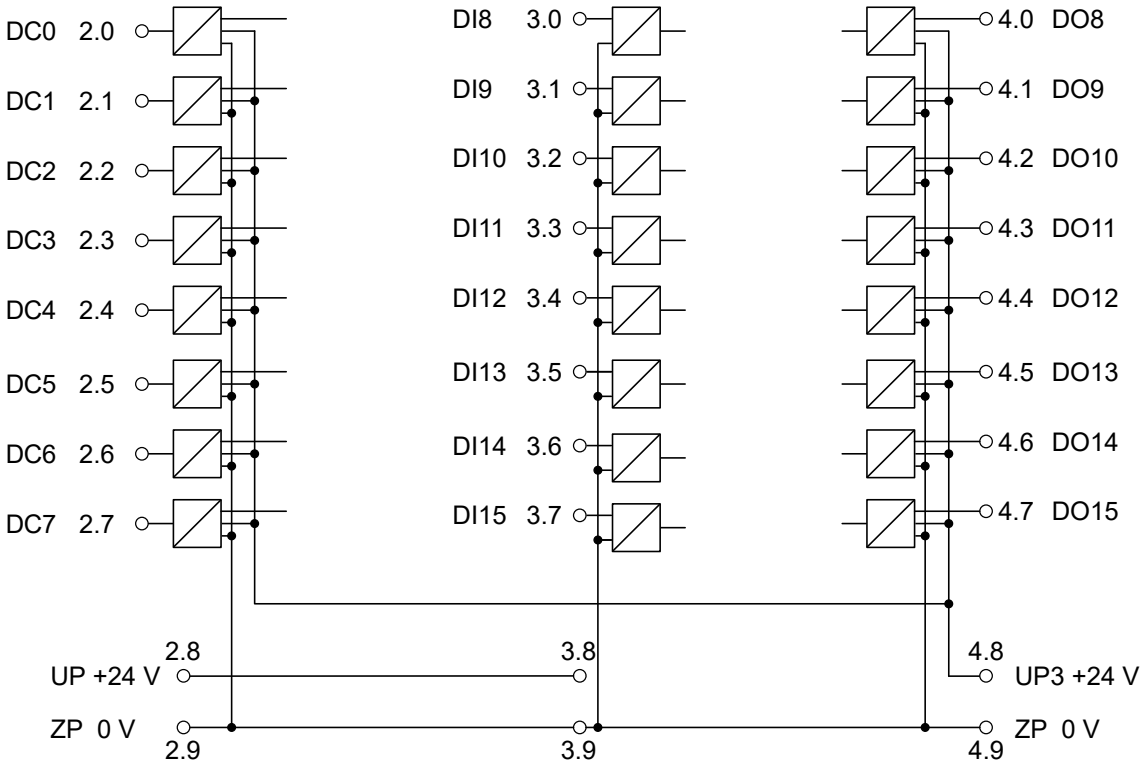


Fig. 246: Connection of the PROFIBUS DP communication interface module CI542-DP

Connection of the digital inputs

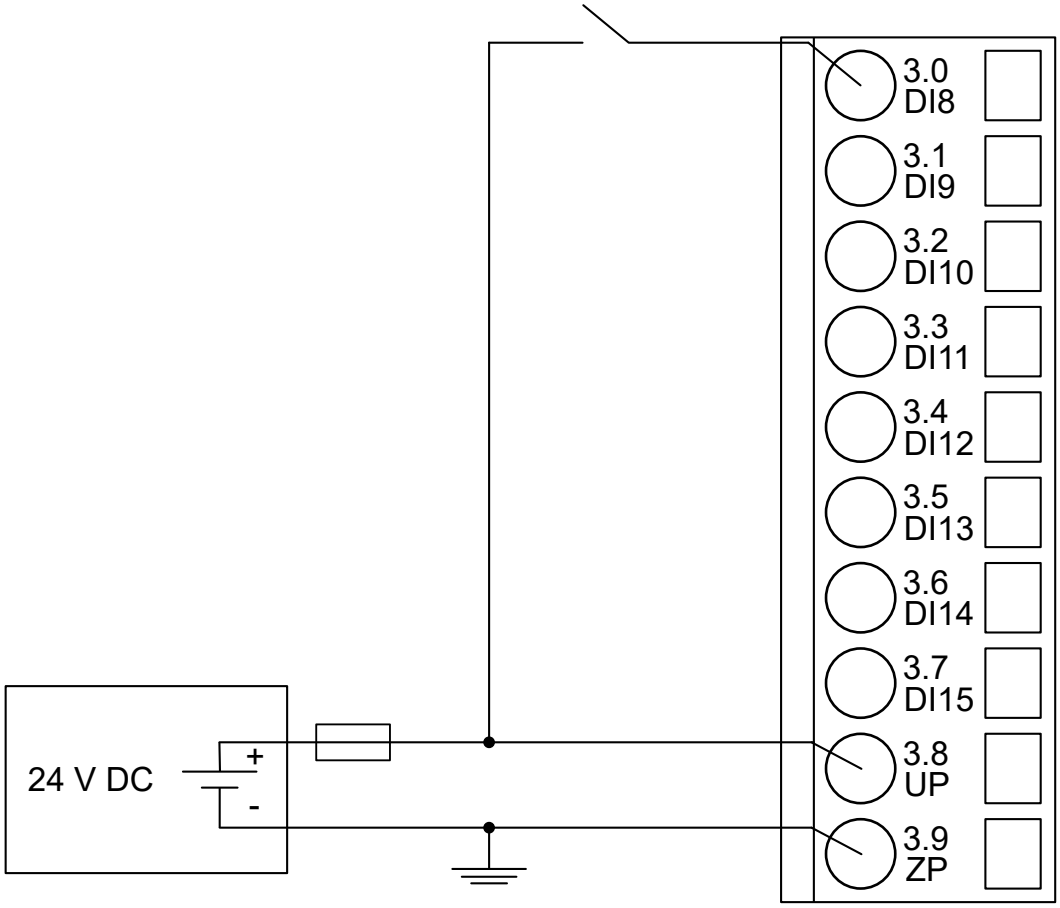


Fig. 247: Connection of the digital input DI8 (Proceed with the digital inputs DI9 to DI15 in the same way)

Meaning of the LEDs

Connection of the digital outputs

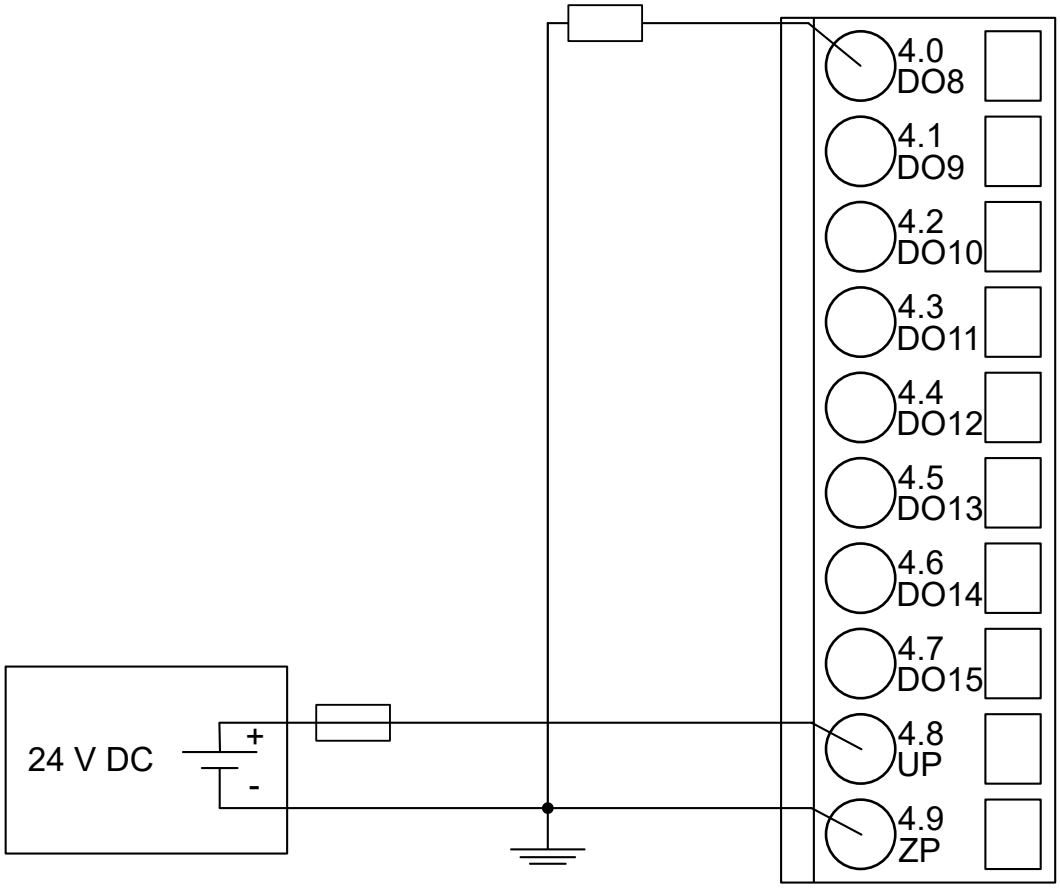


Fig. 248: Connection of the digital output DO8 (Proceed with the digital outputs DO9 - DO15 in the same way)

↳ *Meaning of the LEDs*

Connection of the configurable digital inputs/outputs

CAUTION!
If a DC channel is used as input, the source for the input signals should be the impressed UP3 of the device.

↳ *Chapter 5.6.7.2.3 “Connections” on page 1237*

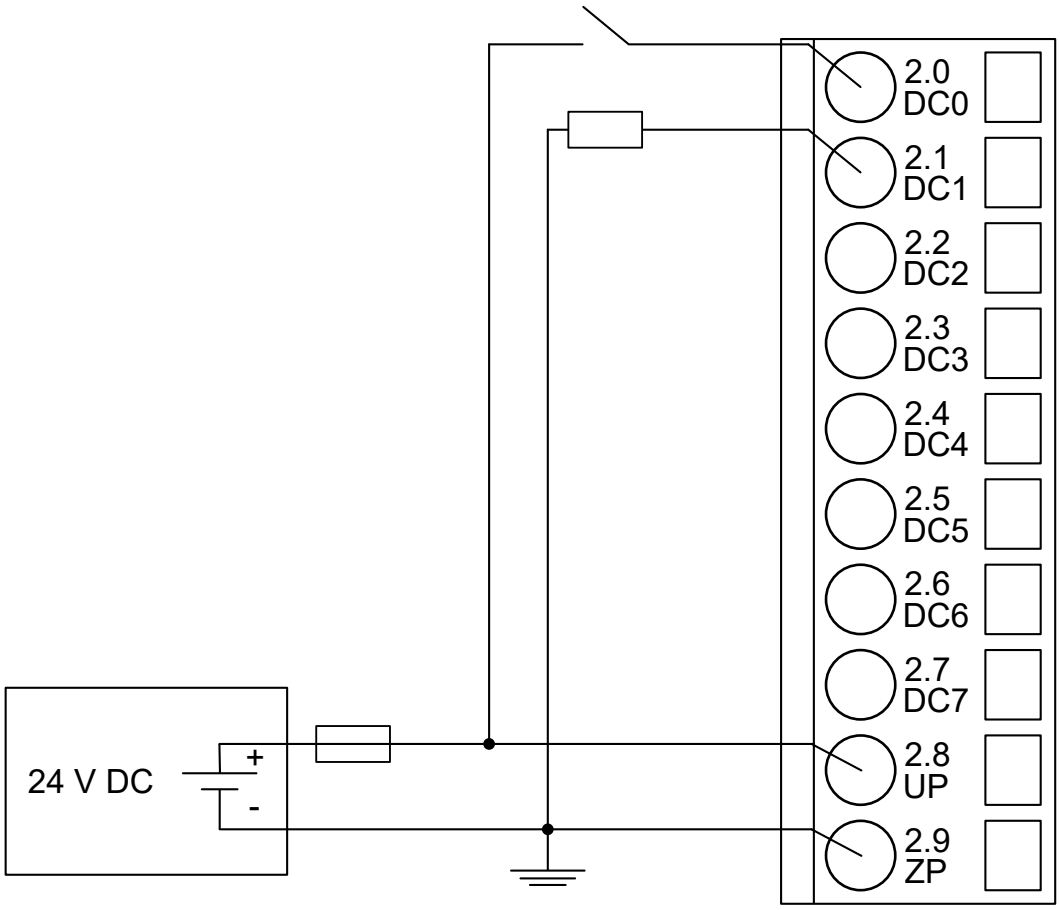


Fig. 249: Connection of the configurable digital input/output DC0 and DC1 (Proceed with the configurable digital inputs/outputs DC2 to DC7 in the same way)

↳ *Meaning of the LEDs*

5.6.7.2.4 Internal data exchange

Parameter	Value
Digital inputs (bytes)	5
Digital outputs (bytes)	5
Counter input data (words)	4
Counter output data (words)	8

5.6.7.2.5 Addressing

The module reads the position of the rotary switches only during power-up, i.e. changes of the switch position during operation will have no effect until the next module initialization.

5.6.7.2.6 I/O configuration

The CI542-DP PROFIBUS DP bus configuration is handled by PROFIBUS DP master with the exception of the slave bus ID (via rotary switches) and the transmission rate (automatic detection).

The digital I/O channels and the fast counter are configured via software.

Details about configuration are described in Parameterization.

5.6.7.2.7 Parameterization

Parameters of the module

Name	Value	Internal value	Internal value, type	Default
Module ID [1])	Internal	0x1C25	WORD	0x1C25
Parameter length	Internal	31	BYTE	31
Reserved (1 byte)	0	0	BYTE	0
Error LED / Failsafe function ↳ *Table 381 “Settings "Error LED / Failsafe function"” on page 1247*	On	0	BYTE	0
	Off by E4	1		
	Off by E3	2		
	On + failsafe	16		
	Off by E4 + failsafe	17		
	Off by E3 + failsafe	18		
Reserved (20 bytes)	0	0	BYTE	0
Check supply	On	0	BYTE	
	Off	1		1
Fast counter	0	0	BYTE	0
	:	:		
	10 [2])	10		

[1]) With a faulty ID, the module reports a "parameter error" and does not perform cyclic process data transmission.

[2]) Counter operating modes ↳ *Chapter 5.4.3.2.9 “Fast counter” on page 522*

Table 381: Settings "Error LED / Failsafe function"

Setting	Description
On	Error LED (S-ERR) lights up at errors of all error classes, Failsafe mode off
Off by E4	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, Failsafe mode off
Off by E3	Error LED (S-ERR) lights up at errors of error classes E1 and E2, Failsafe mode off
On + Failsafe	Error LED (S-ERR) lights up at errors of all error classes, Failsafe mode on *)

Setting	Description
Off by E4 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, Failsafe mode on *)
Off by E3 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1 and E2, Failsafe mode on *)
*) The parameter Behaviour DO at comm. error is only analyzed if the Failsafe mode is ON.	

Group parameters for the digital part

Name	Value	Internal value	Internal value, type	Default
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.1 ms 0x00
Detect short circuit at outputs	Off On	0 1	BYTE	On 0x01
Behaviour DO at comm. error [1])	Off Last value Last value 5 sec Last value 10 sec Substitute value Substitute value 5 sec Substitute value 10 sec	0 1 6 11 2 7 12	BYTE	Off 0x00
Substitute value at output	0 ... 65535	0000h ... FFFFh	WORD	0 0x0000
Preventive voltage feedback monitoring for DC0 ... DC7 [2])	Off On	0 1	BYTE	Off 0x00
Detect voltage overflow at outputs [3])	Off On	0 1	BYTE	Off 0x00

Remarks:

[1])	The parameter Behaviour DO at comm. error is apply to DC and DO channels and only analyzed if the Failsafe-mode is ON.
[2])	The state "externally voltage detected" appears, if the output of a channel DC0 ... DC7 should be switched on while an externally voltage is connected. In this case the start up is disabled, as long as the externally voltage is connected. The monitoring of this state and the resulting diagnosis message can be disabled by setting the parameters to "OFF".
[3])	The error state "voltage overflow at outputs" appears, if externally voltage at digital outputs DC0 ... DC7 and accordingly DO0 ... DO7 has exceeded the process supply voltage UP3 ↬ *Chapter 5.6.7.2.3 “Connections” on page 1237*. The according diagnosis message "Voltage overflow on outputs " can be disabled by setting the parameters on "OFF". This parameter should only be disabled in exceptional cases for voltage overflow may produce reverse voltage.

5.6.7.2.8 Diagnosis

Structure of the diagnosis block via DPM_SLV_DIAG function block.

Byte Number	Description	Possible Values
1	Data length (header included)	7
2	PROFIBUS DP V1 coding: Vendor specific	129
3	Diagnosis Byte, slot number	31 = CI542-DP (e. g. error at integrated 8 DI / 8 DO) 1 = 1st connected S500 I/O module ... 10 = 10th connected S500 I/O module
4	Diagnosis Byte, module number	According to the I/O bus specification passed on by modules to the fieldbus master
5	Diagnosis Byte, channel	According to the I/O bus specification passed on by modules to the fieldbus master
6	Diagnosis Byte, error code	According to the I/O bus specification Bit 7 and bit 6, coded error class 0 = E1 1 = E2 2 = E3 3 = E4 Bit 0 to bit 5, coded error description
7	Diagnosis Byte, flags	According to the I/O bus specification Bit 7: 1 = coming error Bit 6: 1 = leaving error

In cases of short circuit or overload, the digital outputs are turned off. The modules performs reactivation automatically. Thus an acknowledgement of the errors is not necessary. The error message is stored via the LED.

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<– Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**		
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**PROFIBUS DP diag-nosis block**		
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-Identi-fier**	**Error message**		**Remedy**
	[1])	[2])	[3])					
Module errors								
3	-	31	31	31	19	Checksum error in the I/O module		Replace I/O module
3	-	31	31	31	3	Timeout in the I/O module		
3	-	31	31	31	40	Different hard-/firm-ware versions in the module		
3	-	31	31	31	43	Internal error in the module		
3	-	31	31	31	36	Internal data exchange failure		
3	-	31	31	31	9	Overflow diagnosis buffer		Restart
3	-	31	31	31	26	Parameter error		Check master
3	-	31	31	31	11	Process voltage UP too low		Check process supply voltage
3	-	31	31	31	45	Process voltage UP gone		Check process supply voltage
3	-	31/1...10	31	31	17	No communication with I/O module		Replace I/O module
3	-	1...10	31	31	32	Wrong I/O module type on socket		Replace I/O module / Check configu-ration
4	-	1...10	31	31	31	At least one module does not support failsafe function		Check modules and parame-terization

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<– Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**		
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**PROFIBUS DP diag-nosis block**		
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-Identi-fier**	**Error message**		**Remedy**
	[1])	[2])	[3])					
4	-	1...10	31	5	8	I/O module removed from hot swap terminal unit or defective module on hot swap terminal unit [9])		Plug I/O module, replace I/O module
4	-	1...10	31	5	28	Wrong I/O module plugged on hot swap terminal unit [9])		Remove wrong I/O module and plug projected I/O module
4	-	1...10	31	5	42	No communication with I/O module on hot swap terminal unit [9])		Replace I/O module
4	-	1...10	31	5	54	I/O module does not support hot swap [8]) [9])		Power off system and replace I/O module
4	-	1...10	31	6	8	Hot swap terminal unit configured but not found		Replace terminal unit by hot swap terminal unit
4	-	1...10	31	6	42	No communication with hot swap terminal unit [9])		Restart, if error persists replace terminal unit
4	-	31	31	31	45	Process voltage UP3 too low		Check process voltage

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<– Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**		
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**PROFIBUS DP diag-nosis block**		
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-Identi-fier**	**Error message**		**Remedy**
	[1])	[2])	[3])					
4	-	31	31	31	46	Reverse voltage from digital outputs DO0..DO7 to UP3 [4])		Check terminals
4	-	31/1...10	31	31	34	No response during initialization of the I/O module		Replace I/O module
4	-	31	31	31	11	Process voltage UP3 too low		Check process supply voltage
4	-	31	31	31	45	Process voltage UP3 gone		Check process supply voltage
4	-	31	31	31	10	Voltage overflow at outputs (above UP3 level) [5])		Check terminals/ check process supply voltage
Channel error digital								
4	-	31	2	8...15	46	Externally voltage detected at digital output DO0 ... DO7 [6])		Check terminals
4	-	31	4	0...7	46	Externally voltage detected at digital output DC0 ... DC7 [6])		Check terminals
4	-	31	4	0...7	47	Short circuit at digital output DC0 ... DC7[7])		Check terminals
4	-	31	2	8...15	47	Short circuit at digital output DO0 ... DO7[7])		Check terminals

Remarks:

[1])	In AC500 the following interface identifier applies: "-" = Diagnosis via bus-specific function blocks; 0 ... 4 or 10 = Position of the Communication Module;14 = I/O bus; 31 = Module itself The identifier is not contained in the CI542-DP diagnosis block.
[2])	With "Device" the following allocation applies: 31 = Module itself, 1..10 = expansion module
[3])	With "Module" the following allocation applies dependent of the master: Module error: 31 = Module itself Channel error: Module type (1 = AI, 2 = DO, 3 = AO)
[4])	This message appears, if externally voltages at one or more terminals DC0 ... DC7 oder DO0 ... DO7 cause that other digital outputs are supplied through that voltage. All outputs of the apply digital output groups will be turned off for 5 seconds. The diagnosis message appears for the whole output group.
[5])	The voltage at digital outputs DC0 .. DC7 and accordingly DO0 ... DO7 has exceeded the process supply voltage UP3. Diagnosis message appears for the whole module. *Chapter 5.6.7.2.3 “Connections” on page 1237*
[6])	This message appears, if the output of a channel DC0 ... DC7 or DO0 ... DO7 should be switched on while an externally voltage is connected. In this case the start up is disabled, as long as the externally voltage is connected. Otherwise this could produce reverse voltage from this output to other digital outputs. This diagnosis message appears per channel.
[7])	Short circuit: After a detected short circuit, the output is deactivated for 100ms. Then a new start up will be executed. This diagnosis message appears per channel.
[8])	In case of an I/O module doesn’t support hot swapping, do not perform any hot swap operations (also not on any other terminal units (slots)) as modules may be damaged or I/O bus communication may be disturbed.
[9])	Diagnosis for hot swap available as of version index F0.

5.6.7.2.9 State LEDs

The LEDs are located at the front of module.

There are 2 different groups of LEDs:

- The 5 system LEDs (PWR, STA1 DP, STA2 DP, S-ERR and I/O-Bus) show the operation state of the module and display possible errors.
- The 29 process LEDs (UP, UP3, inputs, outputs, CH-ERR1 to CH-ERR3) show the process supply voltage and the states of the inputs and outputs and display possible errors.

Table 382: States of the 5 system LEDs:

LED	Color	OFF	ON	Flashing
PWR/RUN	Green	Process supply voltage missing	Internal supply voltage OK, module ready for communication with I/O Controller	Start-up / preparing communication
	Yellow	---	---	---

LED	Color	OFF	ON	Flashing
STA1-DP	Green	---	PROFIBUS running	Invalid device parameters
STA2-DP	Red	No error	Bus timeout	No communication to master
S-ERR	Red	No error	Internal error	--
I/O-Bus	Green	No communication interface modules connected or communication error	Communication interface module connected and operational	---

Table 383: States of the 29 process LEDs:

LED	Color	OFF	ON	Flashing
DC0 ... DC7	Yellow	Input/Output is OFF	Input/Output is ON	--
DI8 ... DI15	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--
DO8 ... DO15	Yellow	Output is OFF	Output is ON	--
UP	Green	Process supply voltage missing	Process supply voltage OK and initialization finished	--
UP3	Green	Process supply voltage missing	Process supply voltage OK	--
CH-ERR1 to CH-ERR3	Red	No error or process supply voltage missing	Internal error	Error on one channel of the corresponding group

5.6.7.2.10 Technical data

Technical data of the module

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

↳ *Chapter 4.3 “System data AC500-XC” on page 38*

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter		Value
Process supply voltages UP/UP3		
	Rated value	24 V DC (for inputs and outputs)
	Max. load for the terminals	10 A

Parameter		Value
	Protection against reversed voltage	Yes
	Rated protection fuse on UP/UP3	10 A fast
	Galvanic isolation	PROFIBUS interface against the rest of the module
	Inrush current from UP (at power up)	On request
	Current consumption via UP (normal operation)	0.2 A
	Current consumption via UP3	0.06 A + 0.5 A max. per output
	Connections	Terminals 2.8 and 3.8 for +24 V (UP) Terminal 4.8 for +24 V (UP3) Terminals 2.9, 3.9 and 4.9 for 0 V (ZP)
Max. power dissipation within the module		6 W
Number of digital inputs		8
Number of digital outputs		8
Number of analog inputs		4
Number of analog outputs		2
Reference potential for all digital inputs and outputs		Negative pole of the supply voltage, signal name ZP
Setting of the PROFIBUS DP identifier		With 2 rotary switches at the front side of the module
Diagnose		See Diagnosis *Chapter 5.6.7.2.8 “Diagnosis” on page 1249*
Operation and error displays		34 LEDs (totally)
Weight (without terminal unit)		Ca. 125 g
Mounting position		Horizontal mounting or Vertical mounting with derating (output load reduced to 50 % at +40 °C per group)
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Multiple overloads
With multi-channel modules, there are no effects of multiple overloads as each digital output channel is individually protected by an internal intelligent high-side switch.

Technical data of the digital inputs

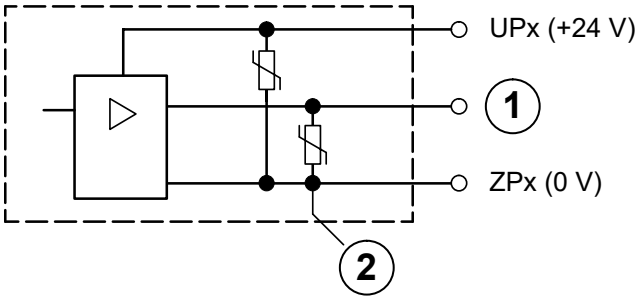
Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DI0 ... DI7		Terminals 3.0 ... 3.7
Reference potential for all inputs		Terminals 2.9 ... 4.9 (negative pole of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1 ms ... 32 ms
Input signal voltage		24 V DC
	Signal 0	-3 V ... +5 V
	Undefined Signal	> +5 V ... < +15 V
	Signal 1	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical data of the digital outputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DO0 ... DO7		Terminals 4.0 ... 4.7
Reference potential for all outputs		Terminals 2.9 ... 4.9 (negative pole of the supply voltage, signal name ZP)
Common power supply voltage		For all outputs terminal 4.8 (positive pole of the supply voltage, signal name UP3)
Output voltage for signal 1		UP3 (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value per channel	500 mA at UP3 = 24 V
	Max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA

Parameter		Value
	Fuse for UP3	10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)
Output switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.



1 Digital output
2 Varistors for demagnetization when inductive loads are turned off

Technical data of the configurable digital inputs/outputs

Each of the configurable I/O channels is defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter		Value
Number of channels per module		8 inputs/outputs (with transistors)
Distribution of the channels into groups		1 group for 8 channels
If the channels are used as inputs		
	Channels DC0 ... DC07	Terminals 2.0 ... 2.7
If the channels are used as outputs		
	Channels DC0 ... DC07	Terminals 2.0 ... 2.7
Indication of the input/output signals		1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Galvanic isolation		From the PROFIBUS network

Technical data of the digital inputs/outputs if used as inputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DC0 ... DC7		Terminals 2.0 .... 2.7
Reference potential for all inputs		Terminals 2.9 ... 4.9 (negative pole of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1 ms ... 32 ms
Input signal voltage		24 V DC
	Signal 0	-3 V ... +5 V
	Undefined Signal	> +5 V ... < +15 V
	Signal 1	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

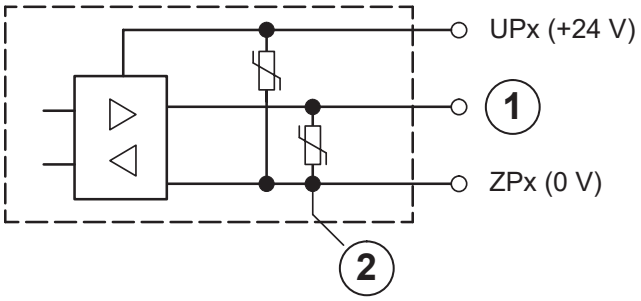
*) Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal may not exceed the clamp voltage of the varistor. The varistor limits the voltage to approx. 36 V. Following this, the input voltage must range from -12 V ... +30 V when UPx = 24 V and from -6 V ... +30 V when UPx = 30 V.

Technical data of the digital inputs/outputs if used as outputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DC0 ... DC7	Terminals 2.0 .... 2.7
Reference potential for all outputs	Terminals 2.9 ... 4.9 (negative pole of the supply voltage, signal name ZP)
Common power supply voltage	For all outputs terminal 4.8 (positive pole of the supply voltage, signal name UP3)
Output voltage for signal 1	UP3 (-0.8 V)
Output delay (0->1 or 1->0)	On request
Output current	

Parameter		Value
	Rated value per channel	500 mA at UP3 = 24 V
	Max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA
	Fuse for UP3	10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)
Output switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

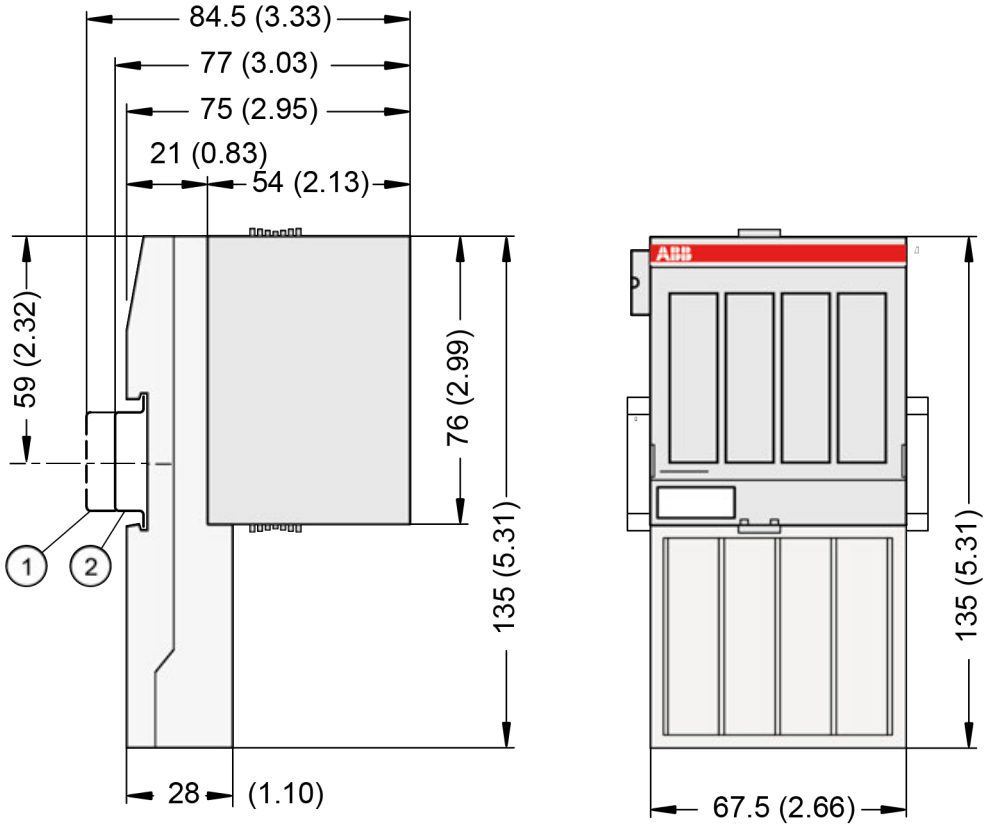


1 Digital input/output
2 For demagnetization when inductive loads are turned off

Technical data of the fast counter

Parameter	Value
Used inputs	Terminal 3.0 (DI0),Terminal 3.1 (DI1)
Used outputs	Terminal 4.0 (DO0)
Counting frequency	Depending on operation mode: Mode 1- 6: max. 200 kHz Mode 7: max. 50 kHz Mode 9: max. 35 kHz Mode 10: max. 20 kHz

5.6.7.2.11 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

5.6.7.2.12 Ordering Data

Part no.	Description	Product life cycle phase *)
1SAP 224 200 R0001	CI542-DP, PROFIBUS DP communication interface module, 8 DI, 8 DO and 8 DC	Active
1SAP 424 200 R0001	CI542-DP-XC, PROFIBUS DP communication interface module, 8 DI, 8 DO and 8 DC, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.6.8 PROFINET

5.6.8.1 Comparison of the CI5xx-PNIO modules

The PROFINET IO devices combine the advantages of decentralized I/O modules with the reaction time of AC500 mounted central I/O modules. The devices for PROFINET provide the extension -PNIO in the device name.

The communication module CM579-PNIO acts as I/O controller in a PROFINET network. It is connected to the processor module via an internal communication bus. Depending on the terminal base, several communication modules can be used for one processor module.

The communication interface modules CI5xx-PNIO act as I/O devices in a PROFINET network.

Additionally the communication module CM589-PNIO(-4) can be used to setup a AC500 PLC to act as I/O module in a PROFINET network.

The difference of the CI5xx-PNIO devices can be found in their input and output characteristics ↳ *Chapter 5.6.8.1.1 “Characteristics of CI50x-PNIO” on page 1261*.

5.6.8.1.1 Characteristics of CI50x-PNIO

Parameter	Value
Bus connection	2 x RJ45
Switch	Integrated
Technology	Hilscher NETX 100
Transfer rate	10/100 Mbit/s (full-duplex)
Transfer method	According to Ethernet II, IEEE 802.3
Ethernet	100 base-TX, internal switch, 2x RJ45 socket
Expandability	Max. 10 S500 I/O modules
Adjusting elements	2 rotary switches for generation of an explicit name
Supported protocols	RTC - real time cyclic protocol, class 1 *) RTA - real time acyclic protocol DCP - discovery and configuration protocol CL-RPC - connectionless remote procedure Call LLDP - link layer discovery protocol MRP - MRP Client
Acyclic services	PNIO read / write sequence (max. 1024 bytes per telegram) Process-Alarm service
Supported alarm types	Process Alarm, Diagnostic Alarm, Return of SubModule, Plug Alarm, Pull Alarm
Min. bus cycle	1 ms

Parameter	Value
Conformance class	CC B
Protective functions (according to IEC 61131-3)	Protected against: ● short circuit ● reverse supply ● overvoltage ● reverse polarity Galvanic isolation from the rest of the module.

*) Prioritization with the aid of VLAN-ID including priority level

5.6.8.1.2 Input/Output characteristics of CI501-PNIO

The PROFINET communication interface module CI501-PNIO is used as decentralized I/O module in PROFINET networks. The network connection is performed via 2 RJ45 connectors which are integrated in the terminal unit. The communication interface module contains 22 I/O channels with the following properties:

- 4 analog inputs (1.0 ... 1.3), configurable as:
  - -10 V ... +10 V
  - 0 V ... +10 V
  - -10 V ... +10 V (differential voltage)
  - 0 mA ... 20 mA
  - 4 mA ... 20 mA
  - Pt100 , Pt1000, Ni1000 (for each 2-wire and 3-wire)
  - 24 V digital input function
- 2 analog outputs (1.5 ... 1.6), configurable as:
  - -10 V ... +10 V
  - 0 mA ... 20 mA
  - 4 mA ... 20 mA
- 8 digital inputs 24 V DC in 1 group (2.0 ... 2.7)
- 8 digital transistor outputs 24 V DC (0.5 A max.) in 1 group (3.0 ... 3.7)
- Resolution of the analog channels: 12 bits

The inputs/outputs are galvanically isolated from the Ethernet network. There is no potential separation between the channels. The configuration of the analog inputs/outputs is performed by software.

For usage in enhanced ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

5.6.8.1.3 Input/Output characteristics of CI502-PNIO

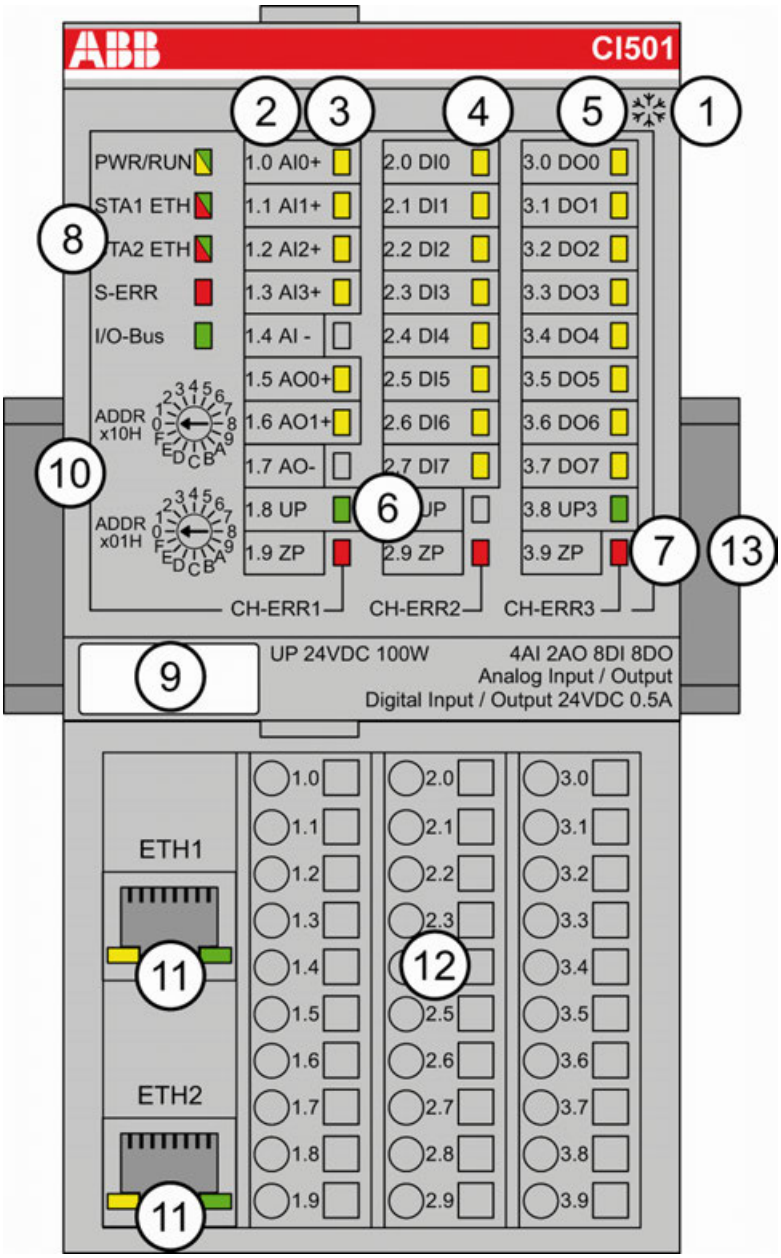
- 8 digital inputs 24 V DC
- 8 digital transistor outputs 24 V DC, 0.5 A max.
- 8 configurable digital inputs/outputs 24 V DC, 0.5 A max.
- Module-wise galvanically isolated
- XC version for usage in extreme ambient conditions available

5.6.8.1.4 Technical data of the serial interfaces of CI504-PNIO

Parameter	Value
Number of serial interfaces	3
Connectors for serial interfaces	X11 for COM1 X12 for COM2 X13 for COM3
Supported physical layers	RS-232 RS-422 RS-485
Supported protocols	ASCII
Transmission rate	Configurable from 300 bit/s to 115.200 bit/s

5.6.8.2 CI501-PNIO

- 4 analog inputs, 2 analog outputs, 8 digital inputs, 8 digital outputs
- Resolution 12 bits including sign
- Module-wise galvanically isolated
- Fast counter
- XC version for usage in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 6 yellow LEDs to display the signal states of the analog inputs/outputs (AI0 ... AI3, AO0 ... AO1)
4 8 yellow LEDs to display the signal states of the digital inputs (DI0 ... DI7)
5 8 yellow LEDs to display the signal states of the digital outputs (DO0 ... DO7)
6 2 green LEDs to display the process supply voltage UP and UP3
7 3 red LEDs to display errors (CH-ERR1, CH-ERR2, CH-ERR3)
8 5 system LEDs: PWR/RUN, STA1 ETH, STA2 ETH, S-ERR, I/O-Bus
9 Label
10 2 rotary switches for setting the I/O device identifier
11 Ethernet interfaces (ETH1, ETH2) on the terminal unit
12 Terminal unit
13 DIN rail
❄ Sign for XC version

5.6.8.2.1 Intended purpose

The PROFINET communication interface modules CI501-PNIO and CI502-PNIO are used as communication interface modules in PROFINET networks. The network connection is performed by Ethernet cables which are inserted in the RJ45 connectors in the terminal unit. An Ethernet switch in the communication interface module allows daisy chaining of the network.

For usage in enhanced ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

5.6.8.2.2 Functionality

The communication interface module contains 22 I/O channels with the following properties:

- 4 configurable analog inputs (2-wire / single-ended) or 2 configurable analog inputs (3-wire / differential) (1.0 ... 1.3)
- 2 analog outputs (1.5 ... 1.6)
- 8 digital inputs 24 V DC in 1 group (2.0 ... 2.7)
- 8 digital outputs 24 V DC, 0.5 A max. in 1 group (3.0 ... 3.7)

The inputs/outputs are galvanically isolated from the PROFINET network. There is no potential separation between the channels. The configuration of the analog inputs/outputs is performed by software.

Parameter	Value
Interface	Ethernet
Protocol	PROFINET IO RT
Power supply	From the process supply voltage UP
Supply of the electronic circuitry of the I/O expansion modules attached	Through the I/O bus interface (I/O bus)
Rotary switches	For setting the I/O device identifier for configuration purposes (00h to FFh)
LED displays	For system displays, signal states, errors and power supply
External supply voltage	Via terminals ZP, UP and UP3 (process supply voltage 24 V DC)
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Required terminal unit	TU507 or TU508 ↳ *Chapter 5.7.2 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 1348*

5.6.8.2.3 Connections

General

The Ethernet communication interface module CI501-PNIO is plugged on the I/O terminal unit TU507-ETH or TU508-ETH. Properly seat the module and press until it locks in place. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting.

↳ *Chapter 5.7.2 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 1348*

↳ *Chapter 5.8.2.6 “TA526 - Wall mounting accessory” on page 1410*

The connection of the I/O channels is carried out using the 30 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The terminals 1.8 and 2.8 as well as 1.9, 2.9 and 3.9 are electrically interconnected within the terminal unit and have always the same assignment, independent of the inserted module:

Terminals 1.8 and 2.8: Process supply voltage UP = +24 V DC

Terminal 3.8: Process supply voltage UP3 = +24 V DC

Terminals 1.9, 2.9 and 3.9: Process supply voltage ZP = 0 V

With a separate UP3 power supply, the digital outputs can be switched off externally. This way, an emergency-off functionality can be realized.

Do not connect any voltages externally to digital outputs!

Reason: External voltages at an output or several outputs may cause that other outputs are supplied through that voltage instead of voltage UP3 (reverse voltage). This is unintended usage.

CAUTION!

Risk of malfunction by unintended usage!

If the function cut-off of the digital outputs is to be used by deactivation of the supply voltage UP3, be sure that no external voltage is connected at the outputs.

Table 384: Assignment of the other terminals

Terminal	Signal	Description
1.0	AI0+	Positive terminal of analog input signal 0
1.1	AI1+	Positive terminal of analog input signal 1
1.2	AI2+	Positive terminal of analog input signal 2
1.3	AI3+	Positive terminal of analog input signal 3
1.4	AI-	Negative terminal of analog input signals 0 to 3
1.5	AO0+	Positive terminal of analog output signal 0
1.6	AO1+	Positive terminal of analog output signal 1
1.7	AI-	Negative terminal of analog output signals 0 and 1
1.8	UP	Process voltage UP (24 V DC)
1.9	ZP	Process voltage ZP (0 V DC)
2.0	DI0	Signal of the digital input DI0
2.1	DI1	Signal of the digital input DI1
2.2	DI2	Signal of the digital input DI2
2.3	DI3	Signal of the digital input DI3

Terminal	Signal	Description
2.4	DI4	Signal of the digital input DI4
2.5	DI5	Signal of the digital input DI5
2.6	DI6	Signal of the digital input DI6
2.7	DI7	Signal of the digital input DI7
2.8	UP	Process voltage UP (24 V DC)
2.9	ZP	Process voltage ZP (0 V DC)
3.0	DO0	Signal of the digital output DO0
3.1	DO1	Signal of the digital output DO1
3.2	DO2	Signal of the digital output DO2
3.3	DO3	Signal of the digital output DO3
3.4	DO4	Signal of the digital output DO4
3.5	DO5	Signal of the digital output DO5
3.6	DO6	Signal of the digital output DO6
3.7	DO7	Signal of the digital output DO7
3.8	UP3	Process voltage UP3 (24 V DC)
3.9	ZP	Process voltage ZP (0 V DC)



WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing the following:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

For the open-circuit detection (wire break), each analog input channel is pulled up to "plus" by a high-resistance resistor. If nothing is connected, the maximum voltage will be read in then.

Generally, analog signals must be laid in shielded cables. The cable shields must be grounded at both sides of the cables. To avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

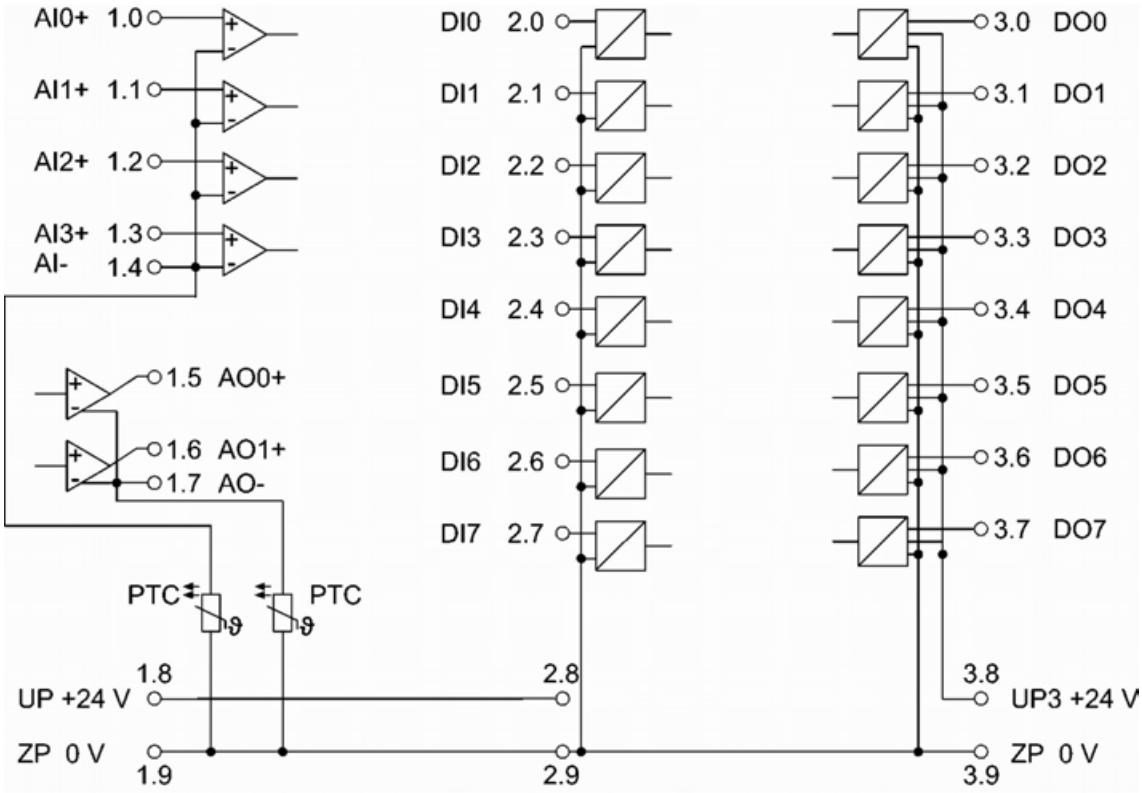


Fig. 250: Connection of the Ethernet bus module CI501-PNIO

Connection of the digital inputs

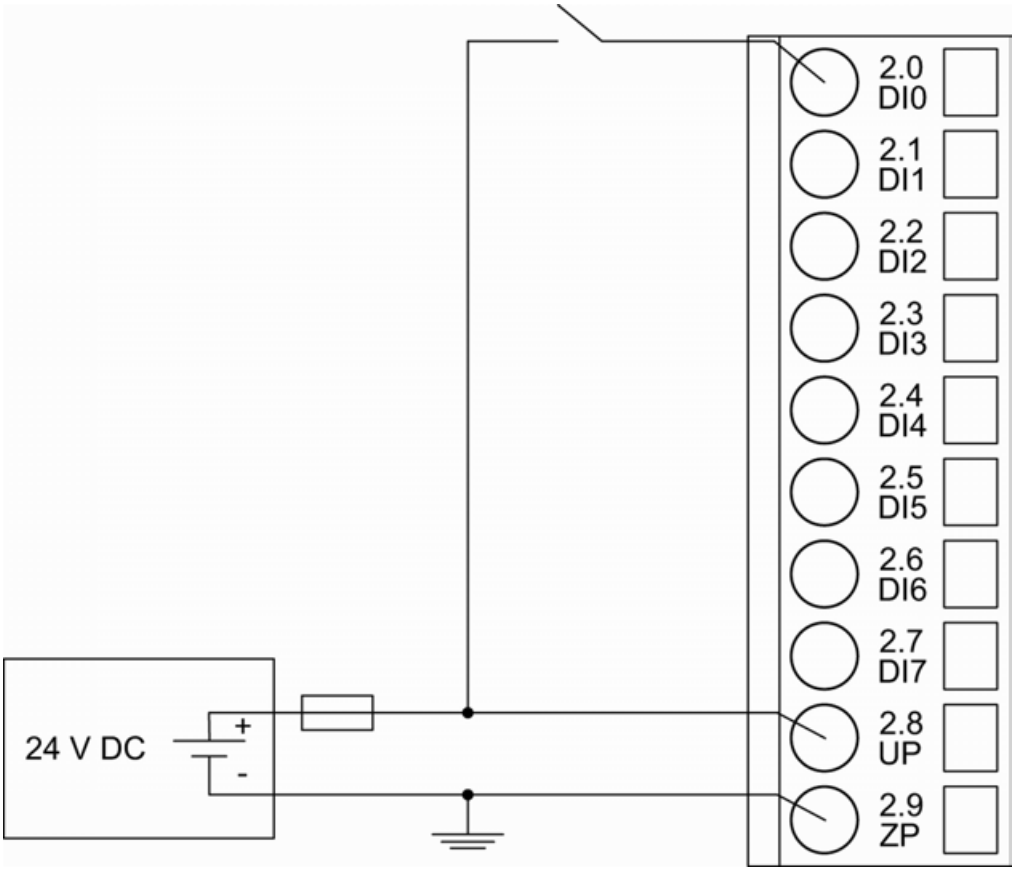


Fig. 251: Connection of the digital inputs (DI0 ... DI7)

Chapter 5.6.8.2.9 “State LEDs” on page 1293

Connection of the digital outputs

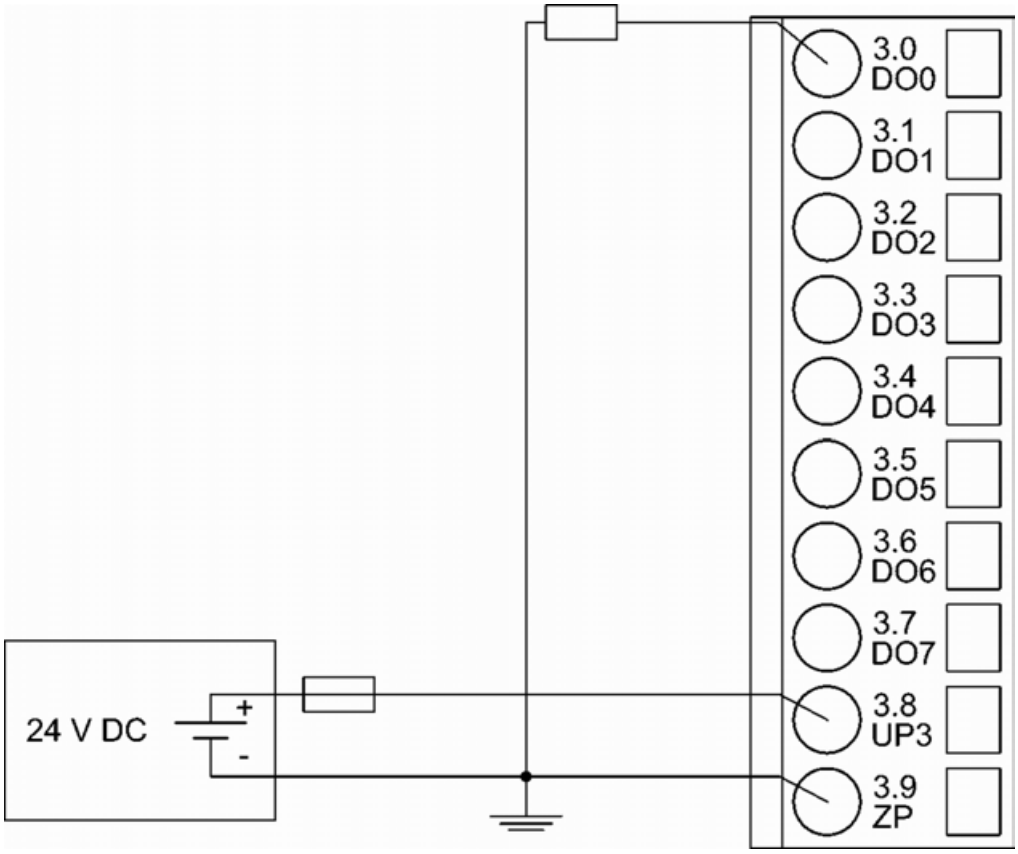


Fig. 252: Connection of the digital output (DO0 ... DO7)

Chapter 5.6.8.2.9 “State LEDs” on page 1293

Connection of resistance thermometers in 2-wire configuration to the analog inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module CI501-PNIO provides a constant current source which is multiplexed over the max. 4 analog input channels.

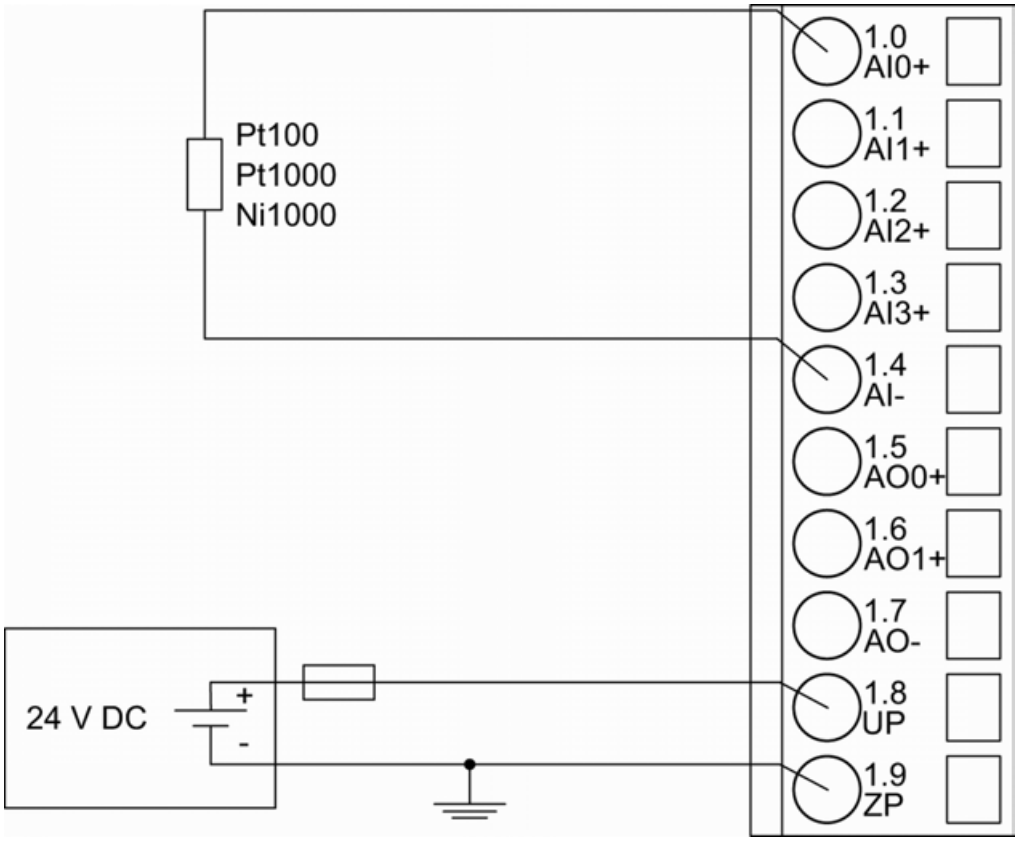


Fig. 253: Connection of resistance thermometers in 2-wire configuration to the analog inputs (AI0 ... AI3)

Table 385: Configurable measuring ranges

Pt100	-50 °C ... +400 °C	2-wire configuration, 1 channel used
Pt1000	-50 °C ... +400 °C	2-wire configuration, 1 channel used
Ni1000	-50 °C ... +150 °C	2-wire configuration, 1 channel used

↳ *Chapter 5.6.8.2.7 “Parameterization” on page 1282*

↳ *Chapter 5.6.8.2.8 “Diagnosis” on page 1288*

The module CI501-PNIO performs a linearization of the resistance characteristic.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of resistance thermometers in 3-wire configuration to the analog inputs

When resistance thermometers (Pt100, Pt1000, Ni1000) are used, a constant current must flow through them to build the necessary voltage drop for the evaluation. For this, the module CI501-PNIO provides a constant current source which is multiplexed over the max. 4 analog input channels.

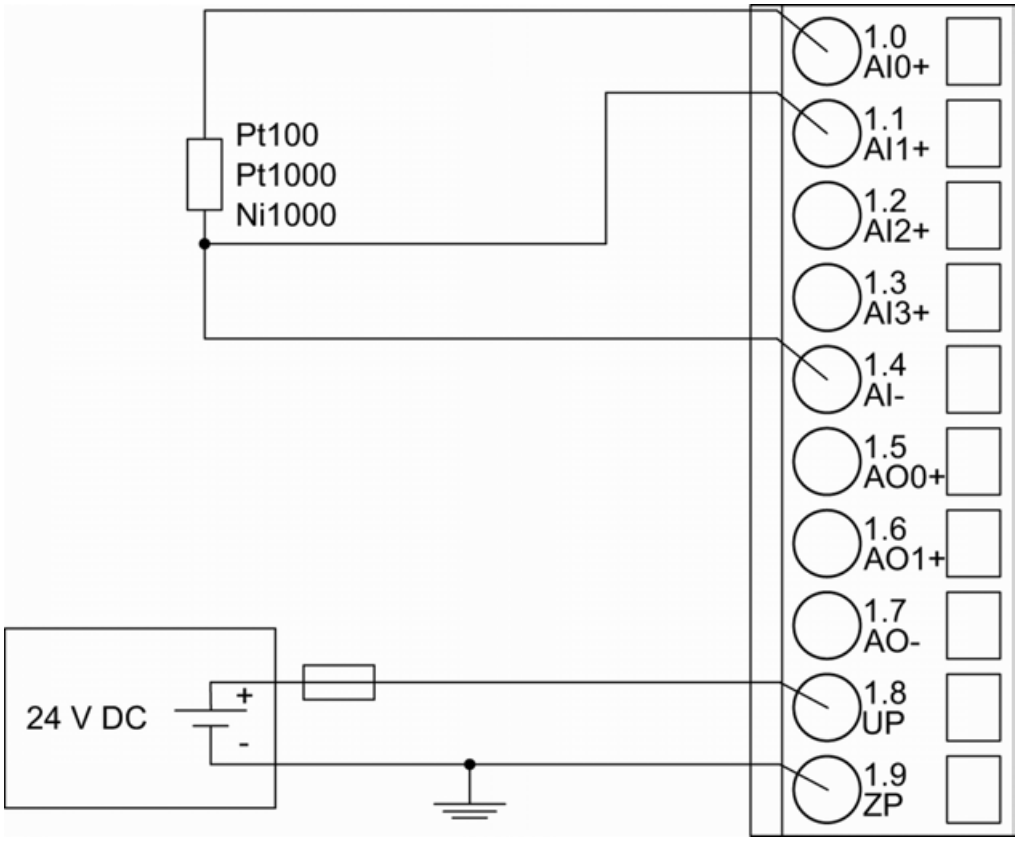


Fig. 254: Connection of resistance thermometers in 3-wire configuration to the analog inputs (AI0 ... AI3)

With 3-wire configuration, 2 adjacent analog channels belong together (e. g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1).

The constant current of one channel flows through the resistance thermometer. The constant current of the other channel flows through one of the cores. The module calculates the measured value from the two voltage drops and stores it under the input with the higher channel number (e. g. I1).

In order to keep measuring errors as small as possible, it is necessary to have all the involved conductors in the same cable. All the conductors must have the same cross section.

Table 386: Configurable measuring ranges

Pt100	-50 °C ... +70 °C	3-wire configuration, 2 channels used
Pt100	-50 °C ... +400 °C	3-wire configuration, 2 channels used
Pt1000	-50 °C ... +400 °C	3-wire configuration, 2 channels used
Ni1000	-50 °C ... +150 °C	3-wire configuration, 2 channels used

↳ *Chapter 5.6.8.2.7 “Parameterization” on page 1282*

↳ *Chapter 5.6.8.2.8 “Diagnosis” on page 1288*

The module CI501-PNIO performs a linearization of the resistance characteristic.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of active-type analog sensors (Voltage) with galvanically isolated power supply to the analog inputs

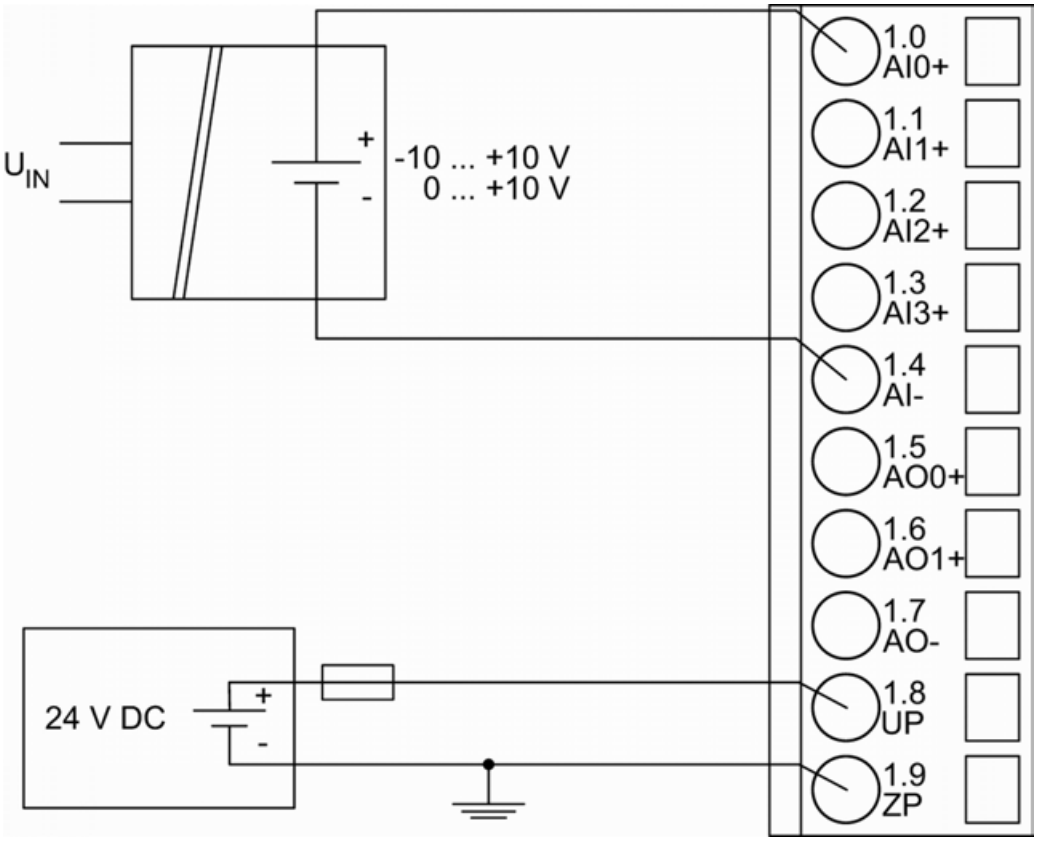


Fig. 255: Connection of active-type analog sensors (voltage) with galvanically isolated power supply to the analog inputs (AI0 ... AI3)

Table 387: Configurable measuring ranges

Voltage	0 V ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

Chapter 5.6.8.2.7 “Parameterization” on page 1282

Chapter 5.6.8.2.8 “Diagnosis” on page 1288

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of active-type analog sensors (Current) with galvanically isolated power supply to the analog inputs

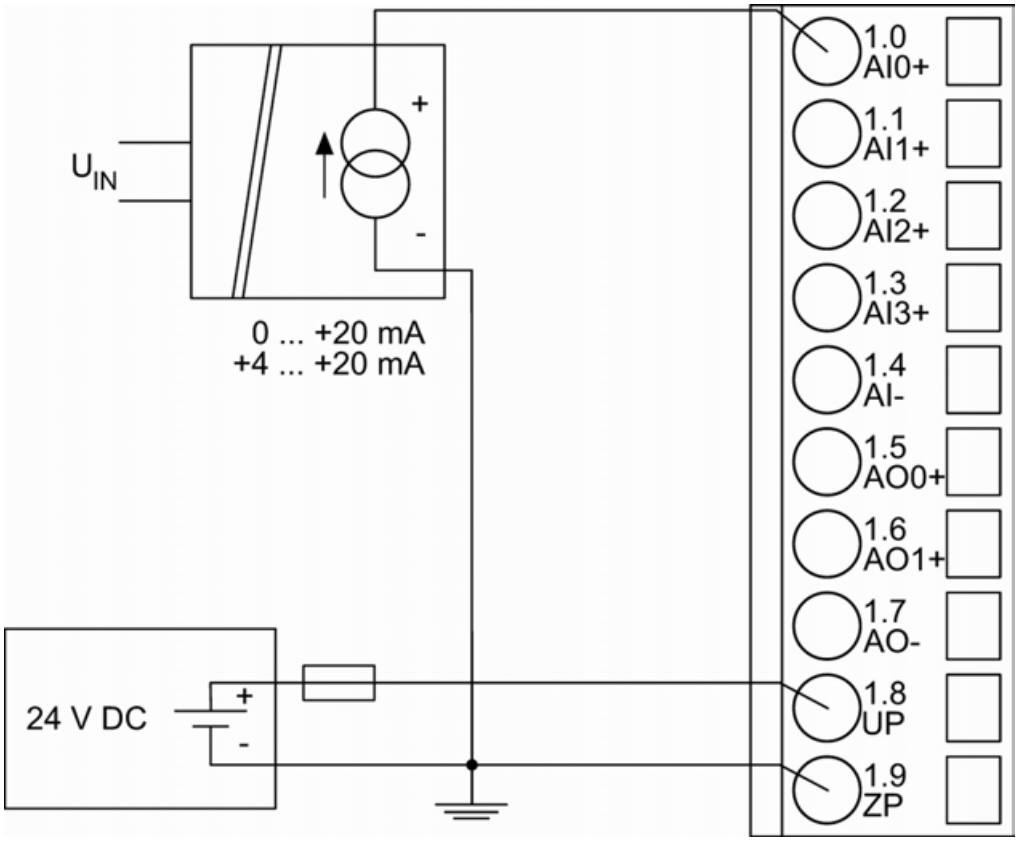


Fig. 256: Connection of active-type analog sensors (current) with galvanically isolated power supply to the analog inputs (AI0 ... AI3)

Table 388: Configurable measuring ranges

Current	0 mA ... 20 mA	1 channel used
Current	4 mA ... 20 mA	1 channel used

Chapter 5.6.8.2.7 “Parameterization” on page 1282

Chapter 5.6.8.2.8 “Diagnosis” on page 1288

Unused input channels can be left open-circuited, because they are of low resistance.

To avoid error messages through unused analog input channels in measuring range 4 mA ... 20 mA, these channels should be configured as "Not used".

Connection of active-type analog sensors (Voltage) with no galvanically isolated power supply to the analog inputs

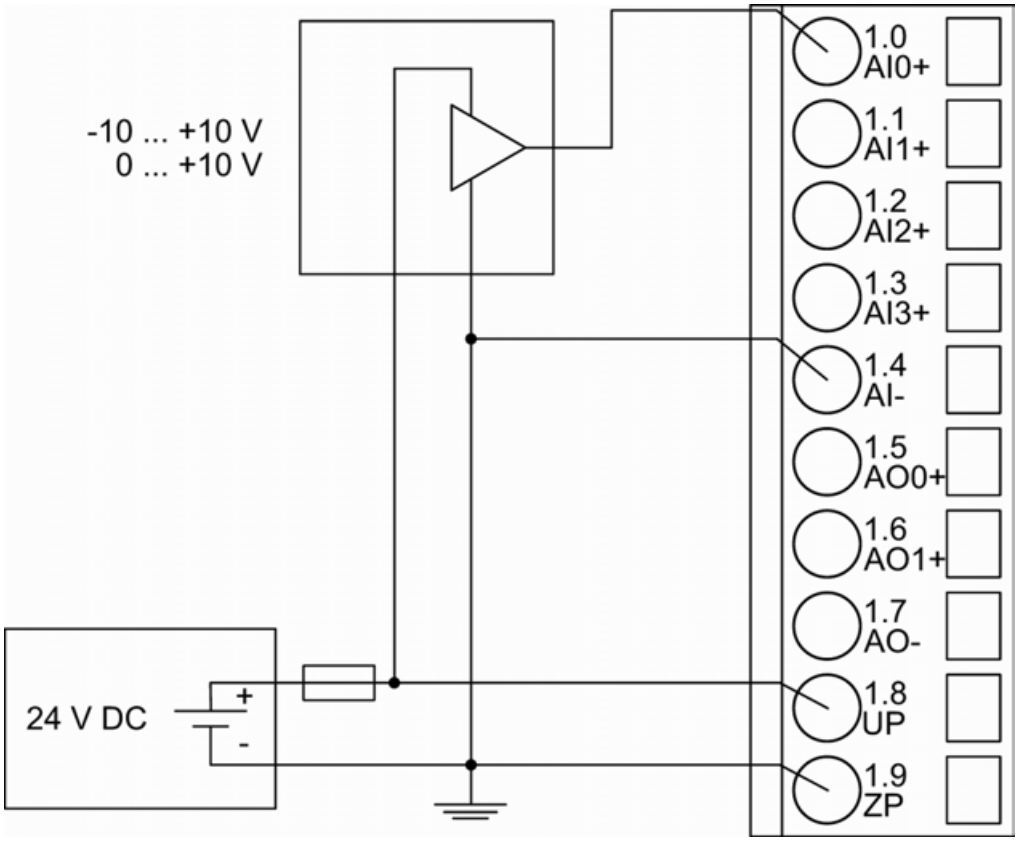


Fig. 257: Connection of active-type analog sensors (voltage) with no galvanically isolated power supply to the analog inputs (AI0 ... AI3)

CAUTION!
Risk of faulty measurements!
The negative pin at the sensors must not have too big a potential difference with respect to ZP (max. ± 1 V).

Make sure that the potential difference never exceeds ± 1 V (also not with long cable lengths).

Table 389: Configurable measuring ranges

Voltage	0 V ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

Chapter 5.6.8.2.7 “Parameterization” on page 1282

Chapter 5.6.8.2.7 “Parameterization” on page 1282

Chapter 5.6.8.2.8 “Diagnosis” on page 1288

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of passive-type analog sensors (Current) to the analog inputs

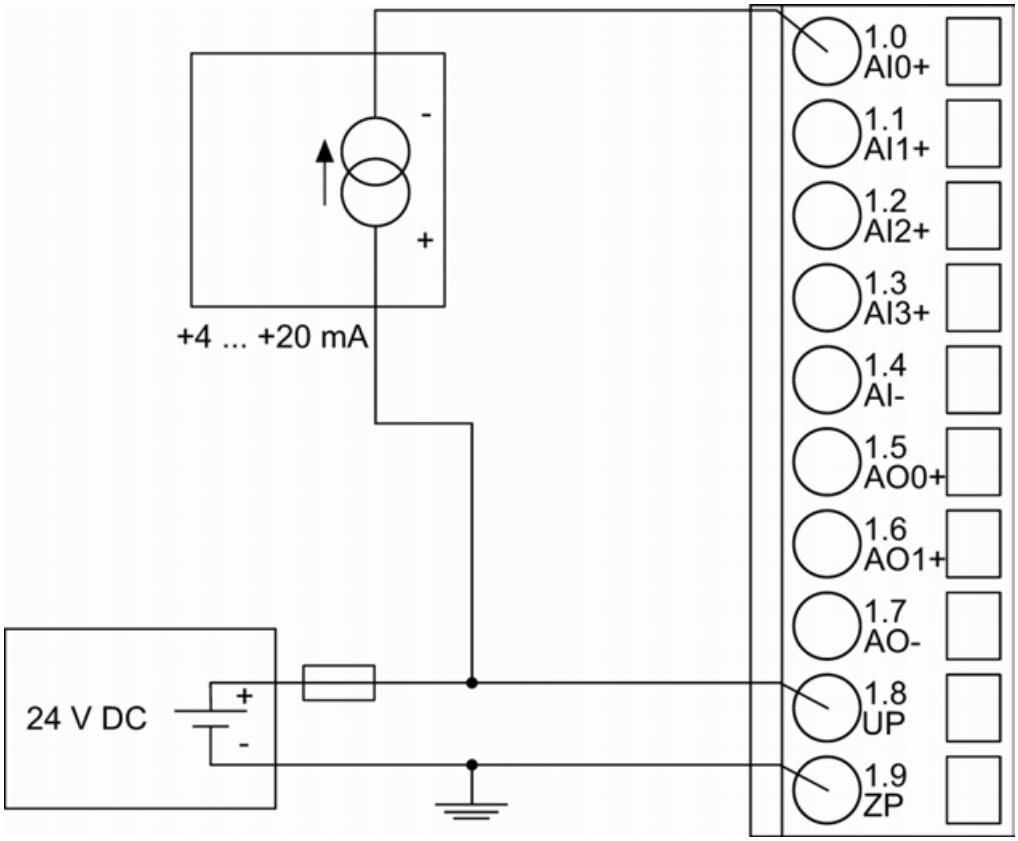


Fig. 258: Connection of passive-type analog sensors (current) to the analog inputs (AI0 ... AI3)

Table 390: Configurable measuring ranges

Current	4 mA ... 20 mA	1 channel used

Chapter 5.6.8.2.7 “Parameterization” on page 1282

Chapter 5.6.8.2.8 “Diagnosis” on page 1288

CAUTION!

Risk of overloading the analog input!

If an analog current sensor supplies more than 25 mA for more than 1 second during initialization, this input is switched off by the module (input protection).

Use only sensors with fast initialization or without current peaks higher than 25 mA. If not possible, connect a 10-volt zener diode in parallel to AIx+ and ZP.

Unused input channels can be left open-circuited, because they are of low resistance.

To avoid error messages through unused analog input channels in measuring range 4 mA ... 20 mA, these channels should be configured as "Not used".

Connection of active-type analog sensors (Voltage) to differential analog inputs

Differential inputs are very useful, if analog sensors are used which are remotely non-isolated (e.g. the minus terminal is remotely grounded).

The evaluation using differential inputs helps to considerably increase the measuring accuracy and to avoid ground loops.

With differential input configurations, two adjacent analog channels belong together (e.g. the channels 0 and 1). In this case, both channels are configured according to the desired operating mode. The lower address must be the even address (channel 0), the next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).

The analog value is calculated by subtraction of the input value with the higher address from the input value of the lower address.

The converted analog value is available at the odd channel (higher address).

CAUTION!

Risk of faulty measurements!

The negative pin at the sensors must not have too big a potential difference with respect to ZP (max. ± 1 V).

Make sure that the potential difference never exceeds ± 1 V.

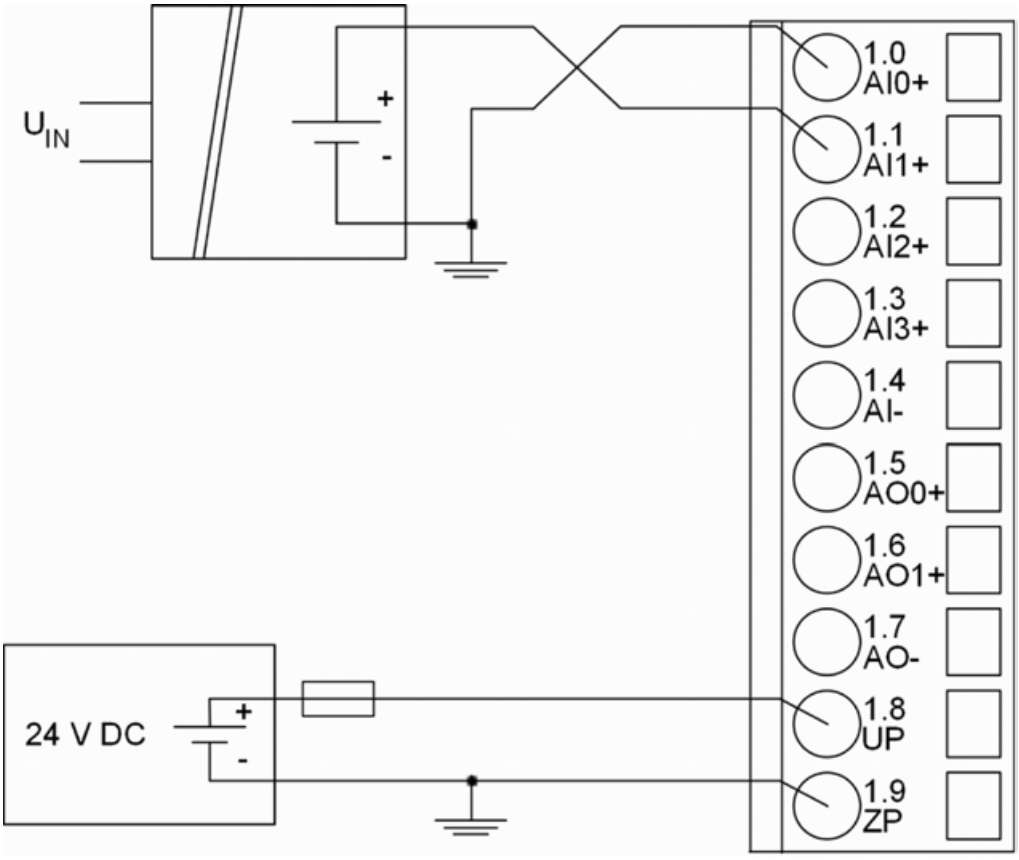


Fig. 259: Connection of active-type analog sensors (voltage) to differential analog inputs (AI0 ... AI3)

Table 391: Configurable measuring ranges

Voltage	0 V ... 10 V	With differential inputs, 2 channels used
Voltage	-10 V ... +10 V	With differential inputs, 2 channels used

↳ *Chapter 5.6.8.2.7 “Parameterization” on page 1282*

↳ *Chapter 5.6.8.2.8 “Diagnosis” on page 1288*

To avoid error messages from unused analog input channels, configure them as "unused".

Use of analog inputs as digital inputs

Several (or all) analog inputs can be configured as digital inputs. The inputs are not galvanically isolated against the other analog channels.

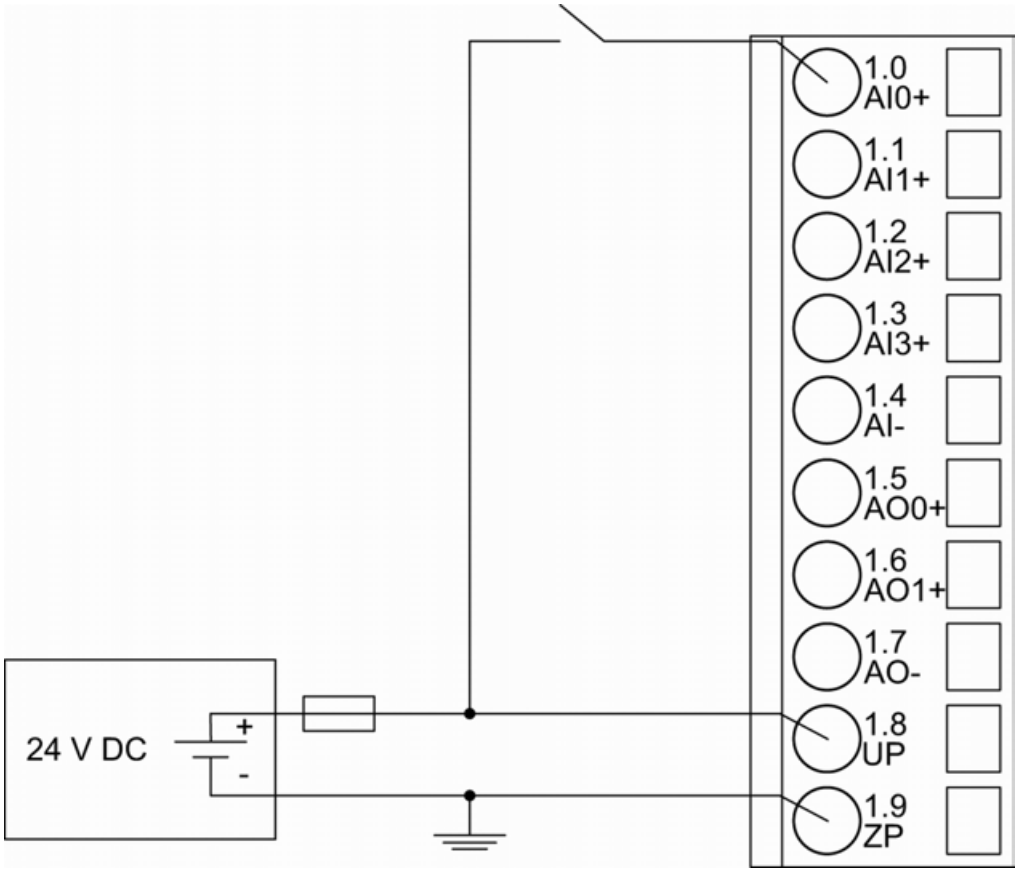


Fig. 260: Connection of digital sensors to the analog inputs (AI0 ... AI3)

Table 392: Configurable measuring ranges

Digital input	24 V	1 channel used
Effect of incorrect input terminal connection		Wrong or no signal detected, no damage up to 35 V

Chapter 5.6.8.2.7 “Parameterization” on page 1282

Chapter 5.6.8.2.8 “Diagnosis” on page 1288

Connection of analog output loads (Voltage)

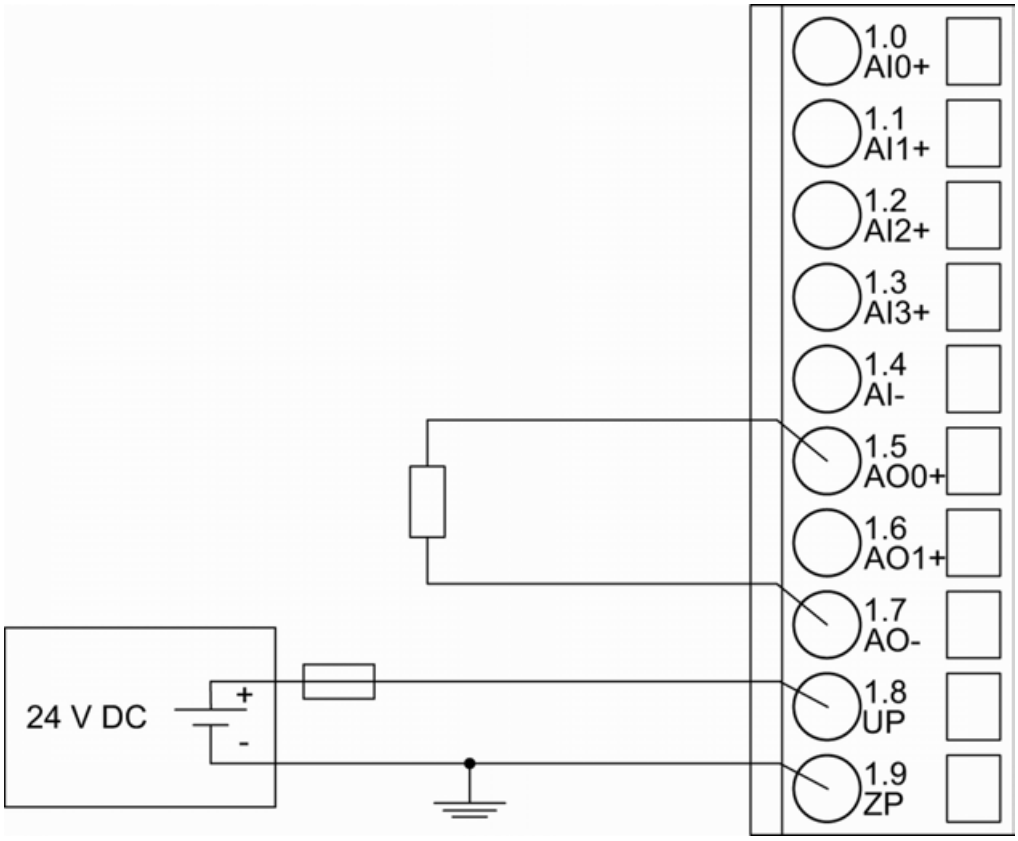


Fig. 261: Connection of analog output loads (voltage) to the analog outputs (AO0 ... AO1)

Table 393: Configurable measuring ranges

Voltage	-10 V ... +10 V	Load ± 10 mA max.	1 channel used

↳ *Chapter 5.6.8.2.7 “Parameterization” on page 1282*

↳ *Chapter 5.6.8.2.8 “Diagnosis” on page 1288*

Unused analog outputs can be left open-circuited.

Connection of analog output loads (Current)

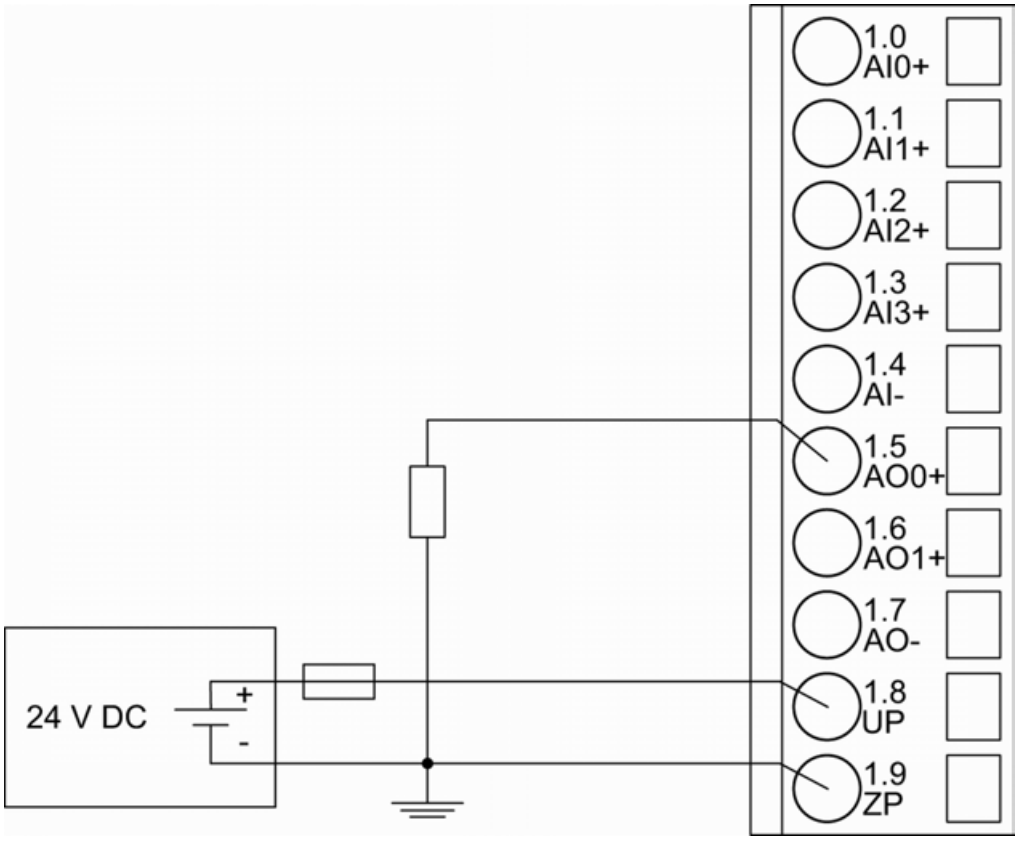


Fig. 262: Connection of analog output loads (current) to the analog otputs (AO0 and AO1)

Table 394: Configurable measuring ranges

Current	0 mA ... 20 mA	Load 0 Ω...500 Ω	1 channel used
Current	4 mA ... 20 mA	Load 0 Ω...500 Ω	1 channel used

↳ *Chapter 5.6.8.2.7 “Parameterization” on page 1282*

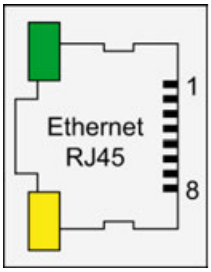
↳ *Chapter 5.6.8.2.8 “Diagnosis” on page 1288*

Unused analog outputs can be left open-circuited.

Assignment of the Ethernet ports

The terminal unit for the communication interface module provides two Ethernet interfaces with the following pin assignment:

Pin assignment

Interface	Pin	Signal	Description
	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NC	Not connected
	5	NC	Not connected
	6	RxD-	Receive data -
	7	NC	Not connected

Interface	Pin	Signal	Description
	8	NC	Not connected
	Shield	Cable shield	Functional earth

In corrosive environment, please protect unused connectors using the TA535 accessory.

Not supplied with this device.

5.6.8.2.4 Internal data exchange

Parameter	Value
Digital inputs (bytes)	3
Digital outputs (bytes)	3
Analog inputs (words)	4
Analog outputs (words)	2
Counter input data (words)	4
Counter output data (words)	8

5.6.8.2.5 Addressing

The module has 2 rotary switches to set an explicit name to the PROFINET IO device before commissioning. No engineering tool is needed in this case.

The device gets its name (including the fixed part of the device name) with the switch settings (01h...FFh). This name can be used directly within the device configuration: “CI5xx-pn-yy”

"CI5xx-pn-yy” xx is the fixed part of the device name (e.g. CI501) and yy represents the position of the rotary switch (0..FFh). The rotary switch values must be entered in hexadecimal format. For example, to set the name to “CI5xx-pn-08”, set the upper rotary switch to “0” and the lower switch to “8”.

The module reads the position of the rotary switches only during power-up, i.e. changes of the switch position during operation will have no effect until the next module initialization.

5.6.8.2.6 I/O configuration

The CI501-PNIO stores some PROFINET configuration parameters (I/O device identifier, I/O device type and IP address configuration). No more configuration data is stored.

The analog/digital I/O channels are configured via software.

↳ *Chapter 5.6.8.2.7 “Parameterization” on page 1282*

5.6.8.2.7 Parameterization

Parameters of the module

Name	Value	Internal value	Internal value, type	Default
Module ID [1])	Internal	7000	WORD	7000
Parameter length	Internal	25	BYTE	25
Error LED / Failsafe function see table Error LED / Failsafe function *Table 395 “Error LED / Failsafe function” on page 1283*	On	0	BYTE	0
	Off by E4	1		
	Off by E3	3		
	On + failsafe	16		
	Off by E4 + failsafe	17		
	Off by E3 + failsafe	19		
Process cycle time [2])	1 ms process cycle time	1	BYTE	1 ms
	2 ms process cycle time	2		
	3 ms process cycle time	3		
	4 ms process cycle time	4		
	5 ms process cycle time	5		
	6 ms process cycle time	6		
	7 ms process cycle time	7		
	8 ms process cycle time	8		
	9 ms process cycle time	9		
	10 ms process cycle time	10		
	11 ms process cycle time	11		
	12 ms process cycle time	12		
	13 ms process cycle time	13		
	14 ms process cycle time	14		
	15 ms process cycle time	15		
	16 ms process cycle time	16		
Check supply	off	0	BYTE	1
	on	1		

Name	Value	Internal value	Internal value, type	Default
Input delay	8 ms	8 ms	BYTE	8 ms
Fast counter	0 : 10 [3])	0 : 10	BYTE	0
Detect short circuit at outputs	On	1	BYTE	On
Behavior digital outputs at comm. error	Off	0	BYTE	Off
Substitute value digital outputs	0	0..255	BYTE	0
Overvoltage behavior on output	Off	0	BYTE	Off
Behavior analog outputs atcomm. error	Off	0	BYTE	Off
I/O-Bus reset	Off	0	BYTE	Off
	On	1	BYTE	Off

Remarks:

[1])	With a faulty ID, the modules reports a "parameter error" and does not perform cyclic process data transmission.
[2])	As for device index C0 the parameter is no longer evaluated.
[3])	Counter operating modes, see description of the Fast counter ↬ *Chapter 5.4.3.2.9 “Fast counter” on page 522*.

Table 395: Error LED / Failsafe function

Setting	Description
On	Error LED (S-ERR) lights up at errors of all error classes, Failsafe-mode off
Off by E4	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, Failsafe-mode off
Off by E3	Error LED (S-ERR) lights up at errors of error classes E1 and E2, Failsafe-mode off
On +Failsafe	Error LED (S-ERR) lights up at errors of all error classes, Failsafe-mode on *)
Off by E4 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, Failsafe-mode on *)
Off by E3 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1 and E2, Failsafe-mode on *)
*) The parameters Behaviour AO at comm. error and Behaviour DO at comm. error are only analyzed if the Failsafe-mode is ON.	

IO-BUS reset after PROFINET reconnection

IO-BUS reset after PROFINET reconnection controls the behavior of PROFINET CI modules in relation to connected I/O modules (both safety and non-safety I/O modules).

- IO-BUS reset after PROFINET reconnection = *"On"* resets and, thus, re-parameterizes all attached I/O modules. All internal I/O modules states are reset, including the related diagnosis information.

  If the parameter is set to *"On"*, the following applies:
  - The bumpless re-start of non-safety I/O modules will not be supported. It means, for example, that non-safety output channels will go from fail-safe values to *"0"* values during the re-connection and re-parameterization time and after that go to new output values.
  - Safety I/O modules will be re-parameterized and re-started as newly started modules, which may not require their PROFIsafe reintegration, depending on safety CPU state, in the safety application.
- IO-BUS reset after PROFINET reconnection = *"Off"* will not reset all attached I/O modules. It will re-parameterize I/O modules only if parameter change is detected during the reconnection. All internal I/O modules states are not reset, including the related diagnosis information.

  If the parameter is set to *"Off"*, the following applies:
  - The bumpless re-start of non-safety I/O modules is supported (if no parameters are changed). It means, for example, that non-safety output channels will not go from fail-safe values to *"0"* values during the re-connection and re-parameterization time, but directly from fail-safe values to new output values.
  - Safety I/O modules will not be re-parameterized (if no parameters are changed). Thus, they may continue their operation, which may require their PROFIsafe reintegration in the safety application on the safety CPU, e.g., if PROFIsafe watchdog time for this safety I/O module has expired. Any reintegration of such safety I/O modules will be not only application specific but also PROFIsafe specific and depend on the safety I/O handling in the safety application.

Group parameters for the analog part

Name	Value	Internal value	Internal value, type	Default
Analog data format	Standard Reserved	0 255	BYTE	0
Behaviour AO at comm. error *)	Off Last value Last value 5 s Last value 10 s Substitute value Substitute value 5 s Substitute value 10 s	0 1 6 11 2 7 12	BYTE	0
*) The parameter Behaviour AO at comm. error is only analyzed if the Failsafe-mode is ON.				

Channel parameters for the analog inputs (4x)

Name	Value	Internal value	Internal value, type	Default
Input 0, Channel configuration	Table Operating modes of the analog inputs *Table 396 “Channel configuration” on page 1285*	Table Operating modes of the analog inputs *Table 396 “Channel configuration” on page 1285*	BYTE	0
Input 0, Check channel	Table Channel montoring *Table 397 “Channel monitoring” on page 1286*	Table Channel montoring *Table 397 “Channel monitoring” on page 1286*	BYTE	0
:	:	:	:	:
:	:	:	:	:
Input 3, Channel configuration	Table Operating modes of the analog inputs *Table 396 “Channel configuration” on page 1285*	Table Operating modes of the analog inputs *Table 396 “Channel configuration” on page 1285*	BYTE	0
Input 3, Check channel	Table Channel montoring *Table 397 “Channel monitoring” on page 1286*	Table Channel montoring *Table 397 “Channel monitoring” on page 1286*	BYTE	0

Table 396: Channel configuration

Internal value	Operating modes of the analog inputs, individually configurable
0 (default)	Not used
1	0 V ... 10 V
2	Digital input
3	0 mA ... 20 mA
4	4 mA ... 20 mA
5	-10 V ... +10 V
8	2-wire Pt100 -50 °C ... +400 °C
9	3-wire Pt100 -50 °C ... +400 °C *)
10	0 V ... 10 V (voltage diff.) *)
11	-10 V ... +10 V (voltage diff.) *)
14	2-wire Pt100 -50 °C ... +70 °C
15	3-wire Pt100 -50 °C ... +70 °C *)
16	2-wire Pt1000 -50 °C ... +400 °C
17	3-wire Pt1000 -50 °C ... +400 °C *)
18	2-wire Ni1000 -50 °C ... +150 °C

Internal value	Operating modes of the analog inputs, individually configurable
19	3-wire Ni1000 -50 °C ... +150 °C *)
*) In the operating modes with 3-wire configuration or with differential inputs, two adjacent analog inputs belong together (e.g. the channels 0 and 1). In these cases, both channels are configured in the desired operating mode. The lower address must be the even address (channel 0). The next higher address must be the odd address (channel 1). The converted analog value is available at the higher address (channel 1).	

Table 397: Channel monitoring

Internal Value	Check Channel
0 (default)	Plausibility, wire break, short circuit
3	Not used

Channel parameters for the analog outputs (2x)

Name	Value	Internal value	Internal value, type	Default
Output 0, Channel configuration	Table Operating modes of the analog outputs *Further information on page 1287*	Table Operating modes of the analog outputs *Further information on page 1287*	BYTE	0
Output 0, Check channel	Table Channel monitoring *Table 399 “Channel monitoring” on page 1287*	Table Channel monitoring *Table 399 “Channel monitoring” on page 1287*	BYTE	0
Output 0, Substitute value	Table Substitute value *Table 400 “Substitute value” on page 1287*	Table Substitute value *Table 400 “Substitute value” on page 1287*	WORD	0
Output 1, Channel configuration	Table Operating modes of the analog outputs *Further information on page 1287*	Table Operating modes of the analog outputs *Further information on page 1287*	BYTE	0
Output 1, Check channel	Table Channel monitoring *Table 399 “Channel monitoring” on page 1287*	Table Channel monitoring *Table 399 “Channel monitoring” on page 1287*	BYTE	0
Output 1, Substitute value	Table Substitute value *Table 400 “Substitute value” on page 1287*	Table Substitute value *Table 400 “Substitute value” on page 1287*	WORD	0

Table 398: Channel configuration

Internal value	Operating modes of the analog outputs, individually configurable
0 (default)	Not used
128	-10 V ... +10 V
129	0 mA ... 20 mA
130	4 mA ... 20 mA

Table 399: Channel monitoring

Internal value	Check channel
0	Plausibility, wire break, short circuit
3	None

Table 400: Substitute value

Intended behavior of output channel when the control system stops	Required setting of the module parameter "Behaviour of outputs in case of a communication error"	Required setting of the channel parameter "Substitute value"
Output OFF	Off	0
Last value infinite	Last value	0
Last value for 5 s and then turn off	Last value 5 sec	0
Last value for 10 s and then turn off	Last value 10 sec	0
Substitute value infinite	Substitute value	Depending on configuration
Substitute value for 5 s and then turn off	Substitute value 5 sec	Depending on configuration
Substitute value for 10 s and then turn off	Substitute value 10 sec	Depending on configuration

Group parameters for the digital part

Name	Value	Internal value	Internal value, type	Default
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.1 ms 0x00
Detect short circuit at outputs	Off On	0 1	BYTE	On 0x01

Name	Value	Internal value	Internal value, type	Default
Behaviour DO at comm. error [1])	Off Last value Last value 5 sec Last value 10 sec Substitute value Substitute value 5 sec Substitute value 10 sec	0 1 6 11 2 7 12	BYTE	Off 0x00
Substitute value at output	0 ... 255	00h ... FFh	BYTE	0 0x0000
Detect voltage overflow at outputs [2])	Off On	0 1	BYTE	On 0x01
[1]) The parameters Behaviour DO at comm. error is only analyzed if the Failsafe-mode is ON. [2]) The state "externally voltage detected" appears, if the output of a channel DC0 ... DC7 should be switched on while an externally voltage is connected. In this case the start up is disabled, as long as the externally voltage is connected. The monitoring of this state and the resulting diagnosis message can be disabled by setting the parameters to "OFF". *Chapter 5.6.8.2.3 “Connections” on page 1265*				

5.6.8.2.8 Diagnosis

Table 401: Structure of the diagnosis block via PNIO_DEV_ALARM function block

Byte Number	Description	Possible Values
1	Diagnosis Byte, slot number	31 = CI501-PNIO (e. g. error at integrated 8 DI / 8 DO) 1 = 1st connected S500 I/O module ... 10 = 10th connected S500 I/O module
2	Diagnosis Byte, module number	According to the I/O bus specification passed on by modules to the fieldbus master
3	Diagnosis Byte, channel	According to the I/O bus specification passed on by modules to the fieldbus master

Byte Number	Description	Possible Values
4	Diagnosis Byte, error code	According to the I/O bus specification Bit 7 and bit 6, coded error class 0 = E1 1 = E2 2 = E3 3 = E4 Bit 0 to bit 5, coded error description
5	Diagnosis Byte, flags	According to the I/O bus specification Bit 7: 1 = coming error Bit 6: 1 = leaving error

In cases of short circuit or overload, the digital outputs are turned off. The modules performs reactivation automatically. Thus an acknowledgement of the errors is not necessary. The error message is stored via the LED.

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<– Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-Identi-fier**	**Error message**	**Remedy**
	[1])	[2])	[3])				
Module errors							
3	-	31	31	31	19	Checksum error in the I/O module	Replace I/O module
3	-	31	31	31	3	Timeout in the I/O module	
3	-	31	31	31	40	Different hard-/firm-ware versions in the module	
3	-	31	31	31	43	Internal error in the module	
3	-	31	31	31	36	Internal data exchange failure	
3	-	31	31	31	9	Overflow diagnosis buffer	Restart
3	-	31	31	31	26	Parameter error	Check master

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<– Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**		
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**PNIO diag-nosis block**		
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**		**Remedy**
	[1])	[2])	[3])					
3	-	31	31	31	11	Process voltage UP too low		Check process supply voltage
3	-	31	31	31	45	No process voltage UP		Check process supply voltage
3	-	31/1...10	31	31	17	No communication with I/O module		Replace I/O module
3	-	1...10	31	31	32	Wrong I/O module type on socket		Replace I/O module / Check configu-ration
4	-	1...10	31	31	31	At least one module does not support failsafe function		Check modules and parame-terization
4	-	1...10	31	5	8	I/O module removed from hot swap terminal unit or defective module on hot swap ter-minal unit [9])		Plug I/O module, replace I/O module
4	-	1...10	31	5	28	Wrong I/O module plugged on hot swap terminal unit [9])		Remove wrong I/O module and plug pro-jected I/O module
4	-	1...10	31	5	42	No communication with I/O module on hot swap terminal unit [9])		Replace I/O module

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<– Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**		
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**PNIO diag-nosis block**		
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**		**Remedy**
	[1])	**[2])**	**[3])**					
4	-	1...10	31	5	54	I/O module does not support hot swap [8]) [9])		Power off system and replace I/O module
4	-	1...10	31	6	8	Hot swap terminal unit configured but not found		Replace terminal unit by hot swap terminal unit
4	-	1...10	31	6	42	No communication with hot swap terminal unit [9])		Restart, if error persists replace terminal unit
4	-	31	31	31	46	Voltage feedback on activated digital outputs DO0...DO7 on UP3 [4])		Check terminals
4	-	31/1...10	31	31	34	No response during initialization of the I/O module		Replace I/O module
4	-	31	31	31	11	Process voltage UP3 too low		Check process supply voltage
4	1...6	255	2	0	45	The connected Communication Module has no connection to the network		Check cabeling
4	-	31	31	31	45	No process voltage UP3		Check process supply voltage

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<– Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**		
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**PNIO diag-nosis block**		
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**		**Remedy**
	[1])	**[2])**	**[3])**					
4	-	31	31	31	10	Voltage overflow on outputs (above UP3 level) [5])		Check terminals/ check process supply voltage
Channel error digital								
4	-	31	2	0...7	46	Externally voltage detected at digital output DO0...DO7 [6])		Check terminals
4	-	31	2	0...7	47	Short circuit at digital output [7])		Check terminals
Channel error analog								
4	-	31	1	0...3	48	Analog value overflow or broken wire at an analog input		Check value or check terminals
4	-	31	1	0...3	7	Analog value underflow at an analog input		Check value
4	-	31	1	0...3	47	Short circuit at an analog input		Check terminals
4	-	31	3	0...1	4	Analog value overflow at an analog output		Check output value
4	-	31	3	0...1	7	Analog value underflow at an analog output		Check output value

Remarks:

[1])	In AC500 the following interface identifier applies: "-" = Diagnosis via bus-specific function blocks; 0 ... 4 or 10 = Position of the communication module;14 = I/O bus; 31 = Module itself The identifier is not contained in the CI501-PNIO diagnosis block.
[2])	With "Device" the following allocation applies: 31 = Module itself; 1 ... 10 = Expansion module
[3])	With "Module" the following allocation applies: 31 = Module itself Module type (1 = AI, 2 = DO, 3 = AO)
[4])	This message appears, if externally voltages at one or more terminals DO0 ... DO7 cause that other digital outputs are supplied through that voltage. All outputs of the apply digital output groups will be turned off for 5 seconds. The diagnosis message appears for the whole output group. *Chapter 5.6.8.2.3 “Connections” on page 1265*
[5])	The voltage on digital outputs DO0 ... DO7 has overrun the process supply voltage UP3. Diagnosis message appears for the whole module. *Chapter 5.6.8.2.3 “Connections” on page 1265*
[6])	This message appears, if the output of a channel DO0 ... DO7 should be switched on while an externally voltage is connected. In this case the start up is disabled, as long as the externally voltage is connected. Otherwise this could produce reverse voltage from this output to other digital outputs. This diagnosis message appears per channel.
[7])	Short circuit: After a detected short circuit, the output is deactivated for 100 ms. Then a new start up will be executed. This diagnosis message appears per channel.
[8])	In case of an I/O module doesn’t support hot swapping, do not perform any hot swap operations (also not on any other terminal units (slots)) as modules may be damaged or I/O bus communication may be disturbed.
[9])	Diagnosis for hot swap available as of version index F0.

5.6.8.2.9 State LEDs

The LEDs are located at the front of module. There are 2 different groups:

- The 5 system LEDs (PWR, STA1 ETH, STA2 ETH, S-ERR and I/O-Bus) show the operation state of the module and display possible errors.
- The 27 process LEDs (UP, UP3, inputs, outputs, CH-ERR1 to CH-ERR3) show the process supply voltage and the states of the inputs and outputs and display possible errors.

Table 402: States of the 5 system LEDs

LED	Color	OFF	ON	Flashing
PWR/RUN	Green	Process supply voltage missing	Internal supply voltage OK, module ready for communication with I/O Controller	Start-up / preparing communication
	Yellow	---	---	---

LED	Color	OFF	ON	Flashing
STA1 ETH (System LED "BF")	Green	---	Device configured, cyclic data exchange running	---
	Red	---	---	Device is not configured
STA2 ETH (System LED "SF")	Green	---	---	Got identification request from I/O controller
	Red	No system error	System error (collective error)	---
S-ERR	Red	No error	Internal error	--
I/O-Bus	Green	No expansion modules connected or communication error	Expansion modules connected and operational	---
ETH1	Green	No connection at Ethernet interface	Connected to Ethernet interface	---
	Yellow	---	Device is transmitting telegrams	Device is transmitting telegrams
ETH2	Green	No connection at Ethernet interface	Connected to Ethernet interface	---
	Yellow	---	Device is transmitting telegrams	Device is transmitting telegrams

Table 403: States of the 27 process LEDs

LED	Color	OFF	ON	Flashing
AI0 ... AI3	Yellow	Input is OFF	Input is ON (brightness depends on the value of the analog signal)	--
AO0 ... AO1	Yellow	Output is OFF	Output is ON (brightness depends on the value of the analog signal)	--
DI0 ... DI7	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--
DO0 ... DO7	Yellow	Output is OFF	Output is ON	--
UP	Green	Process supply voltage missing	Process supply voltage OK and initialization finished	--

LED	Color	OFF	ON	Flashing
UP3	Green	Process supply voltage missing	Process supply voltage OK	--
CH-ERR1 to CH-ERR3	Red	No error or process supply voltage missing	Internal error or module not configured	Error on one channel of the corresponding group

5.6.8.2.10 Measuring ranges

Input ranges voltage, current and digital input

Range	0 V ... +10 V	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital input	Digital value	
						Decimal	Hex.
Overflow	> 11.7589	> 11.7589	> 23.5178	> 22.8142		32767	7FFF
Measured value too high	11.7589 : 10.0004	11.7589 : 10.0004	23.5178 : 20.0007	22.8142 : 20.0006		32511 : 27649	7EFF : 6C01
Normal range Normal range or measured value too low	10.0000 : 0.0004	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	: : On	27648 : 1	6C00 : 0001
	0.0000	0.0000	0	4	Off	0	0000
	-0.0004 -1.7593	-0.0004 : : -10,0000		3.9994 1.1858		-1 -4864 : -27648	FFFF ED00 : 9400
Measured value too low		-10.0004 : -11.7589				-27649 : -32512	93FF : 8100
Underflow	< 1.7593	< -11.7589	< 0.0000	< 1.1858		-32768	8000

The represented resolution corresponds to 16 bits.

Input ranges resistance temperature detector

Range	Pt100 / Pt1000 -50 ... +70 °C	Pt100 / Pt1000 -50 ... +400 °C	Ni1000 -50 ... +150 °C	Digital value	
				Decimal	Hex.
Overflow	> +80.0 °C	> +450.0 °C	> +160.0 °C	32767	7FFF
Measured value too high	+80.0 °C	+450.0 °C : +400.1 °C		4500 : 4001	1194 : 0FA1

Range	Pt100 / Pt1000 -50 ... +70 °C	Pt100 / Pt1000 -50 ... +400 °C	Ni1000 -50 ... +150 °C	Digital value	
				Decimal	Hex.
			+160.0 °C : +150.1 °C	1600 : 1501	0640 : 05DD
Normal range		+400.0 °C : : : + 0.1 °C	+150.0 °C : : +0.1 °C	800 : 701	0320 : 02BD
		0.0 °C	0.0 °C	4000 1500 700 : 1	0FA0 05DC 02BC : 0001
		-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	0	0000
Measured value too low	< -60.0 °C	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-1 : -500	FFFF : FE0C
Underflow	< -60.0 °C	< -60.0 °C	< -60.0 °C	-501 : -600	FE0B : FDA8

Output ranges voltage and current

Range	-10...+10 V	0...20 mA	4...20 mA	Digital value	
				Decimal	Hex.
Overflow	0 V	0 mA	0 mA	> 32511	> 7EFF
Measured value too high	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA	32511 : 27649	7EFF : 6C01
Normal range	10.0000 V : 0.0004 V	20.0000 mA : 0.0007 mA	20.0000 mA : 4.0006 mA	27648 : 1	6C00 : 0001
	0.0000 V	0.0000 mA	4.0000 mA	0	0000
	-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA	-1 -6912 -27648	FFFF E500 9400

Range	-10...+10 V	0...20 mA	4...20 mA	Digital value	
				Decimal	Hex.
Measured value too low	-10.0004 V : -11.7589 V	0 mA : 0 mA	0 mA : 0 mA	-27649 : -32512	93FF : 8100
Underflow	0 V	0 mA	0 mA	< -32512	< 8100

The represented resolution corresponds to 16 bits.

5.6.8.2.11 Technical data

Technical data of the module

The system data of AC500 and S500 is applicable to the standard version.

Chapter 4.2 “System data AC500” on page 34

The system data of AC500-XC is applicable to the XC version.

Chapter 4.3 “System data AC500-XC” on page 38

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter		Value
Process supply voltages UP/UP3		
	Rated value	24 V DC (for inputs and outputs)
	Max. load for the terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse on UP/UP3	10 A fast
	Galvanic isolation	Ethernet interface against the rest of the module
	Inrush current from UP (at power up)	On request
	Current consumption via UP (normal operation)	0.2 A
	Current consumption via UP3	0.06 A + 0.5 A max. per output
	Connections	Terminals 1.8 and 2.8 for +24 V (UP) Terminal 3.8 for +24 V (UP3) Terminals 1.9, 2.9 and 3.9 for 0 V (ZP)
Max. power dissipation within the module		6 W
Number of digital inputs		8
Number of digital outputs		8
Number of analog inputs		4
Number of analog outputs		2
Input data length		19 bytes
Output data length		23 bytes
Reference potential for all digital inputs and outputs		Negative terminal of the supply voltage, signal name ZP

Parameter	Value
Setting of the I/O device identifier	With 2 rotary switches at the front side of the module
Diagnose	See Diagnosis and Displays *Chapter 5.6.8.2.8 “Diagnosis” on page 1288*
Operation and error displays	32 LEDs (totally)
Weight (without terminal unit)	Ca. 125 g
Mounting position	Horizontal mounting or Vertical mounting with derating (output load reduced to 50 % at +40 °C per group)
Extended ambient temperature (XC version)	>+60 °C on request
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Multiple overloads
With multi-channel modules, there are no effects of multiple overloads as each digital output channel is individually protected by an internal intelligent high-side switch.

Parameter	Value
Bus connection	2 x RJ45
Switch	Integrated
Technology	Hilscher NETX 100
Transfer rate	10/100 Mbit/s (full-duplex)
Transfer method	According to Ethernet II, IEEE 802.3
Ethernet	100 base-TX, internal switch, 2x RJ45 socket
Expandability	Max. 10 S500 I/O modules
Adjusting elements	2 rotary switches for generation of an explicit name
Supported protocols	RTC - real time cyclic protocol, class 1 *) RTA - real time acyclic protocol DCP - discovery and configuration protocol CL-RPC - connectionless remote procedure Call LLDP - link layer discovery protocol MRP - MRP Client

Parameter	Value
Acyclic services	PNIO read / write sequence (max. 1024 bytes per telegram) Process-Alarm service
Supported alarm types	Process Alarm, Diagnostic Alarm, Return of SubModule, Plug Alarm, Pull Alarm
Min. bus cycle	1 ms
Conformance class	CC B
Protective functions (according to IEC 61131-3)	Protected against: ● short circuit ● reverse supply ● overvoltage ● reverse polarity Galvanic isolation from the rest of the module.

*) Prioritization with the aid of VLAN-ID including priority level

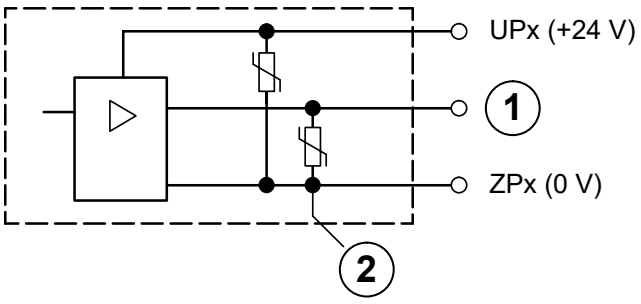
Technical data of the digital inputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DI0 ... DI7		Terminals 2.0 ... 2.7
Reference potential for all inputs		Terminals 1.9 ... 3.9 (negative terminal of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1 ms ... 32 ms
Input signal voltage		24 V DC
	0-Signal	-3 V ... +5 V
	Undefined Signal	> +5 V ... < +15 V
	1-Signal	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical data of the digital outputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DO0 ... DO7		Terminals 3.0 ... 3.7
Reference potential for all outputs		Terminals 1.9 ... 3.9 (negative terminal of the supply voltage, signal name ZP)
Common power supply voltage		For all outputs terminal 3.8 (positive terminal of the supply voltage, signal name UP3)
Output voltage for signal 1		UP3 (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value per channel	500 mA at UP3 = 24 V
	Max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA
	Fuse for UP3	10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)
Output switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.



1 Digital output
2 Varistors for demagnetization when inductive loads are turned off

Technical data of the analog inputs

Parameter		Value
Number of channels per module		4
Distribution of channels into groups		1 group with 4 channels
Connection if channels AI0+ ... AI3+		Terminals 1.0 ... 1.3
Reference potential for AI0+ ... AI3+		Terminal 1.4 (AI-) for voltage and RTD measurement Terminal 1.9, 2.9 and 3.9 for current measurement
Input type		
	Unipolar	Voltage 0 V ... 10 V, current or Pt100/Pt1000/ Ni1000
	Bipolar	Voltage -10 V ... +10 V
Galvanic isolation		Against Ethernet network
Configurability		0 V ... 10 V, -10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA Pt100/1000, Ni1000 (each input can be configured individually)
Channel input resistance		Voltage: > 100 kΩ Current: ca. 330 Ω
Time constant of the input filter		Voltage: 100 µs Current: 100 µs
Indication of the input signals		1 LED per channel (brightness depends on the value of the analog signal)
Conversion cycle		1 ms (for 4 inputs + 2 outputs); with RTDs Pt/ Ni... 1 s
Resolution		Range 0 V ... 10 V: 12 bits Range -10 V ... +10 V: 12 bits including sign Range 0 mA ... 20 mA: 12 bits Range 4 mA ... 20 mA: 12 bits Range RTD (Pt100, PT1000, Ni1000): +0.1 °C
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code		
Unused inputs		Are configured as "unused" (default value)
Overvoltage protection		Yes

Technical data of the analog inputs, if used as digital inputs

Parameter	Value
Number of channels per module	Max. 4
Distribution of channels into groups	1 group of 4 channels
Connections of the channels AI0+ ... AI3+	Terminals 1.0 ... 1.3

Parameter		Value
Reference potential for the inputs		Terminals 1.9, 2.9 and 3.9 (ZP)
Indication of the input signals		1 LED per channel
Input signal voltage		24 V DC
	Signal 0	-30 V ... +5 V
	Undefined signal	+5 V ... +13 V
	Signal 1	+13 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 7 mA
	Input voltage +5 V	Typ. 1.4 mA
	Input voltage +15 V	Typ. 3.7 mA
	Input voltage +30 V	< 9 mA
Input resistance		Ca. 3.5 kΩ

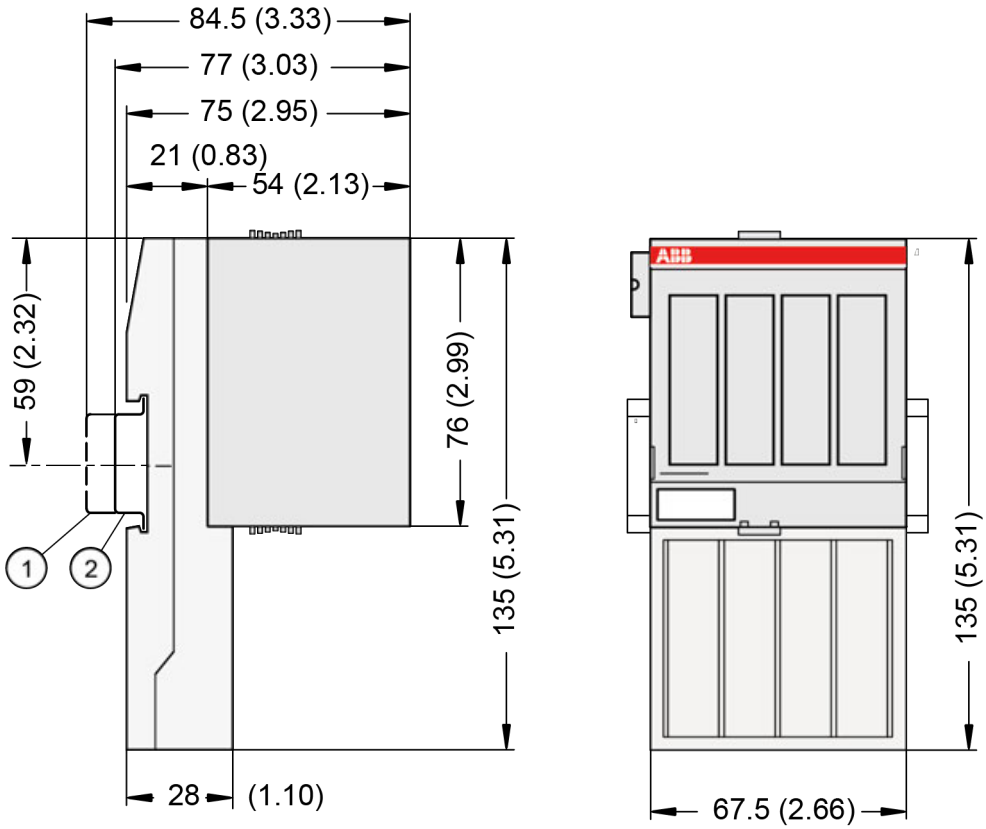
Technical data of the analog outputs

Parameter		Value
Number of channels per module		2
Distribution of channels into groups		1 group for 2 channels
Connection of the channels AO0+ ... AO1+		Terminals 1.5 ... 1.6
Reference potential for AO0+ ... AO1+		Terminal 1.7 (AO-) for voltage output terminal 1.9, 2.9 and 3.9 for current output
Output type		
	Unipolar	Current
	Bipolar	Voltage
Galvanic isolation		Against internal supply and other modules
Configurability		-10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA (each output can be configured individually)
Output resistance (load), as current output		0 Ω ... 500 Ω
Output loadability, as voltage output		± 10 mA max.
Indication of the output signals		1 LED per channel (brightness depends on the value of the analog signal)
Resolution		12 bits including sign
Settling time for full range change (resistive load, output signal within specified tolerance)		Typ. 5 ms
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code		Table Output ranges voltage and current ↳ *Chapter 5.6.8.2.10.3 “Output ranges voltage and current” on page 1296*
Unused outputs		Are configured as "unused" (default value) and can be left open-circuited

Technical data of the fast counter

Parameter	Value
Used inputs	Terminal 2.0 (DI0), 2.1 (DI1)
Used outputs	Terminal 3.0 (DO0)
Counting frequency	Depending on operation mode: Mode 1 - 6: max. 200 kHz Mode 7: max. 50 kHz Mode 9: max. 35 kHz Mode 10: max. 20 kHz

5.6.8.2.12 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

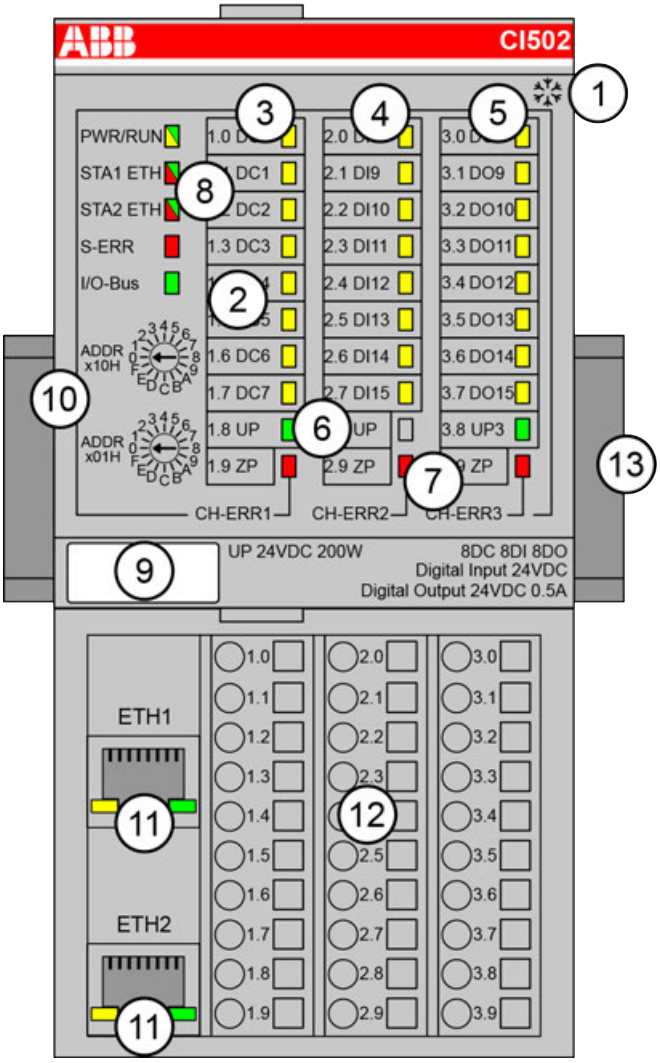
5.6.8.2.13 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 220 600 R0001	CI501-PNIO, PROFINET communication interface module, 8 DI, 8 DO, 4 AI and 2 AO	Active
1SAP 420 600 R0001	CI501-PNIO-XC, PROFINET communication interface module, 8 DI, 8 DO, 4 AI and 2 AO, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.6.8.3 CI502-PNIO

- 8 digital inputs 24 V DC
- 8 digital outputs 24 V DC, 0.5 A max.
- 8 configurable digital inputs/outputs 24 V DC, 0.5 A max.
- Module-wise galvanically isolated
- Fast counter
- XC version for usage in extreme ambient conditions available



1 I/O bus
2 Allocation between terminal number and signal name
3 8 yellow LEDs to display the signal states of the digital configurable inputs/outputs (DC0 ... DC7)
4 8 yellow LEDs to display the signal states of the digital inputs (DI8 ... DI15)
5 8 yellow LEDs to display the signal states of the digital outputs (DO8 ... DO15)
6 2 green LEDs to display the process supply voltage UP and UP3
7 3 red LEDs to display errors (CH-ERR1, CH-ERR2, CH-ERR3)
8 5 system LEDs: PWR/RUN, STA1 ETH, STA2 ETH, S-ERR, I/O-Bus
9 Label
10 2 rotary switches for setting the I/O device identifier
11 Ethernet interfaces (ETH1, ETH2) on the terminal unit
12 Terminal unit
13 DIN rail
❄ Sign for XC version

5.6.8.3.1 Intended purpose

The PROFINET communication interface module CI502-PNIO is used as communication interface module in PROFINET networks. The network connection is performed via 2 RJ45 connectors which are integrated in the terminal unit.

For usage in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

5.6.8.3.2 Functionality

The CI502 communication interface module contains 24 I/O channels with the following properties:

- 8 digital configurable inputs/outputs
- 8 digital inputs: 24 V DC
- 8 digital outputs: 24 V DC, 0.5 A max.

The inputs/outputs are galvanically isolated from the Ethernet network. There is no potential separation between the channels. The configuration of the analog inputs/outputs is performed by software.

Parameter	Value
Interface	Ethernet
Protocol	PROFINET IO RT
Power supply	From the process supply voltage UP
Supply of the electronic circuitry of the I/O expansion modules attached	Through the I/O bus interface (I/O bus)
Rotary switches	For setting the IO device identifier for configuration purposes (00h to FFh)
Configurable digital inputs/outputs	8 (configurable via software)
Digital inputs	8 (24 V DC; delay time configurable via software)
Digital outputs	8 (24 V DC, 0.5 A max.)
LED displays	For system displays, signal states, errors and power supply
External supply voltage	Via terminals ZP, UP and UP3 (process supply voltage 24 V DC)
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Required terminal unit	TU507-ETH or TU508-ETH *Chapter 5.7.2 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 1348*

5.6.8.3.3 Connections

General

The Ethernet communication interface module CI502-PNIO is plugged on the I/O terminal unit TU507-ETH or TU508-ETH. Properly seat the module and press until it locks in place. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting.

Chapter 5.7.2 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 1348

Chapter 5.8.2.6 “TA526 - Wall mounting accessory” on page 1410

The connection of the I/O channels is carried out using the 30 terminals of the I/O terminal unit. I/O modules can be replaced without re-wiring the terminal units.

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The terminals 1.8 and 2.8 as well as 1.9, 2.9 and 3.9 are electrically interconnected within the terminal unit and have always the same assignment, independent of the inserted module:

Terminals 1.8 and 2.8: Process supply voltage UP = +24 V DC

Terminal 3.8: Process supply voltage UP3 = +24 V DC

Terminals 1.9, 2.9 and 3.9: Process supply voltage ZP = 0 V.

The assignment of the other terminals:

With a separate UP3 power supply, the digital outputs can be switched off externally. This way, an emergency-off functionality can be realized.

Do not connect any voltages externally to digital outputs!

This ist not intended usage.

Reason: Externally voltages at one or more terminals DC0 ... DC7 or DO0 ... DO7 may cause that other digital outputs are supplied through that voltage instead of voltage UP3 (reverse voltage).

This is also possible, if DC channels are used as inputs. For this, the source for the input signals should be the impressed UP3 of the device.

This limitation does not apply for the input channels DI0 ... DI7.

CAUTION!

Risk of malfunction by unintended usage!

If the function cut-off of the digital outputs is to be used by deactivation of the supply voltage UP3, be sure that no external voltage is connected at the outputs.

Table 404: Assignment of the other terminals

Terminal	Signal	Description
1.0	DC0	Signal of the configurable digital input/output DC0
1.1	DC1	Signal of the configurable digital input/output DC1
1.2	DC2	Signal of the configurable digital input/output DC2
1.3	DC3	Signal of the configurable digital input/output DC3
1.4	DC4	Signal of the configurable digital input/output DC4
1.5	DC5	Signal of the configurable digital input/output DC5
1.6	DC6	Signal of the configurable digital input/output DC6

Terminal	Signal	Description
1.7	DC7	Signal of the configurable digital input/output DC7
1.8	UP	Process voltage UP (24 V DC)
1.9	ZP	Process voltage ZP (0 V DC)
2.0	DI8	Signal of the digital input DI8
2.1	DI9	Signal of the digital input DI9
2.2	DI10	Signal of the digital input DI10
2.3	DI11	Signal of the digital input DI11
2.4	DI12	Signal of the digital input DI12
2.5	DI13	Signal of the digital input DI13
2.6	DI14	Signal of the digital input DI14
2.7	DI15	Signal of the digital input DI15
2.8	UP	Process voltage UP (24 V DC)
2.9	ZP	Process voltage ZP (0 V DC)
3.0	DO8	Signal of the digital output DO8
3.1	DO9	Signal of the digital output DO9
3.2	DO10	Signal of the digital output DO10
3.3	DO11	Signal of the digital output DO11
3.4	DO12	Signal of the digital output DO12
3.5	DO13	Signal of the digital output DO13
3.6	DO14	Signal of the digital output DO14
3.7	DO15	Signal of the digital output DO15
3.8	UP3	Process voltage UP3 (24 V DC)
3.9	ZP	Process voltage ZP (0 V DC)



WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing the following:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

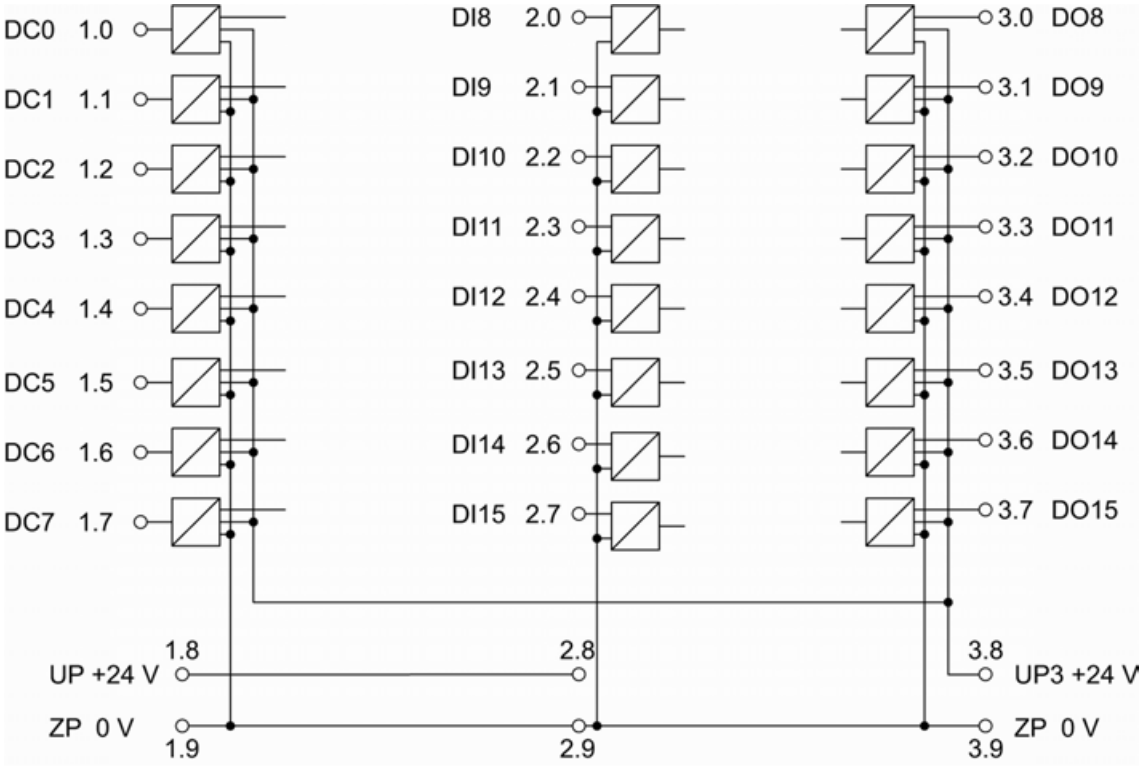


Fig. 263: Connection of the Ethernet communication interface module CI502-PNIO

Connection of the Digital inputs

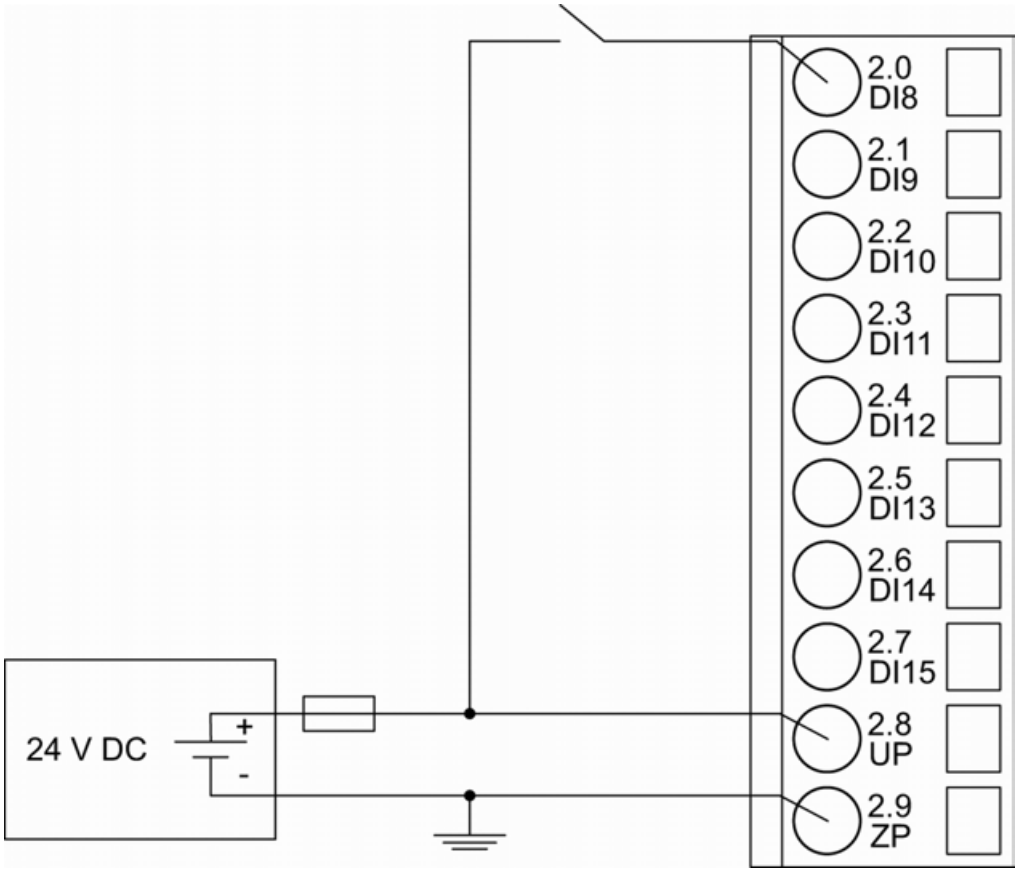


Fig. 264: Connection of the digital inputs (DI8 ... DI15)

Meaning of the LEDs

Connection of the Digital outputs

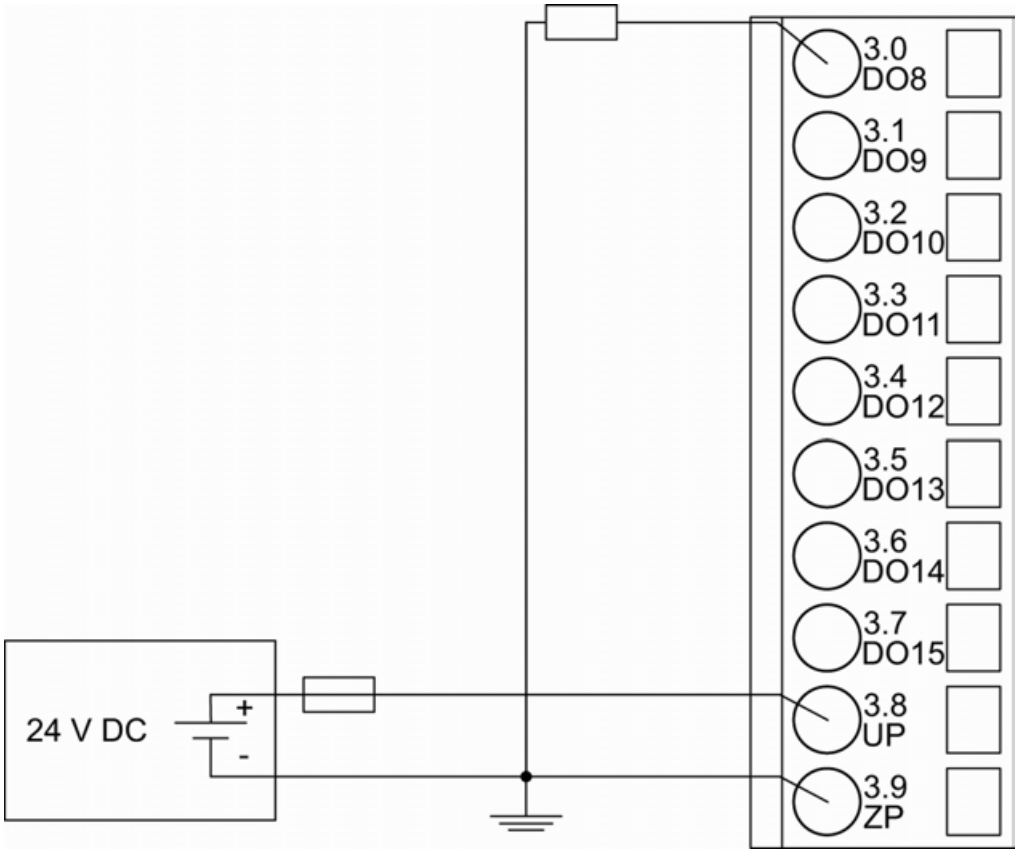


Fig. 265: Connection of the digital outputs (DO8 ... DO15)

Meaning of the LEDs

Connection of the configurable digital inputs/outputs

The following figure shows the connection of the configurable digital input/output DC0 and DC1. DC0 is connected as an input and DC1 is connected as an output. Proceed with the configurable digital inputs/outputs DC2 ... DC7 in the same way.

CAUTION!
If a DC channel is used as input, the source for the input signals should be the impressed UP3 of the device.

↳ *Chapter 5.6.8.3.3 “Connections” on page 1306*

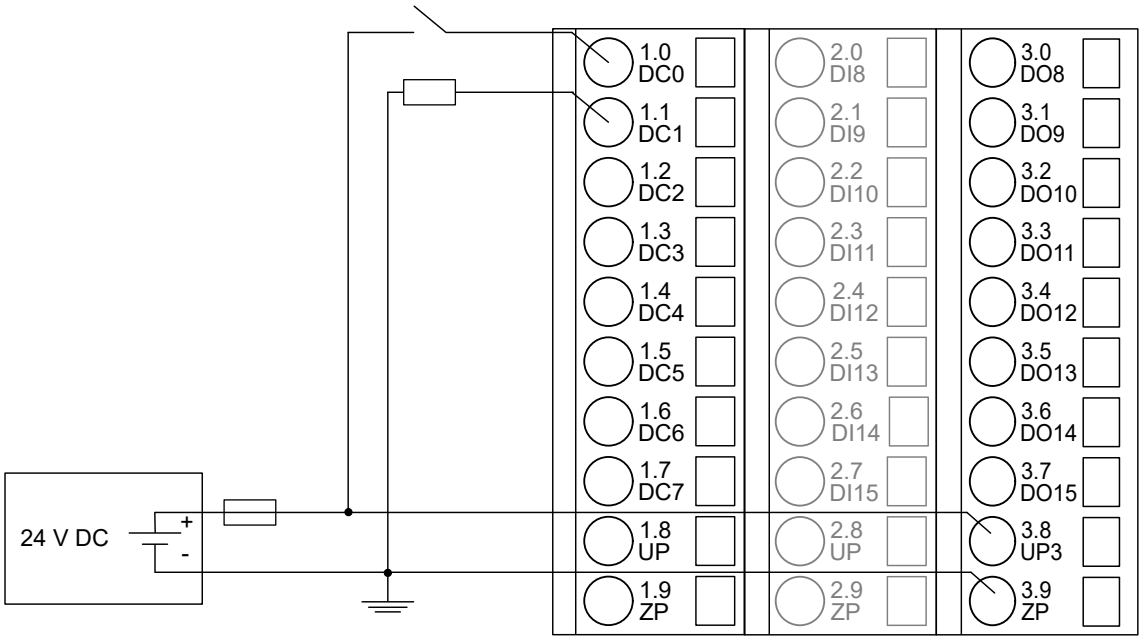


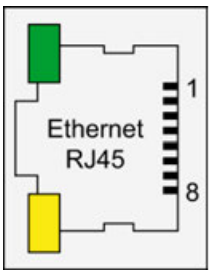
Fig. 266: Connection of the configurable digital inputs/outputs (DC0 ... DC7)(DC0 as input, DC1 as output)

↳ *Meaning of the LEDs*

Assignment of the Ethernet ports

The terminal unit for the communication interface module provides two Ethernet interfaces with the following pin assignment:

Pin assignment

Interface	Pin	Signal	Description
	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NC	Not connected
	5	NC	Not connected
	6	RxD-	Receive data -
	7	NC	Not connected
	8	NC	Not connected
	Shield	Cable shield	Functional earth

In corrosive environment, please protect unused connectors using the TA535 accessory.

Not supplied with this device.

5.6.8.3.4 Internal data exchange

Parameter	Value
Digital inputs (bytes)	5
Digital outputs (bytes)	5
Counter input data (words)	4
Counter output data (words)	8

5.6.8.3.5 Addressing

The module has 2 rotary switches to set an explicit name to the PROFINET IO device before commissioning. No engineering tool is needed in this case.

The device gets its name (including the fixed part of the device name) with the switch settings (01h...FFh). This name can be used directly within the device configuration: “CI5xx-pn-yy”

"CI5xx-pn-yy” xx is the fixed part of the device name (e.g. CI501) and yy represents the position of the rotary switch (0..FFh). The rotary switch values must be entered in hexadecimal format. For example, to set the name to “CI5xx-pn-08”, set the upper rotary switch to “0” and the lower switch to “8”.

The module reads the position of the rotary switches only during power-up, i.e. changes of the switch position during operation will have no effect until the next module initialization.

5.6.8.3.6 I/O configuration

The CI502-PNIO stores some PROFINET configuration parameters (I/O device identifier, I/O device type and IP address configuration). No more configuration data is stored.

The digital I/O channels are configured via software.

↳ *Details about the configuration*

5.6.8.3.7 Parameterization

Parameters of the module

Name	Value	Internal value	Internal value, type	Default
Module ID [1])	Internal	7005	WORD	7005
Parameter length	Internal	8	BYTE	8
Error LED / Fail-safe function *Further information on page 1314*	On	0	BYTE	0
	Off by E4	1		
	Off by E3	3		
	On + failsafe	16		
	Off by E4 + fail-safe	17		
	Off by E3 + fail-safe	19		
Process cycle time	1 ms process cycle time	1	BYTE	1 ms
	2 ms process cycle time	2		
	3 ms process cycle time	3		
	4 ms process cycle time	4		
	5 ms process cycle time	5		
	6 ms process cycle time	6		
	7 ms process cycle time	7		
	8 ms process cycle time	8		
	9 ms process cycle time	9		
	10 ms process cycle time	10		
	11 ms process cycle time	11		
	12 ms process cycle time	12		
	13 ms process cycle time	13		
	14 ms process cycle time	14		
	15 ms process cycle time	15		
	16 ms process cycle time	16		
Check supply	Off	0	BYTE	1
	On	1		

Name	Value	Internal value	Internal value, type	Default
Fast counter	0 : 10 [2])	0 : 10	BYTE	0
I/O-Bus reset	Off	0	BYTE	Off
	On	1	BYTE	Off
[1]) With a faulty ID, the module reports a "parameter error" and does not perform cyclic process data transmission. [2]) Counter operating modes *Chapter 5.4.3.2.9 “Fast counter” on page 522*				

Table 405: Table Error LED / Failsafe function

Setting	Description
On	Error LED (S-ERR) lights up at errors of all error classes, Failsafe-mode off
Off by E4	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, Failsafe-mode off
Off by E3	Error LED (S-ERR) lights up at errors of error classes E1 and E2, Failsafe-mode off
On + Failsafe	Error LED (S-ERR) lights up at errors of all error classes, Failsafe-mode on *)
Off by E4 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, Failsafe-mode on *)
Off by E3 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1 and E2, Failsafe-mode on *)
*) The parameter Behaviour DO at comm. error is only analyzed if the Failsafe-mode is ON.	

IO-BUS reset after PROFINET reconnection

IO-BUS reset after PROFINET reconnection controls the behavior of PROFINET CI modules in relation to connected I/O modules (both safety and non-safety I/O modules).

- IO-BUS reset after PROFINET reconnection = *"On"* resets and, thus, re-parameterizes all attached I/O modules. All internal I/O modules states are reset, including the related diagnosis information.

  If the parameter is set to *"On"*, the following applies:
  - The bumpless re-start of non-safety I/O modules will not be supported. It means, for example, that non-safety output channels will go from fail-safe values to *"0"* values during the re-connection and re-parameterization time and after that go to new output values.
  - Safety I/O modules will be re-parameterized and re-started as newly started modules, which may not require their PROFIsafe reintegration, depending on safety CPU state, in the safety application.
- IO-BUS reset after PROFINET reconnection = *"Off"* will not reset all attached I/O modules. It will re-parameterize I/O modules only if parameter change is detected during the reconnection. All internal I/O modules states are not reset, including the related diagnosis information.

  If the parameter is set to *"Off"*, the following applies:
  - The bumpless re-start of non-safety I/O modules is supported (if no parameters are changed). It means, for example, that non-safety output channels will not go from fail-safe values to *"0"* values during the re-connection and re-parameterization time, but directly from fail-safe values to new output values.
  - Safety I/O modules will not be re-parameterized (if no parameters are changed). Thus, they may continue their operation, which may require their PROFIsafe reintegration in the safety application on the safety CPU, e.g., if PROFIsafe watchdog time for this safety I/O module has expired. Any reintegration of such safety I/O modules will be not only application specific but also PROFIsafe specific and depend on the safety I/O handling in the safety application.

Group parameters for the digital part

Name	Value	Internal value	Internal value, type	Default
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.1 ms 0x00
Detect short circuit at outputs	Off On	0 1	BYTE	On 0x01
Behaviour DO at comm. error [1])	Off Last value Last value 5 sec Last value 10 sec Substitute value Substitute value 5 sec Substitute value 10 sec	0 1 6 11 2 7 12	BYTE	Off 0x00
Substitute value at output	0 ... 65535	0000h ... FFFFh	WORD	0 0x0000

Name	Value	Internal value	Internal value, type	Default
Preventive voltage feedback monitoring for DC0..DC7 [2])	Off On	0 1	BYTE	Off 0x00
Detect voltage overflow at outputs [3])	Off On	0 1	BYTE	Off 0x00

Remarks:

[1])	The parameter Behaviour DO at comm. error is apply to DC and DO channels and only analyzed if the Failsafe-mode is ON.
[2])	The state "externally voltage detected" appears, if the output of a channel DC0 ... DC7 should be switched on while an externally voltage is connected. In this case the start up is disabled, as long as the externally voltage is connected. The monitoring of this state and the resulting diagnosis message can be disabled by setting the parameters to "OFF".
[3])	The error state "voltage overflow at outputs" appears, if externally voltage at digital outputs DC0 ... DC7 and accordingly DO0 ... DO7 has exceeded the process supply voltage UP3. The according diagnosis message "Voltage overflow on outputs " can be disabled by setting the parameters on "OFF". This parameter should only be disabled in exceptional cases for voltage overflow may produce reverse voltage. *Chapter 5.6.8.3.3 “Connections” on page 1306*

5.6.8.3.8 Diagnosis

Structure of the Diagnosis Block via function block PNIO_DEV_ALARM.

Byte Number	Description	Possible Values
1	Diagnosis Byte, slot number	31 = CI502-PNIO (e. g. error at integrated 8 DI / 8 DO) 1 = 1st connected S500 I/O module ... 10 = 10th connected S500 I/O module
2	Diagnosis Byte, module number	According to the I/O bus specification passed on by modules to the fieldbus master
3	Diagnosis Byte, channel	According to the I/O bus specification passed on by modules to the fieldbus master

Byte Number	Description	Possible Values
4	Diagnosis Byte, error code	According to the I/O bus specification Bit 7 and bit 6, coded error class 0 = E1 1 = E2 2 = E3 3 = E4 Bit 0 to bit 5, coded error description
5	Diagnosis Byte, flags	According to the I/O bus specification Bit 7: 1 = coming error Bit 6: 1 = leaving error

In cases of short circuit or overload, the digital outputs are turned off. The modules performs reactivation automatically. Thus an acknowledgement of the errors is not necessary. The error message is stored via the LED.

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<– Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**		
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**PNIO diag-nosis block**		
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-Identi-fier**	**Error message**		**Remedy**
	[1])	[2])	[3])					
Module errors								
3	-	31	31	31	19	Checksum error in the I/O module		Replace I/O module
3	-	31	31	31	3	Timeout in the I/O module		
3	-	31	31	31	40	Different hard-/firm-ware versions in the module		
3	-	31	31	31	43	Internal error in the module		
3	-	31	31	31	36	Internal data exchange failure		
3	-	31	31	31	9	Overflow diagnosis buffer		Restart
3	-	31	31	31	26	Parameter error		Check master

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<– Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**		
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**PNIO diag-nosis block**		
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**		**Remedy**
	[1])	[2])	[3])					
3	-	31	31	31	11	Process voltage UP too low		Check process supply voltage
3	-	31	31	31	45	Process voltage UP gone		Check process supply voltage
3	-	31/1 ... 10	31	31	17	No communication with I/O device		Replace I/O module
3	-	1 ... 10	31	31	32	Wrong I/O device type on socket		Replace I/O module / Check configu-ration
4	-	1 ... 10	31	31	31	At least one module does not support failsafe function		Check modules and parame-terization
4	-	1 ... 10	31	5	8	I/O module removed from hot swap terminal unit or defective module on hot swap ter-minal unit [9])		Plug I/O module, replace I/O module
4	-	1 ... 10	31	5	28	Wrong I/O module plugged on hot swap terminal unit [9])		Remove wrong I/O module and plug pro-jected I/O module
4	-	1 ... 10	31	5	42	No communication with I/O module on hot swap terminal unit [9])		Replace I/O module

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<– Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**	**Remedy**
	[1])	[2])	[3])				
4	-	1 ... 10	31	5	54	I/O module does not support hot swap [8]) [9])	Power off system and replace I/O module
4	-	1 ... 10	31	6	8	Hot swap terminal unit configured but not found	Replace terminal unit by hot swap terminal unit
4	-	1 ... 10	31	6	42	No communication with hot swap terminal unit [9])	Restart, if error persists replace terminal unit
4	1...6	255	2	0	45	The connected Communication Module has no connection to the network	Check cabeling
4	-	31	31	31	45	Process voltage UP3 too low	Check process voltage
4	-	31	31	31	46	Reverse voltage from digital outputs DO0..DO7 to UP3 [4])	Check terminals
4	-	31/1 ... 10	31	31	34	No response during initialization of the I/O module	Replace I/O module
4	-	31	31	31	11	Process voltage UP3 too low	Check process supply voltage
4	-	31	31	31	45	Process voltage UP3 gone	Check process supply voltage

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500-Display**	**<– Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**		
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**PNIO diag-nosis block**		
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-** **Identi-fier**	**Error message**		**Remedy**
	[1])	[2])	[3])					
4	-	31	31	31	10	Voltage overflow at outputs (above UP3 level) [5])		Check termi-nals/ check process supply voltage
Channel error digital								
4	-	31	2	8 ... 15	46	Externally voltage detected at digital output DO0 ... DO7 [6])		Check terminals
4	-	31	4	0 ... 7	46	Externally voltage detected at digital output DC0 ... DC7 [6])		Check terminals
4	-	31	4	0 ... 7	47	Short circuit at digital output DC0 ... DC7[7])		Check terminals
4	-	31	2	8 ... 15	47	Short circuit at digital output DO0 ... DO7[7])		Check terminals

Remarks:

[1])	In AC500 the following interface identifier applies: "-" = Diagnosis via bus-specific function blocks; 0 ... 4 or 10 = Position of the Communication Module;14 = I/O-Bus; 31 = Module itself The identifier is not contained in the CI502-PNIO diagnosis block.
[2])	With "Device" the following allocation applies: 31 = Module itself, 1 ... 10 = Expansion module
[3])	With "Module" the following allocation applies dependent of the master: Module error: 31 = Module itself Channel error: Module type (1 = AI, 2 = DO, 3 = AO)

[4])	This message appears, if externally voltages at one or more terminals DC0 ... DC7 oder DO0 ... DO7 cause that other digital outputs are supplied through that voltage (voltage feedback. All outputs of the apply digital output groups will be turned off for 5 seconds. The diagnosis message appears for the whole output group. ↳ *Chapter 5.6.8.3.3 “Connections” on page 1306*
[5])	The voltage at digital outputs DC0 ... DC7 and accordingly DO0 ... DO7 has exceeded the process supply voltage UP3. Diagnosis message appears for the whole module. ↳ *Chapter 5.6.8.3.3 “Connections” on page 1306*
[6])	This message appears, if the output of a channel DC0 ... DC7 or DO0 ... DO7 should be switched on while an externally voltage is connected. In this case the start up is disabled, as long as the externally voltage is connected. Otherwise this could produce reverse voltage from this output to other digital outputs. This diagnosis message appears per channel.
[7])	Short circuit: After a detected short circuit, the output is deactivated for 2000 ms. Then a new start up will be executed. This diagnosis message appears per channel.
[8])	In case of an I/O module doesn’t support hot swapping, do not perform any hot swap operations (also not on any other terminal units (slots)) as modules may be damaged or I/O bus communication may be disturbed.
[9])	Diagnosis for hot swap available as of version index F0.

5.6.8.3.9 State LEDs

The LEDs are located at the front of module.

There are 2 different groups of LEDs:

- The 5 system LEDs (PWR, STA1 ETH, STA2 ETH, S-ERR and I/O-Bus) show the operation state of the module and display possible errors.
- The 29 process LEDs (UP, UP3, inputs, outputs, CH-ERR1 to CH-ERR3) show the process supply voltage and the states of the inputs and outputs and display possible errors.

Table 406: States of the 5 system LEDs

LED	Color	OFF	ON	Flashing
PWR/RUN	Green	Process supply voltage missing	Internal supply voltage OK, module ready for communication with IO Controller	Start-up / preparing communication
	Yellow	---	---	---
STA1 ETH (System-LED "BF")	Green	---	Device configured, cyclic data exchange running	---
	Red	---	---	Device is not configured
STA2 ETH (System LED "SF")	Green	---	---	Got identification request from I/O controller
	Red	No system error	System error (collective error)	---

LED	Color	OFF	ON	Flashing
S-ERR	Red	No error	Internal error	--
I/O-Bus	Green	No expansion modules connected or communication error	Expansion modules connected and operational	---
ETH1	Green	No connection at Ethernet interface	Connected to Ethernet interface	---
	Yellow	---	Device is transmitting telegrams	Device is transmitting telegrams
ETH2	Green	No connection at Ethernet interface	Connected to Ethernet interface	---
	Yellow	---	Device is transmitting telegrams	Device is transmitting telegrams

Table 407: States of the 29 process LEDs

LED	Color	OFF	ON	Flashing
DC0 ... DC7	Yellow	Input/Output is OFF	Input/Output is ON	--
DI8 ... DI15	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--
DO8 ... DO15	Yellow	Output is OFF	Output is ON	--
UP	Green	Process supply voltage missing	Process supply voltage OK and initialization finished	--
UP3	Green	Process supply voltage missing	Process supply voltage OK	--
CH-ERR1 to CH-ERR3	Red	No error or process supply voltage missing	Internal error or module not configured	Error on one channel of the corresponding group

5.6.8.3.10 Technical data

Technical data of the module

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

↳ *Chapter 4.3 “System data AC500-XC” on page 38*

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter		Value
Process supply voltages UP/UP3		
	Rated value	24 V DC (for inputs and outputs)
	Max. load for the terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse on UP/UP3	10 A fast
	Galvanic isolation	Ethernet interface against the rest of the module
	Inrush current from UP (at power up)	On request
	Current consumption via UP (normal operation)	0.15 A
	Current consumption via UP3	0.06 A + 0.5 A max. per output
	Connections	Terminals 1.8 and 2.8 for +24 V (UP) Terminal 3.8 for +24 V (UP3) Terminals 1.9, 2.9 and 3.9 for 0 V (ZP)
Max. power dissipation within the module		6 W
Number of digital inputs		8
Number of digital outputs		8
Number of configurable digital inputs/outputs		8
Input data length		12 bytes
Output data length		20 bytes
Reference potential for all digital inputs and outputs		Negative terminal of the supply voltage, signal name ZP
Setting of the I/O device identifier		With 2 rotary switches at the front side of the module
Operation and error displays		34 LEDs (totally)
Weight (without terminal unit)		Ca. 125 g
Mounting position		Horizontal mounting or Vertical mounting with derating (output load reduced to 50 % at +40 °C per group)
Extended ambient temperature (XC version)		> +60 °C on request
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Multiple overloads
With multi-channel modules, there are no effects of multiple overloads as each digital output channel is individually protected by an internal intelligent high-side switch.

Parameter	Value
Bus connection	2 x RJ45
Switch	Integrated
Technology	Hilscher NETX 100
Transfer rate	10/100 Mbit/s (full-duplex)
Transfer method	According to Ethernet II, IEEE 802.3
Ethernet	100 base-TX, internal switch, 2x RJ45 socket
Expandability	Max. 10 S500 I/O modules
Adjusting elements	2 rotary switches for generation of an explicit name
Supported protocols	RTC - real time cyclic protocol, class 1 *) RTA - real time acyclic protocol DCP - discovery and configuration protocol CL-RPC - connectionless remote procedure Call LLDP - link layer discovery protocol MRP - MRP Client
Acyclic services	PNIO read / write sequence (max. 1024 bytes per telegram) Process-Alarm service
Supported alarm types	Process Alarm, Diagnostic Alarm, Return of SubModule, Plug Alarm, Pull Alarm
Min. bus cycle	1 ms
Conformance class	CC B
Protective functions (according to IEC 61131-3)	Protected against: ● short circuit ● reverse supply ● overvoltage ● reverse polarity Galvanic isolation from the rest of the module.

*) Prioritization with the aid of VLAN-ID including priority level

Technical data of the digital inputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DI0 ... DI7	Terminals 2.0 ... 2.7
Reference potential for all inputs	Terminals 1.9 ... 3.9 (Negative terminal of the supply voltage, signal name ZP)
Indication of the input signals	1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)	Type 1
Input delay (0->1 or 1->0)	Typ. 0.1 ms, configurable from 0.1 ms ... 32 ms

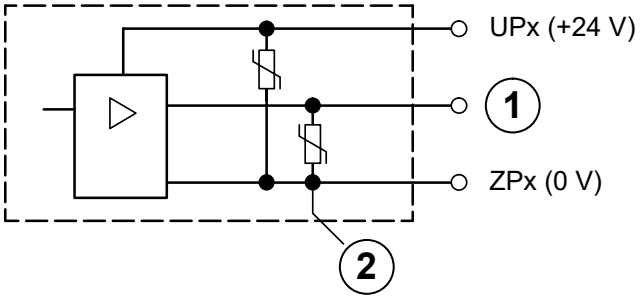
Parameter		Value
Input signal voltage		24 V DC
	Signal 0	-3 V ... +5 V
	Undefined Signal	> +5 V ... < +15 V
	Signal 1	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical data of the digital outputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DO0 ... DO7		Terminals 3.0 ... 3.7
Reference potential for all outputs		Terminals 1.9 ... 3.9 (negative terminal of the supply voltage, signal name ZP)
Common power supply voltage		For all outputs terminal 3.8 (positive terminal of the supply voltage, signal name UP3)
Output voltage for signal 1		UP3 (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value per channel	500 mA at UP3 = 24 V
	Max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA
	Fuse for UP3	10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)
Output switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload-proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms

Parameter		Value
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.



1 Digital output
2 Varistors for demagnetization when inductive loads are turned off

Technical data of the configurable digital inputs/outputs

Each of the configurable I/O channels is defined as input or output by the user program. This is done by interrogating or allocating the corresponding channel.

Parameter		Value
Number of channels per module		8 inputs/outputs (with transistors)
Distribution of the channels into groups		1 group for 8 channels
If the channels are used as inputs		
	Channels DC0 ... DC07	Terminals 1.0 ... 1.7
If the channels are used as outputs		
	Channels DC0 ... DC07	Terminals 1.0 ... 1.7
Indication of the input/output signals		1 yellow LED per channel, the LED is ON when the input/output signal is high (signal 1)
Galvanic isolation		From the Ethernet network

Technical data of the digital inputs/outputs if used as inputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DC0 ... DC7	Terminals 1.0 ... 1.7
Reference potential for all inputs	Terminals 1.9 ... 3.9 (Negative terminal of the supply voltage, signal name ZP)

Parameter		Value
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1 ms ... 32 ms
Input signal voltage		24 V DC
	Signal 0	-3 V ... +5 V
	Undefined Signal	> +5 V ... < +15 V
	Signal 1	+15 V ... +30 V
Ripple with signal 0		Within -3 V ... +5 V
Ripple with signal 1		Within +15 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

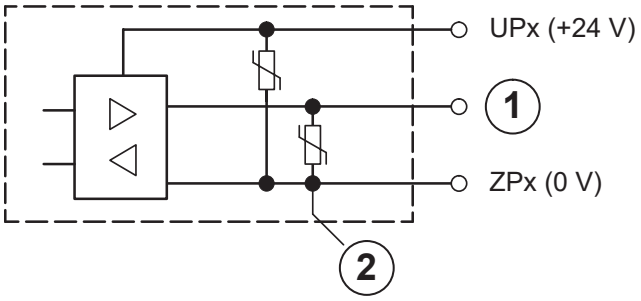
*) Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal may not exceed the clamp voltage of the varistor. The varistor limits the voltage to approx. 36 V. Following this, the input voltage must range from -12 V ... +30 V when UPx = 24 V and from -6 V ... +30 V when UPx = 30 V.

Technical data of the digital inputs/outputs if used as outputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DC0 ... DC7		Terminals 1.0 ... 1.7
Reference potential for all outputs		Terminals 1.9 ... 3.9 (negative terminal of the supply voltage, signal name ZP)
Common power supply voltage		For all outputs terminal 3.8 (positive terminal of the supply voltage, signal name UP3)
Output voltage for signal 1		UP3 (-0.8 V)
Output delay (0->1 or 1->0)		On request
Output current		
	Rated value per channel	500 mA at UP3 = 24 V
	Max. value (all channels together)	4 A
Leakage current with signal 0		< 0.5 mA
	Fuse for UP3	10 A fast
Demagnetization with inductive DC load		Via internal varistors (see figure below this table)

Parameter		Value
Output switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	11 Hz max. at 5 W max.
Short-circuit-proof / overload proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short circuit/overload
Resistance to feedback against 24 V signals		Yes (software-controlled supervision)
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

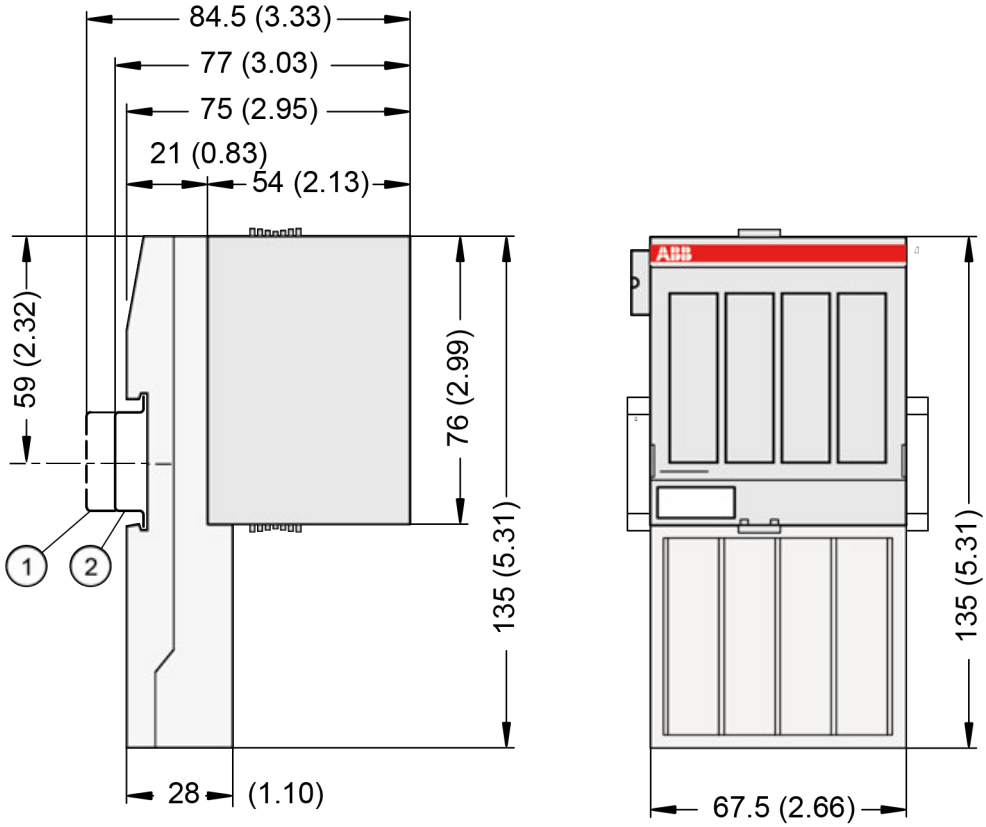


1 Digital input/output
2 For demagnetization when inductive loads are turned off

Technical data of the fast counter

Parameter	Value
Used inputs	Terminal 2.0 (DI8),Terminal 2.1 (DI9)
Used outputs	Terminal 3.0 (DO8)
Counting frequency	Depending on operation mode: Mode 1- 6: max. 200 kHz Mode 7: max. 50 kHz Mode 9: max. 35 kHz Mode 10: max. 20 kHz

5.6.8.3.11 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

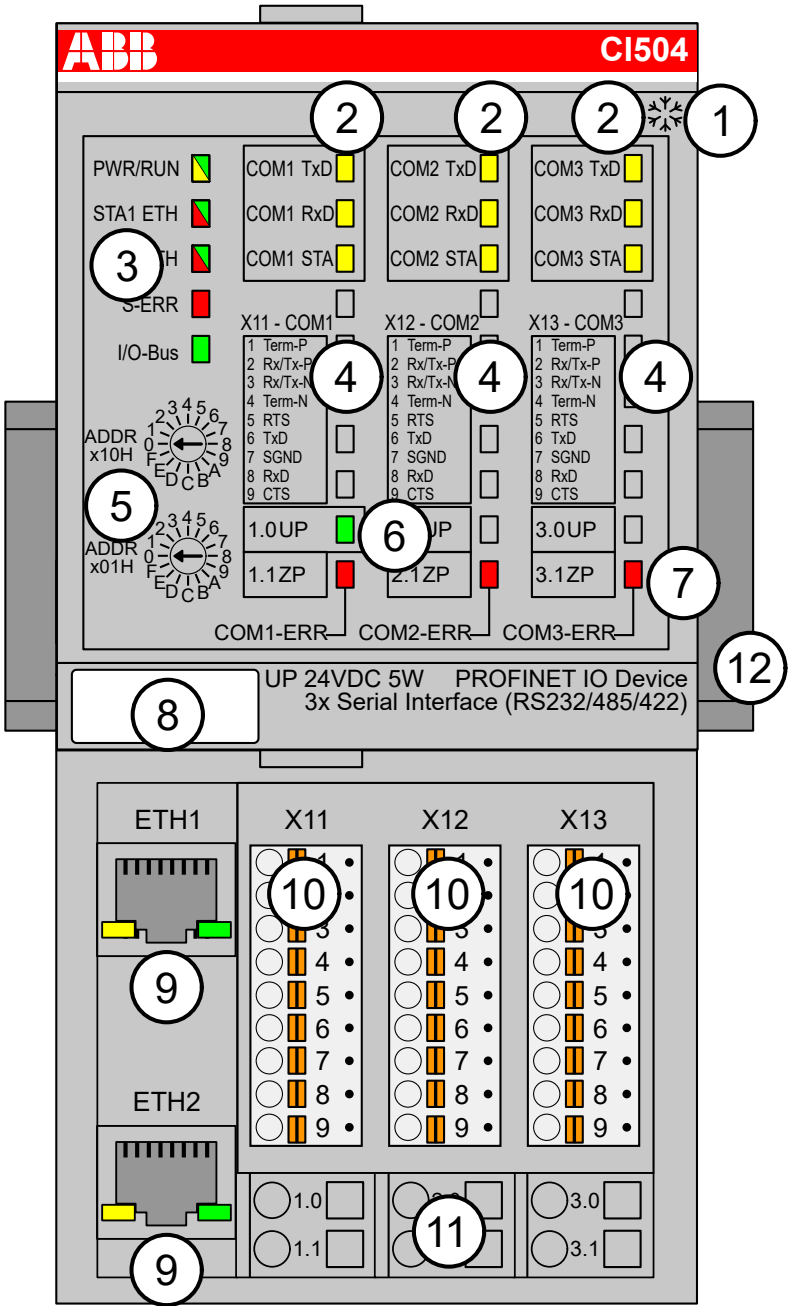
5.6.8.3.12 Ordering data

Active	Active	Product life cycle phase *)
1SAP 220 700 R0001	CI502-PNIO, PROFINET communication interface module, 8 DI, 8 DO and 8 DC	Active
1SAP 420 700 R0001	CI502-PNIO-XC, PROFINET communication interface module, 8 DI, 8 DO and 8 DC, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.6.8.4 CI504-PNIO

- 3 serial UART interfaces (RS-232, RS-422 or RS-485)
- Module-wise galvanically isolated
- XC version for usage in extreme ambient conditions available



1 I/O bus
2 3 x 3 yellow LEDs to display the signal states of the serial interfaces COM1, COM2 and COM3
3 5 system LEDs: PWR/RUN, STA1 ETH, STA2 ETH, S-ERR, I/O-Bus
4 Allocation between terminal number and signal name of the serial interfaces
5 2 rotary switches for setting the I/O device identifier
6 1 green LED to display the process voltage UP
7 3 red LEDs to display errors (COM1-ERR, COM2-ERR, COM3-ERR) of the serial interfaces
8 Label
9 Ethernet Interfaces (ETH1, ETH2) on the terminal unit
10 3 removable connectors to connect the interfaces

11 6 spring terminals for power supply voltage (UP)
12 DIN rail
❄ Sign for XC version

5.6.8.4.1 Intended purpose

The PROFINET communication interface module CI504-PNIO provides 3 onboard serial interfaces. The network connection is performed via 2 RJ45 connectors which are integrated in the terminal unit.

The bus interfaces are galvanically isolated from the Ethernet network.

For usage in extreme ambient conditions (e. g. wider temperature and humidity range), a special XC version of the device is available.

5.6.8.4.2 Functionality

Parameter	Value
Interface	Ethernet
Protocol	PROFINET IO RT
Serial Interfaces	3 Serial UART interfaces RS-232, RS-422 and RS-485 available as physical layer
Serial protocol	ASCII
I/O bus interface	For up to 10 AC500 I/O Modules
Rotary switches	For setting the I/O device identifier for configuration purposes (00h to FFh)
LED displays	For system displays, field bus indication, errors and power supply
Power supply	Via terminals UP and ZP (process supply voltage 24 V DC)
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V
Required terminal unit	TU520 ↳ *Chapter 5.7.5 “TU520-ETH for PROFINET communication interface modules” on page 1359*

5.6.8.4.3 Connections

The PROFINET communication interface module CI504-PNIO is plugged on the terminal unit TU520-ETH ↳ *Chapter 5.7.5 “TU520-ETH for PROFINET communication interface modules” on page 1359*. Properly seat the module and press until it locks in place. The terminal unit is mounted on a DIN rail or with 2 screws plus the additional accessory for wall mounting ↳ *Chapter 5.8.2.6 “TA526 - Wall mounting accessory” on page 1410*.

The connection of the power supply voltage is carried out using the 6 terminals and the 3 removable connectors of the terminal unit. The CI504-PNIO can be replaced without re-wiring the terminal units.



For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

The terminals 1.0, 2.0 and 3.0 as well as 1.1, 2.1 and 3.1 are electrically interconnected within the terminal unit and have always the same assignment, independent of the inserted module:

Table 408: Assignment of the terminals

Terminal	Signal	Description
1.0	UP	Process voltage UP (+24 V DC)
1.1	ZP	Process voltage ZP (0 V DC)
2.0	UP	Process voltage UP (+24 V DC)
2.1	ZP	Process voltage ZP (0 V DC)
3.0	UP	Process voltage UP (+24 V DC)
3.1	ZP	Process voltage ZP (0 V DC)

Table 409: Assignment of the terminals of removable connectors X11, X12 and X13 (Serial interfaces)

Terminal	Signal	Description	
1	Term-P	RS-485	Internal line terminating resistor for non-inverted signal (Rx/Tx-P)
		RS-422	Non-inverted receive signal terminal (RxD+)
2	Rx/Tx-P	RS-485	Non-inverted I/O signal terminal for each channel
		RS-422	Non-inverted transmit signal terminal (TxD+)
3	Rx/Tx-N	RS-485	Inverted I/O signal terminal for each channel
		RS-422	Inverted transmit signal terminal (TxD-)
4	Term-N	RS-485	Internal line-terminating resistor for inverted signal (Rx/Tx-N) terminal
		RS-422	Inverted receive signal terminal (RxD-)
5	RTS	RS-232	Request To Send signal terminal for each channel
6	TxD	RS-232	Transmit signal terminal for each channel
7	SGND	RS-232	Signal ground for each channel
8	RxD	RS-232	Receive signal terminal for each channel
9	CTS	RS-232	Clear To Send signal terminal for each channel



The connection of SGND (ground) is optional for RS-485/RS-422.



For RS-422, no external line-terminating resistors have to connected. They are already connected inside the module.

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before doing the following:

– Connect or disconnect any signal or terminal block.
– Remove, mount or replace a module.

Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

The devices must not be opened when in operation. The same applies to the network interfaces.

NOTICE!

Risk of damaging the PLC modules!

Overvoltages and short circuits might damage the PLC modules.

– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

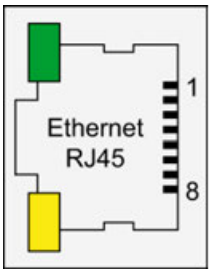
The module provide several diagnosis functions *Chapter 5.6.8.4.7 “Diagnosis” on page 1339*.

Further information is provided in the System Technology chapter PROFINET.

5.6.8.4.4 Assignment of the Ethernet ports

The terminal unit for the communication interface module provides two Ethernet interfaces with the following pin assignment:

Pin assignment

Interface	Pin	Signal	Description
	1	TxD+	Transmit data +
	2	TxD-	Transmit data -
	3	RxD+	Receive data +
	4	NC	Not connected
	5	NC	Not connected
	6	RxD-	Receive data -
	7	NC	Not connected
	8	NC	Not connected
	Shield	Cable shield	Functional earth

In corrosive environment, please protect unused connectors using the TA535 accessory.

Not supplied with this device.

5.6.8.4.5 Addressing

The module has 2 rotary switches to set an explicit name to the PROFINET IO device before commissioning. No engineering tool is needed in this case.

The device gets its name (including the fixed part of the device name) with the switch settings (01h...FFh). This name can be used directly within the device configuration: “CI5xx-pn-yy”

"CI5xx-pn-yy” xx is the fixed part of the device name (e.g. CI501) and yy represents the position of the rotary switch (0..FFh). The rotary switch values must be entered in hexadecimal format. For example, to set the name to “CI5xx-pn-08”, set the upper rotary switch to “0” and the lower switch to “8”.

The module reads the position of the rotary switches only during power-up, i.e. changes of the switch position during operation will have no effect until the next module initialization.

5.6.8.4.6 Parameterization

Parameters of the module

Name	Value	Internal value	Internal value, type	Default
Module ID [1])	Internal	7010	WORD	7010
Parameter length	Internal	33	BYTE	33
Error LED / Fail-safe function see table [2])	On	0	BYTE	0
	Off by E4	1		
	Off by E3	3		
	On + failsafe	16		
	Off by E4 + fail-safe	17		
	Off by E3 + fail-safe	19		
I/O-Bus reset	Off	0	BYTE	Off
	On	1	BYTE	Off

Remarks:

[1]) With a faulty module ID, the module reports a "parameter error" and does not perform cyclic process data transmission

Table 410: Error LED / Failsafe function [2])

Setting	Description
On	Error LED lights up at errors of all error classes, Failsafe-mode off
Off by E4	Error LED lights up at errors of error classes E1, E2 and E3, Failsafe-mode off
Off by E3	Error LED lights up at errors of error classes E1 and E2, Failsafe-mode off
On + Failsafe	Error LED lights up at errors of all error classes, Failsafe-mode on
Off by E4 + Failsafe	Error LED lights up at errors of error classes E1, E2 and E3, Failsafe-mode on
Off by E3 + Failsafe	Error LED lights up at errors of error classes E1 and E2, Failsafe-mode on

All values are validated during the parameterization of the CI504-PNIO according to the appended expansion modules. In the case of error, a diagnosis message "parameter errors" is generated and the cyclic process data transfer is terminated.

IO-BUS reset after PROFINET reconnection

IO-BUS reset after PROFINET reconnection controls the behavior of PROFINET CI modules in relation to connected I/O modules (both safety and non-safety I/O modules).

- IO-BUS reset after PROFINET reconnection = *“On”* resets and, thus, re-parameterizes all attached I/O modules. All internal I/O modules states are reset, including the related diagnosis information.

  If the parameter is set to *“On”*, the following applies:
  - The bumpless re-start of non-safety I/O modules will not be supported. It means, for example, that non-safety output channels will go from fail-safe values to *“0”* values during the re-connection and re-parameterization time and after that go to new output values.
  - Safety I/O modules will be re-parameterized and re-started as newly started modules, which may not require their PROFIsafe reintegration, depending on safety CPU state, in the safety application.
- IO-BUS reset after PROFINET reconnection = *“Off”* will not reset all attached I/O modules. It will re-parameterize I/O modules only if parameter change is detected during the reconnection. All internal I/O modules states are not reset, including the related diagnosis information.

  If the parameter is set to *“Off”*, the following applies:
  - The bumpless re-start of non-safety I/O modules is supported (if no parameters are changed). It means, for example, that non-safety output channels will not go from fail-safe values to *“0”* values during the re-connection and re-parameterization time, but directly from fail-safe values to new output values.
  - Safety I/O modules will not be re-parameterized (if no parameters are changed). Thus, they may continue their operation, which may require their PROFIsafe reintegration in the safety application on the safety CPU, e.g., if PROFIsafe watchdog time for this safety I/O module has expired. Any reintegration of such safety I/O modules will be not only application specific but also PROFIsafe specific and depend on the safety I/O handling in the safety application.

Parameters of the 3 serial channels

Name	Value	Internal value	Internal value, type	Default
Behavior for serial channel communication during PROFINET communication fault	Stop communication and reset FIFO	0	BYTE	0
	Continue serial communication	1		
Number of frames/data blocks in reception FIFO	1 ... 40	1 ... 40	BYTE	1
Number of frames/Data blocks in transmission FIFO	1 ... 40	1 ... 40	BYTE	1
Behavior during reception FIFO overflow	Discard new received frames	1	BYTE	2
	Overwrite oldest frame in FIFO	2		
	Discard new received frames and send PROFINET alarm	3		
	Overwrite oldest frame in FIFO and send PROFINET alarm	4		
Physical layer	RS-232	1	BYTE	1
	RS-485	2		
	RS-422	3		
RTS control	None	0	BYTE	1
	Telegram	1		
	RTS/CTS (DTE <-> DTE)	2		
	RTS/CTS (DTE -> DCE)	3		
	RTS/CTS (DCE <- DTE)	4		
TLS (RTS leading cycle)	0 ms ... 850 ms	0 ... 850	WORD	0
CDLY (RTS trailing cycle)	0 ms ... 850 ms	0 ... 850	WORD	0
Character timeout	0/32 bits	0/32	WORD	0
Telegram ending selection	None	0	BYTE	None
	String (check reception)	1		
	Telegram length	2		
	Character timeout	4		

Name	Value	Internal value	Internal value, type	Default
Telegram ending character	0 ... 255	0 ... 255	BYTE	0
Telegram ending value	0 ... 65535	0 ... 65535	WORD	0
Checksum	None	0	BYTE	0
	CRC8	1		
	CRC16	2		
	LRC	3		
	ADD	4		
	CS31	5		
	CRC8-FBP	6		
	XOR	7		
	CRC16 (Intel)	8		
Handshake mode	None	0	BYTE	0
	XON/XOFF	2		
Transmission rate	Channel inactive	0	DWORD	19200
	300 bit/s	300		
	1200 bit/s	1200		
	4800 bit/s	4800		
	9600 bit/s	9600		
	14400 bit/s	14400		
	19200 bit/s	19200		
	38400 bit/s	38400		
	38400 bit/s	57600		
	57600 bit/s	57600		
	115200 bit/s	115200		
Parity	No parity	0	BYTE	No parity
	Odd parity	1		
	Even parity	2		
Data bits	5 bits	0	BYTE	8
	6 bits	1		
	7 bits	2		
	8 bits	3		
Stop bits	1 bit	0	BYTE	1
	2 bits	1		



Configuration with Automation Builder

The physical layers are selectable as submodules in PROFINET configuration (parameter Physical Layer not visible and fixed with the correct value). Certain parameters are not visible if a certain physical layer is selected. This concept of parameterization provides a better usability than configuring via GSDML (see below).

Configuration via GSDML (use by 3rd party PROFINET configuration tool)
All parameters are visible independent of the configured physical layer (via parameter "Physical Layer"). The user must take precautions for each parameter since certain parameter values are invalid for certain physical layers. Nevertheless, the CI5xx-PNIO module performs a parameter check depending on the configured physical layer and generates a diagnosis message (parameter error) in the case of error.

General precautions

- If parameter telegram ending selection is set to value Character Timeout, the value in the parameter Character Timeout must be set to 0. The parameter End Value must be set to 32 (equivalent to 32-bits character timeout). Only 32-bits character timeout is supported.
- Checksum is only supported if a telegram ending selection is active.
- Please refer to AC500 serial channel documentation for additional precautions.

Precautions for RS-485/RS-422

DTE/DCE is not supported. The parameter RTS Control must be set to value Telegram or to None.

5.6.8.4.7 Diagnosis

Structure of the Diagnosis Block via PNIO_DEV_ALARM function block

Byte Number	Description	Possible Values
1	Diagnosis Byte, slot number	31 = CI504-PNIO (e. g. error at integrated Serial Interface) 1 = 1st connected S500 I/O module ... 10 = 10th connected S500 I/O module
2	Diagnosis Byte, module number	According to the I/O bus specification passed on by modules to the fieldbus master
3	Diagnosis Byte, channel	According to the I/O bus specification passed on by modules to the fieldbus master
4	Diagnosis Byte, error code	According to the I/O bus specification Bit 7 and bit 6, coded error class 0 = E1 1 = E2 2 = E3 3 = E4 Bit 0 to bit 5, coded error description
5	Diagnosis Byte, flags	According to the I/O bus specification Bit 7: 1 = coming error Bit 6: 1 = leaving error

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error message**	**Remedy**
	[1])	[2])	[3])				
Module error							
3	-	31	31	31	43	Internal error in the module	Replace module
3	-	31	31	31	9	Overflow diagnosis buffer	New start
3	-	31	31	31	26	Parameter error	Check master
3	-	31	31	31	11	Process voltage too low	Check process voltage
3	-	31	31	31	45	Process voltage gone	Check process voltage
3	-	1 ... 10	31	31	17	No communication with I/O module	Replace I/O module
4	-	1 ... 10	31	31	31	At least 1 I/O Module does not support failsafe mode	Check I/O modules and parame-terization
4	-	1 ... 10	31	31	32	Wrong I/O Module type on socket	Replace I/O module Check configu-ration
4	-	1 ... 10	31	31	34	No response during initialization of the I/O Module	Replace I/O module
Serial Channel error							

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000 ... 063**	**AC500 display**	**<– Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 4 **Bit 6 ... 7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0 ... 5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error message**	**Remedy**
	[1])	**[2])**	**[3])**				
4	-	31	31	1 ... 3	12	Reception SW FIFO overrun	Check modules and parame-terization
4	-	31	31	1 ... 3	26	Parameter error	Check modules and parame-terization

Remarks:

[1])	In AC500 the following interface identifier applies: "-" = Diagnosis via bus-specific function blocks; 0 ... 4 or 10 = Position of the Communication Module; 14 = I/O bus; 31 = Module itself The identifier is not contained in the CI504-PNIO diagnosis block.
[2])	With "Device" the following allocation applies: 31 = Module itself
[3])	With "Module" the following allocation applies dependent of the master: 31 = Module itself or 1 ... 10 expansion module

5.6.8.4.8 State LEDs

The LEDs are located at the front of module. There are 4 different groups:

- 5 system LEDs (PWR, STA1 ETH, STA2 ETH, S-ERR and I/O-Bus) show the operation state of the module and display possible errors.
- 4 Ethernet state LEDs located at the terminal unit TU520-ETH
- 12 state LEDs for the serial interfaces
- 1 LED to display the presence of the process supply voltage UP

Table 411: States of the 5 system LEDs

LED	Color	OFF	ON	Flashing
PWR/RUN	Green	Process supply voltage missing	Internal supply voltage OK, module ready for communication with I/O Controller	Start-up / preparing communication
	Yellow	---	---	---
STA1 ETH (System LED "BF")	Green	---	Device configured, cyclic data exchange running	---
	Red	---	---	Device is not configured
STA2 ETH (System LED "SF")	Green	---	---	Got identification request from I/O controller
	Red	No system error	System error (collective error)	---
S-ERR	Red	No error	Internal error	--
I/O-Bus	Green	No communication interface module connected or communication error	communication interface module connected and operational	---

Table 412: States of the 4 Ethernet state LEDs

LED	Color	OFF	ON	Flashing
ETH1-Link	Green	No connection at Ethernet interface	Connected to Ethernet interface	---
ETH1-Rx Tx	Yellow	---	Device is transmitting telegrams	Device is transmitting telegrams
ETH2-Link	Green	No connection at Ethernet interface	Connected to Ethernet interface	---
Eth2-Rx Tx	Yellow	---	Device is transmitting telegrams	Device is transmitting telegrams

Table 413: States of the 12 state LEDs (4 per channel) of the serial interfaces

LED	Color	OFF	ON	Flashing
COMx TxD	Yellow	No data transmission over serial network	--	Channel is transmitting data via the serial interface (flashing rate depending on the telegram transmission frequency)
COMx RxD	Yellow	No data reception from serial network	--	Channel is receiving data from the serial interface (flashing rate depending on the telegram reception frequency)
COMx STA	Yellow	RS-232: RTS signal not active RS-485: Channel is in reception mode RS-422:Channel is not enabled	RS-232: RTS signal is active RS-485: Channel is transmitting RS-422: Channel is enabled (able to receive and transmit)	--
COMx-ERR	Red	Channel enabled, no error OR Channel deactivated	Channel boot up	Channel error (receive buffer overflow)

Table 414: State of the power supply LED

LED	Color	OFF	ON	Flashing
UP	Green	No process voltage available	Process voltage available	--

5.6.8.4.9 Technical data

Technical data of the module

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

↳ *Chapter 4.3 “System data AC500-XC” on page 38*

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter		Value
Process supply voltages UP		
	Rated value	24 V DC
	Max. load for the terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Inrush current from UP (at power up)	On request
	Current consumption via UP (normal operation)	0.15 A
	Connections	Terminals 1.0, 2.0 and 3.0 for +24 V (UP) Terminals 1.1, 2.1 and 3.1 for 0 V (ZP)
Input data length		0 ... 36 bytes
Output data length		0 ... 36 bytes
Max. power dissipation within the module		5 W
Setting of the I/O module identifier		With 2 rotary switches at the front side of the module
Operation and error displays		18 LEDs (total)
Weight (without terminal unit)		ca. 125 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

Galvanic isolation	Ethernet interface against the rest of the module, each serial port against each other and the rest of the module
Diagnosis	See Diagnosis *Chapter 5.6.8.4.7 “Diagnosis” on page 1339*

NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Parameter	Value
Bus connection	2 x RJ45
Switch	Integrated
Technology	Hilscher NETX 100
Transfer rate	10/100 Mbit/s (full-duplex)

Parameter	Value
Transfer method	According to Ethernet II, IEEE 802.3
Ethernet	100 base-TX, internal switch, 2x RJ45 socket
Expandability	Max. 10 S500 I/O modules
Adjusting elements	2 rotary switches for generation of an explicit name
Supported protocols	RTC - real time cyclic protocol, class 1 *) RTA - real time acyclic protocol DCP - discovery and configuration protocol CL-RPC - connectionless remote procedure Call LLDP - link layer discovery protocol MRP - MRP Client
Acyclic services	PNIO read / write sequence (max. 1024 bytes per telegram) Process-Alarm service
Supported alarm types	Process Alarm, Diagnostic Alarm, Return of SubModule, Plug Alarm, Pull Alarm
Min. bus cycle	1 ms
Conformance class	CC B
Protective functions (according to IEC 61131-3)	Protected against: ● short circuit ● reverse supply ● overvoltage ● reverse polarity Galvanic isolation from the rest of the module.

*) Prioritization with the aid of VLAN-ID including priority level

Technical data of the serial interfaces

Parameter	Value
Number of serial interfaces	3
Connectors for serial interfaces	X11 for COM1 X12 for COM2 X13 for COM3
Supported physical layers	RS-232 RS-422 RS-485
Supported protocols	ASCII
Transmission rate	Configurable from 300 bit/s to 115.200 bit/s

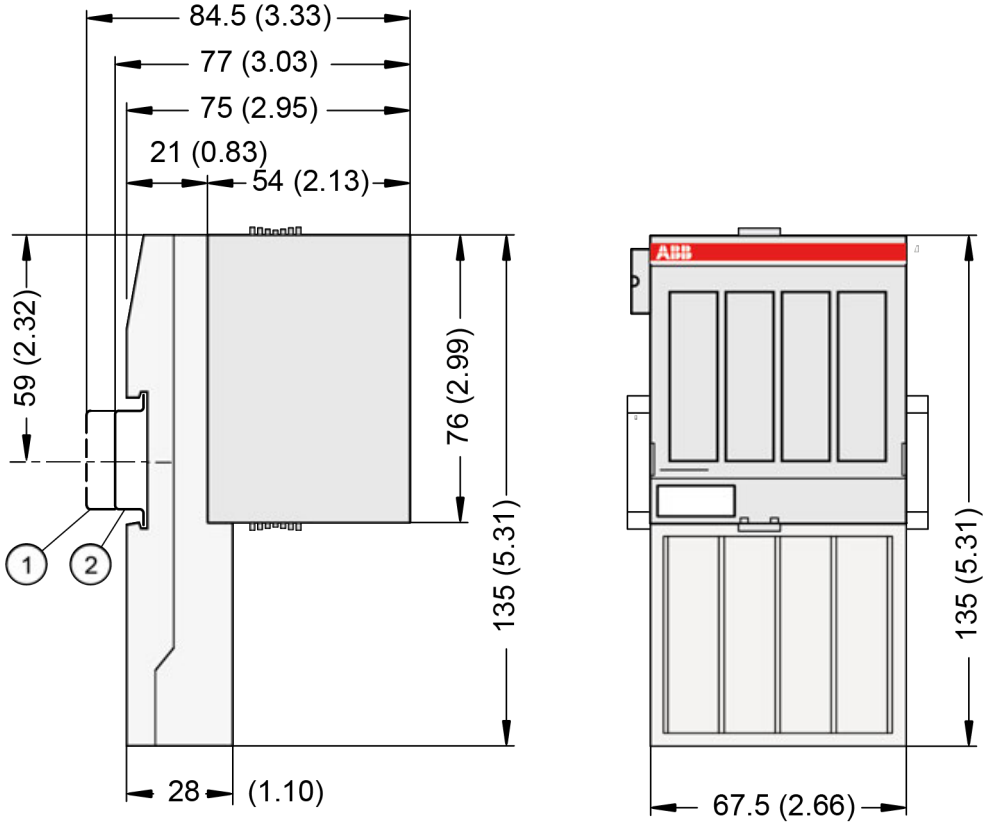
NOTICE!
CI504-PNIO IO module is supported only via CM579-PNIO communication module in AC500 V3. It is not supported via onboard PROFINET in AC500-eCo V3.

CI504 Profinet Library
This is a dedicated library with function blocks to send and receive serial data via PROFINET using a CI504 module.

`CI504PnioComRec`: *Implements the receiving data via serial interface for a CI504.*

`CI504PnioComSend`: *Implements sending of data via serial interface of a CI504*

5.6.8.4.10 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

5.6.8.4.11 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 221 300 R0001	CI504-PNIO, PROFINET communication interface module with 3 serial interfaces	Active
1SAP 421 300 R0001	CI504-PNIO-XC, PROFINET communication interface module with 3 serial interfaces, XC version	Active

*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

5.7 Terminal units for communication interface modules

5.7.1 Safety instructions

NOTICE!

Risk of device damage!

– I/O modules with a device index **above** F0 can be hot-swapped. When I/O modules **below** F0 are inserted or removed from the terminal unit in a powered system the I/O modules can be damaged.
  Before hot swapping a device, check the device index and ensure that the modules meet the requirements. *Table 298 “Allowed device indexes for I/O modules for hot swapping” on page 957*
– Terminal units that support hot swapping of I/O modules have the appendix TU5xx**-H**.
– Hot swap is not supported by AC500-eCo CPU!

The following I/O bus masters support hot swapping of attached I/O modules:

– Communication interface modules CI5xx as of index F0.
– Processor modules PM56xx-2ETH with firmware version as of V3.2.0.

NOTICE!

Risk of damage to I/O modules!

Hot swapping is only allowed for I/O modules.

Processor modules and communication interface modules must not be removed or inserted during operation.

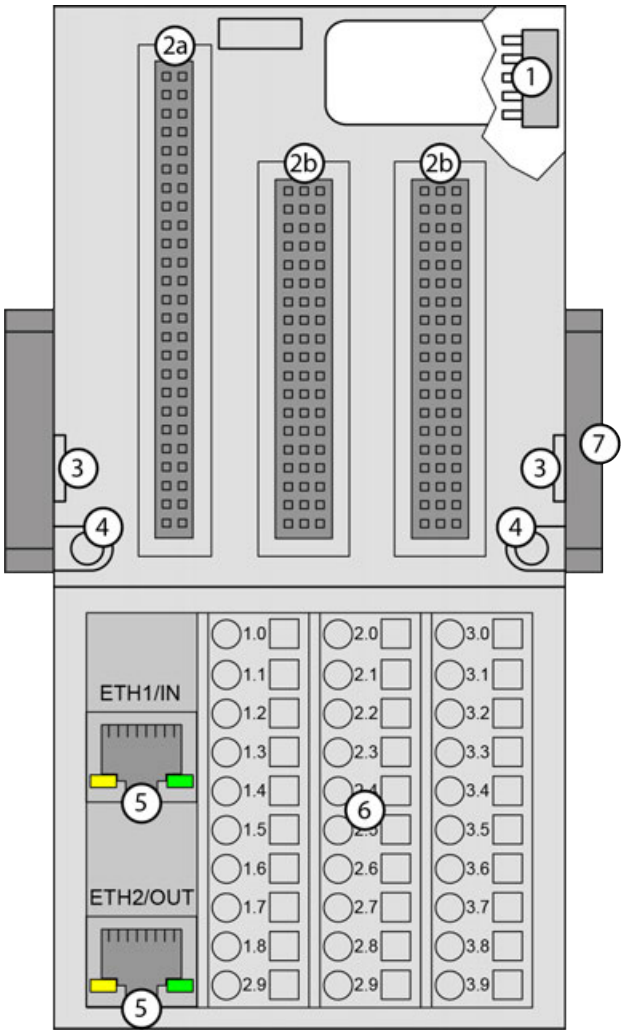
Conditions for hot swapping

– *Digital outputs are not under load.*
– *Input/output voltages above safety extra low voltage/ protective extra low voltages (SELV/PELV) are switched off.*
– *Modules are completely plugged on the terminal unit with both snap fit engaged before switching on loads or input/output voltage.*

.

5.7.2 TU507-ETH and TU508-ETH for Ethernet communication interface modules

- TU507-ETH, Ethernet terminal unit, 24 V DC, screw terminals
- TU508-ETH, Ethernet terminal unit, 24 V DC, spring terminals
- TU508-ETH-XC, Ethernet terminal unit, 24 V DC, spring terminals, XC version



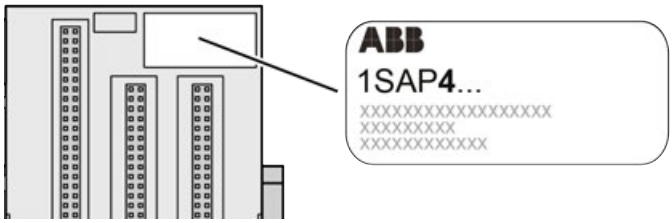
1 I/O bus (10 pins, female) to connect the first terminal unit
2a Plug (2x 25 pins) to connect the inserted Ethernet communication interface module
2b Plug (3x 19 pins) to connect the inserted Ethernet communication interface module
3 With a screwdriver, inserted in this place, the terminal unit and the adjacent terminal unit can be shoved from each other
4 2 holes for wall mounting
5 2 RJ45 interfaces with indication LEDs for connection with the Ethernet network
6 30 terminals for signals and process supply voltages (UP and UP3)
7 DIN rail

The Ethernet communication interface modules plug into the Ethernet terminal unit. When properly seated, they are secured with two mechanical locks. All the connections are made through the Ethernet terminal unit, which allows removal and replacement of the Ethernet communication interface modules without disturbing the wiring at the Ethernet terminal unit.

The Ethernet terminal units TU507-ETH and TU508-ETH are specifically designed for use with AC500/S500 Ethernet communication interface modules (e. g. CI501-PNIO).

XC version

XC = e**X**treme **C**onditions

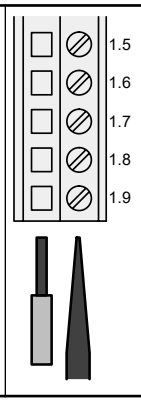
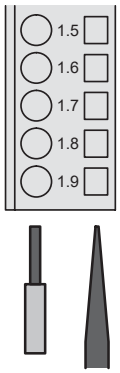


Extreme conditions

Terminal units for use in extreme ambient conditions have no ❄ sign for XC version.

*The figure **4** in the Part no. 1SAP**4**... (label) identifies the XC version.*

Terminals

Screw terminals			**Spring terminals**		
Conductor		Screwdriver	Conductor		Screwdriver (opens terminal)

The terminals 1.8 and 2.8 as well as 1.9, 2.9 and 3.9 are electrically interconnected within the terminal unit and have always the same assignment, independent of the inserted module:

Terminals 1.8 and 2.8: Process supply voltage UP = +24 V DC

Terminal 3.8: Process supply voltage UP3 = +24 V DC

Terminals 1.9, 2.9 and 3.9: Process supply voltage ZP = 0 V

The assignment of the other terminals is dependent on the inserted communication interface module.

NOTICE!

Risk of corrosion!

Unused connectors and slots may corrode if XC devices are used in salt-mist environments.

Protect unused connectors and slots with TA535 protective caps for XC devices
↳ *Chapter 5.8.3.6 “TA535 - Protective caps for XC devices” on page 1418*.

5.7.2.1 Technical data

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

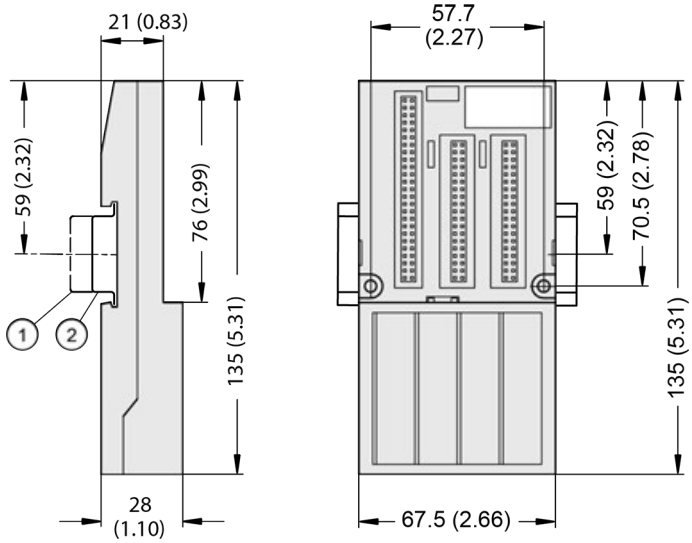
↳ *Chapter 4.3 “System data AC500-XC” on page 38*

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter	Value
Number of I/O channels per module	Max. 24 (depending on the inserted communication interface module)
Distribution of the channels into groups	3 groups of max. 8 channels each (1.0 ... 1.7, 2.0 ... 2.7, 3.0 ... 3.7), the allocation of the channels is given by the inserted Ethernet bus module
Network interface connector	2 RJ45, 8-pole
Rated voltage	24 V DC
Max. permitted total current	10 A via the supply terminals (UP, UP3 and ZP)
Ethernet	10/100 base-TX or 100 base-TX (depending on CI5xx module plugged in), 2 RJ45 socket
Grounding	Direct connection to the grounded DIN rail or via the screws with wall mounting
Screw terminals	Front terminal, conductor connection vertically with respect to the printed circuit board
Spring-type terminals	Front terminal, conductor connection vertically with respect to the printed circuit board
Weight	200 g
Mounting position	Horizontal or vertical

5.7.2.2 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

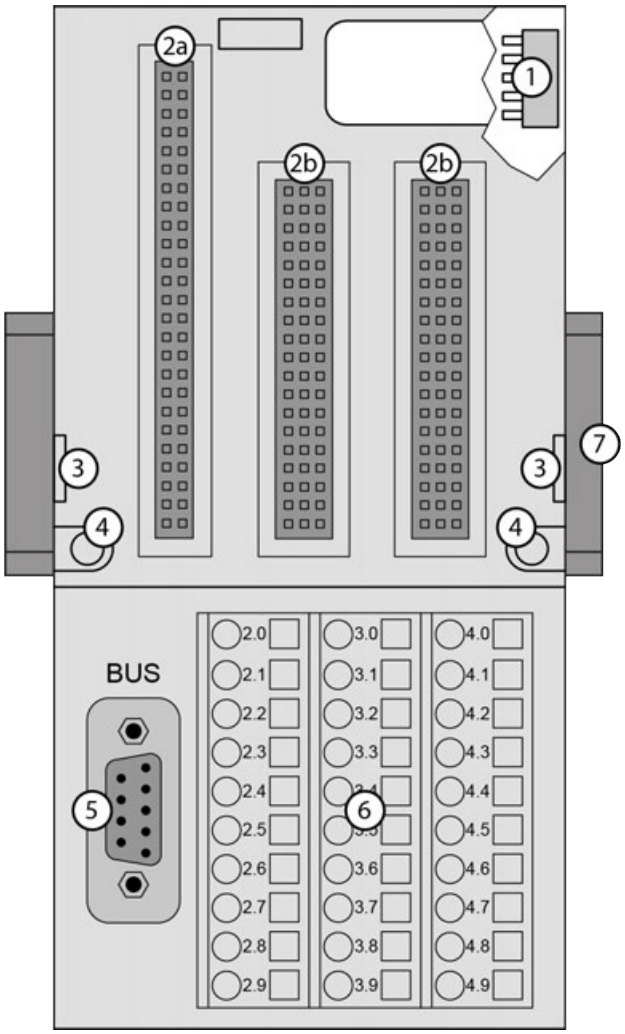
5.7.2.3 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 214 200 R0001	TU507-ETH, Ethernet terminal unit, 24 V DC, screw terminals	Active
1SAP 214 000 R0001	TU508-ETH, Ethernet terminal unit, 24 V DC, spring terminals	Active
1SAP 414 000 R0001	TU508-ETH-XC, Ethernet terminal unit, 24 V DC, spring terminals, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.7.3 TU509 and TU510 for communication interface modules

- TU509, terminal unit, 24 V DC, screw terminals
- TU510, terminal unit, 24 V DC, spring terminals
- TU510-XC, terminal unit, 24 V DC, spring terminals, XC version



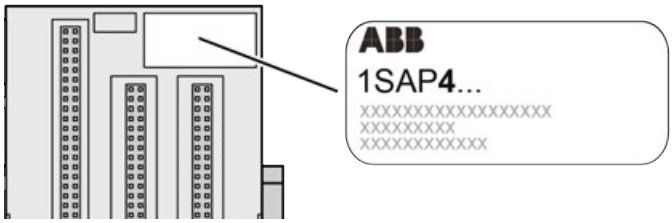
1 I/O bus (10 pins, female) to connect the first terminal unit
2a Plug (2 25 pins) to connect the inserted communication interface module
2b Plug (3 19 pins) to connect the inserted communication interface module
3 With a screwdriver, inserted in this place, the terminal unit and the adjacent terminal unit can be shoved from each other
4 2 holes for wall mounting
5 D-sub 9 (female) for connection with the PROFIBUS network
6 30 terminals for signals and process supply voltages (UP and UP3)
7 DIN rail

The communication interface modules plug into the terminal unit. When properly plugged-in, they are secured with two mechanical locks. All the connections are established via the terminal unit, which allows removal and replacement of the communication interface modules without disturbing the wiring at the terminal unit.

The terminal units TU509 and TU510 are specifically designed for use with AC500/S500 communication interface modules (e. g. CI451-DP).

XC version

XC = e**X**treme **C**onditions

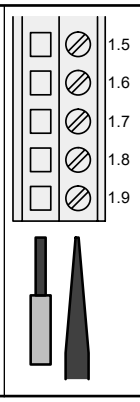
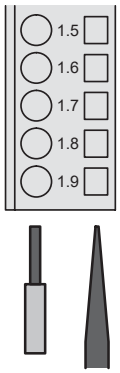


Extreme conditions

Terminal units for use in extreme ambient conditions have no ❄ sign for XC version.

*The figure **4** in the Part no. 1SAP**4**... (label) identifies the XC version.*

Terminals

Screw terminals			**Spring terminals**		
Conductor		Screwdriver	Conductor		Screwdriver (opens terminal)

The terminals 2.8, 3.8, 2.9, 3.9 and 4.9 are electrically interconnected within the terminal unit and always have the same assignment, irrespective of the inserted module:

Terminals 2.8 and 3.8: process supply voltage UP = +24 V DC

Terminal 4.8: process supply voltage UP3 = +24 V DC

Terminals 2.9, 3.9 and 4.9: process supply voltage ZP = 0 V

The assignment of the other terminals depends on the inserted communication interface module (see communication interface modules for CANopen and PROFIBUS).

NOTICE!

Risk of corrosion!

Unused connectors and slots may corrode if XC devices are used in salt-mist environments.

Protect unused connectors and slots with TA535 protective caps for XC devices
↳ *Chapter 5.8.3.6 “TA535 - Protective caps for XC devices” on page 1418*.

5.7.3.1 Technical data

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

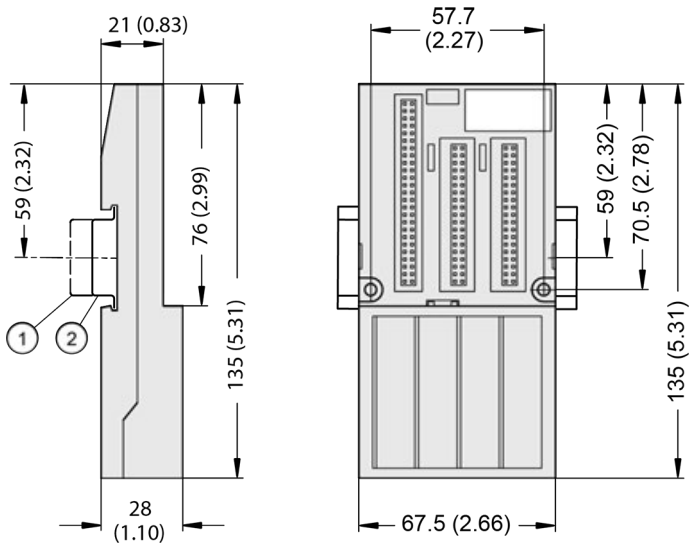
↳ *Chapter 4.3 “System data AC500-XC” on page 38*

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter	Value
Number of I/O channels per module	Max. 24 (depending on the inserted communication interface module)
Distribution of the channels into groups	3 groups of max. 8 channels each (2.0 ... 2.7, 3.0 ... 3.7, 4.0 ... 4.7), the allocation of the channels is given by the inserted communication interface module
Network interface connector	9-pin D-sub connector, female
Rated voltage	24 V DC
Max. permitted total current	10 A via the supply terminals (UP, UP3 and ZP)
Grounding	Direct connection to the grounded DIN rail or via the screws with wall mounting
Screw terminals	Front terminal, conductor connection vertically with respect to the printed circuit board
Spring terminals	Front terminal, conductor connection vertically with respect to the printed circuit board
Weight	200 g
Mounting position	Horizontal or vertical

5.7.3.2 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

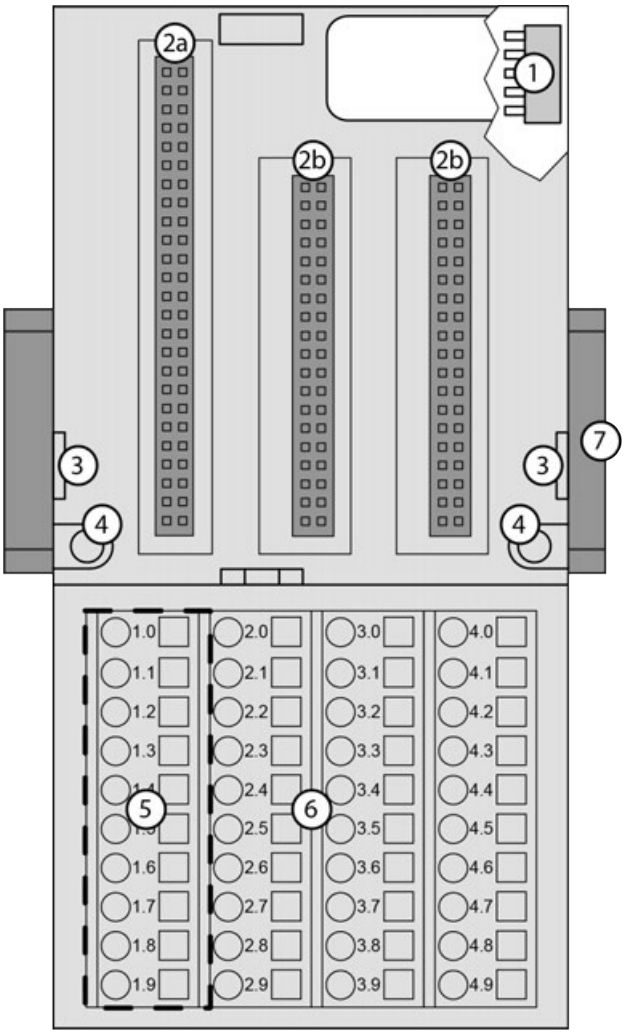
5.7.3.3 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 211 000 R0001	TU509, terminal unit, 24 V DC, screw terminals	Active
1SAP 210 800 R0001	TU510, terminal unit, 24 V DC, spring terminals	Active
1SAP 410 800 R0001	TU510-XC, terminal unit, 24 V DC, spring terminals, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.7.4 TU517 and TU518 for communication interface modules

- TU517, terminal unit, 24 V DC, screw terminals
- TU518, terminal unit, 24 V DC, spring terminals
- TU518-XC, terminal unit, 24 V DC, spring terminals, XC version

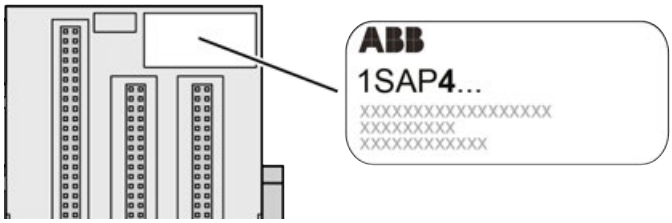


1 I/O bus (10 pins, female) to connect the first terminal unit
2a Plug (2 25 pins) to connect the inserted communication interface module
2b Plug (2 19 pins) to connect the inserted communication interface module
3 With a screwdriver, inserted in this place, the terminal unit and the adjacent I/O terminal unit can be shoved from each other
4 2 holes for wall mounting
5 10 terminals for connection with the bus system
6 30 terminals for signals and process supply voltages (UP and UP3)
7 DIN rail

The communication interface modules plug into the terminal unit. When properly plugged-in, they are secured with two mechanical locks. All the connections are established via the terminal unit, which allows removal and replacement of the communication interface modules without disturbing the wiring at the terminal unit.

XC version

XC = e**X**treme **C**onditions

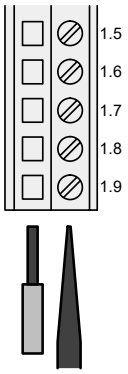
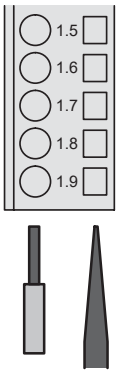


Extreme conditions

Terminal units for use in extreme ambient conditions have no ❄ sign for XC version.

*The figure **4** in the Part no. 1SAP**4**... (label) identifies the XC version.*

Terminals

Screw terminals			**Spring terminals**		
Conductor		Screwdriver	Conductor		Screwdriver (opens terminal)

The terminals 2.8, 3.8, 2.9, 3.9 and 4.9 are electrically interconnected within the terminal unit.

The terminals always have the same assignment, irrespective of the inserted communication interface module:

- Terminals 2.8 and 3.8: process supply voltage UP = +24 V DC
- Terminal 4.8: process supply voltage UP3 = +24 V DC
- Terminals 2.9, 3.9 and 4.9: process supply voltage ZP = 0 V

The assignment of the other terminals depends on the inserted communication interface module (see communication interface modules for CANopen and PROFIBUS).

5.7.4.1 Technical data

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

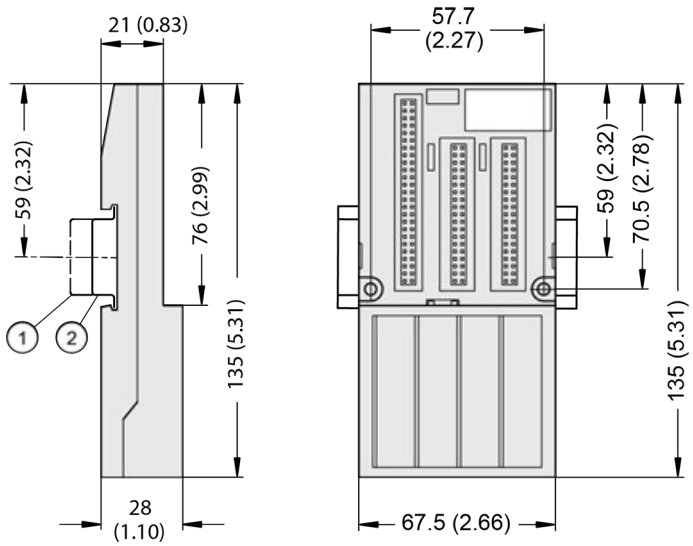
↳ *Chapter 4.3 “System data AC500-XC” on page 38*

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter	Value
Number of I/O channels per module	Max. 24 (depending on the inserted communication interface module)
Distribution of the channels into groups	3 groups of max. 8 channels each (2.0 ... 2.7, 3.0 ... 3.7, 4.0 ... 4.7), the allocation of the channels is given by the inserted communication interface module
Network interface connector	10 screw or spring terminals (1.0 ... 1.9)
Rated voltage	24 V DC
Max. permitted total current	10 A via the supply terminals (UP, UP3 and ZP)
Grounding	Direct connection to the grounded DIN rail or via the screws with wall mounting
Screw terminals	Front terminal, conductor connection vertically with respect to the printed circuit board
Spring terminals	Front terminal, conductor connection vertically with respect to the printed circuit board
Weight	200 g
Mounting position	Horizontal or vertical

5.7.4.2 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

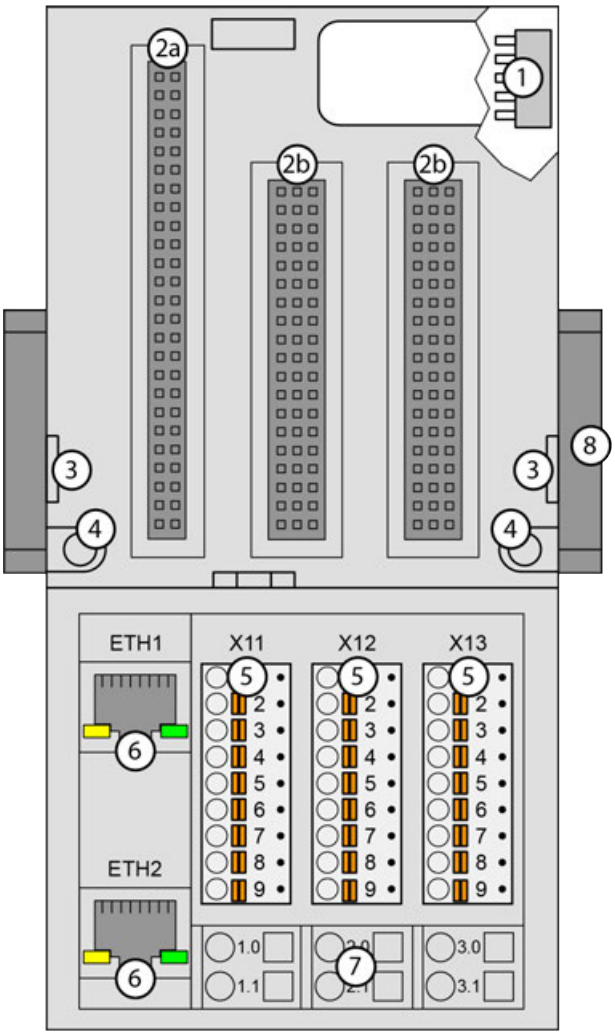
5.7.4.3 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 211 400 R0001	TU517, terminal unit, 24 V DC, screw terminals	Active
1SAP 211 200 R0001	TU518, terminal unit, 24 V DC, spring terminals	Active
1SAP 411 200 R0001	TU518-XC, terminal unit, 24 V DC, spring terminals, XC version	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.7.5 TU520-ETH for PROFINET communication interface modules

- TU520-ETH, 2 RJ45 interfaces for connection to PROFINET network, 3 removable connectors for bus systems
- TU520-ETH-XC, 2 RJ45 interfaces for connection to PROFINET network, 3 removable connectors for bus systems, XC version

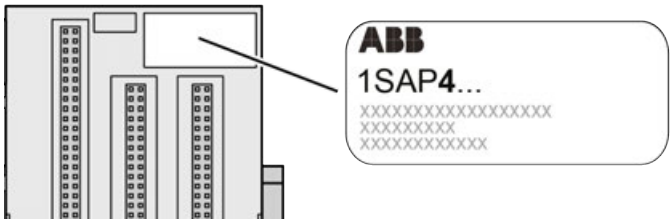


1 I/O bus (10 pins, female) to connect the first terminal unit
2a Plug (2 25 pins) to connect the inserted PROFINET communication interface module
2b Plug (3 19 pins) to connect the inserted PROFINET communication interface module
3 With a screwdriver, inserted in this place, the PROFINET I/O terminal unit and the adjacent I/O terminal unit can be shoved from each other
4 2 holes for wall mounting
5 3 removable connectors to connect the subordinated bus systems
6 2 RJ45 interfaces with indication LEDs for connection with the PROFINET network
7 6 spring terminals for process supply voltage (UP)
8 DIN rail

The PROFINET communication interface modules plug into the PROFINET IO terminal unit. When properly plugged-in, they are secured with two mechanical locks. All the connections are established via the PROFINET IO terminal unit, which allows removal and replacement of the communication interface modules without disturbing the wiring at the PROFINET IO terminal unit.

The PROFINET IO terminal unit TU520-ETH are specifically designed for use with AC500/S500 PROFINET communication interface modules (e. g. CI504-PNIO, CI506-PNIO).

XC version **XC** = e**X**treme **C**onditions



Extreme conditions

Terminal units for use in extreme ambient conditions have no ❄ sign for XC version.

*The figure **4** in the Part no. 1SAP**4**... (label) identifies the XC version.*

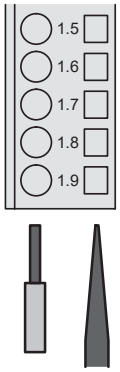
NOTICE!

Risk of corrosion!

Unused connectors and slots may corrode if XC devices are used in salt-mist environments.

Protect unused connectors and slots with TA535 protective caps for XC devices
↳ *Chapter 5.8.3.6 “TA535 - Protective caps for XC devices” on page 1418*.

Spring terminals

Conductor		Screwdriver (opens terminal)
		

The terminals 1.0, 2.0, 3.0, 1.1, 2.1 and 3.1 are electrically interconnected within the PROFINET IO terminal unit.

The terminals always have the same assignment, irrespective of the inserted PROFINET communication interface module:

- Terminals 1.0, 2.0 and 3.0: process supply voltage UP = +24 V DC
- Terminals 1.1, 2.1 and 3.1: process supply voltage ZP = 0 V

The assignment of the bus system terminals depends on the inserted PROFINET communication interface module (see Ethernet communication interface modules overview).

5.7.5.1 Technical data

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

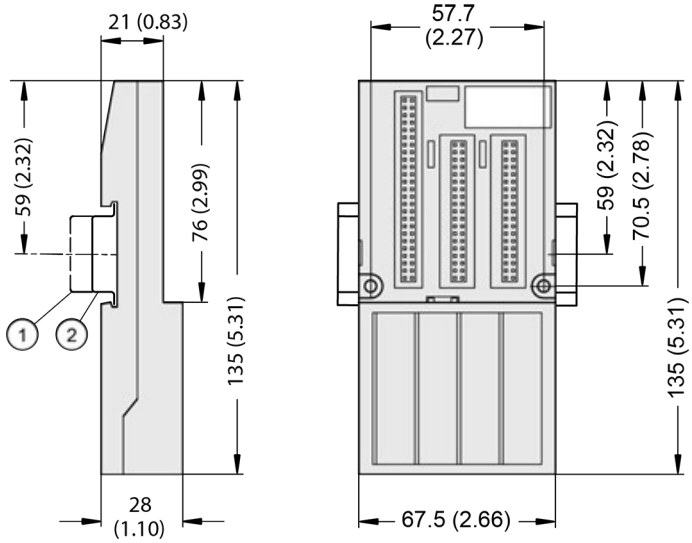
↳ *Chapter 4.3 “System data AC500-XC” on page 38*

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter	Value
Ethernet	10/100 base-TX or 100 base-TX (depending on the plugged CI5xx module), 2 RJ45 socket
Number of bus system connectors	3 (the type of bus system depends on the PROFINET IO communication interface module)
Rated voltage	24 V DC
Max. permitted total current	10 A via the supply terminals (UP and ZP)
Grounding	Direct connection to the grounded DIN rail or via the screws with wall mounting
Spring terminals	Front terminal, conductor connection vertically with respect to the printed circuit board
Weight	200 g
Mounting position	Horizontal or vertical

5.7.5.2 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

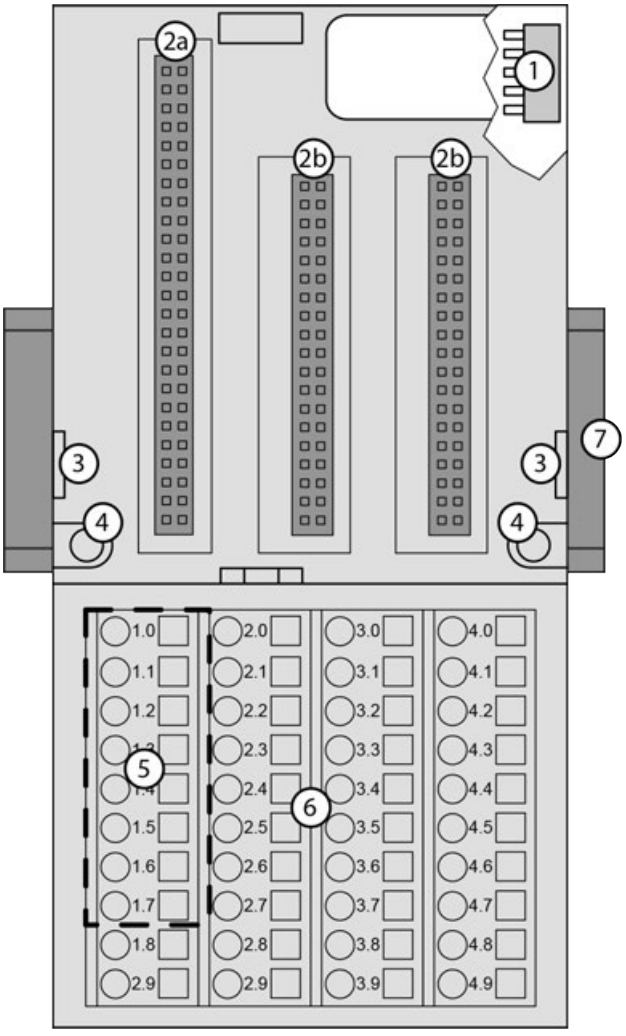
5.7.5.3 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 214 400 R0001	TU520-ETH, PROFINET I/O terminal unit, 24 V DC, spring terminals	Active
1SAP 414 400 R0001	TU520-ETH-XC, PROFINET I/O terminal unit, 24 V DC, spring terminals, XC version	Active

*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

5.7.6 TU551-CS31 and TU552-CS31 for CS31 communication interface modules

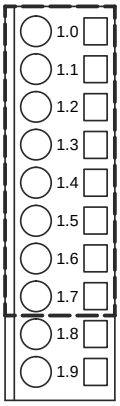
- TU551-CS31, CS31 bus terminal unit, 24 V DC, screw terminals
- TU552-CS31, CS31 bus terminal unit, 24 V DC, spring terminals
- TU552-CS31-XC, CS31 bus terminal unit, 24 V DC, spring terminals, XC version



1 I/O bus (10 pins, female) to connect other terminal units
2a Plug (2 25 pins) to connect the inserted I/O modules
2b Plug (2 19 pins) to connect the inserted I/O modules

3 With a screwdriver inserted in this place, the terminal unit and the adjacent terminal unit can be shoved from each other
4 2 holes for wall mounting
5 CS31 bus interface
6 30 terminals for signals and process supply voltage
7 DIN rail

PIN assignment for bus interface



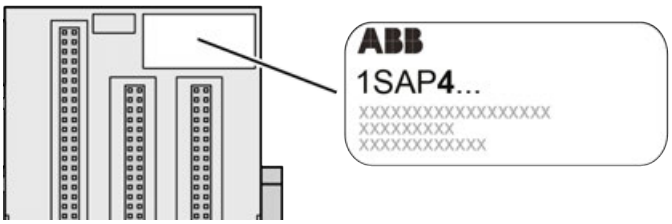
R1	Resistor + (end-of-line)
R2	Resistor - (end-of-line)
B1	CS31 bus +
B2	CS31 bus -
FE	Functional earth
B1	CS31 bus +
B2	CS31 bus -
FE	Functional earth
UP	24 V DC process voltage
ZP	0 V process voltage

The CS31 communication interface modules plug into the terminal unit. When properly plugged-in, they are secured with two mechanical locks. All the connections are established via the terminal unit, which allows removal and replacement of the CS31 communication interface modules without disturbing the wiring at the terminal unit.

The terminal units TU551-CS31 and TU552-CS31 are specifically designed for use with S500 CS31 communication interface modules that incorporate only 24 V DC inputs/outputs or interface signals.

XC version

XC = e**X**treme **C**onditions

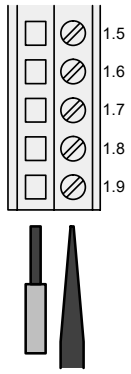
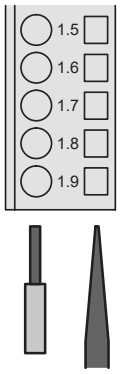


Extreme conditions

Terminal units for use in extreme ambient conditions have no ❄ sign for XC version.

*The figure **4** in the Part no. 1SAP**4**... (label) identifies the XC version.*

Terminals

Screw terminals			Spring terminals		
Conductor		Screwdriver	Conductor		Screwdriver (opens terminal)

The terminals 1.8 ... 4.8 and 1.9 ... 4.9 are electrically interconnected within the terminal unit.

The terminals always have the same assignment, irrespective of the inserted module:

- Terminals 1.8 ... 4.8: process voltage UP = +24 V DC
- Terminals 1.9 ... 4.9: process voltage ZP = 0 V

The assignment of the other terminals depends on the inserted CS31 bus module.

The supply voltage of 24 V DC for the module's circuitry comes from ZP and UP.

5.7.6.1 Technical data

The system data of AC500 and S500 is applicable to the standard version.

↳ *Chapter 4.2 “System data AC500” on page 34*

The system data of AC500-XC is applicable to the XC version.

↳ *Chapter 4.3 “System data AC500-XC” on page 38*

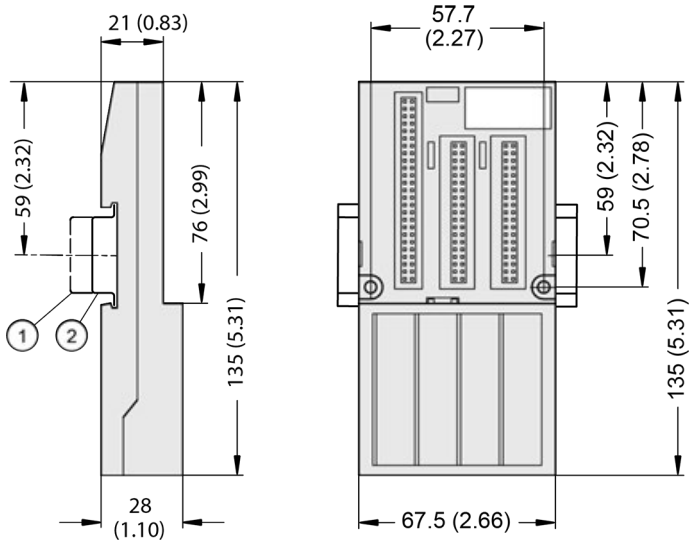
Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter	Value
Number of channels per module	24
Distribution of the channels into groups	3 groups of 8 channels each (2.0...2.7, 3.0...3.7, 4.0...4.7), the allocation of the channels is given by the inserted CS31 communication interface module
CS31 field bus connector	Terminals 1.0 to 1.7
Rated voltage	24 V DC
Max. permitted total current	10 A (between the terminals 1.8...4.8 and 1.9...4.9)
Grounding	Direct connection to the grounded DIN rail or via the screws with wall mounting
Screw terminals	Front terminal, conductor connection vertically with respect to the printed circuit board
Spring terminals	Front terminal, conductor connection vertically with respect to the printed circuit board

Parameter	Value
Weight	200 g
Mounting position	Horizontal or vertical

5.7.6.2 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

5.7.6.3 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 210 600 R0001	TU551-CS31, CS31 bus terminal unit, 24 V DC, screw terminals	Active
1SAP 210 400 R0001	TU552-CS31, CS31 bus terminal unit, 24 V DC, spring terminals	Active
1SAP 410 400 R0001	TU552-CS31-XC, CS31 bus terminal unit, 24 V DC, spring terminals, XC version	Active

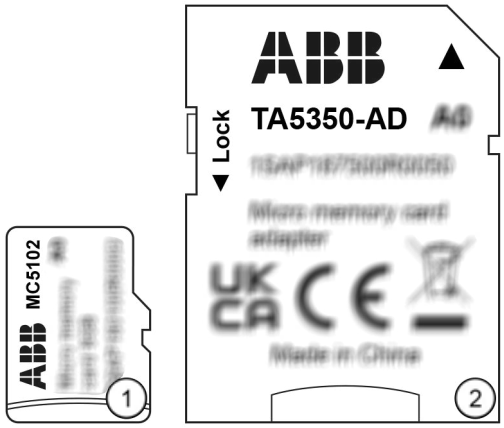
**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.8 Accessories

5.8.1 AC500-eCo

5.8.1.1 MC5102 - Micro memory card with adapter

- Solid state flash memory storage



1 Micro memory card
2 TA5350-AD micro memory card adapter, necessary for use in AC500 processor modules

The MC5102 micro memory card has no write protect switch.

The TA5350-AD micro memory card adapter has a write protect switch.

In the position "LOCK", the inserted micro memory card can only be read.

Memory card type	AC500 V2	AC500-XC V2	AC500 V3	AC500-XC V3	AC500-eCo V3
MC5141	x	x	x	x	-
MC5102 **with** TA5350-AD micro memory card adapter	x [1])	x [1]) [2])	x	x [2])	-
MC5102 **without** TA5350-AD micro memory card adapter	-	-	-	-	x

[1]) As of firmware 2.5.x

[2]) Temporary use of MC5102 is possible under normal environmental conditions, but MC5141 should be preferred.

The use of other micro memory cards is prohibited. ABB is not responsible nor liable for consequences resulting from use of unapproved memory cards.

Purpose

Processor modules can be operated with and without (micro) memory card.

Processor modules are supplied without (micro) memory card. It must be ordered separately.

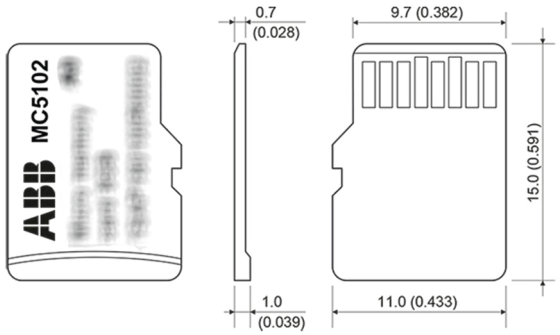
The micro memory card is used to store or backup application data and/or application programs or project source codes as well as to update the internal CPU firmware.

> *The micro memory card can only be used temporarily in standard and XC applications.*
>
> *Do not use the micro memory card for frequent or continuous data logging. It can result in data loss and production loss.*

The memory card can be read/written on a PC with a SDHC compatible memory card reader when using TA5350-AD micro memory card adapter.

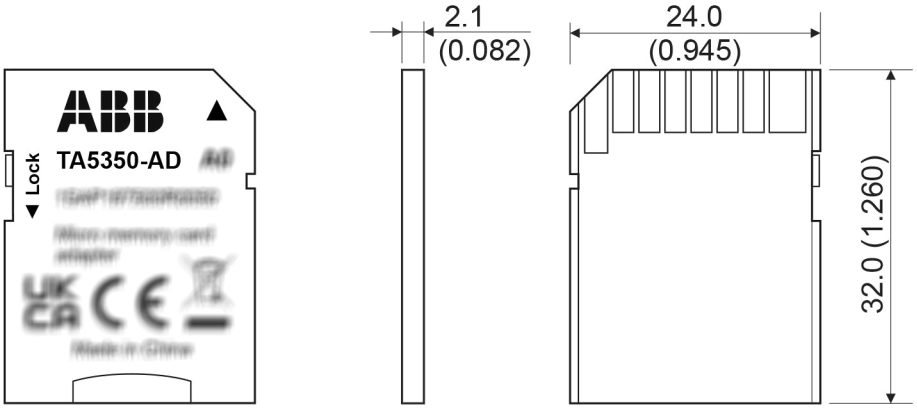
Dimensions

Micro memory card



> *The dimensions are in mm and in brackets in inch.*

Micro memory card adapter



> *The dimensions are in mm and in brackets in inch.*

Insert the micro memory card

AC500

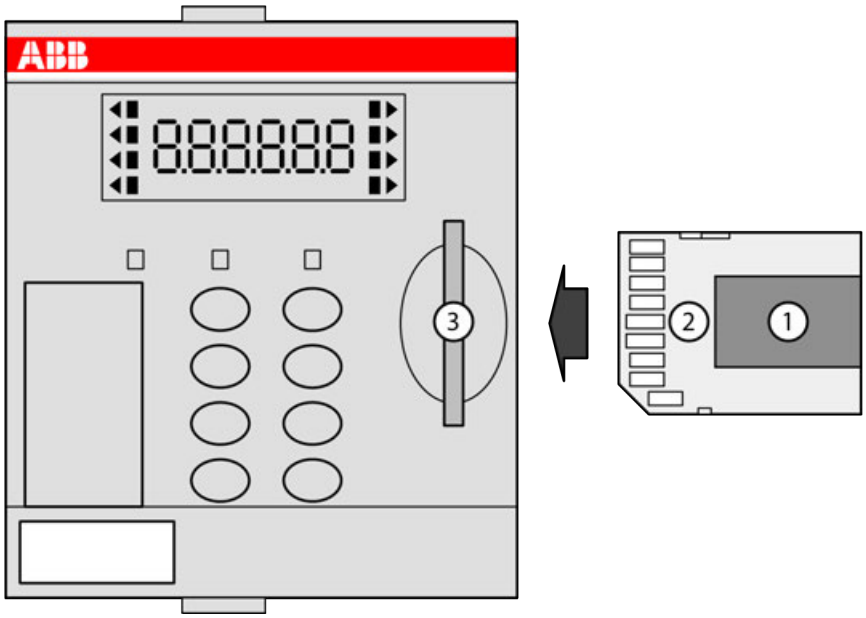
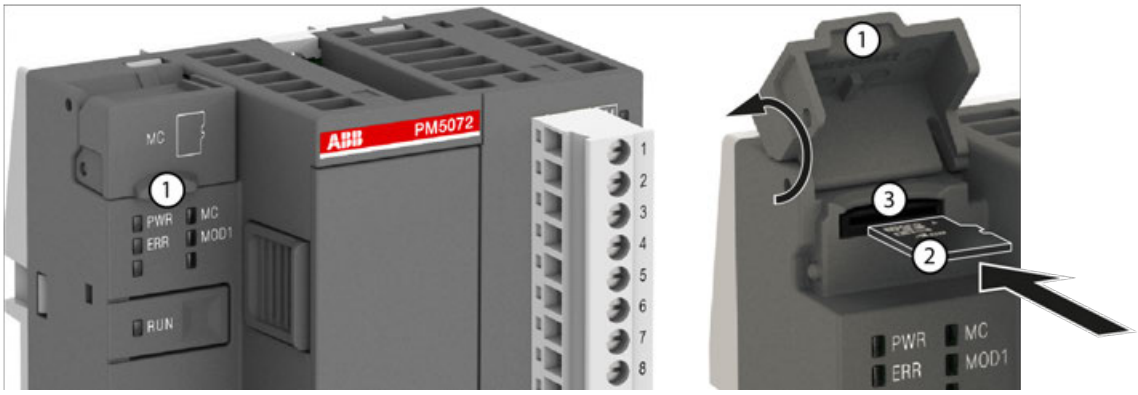


Fig. 267: Insert micro memory card into PM56xx

1 Micro memory card
2 TA5350-AD micro memory card adapter
3 Memory card slot

1. Unpack the micro memory card and insert it into the supplied micro memory card adapter.
2. Insert the micro memory card adapter with integrated micro memory card into the memory card slot of the processor module until locked.

AC500-eCo



1 Micro memory card slot cover
2 Micro memory card
3 Micro memory card slot

1. Open the micro memory card slot cover by turning it upwards.
2. Carefully insert the micro memory card into the micro memory card slot as far as it will go. Observe orientation of card.
3. Close the micro memory card slot cover by turning it downwards.

Remove the micro memory card

NOTICE!

Disturbed PLC operation

Do not remove the micro memory card when it is working!

Otherwise the micro memory card and/or files on it might get corrupted and/or normal PLC operation might be disturbed.

- AC500: Remove the micro memory card only when no black square (■) is shown next to MC in the display.
- AC500-eCo: Remove the micro memory card only when the MC LED is not blinking.

AC500

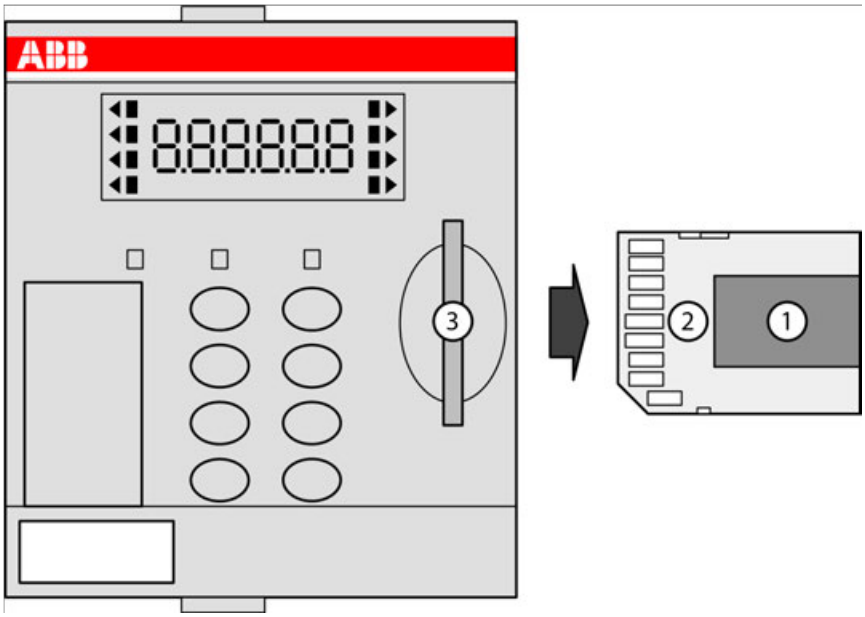


Fig. 268: Remove micro memory card from PM56xx

1 Micro memory card
2 Micro memory card adapter
3 Memory card slot

1. To remove the micro memory card adapter with the integrated micro memory card, push on the micro memory card adapter until it moves forward.
2. By this, the micro memory card adapter is unlocked and can be removed.

AC500-eCo

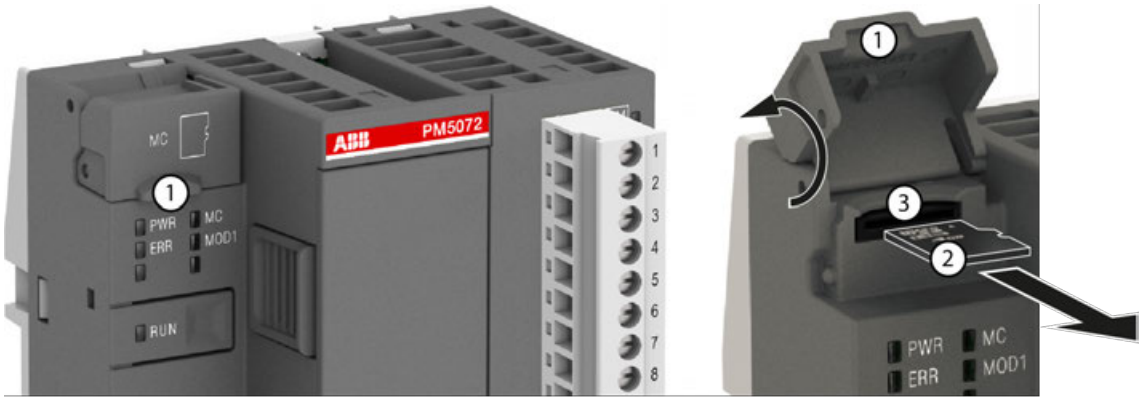
NOTICE!

Disturbed PLC operation

Do not remove the memory card when it is working!

Otherwise the memory card and/or files on it might get corrupted and/or normal PLC operation might be disturbed.

– Remove the memory card only when no black square (■) is shown next to MC in the display.



1 Micro memory card slot cover
2 Micro memory card
3 Micro memory card slot

1. Open the micro memory card slot cover by turning it upwards.
2. Micro memory card can be removed from the micro memory card slot by gripping and pulling with two fingers.
3. Close the micro memory card slot cover by turning it downwards.

Technical data

Parameter		Value
Memory capacity		8 GB
Terrabytes written (TBW)		up to 24 TBW
Number of cycle write/erase operations		up to 3000
Data retention		
	at beginning	10 years at +40 °C
	when number of write processes has been 90 % of lifetime of each cell	1 year at +40 °C
Write protect switch		
	Micro memory card	No
	Micro memory card adapter	Yes
Weight		0.25 g
Dimensions		15 mm x 11 mm x 0.7 mm

It is not possible to use 100 % of a device's memory space. About 10 % of the total available space must remain unused at any time to maintain normal device operation.

The specified values represent the frequency with which memory blocks can be written or erased. However, they do not reflect the user's ability to write or erase these blocks. It should be noted that the internal controller may perform certain operations, such as internal management or error correction actions, which may also affect the total number of write/erase cycles.

Temperature is also a critical factor in memory card life. Therefore, it is imperative that the specified limits are not exceeded. In the case of the PLC, the sequential and non-random way of writing data helps to extend the life of the memory cells. And if the memory card is not used to capacity all the time, this can extend the overall life.

Chapter 4 “Technical data of the system” on page 25

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 180 100 R0002	MC5102, micro memory card with TA5350-AD micro memory card adapter	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.8.1.2 TA5211, TA 5212 - Terminal block sets

Intended purpose

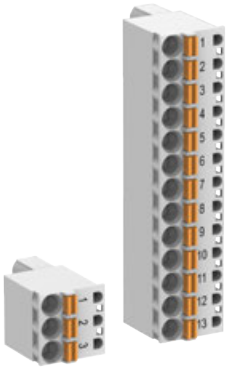
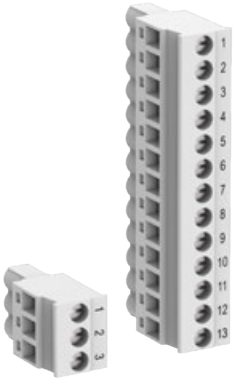
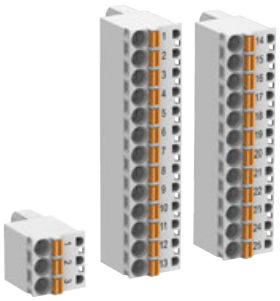
Removable terminal blocks are used for power supply and for I/O connectors on AC500-eCo processor modules PM50x2.

For option boards there are different removable terminal blocks in spring version.

For the AC500-eCo **Basic CPUs** a 3-pin terminal block for power supply and a 13-pin terminal block for I/O connectors are used.

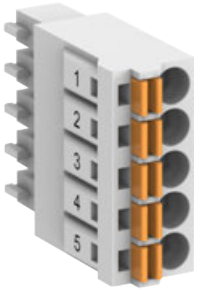
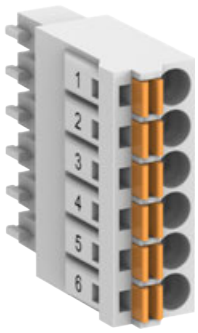
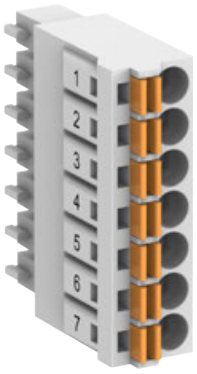
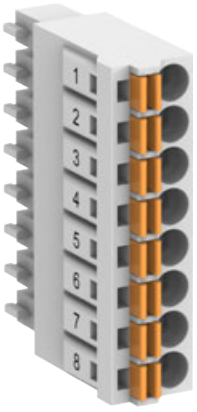
For the AC500-eCo **Standard CPUs** and **Pro CPUs** a 3-pin terminal block for power supply, a 13-pin terminal block and a 12-pin terminal block for I/O connectors are used.

For all CPUs there is a screw and a spring variant available.

Basic CPU		**Standard and Pro CPUs**	
Spring terminal **TA5211-TSPF-B**	**Screw terminal** **TA5211-TSCL-B**	**Spring terminal** **TA5212-TSPF**	**Screw terminal** **TA5212-TSCL**
			

Various removable spring terminal blocks are available for option boards.

The following spare parts are available (depending on the number of pins).

Spring terminals			
TA5220-SPF5	**TA5220-SPF6**	**TA5220-SPF7**	**TA5220-SPF8**
			

CAUTION!

Risk of injury and damaging the product!

Improper installation and maintenance may result in injury and can damage the product!

- Installation and maintenance have to be performed according to the technical rules, codes and relevant standards, e.g. EN 60204-1.
- Read product documentation carefully before wiring. Improper wiring or wrong terminal block from other devices can damage the product!
- Only by qualified personnel.

CAUTION!

Risk of injury and damaging the module when using unapproved terminal blocks!

Only use terminal blocks approved by ABB to avoid injury and damage to the module.

Terminal block set for PM50x2

Processor modules PM50x2 CPU are not delivered with terminal blocks.

Screw terminal block set:

- *TA5211-TSCL-B (1SAP187400R0001) for PM5012-x-ETH*
- *TA5212-TSCL (1SAP187400R0004) for PM5032-x-ETH, PM5052-x-ETH, PM5072-T-2ETH(W), PM5082-T-2ETH, PM5092-T-2ETH*

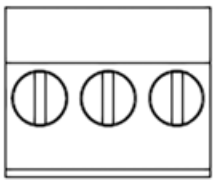
Spring terminal block set:

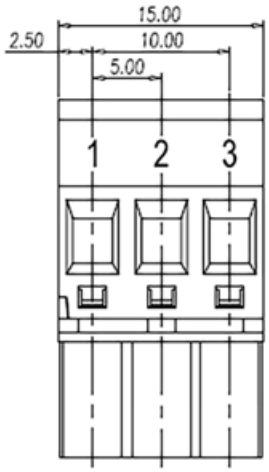
- *TA5211-TSPF-B (1SAP187400R0002) for PM5012-x-ETH*
- *TA5212-TSPF (1SAP187400R0005) for PM5032-x-ETH, PM5052-x-ETH, PM5072-T-2ETH(W), PM5082-T-2ETH, PM5092-T-2ETH*

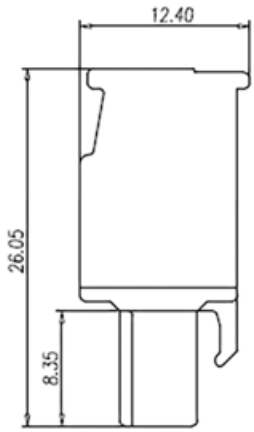
Dimensions

3-pin terminal block for power supply

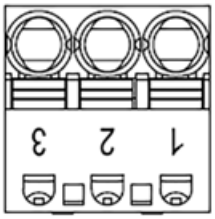
Screw terminal

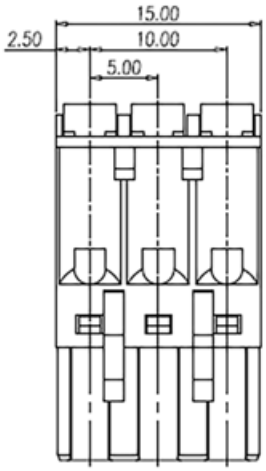


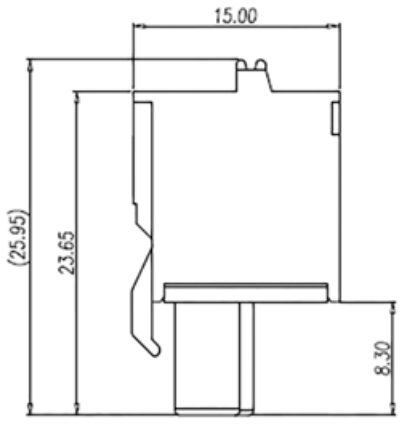




Spring terminal

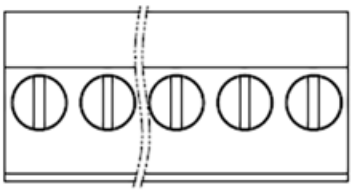


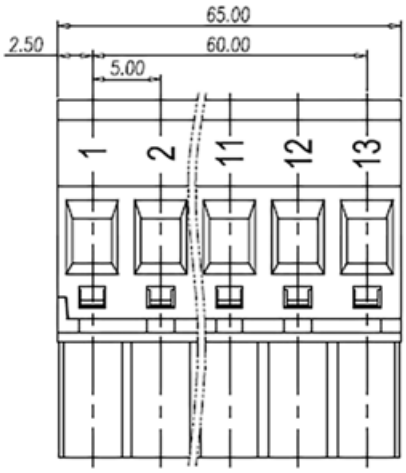


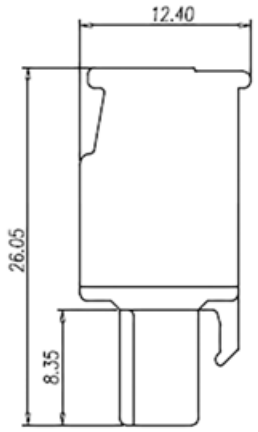


13-pin terminal block for I/O connectors

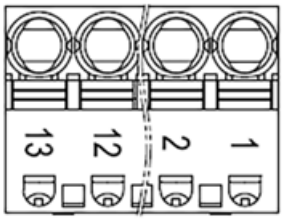
Screw terminal

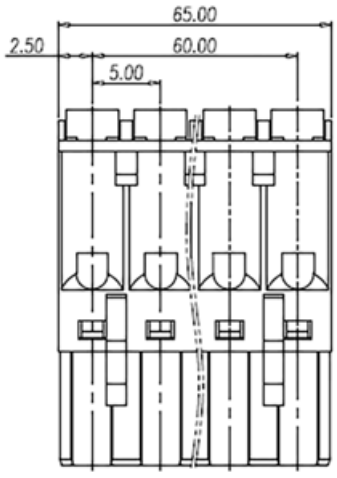


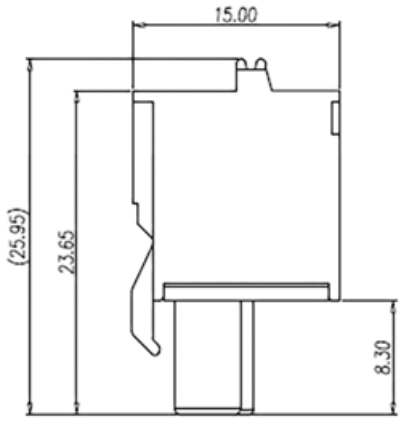




Spring terminal

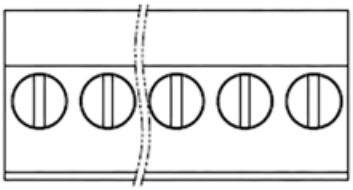


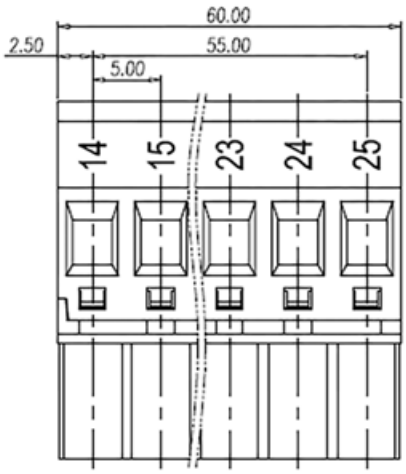


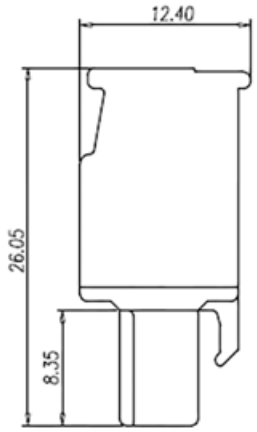


12-pin terminal block for I/O connectors

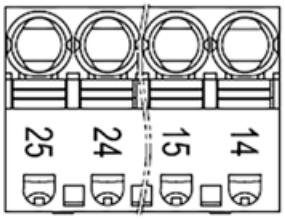
Screw terminal

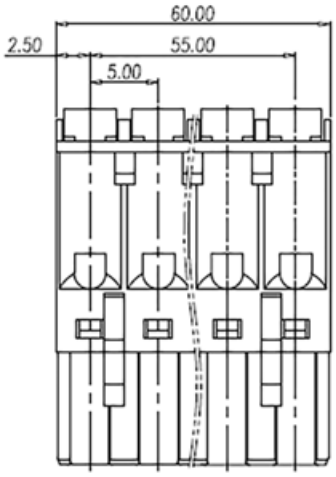


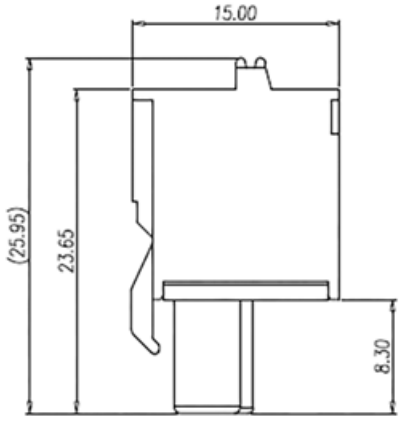




Spring terminal

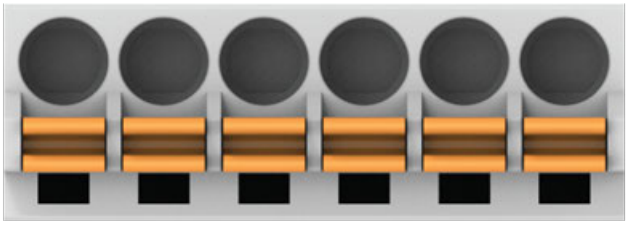


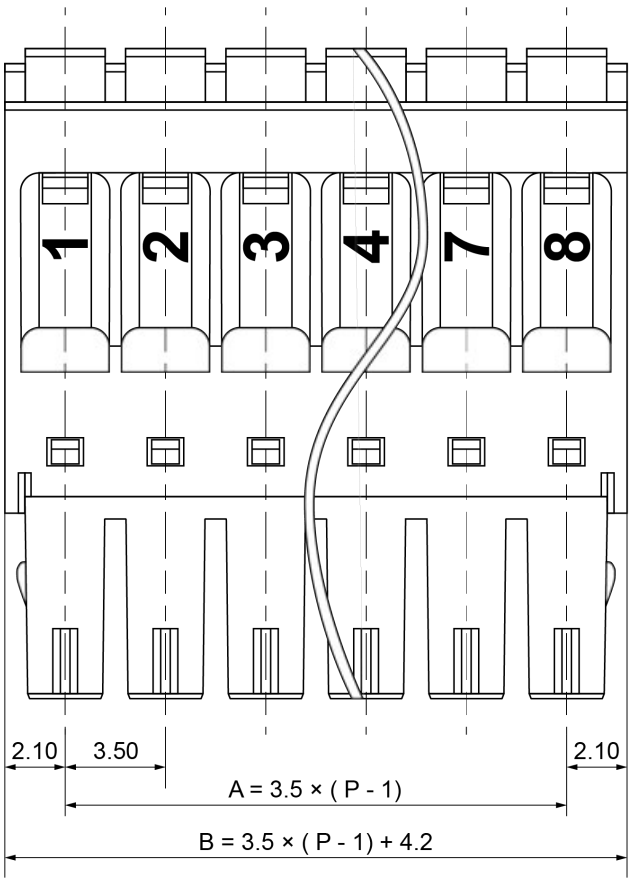


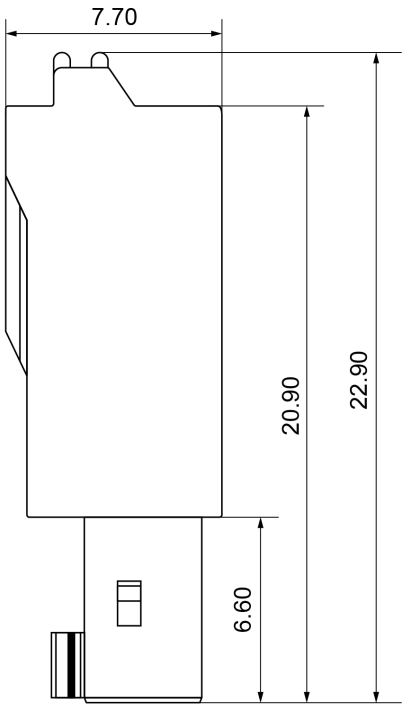


x-PIN terminal blocks for option boards

Only these x-pin terminal blocks are available for the option boards.
*TA5220-SPF**x**, with **x** = 5 ... 8*



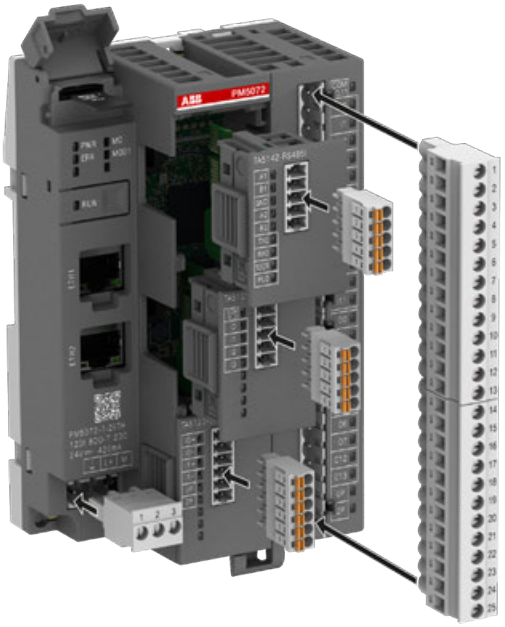




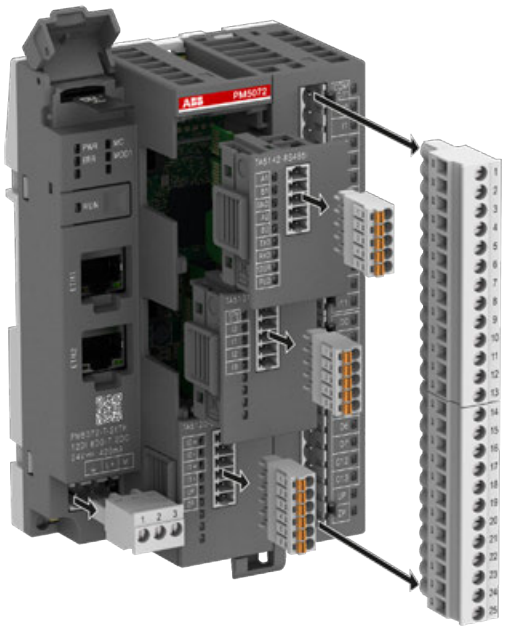
This results in these dimensions for the available spring terminal blocks.

Description	Pin	Length [mm]	Wide [mm]	Height [mm]
TA5220-SPF5	5	18.2	7.7	22.9
TA5220-SPF6	6	21.7	7.7	22.9
TA5220-SPF7	7	25.2	7.7	22.9
TA5220-SPF8	8	28.7	7.7	22.9

Assembly



Disassembly



Technical data

Table 415: Screw terminal block for power supply

Parameter		Value
Type		
	TA5211-TSCL-B	Removable 3-pin terminal block:
	TA5212-TSCL	screw front/cable side 5.00 mm pitch
Usage		Power supply for AC500-eCo processor modules
Conductor cross section		
	Solid (copper)	0.5 mm^2 ... 2.5 mm^2
	Flexible (copper)	0.5 mm^2 ... 2.5 mm^2
Stripped conductor end		7 mm

Parameter		Value
Fastening torque		0.5 Nm
Dimensions		
	3-pin terminal block	15 mm x 12.4 mm x 26.05 mm
Weight		
	TA5211-TSCL-B	150 g (2 terminal blocks)
	TA5212-TSCL	200 g (3 terminal blocks)

Table 416: Spring terminal block for power supply

Parameter		Value
Type		
	TA5211-TSPF-B	Removable 3-pin terminal block:
	TA5212-TSPF	spring front/cable front 5.00 mm pitch
Usage		Power supply for AC500-eCo processor modules
Conductor cross section		
	Solid (copper)	0.5 mm^2 ... 2.5 mm^2
	Flexible (copper)	0.5 mm^2 ... 2.5 mm^2
Stripped conductor end		11 mm
Dimensions		
	3-pin terminal block	15 mm x 15 mm x 25.95 mm
Weight		
	TA5211-TSPF-B	150 g (2 terminal blocks)
	TA5212-TSPF	200 g (3 terminal blocks)

Table 417: Screw terminal block for onboard I/Os

Parameter		Value
Type		
	TA5211-TSCL-B	Removable 13-pin terminal block: screw front/cable side 5.00 mm pitch
	TA5212-TSCL	Removable 13-pin and 12-pin terminal block: screw front/cable side 5.00 mm pitch
Usage		Onboard I/Os for AC500-eCo processor modules
Conductor cross section		
	Solid (copper)	0.5 mm^2 ... 2.5 mm^2
	Flexible (copper)	0.5 mm^2 ... 2.5 mm^2
Stripped conductor end		7 mm
Fastening torque		0.5 Nm
Dimensions		
	13-pin terminal block	65 mm x 12.4 mm x 26.05 mm
	12-pin terminal block	60 mm x 12.4 mm x 26.05 mm
Weight		

Parameter		Value
	TA5211-TSCL-B	150 g (2 terminal blocks)
	TA5212-TSCL	200 g (3 terminal blocks)

Table 418: Spring terminal block for onboard I/Os

Parameter		Value
Type		
	TA5211-TSPF-B	Removable 13-pin terminal block: spring front/cable front 5.00 mm pitch
	TA5212-TSPF	Removable 13-pin and 12-pin terminal block: spring front/cable front 5.00 mm pitch
Usage		Onboard I/Os for AC500-eCo processor modules
Conductor cross section		
	Solid (copper)	0.5 mm^2 ... 2.5 mm^2
	Flexible (copper)	0.5 mm^2 ... 2.5 mm^2
Stripped conductor end		11 mm
Dimensions		
	13-pin terminal block	65 mm x 15 mm x 25.95 mm
	12-pin terminal block	60 mm x 15 mm x 25.95 mm
Weight		
	TA5211-TSPF-B	150 g (2 terminal blocks)
	TA5212-TSPF	200 g (3 terminal blocks)

Table 419: Spring terminal block for option boards

Parameter		Value
Type		
	TA5220-SPF5	Removable 5-pin terminal block: spring front, cable front 3.50 mm pitch
	TA5220-SPF6	Removable 6-pin terminal block: spring front, cable front 3.50 mm pitch
	TA5220-SPF7	Removable 7-pin terminal block: spring front, cable front 3.50 mm pitch
	TA5220-SPF8	Removable 8-pin terminal block: spring front, cable front 3.50 mm pitch
Usage		Connectors for AC500-eCo option boards
Conductor cross section		
	Solid (copper)	0.2 mm^2 ... 1.5 mm^2
	Flexible (copper)	0.2 mm^2 ... 1.5 mm^2
Stripped conductor end		8 mm ... 10 mm
Dimensions		
	TA5220-SPF5	18.2 mm x 7.7 mm x 22.9 mm
	TA5220-SPF6	21.7 mm x 7.7 mm x 22.9 mm

Parameter		Value
	TA5220-SPF7	25.2 mm x 7.7 mm x 22.9 mm
	TA5220-SPF8	28.7 mm x 7.7 mm x 22.9 mm
Weight		
	TA5220-SPF5	150 g
	TA5220-SPF6	170 g
	TA5220-SPF7	180 g
	TA5220-SPF8	200 g

Ordering data

Table 420: Terminal block sets for AC500-eCo Basic

Part no.	Description
1SAP 187 400 R0001	TA5211-TSCL-B: screw terminal block set for AC500-eCo CPU Basic screw front, cable side 5.00 mm pitch ● 1 removable 3-pin terminal block for power supply ● 1 removable 13-pin terminal block for I/O connectors
1SAP 187 400 R0002	TA5211-TSPF-B: spring terminal block set for AC500-eCo CPU Basic spring front, cable front 5.00 mm pitch ● 1 removable 3-pin terminal block for power supply ● 1 removable 13-pin terminal block for I/O connectors

Table 421: Terminal block sets for AC500-eCo Standard and Pro

Part no.	Description
1SAP 187 400 R0004	TA5212-TSCL: screw terminal block set for AC500-eCo Standard and Pro CPU screw front, cable side 5.00 mm pitch ● 1 removable 3-pin terminal block for power supply ● 1 removable 13-pin terminal block for I/O connectors ● 1 removable 12-pin terminal block for I/O connectors
1SAP 187 400 R0005	TA5212-TSPF: spring terminal block set for AC500-eCo Standard and Pro CPU spring front, cable front 5.00 mm pitch ● 1 removable 3-pin terminal block for power supply ● 1 removable 13-pin terminal block for I/O connectors ● 1 removable 12-pin terminal block for I/O connectors

Table 422: Spare parts

Part no.	Description
1SAP 187 400 R0012	TA5220-SPF5: spring terminal block, removable, 5-pin, spring front, cable front, 6 pieces per packing unit
1SAP 187 400 R0013	TA5220-SPF6: spring terminal block, removable, 6-pin, spring front, cable front, 6 pieces per packing unit
1SAP 187 400 R0014	TA5220-SPF7: spring terminal block, removable, 7-pin, spring front, cable front, 6 pieces per packing unit
1SAP 187 400 R0015	TA5220-SPF8: spring terminal block, removable, 8-pin, spring front, cable front, 6 pieces per packing unit

5.8.1.3 TA5300-CVR - Option board slot cover

Intended purpose

TA5300-CVR option board slot covers for PM50xx processor modules are necessary to protect not used option board slots.



CAUTION!

Risk of injury and damaging the product!

Always plug in the option board slot cover when the option board is not inserted.

If the option board slot cover is lost, please order the replacement TA5300-CVR (1SAP187500R0001).

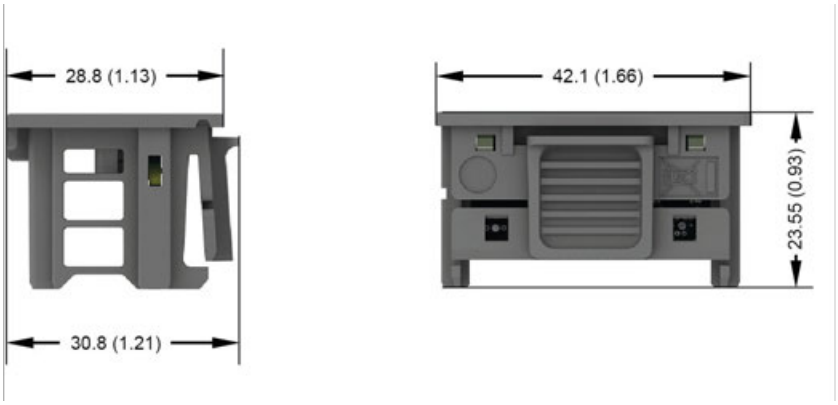
Never power up the CPU with uncovered option board slot, otherwise it may cause serious injury and/or damage the product.

The AC500-eCo processor modules are delivered with option board slot cover(s).

The option board slot cover has to be removed before inserting an option board.

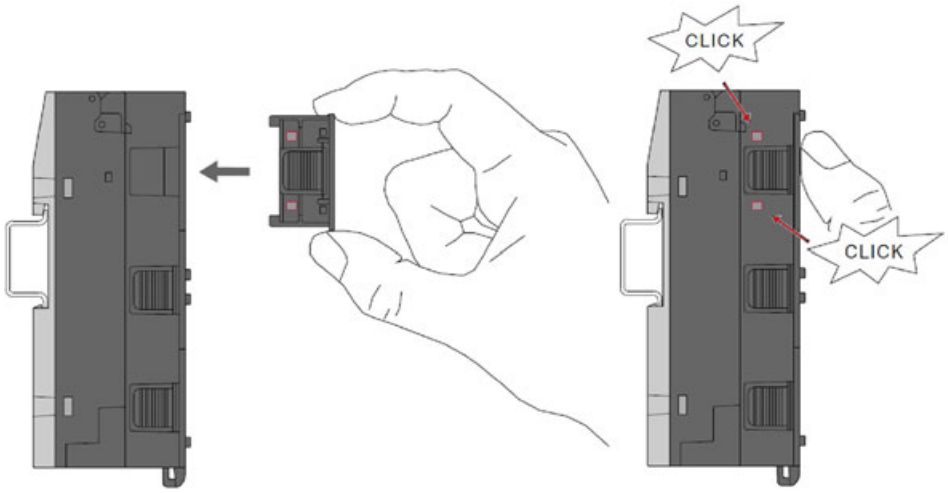
The TA5300-CVR option board slot covers are available as spare parts.

Dimensions



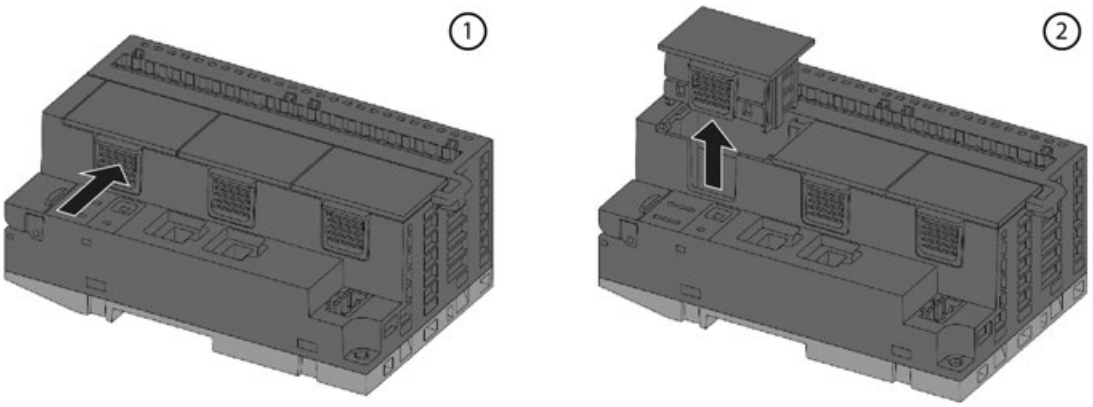
The dimensions are in mm and in brackets in inch.

Inserting of the option board slot cover



1. Press on the option board slot cover to insert it in the not used option board slot of the processor module PM50xx.
2. The option board slot cover must click into the not used option board slot.

Removing of the option board slot cover



1. Press the side of the inserted option board slot cover.
2. At the same time, pull the option board slot cover out of the option board slot of the processor module PM50xx.

Technical data

The system data of AC500-eCo apply *Chapter 4.1 “System data AC500-eCo” on page 25*

Only additional details are therefore documented below.

Parameter	Value
Weight	47 g
Dimensions	42.1 mm x 30.8 mm x 23.55

Ordering data

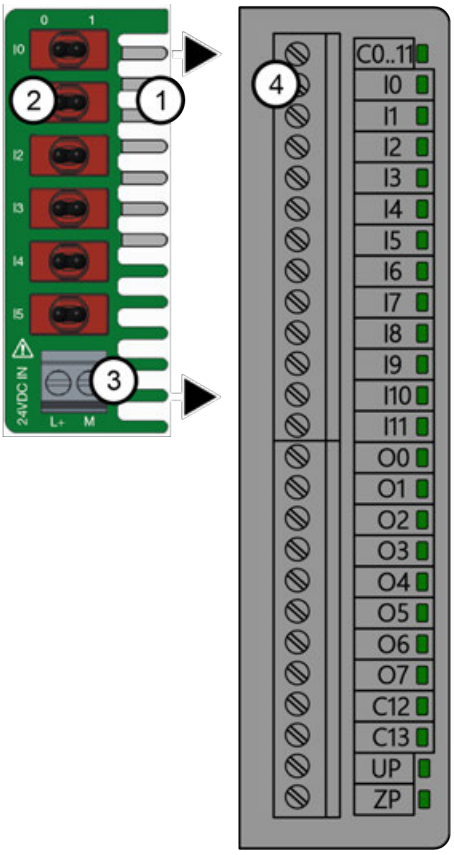
Part no.	Description	Product life cycle phase *)
1SAP 187 500 R0001	TA5300-CVR: option board slot cover, removable plastic part, 6 pieces per packing unit	Active



*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

5.8.1.4 TA5400-SIM - Input simulator

- TA5400-SIM input simulator for 6 digital inputs 24 V DC
- For usage with AC500-eCo processor modules



1 Contacts for connecting the input simulator to the terminal block for I/O connectors
2 6 switches for the digital inputs DI0 ... DI5 (0 means opened switch, 1 means closed switch)
3 Screw terminal block for power supply
4 Screw terminal block(s) for I/O connectors

Intended purpose

TA5400-SIM

The TA5400-SIM input simulator is only intended for testing and training purposes for AC500-eCo processor modules PM50x2.

Continuous operation in a productive system is not permitted.

The TA5400-SIM input simulator may only be used with screw-type terminal blocks.

The TA5400-SIM input simulator must not be used with spring-type terminal blocks.

Environmental conditions for testing and training purposes

In order not to impair the functionality of the product, avoid any kind of disturbing environmental influences:

- *mechanical disturbances*
- *climatic influences*

Make sure that the parameters are within the normal range:

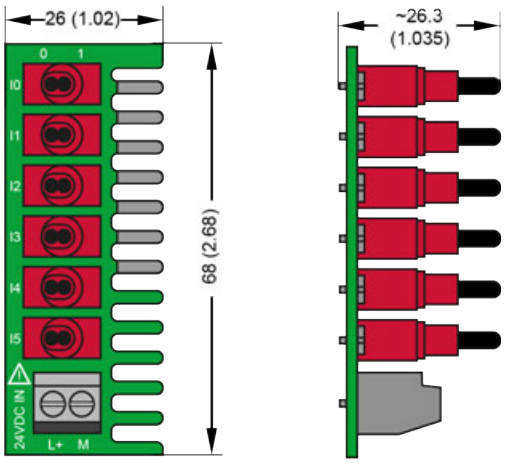
- *temperature*
- *air pressure*
- *humidity*
- *altitude*

The TA5400-SIM input simulator can simulate 6 digital 24 V DC input signals to the digital inputs I0 ... I5 of onboard I/Os.

With the TA5400-SIM input simulator, the digital 24 V DC inputs I0 ... I5 can be turned OFF and ON separately:

- If the lever of the switch is on the right side (1), the input is ON.
- If the lever of the switch is on the left side (0), the input is OFF.

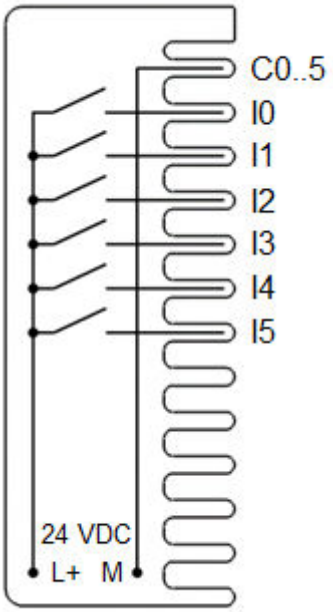
Dimensions



The dimensions are in mm and in brackets in inch.

Electrical diagram

The diagram below shows the connection of the TA5400-SIM input simulator.



NOTICE!

Risk of damage to the TA5400-SIM input simulator!

Do not remove the terminal block while the TA5400-SIM input simulator is connected.

Do not apply mechanical forces to the input simulator when it is connected to the terminal block.

In both cases the input simulator could be damaged.

Assembly

Insertion of the input simulator

1. Make sure that the power supply of the processor module is turned off.

CAUTION!

Risk of damaging the PLC modules!

The PLC modules can be damaged by overvoltages and short circuits.

Make sure that all voltage sources (supply and process voltage) are switched off before working on the system.

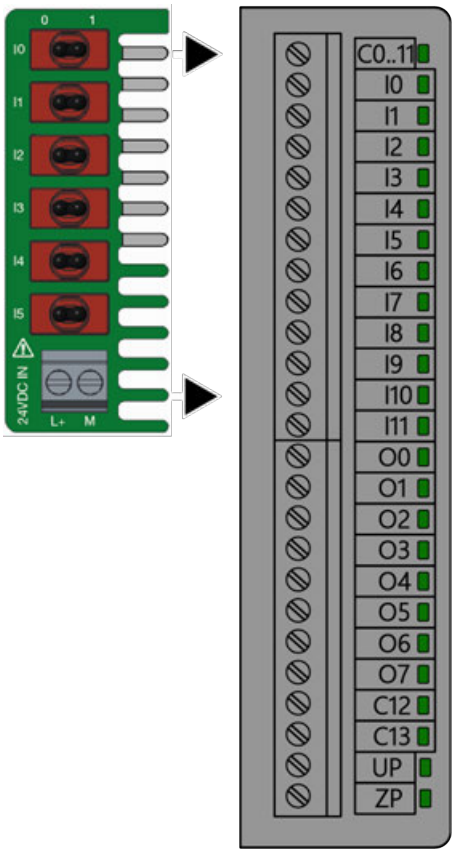
CAUTION!

Risk of damaging the input simulator and the PLC modules!

- Never connect voltages > 24 V DC to the terminal block of the input simulator.
- The input simulator may only be used with AC500-eCo processor modules PM50x2.
  Never use the input simulator with other devices.
- The input simulator may only be used with screw-type terminal blocks.
- The input simulator is only intended for testing and training purposes.
  Never use it within productive sytems.

2. Make sure that all clamps of the onboard I/Os are totally open.

3. Insert the TA5400-SIM input simulator into the screw terminal block as shown in the figure.



4. Tighten all screws of the onboard I/O clamps.
5. Make sure all switches are in OFF state (0).
6. Connect 24 V DC to the power supply of the TA5400-SIM (L+ and M). Tighten the screws.
7. Connect the processor module power supply wires (24 V DC) ↳ *"Pin assignment" on page 55*.

Disassembly

Removal of the input simulator

1. Make sure that the power supply of the processor module is turned off.

> **CAUTION!**
> **Risk of damaging the PLC modules!**
> The PLC modules can be damaged by overvoltages and short circuits.
> Make sure that all voltage sources (supply and process voltage) are switched off before working on the system.

2. Disconnect the TA5400-SIM power supply wires (24 V DC) with a flat-blade screwdriver from the terminal block for power supply (L+ and M).
3. Loosen all screws of the onboard I/Os.
4. Remove the input simulator by pulling it to the left side.

Technical data

The system data of AC500-eCo apply ↳ *Chapter 4.1 "System data AC500-eCo" on page 25*
Only additional details are therefore documented below.

Table 423: Technical data of the module

Parameter		Value
Process supply voltage		
	Connections	Terminal (L+) for +24 V DC and terminal (M) for 0 V DC
	Rated value	24 V DC
	Max. ripple	5 %
Weight		18 g
Mounting position		Horizontal or vertical

Ordering data

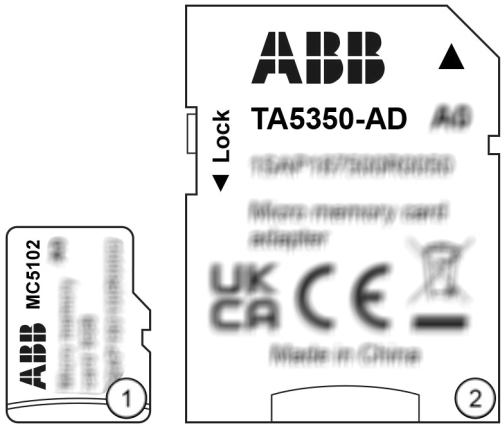
Part no.	Description	Product life cycle phase *)
1SAP 187 600 R0001	TA5400-SIM, input simulator for PM50x2	Active

**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.8.2 AC500 and AC500-XC

5.8.2.1 MC5102 - Micro memory card with adapter

- Solid state flash memory storage



1 Micro memory card
2 TA5350-AD micro memory card adapter, necessary for use in AC500 processor modules

The MC5102 micro memory card has no write protect switch.

The TA5350-AD micro memory card adapter has a write protect switch.

In the position "LOCK", the inserted micro memory card can only be read.

Memory card type	AC500 V2	AC500-XC V2	AC500 V3	AC500-XC V3	AC500-eCo V3
MC5141	x	x	x	x	-
MC5102 **with** TA5350-AD micro memory card adapter	x [1])	x [1]) [2])	x	x [2])	-
MC5102 **without** TA5350-AD micro memory card adapter	-	-	-	-	x

[1]) As of firmware 2.5.x

[2]) Temporary use of MC5102 is possible under normal environmental conditions, but MC5141 should be preferred.

The use of other micro memory cards is prohibited. ABB is not responsible nor liable for consequences resulting from use of unapproved memory cards.

Purpose

Processor modules can be operated with and without (micro) memory card.

Processor modules are supplied without (micro) memory card. It must be ordered separately.

The micro memory card is used to store or backup application data and/or application programs or project source codes as well as to update the internal CPU firmware.

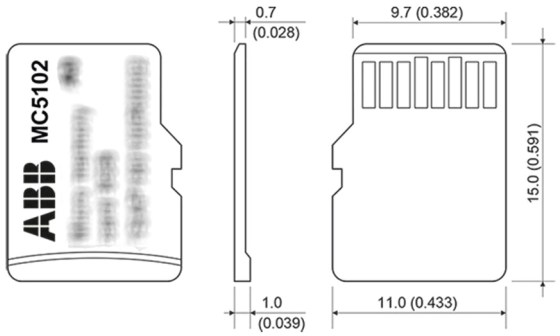
The micro memory card can only be used temporarily in standard and XC applications.

Do not use the micro memory card for frequent or continuous data logging. It can result in data loss and production loss.

The memory card can be read/written on a PC with a SDHC compatible memory card reader when using TA5350-AD micro memory card adapter.

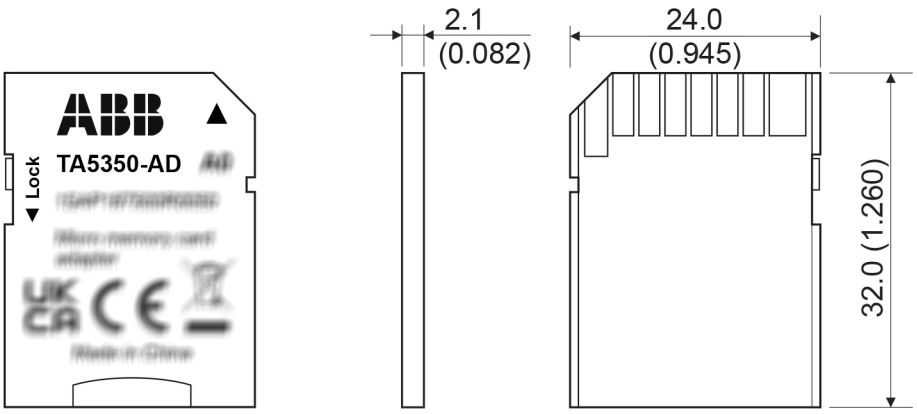
Dimensions

Micro memory card



The dimensions are in mm and in brackets in inch.

Micro memory card adapter



The dimensions are in mm and in brackets in inch.

Insert the micro memory card

AC500

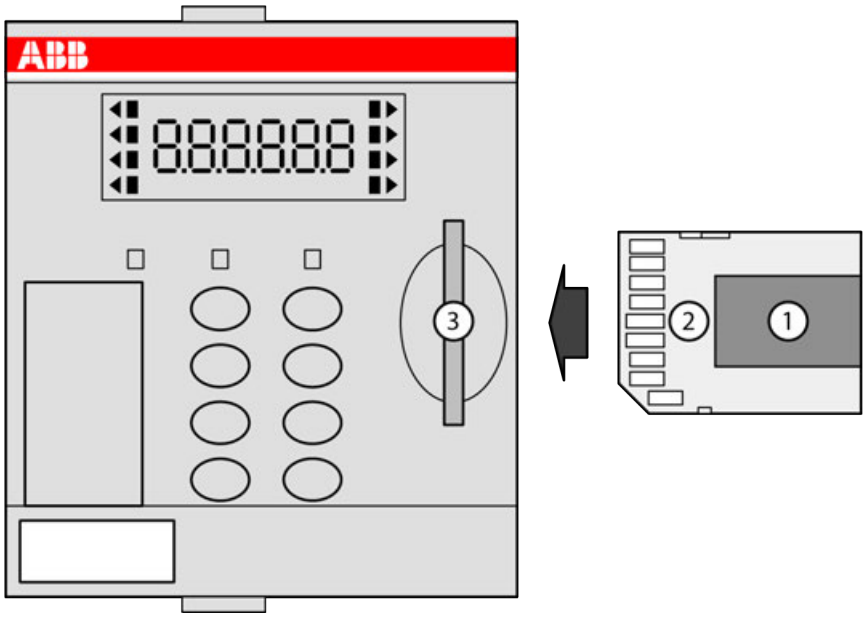
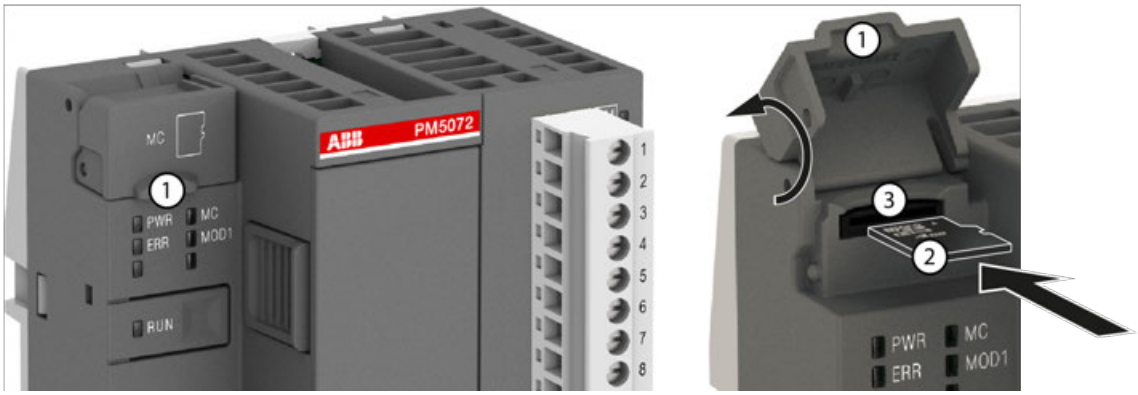


Fig. 269: Insert micro memory card into PM56xx

1 Micro memory card
2 TA5350-AD micro memory card adapter
3 Memory card slot

1. Unpack the micro memory card and insert it into the supplied micro memory card adapter.
2. Insert the micro memory card adapter with integrated micro memory card into the memory card slot of the processor module until locked.

AC500-eCo



1 Micro memory card slot cover
2 Micro memory card
3 Micro memory card slot

1. Open the micro memory card slot cover by turning it upwards.
2. Carefully insert the micro memory card into the micro memory card slot as far as it will go. Observe orientation of card.
3. Close the micro memory card slot cover by turning it downwards.

Remove the micro memory card

NOTICE!

Disturbed PLC operation

Do not remove the micro memory card when it is working!

Otherwise the micro memory card and/or files on it might get corrupted and/or normal PLC operation might be disturbed.

- AC500: Remove the micro memory card only when no black square (■) is shown next to MC in the display.
- AC500-eCo: Remove the micro memory card only when the MC LED is not blinking.

AC500

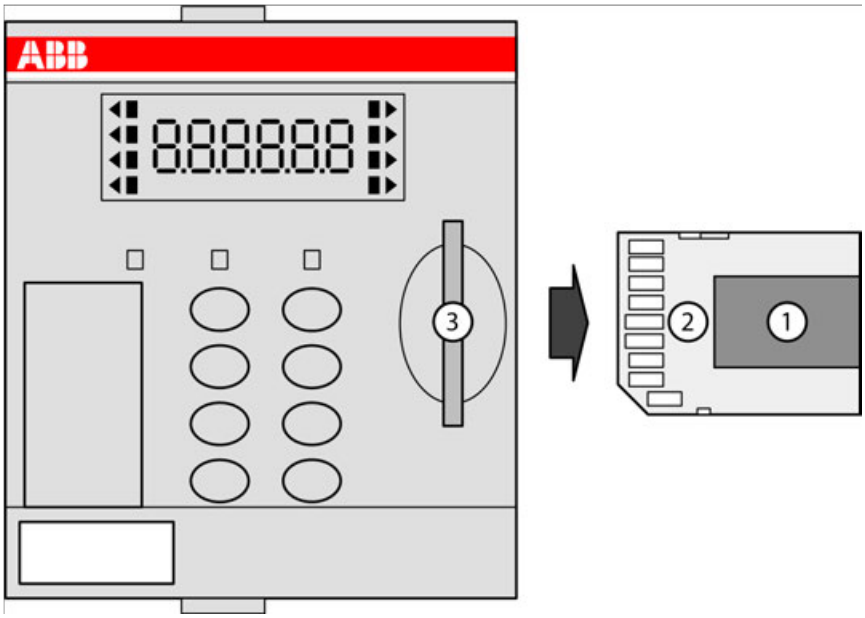


Fig. 270: Remove micro memory card from PM56xx

1 Micro memory card
2 Micro memory card adapter
3 Memory card slot

1. To remove the micro memory card adapter with the integrated micro memory card, push on the micro memory card adapter until it moves forward.
2. By this, the micro memory card adapter is unlocked and can be removed.

AC500-eCo

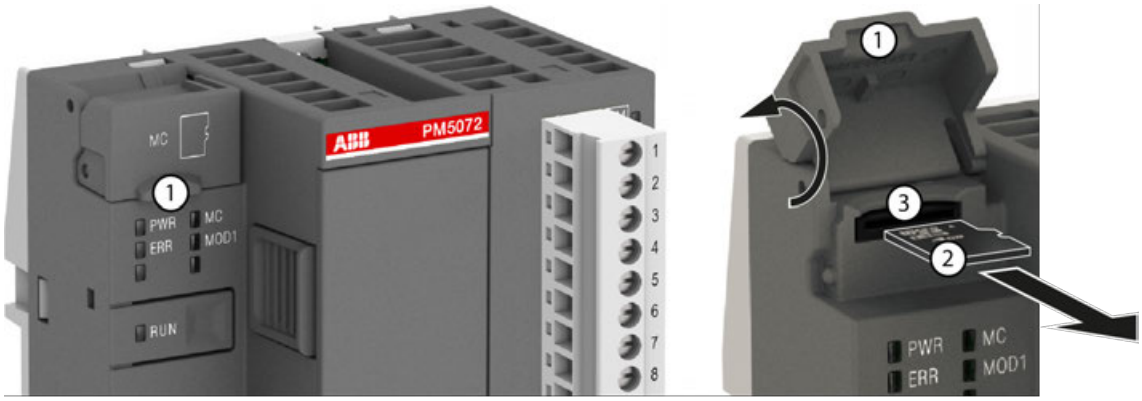
NOTICE!

Disturbed PLC operation

Do not remove the memory card when it is working!

Otherwise the memory card and/or files on it might get corrupted and/or normal PLC operation might be disturbed.

– Remove the memory card only when no black square (■) is shown next to MC in the display.



1 Micro memory card slot cover
2 Micro memory card
3 Micro memory card slot

1. Open the micro memory card slot cover by turning it upwards.
2. Micro memory card can be removed from the micro memory card slot by gripping and pulling with two fingers.
3. Close the micro memory card slot cover by turning it downwards.

Technical data

Parameter		Value
Memory capacity		8 GB
Terrabytes written (TBW)		up to 24 TBW
Number of cycle write/erase operations		up to 3000
Data retention		
	at beginning	10 years at +40 °C
	when number of write processes has been 90 % of lifetime of each cell	1 year at +40 °C
Write protect switch		
	Micro memory card	No
	Micro memory card adapter	Yes
Weight		0.25 g
Dimensions		15 mm x 11 mm x 0.7 mm

It is not possible to use 100 % of a device's memory space. About 10 % of the total available space must remain unused at any time to maintain normal device operation.

The specified values represent the frequency with which memory blocks can be written or erased. However, they do not reflect the user's ability to write or erase these blocks. It should be noted that the internal controller may perform certain operations, such as internal management or error correction actions, which may also affect the total number of write/erase cycles.

Temperature is also a critical factor in memory card life. Therefore, it is imperative that the specified limits are not exceeded. In the case of the PLC, the sequential and non-random way of writing data helps to extend the life of the memory cells. And if the memory card is not used to capacity all the time, this can extend the overall life.

Chapter 4 “Technical data of the system” on page 25

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 180 100 R0002	MC5102, micro memory card with TA5350-AD micro memory card adapter	Active

*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

5.8.2.2 MC5141 - Memory card

- Solid state flash memory storage



1 MC5141 memory card

The memory card has a write protect switch.

In the position "LOCK", the memory card can only be read.

Memory card type	AC500 V2	AC500-XC V2	AC500 V3	AC500-XC V3	AC500-eCo V3
MC5141	x	x	x	x	-
MC5102 **with** TA5350-AD micro memory card adapter	x [1])	x [1]) [2])	x	x [2])	-
MC5102 **without** TA5350-AD micro memory card adapter	-	-	-	-	x

[1]) As of firmware 2.5.x

[2]) Temporary use of MC5102 is possible under normal environmental conditions, but MC5141 should be preferred.

The use of other memory cards is prohibited. ABB is not responsible nor liable for consequences resulting from use of unapproved memory cards.

Purpose

Processor modules can be operated with and without (micro) memory card.

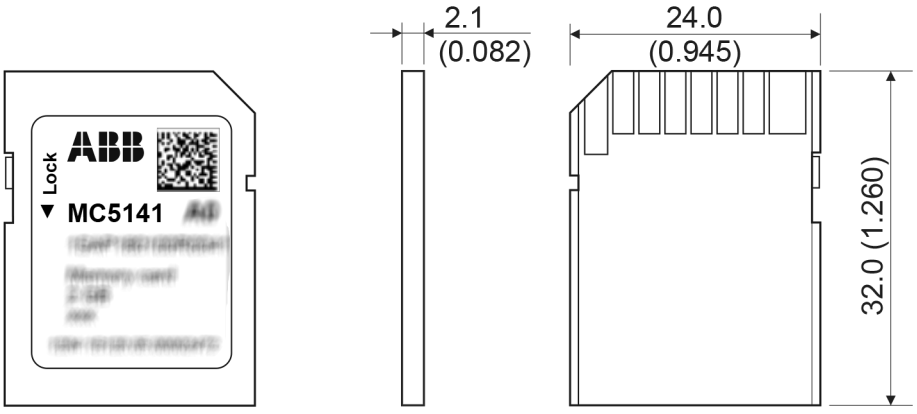
Processor modules are supplied without (micro) memory card. It must be ordered separately.

The memory card is used to store or backup application data and/or application programs or project source codes as well as to update the internal CPU firmware.

The memory card is intended for long-term use in standard and XC application.

The memory card can be read/written on a PC with a SDHC compatible memory card reader.

Dimensions



The dimensions are in mm and in brackets in inch.

Insert the memory card

1. Unpack the memory card.
2. Insert the memory card into the memory card slot of the processor module until locked.

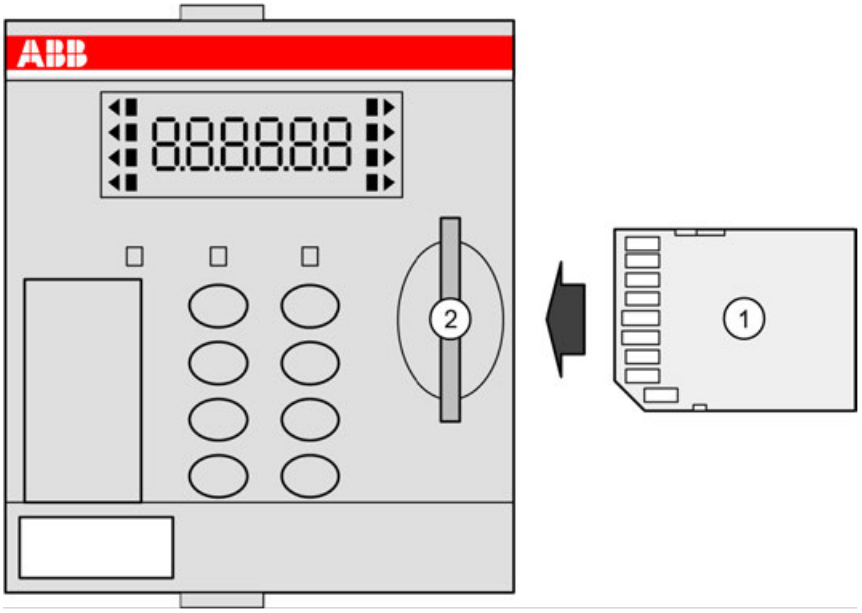


Fig. 271: Insert memory card into PM56xx

1 Memory card
2 Memory card slot

Remove the memory card

NOTICE!

Disturbed PLC operation

Do not remove the memory card when it is working!

Otherwise the memory card and/or files on it might get corrupted and/or normal PLC operation might be disturbed.

– Remove the memory card only when no black square (■) is shown next to MC in the display.

1. To remove the memory card, push on the memory card until it moves forward.
2. By this, the memory card is unlocked and can be removed.

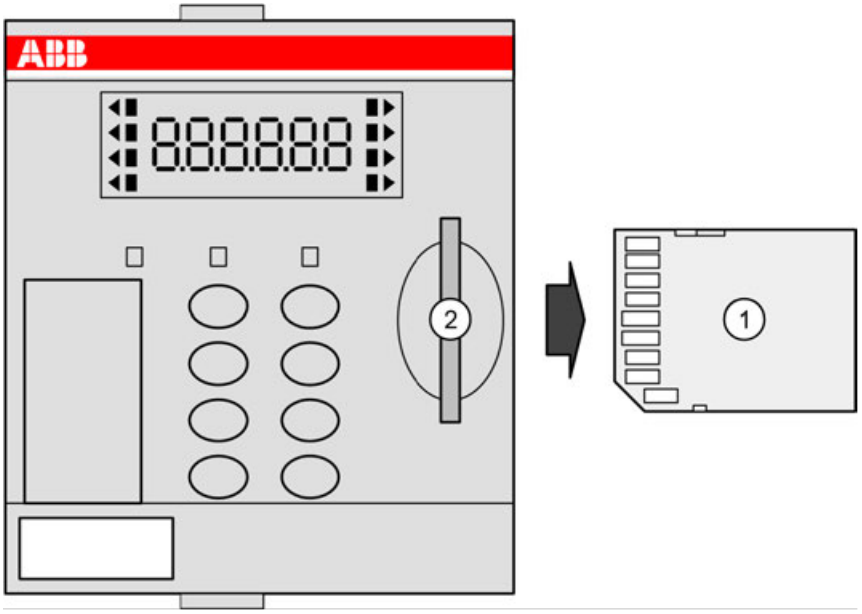


Fig. 272: Remove memory card from PM56xx

1 Memory card
2 Memory card slot

Technical data

Parameter		Value
Memory capacity		2 GB
Terrabytes written (TBW)		up to 140 TBW
Number of cycle write/erase operations		up to 70000
Data retention		
	at beginning	10 years at +40 °C
	when number of write processes has been 90 % of lifetime of each cell	1 year at +40 °C
Write protect switch		Yes, at the edge of the memory card
Weight		2 g
Dimensions		24 mm x 32 mm x 2.1 mm

It is not possible to use 100 % of a device's memory space. About 10 % of the total available space must remain unused at any time to maintain normal device operation.

The specified values represent the frequency with which memory blocks can be written or erased. However, they do not reflect the user's ability to write or erase these blocks. It should be noted that the internal controller may perform certain operations, such as internal management or error correction actions, which may also affect the total number of write/erase cycles.

Temperature is also a critical factor in memory card life. Therefore, it is imperative that the specified limits are not exceeded. In the case of the PLC, the sequential and non-random way of writing data helps to extend the life of the memory cells. And if the memory card is not used to capacity all the time, this can extend the overall life.

Chapter 4 “Technical data of the system” on page 25

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 180 100 R0041	MC5141, memory card	Active

*) *Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.8.2.3 TA521 - Adapter cable with button cell

- Adapter cable with encapsulated primary button cell
- Contains a manganese dioxide lithium primary button cell, 3 V, 560 mAh
- Non-rechargeable



Purpose

The TA521 accessory is used to provide a zero-voltage-safe power supply for the remanent memory and the real-time clock of the AC500 V3 CPU modules PM5630, PM5650, PM5670, PM5675, PM5680, PM5685.

TA521 is the only accessory that may be used for this purpose.

The accessory TA521 is not included with the AC500 V3 CPUs. This accessory must be ordered separately.

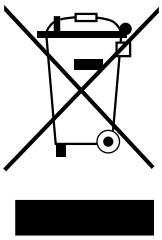
CAUTION!

This adapter cable with button cell is the only one which can be used with AC500 CPUs.

- Replace TA521 only with activated supply voltage.
- In order to prevent data loss or problems, the TA521 should be replaced after 3 years of utilisation or at least as soon as possible after receiving the "low primary lithium battery warning" indication.
- Do not use the TA521 older than 3 years for replacement, do not keep device too long in stock.
- TA521 must not be re-charged, not be disassembled and not be disposed of in fire. Attempting to charge primary lithium button cell will lead to over-heating and can cause explosions.
- TA521 must be stored in a dry place.
- Exhausted TA521 must be recycled to respect the environment.
- Never short-circuit or operate primary lithium button cell with the polarities reversed. The primary lithium button cell are likely to overheat and explode. Avoid unintentional short circuiting do not store primary lithium button cell in metal containers and do not place them on metallic surfaces. Escaping lithium is a health hazard.

Handling instructions

- Do not short-circuit or re-charge the primary lithium button cell! It can cause excessive heating and explosion.
- Do not disassemble the primary lithium button cell!
- Do not heat up the primary lithium button cell and not put into fire! Risk of explosion.
- Store the primary lithium button cell in a dry place.
- Replace the primary lithium button cell with supply voltage ON in order not to risk data being lost.
- Recycle exhausted primary lithium button cells meeting the environmental standards.



Primary lithium button cell life-time

The primary lithium button cell lifetime is the time the primary lithium button cell can store data while the processor module is not powered. As long as the processor module is powered, the primary lithium button cell will only be discharged by its own leakage current.

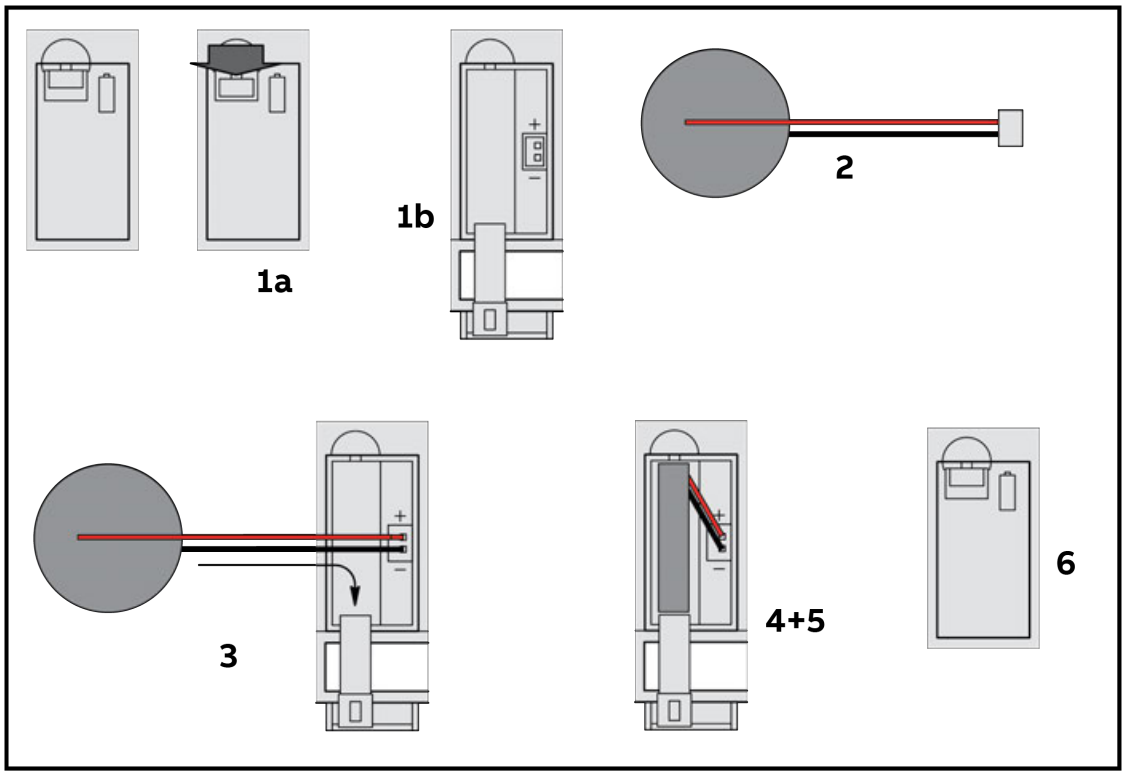
Insertion

To ensure proper operation and to prevent data loss, the insertion or replacement of the TA521 must be always done with the system under power. Data buffering is not possible without the TA521 and power supply at the same time.

WARNING!

Risk of fire or explosion!

Use of incorrect equipment may cause fire or explosion.



1. Open the compartment with the small locking mechanism, press it down and slip down the door. The door is attached to the front panel of the processor module and cannot be removed.
2. Remove the TA521 adapter cable with button cell from its package and hold it by the small cable. If the old TA521 needs to be replaced, remove then the small connector from the socket, do this best by lifting it out with a screwdriver.
3. Insert the TA521 connector of the adapter into the small connector port of the compartment. The connector is keyed to find the correct polarity (red = positive pole = above).
4. Insert first the cable and then the button cell into the compartment, push it until it reaches the bottom of the compartment.
5. Arrange the cable in order not to inhibit the door to close.
6. Pull-up the door and press until the locking mechanism snaps.

Replacement of the adapter cable with button cell

1. Make sure that the system is powered.
2. Open the compartment with the small locking mechanism, press it down and slip down the door. The door is attached to the front panel of the processor module and cannot be removed.

3. Remove the old TA521 adapter cable with button cell from the compartment by pulling it by the small cable. Remove then the small connector from the socket, do this best by lifting it out with a screwdriver.



4. Follow the previous instructions to insert a new TA521.

Parameter	Value
Nominal voltage	3 V
Nominal capacity	560 mAh
Temperature range (index below C0)	Operating: 0 °C ... +60 °C Storage: -20 °C ... +60 °C Transport: -20 °C ... +60 °C
Temperature range (index C0 and above)	Operating: -40 °C ... +70 °C Storage: -40 °C ... +85 °C Transport: -40 °C ... +85 °C
Primary lithium button cell lifetime	Typ. 3 years at +25 °C
Self-discharge	2 % per year at +25 °C 5 % per year at +40 °C 20 % per year at +60 °C
Protection against reverse polarity	Yes, by mechanical coding of the plug.
Insulation	The adapter cable with button cell is completely insulated.
Connection	Red = positive pole = above at plug, black = negative pole,
Weight	7 g
Dimensions	Diameter of the adapter cable with button cell: 24.5 mm Thickness of the adapter cable with button cell: 5 mm

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 180 300 R0001	TA521, adapter cable with primary button cell	Active

*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

5.8.2.4 TA522 - Adapter for CR2450 battery

- Adapter for CR2450 battery, 3 V, 560 mAh
- The CR2450 primary lithium battery is not included.



Purpose

This document describes only the handling of the TA522 adapter for CR2450 battery. Refer to TA521 documentation for all information about handling a buffer primary lithium battery.

CAUTION!

Risk of injury and damaging the product!

Improper installation and maintenance may result in injury and can damage the product!

– Installation and maintenance have to be performed according to the technical rules, codes and relevant standards, e.g. EN 60204-1.
– Only by qualified personnel.

CAUTION!

Lithium battery CR2450 is the only primary lithium battery to be used with AC500 devices.

- Do not use TA522 adapter with unapproved primary lithium battery. It can cause product damage and data loss.
- Replace primary lithium battery only with activated supply voltage.
- Exhausted primary lithium battery must be recycled to respect the environment.

CAUTION!

The TA522 adapter cannot be used with AC500-XC. For more information regarding AC500-XC refer to TA521 documentation.

CAUTION!

Risk of explosion!

Do not open, re-charge or disassemble primary lithium battery. Attempting to charge primary lithium battery will lead to overheating and can cause explosions.

Protect them from heat and fire and store them in a dry place.

Never short-circuit or operate primary lithium battery with the polarities reversed. The primary lithium battery are likely to overheat and explode. Avoid unintentional short circuiting do not store primary lithium batteries in metal containers and do not place them on metallic surfaces. Escaping lithium is a health hazard.

In order to prevent data loss or problems, the primary lithium battery should be replaced after 3 years of utilisation or at least as soon as possible after receiving the "low primary lithium battery warning" indication.

Do not use a primary lithium battery older than 3 years for replacement, do not keep primary lithium battery too long in stock.

To display the primary lithium battery load capacity, use the PLC Shell command “Batt”.

To ensure proper operation and to prevent data loss, the primary lithium battery insertion or replacement must be always done with the system under power. Data buffering is not possible without the primary lithium battery and power supply at the same time.

The TA522 accessory is used to provide a zero-voltage-safe power supply for the remanent memory and the real-time clock of the AC500 V3 CPU modules PM5630, PM5650, PM5670, PM5675, PM5680, PM5685.

In general the AC500 devices are supplied without primary cells. In case a primary lithium battery is desired (e.g. for SRAM storage and RTC buffering while the processor module is not powered) order one of the following accessories:

- TA521: primary lithium battery. It is the accessory to be assembled directly in the primary battery compartment. TA521 is mandatory in case of using a AC500 processor module with XC variant. Note that TA521 is delivered with a CR2450 primary lithium battery. Refer to TA521 documentation for more information.
- TA522: adapter for CR2450 battery. It is the accessory for a more comfortable assembly and replacement of a CR2450 primary lithium battery. Note that the adapter for CR2450 battery is offered and delivered without a CR2450 primary lithium battery (not to be ordered at ABB).

The following CR2450 primary lithium battery have been tested and are recommended in combination with the TA522 adapter:

Manufacturer	Name	Capacity	Temp. Range
Renata	CR2450N	540 mAh	-40 – +85 °C
Maxell	CR2450HR	550 mAh	-40 – +125 °C

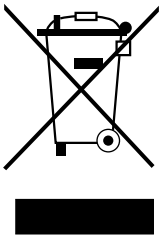
CAUTION!
Do not use unapproved primary lithium battery, it can cause data loss.

The CPU monitors the discharge degree of the primary battery. A warning is issued before the primary lithium battery condition becomes critical (about 2 weeks before). Once the warning message appears, the primary lithium battery should be replaced as soon as possible.

After installation of the adapter for CR2450 battery, make sure that the primary lithium battery is correctly recognized by the device. In the Automation Builder under *“CPU Parameters” -> “Check battery”*. Activate that the value is set to *“ON”* and no primary lithium battery error is displayed on the device (Warning E4).

Handling instructions

- Do not short-circuit or re-charge the primary lithium battery! It can cause excessive heating and explosion.
- Replace the primary lithium battery with supply voltage ON in order not to risk data being lost.
- Dispose of the adapter for battery in accordance with local regulations. (Note: Product contains nickel-plated stainless steel sheet, copper wires, plastics)
- Recycle exhausted primary lithium battery meeting the environmental standards.



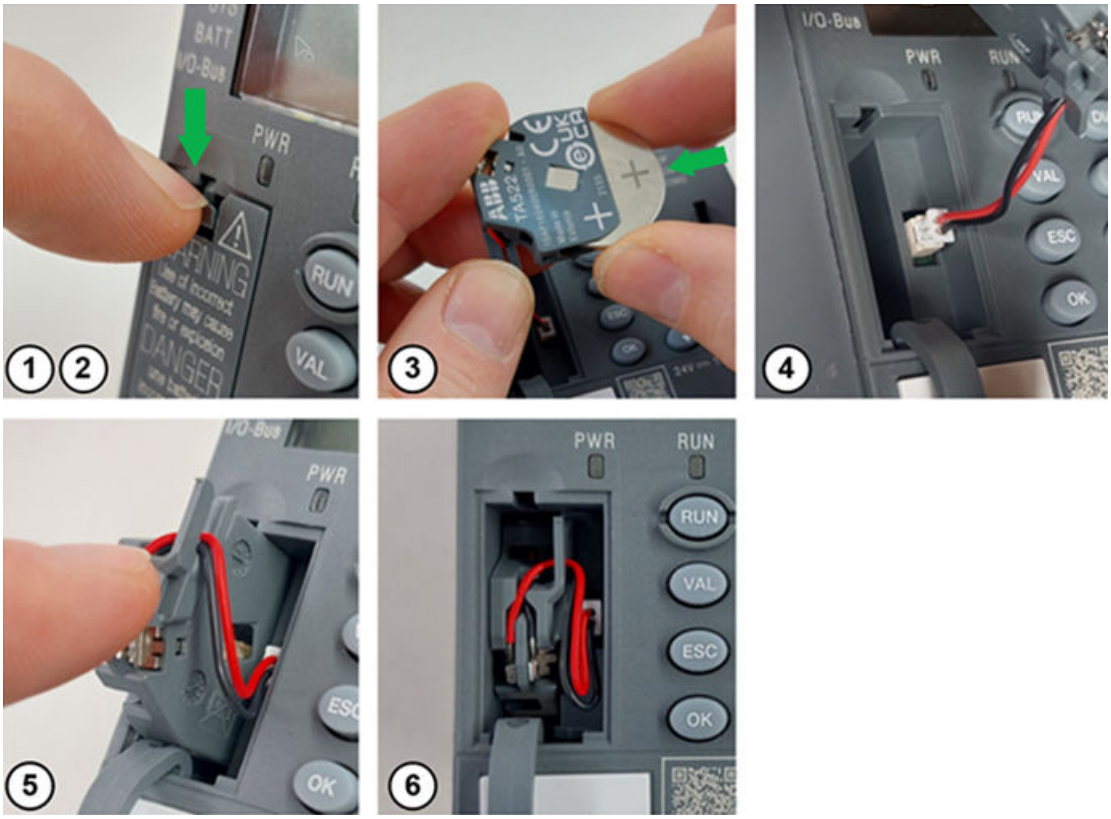
Primary lithium battery lifetime

The primary lithium battery lifetime is the time the primary lithium battery can store data while the processor module is not powered. As long as the processor module is powered, the primary lithium battery will only be discharged by its own leakage current.

To avoid a short primary lithium battery discharge, the primary lithium battery should always be inserted or replaced while the processor module is under power, then the primary lithium battery is correctly recognized and will not shortly discharged.

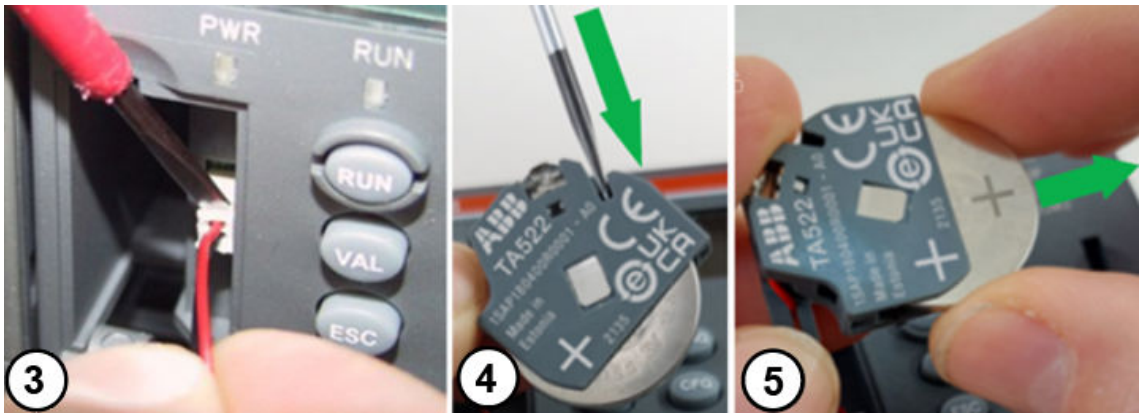
Insertion

WARNING!
Risk of fire or explosion!
Use of incorrect primary lithium battery may cause fire or explosion.



1. Open the primary lithium battery compartment with the small locking mechanism (press direction as arrow shows), press it down and slip down the door. The door is attached to the front panel of the processor module and cannot be removed.
2. Remove the TA522 adapter from its package and insert the primary lithium battery (type CR2450) into the TA522 adapter.
3. Observe the correct polarity according to the markings on the TA522 adapter and the primary lithium battery itself.
4. Insert the primary lithium battery connector into the small connector port of the compartment. The connector is keyed to find the correct polarity (red = positive pole = above).
5. Insert the TA522 adapter for CR2450 battery into the compartment and push it until it reaches the bottom of the compartment.
6. Arrange the cable in a way that allows the cover to close.
7. Pull-up the door and press until the locking mechanism snaps.

Replacement of the primary lithium battery



1. Make sure that the system is powered.
2. Open the primary lithium battery compartment with the small locking mechanism, press it down and slip down the door. The door is attached to the front panel of the processor module and cannot be removed.
3. Remove the old TA521 primary lithium battery or the TA522 adapter from the primary lithium battery compartment. Remove then the small connector from the socket with a screwdriver. Try to avoid pulling it by the cable.
4. Push the old primary lithium battery out of the TA522 adapter for CR2450 battery using a screwdriver.
5. Replace the primary lithium battery type CR2450.
6. Follow the previous instructions to insert a new primary lithium battery *“Insertion” on page 1407*.

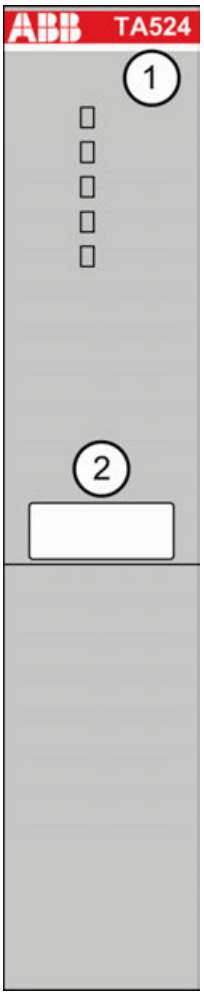
Parameter	Value
Nominal voltage	3 V
Nominal capacity	560 mAh
Protection against reverse polarity	Yes, by mechanical coding of the plug.
Insulation	The primary lithium battery is completely insulated.
Connection	Red = positive pole = above at plug, black = negative pole
Weight (without primary lithium battery)	2 g
Dimensions	26 x 10 x 23 mm (L x W x H)
For primary lithium battery type	CR2450 (Renata CR2450N and Maxell CR2450HR, 3V, minimum 540 mAh)

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 180 400 R0001	TA522, adapter for CR2450 battery	Active

*) *Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.8.2.5 TA524 - Dummy communication module



1 Type
2 Label

Purpose

TA524 is used to cover an unused communication module slot of a terminal base. It protects the terminal base from dust and inadvertent touch.

Chapter 5.3.1 “TB5600, TB5610, TB5620, TB5640, TB5660” on page 284

Handling instructions

TA524 is mounted in the same way as a common communication module.

Technical data

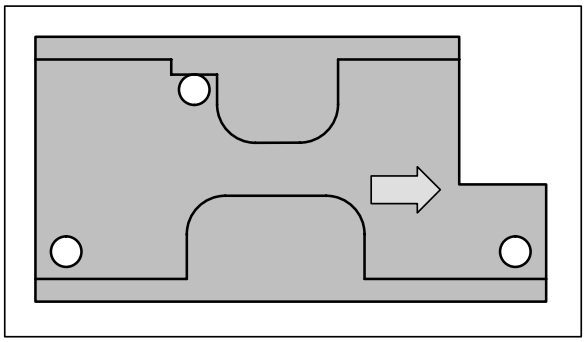
Parameter	Value
Weight	50 g
Dimensions	135 mm x 28 mm x 62 mm

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 180 600 R0001	TA524, dummy communication module	Active

*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

5.8.2.6 TA526 - Wall mounting accessory



Purpose

If a terminal base or a terminal unit should be mounted with screws, the wall mounting accessories TA526 must be inserted at the rear side first. This plastic parts prevent bending of terminal bases and terminal units while screwing up.

Technical data

Parameter	Value
Weight	5 g
Dimensions	67 mm x 35 mm x 5,5 mm

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 180 800 R0001	TA526, wall mounting accessory	Active

*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

5.8.3 S500 and S500-XC

5.8.3.1 CP-E - Economic range



The power supplies feature series and parallel connection as well as a true redundant setup via a redundancy module.

- Wide-range input voltage.
- Mounting on DIN rail.
- High efficiency of up to 90 %
- Low power dissipation and low heating
- Wide ambient temperature range from -40 °C ... +70 °C.
- No-load-proof, overload-proof, continuous short-circuit-proof.
- Power factor correction (depending on the type).
- Approved in accordance with all relevant international standards.

Table 424: Ordering data

Order No.	Type	Input	Output	Overload capacity	Module width [mm]
1SVR427030R0000	CP-E 24/0.75	100-240 V AC or 120-370 V DC	24 V DC, 0.75 A	-	22.5
1SVR427031R0000	CP-E 24/1.25	100 V AC ... 240 V AC or 90V DC ... 375 V DC	24 V DC, 1.25 A	-	40.5
1SVR427032R0000	CP-E 24/2.5	100 V AC ... 240 V AC or 90 V DC ... 375 V DC	24 V DC, 2.5 A	-	40.5
1SVR427034R0000	CP-E 24/5.0	115/230 V AC auto select or 210 V DC ... 370 V DC	24 V DC, 5 A	-	63.2
1SVR427035R0000	CP-E 24/10.0	115/230 V AC auto select or 210 V DC ... 370 V DC	24 V DC, 10 A	-	83
1SVR427036R0000	CP-E 24/20.0	115 V AC ... 230 V AC or 120 V DC ... 370 V DC	24 V DC, 20 A	-	175

5.8.3.2 CP-C.1 - High performance range



The power supplies feature series and parallel connection as well as a true redundant setup via a redundancy module.

The CP-C.1 power supplies are ABB's high performance and most advanced range. With excellent efficiency, high reliability and innovative functionality it is prepared for the most demanding industrial applications. These power supplies have a 50 % integrated power reserve and operate at an efficiency of up to 94 %. They are equipped with overheat protection and active power factor correction. Combinded with a broad AC and DC input range and extensive worldwide approvals the CP-C.1 power supplies are the preferred choice for professional DC applications.

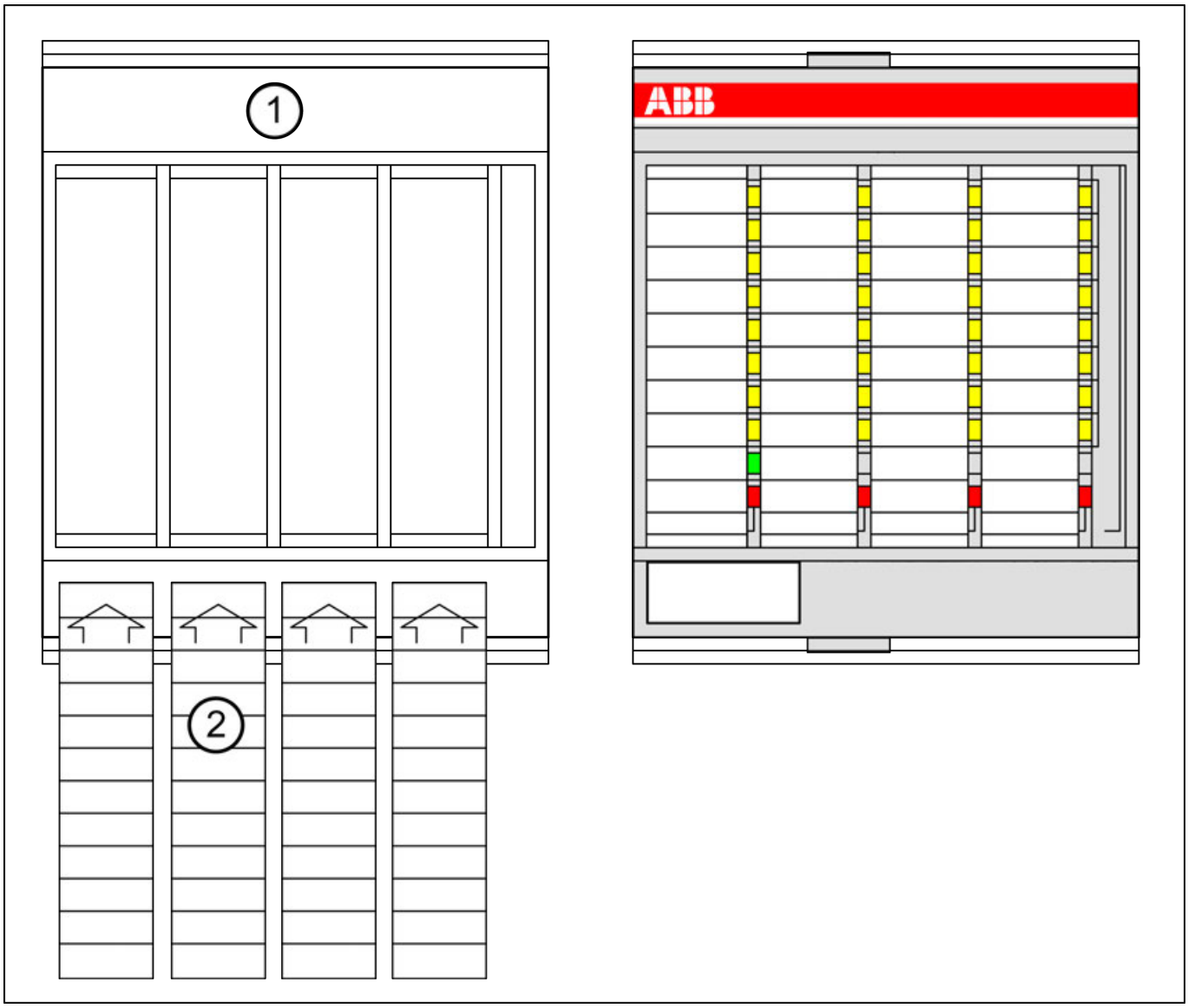
- Typical efficiency of up to 94 %.
- Power reserve design delivers up to 150 % of the nominal output current.
- Signaling outputs for DC OK and power reserve mode.
- High power density leads to very compact and small devices.
- No-load-proof, overload-proof, continuous short-circuit-proof.
- Active power factor correction (PFC).

Table 425: Ordering data

Order No.	Type	Input	Output	Overload capacity	Module width [mm]
1SVR360563R1001	CP-C.1 24/5.0	110 V AC ... 240 V AC or 90 V DC ... 300 V DC	24 V DC, 5 A	+50 %	40
1SVR360663R1001	CP-C.1 24/10.0	110 V AC ... 240 V AC or 90 V DC ... 300 V DC	24 V DC, 10 A	+50 %	60
1SVR360763R1001	CP-C.1 24/20.0	110 V AC ... 240 V AC or 90 V DC ... 300 V DC	24 V DC, 20 A	+30 %	82

5.8.3.3 TA523 - Pluggable label mounting

For labelling the channels of S500 I/O modules.



1 Pluggable label mounting TA523
2 Plastic labels to be inserted into the holder

Purpose

The pluggable label mounting is used to hold 4 plastic labels, on which the meaning of the I/O channels of I/O modules can be written down. The holder is transparent so that after snapping it onto the module the LEDs shine through.

Handling instructions

The plastic labels can be printed out from *TA523.doc*.

Technical data

Parameter	Value
Use	For labelling channels of I/O modules
Mounting	Snap-on to the module
Weight	20 g
Dimensions	82 mm x 67 mm x 13 mm

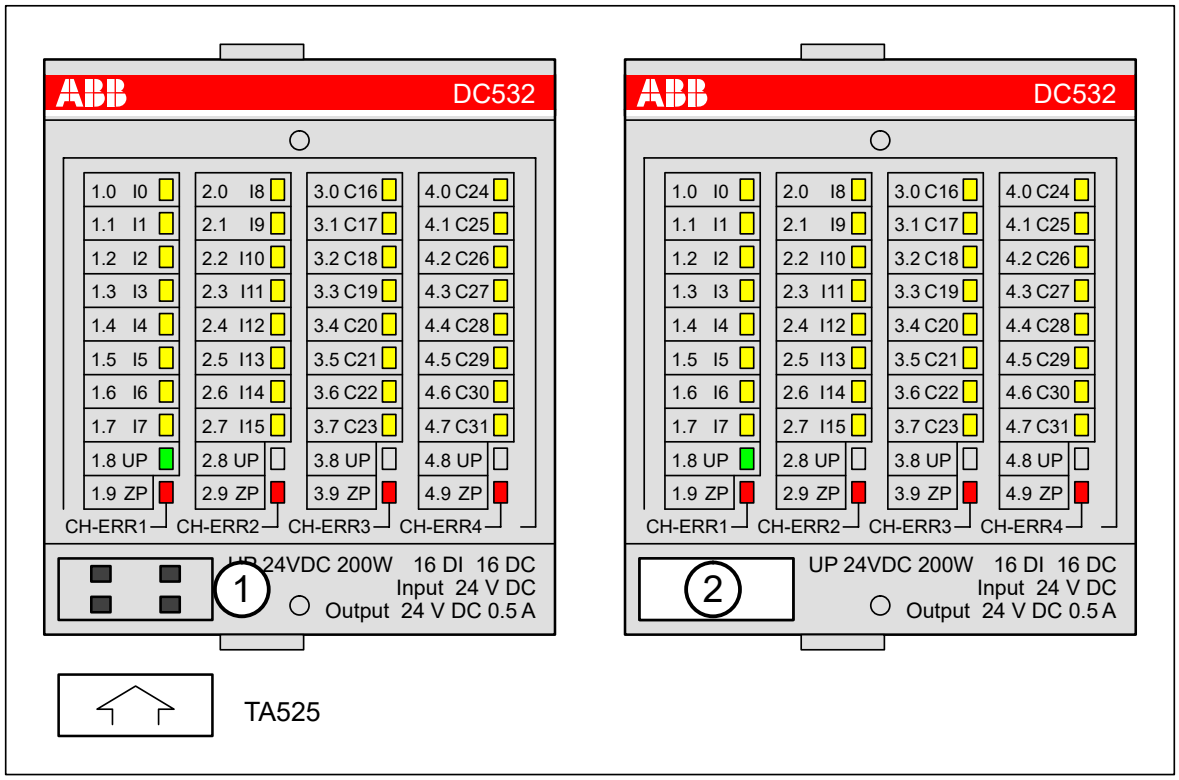
Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 180 500 R0001	TA523, pluggable label mounting (10 pieces)	Active

*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

5.8.3.4 TA525 - Plastic labels

Accessory to label AC500 and S500 modules.



1 Module without plastic label TA525
2 Module with plastic label TA525

Purpose

The plastic labels are suitable for labelling AC500 and S500 modules (CPUs, communication modules and I/O modules). The small plastic parts can be written on with a standard waterproof pen.

Handling instructions

The plastic labels are inserted under a slight pressure. For disassembly, a small screwdriver is inserted at the lower edge of the module.

Technical data

Parameter	Value
Use	For labelling AC500 and S500 modules
Mounting	Insertion under a slight pressure

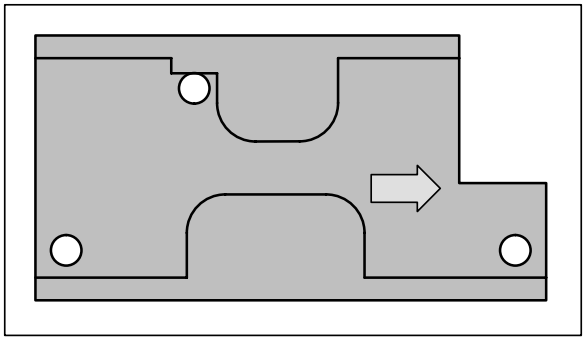
Parameter	Value
Disassembly	With a small screwdriver
Scope of delivery	10 pieces
Weight	1 g per piece
Dimensions	8 mm x 20 mm x 5 mm

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 180 700 R0001	TA525, Set of 10 white plastic labels	Active

*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

5.8.3.5 TA526 - Wall mounting accessory



Purpose

If a terminal base or a terminal unit should be mounted with screws, the wall mounting accessories TA526 must be inserted at the rear side first. This plastic parts prevent bending of terminal bases and terminal units while screwing up.

Technical data

Parameter	Value
Weight	5 g
Dimensions	67 mm x 35 mm x 5,5 mm

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 180 800 R0001	TA526, wall mounting accessory	Active

*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

5.8.3.6 TA535 - Protective caps for XC devices

Purpose

Accessory to cover unused connectors of XC devices in salt mist environments.

One TA535 package includes different cap types for the following connectors:

- RJ45 connectors
- 9-pole D-sub connector
- FieldBusPlug connector

Protection should be done for all unused slots of -XC devices.

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 182 300 R0001	TA535, Protective Caps for XC devices	Active

*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

5.9 Storage devices

5.9.1 Overview

AC500 PLCs offer a variety of storage devices. The following table gives a short overview and a description on these storage devices:

IEC access means that the storage device can be accessed by function blocks of an IEC program.

FTP access means that the device can be accessed via FTP server on the PLC (if available).

Component	Description	IEC access	FTP access	Processor modules
userdisk home/userdisk (customer data)	User disk for custom data (flash) Internal persistent mass storage placed in the internal flash device Can be used for any application purpose	Yes	Yes	All
PLCLogic home/PLCLogic (customer data)	Internal persistent mass storage placed in the internal flash device Used for configuration data, user application (boot project), WebVisu files, etc.	Yes	Yes	All
SRAM (only for AC500)	Battery-buffered, non-volatile RAM Used for retain/ persistent and %M variables	Yes	No	All
FRAM (only for AC500-eCo)	Non-volatile RAM Used for retain/ persistent and %M variables	Yes	No	All
system	System RAM disk (Temp directory) for storing the firmware For internal firmware use only!	Yes	No	All
flash disk	Internal persistent mass storage device Can be used for any application purpose	Yes	Yes	PM5675-2ETH
memory card	memory card (removable) Removable persistent mass storage device Can be used for any application purpose	Yes	Yes	All

5.9.2 Functionalities

Filesystem Name	As of CPU firmware	Description
userdisk	V3.0.0	Boot project (size depends on PLC type) WebVisu files for web server Symbol file for OPC server and CP600 panels User data via CAA_File_xxx.lib *) Files via Automation Builder file download Files via FTP server
	V3.1.0	Save persistent data
SRAM/FRAM	V3.1.0	Save retain and persistent data
system	V3.0.0	Load / save boot project
		Firmware update
		Internal system files
flash disk	V3.1.0	User data via CAA_File_xxx.lib *) Files via Automation Builder file download Files via FTP server
sdcard	V3.0.0	Firmware update, User data via CAA_File_xxx.lib *) Files via Automation Builder file download Files via FTP server
	V3.1.0	Save persistent data Boot project (size depends on PLC type)

*) Examples for the filename with path (sFileName for FILE.Open) specified by the user ('mydir' is optional, but must be an existing directory):

- 'userdisk/myfile.txt'
- 'sdcard/mydir/myfile.txt'
- 'flashdisk/myfile.txt'



The maximum number of files opened at the same time is limited to 1007.

The max. length of the user string (path and filename) is 241 characters.

Unlike the PLC's memory areas like %M or Retain, where 1 byte actually consumes 1 byte, all storage device utilize a file system.

That means there is a difference between a files size and its size on the disk.

On disks the files are stored in so-called clusters which are a group of disk sectors. "Size on disk" refers to the amount of cluster(s) a file is taking up, while "file size" is an actual byte count of the file data. So you will usually find that the size on disk is larger than the file size. This is not an error, but a result of the disk organization via a file system. Since sector and cluster sizes vary depending on a disk's size and the used file system, the ratios between the size on disk and the file size also vary between the various storage devices.

The AC500 V3 internal memory is case sensitive. In contrast to that a memory card with a FAT file system is not case sensitive.

For more details, refer to the application example

5.9.3 Memory sizes

AC500-eCo processor modules

PLC type	userdisk PLCLogic ...	Retain, %M area	flash disk	memory card
PM5012-x-ETH	30 MB	8 kB Retain and persistent 4 kB (of which 88 byte are reserved for allocation table and are not available to the user) %M 4 kB	None	*Chapter 5.8.2.1 “MC5102 - Micro memory card with adapter” on page 1390*
PM5032-x-ETH		32 kB Retain and persistent 16 kB (of which 88 byte are reserved for allocation table and are not available to the user) %M 16 kB		
PM5052-x-ETH				
PM5052-R-ETH	300 MB			
PM5072-T-2ETH(W) PM5082-T-2ETH PM5092-T-2ETH	30 MB	100 kB Retain and persistent 36 kB (of which 88 byte are reserved for allocation table and are not available to the user) %M 64 kB		
PM5082-T-2ETH PM5092-T-2ETH	285 MB			

AC500 processor modules

PLC type	userdisk PlcLogic ...	SRAM Retain, %M area	flash disk	memory card
PM5630-2ETH	40 MB 30 MB (as of V3.4.0)	256 kB Retain and persistent 128 kB (of which 68 byte are reserved for allocation table and are not available to the user) %M 128 kB	None	*Chapter 5.8.2.2 “MC5141 - Memory card” on page 1396* *Chapter 5.8.2.1 “MC5102 - Micro memory card with adapter” on page 1390*
PM5650-2ETH	246 MB (as of V3.0.x) 300 MB (as of V3.1) 285.75 (as of V3.4.0)			
PM5670-2ETH	858 MB	1536 MB		
PM5675-2ETH	643.50 MB (as of V3.4.0)	1 MB retain and persistent (of which 68 byte are reserved for allocation table and are not available to the user) 512 kB %M	8 GB	
PM5680-2ETH				
PM5685-2ETH				

It is not possible to use 100 % of a device's memory space. About 10 % of the total available space must remain unused at any time to maintain normal device operation.

5.9.4 Storage device details

5.9.4.1 SRAM

The SRAM (only used for AC500) is a battery-buffered, non-volatile RAM and is used for the retain/persistent and the %M variables. If a battery is inserted into the processor module, the data stored in the SRAM will not get lost during a power-down cycle.

During PLC startup, the SRAM will be deleted automatically if no or an empty battery is inserted into the processor module. In this case the information

```
ABBInitSram_SetupMemory : SRAM cleared
```

and the warning

```
Retain size in config changed, or retain area got corrupted
```

are written into the log file.

5.9.4.2 FRAM

The FRAM (only used forAC500-eCo) is a non-volatile RAM and is used for the retain/persistent and the %M variables. FRAM does not use battery buffering, it persistently stores the data when unpowered. In exceptional cases writing the data to the FRAM might fail. If this happens, the data will be identified as being corrupt and deleted on start-up.

5.9.4.3 Flash disk

The flash disk is an internal persistent mass storage device and can be used for any application purpose.

It has a memory capacity of 8 GB (preformatted).

The flash disk is capable of high data throughput, however, the actual values to be achieved depend on the use cases. If the performance seems to get insufficient, check the following:

- If the PLCs CPU load is high, reduce overall CPU load of the PLC to have more performance for file operations.
- If the device has low free space, cleanup the disk.
  Please consider the cluster size of 4 kB in your application design to achieve optimal usage of the flash disks space and access performance. For example, 10 files with 10 byte each require 10*4 kB disk space, while 1 file with 100 byte requires only 4 kB.

Number of max. write cycles

Technically, the flash chip used in the flash disk has 20000 erase cycles (Write cycles).

Due to the produced write overhead, the optimum achievable number of write cycles is 10000 (for typical payload sizes of 256 kB).

Example

The write overhead is indicated by the *write amplification factor* (WAF).

$$\mathrm{WAF} = \frac{\text{Flash Write (in Bytes)}}{\text{Host Write (in Bytes)}}$$

Table 426: Rule of thumb for assessing the flash lifetime for an application

Typical payload sizes	WAF	Max. write cycles
256 kB	2	10000
128 kB	4	5000
64 kB	8	2500
...	...	...
1024 Byte	512	< 40
512 Byte	1024	< 20

It is recommended to use the respective function blocks to monitor the status of the flash disk.

Since FW version 3.3.0, there is also a diagnosis event supported when the user flash memory reaches the end of its life cycle.

Lifetime of flash disk will also depend on the operating environment.

E.g. high ambient temperatures will impose stress on the user flash memory and reduce the total overwrites achievable.

- Maximum write speed is 20 MB/s (continuous write of sequential data).
- Read cycles are unlimited.

5.9.4.4 Memory card

The memory card is a removable persistent mass storage device and can be used for any application purpose. Both firmware updates and boot project updates can be run from the memory card.

Size	Product specific ↳ *Chapter 5.9.3 “Memory sizes ” on page 1421*

5.9.4.5 Further information

↳ *Further details on the storage device sizes*

6 Decommissioning

1. Delete the runtime licenses from the device by returning the licenses.
2. Delete certificates available on the CPU.
3. Delete applications.
4. Delete applications from memory card, if available.
5. If available, remove memory card and battery from CPU.
6. Delete all user accounts and user data.
7. Demount and dispose the hardware modules.

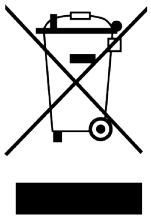
↳ *Chapter 7 “Recycling” on page 1426*



If you can not access the data stored in the CPU, e.g., because the CPU is not functional any more, then physically destroy the device.

This ensures that the credentials that are stored in the device, can not be misused.

7 Recycling



Disposal and recycling information

This symbol on the product (and on its packaging) is in accordance with the European Union's Waste Electrical and Electronic Equipment (WEEE) Directive.

The symbol indicates that this product must be recycled/disposed of separately from other household waste.

It is the end user's responsibility to dispose of this product by taking it to a designated WEEE collection facility for the proper collection and recycling of the waste equipment.

The separate collection and recycling of waste equipment will help to conserve natural resources and protect human health and the environment.

For more information about recycling, please contact your local environmental office, an electrical/electronic waste disposal company or the store where you purchased the product.

8 Glossary

AC500	Standard PLCs
AC500-eCo	Compact PLCs
AC500-eCo V2	Range of AC500-eCo processor modules
AC500-eCo V3	Range of AC500-eCo processor modules
AC500-S	Safety PLCs
AC500-S Programming Tool	IEC 61131-3 editor, integrated in engineering suite Automation Builder
AC500-S-XC	Safety PLCs suitable for extreme environmental conditions
AC500 V2	Range of AC500 and AC500-XC processor modules
AC500 V3	Range of AC500 and AC500-XC processor modules
AC500-XC	Standard PLCs suitable for extreme environmental conditions
Alarm	Diagnosis message which must be acknowledged by the user. The alarm will continue to be displayed even if the issue has been resolved in the meantime until it is acknowledged.
Automation Builder	Engineering suite for configuration and programming of all PLCs
Cold start	Note: The AC500-eCo V3 does not use a battery for buffering the operand areas specified below, hence the “cold start” mode does not exist in this product. ● A cold start is performed by switching power OFF/ON if no battery is connected. ● All RAM memory modules are checked and erased. ● If no user program is stored in the flash EPROM, the default values (as set on delivery) are applied to the interfaces. ● If there is a user program stored in the flash EPROM, it is loaded into RAM. ● The default operating modes set by the PLC configuration are applied.
CP600	Control panels for application visualizations
Data buffering	● Data buffering, i.e., maintaining data after power ON/OFF, is only possible, if a battery is connected for AC500 CPU and the buffering will take place in flash memory with AC500-eCo V3 CPU. The following data can be buffered completely or in parts: – Data in the addressable flag area (%M area) – RETAIN variable – PERSISTENT variable (number is limited, no structured variables) ● In order to buffer particular data, the data must be excluded from the initialization process.
Download	● Download means loading the complete user program into the PLC's RAM. This process is started by selecting the menu item "Online/Download" in the programming system or after confirming a corresponding system message when switching to online mode (menu item "Online/Login"). ● Execution of the user program is stopped. ● In order to store the user program to the user flash memory, the menu item "Online/Create boot project" must be called after downloading the program. ● Variables are set to their initialization values according to the initialization table.

- RETAIN variables can have wrong values as they can be allocated to other memory addresses in the new project!
- A download is forced by the following:
  – changed PLC configuration
  – changed task configuration
  – changed library management
  – changed compile-specific settings (segment sizes)
  – execution of the commands "Project/Clean all" and "Project/Rebuild All".

Event

Diagnosis message which does not require acknowledgement. The event describes the current status of the device. The event disappears once the issue has been resolved.

HMI

Human machine interface

Online change

- After a project has changed, only these changes are compiled when pressing the key <F11> or calling the menu item "Project/Build". The changed program parts are marked with a blue arrow in the block list.
- The term Online Change means loading the changes made in the user program into the PLC's RAM using the programming system (after confirming a corresponding system message when switching to online mode, menu item "Online/Login").
- Execution of the user program is not stopped. After downloading the program changes, the program is re-organized. During re-organization, no further online change command is allowed. The storage of the user program to the user flash memory using the command "Online/Create boot project" cannot be initiated until re-organization is completed.
- Online Change is not possible after:
  – changes in the PLC configuration
  – changes in the task configuration
  – changes in the library management
  – changed compile-specific settings (segment sizes)
  – performing the commands "Project/Clean all" and "Project/Rebuild All".

Panel Builder PB610

Engineering tool for control panels, integrated in engineering suite Automation Builder

Reset

- Performs a START -> STOP process.
- Preparation for program restart, i.e., the variables (VAR) (exception: RETAIN variables) are set to their initialization values.
- Reset is performed using the menu item "Online/Reset" in the programming system or pressing the function key RUN for $\geq$ 5 s in STOP mode.

Reset (cold)

- Performs a START -> STOP process.
- Preparation for program restart, i.e., the variables (VAR) (also RETAIN variables) are set to their initialization values.
- Reset (cold) is performed using the menu item "Online/Reset (cold)" in the programming system.

Reset (original)

- Resets the controller to its original state (deletion of flash, SRAM, communication module configurations and user program!).
- Reset (original) is performed using the menu item "Online/Reset (original)" in the programming system.

RUN -> STOP

- RUN -> STOP means pressing the RUN function key on the PLC while the PLC is in run mode (AC500 PLC display "run", AC500-eCo PLC "RUN LED" is ON).
- If a user program is loaded into RAM, execution is stopped.
- All outputs are set to FALSE or 0.
- Variables keep their current values, i.e., they are not initialized.
- The AC500 PLC display changes from "run" to "StoP", AC500-eCo "RUN LED" changes from ON to OFF.

START -> STOP

- START -> STOP means stopping the execution of the user program in the PLC's RAM using the menu item "Online/Stop" in the programming system.
- All outputs are set to FALSE or 0.

- Variables keep their current values, i.e., they are not initialized.
- The AC500 PLC display changes from "run" to "StoP".

STOP -> RUN

- STOP -> RUN means short pressing the RUN function key on the PLC while the PLC is in STOP mode (AC500 PLC display "StoP", AC500-eCo "RUN LED" is ON). "RUN LED" is OFF of the toggle switch of an AC500-eCo CPU.
- If a user program is loaded into RAM, execution is continued, i.e., variables will not be set to their initialization values.
- The AC500 PLC display changes from "StoP" to "run", AC500-eCo "RUN LED" changes from OFF to ON.

STOP -> START

- STOP -> START means continuing the execution of the user program in the PLC's RAM using the menu item "Online/Start" in the programming system.
- If a user program is loaded into RAM, execution is continued, i.e., variables will not be set to their initialization values.
- The AC500 PLC display changes from "StoP" to "run", AC500-eCo PLC "RUN LED" changes from OFF to ON.

Warm start

- A warm start is performed by switching power OFF/ON with a battery connected.
- All RAM memory modules are checked and erased except of the buffered operand areas and the RETAIN variables.
- If there is a user program stored in the flash EPROM, it is loaded into RAM.
- The default operating modes set by the PLC configuration are applied.

9 Index

A

AC500
- description . . . 20
- system structure . . . 16

AC500 V2/AC500 V3 . . . 4

AC500-eCo
- description . . . 18
- system structure . . . 15

AC500-Safety . . . 23, 43
AC522 . . . 648
accessory . . . 1367
AI523 . . . 675
AI531 . . . 702
AI561 . . . 522
AI562 . . . 534
AI563 . . . 545
AI564 . . . 559
AI565 . . . 571
AI568 . . . 585
AI581-S . . . 23, 43
analog I/O module . . . 522
analog input module
- AI523 . . . 675
- AI531 . . . 702
- AI561 . . . 522
- AI562 . . . 534
- AI563 . . . 545
- AI564 . . . 559
- AI565 . . . 571
- AI568 . . . 585

analog input/output module
- AC522 . . . 648
- AX521 . . . 762
- AX522 . . . 789
- AX561 . . . 633

analog output module
- AO523 . . . 752
- AO561 . . . 599
- AO562 . . . 610
- AO568 . . . 621

AO523 . . . 752
AO561 . . . 599
AO562 . . . 610
AO568 . . . 621
AX521 . . . 762
AX522 . . . 789
AX561 . . . 633

B

Basic CPU . . . 45

C

CANopen . . . 243, 963
CD522 . . . 916
centralized I/O extension . . . 15, 17
CI . . . 23
CI501 . . . 1263
CI501-PNIO . . . 1263
CI502 . . . 1304
CI502-PNIO . . . 1304
CI504 . . . 1331
CI511 . . . 1076
CI512 . . . 1109
CI512-ETHCAT . . . 1109
CI521 . . . 1127
CI521-MODTCP . . . 1127
CI522 . . . 1167
CI522-MODTCP . . . 1167
CI541 . . . 1194
CI541-DP . . . 1194
CI542 . . . 1235
CI542-DP . . . 1235
CI581 . . . 963
CI581-CN . . . 963
CI582 . . . 1002
CI592 . . . 1028
CI592-CS31 . . . 1028
CM . . . 20, 234
CM579 . . . 251, 272
CM579- EtherCAT master . . . 251
CM579-PNIO . . . 272
CM582 . . . 261
CM589 . . . 278
CM589-PNIO . . . 278
CM589-PNIO-4 . . . 278

CM589-PNIO(-4) 278
CM592 265
CM592- PROFIBUS DP Master 265
CM598 243
CM5610-2RS 238
CM5610-2RS-XC 238
CM5640-2ETH 255
CM5640-2ETH-XC 255
communication interface module 961
  CANopen 963
  CS31 1028
  EtherCAT 1076
  Modbus 1127
  PROFIBUS 1194
  PROFINET 1261
communication module 234
  CANopen 243
  EtherCAT 250
  Ethernet 255
  PROFIBUS 261
  PROFINET 272
  serial 238
Comparison
  AC500 terminal bases 207
connection
  AC522 650
CP-C.1 1413
CS31 1028

D

DA501 816
DA502 849
DC522 429
DC523 441
DC532 454
DC551 1060
DC562 298
decentralized I/O extension 16, 17
Decommissioning 1425
description
  AC500 20
  S500 20
DI524 468
DI561 310
DI562 318
DI571 328
DI572 337
DI581-S 23, 43
Diagnosis
  AC522 666
Differentiation AC500 V2/AC500 V3 4
digital I/O module 298
digital input module
  DI524 468
  DI561 310
  DI562 318
  DI571 328
  DI572 337
digital input/output module
  DC522 429
  DC523 441
  DC532 454
  DC562 298
  DX522 497
  DX531 510
  DX561 403
  DX571 415
digital output module
  DO524 479
  DO526 489
  DO561 347
  DO562 357
  DO571 368
  DO572 380
  DO573 390
digital/analog I/O module 816
digital/analog input/output module
  DA501 816
  DA502 849
DO524 479
DO526 489
DO561 347
DO562 357
DO571 368
DO572 380
DO573 390
DX522 497
DX531 510
DX561 403
DX571 415

DX581-S 23, 43

E

electrical connection
AC522 650
encoder, counter and PWM module 916
EtherCAT 250, 1076
Ethernet 255
Ethernet communication interface modules 1348
Ethernet protocols and ports 212

F

fast counters 81, 453, 919, 1192
FM 23
FM565 877
FM566 896
function module 877
functionality
AC522 649

H

High performance range 1413

I

I/O configuration
AC522 661
i/o faq 207
I/O module 22, 295
analog 522
digital 298
digital/analog 816
function module 877
Input simulator 1386
Intended purpose
AC522 649
Internal data exchange
AC522 661
io modules 19

M

MC5102 . . . . . 1367, 1390
MC5141 1396
Measuring ranges
AC522 668
memory card
MC5102 (micro) 1367, 1390
MC5141 1396
micro memory card
MC5102 . . . . . 1367, 1390
micro memory card adapter
TA5350-AD 1367, 1390
Modbus 1127

O

older versions of this document 7
Onboard I/Os
PM50x2 68
Onboard I/Os in processor module PM50x2 68
OPC DA
Communication and protocols . 211, 213, 216, 218
option board 89
analog input, TA5120-2AI-UI 112
analog input, TA5120-2AI-UIW 112
analog input, TA5122-2AI-TC 126
analog input, TA5122-2AI-TCW 126
analog input, TA5123-2AI-RTD 140
analog input, TA5123-2AI-RTW 140
analog input/output, TA5128-2AI1AO 166
analog input/output, TA5128-2AI1AOW 166
analog output, TA5126-2AO-UI 155
analog output, TA5126-2AO-UIW 155
CAN communication, TA5146-CN 201
CAN communication, TA5146-CNW 201
COMx serial communication, TA5141-RS232I 182
COMx serial communication, TA5141-RS232IW 182
COMx serial communication, TA5142-RS485 194
COMx serial communication, TA5142-RS485I 186
COMx serial communication, TA5142-RS485IW 186
COMx serial communication, TA5142-RS485W 194
digital I/O, TA5110-2DI2DOT 103
digital I/O, TA5110-2DI2DOW 103
digital input, TA5101-4DI 89
digital input, TA5101-4DIW 89
digital output, TA5105-4DOT 95
digital output, TA5105-4DOTW 95
KNX address push button, TA5130-KNXPB . . 178
KNX adress push button, TA5130-KNXPBW . . 178
real-time clock, TA5131-RTC 180
ordering data
AC522 674

P

Parameterization
AC522 661
Plastic labels 1416
Plastic markers 1416
pluggable label mounting 1414
pluggable marker holder 1414
PM 18, 20, 44
PM5012 44
PM5032 44
PM5052 44
PM5072 44
PM5082 44
PM5092 44
PM5630 220
PM5650 220
PM5670 220
PM5675 220
PM5680 220
PM5685 220
Pro CPU 46
processor module 44
processor modules 20
PROFIBUS 261, 1194
PROFIBUS DP slave 261
PROFINET 272, 1261

R

Recycling 1426

S

S500
description 20
system structure 16
S500-eCo
description 18
system structure 15
Safety devices 23, 43
safety notice 7, 9
security notice 7, 9
SM560-S 23, 43
SM560-S-FD-1 . . . . . 23, 43
SM560-S-FD-4 . . . . . 23, 43
Standard CPU 45
State LEDs
AC522 668
strain gauge module
FM565 877
FM566 896
synchronization with table of contents 7
system structure
AC500 16
AC500-eCo 15
S500 16
S500-eCo 15

T

TA521 1400
TA522 1404
TA523 1414
TA524 1409
TA525 1416
TA526 . . . . . 1410, 1417
TA535 1418
TA5101-4DI
digital input option board 89
TA5101-4DIW
digital input option board 89
TA5105-4DOT
digital output option board 95
TA5105-4DOTW
digital output option board 95
TA5110-2DI2DOT
digital I/O option board 103
TA5110-2DI2DOW
digital I/O option board 103
TA5120-2AI-UI
analog input option board 112
TA5120-2AI-UIW
analog input option board 112
TA5122-2AI-TC
analog input option board 126
TA5122-2AI-TCW
analog input option board 126
TA5123-2AI-RTD
analog input option board 140
TA5123-2AI-RTW
analog input option board 140

TA5126-2AO-UI
analog output option board 155
TA5126-2AO-UIW
analog output option board 155
TA5128-2AI1AO
analog input/output option board 166
TA5128-2AI1AOW
analog input/output option board 166
TA5130-KNXPB
option board KNX address push button 178
TA5130-KNXPBW
option board KNX adress push button 178
TA5131-RTC
option board for real-time clock 180
TA5141-RS232I
option board, COMx serial communication . . . 182
TA5141-RS232IW
option board, COMx serial communication . . . 182
TA5142-RS485
option board, COMx serial communication . . . 194
TA5142-RS485I
option board, COMx serial communication . . . 186
TA5142-RS485IW
option board, COMx serial communication . . . 186
TA5142-RS485W
option board, COMx serial communication . . . 194
TA5146-CN
option board for CAN communication 201
TA5146-CNW
option board for CAN communication 201
TA5211-TSCL-B 1372
TA5211-TSPF-B 1372
TA5212-TSCL 1372
TA5212-TSPF 1372
TA5220-SPF5 1372
TA5220-SPF6 1372
TA5220-SPF7 1372
TA5220-SPF8 1372
TA5300-CVR 1383
TA5350-AD 1367, 1390
TA5400-SIM 1386
TB 21, 284
TB511
Technical data 291
TB521
Technical data 291
TB523
Technical data 291
TB541
Technical data 291
TB5600 284
Technical data 291
TB5610 284
Technical data 291
TB5620 284
Technical data 291
TB5640 284
Technical data 291
TB5660 284
Technical data 291
Technical data
AC522 670
TB511 291
TB521 291
TB523 291
TB541 291
TB5600 291
TB5610 291
TB5620 291
TB5640 291
TB5660 291
terminal base 284
terminal unit
for communication modules 1347
for S500 I/O modules 946
Terminal unit for PROFINET communication interface modules 1359
terminal units for communication interface modules 1351, 1355
Terminal units for CS31 communication interface modules 1363
terminal units for I/O modules 946, 953
TU 22, 946, 1347
TU507 1348
TU508 1348
TU509 1351
TU510 1351
TU515 946
TU516 946

TU517 1355
TU518 1355
TU520 1359
TU531 953
TU532 953
TU541 946
TU542 946
TU551 1363
TU552 1363
TU582-S 23, 43

V

V2/V3 4

W

wall mounting accessory 1410, 1417
warning notices 7, 9

—

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—

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