HARDWARE MANUAL

Programmable logic controllers

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

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1 Preface

1.1 Documentation guide

Where to find information about:

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1.2 Do I have 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.

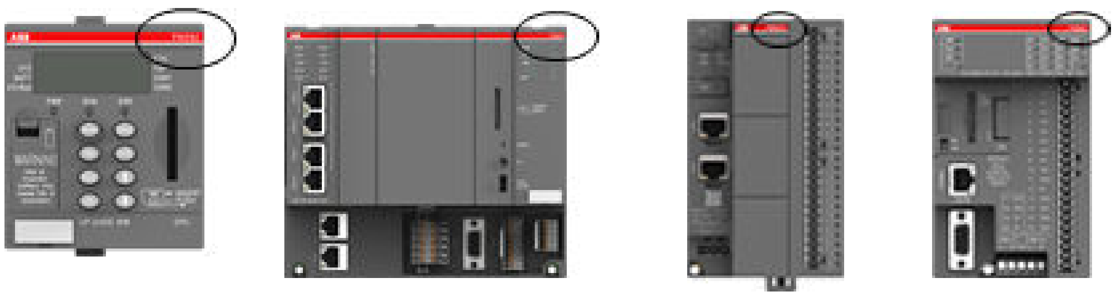


Fig. 1: Hardware: Processor modules

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)

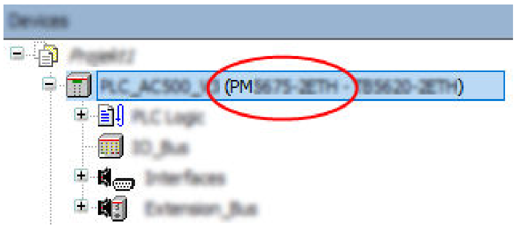


Fig. 2: Software: Configuration in engineering software Automation Builder

Written type in brackets	Example	Range	Relevant manual
Processor module type PM + **3 digits**	PM564	V2	*AC500 V2*
Processor module type PM + **4 digits**	PM5675	V3	AC500 V3 (this manual)

1.3 Regulations

Planning and installation of the electrical system

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*.

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.

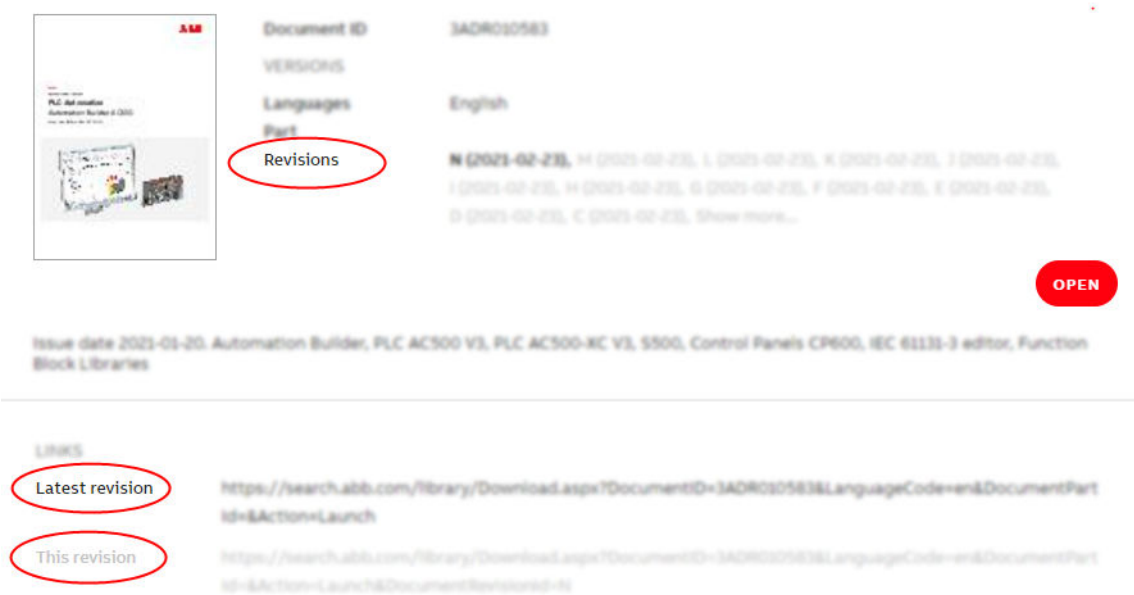
To avoid such risks and the occurrence of property damage, persons involved in the installation, commissioning and maintenance must have relevant knowledge about:

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

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

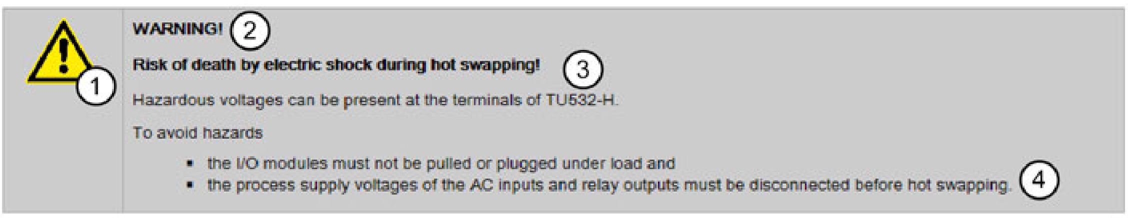
☑ Documentation is opened in a PDF reader. PDF readers often provide a button to synchronize with the table of contents. Usually, you can find the "magic button" in the bookmarks tab. For example, it looks like this: /

▷ 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

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.

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:

- Automation technology
- Handling of hazardous voltages
- Application of relevant standards and regulations, 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.

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 10

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 you

– 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 are not present.

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

Conditions for hot swap

Hot swap
System requirements for hot swapping of I/O modules:

– *Types of terminal units that support hot swapping of I/O modules have the appendix TU5xx-**H**.*
– *I/O modules as of index F0.*

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 lithium batteries. Attempting to charge lithium batteries 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 lithium batteries with the polarities reversed. The batteries are likely to overheat and explode. Avoid unintentional short circuiting do not store 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 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 35*.

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.

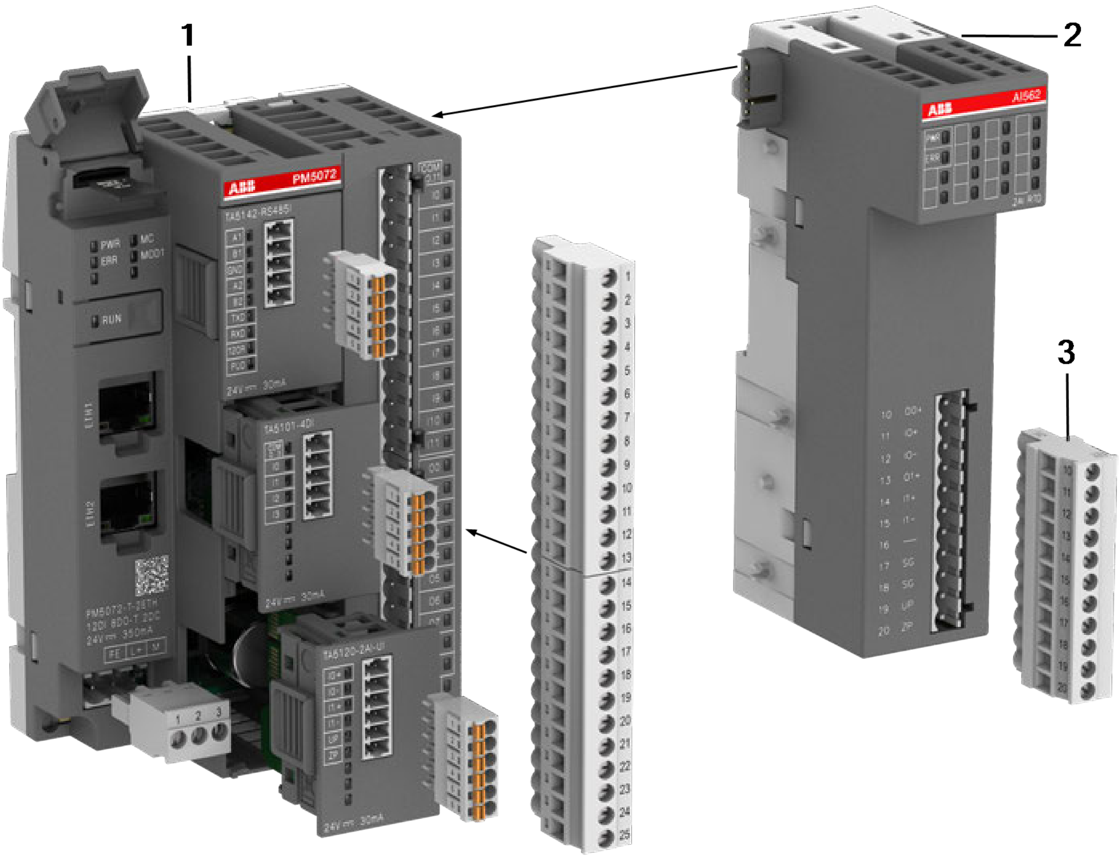
3.1 AC500-eCo/S500-eCo system structure

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.

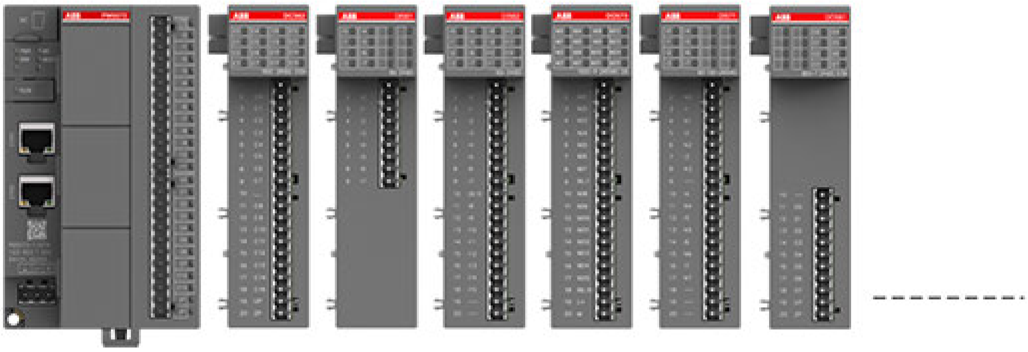


Fig. 3: I/O modules (S500-eCo) directly connected to an AC500-eCo processor module

Decentralized I/O extension

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

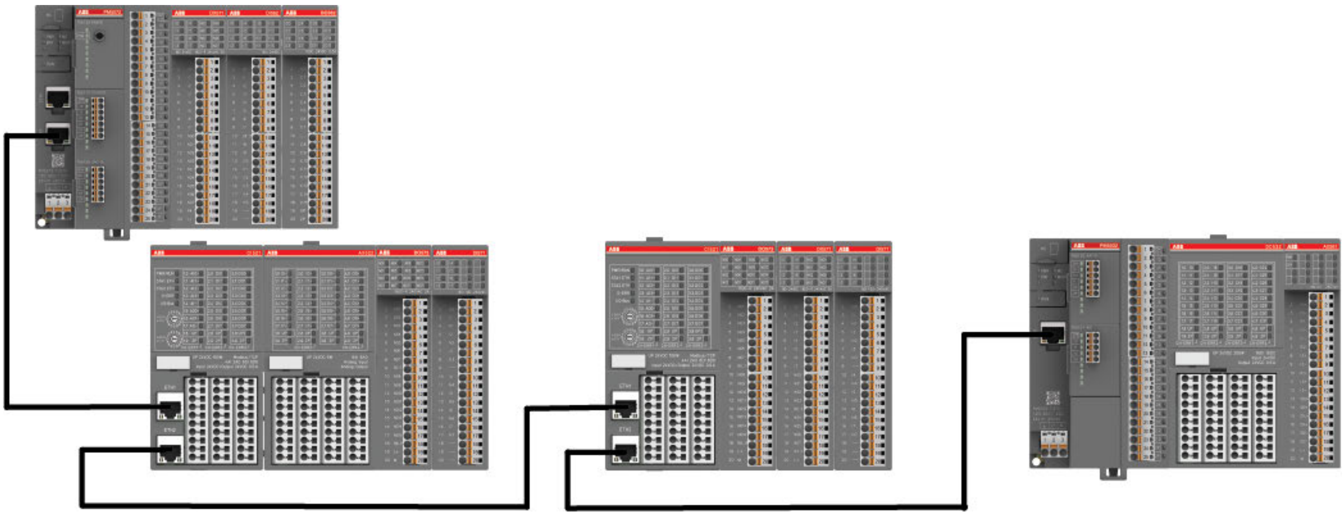
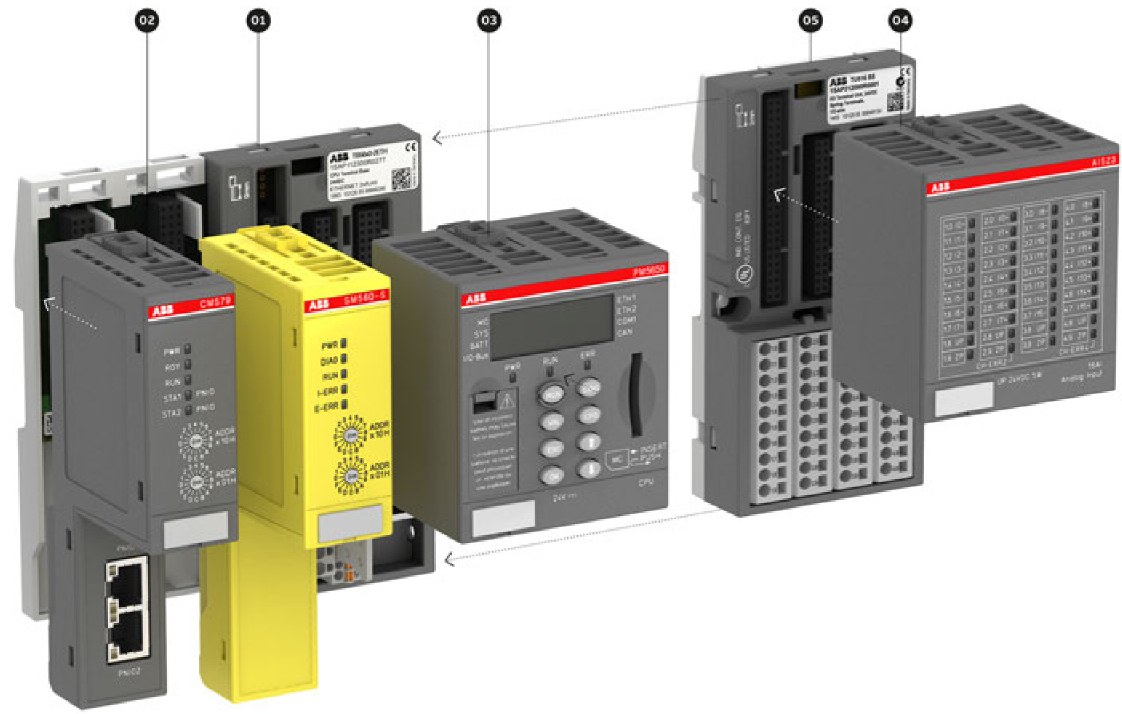


Fig. 4: I/O modules (S500-eCo) connected to an AC500-eCo processor module via Modbus/TCP network, using a Modbus/TCP communication interface module or a processor module as client.

3.2 AC500/S500 system structure

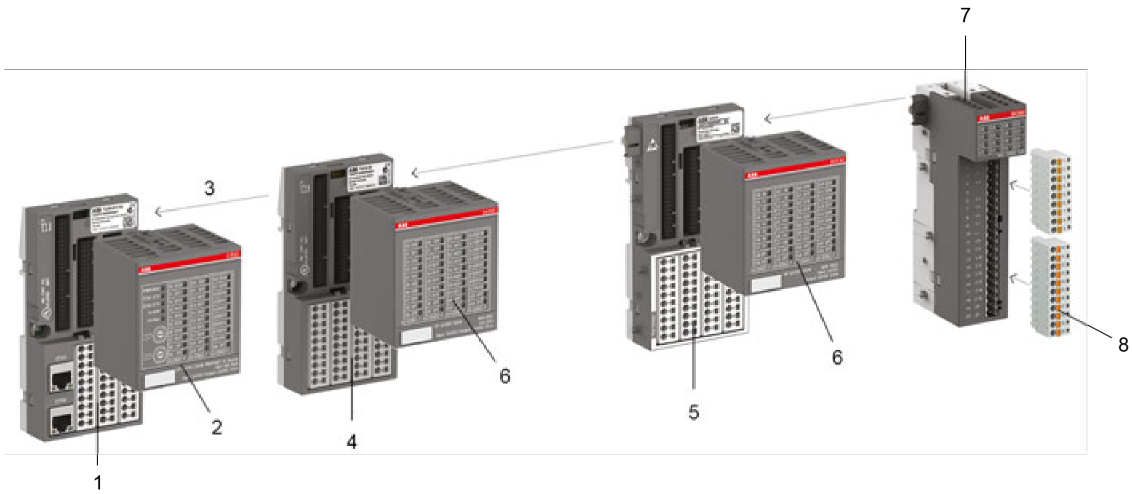
The AC500 product family provides a variety of modules and pluggable components for expanding the capabilities of the processor module with additional I/Os or other communication protocols. Depending on the features and functions of the processor module (CPU) compatible components can be added to a complete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

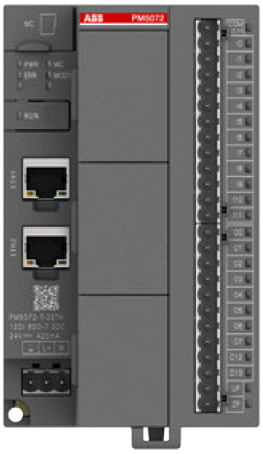
Decentralized I/O extension



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.

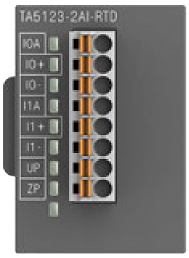
Functions:

- To download user programs
- To run the CPU
- To execute user programs in loops
- To monitor program input and 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.

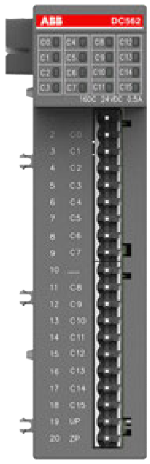
Option boards



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 module. The option board modules provide the following functionality for processor module extension:

- Serial interface RS232 (isolated) or RS485 (isolated or not 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 and PM5082

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:
  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.

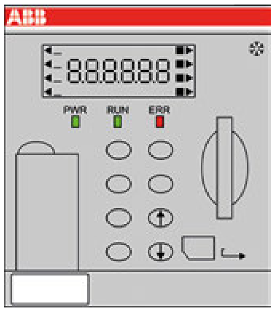
Power supply

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.

It has the following functions:

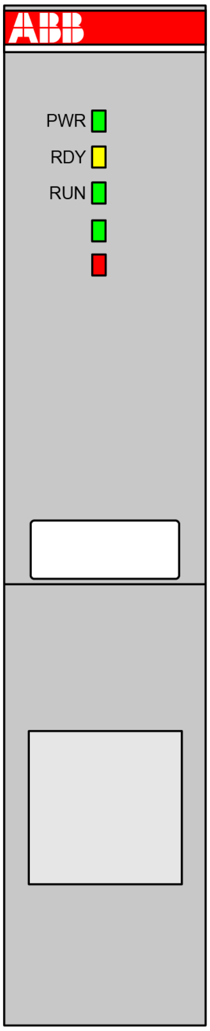
- To receive user programs and data entered
- To diagnose work faults of the power supply and PLC circuit as well as syntax errors in programming
- To receive the state or data of the site via the input interface and save it into the shadow register or data register
- To read the user programs in the 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



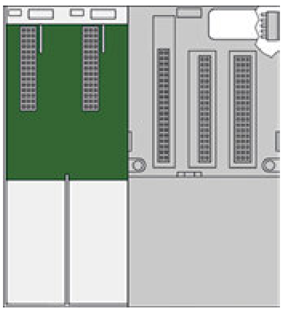
AC500 communication modules are required for

- a connection to standard fieldbus systems and
- for integration into existing networks.

AC500 communication modules

- enable communication on different fieldbuses.
- are mounted on the left side of the processor module on the same terminal base.
- are directly powered via the internal communication module bus of the terminal base. A separate voltage source is not required.

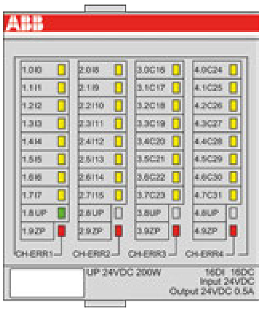
Terminal bases



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

> *On AC500-eCo processor modules and special AC500 (Standard) processor modules the terminal base cannot be removed.*

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.

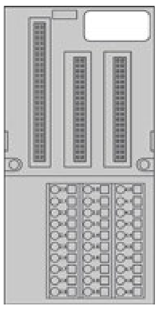
External input equipment and output equipment needs various signal levels whereas the information processed by the processor module in the PLC can only be the standard level. In order to perform this conversion, the I/O interface generally uses optical isolation and filtering to improve the interference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

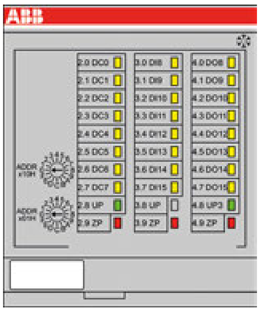
Terminal units



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:
  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 operation of the PLC 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 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.

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		
	Voltage	100 V (-15 %, +10 %)
	Frequency	50/60 Hz (-6 %, +4 %)
230 V AC		
	Voltage	230 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 23

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

– AC voltage above 264 V
– Frenquency 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.

CPUs

Table 2: Temperature ranges for processor modules revision 0

<table>
<tr><th colspan="3" rowspan="2">Parameter</th><th colspan="3">Value</th></tr>
<tr><th>PM5012-x-ETH</th><th>PM5032-x-ETH, PM5052-x-ETH, PM5072-T-2ETH</th><th>PM5072-T-2ETHW</th></tr>
<tr><td colspan="6">Temperature</td></tr>
<tr><td rowspan="5"></td><td colspan="5">Operating</td></tr>
<tr><td rowspan="2"></td><td>Horizontal mounting</td><td>0 °C ... +55 °C</td><td>0 °C ... +60 °C</td><td>-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.</td></tr>
<tr><td>Vertical mounting
(output load reduced to 50 % per group)</td><td colspan="2">0 °C ... +40 °C</td><td>-20 °C ... +40 °C</td></tr>
<tr><td colspan="2">Storage</td><td colspan="3">-40 °C ... +70 °C</td></tr>
<tr><td colspan="2">Transport</td><td colspan="3">-40 °C ... +70 °C</td></tr>
<tr><td colspan="3">Humidity</td><td colspan="3">Max. 95 %, without condensation</td></tr>
<tr><td colspan="6">Air pressure</td></tr>
<tr><td rowspan="2"></td><td colspan="2">Operating</td><td colspan="3">> 800 hPa / < 2000 m</td></tr>
<tr><td colspan="2">Storage</td><td colspan="3">> 660 hPa / < 3500 m</td></tr>
</table>

Table 3: Temperature ranges for processor modules revision 1

<table>
<tr><th colspan="2" rowspan="2">Parameter</th><th colspan="3">Value</th></tr>
<tr><th>PM5012-x-ETH</th><th>PM5032-x-ETH, PM5052-x-ETH, PM5072-T-2ETH, PM5082-T-2ETH</th><th>PM5072-T-2ETHW</th></tr>
<tr><td colspan="5">Temperature</td></tr>
<tr><td></td><td colspan="4">Operating</td></tr>
</table>

Parameter	Value		
	PM5012-x-ETH	**PM5032-x-ETH, PM5052-x-ETH, PM5072-T-2ETH, PM5082-T-2ETH**	**PM5072-T-2ETHW**
Horizontal mounting	0 °C ... +55 °C	-20 °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	-20 °C ... +40 °C
Storage	-40 °C ... +70 °C		
Transport	-40 °C ... +70 °C		
Humidity	Max. 95 %, without condensation		
	-		Simple coating for accidental condensation
Air pressure			
Operating	> 800 hPa / < 2000 m		
Storage	> 660 hPa / < 3500 m		

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 TA5105-4DOT TA5110-2DI2DOT	Not relevant	PM5012-x-ETH	0 °C ... +55 °C	**No derating**
		PM50x2-x-ETH PM5072-T-2ETH	0 °C ... +60 °C	**No derating**
Analog input option boards				
TA5120-2AI-UI TA5123-2AI-RTD	Not relevant	PM5012-x-ETH	0 °C ... +55 °C	**No derating**
		PM50x2-x-ETH PM5072-T-2ETH	0 °C ... +60 °C	**No derating**
Analog output option boards				
TA5126-2AO-UI	0 V ... +10 V	PM5012-T-ETH PM50x2-R-ETH	0 °C ... +55 °C	**No derating**
		PM50x2-T-ETH PM5072-T-2ETH	0 °C ... +60 °C	**No derating**
	0 mA ... +20 mA	PM50x2-x-ETH PM5072-T-2ETH	0 °C ... +45 °C	**No derating** Load: 0 Ω ... 500 Ω

Option boards	Configuration	Processor modules	Operating tem-perature ranges	Derating
			+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 TA5142-RS485I TA5142-RS485	Not relevant	PM5012-x-ETH	0 °C ... +55 °C	**No derating**
		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 tem-perature ranges	Derating
Digital I/O option boards				
TA5101-4DI TA5105-4DOT TA5110-2DI2DOT	Not relevant	PM5012-x-ETH	0 °C ... +55 °C	**No derating**
		PM50x2-x-ETH PM50x2-T-2ETH	-20 °C ... +60 °C	**No derating**
Analog input option boards				
TA5120-2AI-UI TA5123-2AI-RTD	Not relevant	PM5012-x-ETH	0 °C ... +55 °C	**No derating**
		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
		PM50x2-x-ETH PM50x2-T-2ETH	+50 °C ... +55 °C	**100 %** Load: 500 Ω
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				

Option boards	Configuration	Processor modules	Operating temperature ranges	Derating
TA5141-RS232I TA5142-RS485I TA5142-RS485	Not relevant	PM5012-x-ETH	0 °C ... +55 °C	**No derating**
		PM50x2-x-ETH PM50x2-T-2ETH	-20 °C ... +60 °C	**No derating**

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	-20 °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	-20 °C ... +60 °C	**No derating**
Analog output option boards				
TA5126-2AO-UIW	0 V ... +10 V	PM5072-T-2ETHW	-20 °C ... +60 °C	**No derating**
	0 mA ... +20 mA	PM5072-T-2ETHW	-20 °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-KNXPBW	Not relevant	PM5072-T-2ETHW	-20 °C ... 70 °C	**No derating**
Option boards for serial interface				
TA5141-RS232IW TA5142-RS485IW TA5142-RS485W	Not relevant	PM5072-T-2ETHW	-20 °C ... +70 °C	**No derating**

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

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 7: Range of use

Application
Device suitable only as *Control Equipment for Industrial Applications*.

Immunity against electrostatic discharge (ESD):		**According to IEC 61000-4-2, zone B, criterion B**
	Electrostatic voltage in case of air discharge	8 kV
	Electrostatic voltage in case of contact discharge	6 kV
	ESD with communication connectors	In order to prevent operating malfunctions, it is recommended, that the operating personnel discharge themselves prior to touching communication connectors or perform other suitable measures to reduce effects of electrostatic discharges.
Immunity against the influence of radiated (CW radiated):		According to IEC 61000-4-3, zone B, criterion A
	Test field strength	10 V/m
Immunity against transient interference voltages (burst):		According to IEC 61000-4-4, zone B, criterion B
	Power supply (DC)	2 kV
	Digital inputs/outputs (24 V DC)	1 kV
	Digital inputs/outputs (100 V AC ... 240 V AC)	Relay 2 kV
	Ethernet	1 kV
	Serial interfaces	1 kV

Immunity against electrostatic discharge (ESD):		**According to IEC 61000-4-2, zone B, criterion B**
Immunity against the influence of line-conducted interferences (CW conducted):		According to IEC 61000-4-6, zone B, criterion A
Test voltage		10 V pass A
High energy surges		According to IEC 61000-4-5, zone B, criterion B
	Power supply (DC)	1 kV CM / 0.5 kV DM [1])
	DC I/O supply	1 kV CM / 0.5 kV DM [1])
	Ethernet	1 kV CM [1])
	Serial interfaces	1 kV CM [1])
	AC I/O unshielded	2 kV CM, 1 kV DM [1])
	I/O analog, I/O DC unshielded	1 kV CM [1])
Radiation (radio disturbance)		According to IEC 55011, group 1, class A

[1]) CM = Common Mode, DM = Differential Mode

4.1.5 Mechanical data

Parameter	**Value**
Mounting	Horizontal
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 V0 according to UL 94
Vibration resistance acc. to EN 61131-2	all three axes (DIN rail mounting) 5 Hz ... 8.2 Hz: ± 7.5 mm peak 8.2 Hz...150 Hz: 2 g peak
Shock test	All three axes 15 g, 11 ms, half-sinusoidal
Mounting of the modules:	
DIN rail according to DIN EN 50022	35 mm, depth 7.5 mm or 15 mm
Mounting with screws	M3
Fastening torque	1.2 Nm

4.1.6 Approvals and certifications

Information on approvals and certificates can be found in the PLC Automation *catalog*, in the table "Certifications" in the chapter "Additional information".

4.2 System data AC500

4.2.1 Environmental conditions

Table 8: Process and supply voltages

Parameter		Value
24 V DC		
	Voltage	24 V (-15 %, +20 %)
	Protection against reverse polarity	Yes
120 V AC		
	Voltage	120 V (-15 %, +10 %)
	Frequency	50/60 Hz (-6 %, +4 %)
230 V AC		
	Voltage	230 V AC (-15 %, +10 %)
	Frequency	50/60 Hz (-6 %, +4 %)
120 V AC...240 V AC wide-range supply		
	Voltage	120 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 30* 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
– Frenquency 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 Insulation test voltages, routine test

According to EN 61131-2

Parameter	Value	
230 V circuits against other circuitry	2500 V	1.2/50 µs
120 V circuits against other circuitry	1500 V	1.2/50 µs
120 V ... 240 V circuits against other circuitry	2500 V	1.2/50 µs
24 V circuits (supply, 24 V inputs/outputs, analog inputs/ outputs), if they are galvanically isolated against other circuitry	500 V	1.2/50 µs
COM interfaces, galvanically isolated	500 V	1.2/50 µs
Ethernet	500 V	1.2/50 µs
230 V circuits against other circuitry	1350 V	AC 2 s
120 V circuits against other circuitry	820 V	AC 2 s
120 V ... 240 V circuits against other circuitry	1350 V	AC 2 s

Parameter	Value	
24 V circuits (supply, 24 V inputs/outputs, analog inputs/outputs), if they are galvanically isolated against other circuitry	350 V	AC 2 s
COM interfaces, galvanically isolated	350 V	AC 2 s
Ethernet	350 V	AC 2 s

According to IEC 61010-2-201

The content of the following table is only valid for PM56xx, CM56xx and TB56xx.

Table 9: Insulation, test voltages and continuous voltages

	Insulation	Test Voltage	Continuous Voltage
COM interfaces, galvanically isolated	1.1 mm	1216 V DC (60 s) 1500 V (1.2/50µs)	75 V
CAN interface, galvanically isolated	1.1 mm	1216 V DC (60 s) 1500 V (1.2/50µs)	75 V
Ethernet	1.1 mm	1500 V rms (50-60 Hz, 60 s) 2400 V (1.2/50µs)	On request

4.2.4 Power supply units

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.

4.2.5 Electromagnetic compatibility

Table 10: Range of use

Application
Device suitable only as *Control Equipment for Industrial Applications*.

Table 11: Immunity against electrostatic discharge (ESD), according to IEC 61000-4-2, zone B, criterion B

Parameter	Value
Electrostatic voltage in case of air discharge	8 kV
Electrostatic voltage in case of contact discharge	4 kV, in a closed control cabinet 6 kV [1])
ESD with communication connectors	In order to prevent operating malfunctions, it is recommended, that the operating personnel discharge themselves prior to touching communication connectors or perform other suitable measures to reduce effects of electrostatic discharges.
ESD with connectors of terminal bases	The connectors between the terminal bases and processor modules or communication modules must not be touched during operation. The same is valid for the I/O bus with all modules involved.

[1]) High requirement for shipping classes are achieved with additional specific measures (see specific documentation).

Table 12: Immunity against the influence of radiated (CW radiated), according to IEC 61000-4-3, zone B, criterion A

Parameter	Value
Test field strength	10 V/m

Table 13: Immunity against fast transient interference voltages (burst), according to IEC 61000-4-4, zone B, criterion B

Parameter	Value
Power supply (DC)	2 kV
Power supply (AC)	2 kV
Digital inputs/outputs (24 V DC)	1 kV
Digital inputs/outputs (120 V AC ... 240 V AC)	2 kV
Analog inputs/outputs	1 kV
CS31 bus	1 kV
Serial RS-485 interfaces (COM)	1 kV
Serial RS-232 interfaces (COM)	1 kV
Ethernet	1 kV
I/O supply (DC-out)	1 kV

Table 14: Immunity against the influence of line-conducted interferences (CW conducted), according to IEC 61000-4-6, zone B, criterion A

Parameter		Value
Test voltage		3V zone B, 10 V is also met.
High energy surges		According to IEC 61000-4-5, zone B, criterion B
	Power supply (DC)	1 kV CM / 0.5 kV DM [2])
	DC I/O supply	0.5 kV CM / 0.5 kV DM [2])
	Communication Lines, shielded	1 kV CM [2])
	AC I/O unshielded [3])	2 kV CM / 1 kV DM [2])
	I/O analog, I/O DC unshielded [3])	1 kV CM / 0.5 kV DM [2])
Radiation (radio disturbance)		According to IEC 55011, group 1, class A

[2]) CM = Common Mode, DM = Differential Mode

[3]) When DC I/O inputs are used with AC voltage, external filters limiting high energy surges to 1 kV CM / 0.5 DM are required to meet requirements according IEC 61131-2.

4.2.6 Mechanical data

Parameter	Value
Mounting	Horizontal
Degree of protection	PLC system: IP 20 ● with all modules plugged in ● with all terminals plugged in ● with all covers closed
Housing	Classification V-2 according to UL 94
Vibration resistance acc. to EN 61131-2	all three axes 2 Hz ... 8.4 Hz, continuous 3.5 mm 8.4 Hz ... 150 Hz, continuous 1 g (higher values on request)

Parameter	Value
Shock test	All three axes 15 g, 11 ms, half-sinusoidal
Mounting of the modules:	
DIN rail according to DIN EN 50022	35 mm, depth 7.5 mm or 15 mm
Mounting with screws	Screws with a diameter of 4 mm
Fastening torque	1.2 Nm

4.2.7 Approvals and certifications

Information on approvals and certificates can be found in the PLC Automation *catalog*, in the table "Certifications" in the chapter "Additional information".

4.3 System data AC500-XC

Assembly, construction and connection of devices of the variant AC500-XC is identical to AC500 (standard).

Chapter 4.2 “System data AC500” on page 30

The following description provides information on general technical data of AC500-XC system.

4.3.1 Environmental conditions

Table 15: Process and supply voltages

Parameter		Value
24 V DC		
	Voltage	24 V (-15 %, +20 %)
	Protection against reverse polarity	Yes
120 V AC...240 V AC wide-range supply		
	Voltage	120 ... 240 V (-15 %, +10 %)
	Frequency	50/60 Hz (-6 %, +4 %)
Allowed interruptions of power supply		
	DC supply	Interruption < 10 ms, time between 2 interruptions > 1 s, PS2

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.

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

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

– AC voltage above 264 V
– Frenquency 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.

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

Parameter		Value
Temperature		
	Operating	-40 °C ... +70 °C -40 °C ... -30 °C: Proper start-up of system; technical data not guaranteed -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 max. 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

Parameter	Value
Humidity	Operating / Storage: 100 % r. H. with condensation
Air pressure	Operating: -1000 m .... 4000 m (1080 hPa ... 620 hPa) > 2000 m (< 795 hPa): ● max. operating temperature must be reduced by 10 K (e.g. 70 °C ... 60°C) ● I/O module relay contacts must be operated with 24 V nominal only
Immunity to corrosive gases	Operating: Yes, according to: ISA S71.04.1985 Harsh group A, G3/GX IEC 60721-3-3 3C2 / 3C3
Immunity to salt mist	Operating: 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 1191*.

Table 16: Electromagnetic compatibility

Parameter	Value
Device suitable only as *Control Equipment for Industial Applications*.	
Radiated emission (radio disturbances)	Yes, according to: CISPR 16-2-3
Conducted emission (radio disturbances)	Yes, according to: CISPR 16-2-1, CISPR 16-1-2
Electrostatic discharge (ESD)	Yes, according to: IEC 61000-4-2, zone B, criterion B
Fast transient interference voltages (burst)	Yes, according to: IEC 61000-4-4, zone B, criterion B
High energy transient interference voltages (surge)	Yes, according to: IEC 61000-4-5, zone B, criterion B
Influence of radiated disturbances	Yes, according to: IEC 61000-4-3, zone B, criterion A

Parameter	Value
Influence of line-conducted interferences	Yes, according to: IEC 61000-4-6, zone B, criterion A
Influence of power frequency magnetic fields	Yes, according to: IEC 61000-4-8, zone B, criterion A

In order to prevent malfunctions, it is recommended, that the operating personnel discharge themselves prior to touching communication connectors or perform other suitable measures to reduce effects of electrostatic discharges.

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 5.8.2.4 “TA524 - Dummy communication module” on page 1182*.
– I/O bus connectors must not be touched during operation.

4.3.2 Mechanical data

Parameter	Value
Wiring method	Spring terminals
Degree of protection	PLC system: IP 20 ● with all modules plugged in ● with all terminals plugged in ● with all covers closed
Vibration resistance	Yes, according to: IEC 61131-2 IEC 60068-2-6 IEC 60068-2-64
Shock resistance	Yes, according to: IEC 60068-2-27
Assembly position	Horizontal Vertical (no application in salt mist environment)
Assembly on DIN rail	
DIN rail type	According to IEC 60715 35 mm, depth 7.5 mm or 15 mm
Assembly with screws	
Screw diameter	4 mm
Fastening torque	1.2 Nm

4.3.3 Environmental tests

Parameter	Value
Storage	IEC 60068-2-1 Test Ab: cold withstand test -40 °C / 16 h IEC 60068-2-2 Test Bb: dry heat withstand test +85 °C / 16 h
Humidity	IEC 60068-2-30 Test Db: Cyclic (12 h / 12 h) damp-heat test 55 °C, 93 % r. H. / 25 °C, 95 % r. H., 6 cycles IEC 60068-2-78, stationary humidity test: 40 °C, 93 % r. H., 240 h
Insulation Test	IEC 61131-2
Vibration resistance	IEC 61131-2 / IEC 60068-26: 5 Hz ... 500 Hz, 2 g (with memory card inserted) IEC 60068-2-64: 5 Hz ... 500 Hz, 4 g rms
Shock resistance	IEC 60068-2-27: all 3 axes 15 g, 11 ms, half-sinusoidal

Table 17: EMC immunity

Parameter	Value
Electrostatic discharge (ESD)	Electrostatic voltage in case of air discharge: 8 kV Electrostatic voltage in case of contact discharge: 6 kV
Fast transient interference voltages (burst)	Power supply (DC): 4 kV Digital inputs/outputs (24 V DC): 2 kV Analog inputs/outputs: 2 kV Communication lines shielded: 2 kV I/O supply (DC-out): 2 kV
High energy transient interference voltages (surge)	Power supply (DC): 1 kV CM *) / 0.5 kV DM *) Digital inputs/outputs (24 V DC): 1 kV CM *) / 0.5 kV DM *) Digital inputs/outputs (AC): 4 kV Analog inputs/outputs: 1 kV CM *) / 0.5 kV DM *) Communication lines shielded: 1 kV CM)* I/O supply (DC-out): 0,5 kV CM *) / 0.5 kV DM *)
Influence of radiated disturbances	Test field strength: 10 V/m
Influence of line-conducted interferences	Test voltage: 10 V
Power frequency magnetic fields	30 A/m 50 Hz 30 A/m 60 Hz

*) CM = Common Mode, * DM = Differential Mode

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.

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 PM50x2

Table 18: AC500-eCo V3 CPUs 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
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

Processor modules	Total maximum downloadable application size	Configurable input/output	Digital inputs	Digital outputs	Power supply	Ethernet interfaces	Option board slots
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
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

*) W = wide temperature range

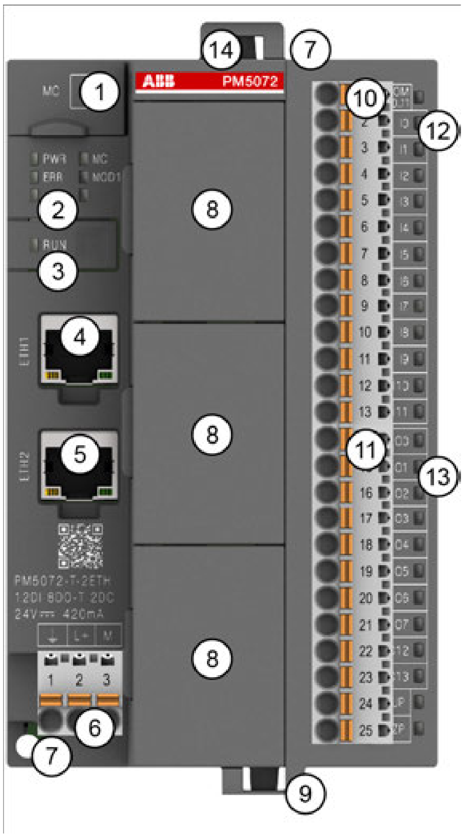


Fig. 5: Example: PM5072-T-2ETH

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.

5.1.1.1.1 Short description

The processor modules PM50x2 series are the central units of AC500-eCo V3 PLC. Their main characteristics are:

- 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 54*.

5.1.1.1.2 Assortment

Detailed data

Parameter		Value				
		PM5012	**PM5032**	**PM5052**	**PM5072**	**PM5082**
Total maximum downloadable application size [1)]		1 MB	5 MB	7 MB	9 MB	9 MB
	Thereof user program code / data memory dynamically allocated	256 KB	512 KB	768 KB	1 MB	1 MB
	Thereof user web server memory for web visualization max.	no web	1.5 MB	3.2 MB	7 MB	7 MB
	Flash memory for user data					
	Remaining for all other usage (project save, infra- struc-ture...)	30 MB	30 MB	30 MB	30 MB	30 MB
	Buffered (FRAM)	8 KB	32 KB	32 KB	100 KB	100 KB
	VAR_RETAIN persistent	4 KB	16 KB	16 KB	36 KB	36 KB
	%MB data	4 KB	16 KB	16 KB	64 KB	64 KB
Expandable memory		None	None	None	None	None

Parameter		**Value**				
		PM5012	**PM5032**	**PM5052**	**PM5072**	**PM5082**
Integrated mass storage memory (FLASH)		None	None	None	None	None
Slot for pluggable memory card		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
Calculation time per instructions (minimum)		PM5012	PM5032	PM5052	PM5072	PM5082
	Binary	20 ns				10 ns
	Word	50 ns				10 ns
	Floating point	600 ns				10 ns
	Lowest cycle time usable (also f. PTO)	-	5	2	1	1
Using onboard EtherCAT protocol (licensed) in preparation						
EtherCAT onboard No. of synchronized axis		PM5012	PM5032	PM5052	PM5072	PM5082
	axis per 1 ms CM typically	-	-	-	-	2 - 4*
	axis per 2 msCM typically	-	-	-	2 - 4*	4 - 8*
	axis per 4 ms CM typically	-	-	-	4 - 8*	8 - 16
	Cyclic min. configurable	10 ms	5 ms	2 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 [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
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 counter 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
	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/2-4 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				
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

Data of I/Os	PM5012-x-ETH	PM5032-x-ETH	PM5052-x-ETH	PM5072-T-2ETH(W)	PM5082-T-2ETH
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				
Digital in/out channels	TA5101-4DI, TA5105-4DOT, TA5110-2DI2DOT				
Analog in/out channels	TA5120-2AI-UI, TA5123-2AI-RTD, TA5126-2AO-UI				
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 30 / 15
SNTP client/server	No	Yes			
HTTPs and WebVisu number of connections	No	Yes 1	Yes 2	Yes 4	Yes 4
FTPs number of connections	No	Yes 1	Yes 2	Yes 2	Yes 2

Data of I/Os	PM5012-x-ETH	PM5032-x-ETH	PM5052-x-ETH	PM5072-T-2ETH(W)	PM5082-T-2ETH
OPC UA server number of free tags	No	Yes 125	Yes 250	Yes 1000	Yes 3000
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	
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			

5.1.1.1.3 Connections and interfaces

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 86

Serial interface

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

- TA5141-RS232I (isolated)
  Chapter 5.1.1.3.9 “TA5141-RS232I - Option board for COMx serial communication” on page 151

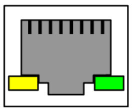
RS-485 communication interface is available by using option boards:

- TA5142-RS485I (isolated)
  Chapter 5.1.1.3.10 "TA5142-RS485I - Option board for COMx serial communication" on page 155
- TA5142-RS485 (non isolated)
  Chapter 5.1.1.3.11 "TA5142-RS485 - Option board for COMx serial communication" on page 162

Ethernet interface

The Ethernet interface is carried out via a RJ45 jack.

Table 19: Pin assignment of the Ethernet interface

Interface	Pin	Description	
1 8 	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 64*.

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 20: 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

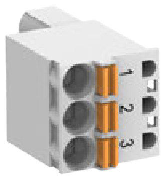
Parameter	Value
Data transmission speed	From 9,600 bits/s to 115,200 bits/s
Encoding	1 start bit 8 data bits 1 or 2 stop bits 1 parity bit
Max. cable length for RS-485 on serial interface option board used on the CPU.	1.200 m at 19.200 baud

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 21: Removable terminal block for the supply voltage 24 V DC

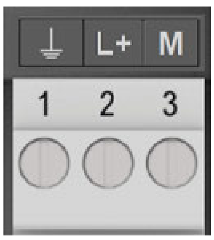
3-pin spring terminal block	3-pin screw terminal block
	

The terminal block is available as a set for AC500-eCo V3 processor modules.

Basic CPU (PM5012)		Standard CPUs (PM5032, PM5052) and Pro CPUs (PM5072, PM5082)	
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 23*

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
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	-

LED	State	Color	LED = ON	LED = OFF	LED flashing
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.
					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 AC500-eCo V3 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 AC500 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) 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

Processor module	LED	State	Color	LED = ON	LED = 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 configu-rable input/ output	Yellow	Input/Output is ON	Input/Output is OFF
PM5072-T-2ETH(W) PM5082-T-2ETH	I0 ... I11	Digital input	Yellow	Input is ON	Input is OFF
	O0 ...O7	Transistor output	Yellow	Output is ON	Output is OFF
	C12, C13	Digital configu-rable input/ output	Yellow	Input/Output is ON	Input/Output is OFF

Ethernet state LEDs

Table 22: 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 func-tioning without problems, but the error-free processing of the user program is no longer guaranteed.	Checksum error in the user Flash, 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 deter-mine which reaction is necessary.	Flash could not be pro-grammed, 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 deter-mine 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 of AC500-eCo V3 apply *Chapter 4.1 “System data AC500-eCo” on page 23* Only additional details are therefore documented below.

General data

Parameter		Value				
		PM5012	PM5032	PM5052	PM5072	PM5082
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
	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
	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
	Relay version	235 g	268 g	273 g		
Mounting position		Horizontal or vertical				

Detailed data

Parameter		Value				
		PM5012	PM5032	PM5052	PM5072	PM5082
Total maximum downloadable application size 1)		1 MB	5 MB	7 MB	9 MB	9 MB
	Thereof user program code / data memory dynamically allocated	256 KB	512 KB	768 KB	1 MB	1 MB
	Thereof user web server memory for web visualization max.	no web	1.5 MB	3.2 MB	7 MB	7 MB
	Flash memory for user data					
	Remaining for all other usage (project save, infra- struc- ture...)	30 MB	30 MB	30 MB	30 MB	30 MB
	Buffered (FRAM)	8 KB	32 KB	32 KB	100 KB	100 KB
	VAR_RETAIN persistent	4 KB	16 KB	16 KB	36 KB	36 KB
	%MB data	4 KB	16 KB	16 KB	64 KB	64 KB
Expandable memory		None	None	None	None	None
Integrated mass storage memory (FLASH)		None	None	None	None	None
Slot for pluggable memory card		x	x	x	x	x

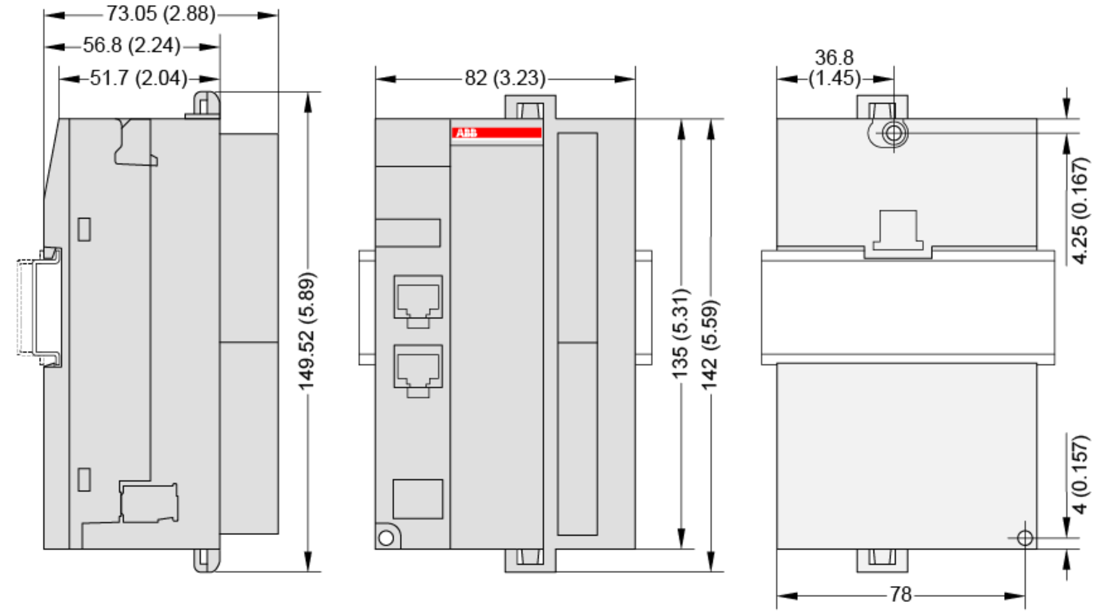
Parameter		Value				
		PM5012	**PM5032**	**PM5052**	**PM5072**	**PM5082**
Real-time clock (RTC)		Optional with TA5131-RTC	Built in			
Min. retention time for RTC at room temperature (if at least powered for 8 hours)		7 days	20 days			
	Accuracy	±2 s/day				
Programming languages		● Instruction List (IL) ● 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
Calculation time per instructions (minimum)		PM5012	PM5032	PM5052	PM5072	PM5082
	Binary	20 ns				10 ns
	Word	50 ns				10 ns
	Floating point	600 ns				10 ns
	Lowest cycle time usable (also f. PTO)	-	5	2	1	1
Using onboard EtherCAT protocol (licensed) in preparation						
EtherCAT onboard No. of synchronized axis		PM5012	PM5032	PM5052	PM5072	PM5082
	axis per 1 ms CM typically	-	-	-	-	2 - 4*
	axis per 2 msCM typically	-	-	-	2 - 4*	4 - 8*
	axis per 4 ms CM typically	-	-	-	4 - 8*	8 - 16
	Cyclic min. configurable	10 ms	5 ms	2 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 [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
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 counter 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
	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/2-4 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				
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

Data of I/Os	PM5012-x-ETH	PM5032-x-ETH	PM5052-x-ETH	PM5072-T-2ETH(W)	PM5082-T-2ETH
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				
Digital in/out channels	TA5101-4DI, TA5105-4DOT, TA5110-2DI2DOT				
Analog in/out channels	TA5120-2AI-UI, TA5123-2AI-RTD, TA5126-2AO-UI				
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 30 / 15
SNTP client/server	No	Yes			
HTTPs and WebVisu number of connections	No	Yes 1	Yes 2	Yes 4	Yes 4
FTPs number of connections	No	Yes 1	Yes 2	Yes 2	Yes 2

Data of I/Os	**PM5012-x-ETH**	**PM5032-x-ETH**	**PM5052-x-ETH**	**PM5072-T-2ETH(W)**	**PM5082-T-2ETH**
OPC UA server number of free tags	No	Yes 125	Yes 250	Yes 1000	Yes 3000
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	
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			

5.1.1.1.8 Dimensions



The dimensions are in mm and in brackets in inch.

5.1.1.1.9 Ordering Data

Processor modules for AC500-eCo V3 products

To enable better product availability into the production and to provide some new features, a revision of the existing AC500-eCo V3 processor module was necessary. The existing AC500-eCo V3 processor module with rubric **R007x** will move to classic and will be replaced by compatible new AC500-eCo V3 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 23: Processor modules for AC500-eCo V3

Part no.	Description	Product life cycle phase *)
1SAP 122 600 R0072 (processor module revision 0)	Basic CPU PM5012-T-ETH, AC500-eCo V3 processor module, programmable logic controller 1 MB, 6DI/4DO-Transistor, Ethernet, 24 V DC, 1 option board slot	Active -> Classic in 2024 (replaced by processor module revision 1)
1SAP 122 600 **R0172** (processor module revision 1)	Basic CPU PM5012-T-ETH, AC500-eCo V3 processor module, programmable logic controller 1 MB, 6DI/4DO-Transistor, Ethernet, 24 V DC, 1 option board slot	In preparation
1SAP 122 700 R0072 (processor module revision 0)	Basic CPU PM5012-R-ETH, AC500-eCo V3 processor module, programmable logic controller 1 MB, 6DI/4DO-Relay, Ethernet, 24 V DC, 1 option board slot	Active -> Classic in 2024 (replaced by processor module revision 1)
1SAP 122 700 **R0172** (processor module revision 1)	Basic CPU PM5012-R-ETH, AC500-eCo V3 processor module, programmable logic controller 1 MB, 6DI/4DO-Relay, Ethernet, 24 V DC, 1 option board slot	In preparation
1SAP 123 400 R0072 (processor module revision 0)	Standard CPU PM5032-T-ETH, AC500-eCo V3 processor module, programmable logic controller 2 MB, 12DI/8DO-Transistor/2DC, Ethernet, 24 V DC, 2 option board slots	Active -> Classic in 2024 (replaced by processor module revision 1)
1SAP 123 400 **R0172** (processor module revision 1)	Standard CPU PM5032-T-ETH, AC500-eCo V3 processor module, programmable logic controller 2 MB, 12DI/8DO-Transistor/2DC, Ethernet, 24 V DC, 2 option board slots	In preparation
1SAP 123 500 R0072 (processor module revision 0)	Standard CPU PM5032-R-ETH, AC500-eCo V3 processor module, programmable logic controller 2 MB, 12DI/6DO-Relay/2DC, Ethernet, 24 V DC, 2 option board slots	Active -> Classic in 2024 (replaced by processor module revision 1)
1SAP 123 500 **R0172** (processor module revision 1)	Standard CPU PM5032-R-ETH, AC500-eCo V3 processor module, programmable logic controller 2 MB, 12DI/6DO-Relay/2DC, Ethernet, 24 V DC, 2 option board slots	In preparation

Part no.	Description	Product life cycle phase *)
1SAP 124 000 R0072 (processor module revision 0)	Standard CPU PM5052-T-ETH, AC500-eCo V3 processor module, programmable logic controller 4 MB, 12DI/8DO-Transistor/2DC, Ethernet, 24 V DC, 3 option board slots	Active -> Classic in 2024 (replaced by processor module revision 1)
1SAP 124 000 **R0172** (processor module revision 1)	Standard CPU PM5052-T-ETH, AC500-eCo V3 processor module, programmable logic controller 4 MB, 12DI/8DO-Transistor/2DC, Ethernet, 24 V DC, 3 option board slots	In preparation
1SAP 124 100 R0072 (processor module revision 0)	Standard CPU PM5052-R-ETH, AC500-eCo V3 processor module, programmable logic controller 4 MB, 12DI/6DO-Relay/2DC, Ethernet, 24 V DC, 3 option board slots	Active -> Classic in 2024 (replaced by processor module revision 1)
1SAP 124 100 **R0172** (processor module revision 1)	Standard CPU PM5052-R-ETH, AC500-eCo V3 processor module, programmable logic controller 4 MB, 12DI/6DO-Relay/2DC, Ethernet, 24 V DC, 3 option board slots	In preparation
1SAP 124 500 R0073 (processor module revision 0)	Pro CPU PM5072-T-2ETH, AC500-eCo V3 processor module, programmable logic controller 8 MB, 12DI/8DO-Transistor/2DC, 2 Ethernet, 24 V DC, 3 option board slots	Active -> Classic in 2024 (replaced by processor module revision 1)
1SAP 124 500 **R0173** (processor module revision 1)	Pro CPU PM5072-T-2ETH, AC500-eCo V3 processor module, programmable logic controller 8 MB, 12DI/8DO-Transistor/2DC, 2 Ethernet, 24 V DC, 3 option board slots	In preparation
1SAP 124 400 R0073 (processor module revision 0)	Pro CPU PM5072-T-2ETHW, AC500-eCo V3 processor module, programmable logic controller 8 MB, 12DI/8DO-Transistor/2DC, 2 Ethernet, 24 V DC, 3 option board slots, wide temperature	Active -> Classic in 2024 (replaced by processor module revision 1)
1SAP 124 400 **R0173** (processor module revision 1)	Pro CPU PM5072-T-2ETHW, AC500-eCo V3 processor module, programmable logic controller 8 MB, 12DI/8DO-Transistor/2DC, 2 Ethernet, 24 V DC, 3 option board slots, wide temperature	In preparation
1SAP 124 600 **R0173** (processor module revision 1)	Pro CPU PM5082-T-2ETH, AC500-eCo V3 processor module, programmable logic controller 8 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 24: Accessories for AC500-eCo V3

Part no.	Description	Product life cycle phase *)
Option boards ↳ *Chapter 5.1.1.3 “Option boards” on page 86*		
1SAP 187 000 R0001	TA5101-4DI, digital input option board, 4DI 24 V DC, spring/cable front terminal 3.50 mm pitch	Active
1SAP 187 000 R0201	TA5101-4DIW, digital input option board, 4DI 24 V DC, spring/cable front terminal 3.50 mm pitch, wide temperature range	Active
1SAP 187 000 R0002	TA5105-4DOT, 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, digital output option board, 4DO-T 24 V DC / 0.5 A, spring/cable front terminal 3.50 mm pitch, wide temperature range	Active
1SAP 187 000 R0003	TA5110-2DI2DOT, 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, 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
1SAP 187 100 R0001	TA5120-2AI-UI, 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, analog input option board, 2AI U/I, 12 bits, spring/cable front terminal 3.50 mm pitch, wide temperature range	Active
1SAP 187 100 R0002	TA5123-2AI-RTD, analog input option board, 2AI RTD, spring/cable front terminal 3.50 mm pitch	Active
1SAP 187 100 R0202	TA5123-2AI-RTW, analog input option board, 2AI RTD, spring/cable front terminal 3.50 mm pitch, wide temperature range	Active
1SAP 187 100 R0003	TA5126-2AO-UI, 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, analog output option board, 2AO U/I, 12 bits, spring/cable front terminal 3.50 mm pitch, wide temperature range	Active
1SAP 187 200 R0001	TA5130-KNXPB, option board KNX adress push button (only for PRO CPU)	Active
1SAP 187 200 R0201	TA5130-KNXPBW, option board KNX adress push button, wide temperature range (only for PRO CPU)	Active
1SAP 187 200 R0002	TA5131-RTC, real-time clock without battery (only for Basic CPU)	Active

Part no.	Description	Product life cycle phase *)
1SAP 187 300 R0001	TA5141-RS232I, RS-232 isolated option board for COMx serial communication, spring/cable front terminal 3.50 mm pitch	Active
1SAP 187 300 R0201	TA5141-RS232IW, RS-232 isolated option board for COMx serial communication, spring/cable front terminal 3.50 mm pitch, wide temperature range	Active
1SAP 187 300 R0002	TA5142-RS485I, RS-485 isolated option board for COMx serial communication, spring/cable front terminal 3.50 mm pitch	Active
1SAP 187 300 R0202	TA5142-RS485IW, RS-485 isolated option board for COMx serial communication, spring/cable front terminal 3.50 mm pitch, wide temperature range	Active
1SAP 187 300 R0003	TA5142-RS485, 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, RS-485 non isolated option board for COMx serial communication, spring/cable front terminal 3.50 mm pitch, wide temperature range	Active
Accessories *Chapter 5.8.1 “AC500-eCo” on page 1145*		
1SAP 187 400 R0001	TA5211-TSCL-B: screw terminal block set for AC500-eCo V3 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	Active
1SAP 187 400 R0002	TA5211-TSPF-B: spring terminal block set for AC500-eCo V3 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	Active
1SAP 187 400 R0004	TA5212-TSCL: screw terminal block set for AC500-eCo V3 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	Active

Part no.	Description	Product life cycle phase *)
1SAP 187 400 R0005	TA5212-TSPF: spring terminal block set for AC500-eCo V3 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	Active
1SAP 187 600 R0001	TA5400-SIM: input simulator (for CPU testing), 6 switches	Active
1SAP 180 100 R0002	MC5102 - Micro memory card with memory card adapter	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
Spare parts ⇘ *Chapter 5.8.1 "AC500-eCo" on page 1145*		
1SAP 187 400 R0012	TA5220-SPF5: spring terminal block, removable, 5-pin, spring front, cable front, 6 pieces per packing unit	Active
1SAP 187 400 R0013	TA5220-SPF6: spring terminal block, removable, 6-pin, spring front, cable front, 6 pieces per packing unit	Active
1SAP 187 400 R0014	TA5220-SPF7: spring terminal block, removable, 7-pin, spring front, cable front, 6 pieces per packing unit	Active
1SAP 187 400 R0015	TA5220-SPF8: spring terminal block, removable, 8-pin, spring front, cable front, 6 pieces per packing unit	Active
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.*

5.1.1.2 Onboard I/Os in processor module PM50x2

The AC500-eCo V3 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.

5.1.1.2.1 Functionality

<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</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 rowspan="3">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)
usable as
● 6 DI 24 V DC standard
● 2 channel 5 kHz encoder with frequency measurement or
● 2 channel 5 kHz encoder with frequency measurement and with touch/reset using standard DI or
● 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)
usable as
● 4 DI 24 V DC standard or
● 4 fast counter (100 kHz) or
● 2 A/B encoder (200 kHz) with frequency measurement or
● 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)
usable as
● 4 DI 24 V DC standard or
● 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**	**PM5032-R-ETH** **PM5052-R-ETH**
Functionality of digital outputs	**4 fast output DO-T** 24 V DC/0.5 A (max. 5 kHz) usable as ● 4 DO-T 24 V DC/0.5 A or ● 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) usable as ● 4 DO-T 24 V DC/0.5 A ● 4 limit/ switch outputs for encoder/ counter or ● 4 PWM (30 kHz, 2 µs accuracy and maximum duty 95 %) or ● 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**	**PM5032-R-ETH** **PM5052-R-ETH**
			4 fast output DO-T 24 V DC/0.5 A (5 kHz) (max. 5 kHz) usable as ● 4 DO-T 24 V DC/0.5 A ● 4 limit/ switch outputs for encoder/ counter or ● 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
Functionality of digital inputs/ outputs, configurable	-	-	**2 DC 24 V DC** ● 2 standard I/Os configurable	**2 DC 24 V DC** usable as ● 2 DC standard (DI 24 V DC or DO-T) or ● 2 PWM (30 kHz) or ● 1 PTO (200 kHz) as Pulse/Direction or CW/CCW
LED displays	For signal states			

Parameter	Value			
	PM5012-T-ETH	**PM5012-R-ETH**	**PM5032-T-ETH** **PM5052-T-ETH** **PM5072-T-2ETH(W)** **PM5082-T-2ETH**	**PM5032-R-ETH** **PM5052-R-ETH**
Internal power supply	Via processor module			
External power supply	Via UP and ZP terminal			

5.1.1.2.2 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.

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

– 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.

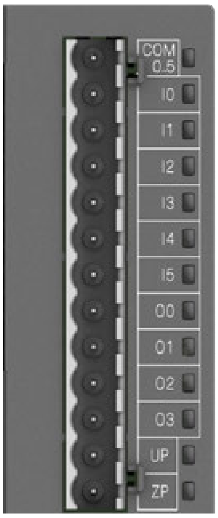


Table 25: Assignment of the terminals for PM5012-T-ETH:

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 26: 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
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

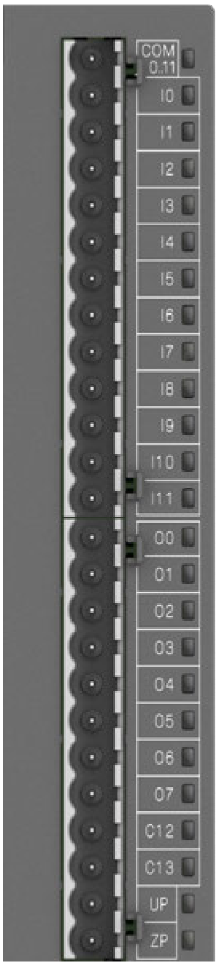


Table 27: Assignment of the terminals for PM5032-T-ETH, PM5052-T-ETH, PM5072-T-2ETH(W) and PM5082-T-2ETH:

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
24	UP	Process supply voltage UP +24 V DC
25	ZP	Process supply voltage ZP 0 V DC

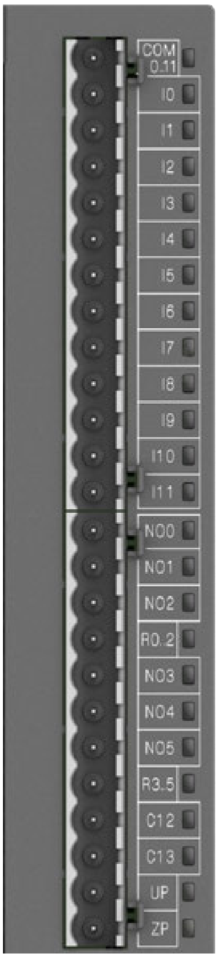
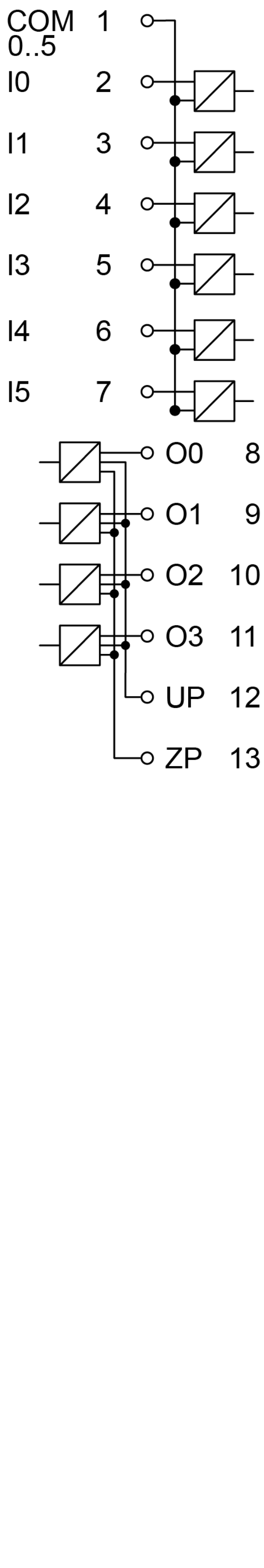


Table 28: Assignment of the terminals for PM5032-R-ETH and PM5052-R-ETH:

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 29: Internal structure of the onboard I/Os

<table>
<tr><th>PM5012-T-ETH</th><th>PM5012-R-ETH</th><th>PM5032-ETH
PM5052-T-ETH
PM5072-T-2ETH(W)
PM5082-T-2ETH</th><th>PM5032-R-ETH
PM5052-R-ETH</th></tr>
<tr><td>
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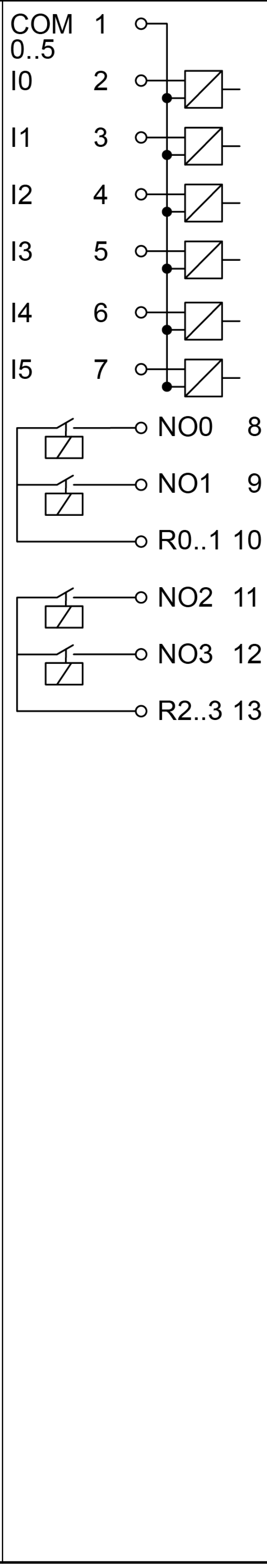
<td>
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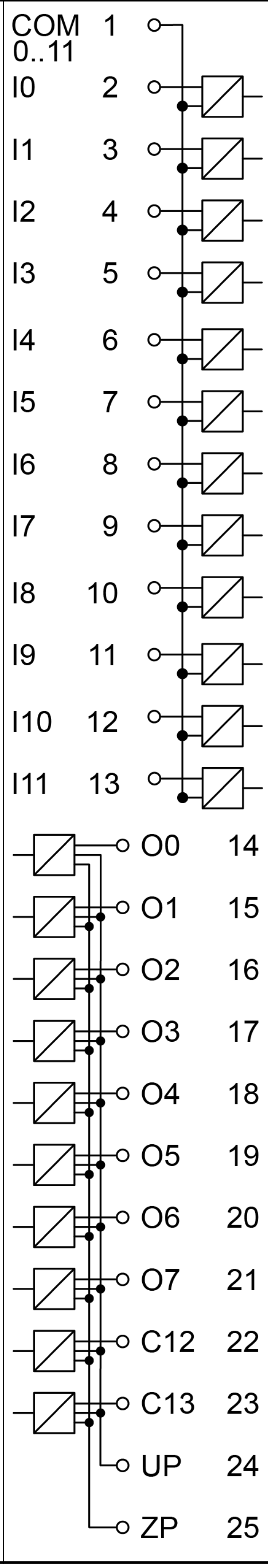
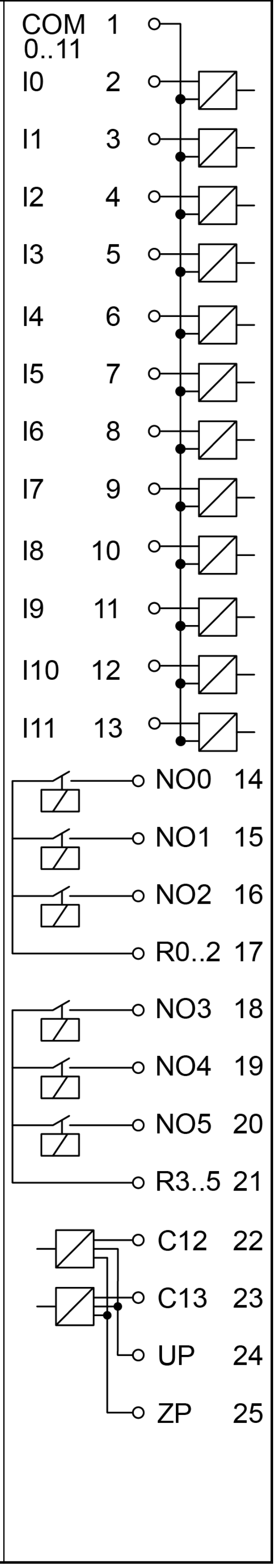
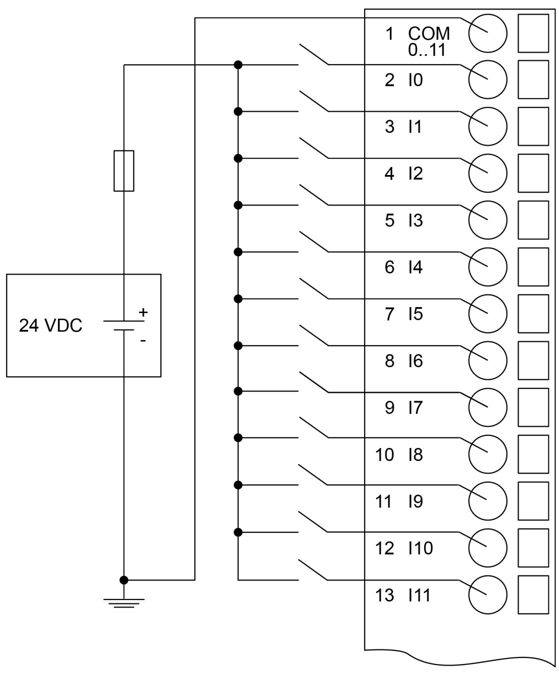
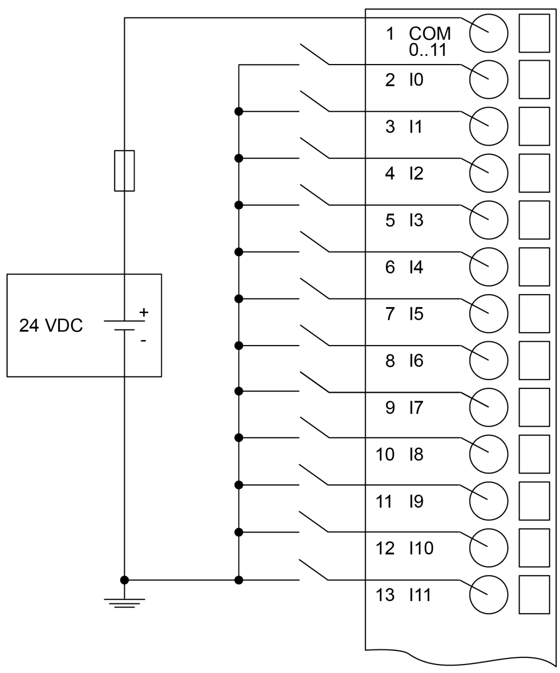
<td>
</td>
<td>
</td></tr>
</table>

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 30: Connection of the digital inputs to the PM50x2 processor modules

<table>
<tr>
<td>
</td>
<td>
</td>
</tr>
<tr>
<td>Connection of digital inputs (sink inputs)</td>
<td>Connection digital inputs (source inputs)</td>
</tr>
</table>

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

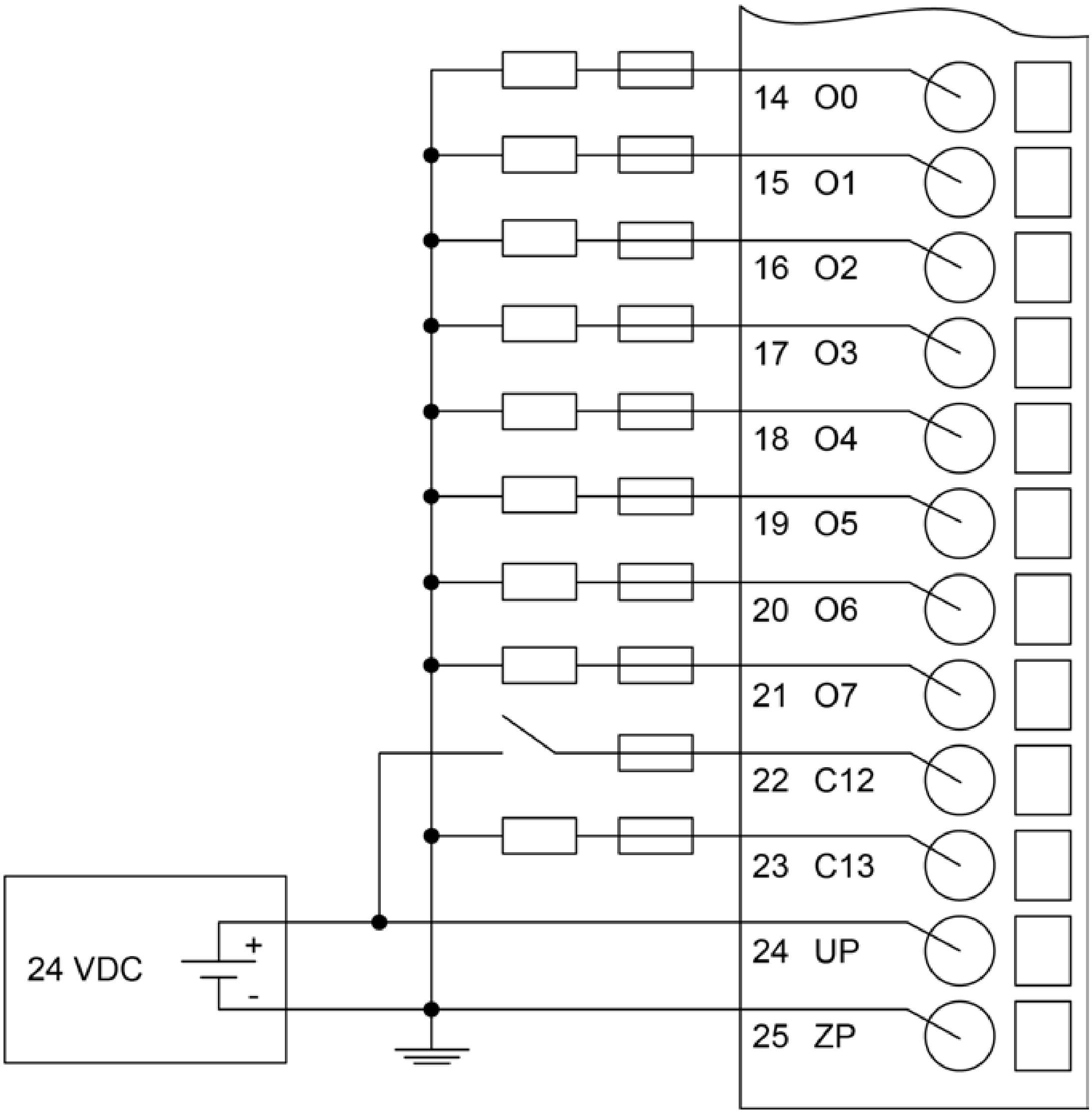


Fig. 6: Connection of digital transistor outputs and configurable digital inputs/outputs

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)

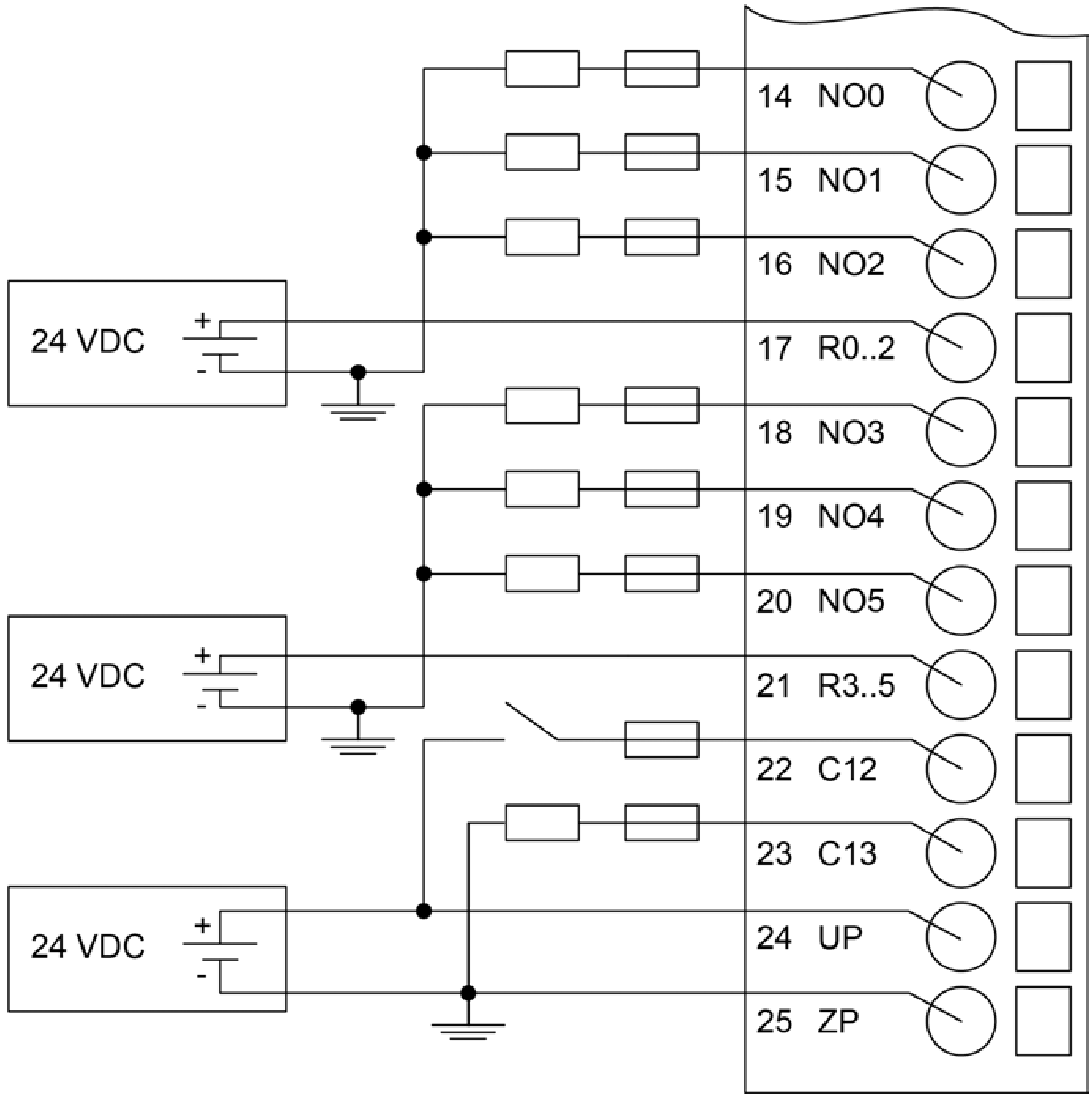


Fig. 7: Connection of digital relay outputs and configurable digital inputs/outputs

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.*

5.1.1.2.3 I/O configuration

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

5.1.1.2.4 Parameterization

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

5.1.1.2.5 Diagnosis

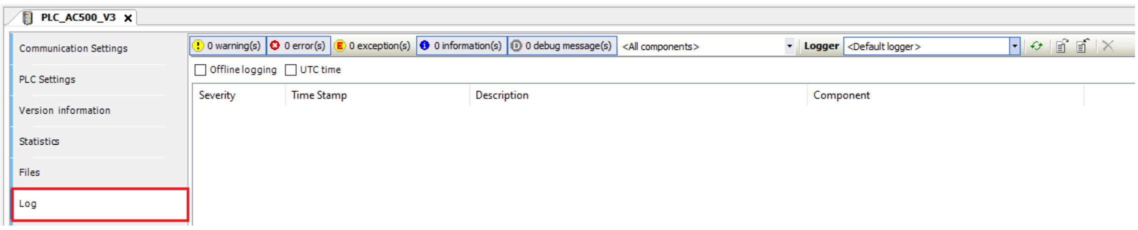
No diagnosis is generated for the onboard I/O.

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.



5.1.1.2.6 State LEDs

Table 31: 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

5.1.1.2.7 Technical data

Technical data of the digital inputs

Table 32: 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 33: PM5032-x-ETH, PM5052-x-ETH, PM5072-T-2ETH(W) and PM5082-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	
Input type according to EN 61131-2	Type 1 source	Type 1 sink

Parameter		Value	
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 V3 devices the function "fast counter" is available in onboard I/Os of PM50xx.

The AC500-eCo V3 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 V3 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 V3 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	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	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	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	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

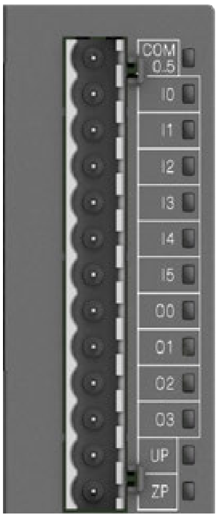


Table 34: PM5012-T-ETH

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		
	With inductive loads	On request

Parameter	Value
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.

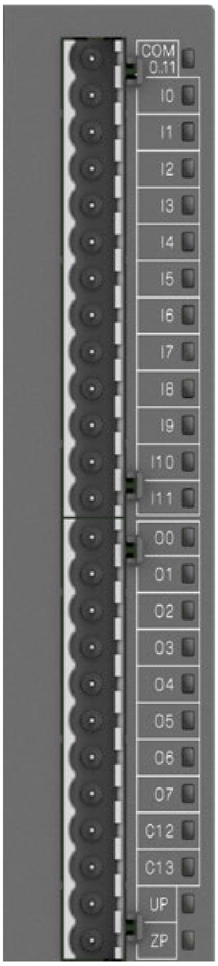


Table 35: PM5032-T-ETH, PM5052-T-ETH, PM5072-T-2ETH(W) and PM5082-T-2ETH

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
Connection of 2 outputs in parallel	Not possible
Max. cable length *)	

Parameter	Value
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 36: 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	
With resistive loads	Max. 1 Hz
With inductive loads	On request

Parameter	Value
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.

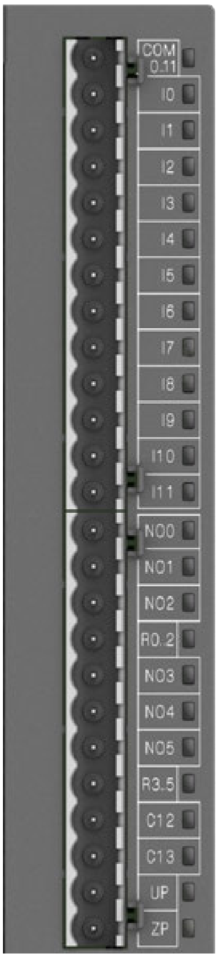


Table 37: PM5032-R-ETH and PM5052-R-ETH

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	
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

Parameter		Value
	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	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	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

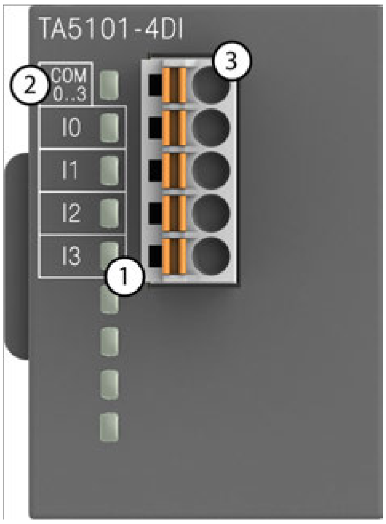
Parameter	PM5012-T-ETH	PM5012-R-ETH	PM5032-T-ETH PM5052-T-ETH PM5072-T-2ETH(W) PM5082-T-2ETH	PM5032-R-ETH PM5052-R-ETH
PWM				
Useable outputs	4	-	8	2
Fast output max. 5 kHz	O0 ... O3	-	O0 … O3	-
Fast output, max. 100 kHz	-	-	O4 … O7	C12 … C13

5.1.1.3 Option boards

Frequently asked and important questions about the AC500-eCo V3 serial communication option boards from 2023 are collected and answered in the application note. *AC500 V3-eCo FAQ - TA514X-RSXXX Serial 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 V3 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 V3 system. The terminal blocks are included in the module's scope of delivery and additional terminal blocks as spare parts can be ordered separately.

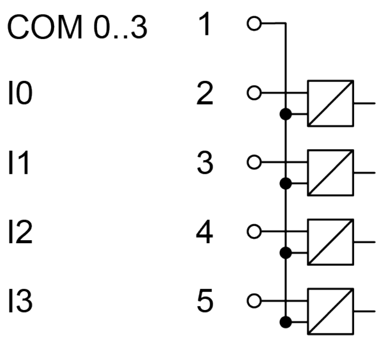


Fig. 8: Internal construction of the digital inputs

Table 38: 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 boards are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug option boards with the power being ON.

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

– connect or disconnect any signal or terminal block
– remove, mount or replace an option board.

Disconnecting any powered option board 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.

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.

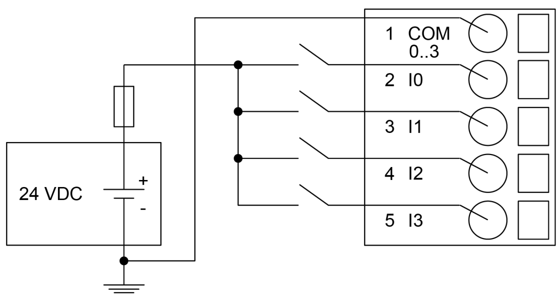
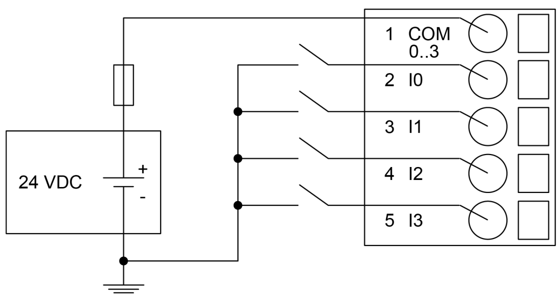
NOTICE!

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 39: 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 89*.

The meaning of the LEDs is described in the section 'State LEDs' ↳ *"State LEDs" on page 90*.

I/O configuration

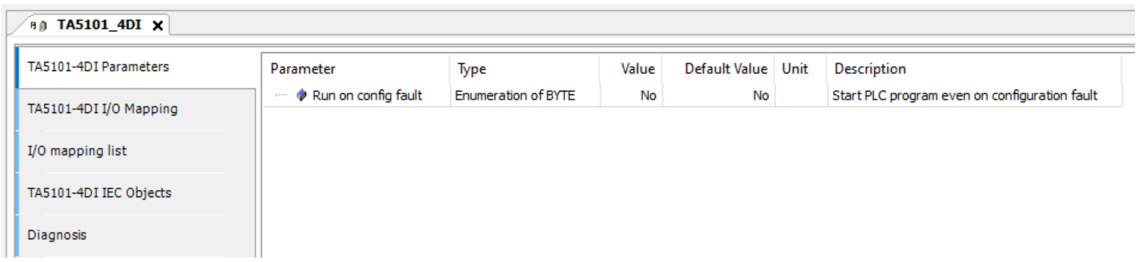
The module itself does not store configuration data. It receives its parameterization data from the CPU module during power-up of the system.

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

Parameterization

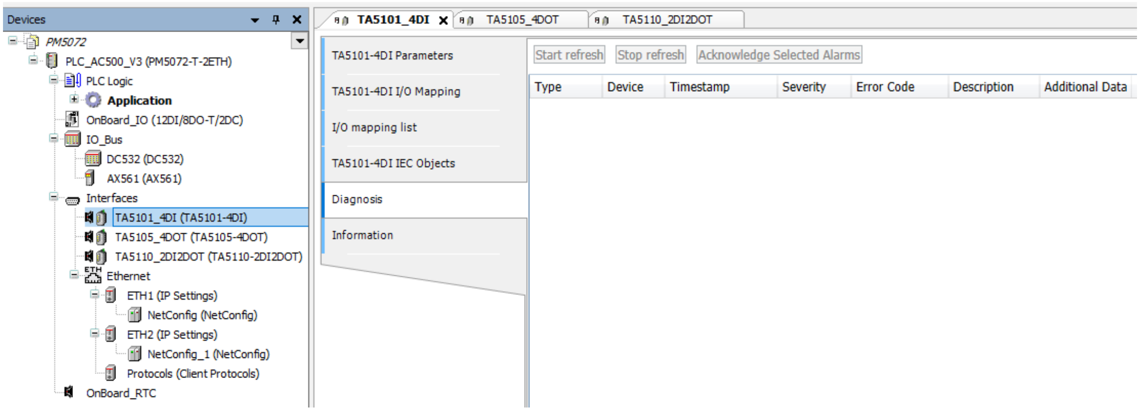
The arrangement of the parameter data is performed with Automation Builder software.

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 40: 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”

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 of AC500-eCo V3 apply *Chapter 4.1 “System data AC500-eCo” on page 23*
Only additional details are therefore documented below.

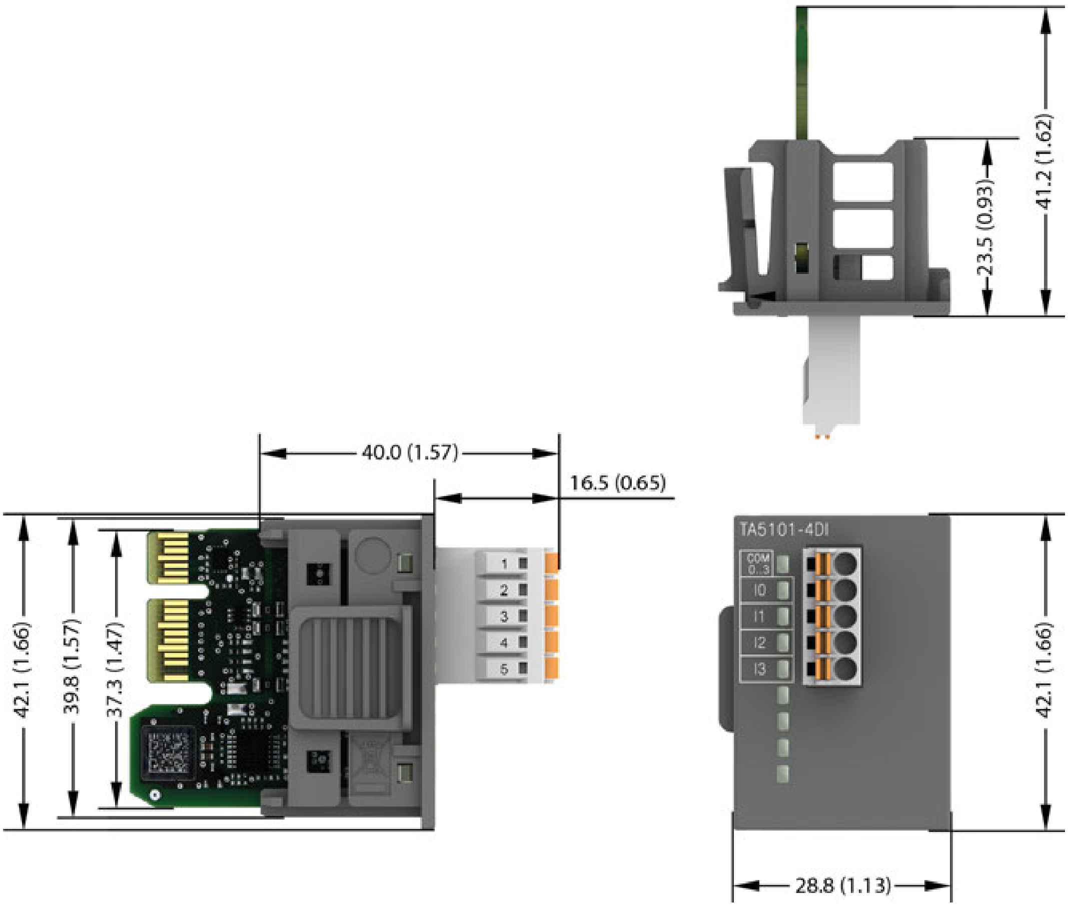
Parameter		Value
Galvanic isolation		Yes, between the input group and the rest of the module
	Isolated groups	1 (4 channels per group)
Current consumption from 24 V DC power supply at the L+ and M terminals of the CPU		Ca. 10 mA
Max. power dissipation within the module		0.8 W
Weight		15 g
Mounting position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

Table 41: 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		

Parameter	Value
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	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 V3, 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 V3, 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

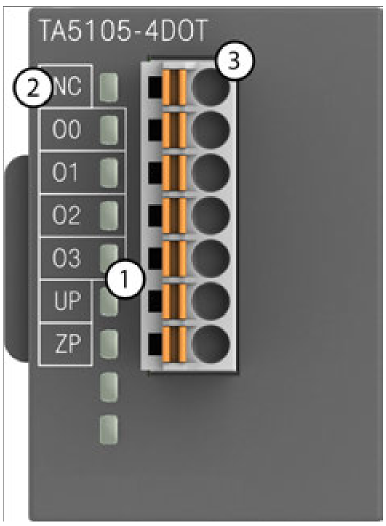
**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

***) 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 V3 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 V3 system. The terminal blocks are included in the module's scope of delivery and additional terminal blocks as spare parts can be ordered separately.

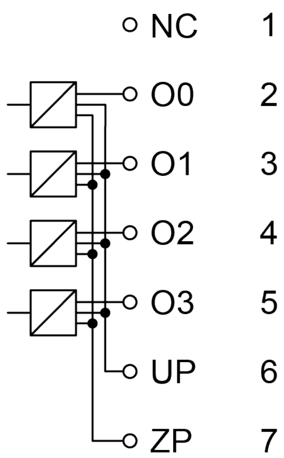


Fig. 9: Internal construction of the digital outputs

Table 42: 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 boards are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug option boards with the power being ON.

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

– connect or disconnect any signal or terminal block
– remove, mount or replace an option board.

Disconnecting any powered option board 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.

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.

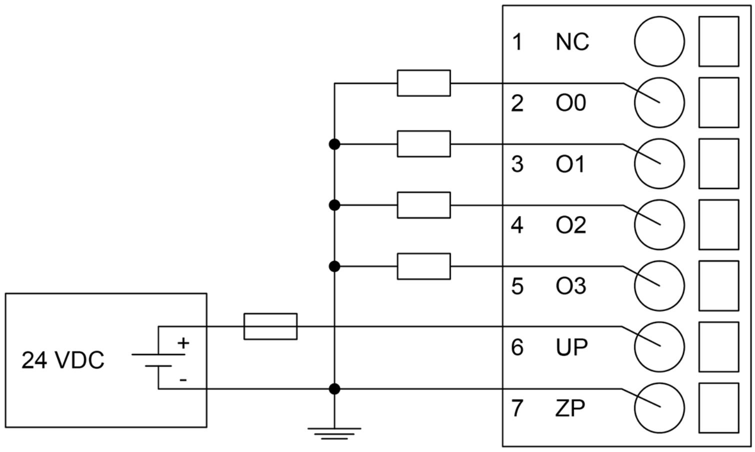


Fig. 10: Connection of the option board for digital I/O extension TA5105-4DOT

> **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 96*.

The meaning of the LEDs is described in the section State LEDs ↪ *“State LEDs” on page 96*.

I/O configuration

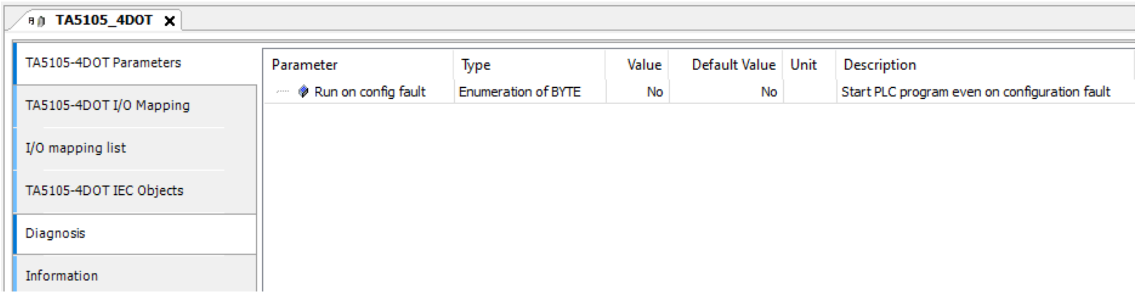
The module itself does not store configuration data. It receives its parameterization data from the CPU module during power-up of the system.

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

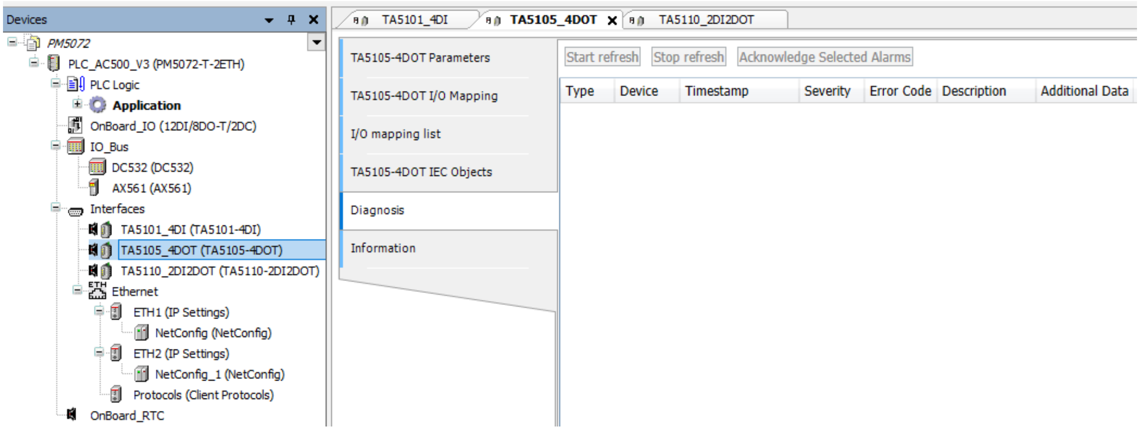
Parameterization

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 43: 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"

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 of AC500-eCo V3 apply *Chapter 4.1 “System data AC500-eCo” on page 23*

Only additional details are therefore documented below.

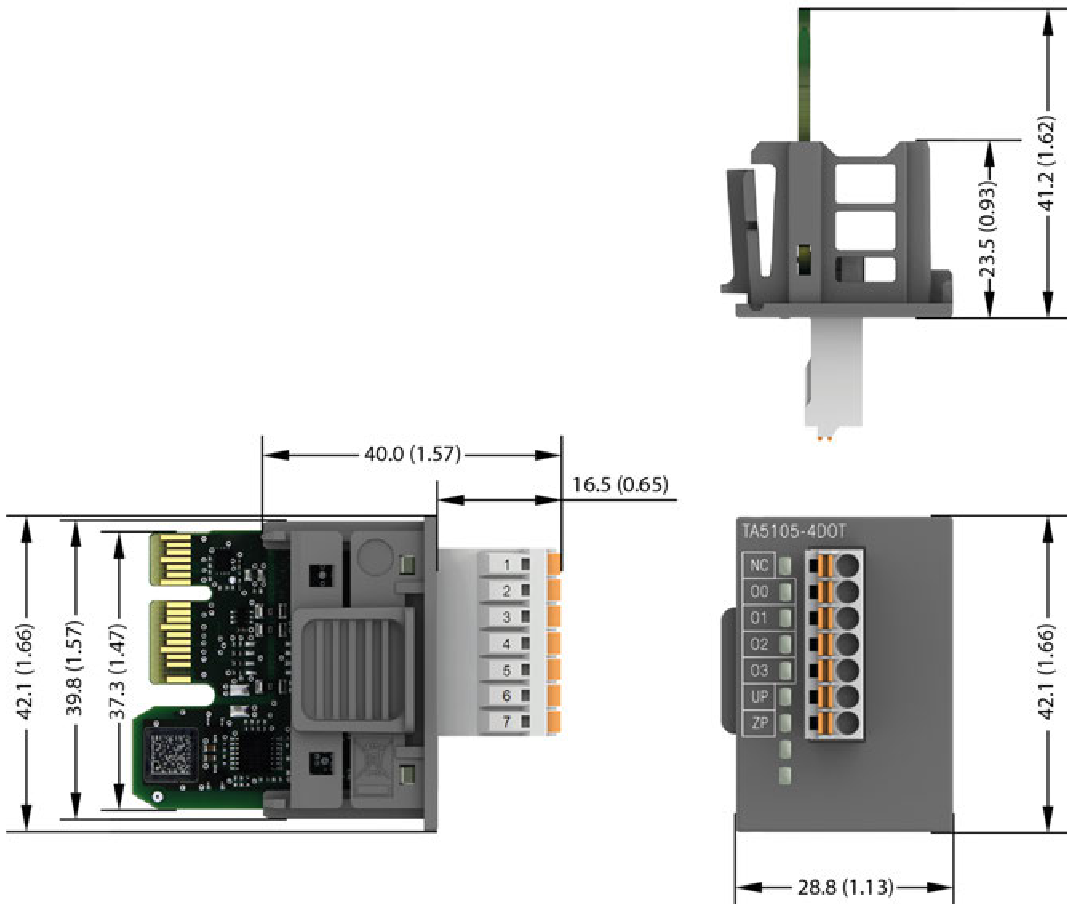
Parameter		Value
Process supply voltage UP		
	Connections	Terminal 6 for UP (+24 V DC) and terminal 7 for ZP (0 V DC)
	Rated value	24 V DC
	Current consumption via UP terminal	5 mA + max. 0.5 A per output
	Max. ripple	5 %
	Inrush current	0.000002 A^2s
	Protection against reversed voltage	Yes
	Rated protection 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 44: 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
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

Parameter		Value
	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 V3, 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 V3, 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

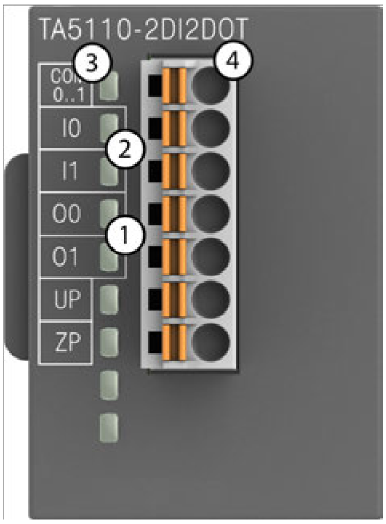
**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

***) 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 V3 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 V3 system. The terminal blocks are included in the module's scope of delivery and additional terminal blocks as spare parts can be ordered separately.

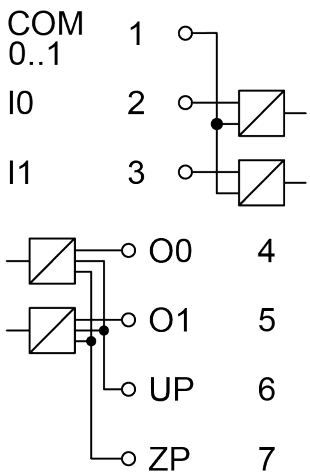


Fig. 11: Internal construction of the digital inputs and outputs

Table 45: 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 boards are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug option boards with the power being ON.

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

– connect or disconnect any signal or terminal block
– remove, mount or replace an option board.

Disconnecting any powered option board 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.

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.

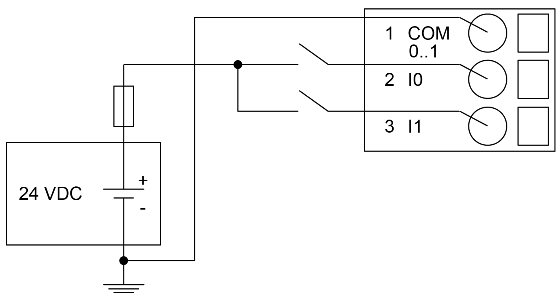
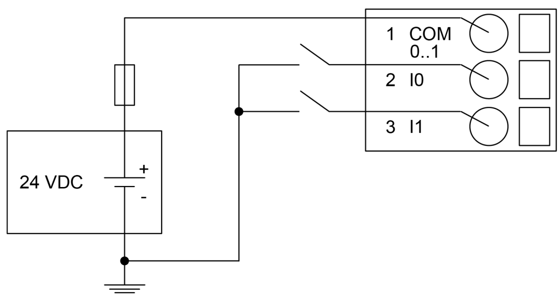
NOTICE!

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

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

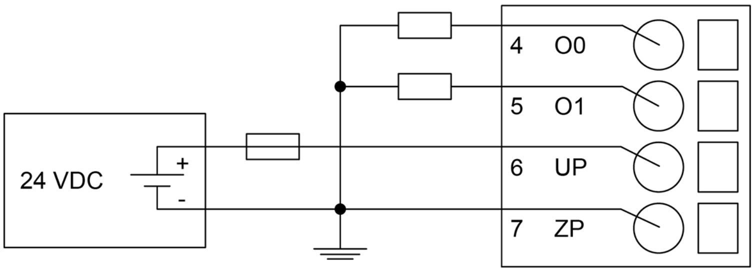


Fig. 12: Connection for outputs of the option board for digital I/O extension TA5110-2DI2DOT

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 104*.

The meaning of the LEDs is described in the section State LEDs *“State LEDs” on page 104*.

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.

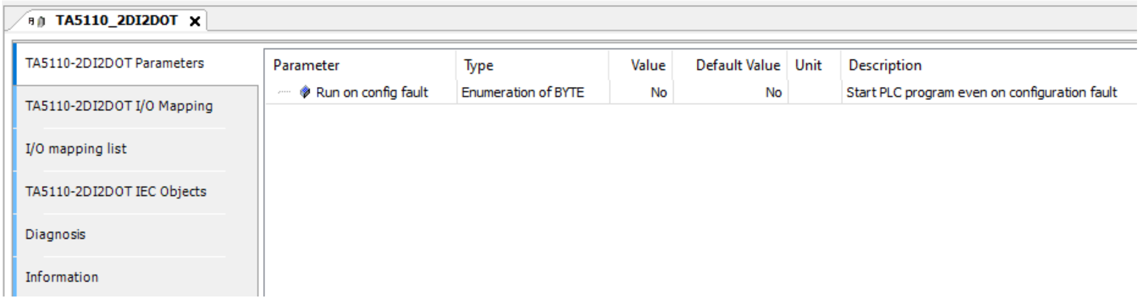
Hence, replacing optional modules is possible without any re-parameterization via software.

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.

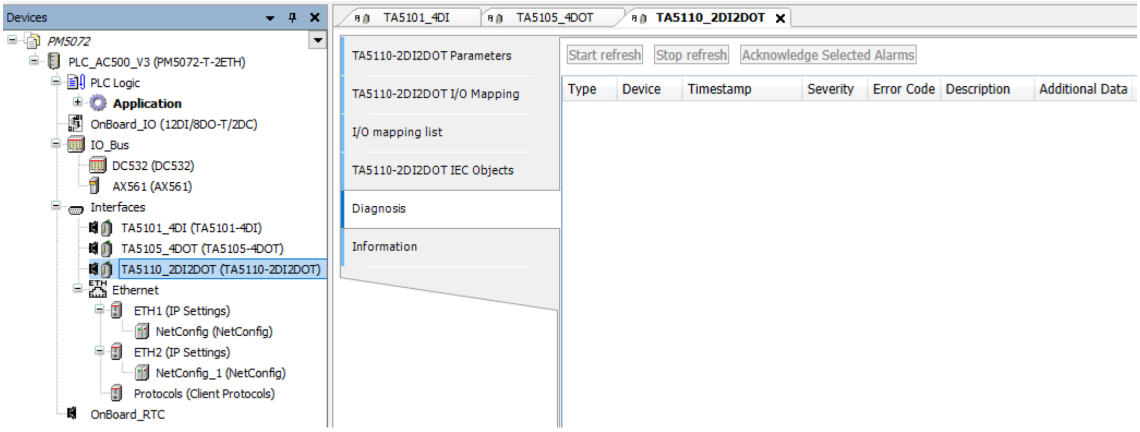
Parameterization

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 47: 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"

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 of AC500-eCo V3 apply *Chapter 4.1 "System data AC500-eCo" on page 23*

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 48: 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)	
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		

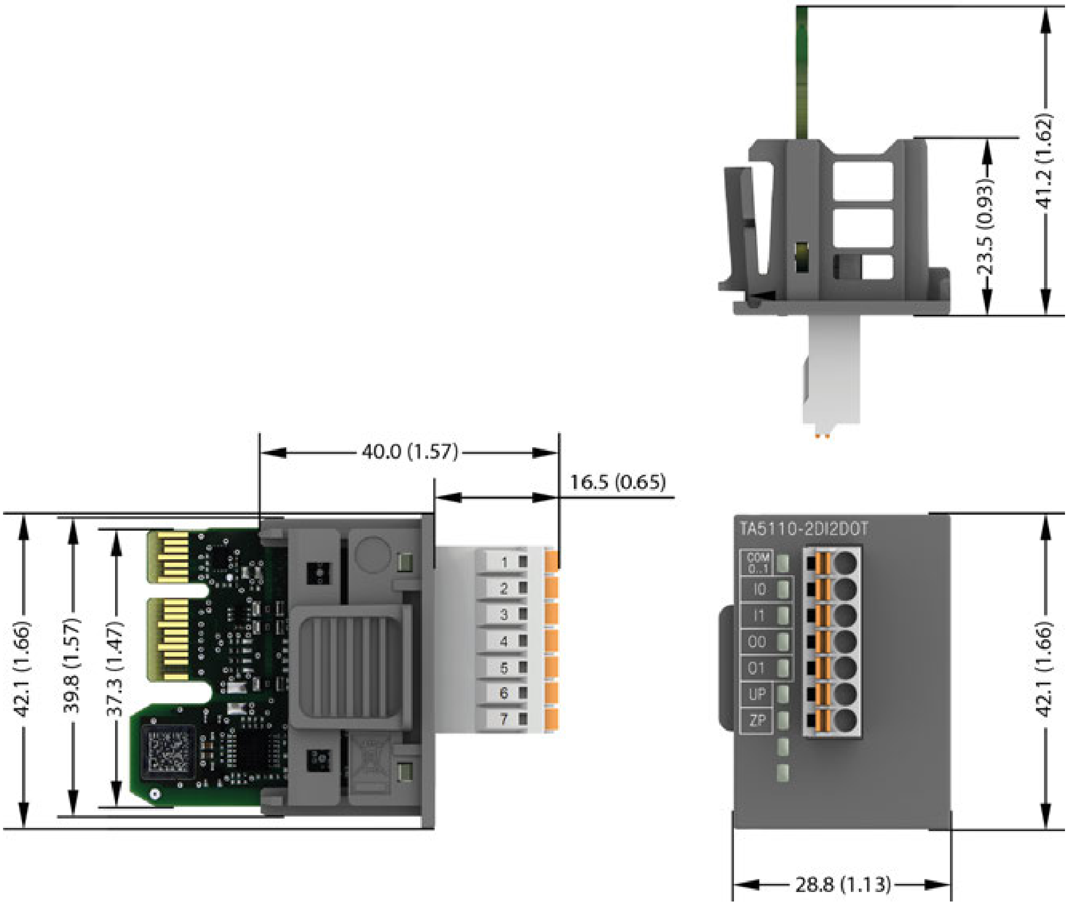
Parameter		Value
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	Typ. 1 mA
	Input voltage +15 V	< 3 mA
	Input voltage +30 V	< 7 mA
Max. permissible leakage current (at 2-wire proximity switches)		1 mA
Input delay (0->1 or 1->0)		Typ. 8 ms
Input data length		1 byte
Max. cable length		
	Shielded	500 m
	Unshielded	150 m

Table 49: 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
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

Parameter		Value
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 V3, 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 V3, 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

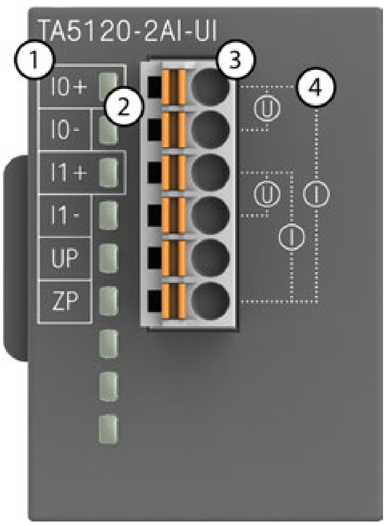
**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

***) 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 V3 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 for

- 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 boards are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug option boards with the power being ON.
>
> Make sure that all voltage sources (supply and process voltage) are switched off before you
>
> – connect or disconnect any signal or terminal block
> – remove, mount or replace an option board.
>
> Disconnecting any powered option board 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 option board TA5120-2AI-UI for analog input extension is plugged into an AC500-eCo V3 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 “TA52xx(-x) - Terminal block sets” on page 1151

Table 50: 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 (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. 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.

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.

The following figure shows the connection of the module:

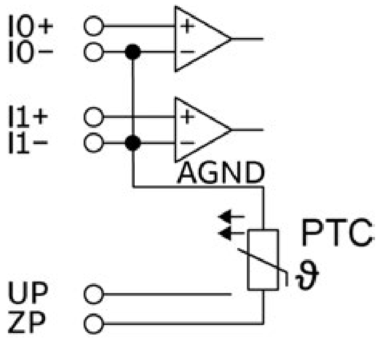


Fig. 13: Internal construction of the analog inputs

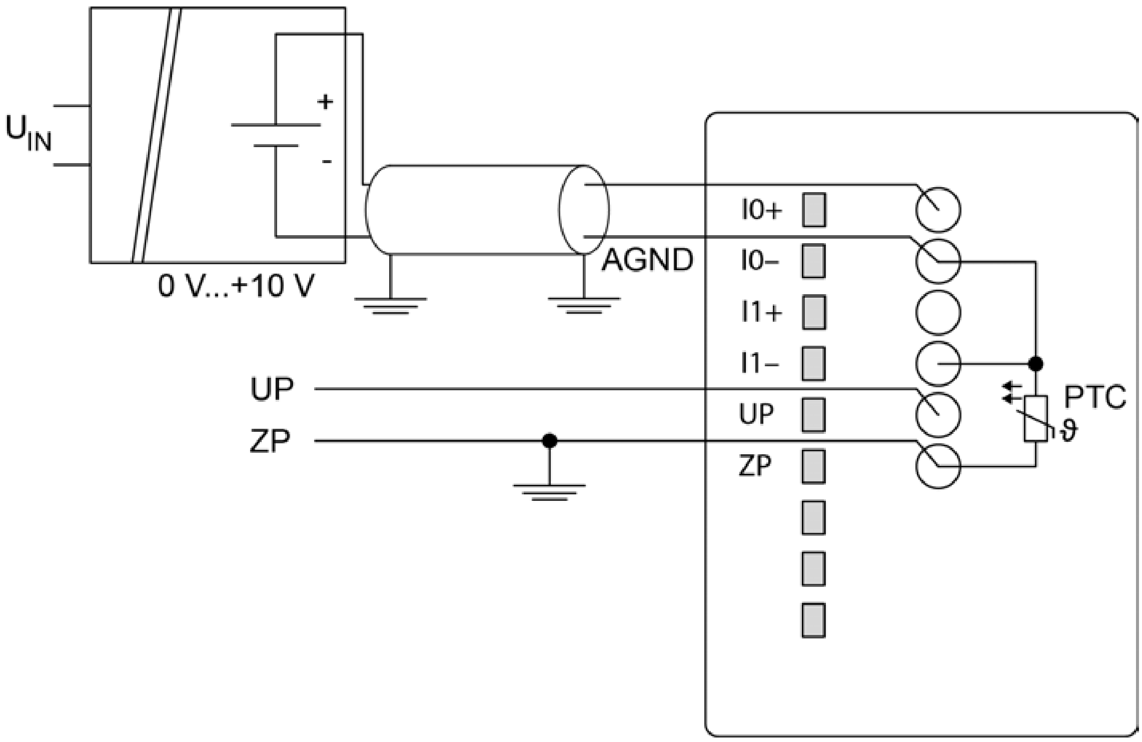
> **CAUTION!**
> By installing equipotential bonding conductors between the different parts of the system, it must be ensured that the potential difference between ZP and AGND never can exceed 1 V.

> **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 5.1.1.3.4.6 “Diagnosis” on page 115

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



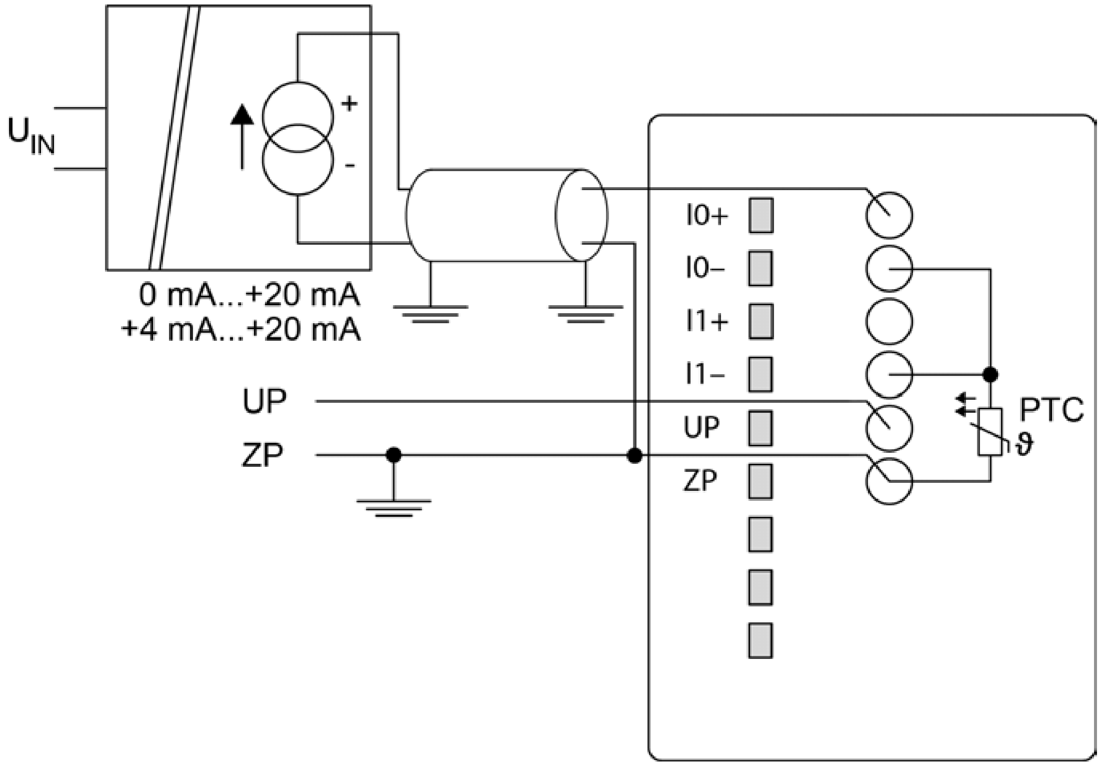
> *By connecting the sensor's negative terminal of the output voltage to AGND, the galvanically isolated voltage source of the sensor is referred to ZP.*

Table 51: 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".

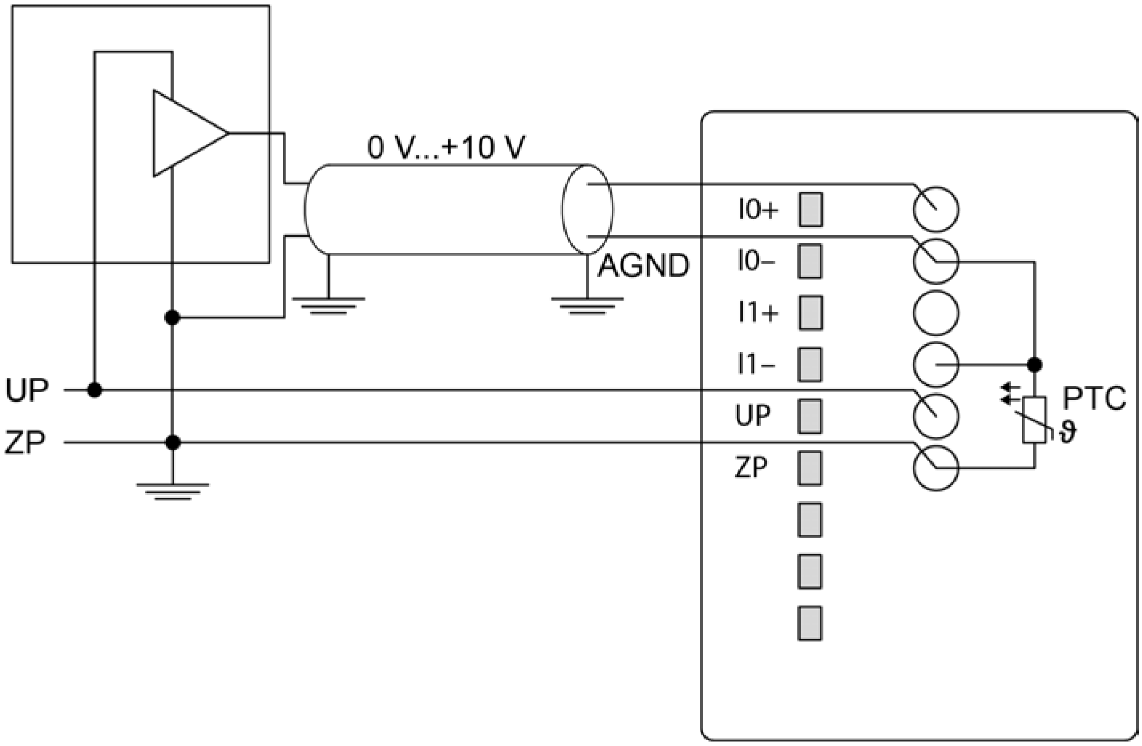
Connection of active-type analog sensors (Current) with galvanically isolated power supply



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



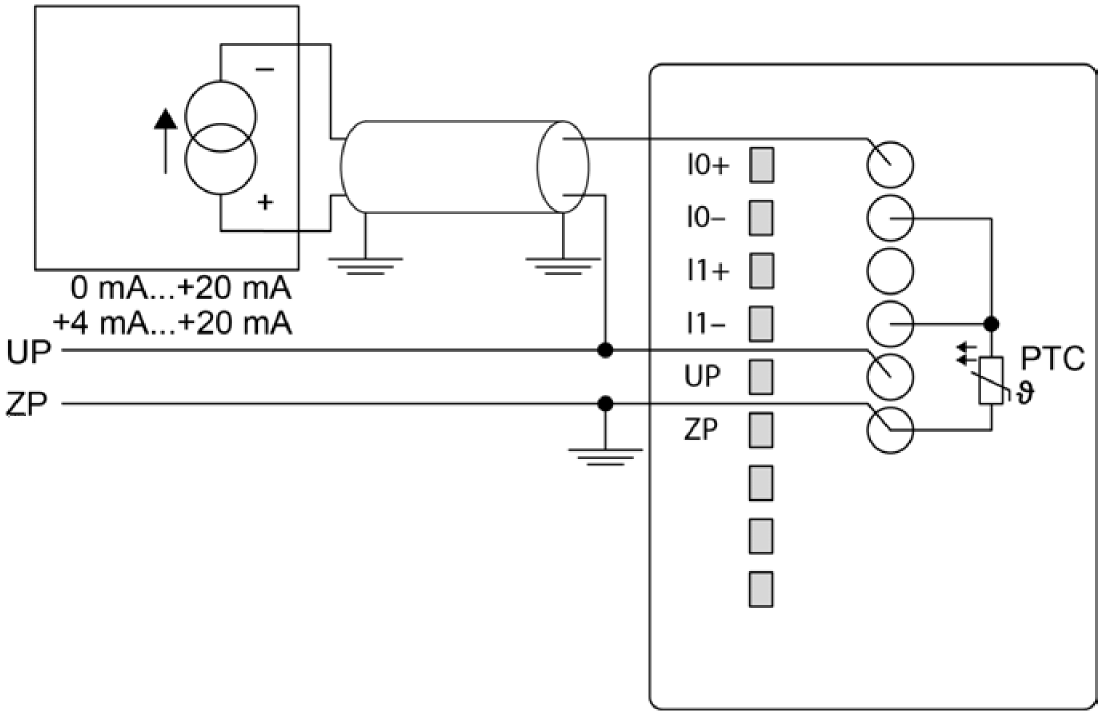
CAUTION!
The potential difference between AGND and ZP at the module must not be greater than 1V, not even in case of long lines.

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!
If, during initialization, an analog current sensor supplies more than 25 mA for more than 1 second to an analog input, this input is switched off by the module (input protection). In such cases, it is recommended to protect the analog input by a 10-Volt Zener diode (in parallel to I+ and I-). But, in general, sensors with fast initialization or without current peaks higher than 25 mA are preferrable.

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.

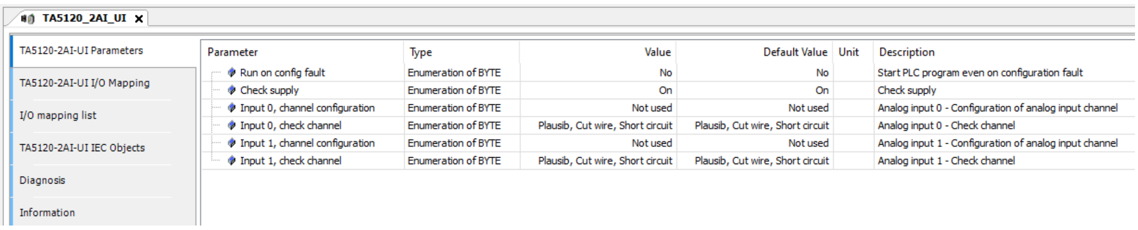
Hence, replacing option boards is possible without any re-parameterization via software.

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

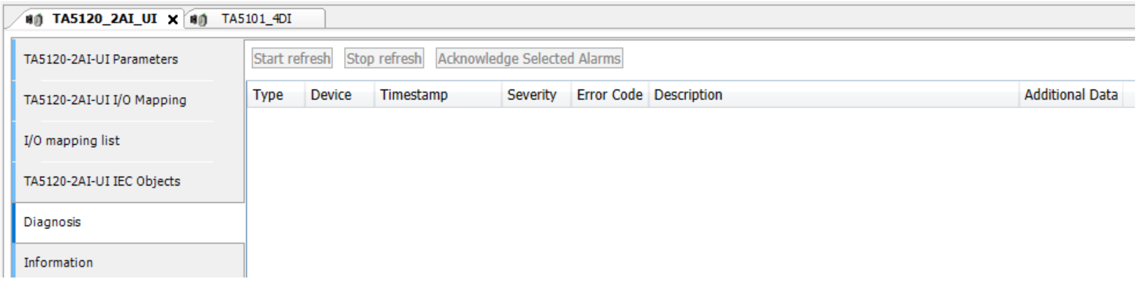
Parameterization

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 *"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.

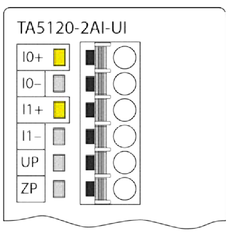
Severity	Error	Description	Remedy
Option board error (Channel 255)			
3	3	Timeout Communication timeout to CPU	If the process voltage is connected properly, replace the option board.
3	51	Invalid slot Wrong or missing option board in the appropriate slot	Check the configuration and the hard-ware setup.
4	11	Process voltage is too low	Check the process voltage.

Severity	Error	Description	Remedy
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 52: 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 53: 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
Input current too low	-0.0058 : -3.5185	-8 : -4864	FFF8 : ED00
Underflow	< -3.5185	-32768	8000
Negative overange	< -23.5185	-32768	8000

Table 54: 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 of AC500-eCo V3 apply *Chapter 4.1 “System data AC500-eCo” on page 23* 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. 20 mA
Inrush current from UP (at power up)		0.005 A^2s
Max. length of analog cables, conductor cross section > 0.2 mm^2		On request
Weight		20 g

Parameter	Value
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

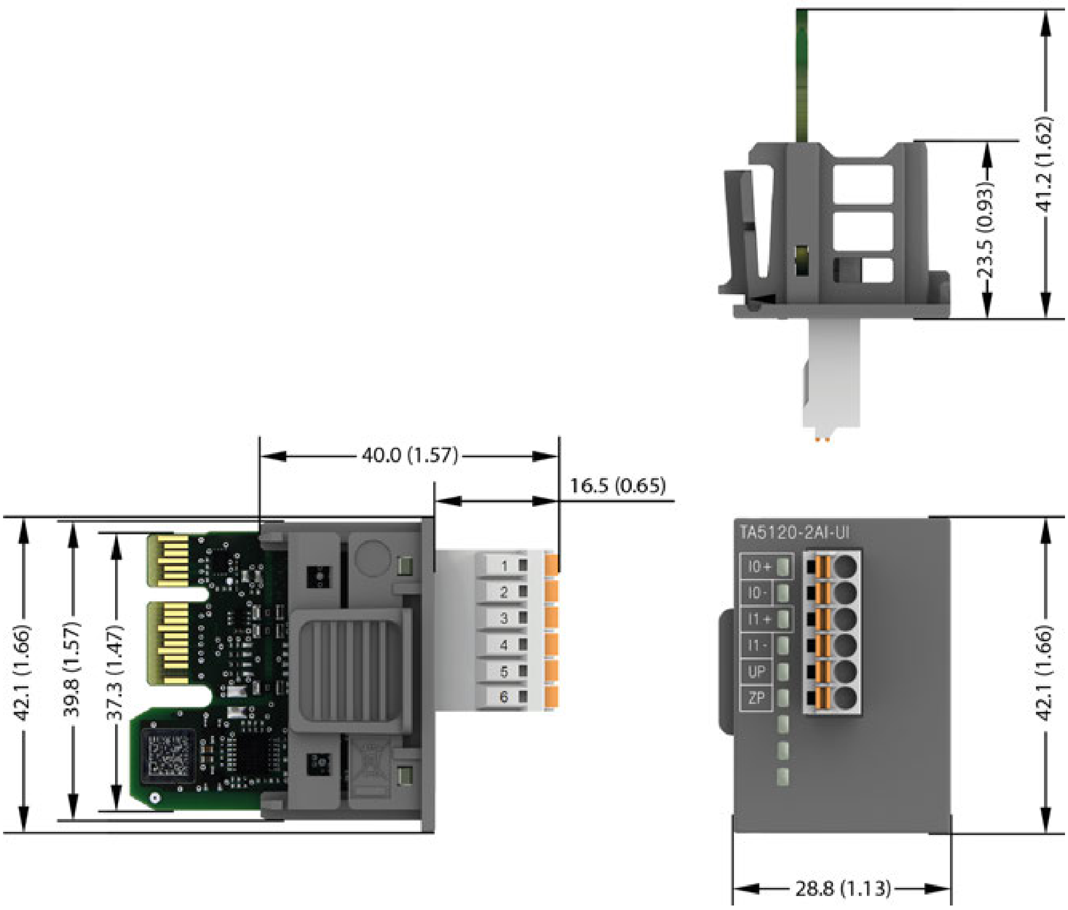
NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

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
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

Parameter	Value	
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 V3, 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 V3, 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

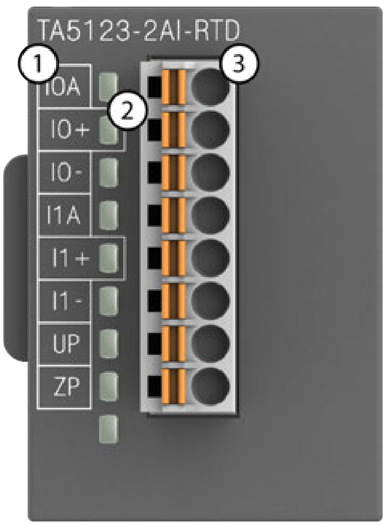
**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

***) 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 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 V3 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 for

- 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 boards are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug option boards with the power being ON.
>
> Make sure that all voltage sources (supply and process voltage) are switched off before you
>
> – connect or disconnect any signal or terminal block
> – remove, mount or replace an option board.
>
> Disconnecting any powered option board 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 option board TA5123-2AI-RTD for analog input extension is plugged into an AC500-eCo V3 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 55: 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
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.

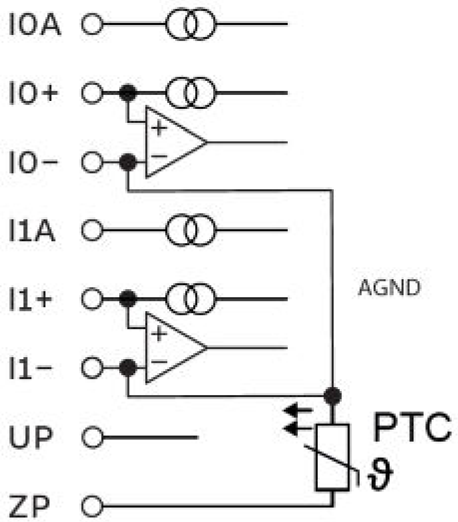
The internal power supply of the circuits of the module takes place via the connection to the CPU. Thus, the current consumption from 24 VDC power supply at the terminals L+ and M of the CPU module increases by << 1 mA per TA5123-2AI-RTD.

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.

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.

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

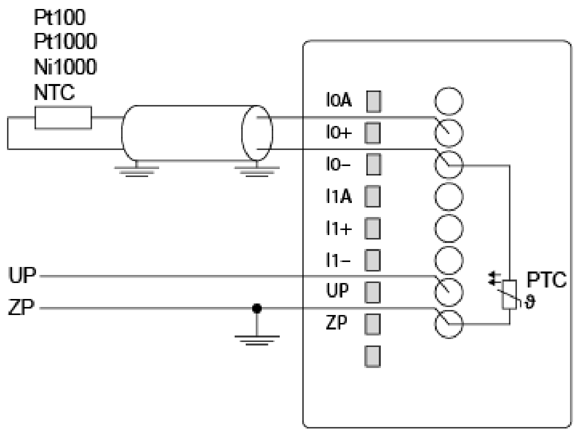


Fig. 14: Connection example

The following measuring ranges can be configured ✎ *Chapter 5.4.3.2.3.6 “Parameterization” on page 611*:

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

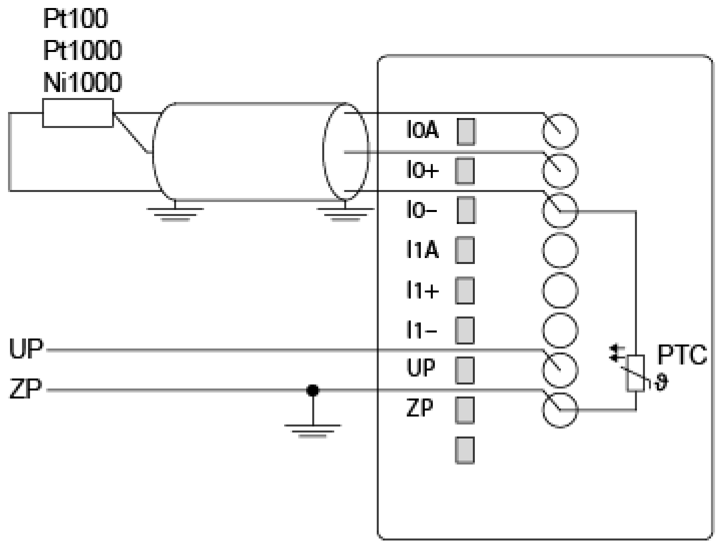


Fig. 15: Connection example

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.

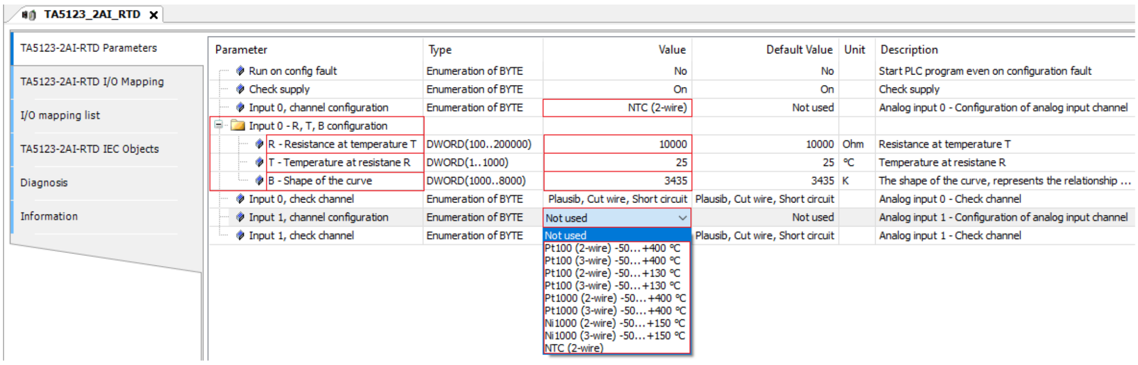
Hence, replacing option boards is possible without any re-parameterization via software.

⇘ *Further information to the option board.*

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.

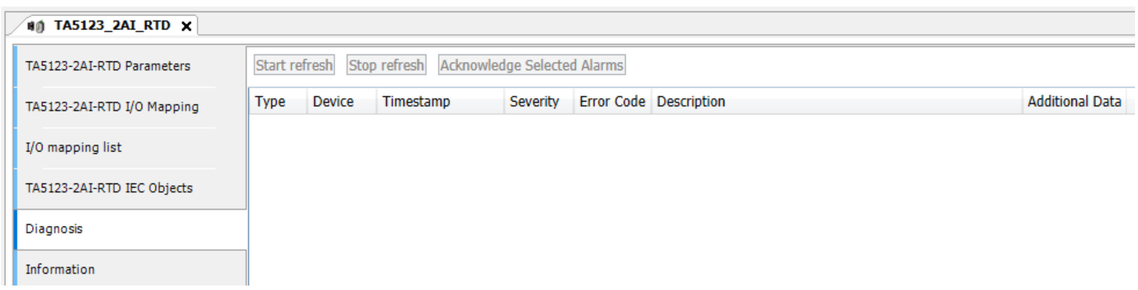
   > ***Data sheet of used NTC***
   >
   > *Take the following values from the data sheet of the NTC used.*
   >
   > – *Resistance at temperature T [Ω]*
   > – *Temperature at resistance R [°C] (the reference temperature is usually 25 °C)*
   > – *B [K] - The shape of the curve, represents the relationship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

   Table 59 "Measuring range: NTC" on page 131

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.

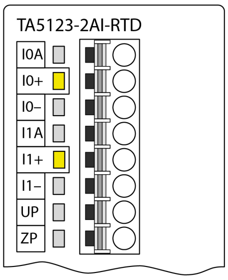
The following table shows the diagnosis messages.

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 56: 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 57: 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 58: 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 59: 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 of AC500-eCo V3 apply ➥ *Chapter 4.1 “System data AC500-eCo” on page 23*

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

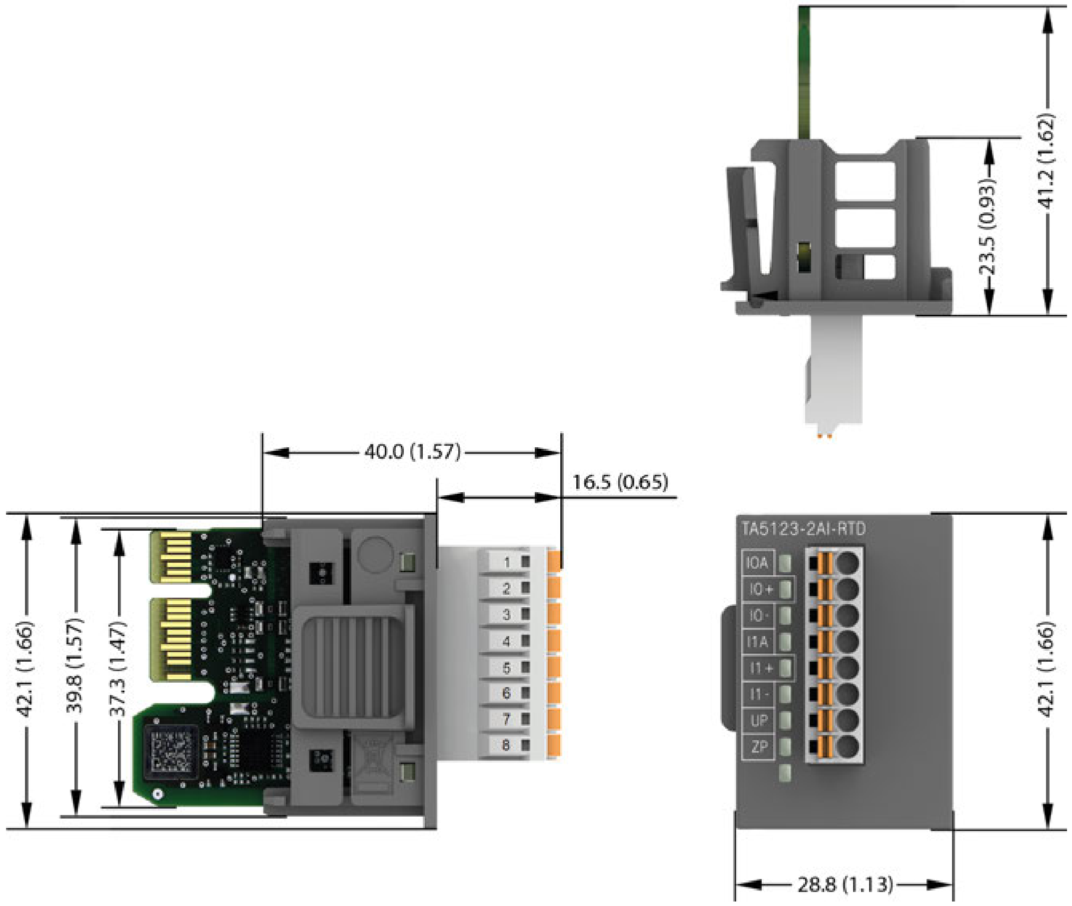
NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

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 V3, 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 V3, 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

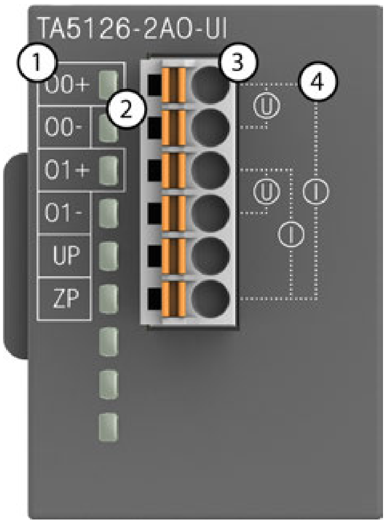
**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

***) 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.

5.1.1.3.6 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



1 Allocation of signal name
2 2 yellow LEDs to display the signal states at the analog outputs O0 and O1
3 6-pin terminal block for analog output signals and power supply (UP, ZP)
4 Output connection diagram for U and I

Intended purpose

The option board is used as analog output extension module for AC500-eCo V3 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 boards are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug option boards with the power being ON.

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

– connect or disconnect any signal or terminal block
– remove, mount or replace an option board.

Disconnecting any powered option board 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 option board TA5126-2AO-UI for analog output extension is plugged into an AC500-eCo V3 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 “TA52xx(-x) - Terminal block sets” on page 1151

Table 60: 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.

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.

The following figure shows the connection of the module:

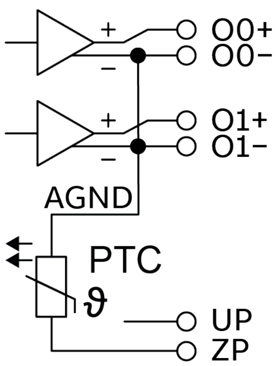


Fig. 16: Internal construction of the analog outputs

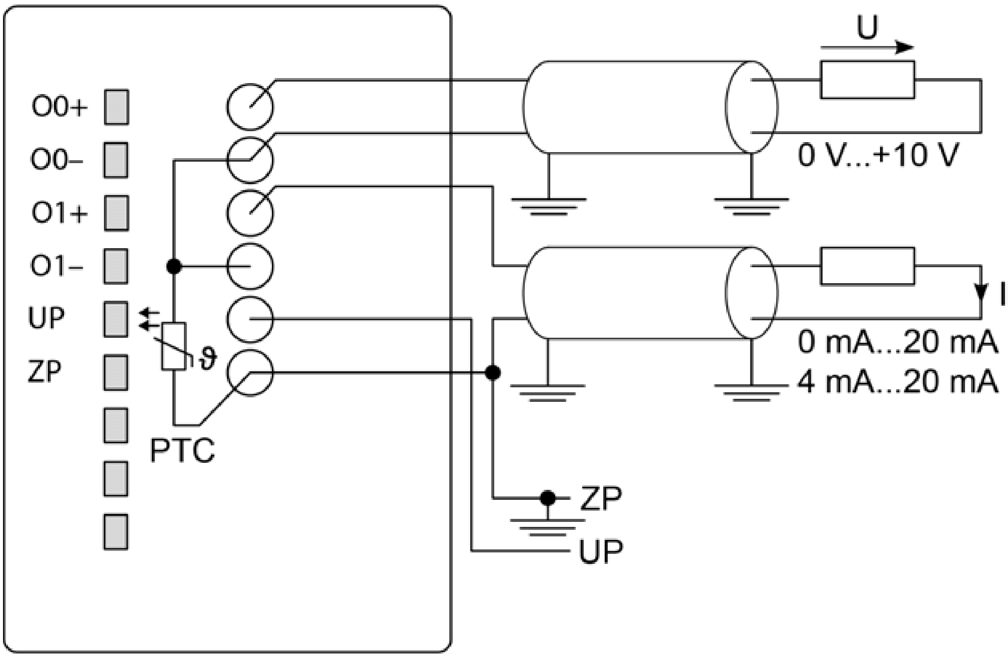
CAUTION!
By installing equipotential bonding conductors between the different parts of the system, it must be ensured that the potential difference between ZP and AGND never can exceed 1 V.

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 5.1.1.3.6.6 "Diagnosis" on page 139

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.

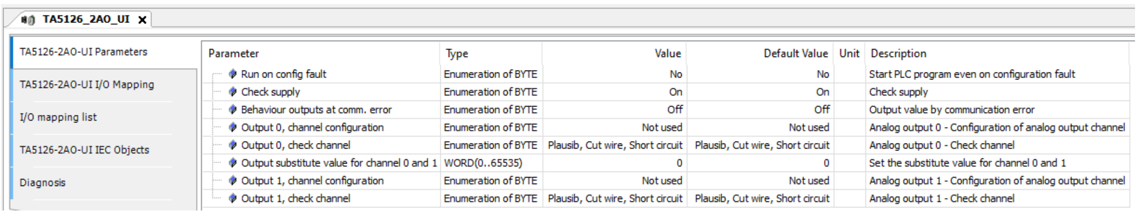
Hence, replacing optional modules is possible without any re-parameterization via software.

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

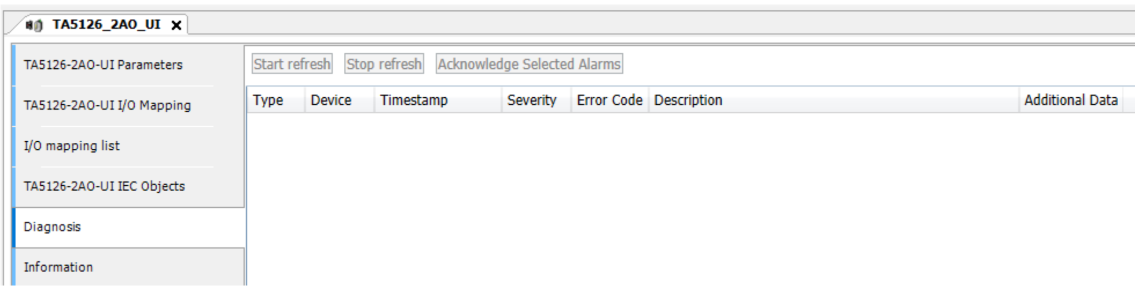
Parameterization

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 *"TA5126-2AO-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.

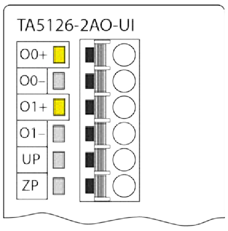
Bus pos.	Type	Channel	Class	Error	Description	Remedy
Module error (Channel 255)						
0..2	31	255	3	3	Timeout Communication timeout to CPU	If the process voltage is connected properly, replace the option board.
0..2	31	255	3	51	Invalid slot Wrong or missing option board in the appropriate slot	Check the configuration and the hardware setup.

Bus pos.	Type	Channel	Class	Error	Description	Remedy
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 firm-ware update	Replace the option board. [2])
0..2	31	255	3	9	DIAG_BUF_OVERFLOW Overflow in Diagnosis buffer	Diagnosis overflow usu-ally 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 parame-terization.
0..2	31	255	3	19	DIAG_CRC_ERR Checksum error in option board	Replace the option board.
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 61: 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 62: 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 63: 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
Output value too low	3.995 : 0.0046 0.0000	-8 : -6904 -6912	FFF8 : E508 E500
Underflow	0	< -6912	< E500

Technical data

The system data of AC500-eCo V3 apply *Chapter 4.1 “System data AC500-eCo” on page 23* 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

Parameter		Value
	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.

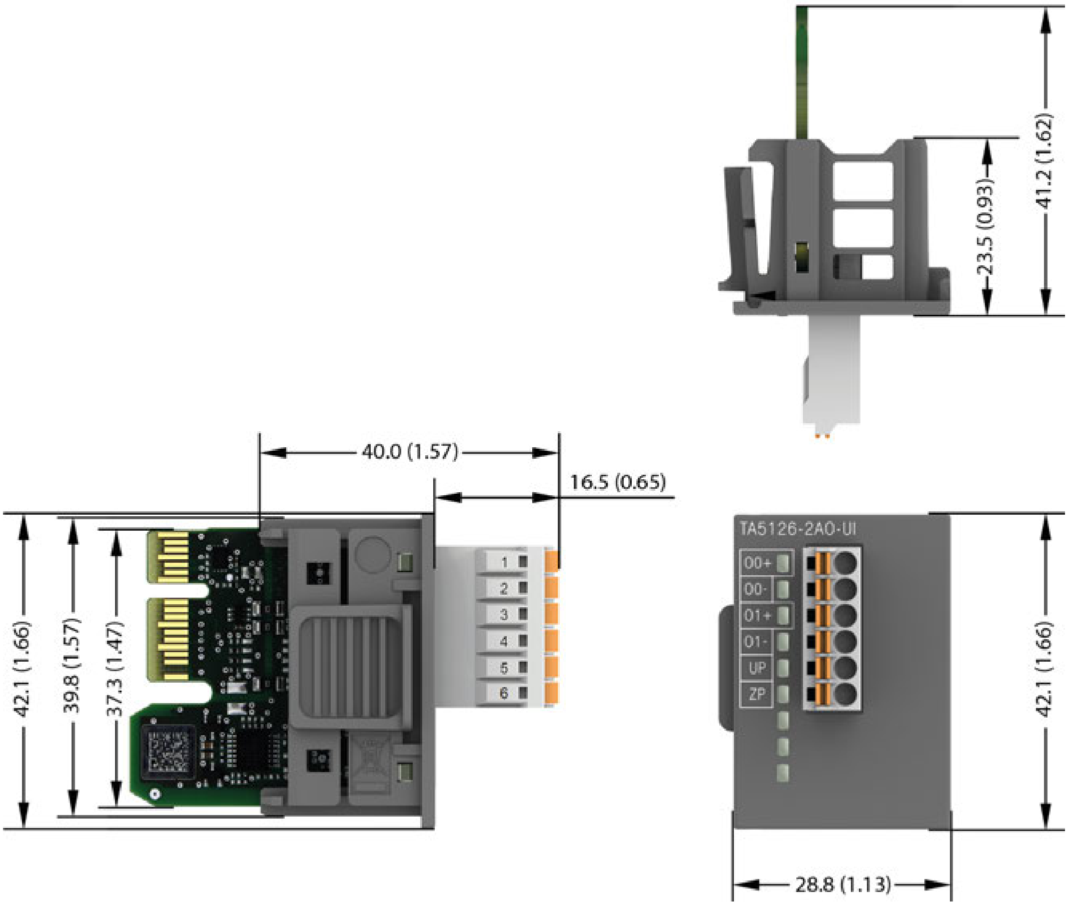
Technical data of the analog outputs

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)

Parameter		Value	
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 V3, 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 V3, 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

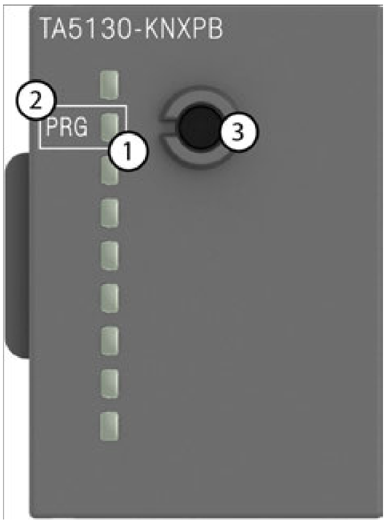
**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

***) 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.

5.1.1.3.7 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 Connector

Intended purpose

This option board is only intended to be used with PM5072-T-2ETH(W) and PM5082-T-2ETH.

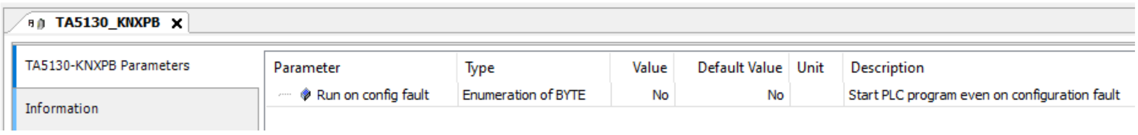
This option board can only be used once on one slot at a time!

The option board is not supported by other AC500-eCo V3 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

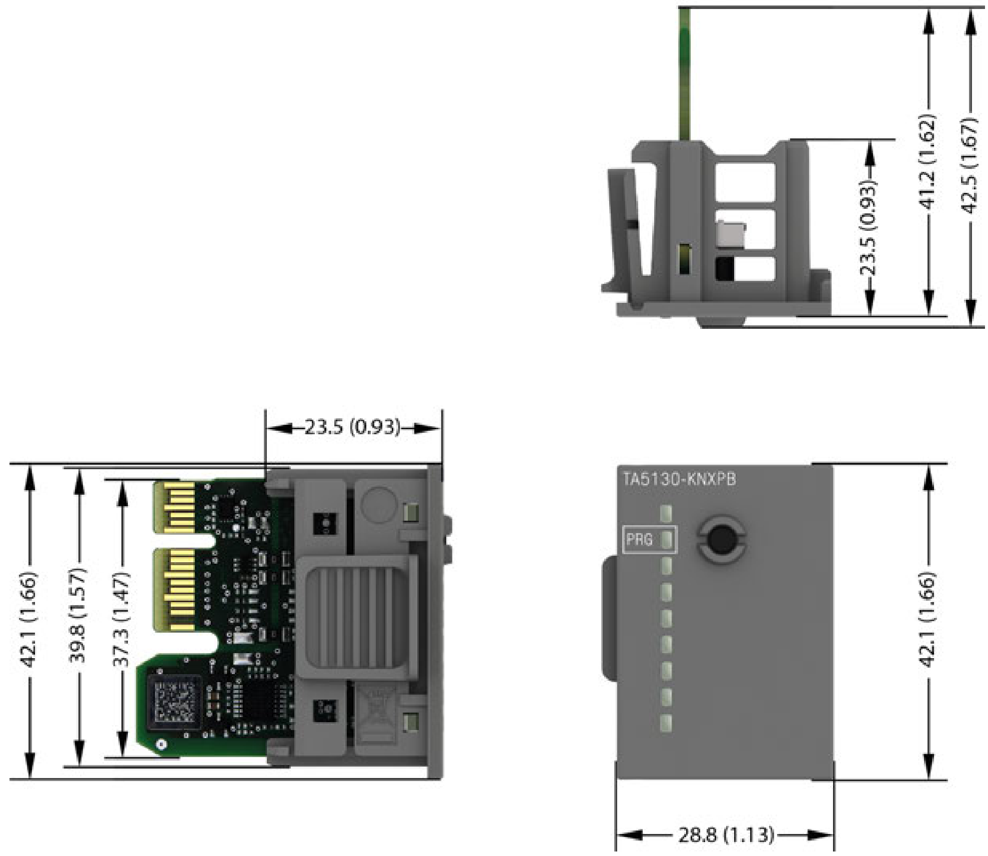
Technical data

The system data of AC500-eCo V3 apply *Chapter 4.1 “System data AC500-eCo” on page 23*

Only additional details are therefore documented below.

Parameter	Value
Usable CPUs	PM5072-T-2ETH(W) and PM5082-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 V3, option board KNX address push button for AC500-eCo V3 Pro CPU only	Active
1SAP 187 200 R0201	TA5130-KNXPBW: AC500-eCo V3, option board KNX address push button for AC500-eCo V3 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.*

5.1.1.3.8 TA5131-RTC - Option board for real-time clock

1 TA5131-RTC option board

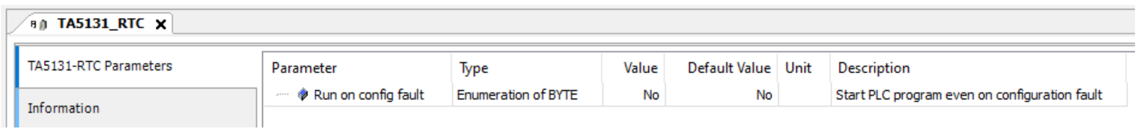
Intended purpose

> *This option board is only for the basic CPUs PM5012-T-ETH and PM5012-R-ETH.*
>
> *All other AC500-eCo V3 CPUs have the real-time clock already integrated.*

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.



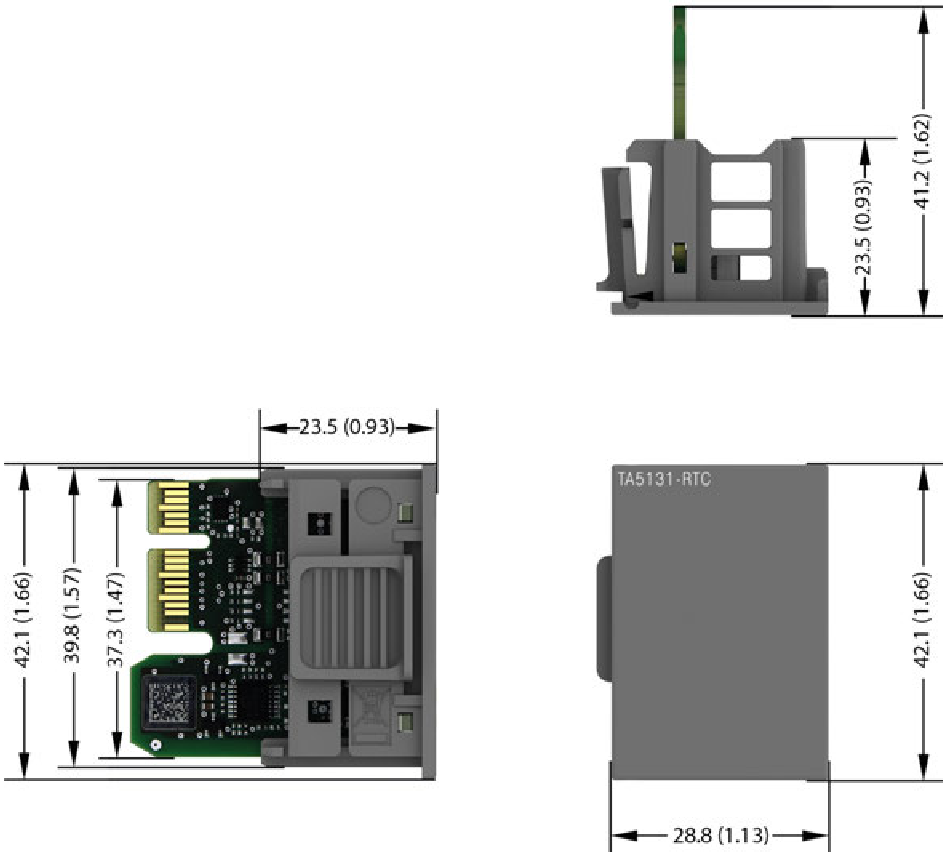
Technical data

The system data of AC500-eCo V3 apply ⇨ *Chapter 4.1 "System data AC500-eCo" on page 23*

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.

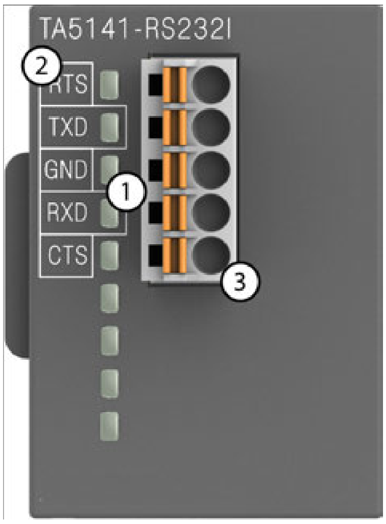
Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 187 200 R0002	TA5131-RTC:AC500-eCo V3, real-time clock without battery, option board for AC500-eCo V3 Basic CPU only	Active

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

5.1.1.3.9 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

Intended purpose

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.

Application note AC500-eCo V3 - FAQ

Connections

Serial interfaces

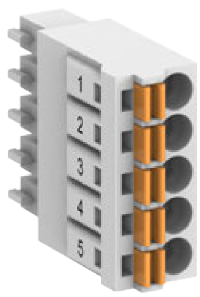
NOTICE!

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 64: 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.

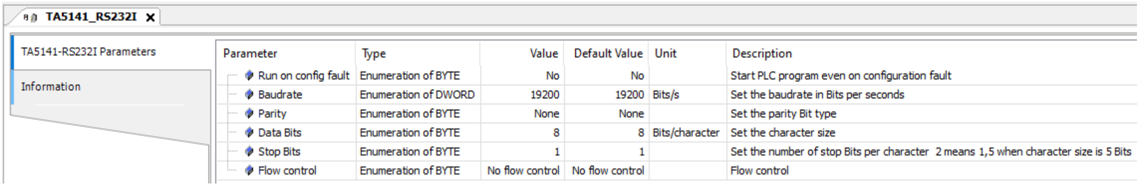
RS-232 for point-to-point connection:

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.



Parameter	Type	Value	Default Value	Unit	Description
Run on config fault	Enumeration of BYTE	No	No		Start PLC program even on configuration fault
Baudrate	Enumeration of DWORD	19200	19200	Bits/s	Set the baudrate in Bits per seconds
Parity	Enumeration of BYTE	None	None		Set the parity Bit type
Data Bits	Enumeration of BYTE	8	8	Bits/character	Set the character size
Stop Bits	Enumeration of BYTE	1	1		Set the number of stop Bits per character 2 means 1,5 when character size is 5 Bits
Flow control	Enumeration of BYTE	No flow control	No flow control		Flow control

State LEDs

Signal	Color	State	Description
TxD	Yellow	ON (blinking)	Transmitting
RxD	Yellow	ON (blinking)	Receiving

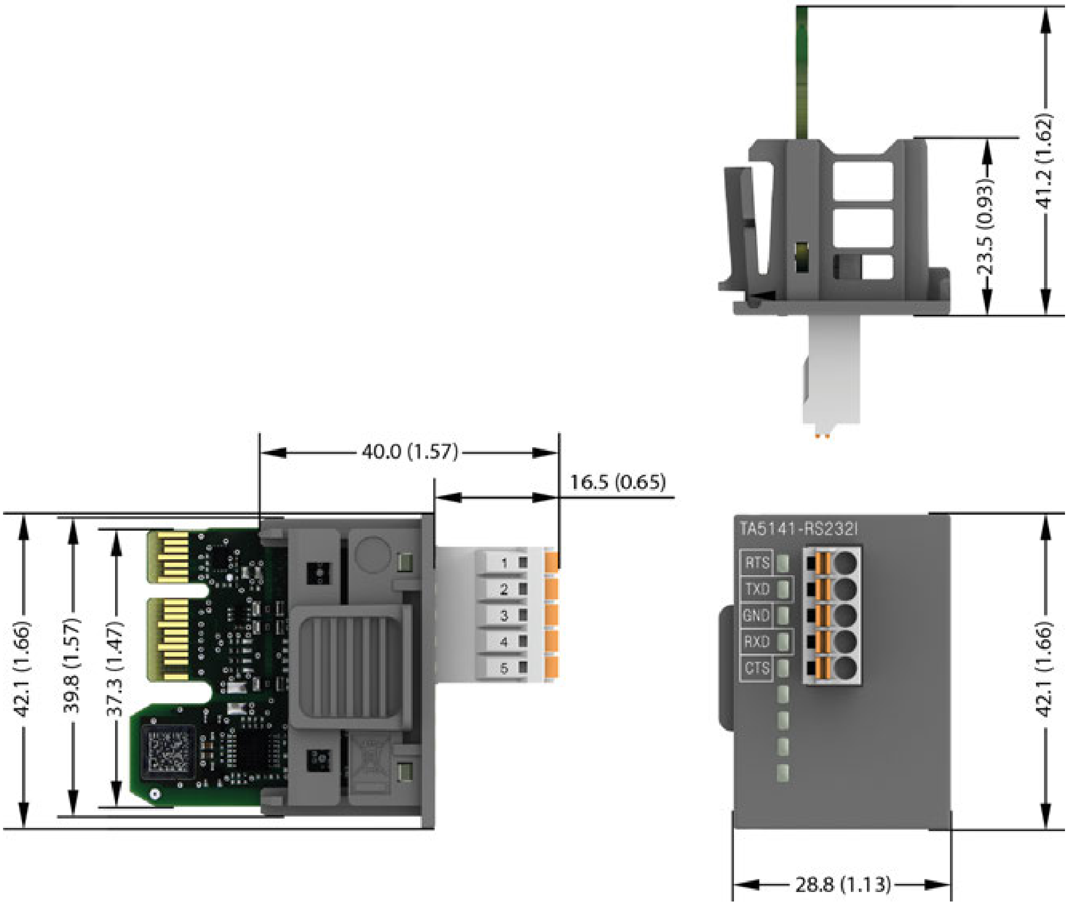
Technical data

The system data of AC500-eCo V3 apply *Chapter 4.1 “System data AC500-eCo” on page 23*

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 V3, 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 V3, 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

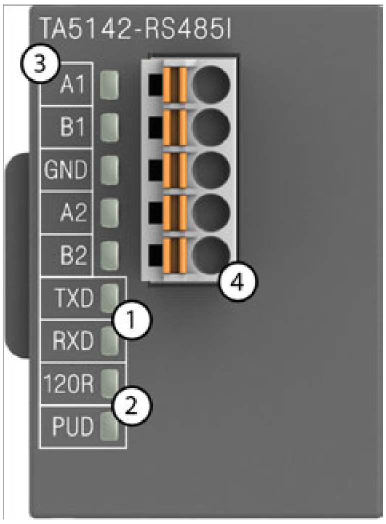
**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

***) 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.

5.1.1.3.10 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

Intended purpose

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.

Application note AC500-eCo V3 - FAQ

Connections

Serial interfaces

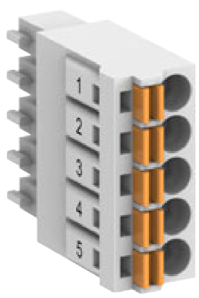
NOTICE!

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 65: 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

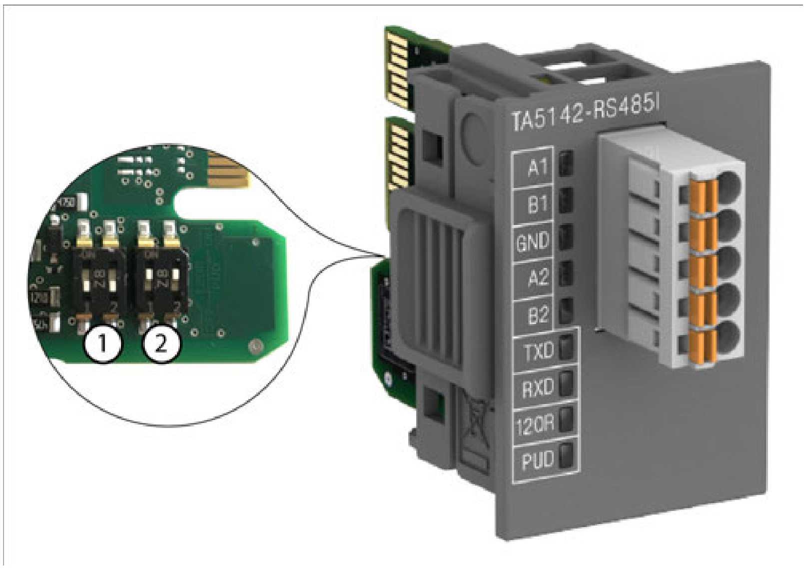
The maximum possible cable length of a serial connection subnet within a segment depends on the transmission rate.

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

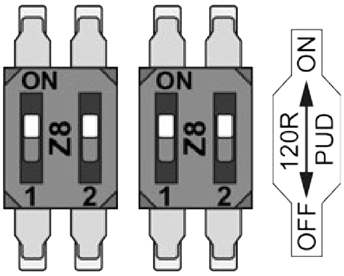
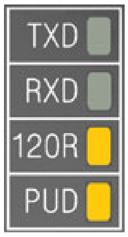
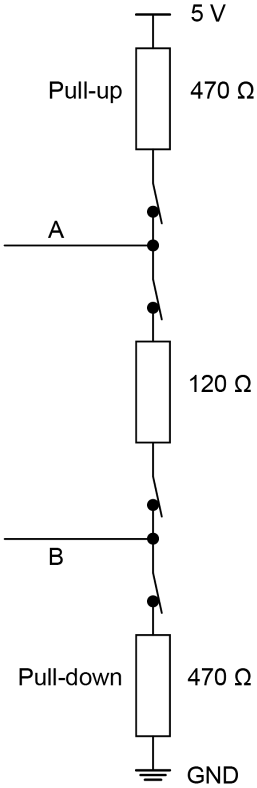
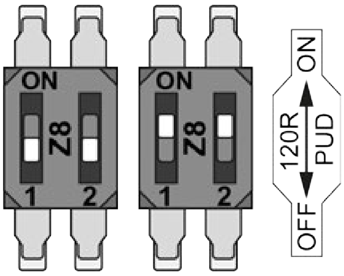
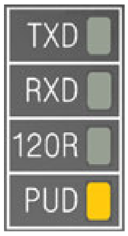
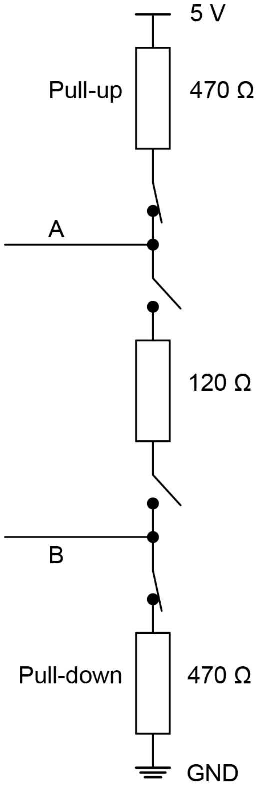
Bus termination

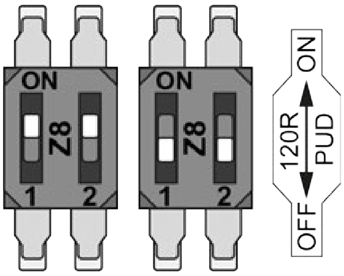
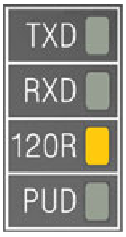
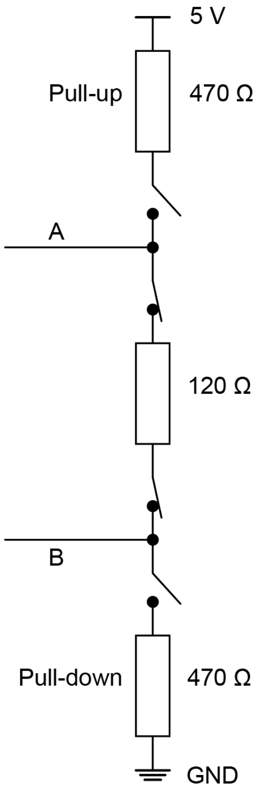
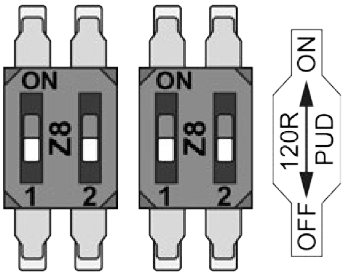
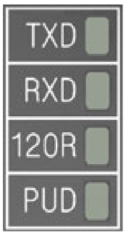
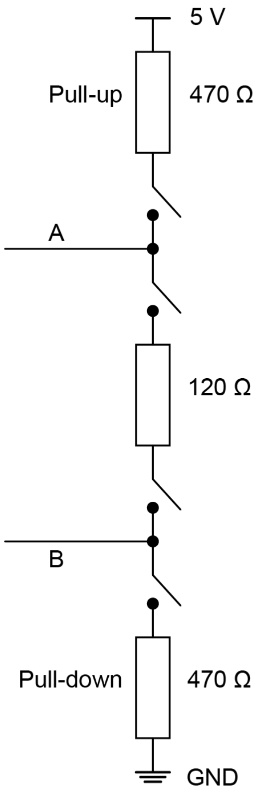
The line ends of the bus segment must be equipped with bus terminating resistors. These resistors are integrated in the module TA5142-RS485I. The pull-up and pull-down settings must also be made on the circuit board of the module.



1 Termination resistance settings
2 Pull-up and pull-down settings

Table 66: Configuration

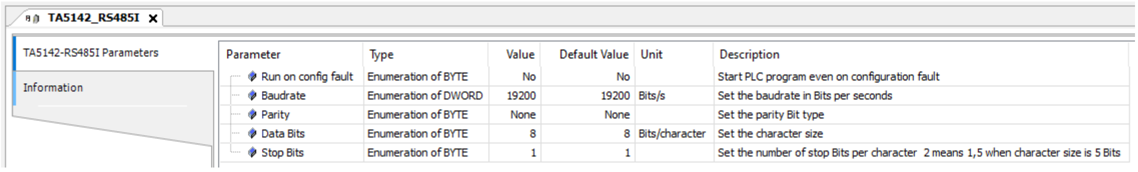
Settings on the module	State of LEDs	Internal wiring diagram	Description
			Master at the bus line end, pull-up and pull-down activated, bus termination 120 Ω
			Master within the bus line, pull-up and pull-down activated

<table>
<tr><th>Settings on the module</th><th>State of LEDs</th><th>Internal wiring diagram</th><th>Description</th></tr>
<tr><td>
</td><td>
</td><td>
</td><td>Slave at the bus line end, bus termination 120 Ω</td></tr>
<tr><td>
</td><td>
</td><td>
</td><td>Slave within the bus line</td></tr>
</table>

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

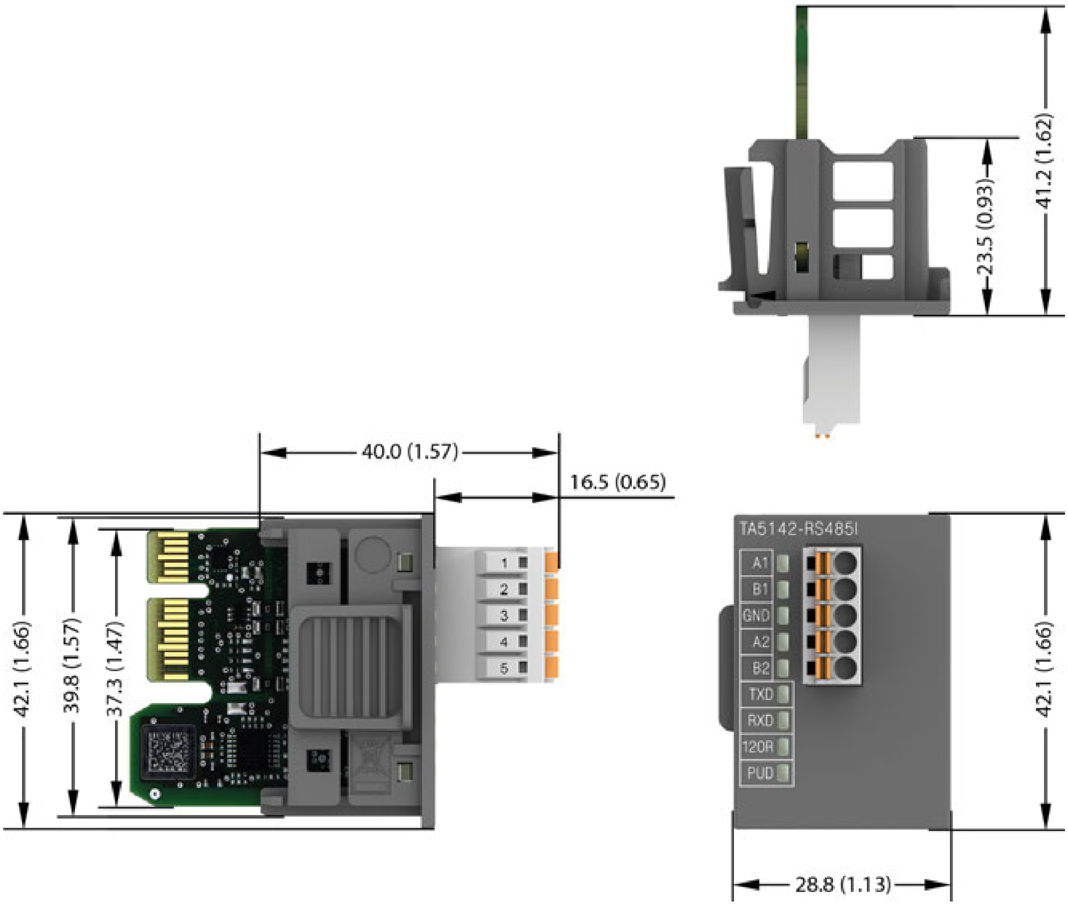
The system data of AC500-eCo V3 apply *Chapter 4.1 “System data AC500-eCo” on page 23*

Only additional details are therefore documented below.

Table 67: 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 V3, 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 V3, 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

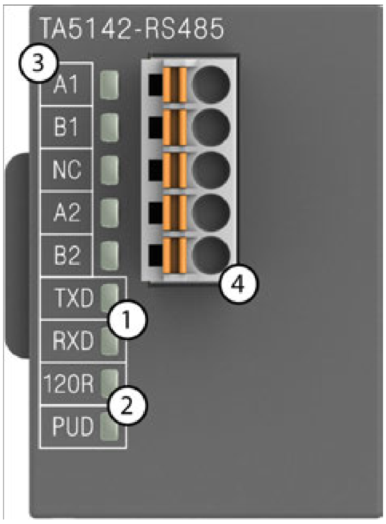
**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

***) 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.

5.1.1.3.11 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

Intended purpose

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.

Application note AC500-eCo V3 - FAQ

Connections

Serial interfaces

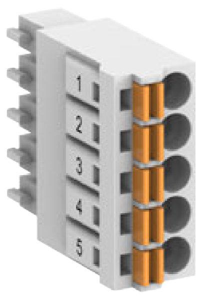
NOTICE!

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 68: 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

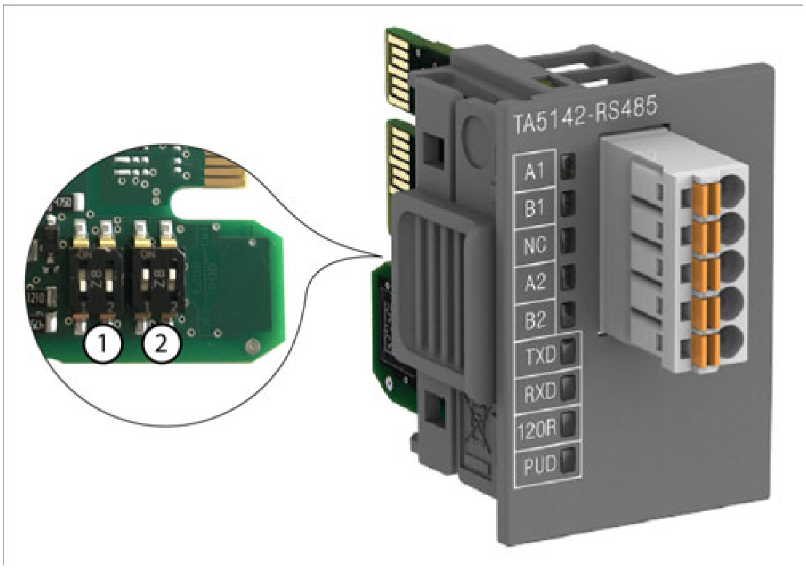
The maximum possible cable length of a serial connection subnet within a segment depends on the transmission rate.

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

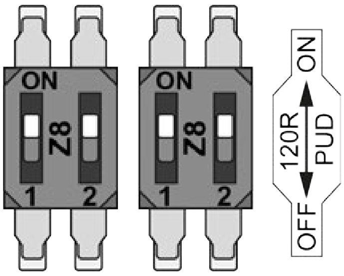
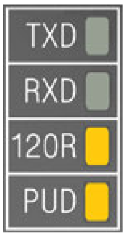
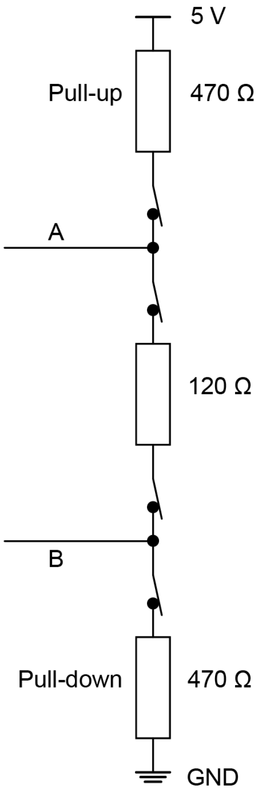
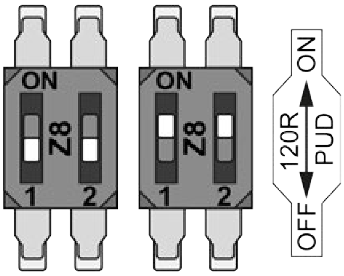
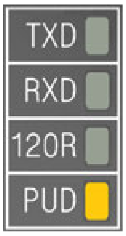
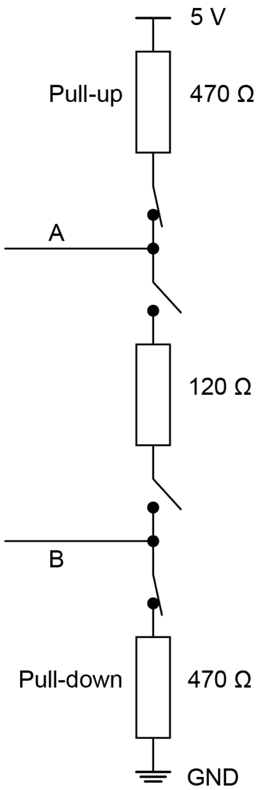
Bus termination

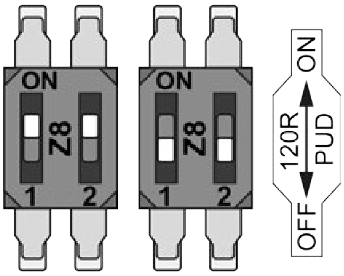
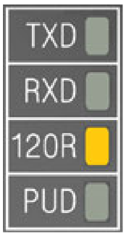
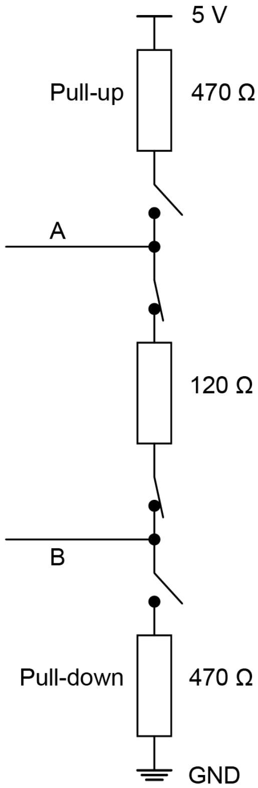
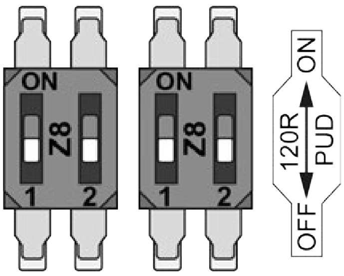
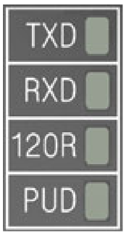
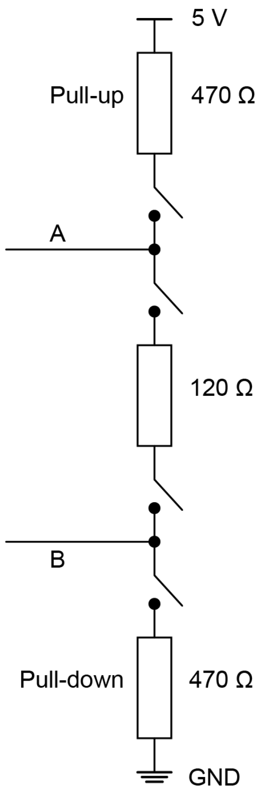
The line ends of the bus segment must be equipped with bus terminating resistors. These resistors are integrated in the module TA5142-RS485. The pull-up and pull-down settings must also be made on the circuit board of the module.



1 Termination resistance settings
2 Pull-up and pull-down settings

Table 69: Configuration

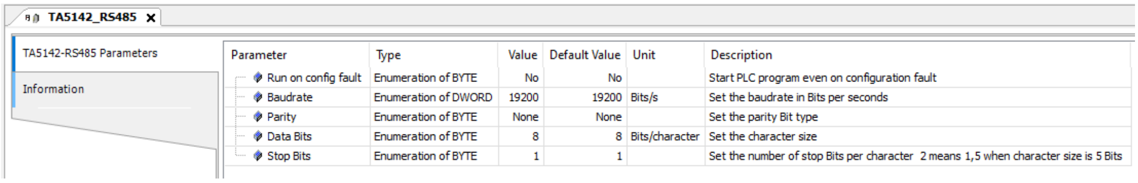
Settings on the module	State of LEDs	Internal wiring diagram	Description
			Master at the bus line end, pull-up and pull-down activated, bus termination 120 Ω
			Master within the bus line, pull-up and pull-down activated

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.



Parameter	Type	Value	Default Value	Unit	Description
Run on config fault	Enumeration of BYTE	No	No		Start PLC program even on configuration fault
Baudrate	Enumeration of DWORD	19200	19200	Bits/s	Set the baudrate in Bits per seconds
Parity	Enumeration of BYTE	None	None		Set the parity Bit type
Data Bits	Enumeration of BYTE	8	8	Bits/character	Set the character size
Stop Bits	Enumeration of BYTE	1	1		Set the number of stop Bits per character 2 means 1,5 when character size is 5 Bits

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

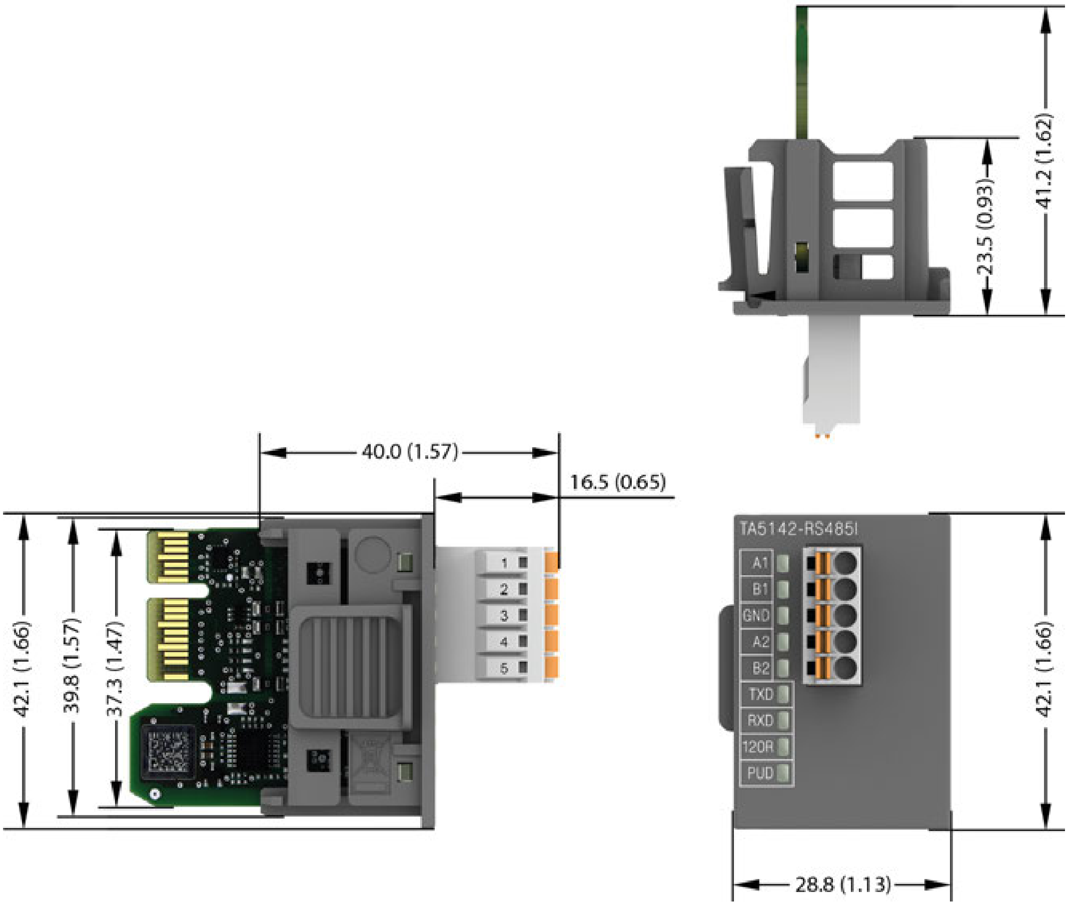
The system data of AC500-eCo V3 apply *Chapter 4.1 “System data AC500-eCo” on page 23*

Only additional details are therefore documented below.

Table 70: 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
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 V3, 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 V3, RS-485 non 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.*

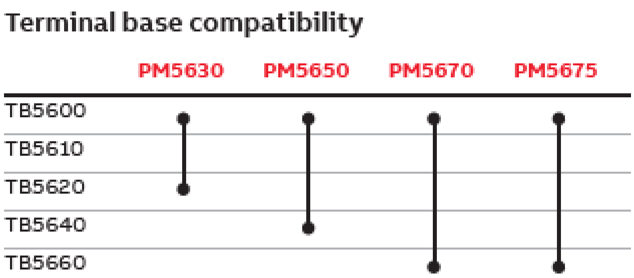
The terminal block listed in the table is for spare part only if needed.

5.1.2 AC500 and AC500-XC

5.1.2.1 Product overview and comparison

5.1.2.1.1 Comparison of AC500 V3 terminal bases

With the latest Automation Builder version the following terminal bases are compatible with the AC500 V3 processor modules:



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 71: Combination of TB56xx-2ETH(-XC) and PM56xx(-XC)

Processor module	PM5630	PM5650	PM5670	PM5675
TB5600-2ETH	0 slot	0 slot	0 slot	0 slot
TB5610-2ETH	1 slot	1 slot	1 slot	1 slot
TB5620-2ETH	2 slots	2 slots	2 slots	2 slots
TB5640-2ETH	-	4 slots	4 slots	4 slots
TB5660-2ETH	-	-	6 slots [1])	6 slots [1])
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 an index ≥ C0.				

Supported devices

The AC500 V3 terminal bases can be equipped with the following supported devices:

Table 72: Comparison: TB56xx

Processor module		PM5630	PM5650	PM5670	PM5675
Max. number of variables allowed for each communication module supported					
	Input variables	4 kB	4 kB	5 kB	5 kB
	Output variables	4 kB	4 kB	5 kB	5 kB

Processor module		PM5630	PM5650	PM5670	PM5675
Type of communication module supported					
	CM574-RS/RCOM - serial interface	No	No	No	No
	CM5610-2RS - 2 serial interfaces	x	x	x	x
	CM582-DP - PROFIBUS DP V0/V1 slave	x	x	x	x
	CM592-DP - PROFIBUS DP V0/V1 master	x	x	x	x
	CM579-ETHCAT - EtherCAT master	x	x	x	x
	CM579-PNIO - PROFINET IO RT controller	x	x	x	x
	CM589-PNIO - PROFINET IO RT device	x	x	x	x
	CM589-PNIO-4 - PROFINET IO RT with 4 devices	x	x	x	x
	CM597-ETH - Ethernet interface	No	No	No	No
	CM5640-2ETH - 2 Ethernet interfaces	x	x	x	x
	CM588-CN - CAN, CANopen slave	No	No	No	No
	CM598-CN - CAN, CANopen master	only CAN 2A/2B	only CAN 2A/2B	only CAN 2A/2B	only CAN 2A/2B
Type of AC500-S module supported					
	SM560-S - safety module	x	x	x	x
	SM560-S-FD-1 - safety module with F-Device functionality for 1 PROFIsafe network	x	x	x	x
	SM560-S -FD-4 - safety module with F-Device functionality for 1 PROFIsafe network	x	x	x	x

Memory size and performance

Table 73: Comparison: PM56xx

Processor module		PM5630	PM5650	PM5670	PM5675
Total maximum downloadable application size [1)]		9 MB	84 MB	176 MB	176 MB
	Thereof user program code and data (dynamically allocated)	2 MB	8 MB	32 MB	32 MB
	Thereof user webserver data max.	6 MB	72 MB	128 MB	128 MB
Flash memory for User data					
	Remaining for all other usage (project save, infrastructure...)	30 MB	285 MB	643 MB	643 MB
Buffered (SRAM)		256 kB	256 kB	1.5 MB	1.5 MB
	Thereof VAR retain persistent	128 kB	128 kB	1024 kB	1024 kB
	Thereof %M memory (e.g. Modbus register)	128 kB	128 kB	512 kB	512 kB
Expandable memory		None	None	None	None
Integrated mass storage memory (FLASH)		None	None	None	8 GB
Slot for pluggable memory card		x	x	x	x
Processor type		TI ARM Cortex-A9 32-bit-RISC			

Processor module		**PM5630**	**PM5650**	**PM5670**	**PM5675**
Processor clock speed		300 MHz	600 MHz	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
	Word	Min. 0.02 µs	Min. 0.01 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
Mathematic co-processor		x	x	x	x
Motion capability					
	No. synchronized axis per 1 ms on EtherCAT CM typically	-	8*	16*	16*
	No. synchronized axis per 2 ms on EtherCAT CM typically	4*	16*	32*	32*
	No. synchronized axis per 4 ms on EtherCAT CM or CANopen onboard typically	8*	32*	64*	64*
	Min. bus cycle time for EtherCAT using external CM579	2 ms	1 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			
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

Processor module		PM5630	PM5650	PM5670	PM5675
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
	Output variables	2 kB	4 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.

5.1.2.1.2 Comparison of features and protocols

Communication and onboard protocols

Table 74: OPC UA server / OPC DA server

Processor module		PM5630	PM5650	PM5670	PM5675
OPC UA server		x	x	x	x
	Number of free tags	3.000	10.000	30.000	30.000
	Number of connections	10	20	50	50
	Min. sampling rate (limit)	500 ms	100 ms	50 ms	50 ms
OPC DA server AE		x	x	x	x
	Number of connections	8	8	8	8

Table 75: Modbus, Telecontrol

Processor module		PM5630	PM5650	PM5670	PM5675
Modbus TCP client / server		x	x	x	x
	Number of Modbus clients ModMast in parallel on a CPU master (server)	30	50	120	120
	Number of Modbus server in parallel (e.g. for SCADA access)	15	25	50	50
IEC 60870-5-104 telecontrol protocol		x	x	x	x
	Number of free tags	1.000	5.000	10.000	10.000
	Control station (number of connections)	5	10	20	20
	Sub-station (number of connections)	5	10	20	20

5.1.2.1.3 Ethernet protocols and ports for AC500 V3 products

The communication module CM5640-2ETH acts as a port extender of the used AC500 V3 CPU.

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:

- 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.

Supported as of Automation Builder V 2.1

Description	**≥ CPU firm-ware**	**PM5630-2ETH**	**PM5650-2ETH**	**PM5670-2ETH**	**PM5675-2ETH**	**≥ CPU firm-ware**	**CM5640-2ETH**
ABB netConfig	V3.0.0	x	x	x	x	V3.6.0	x
Online access with driver 3S TCP/IP BlkDrvTcp	V3.0.0	x	x	x	x	V3.6.0	x
Modbus TCP server	V3.0.3	x	x	x	x	V3.6.0	x
Modbus TCP client with POU ETHx_MOD_MAST	V3.0.1	x	x	x	x	V3.6.0	x
UDP out of user program with library netBaseService.lib	V3.0.0	x	x	x	x	V3.6.0	x
UDP data exchange, Network variables	V3.0.0	x	x	x	x	V3.6.0	x
TCP/IP out of user program with library netBaseService.lib	V3.0.0	x	x	x	x	V3.6.0	x
Web server on PLC with web visualization	V3.0.0	x	x	x	x	V3.6.0	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
IEC60870-5-104 control station incl. 2^{nd} connection and 2^{nd} port	V3.0.0	x	x	x	x	V3.6.0	x
IEC60870-5-104 substation incl. 2^{nd} port	V3.0.0	x	x	x	x	V3.6.0	x
FTP server	V3.0.0	x	x	x	x	V3.6.0	x
CODESYS network variables	V3.0.0	x	x	x	x	V3.6.0	x
OPC DA server	V3.0.0	x	x	x	x	V3.6.0	x
OPC UA server	V3.0.0	x	x	x	x	V3.6.0	x
ICMP – ping out of user project with POU *ETHx_ICMP_PING*	V3.0.0	x	x	x	x	V3.6.0	x
DHCP client	V3.1.0	x	x	x	x	V3.6.0	x
NTP/SNTP ((Simple) Network Time Protocol) client system solution	V3.1.0	x	x	x	x	V3.6.0	x
NTP/SNTP ((Simple) Network Time Protocol) server system solution	V3.1.0	x	x	x	x	V3.6.0	x
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
IEC 61850 (MMS server, GOOSE) [2])	V3.1.0	x	x	x	x	V3.6.0	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	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
KNX - Building communication [2])	V3.2.x	x	x	x	x	V3.6.0	x
BACnet-BC - Infrastructure communication [2])	V3.3.1	x	x	x	x	V3.6.0	x

Description		≥ CPU firm-ware	PM5630-2ETH	PM5650-2ETH	PM5670-2ETH	PM5675-2ETH	≥ CPU firm-ware	CM5640-2ETH
HTTPS – secure web server on PLC with CODESYS web visualization		V3.1.0	x	x	x	x	V3.6.0	x
	WebVisu for data visualisation on web server HTML5	V3.0.0	x	x	x	x	V3.6.0	x
FTPS – secure FTP		V3.1.0	x	x	x	x	V3.6.0	x
Secure online access with driver 3S UDP BlkDrvUdp		V3.1.0	x	x	x	x	V3.6.0	x
Secure online access with driver 3S TCP/IP BlkDrvTcp		V3.1.0	x	x	x	x	V3.6.0	x
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
Modbus TCP client (master) with POU ETHx_MOD_MAST or ModTcpMast (PLCopen style)		V3.1.0	x	x	x	x	V3.6.0	x
RTV (Remote Target Visualization)		V3.1.0	x	x	x	x	V3.6.0	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 UDP BlkDrvUdp (with scan)	UDP 1740
Online access with driver 3S Tcp/Ip BlkDrvTcp (no scan)	TCP 11740
OPC UA server [2])	TCP 4840
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.	

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

Protocol	Port	Sockets
Online access with driver 3S UDP BlkDrvUdp (with scan)	1740	1 socket per connection + 4 listen
Online access with driver 3S block driver TCP/IP (no scan)	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 *ETHx_MOD_MAST*	Random	1 socket per connection with POU *ETHx_MOD_MAST*
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	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
FTPS – secure FTP	Command port = 21 Data active mode = 20 Data passive mode = random	1 per session, max. 4 allowed

Protocol	Port	Sockets
Secure online access with driver 3S UDP BlkDrvUdp	1740	1 socket per connection + 1 listen
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 *ETHx_MOD_MAST* or *ModTcpMast* (PLCopen style)	Random	1 socket per connection with POU *ETHx_MOD_MAST* or *ModTcpMast*

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	≥ CPU firm-ware
Modbus TCP server (e.g. for SCADA access)	30	100	100	100	3.0.3
	40	40	40	40	3.1.0
	15	25	50	50	3.1.3
Modbus TCP client with POU *ETHx_MOD_MAST*	n/a	100	n/a	n/a	3.0.1
	40	40	40	40	3.1.0
	30	50	120	120	3.1.3
Modbus TCP client with POU *ETHx_MOD_MAST* or *ModTcpMast* (PLCopen style)	30	100	100	100	3.1.0
	30	50	120	120	3.1.3
IEC60870-5-104 control station incl. 2nd connection and 2nd port	10	10	10	10	3.1.0
	5	10	20	20	3.4.0
IEC60870-5-104 substation incl. 2nd port	10	10	10	10	3.1.0
	5	10	20	20	3.4.0
IEC60870-5-104: No. of free tags + additional license for extension [1])	1.000	5.000	10.000	10.000	3.4.0
FTP server	4	4	4	4	3.1.0
Online access with driver 3S UDP BlkDrvUdp	n/a	4	n/a	n/a	3.0.0
	8	8	8	8	3.1.0
Online access with driver 3S TCP/IP BlkDrvTcp	n/a	4	n/a	n/a	3.0.0
	8	8	8	8	3.1.0
OPC DA server (number of connections)	n/a	4	n/a	n/a	3.0.0
	8	8	8	8	3.1.0
OPC UA server (number of connections)	50	50	50	50	3.1.0
	10	20	50	50	3.4.0

Protocol		PM5630-2ETH	PM5650-2ETH	PM5670-2ETH	PM5675-2ETH	≥ CPU firmware
	No. of free tags + additional license for extension [1])	1.000	5.000	30.000	30.000	3.4.0
	min sampling rate (limit)	500 ms	100 ms	50 ms	50 ms	3.4.0
Secure online access with driver 3S UDP BlkDrvUdp		8	8	8	8	3.1.0
Secure online access with driver 3S TCP/IP BlkDrvTcp		8	8	8	8	3.1.0
FTPS - secure FTP server		4	4	4	4	3.1.0
HTTPS – Integrated webserver – number of connections		4	8	12	12	3.4.0
RTV (Remote Target Visualization)		5	5	5	5	3.1.0
Remarks: [1]): in preparation						

The PLC types PM5630-2ETH, PM5670-2ETH and PM5675-2ETH are available as of SystemFW 3.1.0.

Ethernet configuration

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

Preferred driver for online access: 3S UDP block driver BlkDrvUdp. This driver allows to scan and select the connected PLC’s.

Alternative: 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*

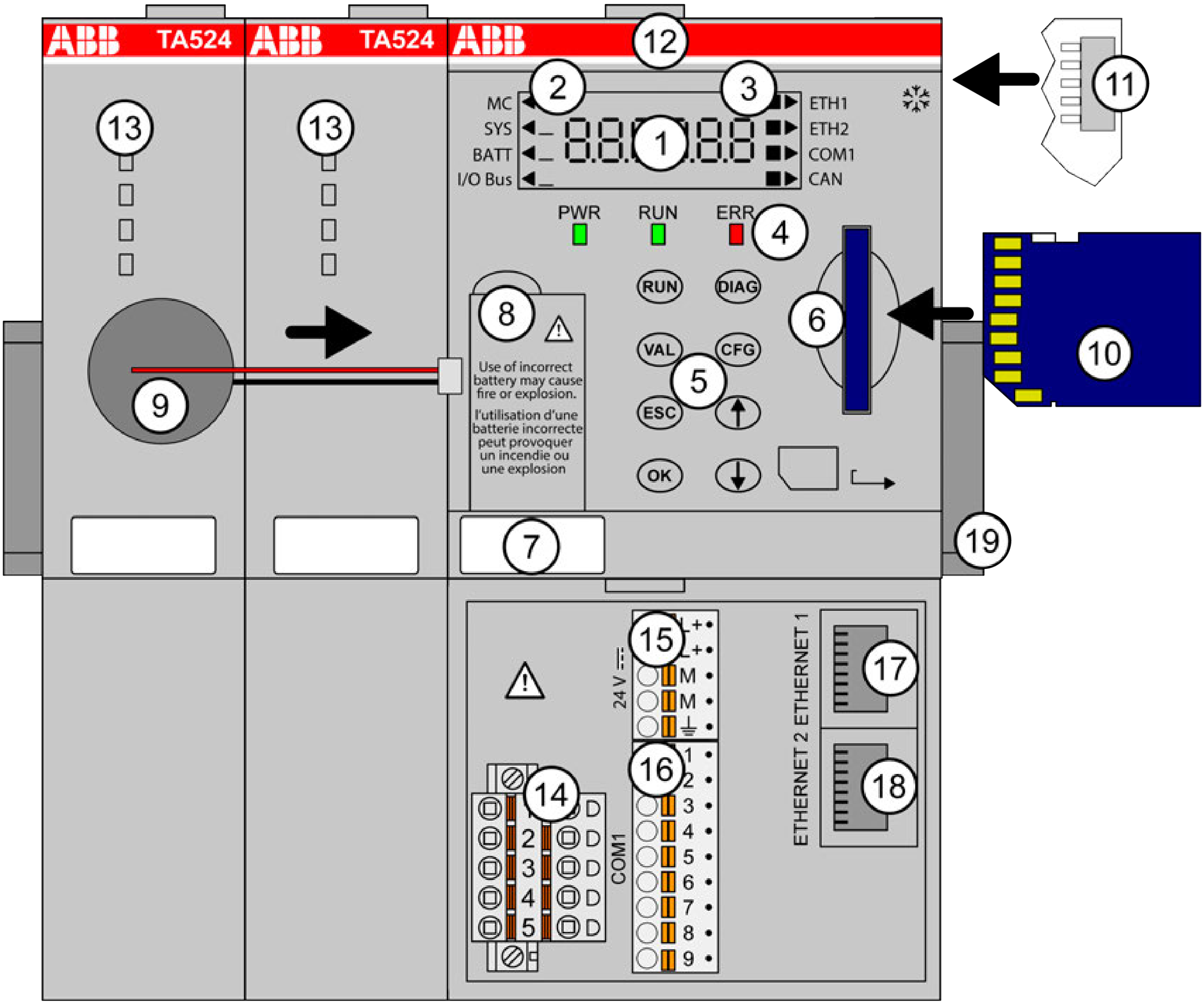
Each established connection needs one socket. In addition one socket on port 11740 is listening.

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 PM56xx-2ETH for AC500 V3 products

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.
- 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 lithium battery TA521
9 Lithium battery TA521
10 Memory card
11 I/O bus for connection of I/O modules
12 Slot for processor module (processor module mounted on terminal base)
13 Slots for communication modules (multiple, depending on terminal base; unused slots must be covered with TA524)
14 Interface for CAN (5-pin terminal block, removable)
15 Power supply (5-pin terminal block, removable)
16 Serial interface COM1 (9-pin terminal block, removable)
17 RJ45 female connector for ETHERNET1 connection
18 RJ45 female connector for ETHERNET2 connection
19 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 76: Comparison: TB56xx

Processor module		PM5630	PM5650	PM5670	PM5675
Max. number of variables allowed for each communication module supported					
	Input variables	4 kB	4 kB	5 kB	5 kB
	Output variables	4 kB	4 kB	5 kB	5 kB
Type of communication module supported					
	CM574-RS/RCOM - serial interface	No	No	No	No
	CM5610-2RS - 2 serial interfaces	x	x	x	x
	CM582-DP - PROFIBUS DP V0/V1 slave	x	x	x	x
	CM592-DP - PROFIBUS DP V0/V1 master	x	x	x	x
	CM579-ETHCAT - EtherCAT master	x	x	x	x
	CM579-PNIO - PROFINET IO RT controller	x	x	x	x
	CM589-PNIO - PROFINET IO RT device	x	x	x	x
	CM589-PNIO-4 - PROFINET IO RT with 4 devices	x	x	x	x
	CM597-ETH - Ethernet interface	No	No	No	No
	CM5640-2ETH - 2 Ethernet interfaces	x	x	x	x
	CM588-CN - CAN, CANopen slave	No	No	No	No
	CM598-CN - CAN, CANopen master	only CAN 2A/2B	only CAN 2A/2B	only CAN 2A/2B	only CAN 2A/2B
Type of AC500-S module supported					
	SM560-S - safety module	x	x	x	x
	SM560-S-FD-1 - safety module with F-Device functionality for 1 PROFIsafe network	x	x	x	x
	SM560-S -FD-4 - safety module with F-Device functionality for 1 PROFIsafe network	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 241*.

All other V3 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 you

– 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. For information on connection and available interfaces see the descriptions for

- *Chapter 5.3.1 “TB56xx for AC500 V3 products” on page 235*.

Processor modules PM56xx-2ETH can only be used with TB56xx-2ETH terminal bases.

Table 77: Combination of TB56xx-2ETH(-XC) and PM56xx(-XC)

Processor module	PM5630	PM5650	PM5670	PM5675
TB5600-2ETH	0 slot	0 slot	0 slot	0 slot
TB5610-2ETH	1 slot	1 slot	1 slot	1 slot
TB5620-2ETH	2 slots	2 slots	2 slots	2 slots
TB5640-2ETH	-	4 slots	4 slots	4 slots
TB5660-2ETH	-	-	6 slots [1])	6 slots [1])

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 an index ≥ C0.

5.1.2.2.3 Storage elements

Lithium battery

The processor modules are supplied without lithium battery. It must be ordered separately. The TA521 lithium battery is used for data (SRAM) and RTC buffering while the processor module is not powered.

The CPU monitors the discharge degree of the battery. A warning is issued before the battery condition becomes critical (about 2 weeks before). Once the warning message appears, the 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 lithium battery *Chapter 5.8.2.3 “TA521 - Battery” on page 1178*.

Memory card

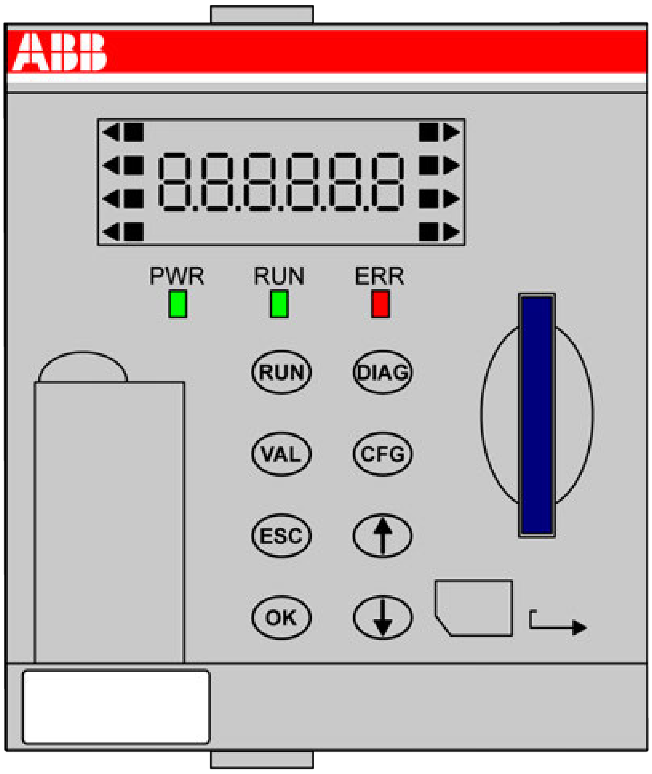
AC500 processor modules are supplied without memory card. It must be ordered separately.

The memory card can be used

- to read and write user files,
- to download a user program,
- for firmware updates,
- for program source code storage.

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 are applicable to the standard version. *Chapter 4.2 “System data AC500” on page 30*

The system data of AC500-XC are applicable to the XC version. *Chapter 4.3 “System data AC500-XC” on page 35*

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
Max. typ. (all communication modules and I/Os)	PM5630-2ETH: 850 mA PM5650-2ETH: 900 mA PM5670-2ETH: 950 mA PM5675-2ETH: 950 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 78: Comparison: PM56xx

Processor module		PM5630	PM5650	PM5670	PM5675
Total maximum downloadable application size 1)		9 MB	84 MB	176 MB	176 MB
	Thereof user program code and data (dynamically allocated)	2 MB	8 MB	32 MB	32 MB
	Thereof user webserver data max.	6 MB	72 MB	128 MB	128 MB
Flash memory for User data					
	Remaining for all other usage (project save, infrastructure...)	30 MB	285 MB	643 MB	643 MB
Buffered (SRAM)		256 kB	256 kB	1.5 MB	1.5 MB
	Thereof VAR retain persistent	128 kB	128 kB	1024 kB	1024 kB
	Thereof %M memory (e.g. Modbus register)	128 kB	128 kB	512 kB	512 kB
Expandable memory		None	None	None	None
Integrated mass storage memory (FLASH)		None	None	None	8 GB
Slot for pluggable memory card		x	x	x	x
Processor type		TI ARM Cortex-A9 32-bit-RISC			
Processor clock speed		300 MHz	600 MHz	1 GHz	1 GHz

Processor module		**PM5630**	**PM5650**	**PM5670**	**PM5675**
Cycle time for 1 instruction (minimum):					
	Binary	Min. 0.02 µs	Min. 0.01 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
	Floating point	Min. 0.12 µs	Min. 0.01 µs	Min. 0.002 µs	Min. 0.002 µs
Mathematic co-processor		x	x	x	x
Motion capability					
	No. synchronized axis per 1 ms on EtherCAT CM typically	-	8*	16*	16*
	No. synchronized axis per 2 ms on EtherCAT CM typically	4*	16*	32*	32*
	No. synchronized axis per 4 ms on EtherCAT CM or CANopen onboard typically	8*	32*	64*	64*
	Min. bus cycle time for EtherCAT using external CM579	2 ms	1 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			
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
User program protection by password		x (user management)			
Internal interfaces for communication:					

Processor module		PM5630	PM5650	PM5670	PM5675
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
	Output variables	2 kB	4 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 79: Combination of TB56xx-2ETH(-XC) and PM56xx(-XC)

Processor module	PM5630	PM5650	PM5670	PM5675
TB5600-2ETH	0 slot	0 slot	0 slot	0 slot
TB5610-2ETH	1 slot	1 slot	1 slot	1 slot

Processor module	PM5630	PM5650	PM5670	PM5675
TB5620-2ETH	2 slots	2 slots	2 slots	2 slots
TB5640-2ETH	-	4 slots	4 slots	4 slots
TB5660-2ETH	-	-	6 slots [1])	6 slots [1])
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 an index ≥ C0.				

Table 80: Comparison: TB56xx

Processor module		PM5630	PM5650	PM5670	PM5675
Max. number of variables allowed for each communication module supported					
	Input variables	4 kB	4 kB	5 kB	5 kB
	Output variables	4 kB	4 kB	5 kB	5 kB
Type of communication module supported					
	CM574-RS/RCOM - serial interface	No	No	No	No
	CM5610-2RS - 2 serial interfaces	x	x	x	x
	CM582-DP - PROFIBUS DP V0/V1 slave	x	x	x	x
	CM592-DP - PROFIBUS DP V0/V1 master	x	x	x	x
	CM579-ETHCAT - EtherCAT master	x	x	x	x
	CM579-PNIO - PROFINET IO RT controller	x	x	x	x
	CM589-PNIO - PROFINET IO RT device	x	x	x	x
	CM589-PNIO-4 - PROFINET IO RT with 4 devices	x	x	x	x
	CM597-ETH - Ethernet interface	No	No	No	No
	CM5640-2ETH - 2 Ethernet interfaces	x	x	x	x
	CM588-CN - CAN, CANopen slave	No	No	No	No
	CM598-CN - CAN, CANopen master	only CAN 2A/2B	only CAN 2A/2B	only CAN 2A/2B	only CAN 2A/2B
Type of AC500-S module supported					
	SM560-S - safety module	x	x	x	x
	SM560-S-FD-1 - safety module with F-Device functionality for 1 PROFIsafe network	x	x	x	x
	SM560-S -FD-4 - safety module with F-Device functionality for 1 PROFIsafe network	x	x	x	x

Communication and onboard protocols

Table 81: OPC UA server / OPC DA server

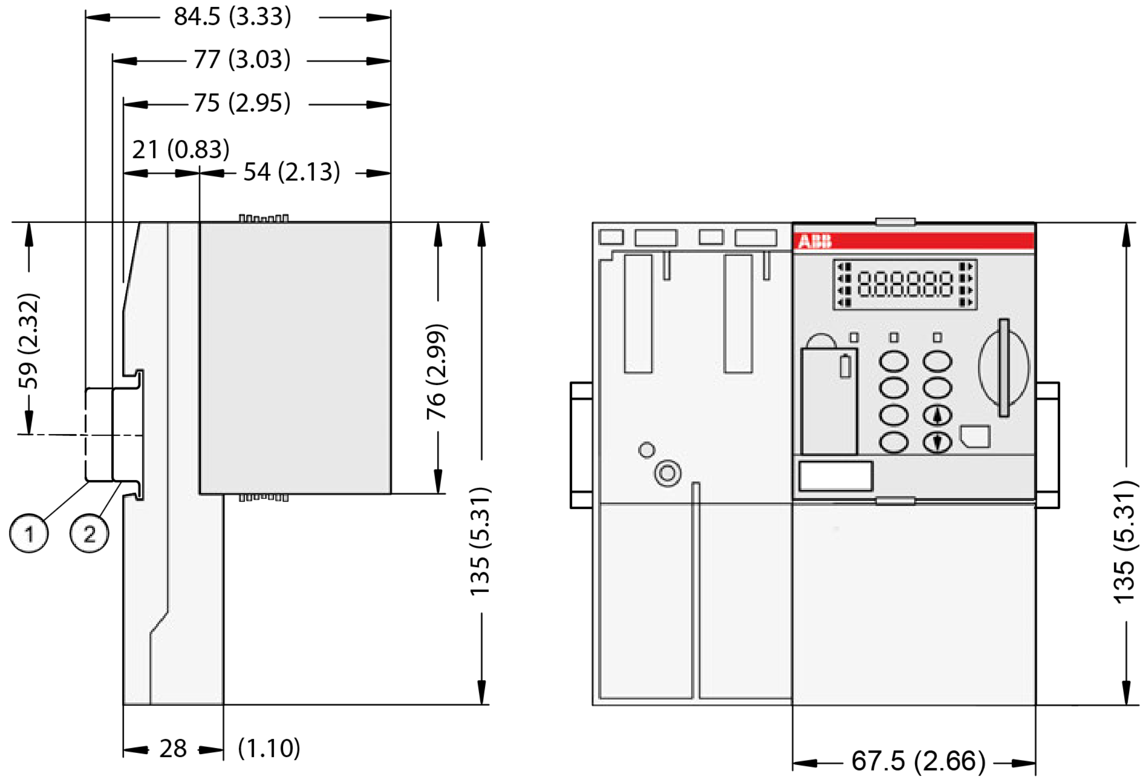
Processor module		PM5630	PM5650	PM5670	PM5675
OPC UA server		x	x	x	x
	Number of free tags	3.000	10.000	30.000	30.000
	Number of connections	10	20	50	50
	Min. sampling rate (limit)	500 ms	100 ms	50 ms	50 ms

Processor module		PM5630	PM5650	PM5670	PM5675
OPC DA server AE		x	x	x	x
	Number of connections	8	8	8	8

Table 82: Modbus, Telecontrol

Processor module		PM5630	PM5650	PM5670	PM5675
Modbus TCP client / server		x	x	x	x
	Number of Modbus clients ModMast in parallel on a CPU master (server)	30	50	120	120
	Number of Modbus server in parallel (e.g. for SCADA access)	15	25	50	50
IEC 60870-5-104 telecontrol protocol		x	x	x	x
	Number of free tags	1.000	5.000	10.000	10.000
	Control station (number of connec- tions)	5	10	20	20
	Sub-station (number of connections)	5	10	20	20

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 for AC500 (Standard) V3 products

To enable better product availability into the production and to provide some new features, a revision 3 of the existing AC500 V3 processor module was necessary. The existing AC500 V3 processor module revision 2 with rubric R0**2**78 will move to classic and will be replaced by compatible new AC500 V3 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.

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 83: Processor modules for AC500 (Standard) V3

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	Active -> 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	In preparation

Part no.	Description	Product life cycle phase *)
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	Active -> Classic (replaced by processor module revision 3)
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	In preparation
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	Active -> 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	In preparation
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	Active -> 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	In preparation
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	Active -> Classic (replaced by processor module revision 3)

Part no.	Description	Product life cycle phase *)
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	In preparation
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	Active -> 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	In preparation
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	Active -> 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	In preparation
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	Active -> Classic (replaced by processor module revision 3)

Part no.	Description	Product life cycle phase *)
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	In preparation
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

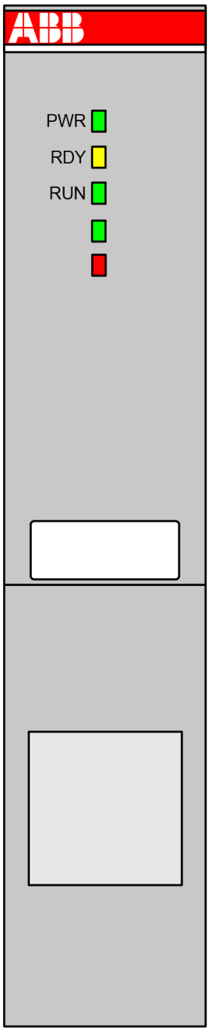
**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

Table 84: Accessories

Part no.	Description
1SAP 180 300 R0001	TA521, lithium battery

5.2 Communication modules for AC500(-XC) processor modules

5.2.1 Overview



AC500 communication modules are required for

- a connection to standard fieldbus systems and
- for integration into existing networks.

AC500 communication modules

- enable communication on different fieldbuses.
- are mounted on the left side of the processor module on the same terminal base.
- 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 you

– 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, which is integrated in the terminal base. Depending on the used terminal base up to 6 communication modules can be connected.

- *Chapter 5.3.1 "TB56xx for AC500 V3 products" on page 235*

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

- bus master or
- slave.

It depends on the

- selected protocol,
- the functionality of the communication module and
- the several field buses and networks.

The following name extensions of the device names describe the supported field bus/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.

5.2.1.1 Compatibility of communication modules and communication interface modules

Table 85: 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 inter-face	CI521-MODTCP CI522-MODTCP	x	x	--	high availability, remote I/O
Onboard Ethernet inter-face	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 86: 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 87: 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 88: 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 89: 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

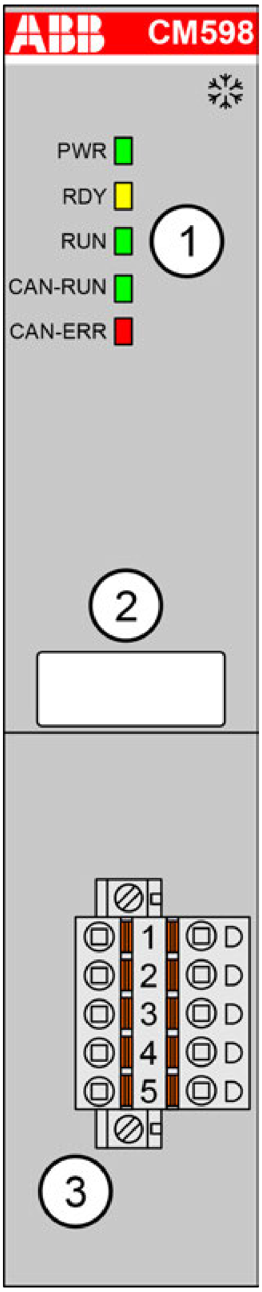
5.2.1.2 Technical data (Overview)

Communica-tion module	Field bus	Transmission rate	Field bus connector	Processor	Communica-tion module interface	Current con-sumption from 24 V DC power supply at the ter-minal 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
CM5640-2ET H	2 x Ethernet	10 or 100 MBit/s	2 x RJ45	TI ARM Cortex-A9	Dual-port RAM	Typ. 47 mA

5.2.2 CANopen

5.2.2.1 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

5.2.2.1.1 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.

> *The AC500 V3 CPUs only support CAN 2A/2B protocol on the communication module CM598-CAN.*
>
> *Support of CANopen protocol is in preparation.*

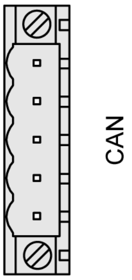
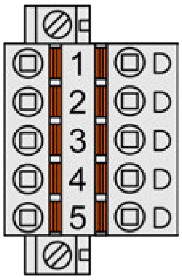
5.2.2.1.2 Connections

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,

The CANopen connector has the following pin assignment:

Pin assignment

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.

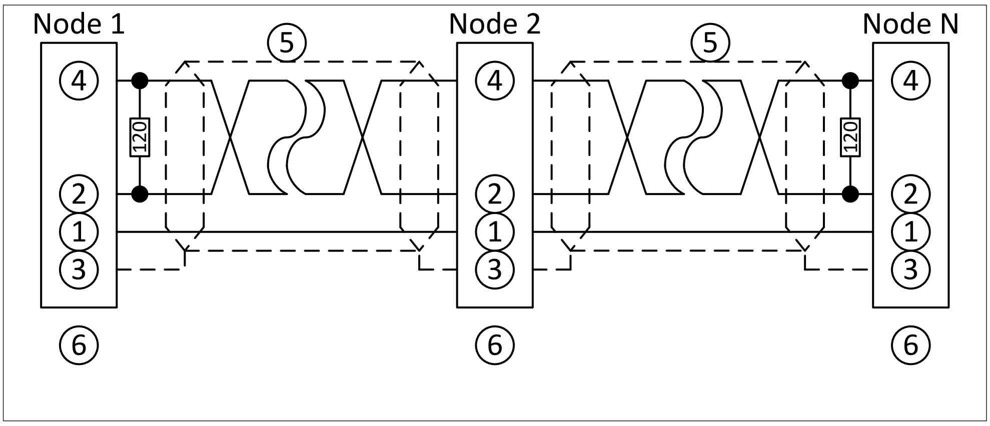


Fig. 17: CANopen interface, bus terminating resistors connected to the line ends

1	CAN_GND
2	CAN_L
3	Shield
4	CAN_H
5	Data line, shielded twisted pair
6	COMBICON connection, CANopen interface

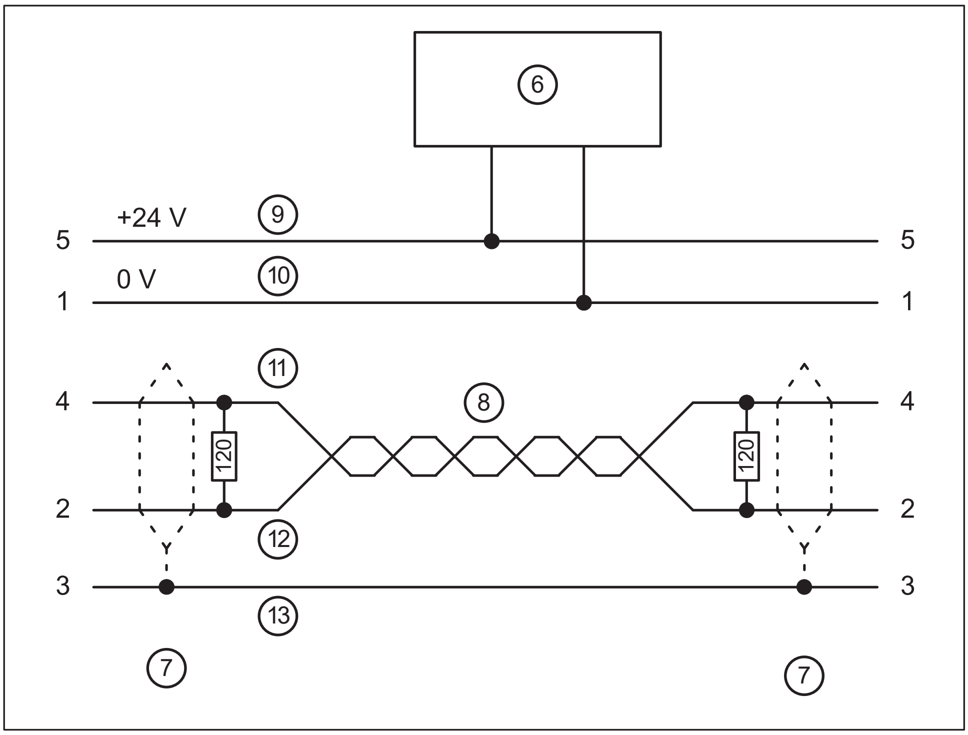


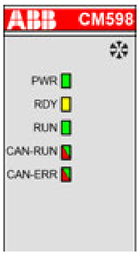
Fig. 18: DeviceNet interface, bus terminating resistors connected to the line ends

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 30.*

5.2.2.1.3 State LEDs

Table 90: 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.
	CAN-ERR	Red	(alternately)	Do not power off the PLC!

5.2.2.1.4 Technical data

The system data of AC500 and S500 are applicable to the standard version *Chapter 4.2 "System data AC500" on page 30*.

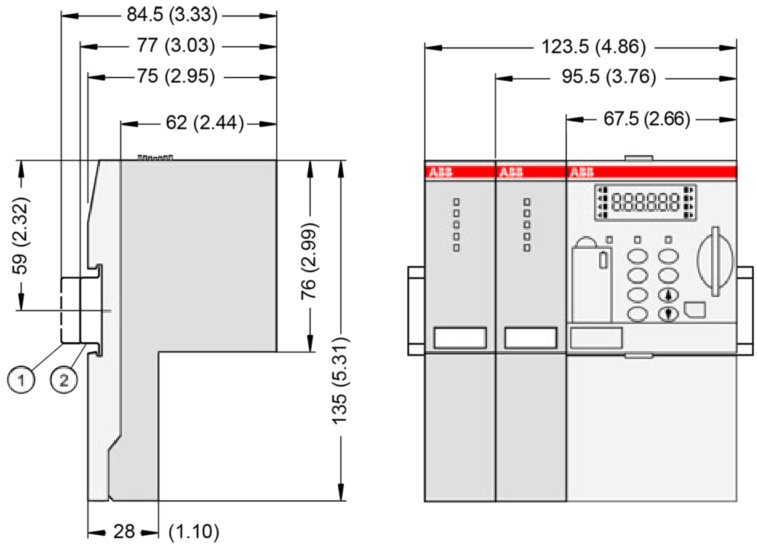
The system data of AC500-XC are applicable to the XC version *Chapter 4.3 "System data AC500-XC" on page 35*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter	Value
Protocol	CANopen master (in preparation), 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 30* System Data AC500-XC ⇨ *Chapter 4.3 “System data AC500-XC” on page 35*
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

5.2.2.1.5 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

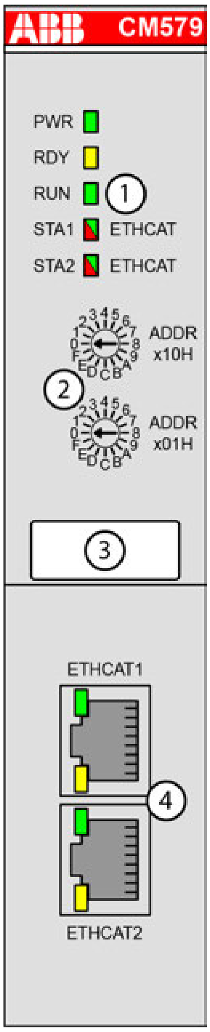
5.2.2.1.6 Ordering data

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.*

5.2.3 EtherCAT

5.2.3.1 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)

5.2.3.1.1 Intended purpose

Communication module CM579-ETHCAT is for EtherCAT communication.

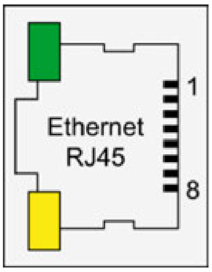
The comunication module is configured via the dual-port memory by means of a system configurator. The configuration is saved on a non-volatile Flash EPROM memory.

5.2.3.1.2 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):

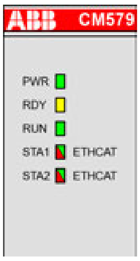
At the EtherCAT slaves (communication interface modules), the ETH1-connector is IN and the ETH2-connector is OUT.

At the EtherCAT master (communication module), the ETHCAT1 connector has to be used. The ETHCAT2 connector is reserved for future extensions.

5.2.3.1.3 State LEDs

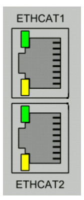
The EtherCAT state is shown by the EtherCAT communication module's LEDs. Some LEDs are two-colored.

Table 91: 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 92: 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		

5.2.3.1.4 Technical data

The system data of AC500 and S500 are applicable to the standard version *Chapter 4.2 "System data AC500" on page 30*.

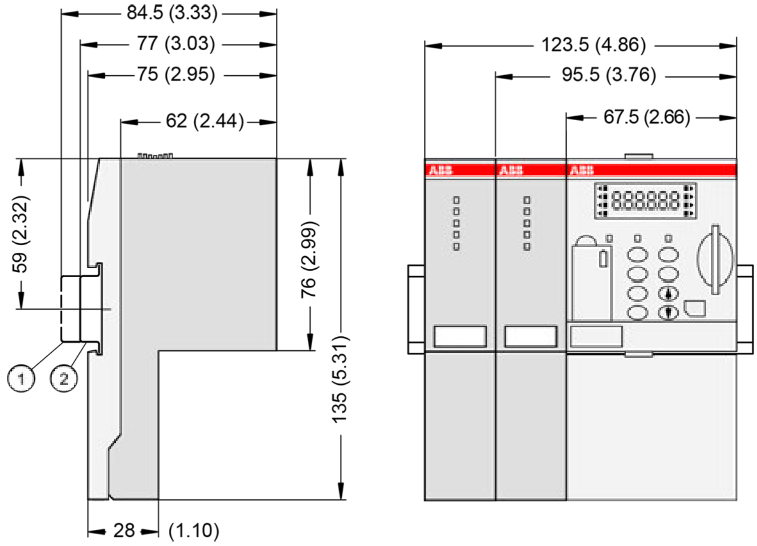
The system data of AC500-XC are applicable to the XC version *Chapter 4.3 "System data AC500-XC" on page 35*.

Only additional details are therefore documented below.

The technical data are 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 "PM56xx-2ETH for AC500 V3 products" on page 179*
Usable terminal bases	All TB56xx (not TB5600) *Chapter 5.3.1 "TB56xx for AC500 V3 products" on page 235*
Ambient temperature	System data AC500 *Chapter 4.2 "System data AC500" on page 30* System Data AC500 XC *Chapter 4.3 "System data AC500-XC" on page 35*
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
Max. size of the bus configuration file	2 MB
Weight	Ca. 170 g

5.2.3.1.5 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

5.2.3.1.6 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.*

5.2.4 Ethernet

5.2.4.1 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

5.2.4.1.1 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)

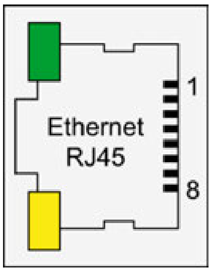
For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

5.2.4.1.2 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

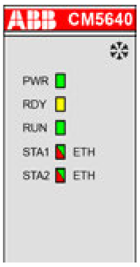
In corrosive environment, please protect unused connectors using the TA535 accessory.

Not supplied with this device.

5.2.4.1.3 State LEDs

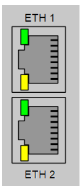
The Ethernet state is shown by the Ethernet communication module's LEDs.

Table 93: 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	Communication module is in firmware update state. Do not power off the PLC!
	STA2	Red	(alternately)	

The RJ45 Ethernet connector contains two LEDs showing the current Ethernet port connection state.

Table 94: 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	---

5.2.4.1.4 Technical data

The system data of AC500 and S500 are applicable to the standard version *Chapter 4.2 “System data AC500” on page 30*.

The system data of AC500-XC are applicable to the XC version *Chapter 4.3 “System data AC500-XC” on page 35*.

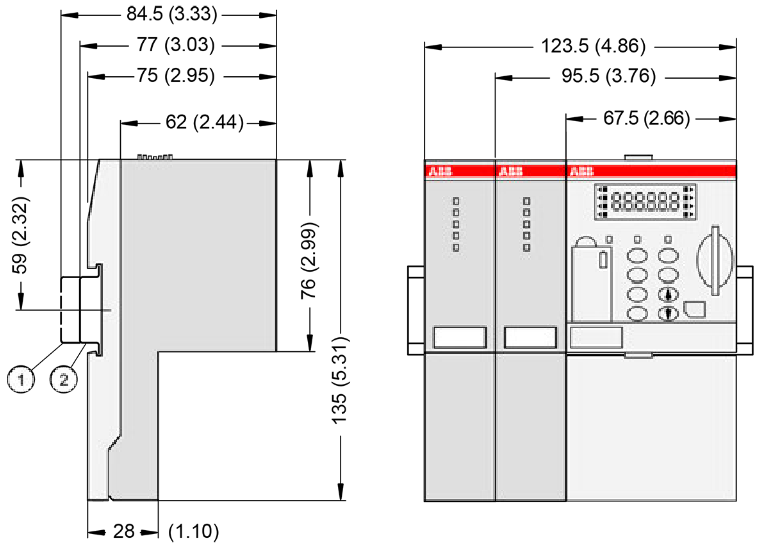
Only additional details are therefore documented below.

The technical data are 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
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 “PM56xx-2ETH for AC500 V3 products” on page 179*
	Usable terminal bases	TB56xx *Chapter 5.3.1 “TB56xx for AC500 V3 products” on page 235*

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

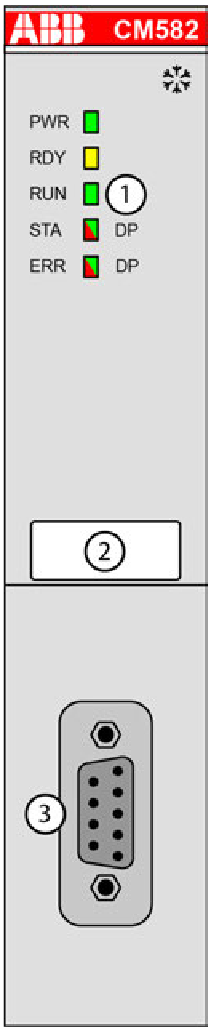
Part no.	Description	Product life cycle phase *)
1SAP 176 000 R0080	CM5640-2ETH, communication module Ethernet TCP/IP with 2 RJ45 CPU port extensions	Active
1SAP 376 000 R0080	CM5640-2ETH-XC, communication module Ethernet TCP/IP with 2 RJ45 CPU port extensions, XC version	Active

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

5.2.5 PROFIBUS

5.2.5.1 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

5.2.5.1.1 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.

5.2.5.1.2 Connections

Field bus interface

The PROFIBUS DP connector (9-pin, female) has the following pin assignment:

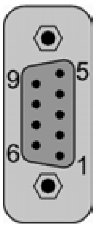
Pin		Signal	Description
	1	NC	Not connected
	2	NC	Not connected
	3	RxD/TxD-P	Receive/Transmit positive
	4	CNTR-P	Control signal for repeater, positive
	5	DGND	Reference potential for data exchange and +5 Vl
	6	VP	+5 V (power supply for the bus terminating resistors)
	7	NC	Not connected
	8	RxD/TxD-N	Receive/Transmit negative
	9	NC	Not connected

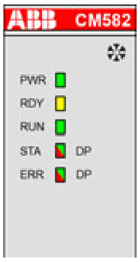
Table 95: Correlation of transmission rate, bit time and cable length:

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

5.2.5.1.3 State LEDs

The PROFIBUS state is shown by state LEDs.

Table 96: 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	No production data available,
	ERR	Yellow	(synchronously)	no bus communication possible.
LED state during firmware update	STA	Green	Blinking	Firmware file transfers during communication module firmware update.
	ERR	Red	(synchronously)	
	STA	Green	Blinking	Communication module writes the firmware file to the internal flash.
	ERR	Red	(alternately)	Do not power off the PLC!

5.2.5.1.4 Technical data

The system data of AC500 and S500 are applicable to the standard version *Chapter 4.2 “System data AC500” on page 30*.

The system data of AC500-XC are applicable to the XC version *Chapter 4.3 “System data AC500-XC” on page 35*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

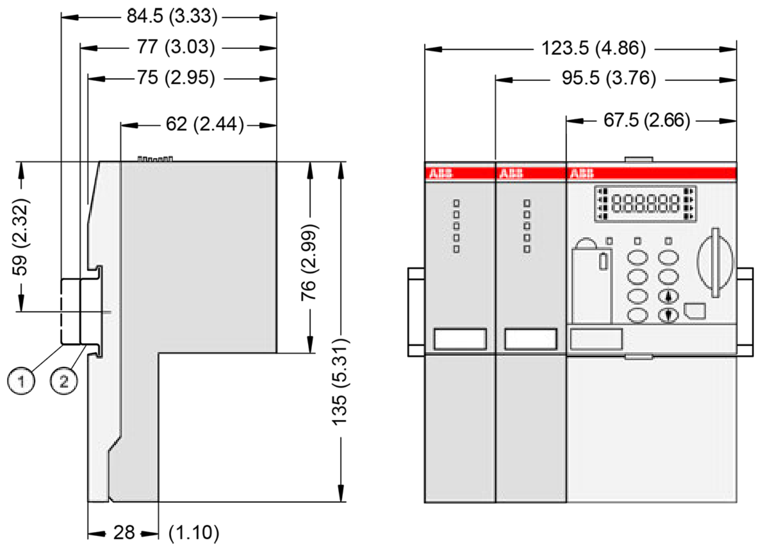
Parameter	Value
State indication	By 5 LEDs PWR, RDY, RUN, STA, ERR
Usable CPUs	PM57x, PM58x, PM59x
Usable terminal bases	All TB5xx

Parameter	Value
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

5.2.5.1.5 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

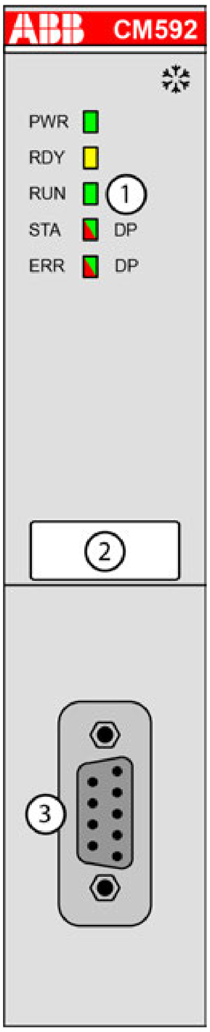
5.2.5.1.6 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 172 200 R0001	CM582-DP, communication module PROFIBUS DP slave, 12 MBit/s	Active
1SAP 372 200 R0001	CM582-DP, 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.*

5.2.5.2 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

5.2.5.2.1 Purpose

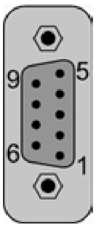
Communication module CM592-DP enables communication over the PROFIBUS DP field bus.

For use in extreme ambient conditions (e.g. wider temperature and humidity range), a special XC version of the device is available.

5.2.5.2.2 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

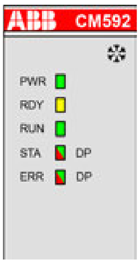
Table 97: Correlation of transmission rate, bit time and cable length:

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

5.2.5.2.3 State LEDs

The PROFIBUS state is shown by state LEDs.

Table 98: 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 dis-connected
			Flashes cyclic	Communication to at least one slave is disconnected
			OFF	No error
	STA	Yellow	Blinking	No production data available,
	ERR	Yellow	(synchronously)	no bus communication possible.
LED state during firmware update	STA	Green	Blinking	Firmware file transfers during communication module firmware update.
	ERR	Red	(synchronously)	
	STA	Green	Blinking	Communication module writes the firmware file to the user flash memory. Do not power off the PLC!
	ERR	Red	(alternately)	

5.2.5.2.4 Technical data

The system data of AC500 and S500 are applicable to the standard version *Chapter 4.2 “System data AC500” on page 30*.

The system data of AC500-XC are applicable to the XC version *Chapter 4.3 “System data AC500-XC” on page 35*.

Only additional details are therefore documented below.

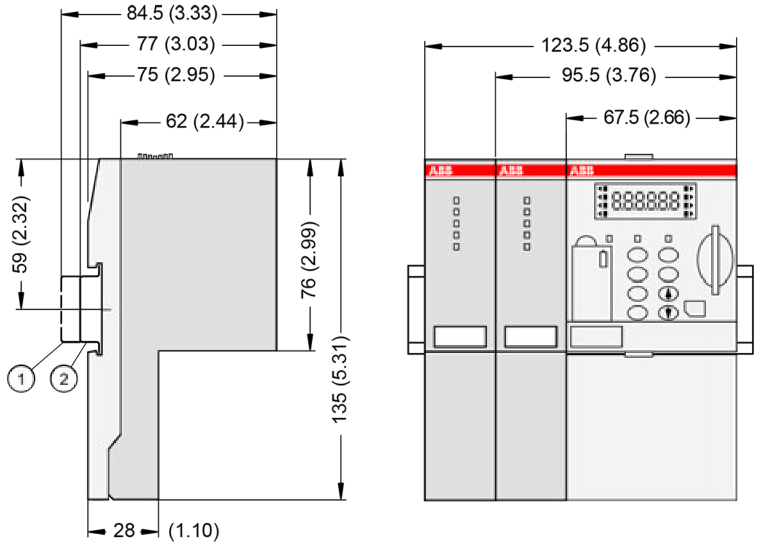
The technical data are also applicable to the XC version.

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

5.2.5.2.5 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

5.2.5.2.6 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, 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.*

5.2.5.3 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

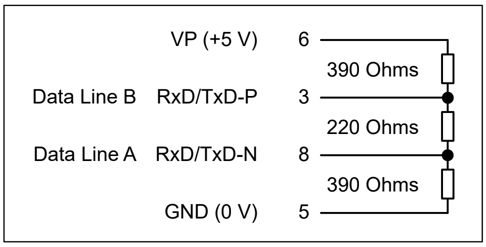
The maximum possible cable length of a PROFIBUS subnet within a segment depends on the tranmission rate (baud rate).

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.

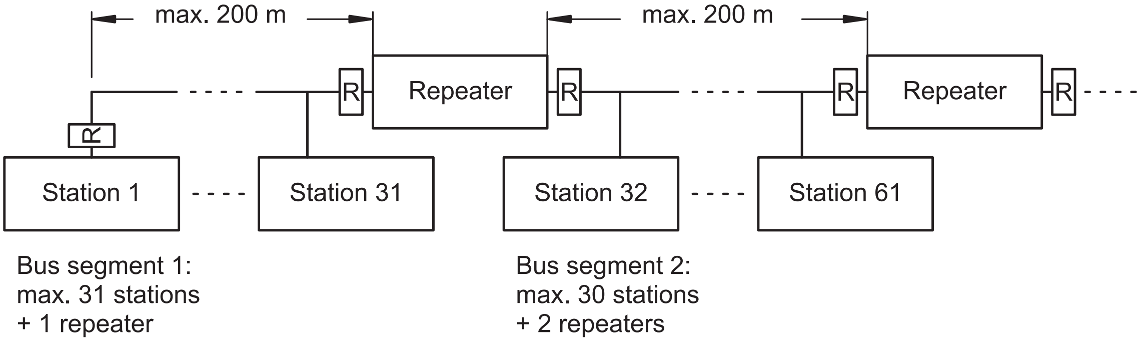
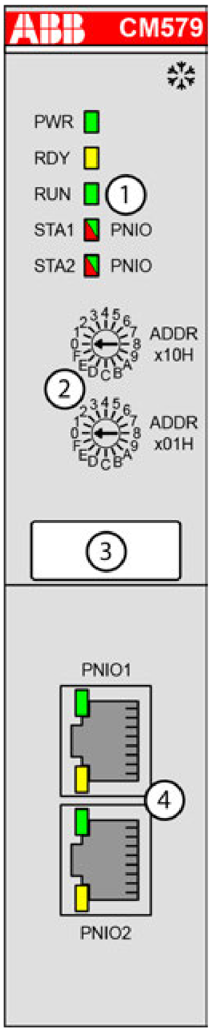


Fig. 19: Principle example for a PROFIBUS-DP system with repeaters (1500 kbit/s baud rate)

5.2.6 PROFINET

5.2.6.1 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

5.2.6.1.1 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.

5.2.6.1.2 Functionality

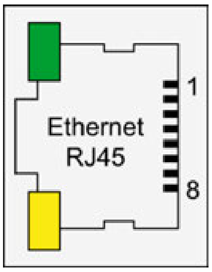
Parameter	Value
Protocol	PROFINET IO RT
Usable CPUs	PM57x, PM58x, PM59x *Chapter 5.1.2.2 “PM56xx-2ETH for AC500 V3 products” on page 179*
Usable terminal bases	All TB56xx (not TB5600) *Chapter 5.3.1 “TB56xx for AC500 V3 products” on page 235*
Field bus connector	2 RJ45 (PNIO1 and PNIO2), with integrated 2-port switch
Internal supply	Via the communication module interface of the terminal base

5.2.6.1.3 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

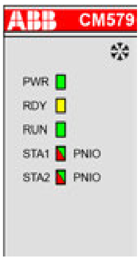
In corrosive environment, please protect unused connectors using the TA535 accessory.

Not supplied with this device.

5.2.6.1.4 State LEDs

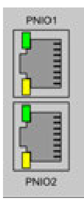
The PROFINET state is shown by the state LEDs.

Table 99: 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.
	STA2	Red	(alternately)	Do not power off the PLC!

The RJ45 Ethernet connector contains two LEDs showing the current Ethernet port connection state.

Table 100: 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	---

5.2.6.1.5 Technical data

The system data of AC500 and S500 are applicable to the standard version *Chapter 4.2 “System data AC500” on page 30*.

The system data of AC500-XC are applicable to the XC version *Chapter 4.3 “System data AC500-XC” on page 35*.

Only additional details are therefore documented below.

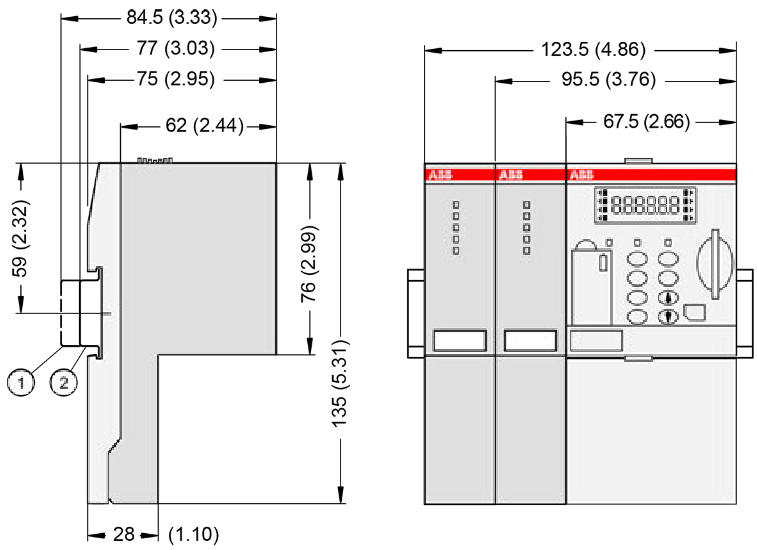
The technical data are also applicable to the XC version.

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 “TB56xx for AC500 V3 products” on page 235*
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".

5.2.6.1.6 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

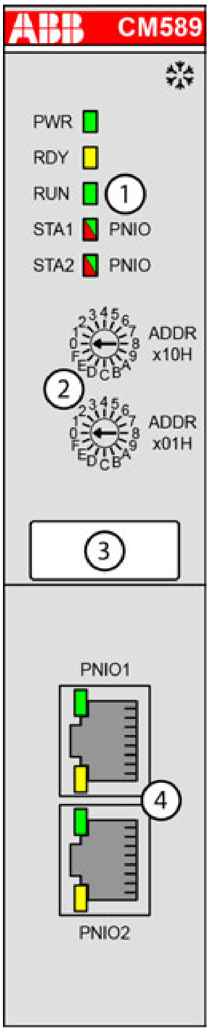
5.2.6.1.7 Ordering data

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.*

5.2.6.2 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.*

5.2.6.2.1 Functionality

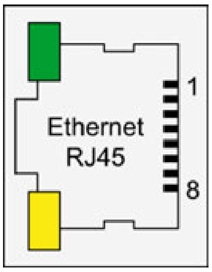
Parameter	Value
Protocol	PROFINET IO RT
Usable CPUs	PM57x, PM58x, PM59x ➡ *Chapter 5.1.2.2 “PM56xx-2ETH for AC500 V3 products” on page 179*
Usable terminal bases	All TB56xx (not TB5600) ➡ *Chapter 5.3.1 “TB56xx for AC500 V3 products” on page 235*
Field bus connector	2 RJ45 (PNIO1 and PNIO2), with integrated 2-port switch
Internal supply	Via the communication module interface of the terminal base

5.2.6.2.2 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.

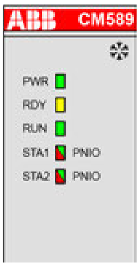
5.2.6.2.3 Addressing

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.

5.2.6.2.4 State LEDs

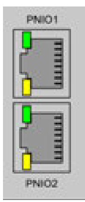
The PROFINET state is shown by the state LEDs.

Table 101: 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	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 102: 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	---

5.2.6.2.5 Technical data

The system data of AC500 and S500 are applicable to the standard version *Chapter 4.2 "System data AC500" on page 30*.

The system data of AC500-XC are applicable to the XC version *Chapter 4.3 "System data AC500-XC" on page 35*.

Only additional details are therefore documented below.

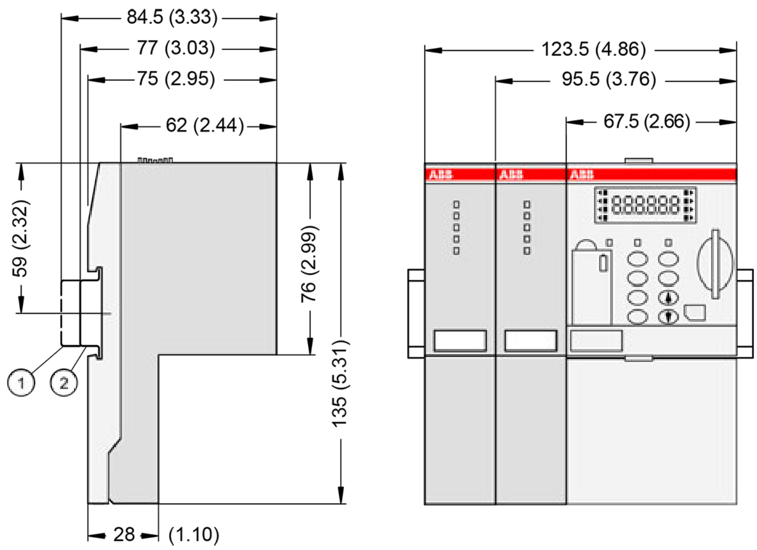
The technical data are also applicable to the XC version.

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 TB5xx
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
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

Parameter	Value
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".

5.2.6.2.6 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

> *The dimensions are in mm and in brackets in inch.*

5.2.6.2.7 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

Part no.	Description	Product life cycle phase *)
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 TB56xx for AC500 V3 products

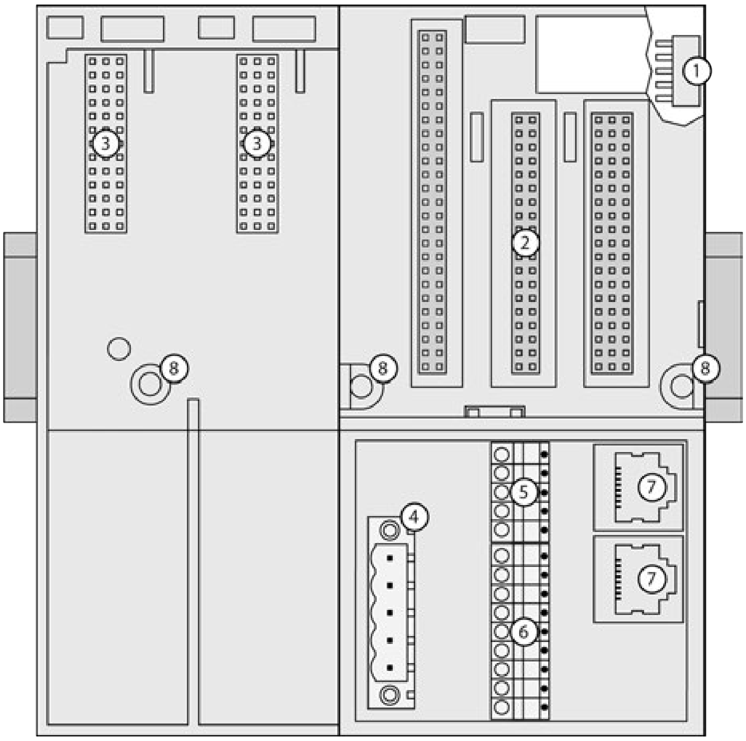
- TB5600-2ETH: 1 processor module, with network interface 2 Ethernet RJ45, 1 CAN and 1 COM1
- TB5610-2ETH: 1 processor module, 1 communication module, with network interface 2 Ethernet RJ45, 1 CAN and 1 COM1
- TB5620-2ETH: 1 processor module, 2 communication modules, with network interface 2 Ethernet 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 103: Combination of TB56xx-2ETH(-XC) and PM56xx(-XC)

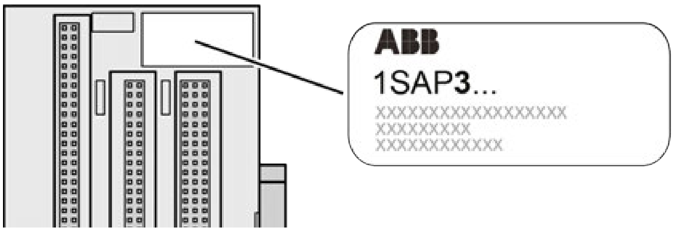
Processor module	PM5630	PM5650	PM5670	PM5675
TB5600-2ETH	0 slot	0 slot	0 slot	0 slot
TB5610-2ETH	1 slot	1 slot	1 slot	1 slot
TB5620-2ETH	2 slots	2 slots	2 slots	2 slots
TB5640-2ETH	-	4 slots	4 slots	4 slots
TB5660-2ETH	-	-	6 slots [1])	6 slots [1])
Remarks: The slots can be used for connecting communication modules or AC500-S modules. Note that only one AC500-S module can be connected at one terminal base. [1]) PM567x must have an index ≥ C0.				

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 104: Combination of TB56xx-2ETH(-XC) and PM56xx(-XC)

Processor module	PM5630	PM5650	PM5670	PM5675
TB5600-2ETH	0 slot	0 slot	0 slot	0 slot
TB5610-2ETH	1 slot	1 slot	1 slot	1 slot
TB5620-2ETH	2 slots	2 slots	2 slots	2 slots
TB5640-2ETH	-	4 slots	4 slots	4 slots
TB5660-2ETH	-	-	6 slots [1])	6 slots [1])
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 an index ≥ C0.				

> **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 5.8.2.4 “TA524 - Dummy communication module” on page 1182*.
> – I/O bus connectors must not be touched during operation.

5.3.1.2 Connections

5.3.1.2.1 I/O bus

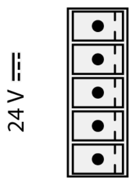
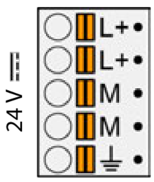
The I/O bus is the I/O data bus for the I/O modules. Through this bus, I/O and diagnosis data are transferred between the processor module and the I/O modules. Up to 10 I/O modules can be added.

Chapter 5.4.1 “I/O bus - Data transfer” on page 245

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 30* 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).

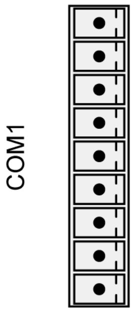
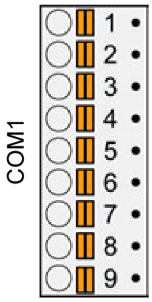
NOTICE!
For applications using XC versions!
To ensure reliability and proper function, make sure the ambient temperature never exceeds +60 °C when the current flowing through the removable clamps is 8 A (with 1.5 mm^2 conductor).

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
 Terminal block removed	 Terminal block inserted	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.

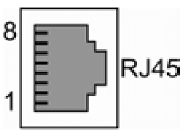
TB56xx-2ETH for processor modules PM56xx-2ETH provide 2 independent Ethernet interfaces.

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 1191*.

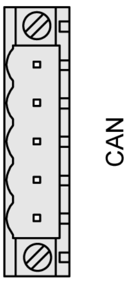
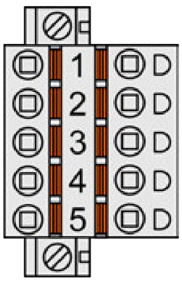
Supported protocols and used Ethernet ports

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 (transmis- sion 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

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 are applicable to the standard version. *Chapter 4.2 “System data AC500” on page 30*

The system data of AC500-XC are applicable to the XC version. *Chapter 4.3 “System data AC500-XC” on page 35*

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: 0.25 A [1]) TB5610: 0.35 A [1]) TB5620: 0.4 A [1]) TB5640: 0.6 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

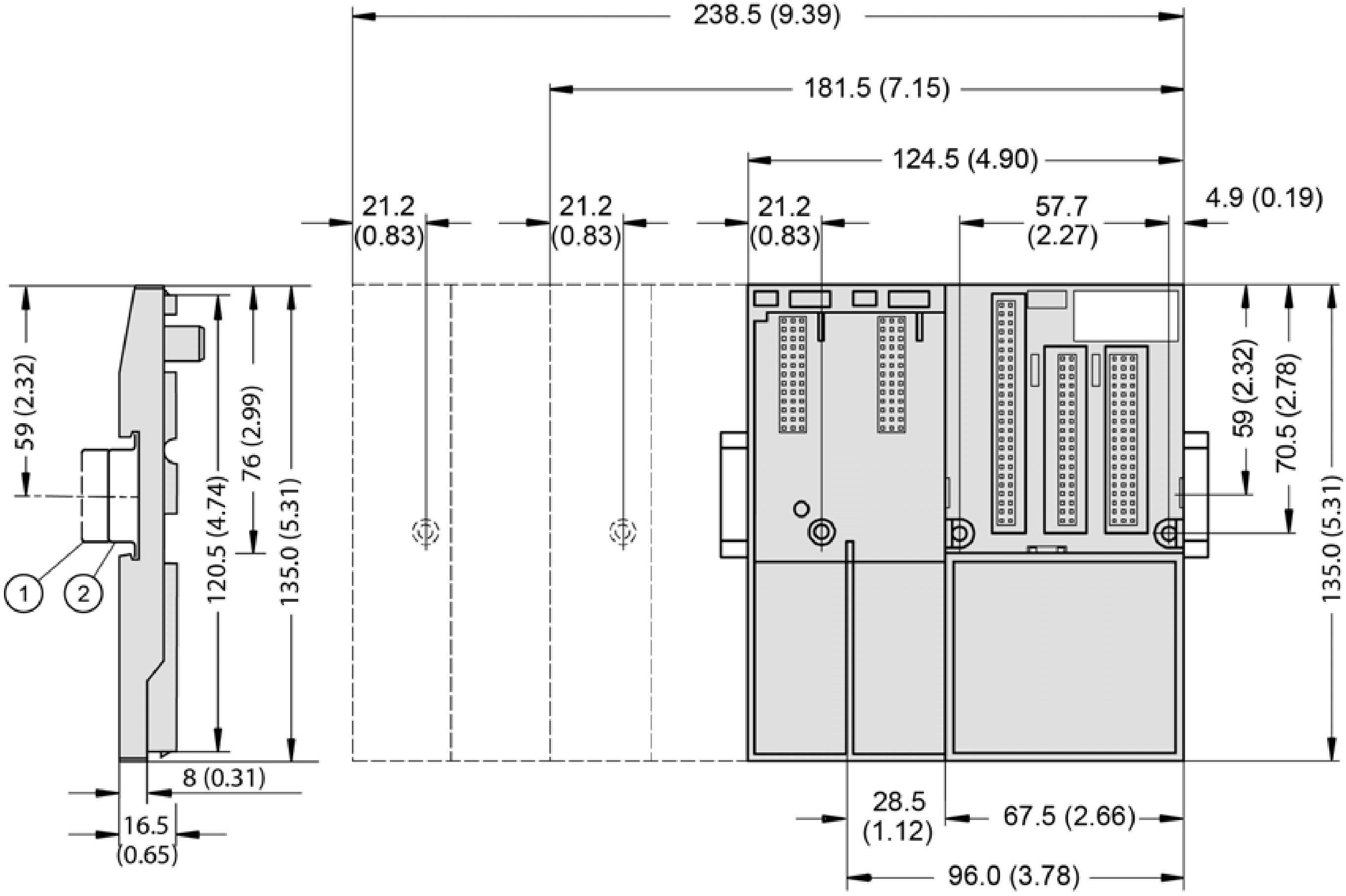
[1]) Including processor modules, communication modules and communication interface modules

[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 105: Combination of TB56xx-2ETH(-XC) and PM56xx(-XC)

Processor module	PM5630	PM5650	PM5670	PM5675
TB5600-2ETH	0 slot	0 slot	0 slot	0 slot
TB5610-2ETH	1 slot	1 slot	1 slot	1 slot
TB5620-2ETH	2 slots	2 slots	2 slots	2 slots
TB5640-2ETH	-	4 slots	4 slots	4 slots
TB5660-2ETH	-	-	6 slots [1])	6 slots [1])
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 an index ≥ C0.				

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 106: Combination of TB56xx-2ETH(-XC) and PM56xx(-XC)

Processor module	PM5630	PM5650	PM5670	PM5675
TB5600-2ETH	0 slot	0 slot	0 slot	0 slot
TB5610-2ETH	1 slot	1 slot	1 slot	1 slot
TB5620-2ETH	2 slots	2 slots	2 slots	2 slots
TB5640-2ETH	-	4 slots	4 slots	4 slots
TB5660-2ETH	-	-	6 slots [1])	6 slots [1])
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 an index ≥ C0.				

Table 107: Accessories

Part no.	Description
1SAP 180 800 R0001	TA526, wall mounting accessory

5.4 I/O modules

Hot swap

System requirements for hot swapping of I/O modules:

- *Types of terminal units that support hot swapping of I/O modules have the appendix TU5xx**-H**.*
- *I/O modules as of index F0.*

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.*

.

5.4.1 I/O bus - Data transfer

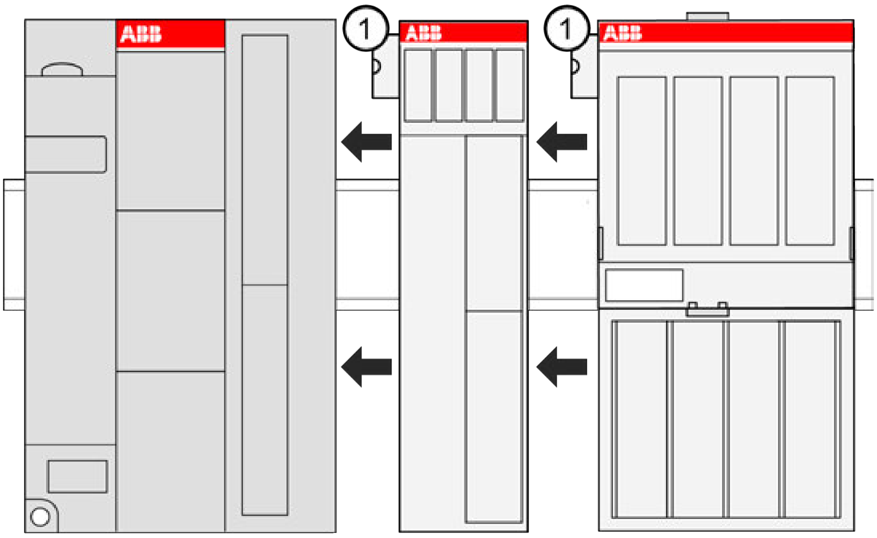
The I/O bus is the I/O data bus for the I/O modules. Through this bus, I/O and diagnosis data are transferred between the processor module and the I/O modules. Up to 10 I/O modules can be added.

Chapter 5.4.1 “I/O bus - Data transfer” on page 245

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 108 “Maximum number of I/O devices which can be connected to the I/O bus” on page 247*.



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 10

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 you

– 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 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 108: 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 109: 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 110: Wiring (bus connection)

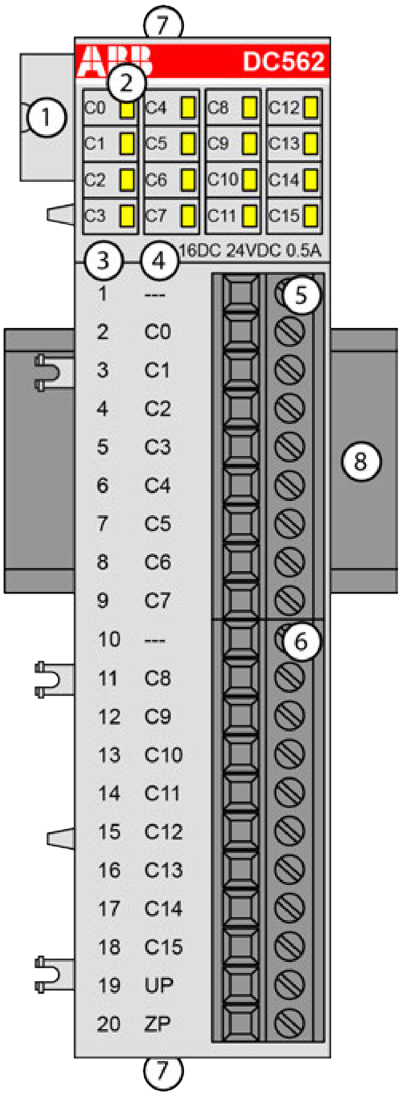
Parameter	Value
Bus connection	Left-side and right-side connection from module to module via a 10-pole HE plug (male at the left side, female at the right side)
Mechanical connection	Established by the terminal units
Max. bus length	1 m

5.4.2 Digital I/O modules

5.4.2.1 S500-eCo

5.4.2.1.1 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.

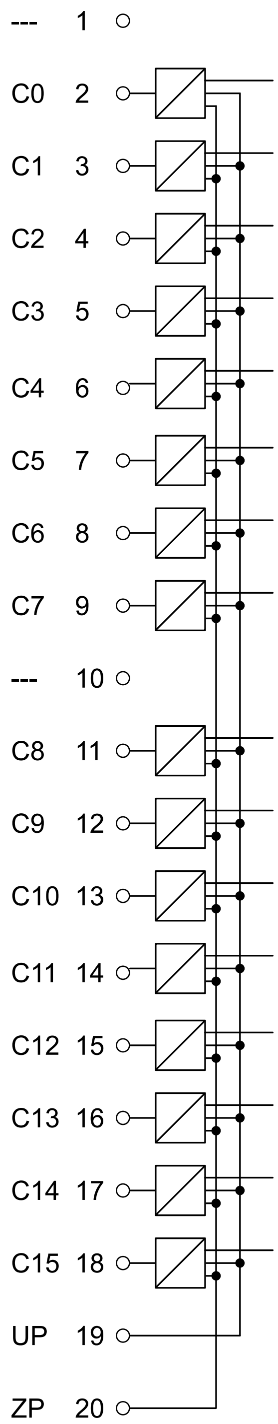


Fig. 20: Internal construction of the digital inputs and outputs

Table 111: 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

Terminal	Signal	Description
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 you

– 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.

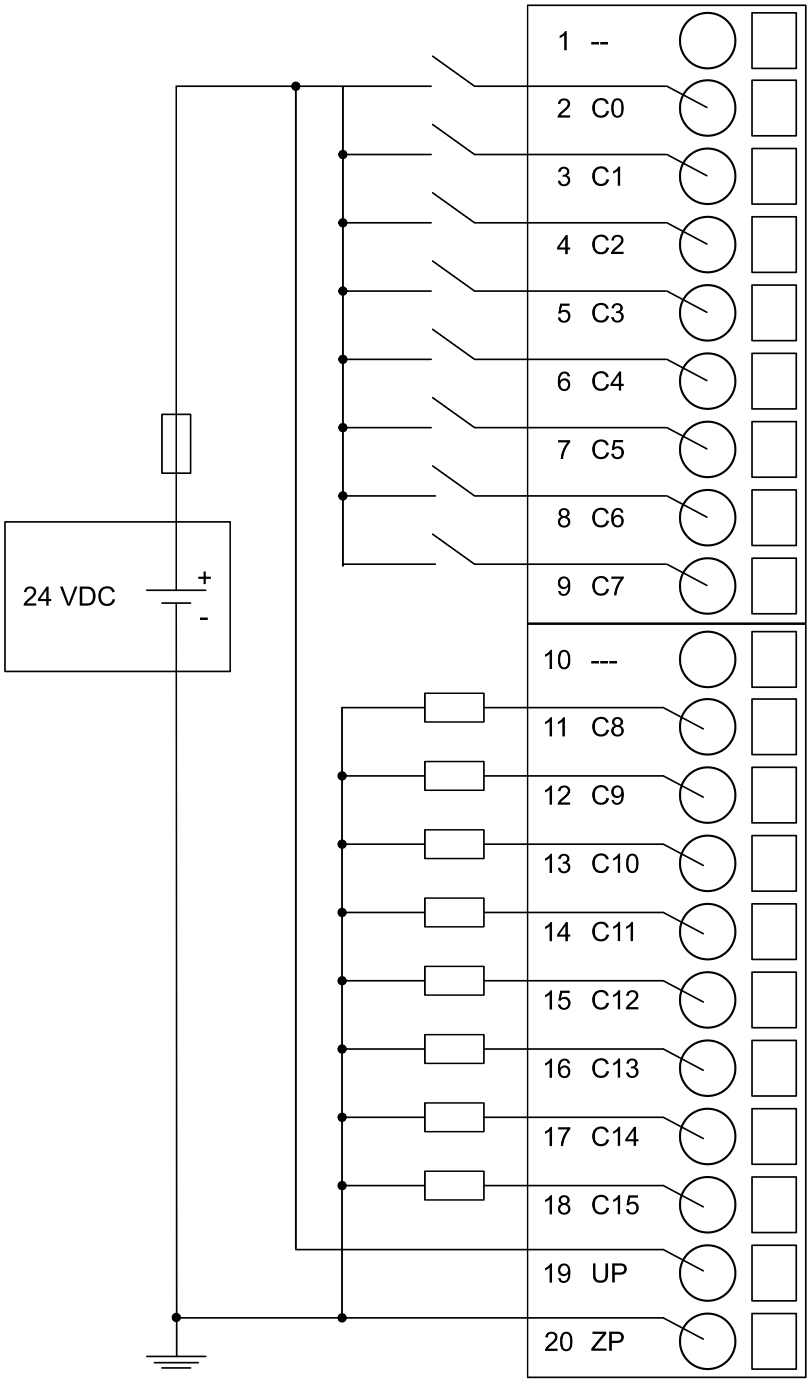


Fig. 21: Connection of the digital input/output module DC562

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 5.4.2.1.1.6 “Diagnosis” on page 255*.

The meaning of the LEDs is described in the section State LEDs ↺ *Chapter 5.4.2.1.1.7 “State LEDs” on page 255*.

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;

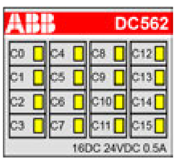
Diagnosis

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

The system data of AC500-eCo apply.

Chapter 4.1 “System data AC500-eCo” on page 23

Only additional details are therefore documented below.

Technical data of the module

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)

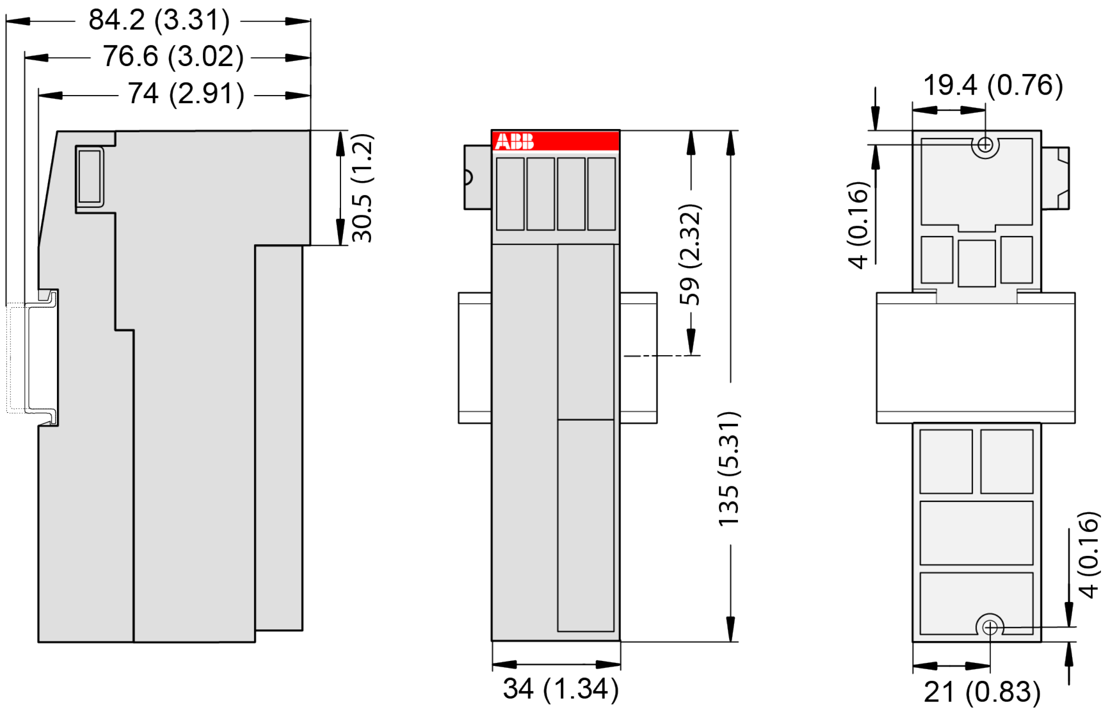
Parameter		Value
Indication of the input signals		1 yellow LED per channel; the LED is ON when the input signal is high (signal 1). The module is powered through the I/O bus.
Input type according to EN 61131-2		Type 1 sink
Input signal range		+24 V DC
	Signal 0	-3 V ... +5 V
	Undefined signal	+5 V ... +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.

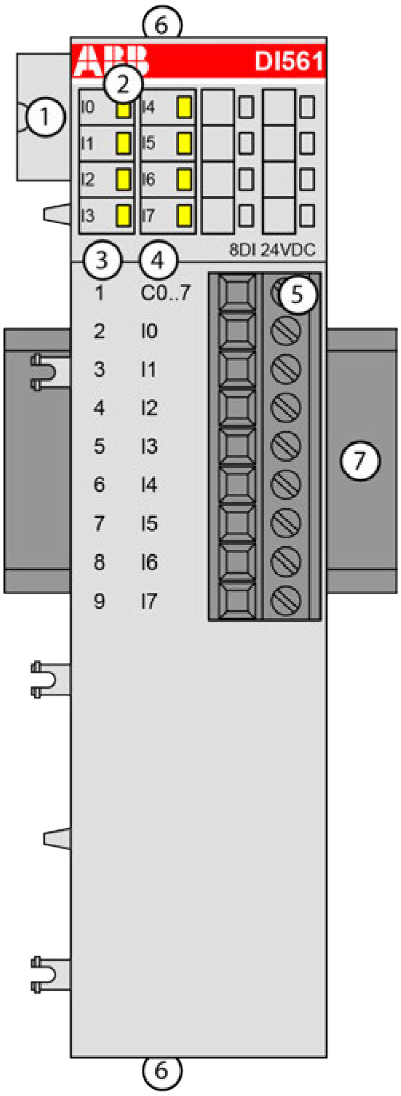
Ordering data

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.

5.4.2.1.2 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

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.

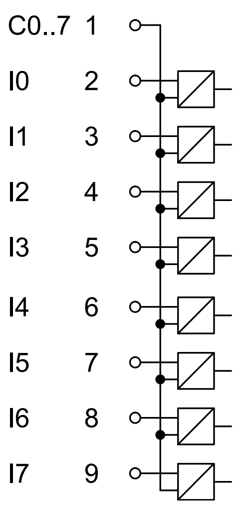


Fig. 22: Internal construction of the digital inputs

Table 112: 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 10 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 you

– 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.

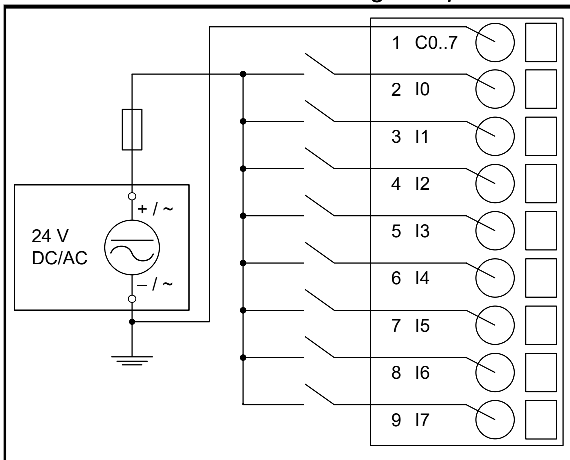
NOTICE!
Risk of damaging the PLC modules!
Overvoltages and short circuits might damage the PLC modules.

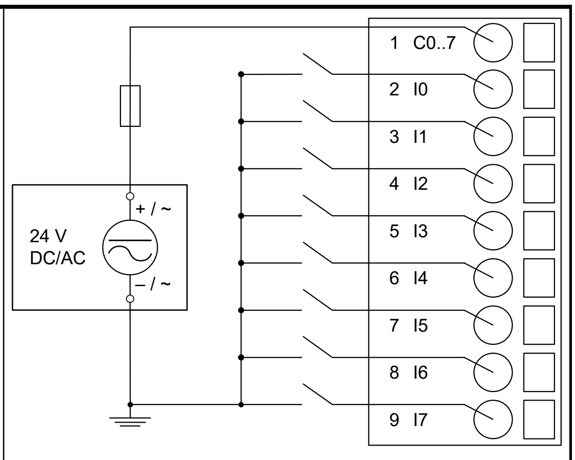
– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

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 113: Connection of the digital input module DI561





Connection of DI561 - sink inputs	Connection of DI561 - source inputs

The module provides several diagnosis functions *Chapter 5.4.2.1.2.6 “Diagnosis” on page 264*.

The meaning of the LEDs is described in the section State LEDs *Chapter 5.4.2.1.2.7 “State LEDs” on page 265*.

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;

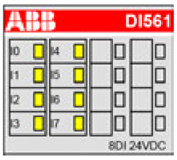
Diagnosis

E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000 ... 063**	**AC500-Display**	**<− Display in**	
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**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

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

The system data of AC500-eCo apply.

Chapter 4.1 “System data AC500-eCo” on page 23

Only additional details are therefore documented below.

Technical data of the module

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. 10 mA
Max. power dissipation within the module		1.6 W
Weight		Ca. 110 g

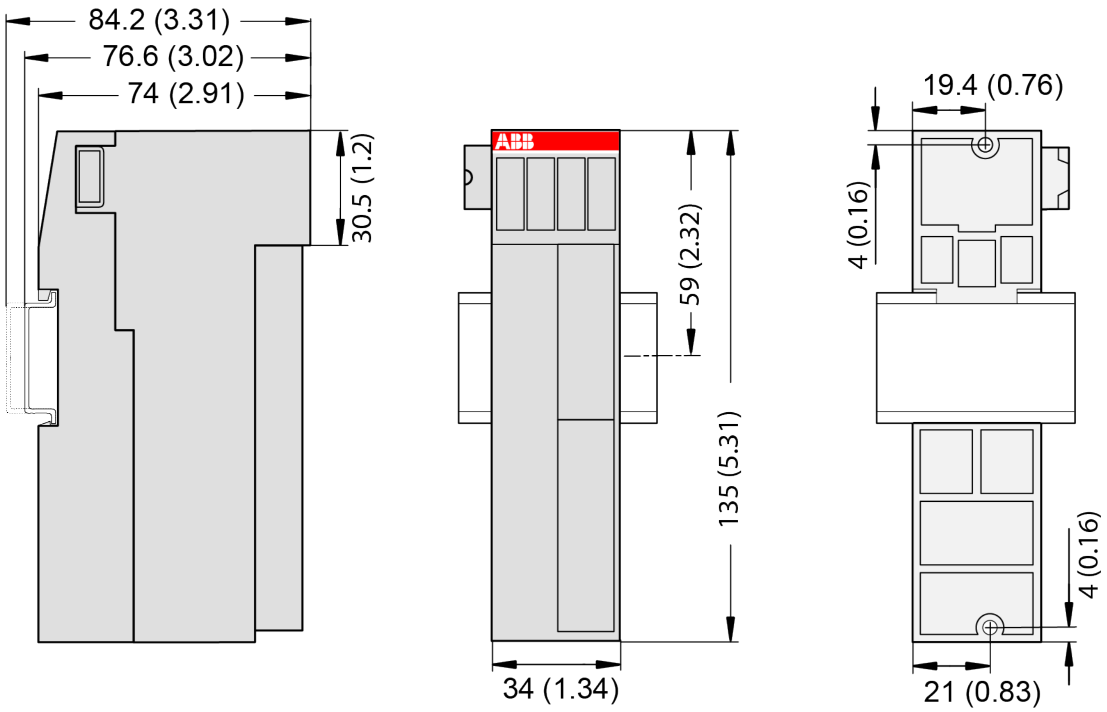
Parameter	Value
Mounting position	Horizontal or vertical
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.

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.		
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.

Dimensions



The dimensions are in mm and in brackets in inch.

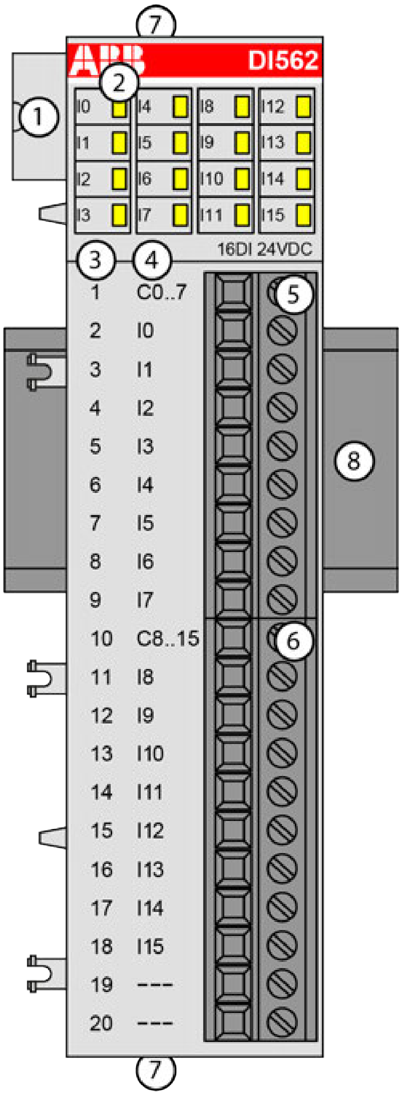
Ordering data

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.*

5.4.2.1.3 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

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.

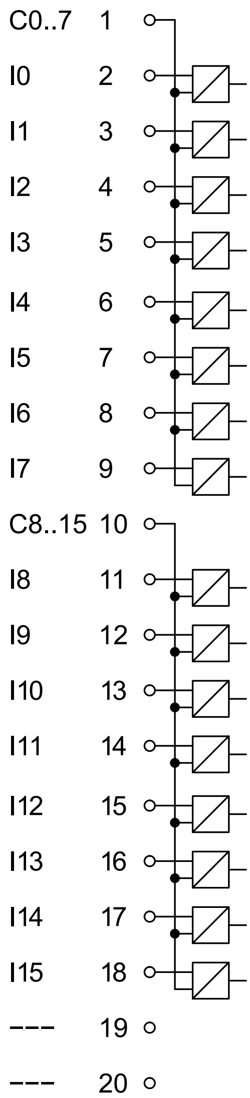


Fig. 23: Internal construction of the digital inputs

Table 114: 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 10 mA 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 you

– 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.

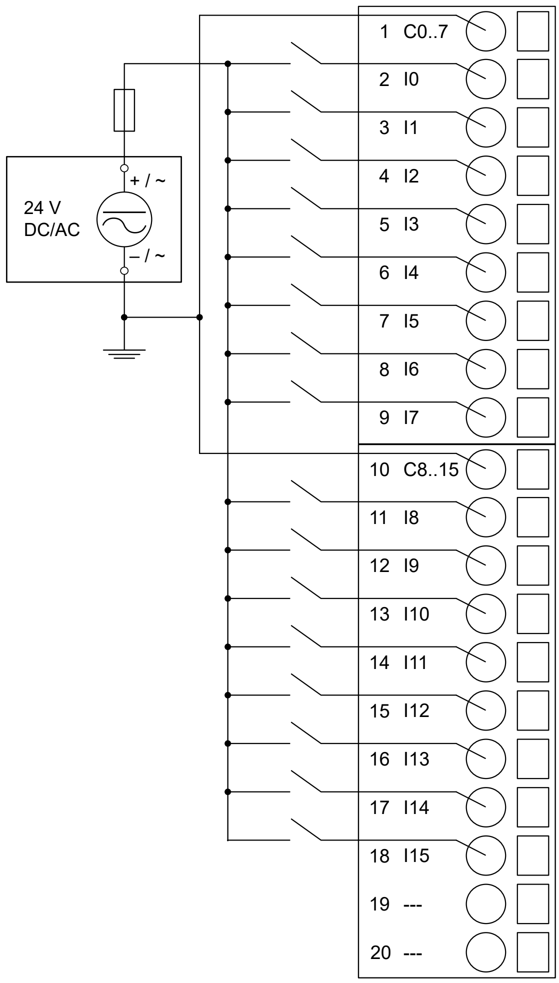
> **NOTICE!**
> **Risk of damaging the PLC modules!**
> Overvoltages and short circuits might damage the PLC modules.
> – Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
> – Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

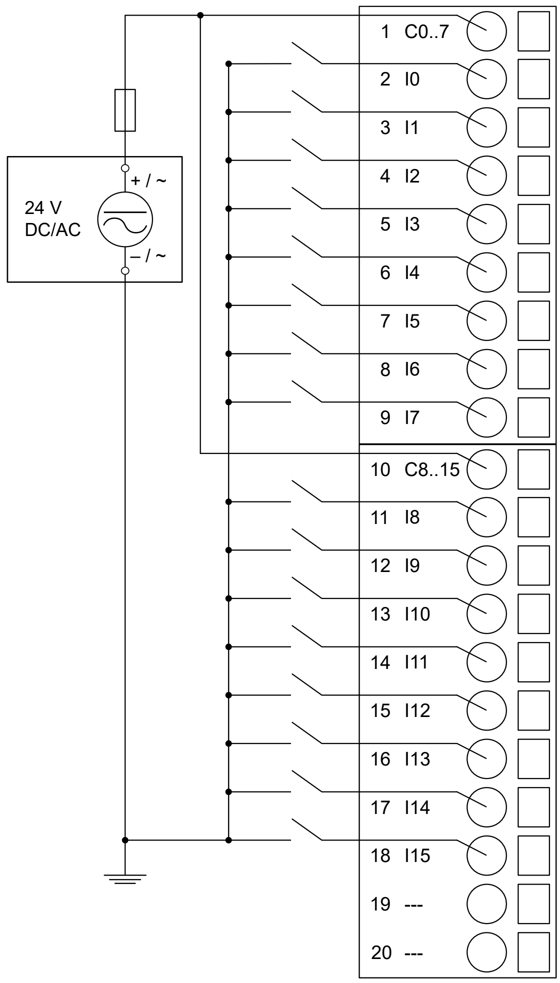
The module provides several diagnosis functions *Chapter 5.4.2.1.3.6 “Diagnosis” on page 273*.

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 115: 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 5.4.2.1.3.7 "State LEDs" on page 273*.

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 = Ext_User_Prm_Data_Const(0) =	0x03 0xDF, 0x17, 0x00;

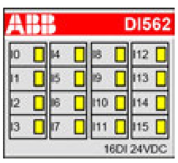
Diagnosis

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 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

The system data of AC500-eCo apply.

Chapter 4.1 “System data AC500-eCo” on page 23

Only additional details are therefore documented below.

Technical data of the module

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	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.

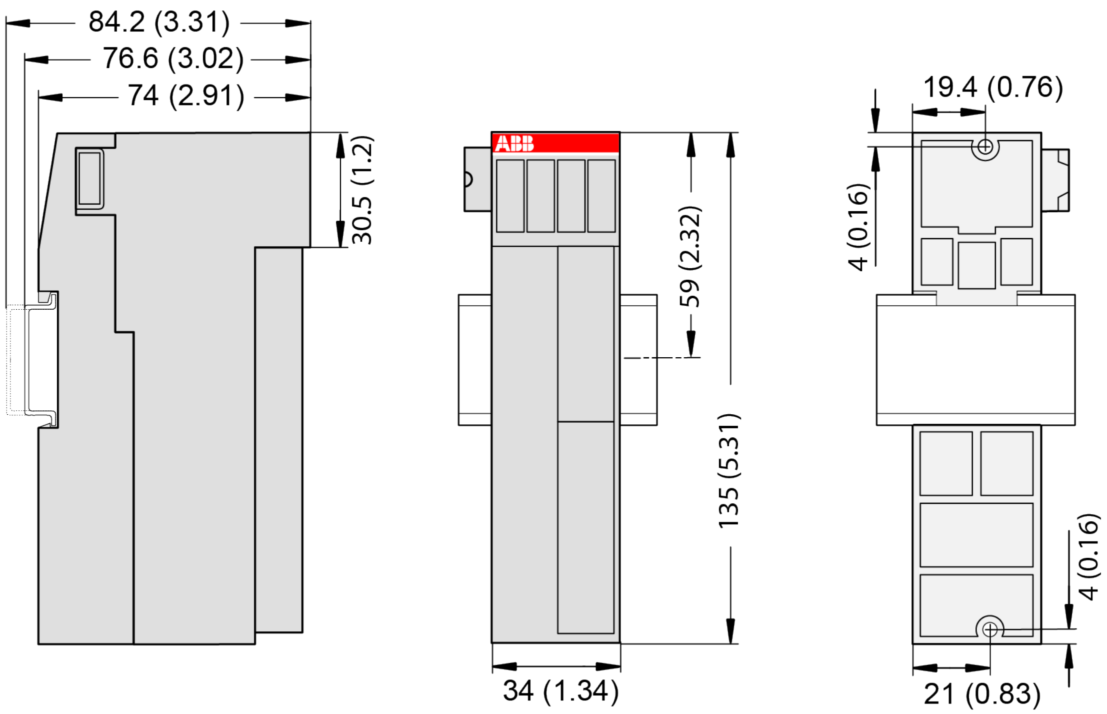
Technical data of the digital inputs

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]) 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.

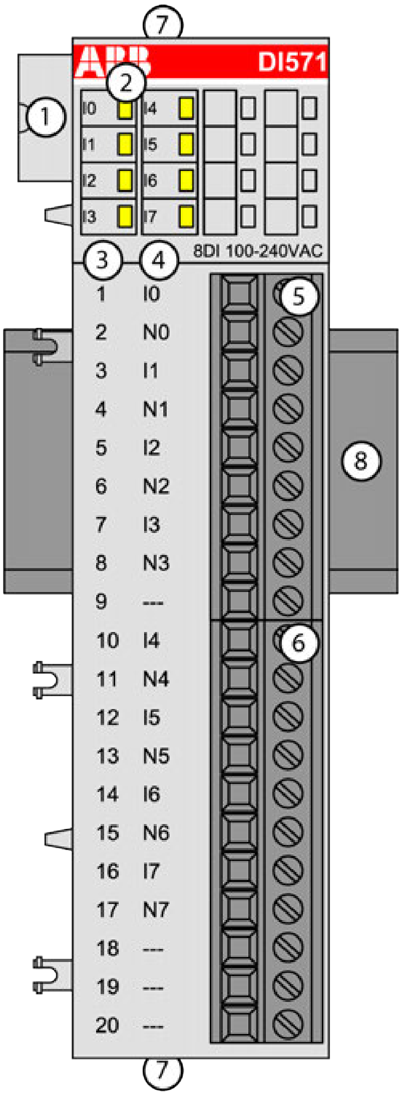
Ordering data

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.*

5.4.2.1.4 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.

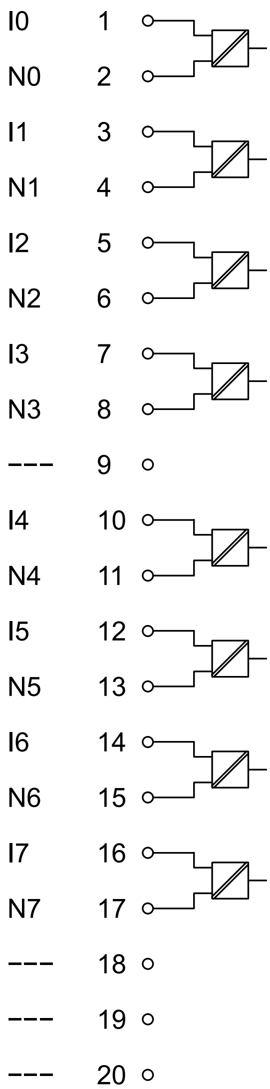


Fig. 24: Internal construction of the digital inputs

Table 116: 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 you

– 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.

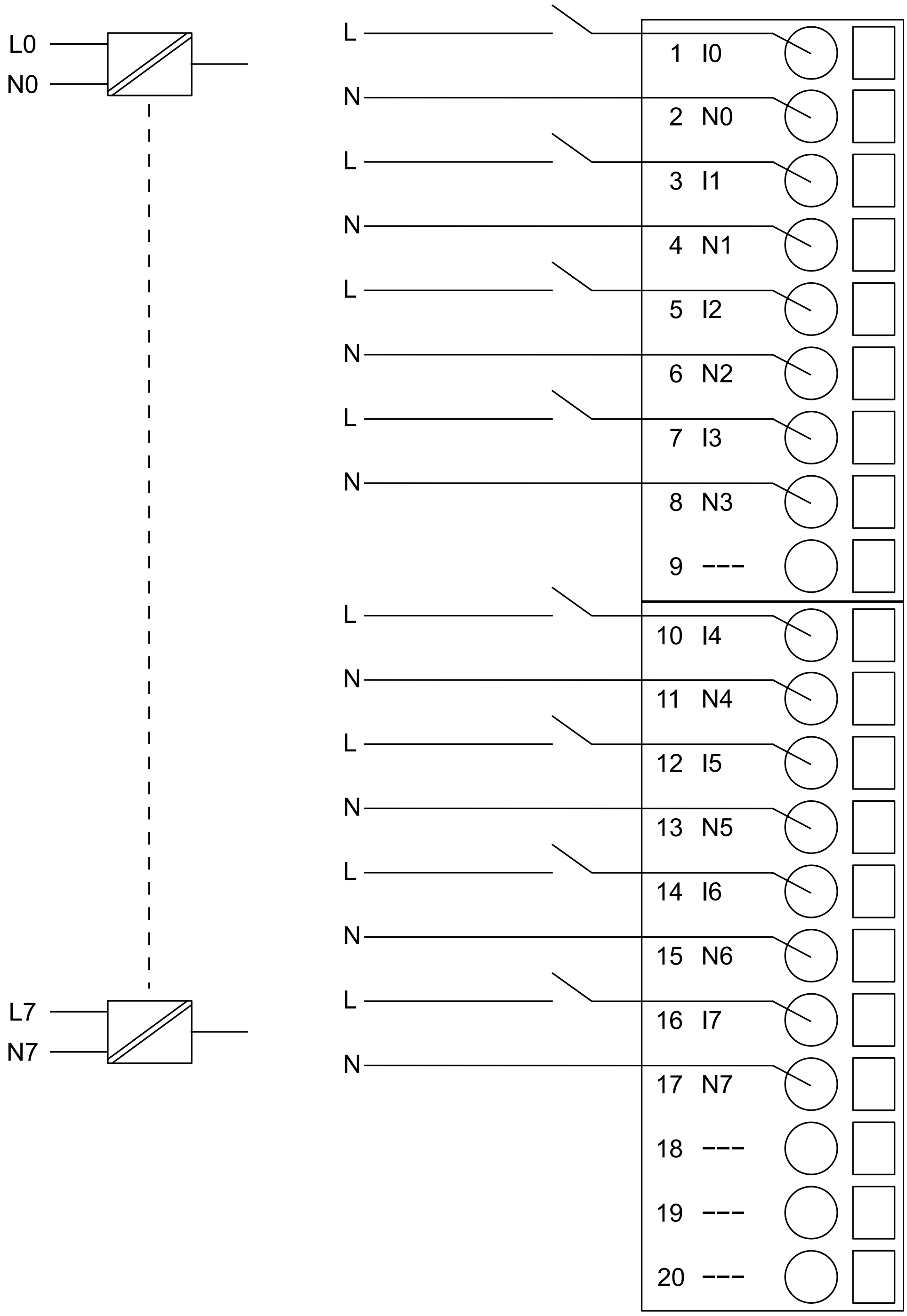


Fig. 25: Connection of the digital input module DI571

> **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 5.4.2.1.4.7 “Diagnosis” on page 283*.

The meaning of the LEDs is described in the section State LEDs ➪ *Chapter 5.4.2.1.4.8 “State LEDs” on page 283*.

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;

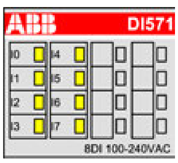
Diagnosis

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

The system data of AC500-eCo apply.

Chapter 4.1 “System data AC500-eCo” on page 23

Only additional details are therefore documented below.

Technical data of the module

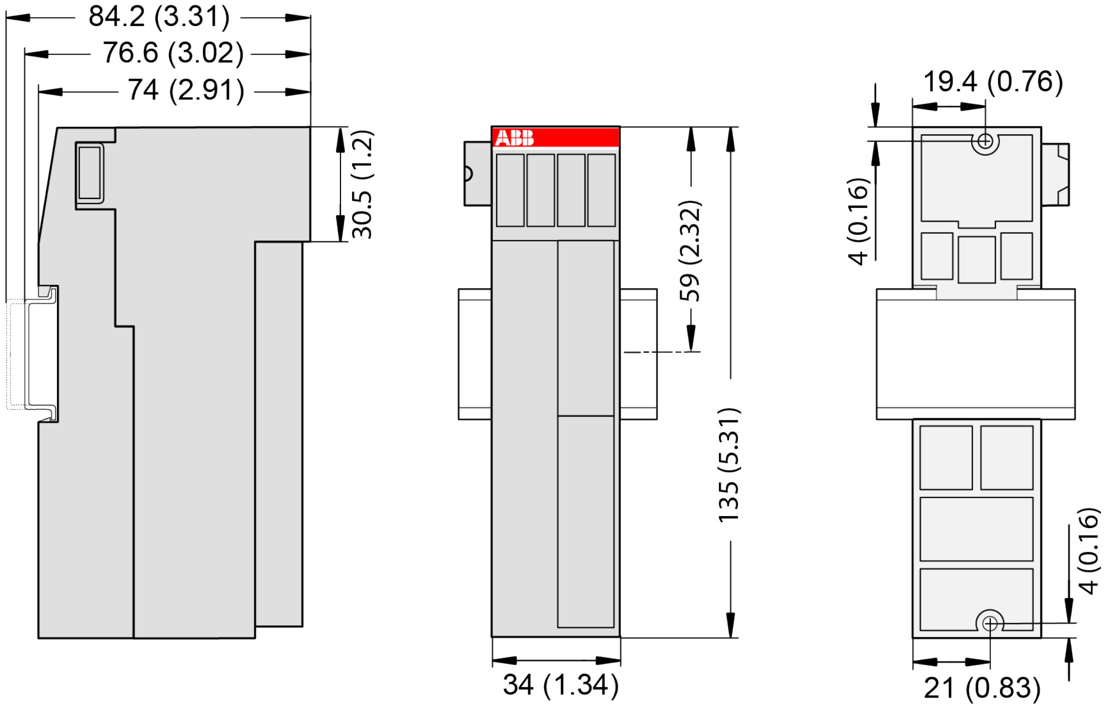
Parameter	Value
Galvanic isolation	Yes, between the channels and the rest of the module
Isolated groups	8 (1 channel per group)
Current consumption from 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module	Ca. 10 mA
Max. power dissipation within the module	On 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

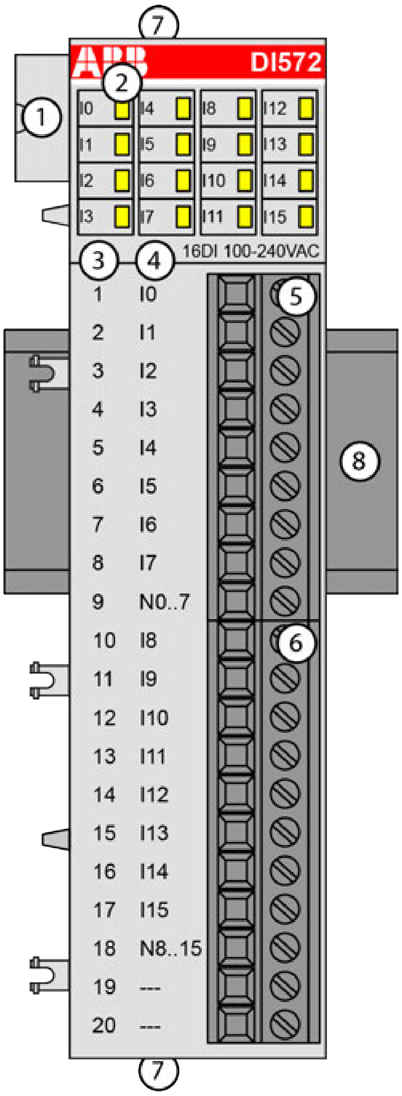
Part no.	Description	Product life cycle phase *)
1TNE 968 902 R2103	DI571, digital input module, 8 DI, 100 V AC ... 240 V AC	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable 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.*

5.4.2.1.5 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.

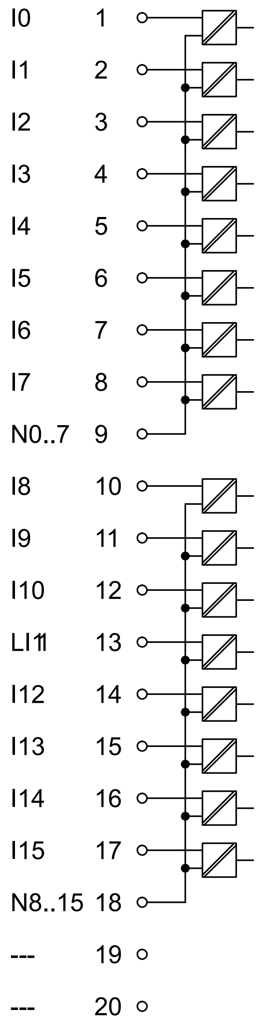


Fig. 26: Block diagram for the internal construction of the digital inputs.

Table 117: 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
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 you

– 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.

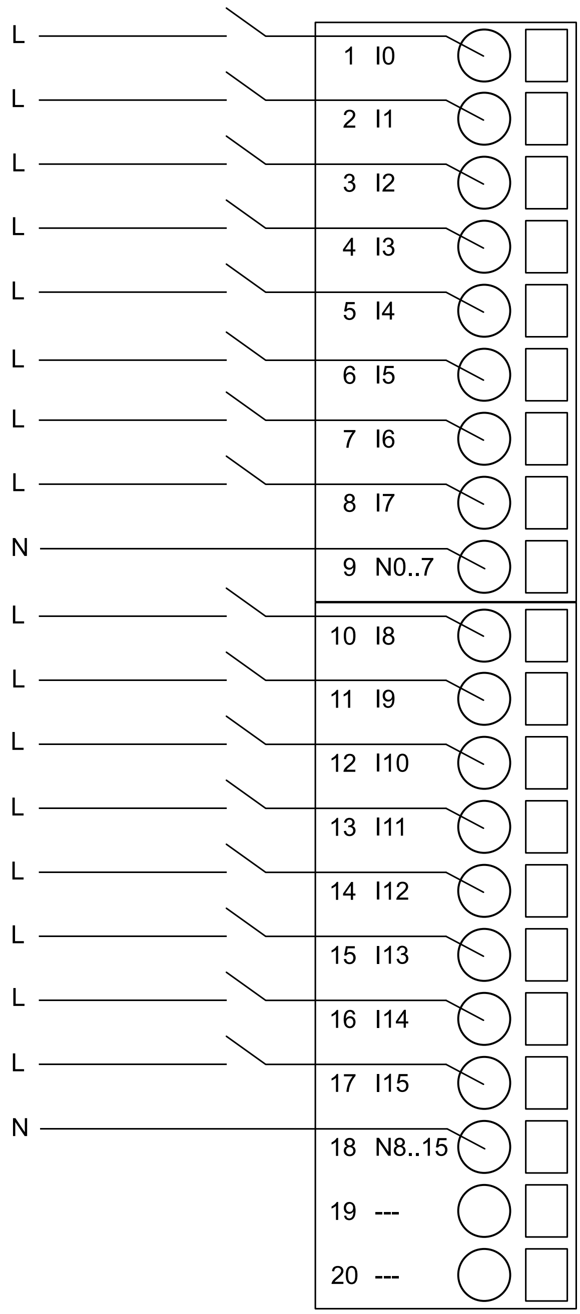
The devices must not be opened when in operation. The same applies to the network interfaces.

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 5.4.2.1.5.6 "Diagnosis" on page 293*.

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;

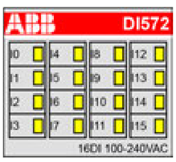
Diagnosis

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:

Param-eter	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 = expan-sion 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

The system data of AC500-eCo apply.

Chapter 4.1 “System data AC500-eCo” on page 23

Only additional details are therefore documented below.

Technical data of the module

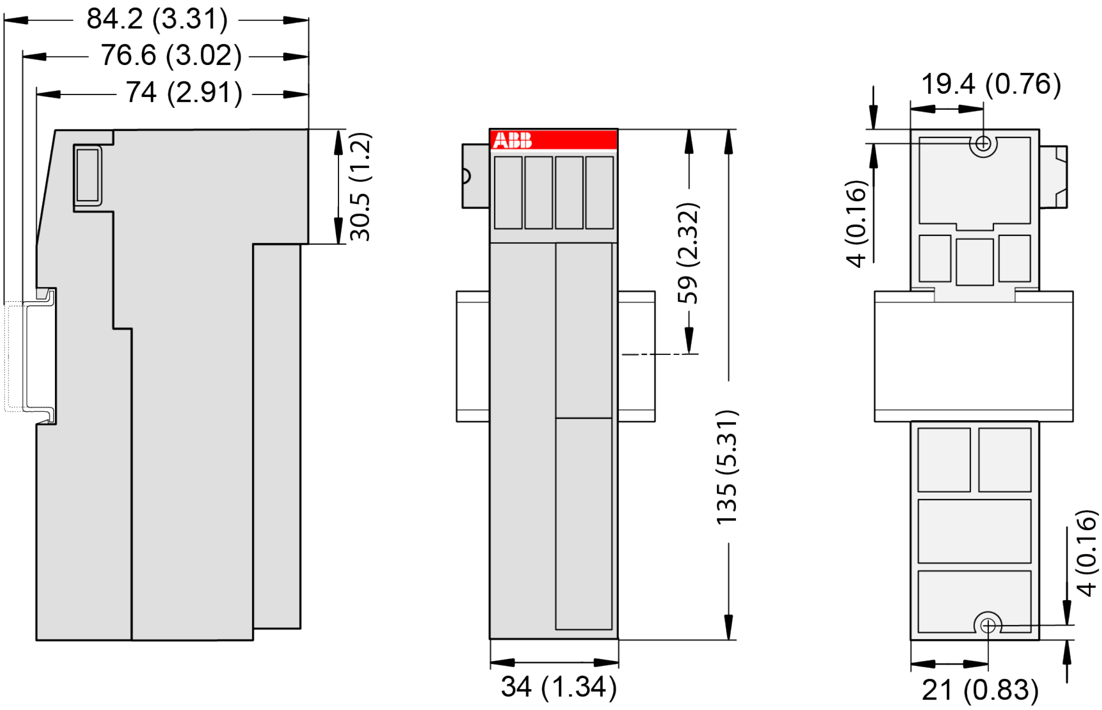
Parameter	Value
Galvanic isolation	Yes, between the input groups and the rest of the module
Isolated groups	2 (8 channels per group)
Current consumption from 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module	Ca. 10 mA
Max. power dissipation within the module	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

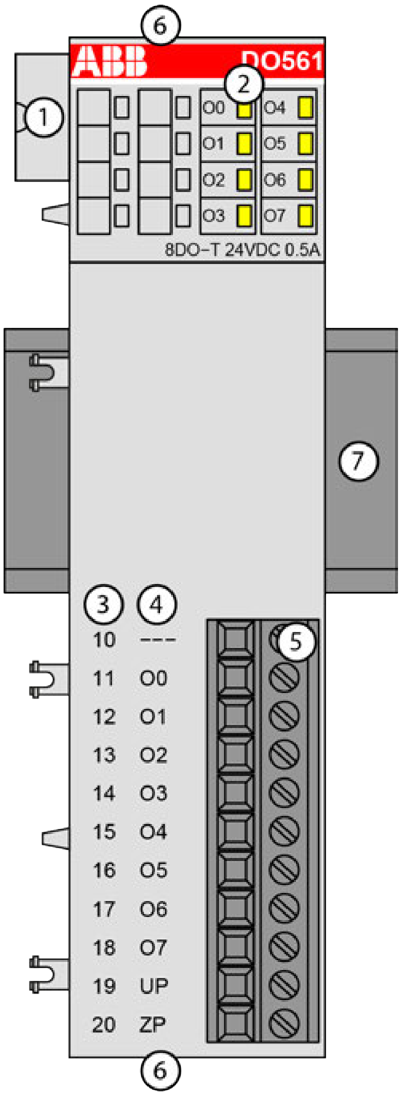
Part no.	Description	Product life cycle phase *)
1SAP 230 500 R0000	DI572, digital input module, 16 DI, 100 V AC ... 240 V AC	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable 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.*

5.4.2.1.6 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

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.

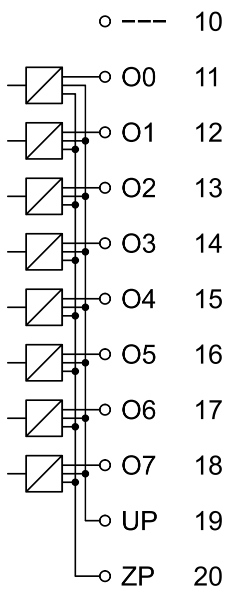


Fig. 27: Internal construction of the digital outputs

Table 118: 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

Terminals	Signal	Description
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 10 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 you

– 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.

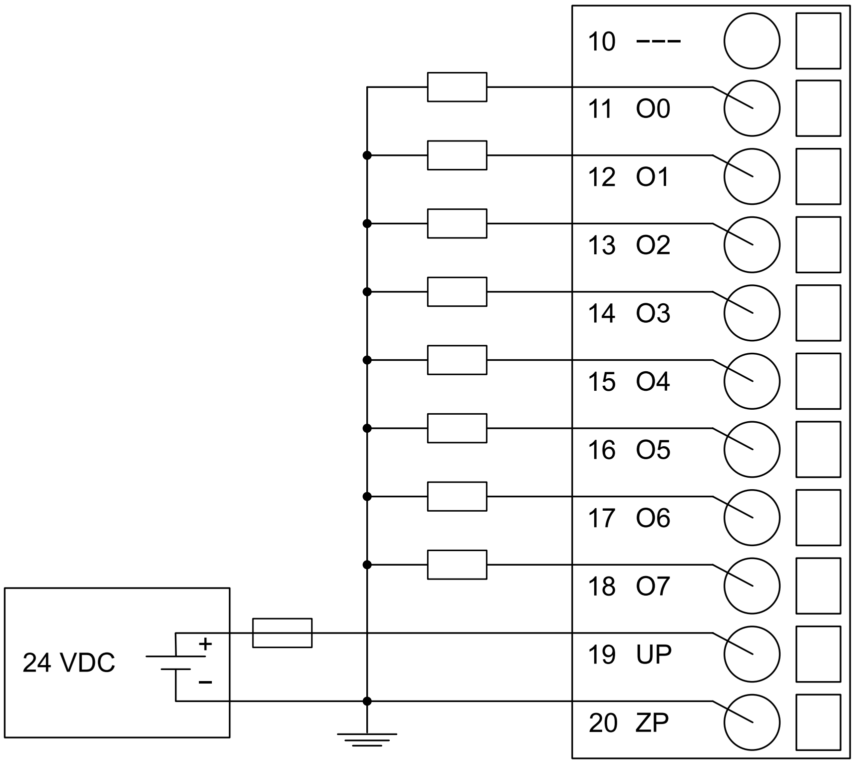


Fig. 28: Connection of the digital output module DO561

> **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 5.4.2.1.6.6 “Diagnosis” on page 301*.

The meaning of the LEDs is described in the section State LEDs ↳ *Chapter 5.4.2.1.6.7 “State LEDs” on page 302*.

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

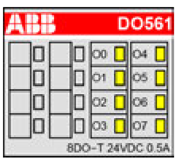
<table>
<tr><th>E1 ... E4</th><th>d1</th><th>d2</th><th>d3</th><th>d4</th><th>Identifier
000 ... 063</th><th>AC500-Display</th><th colspan="2" rowspan="3"><− Display in</th></tr>
<tr><th>Class</th><th>Comp</th><th>Dev</th><th>Mod</th><th>Ch</th><th>Err</th><th>PS501 PLC Browser</th></tr>
<tr><th>Byte 6
Bit 6 ... 7</th><th>-</th><th>Byte 3</th><th>Byte 4</th><th>Byte 5</th><th>Byte 6
Bit 0 ... 5</th><th>PNIO diagnosis block</th></tr>
<tr><th>Class</th><th>Interface</th><th>Device</th><th>Module</th><th>Channel</th><th>Error Identifier</th><th colspan="2">Error message</th><th>Remedy</th></tr>
<tr><td></td><td>1)</td><td>2)</td><td>3)</td><td>4)</td><td></td><td colspan="2"></td><td></td></tr>
<tr><td colspan="9">Module error DO561</td></tr>
<tr><td rowspan="2">3</td><td>14</td><td>1 ... 10</td><td>31</td><td rowspan="2">31</td><td rowspan="2">19</td><td colspan="2" rowspan="2">Checksum error in the I/O module</td><td rowspan="2">Replace I/O module</td></tr>
<tr><td>11 / 12</td><td>ADR</td><td>1 ... 10</td></tr>
</table>

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 DO561							
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 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

The system data of AC500-eCo apply.

Chapter 4.1 “System data AC500-eCo” on page 23

Only additional details are therefore documented below.

Technical data of the module

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	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	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 (8 channels per group)
Surge-voltage (max.)		35 V DC for 0.5 s
Power dissipation within the module (max.)		1.6 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

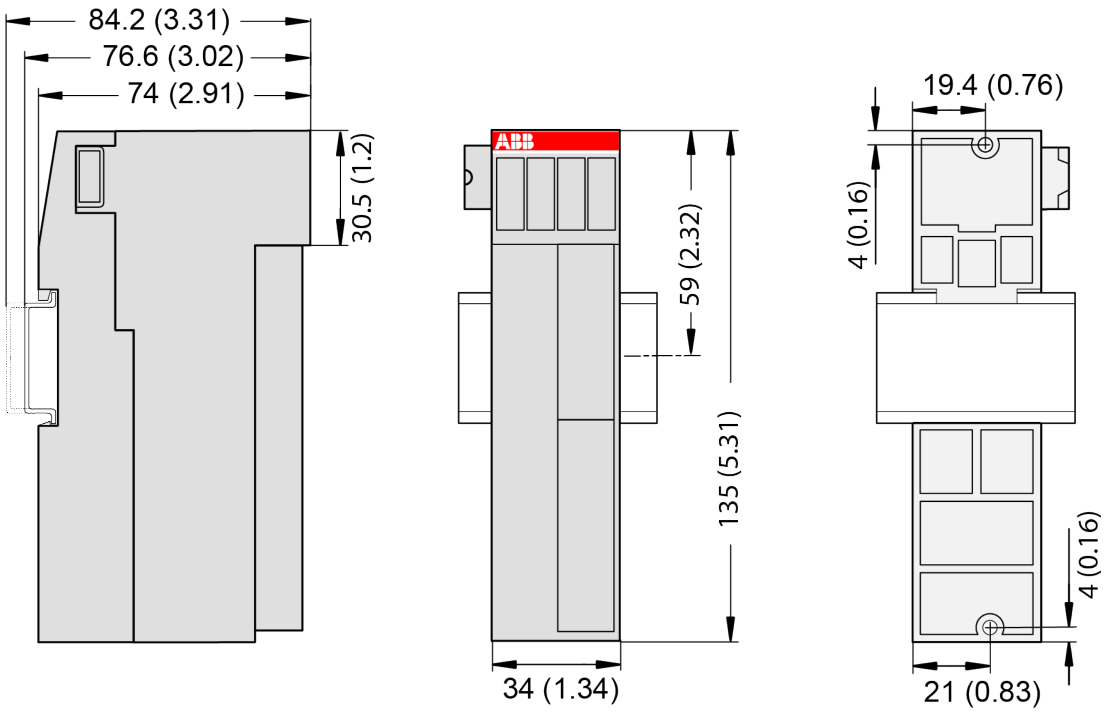
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

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

Parameter		Value
Way of operation		Non-latching type
Min. output voltage at signal 1		20 V DC at max. current consumption
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
	Rated current per group (max.)	4 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.

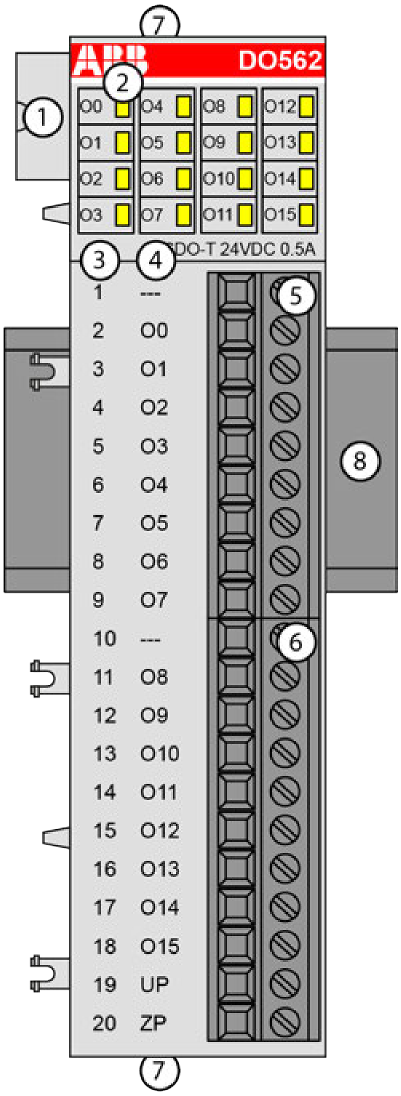
Ordering data

Part no.	Description	Product life cycle phase *)
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.*

5.4.2.1.7 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.

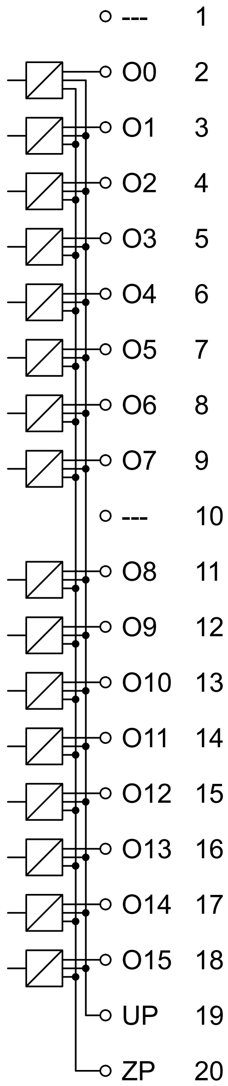


Fig. 29: Internal construction of the digital outputs

Table 119: 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
13	O10	Output signal O10

Terminal	Signal	Description
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 you

– 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.

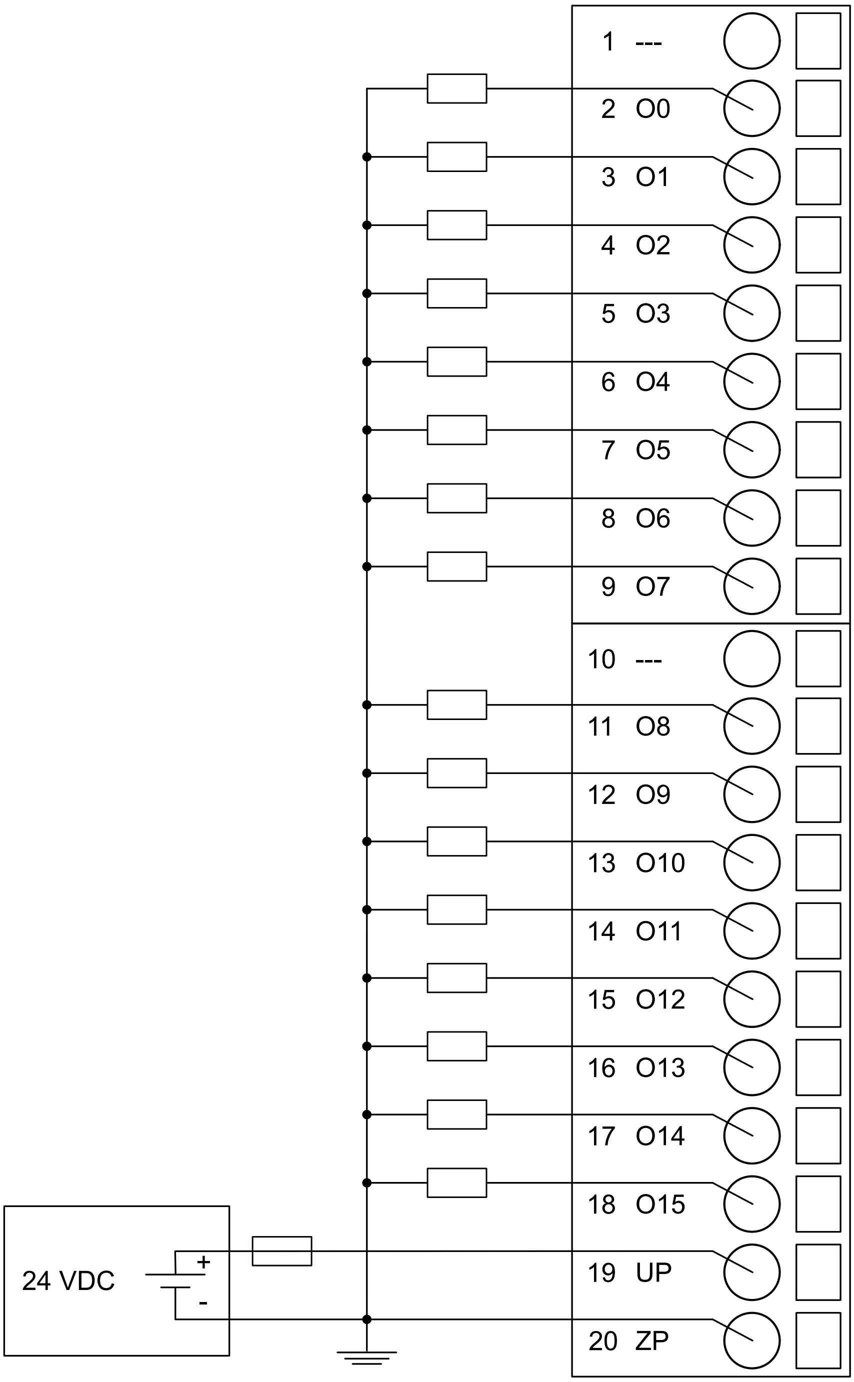


Fig. 30: Connection of the digital output module DO562

> **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 5.4.2.1.7.6 “Diagnosis” on page 312*.

The meaning of the LEDs is described in the section Status LEDs *Chapter 5.4.2.1.7.7 “State LEDs” on page 312*.

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;

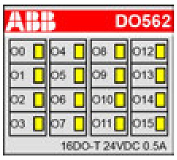
Diagnosis

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

The system data of AC500-eCo apply.

⇨ *Chapter 4.1 “System data AC500-eCo” on page 23*

Only additional details are therefore documented below.

Technical data of the module

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

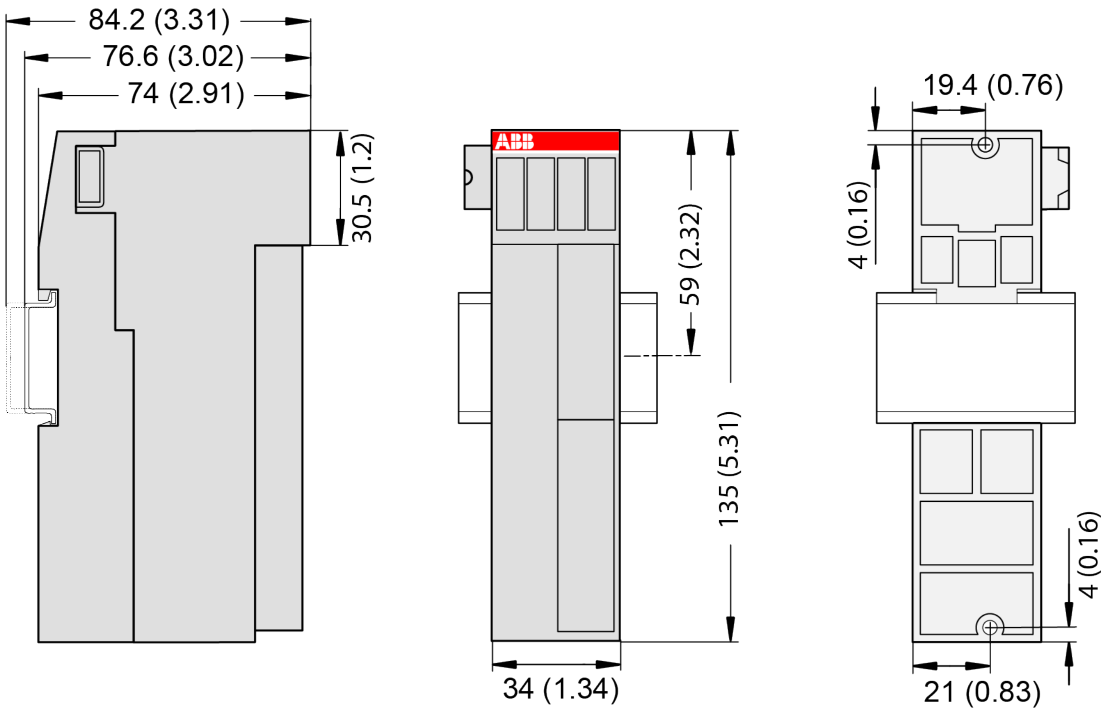
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

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.

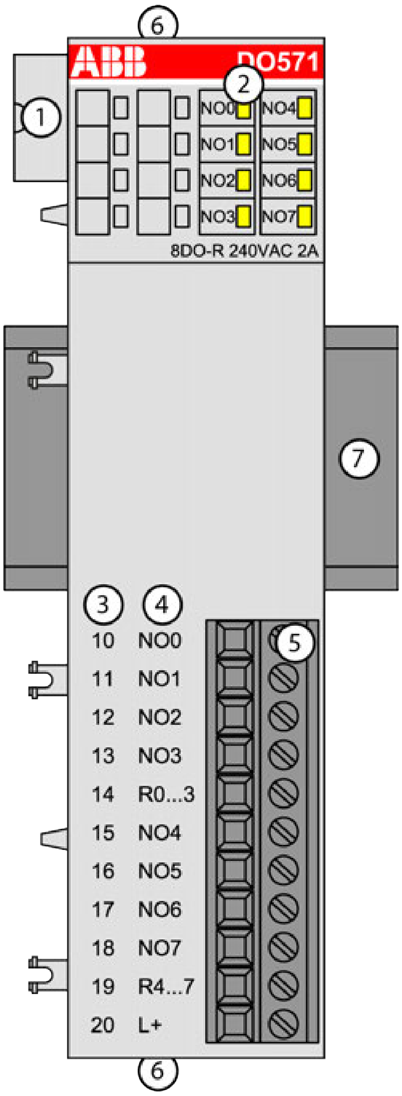
Ordering data

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.*

5.4.2.1.8 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.

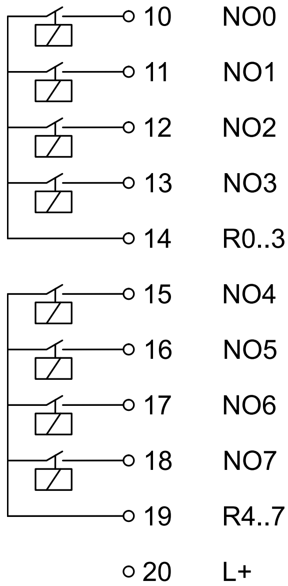


Fig. 31: Internal construction of the digital outputs

Table 120: 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 you

– 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 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:

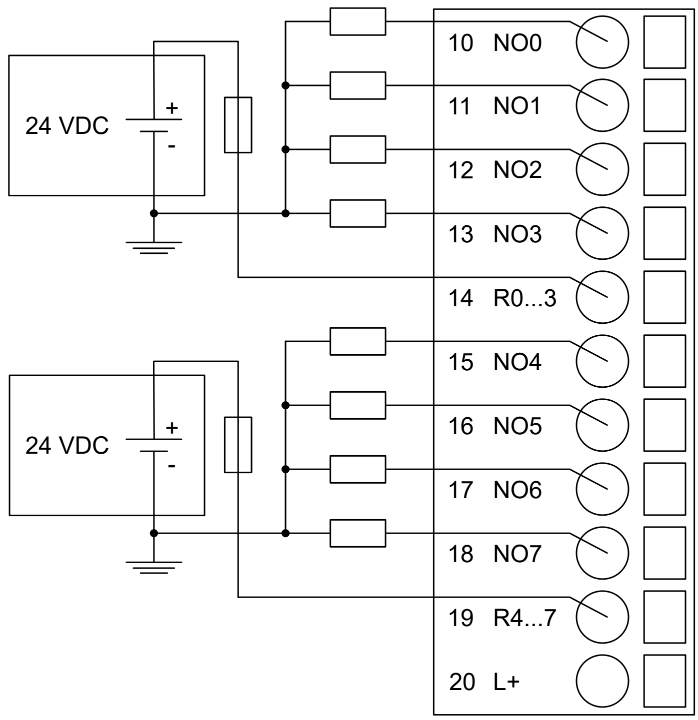


Fig. 32: Connection of 24 V DC actuators

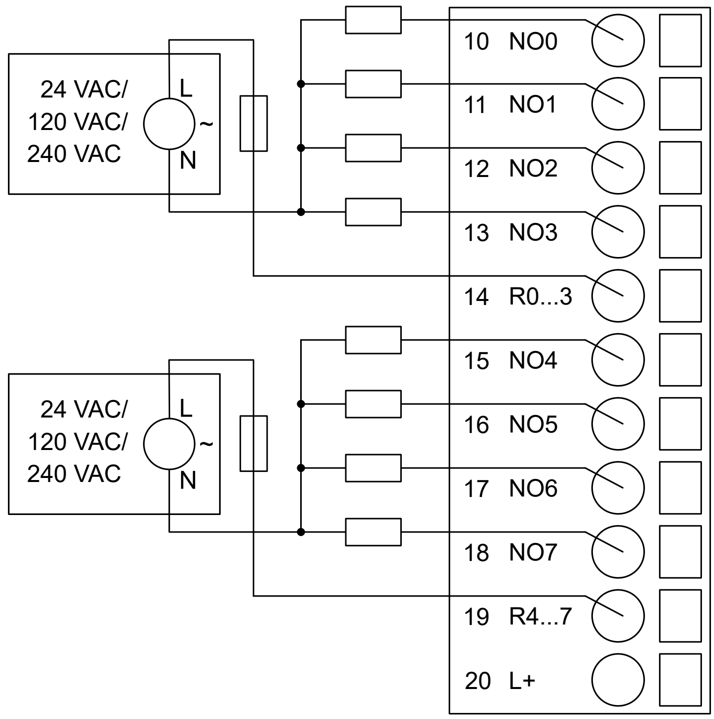


Fig. 33: Connection of 24 V AC or 100 V AC ... 240 V AC actuators

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.

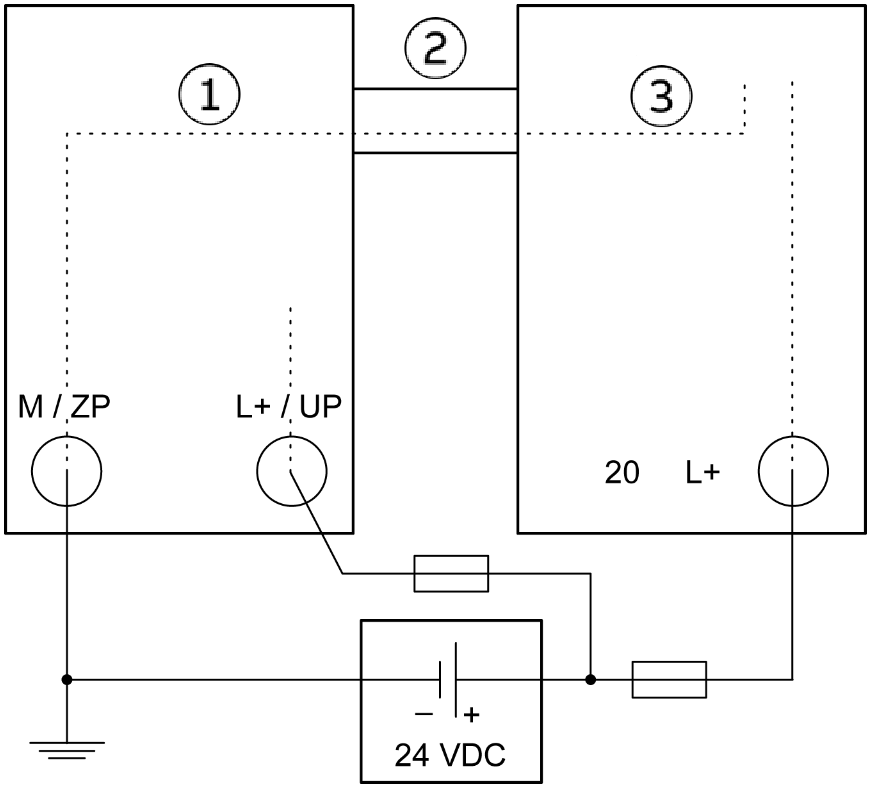


Fig. 34: Power supply - the negative connection is realized via the I/O bus

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 5.4.2.1.8.6 “Diagnosis” on page 323*.

The meaning of the LEDs is described in the section Status LEDs *Chapter 5.4.2.1.8.7 “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	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 = Ext_User_Prm_Data_Const(0) =	0x04 0xEF, 0x17, 0x00,\ 0x01;

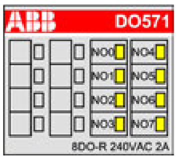
Diagnosis

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

The system data of AC500-eCo apply.

Chapter 4.1 "System data AC500-eCo" on page 23

Only additional details are therefore documented below.

Technical data of the module

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.

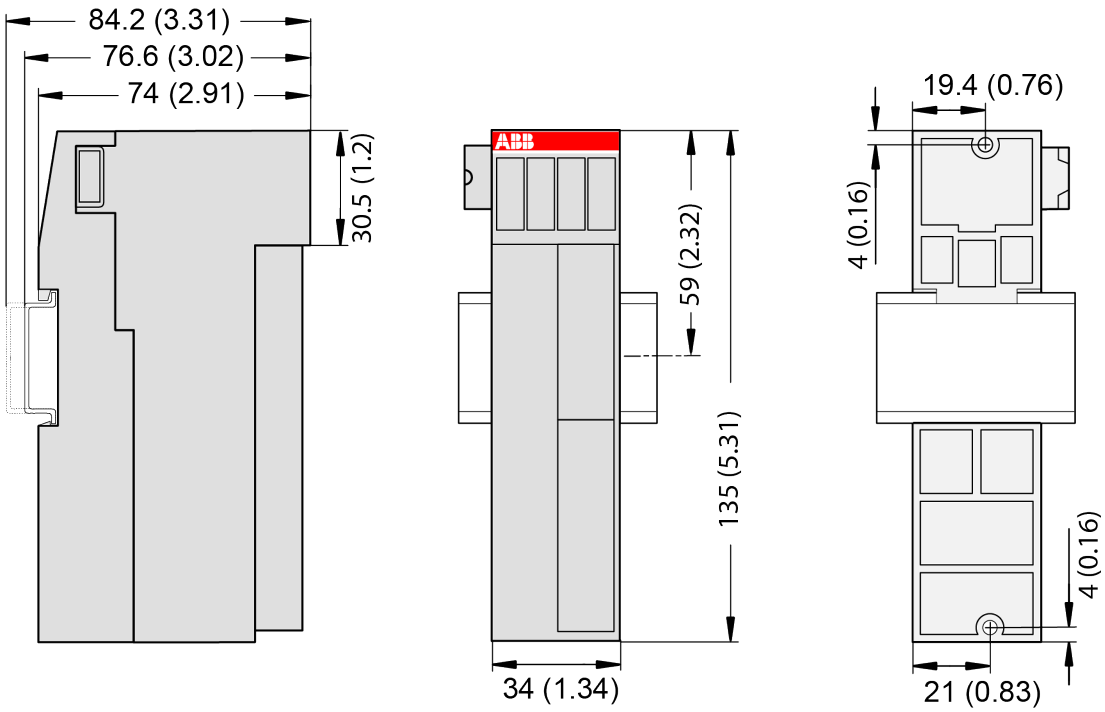
Technical data of the digital outputs

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.

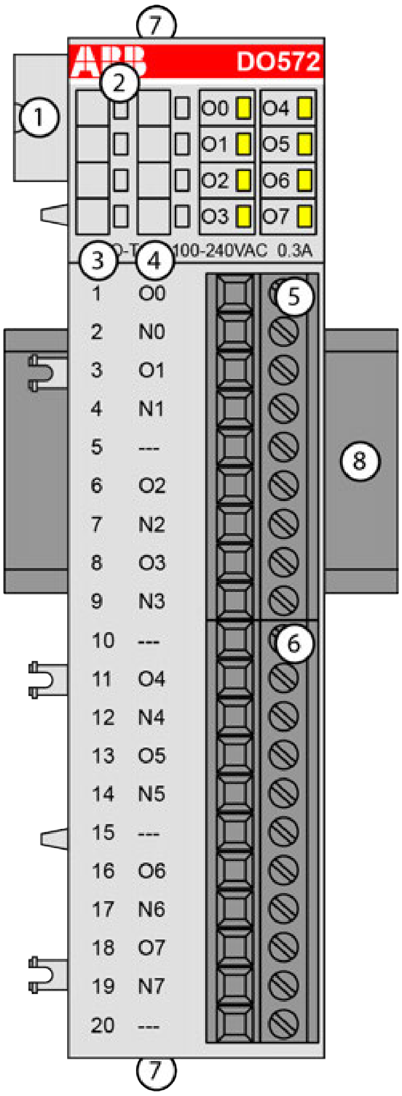
Ordering data

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.

5.4.2.1.9 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.

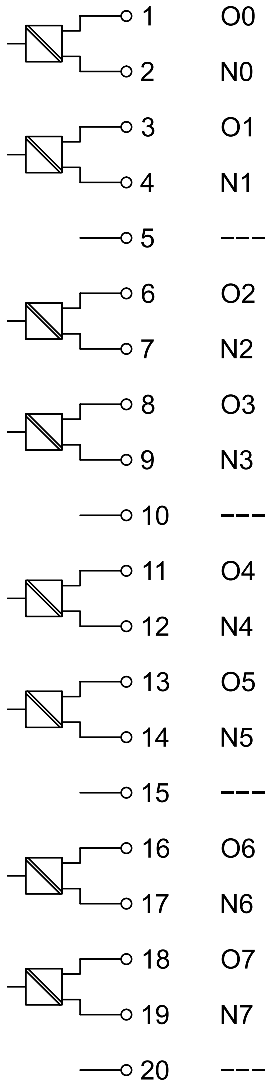


Fig. 35: Internal construction of the digital outputs

Table 121: 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
11	O4	Output signal O4

Terminal	Signal	Description
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 you

– 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.

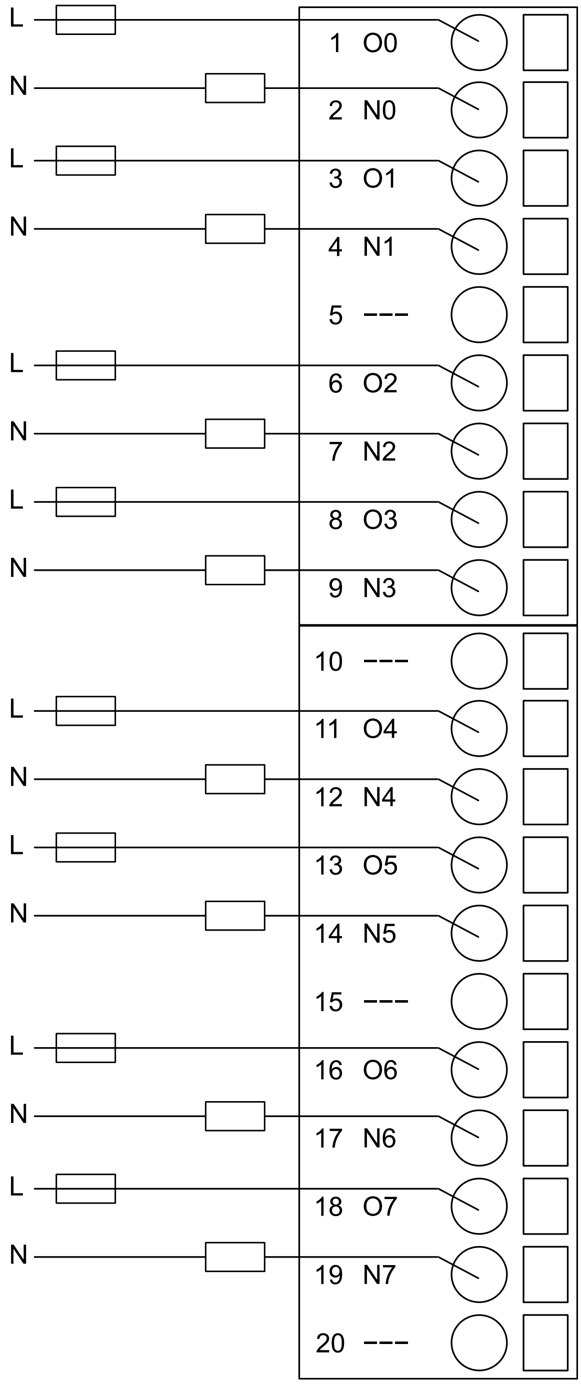


Fig. 36: Connection of the module

> **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 5.4.2.1.9.6 “Diagnosis” on page 333*.

The meaning of the LEDs is described in the section State LEDs *Chapter 5.4.2.1.9.7 “State LEDs” on page 334*.

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;

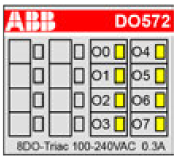
Diagnosis

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

The system data of AC500-eCo apply.

Chapter 4.1 “System data AC500-eCo” on page 23

Only additional details are therefore documented below.

Technical data of the module

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

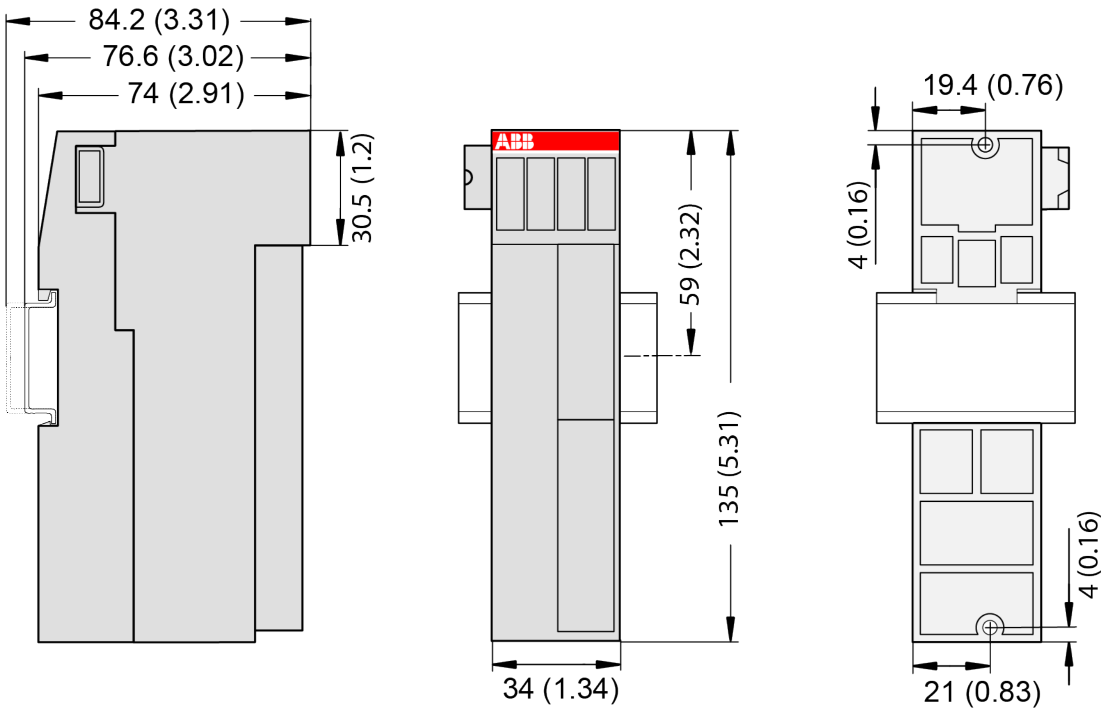
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

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.

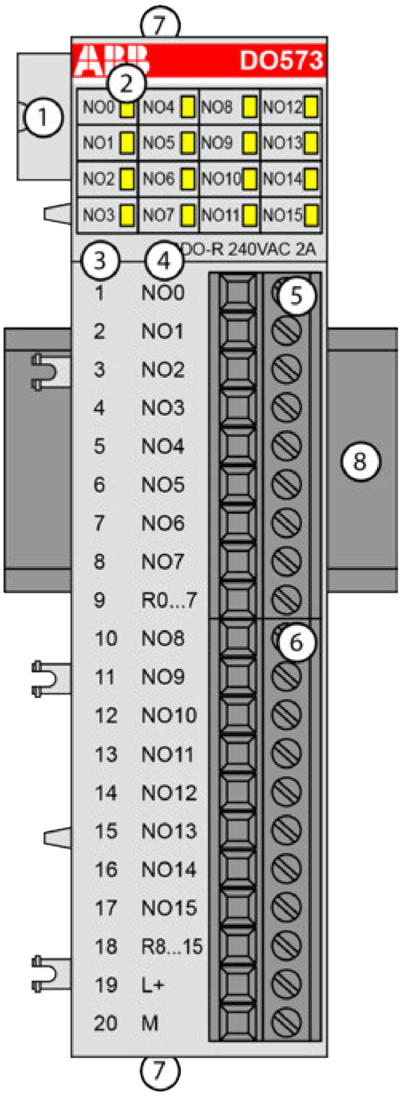
Ordering data

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.*

5.4.2.1.10 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.

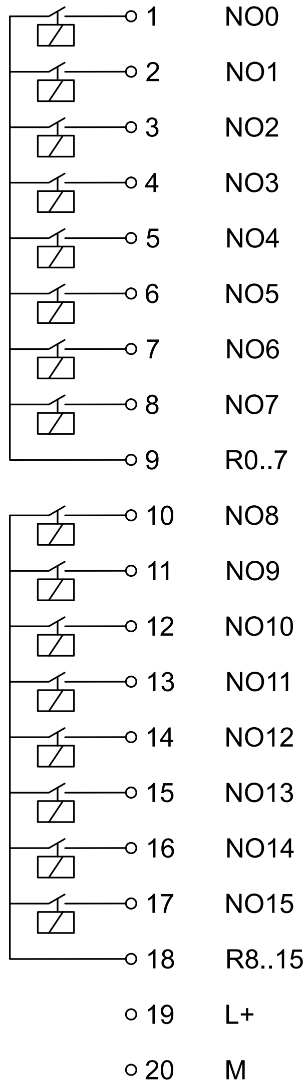


Fig. 37: Internal construction of the digital outputs

Table 122: 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

Terminal	Signal	Description
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 you

– 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 modules!

The PLC modules can be damaged by overload.

Make sure that the total current of each output common terminal (R0..7 and R8..15) 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:

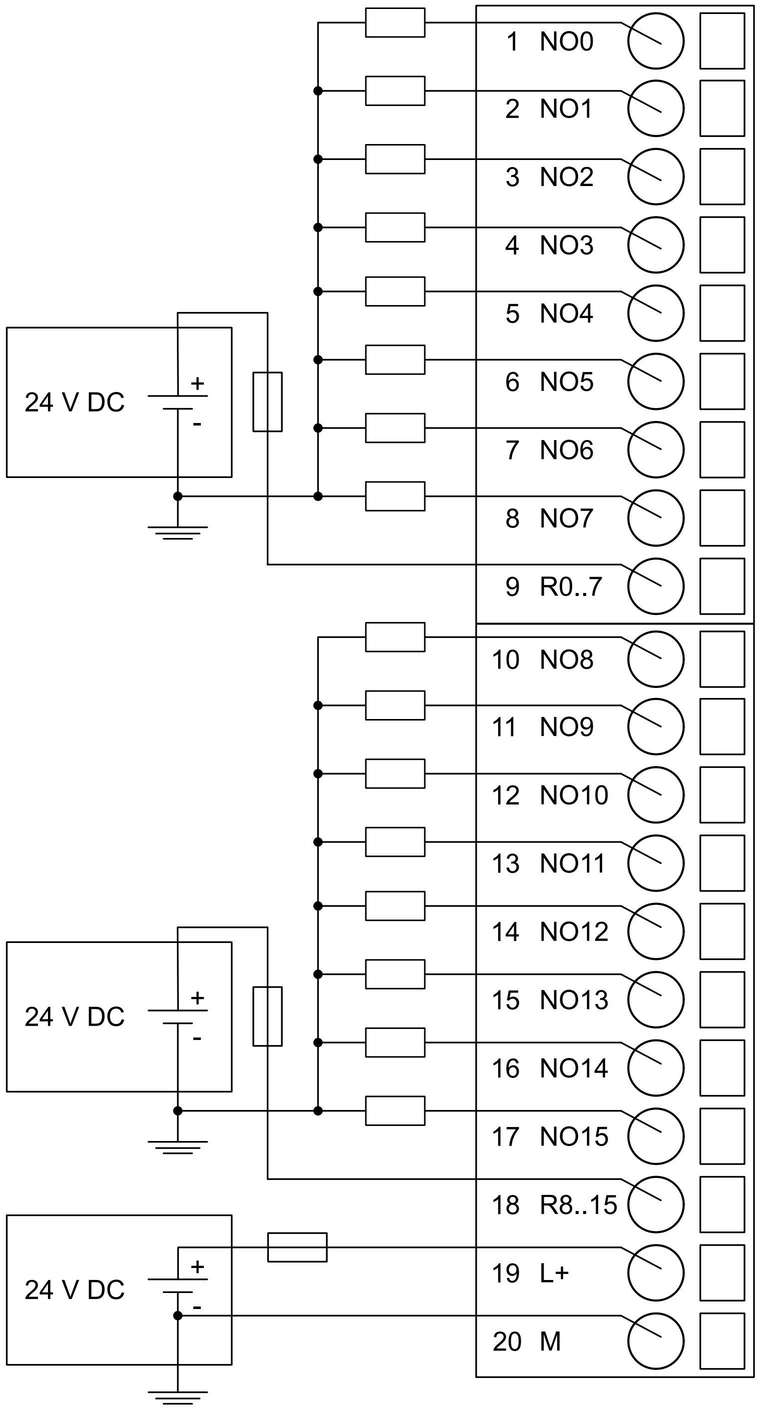


Fig. 38: Connection of 24 V DC actuators

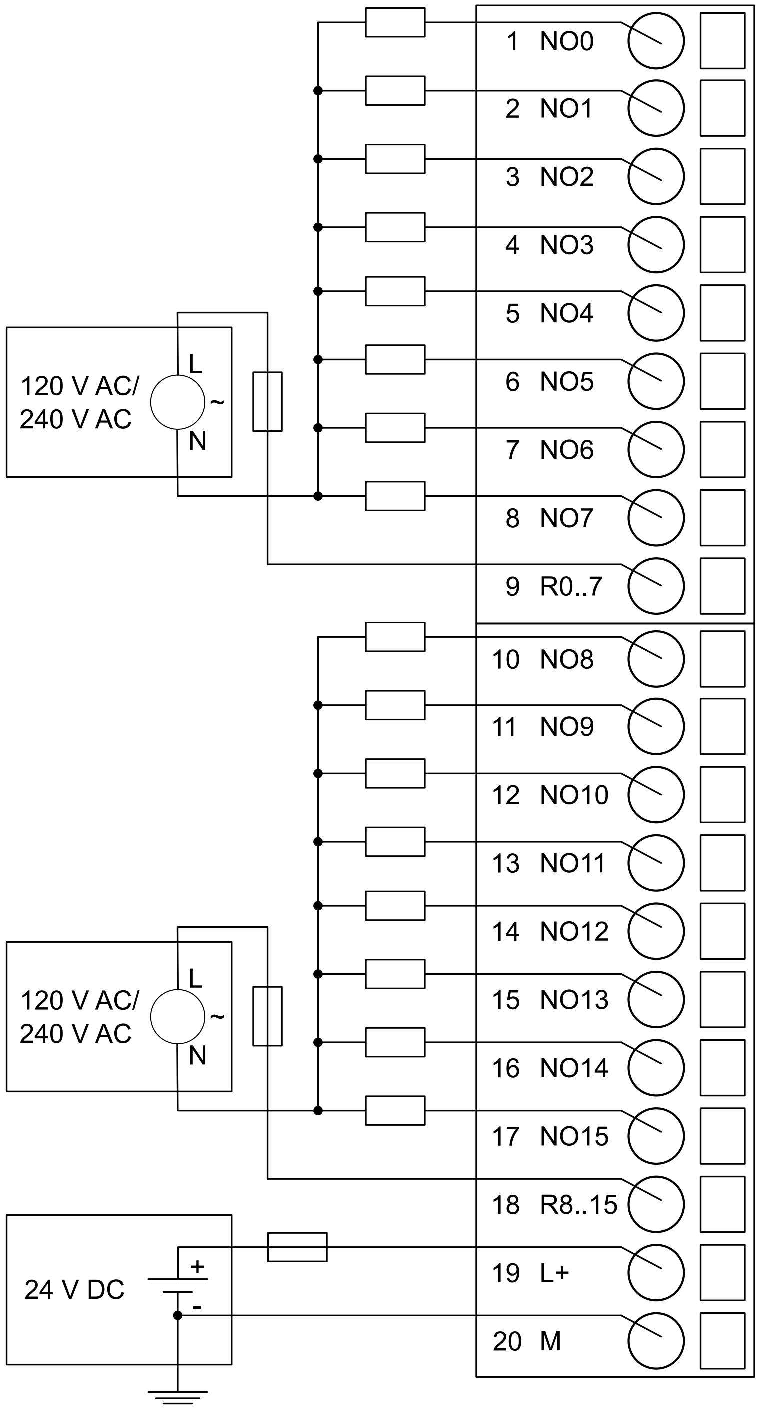


Fig. 39: Connection of 100-240 V AC actuators

The module provides several diagnosis functions.

The meaning of the LEDs is described in the section State LEDs *Chapter 5.4.2.1.9.7 “State LEDs” on page 334*.

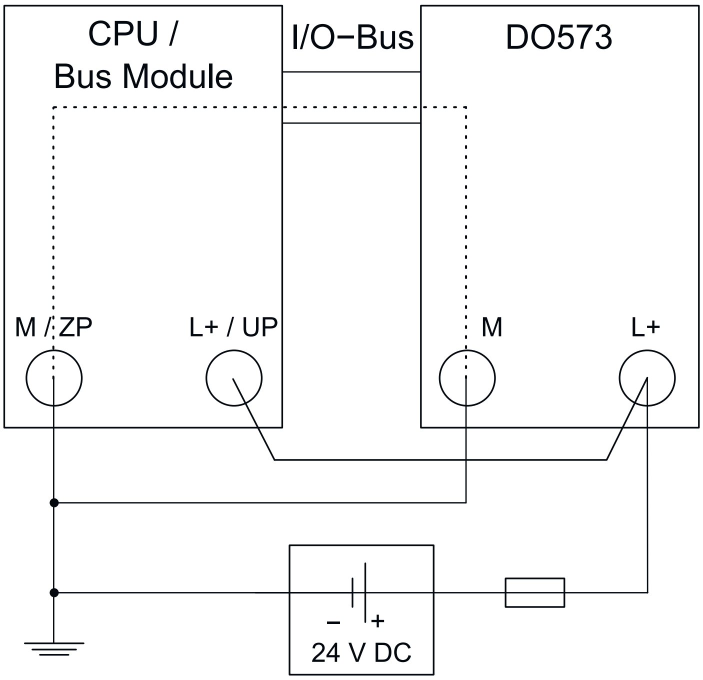


Fig. 40: Power supply - the negative connection is realized via the I/O bus

> *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

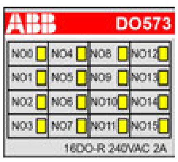
E1 ... E4	d1	d2	d3	d4	Identi-fier 000 ... 063	AC500-Display	<− Display in
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC Browser	
Byte 6 Bit 6 ... 7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0 ... 5	PNIO diag-nosis block	
Class	Inter-face	Device	Module	Channel	Error-Identi-fier	Error message	Remedy
	[1])	[2])	[3])	[4])			
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	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	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

The system data of AC500-eCo apply.

Chapter 4.1 “System data AC500-eCo” on page 23

Only additional details are therefore documented below.

Technical data of the module

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.

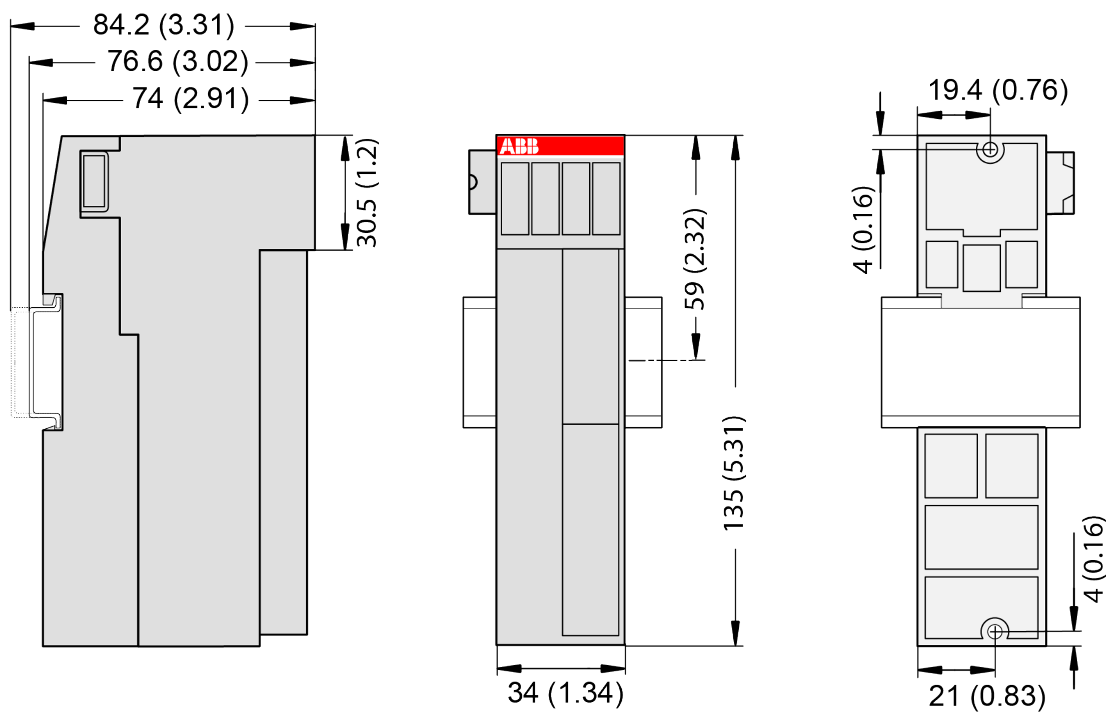
Technical data of the digital outputs

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)

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
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.

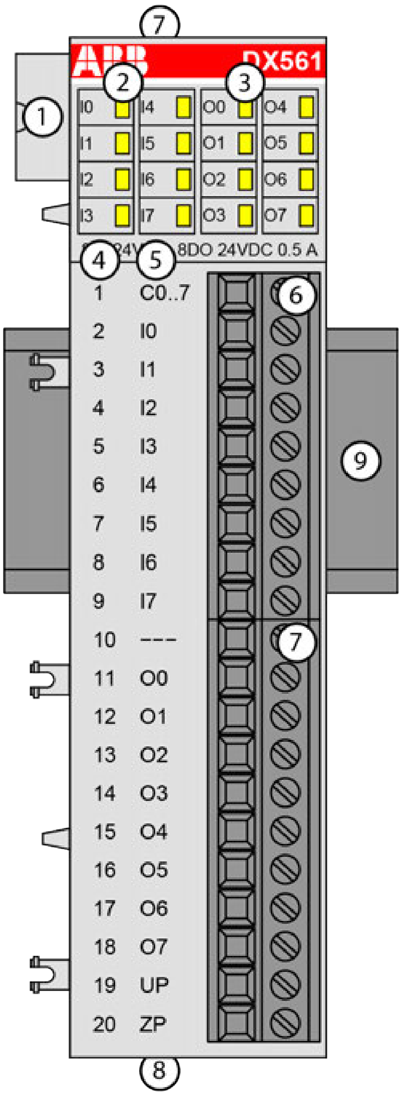
Ordering data

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.*

5.4.2.1.11 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

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.

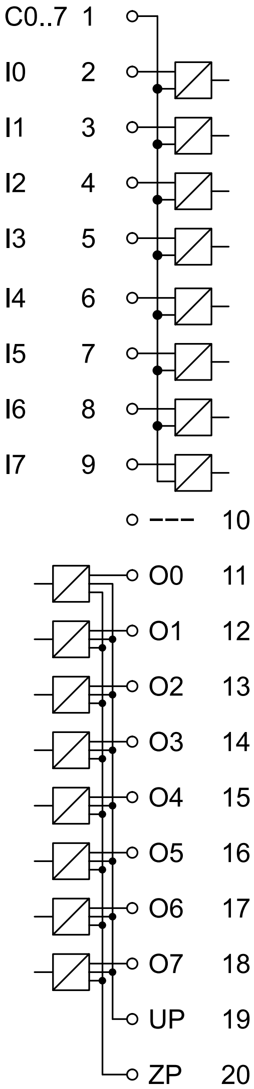


Fig. 41: Internal construction of the digital inputs and outputs

Table 123: 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
13	O2	Output signal O2

Terminal	Signal	Description
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 10 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 you

– 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.

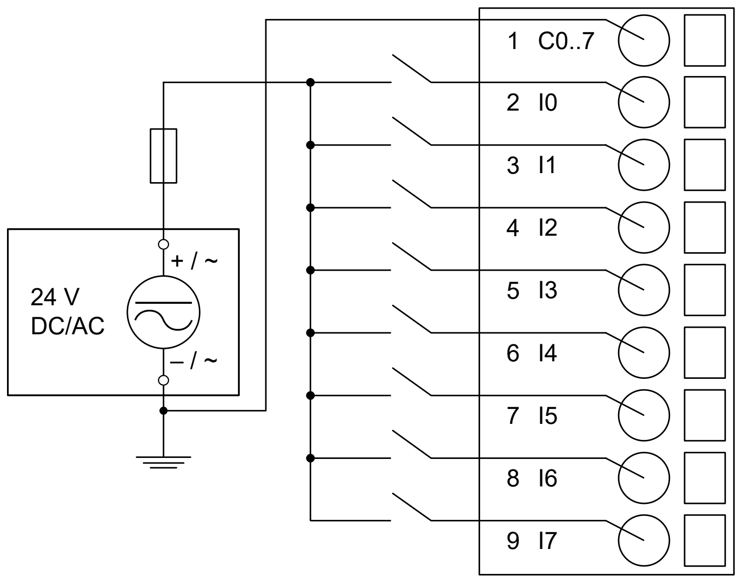


Fig. 42: Connection of inputs to the digital input/output module - sink inputs

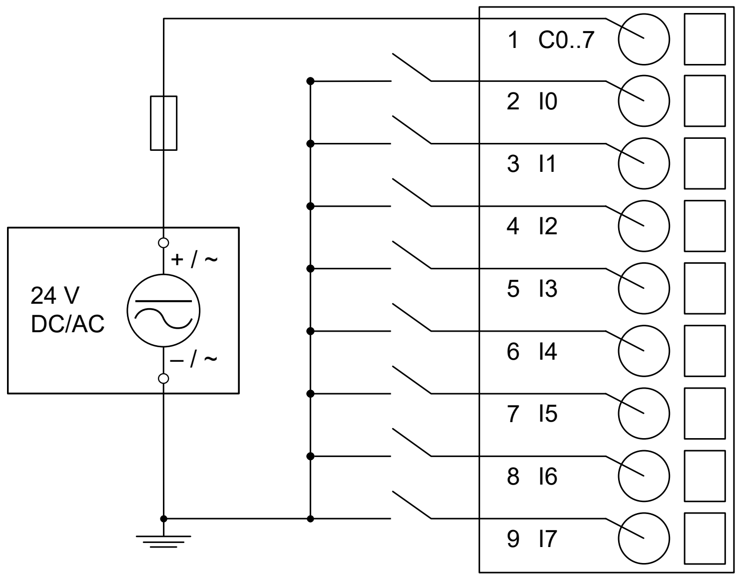


Fig. 43: Connection of inputs to the digital input/output module - source inputs

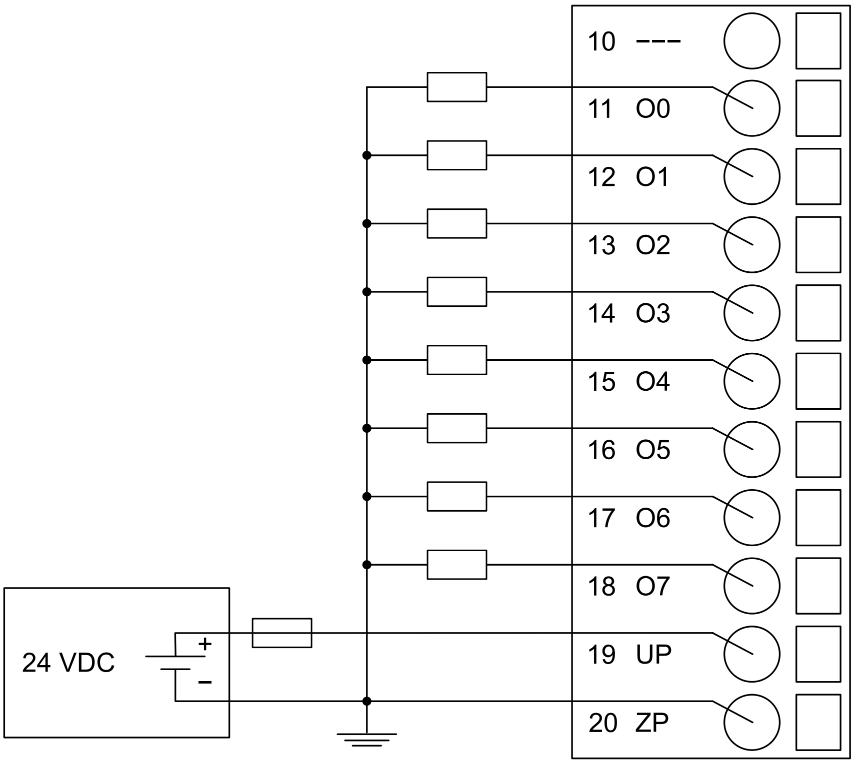


Fig. 44: Connection of the outputs to the module

> **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 5.4.2.1.11.6 “Diagnosis” on page 357*.

The meaning of the LEDs is described in the Displays section *Chapter 5.4.2.1.11.7 “State LEDs” on page 358* 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;

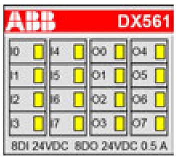
Diagnosis

E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500-Display	<– Display in	
Class	Comp	Dev	Mod	Ch	Err	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
	Inputs I0 ... I7	Digital input	Yellow	Input is OFF	Input is ON
	Outputs O0 ... O7	Digital output	Yellow	Output is OFF	Output is ON

Technical data

The system data of AC500-eCo apply.

Chapter 4.1 “System data AC500-eCo” on page 23

Only additional details are therefore documented below.

Technical data of the module

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	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	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 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

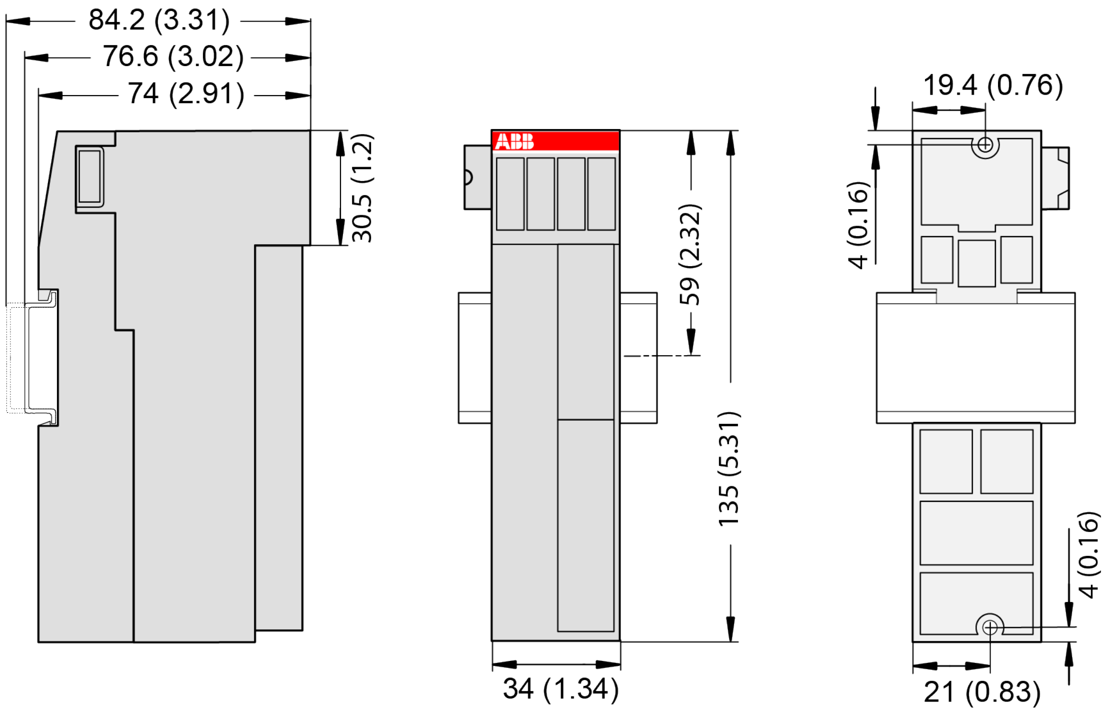
Parameter		Value	
Number of channels per module		8	
Distribution of the channels into groups		1 group for 8 channels	
Connections of the channels I0 ... I7		Terminals 2 ... 9	
Reference potential for the channels I0 ... I7		Terminal 1	
Indication of the input signals		1 yellow LED per channel; the LED is ON when the input signal is high (signal 1)	
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

Parameter		Value
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		
	Rated current per channel (max.)	0.5 A at UP 24 V DC
	Rated current per group (max.)	4 A
	Rated current (all channels together, max.)	4 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.

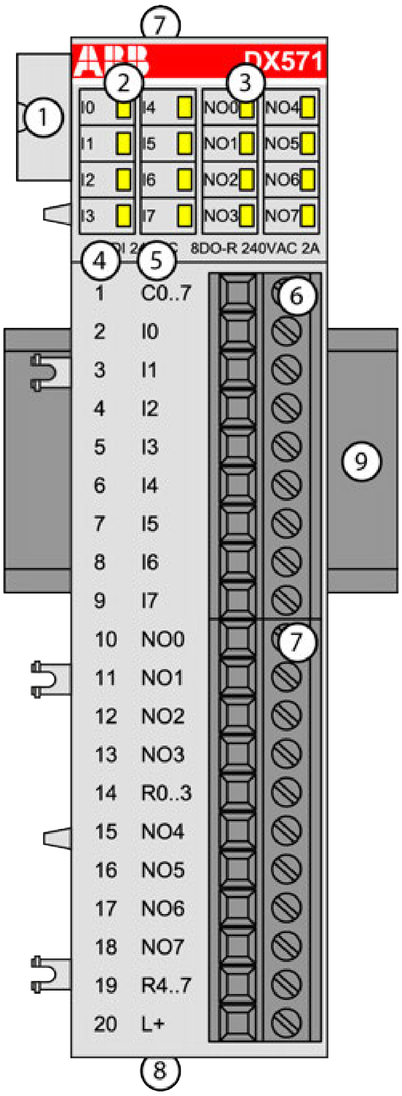
Ordering data

Part no.	Description	Product life cycle phase *)
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.*

5.4.2.1.12 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.

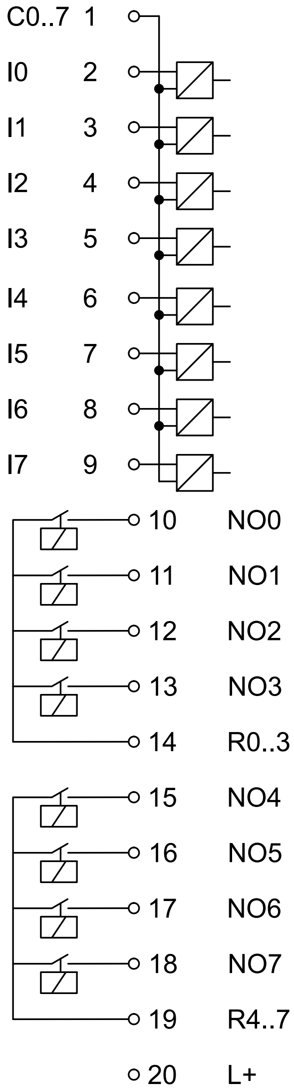


Fig. 45: Internal construction of the digital inputs and outputs

Table 124: 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

Terminal	Signal	Description
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 you

– 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 can be damaged by overload.

Make sure that the total current of each output common terminal (R0 ... 3 and R4 ... 7) 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 (see Diagnosis *Chapter 5.4.2.1.12.6 “Diagnosis” on page 370*).

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.

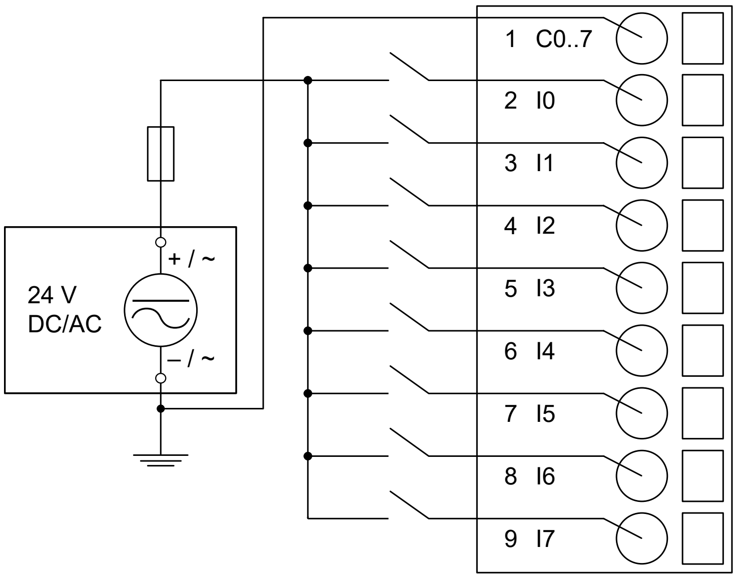


Fig. 46: Connection of inputs to the digital input/output module DX571 - sink inputs

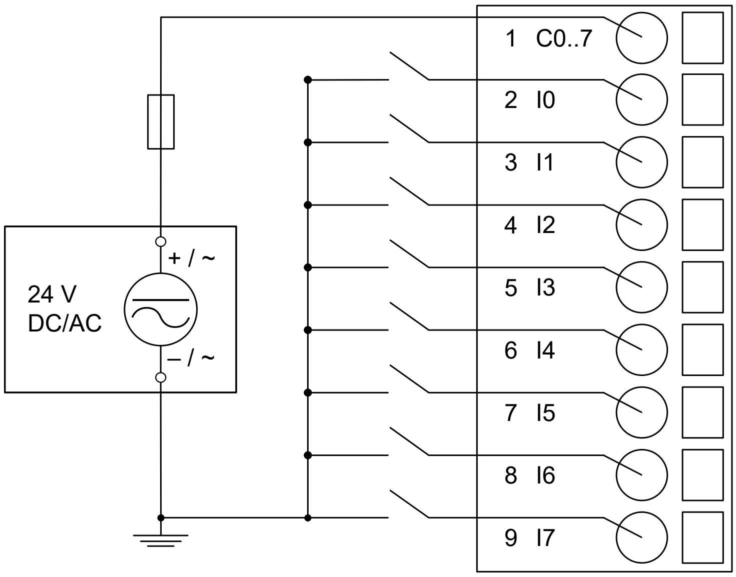


Fig. 47: Connection of inputs to the digital input/output module DX571 - source inputs

The following figures show the connection of the outputs to the module:

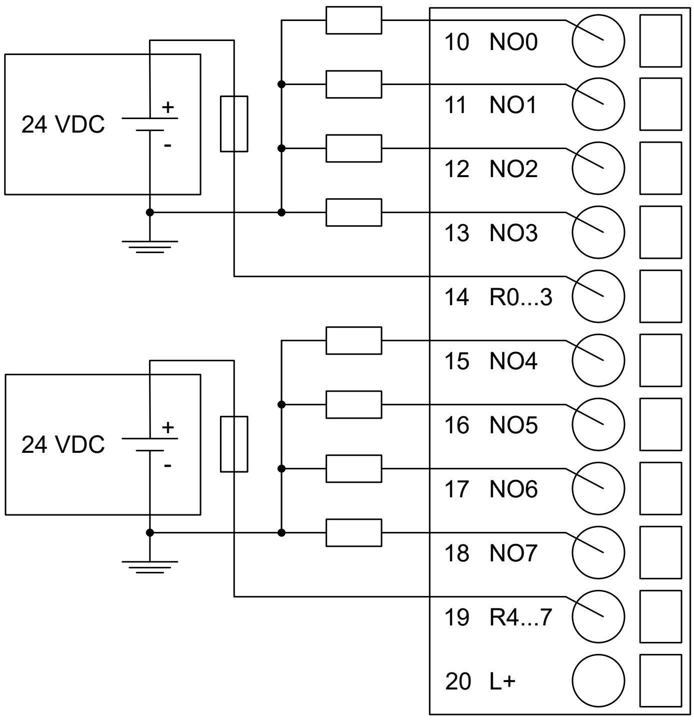


Fig. 48: Connection of 24 V DC actuators

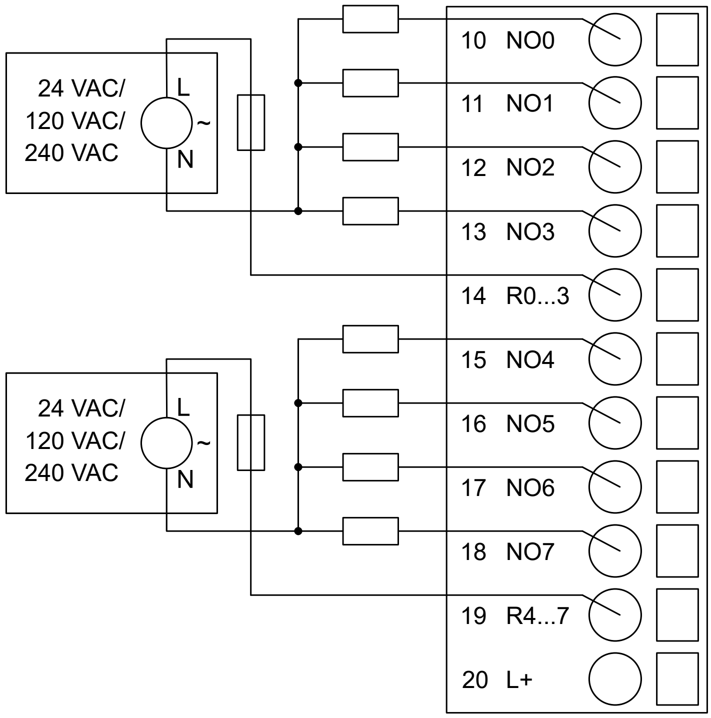


Fig. 49: Connection of 24 V AC or 100 ... 240 V AC actuators

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.

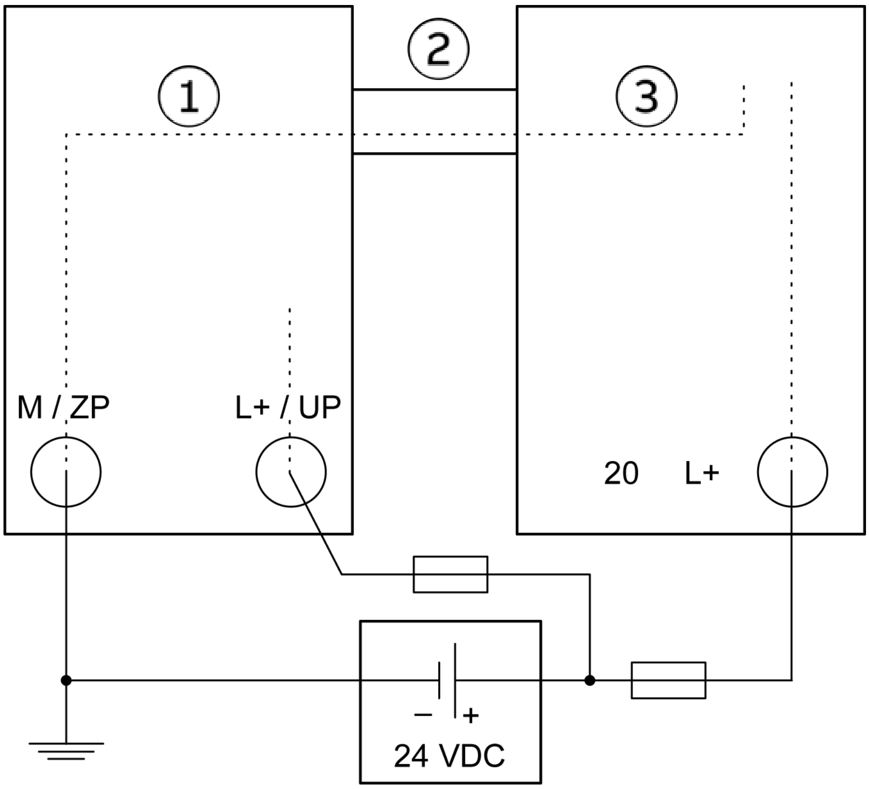


Fig. 50: Power supply - the minus connection is realized via the I/O bus

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.

The meaning of the LEDs is described in the Displays section *Chapter 5.4.2.1.12.7 “State LEDs” on page 371*.

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;

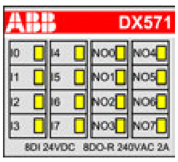
Diagnosis

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

The system data of AC500-eCo apply.

Chapter 4.1 “System data AC500-eCo” on page 23

Only additional details are therefore documented below.

Technical data of the module

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

Parameter		Value
	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.

Parameter		Value	
	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.

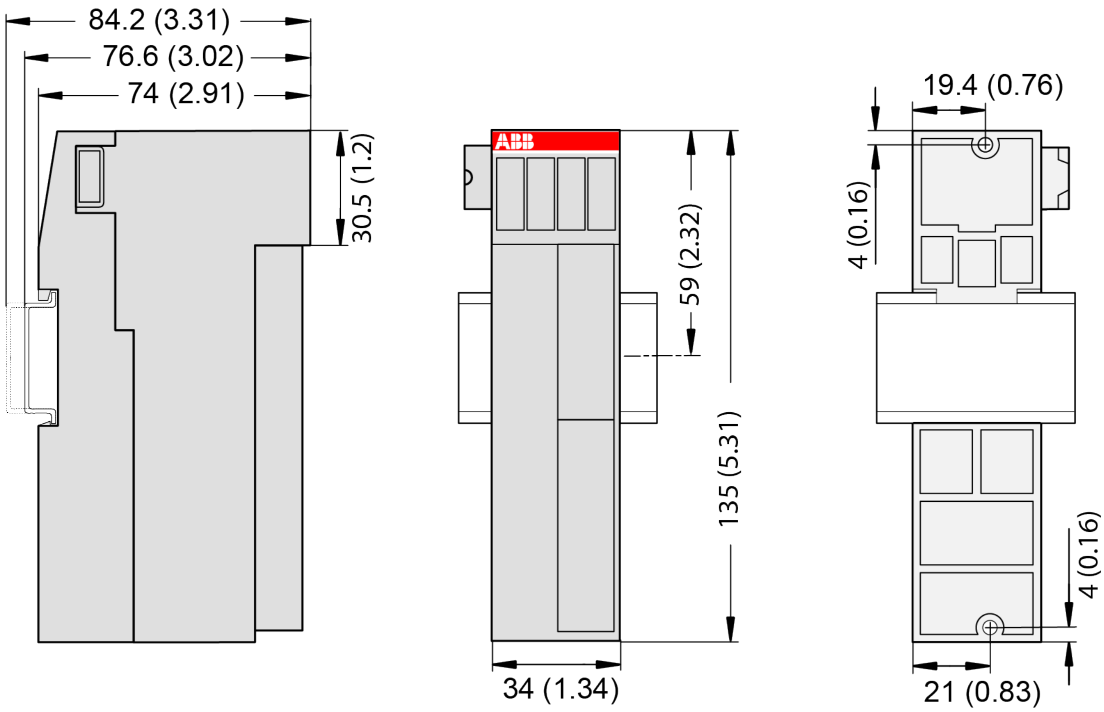
Technical data of the digital outputs

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
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

Parameter		Value
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

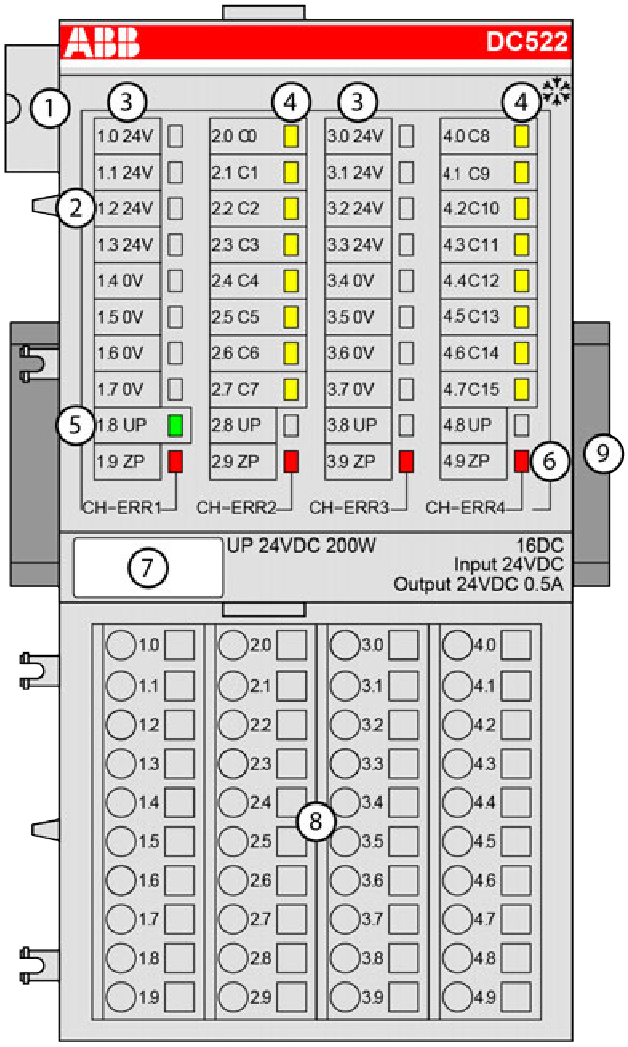
Part no.	Description	Product life cycle phase *)
1TNE 968 902 R2302	DX571, digital input/output module, 8 DI 24 V DC / 24 V AC, 8 DO, relay output	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 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
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.*

5.4.2.2 S500 and S500-XC

5.4.2.2.1 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 *Chapter 5.5.1 “TU515, TU516, TU541 and TU542 for I/O modules” on page 801*
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 5.5.1 “TU515, TU516, TU541 and TU542 for I/O modules” on page 801*. 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 5.8.2.5 “TA526 - Wall mounting accessory” on page 1183*.

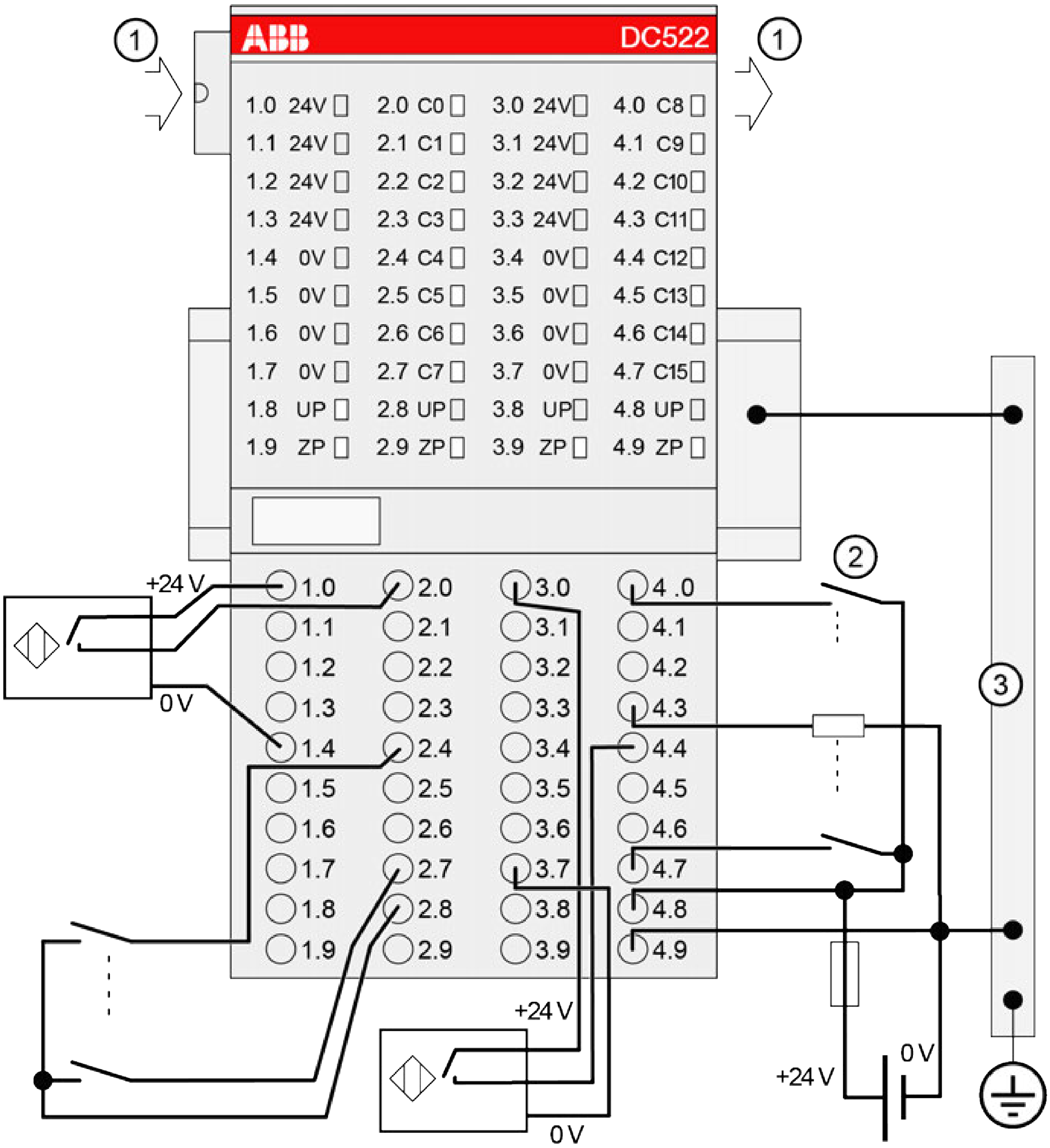
Connections

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



1 I/O bus
2 4.0 ... 4.7: Connected with UP (switch) -> Input;
Connected with ZP (load) -> Output
3 Control cabinet earth

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)

Terminals	Signal	Description
3.4 ... 3.7	0 V	0 V (reference potential)
4.0 ... 4.7	C8 ... C15	8 digital inputs/outputs

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 10

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 you

– 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 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
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:

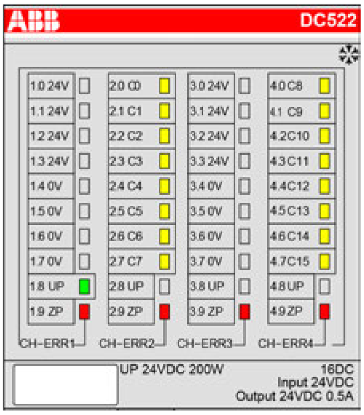
[1])	With CS31 and addresses smaller than 70 and FBP, the value is increased by 1
[2])	Not with FBP
[3])	For a description of the counter operating modes, please refer to the 'Fast Counter' section ↬ *Chapter 5.4.2.2.9 “Fast counter” on page 464*
[4])	With FBP or CS31 without the parameter Fast Counter

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

The system data of AC500 and S500 are applicable to the standard version *Chapter 4.2 “System data AC500” on page 30.*

The system data of AC500-XC are applicable to the XC version *Chapter 4.3 “System data AC500-XC” on page 35.*

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Technical data of the module

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)

Parameter		Value
	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 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 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.

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.

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 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 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 range -12 V ... +30 V when UPx = 24 V and -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		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.

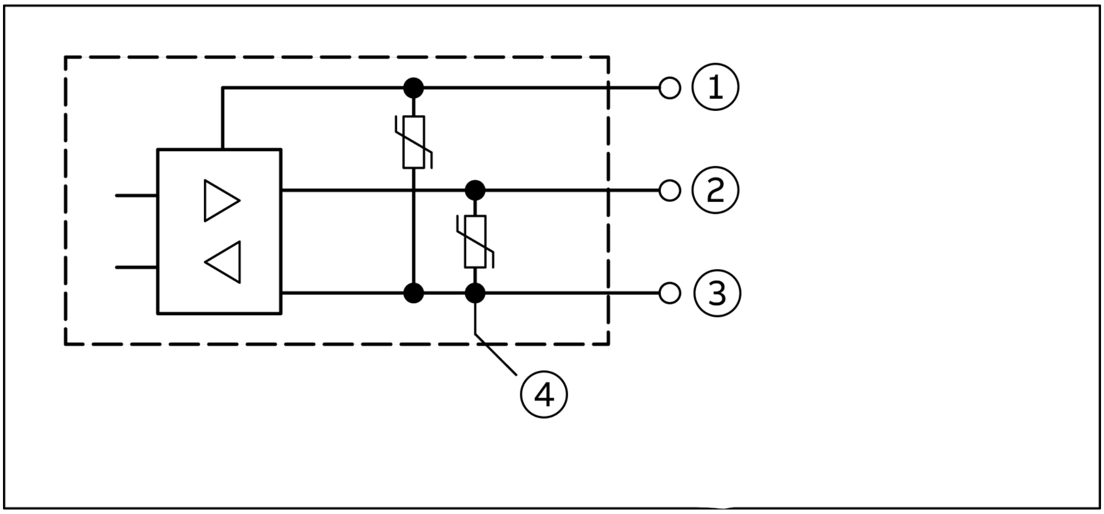


Fig. 51: Digital input/output (circuit diagram)

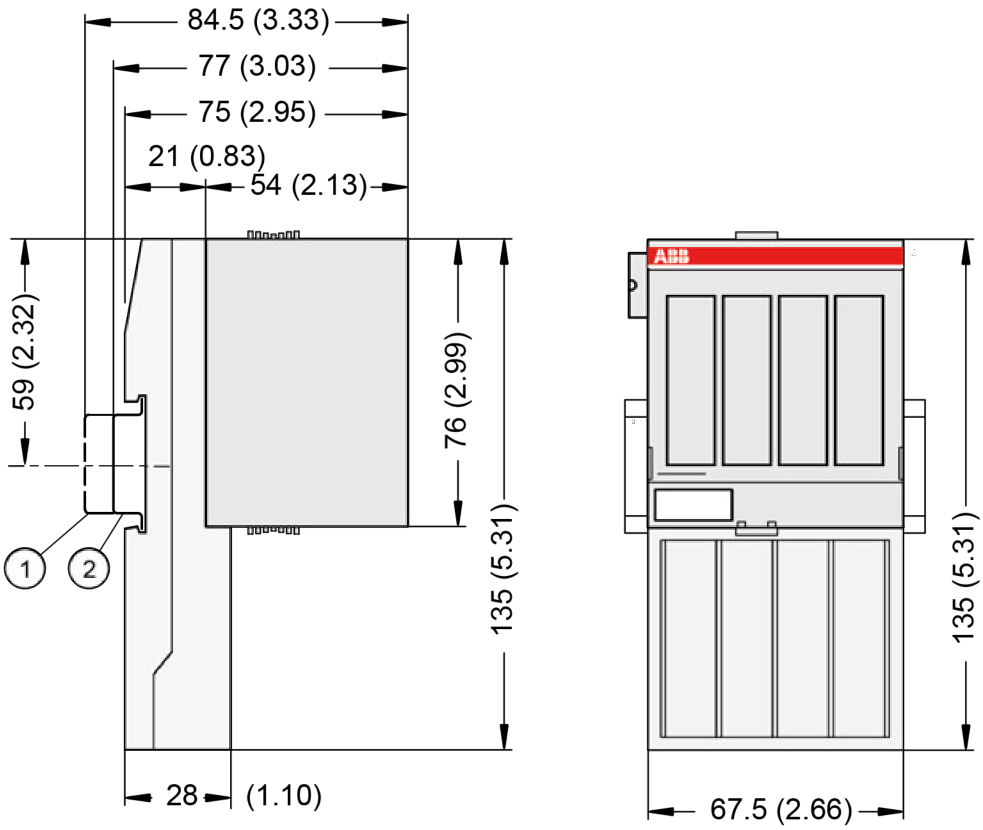
1 UPx (+ 24 V)
2 Digital input/output
3 ZPx (0 V)
4 For demagnization when inductive loads are switched off

Technical data of the fast counter

The fast counter of the module does not work if the module is connected to a
- *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

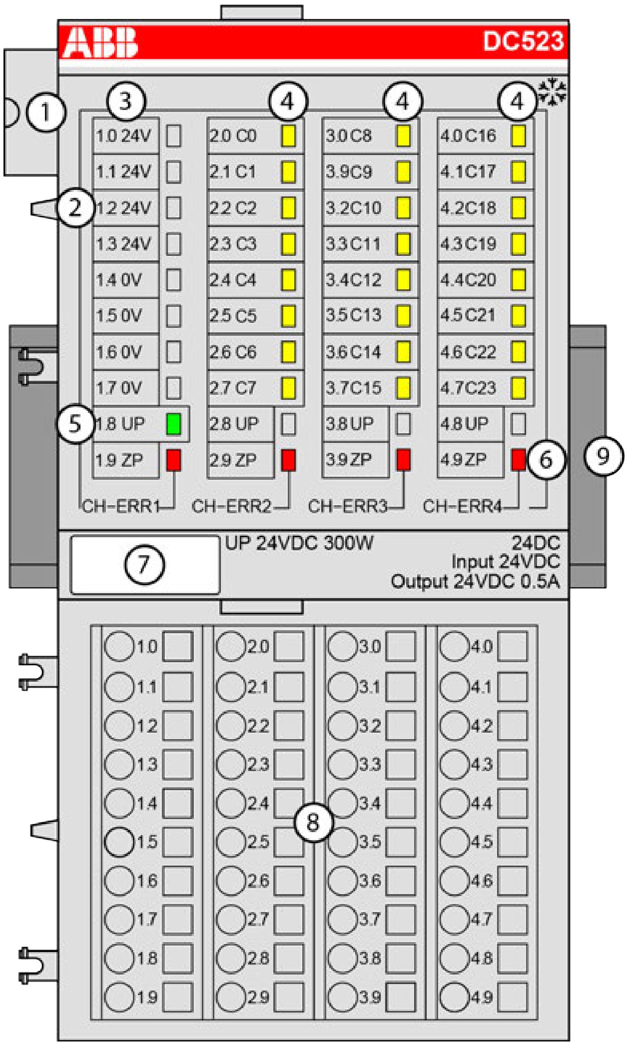
Part no.	Description	Product life cycle phase *)
1SAP 240 600 R0001	DC522, digital input/output module, 16 DC, 24 V DC / 0.5 A, 2-wires	Active
1SAP 440 600 R0001	DC522-XC, digital input/output module, 16 DC, 24 V DC / 0.5 A, 2-wires, XC version	Active

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

5.4.2.2.2 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 ␖ *Chapter 5.5.1 “TU515, TU516, TU541 and TU542 for I/O modules” on page 801*
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 5.5.1 “TU515, TU516, TU541 and TU542 for I/O modules” on page 801*. 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 5.8.2.5 “TA526 - Wall mounting accessory” on page 1183*.

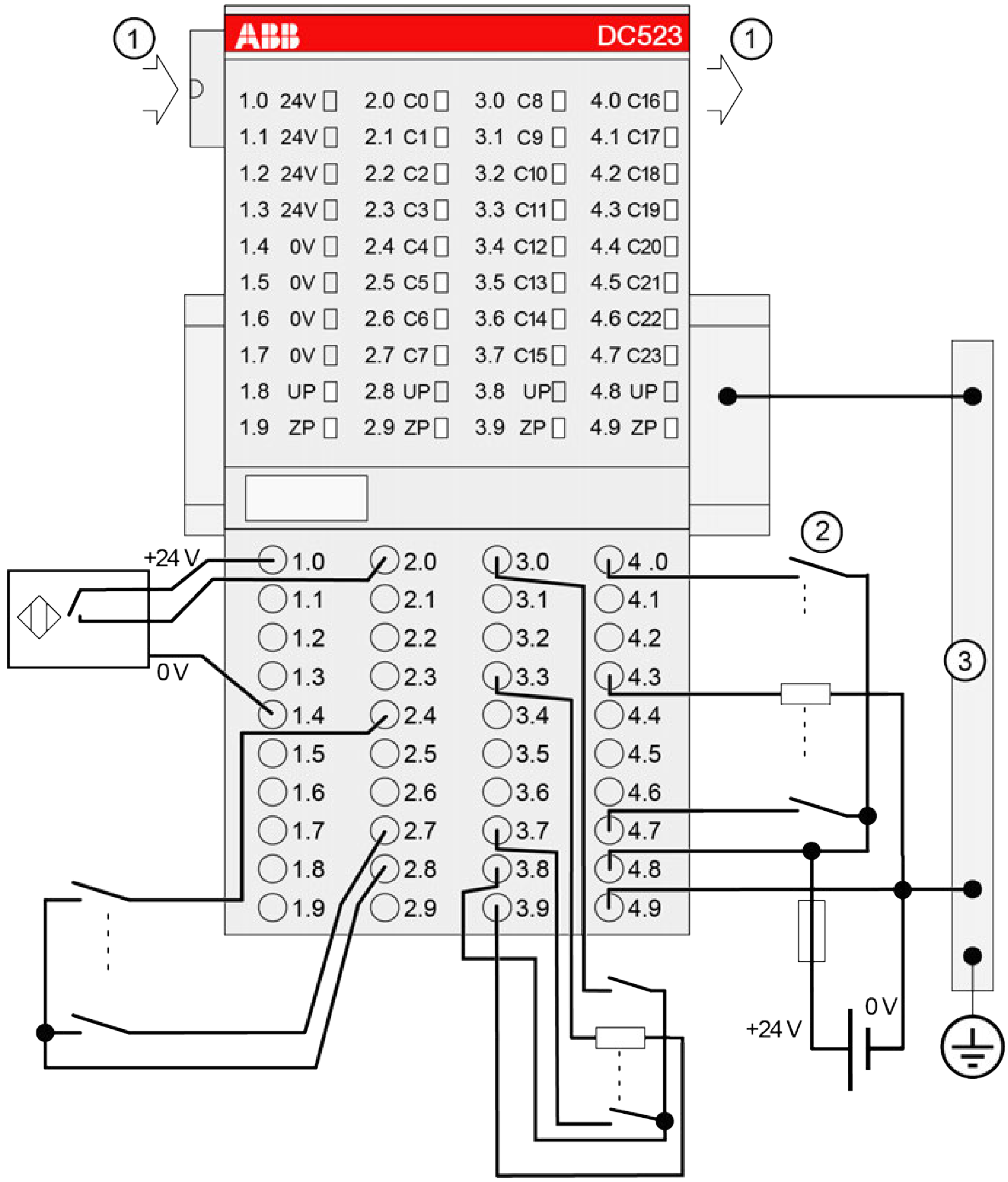
Connections

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



1 I/O bus
2 4.0 ... 4.7: Connected with UP (switch) -> Input;
Connected with ZP (load) -> Output
3 Control cabinet earth

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

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 10

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 you

– 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 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
Check supply	Off on	0 1	Byte	On 0x01	0	1	0x=Y03

Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
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:

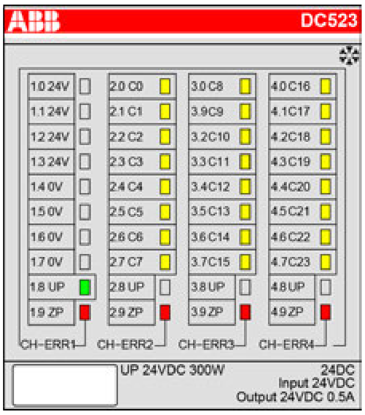
1)	With CS31 and addresses smaller than 70 and FBP, the value is increased by 1
2)	Not with FBP
3)	For a description of the counter operating modes, please refer to the 'Fast Counter' section ⇘ *Chapter 5.4.2.2.9 “Fast counter” on page 464*
4)	With FBP or CS31 without the parameter Fast Counter

GSD file:

Ext_User_Prm_Data_Len =	11
Ext_User_Prm_Data_Const(0) =	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	--
	[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

The system data of AC500 and S500 are applicable to the standard version ⇘ *Chapter 4.2 "System data AC500" on page 30*.

The system data of AC500-XC are applicable to the XC version ⇘ *Chapter 4.3 "System data AC500-XC" on page 35*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Technical data of the module

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 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 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 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
	Channels C16 ... C23	Terminals 4.0 ... 4.7
If the channels are used as outputs		

Parameter		Value
	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 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	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.

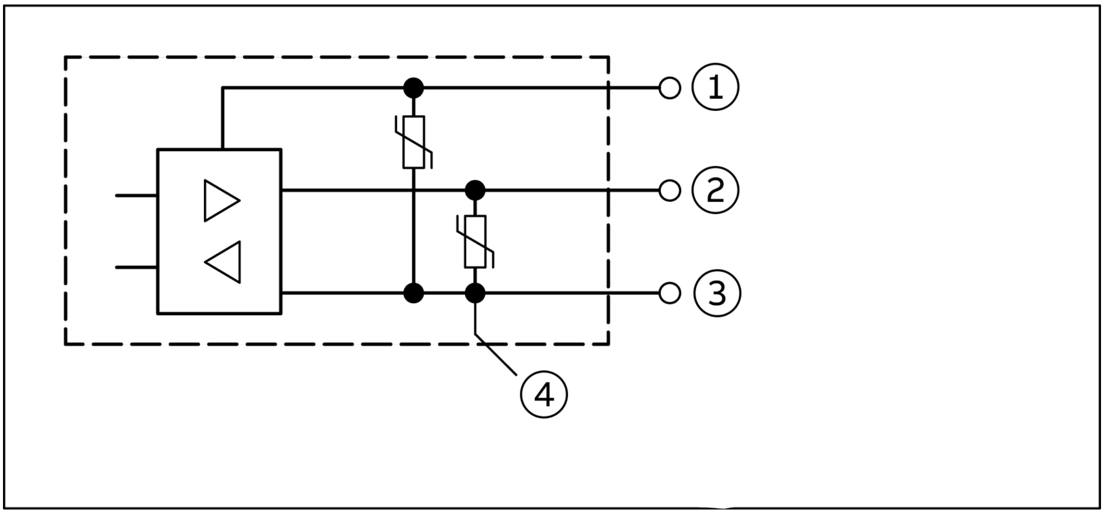


Fig. 52: Digital input/output (circuit diagram)

1 UPx (+ 24 V)
2 Digital input/output
3 ZPx (0 V)
4 For demagnization when inductive loads are switched off

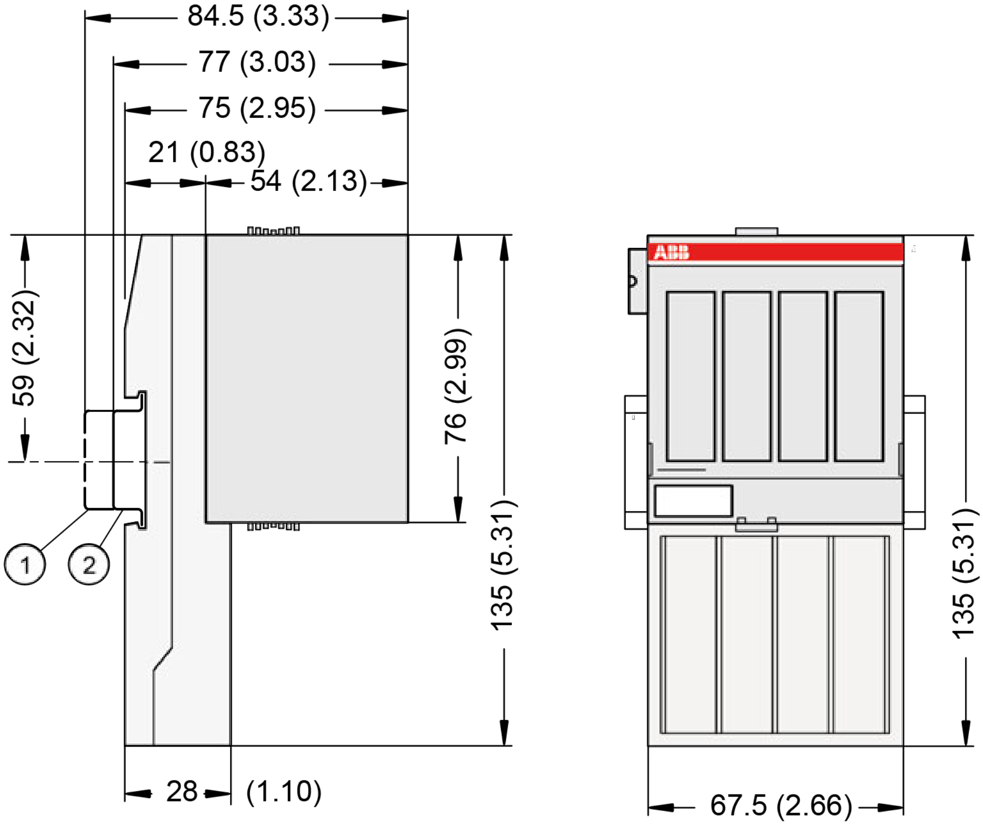
Technical data of the fast counter

The fast counter of the module does not work if the module is connected to a
- *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

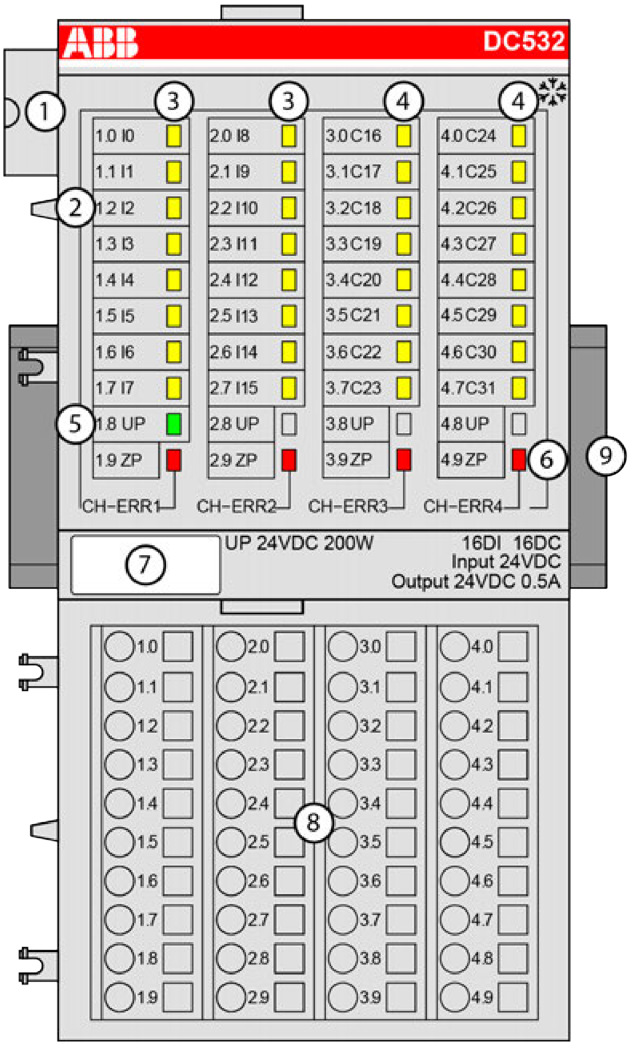
Part no.	Description	Product life cycle phase *)
1SAP 240 500 R0001	DC523, digital input/output module, 24 DC, 24 V DC / 0.5 A, 1-wire	Active
1SAP 440 500 R0001	DC523-XC, digital input/output module, 24 DC, 24 V DC / 0.5 A, 1-wire, XC version	Active

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

5.4.2.2.3 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 *Chapter 5.5.1 “TU515, TU516, TU541 and TU542 for I/O modules” on page 801*
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 5.5.1 “TU515, TU516, TU541 and TU542 for I/O modules” on page 801*. 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 5.8.2.5 “TA526 - Wall mounting accessory” on page 1183*.

For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.

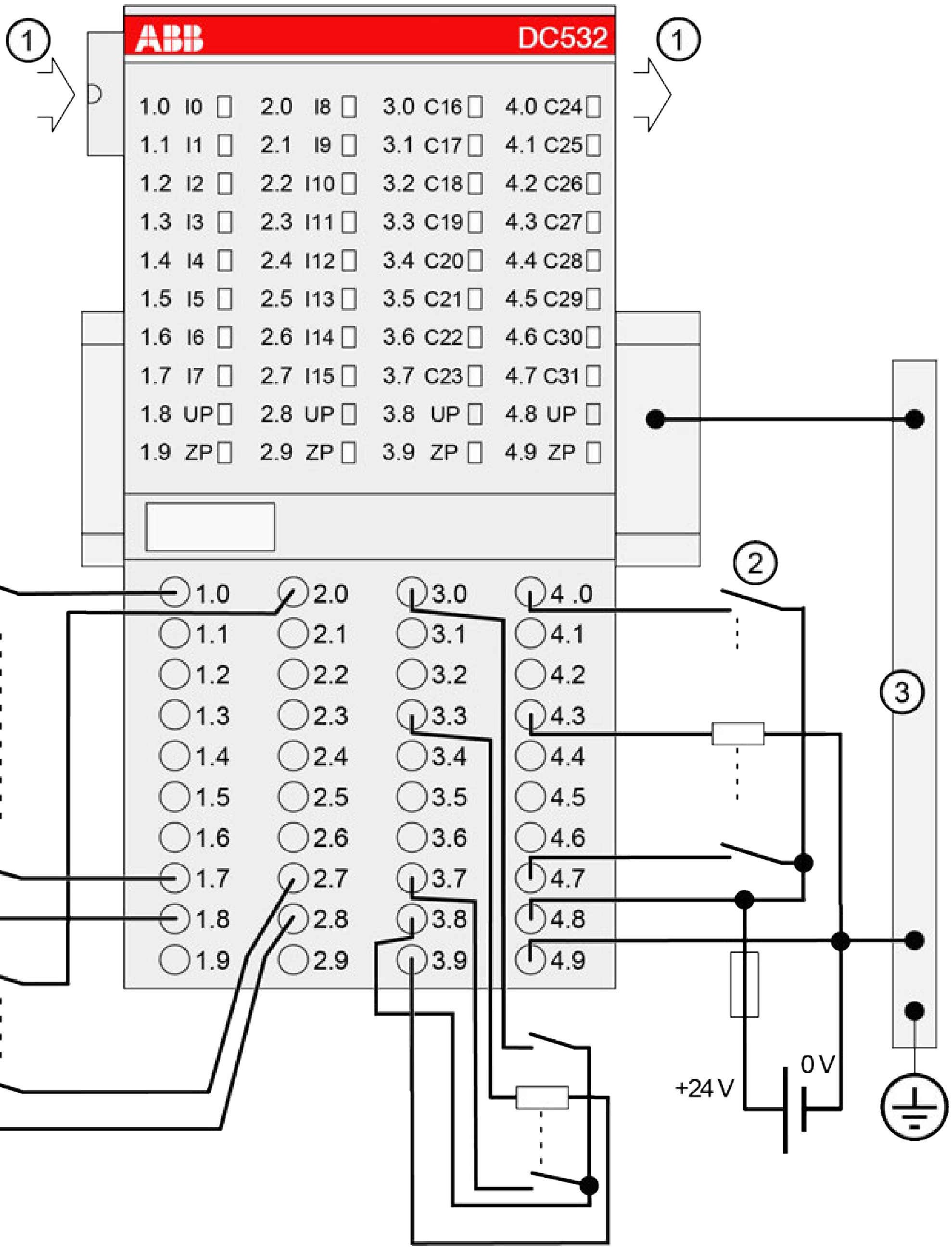
Connections

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



1 I/O bus
2 4.0 ... 4.7: Connected with UP (switch) -> Input;
Connected with ZP (load) -> Output
3 Control cabinet earth

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

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 10

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 you

– 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 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
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:

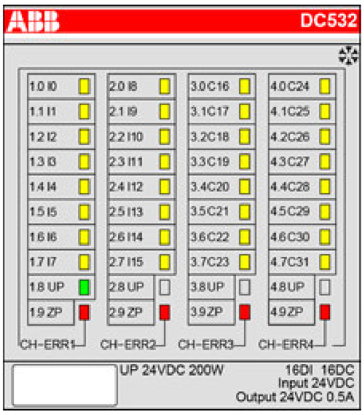
[1])	With CS31 and addresses smaller than 70 and FBP, the value is increased by 1
[2])	Not with FBP
[3])	For a description of the counter operating modes, please refer to the 'Fast Counter' section *Chapter 5.4.2.2.9 “Fast counter” on page 464*
[4])	With FBP or CS31 without the parameter Fast Counter

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	--
	[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

The system data of AC500 and S500 are applicable to the standard version *Chapter 4.2 “System data AC500” on page 30*.

The system data of AC500-XC are applicable to the XC version *Chapter 4.3 “System data AC500-XC” on page 35*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Technical data of the module

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	0.15 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 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	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)

Parameter	Value
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
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 5.4.2.2.3.8.2 “Technical data of the digital inputs” on page 407*
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 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	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

Parameter		Value
	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.

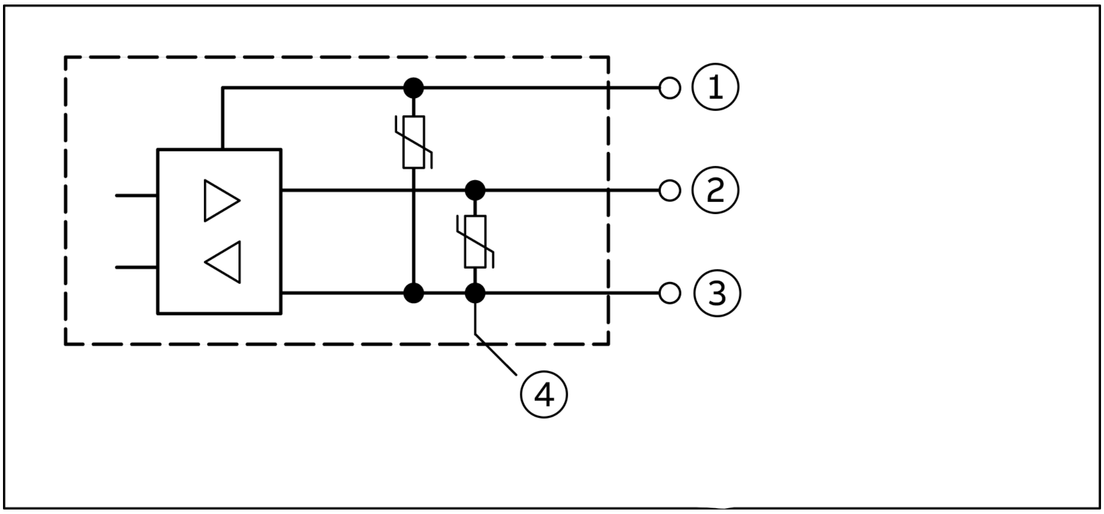


Fig. 53: Digital input/output (circuit diagram)

1 UPx (+ 24 V)
2 Digital input/output
3 ZPx (0 V)
4 For demagnization when inductive loads are switched off

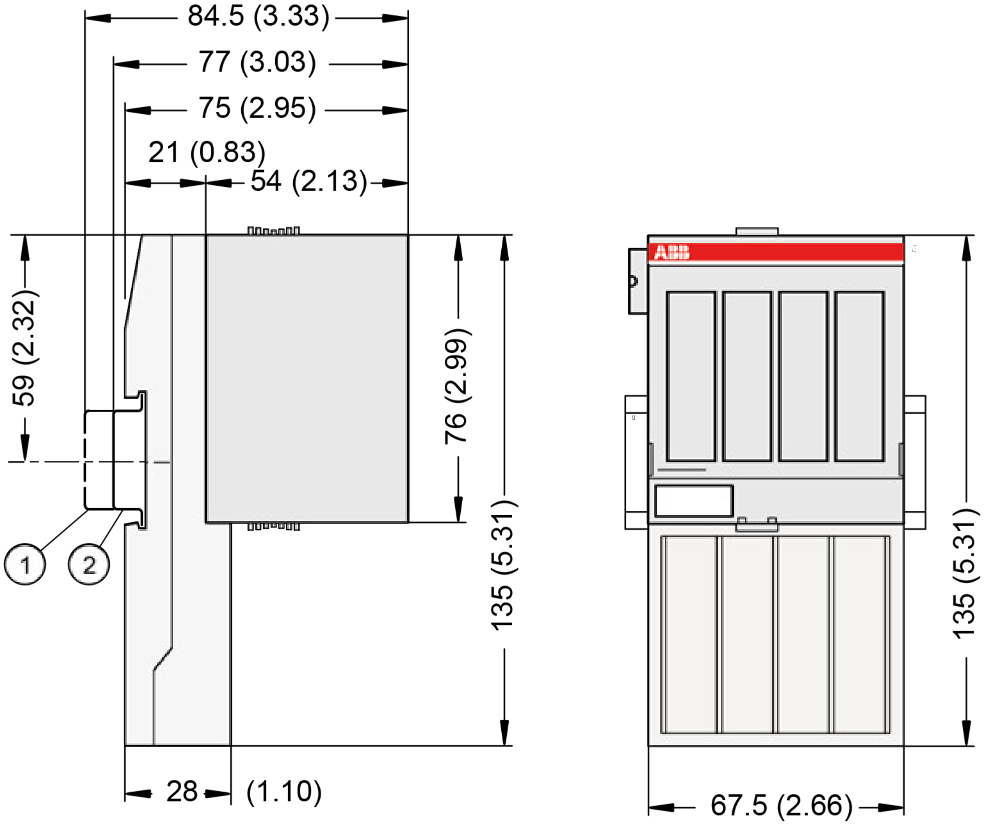
Technical data of the fast counter

The fast counter of the module does not work if the module is connected to a

- *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

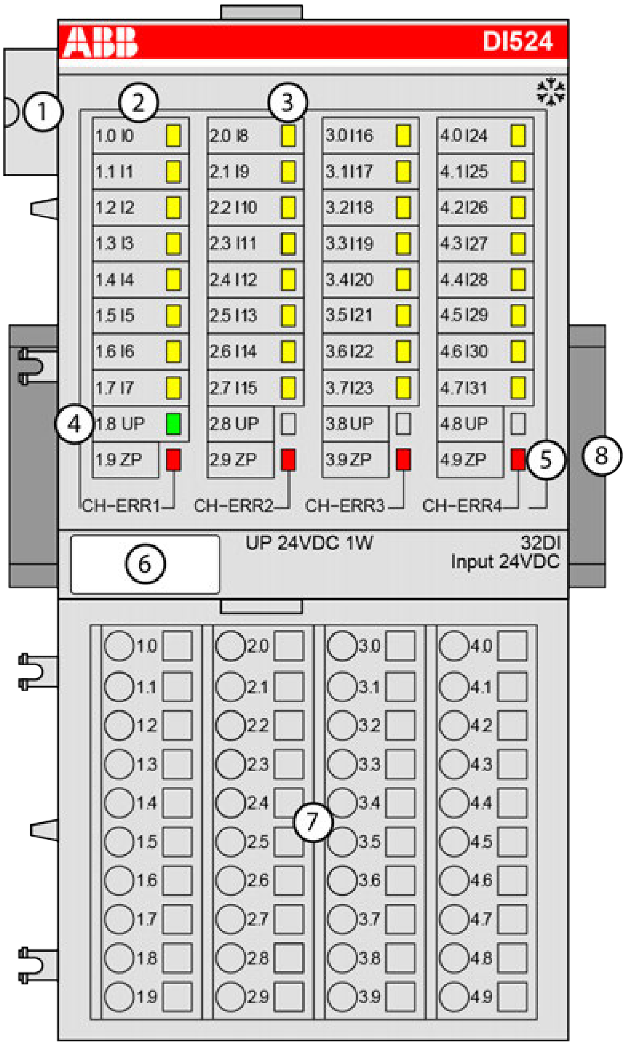
Part no.	Description	Product life cycle phase *)
1SAP 240 100 R0001	DC532, digital input/output module, 16 DI, 16 DC, 24 V DC / 0.5 A, 1-wire	Active
1SAP 440 100 R0001	DC532-XC, digital input/output module, 16 DI, 16 DC, 24 V DC / 0.5 A, 1-wire, XC version	Active

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

5.4.2.2.4 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 ␗ *Chapter 5.5.1 “TU515, TU516, TU541 and TU542 for I/O modules” on page 801*
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 5.5.1 “TU515, TU516, TU541 and TU542 for I/O modules” on page 801*. 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 5.8.2.5 “TA526 - Wall mounting accessory” on page 1183*.

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 125: 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

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 10

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 you

– connect or disconnect any signal or terminal block
– remove, mount or replace a module.

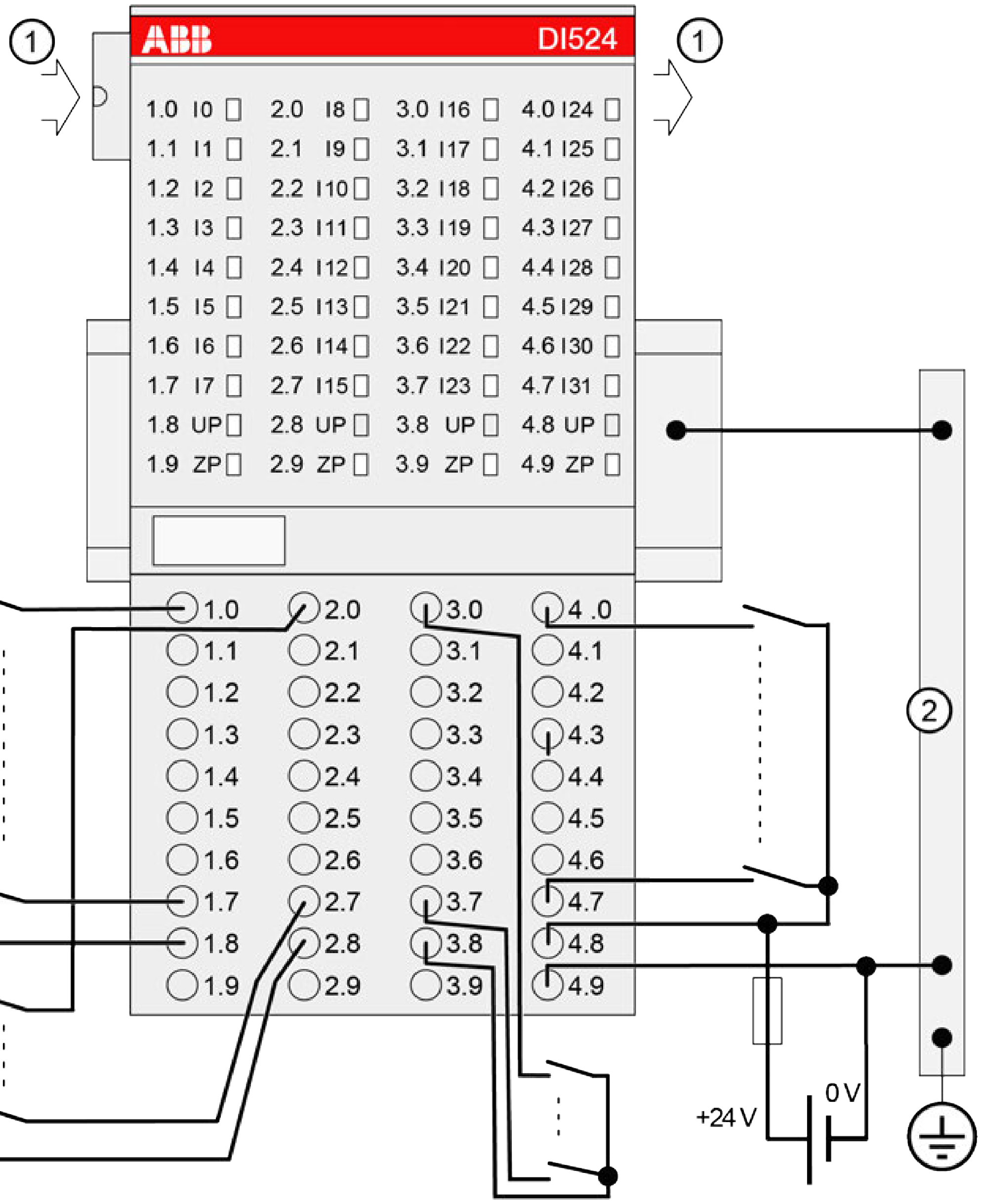
Disconnecting any powered devices while they are energized in a hazardous location could result in an electric arc, which could create an ignition source resulting in fire or explosion.

Prior to proceeding, make sure that power is been disconnected and that the area has been thoroughly checked to ensure that flammable materials 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:

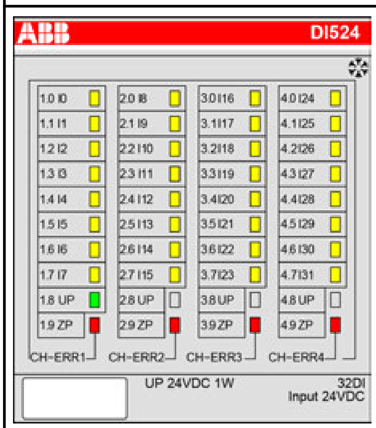
[1])	With CS31 and addresses smaller than 70 and FBP, the value is increased by 1
[2])	Not with FBP
[3])	For a description of the counter operating modes, please refer to the 'Fast Counter' section *Chapter 5.4.2.2.9 “Fast counter” on page 464*
[4])	With FBP or CS31 without the parameter Fast counter

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	--
	[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

The system data of AC500 and S500 are applicable to the standard version ➡ *Chapter 4.2 “System data AC500” on page 30*.

The system data of AC500-XC are applicable to the XC version ➡ *Chapter 4.3 “System data AC500-XC” on page 35*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Technical data of the module

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
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.

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		
	Shielded	1000 m
	Unshielded	600 m

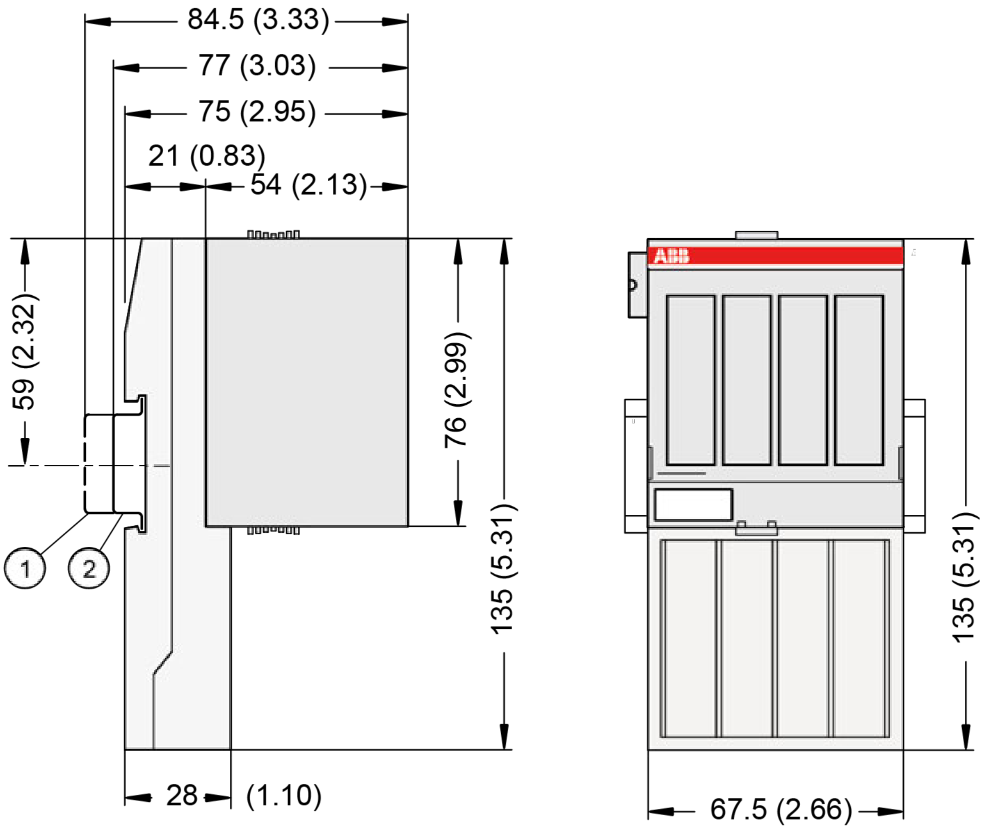
Technical data of the fast counter

The fast counter of the module does not work if the module is connected to a

- *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.

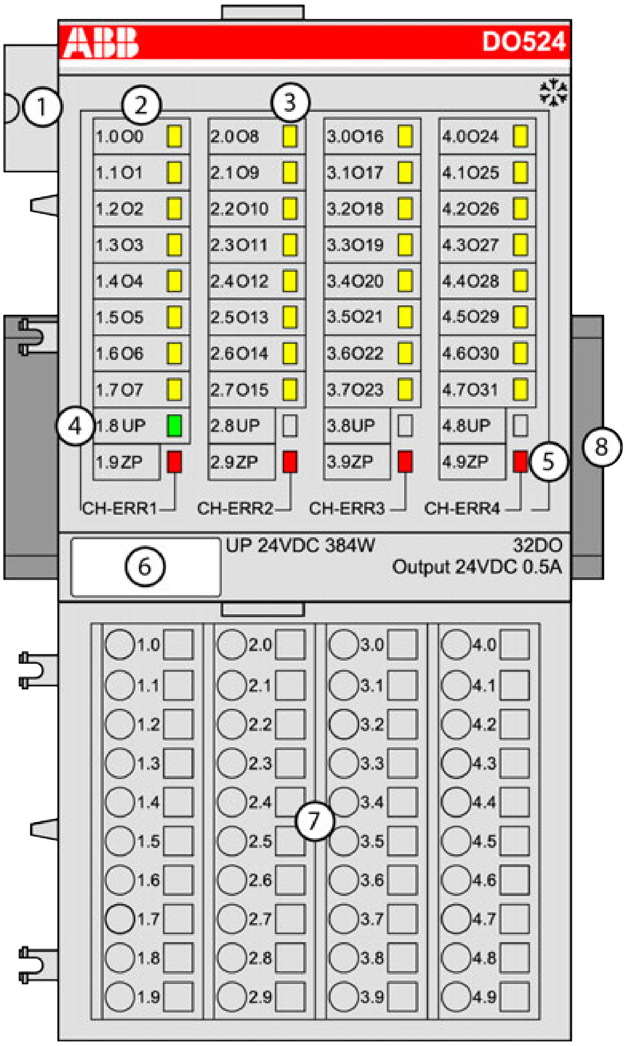
Ordering data

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.*

5.4.2.2.5 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 *Chapter 5.5.1 “TU515, TU516, TU541 and TU542 for I/O modules” on page 801*

The device is plugged on a terminal unit *Chapter 5.5.1 “TU515, TU516, TU541 and TU542 for I/O modules” on page 801*. 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 5.8.2.5 “TA526 - Wall mounting accessory” on page 1183*.

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

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 10

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 you

– 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 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.

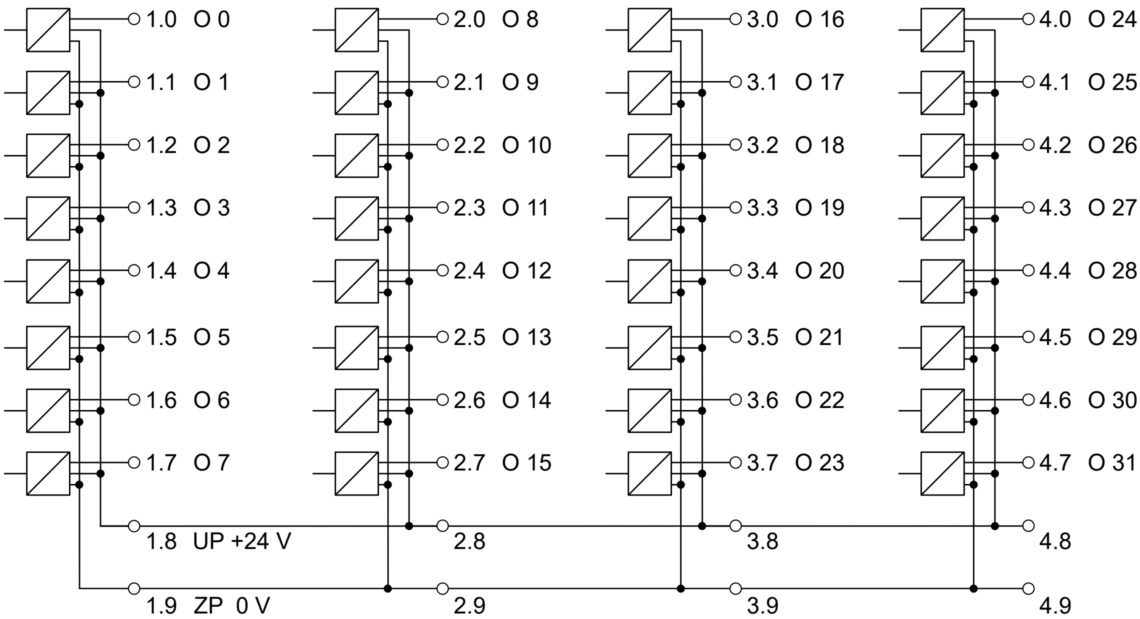


Fig. 54: Internal construction of the digital outputs

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

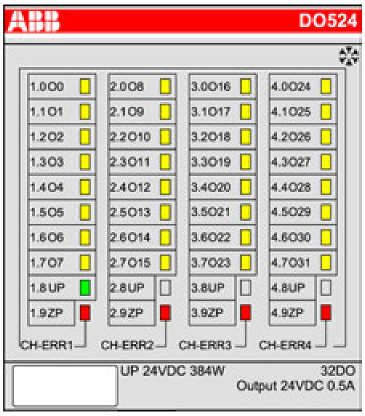
[2]) Not with FBP

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

The system data of AC500 and S500 are applicable to the standard version *Chapter 4.2 “System data AC500” on page 30*.

The system data of AC500-XC are applicable to the XC version *Chapter 4.3 “System data AC500-XC” on page 35*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Technical data of the module

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	0.10 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)

Parameter	Value
Weight (without terminal unit)	Ca. 100 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.

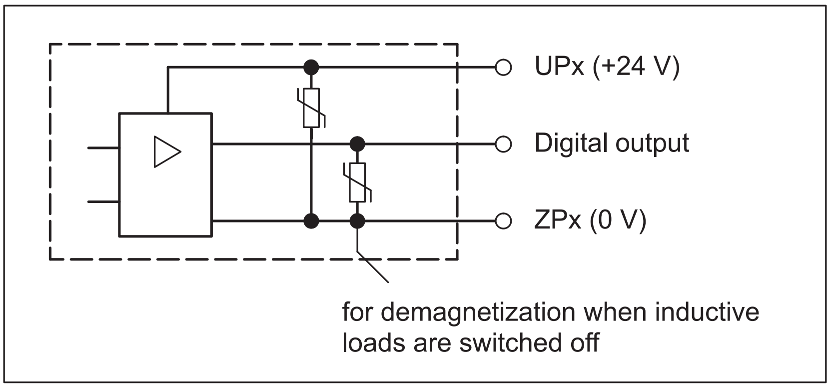
Multiple overloads
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an internal smart high-side switch.

Technical data of the digital outputs

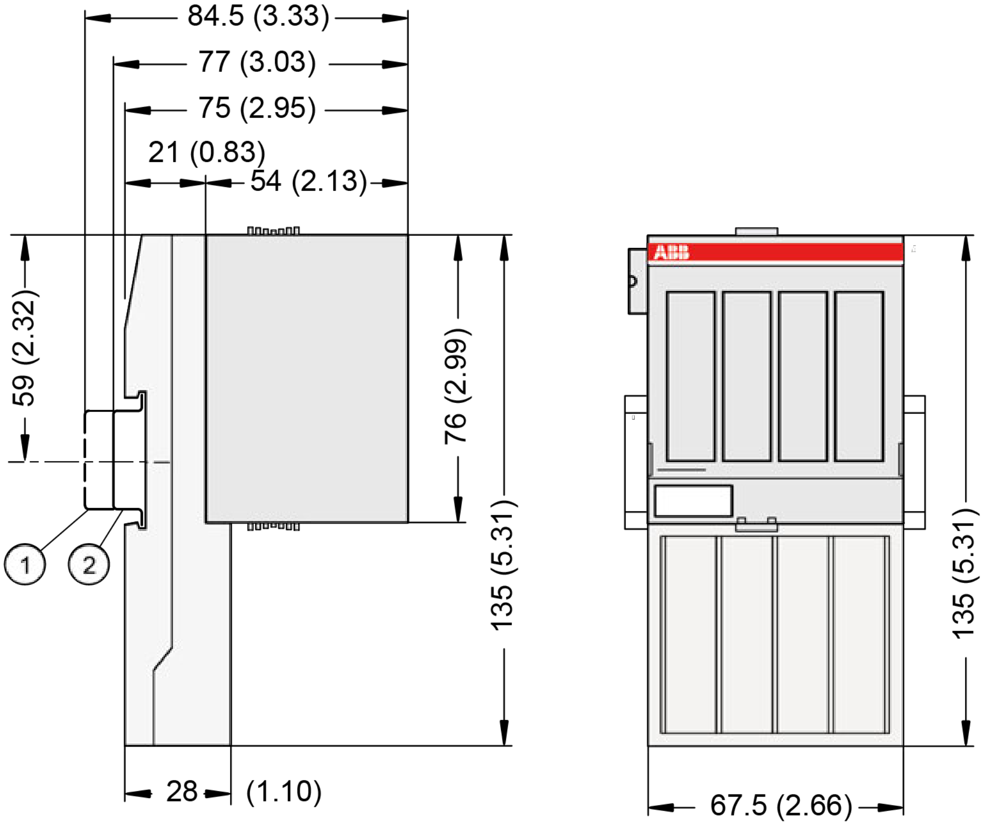
Parameter		Value
Number of channels per module		32 outputs (with transistors)
Distribution of the channels into groups		1 group of 32 channels
Connection of the channels		
	O0 ... O7	Terminals 1.0 ... 1.7
	O8 ... O15	Terminals 2.0 ... 2.7
	O16 ... O23	Terminals 3.0 ... 3.7
	O24 ... O31	Terminals 4.0 ... 4.7
Indication of the output signals		1 yellow LED per channel, the LED is ON if the output signal is high (signal 1)
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

Parameter		Value
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.*

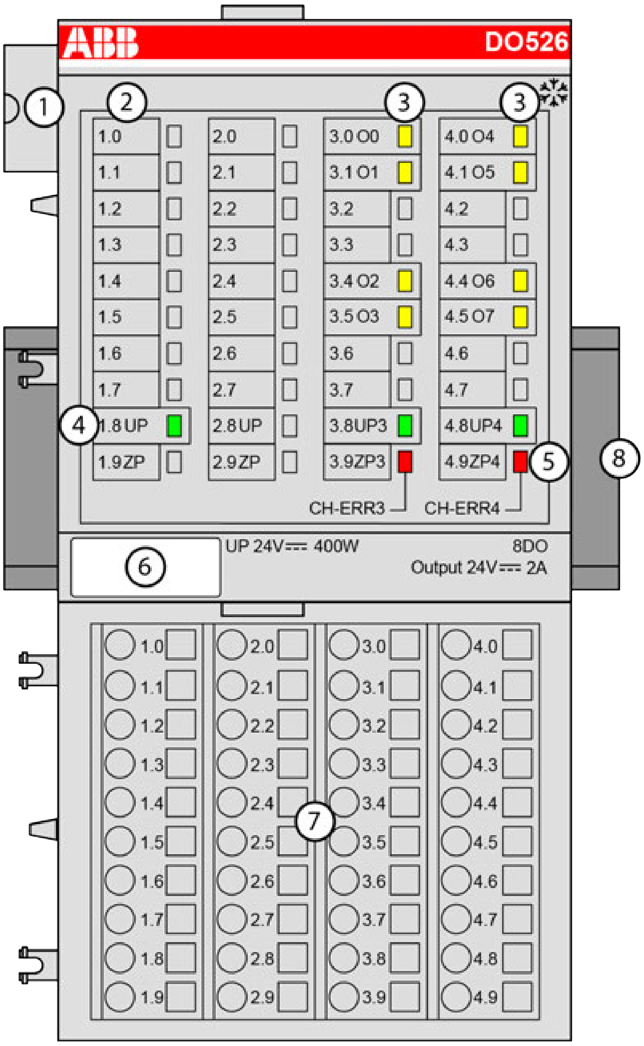
Ordering data

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.*

5.4.2.2.6 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 ➪ *Chapter 5.5.1 “TU515, TU516, TU541 and TU542 for I/O modules” on page 801*

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 5.8.2.5 “TA526 - Wall mounting accessory” on page 1183*.

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.

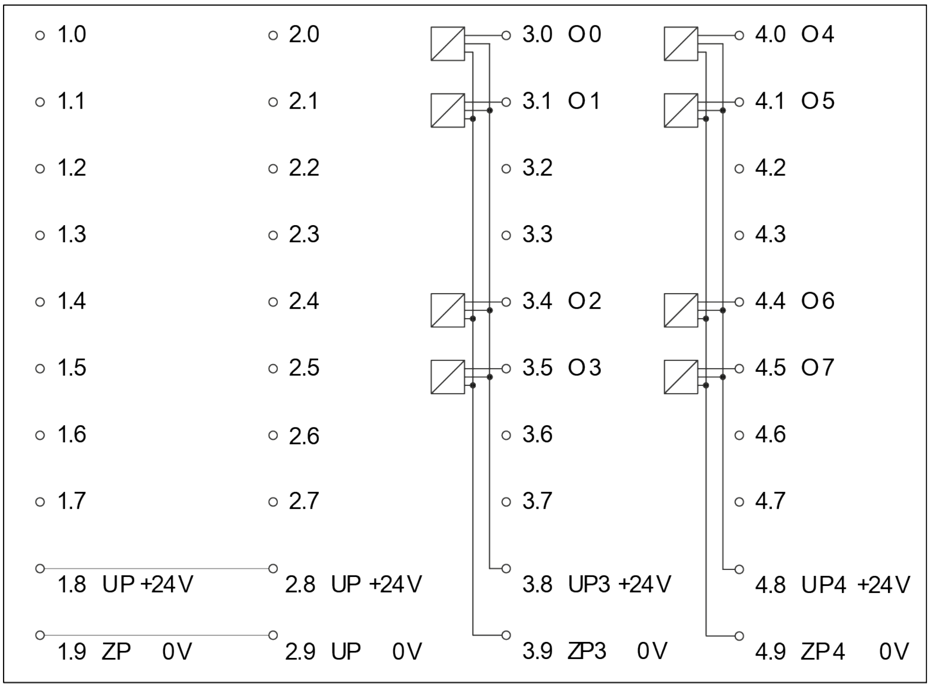
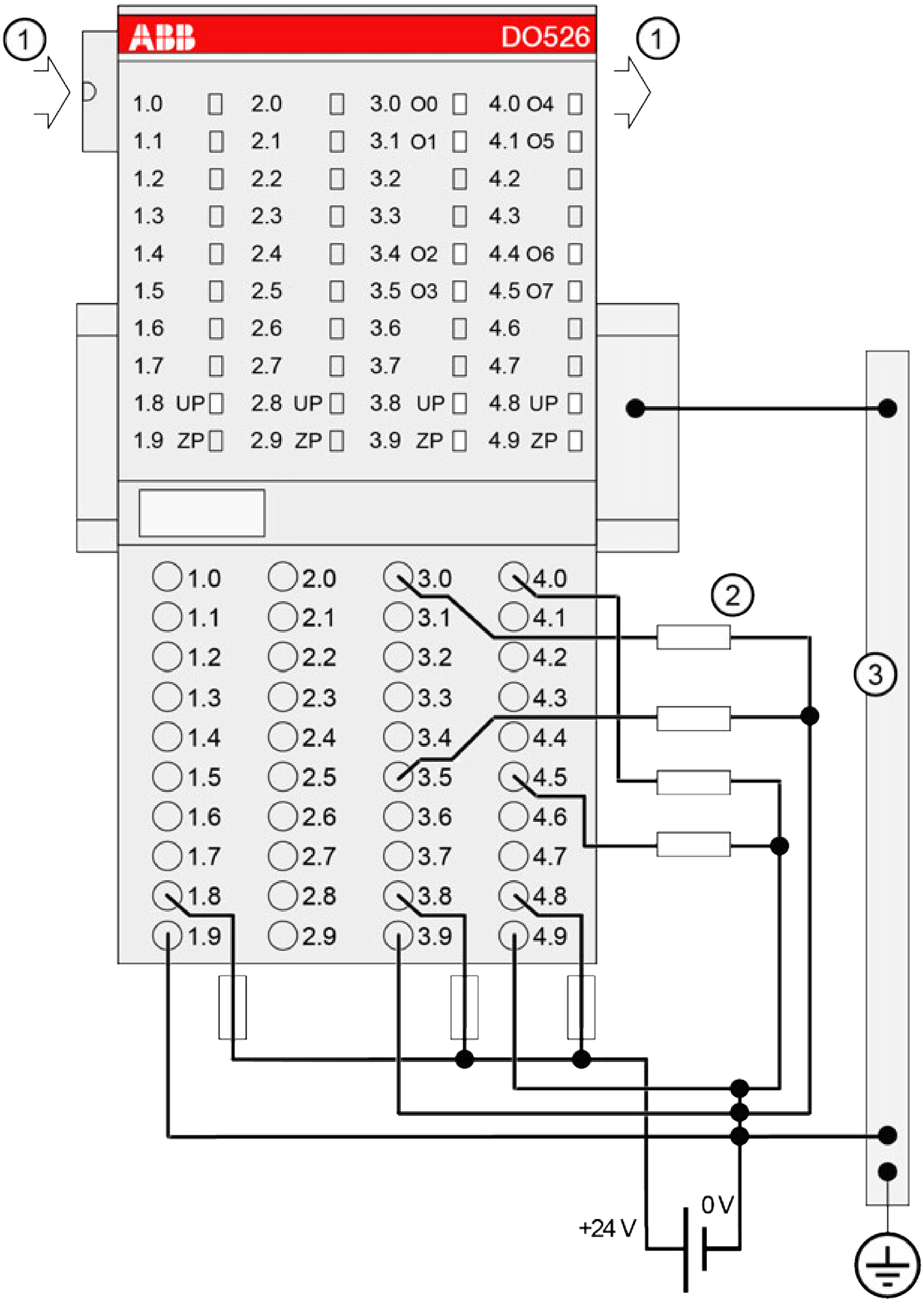


Fig. 55: Internal construction of the digital outputs



1 I/O bus
2 4.0 ... 4.7: Connected with UP (switch) -> Input;
Connected with ZP (load) -> Output
3 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

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

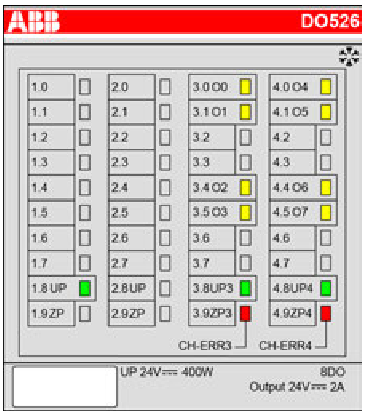
[2]) Not with FBP

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 out-puts 0 ... 3 24 V DC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
	UP4	Process supply voltage out-puts 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

The system data of AC500 and S500 are applicable to the standard version *Chapter 4.2 "System data AC500" on page 30*.

The system data of AC500-XC are applicable to the XC version *Chapter 4.3 "System data AC500-XC" on page 35*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Technical data of the module

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 A²s
	Inrush current from UP3 or UP4 (at power up)	0.005 A²s (without output load)
Max. power dissipation within the module		6 W
Weight (without terminal unit)		Ca. 135 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!
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

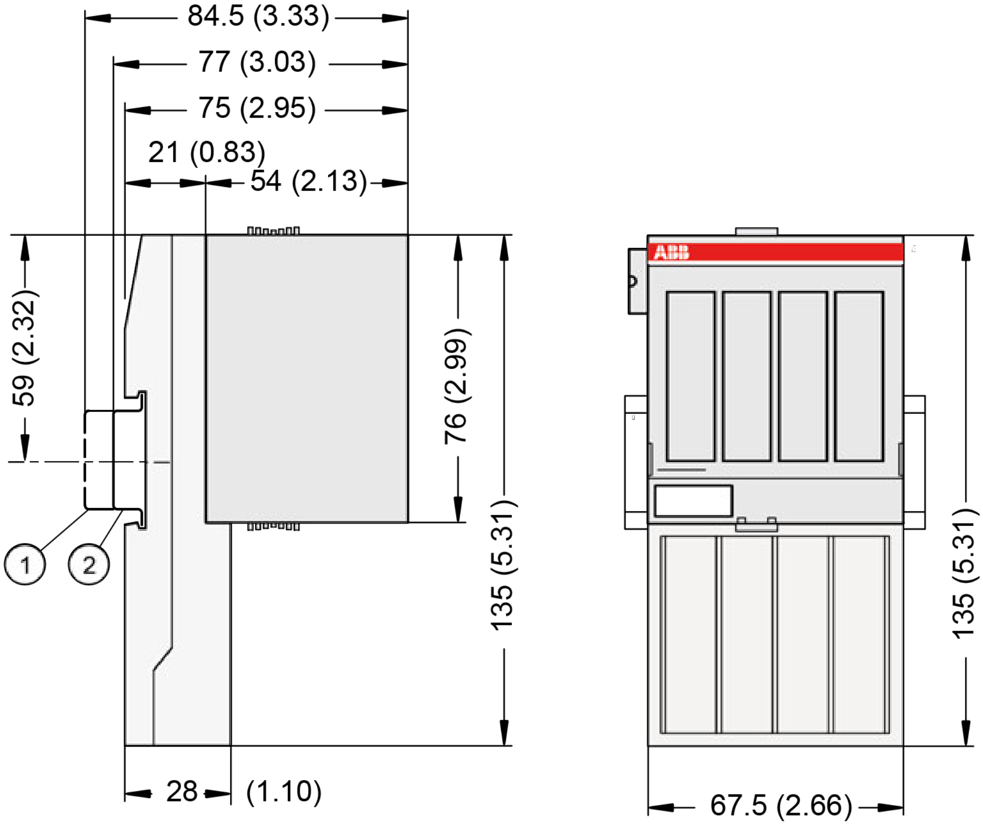
No effects of multiple overloads on isolated multi-channel modules occur, as every channel is protected individually by an external fuse.

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.

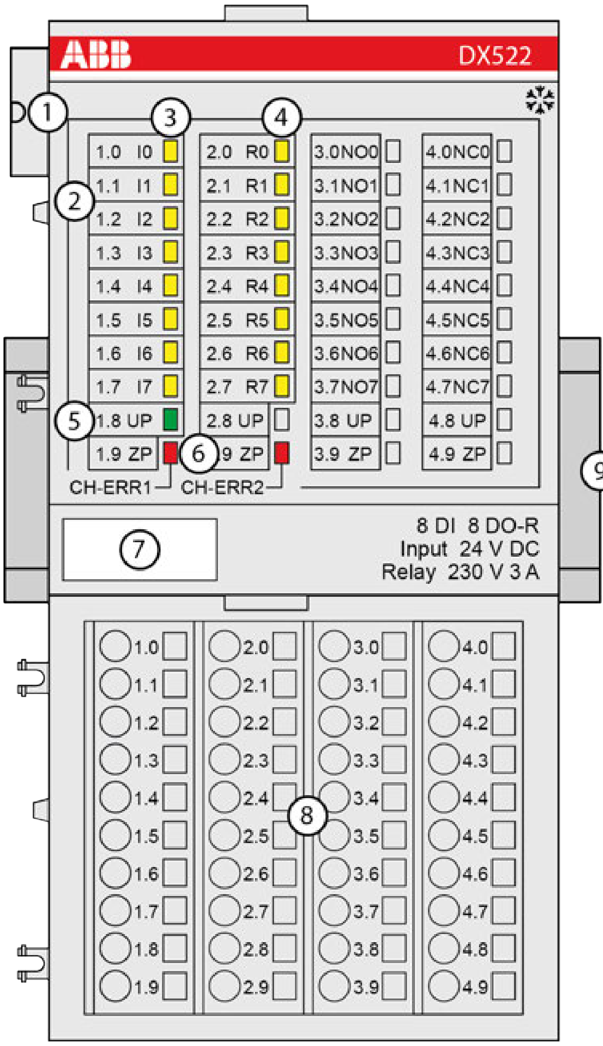
Ordering data

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

5.4.2.2.7 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 *Chapter 5.5.2 “TU531 and TU532 for I/O modules” on page 807*

The device is plugged on a terminal unit *Chapter 5.5.2 “TU531 and TU532 for I/O modules” on page 807*. 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 5.8.2.5 “TA526 - Wall mounting accessory” on page 1183*.

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 and 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 126: 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 10

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 you

– 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 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.

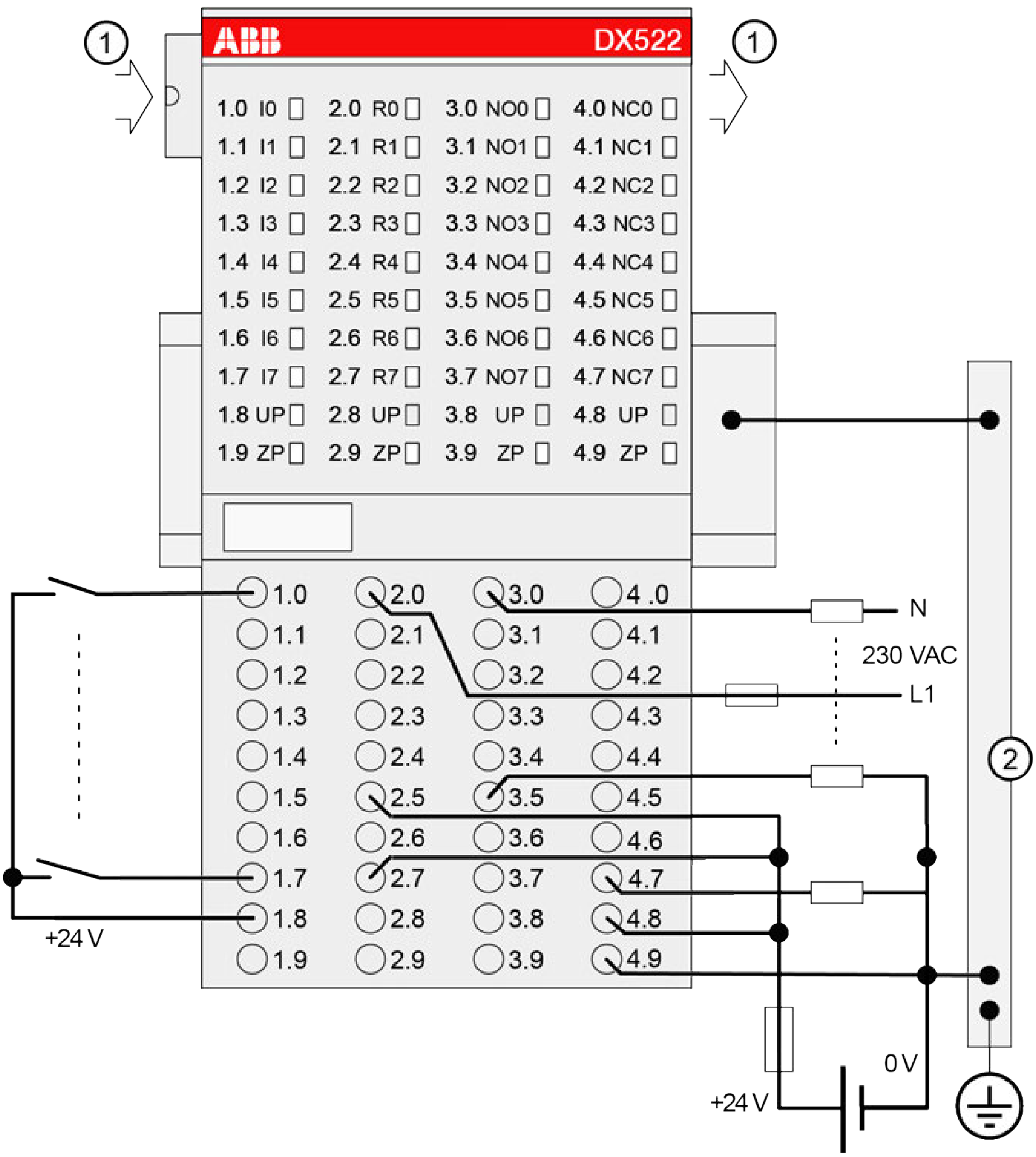


Fig. 56: Connection of the digital input/output module DX522

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 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
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:

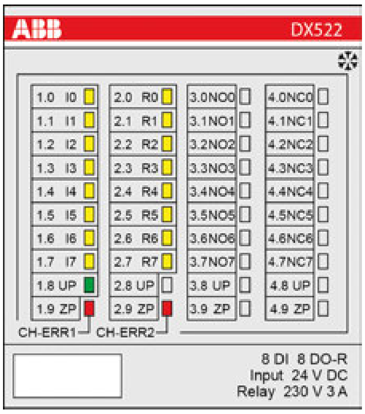
[1])	With CS31 and addresses smaller than 70 and FBP, the value is increased by 1
[2])	Not with FBP
[3])	For a description of the counter operating modes, please refer to the 'Fast Counter' section *Chapter 5.4.2.2.9 “Fast counter” on page 464*
[4])	With FBP and without the parameter Fast Counter

GSD file:

Ext_User_Prm_Data_Len =	7
Ext_User_Prm_Data_Const	0x04, 0xbb, 0x04, \
(0) =	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
(image)	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	--
	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

The system data of AC500 and S500 are applicable to the standard version *Chapter 4.2 “System data AC500” on page 30*.

The system data of AC500-XC are applicable to the XC version *Chapter 4.3 “System data AC500-XC” on page 35*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Technical data of the module

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
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.

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

Parameter		Value
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)

Parameter		Value
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

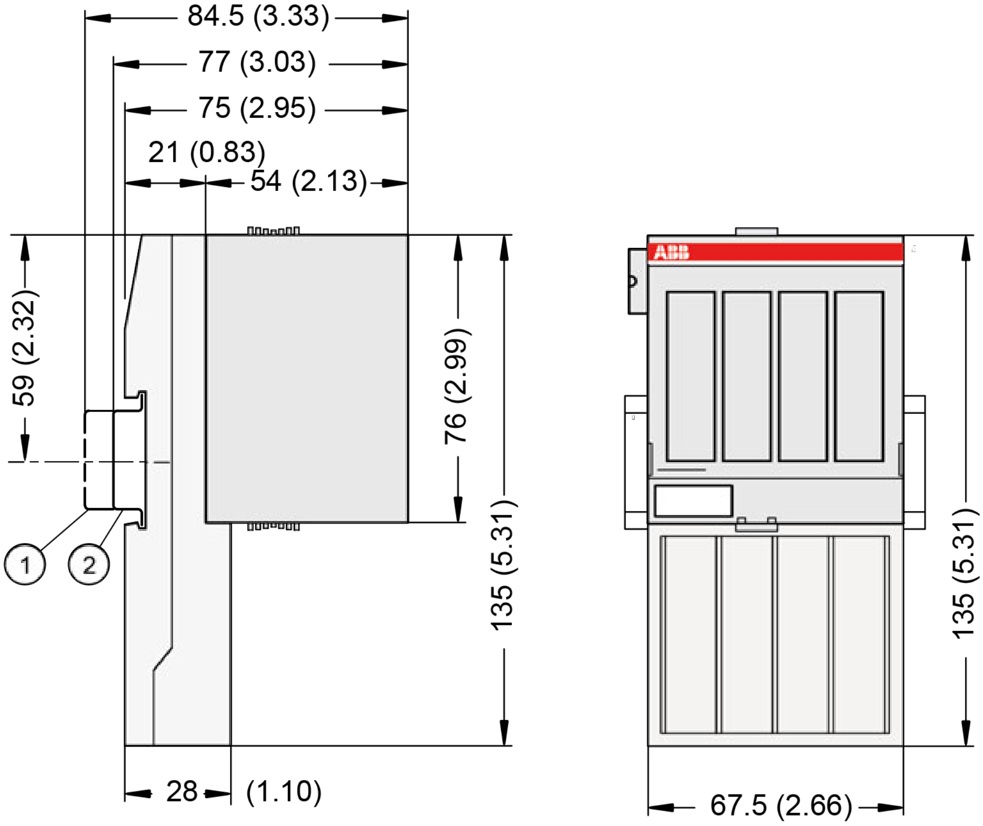
Technical data of the fast counter

The fast counter of the module does not work if the module is connected to a

- *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.*

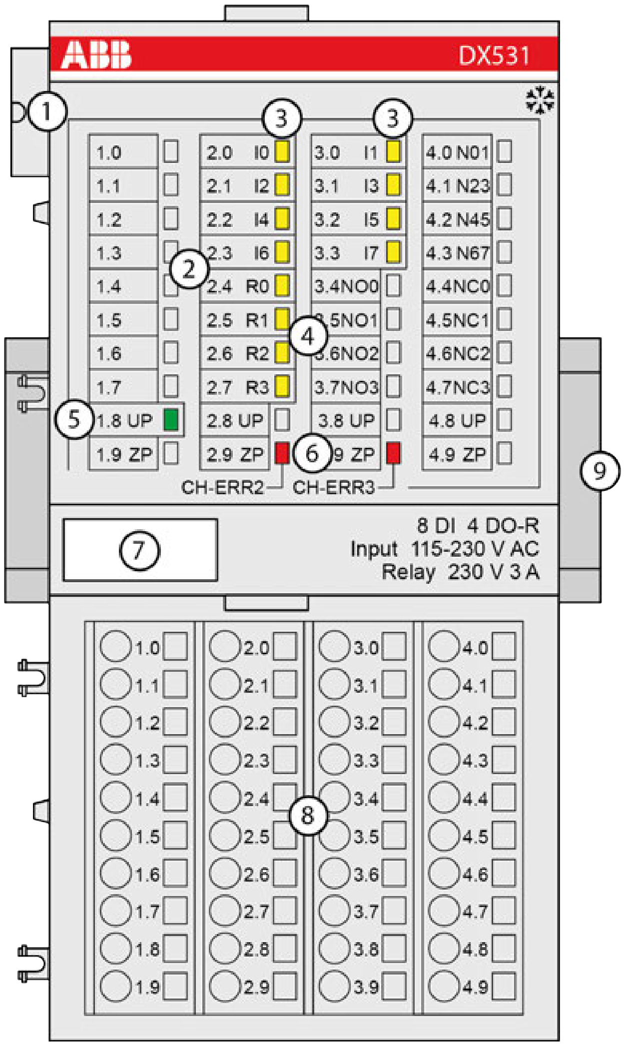
Ordering data

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.*

5.4.2.2.8 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 *Chapter 5.5.2 “TU531 and TU532 for I/O modules” on page 807*

The device is plugged on a terminal unit *Chapter 5.5.2 “TU531 and TU532 for I/O modules” on page 807*. 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 5.8.2.5 “TA526 - Wall mounting accessory” on page 1183*.

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 and 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 127: 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
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

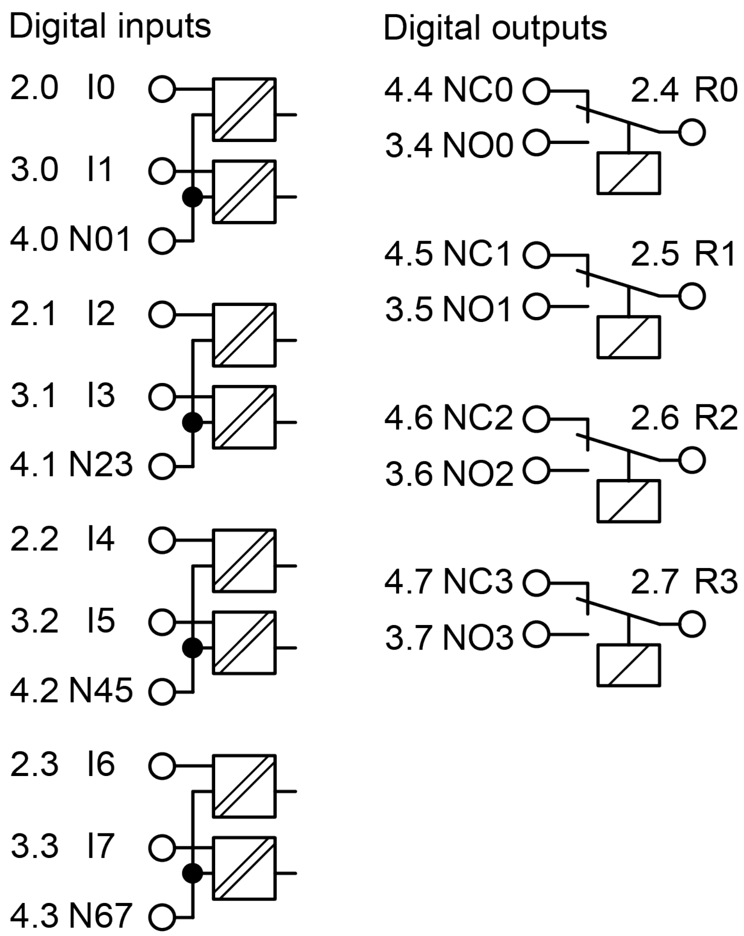


Fig. 57: Internal construction

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 10

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 you

– 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 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.

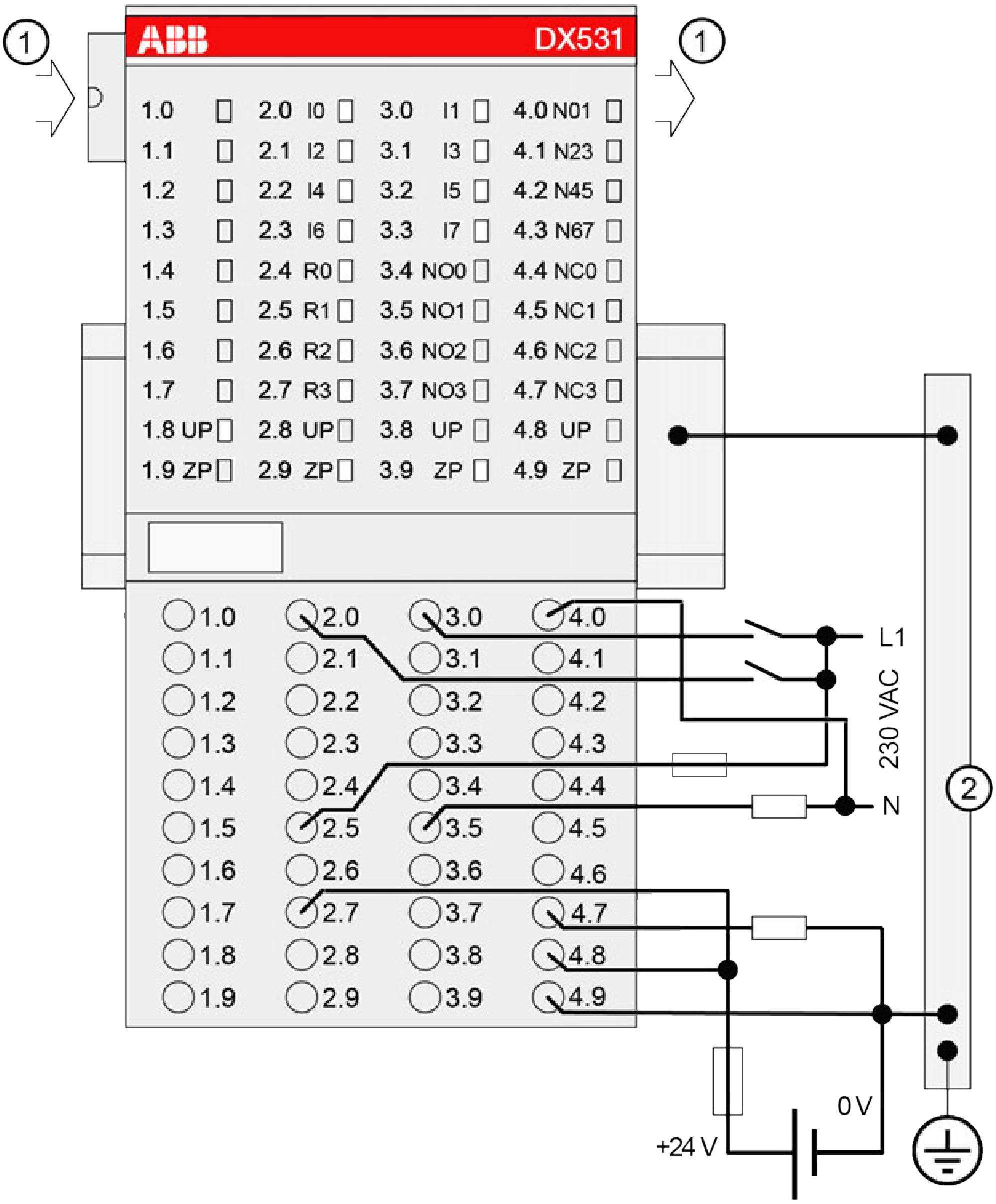


Fig. 58: Connection of the module

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

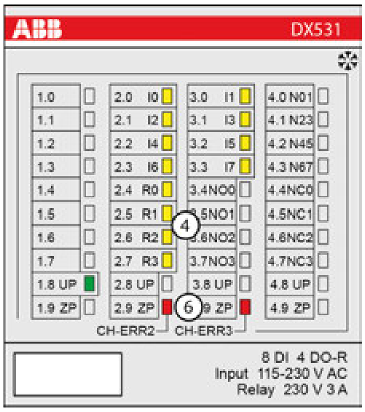
Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
Module ID	Internal	1205 [1])	Word	1205 0x04B5	0	65535	0x0Y01
Ignore module [2])	No Yes	0 1	Byte	No 0x00			not for FBP
Parameter length	Internal	4	Byte	4-CPU 4-FBP	0	255	0x0Y02
Check supply	Off on	0 1	Byte	On 0x01	0	1	0x0Y03
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 = Ext_User_Prm_Data_Const (0) =	7 0x04, 0xb6, 0x04, \ 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

The system data of AC500 and S500 are applicable to the standard version *Chapter 4.2 “System data AC500” on page 30.*

The system data of AC500-XC are applicable to the XC version *Chapter 4.3 “System data AC500-XC” on page 35.*

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Technical data of the module

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 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.

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 5.4.2.2.8.3 “Connections” on page 453*
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
Undefined signal	> 40 V AC ... < 74 V AC

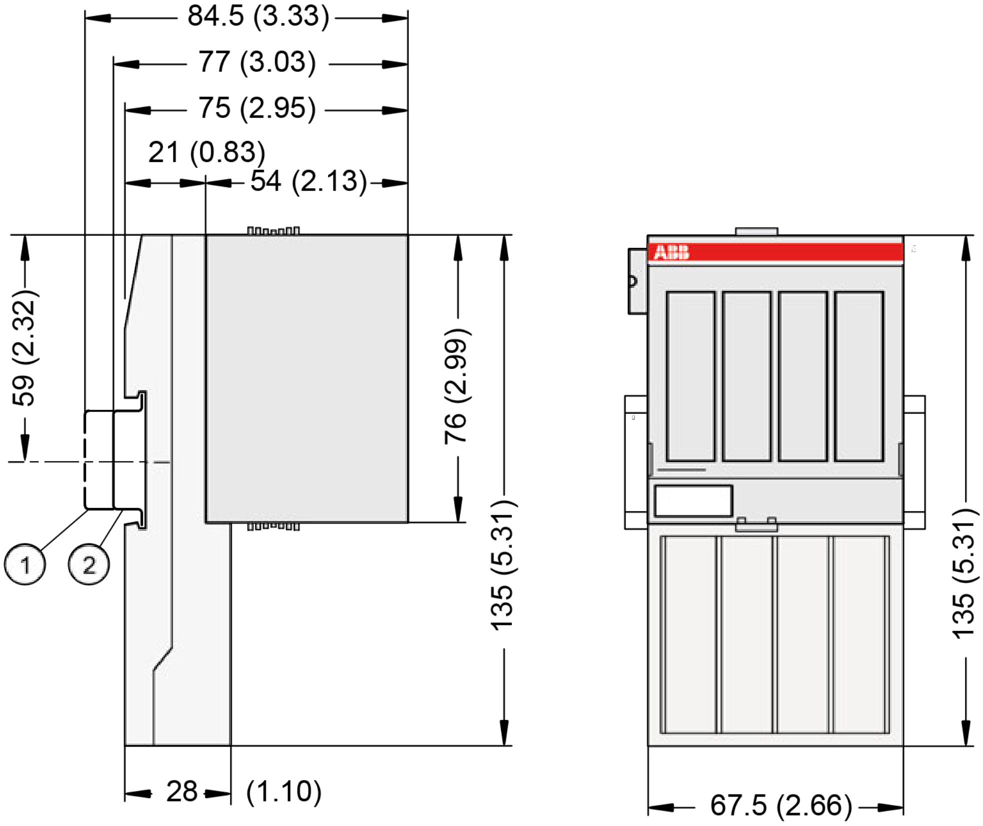
Parameter		Value
Signal 1		74 V AC ... 265 V AC
Input current per channel		
	Input voltage = 159 V AC	> 7 mA
	Input voltage = 40 V AC	< 5 mA
Overvoltage protection		Yes
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

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 5.4.2.2.8.3 “Connections” on page 453*
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
	With lamp load	On request

Parameter		Value
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.*

5.4.2.2.9 Fast counter

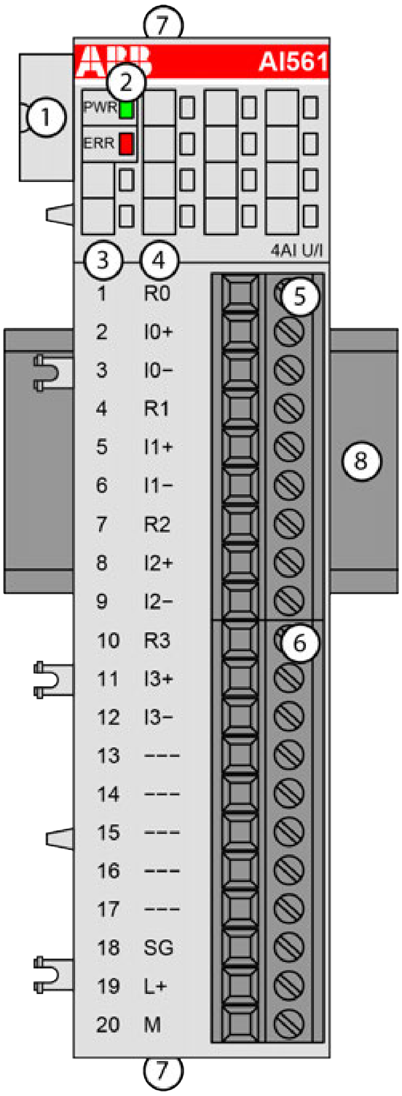
More information can be found in the Automation Builder chapter, *“Fast counters in AC500 devices”*.

5.4.3 Analog I/O modules

5.4.3.1 S500-eCo

5.4.3.1.1 AI561 - Analog input module

- 4 configurable analog inputs (I0 ... I3) in 1 group
- Resolution: 12 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

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 for

- 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
	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.

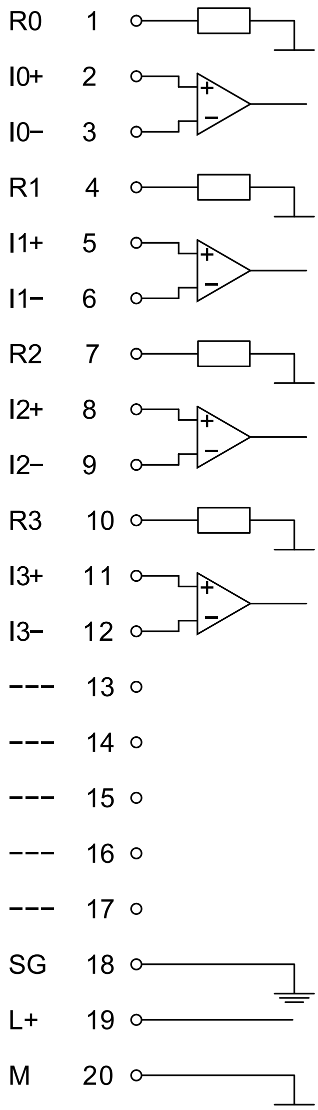


Fig. 59: Internal construction of the analog inputs

The 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

Terminal	Signal	Description
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 10 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 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 equalisation of a low resistance to avoid high potential differences between different parts of the plant.

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

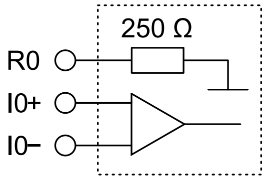
– connect or disconnect any signal or terminal block
– remove or replace a module.

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 5.4.3.1.1.7 “Diagnosis” on page 474*.

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.



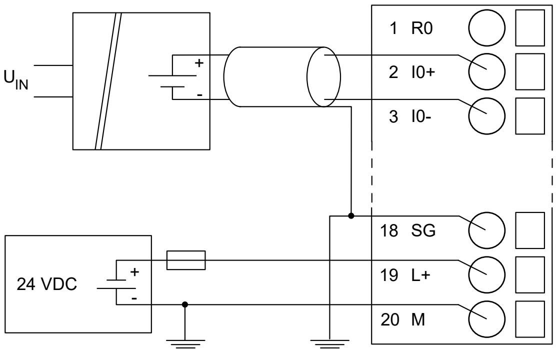
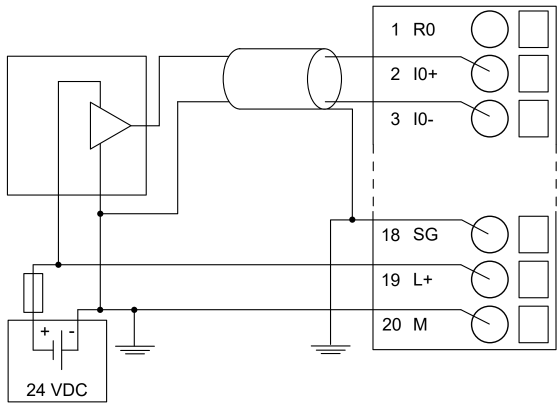
CAUTION!

Risk of damaging the analog input!

The 250 Ω input resistor can be damaged by overcurrent.

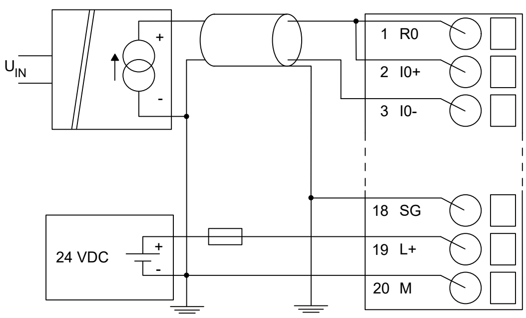
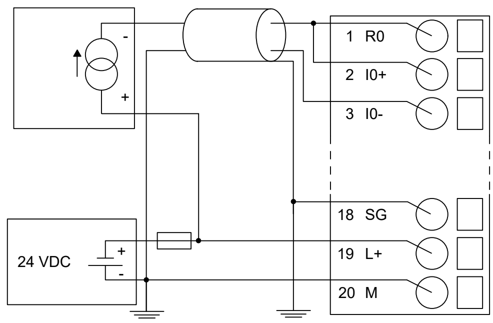
Make sure that the current through the resistor never exceeds 30 mA.

Table 128: 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 129: 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	

The meaning of the LEDs is described in the Displays section *Chapter 5.4.3.1.1.8 “State LEDs” on page 475*.

I/O configuration

The analog input module AI561 does not store configuration data itself.

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 online download from ABB.

Direct from ABB Software.

Click this link and on the next web page find the relevant firmware package and download it.

- Unpack this .zip archive file at any location of your hard disc
- Insert empty formatted (FAT16 / FAT32) memory card in the PC card reader
- Execute the unpacked *.exe file
- Select 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 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.

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 configuration	see table [2])	see table [2])	BYTE	0 0x00	0	65535

Table 130: 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

Internal value	Operating modes for the analog inputs, individually configurable
7	-5 V ... +5 V
20	-2,5 V ... +2,5 V

Diagnosis

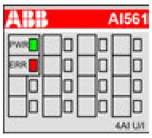
E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500 display	<− Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**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	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 ... 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 : 2.5014	5.8795 : 5.0029	5.8795 : : : 5.0015	11.7589 : : : 10.0029	23.5178 : : : 20.0058	22.8142 : : 20.0058	32511 : 27664 27658 27656	7EFF : 6C10 6C0A 6C08
Normal range	2.5000 : 0.0014	5.0000 : 0.0029	5.0000 : : : 0.0015	10.0000 : : : 0.0029	20.0000 : : : 0.0058	20.0000 : : 4.0058	27648 : 16 10 8	6C00 : 0010 000A 0008

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.**
Normal range or meas-ured value too low	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
Meas-ured value too low	-2.5014	-5.0029					-27664	93F0
	:	:					:	:
	-2.9398	-5.8795					-32512	8100
Under-flow	<-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

The system data of AC500-eCo apply.

Chapter 4.1 “System data AC500-eCo” on page 23

Only additional details are therefore documented below.

Technical data of the module

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
	Inrush current (at power up)	0.05 A^2s
	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. 10 mA
Galvanic isolation		No
Surge-voltage (max.)		35 V DC for 0.5 s
Max. power dissipation within the module		2.7 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.

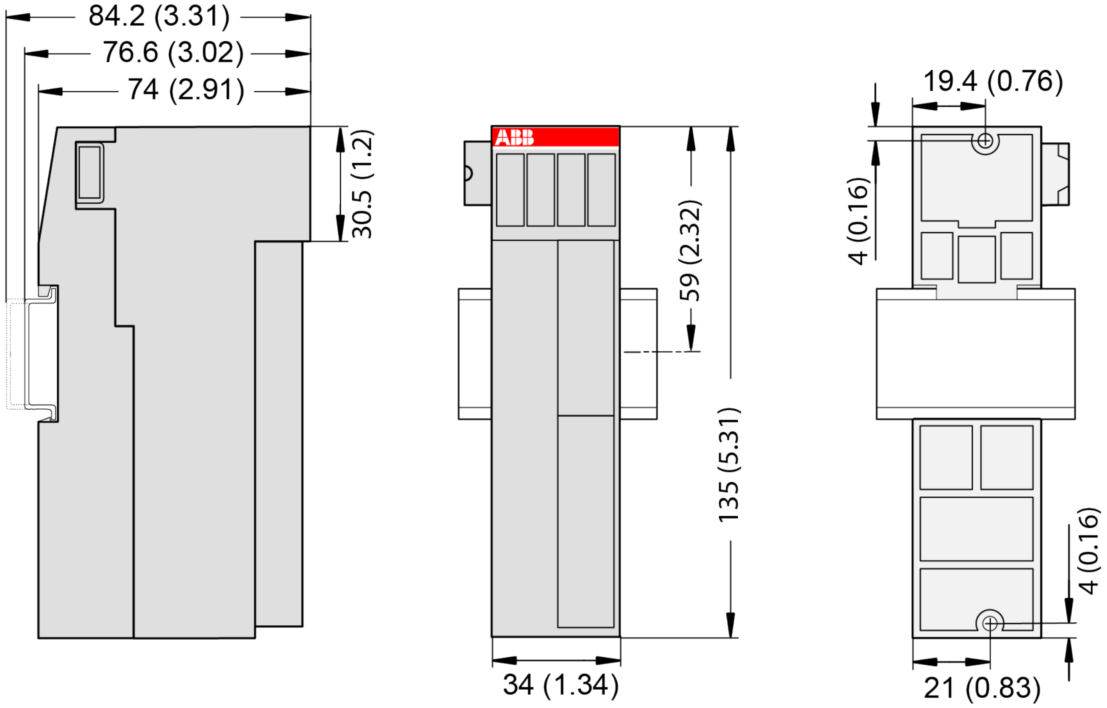
NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Technical data of the analog inputs

Parameter		Value	
Number of channels per module		4 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	
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 5.4.3.1.1.9 “Measuring ranges” on page 475*	
Analog to digital conversion time		Typ. 500 µs per channel	

Parameter		Value
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	10 m
	Shielded wire	100 m

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

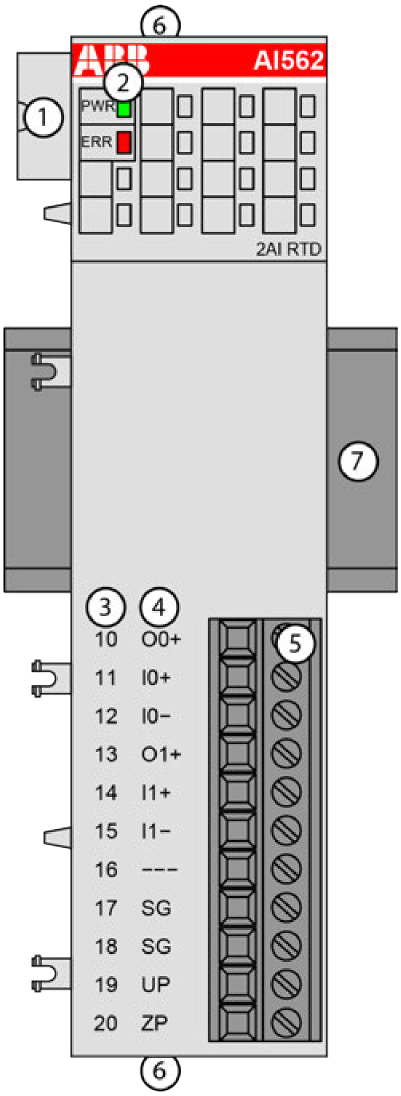
Part no.	Description	Product life cycle phase *)
1TNE 968 902 R1101	AI561, analog input module, 4 AI, U/I	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active

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.*

5.4.3.1.2 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

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 for

- 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
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 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.

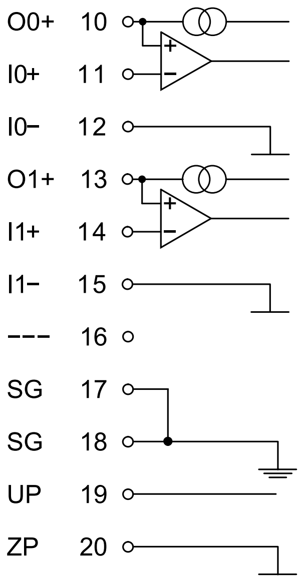


Fig. 60: Internal construction of the analog inputs

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 distorted seriously by external electromagnetic influences.

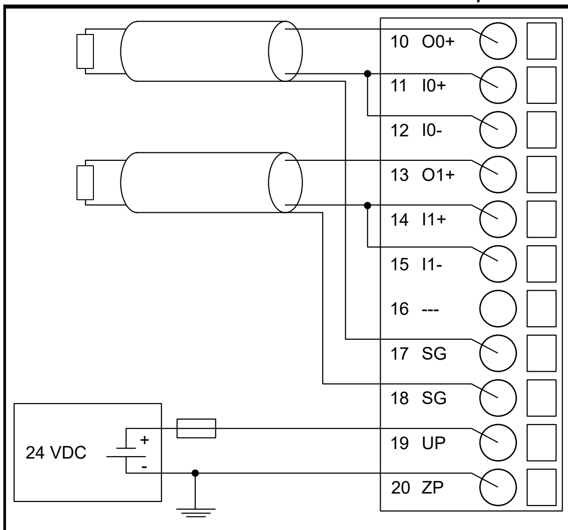
Use shielded wires when wiring analog signal sources. The cable shield must be grounded at both ends of the cable. Provide a potential equalisation of a low resistance to avoid high potential differences between different parts of the plant.

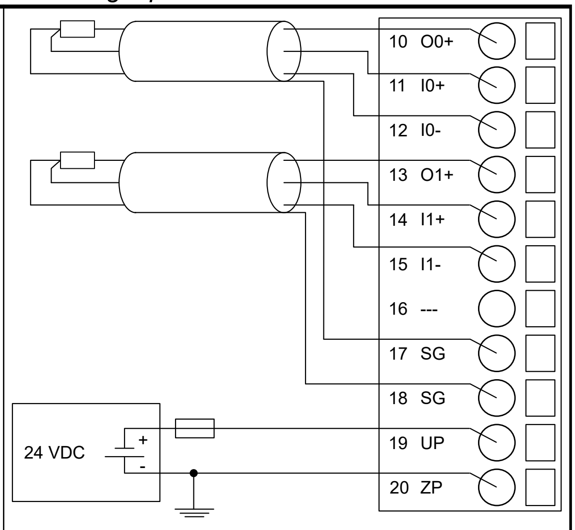
> **NOTICE!**
> **Risk of damaging the PLC modules!**
> The PLC modules must not be removed while the plant is connected to a power supply.
>
> Make sure that all voltage sources (supply and process voltage) are switched off before you
>
> – connect or disconnect any signal or terminal block
> – remove 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 5.4.3.1.2.7 “Diagnosis” on page 486*.

Table 131: Connection of RTDs to the inputs of the analog input module AI562

<table>
<tr>
<td>


</td>
<td>


</td>
</tr>
<tr>
<td>2-wires input</td>
<td>3-wires input</td>
</tr>
</table>

> *With 2-wires connection, the resistance of the connection wires influences the accuracy of the measured value. Use 3-wires connection to achieve the guaranteed measuring accuracy.*

The meaning of the LEDs is described in the Displays section *Chapter 5.4.3.1.2.8 “State LEDs” on page 487*.

I/O configuration

The analog input module AI562 does not store configuration data itself.

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 online download from ABB.

Direct from *ABB Software*.

Click this link and on the next web page find the relevant firmware package and download it.

- Unpack this .zip archive file at any location of your hard disc
- Insert empty formatted (FAT16 / FAT32) memory card in the PC card reader
- Execute the unpacked *.exe file
- Select 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 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.

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			

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
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 configura- tion	see table [2])	see table [2])	BYTE	0 0x00 see table [3])	0	65535

Table 132: Channel configuration [2])

Internal value	Operating modes for the analog inputs, individually configurable
0	Not used (default) [3])
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 resistor 0 Ω ... 150 Ω
33	Analog input resistor 0 Ω ... 300 Ω

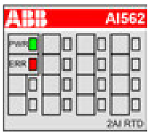
Diagnosis

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	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 chan-nels 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

Range	Pt100 / Pt1000 -50 °C ... +400 °C	Ni1000 / Ni100 -50 °C ... +150 °C	Digital value	
			Decimal	Hex.
	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-1 : -500 -2000	FFFF : FE0C F830
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	>352.767	32767	7FFF
Measured value too high	176.383 150.005	352.767 300.011	32511 27649	7EFF 6C01
Normal range	150.000 : 0.005	300.000 : 0.011	27648 : 1	6C00 : 0001
	0	0	0	0000

Technical data

The system data of AC500-eCo apply.

Chapter 4.1 “System data AC500-eCo” on page 23

Only additional details are therefore documented below.

Technical data of the module

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
	Inrush current (at power-up)	0.05 A^2s
	Max. ripple	5 %
	Protection against reversed voltage	Yes

Parameter	Value
Protection fuse for UP	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
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
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.

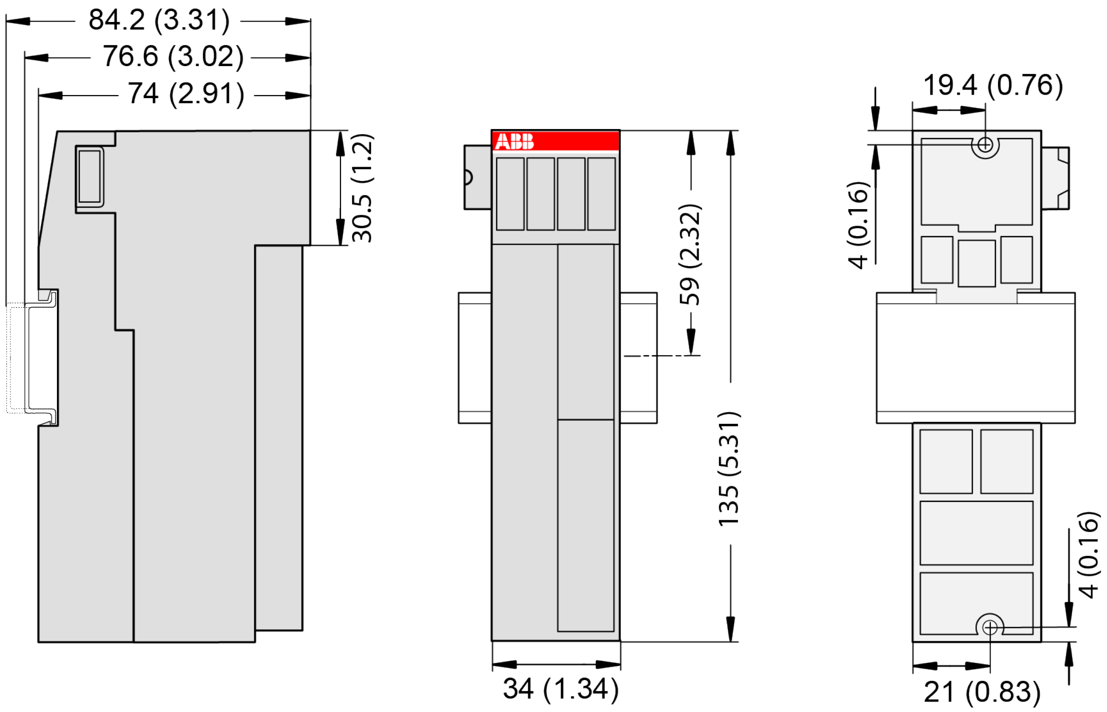
NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Technical data of the analog inputs

Parameter	Value
Number of channels per module	2 configurable RTD (resistance temperature detector) inputs
Distribution of channels into groups	1 (2 channels per group)
Resolution	
RTD	+0.1 °C / 0.1 °F
Resistance	16 bits including sign
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
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

Parameter		Value	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ.	Depending on RTD max. ±0.6 % of full scale (guaranteed for 3-wires connection only) at +25 °C
		Max.	± 2 % of full scale (guaranteed for 3-wires connection only) at 0 °C ... +60 °C or EMC disturbances
Measuring range		↳ *Chapter 5.4.3.1.2.9 “Measuring ranges” on page 487*	
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	

Dimensions



The dimensions are in mm and in brackets in inch.

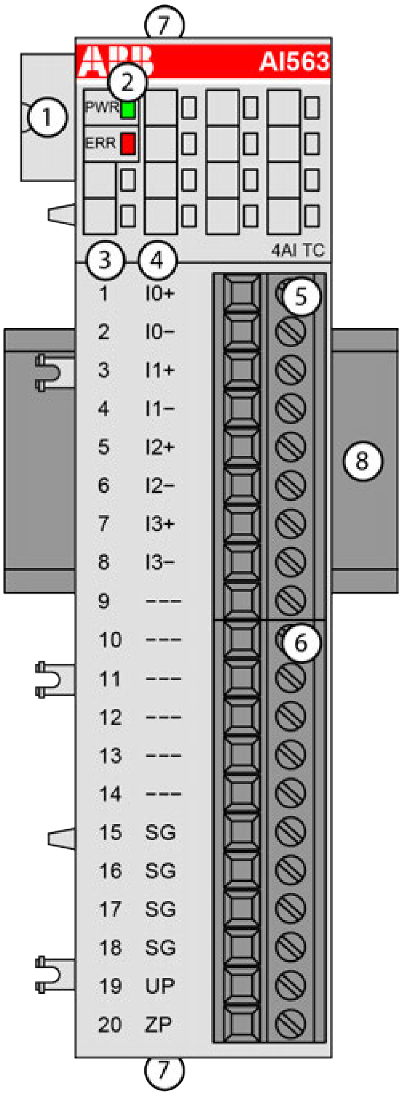
Ordering data

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.*

5.4.3.1.3 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

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 for

- 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
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.

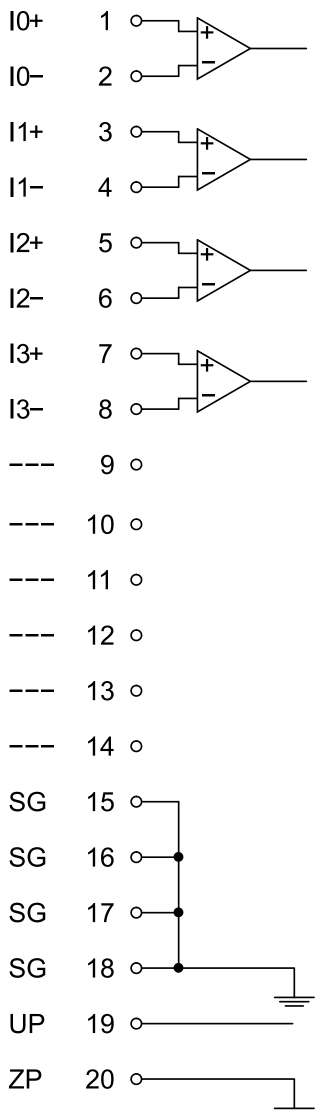


Fig. 61: Internal construction of the analog inputs

Table 133: 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	---	Reserved
11	---	Reserved
12	---	Reserved
13	---	Reserved

Terminal	Signal	Description
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 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 equalisation of a low resistance to avoid high potential differences between different parts of the plant.

> **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
>
> – 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 5.4.3.1.3.7 “Diagnosis” on page 499*.

The following figure shows the connection of thermocouples to the inputs of the module:

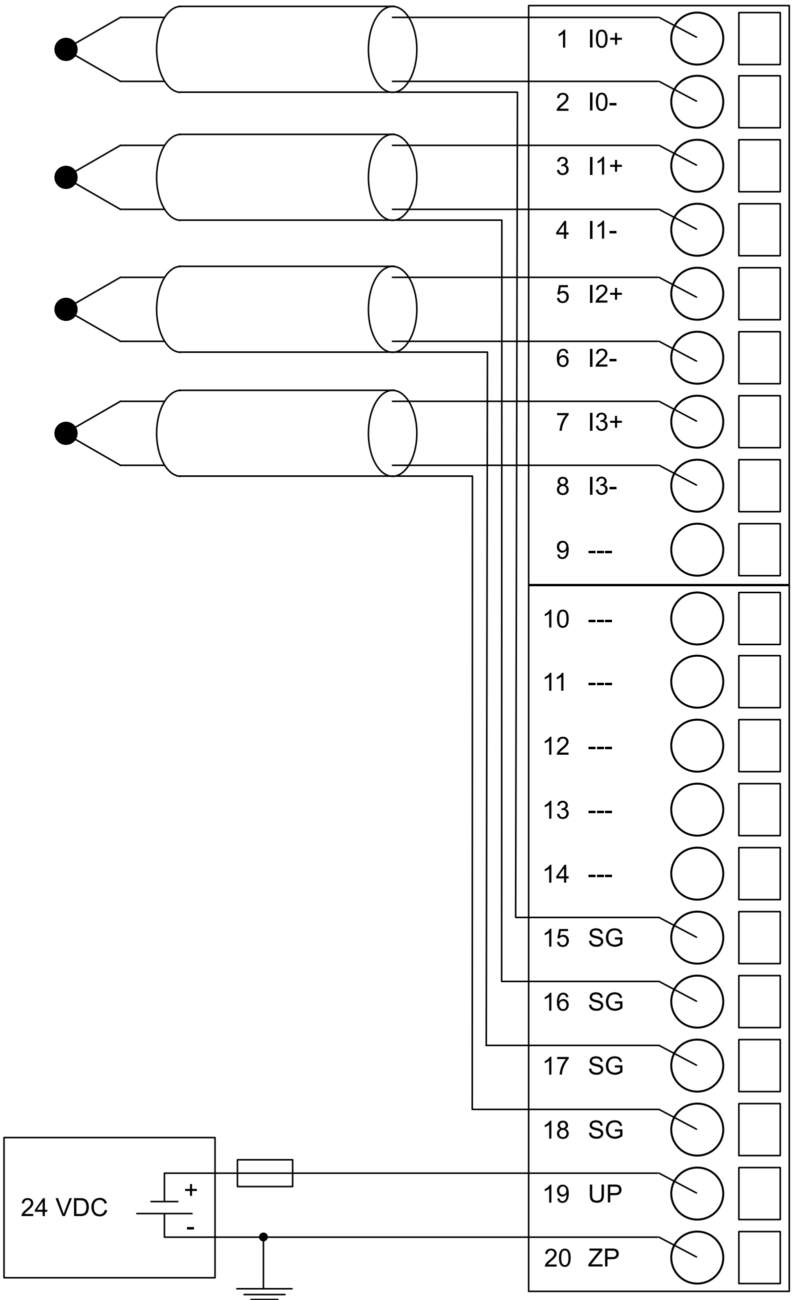


Fig. 62: Connection of thermocouples to the inputs of the module

The meaning of the LEDs is described in Displays chapter *Chapter 5.4.3.1.3.8 “State LEDs” on page 500*.

I/O configuration

The analog input module AI563 does not store configuration data itself.

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 online download from ABB.

Direct from ABB Software.

Click this link and on the next web page find the relevant firmware package and download it.

- Unpack this .zip archive file at any location of your hard disc
- Insert empty formatted (FAT16 / FAT32) memory card in the PC card reader
- Execute the unpacked *.exe file
- Select 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 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.

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			

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 = Ext_User_Prm_Data_Const(0) =	0x09 0x6F, 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 see table [2])	0	65535

Table 134: Channel configuration [2])

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

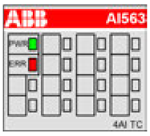
Diagnosis

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	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 chan-nels 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 measure-ment 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					17680	4510
		+1372.0 °C			13720	3598
		:	+1300.0 °C		13000	32C8
	+1200.0 °C	:	:		12000	2EE0
	:	:	:	+400.0 °C	4000	0FA0
	:	:	:	:	:	:

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.**
	+0.1 °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

The system data of AC500-eCo apply.

Chapter 4.1 “System data AC500-eCo” on page 23

Only additional details are therefore documented below.

Technical data of the module

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
	Inrush current (at power-up)	0.07 A^2s
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse for UP	Not necessary
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
	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
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.

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 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
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

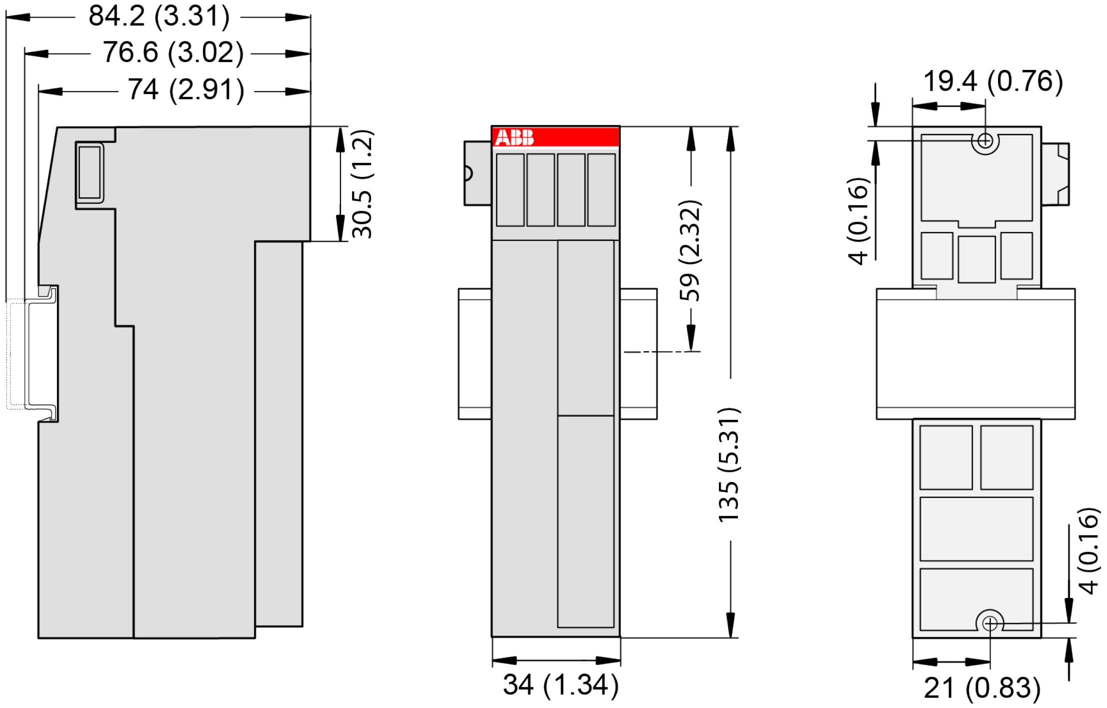
Parameter	Value	
Module update time	All channels: < 1.6 s	
Channel input resistance	On request	
Input filter attenuation	-3 dB at 15 kHz	
Cold junction error	± 1.5 °C	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ.	0.1 % of full-scale (voltage) Depending on thermocouple, see table 'Accuracy of thermocouple ranges at +25 °C' *Chapter 5.4.3.1.3.10.2.1 “Accuracy of thermocouple ranges at 25 °C (with cold junction compensation)” on page 503*
	Max.	± 2 % of full scale (T-Type: ± 3 % for -240 °C ... -270 °C) at 0 °C ... +60 °C
Relationship between input signal and hex code	*Chapter 5.4.3.1.3.9 “Measuring ranges” on page 500*	
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 at 25 °C (with cold junction compensation)

Thermocouple Type	Range	Accuracy
E	-270 °C ... -220 °C	± 2 %
	-220 °C ... +1000 °C	± 0.6 %
J	-210 °C ... +1200 °C	± 0.6 %
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	-50 °C ... +150 °C	± 1.5 %
	+150 °C ... +1768 °C	± 0.6 %
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 %

These accuracy values are valid only for stable module temperatures.

Dimensions



The dimensions are in mm and in brackets in inch.

Ordering data

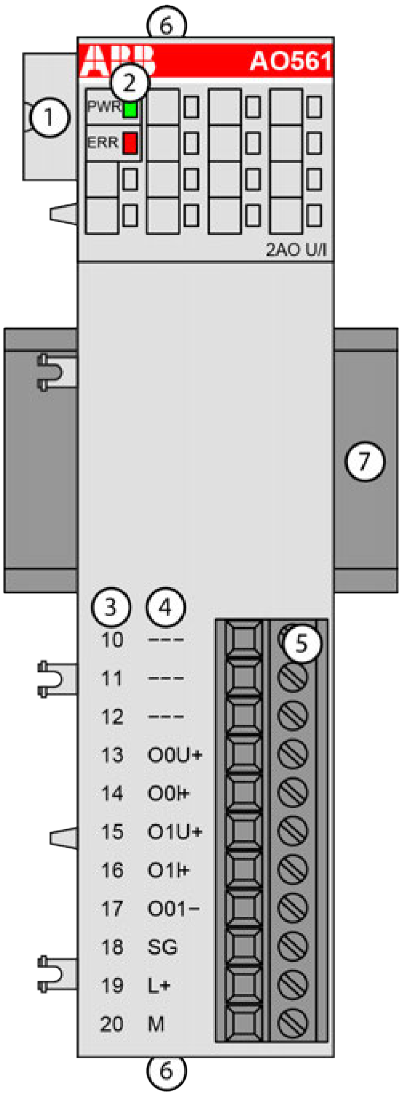
Part no.	Description	Product life cycle phase *)
1TNE 968 902 R1103	AI563, analog input module, 4 AI, thermocouple	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 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

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.*

5.4.3.1.4 AO561 - Analog output module

- 2 configurable analog outputs (O0 ... O1) in 1 group
- Resolution: 12 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

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
	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.

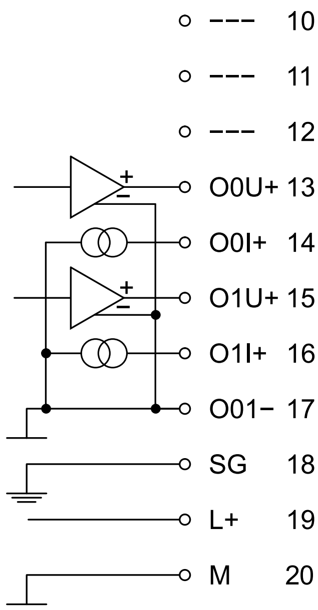


Fig. 63: Internal construction of the analog outputs

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 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 equalisation of a low resistance to avoid high potential differences between different parts of the plant.

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

– connect or disconnect any signal or terminal block
– remove or replace a module.

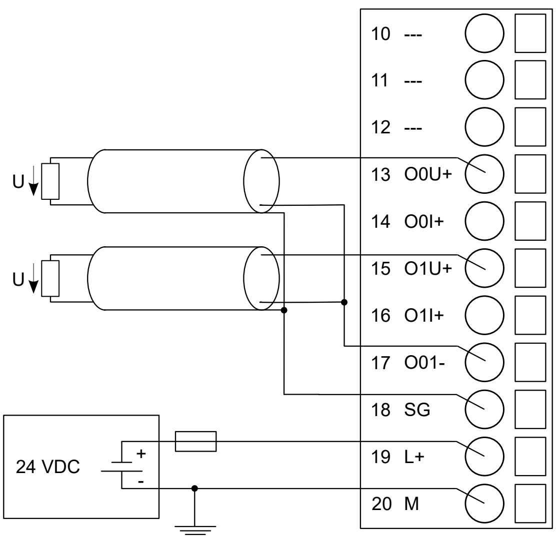
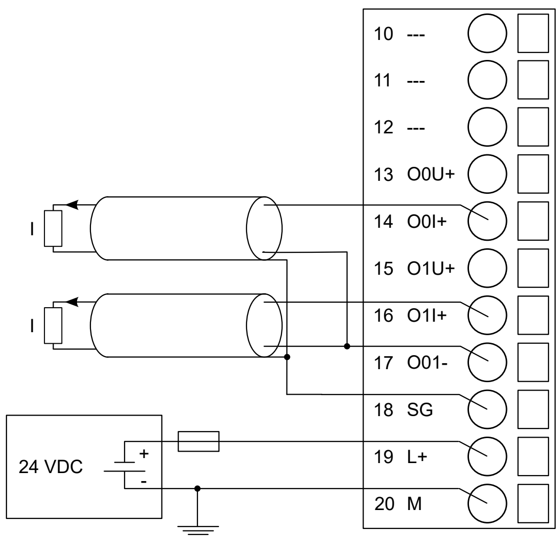
NOTICE!
Risk of damaging the PLC modules!

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 5.4.3.1.4.7 “Diagnosis” on page 512*.

Table 135: 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.

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 online download from ABB.

Direct from *ABB Software*.

Click this link and on the next web page find the relevant firmware package and download it.

- Unpack this .zip archive file at any location of your hard disc
- Insert empty formatted (FAT16 / FAT32) memory card in the PC card reader
- Execute the unpacked *.exe file
- Select 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 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.

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			
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 configura-tion	see table [2])	see table [2])	BYTE	0 0x00 see table [2])	0	65535

Table 136: 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

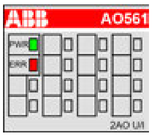
Diagnosis

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	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 chan-nels of the module

Output ranges

Range	-10 ... +10 V	0 ... 20 mA	4 ... 20 mA	Digital value	
				Decimal	**Hex.**
Overflow	>11.7589	>23.5178	>22.8142	32767	7FFF
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 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
Value too low	-10.0058 : -11.7589			-27664 : -32512	93F0 : 8100
Underflow	<-11.7589		<0.0000	-32768	8000

The represented resolution corresponds to 12 bits including sign.

Technical data

The system data of AC500-eCo apply.

Chapter 4.1 “System data AC500-eCo” on page 23

Only additional details are therefore documented below.

Technical data of the module

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
	Inrush current (at power-up)	0.05 A^2s
	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		3.1 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.

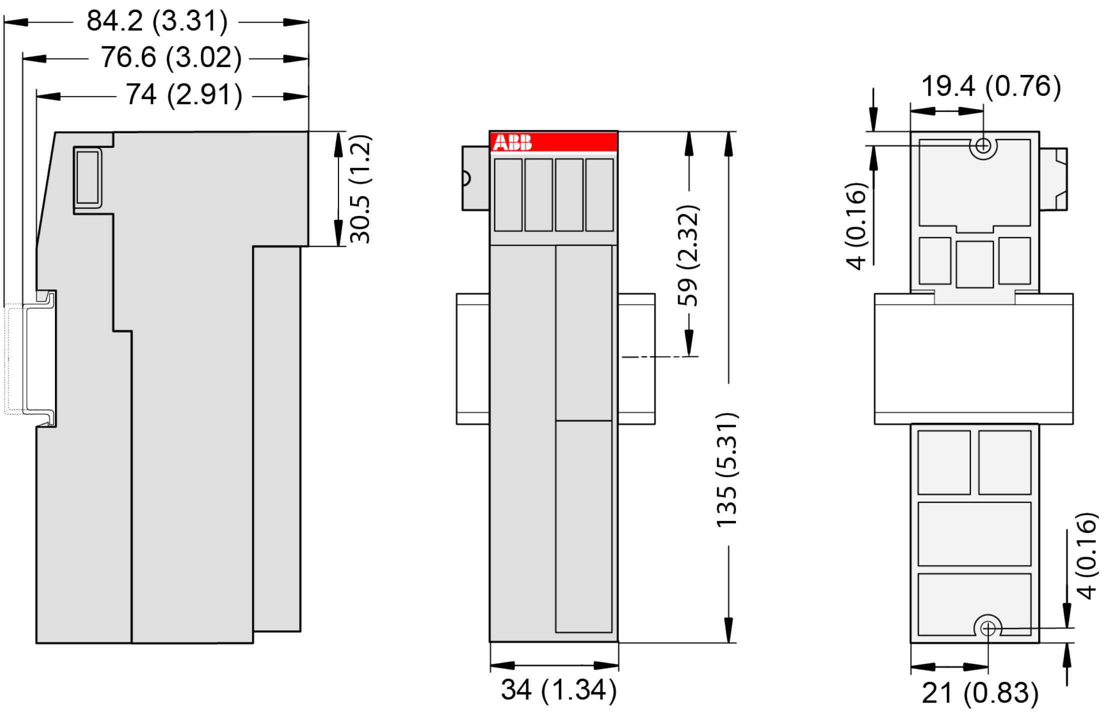
NOTICE!
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

Technical data of the analog 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	
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 5.4.3.1.4.9 “Output ranges” on page 513*	
Unused outputs		Must not be connected and must be configured as "unused"	
Overvoltage protection		Yes, up to 30 V DC	
Max. cable length (conductor cross section > 0.14 mm²)			
	Unshielded wire	10 m	
	Shielded wire	100 m	

Dimensions



The dimensions are in mm and in brackets in inch.

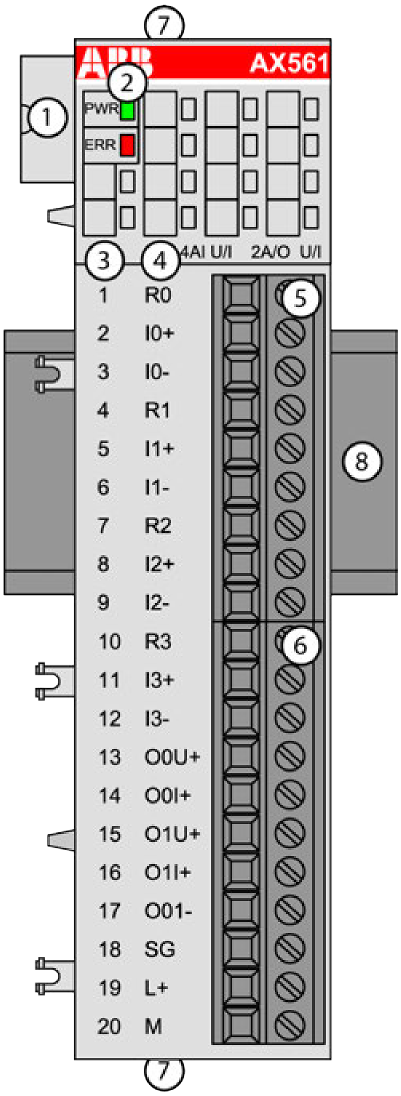
Ordering data

Part no.	Description	Product life cycle phase *)
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.*

5.4.3.1.5 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



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

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 for

- 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 for

- 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
	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.

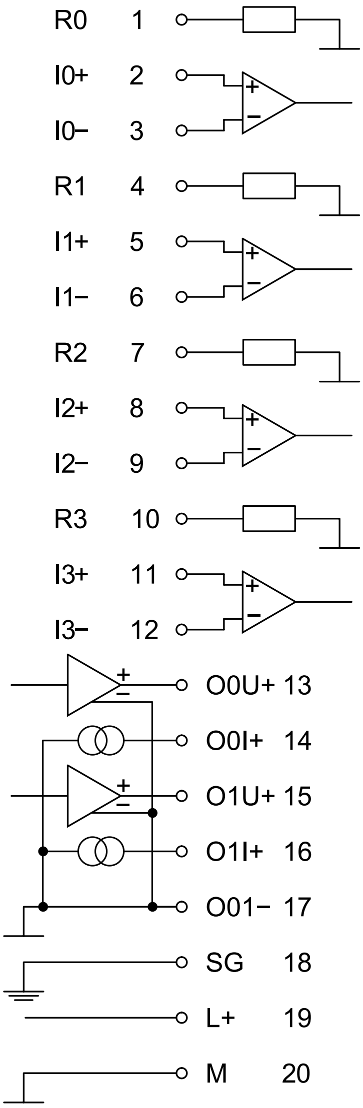


Fig. 64: Internal construction of the analog inputs and outputs

Table 137: 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

Terminal	Signal	Description
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 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 equalisation of a low resistance to avoid high potential differences between different parts of the plant.

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 you

– 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 5.4.3.1.5.6 “Diagnosis” on page 527*.

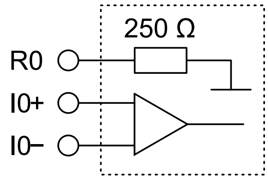


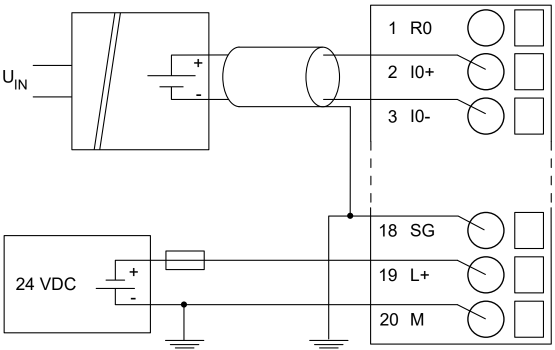
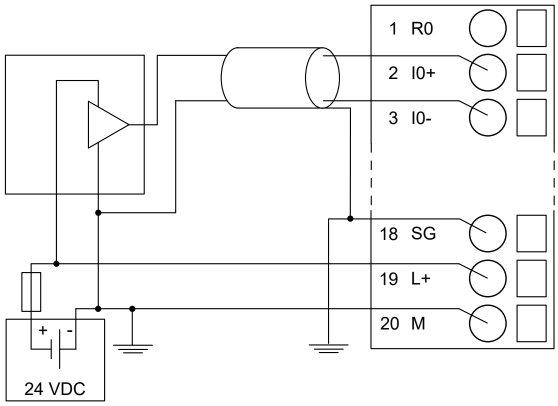
Fig. 65: Example of the internal construction of the analog input AI0 (analog inputs AI1 ... AI3 are designed in the same way)

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.

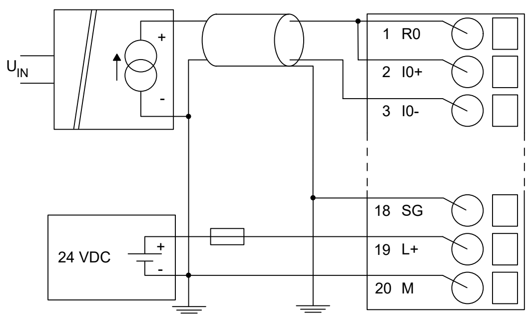
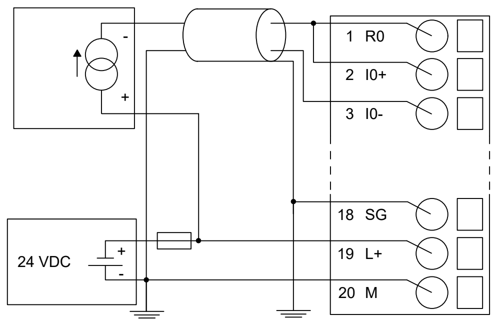
The following figures are an example of the connection of analog sensors (voltage) to the input I0 of the analog input/output module AX561. Proceed with the inputs I1 ... I3 in the same way.

Table 138: 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)

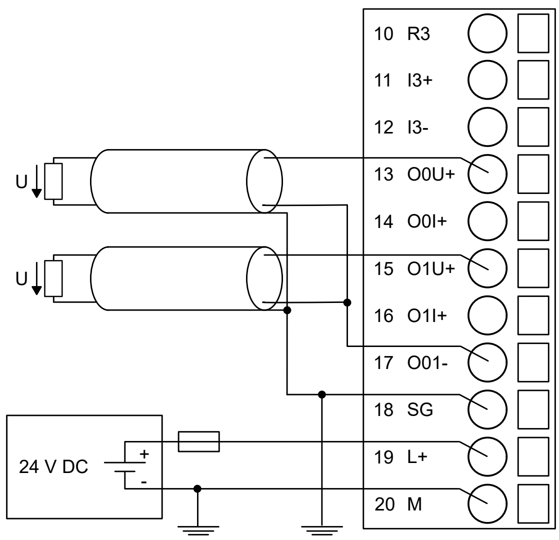
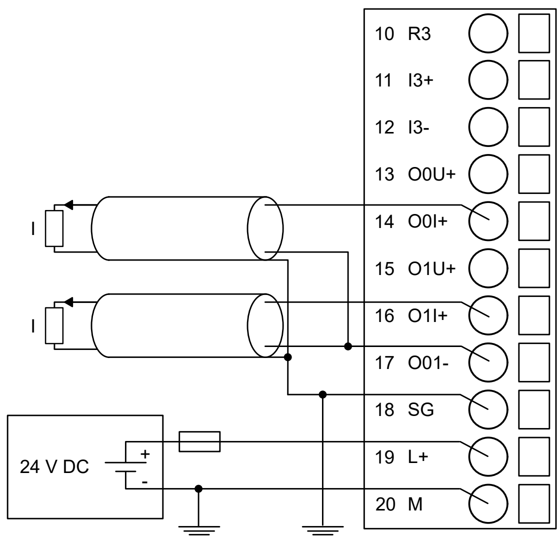
Connection of active-type analog sensors (voltage)	Connection of passive-type analog sensors (voltage)
-2.5 V ... 2.5 V	-2.5 V ... 2.5 V
-5 V ... 5 V	-5 V ... 5 V
0 V ... 5 V	0 V ... 5 V
0 V ... 10 V	0 V ... 10 V

Table 139: 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 140: Example of the connection of analog actuators to the analog input/output module AX561

<table>
<tr>
<td>
</td>
<td>
</td>
</tr>
<tr>
<td>Connection of analog voltage actuators</td>
<td>Connection of analog current actuators</td>
</tr>
</table>

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.

The meaning of the LEDs is described in the displays chapter ↳ *Chapter 5.4.3.1.5.7 “State LEDs” on page 528*.

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			
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)

GSD 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 configura-tion	see table [2])	see table [2])	BYTE	0 0x00 see table [2])	0	65535

Table 141: Channel configuration [2])

Internal value	Operating modes for the analog inputs, individually configu-rable
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 configura-tion	see see table [2])	see see table [2])	BYTE	0 0x00 see table [2])	0	65535

Table 142: 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

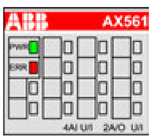
E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier** **000 ... 063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**PNIO diagnosis block**	
Class	**Interface**	**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	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				

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])			
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 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	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
Normal range or measured value too low	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	> 11.7589	> 23.5178	> 22.8142	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	< -11.7589		<0.0000	-32768	8000

The represented resolution corresponds to 12 bits including sign.

Technical data

The system data of AC500-eCo apply.

Chapter 4.1 "System data AC500-eCo" on page 23

Only additional details are therefore documented below.

Technical data of the module

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

Parameter		Value
	Inrush current (at power-up)	0.05 A
	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
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.

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 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
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

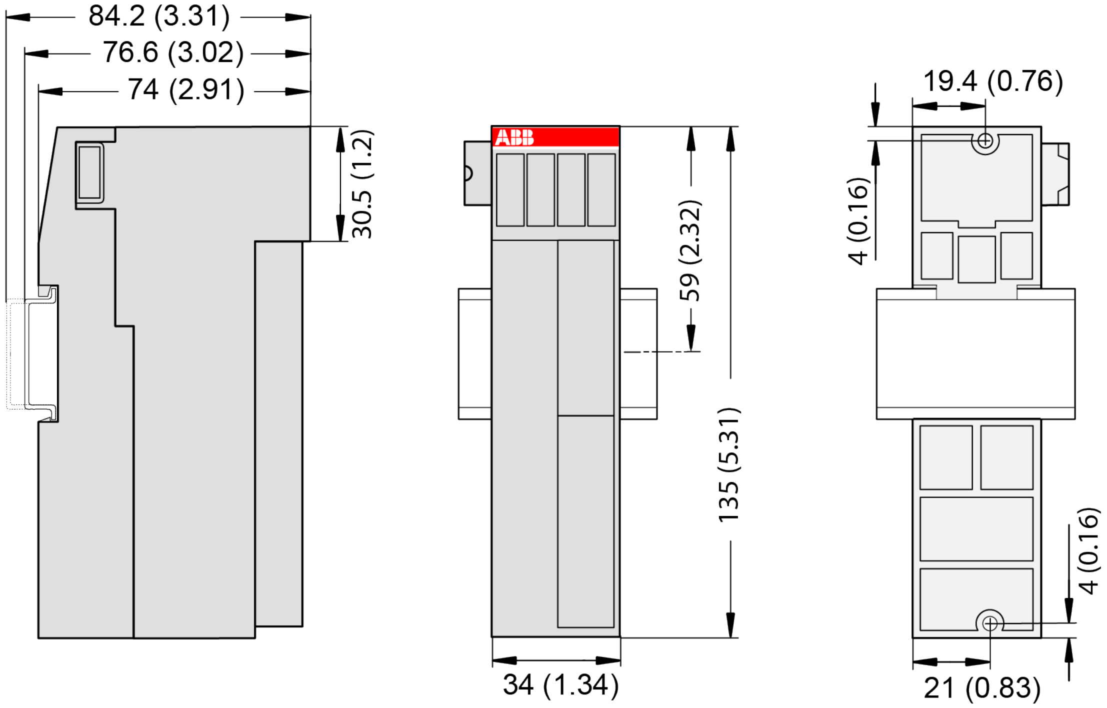
Parameter	Value	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ.	± 0.5 % of full scale (voltage) ± 0.5 % of full scale (current 0 mA ... 20 mA) ± 0.7 % of full scale (current 4 mA ... 20 mA) at +25 °C
	Max.	± 2 % of 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	➡ *Table on page 529*	
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	10 m	
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	
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 530*	
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

Parameter		Value
Unused outputs		Can be left open and should be configured as "unused"
Output data length		4 bytes
Overvoltage protection		Yes, up to 30 V DC
Max. cable length (conductor cross section > 0.14 mm²)		
	Unshielded wire	10 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 *)
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

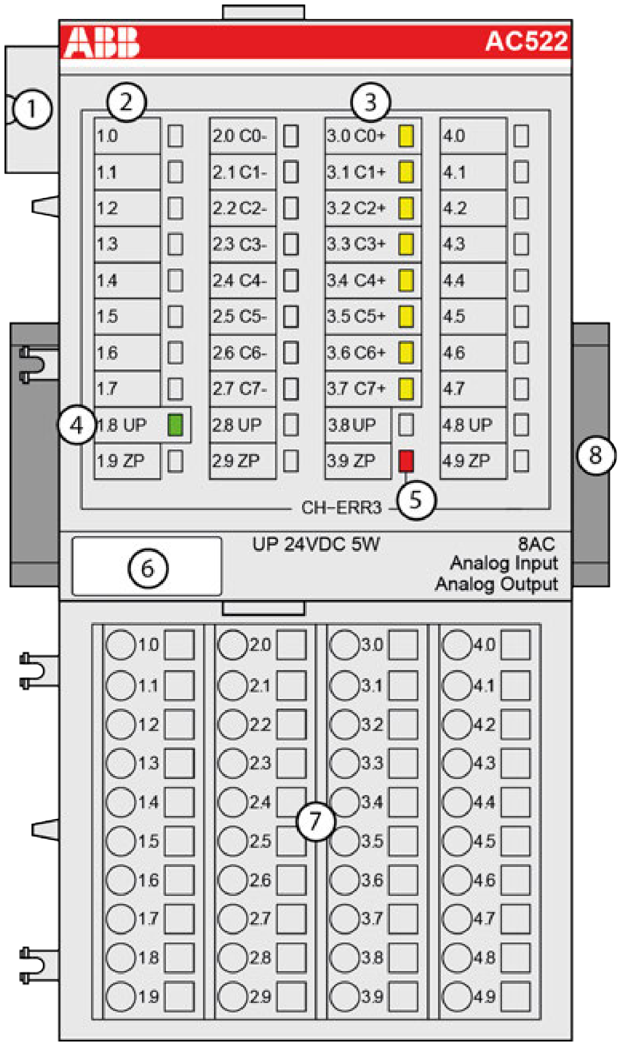
Part no.	Description	Product life cycle phase *)
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, 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.*

5.4.3.2 S500 and S500-XC

5.4.3.2.1 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)

If used as outputs, the following signal ranges are individually configurable:

4 analog outputs (channel 0 ... channel 3) for

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

4 analog outputs (channel 4 ... channel 7) for

- Unused (default setting)
- -10 V ... +10 V

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 ⇨ *Chapter 5.5.1 “TU515, TU516, TU541 and TU542 for I/O modules” on page 801*

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 *Chapter 5.5.1 “TU515, TU516, TU541 and TU542 for I/O modules” on page 801*. 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 5.8.2.5 “TA526 - Wall mounting accessory” on page 1183*.

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

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 10

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 you

– 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 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.

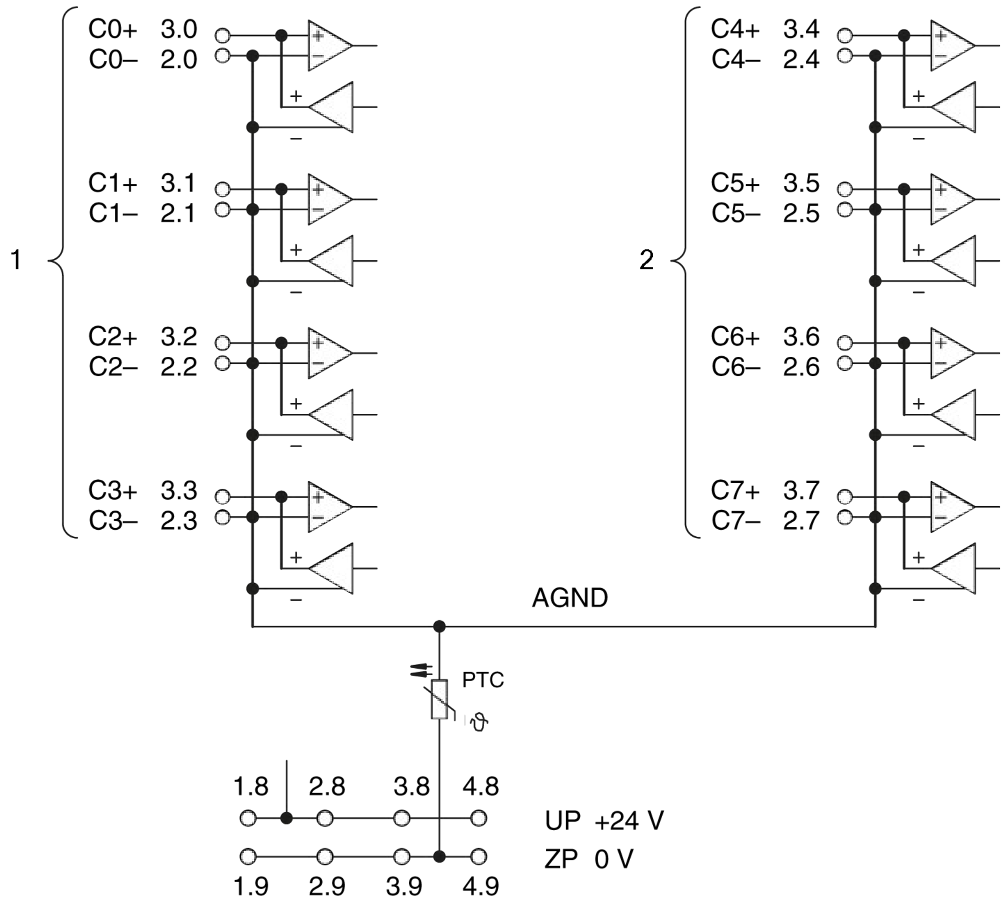


Fig. 66: Connection of the I/O module

1 4 analog I/O channels
as inputs for 0 V ... 10 V, -10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA, Pt100/Pt1000/Ni1000 digital signals
as outputs for -10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA

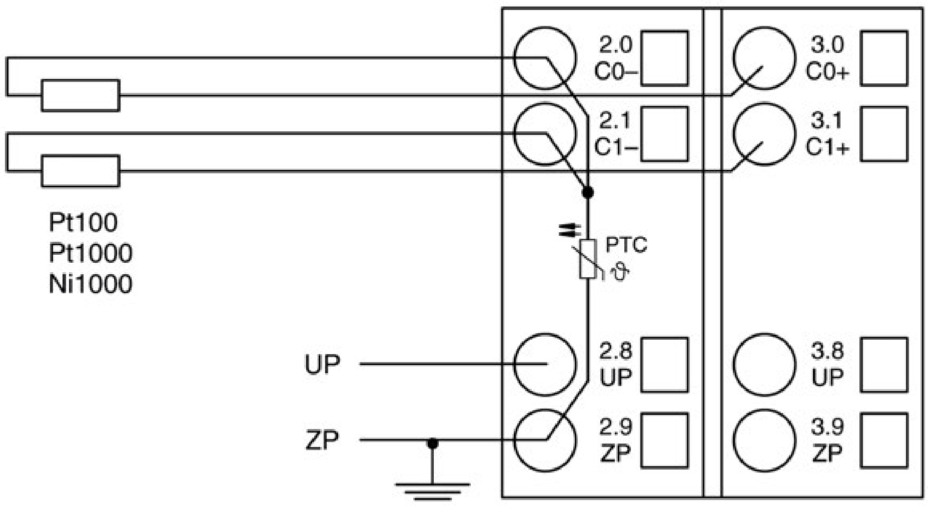
2 4 analog I/O channels
as inputs for 0 V ... 10 V, -10 V ... +10 V, 0 mA ... 20 mA, 4 mA ... 20 mA, Pt100/Pt1000/Ni1000 digital signals
as outputs for -10 V ... +10 V

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.



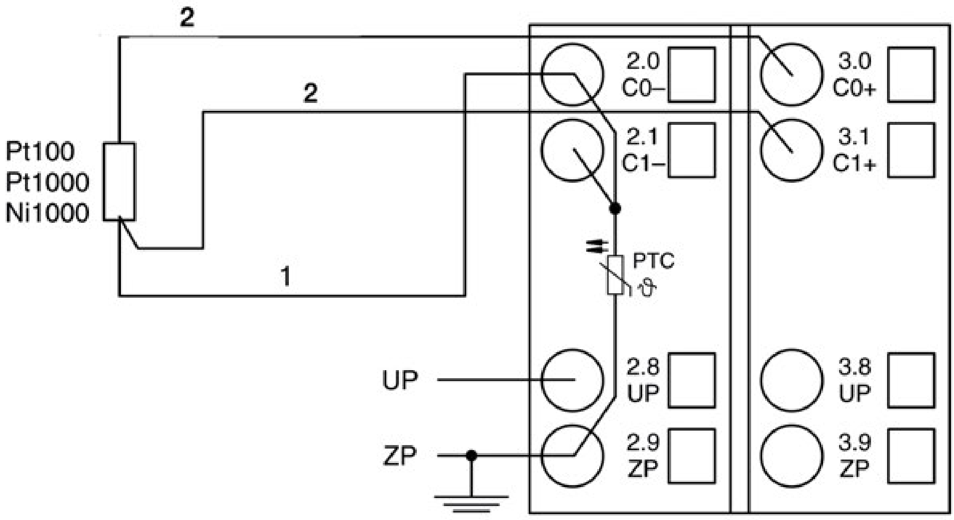
Pt100	-50 °C ... +70 °C	2-wire configuration, one channel used
Pt100	-50 °C ... +400 °C	2-wire configuration, one channel used
Pt1000	-50 °C ... +400 °C	2-wire configuration, one channel used
Ni1000	-50 °C ... +150 °C	2-wire configuration, one channel used

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).

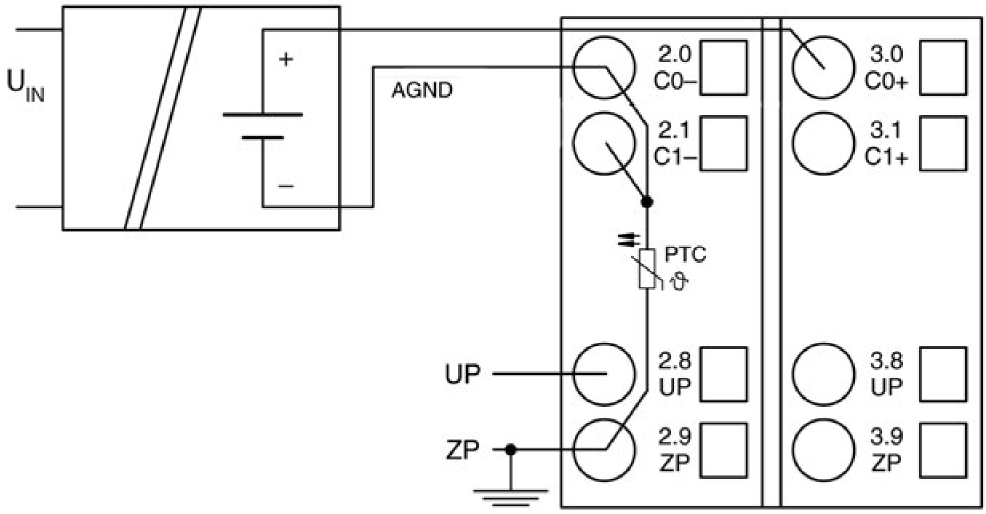
In order to keep measuring errors as small as possible, it is necessary to have all the involved conductors in the same cable. All the conductors must have the same cross section.

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.

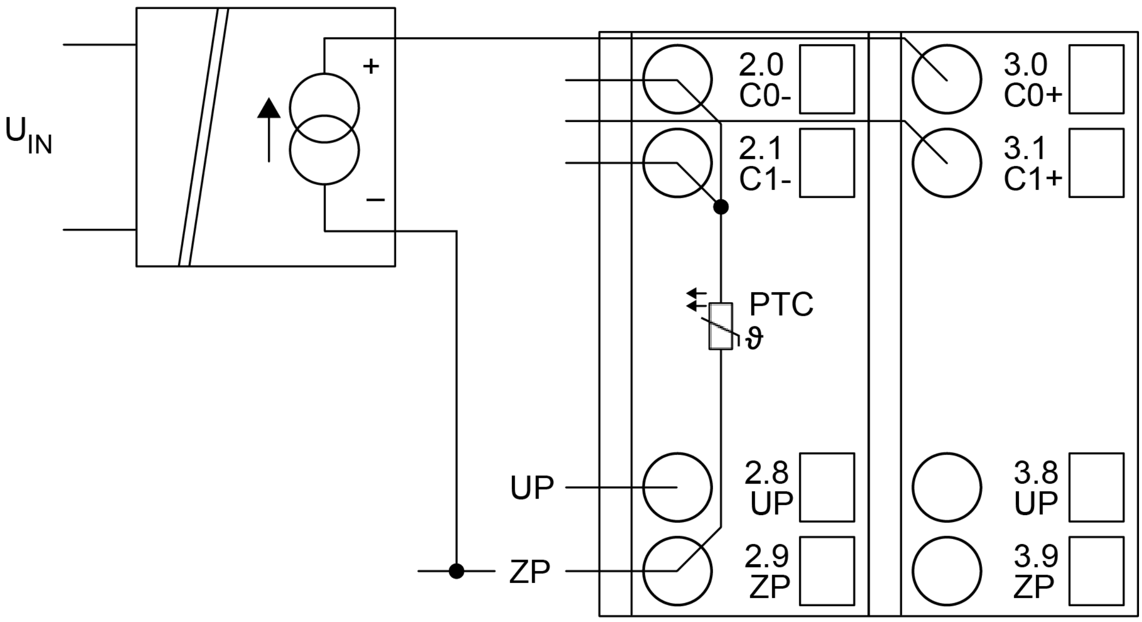
By connecting to AGND the galvanically isolated voltage source of the sensor is referred to ZP.

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

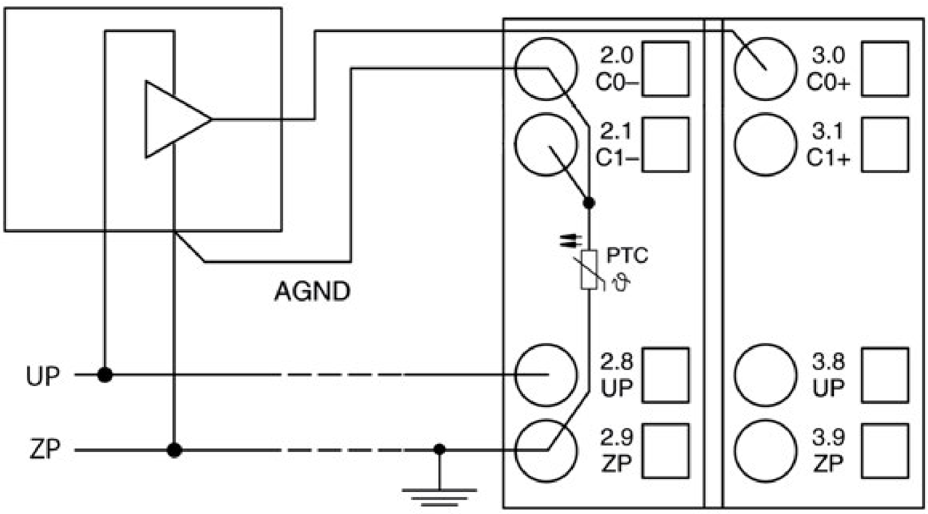


The following measuring ranges can be configured:

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



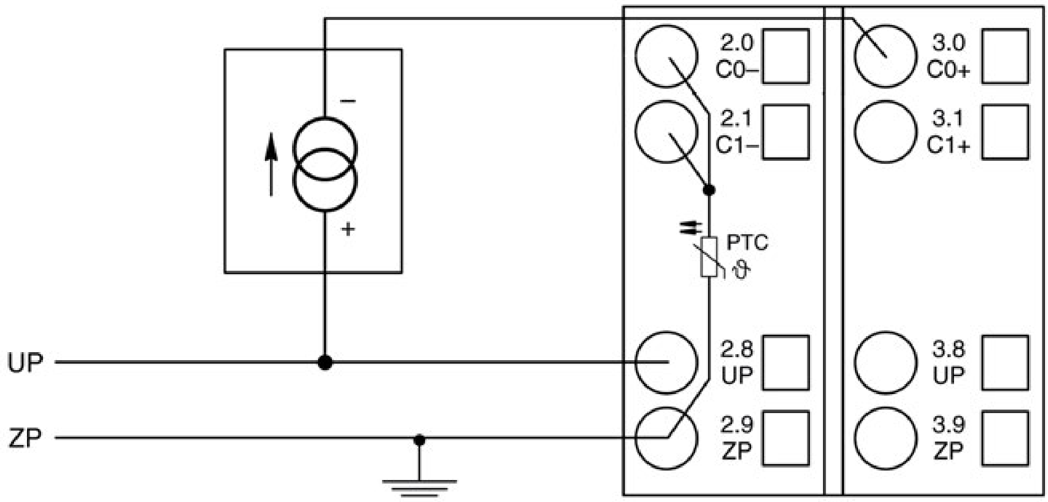
CAUTION!
The potential difference between AGND and ZP at the module must not be greater than 1V, not even in case of long lines (see figure Terminal Assignment).

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!
If, during initialization, an analog current sensor supplies more than 25 mA for more than 1 second to an analog input, this input is switched off by the module (input protection). In such cases, it is recommended to protect the analog input by a 10-volt Zener diode (in parallel to I+ and ZP). But, in general, sensors with fast initialization or without current peaks higher than 25 mA are preferrable.

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).

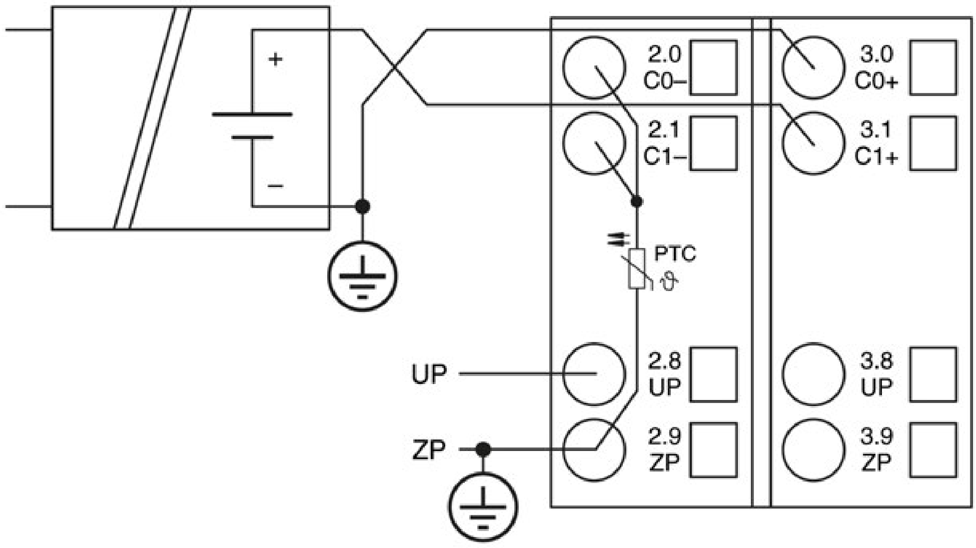
The use of differential inputs helps to considerably increase the measuring accuracy and to avoid ground loops.

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!
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). Otherwise, problems may occur concerning the common-mode input voltages of the involved analog inputs.



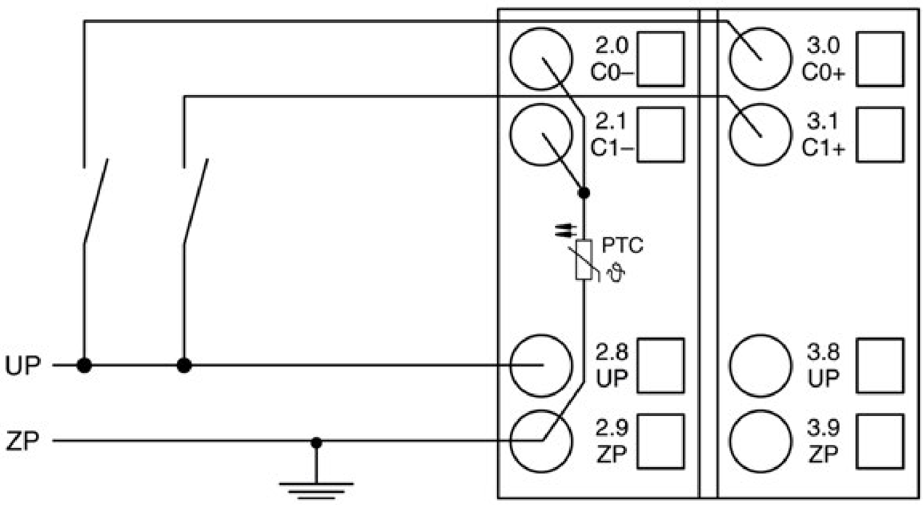
The negative pole of the sensor must be grounded next to the sensor.

Voltage	0 V ... 10 V	with differential inputs, 2 chan-nels used
Voltage	-10 V ... +10 V	with differential inputs, 2 chan-nels used

In order to avoid error messages or long processing times, it is useful to configure unused analog input channels as "unused".

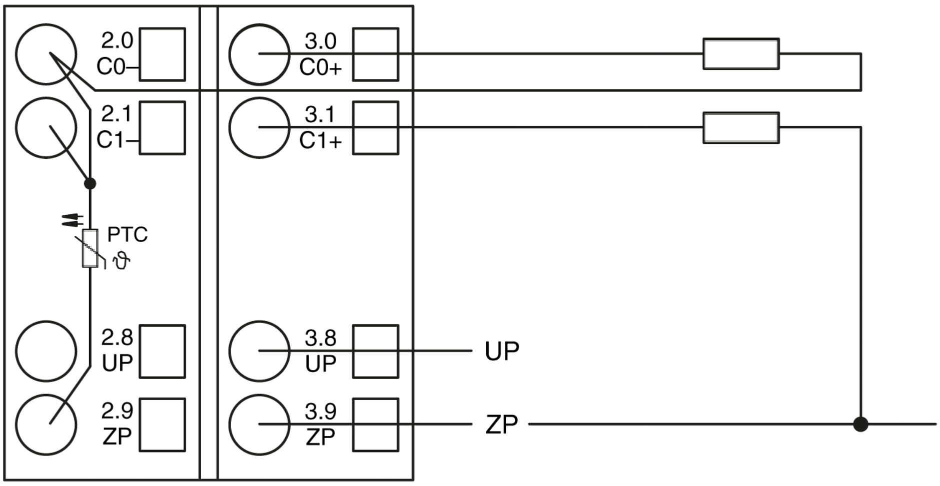
Use of analog inputs as digital inputs

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
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

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 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
32	Channel configuration Output channel 4	see table Channel configuration		Byte	Default 0x00	0	128	0x0Y1F

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
33	Channel moni- toring Output channel 4	see table Channel monitoring		Byte	Default 0x00	0	3	0x0Y20
34 to 39	Channel configu- ration and channel moni- toring of the output channels 5 to 7	see tables channel configura- tion 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 = Ext_User_Prm_Data_Const(0) =	40 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 143: 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 144: 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 145: 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 146: 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 147: 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 148: 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 149: 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 150: 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 151: 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 152: 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			

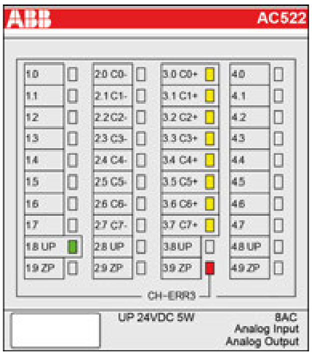
E1 ... E4	d1	d2	d3	d4		Identifier 000 ... 063	AC500 display	<− Display in
Class	Comp	Dev	Mod	Ch		Err	PS501 PLC browser	
Byte 6 Bit 6 ... 7	-	Byte 3	Byte 4	Byte 5		Byte 6 Bit 0 ... 5	FBP diagnosis block	
Class	**Interface**	**Device**	**Module**	**Channel**		**Error Identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)				
4	14	1 ... 10	1	0 ... 3	0 ... 7	48	Analog value 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	0 ... 7	7	Analog value underflow 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 overflow at an analog output	Check output value
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	3	4 ... 7	8 ... 15	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 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
	-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 / Pt 1000** **-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

Range	**-10 V ... +10 V**	**0 mA ... 20 mA**	**4 mA ... 20 mA**	**Digital value**	
				Decimal	**Hex.**
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

The System Data of AC500 and S500 ⇘ *Chapter 4.2 “System data AC500” on page 30* are applicable to the standard version.

Only additional details are therefore documented below.

Technical data of the module

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 VDC
	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 VDC 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 mm²		100 m
Weight		300 g

Parameter	Value
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.

Technical data of the analog inputs

<table>
<tr><th>Parameter</th><th colspan="2">Value</th></tr>
<tr><td>Number of channels per module</td><td colspan="2">8</td></tr>
<tr><td>Distribution of channels into groups</td><td colspan="2">1 group of 8 channels</td></tr>
<tr><td>Connections of the channels C0- ... C7-</td><td colspan="2">Terminals 2.0 ... 2.7</td></tr>
<tr><td>Connections of the channels C0+ ... C7+</td><td colspan="2">Terminals 3.0 ... 3.7</td></tr>
<tr><td>Input type</td><td colspan="2">Bipolar (not with current or Pt100/Pt1000/Ni1000)</td></tr>
<tr><td>Galvanic isolation</td><td colspan="2">Against internal supply and other modules</td></tr>
<tr><td>Configurability</td><td colspan="2">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)</td></tr>
<tr><td>Channel input resistance</td><td colspan="2">Voltage: > 100 kΩ
Current: ca. 330 Ω</td></tr>
<tr><td>Time constant of the input filter</td><td colspan="2">Voltage: 100 µs
Current: 100 µs</td></tr>
<tr><td>Indication of the input signals</td><td colspan="2">One LED per channel</td></tr>
<tr><td>Conversion cycle</td><td colspan="2">2 ms (for 8 inputs + 8 outputs), with Pt/Ni... 1 s</td></tr>
<tr><td>Resolution</td><td colspan="2">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</td></tr>
<tr><td rowspan="2">Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range</td><td>Typ.</td><td>± 0.5 % of full scale
at +25 °C</td></tr>
<tr><td>Max.</td><td>± 1 % of full scale (all ranges)
at 0 °C ... +60 °C or EMC disturbance</td></tr>
<tr><td>Relationship between input signal and hex code</td><td colspan="2">See table Chapter 5.4.3.2.1.9.1 “Input ranges of voltage, current and digital input” on page 554</td></tr>
<tr><td>Unused inputs</td><td colspan="2">Must be configured as "unused".</td></tr>
<tr><td>Overvoltage protection</td><td colspan="2">Yes</td></tr>
</table>

Technical data of the analog inputs, if used as digital inputs

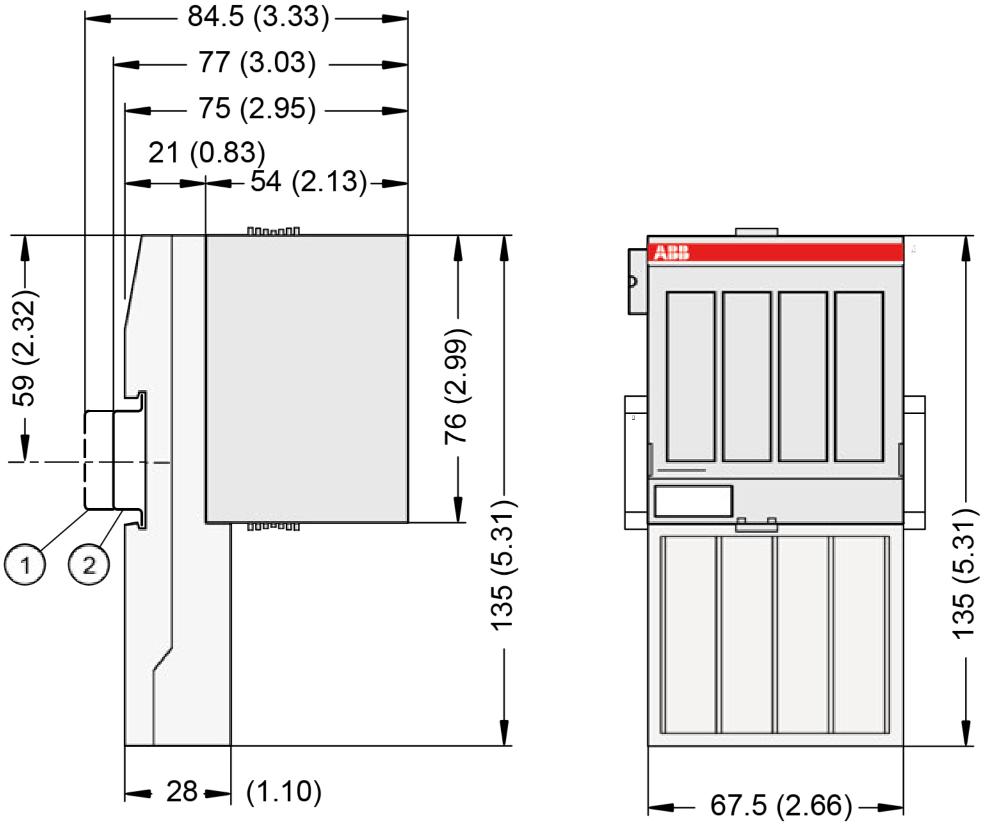
Parameter	Value
Number of channels per module	Max. 8
Distribution of channels into groups	1 group of 8 channels
Connections of the channels C0+ ... C7+	Terminals 3.0 ... 3.7
Reference potential for the inputs	Terminals 1.9 ... 4.9 (ZP)
Input signal delay	Typ. 8 ms, configurable from 0.1 ... 32 ms
Indication of the input signals	1 LED per channel
Input signal voltage	24 VDC
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

Parameter	Value	
	Max.	± 1 % of full scale (all ranges) at 0 °C ... +60 °C or EMC disturb-ance
Relationship between output signal and hex code	See table 'AC522 - Analog input/output mod-ule' *Chapter 5.4.3.2.1.9.3 "Output ranges voltage and current" on page 555*	
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.

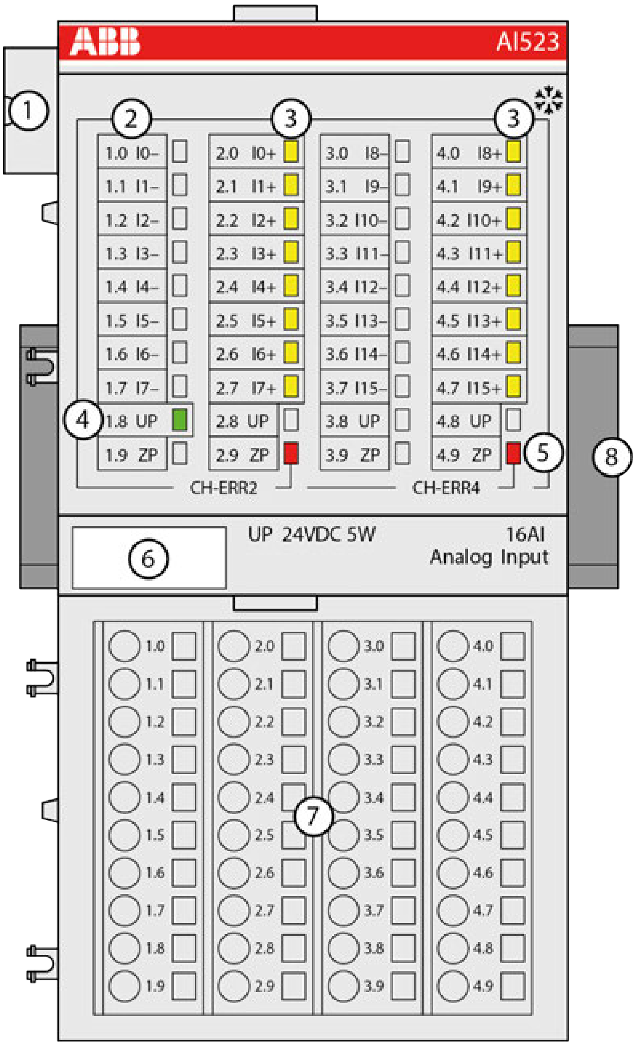
Ordering data

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.*

5.4.3.2.2 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 for

- 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 ➙ *Chapter 5.5.1 “TU515, TU516, TU541 and TU542 for I/O modules” on page 801*

Connections

The modules are plugged on an I/O terminal unit ➙ *Chapter 5.5.1 “TU515, TU516, TU541 and TU542 for I/O modules” on page 801*. 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 5.8.2.5 “TA526 - Wall mounting accessory” on page 1183*.

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 10

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 you

– 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 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.

The following figure shows the connection of the module:

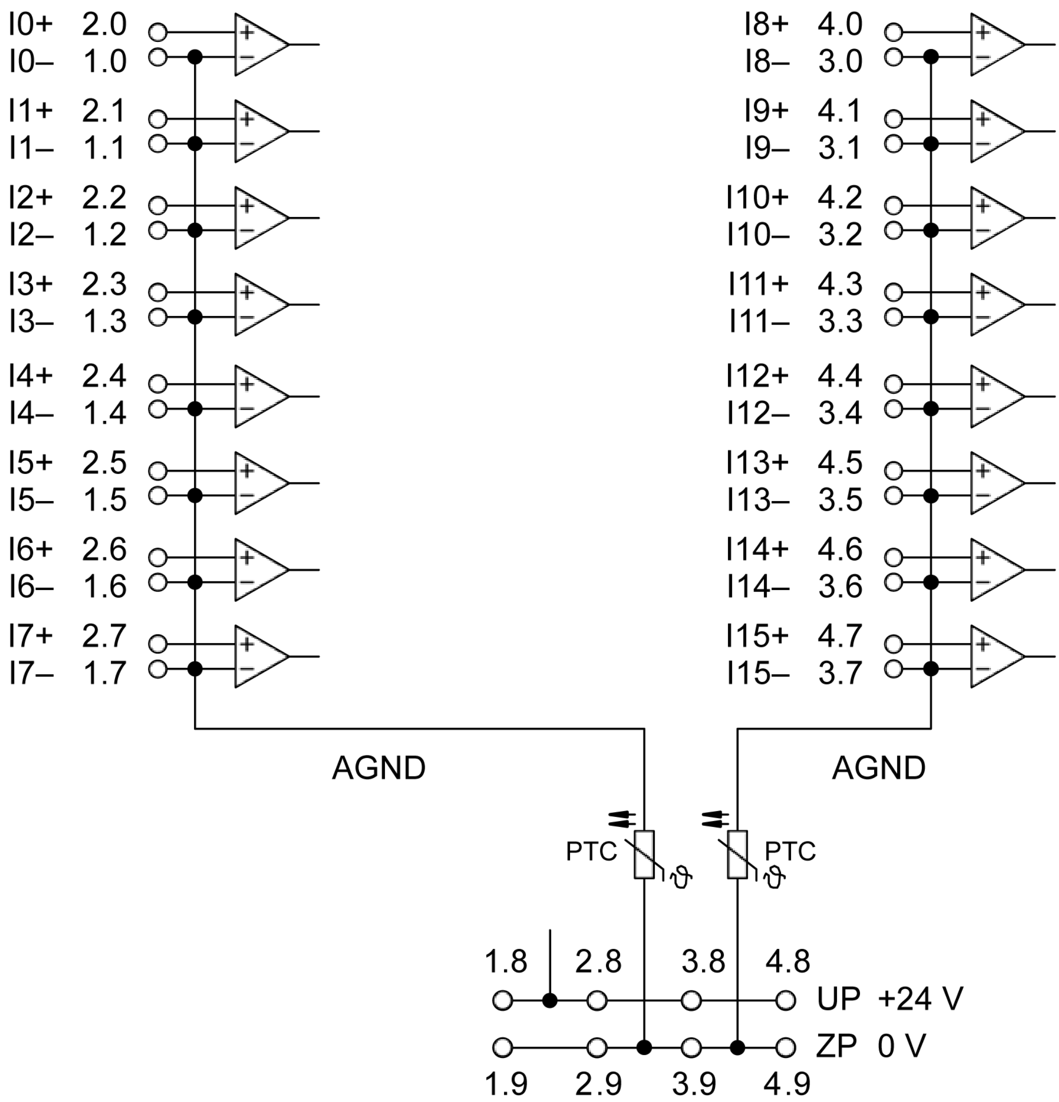


Fig. 67: 16 analog inputs in two groups, individually configurable *Chapter 5.4.3.2.2.2 “Functionality” on page 561*

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 5.4.3.2.2.7 “Diagnosis” on page 579*.

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.

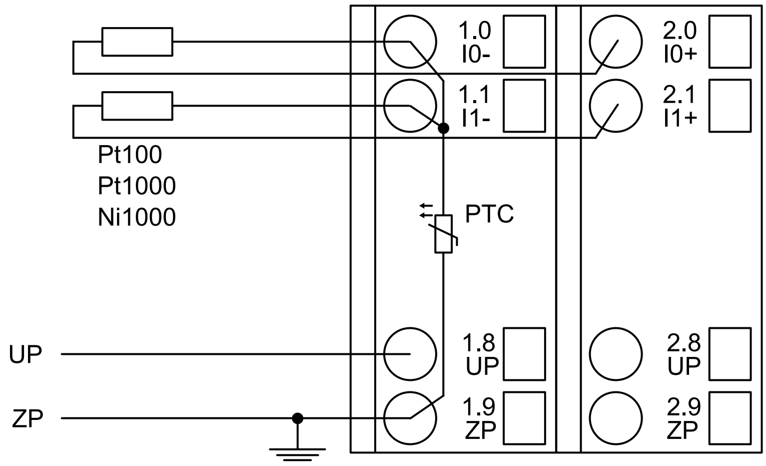


Fig. 68: Connection example

The following measuring ranges can be configured ➪ *Chapter 5.4.3.2.2.6 “Parameterization” on page 576*.

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 function of the LEDs is described under Displays ➪ *Chapter 5.4.3.2.2.7 “Diagnosis” on page 579*.

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.

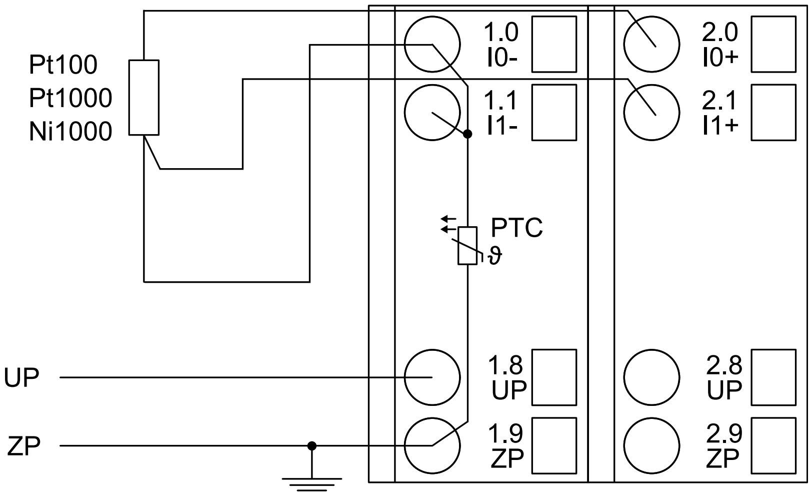


Fig. 69: Connection example

> *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.

The following measuring ranges can be configured *Chapter 5.4.3.2.2.6 “Parameterization” on page 576*

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 function of the LEDs is described under Displays *Chapter 5.4.3.2.2.7 “Diagnosis” on page 579*.

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

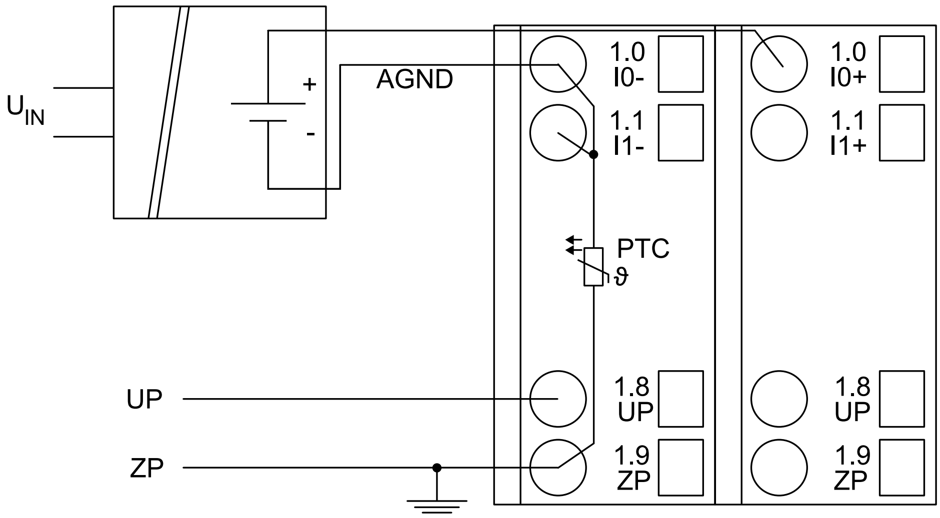


Fig. 70: Connection example

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 ➪ *Chapter 5.4.3.2.2.6 “Parameterization” on page 576* ➪ *Chapter 5.4.3.2.2.9 “Measuring ranges” on page 581*

Voltage	0 V ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

The function of the LEDs is described under Displays ➪ *Chapter 5.4.3.2.2.7 “Diagnosis” on page 579*.

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

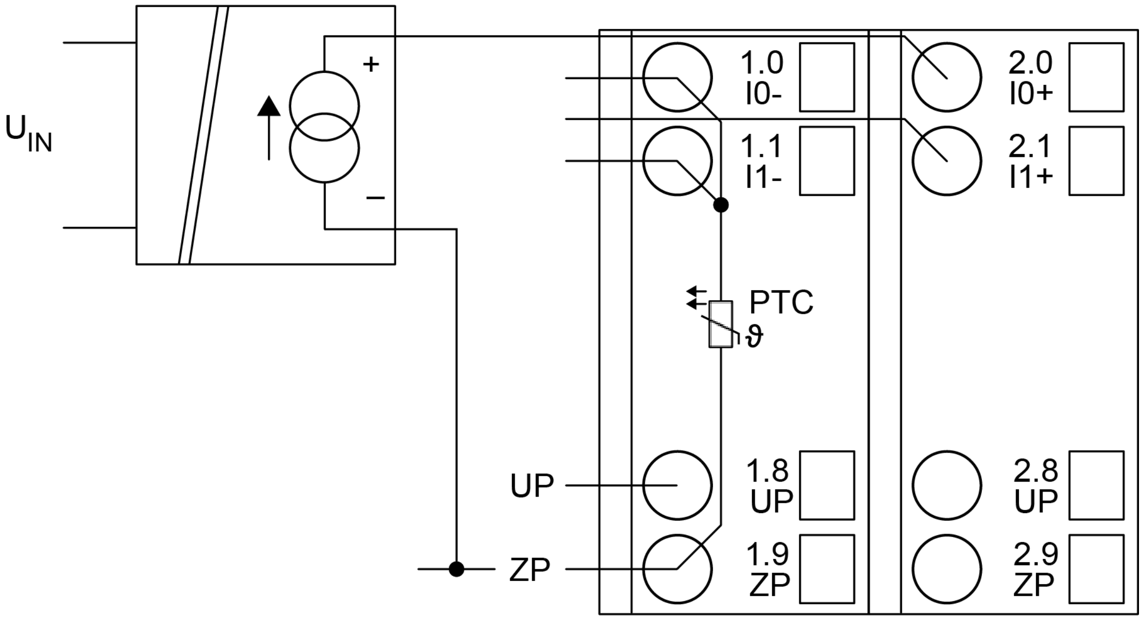


Fig. 71: Connection example

The following measuring ranges can be configured ➪ *Chapter 5.4.3.2.2.6 “Parameterization” on page 576* ➪ *Chapter 5.4.3.2.2.9 “Measuring ranges” on page 581*

Current	0 mA ... 20 mA	1 channel used
Current	4 mA ... 20 mA	1 channel used

The function of the LEDs is described under Displays ➪ *Chapter 5.4.3.2.2.7 “Diagnosis” on page 579*.

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

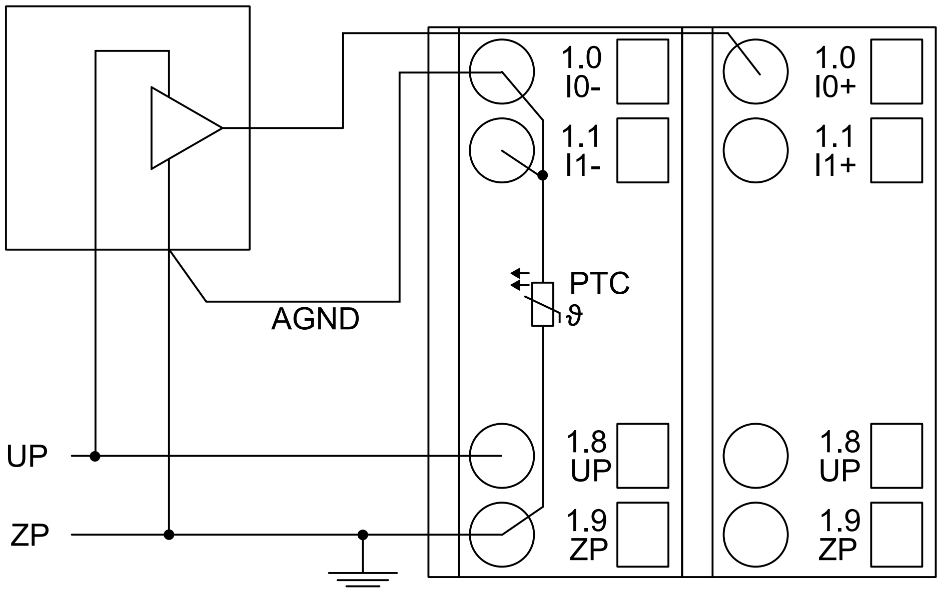


Fig. 72: Connection example

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 5.4.3.2.2 “AI523 - Analog input module” on page 560*.

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.

The following measuring ranges can be configured *Chapter 5.4.3.2.2.9 “Measuring ranges” on page 581*

Voltage	0 V ... 10 V	1 channel used
Voltage	-10 V ... +10 V *)	1 channel used
*) if the sensor can provide this signal range		

The function of the LEDs is described under Displays *Chapter 5.4.3.2.2.7 “Diagnosis” on page 579*.

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)

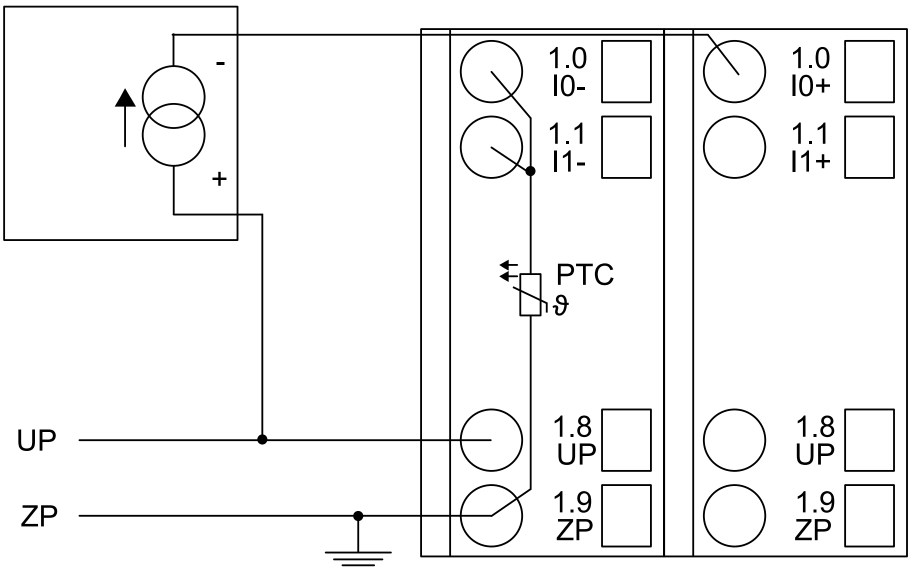


Fig. 73: Connection example

The following measuring ranges can be configured ⇘ *Chapter 5.4.3.2.2.6 "Parameterization" on page 576* ⇘ *Chapter 5.4.3.2.2.9 "Measuring ranges" on page 581*

Current	4 mA ... 20 mA	1 channel used

The function of the LEDs is described under Displays *Chapter 5.4.3.2.2.7 “Diagnosis” on page 579*.

CAUTION!
If, during initialization, an analog current sensor supplies more than 25 mA for more than 1 second into an analog input, this input is switched off by the module (input protection). In such cases, it is recommended to protect the analog input by a 10-volt Zener diode (in parallel to I+ and ZP). But, in general, it is a better solution to use sensors with fast initialization or without current peaks higher than 25 mA.

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!
The ground potential at the sensors must not have too big a potential difference with respect to ZP (max. ±1 V within the full signal range). Otherwise problems can occur concerning the common-mode input voltages of the involved analog inputs.

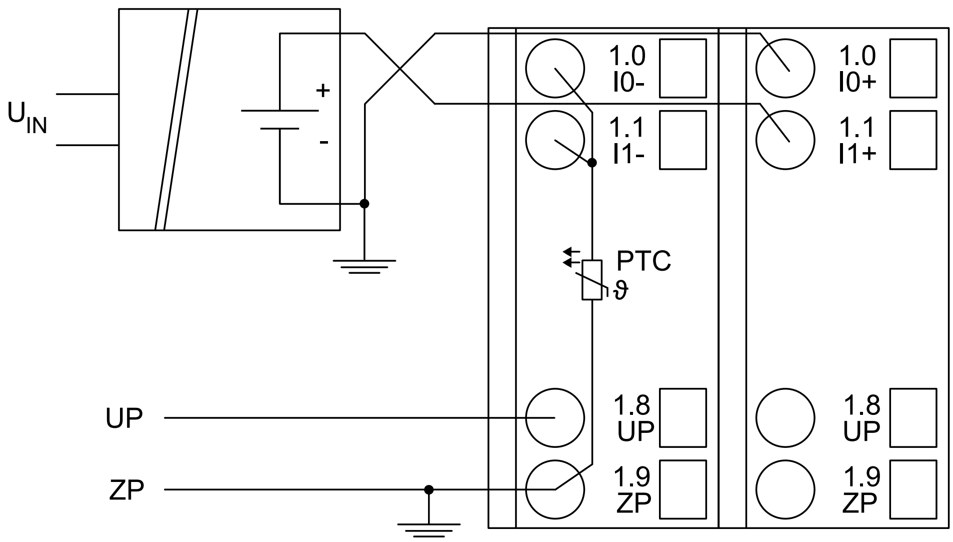


Fig. 74: Connection example

The negative pole of the sensor must be grounded next to the sensor.

The following measuring ranges can be configured *Chapter 5.4.3.2.2.6 “Parameterization” on page 576* *Chapter 5.4.3.2.2.9 “Measuring ranges” on page 581*:

Voltage	0 V ... 10 V	with differential inputs, 2 channels used
Voltage	-10 V ... +10 V	with differential inputs, 2 channels used

The function of the LEDs is described under Displays *Chapter 5.4.3.2.2.7 “Diagnosis” on page 579*.

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.

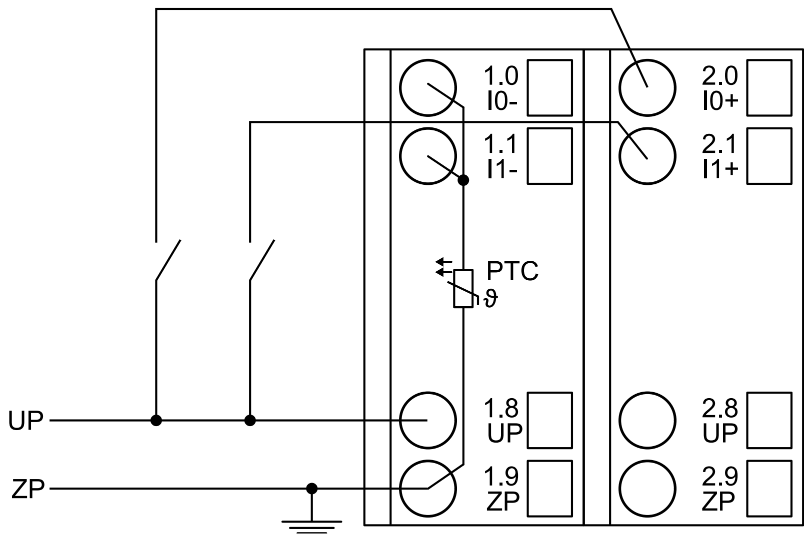


Fig. 75: Connection example

The following operating mode can be configured *Chapter 5.4.3.2.2.6 “Parameterization” on page 576* *Chapter 5.4.3.2.2.9 “Measuring ranges” on page 581*

Digital input	24 V	1 channel used
Effect of incorrect input terminal connection		Wrong or no signal detected, no damage up to 35 V

The function of the LEDs is described under Displays.

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 configu-ration Input channel 0	See table 'Channel configuration' *Table 153 “Channel configuration [2])” on page 578*		Byte	Default 0x00	0	19	0x0Y05
7	Channel moni-toring Input channel 0	See table 'Channel monitoring' *Table 154 “Channel monitoring [4])” on page 579*		Byte	Default 0x00	0	3	0x0Y06
8 to 35	Channel configu-ration and channel moni-toring of the input channels 1 ... 14	See table 'Channel con-figuration' *Table 153 “Channel configuration [2])” on page 578* and table 'Channel monitoring' *Table 154 “Channel monitoring [4])” on page 579*		Byte Byte	Default 0x00 0x00	0 0	19 3	0x0Y07 to 0x0Y22
36	Channel configu-ration Input channel 15	See table 'Channel con-figuration' *Table 153 “Channel configuration [2])” on page 578*		Byte	Default 0x00	0	19	0x0Y23
37	Channel moni-toring Input channel 15	See table 'Channel monitorings' *Table 154 “Channel monitoring [4])” on page 579*		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 153: 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 154: 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 155: Possible diagnosis of I/O channels

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

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				

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				

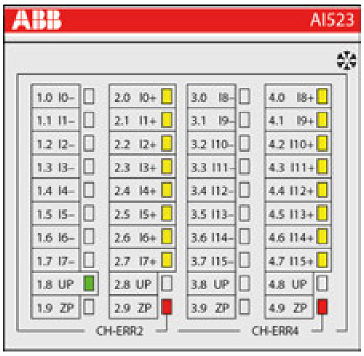
Remarks:

[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
Meas-ured 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 meas-ured 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
Meas-ured value too low		-10.0004 : -11.7589				-27649 : -32512	93FF : 8100
Under-flow	<-1.7593	<-11.7589	<0.0000	<1.1858		-32768	8000

Input ranges resistance temperature detector

The resolution corresponds to 16 bits.

Range	Pt100 / Pt 1000 -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 / Pt 1000 -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

The system data of AC500 and S500 are applicable to the standard version *Chapter 4.2 “System data AC500” on page 30*.

The system data of AC500-XC are applicable to the XC version *Chapter 4.3 “System data AC500-XC” on page 35*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Technical data of the module

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 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.

Technical data of the analog inputs

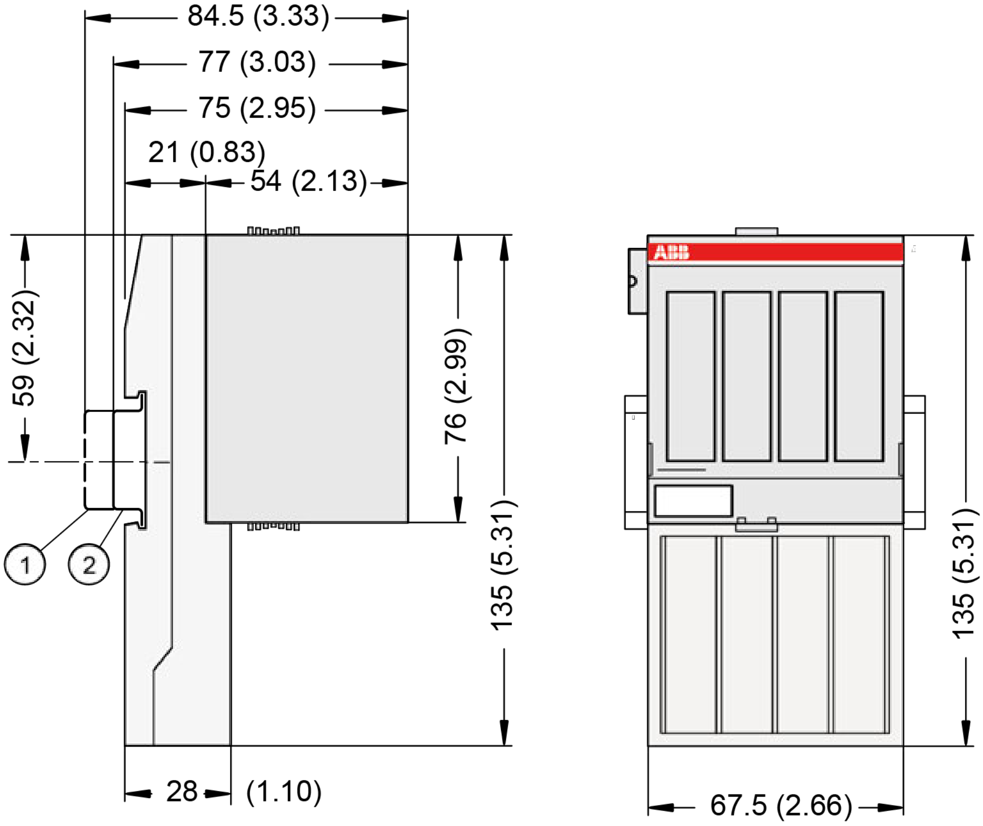
Parameter	Value
Number of channels per module	16
Distribution of channels into groups	2 groups of 8 channels each
Connections of the channels I0- ... I7- Connections of the channels I0+ ... I7+	Terminals 1.0 ... 1.7 Terminals 2.0 ... 2.7
Connections of the channels I8- ... I15- Connections of the channels 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 5.4.3.2.2.9.2 "Input ranges resistance temperature detector" on page 582*	
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		2 groups of 8 channels each
Connections of the channels I0+ ... I7+ Connections of the channels I8+ ... I15+		Terminals 2.0 ... 2.7 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.

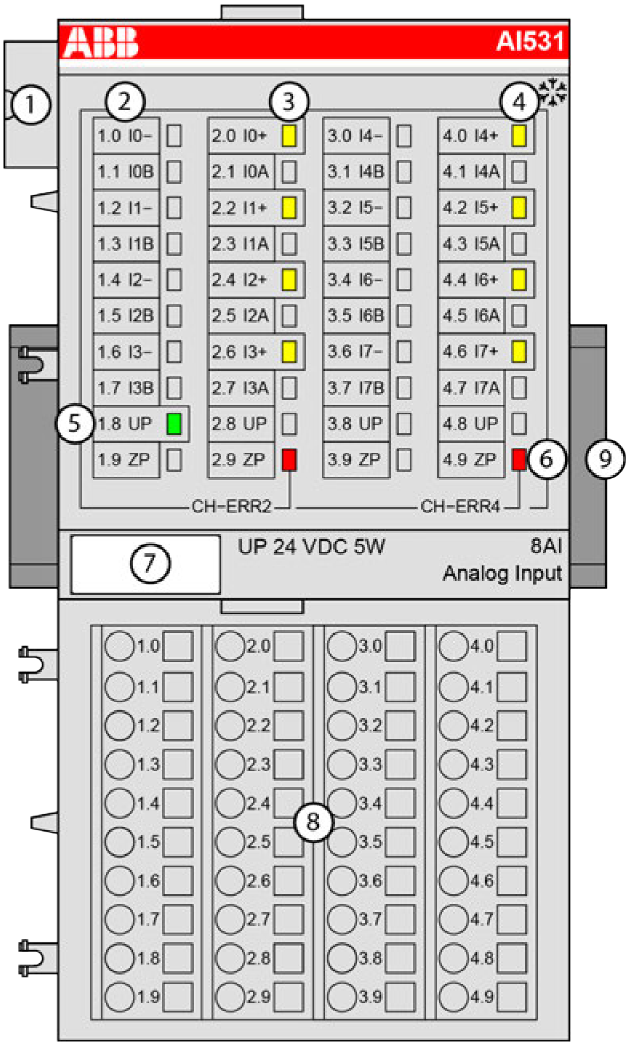
Ordering data

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.*

5.4.3.2.3 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 for

- 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 *Chapter 5.5.1 “TU515, TU516, TU541 and TU542 for I/O modules” on page 801*

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 *Chapter 5.5.1 “TU515, TU516, TU541 and TU542 for I/O modules” on page 801*. 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 5.8.2.5 “TA526 - Wall mounting accessory” on page 1183*.

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

The assignment 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 fol-lowing 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.

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 10

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 you

– 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 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.

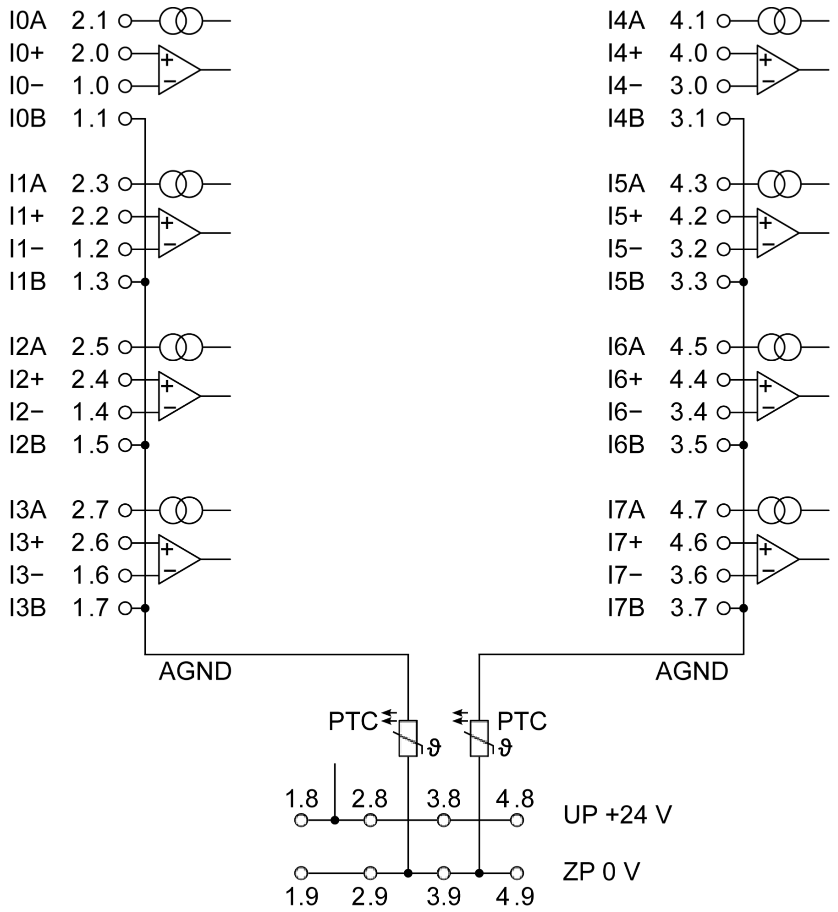


Fig. 76: 8 analog inputs in two groups, individually configurable ⇨ Chapter 5.4.3.2.3.2 “Functionality” on page 588

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 5.4.3.2.3.7 “Diagnosis” on page 615.*

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

Standard ranges

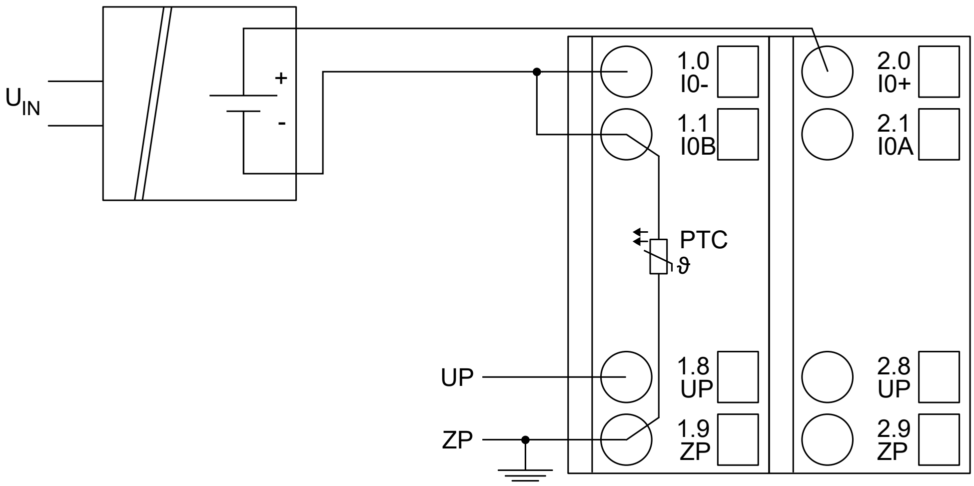


Fig. 77: Connection example

The measuring ranges can be configured ➪ *Chapter 5.4.3.2.3.6 “Parameterization” on page 611*:

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

Common mode range (+/-20 V)

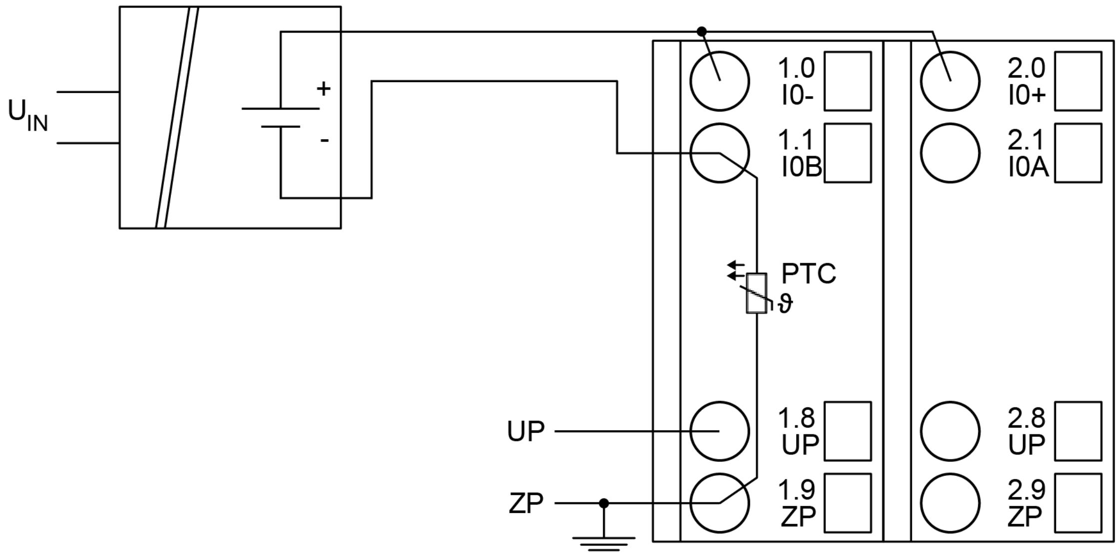


Fig. 78: Connection example

The measuring range can be configured *Chapter 5.4.3.2.3.6 “Parameterization” on page 611*:

Voltage	Common mode voltage	1 channel used

The function of the LEDs is described under diagnosis and displays/displays *Chapter 5.4.3.2.3.7 “Diagnosis” on page 615*.

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

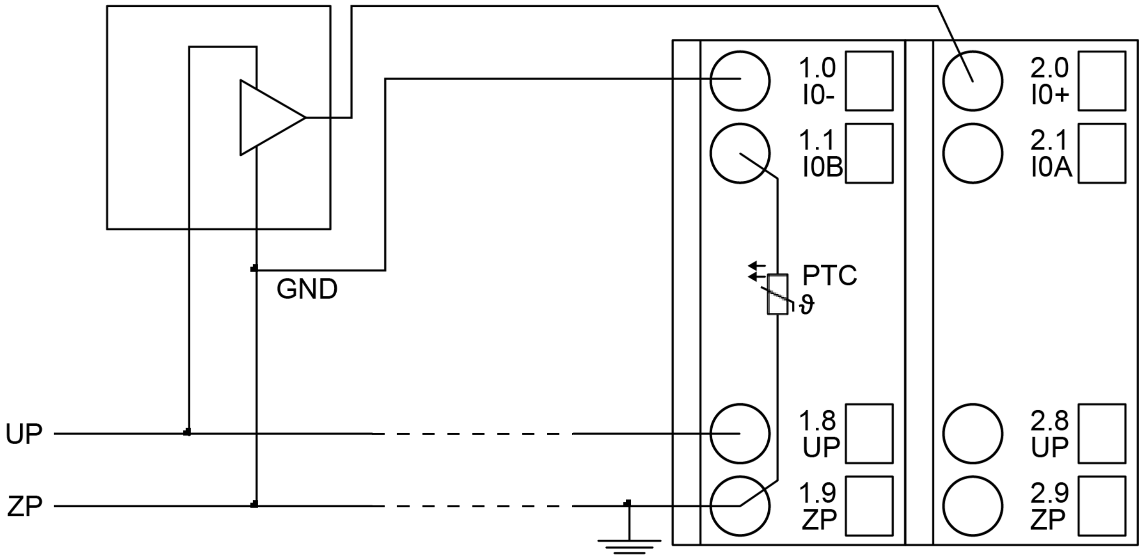


Fig. 79: Connection example

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.

The measuring ranges can be configured *Chapter 5.4.3.2.3.6 "Parameterization" on page 611* :

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

Common mode range (+/-20 V)

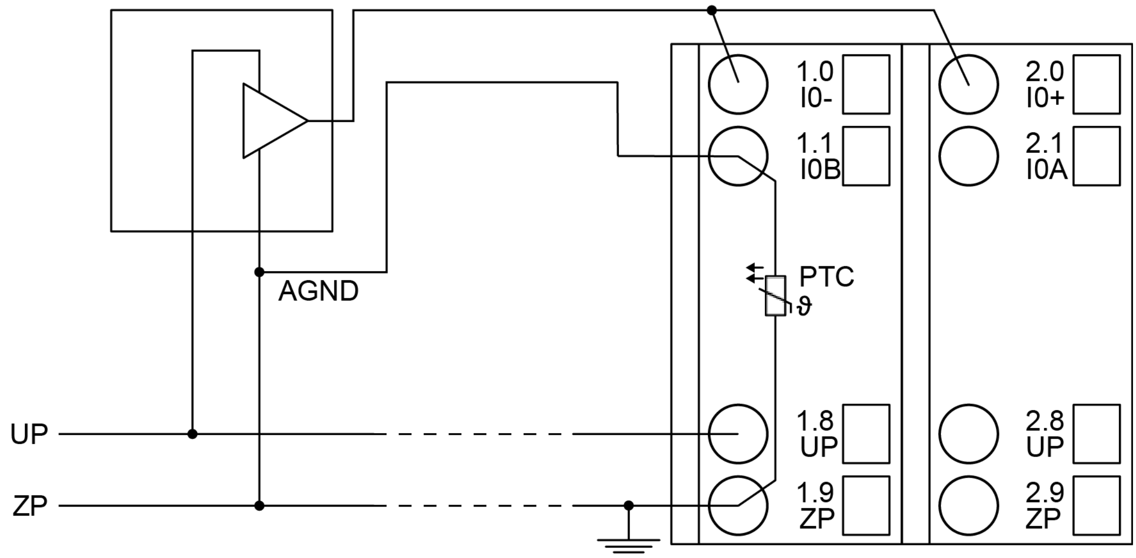


Fig. 80: Connection example

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.

The measuring range can be configured ↪ *Chapter 5.4.3.2.3.6 "Parameterization" on page 611*:

Voltage	Common mode voltage	1 channel used

The function of the LEDs is described under diagnosis and displays/displays ↪ *Chapter 5.4.3.2.3.7 "Diagnosis" on page 615*.

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

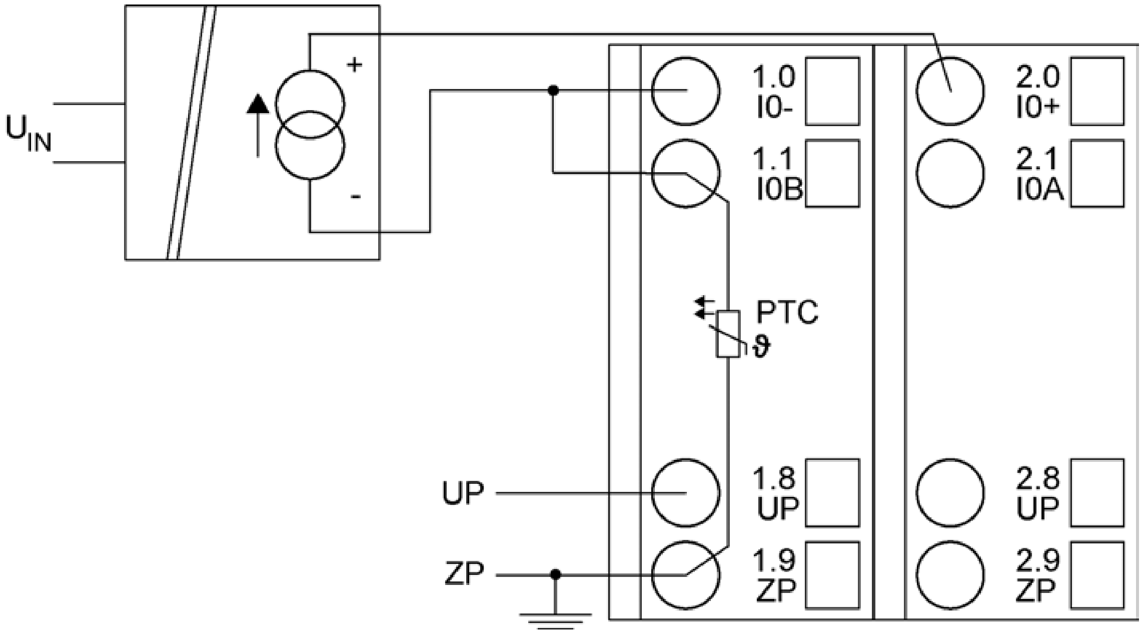


Fig. 81: Connection example

The following measuring ranges can be configured *Chapter 5.4.3.2.3.6 “Parameterization” on page 611*:

Current	-20 mA ... 20 mA	1 channel used
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 5.4.3.2.3.7 “Diagnosis” on page 615*.

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

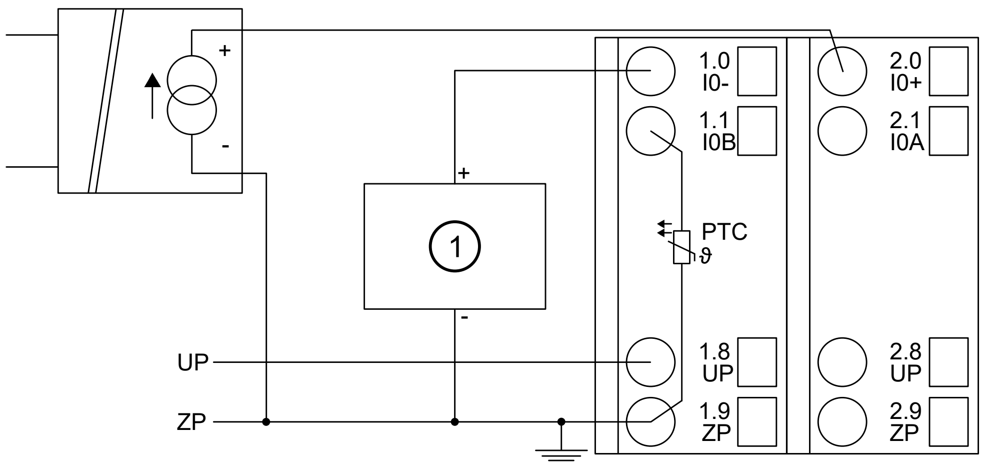


Fig. 82: Connection example

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).

The following measuring ranges can be configured *Chapter 5.4.3.2.3.6 “Parameterization” on page 611*:

Current	-20 mA ... 20 mA	1 channel used
Current	0 mA ... 20 mA	1 channel used
Current	4 mA ... 20 mA	1 channel used

For a description of the functions of the LEDs, please refer to diagnosis and displays/displays *Chapter 5.4.3.2.3.7 “Diagnosis” on page 615*.

Unused input channels can be left open, because they are of low resistance.

Connection of passive-type analog sensors (Current)

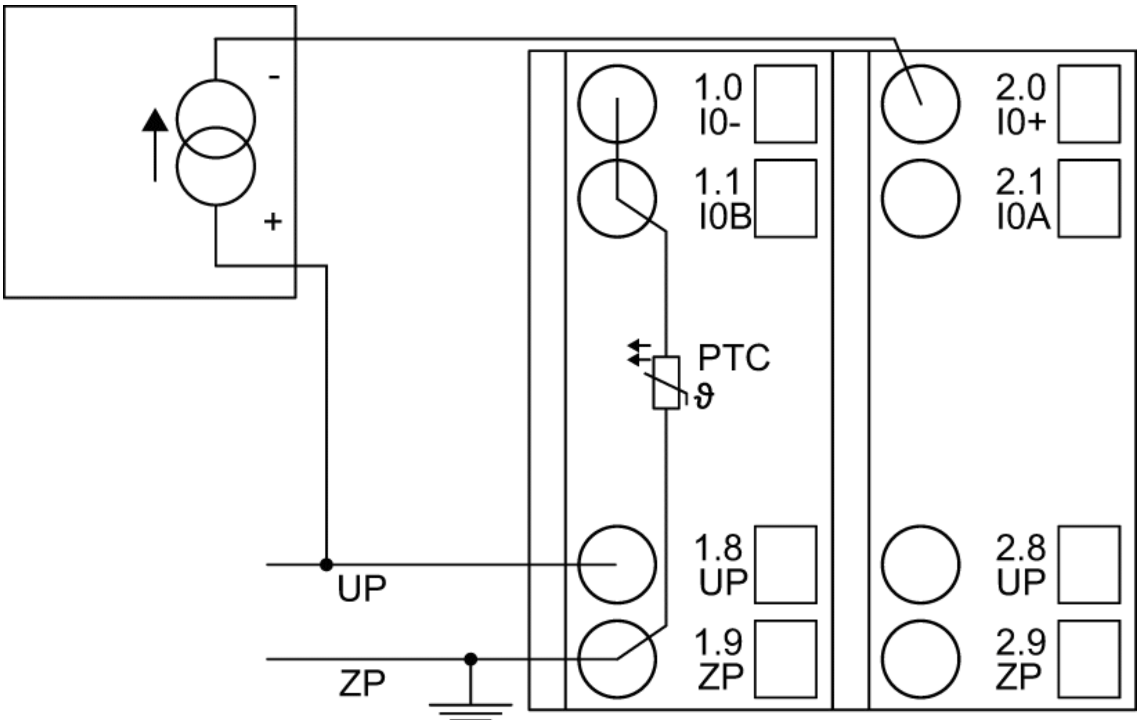


Fig. 83: Connection example

The following measuring ranges can be configured *Chapter 5.4.3.2.3.6 “Parameterization” on page 611*:

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).		

The function of the LEDs is described under diagnosis and displays/displays ↬ *Chapter 5.4.3.2.3.7 “Diagnosis” on page 615*.

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

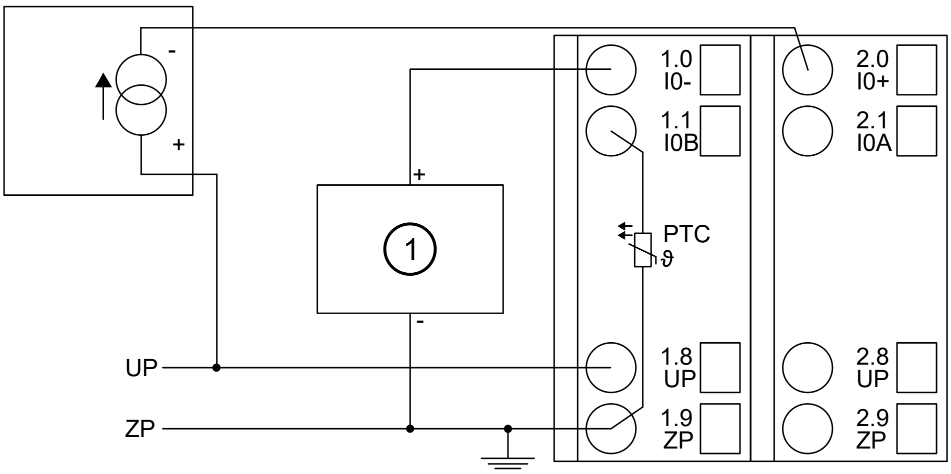


Fig. 84: Connection example

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).

The following measuring ranges can be configured *Chapter 5.4.3.2.3.6 "Parameterization" on page 611*:

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).		

The function of the LEDs is described under diagnosis and displays/displays *Chapter 5.4.3.2.3.7 "Diagnosis" on page 615*.

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.

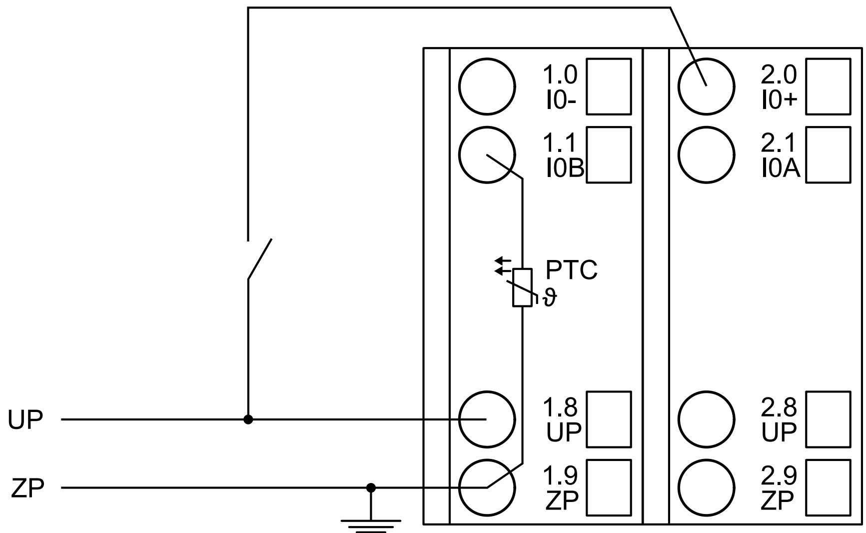


Fig. 85: Connection example

The following operating mode can be configured *Chapter 5.4.3.2.3.6 "Parameterization" on page 611* :

Digital input	24 V	1 channel used
Effect of incorrect input terminal connection		Wrong or no signal detected, no damage up to 35 V

For a description of the function of the LEDs, please refer to diagnosis and displays/displays *Chapter 5.4.3.2.3.7 “Diagnosis” on page 615*.

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.

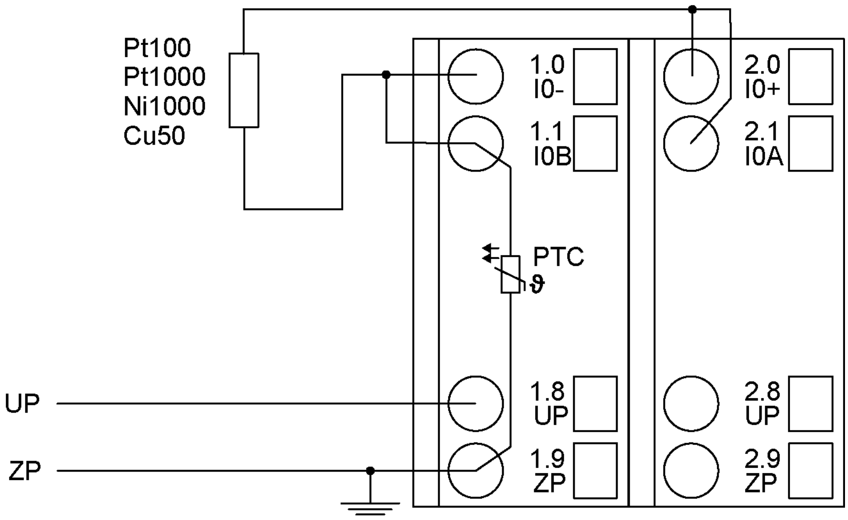


Fig. 86: Connection example

The following measuring ranges can be configured *Chapter 5.4.3.2.3.6 “Parameterization” on page 611*:

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

For a description of the function of the LEDs, please refer to Diagnosis and displays / displays *Chapter 5.4.3.2.3.7 “Diagnosis” on page 615*.

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.

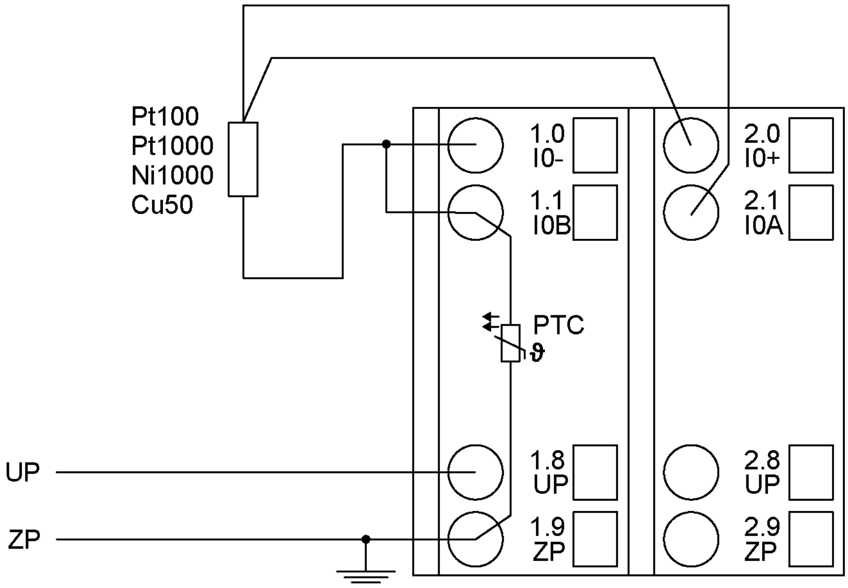


Fig. 87: Connection example

The following measuring ranges can be configured ✎ *Chapter 5.4.3.2.3.6 “Parameterization” on page 611*:

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

For a description of the function of the LEDs, please refer to diagnosis and displays/displays ✎ *Chapter 5.4.3.2.3.7 “Diagnosis” on page 615*.

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.

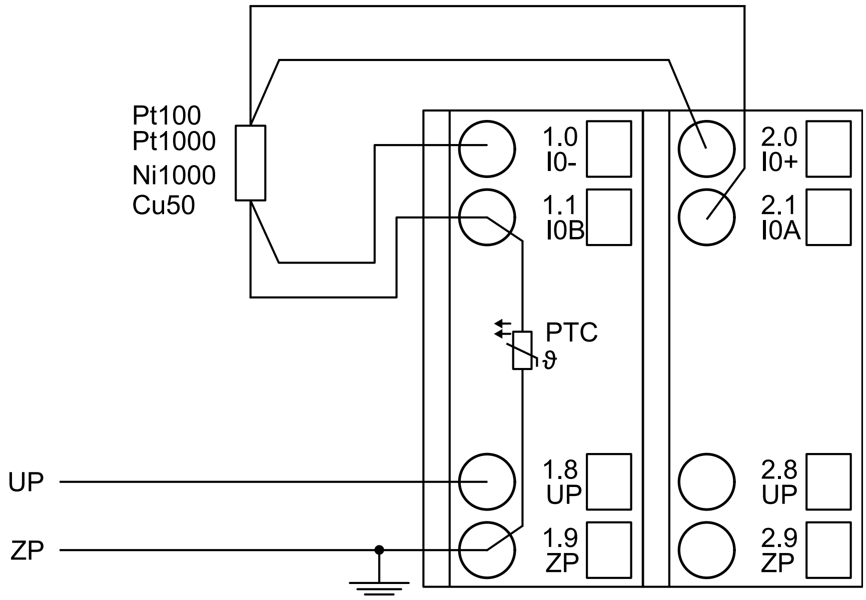


Fig. 88: Connection example

The following measuring ranges can be configured *Chapter 5.4.3.2.3.6 “Parameterization” on page 611*:

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

For a description of the function of the LEDs, please refer to diagnosis and displays/displays *Chapter 5.4.3.2.3.7 “Diagnosis” on page 615*.

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.

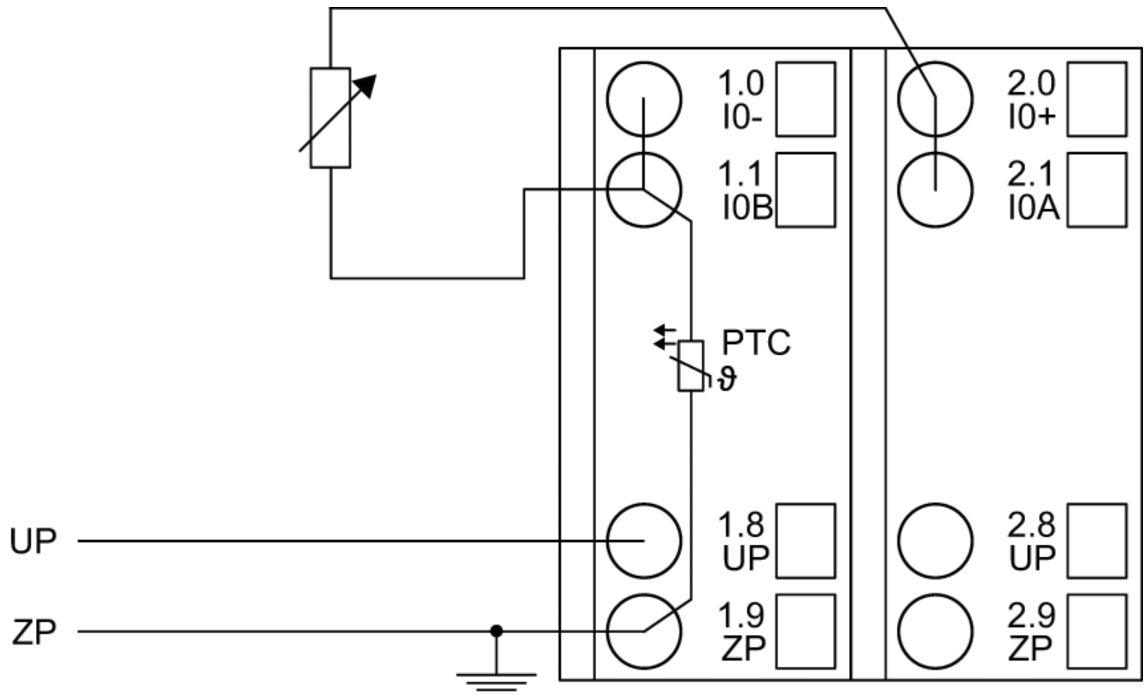


Fig. 89: Connection example

The following measuring ranges can be configured *Chapter 5.4.3.2.3.6 “Parameterization” on page 611* :

Resistor	50 kΩ	1 channel used

For a description of the function of the LEDs, please refer to diagnosis and displays/displays *Chapter 5.4.3.2.3.7 “Diagnosis” on page 615*.

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.

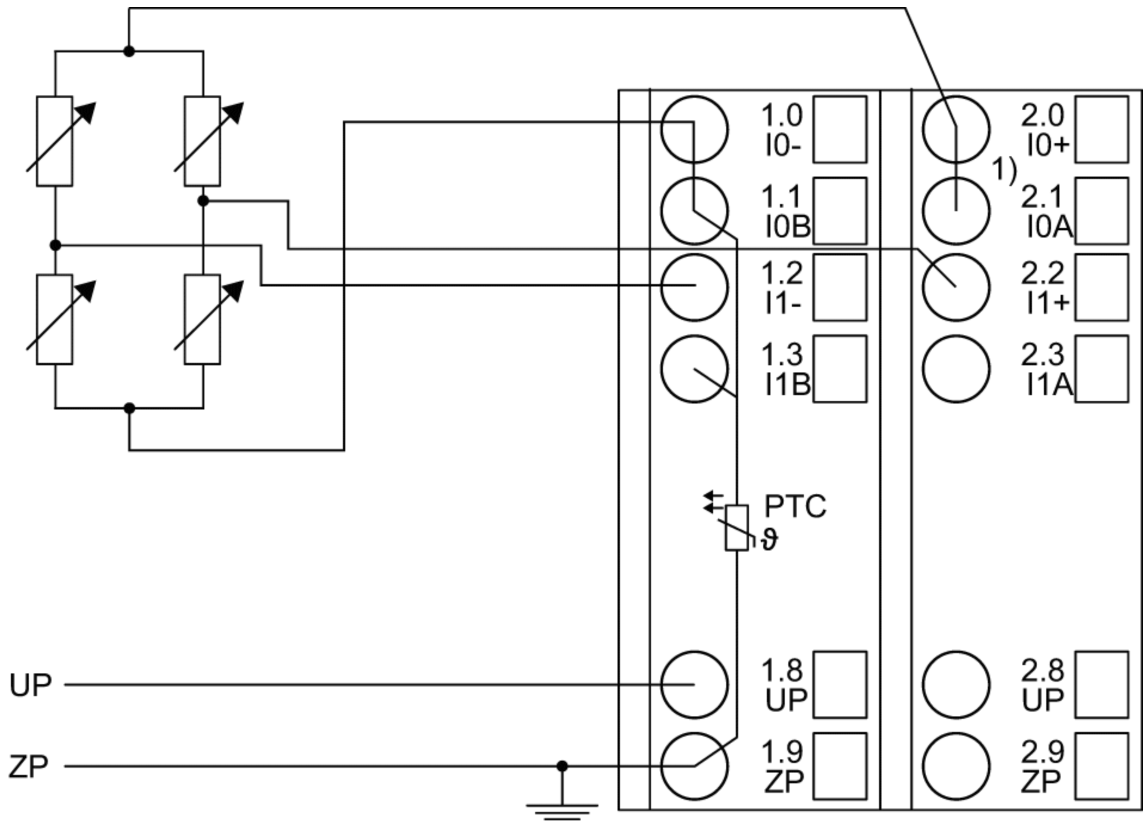


Fig. 90: Connection example

1 Internal supply

All voltage measuring ranges can be configured ✎ *Chapter 5.4.3.2.3.6 "Parameterization" on page 611*.

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

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.

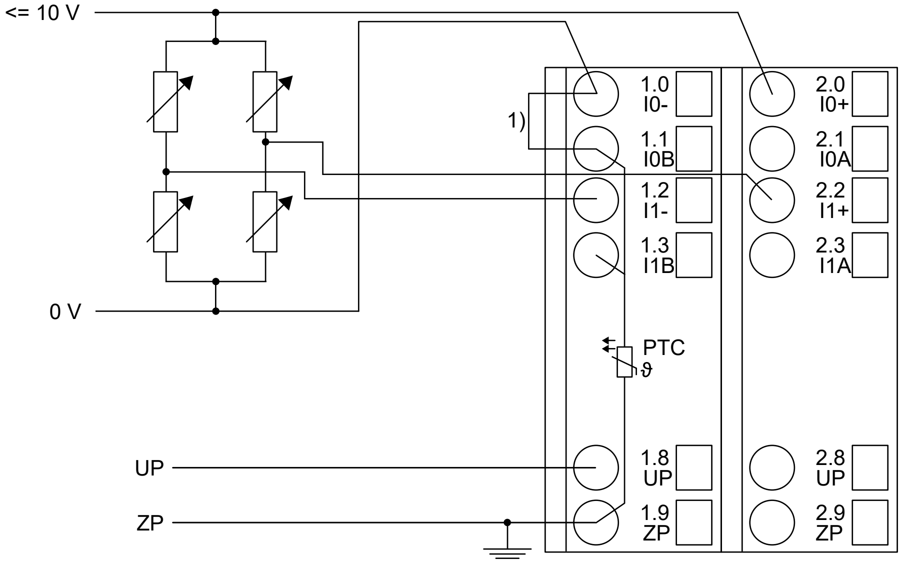


Fig. 91: Connection example

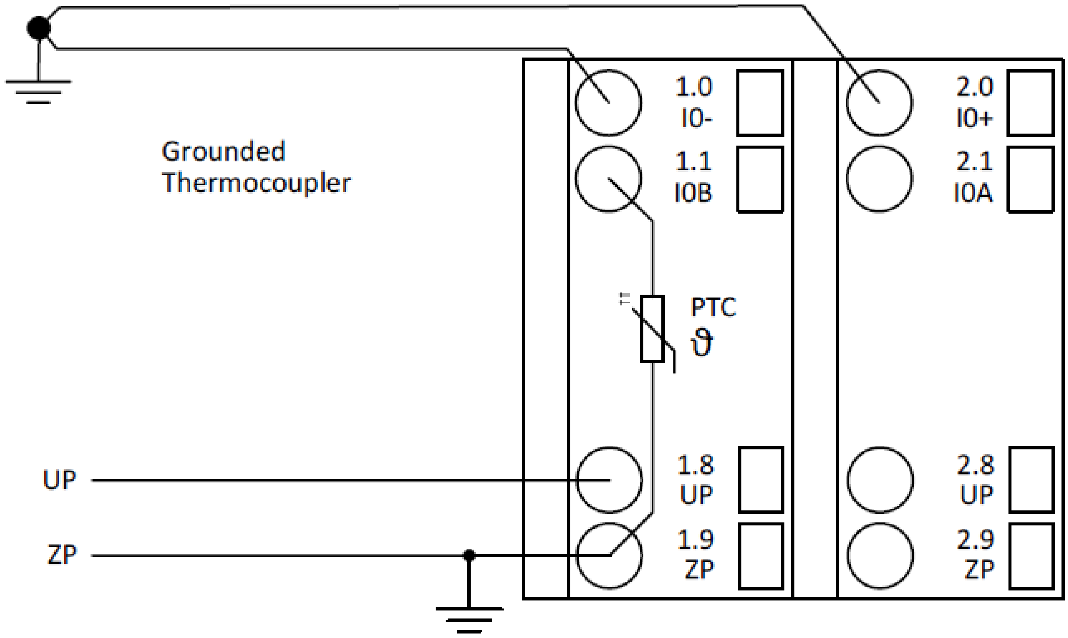
1 Bridge to IxB necessary with galvanically isolated supply

All voltage measuring ranges can be configured ⇘ *Chapter 5.4.3.2.3.6 “Parameterization” on page 611* .

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

The calculation of the resistor deviation must be performed via the bridge voltage by the PLC user program.

Connection of thermocouples



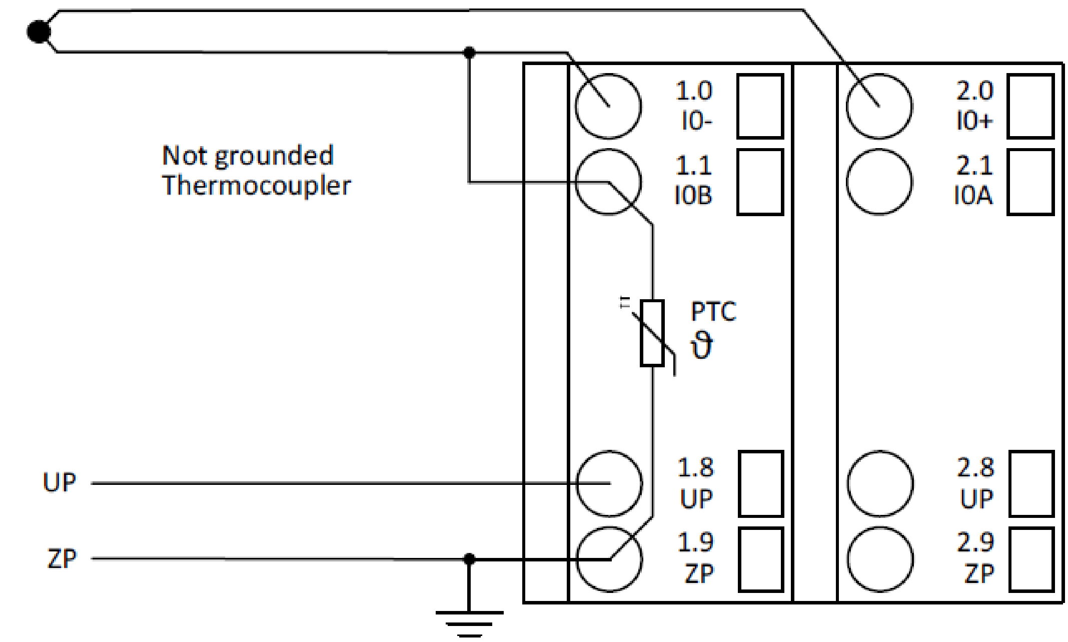


Fig. 92: Connection example

The following measuring ranges can be configured *Chapter 5.4.3.2.3.6 “Parameterization” on page 611* :

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

For a description of the function of the LEDs, please refer to diagnosis and displays/displays *Chapter 5.4.3.2.3.7 “Diagnosis” on page 615*.

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.
Refer to 'Channel configuration' for possible settings *Chapter 5.4.3.2.3.6 “Parameterization” on page 611*.

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

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	see table 'Channel configuration' *Table 156 "Channel configuration" on page 613*	see 'Channel configuration' *Table 156 "Channel configuration" on page 613*	Byte	0 0x00	0x0Y07
2	Channel monitoring	see table 'Channel monitoring' *Table 157 "Channel monitoring" on page 614*	see 'Channel monitoring' *Table 157 "Channel monitoring" on page 614*	Byte	0 0x03	
3	Line frequency suppression	see table 'Line frequency suppression' *Further information on page 614*	see 'Line frequency suppression' *Further information on page 614*	Byte	0 0x00	
4	Compensation channel	see table 'Compensation channel' *Further information on page 614*	see table 'Compensation channel' *Further information on page 614*	Byte	0 0x00	

Table 156: 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
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

Internal value	Operating modes for the analog inputs, individually configurable
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 157: Channel monitoring

Internal value	Monitoring
0	Plausibility, open-circuit (wire break) and short circuit (default)
3	No monitoring

Table 158: Line frequency suppression

Internal value	Line frequency suppression
0	50 Hz
1	60 Hz
2	No line frequency suppression

Table 159: 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				
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 dif-ference; install equalizing conductors if neces-sary
	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				

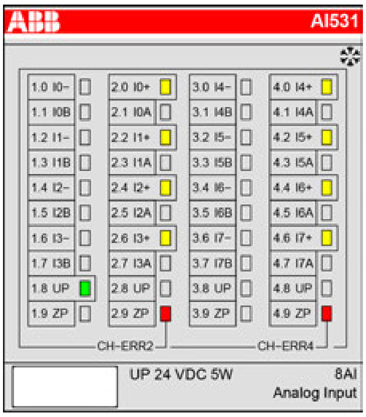
Remarks:

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):

<table>
<tr><th colspan="2">LED</th><th>State</th><th>Color</th><th>LED = OFF</th><th>LED = ON</th><th>LED flashes</th></tr>
<tr><td rowspan="6">
</td><td>Inputs I0 ... I3 and I4 ... I7</td><td>Analog input</td><td>Yellow</td><td>Input is OFF</td><td>Input is ON (brightness depends on the value of the analog signal)</td><td>--</td></tr>
<tr><td>UP</td><td>Process voltage 24 V DC via ter-minal</td><td>Green</td><td>Process voltage is missing</td><td>Process voltage OK</td><td>--</td></tr>
<tr><td>CH-ERR2</td><td rowspan="2">Channel error, mes-sages in groups (analog inputs com-bined into the groups 2 and 4)</td><td>Red</td><td rowspan="2">No error, or process voltage is missing</td><td rowspan="2">Severe error within the cor-responding group</td><td rowspan="2">Error on one channel of the group</td></tr>
<tr><td>CH-ERR4</td><td>Red</td></tr>
<tr><td>CH-ERR *)</td><td>Module error</td><td>Red</td><td>--</td><td>Internal error</td><td>--</td></tr>
<tr><td colspan="6">*) Both LEDs CH-ERR2 and CH-ERR4 light up together</td></tr>
</table>

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.
Over-flow	> 58.7945	> 587.9449	> 1.17589	> 5.8794	> 11.7589	> 20.0000	32767	7FFF
Meas-ured 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 Meas- ured 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
Meas- ured 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
Under- flow	< -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

The system data of AC500 and S500 are applicable to the standard version ↯ *Chapter 4.2 “System data AC500” on page 30.*

The system data of AC500-XC are applicable to the XC version *Chapter 4.3 “System data AC500-XC” on page 35*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Technical data of the module

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 or vertical 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	2 groups of 4 channels each

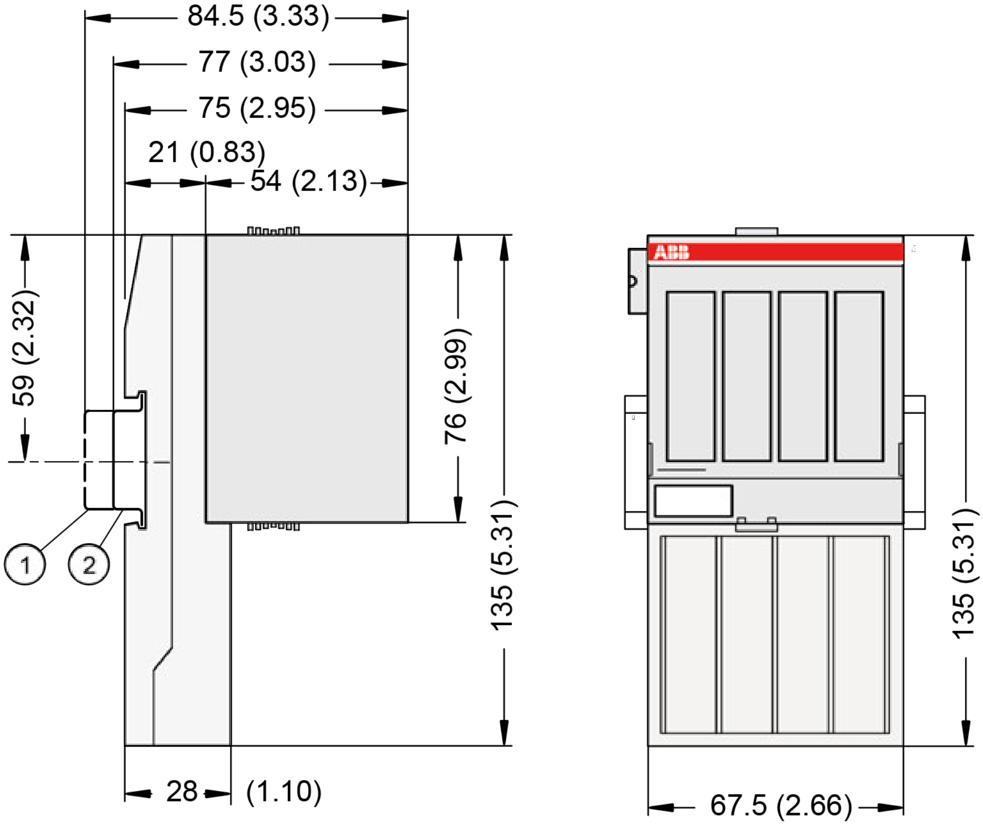
Parameter	Value	
Connections of the channels I0 ... I3	Terminals 1.0 ... 1.7 and terminals 2.0 ... 2.7	
Connections of the channels I4 ... I7	Terminals 3.0 ... 3.7 and terminals 4.0 ... 4.7	
Input type	Bipolar (not with current or Pt100/ Pt1000/ Ni1000/ Cu50/ resistor)	
Galvanic isolation	Against internal 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 157 “Channel monitoring” on page 614*
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		2 groups of 4 channels each
Connections of the channels I0+ to I3+ Connections of the channels I4+ to I7+		Terminals 2.0, 2.2, 2.4, 2.6 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.

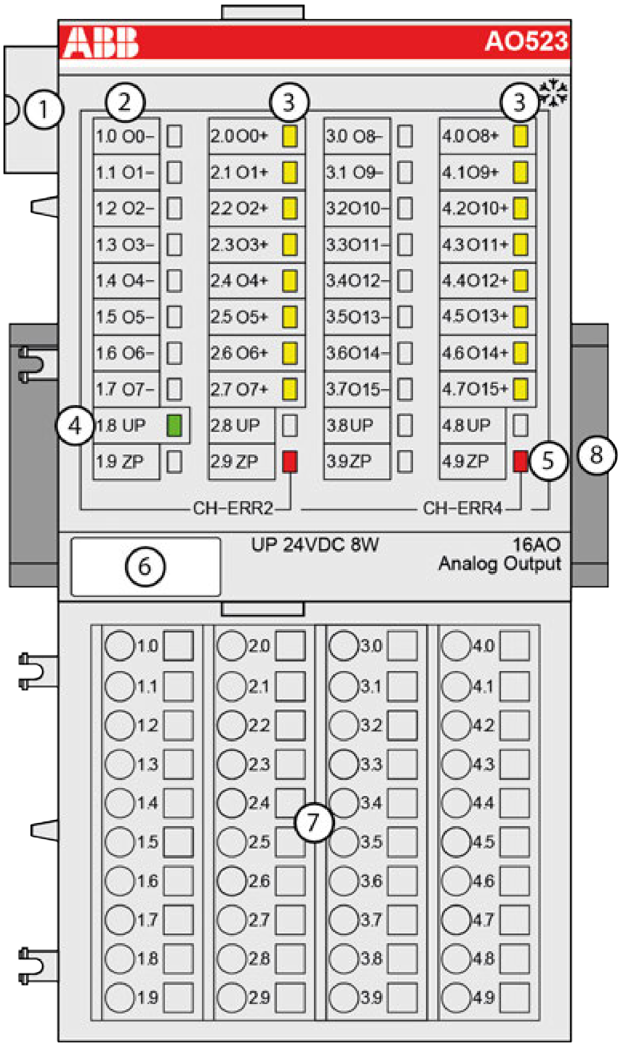
Ordering data

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.*

5.4.3.2.4 AO523 - Analog output module

- 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 outputs (O0 ... O15)
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 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

Parameter	Value
Resolution of the analog channels	
Voltage -10 V ... +10 V	12 bits including sign
Current 0 mA ... 20 mA, 4 mA ... 20 mA	12 bits
LED displays	19 LEDs for signals and error messages
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 ➥ *Chapter 5.5.1 “TU515, TU516, TU541 and TU542 for I/O modules” on page 801*

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 ➥ *Chapter 5.5.1 “TU515, TU516, TU541 and TU542 for I/O modules” on page 801*. 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 5.8.2.5 “TA526 - Wall mounting accessory” on page 1183*.

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 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 DC

The assignment of the other terminals:

Terminals	Signal	Description
1.0 ... 1.7	O0- ... O7-	Negative poles of the first 8 analog outputs
2.0 ... 2.7	O0+ ... O7+	Positive poles of the first 8 analog outputs

Terminals	Signal	Description
3.0 ... 3.7	O8- ... O15-	Negative poles of the following 8 analog outputs
4.0 ... 4.7	O8+ ... O15+	Positive poles of the following 8 analog outputs

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 AO523.

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 10

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 you

– 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 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.

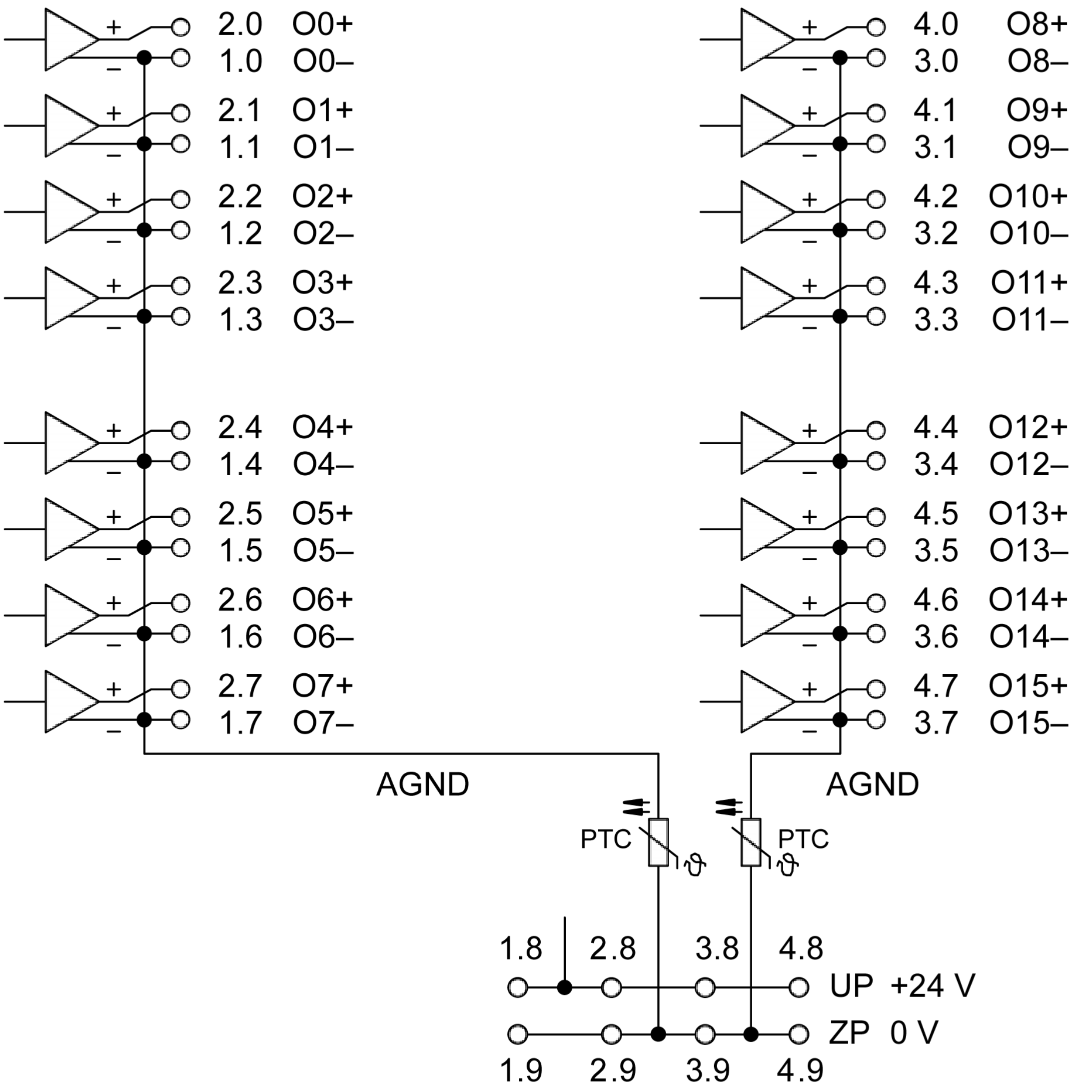


Fig. 93: Connection of the module: 16 analog outputs in two groups *↯ Chapter 5.4.3.2.4.2 "Functionality" on page 627*

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 5.4.3.2.4.7 “Diagnosis” on page 637*.

Connection of analog output loads (Voltage, current)

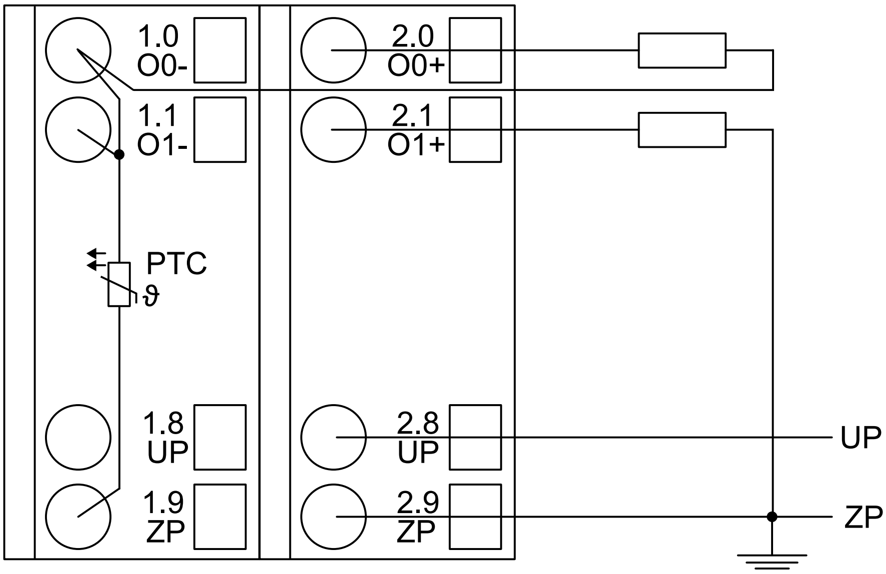


Fig. 94: Connection example

The following measuring ranges can be configured ↻ *Chapter 5.4.3.2.4.6 “Parameterization” on page 632*:

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 ... 20 mA	Load 0 Ω ... 500 Ω	1 channel used

Only the channels 0 ... 3 and 8 ... 11 can be configured as current output (0 mA ... 20 mA or 4 mA ... 20 mA).

The function of the LEDs is described under Displays.

Unused analog outputs can be left open-circuited.

Internal data exchange

Digital inputs (bytes)	0
Digital outputs (bytes)	0
Counter input data (words)	0
Counter output data (words)	16

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	1510 [1])	Word	1510 0x05e6	0	65535	0x0Y01
2	Ignore module [2])	No Yes	0 1	Byte	No 0x00			Not for FBP
3	Param-eter length in bytes	Internal	39	Byte	39-CPU 39-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	Behav-iour of outputs at com-munica-tion errors	Off Last value Substi-tute value	0 1+(n*5) 2+(n*5), n ≤ 2	Byte	Off 0x00	0	2	0x0Y05
7	Channel con-figura tion Output channel 0	See table 'Channel configuration' *Table 160 “Chan nel configuration [3])” on page 636*		Byte	Default 0x00	0	130	0x0Y06
8	Channel moni-toring Output channel 0	See table 'Channel monitoring' *Table 161 “Chan nel monitoring [4])” on page 636*		Byte	Default 0x00	0	3	0x0Y07
9	Substi-tute value Output channel 0	Output channel 0!	0 ... 0xffff	Word	Default 0x0000	0	65535	0x0Y08

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
10 ... 15	Channel configuration and channel monitoring of the output channels 1 to 3	See table 'Channel configuration' ⇨ *Table 160 “Channel configuration 3)” on page 636* and table 'Channel monitoring' ⇨ *Table 161 “Channel monitoring 4)” on page 636*		Byte Byte	Default 0x00 0x00	0 0	130 3	0x0Y09 to 0x0Y0E
16 ... 23	Channel configuration and channel monitoring of the output channels 4 to 7	See table 'Channel configuration' ⇨ *Table 160 “Channel configuration 3)” on page 636* and table 'Channel monitoring' ⇨ *Table 161 “Channel monitoring 4)” on page 636*		Byte Byte	Default 0x00 0x00	0 0	128 3	0x0Y0F to 0x0Y16
24	Channel configuration Output channel 8	See table 'Channel configuration' ⇨ *Table 160 “Channel configuration 3)” on page 636*		Byte	Default 0x00	0	130	0x0Y17
25	Channel monitoring Output channel 8	See table 'Channel monitoring' ⇨ *Table 161 “Channel monitoring 4)” on page 636*		Byte	Default 0x00	0	3	0x0Y18
26	Substitute value Output channel 8	Output channel 8!	0 ... 0xffff	Word	Default 0x0000	0	65535	0x0Y19

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
27 ... 32	Channel configuration and channel monitoring of the output channels 9 to 11	See table 'Channel configuration' *Table 160 "Channel configuration [3])" on page 636* and table 'Channel moitoring' *Table 161 "Channel monitoring [4])" on page 636*		Byte Byte	Default 0x00 0x00	0 0	130 3	0x0Y1A to 0x0Y1F
33 ... 40	Channel configuration and channel monitoring of the output channels 12 to 15	See table 'Channel configuration' *Table 160 "Channel configuration [3])" on page 636* and table 'Channel monitoring' *Table 161 "Channel monitoring [4])" on page 636*		Byte Byte	Default 0x00 0x00	0 0	128 3	0x0Y20 to 0x0Y27
[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 =	42
Ext_User_Prm_Data_Const(0) =	0x05, 0xe7, 0x27, \
	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, 0x00, 0x00;

Output channels 0 and 8 (2 channels, AO523)

No.	Name	Value	Internal value	Internal value, type	Default
1	Channel configuration	see below table 'Channel configuration' *Table 160 " Channel configuration 3)" on page 636*	see below table 'Channel configuration' *Table 160 " Channel configuration 3)" on page 636*	Byte	see below table 'Channel configuration' *Table 160 " Channel configuration 3)" on page 636*
2	Channel monitoring	see below table 'Channel monitoring' *Table 161 " Channel monitoring 4)" on page 636*	see below table 'Channel monitoring' *Table 161 " Channel monitoring 4)" on page 636** 8)	Byte	see below table 'Channel monitoring' *Table 161 " Channel monitoring 4)" on page 636*
3	Substitute value *Table 162 " Substitute value" on page 637*	0 ... 65535	0 ... 0xffff	Word	0

Output channels 1 ... 7 and 9 ... 15 (14 channels, AO523)

No.	Name	Internal value, type
1	Channel configuration see table 3)	Byte
2	Channel monitoring see table 4)	Byte

Table 160: Channel configuration 3)

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 161: Channel monitoring 4)

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 162: Substitute value

Intended behavior of channel 0 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 163: 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		

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				
3	14	1 ... 10	31	31	26	Parameter error	Check master

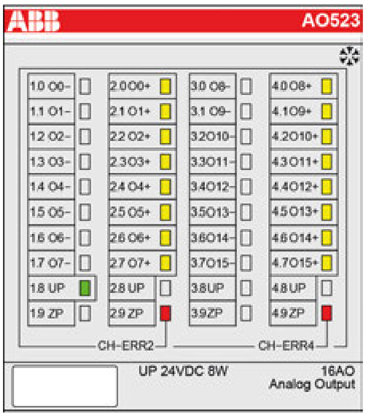
E1 ... E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500 display	<− Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**FBP diag-nosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**			
	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	3	0 ... 15	48	Analog value overflow at an analog output	Check output value
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	3	0 ... 15	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 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 (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
	Outputs O0 ... O7 and O8 ... O15	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 cor- responding 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					

Output ranges

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	> 11.7589 V	> 23.5178 mA	> 22.8142 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

Range	-10 V ... +10 V	0 mA ... 20 mA	4 mA ... 20 mA	Digital value	
				Decimal	Hex.
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

The system data of AC500 and S500 are applicable to the standard version *Chapter 4.2 “System data AC500” on page 30*.

The system data of AC500-XC are applicable to the XC version *Chapter 4.3 “System data AC500-XC” on page 35*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Technical data of the module

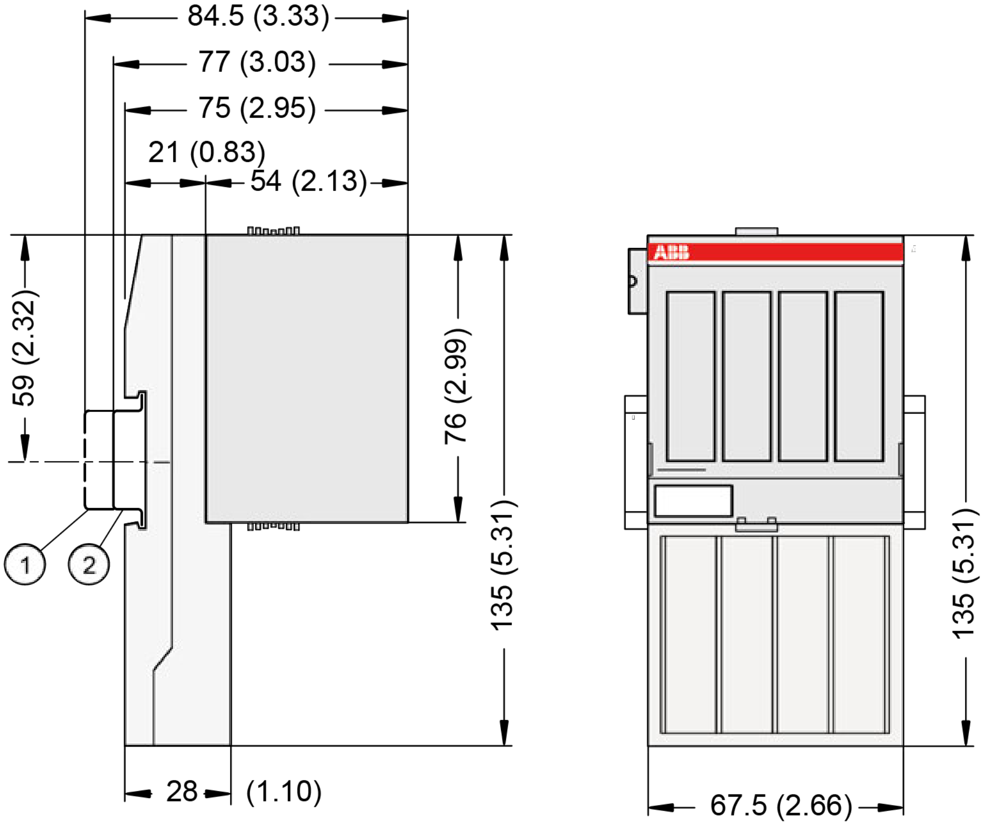
Parameter		Value
Process voltage		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 V DC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current 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 at normal operation	0.15 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 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.

Technical data of the analog outputs

Parameter	Value
Number of channels per module	16, of which channnels O0 ... O3 and O8 ... O11 for voltage and current, and channels O4 ... 7 and O12 ... 15 only for voltage
Distribution of channels into groups	2 groups of 8 channels each
Channels O0- ... O7-	Terminals 1.0 ... 1.7
Channels O0+ ... O7+	Terminals 2.0 ... 2.7
Channels O8- ... O15-	Terminals 3.0 ... 3.7
Channels O8+ ... O15+	Terminals 4.0 ... 4.7
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 and 8 ... 11
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	*Chapter 5.4.3.2.4.9 “Output ranges” on page 639*
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.

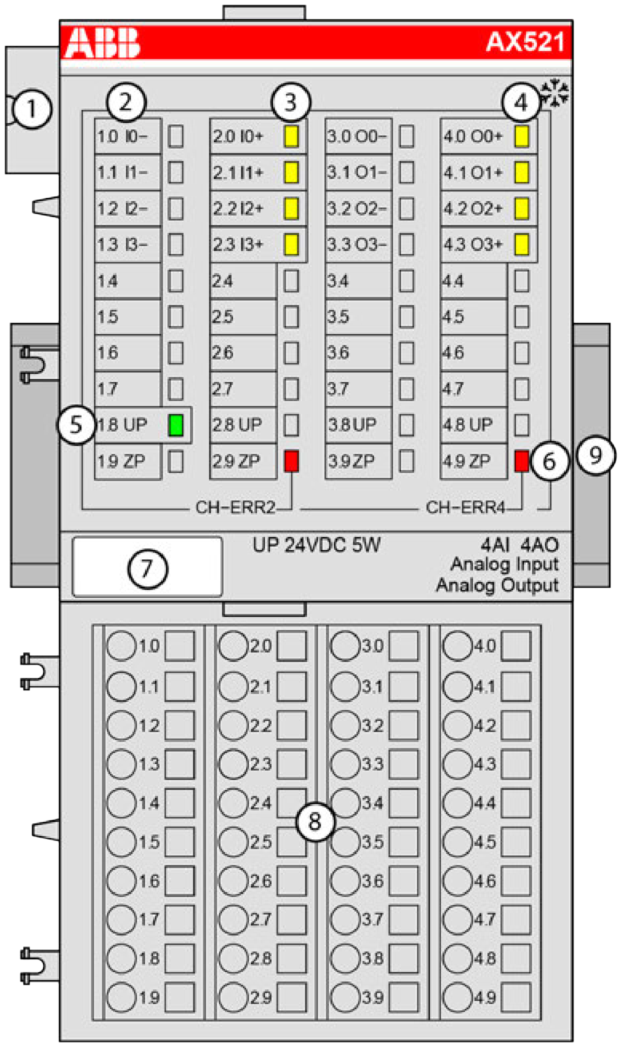
Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 250 200 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.*

5.4.3.2.5 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 for

- 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 for

- 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 ⇘ *Chapter 5.5.1 “TU515, TU516, TU541 and TU542 for I/O modules” on page 801*

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 ↪ *Chapter 5.5.1 “TU515, TU516, TU541 and TU542 for I/O modules” on page 801*. 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 5.8.2.5 “TA526 - Wall mounting accessory” on page 1183*.

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 164: 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 10

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 you

– 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 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.

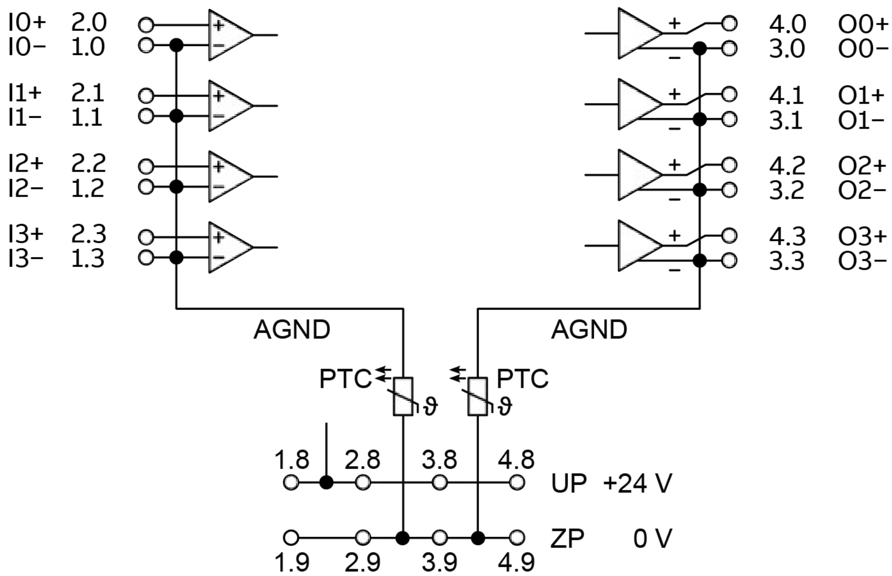


Fig. 95: Connection of the I/O module: 4 analog inputs and 4 analog outputs, individually configurable ↳ Chapter 5.4.3.2.5.2 "Functionality" on page 644

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.

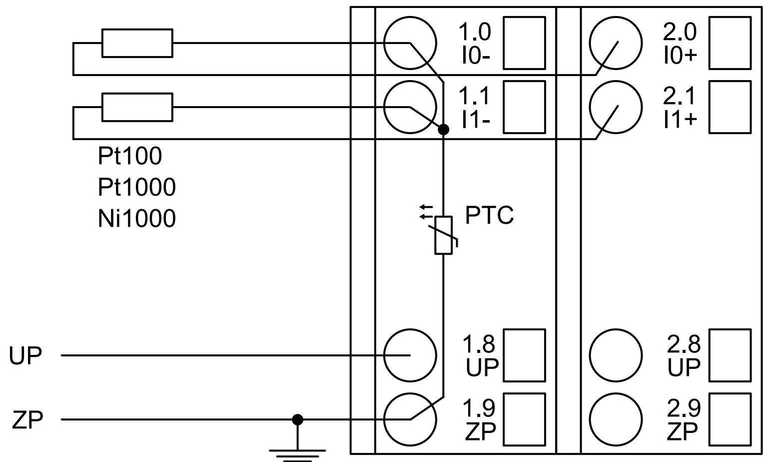


Fig. 96: Connection example

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.

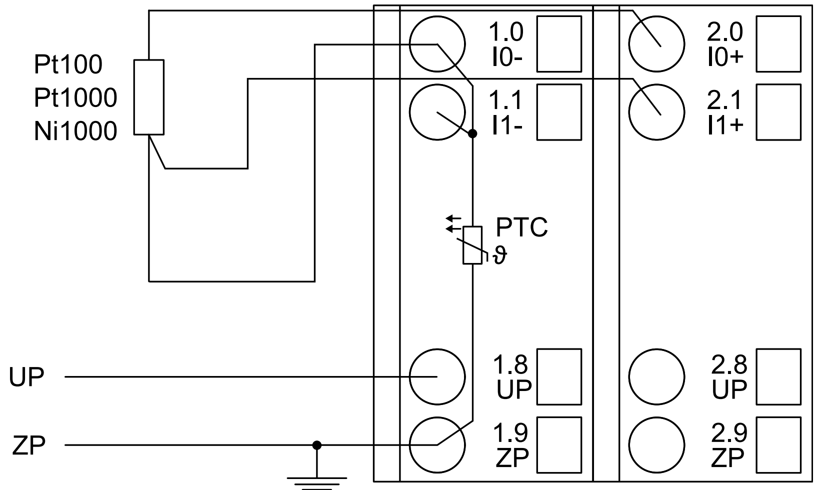


Fig. 97: Connection example

> *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

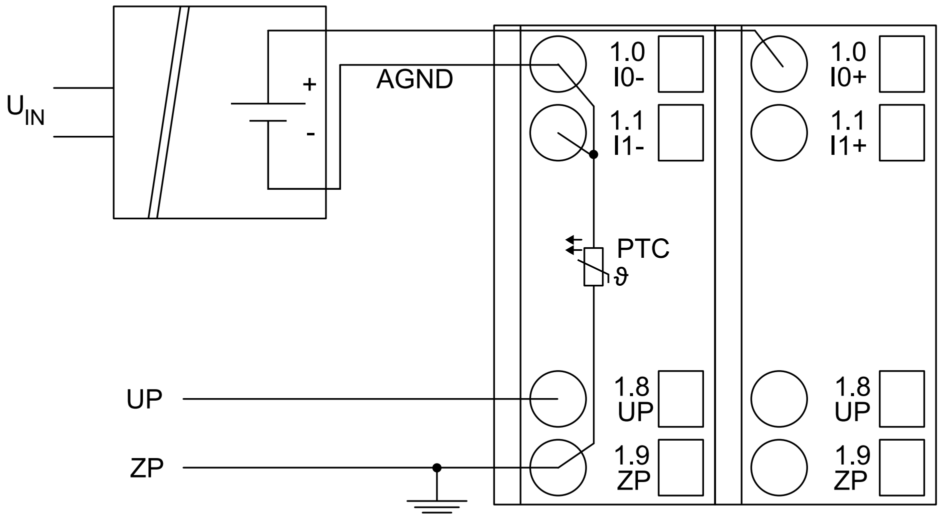


Fig. 98: Connection example

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 5.4.3.2.5.6 "Parameterization" on page 659* and for AX522 *Chapter 5.4.3.2.6.6 "Parameterization" on page 689*:

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

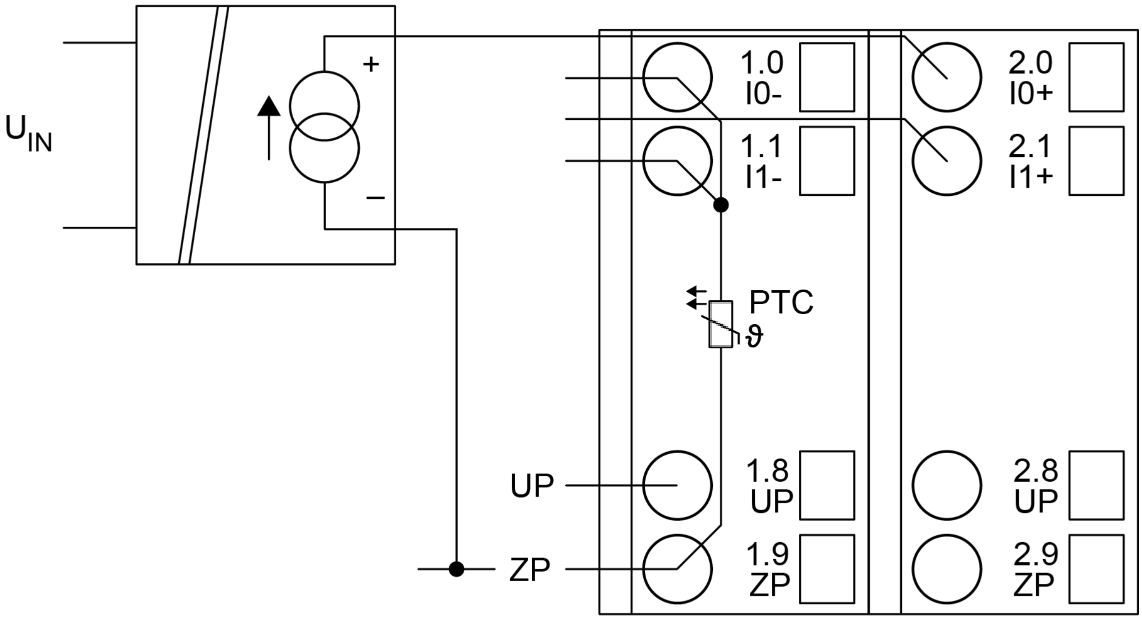


Fig. 99: Connection example

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

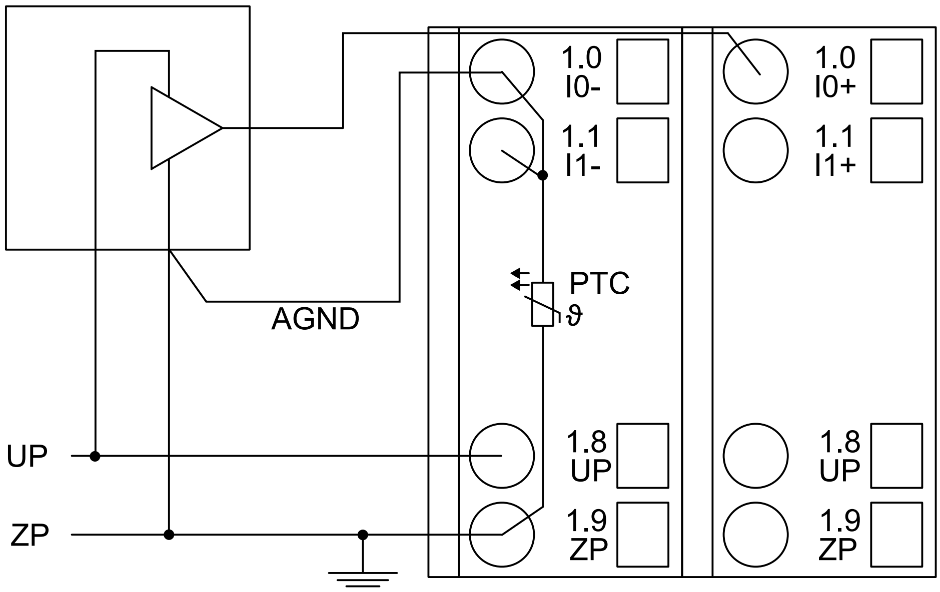


Fig. 100: Connection example

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

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)

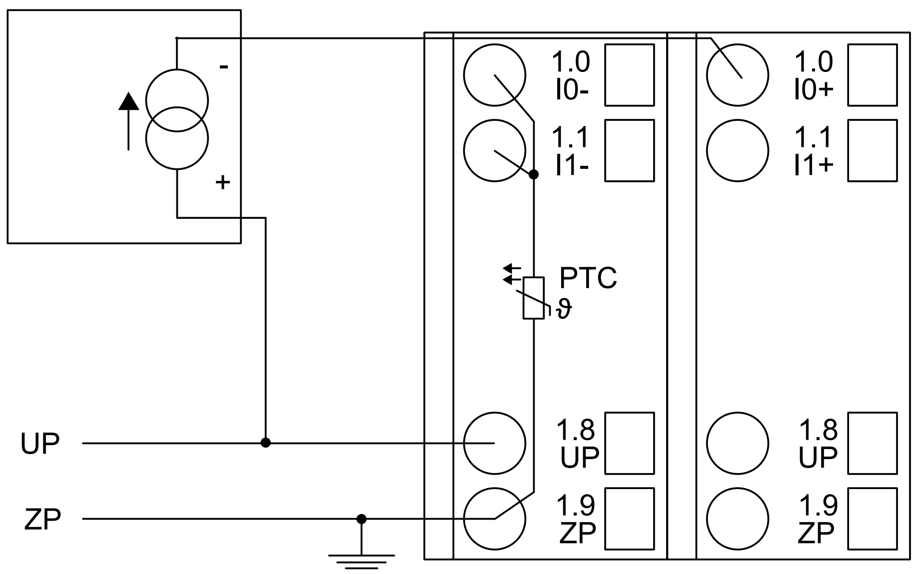


Fig. 101: Connection example

Current	4 mA ... 20 mA	1 channel used

CAUTION!
If, during initialization, an analog current sensor supplies more than 25 mA for more than 1 second to an analog input, this input is switched off by the module (input protection). In such cases, it is recommended to protect the analog input by a 10-volt Zener diode (in parallel to I+ and ZP). But, in general, sensors with fast initialization or without current peaks higher than 25 mA are preferrable.

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!
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). Otherwise, problems may occur concerning the common-mode input voltages of the involved analog inputs.

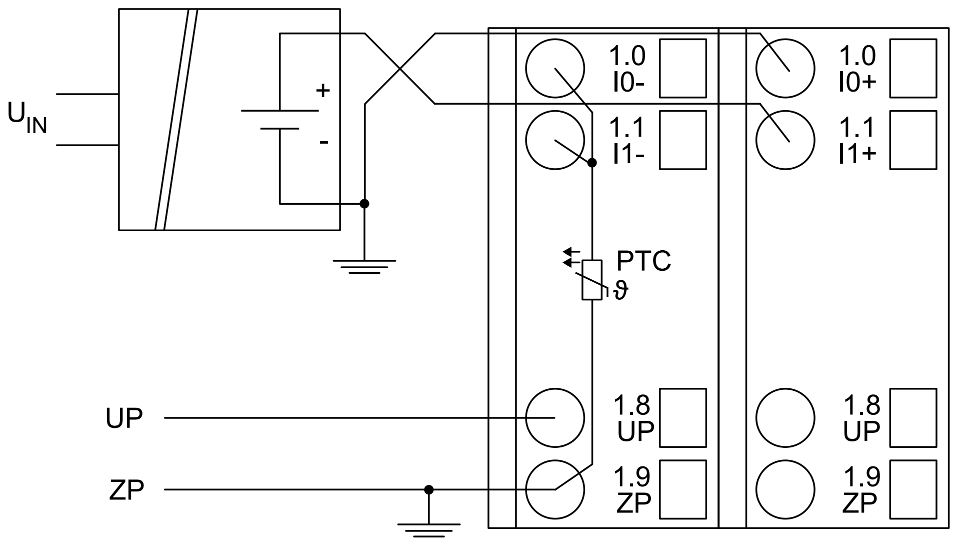


Fig. 102: Connection example

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.

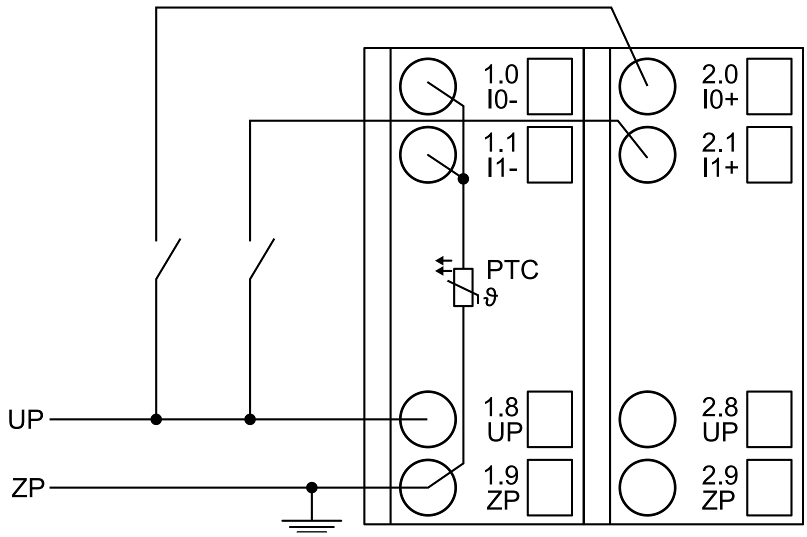


Fig. 103: Connection example

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)

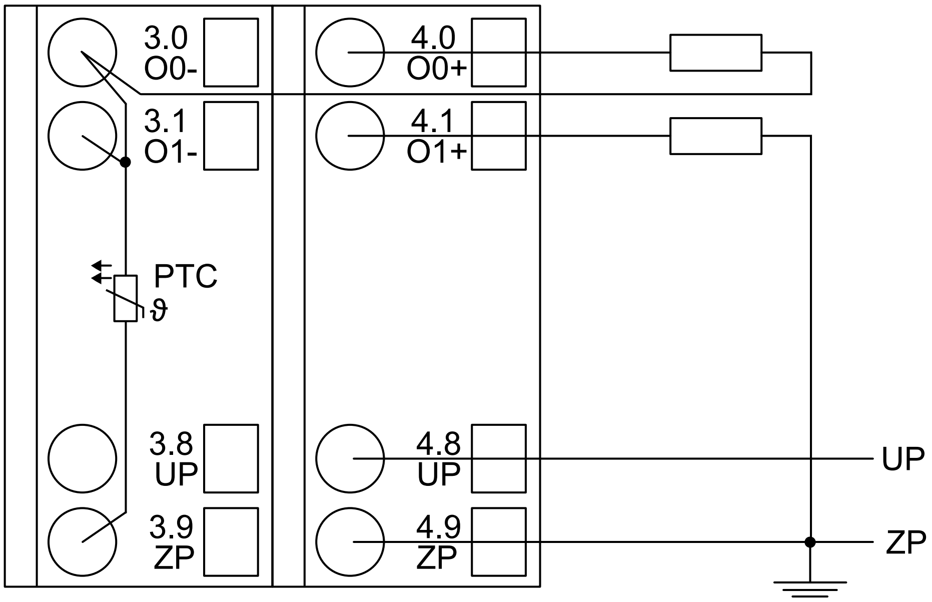


Fig. 104: Connection example

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

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
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 166 "Channel configuration 2)" on page 662*		Byte	Default 0x00	0	19	0x0Y06
8	Channel monitoring Input channel 0	See table 'Channel monitoring' *Table 167 "Channel monitoring 3)" on page 662*		Byte	Default 0x00	0	3	0x0Y07
9 to 14	Channel configuration and channel monitoring of the input channels 1 to 3	See tables 'Channel configuration' *Table 166 "Channel configuration 2)" on page 662* and 'Channel monitoring' *Table 167 "Channel monitoring 3)" on page 662*		Byte Byte	Default 0x00 0x00	0 0	19 3	0x0Y08 to 0x0Y0D
15	Channel configuration Output channel 0	See table 'Channel configuration' *Table 166 "Channel configuration 2)" on page 662*		Byte	Default 0x00	0	130	0x0Y0E
16	Channel monitoring Output channel 0	See table 'Channel monitoring' *Table 167 "Channel monitoring 3)" on page 662*		Byte	Default 0x00	0	3	0x0Y0F

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
17	Substi-tute value Output channel 0	only valid for output channel 0	0 ... 0xffff	Word	Default 0x0000	0	65535	0x0Y10
18 to 21	Channel configu-ration and channel moni-toring of the output channels 1 to 2	See tables 'Channel configura-tion' *Table 166 “Chan nel configuration 2)” on page 662* and 'Channel monitor-ing' *Table 167 “Chan nel monitoring 3)” on page 662*		Byte Byte	Default 0x00 0x00	0 0	130 3	0x0Y11 to 0x0Y14
22	Channel configu-ration Output channel 3	See table 'Channel monitoring' *Table 166 “Chan nel configuration 2)” on page 662*		Byte	Default 0x00	0	130	0x0Y15
23	Channel moni-toring Output channel 3	See table 'Channel monitoring' *Table 167 “Chan nel monitoring 3)” on page 662*		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 165: 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 166: 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 167: Channel monitoring ^{3})

Internal value	Monitoring
0	Plausibility, open-circuit (broken wire) and short circuit
3	No monitoring

Table 168: 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 169: 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 170: 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 171: Channel monitoring 5)

Internal value	Monitoring
0	Plausibility, open circuit (broken wire) and short circuit (default)
3	No monitoring

Table 172: 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

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"
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 173: Possible diagnosis of I/O channels

<table>
<tr><th rowspan="2">Output range</th><th colspan="2">Condition</th></tr>
<tr><th>Output value in the PLC underflow</th><th>Output value in the PLC overflow</th></tr>
<tr><td>0 mA ... 20 mA</td><td rowspan="3">Error identifier = 7</td><td rowspan="3">Error identifier = 4</td></tr>
<tr><td>4 mA ... 20 mA</td></tr>
<tr><td>-10 V ... +10 V</td></tr>
</table>

<table>
<tr><th rowspan="2">Input range</th><th colspan="4">Condition</th></tr>
<tr><th>Short circuit</th><th>Wire break</th><th>Input value underflow</th><th>Input value overflow</th></tr>
<tr><td>0 mA ... 20 mA</td><td>no diagnosis possible</td><td>no diagnosis possible</td><td>no diagnosis possible</td><td>Error identifier = 48</td></tr>
<tr><td>4 mA ... 20 mA</td><td>Error identifier = 7</td><td>Error identifier = 7</td><td>Error identifier = 7</td><td>Error identifier = 48</td></tr>
<tr><td>-10 V ... +10 V</td><td>no diagnosis possible</td><td>Error identifier = 48</td><td>Error identifier = 7</td><td>Error identifier = 48</td></tr>
</table>

Table 174: Content of diagnosis messages

<table>
<tr><th>E1 ... E4</th><th>d1</th><th>d2</th><th>d3</th><th>d4</th><th>Identifier
000 ... 063</th><th>AC500 display</th><th rowspan="3" colspan="2"><− Display in</th></tr>
<tr><th>Class</th><th>Comp</th><th>Dev</th><th>Mod</th><th>Ch</th><th>Err</th><th>PS501 PLC browser</th></tr>
<tr><th>Byte 6
Bit 6 ... 7</th><th>-</th><th>Byte 3</th><th>Byte 4</th><th>Byte 5</th><th>Byte 6
Bit 0 ... 5</th><th>FBP diagnosis block</th></tr>
<tr><th>Class</th><th>Interface</th><th>Device</th><th>Module</th><th>Channel</th><th>Error Identifier</th><th colspan="2">Error message</th><th>Remedy</th></tr>
<tr><td></td><td>1)</td><td>2)</td><td>3)</td><td>4)</td><td></td><td colspan="2"></td><td></td></tr>
<tr><td colspan="9">Module error</td></tr>
<tr><td rowspan="2">3</td><td>14</td><td>1 ... 10</td><td>31</td><td rowspan="2">31</td><td rowspan="2">19</td><td rowspan="2" colspan="2">Checksum error in the I/O module</td><td rowspan="2">Replace I/O module</td></tr>
<tr><td>11 / 12</td><td>ADR</td><td>1 ... 10</td></tr>
<tr><td rowspan="2">3</td><td>14</td><td>1 ... 10</td><td>31</td><td rowspan="2">31</td><td rowspan="2">3</td><td rowspan="2" colspan="2">Timeout in the I/O module</td><td rowspan="2">Replace I/O module</td></tr>
<tr><td>11 / 12</td><td>ADR</td><td>1 ... 10</td></tr>
</table>

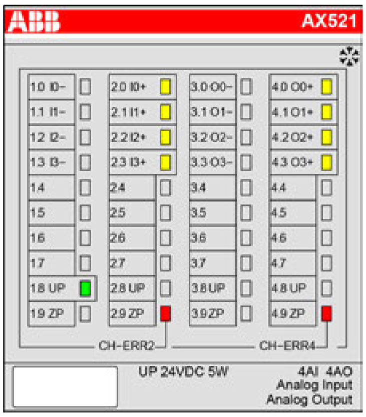
E1 ... E4	d1	d2	d3	d4		Identifier 000 ... 063	AC500 display	<− Display in
Class	Comp	Dev	Mod	Ch		Err	PS501 PLC browser	
Byte 6 Bit 6 ... 7	-	Byte 3	Byte 4	Byte 5		Byte 6 Bit 0 ... 5	FBP diagnosis block	
Class	Interface	Device	Module	Channel		Error Identifier	Error message	Remedy
	1)	2)	3)	4)				
3	14	1 ... 10	31	31		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								
				AX521	AX522			
4	14	1 ... 10	1	0 ... 3	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...3	0 ... 7	7	Analog value underflow 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 overflow at an analog output	Check output value
	11 / 12	ADR	1 ... 10					
4	14	1 ... 10	3	4 ... 7	8 ... 15	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 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 ter-minal	Green	Process voltage is missing	Process voltage OK	--
	CH-ERR2	Channel error, error mes-sages in groups (analog inputs or outputs com-bined into the groups 2 and 4)	Red	No error or process voltage is missing	Severe error within the cor-responding 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
Meas-ured 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 meas-ured 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
Meas-ured value too low		-10.0004 : -11.7589				-27649 : -32512	93FF : 8100
Under-flow	<-1.7593	<-11.7589	<0.0000	<1.1858		-32768	8000

Input ranges resistance temperature detector

Range	Pt100 / Pt 1000 -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 / Pt 1000 -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

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

The system data of AC500 and S500 are applicable to the standard version *Chapter 4.2 “System data AC500” on page 30*.

The system data of AC500-XC are applicable to the XC version *Chapter 4.3 “System data AC500-XC” on page 35*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Technical data of the module

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
	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 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.

Technical data of the analog inputs

Parameter	Value
Number of channels per module	4
Distribution of channels into groups	1 group of 4 channels

Parameter	Value
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
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 5.4.3.2.5.9.2 “Input ranges resistance temperature detector” on page 667*
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

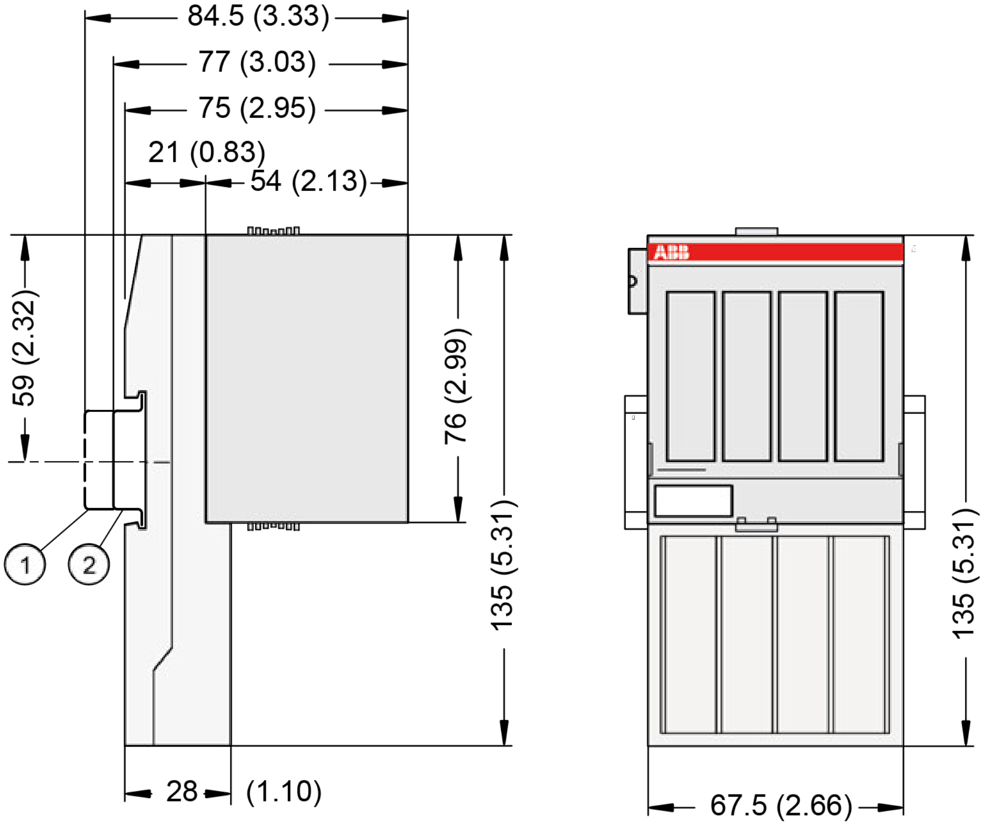
Parameter		Value
Number of channels per module		Max. 4
Distribution of channels into groups		1 group of 4 channels
Connections of the channels I0+ to I3+		Terminals 2.0 to 2.3
Reference potential for the inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (ZP)
Input signal delay		Typ. 8 ms, configurable from 0.1 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		

Parameter		Value
	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	
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.

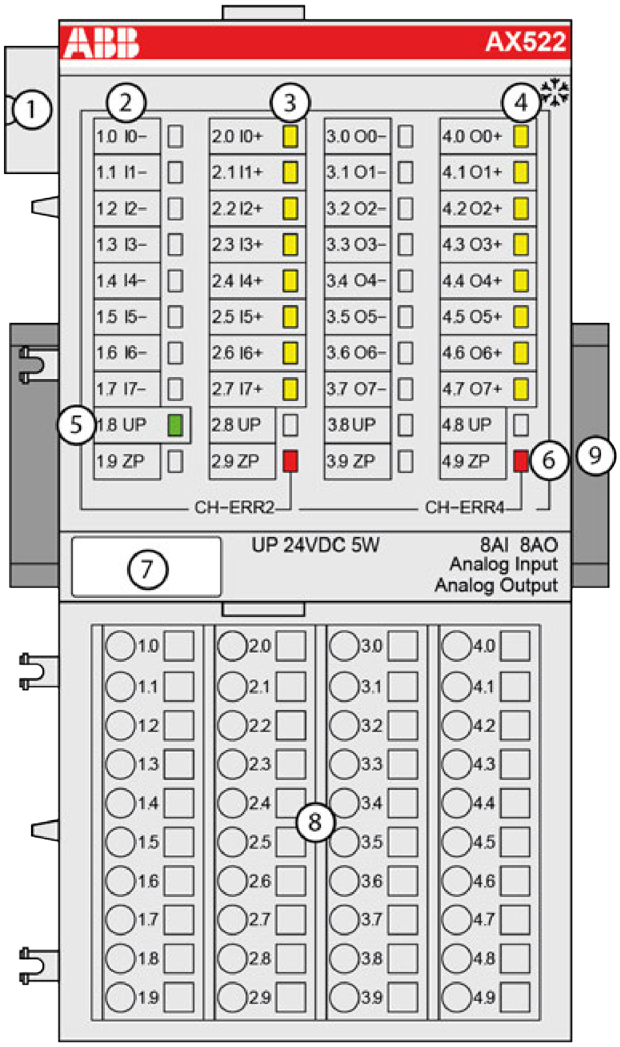
Ordering Data

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.*

5.4.3.2.6 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 for

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)

If used as outputs, the following signal ranges are individually configurable:

4 analog outputs (channel 0 ... channel 3) for

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

4 analog outputs (channel 4 ... channel 7) for

- Unused (default setting)
- -10 V ... +10 V

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 *Chapter 5.5.1 “TU515, TU516, TU541 and TU542 for I/O modules” on page 801*

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 ↬ *Chapter 5.5.1 "TU515, TU516, TU541 and TU542 for I/O modules" on page 801*. 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 5.8.2.5 "TA526 - Wall mounting accessory" on page 1183*.

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 10

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 you

– 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 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.*

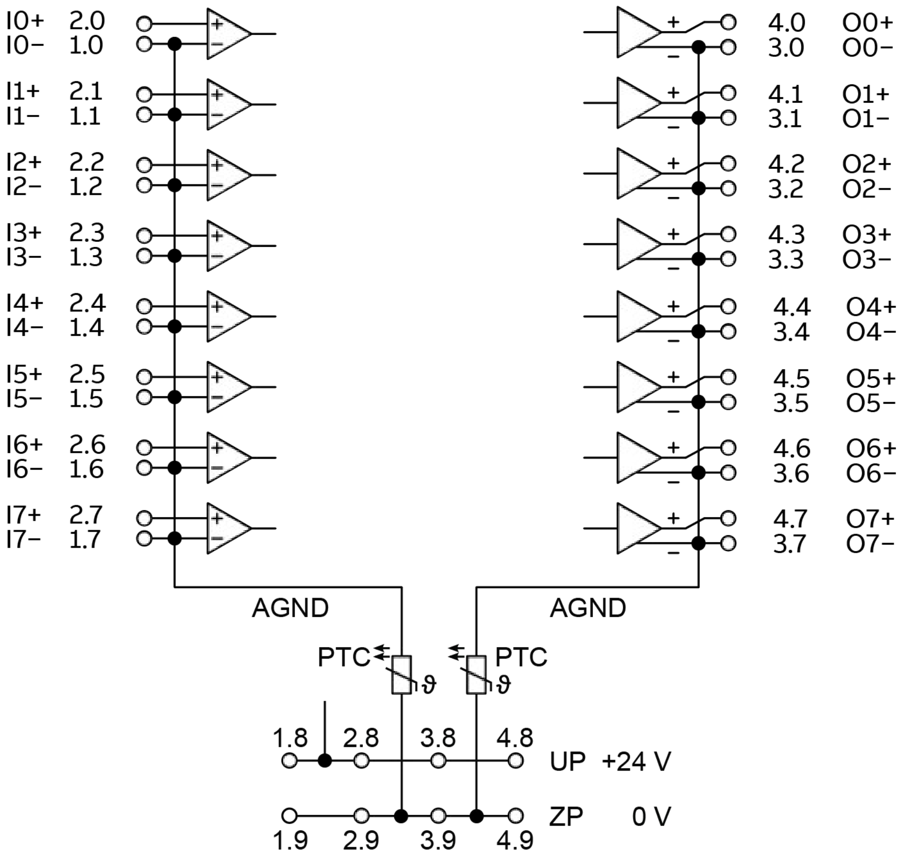


Fig. 105: Connection of the I/O module: 8 analog inputs and 8 analog outputs, individually configurable *Chapter 5.4.3.2.6.2 "Functionality" on page 674*

> **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.

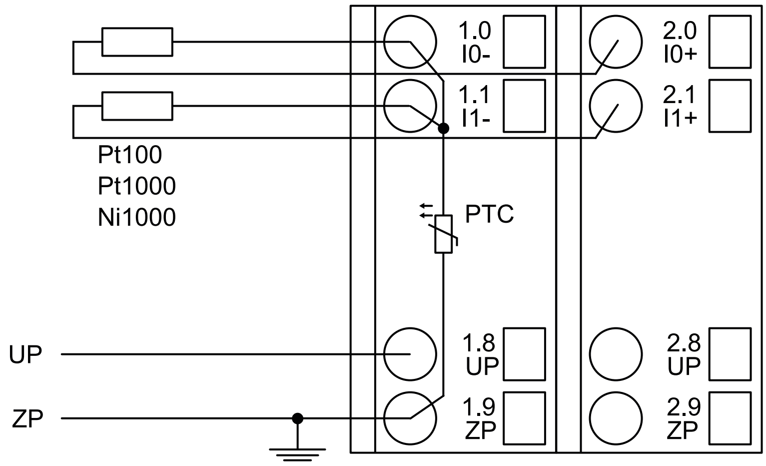


Fig. 106: Connection example

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.

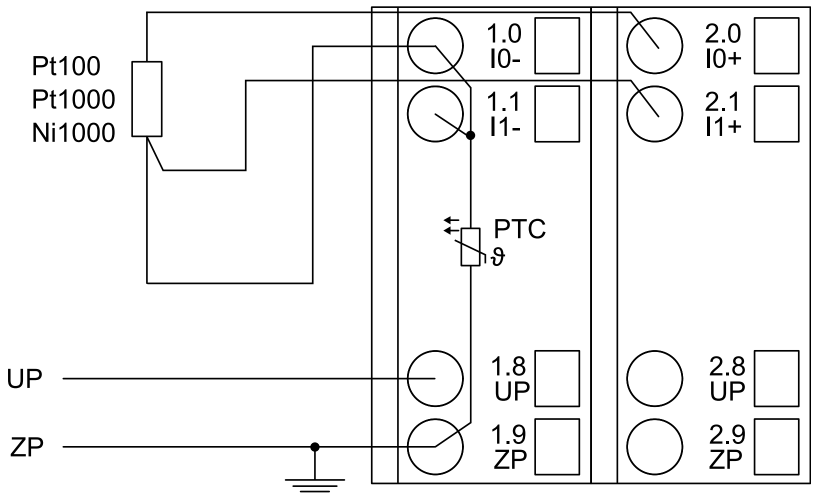


Fig. 107: Connection example

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

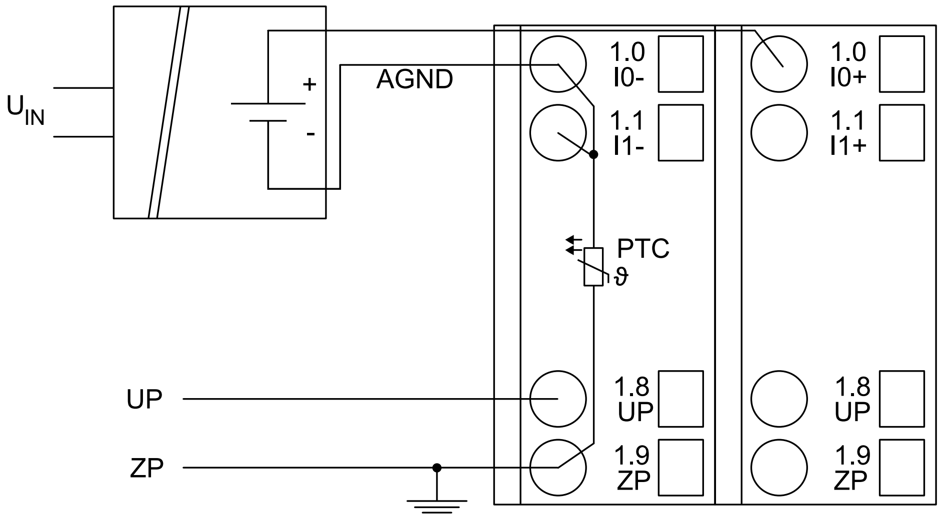


Fig. 108: Connection example

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 5.4.3.2.5.6 “Parameterization” on page 659* and for AX522 *Chapter 5.4.3.2.6.6 “Parameterization” on page 689*:

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

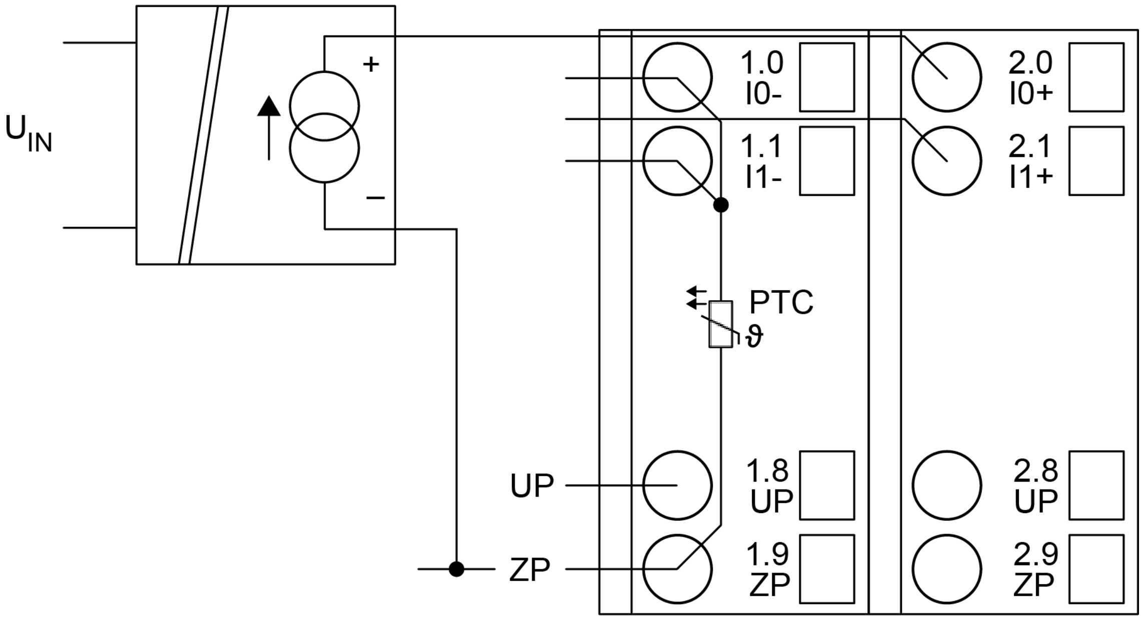


Fig. 109: Connection example

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

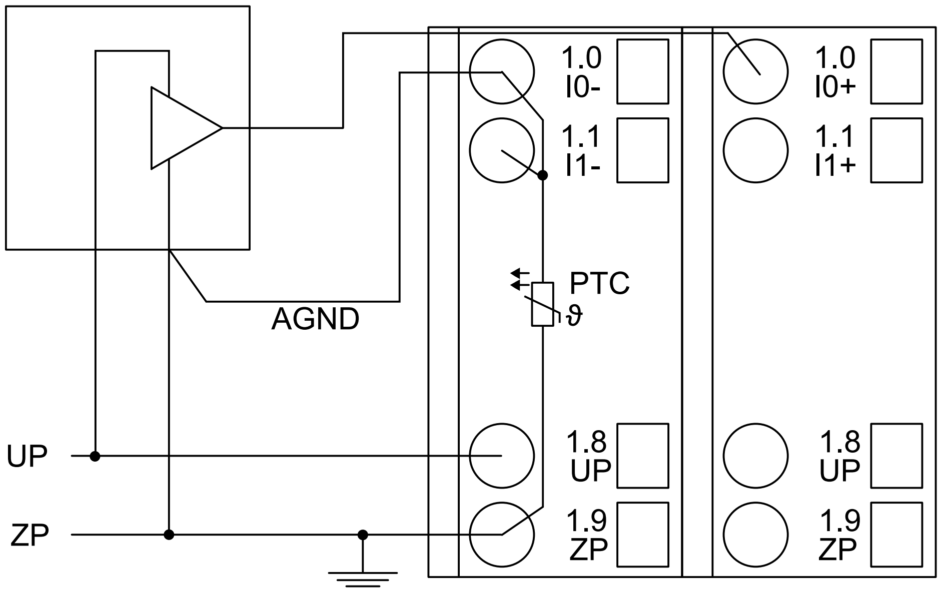


Fig. 110: Connection example

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

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)

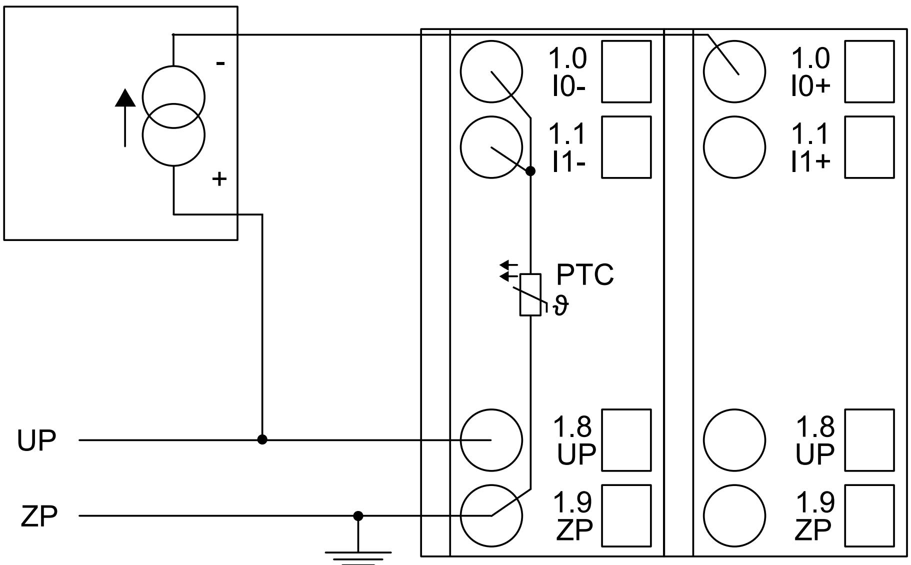


Fig. 111: Connection example

Current	4 mA ... 20 mA	1 channel used

CAUTION!
If, during initialization, an analog current sensor supplies more than 25 mA for more than 1 second to an analog input, this input is switched off by the module (input protection). In such cases, it is recommended to protect the analog input by a 10-volt Zener diode (in parallel to I+ and ZP). But, in general, sensors with fast initialization or without current peaks higher than 25 mA are preferrable.

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!
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). Otherwise, problems may occur concerning the common-mode input voltages of the involved analog inputs.

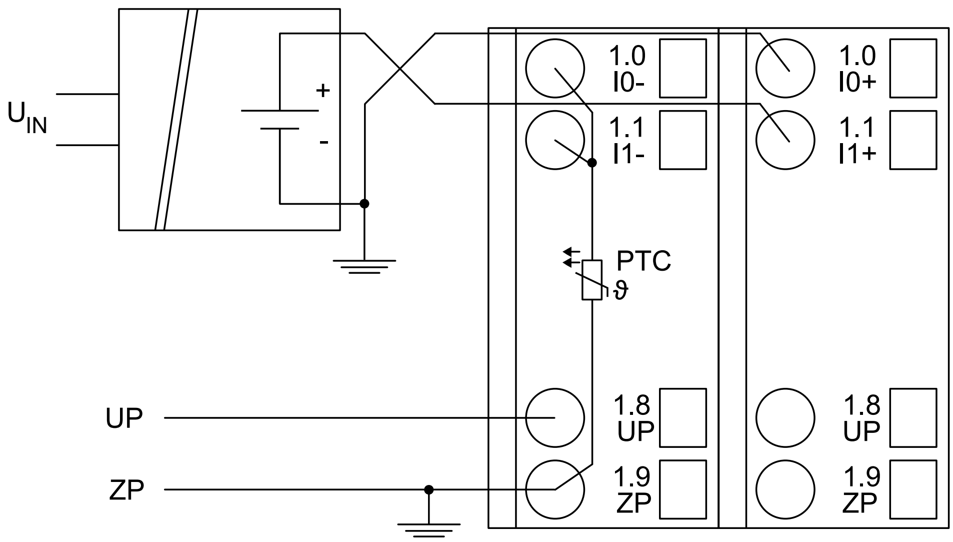


Fig. 112: Connection example

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.

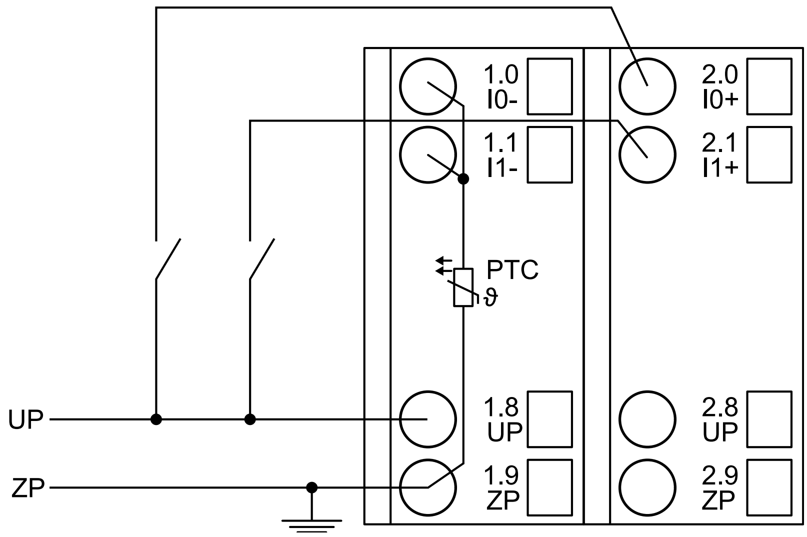


Fig. 113: Connection example

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)

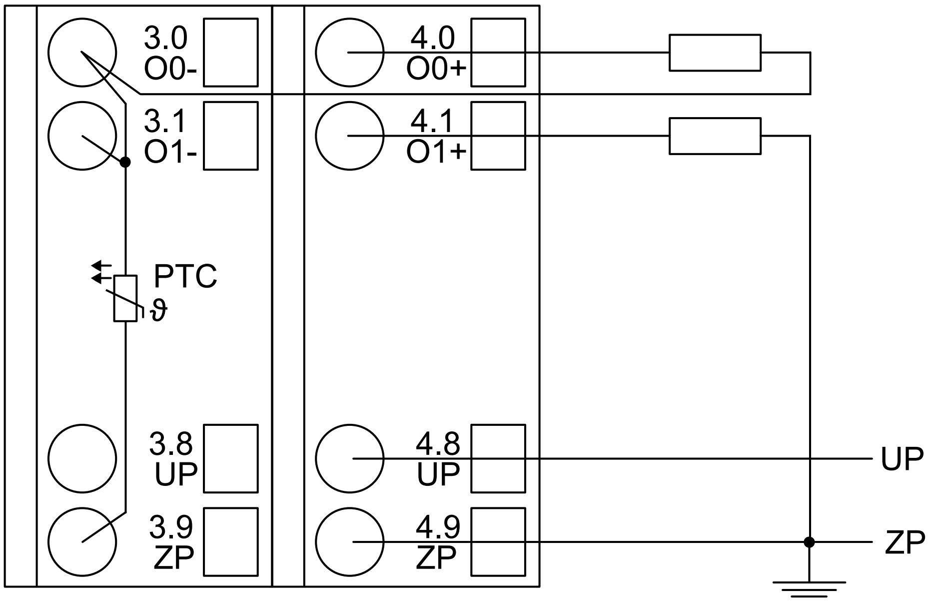


Fig. 114: Connection example

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

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
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 176 “Chan nel configuration [2])” on page 692*		Byte	Default 0x00	0	19	0x0Y06
8	Channel monitoring Input channel 0	See table 'Channel monitoring' *Table 177 “Chan nel monitoring [3])” on page 693*		Byte	Default 0x00	0	3	0x0Y07
9 to 22	Channel configuration and channel monitoring of the input channels 1 ... 7	See table 'Channel configuration' *Table 176 “Chan nel configuration [2])” on page 692* and table 'Channel monitoring' *Table 177 “Chan nel monitoring [3])” on page 693*		Byte Byte	Default 0x00 0x00	0 0	19 3	0x0Y08 to 0x0Y15
23	Channel configuration Output channel 0	See table 'Channel configuration' *Table 176 “Chan nel configuration [2])” on page 692*		Byte	Default 0x00	0	130	0x0Y16

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
24	Channel moni-toring Output channel 0	See table 'Channel monitoring' ↳ *Table 177 “Chan nel monitoring 3)” on page 693*		Byte	Default 0x00	0	3	0x0Y17
25	Substi-tute value Output channel 0	only valid for output channel 0	0 ... 0xffff	Word	Default 0x0000	0	65535	0x0Y18
26 to 31	Channel configu-ration and channel moni-toring of the output channels 1 ... 3	See table 'Channel con-figuration' ↳ *Table 176 “Chan nel configuration 2)” on page 692* and table 'Channel monitoring' ↳ *Table 177 “Chan nel monitoring 3)” on page 693*		Byte Byte	Default 0x00 0x00	0 0	130 3	0x0Y19 to 0x0Y1E
32	Channel configu-ration Output channel 4	See table 'Channel configuration' ↳ *Table 176 “Chan nel configuration 2)” on page 692*		Byte	Default 0x00	0	128	0x0Y1F
33	Channel moni-toring Output channel 4	See table 'Channel monitoring' ↳ *Table 177 “Chan nel monitoring 3)” on page 693*		Byte	Default 0x00	0	3	0x0Y20
34 to 39	Channel configu-ration and channel moni-toring of the output channels 5 ... 7	See table 'Channel con-figuration' ↳ *Table 176 “Chan nel configuration 2)” on page 692* and table 'Channel monitoring' ↳ *Table 177 “Chan nel monitoring 3)” on page 693*		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 175: 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 176: 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 177: Channel monitoring [3])

Internal value	Monitoring
0	Plausibility, open-circuit (broken wire) and short circuit
3	No monitoring

Table 178: 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 179: 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 180: 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 181: Channel monitoring [5])

Internal value	Monitoring
0	Plausibility, open circuit (broken wire) and short circuit (default)
3	No monitoring

Table 182: 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

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"
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 183: 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 184: 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-/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					

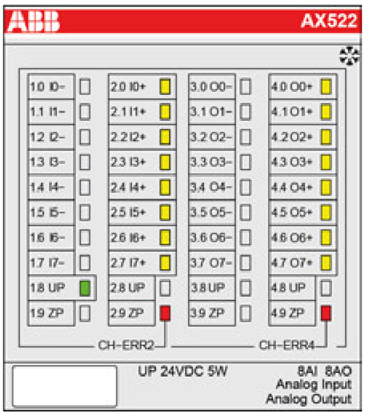
<table>
<tr><th>E1 ... E4</th><th>d1</th><th>d2</th><th>d3</th><th colspan="2">d4</th><th>Identifier
000 ...
063</th><th>AC500 display</th><th colspan="2" rowspan="3"><− Display in</th></tr>
<tr><th>Class</th><th>Comp</th><th>Dev</th><th>Mod</th><th colspan="2">Ch</th><th>Err</th><th>PS501 PLC browser</th></tr>
<tr><th>Byte 6
Bit 6 ... 7</th><th>-</th><th>Byte 3</th><th>Byte 4</th><th colspan="2">Byte 5</th><th>Byte 6
Bit 0 ... 5</th><th>FBP diag-nosis block</th></tr>
<tr><th>Class</th><th>Interface</th><th>Device</th><th>Module</th><th colspan="2">Channel</th><th>Error Identifier</th><th colspan="2">Error message</th><th>Remedy</th></tr>
<tr><td></td><td>1)</td><td>2)</td><td>3)</td><td colspan="2">4)</td><td></td><td colspan="2"></td><td></td></tr>
<tr><td rowspan="2">4</td><td>14</td><td>1 ... 10</td><td>3</td><td rowspan="2">4 ... 7</td><td rowspan="2">8 ... 15</td><td rowspan="2">4</td><td colspan="2" rowspan="2">Analog value over-flow at an analog output</td><td rowspan="2">Check output value</td></tr>
<tr><td>11 / 12</td><td>ADR</td><td>1 ... 10</td></tr>
<tr><td rowspan="2">4</td><td>14</td><td>1 ... 10</td><td>3</td><td rowspan="2">4 ... 7</td><td rowspan="2">8 ... 15</td><td rowspan="2">7</td><td colspan="2" rowspan="2">Analog value under-flow at an analog output</td><td rowspan="2">Check output value</td></tr>
<tr><td>11 / 12</td><td>ADR</td><td>1 ... 10</td></tr>
</table>

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 / Pt 1000 -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

The system data of AC500 and S500 are applicable to the standard version *Chapter 4.2 “System data AC500” on page 30*.

The system data of AC500-XC are applicable to the XC version *Chapter 4.3 “System data AC500-XC” on page 35*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Technical data of the module

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 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.

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	
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.	± 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

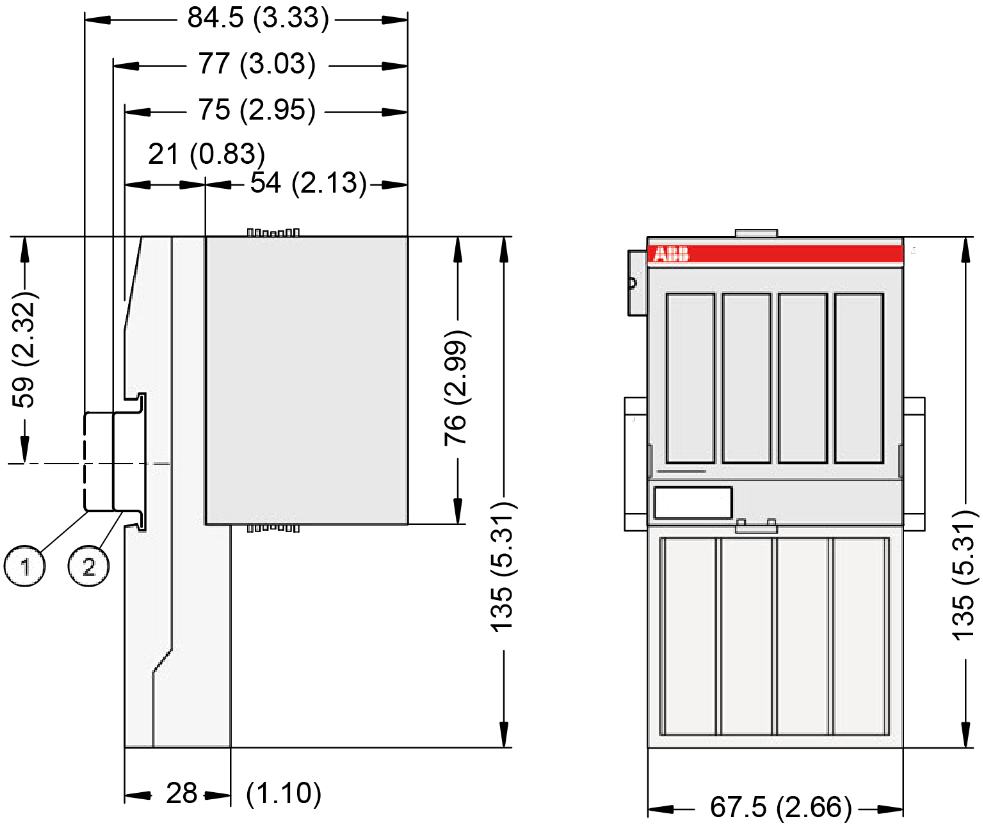
Parameter		Value
Number of channels per module		Max. 8
Distribution of channels into groups		1 group of 8 channels
Connections of the channels I0+ ... I7+		Terminals 2.0 ... 2.7
Reference potential for the inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (ZP)
Input signal delay		Typ. 8 ms, configurable from 0.1 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
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

Parameter	Value	
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.*

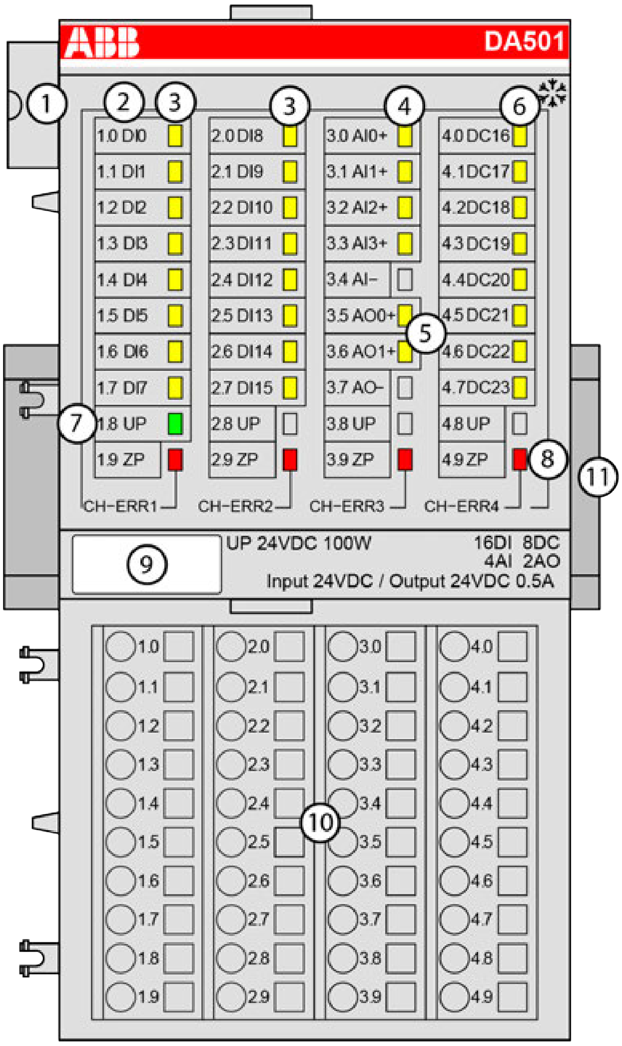
5.4.4 Digital/Analog I/O modules

5.4.4.1 S500 and S500-XC

5.4.4.1.1 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 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 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

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 *Chapter 5.5.1 “TU515, TU516, TU541 and TU542 for I/O modules” on page 801*

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 5.5.1 “TU515, TU516, TU541 and TU542 for I/O modules” on page 801*.

The assignment of the terminals:

Terminal	Signal	Description
1.0	DI0	Signal of the digital input DI0
1.1	DI1	Signal of the digital input DI1
1.2	DI2	Signal of the digital input DI2
1.3	DI3	Signal of the digital input DI3
1.4	DI4	Signal of the digital input DI4
1.5	DI5	Signal of the digital input DI5
1.6	DI6	Signal of the digital input DI6
1.7	DI7	Signal of the digital input DI7
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

Terminal	Signal	Description
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	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 to 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	C16	Signal of the configurable digital input/ output C16
4.1	C17	Signal of the configurable digital input/ output C17
4.2	C18	Signal of the configurable digital input/ output C18
4.3	C19	Signal of the configurable digital input/ output C19
4.4	C20	Signal of the configurable digital input/ output C20
4.5	C21	Signal of the configurable digital input/ output C21
4.6	C22	Signal of the configurable digital input/ output C22
4.7	C23	Signal of the configurable digital input/ output C23
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 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 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 10

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 you

– 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 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

– 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.

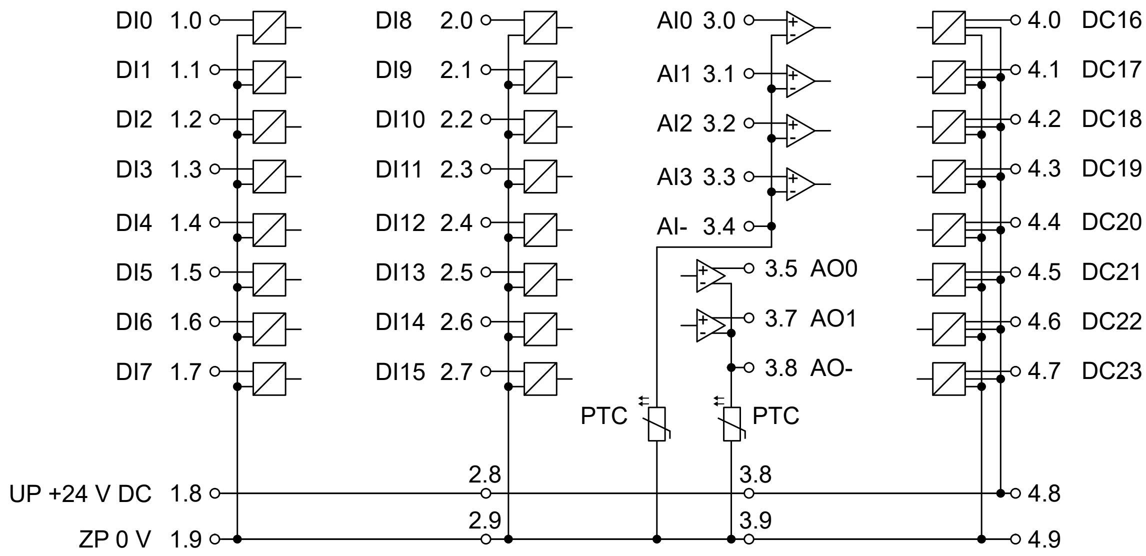


Fig. 115: Terminal assignment of the module

The module provides several diagnosis functions *Chapter 5.4.4.1.1.7 "Diagnosis" on page 724*.

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.

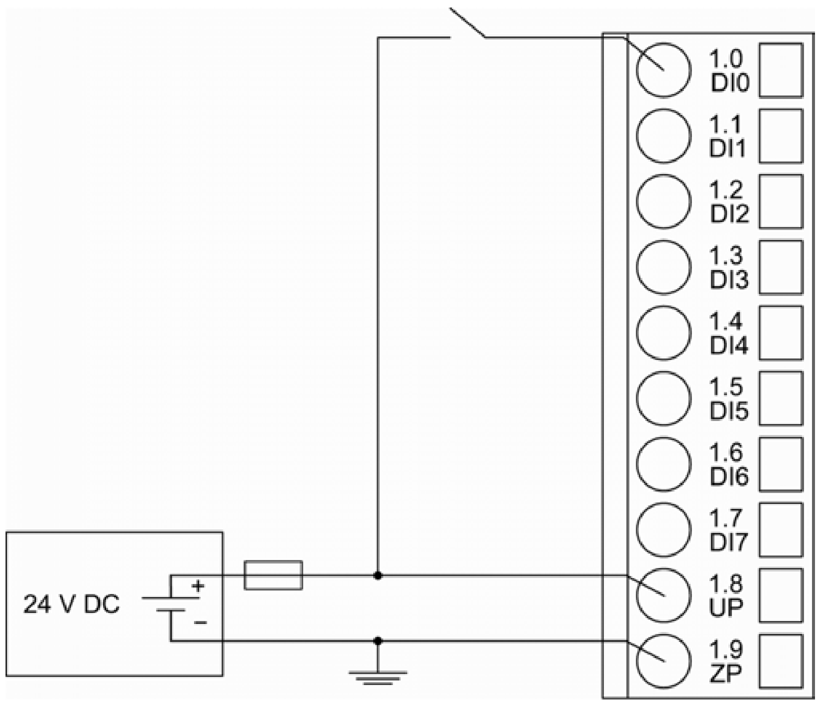


Fig. 116: Connection of the module

The meaning of the LEDs is described in the Displays chapter *Chapter 5.4.4.1.1.8 "State LEDs" on page 726*.

Connection of the configurable digital inputs/outputs

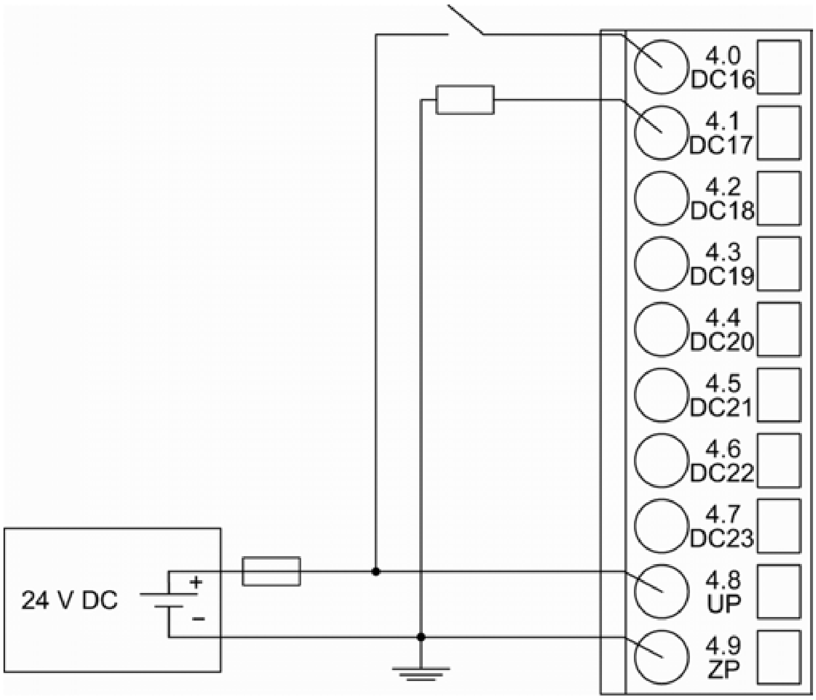


Fig. 117: Connection of configurable digital inputs/outputs to the module (DC16 ... DC23) (DC16 as an input, DC17 as an output)

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.

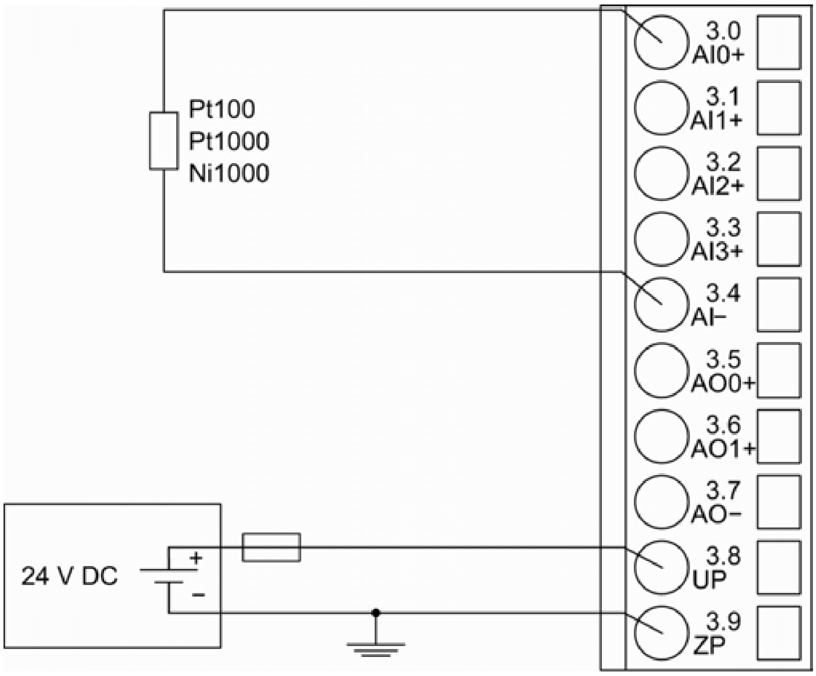


Fig. 118: Connection of resistance thermometers in 2-wire configuration to the analog inputs (AI0 to AI3)

The following measuring ranges can be configured *Chapter 5.4.4.1.1.6 “Parameterization” on page 719*:

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 5.4.4.1.1.8 “State LEDs” on page 726*.

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.

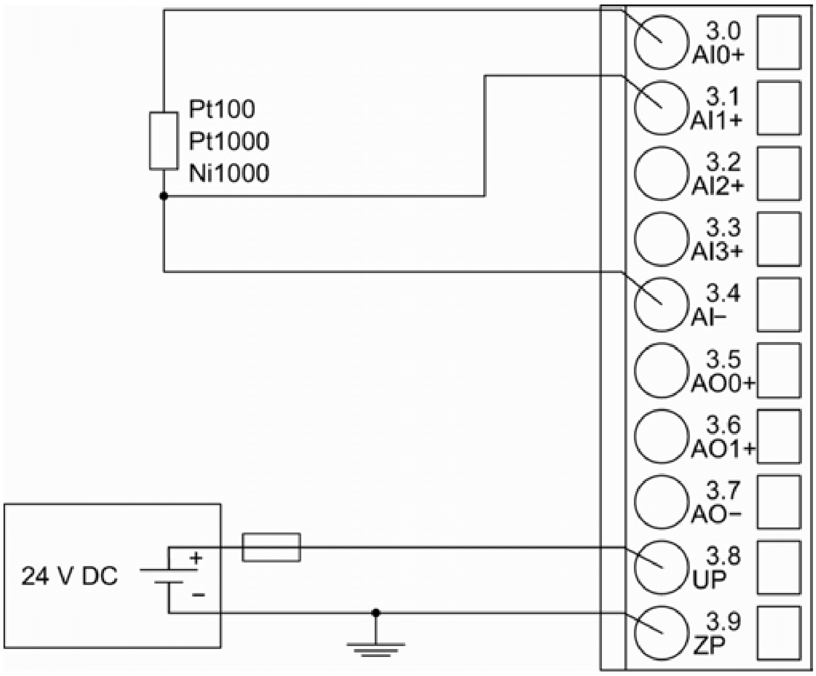


Fig. 119: Connection of resistance thermometers in 3-wire configuration to the analog inputs (AI0 ... AI3)

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 5.4.4.1.1.6 “Parameterization” on page 719*:

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 ➪ *Chapter 5.4.4.1.1.7 “Diagnosis” on page 724*.

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

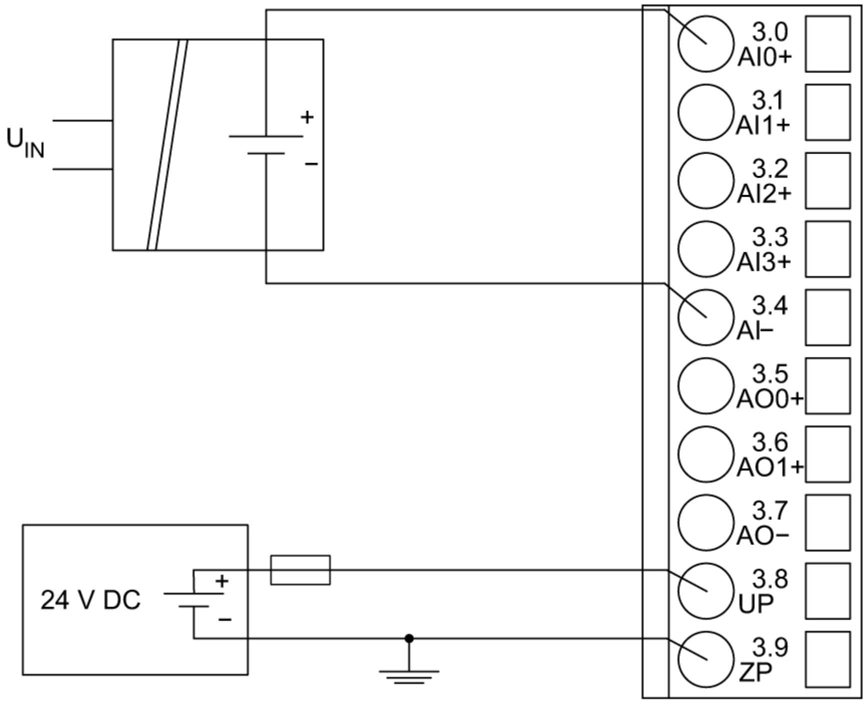


Fig. 120: Connection of active-type analog sensors (voltage) with galvanically isolated power supply to the analog inputs (AI0 ... AI3)

The following measuring ranges can be configured ➪ *Chapter 5.4.4.1.1.6 “Parameterization” on page 719*:

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 5.4.4.1.1.8 “State LEDs” on page 726*.

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

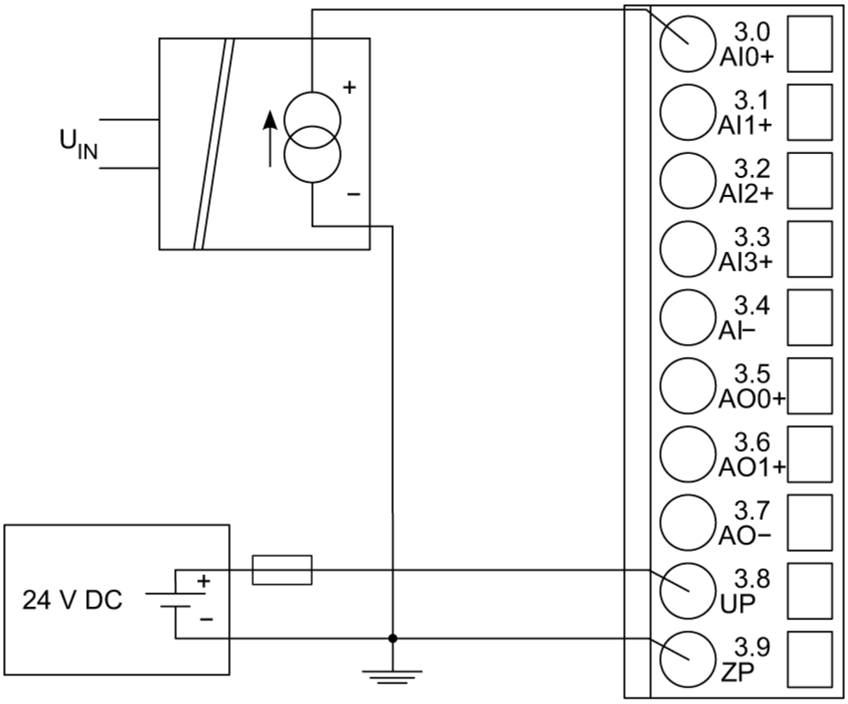


Fig. 121: Connection of active-type analog sensors (current) with galvanically isolated power supply to the analog inputs (AI0 ... AI3)

The following measuring ranges can be configured ⇘ *Chapter 5.4.4.1.1.6 “Parameterization” on page 719*:

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 5.4.4.1.1.8 “State LEDs” on page 726*.

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

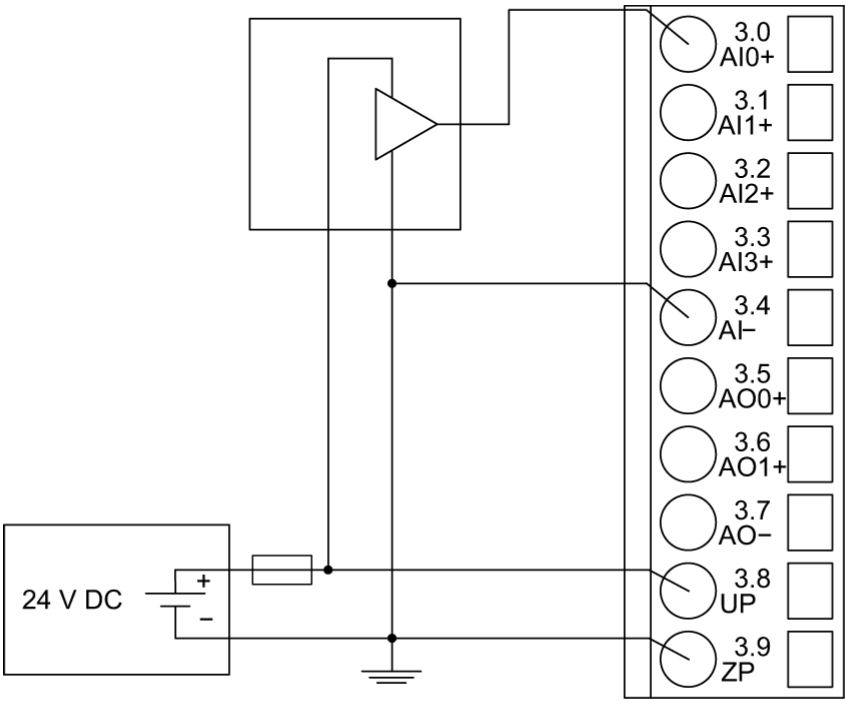


Fig. 122: Connection of active-type sensors (voltage) with no galvanically isolated power supply to the analog inputs (AI0 ... AI3)

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 5.4.4.1.1.6 “Parameterization” on page 719*:

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 5.4.4.1.1.8 “State LEDs” on page 726*.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of passive-type analog sensors (Current) to the analog inputs

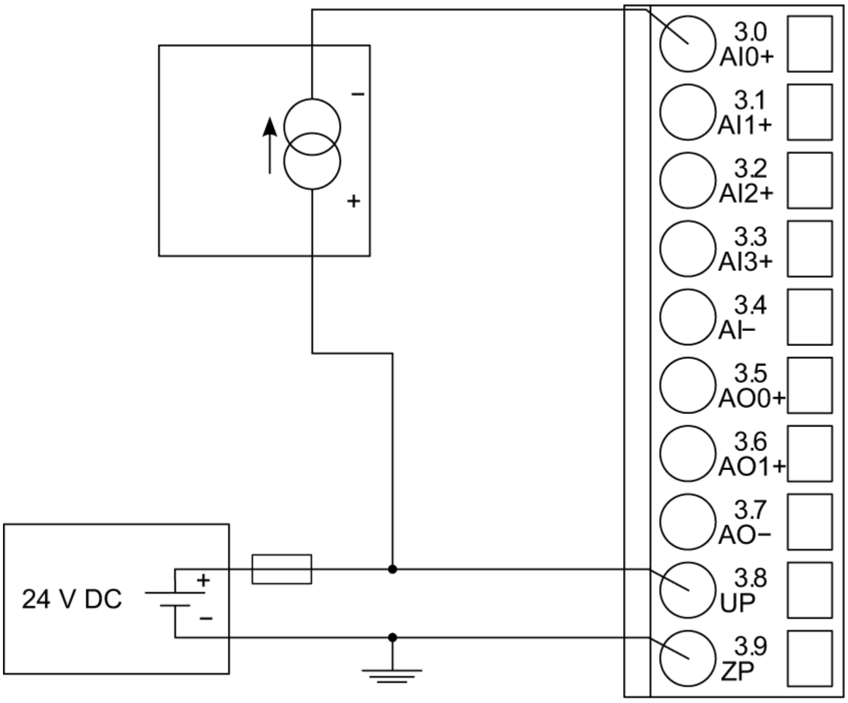


Fig. 123: Connection of passive-type analog sensors (current) to the analog inputs (AI0 to AI3)

The following measuring ranges can be configured ✎ *Chapter 5.4.4.1.1.6 "Parameterization" on page 719*:

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 5.4.4.1.1.8 "State LEDs" on page 726*.

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.

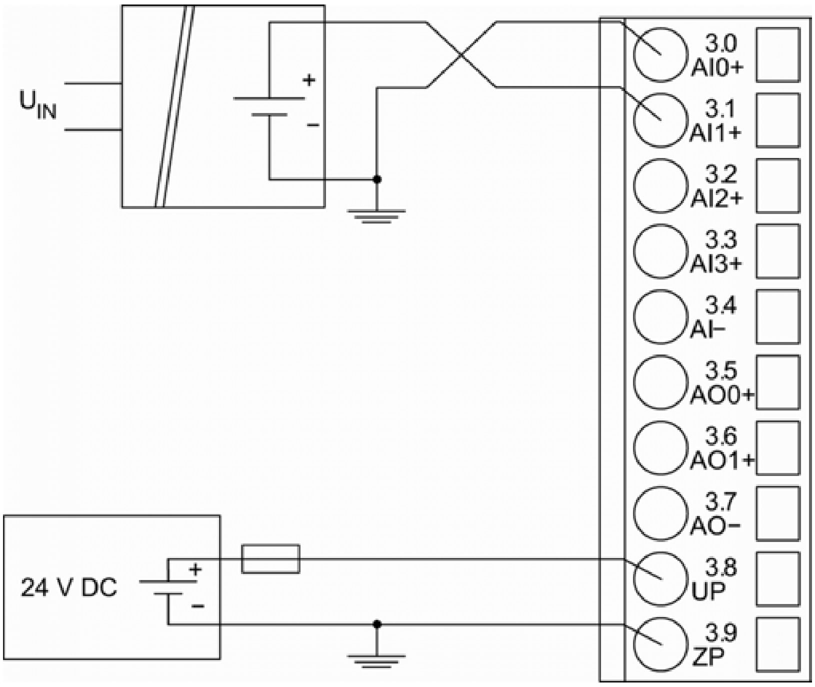


Fig. 124: Connection of active-type analog sensors (voltage) to differential analog inputs (AI0 ... AI3)

The following measuring ranges can be configured *Chapter 5.4.4.1.1.6 “Parameterization” on page 719*:

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 5.4.4.1.1.8 “State LEDs” on page 726.*

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.

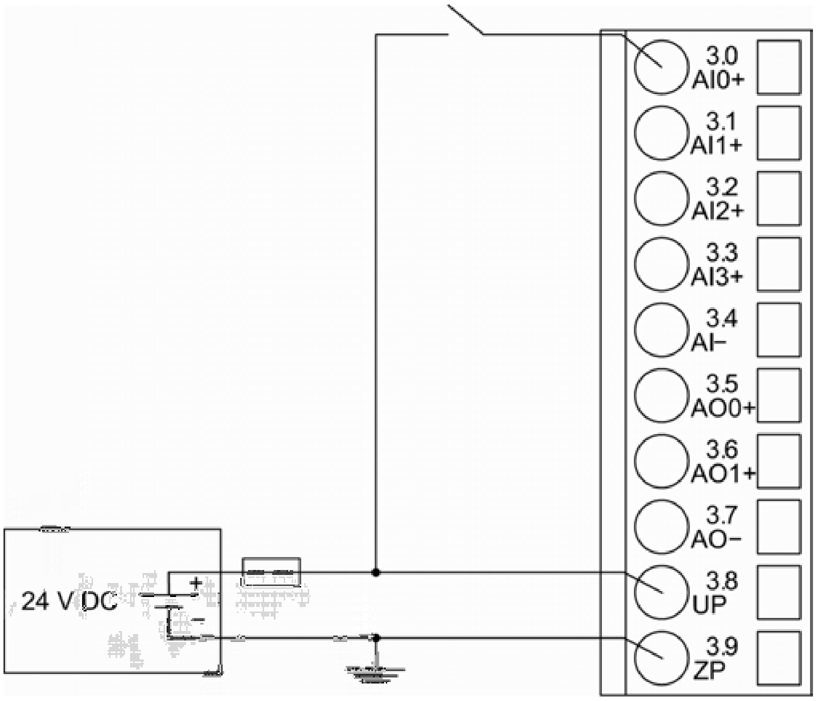


Fig. 125: connection of digital sensors to the analog inputs (AI0 ... AI3)

The following measuring ranges can be configured *Chapter 5.4.4.1.1.6 "Parameterization" on page 719*:

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 5.4.4.1.1.8 "State LEDs" on page 726*.

Connection of analog output loads (Voltage)

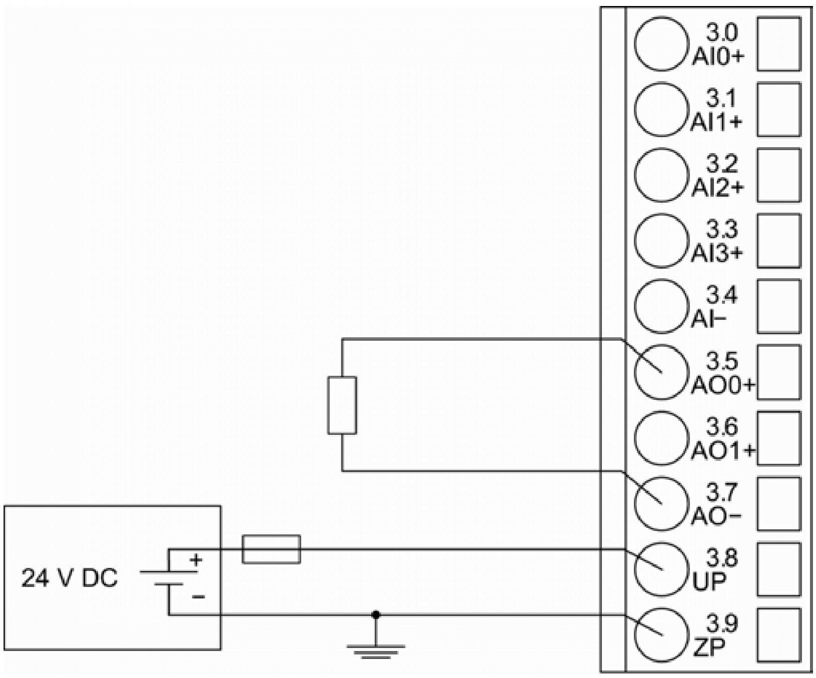


Fig. 126: Connection of analog output loads (voltage) to the analog outputs (AO0 and AO1)

The following measuring ranges can be configured ✎ *Chapter 5.4.4.1.1.6 “Parameterization” on page 719* :

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 5.4.4.1.1.8 “State LEDs” on page 726*.

Unused analog outputs can be left open-circuited.

Connection of analog output loads (Current)

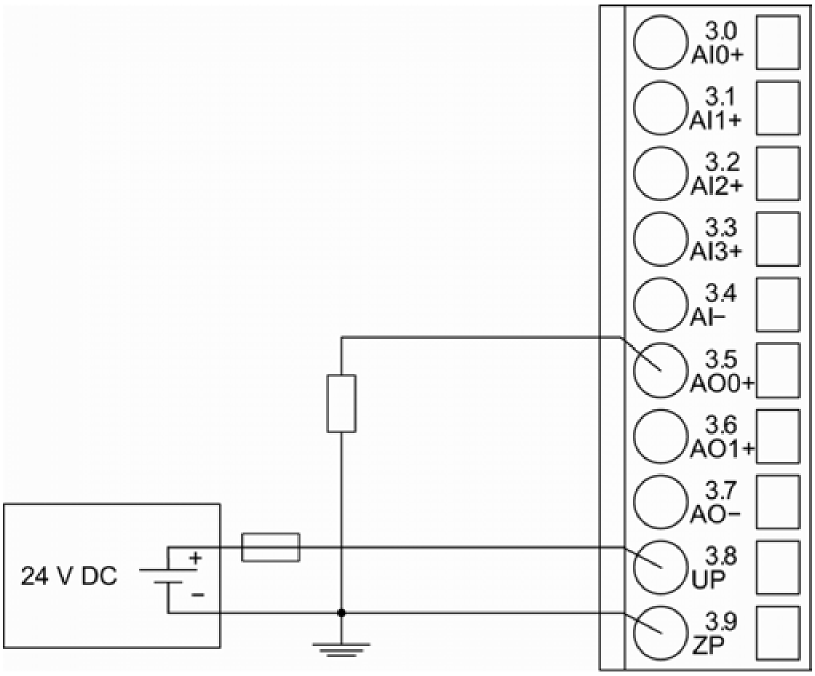


Fig. 127: Connection of analog output loads (current) to the analog outputs (AO0 and AO1)

The following measuring ranges can be configured ✎ *Chapter 5.4.4.1.1.6 “Parameterization” on page 719*:

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 5.4.4.1.1.8 “State LEDs” on page 726*.

Unused analog outputs can be left open-circuited.

Internal data exchange

	Without the fast counter	**With the fast counter (only with AC500)**
Digital inputs (bytes)	3	5
Digital outputs (bytes)	1	3
Analog inputs (words)	4	4

	Without the fast counter	With the fast counter (only with AC500)
Digital outputs (words)	2	2
Counter input data (words)	0	4
Counter output data (words)	0	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

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			

Name	Value	Internal value	Internal value, type	Default	EDS Slot / Index
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 5.4.2.2.9 “Fast counter” on page 464*

[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 185 "Channel configuration" on page 722*	see table 'Channel configuration' *Table 185 "Channel configuration" on page 722*	BYTE	0	0x0Y09
Input 0, Check channel	see table 'Channel monitoring' *Table 186 "Channel monitoring" on page 722*	see table 'Channel monitoring' *Table 186 "Channel monitoring" on page 722*	BYTE	0	0x0Y0A
:	:	:	:	:	
:	:	:	:	:	

Name	Value	Internal value	Internal value, type	Default	EDS Slot / Index
Input 3, Channel configuration	see table 'Channel configuration' *Table 185 “ Channel configuration” on page 722*	see table 'Channel configuration' *Table 185 “ Channel configuration” on page 722*	BYTE	0	0x0Y0F
Input 3, Check channel	see table 'Channel monitoring' *Table 186 “ Channel monitoring” on page 722*	see table 'Channel monitoring' *Table 186 “ Channel monitoring” on page 722*	BYTE	0	0x0Y10

Table 185: 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
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 186: 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 187 "Channel configuration" on page 723*	see table 'Channel configuration' *Table 187 "Channel configuration" on page 723*	BYTE	0	0x0Y11
Output 0, Check channel	see table 'Channel monitoring' *Table 188 "Channel monitoring" on page 724*	see table 'Channel monitoring' *Table 188 "Channel monitoring" on page 724*	BYTE	0	0x0Y12
Output 0, Substitute value	see table 'Substitute value' *Table 189 "Substitute value" on page 724*	see table 'Substitute value' *Table 189 "Substitute value" on page 724*	WORD	0	0x0Y13
Output 1, Channel configuration	see table 'Channel configuration' *Table 187 "Channel configuration" on page 723*	see table 'Channel configuration' *Table 187 "Channel configuration" on page 723*	BYTE	0	0x0Y14
Output 1, Check channel	see table 'Channel monitoring' *Table 188 "Channel monitoring" on page 724*	see table 'Channel monitoring' *Table 188 "Channel monitoring" on page 724*	BYTE	0	0x0Y15
Output 1, Substitute value	see table 'Substitute value' *Table 189 "Substitute value" on page 724*	see table 'Substitute value' *Table 189 "Substitute value" on page 724*	WORD	0	0x0Y16

Table 187: 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 188: Channel monitoring

Internal value	Check channel
0	Plausibility, wire break, short circuit
3	None

Table 189: 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. Thus an acknowledgement of the errors is not necessary. The error message is stored via the LED.

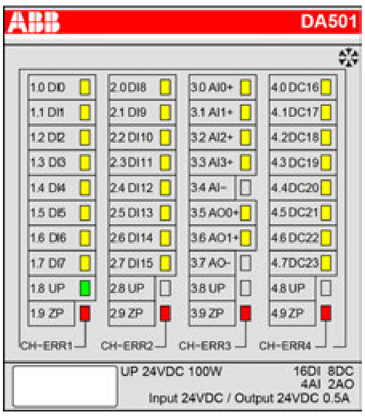
E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier** **000 ... 063**	**AC500 display**	**<– Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 **Bit 6 ... 7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0 ... 5**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**			
Module error							
0	14	1 ... 10	31	31	19	Checksum error in the I/O module	Replace I/O module
3	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	3	Timeout in the I/O module	
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	40	Different hard-/firmware versions in the 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	43	Internal error in the module	
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	36	Internal data exchange failure	
	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 DA501							
4	14	1 ... 10	2	22 ... 29 5)	47	Short circuit at a digital output	Check connection
	11 / 12	ADR	1 ... 10				
Channel error DA501							
4	14	1 ... 10	1	16 ... 19 6)	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	16 ... 19 6)	7	Analog value underflow at an analog input	Check input value
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	1	16 ... 19 6)	47	Short circuit at an analog input	Check ter-minal
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	3	20 ... 21 7)	4	Analog value overflow at an analog output	Check output value
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	3	20 ... 21 7)	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 FBP diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = 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 (1 = AI, 3 = AO, 4 = DC); COM1/COM2: 1 ... 10 = expansion 1 ... 10
4)	In case of module errors, with channel "31 = module itself" is output.
5)	Ch = 22 ... 29 indicates the digital inputs/outputs DC16 ... DC23
6)	Ch = 16 ... 19 indicates the analog inputs AI0 ... AI3
7)	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					

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
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 ... +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

Range	Pt100 / Pt1000 -50 °C ... +70 °C	Pt100 / Pt1000 -50 °C ... +400 °C	Ni1000 -50 °C ... +150 °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
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	>11.7589 V	>23.5178 mA	>22.8142 mA
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
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 are applicable to the standard version *Chapter 4.2 “System data AC500” on page 30*.

The system data of AC500-XC are applicable to the XC version ↳ *Chapter 4.3 “System data AC500-XC” on page 35*.

Only additional details are therefore documented below.

The technical data are 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 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		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 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
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	16
Distribution of the channels into groups	2 groups of 8 channels

Parameter	Value
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	
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 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 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)

Parameter		Value
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.

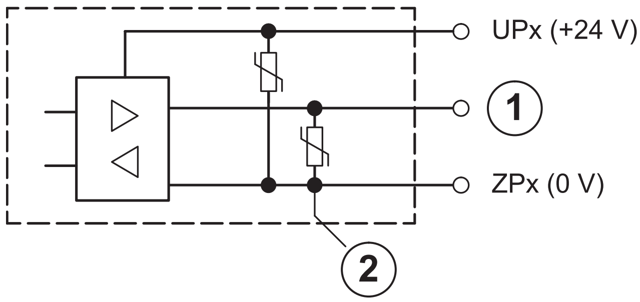


Fig. 128: Digital input/output (circuit diagram)

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
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 5.4.4.1.1.9.2 “Input ranges resistance temperature detector” on page 727*
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

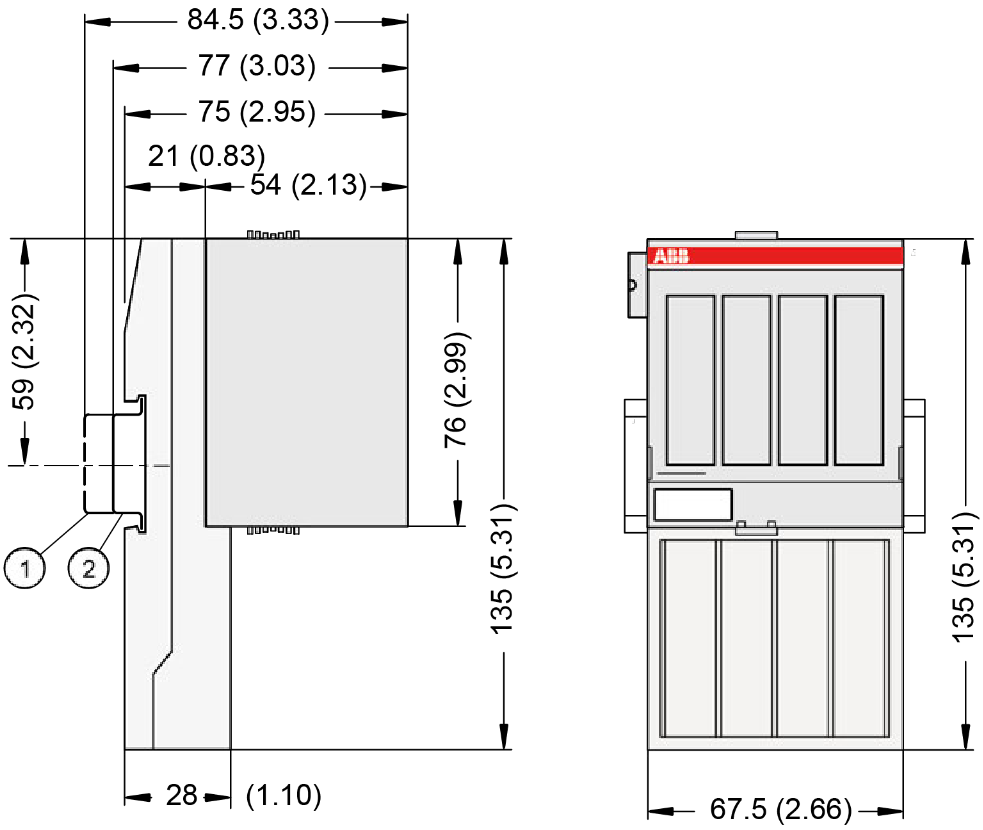
Parameter	Value
Number of channels per module	2
Distribution of channels into groups	1 group for 2 channels
Connection of the channels AO0+ ... AO1+	Terminals 3.5 and 3.6
Reference potential for AO0+ ... AO1+	Terminal 3.7 (AO-) for voltage output Terminals 1.9, 2.9, 3.9 and 4.9 for current output
Output 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 %

Parameter	Value
Relationship between input signal and hex code	*Chapter 5.4.4.1.1.9.3 "Output ranges voltage and current" on page 729*
Unused outputs	Are configured as "unused" (default value) and can be left open-circuited

Internal data exchange

	Without the fast counter	With the fast counter (only with AC500)
Digital inputs (bytes)	3	5
Digital outputs (bytes)	1	3
Analog inputs (words)	4	4
Analog outputs (words)	2	2
Counter input data (words)	0	4
Counter output data (words)	0	8

Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

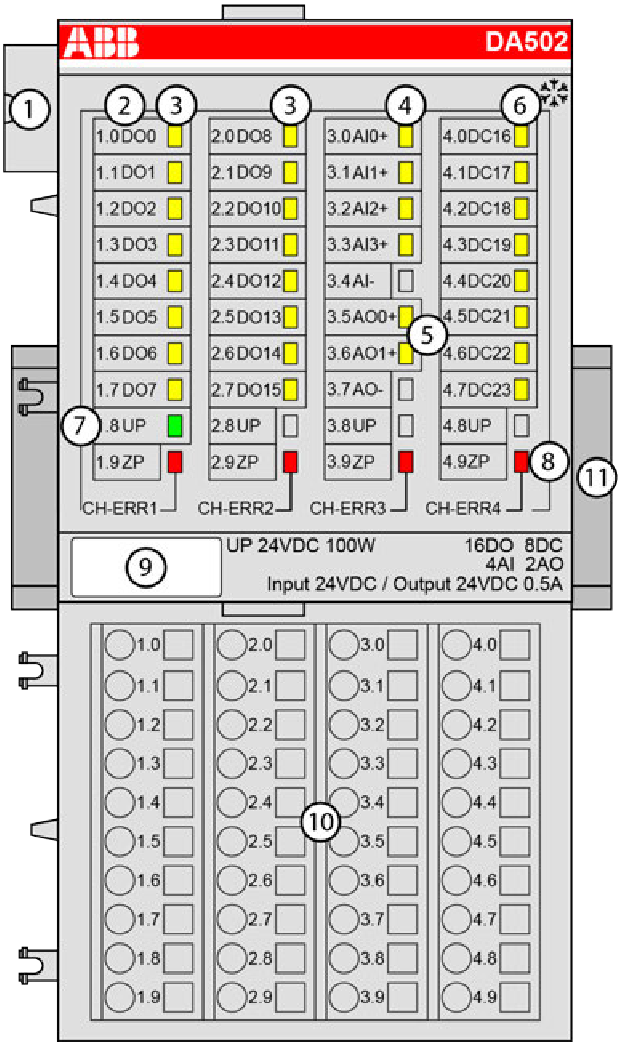
Ordering data

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.*

5.4.4.1.2 DA502 - Digital/Analog input/output module

- 16 digital outputs, 24 V DC, 0.5 A max.
- 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 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

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 ➪ *Chapter 5.5.1 “TU515, TU516, TU541 and TU542 for I/O modules” on page 801*

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 5.5.1 “TU515, TU516, TU541 and TU542 for I/O modules” on page 801*.

The assignment of the terminals:

Terminal	Signal	Description
1.0	DO0	Signal of the digital output DO0
1.1	DO1	Signal of the digital output DO1
1.2	DO2	Signal of the digital output DO2
1.3	DO3	Signal of the digital output DO3
1.4	DO4	Signal of the digital output DO4
1.5	DO5	Signal of the digital output DO5
1.6	DO6	Signal of the digital output DO6
1.7	DO7	Signal of the digital output DO7
1.8	UP	Process voltage UP (24 V DC)
1.9	ZP	Process voltage ZP (0 V DC)
2.0	DO8	Signal of the digital output DO8
2.1	DO9	Signal of the digital output DO9
2.2	DO10	Signal of the digital output DO10
2.3	DO11	Signal of the digital output DO11
2.4	DO12	Signal of the digital output DO12
2.5	DO13	Signal of the digital output DO13
2.6	DO14	Signal of the digital output DO14

Terminal	Signal	Description
2.7	DO15	Signal of the digital output DO15
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	DC16	Signal of the configurable digital input/output DC16
4.1	DC17	Signal of the configurable digital input/output DC17
4.2	DC18	Signal of the configurable digital input/output DC18
4.3	DC19	Signal of the configurable digital input/output DC19
4.4	DC20	Signal of the configurable digital input/output DC20
4.5	DC21	Signal of the configurable digital input/output DC21
4.6	DC22	Signal of the configurable digital input/output DC22
4.7	DC23	Signal of the configurable digital input/output DC23
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 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 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 10

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 you

– 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 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

– 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.

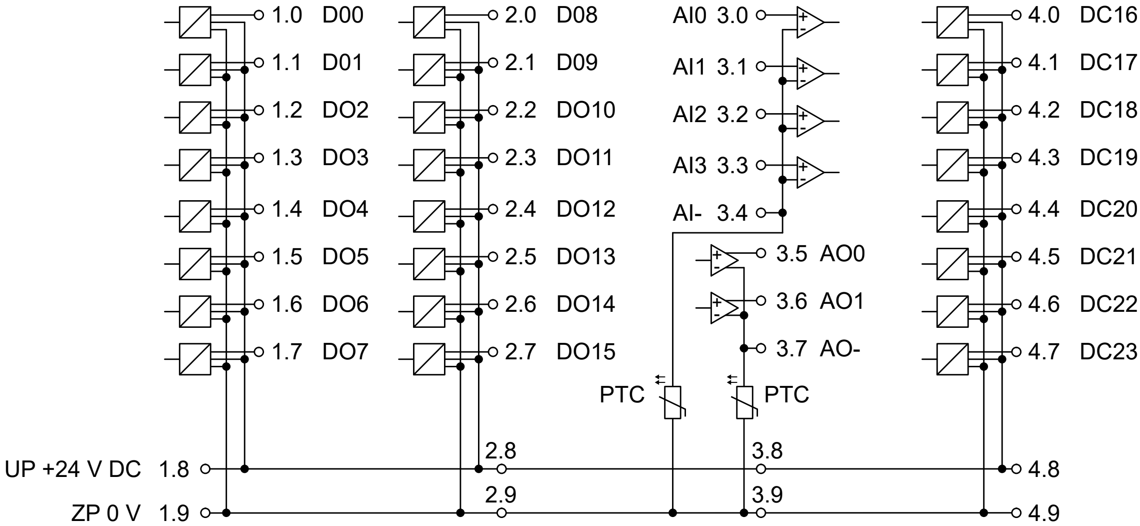


Fig. 129: Terminal assignment of the module

The module provides several diagnosis functions ↯ *Chapter 5.4.4.1.2.7 “Diagnosis” on page 758*.

Connection of the digital outputs

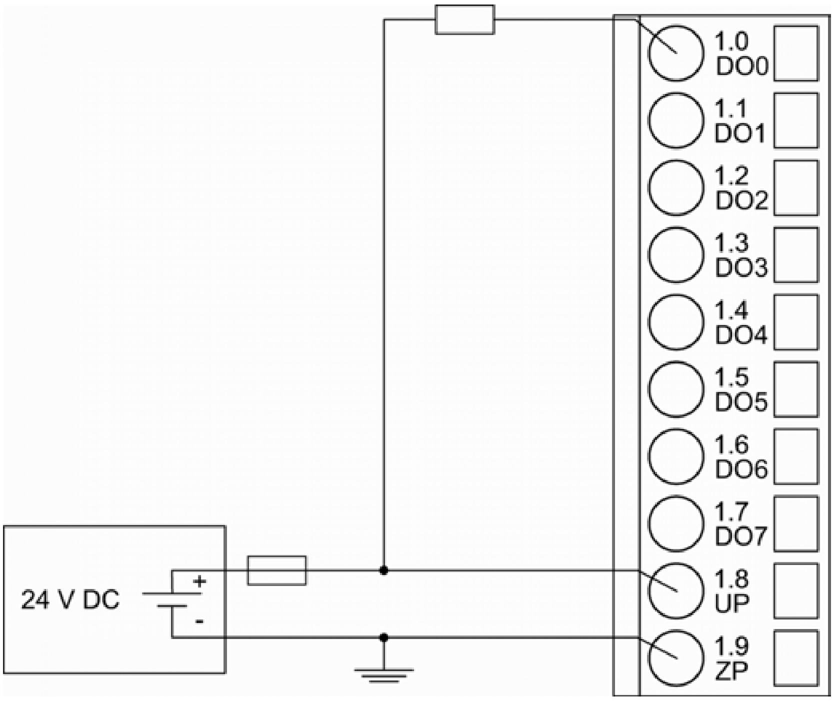


Fig. 130: Connection of the digital outputs (DO0 ... DO15)

For a description of the meaning of the LEDs, please refer to the Displays chapter ↯ *Chapter 5.4.4.1.2.8 “State LEDs” on page 760*.

Connection of the configurable digital inputs/outputs

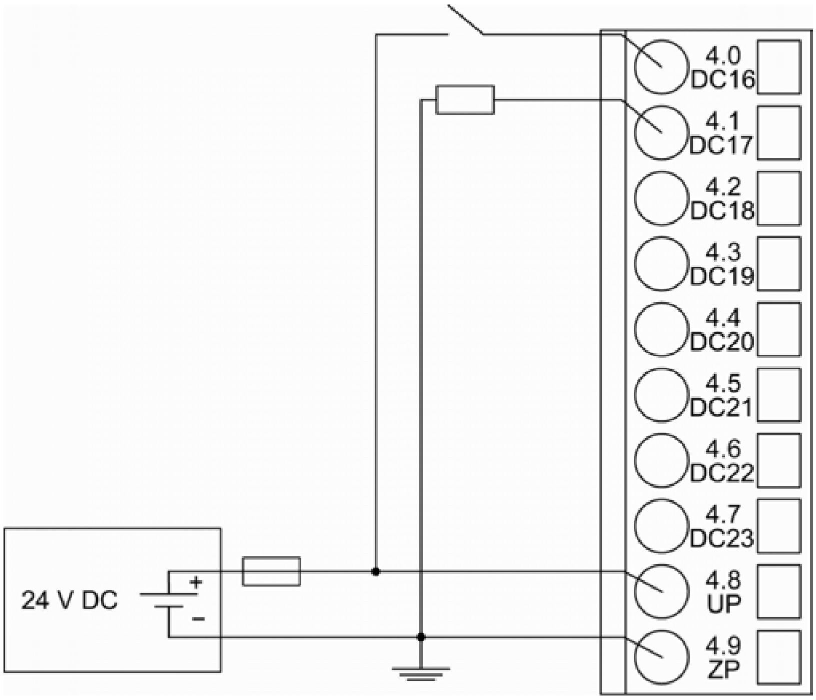


Fig. 131: Connection of the configurable digital input/outputs (DC16 ... DC23) (DC16 as an input, DC17 as an output)

> **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.

For a description of tthe meaning of the LEDs, please refer to the Displays *Chapter 5.4.4.1.2.8 "State LEDs" on page 760* chapter.

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.

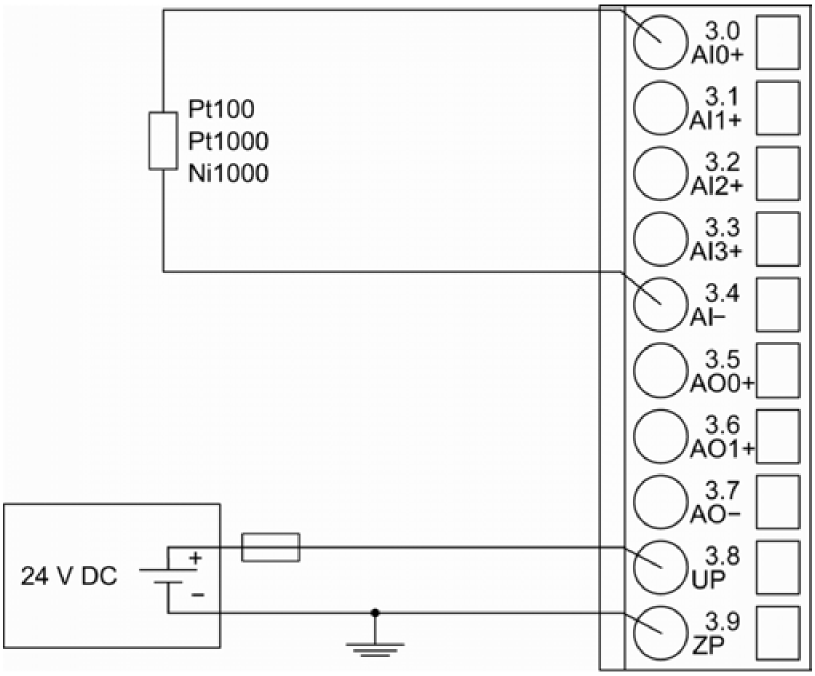


Fig. 132: Connection of resistance thermometers in 2-wire configuration to the analog inputs (AI0 ... AI3)

The following measuring ranges can be configured ⇘ *Chapter 5.4.4.1.2.6 “Parameterization” on page 753* ⇘ *Chapter 5.4.4.1.2.9 “Measuring ranges” on page 761*:

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

For a description of the function of the LEDs, please refer to Diagnosis and displays / Displays ⇘ *Chapter 5.4.4.1.2.8 “State LEDs” on page 760*.

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.

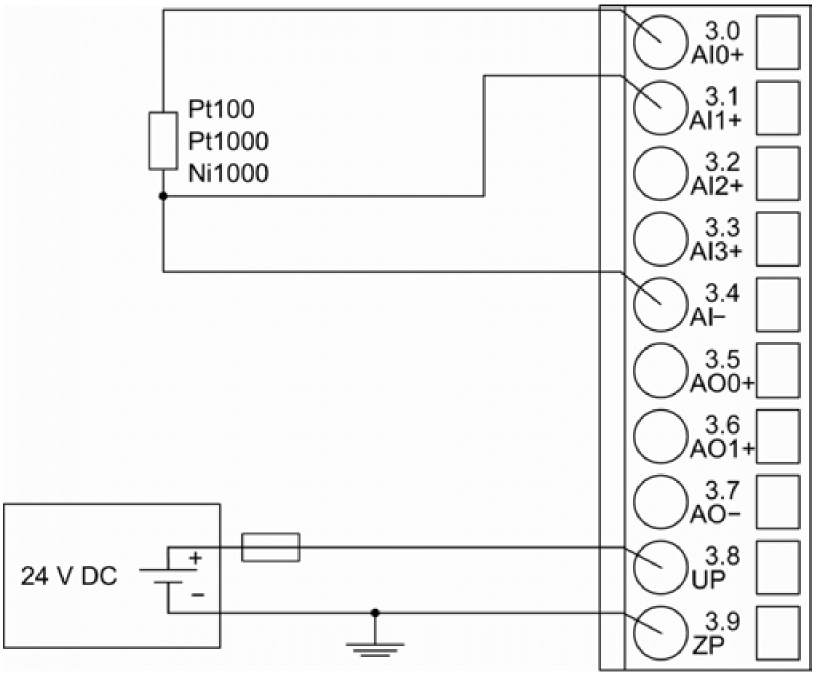


Fig. 133: Connection of resistance thermometers in 3-wire configuration to the analog inputs (AI0 ... AI3)

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 5.4.4.1.2.6 “Parameterization” on page 753* *Chapter 5.4.4.1.2.9 “Measuring ranges” on page 761*:

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

For a description of the function of the LEDs, please refer to Diagnosis and displays / Displays *Chapter 5.4.4.1.2.8 “State LEDs” on page 760*.

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

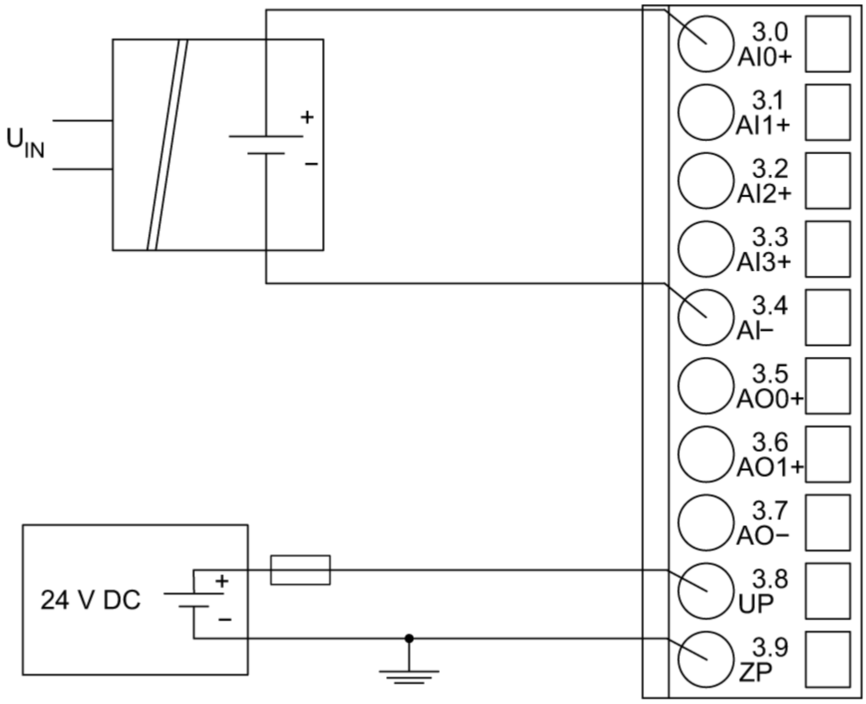


Fig. 134: Connection of active-type analog sensors (voltage) with galvanically isolated power supply to the analog inputs (AI0 ... AI3)

The following measuring ranges can be configured ↬ *Chapter 5.4.4.1.2.6 “Parameterization” on page 753* ↬ *Chapter 5.4.4.1.2.9 “Measuring ranges” on page 761*:

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 Diagnosis and displays / Displays ↬ *Chapter 5.4.4.1.2.8 “State LEDs” on page 760*.

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

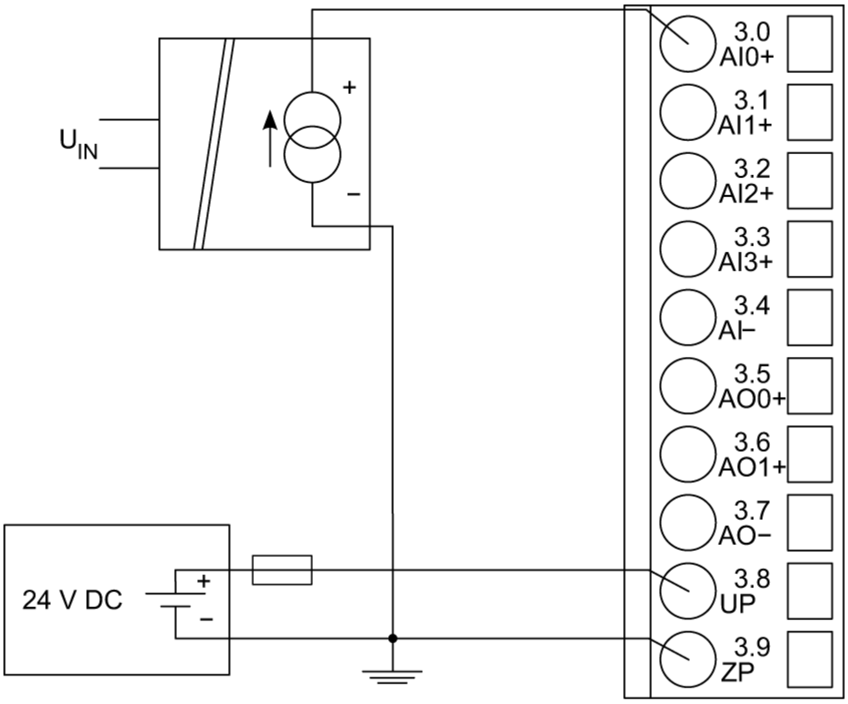


Fig. 135: Connection of active-type analog sensors (current) with galvanically isolated power supply to the analog inputs (AI0 ... AI3)

The following measuring ranges can be configured ✎ *Chapter 5.4.4.1.2.6 “Parameterization” on page 753* ✎ *Chapter 5.4.4.1.2.9 “Measuring ranges” on page 761*:

Current	0 mA ... 20 mA	1 channel used
Current	4 mA ... 20 mA	1 channel used

For a description of the function of the LEDs, please refer to Diagnosis and displays / Displays ✎ *Chapter 5.4.4.1.2.8 “State LEDs” on page 760*.

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

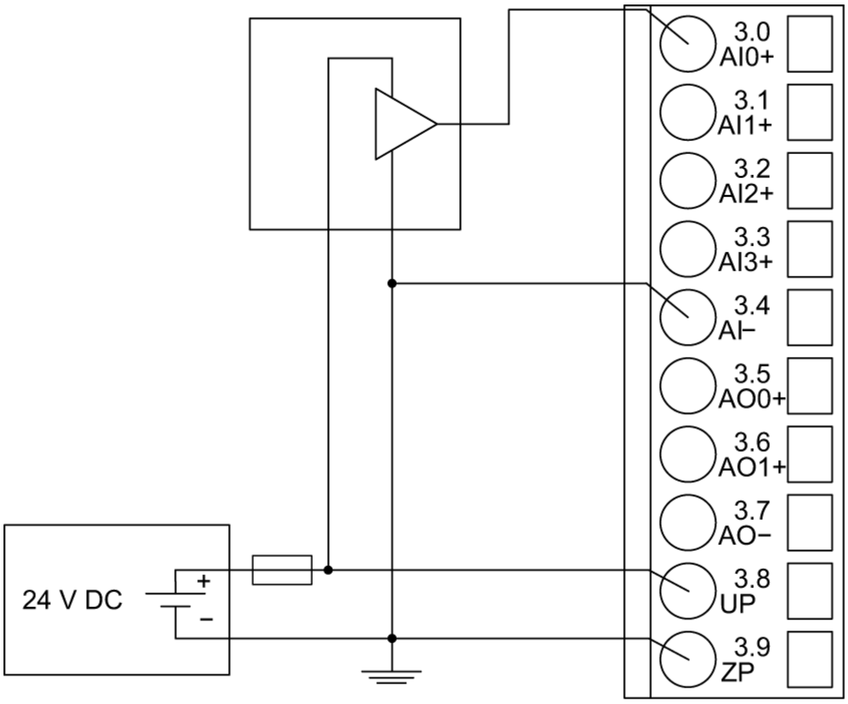


Fig. 136: Connection of active-type sensors (voltage) with no galvanically isolated power supply to the analog inputs (AI0 ... AI3)

CAUTION!
Risk of faulty measurements!
The negative pole at the sensors must not have too 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 measuring ranges can be configured *Chapter 5.4.4.1.2.6 “Parameterization” on page 753* *Chapter 5.4.4.1.2.9 “Measuring ranges” on page 761*:

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 Diagnosis and displays / Displays *Chapter 5.4.4.1.2.8 “State LEDs” on page 760*.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of passive-type analog sensors (Current) to the analog inputs

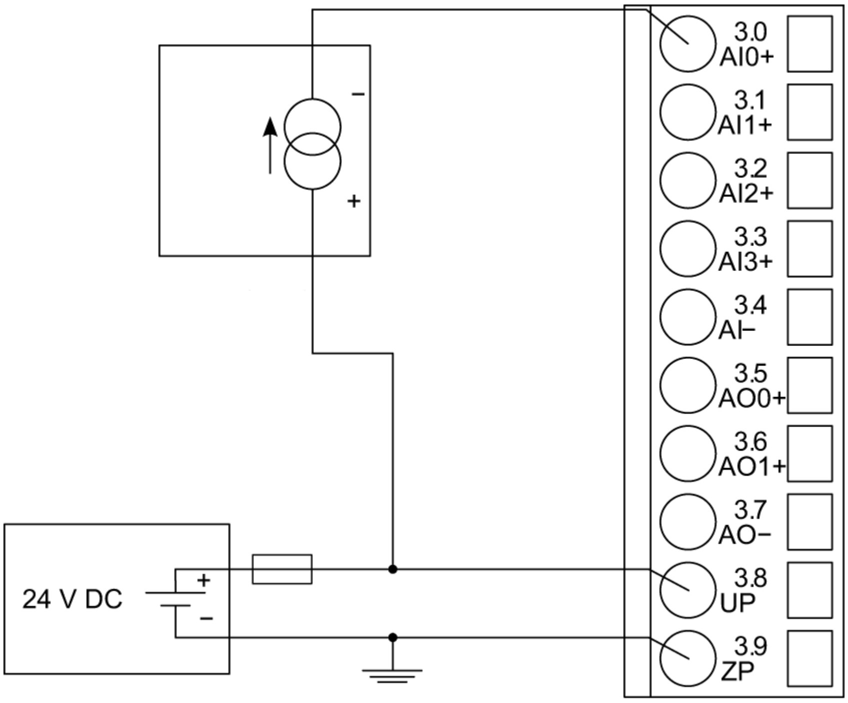


Fig. 137: Connection of passive-type analog sensors (current) to the analog inputs (AI0 ... AI3)

The following measuring ranges can be configured ➪ *Chapter 5.4.4.1.2.6 “Parameterization” on page 753* ➪ *Chapter 5.4.4.1.2.9 “Measuring ranges” on page 761*:

Current	4 mA ... 20 mA	1 channel used

For a description of the function of the LEDs, please refer to Diagnosis and displays / Displays ➪ *Chapter 5.4.4.1.2.8 “State LEDs” on page 760*.

> **NOTICE!**
> **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 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.

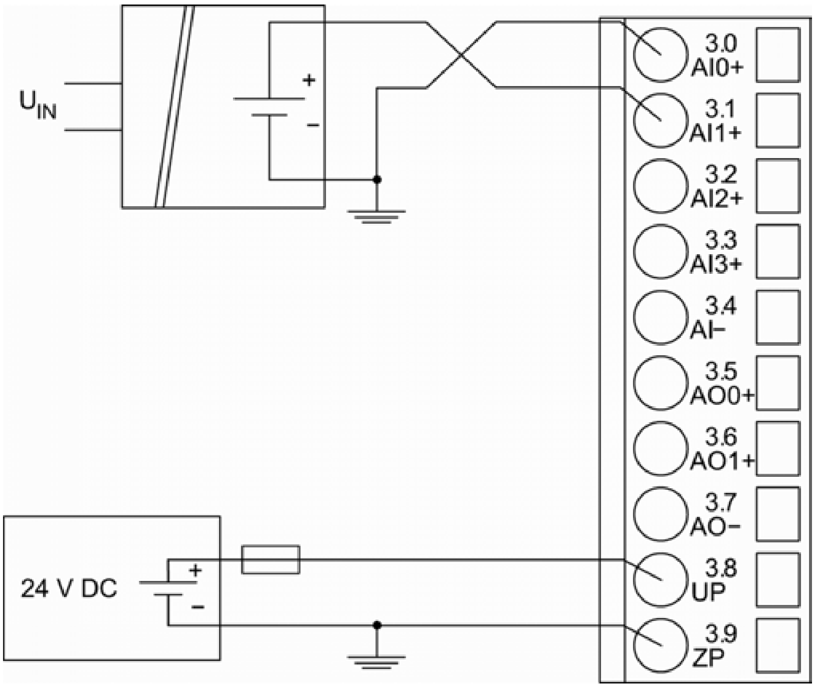


Fig. 138: Connection of active-type analog sensors (voltage) to differential analog inputs (AI0 ... AI3)

The following measuring ranges can be configured *Chapter 5.4.4.1.2.6 “Parameterization” on page 753* *Chapter 5.4.4.1.2.9 “Measuring ranges” on page 761*:

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 Diagnosis and displays / Displays *Chapter 5.4.4.1.2.8 “State LEDs” on page 760.*

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.

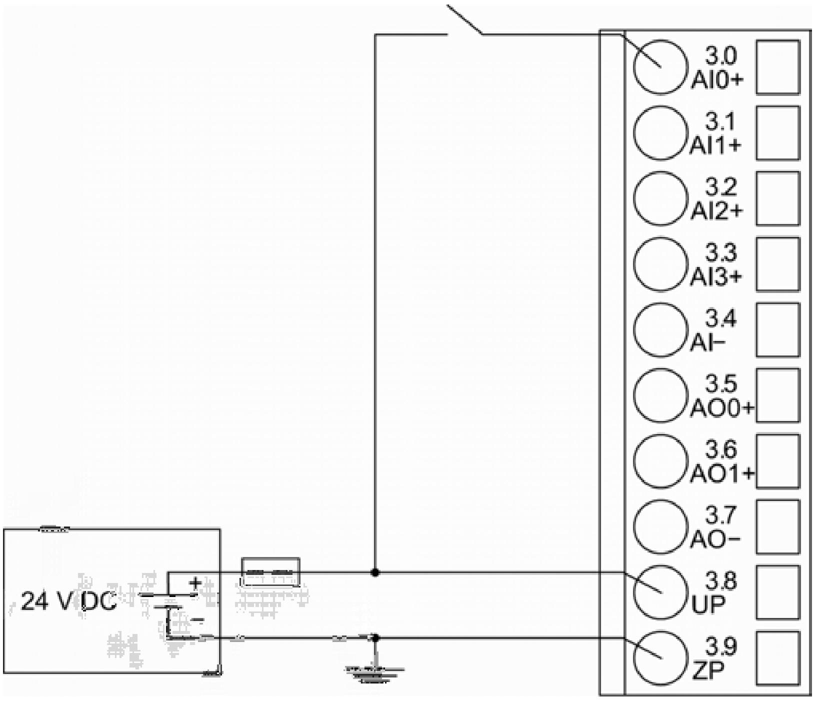


Fig. 139: connection of digital sensors to the analog input (AI0 ... AI3)

The following measuring ranges can be configured ⇨ *Chapter 5.4.4.1.2.6 “Parameterization” on page 753* ⇨ *Chapter 5.4.4.1.2.9 “Measuring ranges” on page 761* :

Digital input	24 V	1 channel used

For a description of the function of the LEDs, please refer to Diagnosis and displays / Displays ⇨ *Chapter 5.4.4.1.2.8 “State LEDs” on page 760*.

Connection of analog output loads (Voltage)

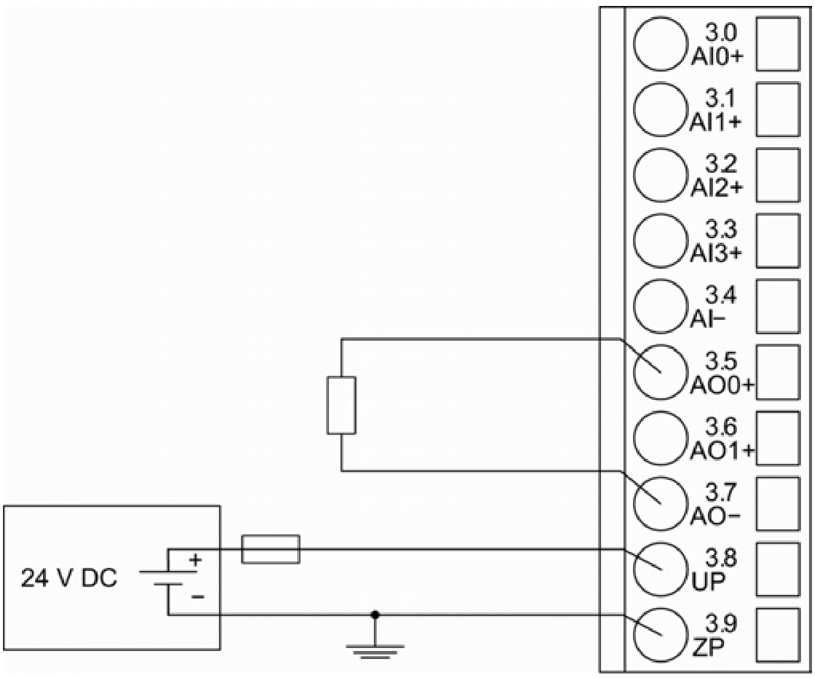


Fig. 140: Connection of analog output loads (voltage) to the analog outputs (AO0 ... AO1)

The following measuring ranges can be configured ↬ *Chapter 5.4.4.1.2.6 “Parameterization” on page 753* ↬ *Chapter 5.4.4.1.2.9 “Measuring ranges” on page 761*:

Voltage	-10 V ... +10 V	Load ± 10 mA max.	1 channel used

For a description of the function of the LEDs, please refer to Diagnosis and displays / Displays ↬ *Chapter 5.4.4.1.2.8 “State LEDs” on page 760*.

Unused analog outputs can be left open-circuited.

Connection of analog output loads (Current)

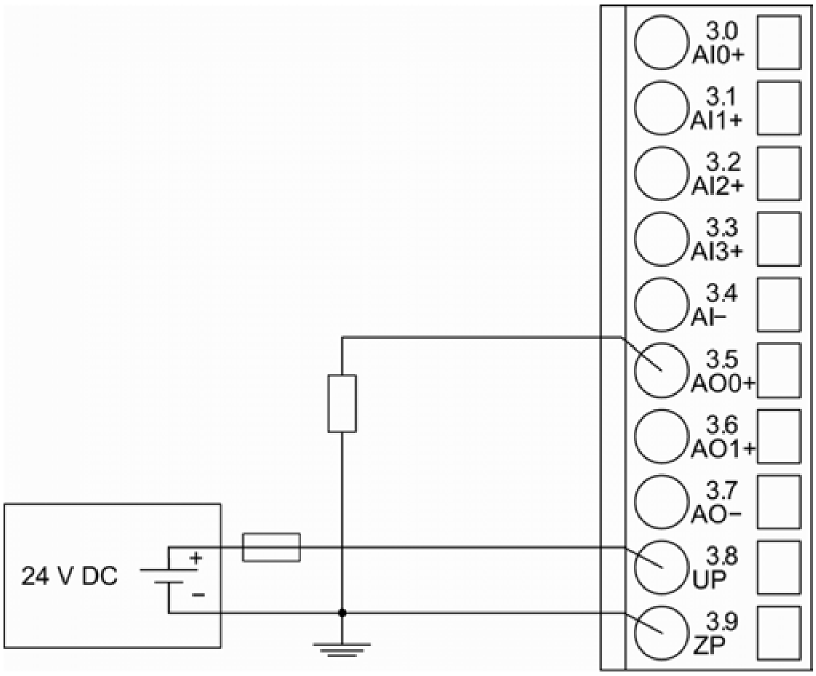


Fig. 141: Connection of analog output loads (current) to the analog outputs (AO0 ... AO1)

The following measuring ranges can be configured ↬ *Chapter 5.4.4.1.2.6 “Parameterization” on page 753*↬ *Chapter 5.4.4.1.2.9 “Measuring ranges” on page 761*:

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 Diagnosis and displays / Displays ↬ *Chapter 5.4.4.1.2.8 “State LEDs” on page 760*.

Unused analog outputs can be left open-circuited.

Internal data exchange

	Without the fast counter	**With the fast counter (only with AC500)**
Digital inputs (bytes)	1	1
Digital outputs (bytes)	3	3
Analog inputs (words)	4	4
Analog outputs (words)	2	2

	Without the fast counter	With the fast counter (only with AC500)
Counter input data (words)	0	5
Counter output data (words)	0	9

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.

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	EDS Slot / Index
Module ID [1])	Internal	1815	WORD	1815	0x0Y01
Ignore module	Internal	Yes No	BYTE	No	
Parameter length	Internal	8	BYTE	8	0xY02
Check supply	off	0	BYTE	1	0xY03
	on	1			

Name	Value	Internal value	Internal value, type	Default	EDS Slot / Index
Fast counter 3)	0 : 10 2)	0 : 10	BYTE	0	Not for FBP
Behavior outputs at comm. error 5)	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	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 *)

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 5.4.2.2.9 “Fast counter” on page 464*

3) With CS31 without the parameter "Fast Counter"

The fast counter of the module does not work if the module is connected to a CS31 bus module.

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 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	EDS Slot / Index
Input 0, Channel configuration	see table 'Channel configuration' *Table 190 " Channel configuration" on page 756*	see table 'Channel configuration' *Table 190 " Channel configuration" on page 756*	BYTE	0	0x0Y09
Input 0, Check channel	see table 'Channel monitoring' *Table 191 " Channel monitoring" on page 756*	see table 'Channel monitoring' *Table 191 " Channel monitoring" on page 756*	BYTE	0	0x0Y0A
:	:	:	:	:	
:	:	:	:	:	

Name	Value	Internal value	Internal value, type	Default	EDS Slot / Index
Input 3, Channel configuration	see table 'Channel configuration' *Table 190 " Channel configuration" on page 756*	see table 'Channel configuration' *Table 190 " Channel configuration" on page 756*	BYTE	0	0x0Y0F
Input 3, Check channel	see table 'Channel monitoring' *Table 191 " Channel monitoring" on page 756*	see table 'Channel monitoring' *Table 191 " Channel monitoring" on page 756*	BYTE	0	0x0Y10

Table 190: 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
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 191: 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 192 "Channel configuration" on page 757*	see table 'Channel configuration' *Table 192 "Channel configuration" on page 757*	BYTE	0	0x0Y11
Output 0, Check channel	see table 'Channel monitoring' *Table 193 "Channel monitoring" on page 758*	see table 'Channel monitoring' *Table 193 "Channel monitoring" on page 758*	BYTE	0	0x0Y12
Output 0, Substitute value	see table 'Substitute values' *Table 194 "Substitute value" on page 758*	see table 'Substitute values' *Table 194 "Substitute value" on page 758*	WORD	0	0x0Y13
Output 1, Channel configuration	see table 'Channel configuration' *Table 192 "Channel configuration" on page 757*	see table 'Channel configuration' *Table 192 "Channel configuration" on page 757*	BYTE	0	0x0Y14
Output 1, Check channel	see table 'Channel monitoring' *Table 193 "Channel monitoring" on page 758*	see table 'Channel monitoring' *Table 193 "Channel monitoring" on page 758*	BYTE	0	0x0Y15
Output 1, Substitute value	see table 'Substitute values' *Table 194 "Substitute value" on page 758*	see table 'Substitute values' *Table 194 "Substitute value" on page 758*	WORD	0	0x0Y16

Table 192: 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 193: Channel monitoring

Internal value	Check channel
0	Plausibility, wire break, short circuit
3	None

Table 194: 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 s	0
Last value for 10 s and then turn off	Last value 10 s	0
Substitute value infinite	Substitute value	Depending on configuration
Substitute value for 5 s and then turn off	Substitute value 5 s	Depending on configuration
Substitute value for 10 s and then turn off	Substitute value 10 s	Depending on configuration

Diagnosis

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.

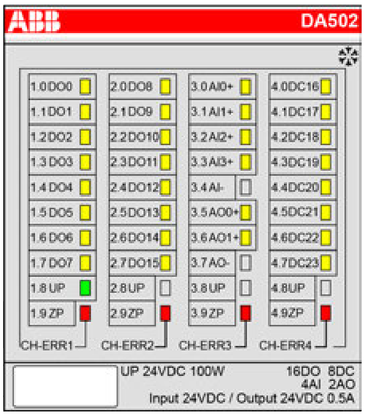
E1 ... E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000 ... 063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**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	
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	40	Different hard-/firmware versions in the 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	43	Internal error in the module	
	11 / 12	ADR	1 ... 10				
3	14	1 ... 10	31	31	36	Internal data exchange failure	
	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 DA502							
4	14	1 ... 10	2	0 ... 15	47	Short-circuit at a digital output	Check connection
	11 / 12	ADR	1 ... 10	22 ... 29 [5])			
Channel error DA502							
4	14	1 ... 10	1	16 ... 19 [6])	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	16 ... 19 [6])	7	Analog value underflow at an analog input	Check input value
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	1	16 ... 19 [6])	47	Short circuit at an analog input	Check ter-minal
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	3	20 ... 21 [7])	4	Analog value overflow at an analog output	Check output value
	11 / 12	ADR	1 ... 10				
4	14	1 ... 10	3	20 ... 21 [7])	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.
[2])	With "Device" the following allocation applies: 31 = module itself, 1 ... 10 = 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: 31 = Module itself; COM1/COM2: 1 ... 10 = expansion 1 ... 10 Channel error: I/O bus = module type (1 = AI, 3 = AO, 4 = DC); COM1/COM2: 1 ... 10 = expansion 1 ... 10
[4])	In case of module errors, with channel "31 = module itself" is output.
[5])	Ch = 22 ... 29 indicate the digital inputs/outputs DC16 ... DC23
[6])	Ch = 16 ... 19 indicates the analog inputs AI0 ... AI3
[7])	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

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
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 ... +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 / Pt1000** **-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

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

The system data of AC500 and S500 are applicable to the standard version ↳ *Chapter 4.2 “System data AC500” on page 30*.

The system data of AC500-XC are applicable to the XC version ↳ *Chapter 4.3 “System data AC500-XC” on page 35*.

Only additional details are therefore documented below.

The technical data are 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		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 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
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 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		
	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
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 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 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.

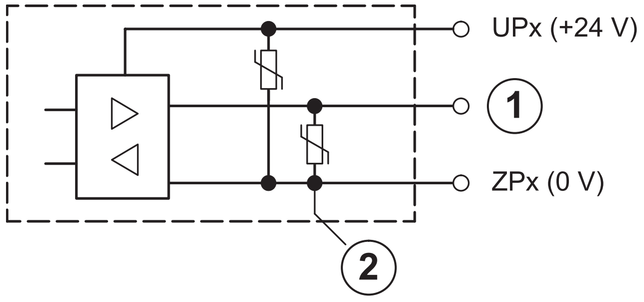


Fig. 142: Digital input/output (circuit diagram)

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
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 5.4.4.1.2.9.2 “Input ranges resistance temperature detector” on page 761*

Parameter	Value
Unused inputs	Are configured as "unused" (default value)
Overvoltage protection	Yes

Technical data of the analog inputs, if used as digital inputs

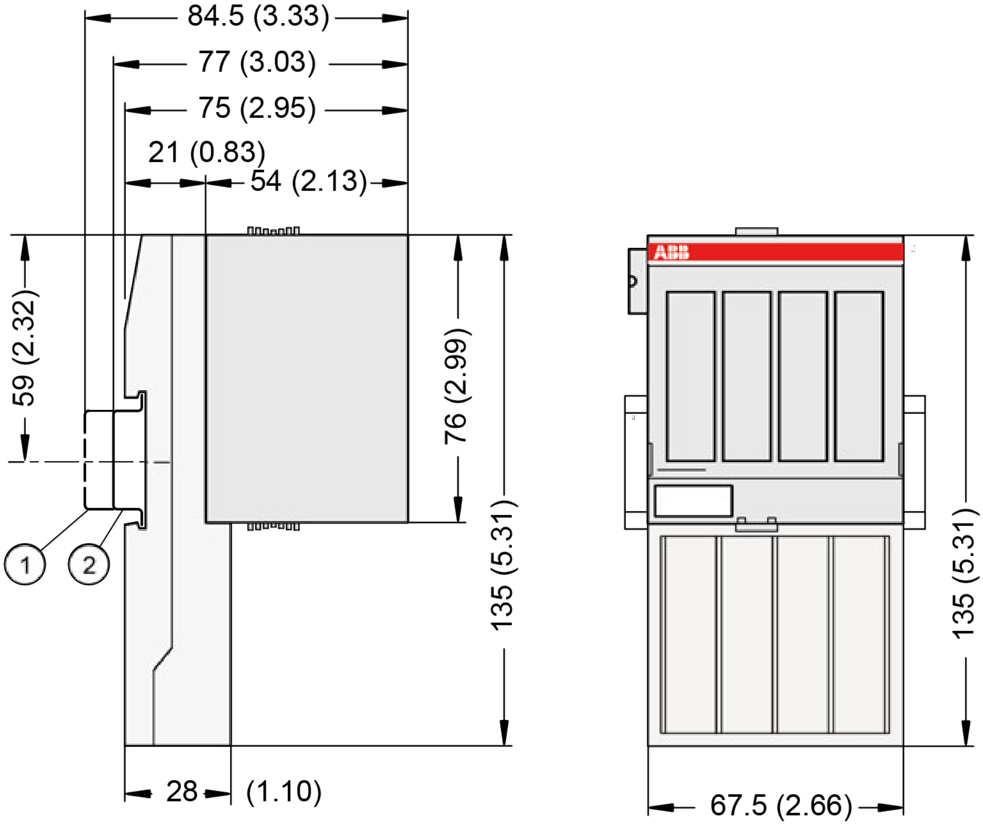
Parameter		Value
Number of channels per module		Max. 4
Distribution of channels into groups		1 group of 4 channels
Connections of the channels AI0+ ... AI3+		Terminals 3.0... 3.3
Reference potential for the inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (ZP)
Indication of the input signals		1 LED per channel
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

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	*Chapter 5.4.4.1.2.9.3 “Output ranges voltage and current” on page 762*
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

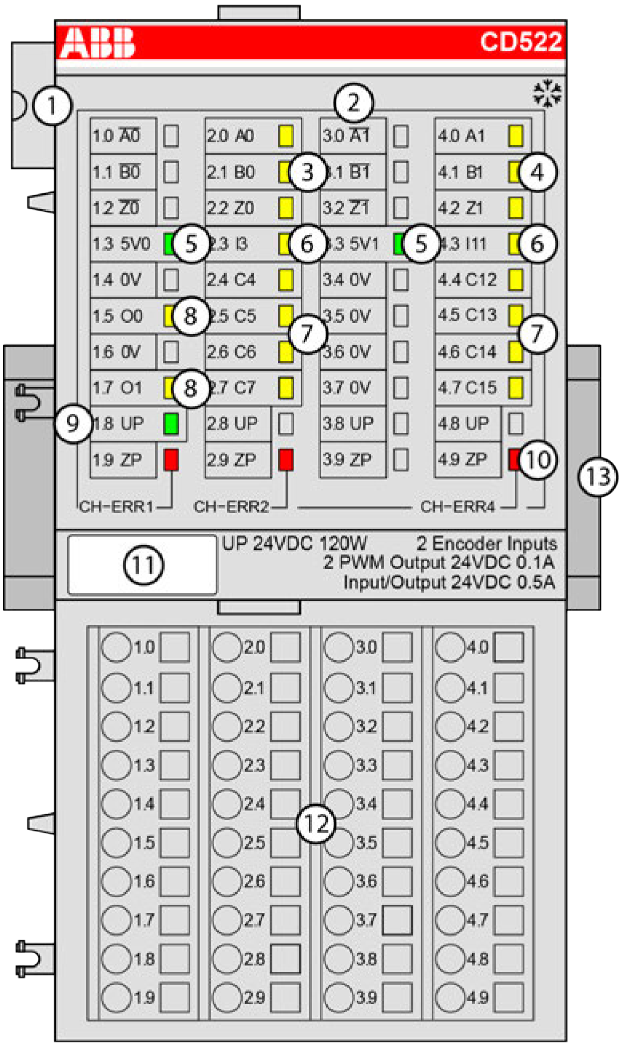
**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.4.5 Function modules

5.4.5.1 S500 and S500-XC

5.4.5.1.1 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 *Chapter 5.5.1 "TU515, TU516, TU541 and TU542 for I/O modules" on page 801*

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 5.5.1 "TU515, TU516, TU541 and TU542 for I/O modules" on page 801*.

Table 195: 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

Terminal	Signal	Description
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)
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 you

– 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.

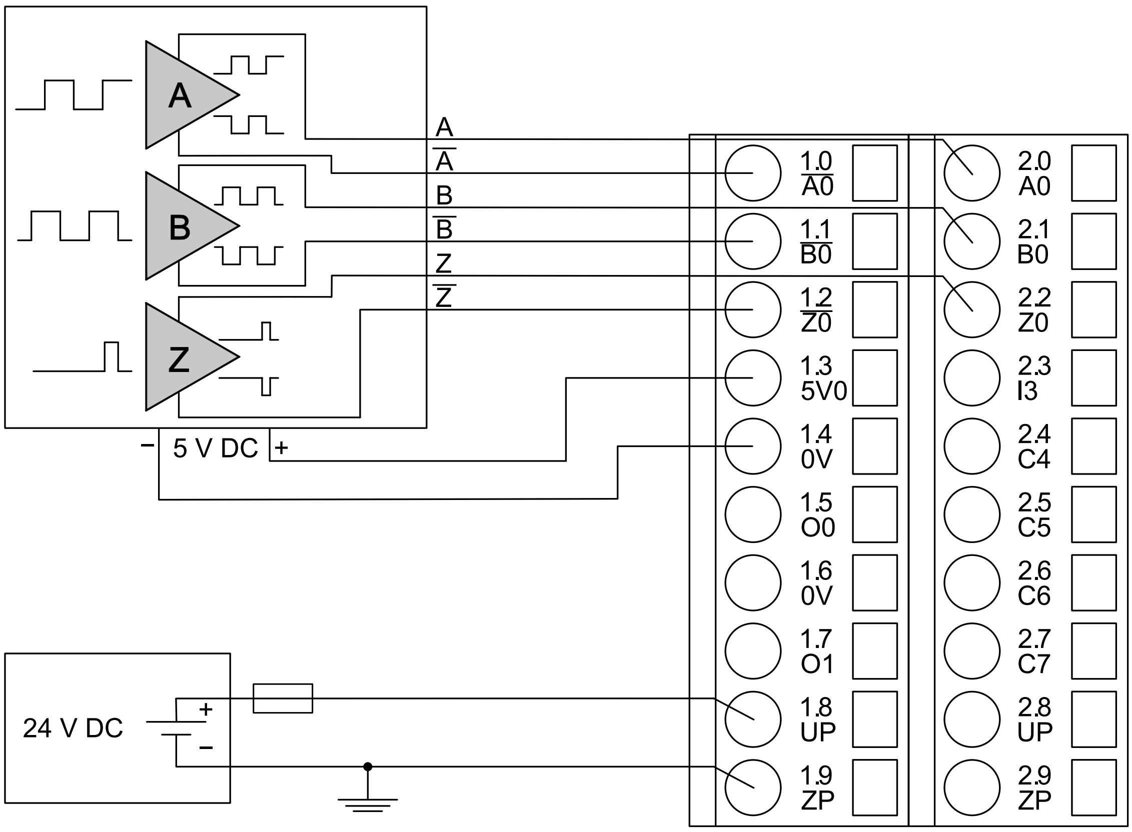
NOTICE!
Risk of damaging the PLC modules!

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.

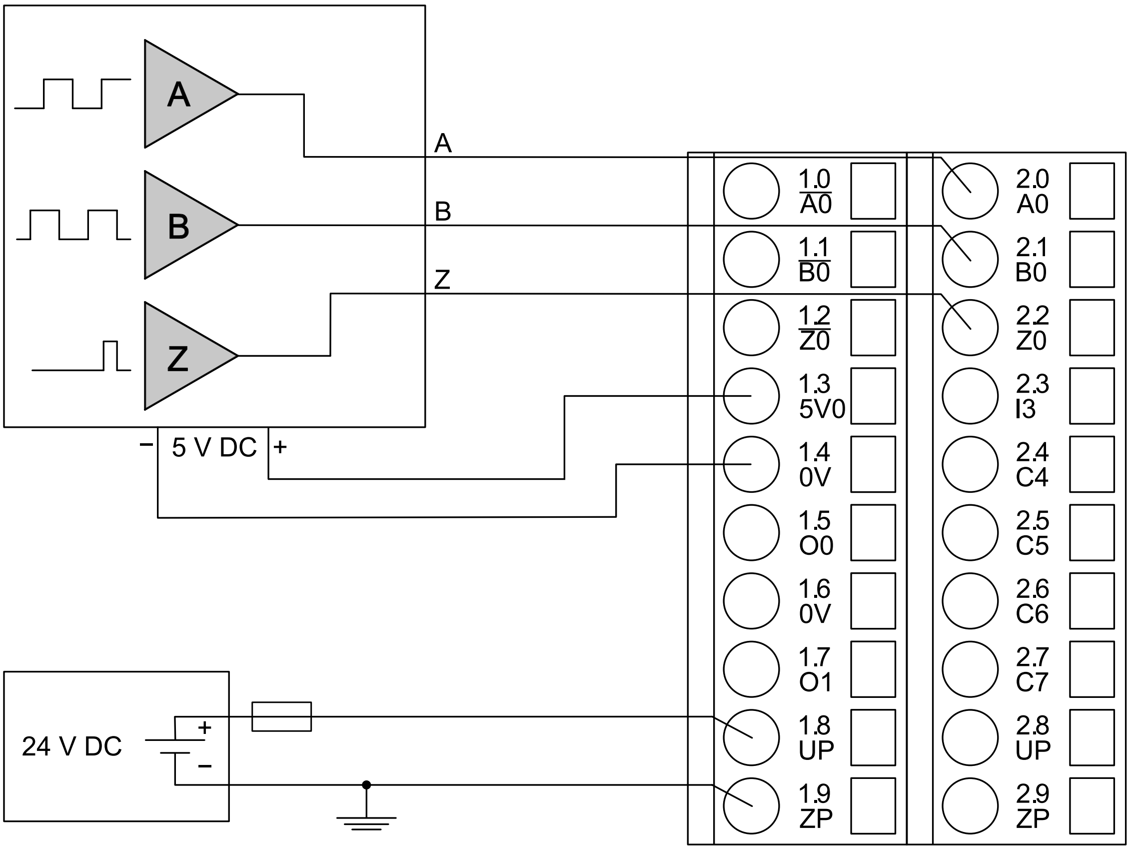
Connection of encoders with differential RS-422 signal

The encoder is powered by the 5 V power supply which is integrated in CD522.

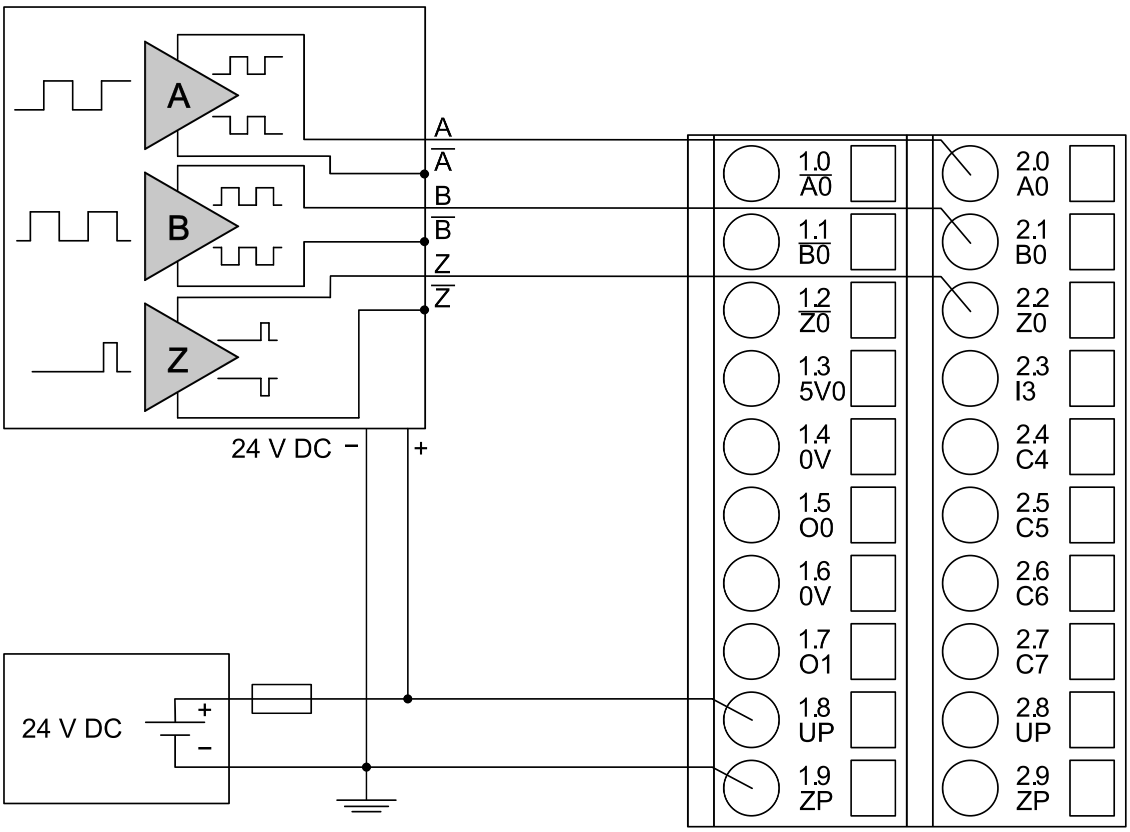


Connection of encoders with 5 V TTL signal

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

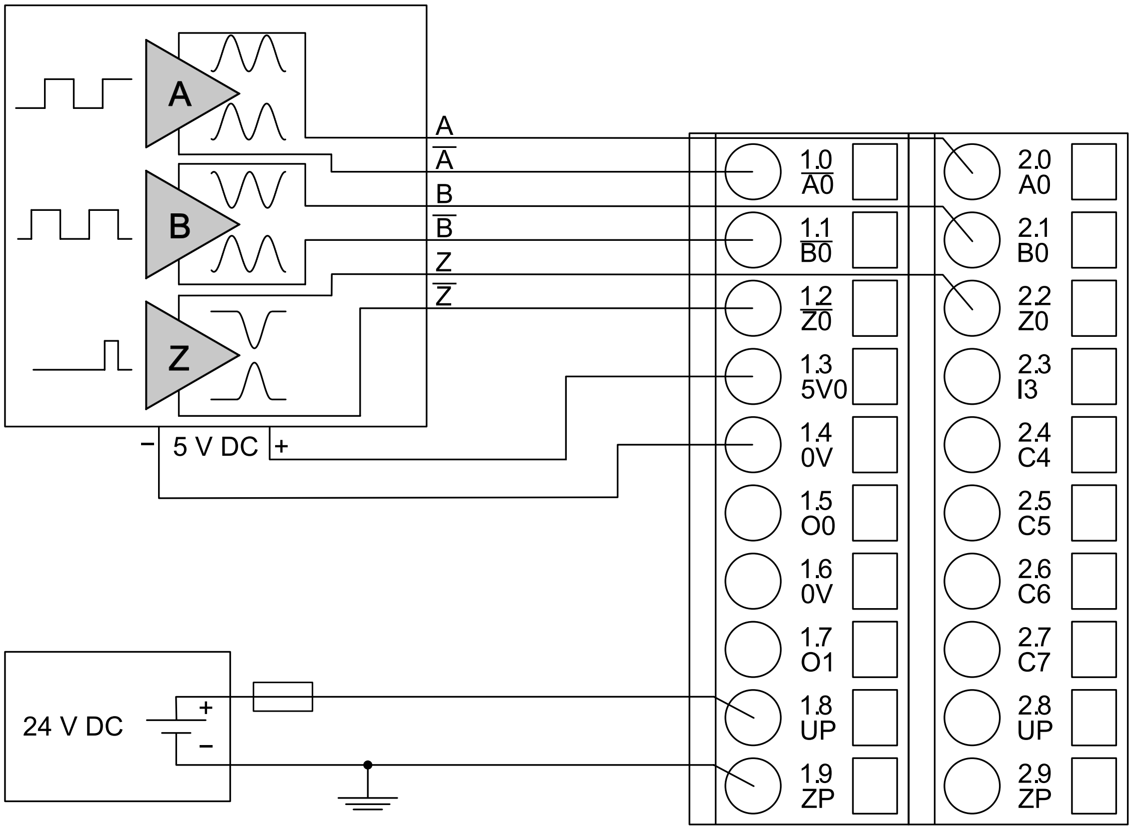


The wires A, B and Z need not to be connected to the module. They are left open.

When using different power supplies for the encoder device and the CD522, make sure that the reference potentials of both power supplies are interconnected.

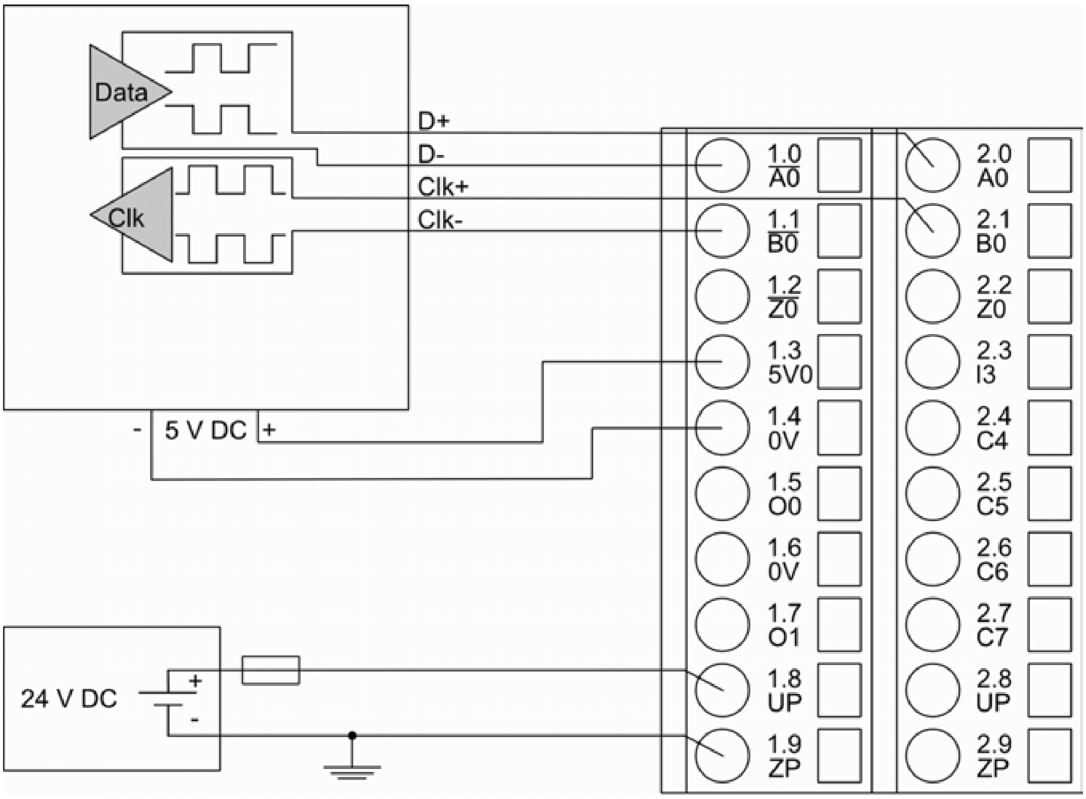
Connection of encoders with 1 Vpp sine signal

The encoder is powered through the 5 V power supply which is integrated in the CD522.



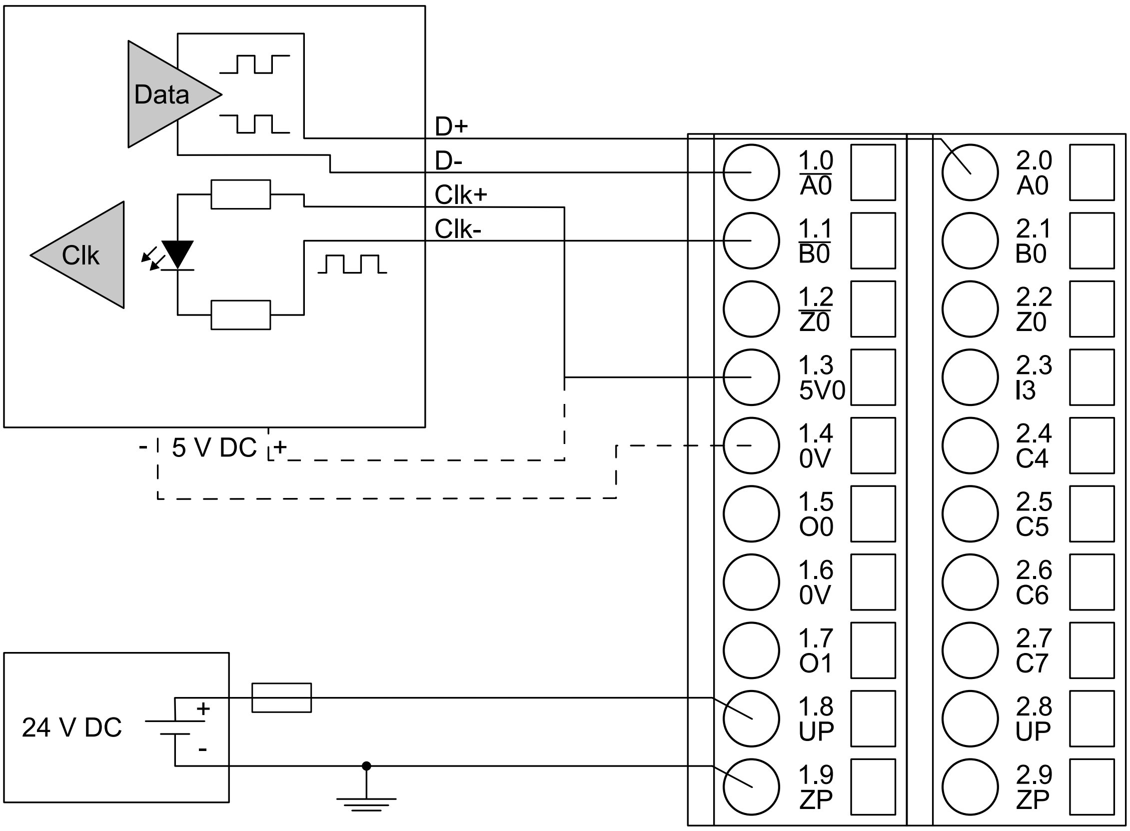
Connection of absolute encoders with SSI interface and differential RS-422 signal

The encoder is powered by the 5 V power supply which is integrated in the CD522.

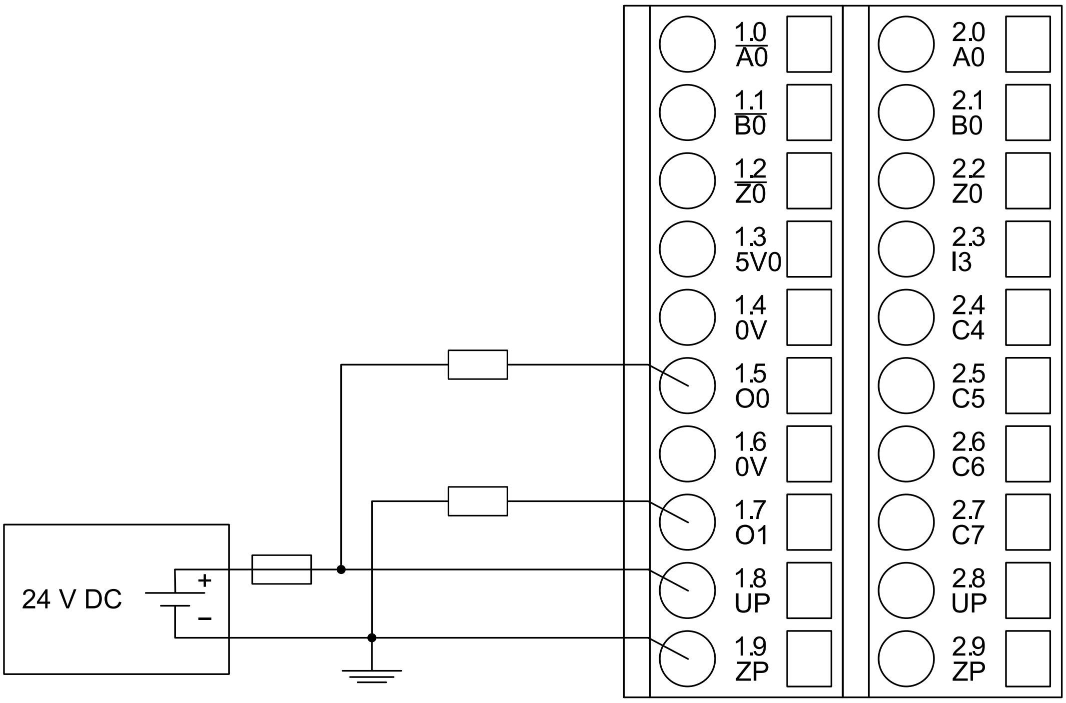


Connection of absolute encoders with an SSI interface and an optocoupler interface at CLK input

The encoder can optionally be powered by the 5 V power supply which is integrated in the CD522.



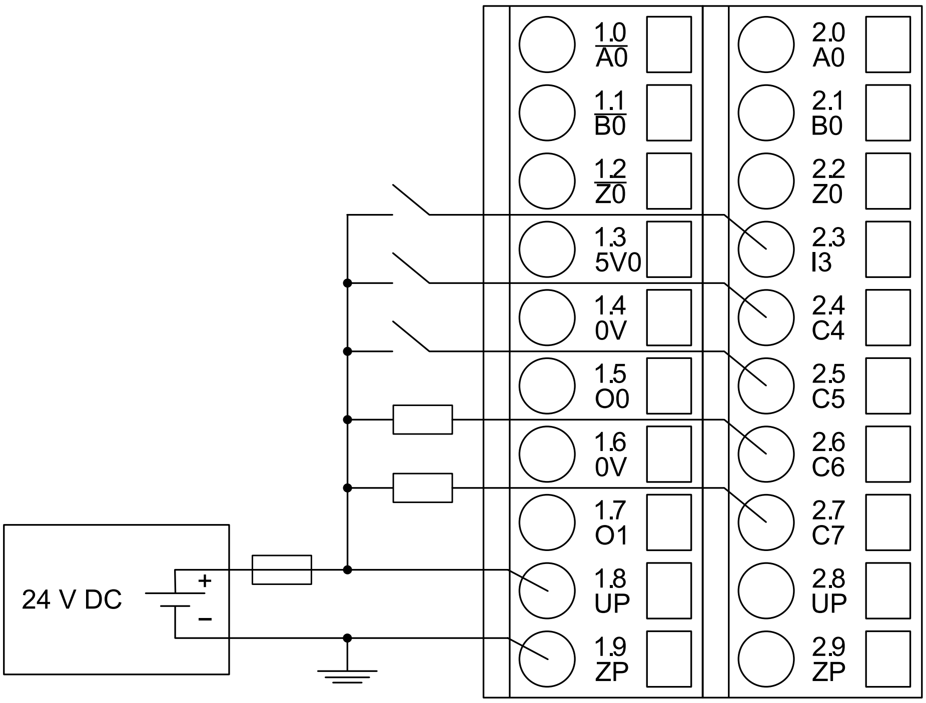
Connection of output loads to the PWM/Pulse putputs



> **NOTICE!**
> **Risk of damaging the module**
> The PWM outputs have no protection against reverse polarity.

Connection of standard inputs/ outputs

Proceed with the inputs/outputs I11 and C12 ... C15 in the same way.



Connection of sensors with frequency out-puts

Proceed with the A0, B0, A1, B1 and Z1 in the same way.

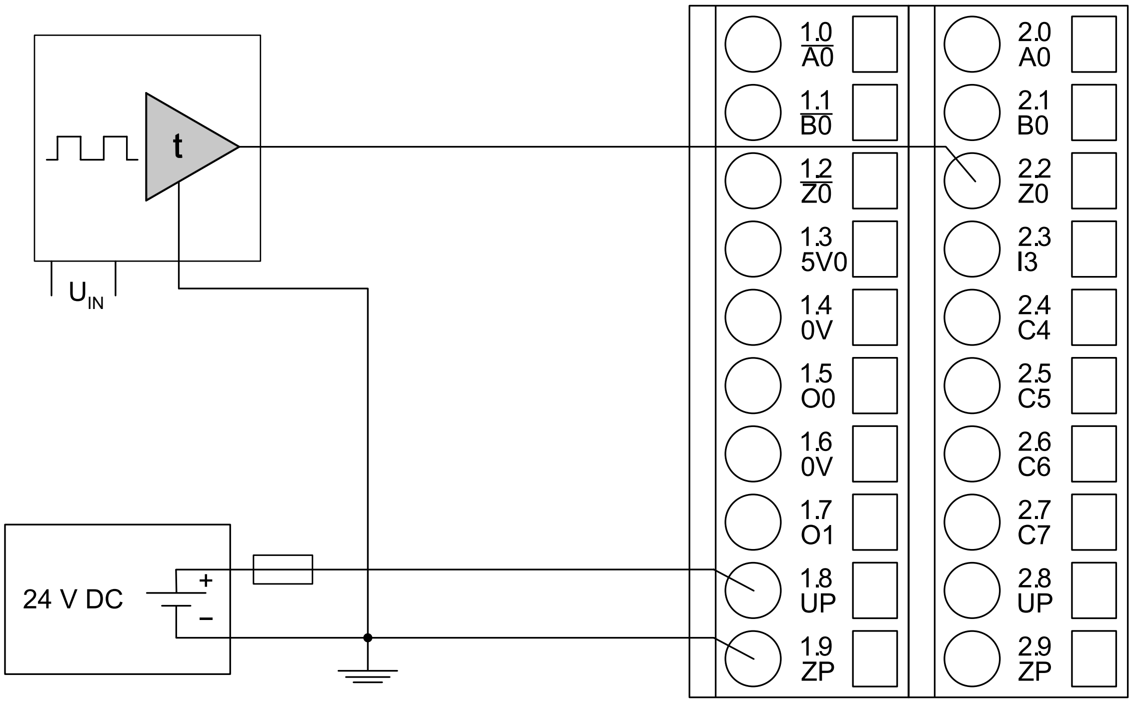


Fig. 143: Example of the connection of sensors with frequency outputs to the input Z0 of the CD522

NOTICE!

Risk of malfunctions!

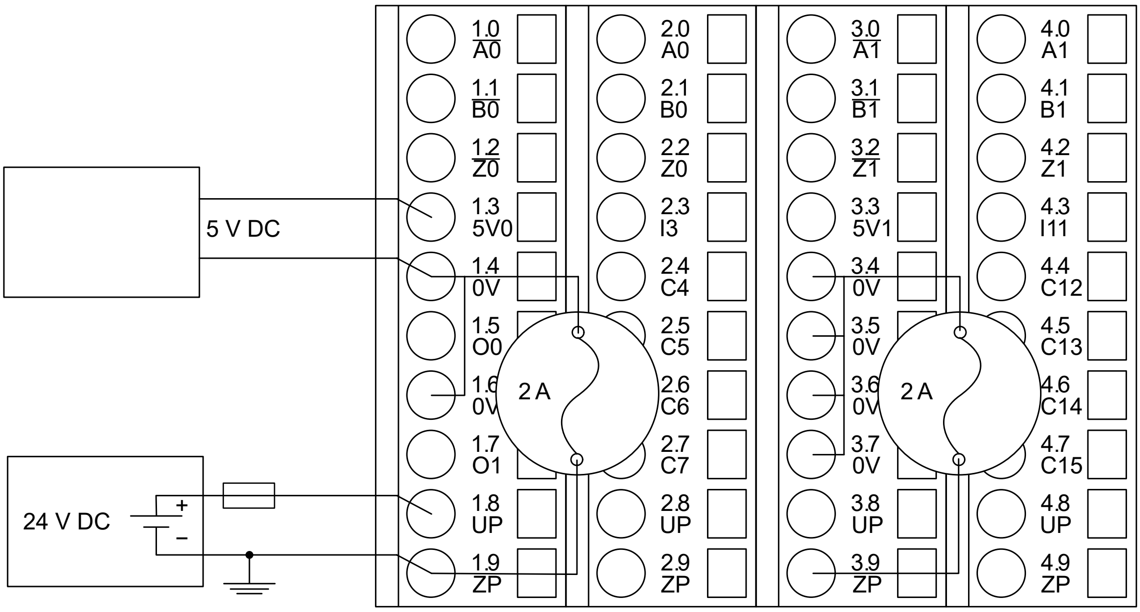
The edges of a signal must be strong enough (0.4 V/µs) to be recognized correctly by the module.

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

<table>
<tr><th colspan="6">TYPE structCD522In</th></tr>
<tr><td colspan="6">STRUCT</td></tr>
<tr><td>StateBytePWM0</td><td>High Byte</td><td>0..100</td><td colspan="3">Percentage of pulses already sent on channel 0</td></tr>
<tr><td>StateBytePWM1</td><td>Low Byte</td><td>0..100</td><td colspan="3">Percentage of pulses already sent on channel 1</td></tr>
<tr><td>StateByteC0</td><td>High Byte</td><td></td><td colspan="3">*)</td></tr>
<tr><td rowspan="9">InputC0</td><td rowspan="9">Low Byte</td><td rowspan="9"></td><td>Name</td><td>Bitposition</td><td>Description</td></tr>
<tr><td>Input A</td><td>0</td><td>Digital Input A</td></tr>
<tr><td>Input B</td><td>1</td><td>Digital Input B</td></tr>
<tr><td>Input Z</td><td>2</td><td>Digital Input C</td></tr>
<tr><td>Input I3</td><td>3</td><td>Digital Input I3</td></tr>
<tr><td>Input I4</td><td>4</td><td>Digital Input I4</td></tr>
<tr><td>Input I5</td><td>5</td><td>Digital Input I5</td></tr>
<tr><td>Input I6</td><td>6</td><td>Digital Input I6</td></tr>
<tr><td>Input I7</td><td>7</td><td>Digital Input I7</td></tr>
<tr><td>TouchCounterHiC0</td><td>WORD</td><td></td><td colspan="3"></td></tr>
<tr><td>TouchCounterLoC0</td><td>WORD</td><td></td><td colspan="3"></td></tr>
<tr><td>CounterHiC0</td><td>WORD</td><td></td><td colspan="3"></td></tr>
<tr><td>CounterLoC0</td><td>WORD</td><td></td><td colspan="3"></td></tr>
<tr><td>CounterHiC1</td><td>WORD</td><td></td><td colspan="3"></td></tr>
<tr><td>CounterLoC1</td><td>WORD</td><td></td><td colspan="3"></td></tr>
<tr><td>ReservedWC1</td><td>WORD</td><td></td><td colspan="3"></td></tr>
<tr><td>StateByteC1</td><td>High Byte</td><td></td><td colspan="3">*)</td></tr>
<tr><td rowspan="7">InputC1</td><td rowspan="7">Low Byte</td><td rowspan="7"></td><td>Name</td><td>Bitposition</td><td>Description</td></tr>
<tr><td>Input A</td><td>0</td><td>Digital Input A</td></tr>
<tr><td>Input B</td><td>1</td><td>Digital Input B</td></tr>
<tr><td>Input Z</td><td>2</td><td>Digital Input C</td></tr>
<tr><td>Input I3</td><td>3</td><td>Digital Input I3</td></tr>
<tr><td>Input I4</td><td>4</td><td>Digital Input I4</td></tr>
<tr><td>Input I5</td><td>5</td><td>Digital Input I5</td></tr>
</table>

TYPE structCD522In					
			Input I6	6	Digital Input I6
			Input I7	7	Digital Input I7
Touch-Coun-terHiC1	WORD				
Touch-Coun-terLoC1	WORD				
END_STRUCT					
END_TYPE					

*Table 196: *) 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)
5	RESET0_INPUT Logical OR on all inputs configured as reset0 input	RESET0_INPUT Logical OR on all inputs con-figured as reset0 input
6	not used	not used
7	not used	RESET1_INPUT Logical OR on all inputs con-figured 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

Bit	16-bit One Counter Mode (8)	Time frequency meter mode (15)
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
DutyPul-sePWM0	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
		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
Reser-vedBPWM0	Low Byte		
Reser-vedWPWM0	WORD		
FreqPWM1	WORD	0…65535	PWM frequency of channel 1 Unit: Hz or 10Hz (depending on control byte in slot 3) Limit: 100kHz
DutyPul-sePWM1	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**

TYPE structCD522Out			
		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
Out-putPW0PWM1	Low Byte	Bit 0 = Digital output value of channel 0 BIT 4 = Digital output value of channel 1	
Reser-vedWPWM1	WORD		
Counter-SetHiC0	WORD		
Counter-SetLoC0	WORD		
CtrlByteC0	High Byte		**)
OutputC0	Low Byte		
ReservedWC0	WORD		
Counter-SetHiC1	WORD		
Counter-SetLoC1	WORD		
CtrlByteC1	High Byte		**)
OutputC1	Low Byte		
ReservedWC1	WORD		
END_STRUCT			
END_TYPE			

*Table 197: **) 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

Bit	One Counter Modes (1,2,5,6,8)	Two Counter Modes (3,4)
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
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

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
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 Differen- tial 1 Vpp sinus	0 1 2 3	BYTE	0-24 V DC 0x00	0	3	0X0Y07
SSI 0 fre- quency	200 kHz 500 kHz 1 MHz	2 3 4	BYTE	200 kHz 0x02	0	4	0x0Y08
SSI 0 res- olution (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

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
Counter 1 input level	0-24 V DC 0-5 V DC Differen-tial 1 Vpp sinus	0 1 2 3	BYTE	0-24 V DC 0x00	0	3	0X0Y0F
SSI 1 fre-quency	200 kHz 500 kHz 1 MHz	2 3 4	BYTE	200 kHz 0x02	2	4	0x0Y10
SSI 1 res-olution (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
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 198: 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

Internal value	Operating modes of counter
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 199: 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

E1...E4	d1	d2	d3	d4	Identi-fier 000 ... 063	AC500 dis-play	<− 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	Inter-face	Device	Module	Channel	Error identi-fier	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				

Table 200: Channel error CD522

E1...E4	d1	d2	d3	d4	Identi-fier 000 ... 063	AC500dis-play	<− 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	Inter-face	Device	Module	Channel	Error identi-fier	Error message	Remedy
	[1])	[2])	[3])	[4])			
Channel error							
4	14	1...10	1	0...15	47	Output short cir-cuit	Check output con-nection or terminal
	11 / 12	ADR	1..10				
4	14	1...10	1	0, 1, 8, 9	10	Input frequency too high	Check fre-quency 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 pro-gram
	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				

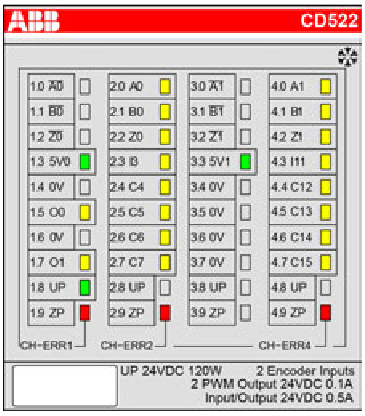
E1...E4	d1	d2	d3	d4	Identifier 000 ... 063	AC500display	<− Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6 ... 7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0 ... 5**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**	**Remedy**
	[1])	**[2])**	**[3])**	**[4])**			
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	---
CH-ERR1, CH-ERR2, CH-ERR4		Red	Severe error within the corresponding 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 indication	Red	Internal error or configuration is not loaded	--	---
*) All LEDs CH-ERR1, CH-ERR2 and CH-ERR4 light up simultaneously					

Technical data

The system data of AC500 and S500 are applicable to the standard version ⮩ *Chapter 4.2 "System data AC500" on page 30.*

The system data of AC500-XC are applicable to the XC version *Chapter 4.3 “System data AC500-XC” on page 35*.

Only additional details are therefore documented below.

The technical data are 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 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
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/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

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 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 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 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	

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

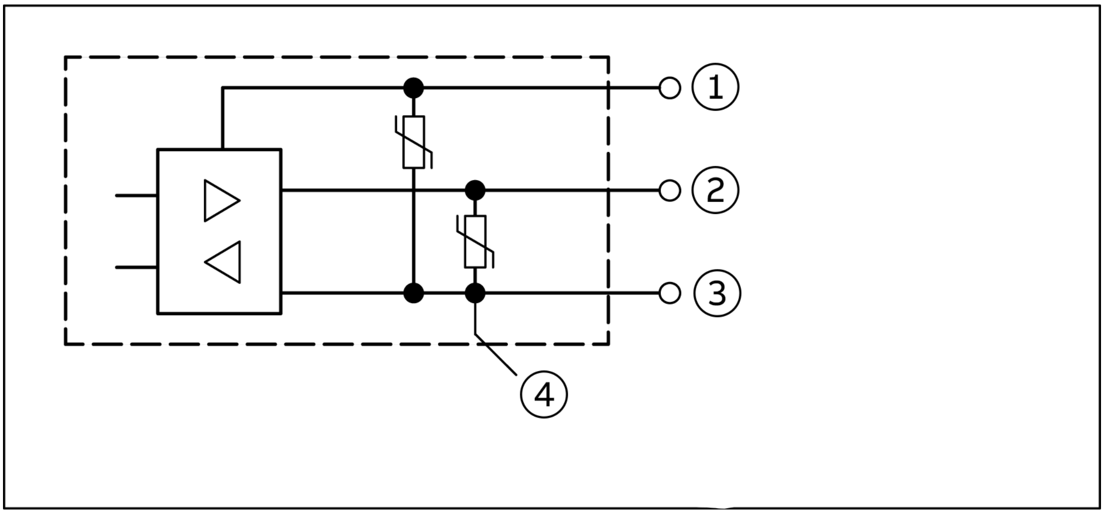


Fig. 144: Digital input/output (circuit diagram)

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

Parameter		Value	
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		

Parameter		Value
	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)
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	≥ 2.9 V at 10 mA
Output voltage for signal 0	≤ 1.3 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)
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

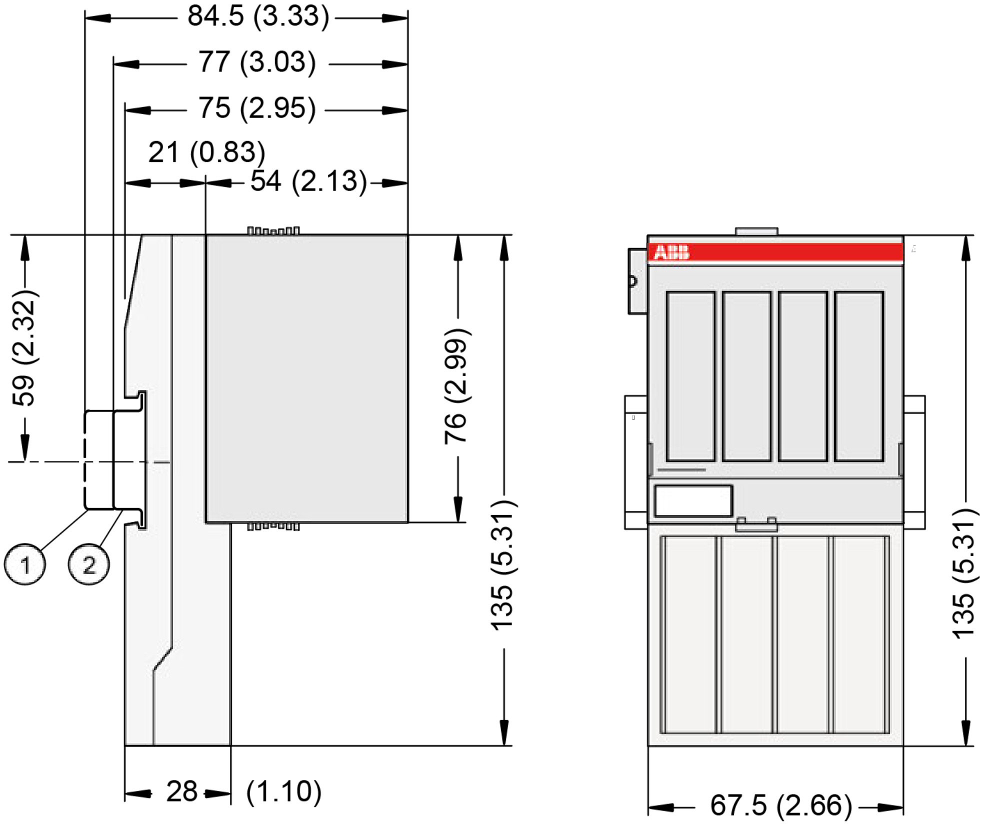
Technical data of the 5 V sensor supply

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
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

Hot swap

System requirements for hot swapping of I/O modules:

- *Types of terminal units that support hot swapping of I/O modules have the appendix TU5xx**-H**.*
- *I/O modules as of index F0.*

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

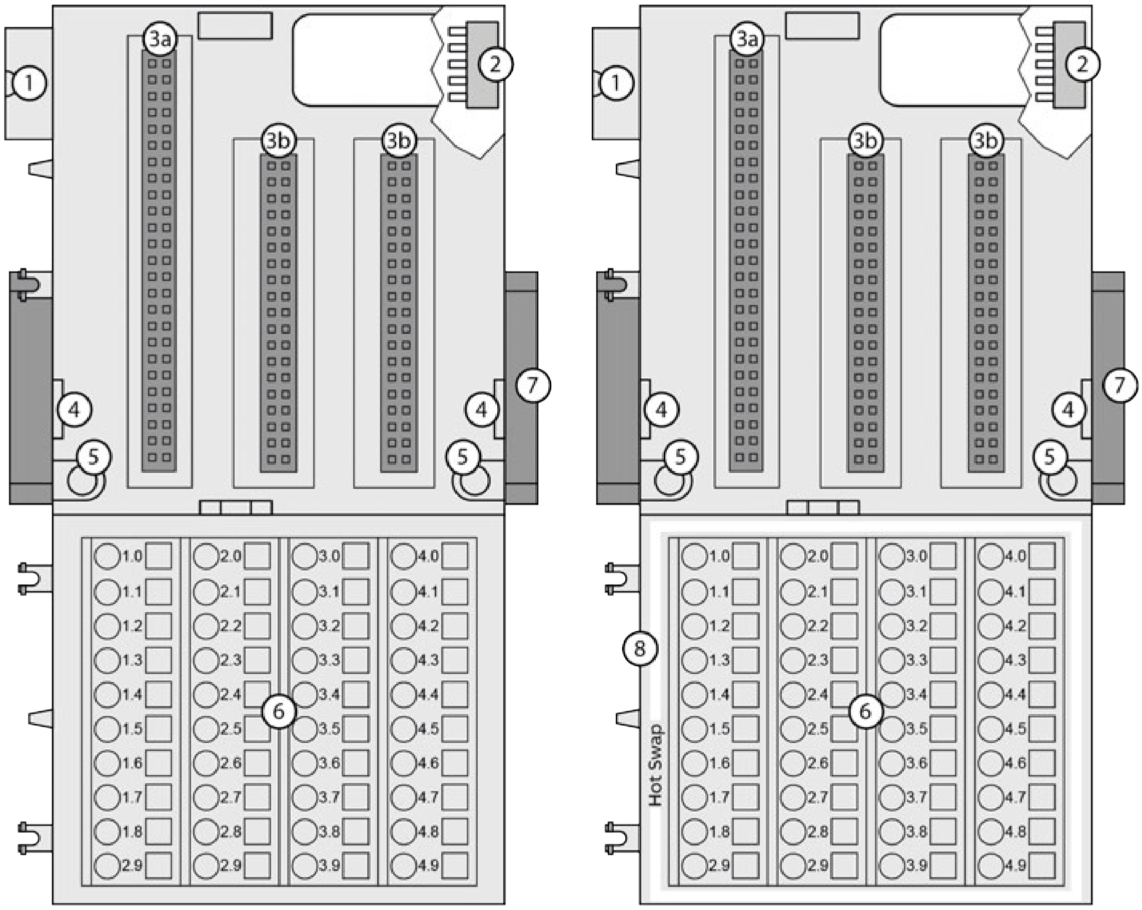
- *Digital outputs are not under load.*
- *Input/output voltages above safety extra low voltage/ protective extra low voltages (SELV/PELV) are switched off.*
- *Modules are completely plugged on the terminal unit with both snap fit engaged before switching on loads or input/output voltage.*

.

5.5.1 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

Hot swap

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

- 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.

H = **H**ot swap

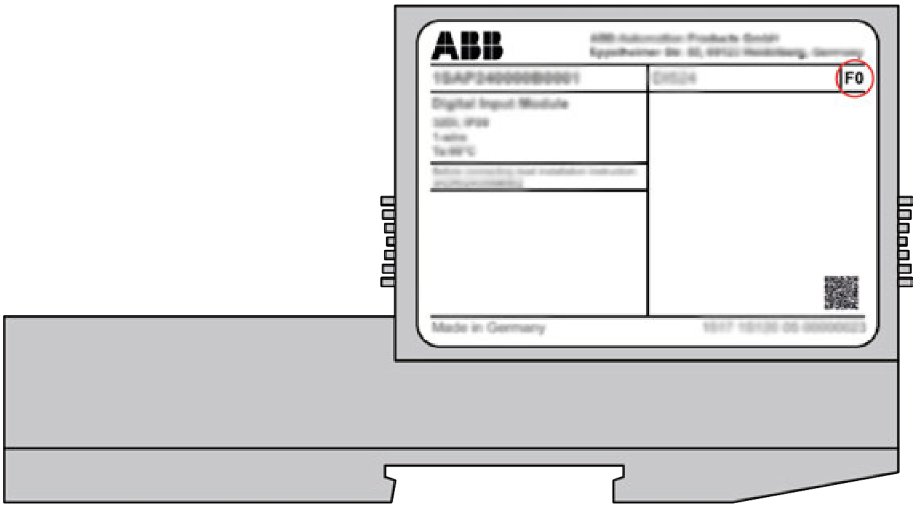
Hot swap
System requirements for hot swapping of I/O modules:

- *Types of terminal units that support hot swapping of I/O modules have the appendix TU5xx-**H**.*
- *I/O modules as of index F0.*

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.*

Hot swap is not supported by AC500-eCo V3 CPU!



The index of the module is in the right corner of the label.

NOTICE!
Risk of damage to I/O modules!
Modules with index below F0 can be damaged when inserted or removed from the terminal unit in a powered system.

NOTICE!
Risk of damage to I/O modules!
Do not perform hot swapping if any I/O module with firmware version lower than 3.0.14 is part of the I/O configuration.

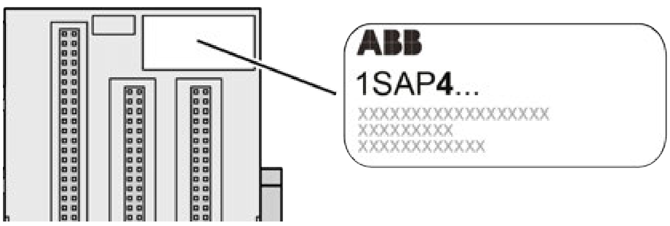
For min. required device index see table below.

Device	Min. required device index for I/O module as of FW Version 3.0.14
AC522(-XC)	F0
AI523 (-XC)	D2
AI531	D4
AI531-XC	D2
AI561	B2
AI562	B2
AI563	B3
AO523 (-XC)	D2
AO561	B2
AX521 (-XC)	D2
AX522 (-XC)	D2
AX561	B2
CD522 (-XC)	D1

Device	Min. required device index for I/O module as of FW Version 3.0.14
DA501 (-XC)	D2
DA502 (-XC)	F0
DC522 (-XC)	D2
DC523 (-XC)	D2
DC532 (-XC)	D2
DC562	A2
DI524 (-XC)	D2
DI561	B2
DI562	B2
DI571	B2
DI572	A1
DO524 (-XC)	A3
DO526	A2
DO526-XC	A0
DO561	B2
DO562	A2
DO571	B3
DO572	B2
DO573	A1
DX522 (-XC)	D2
DX531	D2
DX561	B2
DX571	B3
FM562	A1

XC version

XC = e**X**treme **C**onditions

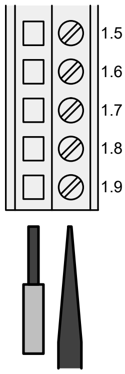
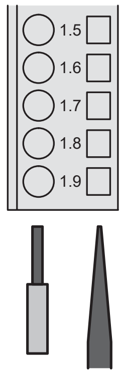


Extreme conditions

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).

5.5.1.1 Technical data

The system data of AC500 and S500 are applicable to the standard version ↳ *Chapter 4.2 “System data AC500” on page 30*.

The system data of AC500-XC are applicable to the XC version ↳ *Chapter 4.3 “System data AC500-XC” on page 35*.

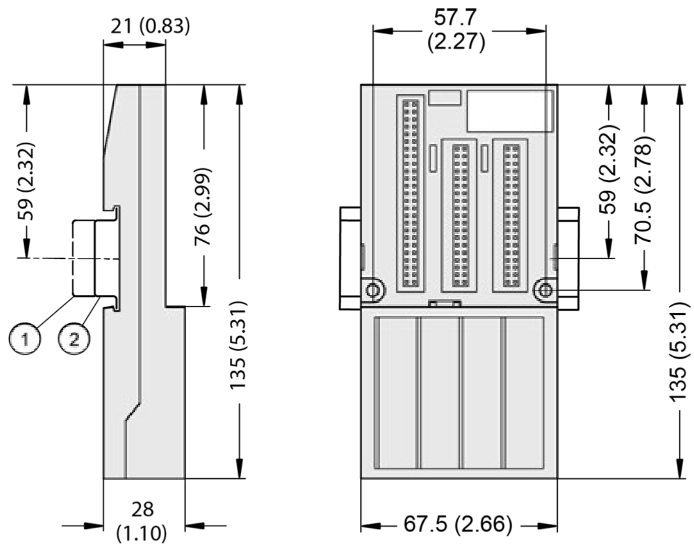
Only additional details are therefore documented below.

The technical data are 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

Parameter	Value
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

5.5.1.2 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

5.5.1.3 Ordering data

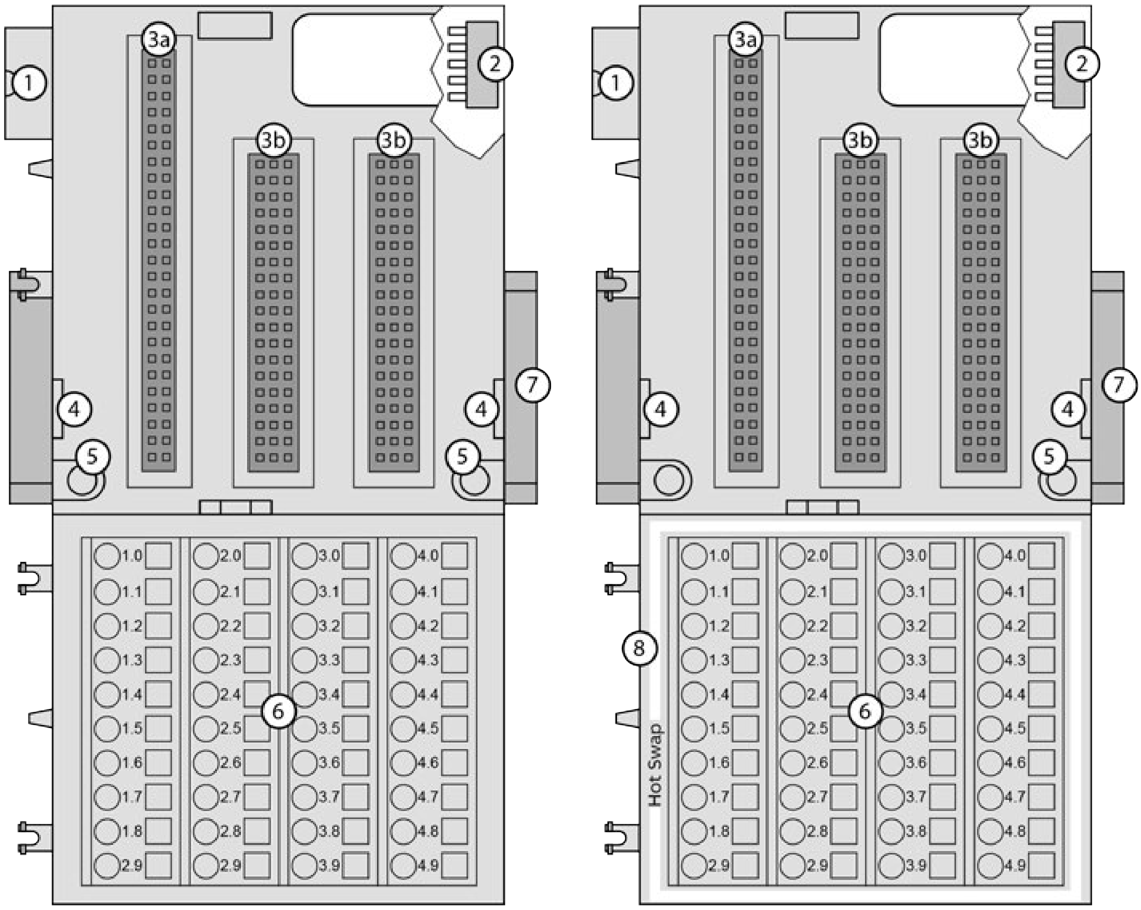
Part no.	Description	Product life cycle phase *)
1SAP 212 200 R0001	TU515, I/O terminal unit, 24 V DC, screw terminals	Active
1SAP 212 000 R0001	TU516, I/O terminal unit, 24 V DC, spring terminals	Active
1SAP 412 000 R0001	TU516-XC, I/O terminal unit, 24 V DC, spring terminals, XC version	Active
1SAP 215 000 R0001	TU516-H, I/O terminal unit, hot swap, 24 V DC, spring terminals, XC version	Active

Part no.	Description	Product life cycle phase *)
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.*

5.5.2 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.

Hot swap

> **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

- 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.

H = **H**ot swap

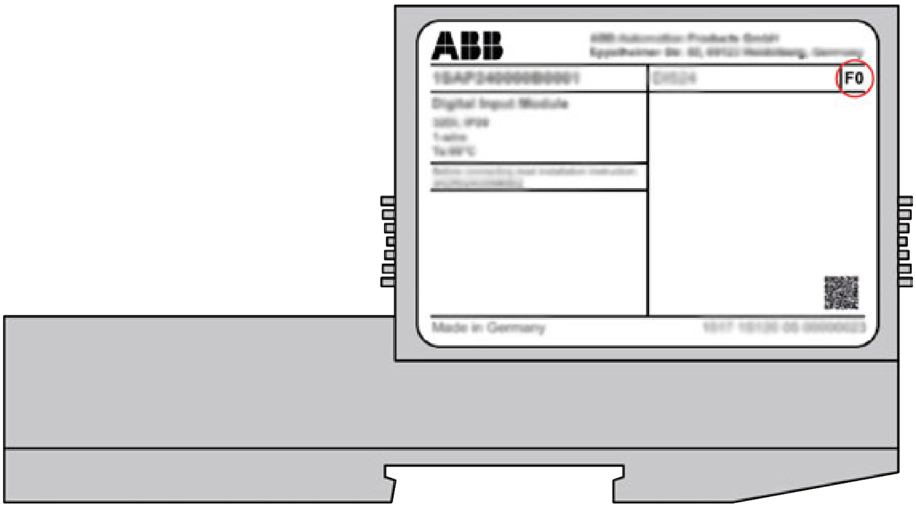
Hot swap
System requirements for hot swapping of I/O modules:

- *Types of terminal units that support hot swapping of I/O modules have the appendix TU5xx-**H**.*
- *I/O modules as of index F0.*

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.*

Hot swap is not supported by AC500-eCo V3 CPU!



The index of the module is in the right corner of the label.

NOTICE!
Risk of damage to I/O modules!
Modules with index below F0 can be damaged when inserted or removed from the terminal unit in a powered system.

NOTICE!
Risk of damage to I/O modules!
Do not perform hot swapping if any I/O module with firmware version lower than 3.0.14 is part of the I/O configuration.

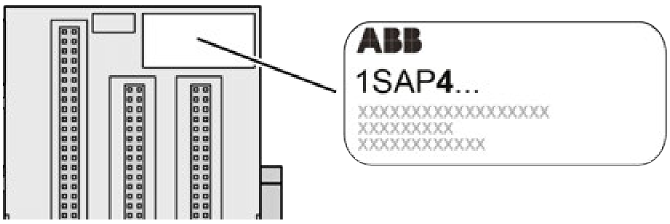
For min. required device index see table below.

Device	Min. required device index for I/O module as of FW Version 3.0.14
AC522(-XC)	F0
AI523 (-XC)	D2
AI531	D4
AI531-XC	D2
AI561	B2
AI562	B2
AI563	B3
AO523 (-XC)	D2
AO561	B2
AX521 (-XC)	D2
AX522 (-XC)	D2
AX561	B2
CD522 (-XC)	D1
DA501 (-XC)	D2
DA502 (-XC)	F0
DC522 (-XC)	D2
DC523 (-XC)	D2
DC532 (-XC)	D2
DC562	A2
DI524 (-XC)	D2
DI561	B2
DI562	B2
DI571	B2
DI572	A1

Device	Min. required device index for I/O module as of FW Version 3.0.14
DO524 (-XC)	A3
DO526	A2
DO526-XC	A0
DO561	B2
DO562	A2
DO571	B3
DO572	B2
DO573	A1
DX522 (-XC)	D2
DX531	D2
DX561	B2
DX571	B3
FM562	A1

XC version

XC = e**X**treme **C**onditions

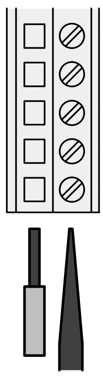
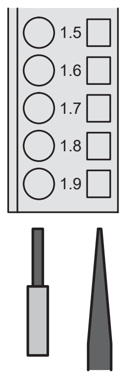


Extreme conditions

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 and 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).

5.5.2.1 Technical data

The system data of AC500 and S500 are applicable to the standard version *Chapter 4.2 “System data AC500” on page 30*.

The system data of AC500-XC are applicable to the XC version *Chapter 4.3 “System data AC500-XC” on page 35*.

Only additional details are therefore documented below.

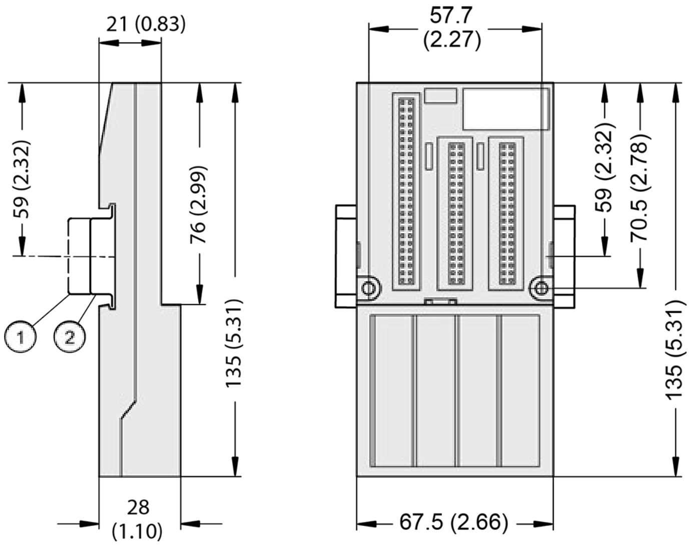
The technical data are also applicable to the XC version.

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.

5.5.2.2 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

5.5.2.3 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

> ***Hot swap***
>
> *System requirements for hot swapping of I/O modules:*
>
> – *Types of terminal units that support hot swapping of I/O modules have the appendix TU5xx-**H**.*
> – *I/O modules as of index F0.*
>
> *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.*

.

5.6.1 Compatibility of communication modules and communication interface modules

Table 201: 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 inter-face	CI521-MODTCP CI522-MODTCP	x	x	--	high availability, remote I/O
Onboard Ethernet inter-face	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 202: 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 203: 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 204: 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 205: 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

5.6.2 CANopen

5.6.2.1 Comparison CI581 and CI582

CI581/CI582: Technical data

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)

Parameter		Value
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 204 “CANopen” on page 815*.
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 30* System data AC500 XC ↻ *Chapter 4.3 “System data AC500-XC” on page 35*
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

Parameter	Value
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.
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 “TU517 and TU518 for communication interface modules” on page 1138*

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

The difference of those devices can be found in their input and output characteristics.

CI581-CN: Input/Output characteristics

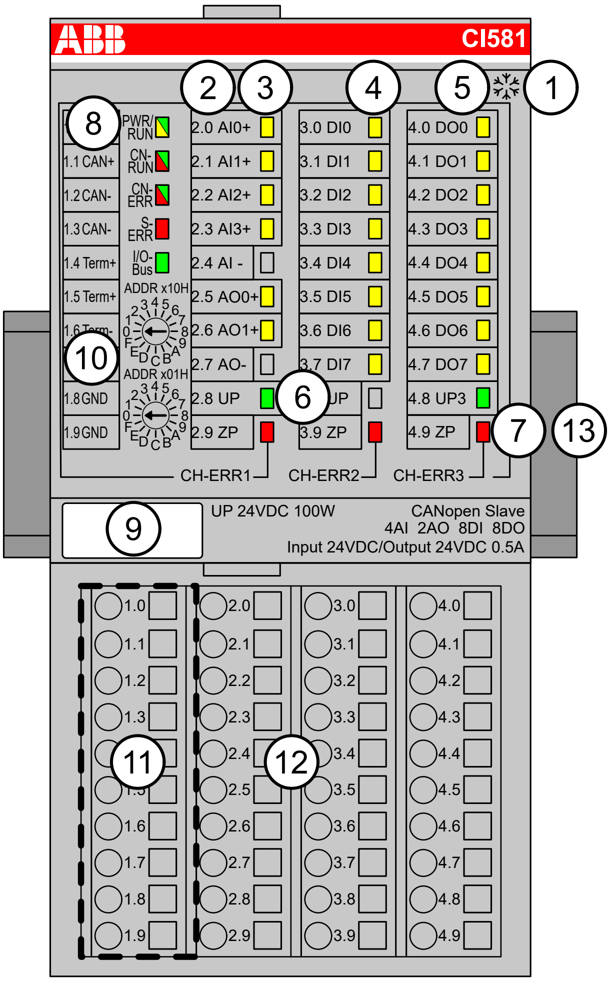
Parameter	Value
Inputs and outputs	8 digital inputs (24 V DC; delay time configurable via software) 8 digital transistor outputs (24 V DC, 0.5 A max.) 4 analog inputs, configurable as: ● -10 V ... +10 V ● 0 V ... +10 V ● -10 V ... +10 V (differential voltage) ● 0 mA ... 20 mA ● 4 mA ... 20 mA ● Pt100 , 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.)

5.6.2.2 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

5.6.2.2.1 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.

5.6.2.2.2 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 204 “CANopen” on page 815*.
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 30* System data AC500 XC *Chapter 4.3 “System data AC500-XC” on page 35*
Current consumption	UP: 0.2 A UP3: 0.06 A + 0.5 A max. per output
Weight (without terminal unit)	Ca. 125 g

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	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 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.
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 “TU517 and TU518 for communication interface modules” on page 1138*

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

5.6.2.2.3 Connections

The CANopen communication interface module is plugged on the I/O terminal units TU517 *Chapter 5.7.3 “TU517 and TU518 for communication interface modules” on page 1138* or TU518 *Chapter 5.7.3 “TU517 and TU518 for communication interface modules” on page 1138* and accordingly TU509 or TU510. Properly position the module and press until it locks in place.

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!

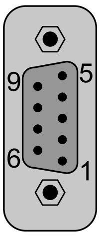
Reason: External voltages at an output or several outputs may cause other outputs to be supplied via that voltage instead of voltage UP3 (reverse voltage). This ist not the intended use.

CAUTION!
Risk of malfunctions by unintended use!
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 DO0 ... DO7 and DC0 ... DC7.

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.

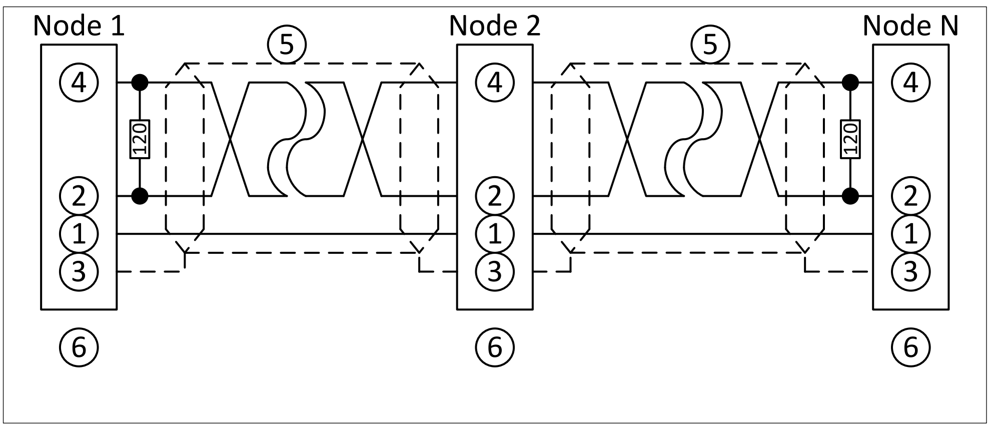


Fig. 145: CANopen interface, bus terminating resistors connected to the line ends

1	CAN_GND
2	CAN_L
3	Shield
4	CAN_H
5	Data line, shielded twisted pair
6	COMBICON connection, CANopen interface

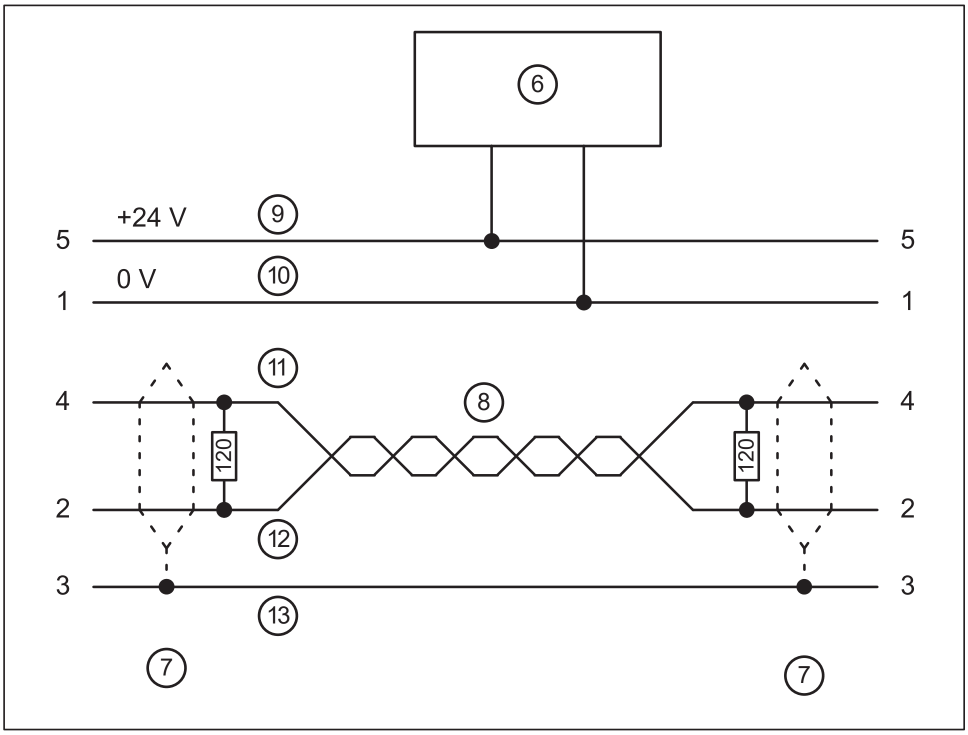


Fig. 146: DeviceNet interface, bus terminating resistors connected to the line ends

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 30.*

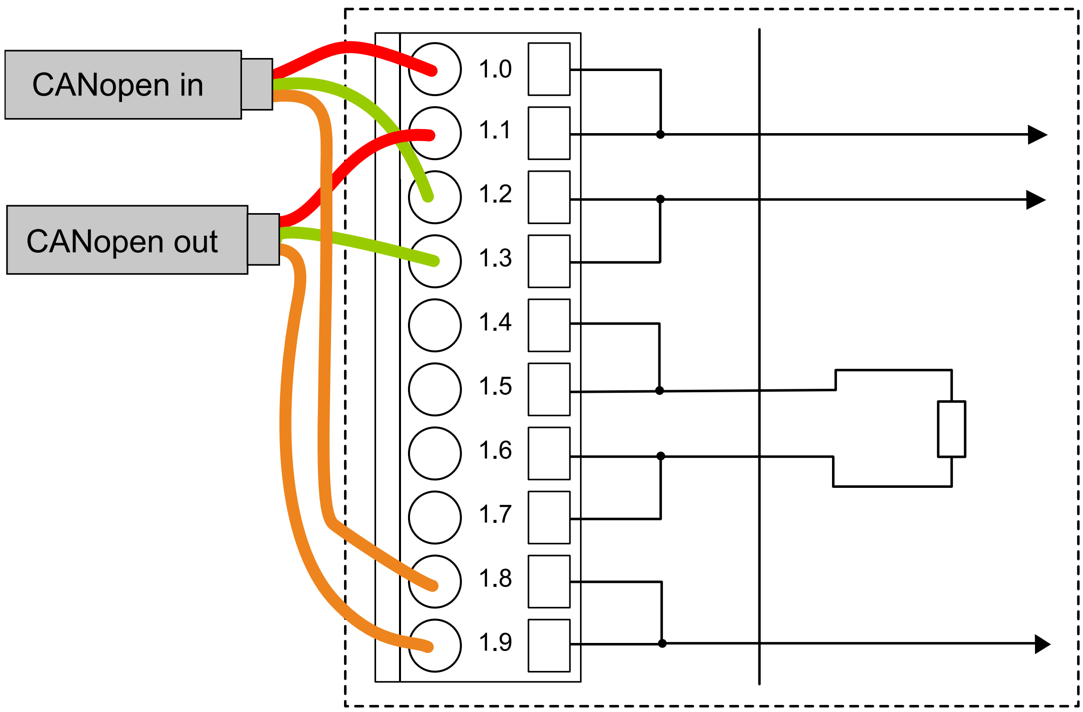
Mounting on terminal units TU517 or TU518

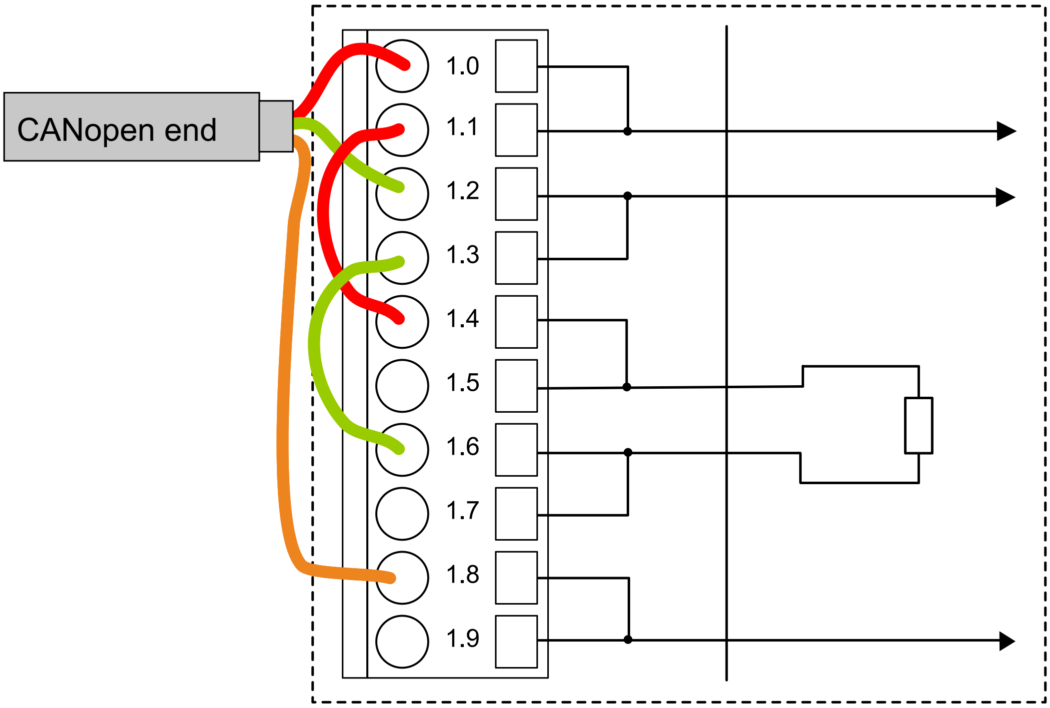
Table 206: Assignment of the terminals

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. Please refer to the AC500 System-Data *Chapter 4.2 “System data AC500” on page 30.*

Table 207: 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 you

– 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. In order to avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

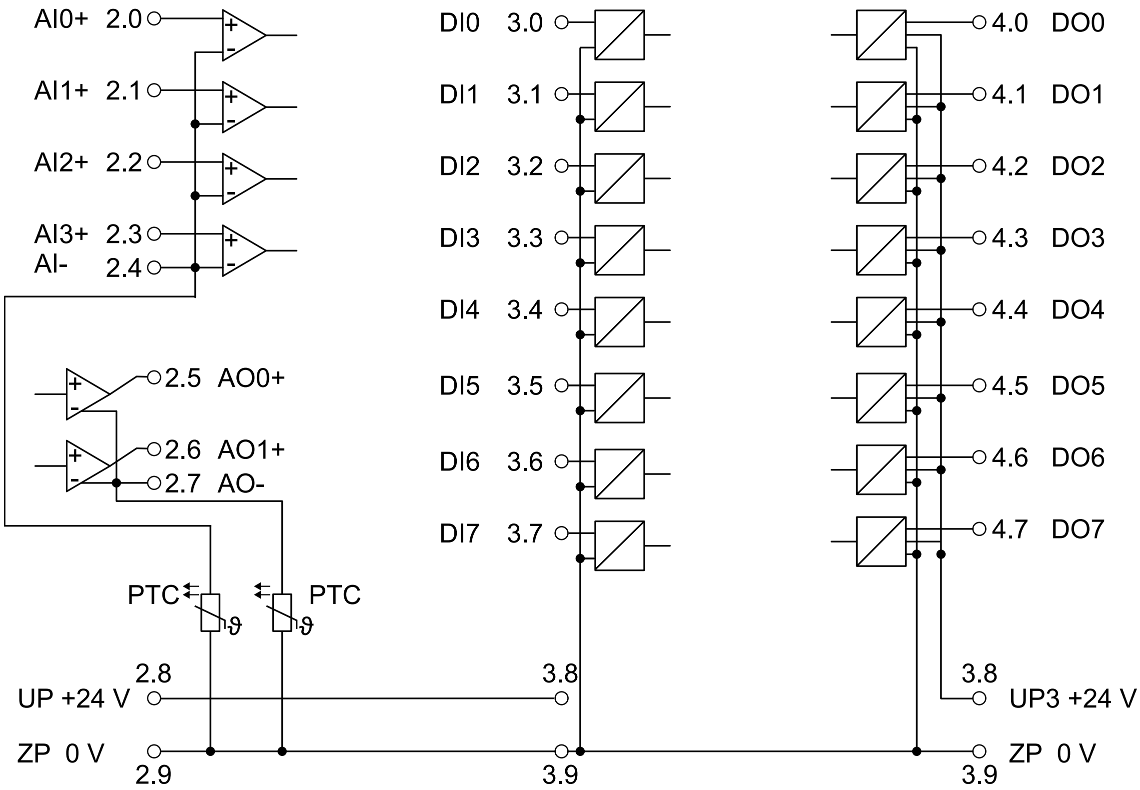


Fig. 147: Connection of the communication interface module CI581-CN

The module provides several diagnosis functions ⇘ *Chapter 5.6.2.2.8 “Diagnosis” on page 843*.

For the measuring ranges that can be configured, please refer to the sections Measuring Ranges ⇘ *Chapter 5.6.2.2.10 “Measuring ranges” on page 848* and Parameterization ⇘ *Chapter 5.6.2.2.7 “Parameterization” on page 838*.

The meaning of the LEDs is described in the section for the state LEDs ⇘ *Chapter 5.6.2.2.9 “State LEDs” on page 846*.

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

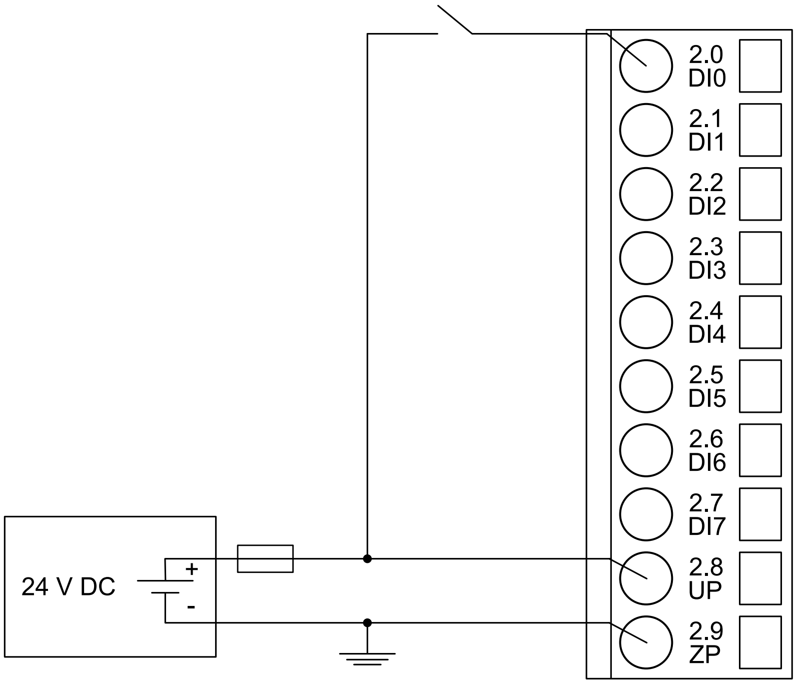


Fig. 148: Connection of the digital inputs to the module CI581-CN

Connection of the digital outputs

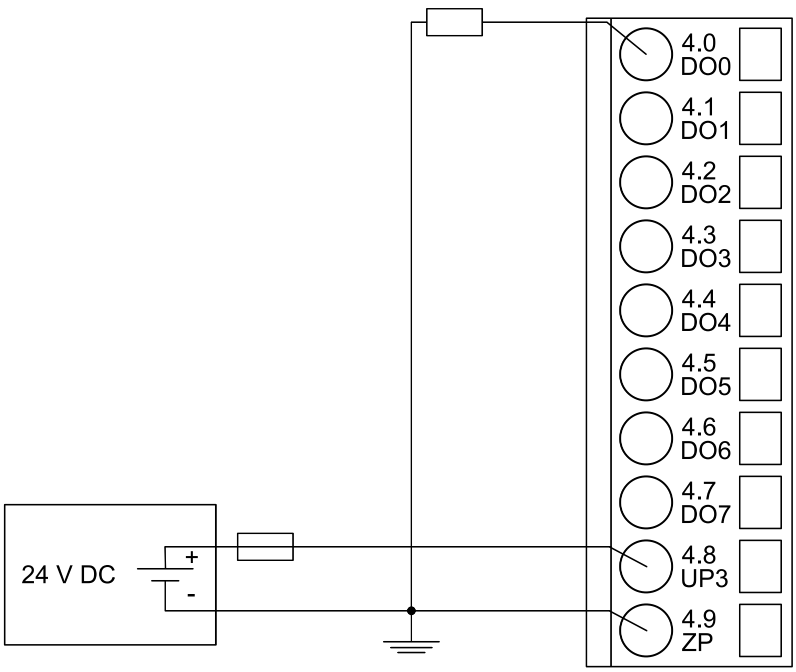


Fig. 149: Connection of configurable digital outputs to the module CI581-CN

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.

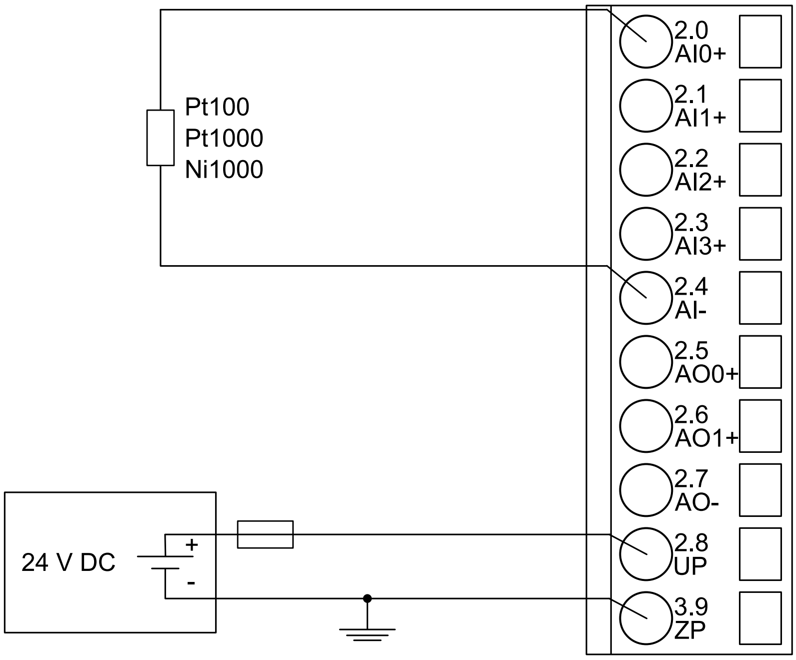


Fig. 150: Connection of resistance thermometers in 2-wire configuration to the analog inputs

Pt100	2-wire configuration, 1 channel used
Pt1000	2-wire configuration, 1 channel used
Ni1000	2-wire configuration, 1 channel used

For the measuring ranges that can be configured, please refer to sections Measuring Ranges *Chapter 5.6.2.2.10 “Measuring ranges” on page 848* and Parameterization *Chapter 5.6.2.2.7 “Parameterization” on page 838*.

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.

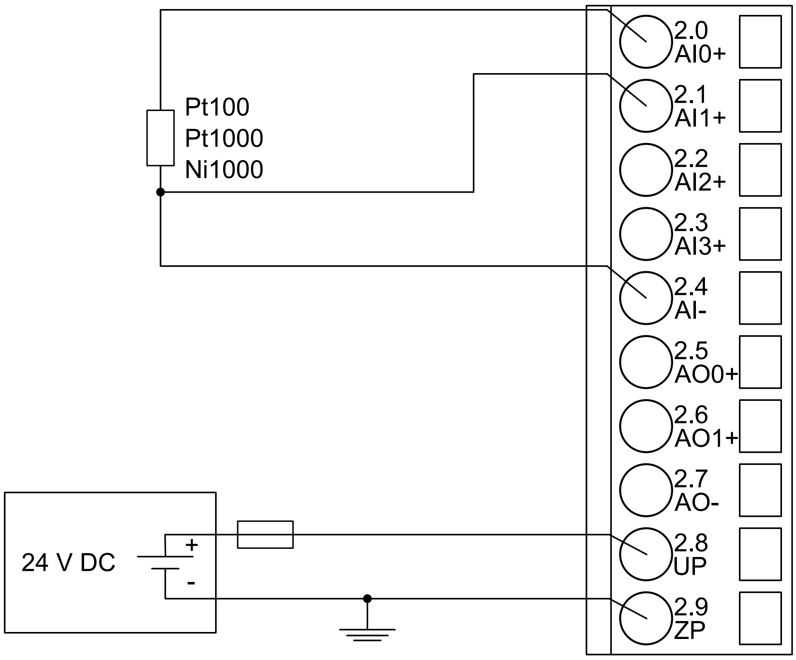


Fig. 151: Connection of resistance thermometers in 3-wire configuration to the analog inputs

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

For the measuring ranges that can be configured, please refer to the sections Measuring Ranges *Chapter 5.6.2.2.10 “Measuring ranges” on page 848* and Parameterization *Chapter 5.6.2.2.7 “Parameterization” on page 838*.

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

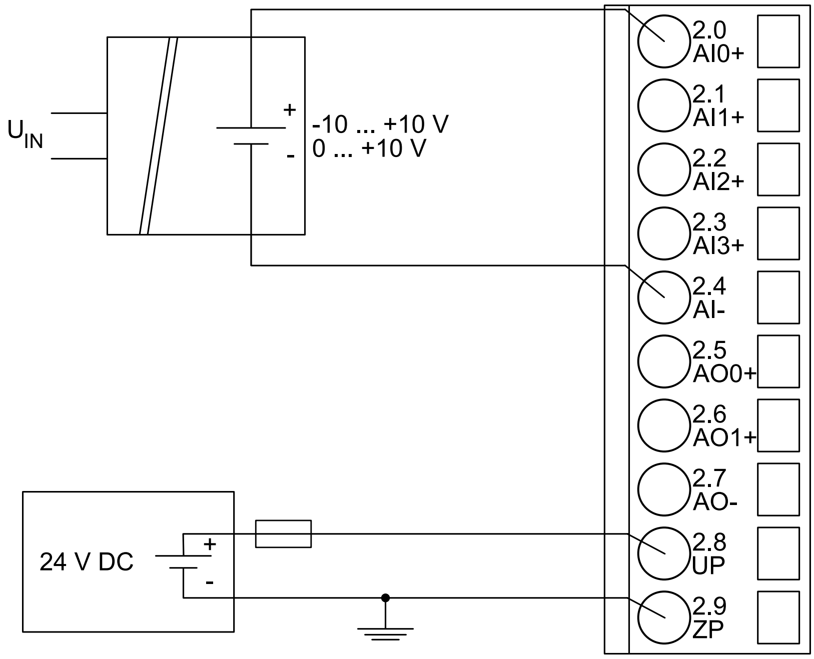


Fig. 152: Connection of active-type analog sensors (voltage) with galvanically isolated power supply to the analog inputs

Voltage	0 ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

For the measuring ranges that can be configured, please refer to the sections Measuring Ranges *Chapter 5.6.2.2.10 "Measuring ranges" on page 848* and Parameterization *Chapter 5.6.2.2.7 "Parameterization" on page 838*.

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

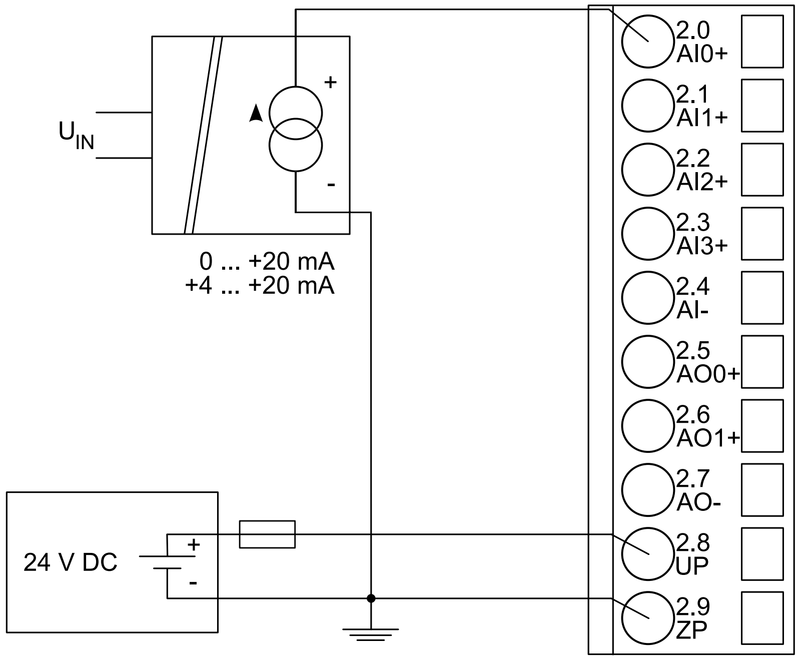


Fig. 153: Connection of active-type analog sensors (current) with galvanically isolated power supply to the analog input AI0 (Proceed with the analog inputs AI1 ... AI3 in the same way)

Current	0 ... 20 mA	1 channel used
Current	4 ... 20 mA	1 channel used

For the measuring ranges that can be configured, please refer to the sections Measuring Ranges ➪ *Chapter 5.6.2.2.10 “Measuring ranges” on page 848* and Parameterization ➪ *Chapter 5.6.2.2.7 “Parameterization” 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

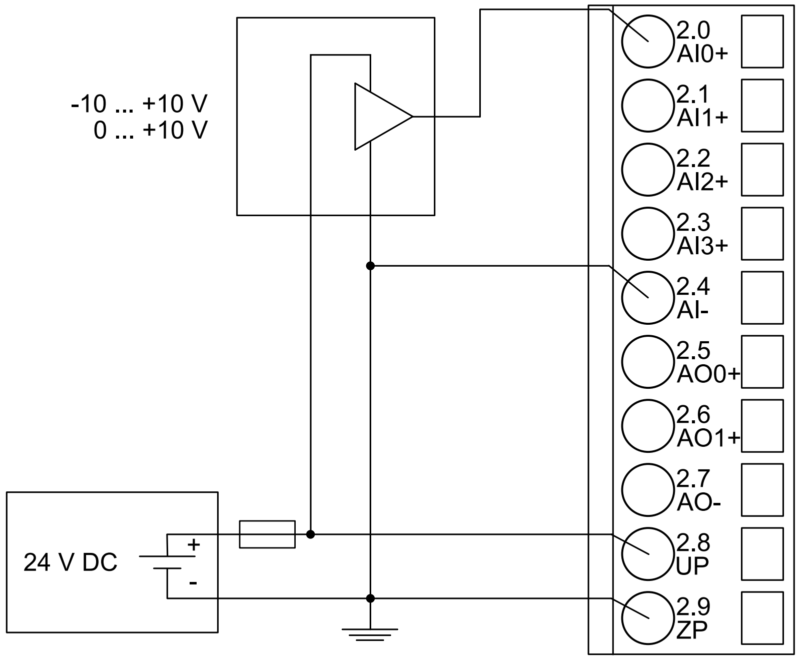


Fig. 154: Connection of active-type sensors (voltage) with no galvanically isolated power supply to the analog inputs (AO ... AI3)

> **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

For the measuring ranges that can be configured, plese refer to the sections Measuring Ranges ➾ *Chapter 5.6.2.2.10 “Measuring ranges” on page 848* and Parameterization ➾ *Chapter 5.6.2.2.7 “Parameterization” on page 838*.

To avoid error messages, configure unused analog input channels as "unused".

Connection of passive-type analog sensors (Current) to the analog inputs

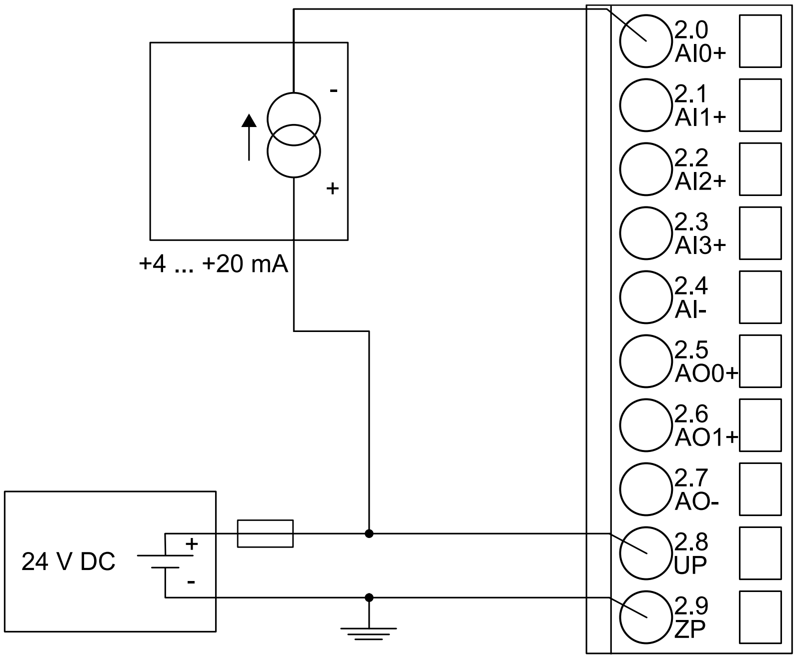


Fig. 155: Connection of passive-type analog sensors (current) to the analog inputs (A0 ... A3)

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).

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 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 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.

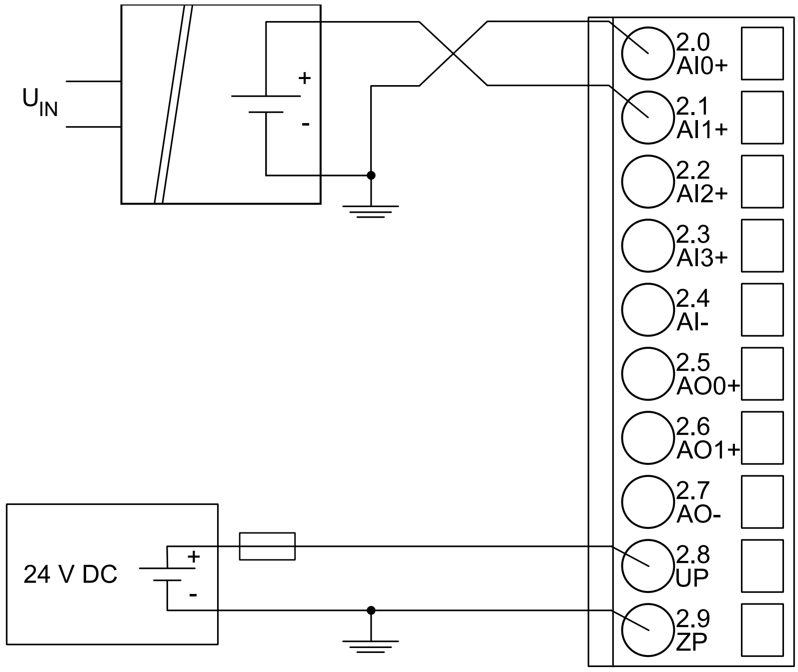


Fig. 156: Connection of active-type analog sensors (voltage) to differential analog inputs (AI0 ... AI3)

Voltage	0 ... 10 V	with differential inputs, 2 channels used
Voltage	-10 V ... +10 V	with differential inputs, 2 channels used

For the measuring ranges that can be configured, please refer to the sections Measuring Ranges *Chapter 5.6.2.2.10 “Measuring ranges” on page 848* and Parameterization *Chapter 5.6.2.2.7 “Parameterization” on page 838*.

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.

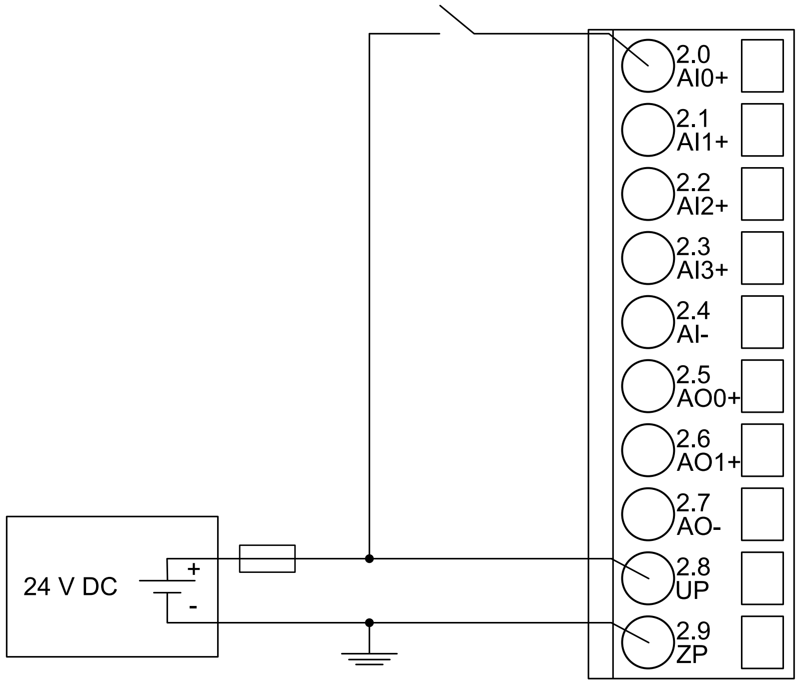


Fig. 157: Connection of digital sensors to the analog input (AI0 ... AI3)

Digital input	24 V	1 channel used

For the measuring ranges that can be configured, please refer to the sections Measuring Ranges *Chapter 5.6.2.2.10 "Measuring ranges" on page 848* and Parameterization *Chapter 5.6.2.2.7 "Parameterization" on page 838*.

Connection of analog output loads (Voltage)

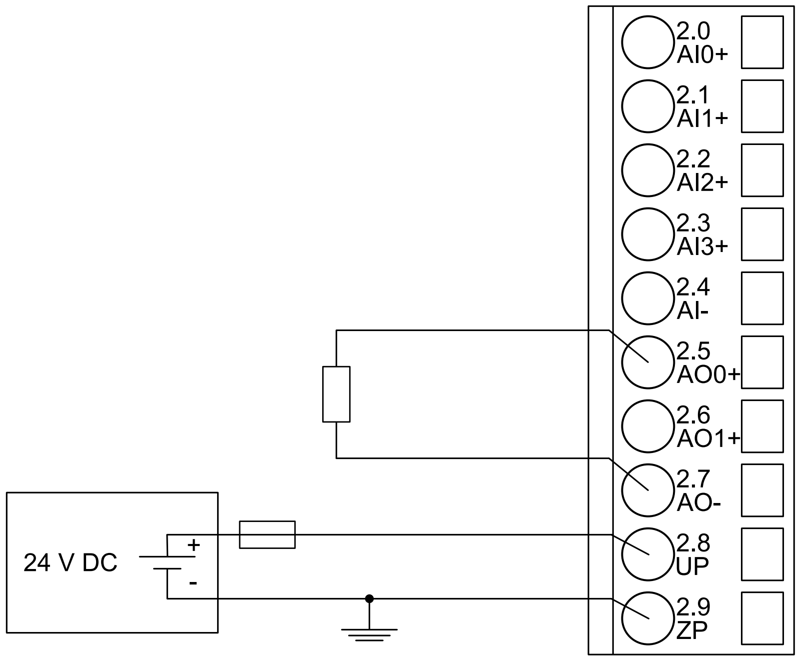


Fig. 158: Connection of analog output loads (voltage) to the analog outputs (AO0 ... AO1)

Voltage	-10 V ... +10 V	Load ± 10 mA max.	1 channel used

For the measuring ranges that can be configured, please refer to the sections Measuring Ranges ✎ *Chapter 5.6.2.2.10 “Measuring ranges” on page 848* and Parameterization ✎ *Chapter 5.6.2.2.7 “Parameterization” on page 838*.

Unused analog outputs can be left open-circuited.

Connection of analog output loads (Current)

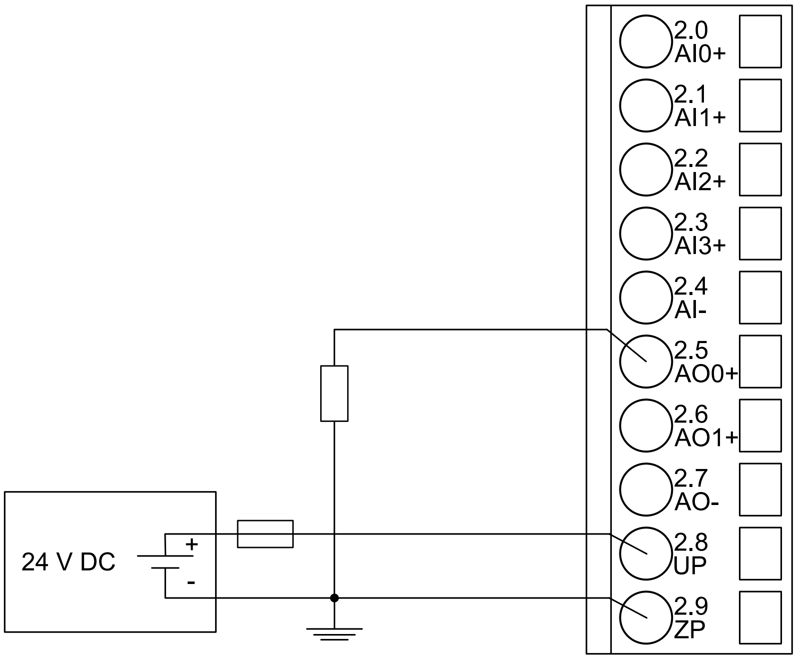


Fig. 159: Connection of analog output loads (current) to the analog outputs (AO0 ... AO1)

Current	0 ... 20 mA	Load 0 ... 500 Ω	1 channel used
Current	4 ... 20 mA	Load 0 ... 500 Ω	1 channel used

For the measuring ranges that can be configured, please refer to the sections Measuring Ranges ✎ *Chapter 5.6.2.2.10 “Measuring ranges” on page 848* and Parameterization ✎ *Chapter 5.6.2.2.7 “Parameterization” on page 838*.

Unused analog outputs can be left open-circuited.

5.6.2.2.4 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

5.6.2.2.5 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.*

5.6.2.2.6 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.

5.6.2.2.7 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 (table error LED / Failsafe function ↳ *Further information on page 838*)	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]) For a description of the counter operating modes, please refer to the fast counter section ↳ *Chapter 5.4.2.2.9 “Fast counter” on page 464*.

Table 208: 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 209: Channel configuration - Operating modes of the analog inputs

Internal Value	Operating Modes (individually configu-rable)
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 210: 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 configu-ration	Operation modes of analog outputs	Operation modes of analog outputs	BYTE	0
Output 0, Check channel	Channel moni-toring	Channel moni-toring	BYTE	0
Output 0, Substi-tute value	Substitute value	Substitute value	WORD	0
Output 1, Channel configu-ration	Operation modes of analog outputs	Operation modes of analog outputs	BYTE	0
Output 1, Check channel	Channel moni-toring	Channel moni-toring	BYTE	0
Output 1, Substi-tute value	Substitute value	Substitute value	WORD	0

Table 211: Channel configuration - Operating modes of the analog outputs

Internal value	Operating Modes (individually configu-rable)
0 (default)	Not used
128	-10 V ... +10 V
129	0 mA ... 20 mA
130	4 mA ... 20 mA

Table 212: Channel monitoring

Internal value	Check channel
0	Plausibility, wire break, short circuit
3	None

Table 213: 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 "Substi-tute 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 ⇨ *Chapter 5.6.2.2.3 "Connections" on page 821*. 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".				

5.6.2.2.8 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	Identifier 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 diagnosis block	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error-Identifier**	**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 configuration
4	-	1...10	31	31	31	At least one module does not support failsafe function	Check modules and parameterization
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 termi-nals/ check process supply voltage
Channel error digital							
4	-	31	2	0...7	46	Voltage feedback on deactivated dig-ital output [6])	Check terminals
4	-	31	2	0...7	47	Short circuit at dig-ital output [7])	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	4	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 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 *Chapter 5.6.2.2.3 "Connections" on page 821*. 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 on digital outputs DO0 ... DO7 has overrun the process supply voltage UP3 *Chapter 5.6.2.2.3 "Connections" on page 821*. Diagnosis message appears for the whole module.
[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 100ms seconds. Subsequently, a new start-up will be executed. This diagnosis message appears for each channel.

5.6.2.2.9 State LEDs

The state LEDs are located at the front of module. There are 2 different groups:

- 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	---	---	---
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: Auto-detect 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	--
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

5.6.2.2.10 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	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
	-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

Range	**Pt100 / Pt1000 -50 °C ... +400 °C**	**Ni1000 -50 °C ... +150 °C**	**Digital value**	
			Decimal	**Hex.**
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.

5.6.2.2.11 Technical data

The system data of AC500 and S500 are applicable to the standard version ↳ *Chapter 4.2 “System data AC500” on page 30*.

The system data of AC500-XC are applicable to the XC version ↳ *Chapter 4.3 “System data AC500-XC” on page 35*.

Only additional details are therefore documented below.

The technical data are 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.*

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
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

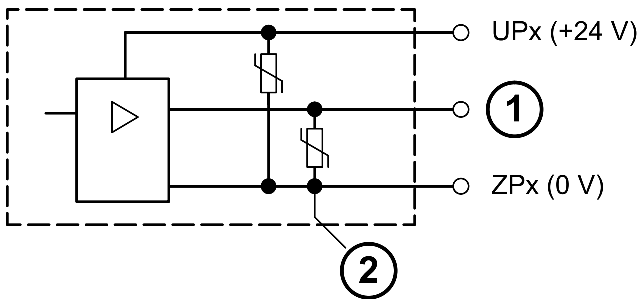


Fig. 160: Circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off

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
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 5.6.2.2.10.2 “Input ranges resistance temperature detector” on page 848*
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

Parameter		Value
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 VDC
	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

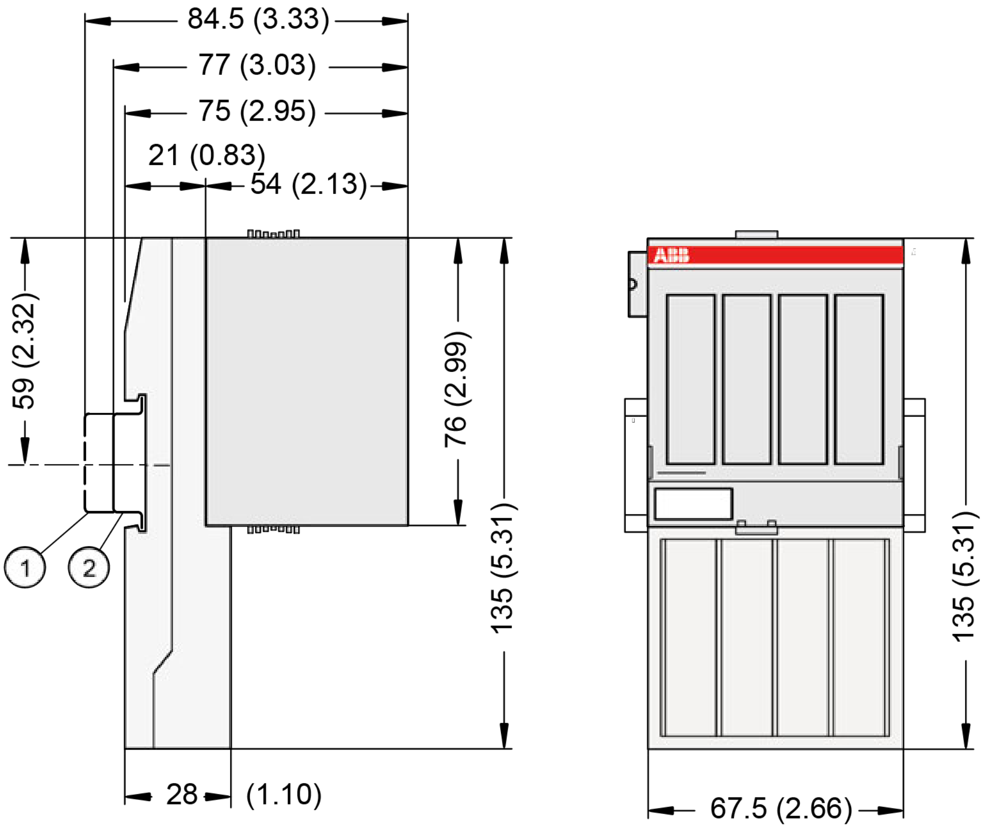
Technical data of the analog outputs

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 5.6.2.2.10.3 “Output ranges voltage and current” on page 849*
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 5.4.2.2.9 “Fast counter” on page 464*
Operating modes	Operating modes *Chapter 5.4.2.2.9 “Fast counter” on page 464*

5.6.2.2.12 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

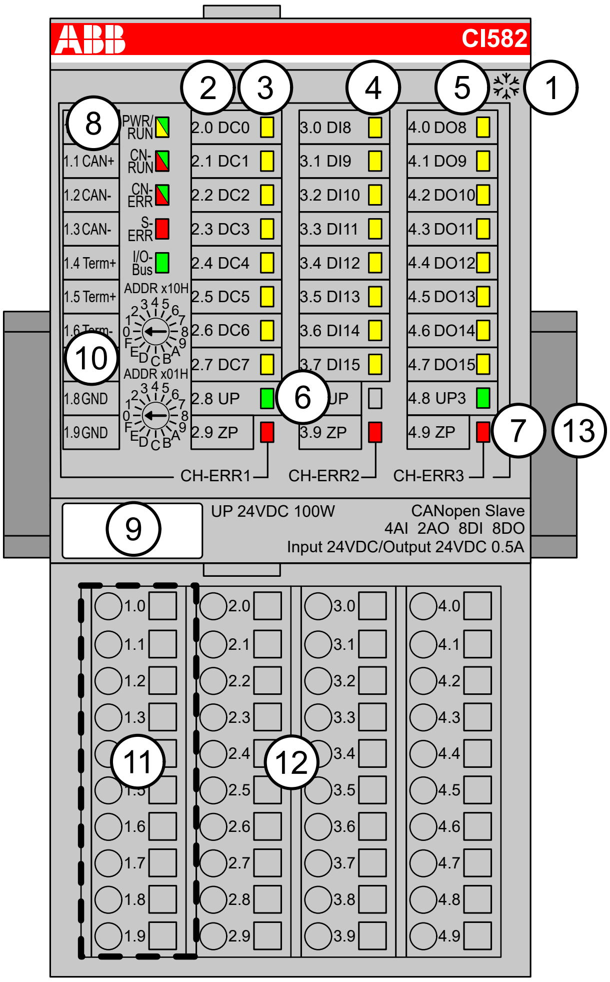
5.6.2.2.13 Ordering data

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.*

5.6.2.3 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

5.6.2.3.1 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.

5.6.2.3.2 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 204 “CANopen” on page 815*.
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 30* System data AC500 XC ➪ *Chapter 4.3 “System data AC500-XC” on page 35*
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 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.
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 "TU517 and TU518 for communication interface modules" on page 1138*

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.)

5.6.2.3.3 Connections

The CANopen communication interface module is plugged on the I/O terminal units TU517 *Chapter 5.7.3 "TU517 and TU518 for communication interface modules" on page 1138* or TU518 *Chapter 5.7.3 "TU517 and TU518 for communication interface modules" on page 1138* and accordingly TU509 or TU510. Properly position the module and press until it locks in place.

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

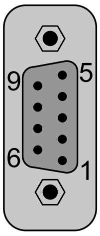
> *For a detailed description of the mounting, disassembly and connection of the module, please refer to the installation instructions.*

> *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.

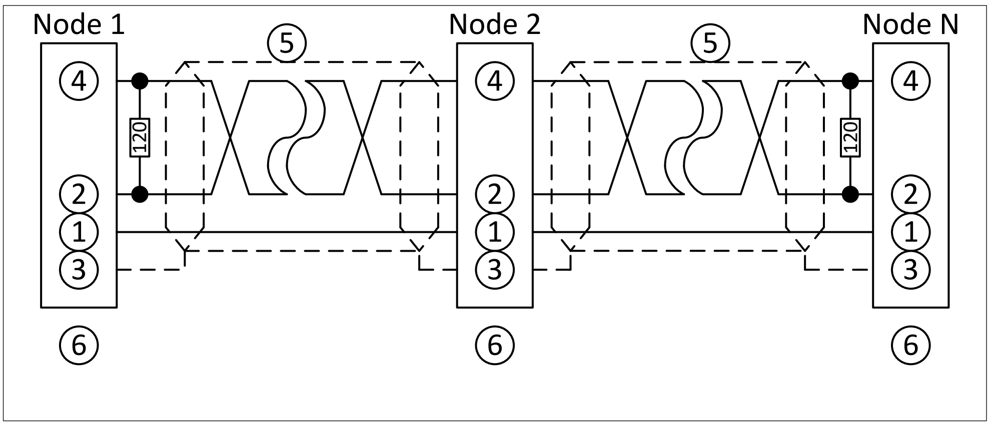


Fig. 161: CANopen interface, bus terminating resistors connected to the line ends

1	CAN_GND
2	CAN_L
3	Shield
4	CAN_H
5	Data line, shielded twisted pair
6	COMBICON connection, CANopen interface

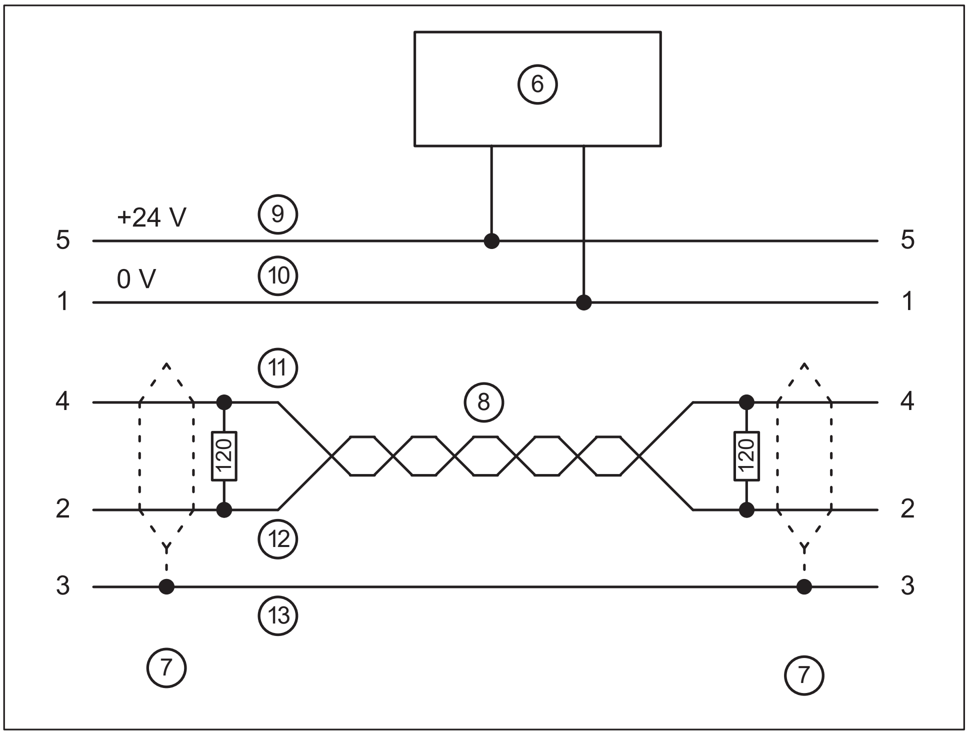


Fig. 162: DeviceNet interface, bus terminating resistors connected to the line ends

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 30.*

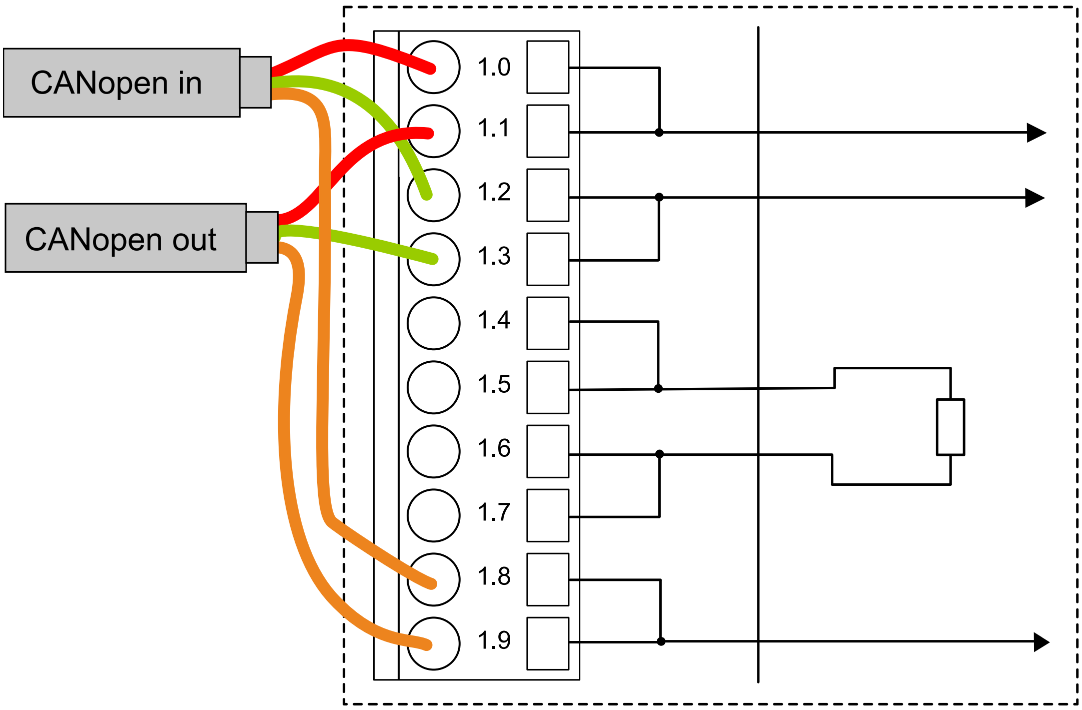
Mounting on terminal units TU517 or TU518

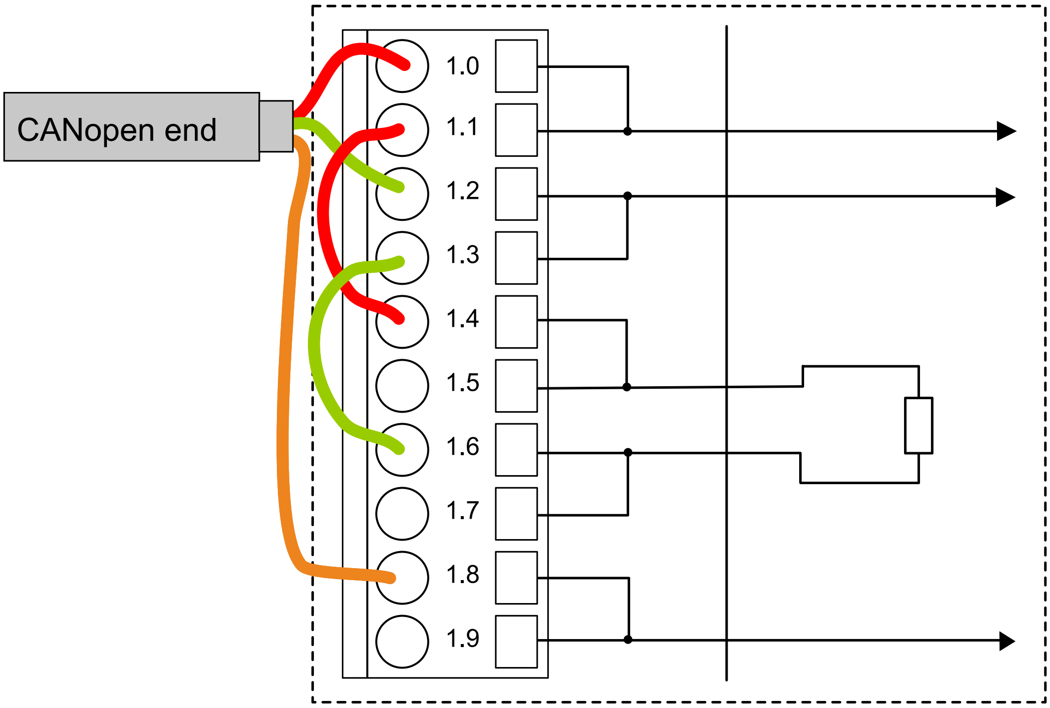
Table 214: Assignment of the terminals

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. Please refer to the AC500 System-Data *➪ Chapter 4.2 “System data AC500” on page 30.*

Table 215: 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

Terminal	Signal	Description
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 you

– 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.

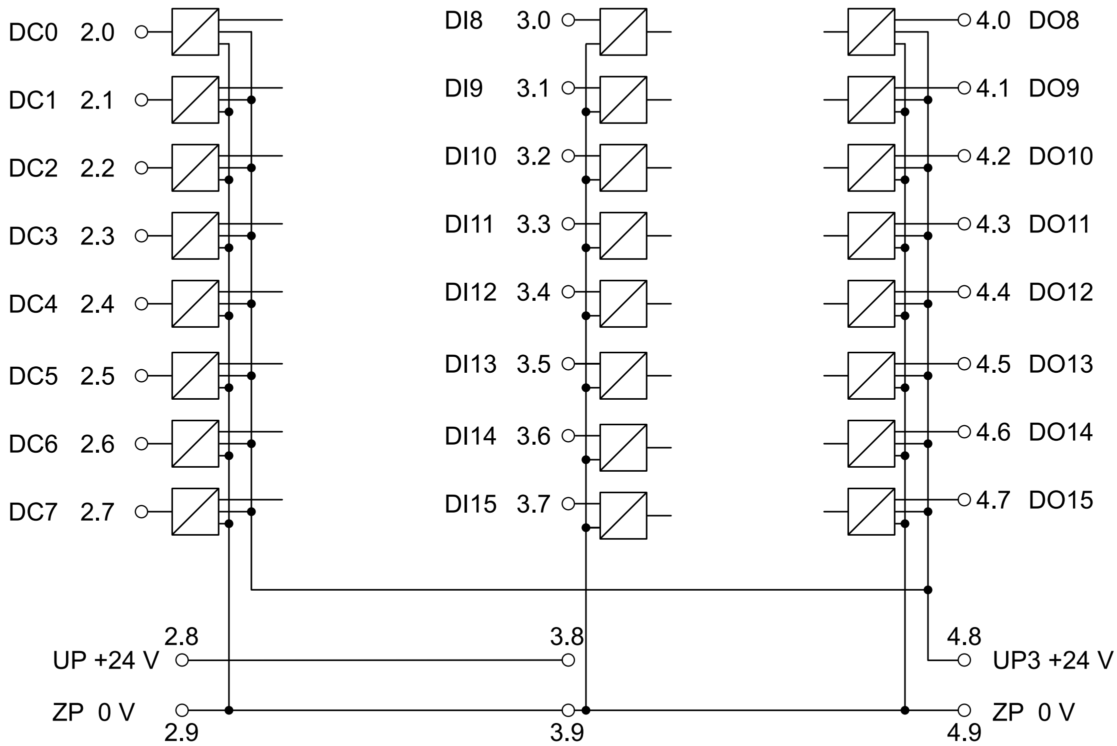


Fig. 163: Connection of the communication interface module CI582-CN

For a description of the meaning of the LEDs, please refer to the section for the state LEDs
Chapter 5.6.2.3.9 “State LEDs” on page 872.

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

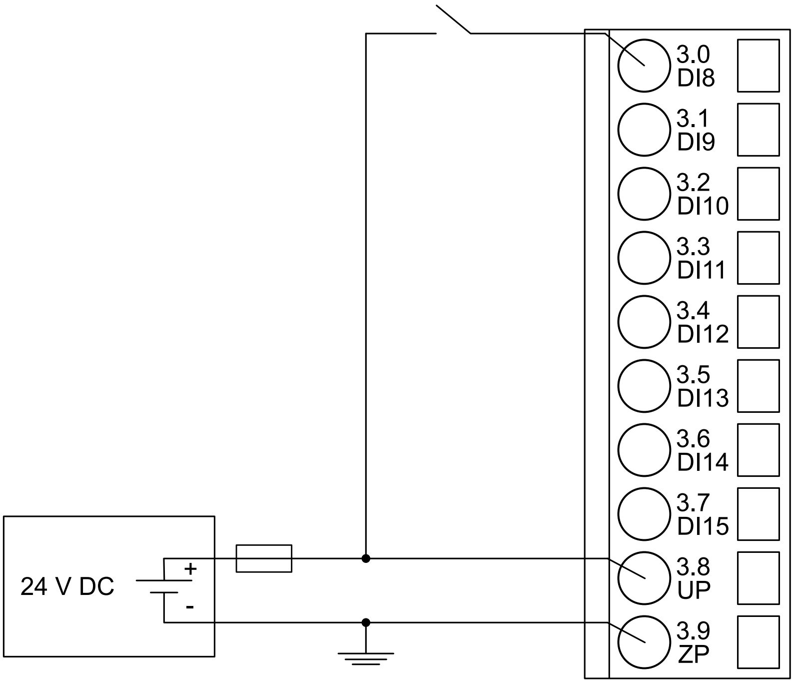


Fig. 164: Connection of the digital inputs (DI8 ... DI15) to the module CI582-CN

Connection of the digital outputs

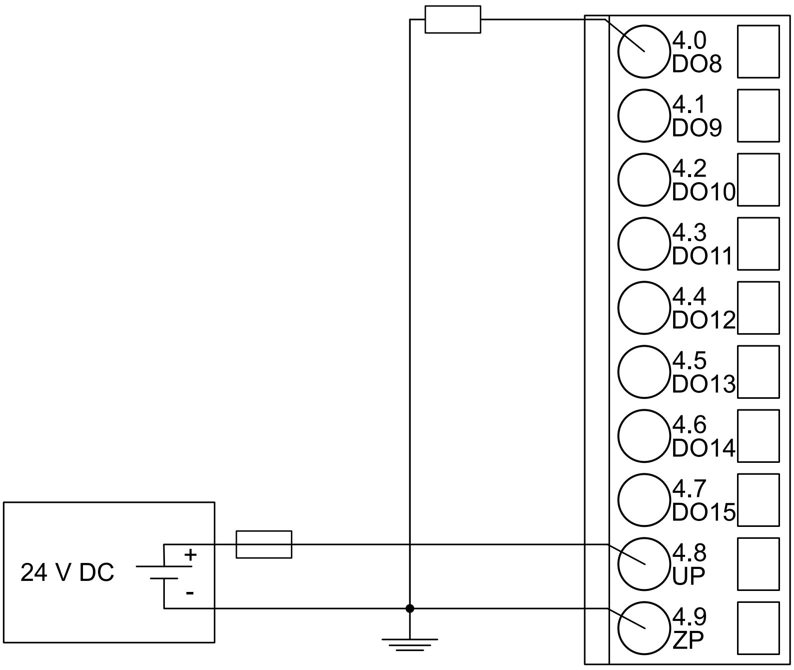


Fig. 165: Connection of configurable digital outputs (DO8 ... DO15) to the module CI582-CN

Connection of the configurable digital inputs/outputs

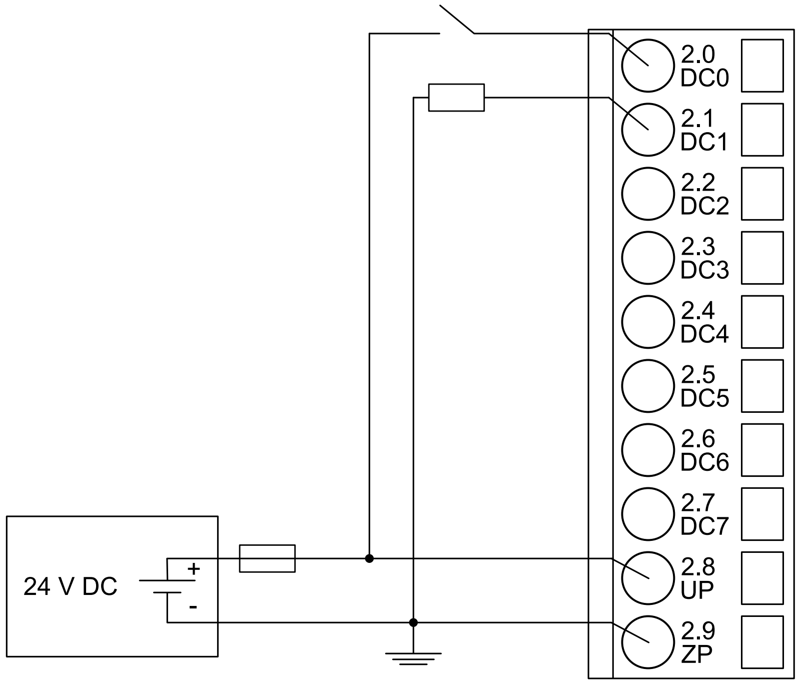


Fig. 166: Connection of configurable digital inputs/outputs (DC0 ... DC7) to the module CI582-CN

5.6.2.3.4 Internal data exchange

Parameter	Value
Digital inputs (bytes)	5
Digital outputs (bytes)	5
Counter input data (words)	4
Counter output data (words)	8

5.6.2.3.5 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.

5.6.2.3.6 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.

5.6.2.3.7 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 / fail-safe function table error LED / failsafe function (*Table 216 “Error LED / Failsafe function” on page 867*)	On	0	BYTE	0
	Off by E4	1		
	Off by E3	2		
	On + failsafe	16		
	Off by E4 + fail-safe	17		
	Off by E3 + fail-safe	18		
Reserved	0	0	ARRAY of 24 BYTES	
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]) For a description of the counter operating modes, please refer to the 'Fast Counter' section *Chapter 5.4.2.2.9 “Fast counter” on page 464*.

Table 216: 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 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 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 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 5.6.2.3.3 “Connections” on page 858*. 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.

5.6.2.3.8 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
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**	**Identifier** **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 diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error** **identifier**	**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-/firmware 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	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

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 diagnosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
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 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 5.6.2.3.3 “Connections” on page 858*. 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 5.6.2.3.3 “Connections” on page 858*. 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.

5.6.2.3.9 State LEDs

The LEDs are located at the front of the module. There are 2 different groups:

- 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: Auto-detect 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: Auto-detect 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

5.6.2.3.10 Technical data

The system data of AC500 and S500 are applicable to the standard version *Chapter 4.2 “System data AC500” on page 30*.

The system data of AC500-XC are applicable to the XC version *Chapter 4.3 “System data AC500-XC” on page 35*.

Only additional details are therefore documented below.

The technical data are 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.

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

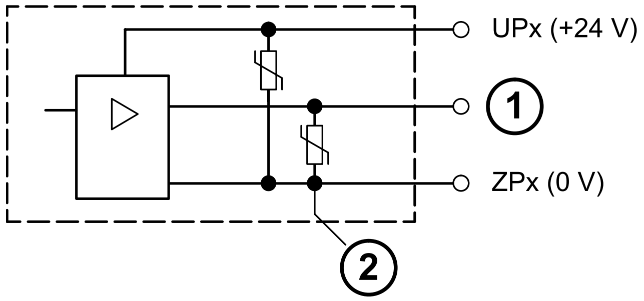


Fig. 167: Circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off

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 5.6.2.3.10 “Technical data” on page 873*. 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 range from -12 V to +30 V when UPx = 24 V and from -6 V to +30 V when UPx = 30 V.

Technical data of the digital inputs/outputs if used as outputs

Please refer to the Technical Data of the Digital Outputs ↬ *Chapter 5.6.2.3.10 “Technical data” on page 873*. 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.

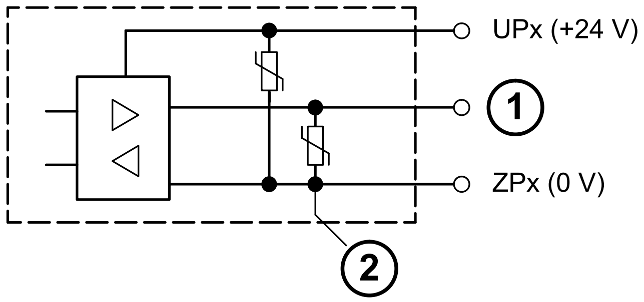


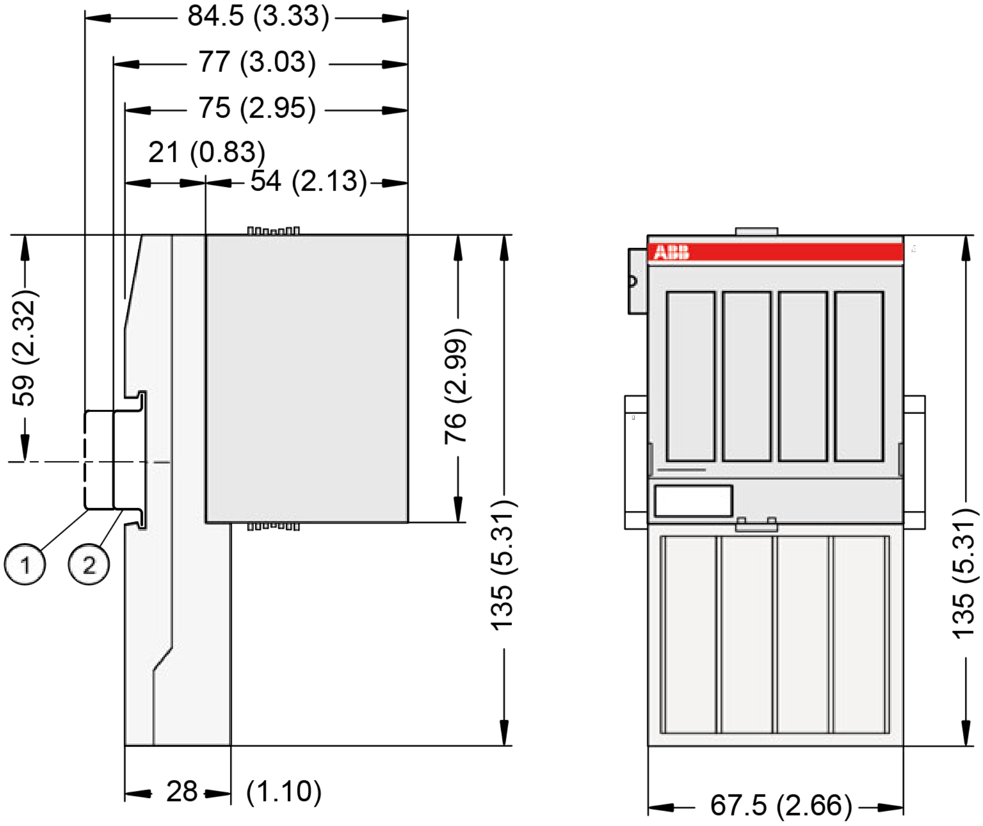
Fig. 168: Digital input/output (circuit diagram)

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 5.4.2.2.9 “Fast counter” on page 464*
Operating modes	Operating modes ↬ *Chapter 5.4.2.2.9 “Fast counter” on page 464*

5.6.2.3.11 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

5.6.2.3.12 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

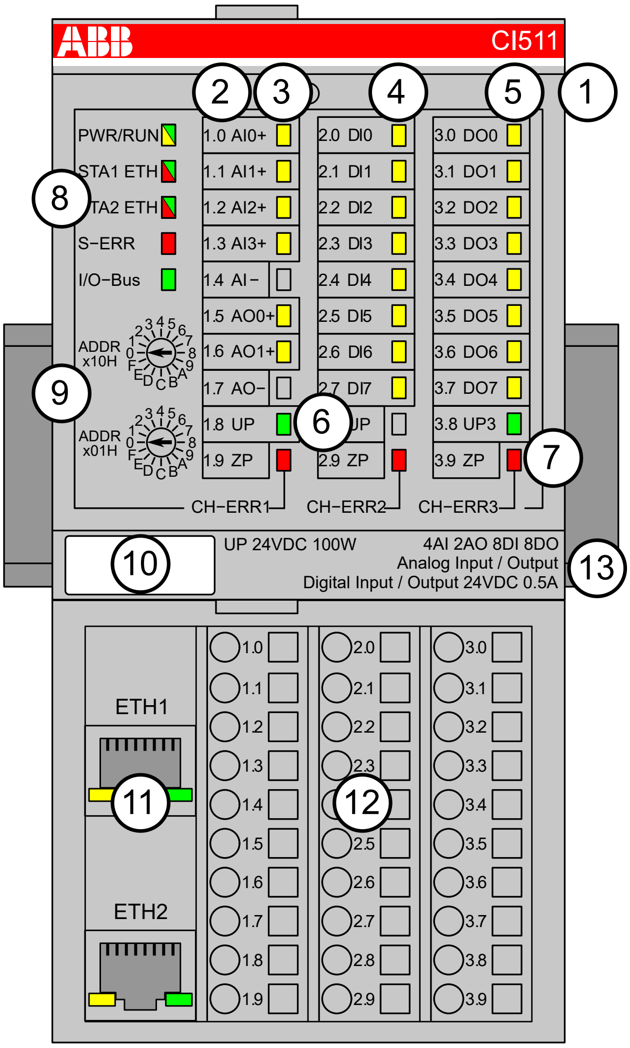
**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.6.3 EtherCAT

5.6.3.1 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

5.6.3.1.1 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.

5.6.3.1.2 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 soft-ware)
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 5.7.1 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 1130*

5.6.3.1.3 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 you

– 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.

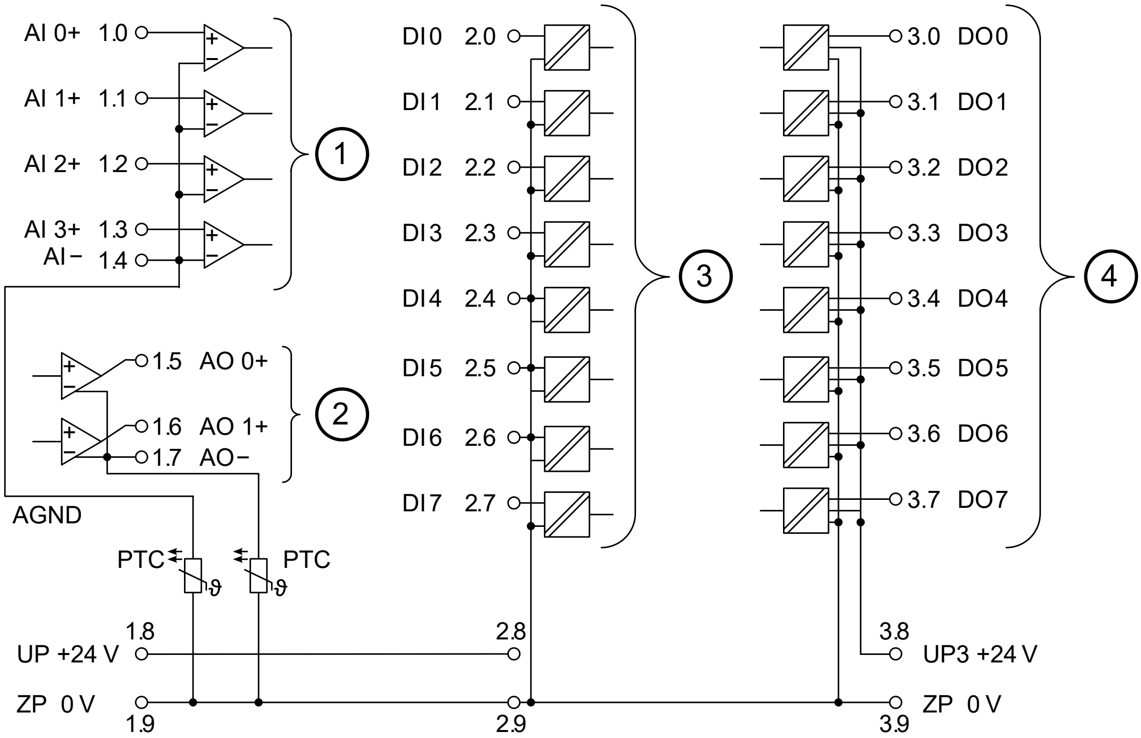


Fig. 169: Connection of the communication interface module CI511-ETHCAT

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 within the grounding concept of the plant (e. g. grounding of the negative pole).

The module provide several diagnosis functions *Chapter 5.6.3.1.8 “Diagnosis” on page 899*.

The measuring ranges are described in the section Measuring Ranges *Chapter 5.6.3.1.7 “Parameterization” on page 893* *Chapter 5.6.3.1.10 “Measuring ranges” on page 902*.

The function of the LEDs is described in the section State LEDs *Chapter 5.6.3.1.8 “Diagnosis” on page 899*.

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.

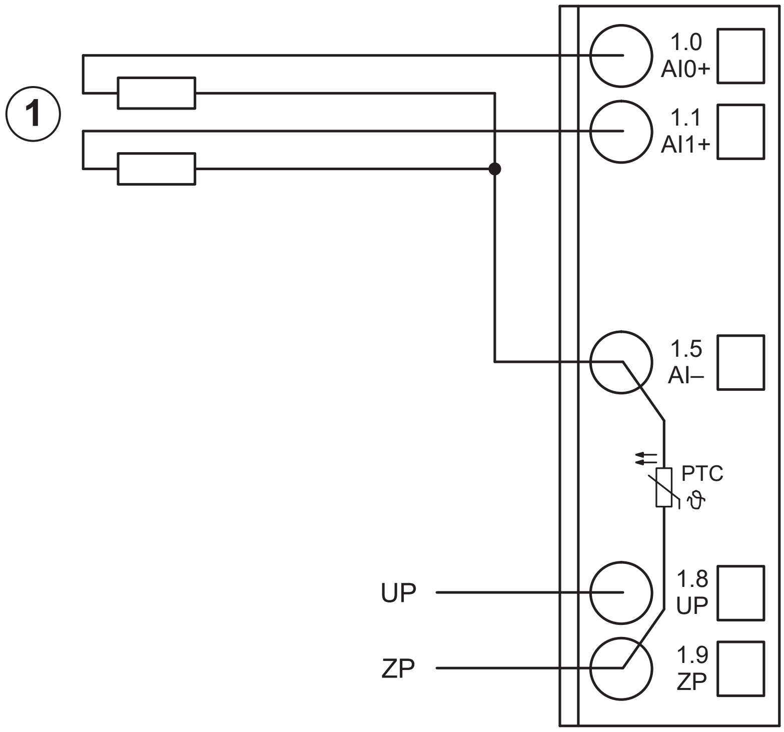


Fig. 170: Connection of resistance thermometers in 2-wire configuration

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

The measuring ranges are described in the section Measuring Ranges *Chapter 5.6.3.1.7 “Parameterization” on page 893* *Chapter 5.6.3.1.10 “Measuring ranges” on page 902*.

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.

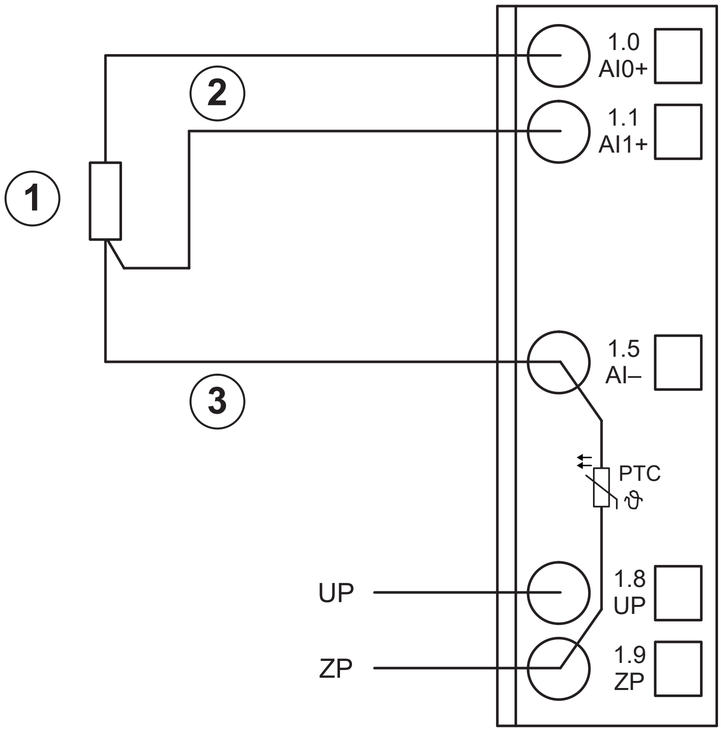


Fig. 171: Connection of resistance thermometers in 3-wire configuration

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

The measuring ranges are described in the section Measuring Ranges *Chapter 5.6.3.1.7 “Parameterization” on page 893* *Chapter 5.6.3.1.10 “Measuring ranges” on page 902*.

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

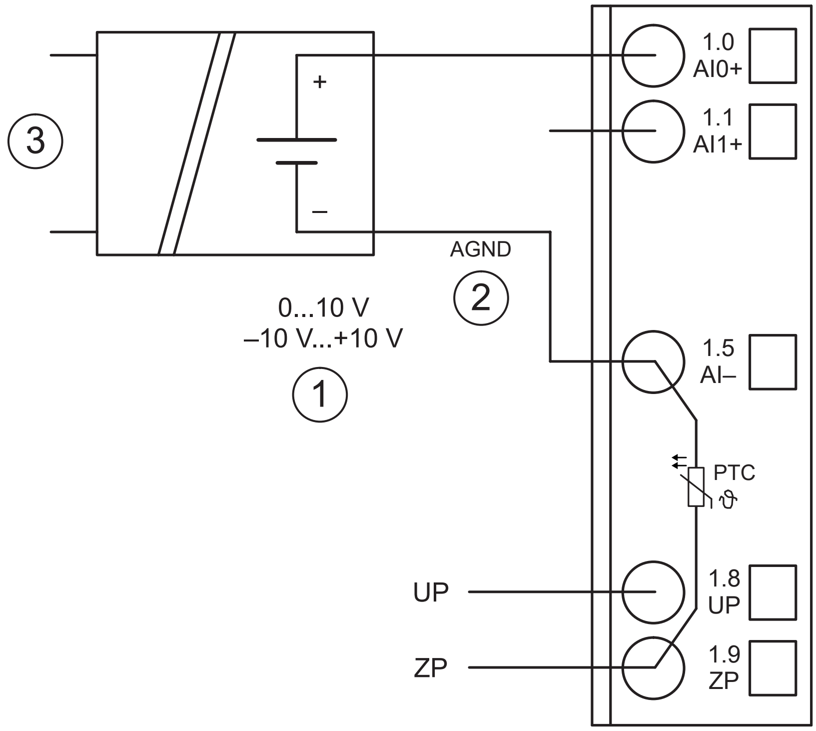


Fig. 172: Connection of active-type analog sensors (voltage) with galvanically isolated power supply

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

The measuring ranges are described in the section Measuring Ranges *Chapter 5.6.3.1.7 "Parameterization" on page 893* *Chapter 5.6.3.1.10 "Measuring ranges" on page 902*.

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

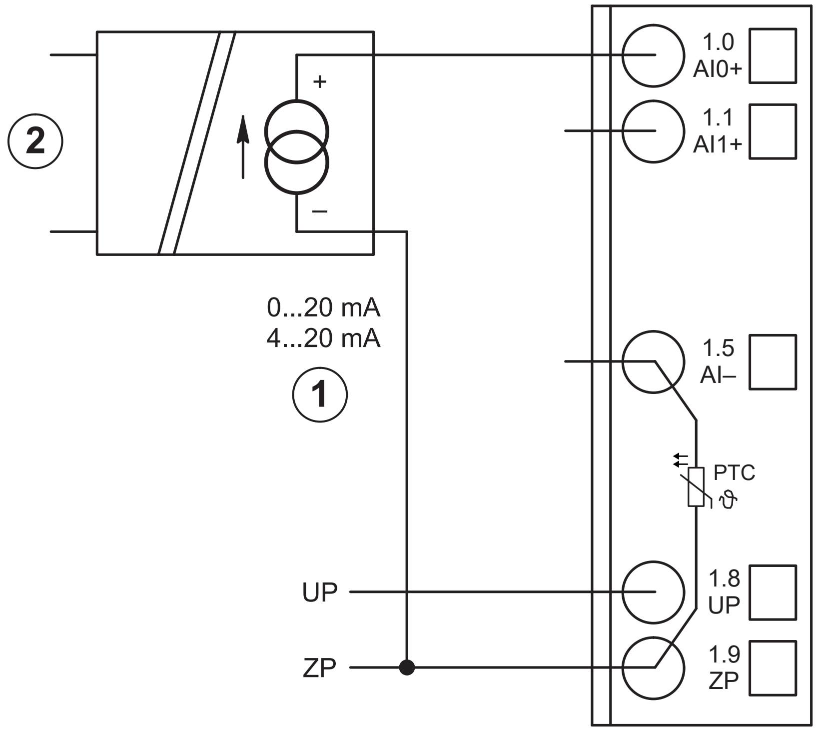


Fig. 173: Connection of active-type analog sensors (current) with galvanically isolated power supply

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

The measuring ranges are described in the section Measuring Ranges *Chapter 5.6.3.1.7 “Parameterization” on page 893* *Chapter 5.6.3.1.10 “Measuring ranges” on page 902*.

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

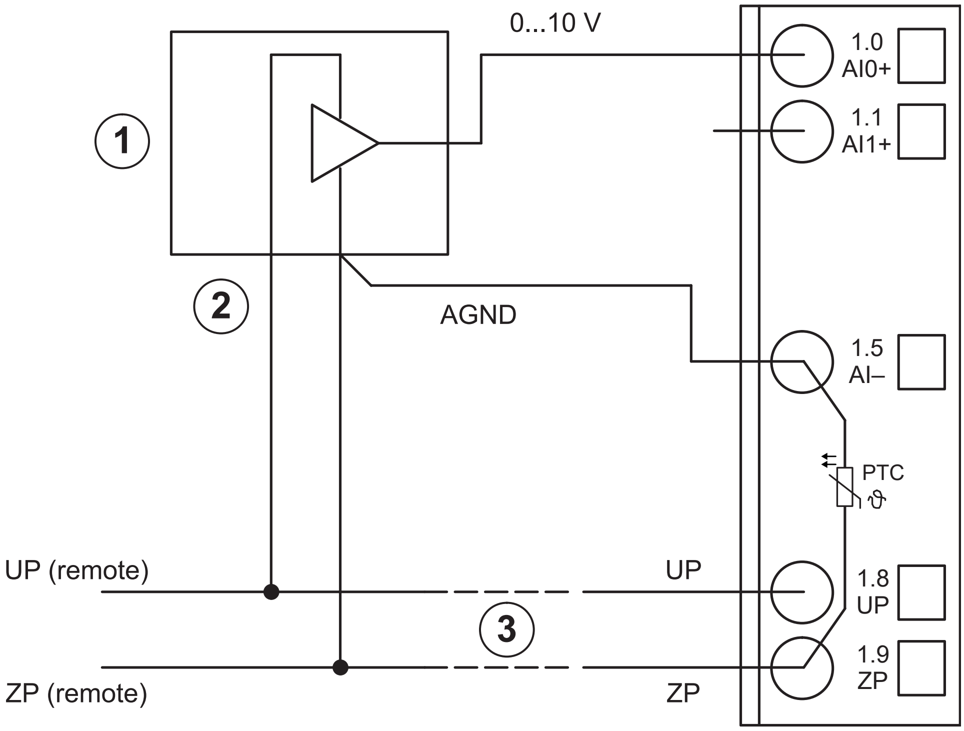


Fig. 174: Connection of active-type sensors (voltage) with no galvanically isolated power supply

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

The measuring ranges are described in the section Measuring Ranges *Chapter 5.6.3.1.7 “Parameterization” on page 893* *Chapter 5.6.3.1.10 “Measuring ranges” on page 902*.

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)

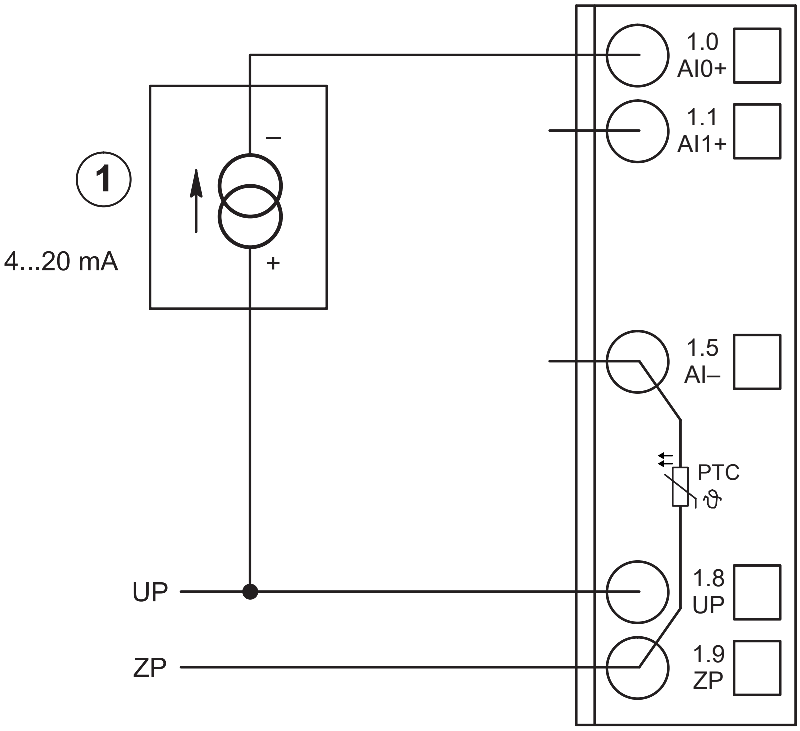


Fig. 175: Connection of passive-type analog sensors (current)

1 1 analog sensor requires 1 channel

Current	4 ... 20 mA	1 channel used

The measuring ranges are described in the section Measuring Ranges ⇘ *Chapter 5.6.3.1.7 “Parameterization” on page 893* ⇘ *Chapter 5.6.3.1.10 “Measuring ranges” on page 902*.

CAUTION!
If, during initialization, an analog current sensor supplies more than 25 mA for more than 1 second into an analog input, this input is switched off by the module (input protection). In such cases, it is recommended, to protect the analog input by a 10-volt Zener diode (in parallel to I+ and ZP). But, in general, it is a better solution to prefer sensors with fast initialization or without current peaks higher than 25 mA.

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).

Important: The ground potential at the sensors must not have a too big potential difference with respect to ZP (max. ±1 V within the full signal range). Otherwise problems can occur concerning the common-mode input voltages of the involved analog inputs

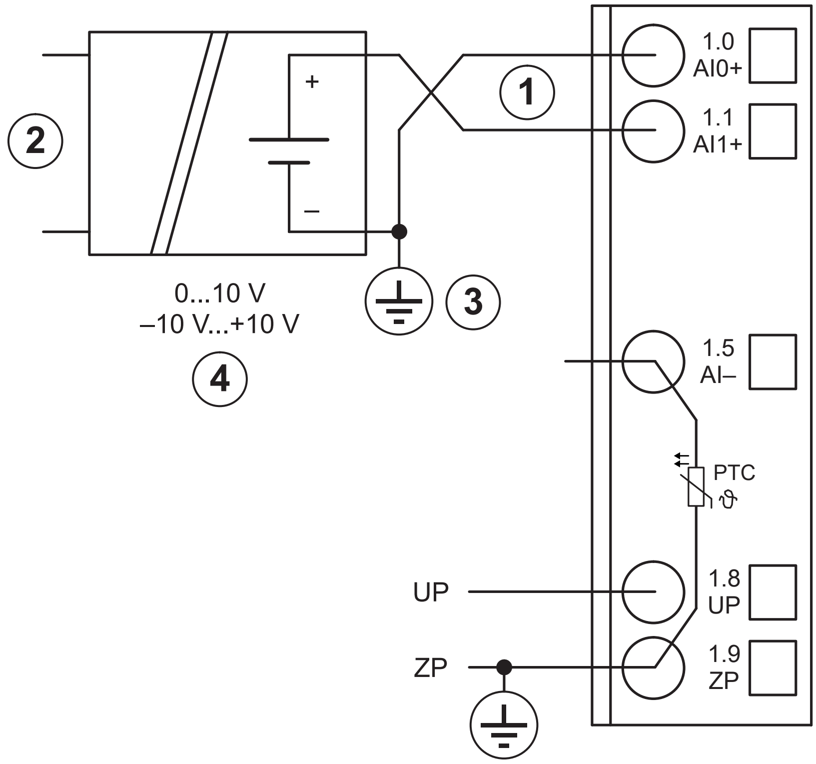


Fig. 176: Connection of active-type analog sensors (voltage) to differential inputs

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

The measuring ranges are described in the section Measuring Ranges *Chapter 5.6.3.1.7 “Parameterization” on page 893* *Chapter 5.6.3.1.10 “Measuring ranges” on page 902*.

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.

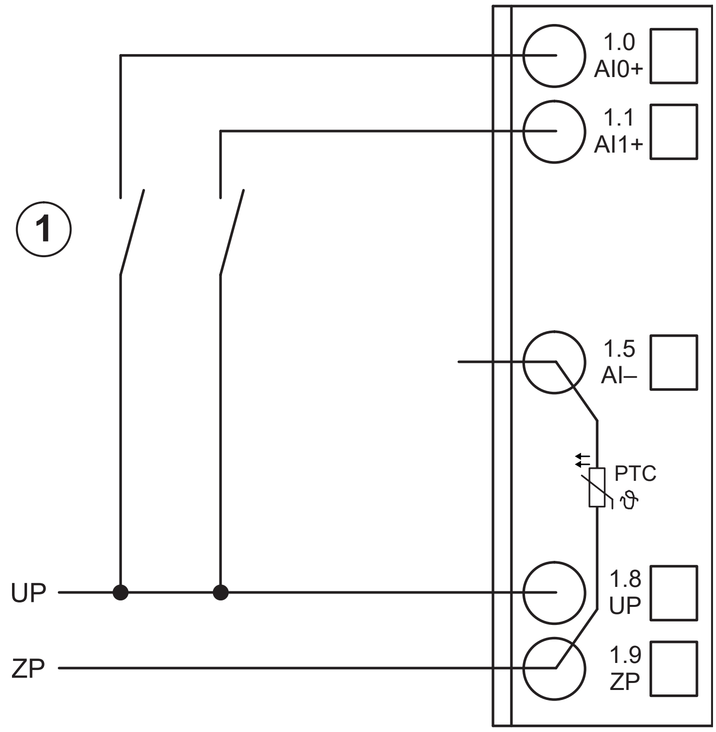


Fig. 177: Use of analog inputs as digital inputs

1 1 digital signal requires 1 channel

Digital input	24 V	1 channel used

The measuring ranges are described in the section Measuring Ranges ⇘ *Chapter 5.6.3.1.7 “Parameterization” on page 893* ⇘ *Chapter 5.6.3.1.10 “Measuring ranges” on page 902*.

Connection of analog output loads (Voltage, current)

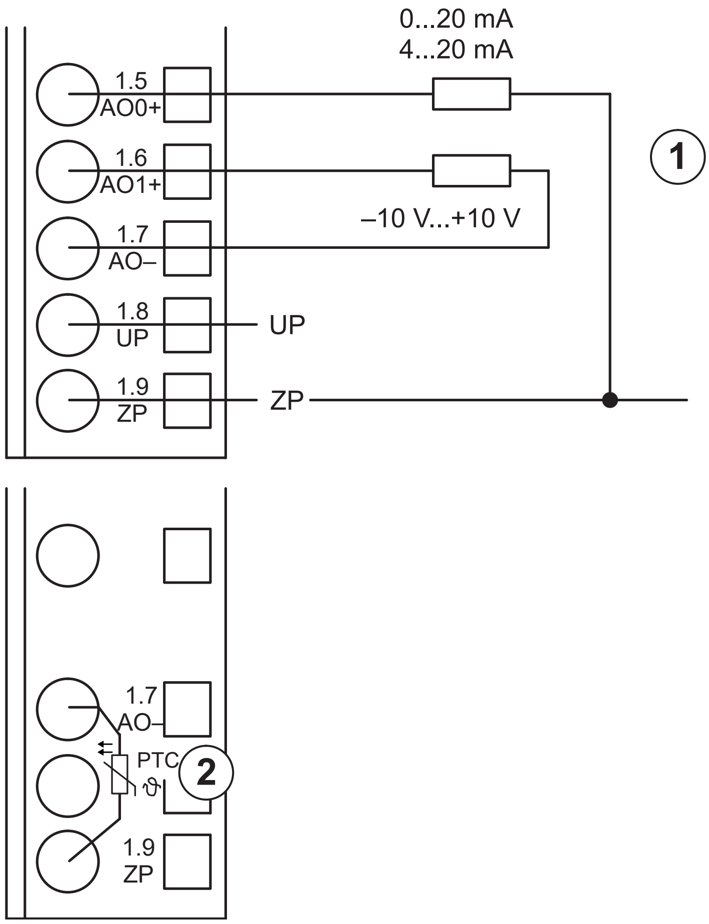


Fig. 178: Connection of analog output loads (voltage, current)

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

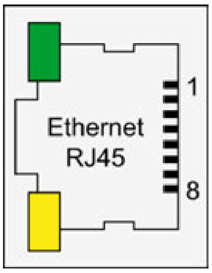
The measuring ranges are described in the section Measuring Ranges *Chapter 5.6.3.1.7 “Parameterization” on page 893* *Chapter 5.6.3.1.10 “Measuring ranges” on page 902*.

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.

5.6.3.1.4 Internal data exchange

Parameter	Value
Digital inputs (bytes)	1
Digital outputs (bytes)	1
Analog inputs (words)	4
Analog outputs (words)	2

5.6.3.1.5 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.

5.6.3.1.6 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.

5.6.3.1.7 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 217: 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 infor-mation 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 acti-vated trough the user program
129 ... 136	1 ... 8	80 µs	Module keeps in "operational" state; the cam switch out-puts are activated according to an inter-polated timing infor-mation
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 Pulsed Timed Comfort Cam shift Binary shift Multiturn cam Time timed Reference Multiturn timed	MCX_CamSwitchSimple_c MCX_CamSwitchSimple_dc MCX_PulseSwitch_dc MCX_CamSwitchTimed_dc MCX_CamSwitchCom-fort_dc MCX_CamShift_dc MCX_BinaryShift_dc MCX_CamSwitchMulti_dc MCX_SwitchTimeTimed_dc MCX_BinaryReference_dc MCX_CamSwitchMulti-Timed_dc	0 1 2 3 4 5 6 7 8 9	BYTE	0

[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 218: 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 219: 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 220: Channel monitoring [4])

Internal value	Check channel
0	Plausibility, wire break, short circuit
3	None

Table 221: 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 configura-tion
Substitute value for 5 s	Substitute value 5 s	Depending on configura-tion
Substitute value for 10 s	Substitute value 10 s	Depending on configura-tion

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.

5.6.3.1.8 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.

5.6.3.1.9 State LEDs

The LEDs are located at the front of module. There are 2 different groups:

- 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 222: 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 223: 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 fin-ished	--
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

5.6.3.1.10 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.

5.6.3.1.11 Technical data

The system data of AC500 and S500 are applicable to the standard version ␥ *Chapter 4.2 “System data AC500” on page 30*.

The system data of AC500-XC are applicable to the XC version ␥ *Chapter 4.3 “System data AC500-XC” on page 35*.

Only additional details are therefore documented below.

The technical data are 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

Technical data of the module

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 5.6.3.1.8 “Diagnosis” on page 899*
Operation and error displays		32 LEDs (totally)
Weight (without terminal unit)		ca. 125 g

Parameter	Value
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 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)
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.

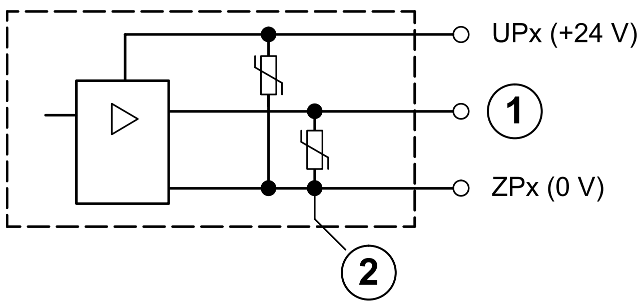


Fig. 179: Digital input/output (circuit diagram)

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 %
Relationship between input signal and hex code	*Chapter 5.6.3.1.10.2 “Input ranges resistance temperature detector” on page 903*
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

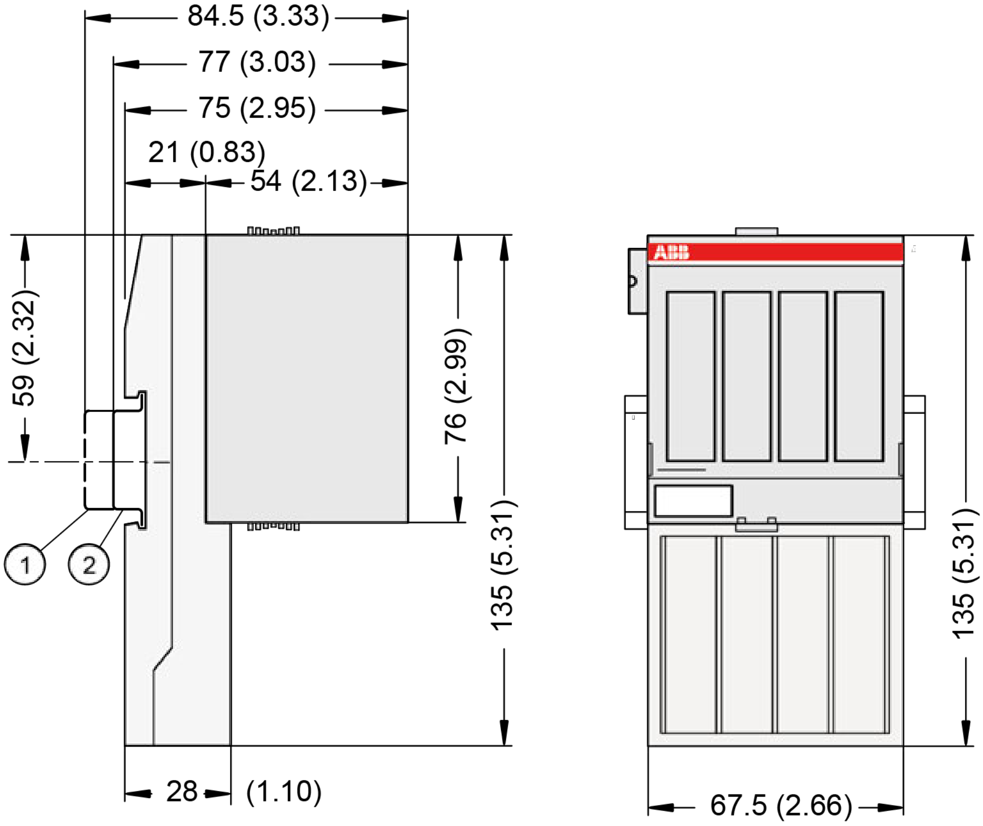
Parameter		Value
Reference potential for the inputs		Terminals 1.9, 2.9 and 3.9 (ZP)
Indication of the input signals		1 LED per channel
Input signal voltage		24 V DC
	Signal 0	-30 V ... +5 V
	Undefined signal	+5 V ... +13 V
	Signal 1	+13 V ... +30 V
Input current per channel		
	Input voltage +24 V	Typ. 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 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
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 %

Parameter	Value
Relationship between input signal and hex code	Table Output Ranges Voltage and Current *Chapter 5.6.3.1.10.3 “Output ranges voltage and current” on page 904*
Unused outputs	Are configured as unused (default value) and can be left open-circuited

5.6.3.1.12 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

5.6.3.1.13 Ordering data

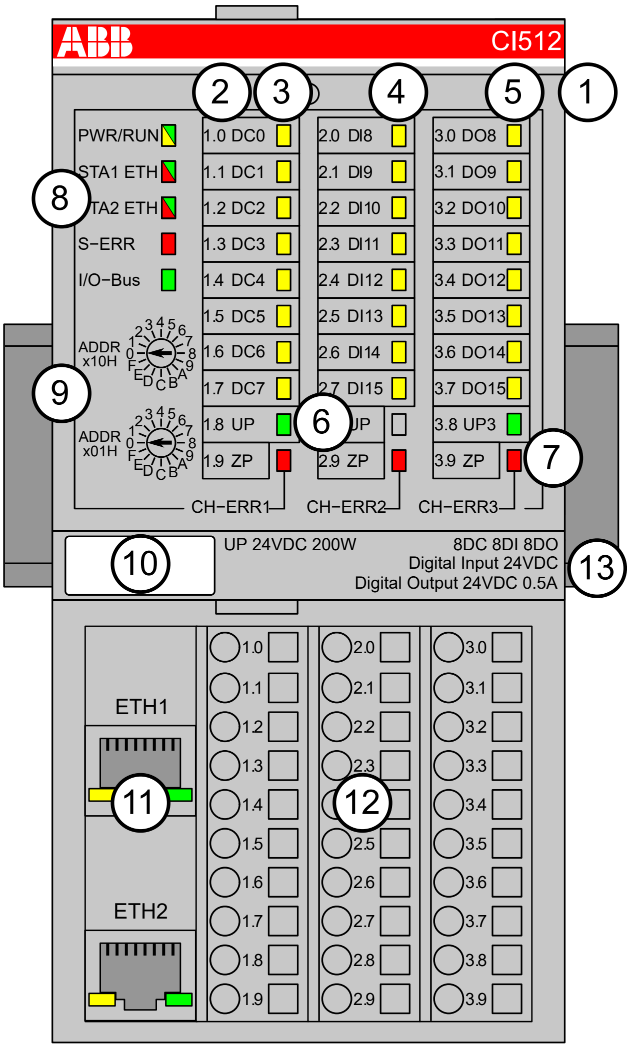
Part no.	Description	Product life cycle phase *)
1SAP 220 900 R0001	CI511-ETHCAT, EtherCAT communication interface module, 8 DI, 8 DO, 4 AI and 2 AO	Active

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

5.6.3.2 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

5.6.3.2.1 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.

5.6.3.2.2 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 5.7.1 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 1130*

5.6.3.2.3 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 you

– 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.

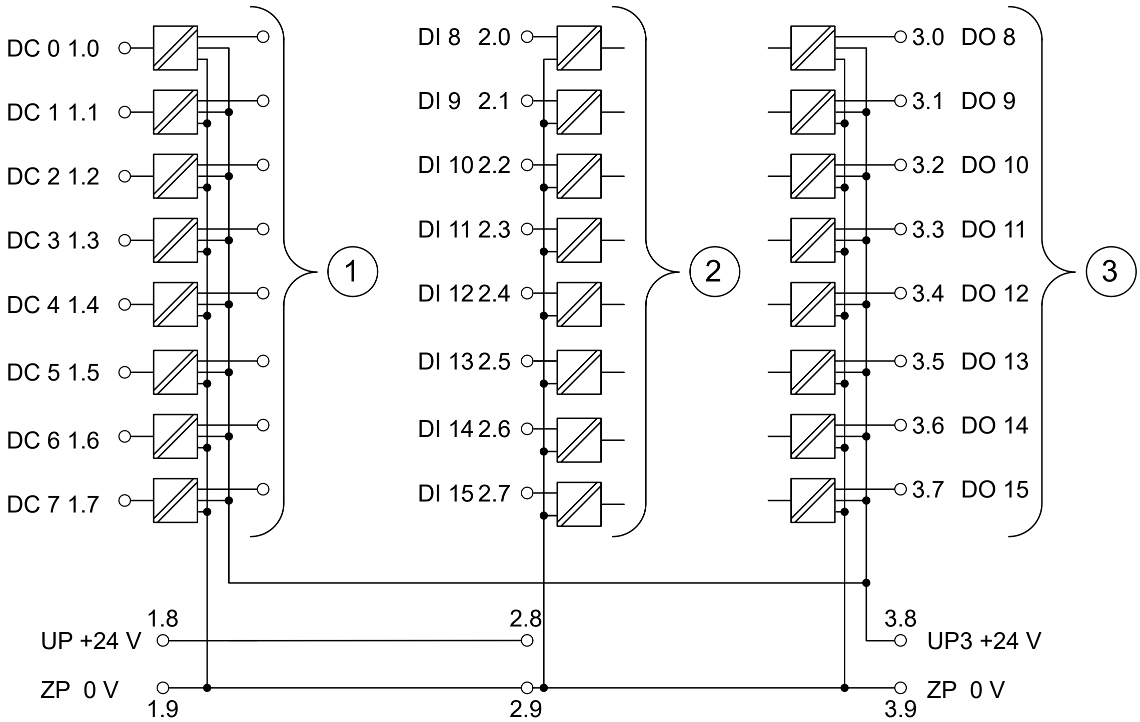


Fig. 180: Connection of the communication interface module CI512-ETHCAT

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.

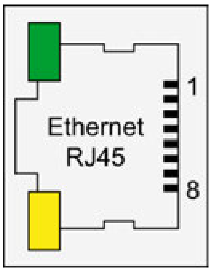
CAUTION!
The process supply voltage must be included within the grounding concept of the plant (e. g. grounding of the negative pole).

The module provides several diagnosis functions *Chapter 5.6.3.2.9 “Diagnosis” on page 919*.

5.6.3.2.4 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.

5.6.3.2.5 Internal data exchange

Parameter	Value
Digital inputs (bytes)	1
Digital outputs (bytes)	1
Configurable digital inputs/outputs (bytes)	1 + 1

5.6.3.2.6 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.

5.6.3.2.7 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.

5.6.3.2.8 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 224: 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.				

5.6.3.2.9 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.

5.6.3.2.10 State LEDs

The LEDs are located at the front of module. There are 2 different groups:

- 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 225: 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 config-ured	--	--
	Yellow	--	--	--	--	--
NET	Green	Init	Operational	Pre-opera-tional	Safe-opera-tional	--
	Red	No error	PDI Watchdog Timeout	Invalid Con-figuration	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 commu-nication interface modules connected or commu-nication 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 226: 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

5.6.3.2.11 Technical data

The system data of AC500 and S500 are applicable to the standard version ↯ *Chapter 4.2 “System data AC500” on page 30*.

The system data of AC500-XC are applicable to the XC version ↯ *Chapter 4.3 “System data AC500-XC” on page 35*.

Only additional details are therefore documented below.

The technical data are 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

Technical data of the module

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
Diagnosis		See Diagnosis and Displays *Chapter 5.6.3.2.9 “Diagnosis” on page 919*
Operation and error displays		34 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
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 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

Parameter		Value
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 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.

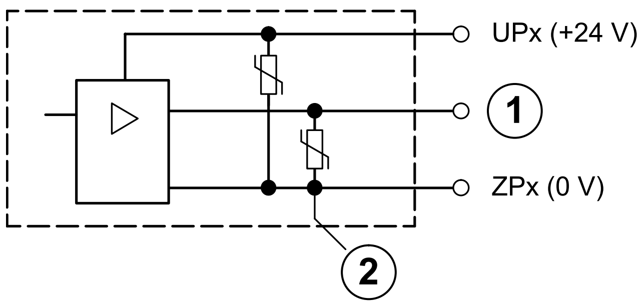


Fig. 181: Digital input/output (circuit diagram)

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.

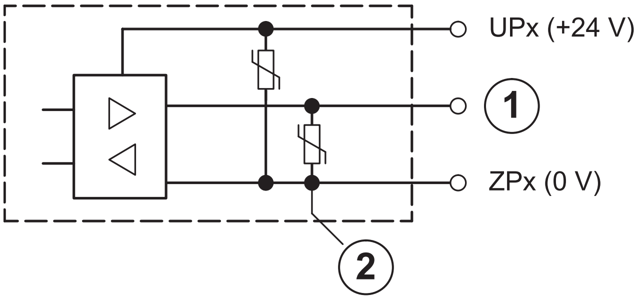
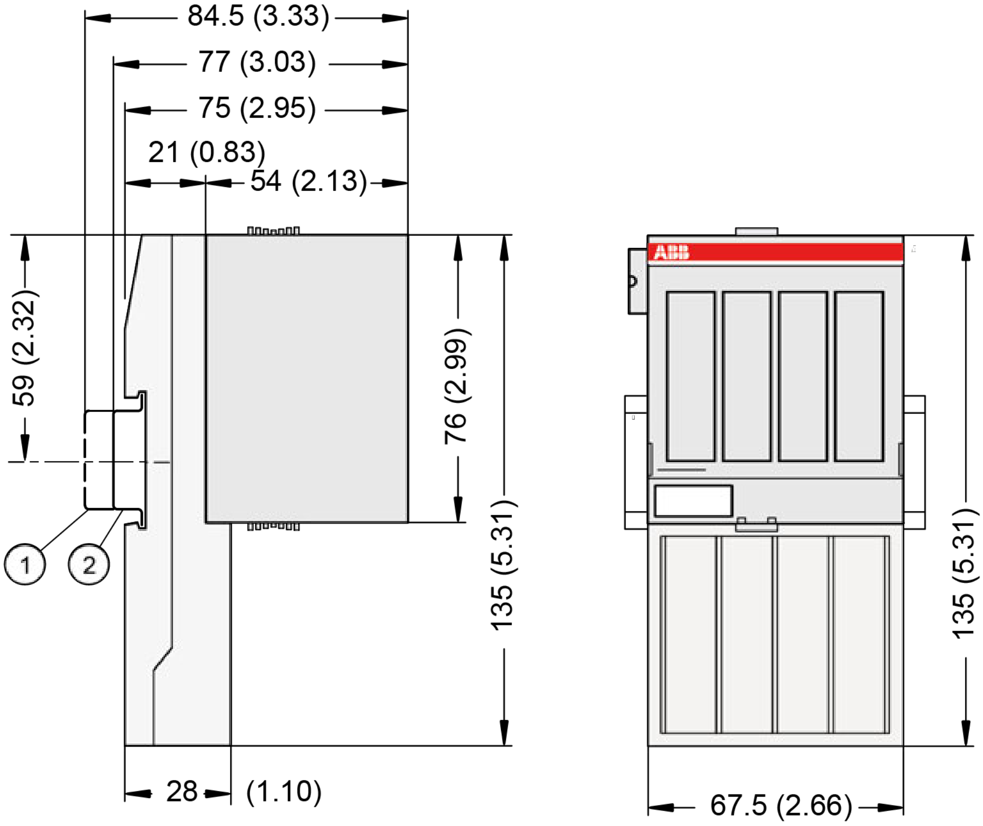


Fig. 182: Digital input/output (circuit diagram)

1 Digital input/output
2 For demagnetization when inductive loads are turned off

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

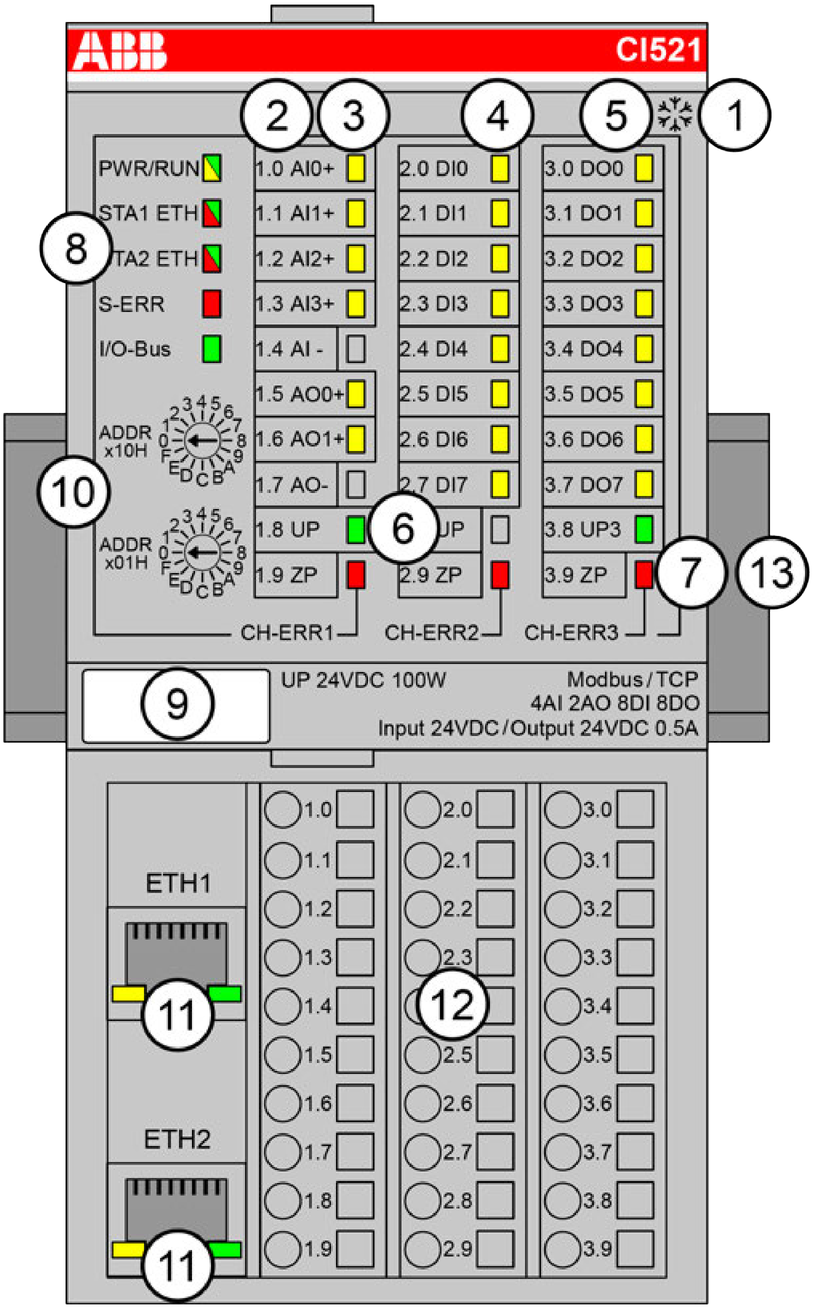
Part no.	Description	Product life cycle phase *)
1SAP 221 000 R0001	CI512-ETHCAT, EtherCAT communication interface module, 8 DI, 8 DO and 8 DC	Active

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

5.6.4 Modbus

5.6.4.1 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

5.6.4.1.1 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.

5.6.4.1.2 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 5.7.1 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 1130*

5.6.4.1.3 Connections

The Ethernet communication interface module CI521-MODTCP is plugged on the I/O terminal unit TU507-ETH or TU508-ETH *Chapter 5.7.1 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 1130*. 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 5.8.2.5 “TA526 - Wall mounting accessory” on page 1183*.

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!

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 conncted at the outputs DO0..DO7.

Table 227: 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
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

Terminal	Signal	Description
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 you

– 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. In order to avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

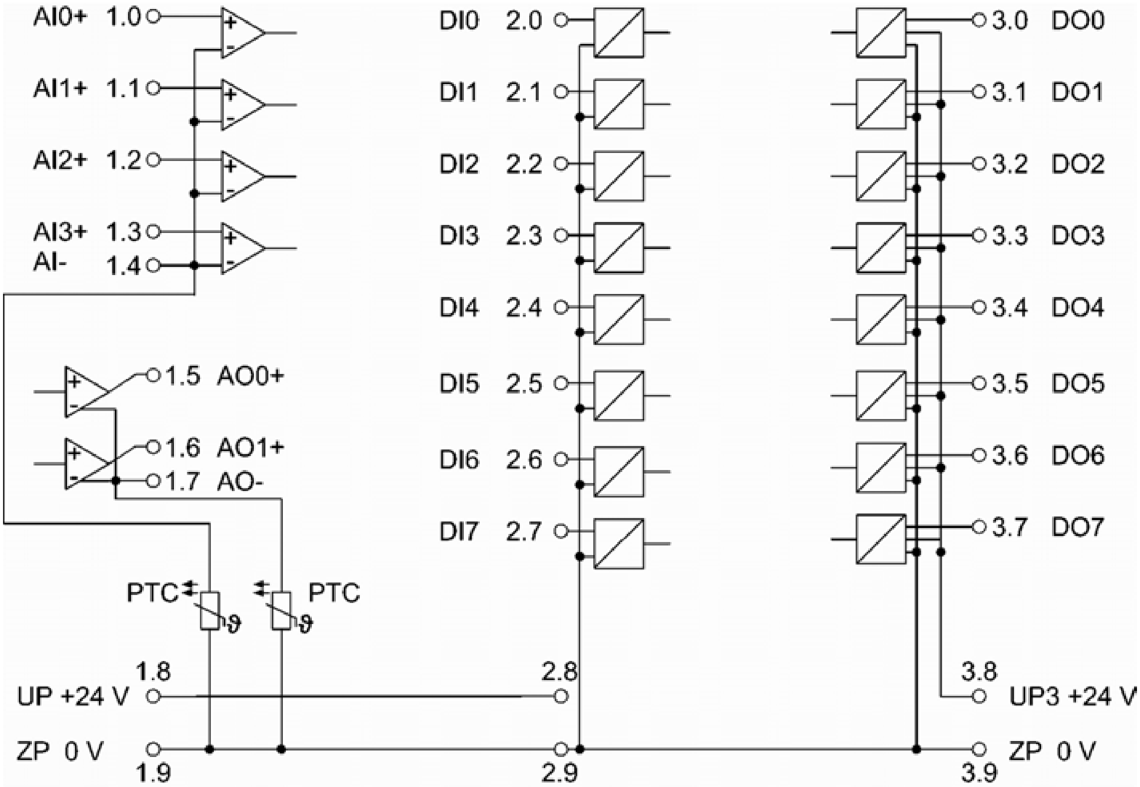


Fig. 183: Connection of the communication interface module CI521-MODTCP

Connection of the digital inputs

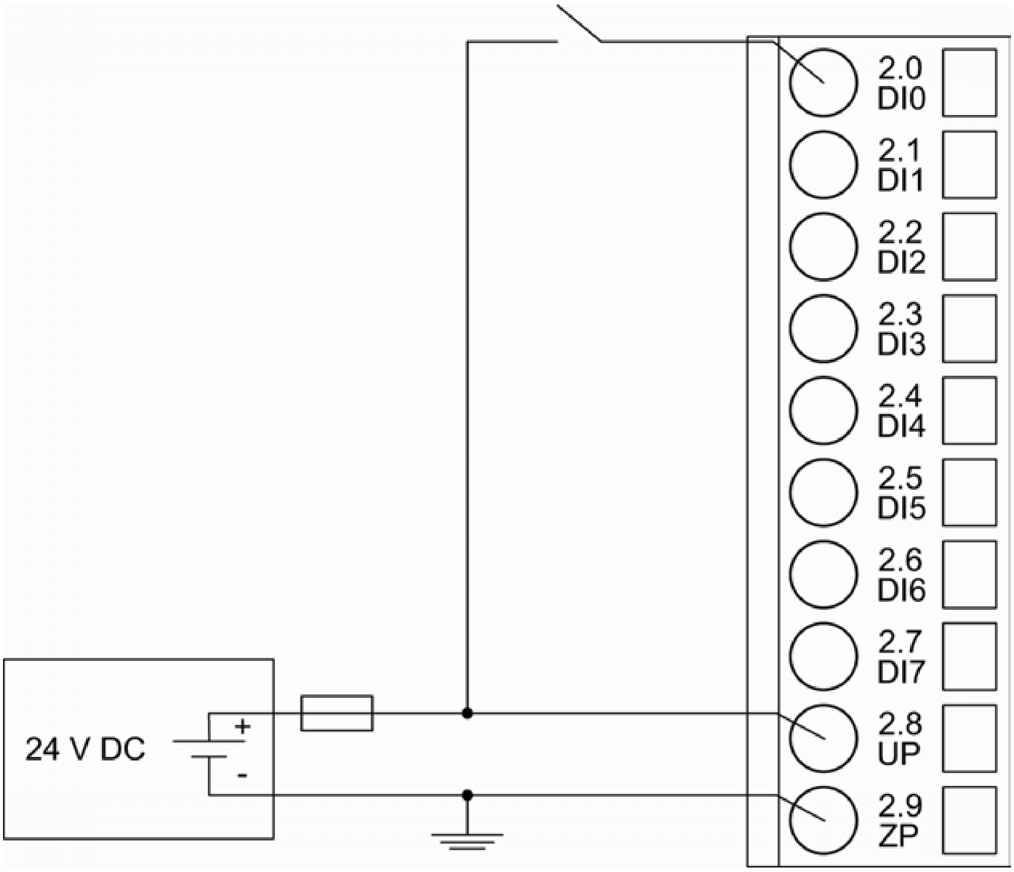


Fig. 184: Connection of the digital inputs (DO0 ... DO7) to the module CI521-MODTCP

The meaning of the LEDs is described in Displays *Chapter 5.6.4.1.9 “State LEDs” on page 960*.

Connection of the digital outputs

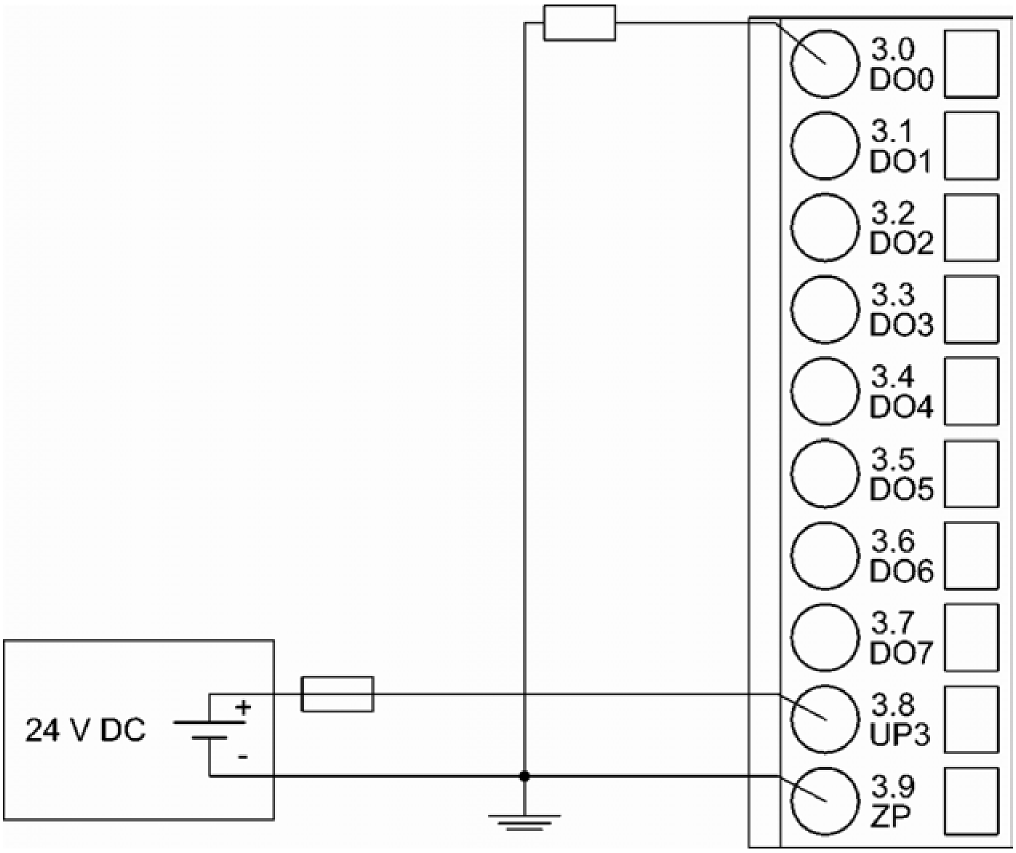


Fig. 185: Connection of configurable digital inputs/outputs (DO0 ... DO7) to the module CI521-MODTCP

The meaning of the LEDs is described in Displays *Chapter 5.6.4.1.9 “State LEDs” on page 960*.

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.

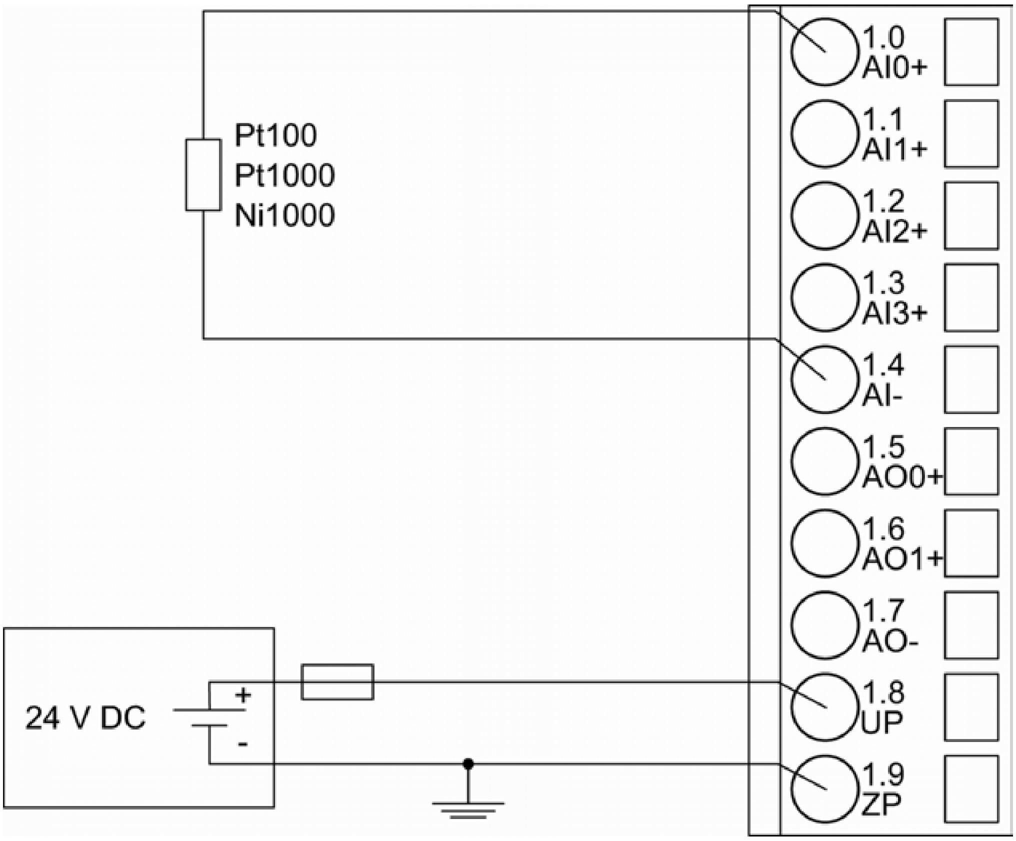


Fig. 186: Connection of resistance thermometers in 2-wire configuration to the analog inputs (AI0 ... AI3)

The following measuring ranges can be configured ⇘ *Chapter 5.6.4.1.7 “Parameterization” on page 949* ⇘ *Chapter 5.6.4.1.10 “Measuring ranges” on page 961*:

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

The function of the LEDs is described under Diagnosis and displays / Displays ⇘ *Chapter 5.6.4.1.8 “Diagnosis” on page 955*.

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.

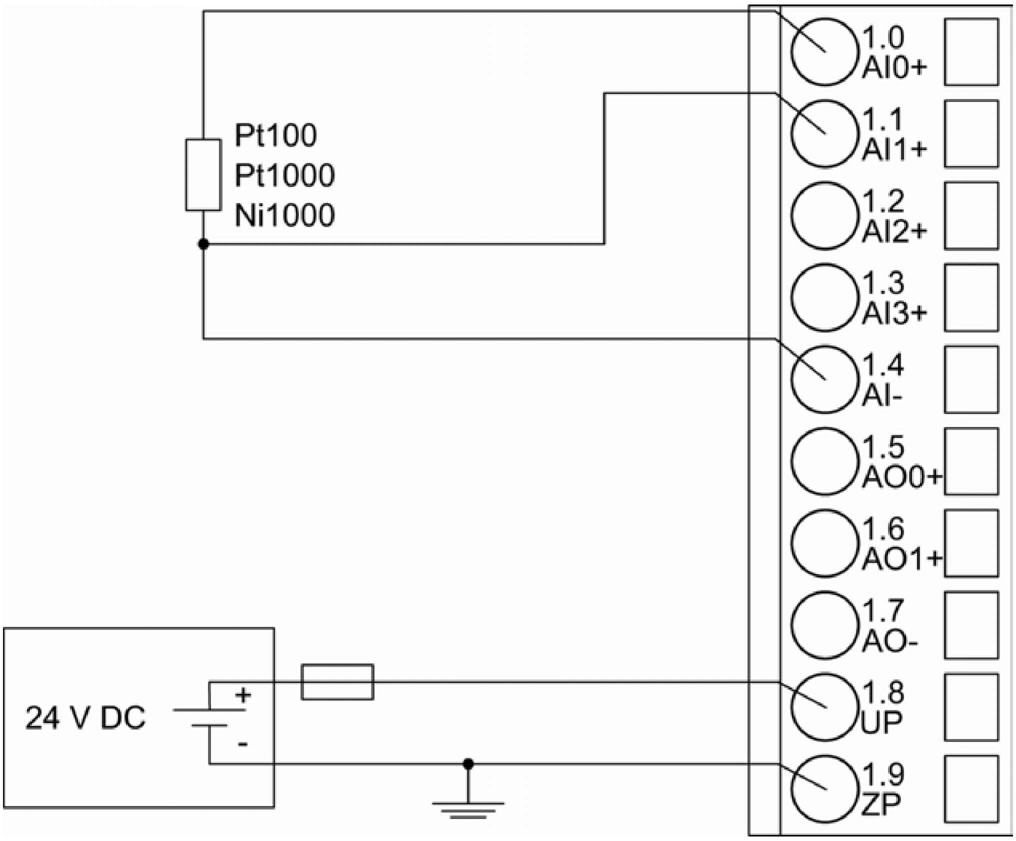


Fig. 187: Connection of resistance thermometers in 3-wire configuration to the analog inputs (AI0 ... AI3)

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 5.6.4.1.7 “Parameterization” on page 949* and 🔗 *Chapter 5.6.4.1.10 “Measuring ranges” on page 961*:

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

The function of the LEDs is described under Diagnosis and displays / Displays 🔗 *Chapter 5.6.4.1.8 “Diagnosis” on page 955*.

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

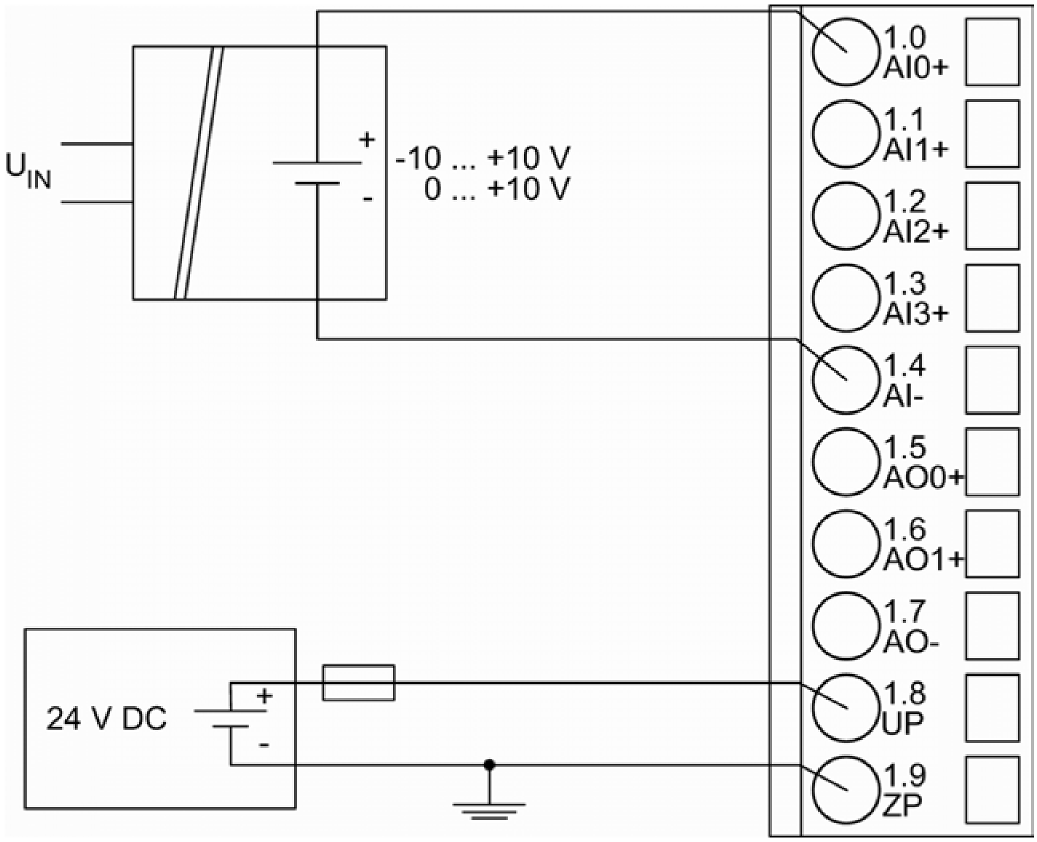


Fig. 188: Connection of active-type analog sensors (voltage) with galvanically isolated power supply to the analog inputs (AI0 ... AI3)

The following measuring ranges can be configured ↳ *Chapter 5.6.4.1.7 “Parameterization” on page 949* ↳ *Chapter 5.6.4.1.10 “Measuring ranges” on page 961*:

Voltage	0 ... 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 5.6.4.1.8 “Diagnosis” on page 955*.

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

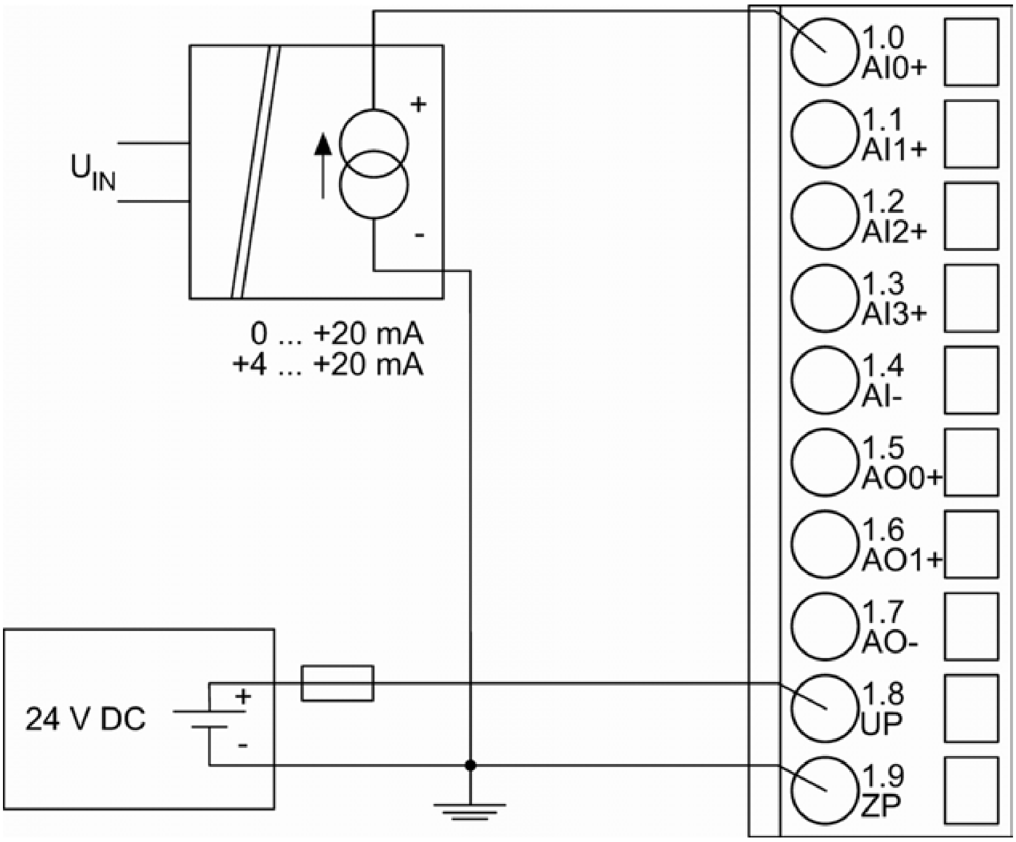


Fig. 189: Connection of active-type analog sensors (current) with galvanically isolated power supply to the analog inputs (AI0 ... AI3)

The following measuring ranges can be configured ➾ *Chapter 5.6.4.1.7 “Parameterization” on page 949* ➾ *Chapter 5.6.4.1.10 “Measuring ranges” on page 961*:

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 5.6.4.1.8 “Diagnosis” on page 955*.

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

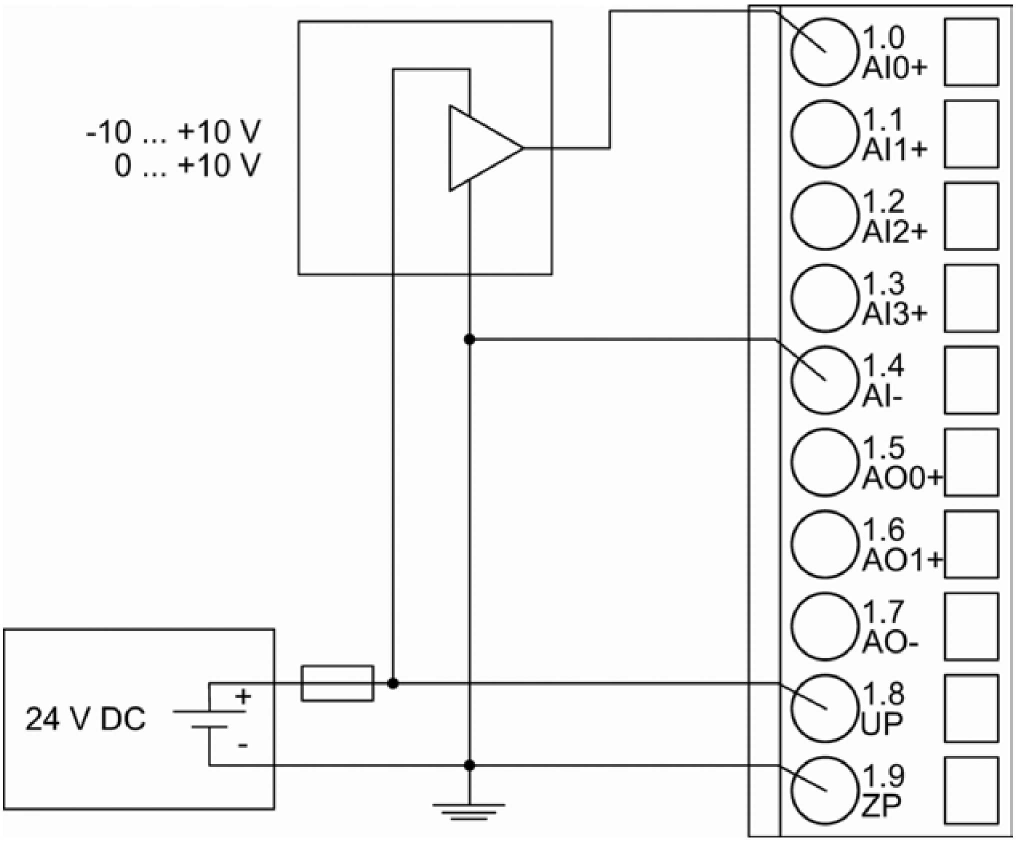


Fig. 190: Connection of active-type sensors (voltage) with no galvanically isolated power supply to the analog inputs (AI0 ... AI3)

> **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).

The following measuring ranges can be configured *Chapter 5.6.4.1.7 “Parameterization” on page 949* *Chapter 5.6.4.1.10 “Measuring ranges” on page 961*.

Voltage	0 ... 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 5.6.4.1.8 “Diagnosis” on page 955*.

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.

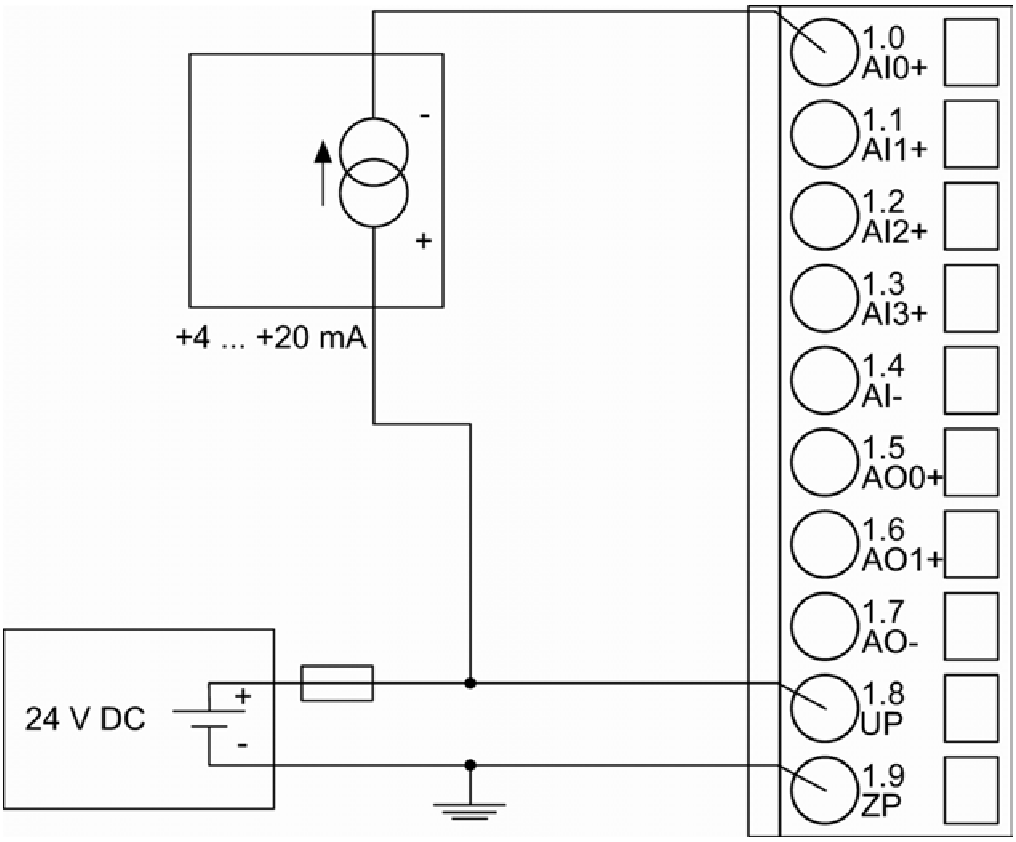


Fig. 191: Connection of passive-type analog sensors (current) to the analog inputs (AI0 ... AI3)

The following measuring ranges can be configured *Chapter 5.6.4.1.7 “Parameterization” on page 949* *Chapter 5.6.4.1.10 “Measuring ranges” on page 961*:

Current	4 mA ... 20 mA	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays *Chapter 5.6.4.1.8 “Diagnosis” on page 955*.

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.

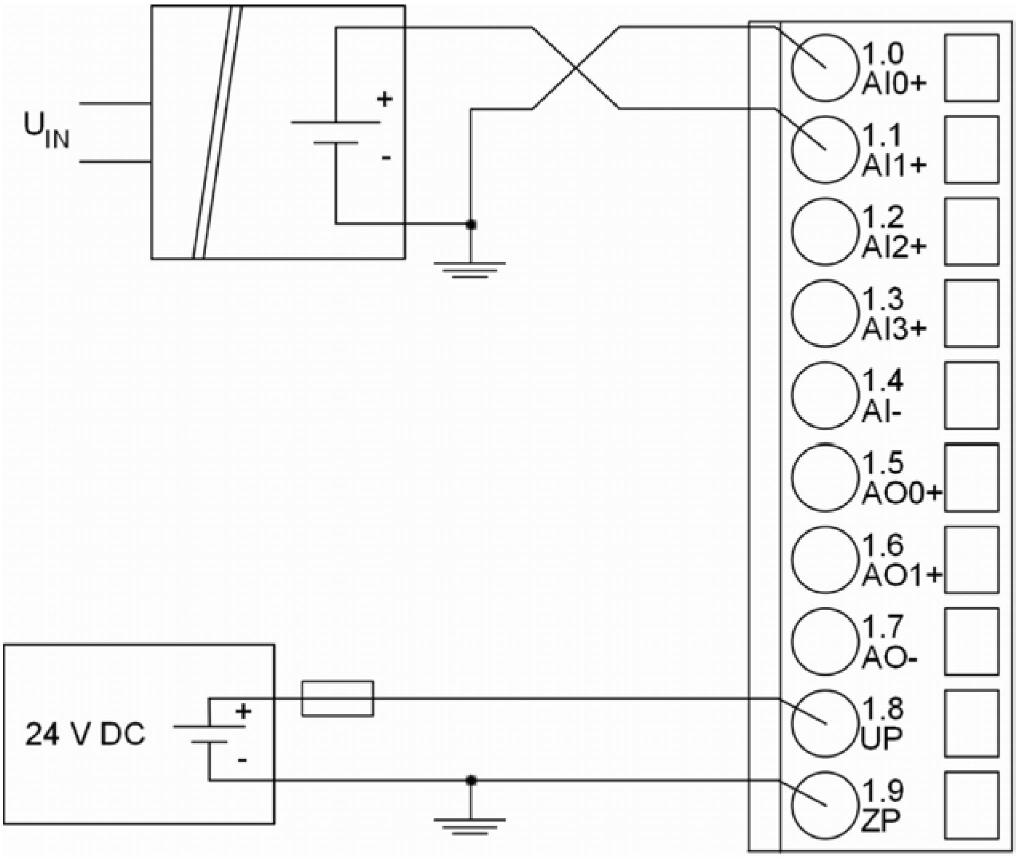


Fig. 192: Connection of active-type analog sensors (voltage) to differential analog inputs (AI0 ... AI3)

The following measuring ranges can be configured *Chapter 5.6.4.1.7 “Parameterization” on page 949* *Chapter 5.6.4.1.10 “Measuring ranges” on page 961*:

Voltage	0 V ... 10 V	With differential inputs, 2 channels used
Voltage	-10 V ... +10 V	With differential inputs, 2 channels used

The function of the LEDs is described under Diagnosis and displays / Displays ↬ *Chapter 5.6.4.1.8 “Diagnosis” on page 955*.

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 ↬ *Chapter 5.6.4.1.11.5 “Technical data of the analog inputs if used as digital inputs” on page 967*. The inputs are not galvanically isolated against the other analog channels.

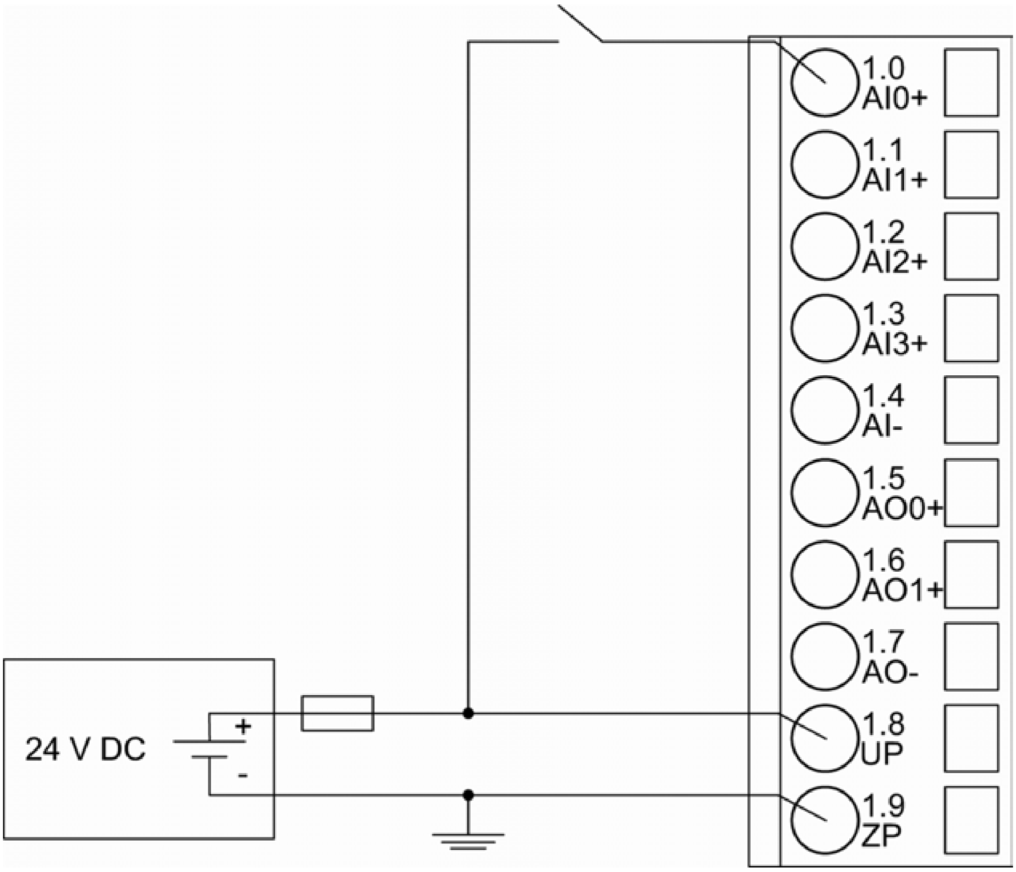


Fig. 193: Connection of digital sensors to the analog inputs (AI0 ... AI3)

The following measuring ranges can be configured ↬ *Chapter 5.6.4.1.7 “Parameterization” on page 949* and ↬ *Chapter 5.6.4.1.10 “Measuring ranges” on page 961* :

Digital input	24 V	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays ↬ *Chapter 5.6.4.1.8 “Diagnosis” on page 955*.

Connection of analog output loads (Voltage)

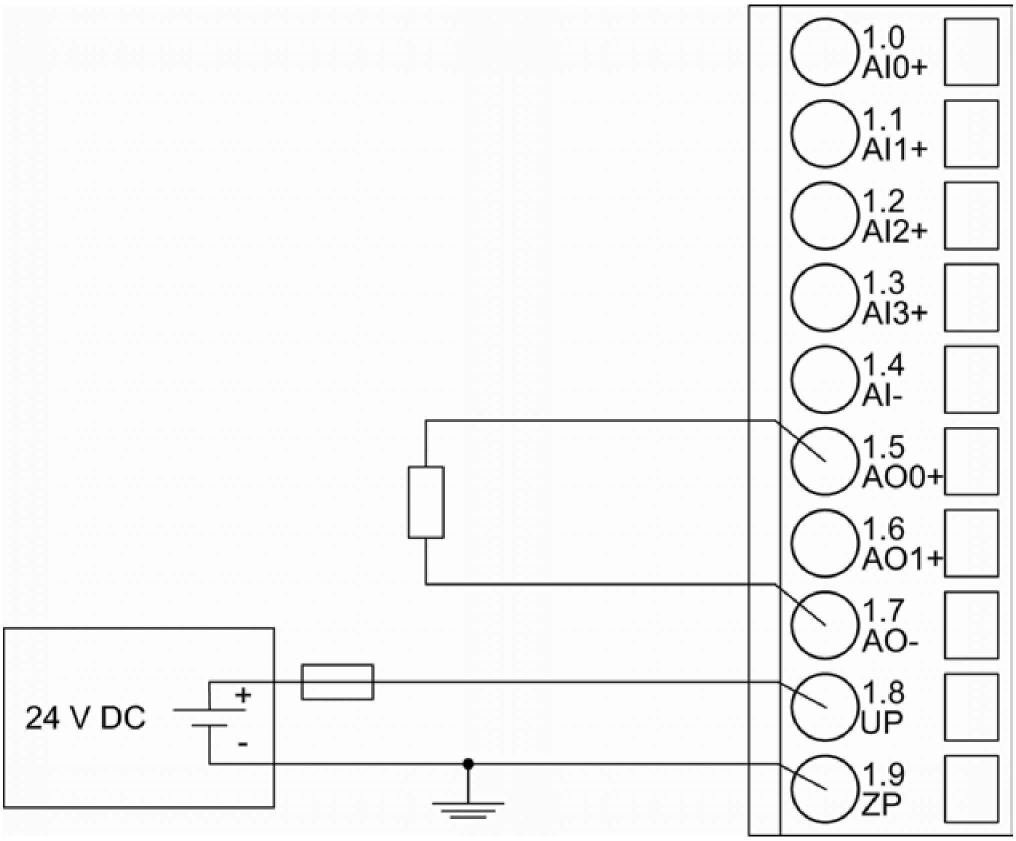


Fig. 194: Connection of analog output loads (voltage) to the analog outputs (AO0 ... AO1)

The following measuring ranges can be configured ✎ *Chapter 5.6.4.1.7 “Parameterization” on page 949* ✎ *Chapter 5.6.4.1.10 “Measuring ranges” on page 961*

Voltage	-10 V ... +10 V	Load ± 10 mA max.	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays ✎ *Chapter 5.6.4.1.8 “Diagnosis” on page 955*.

Unused analog outputs can be left open-circuited.

Connection of analog output loads (Current)

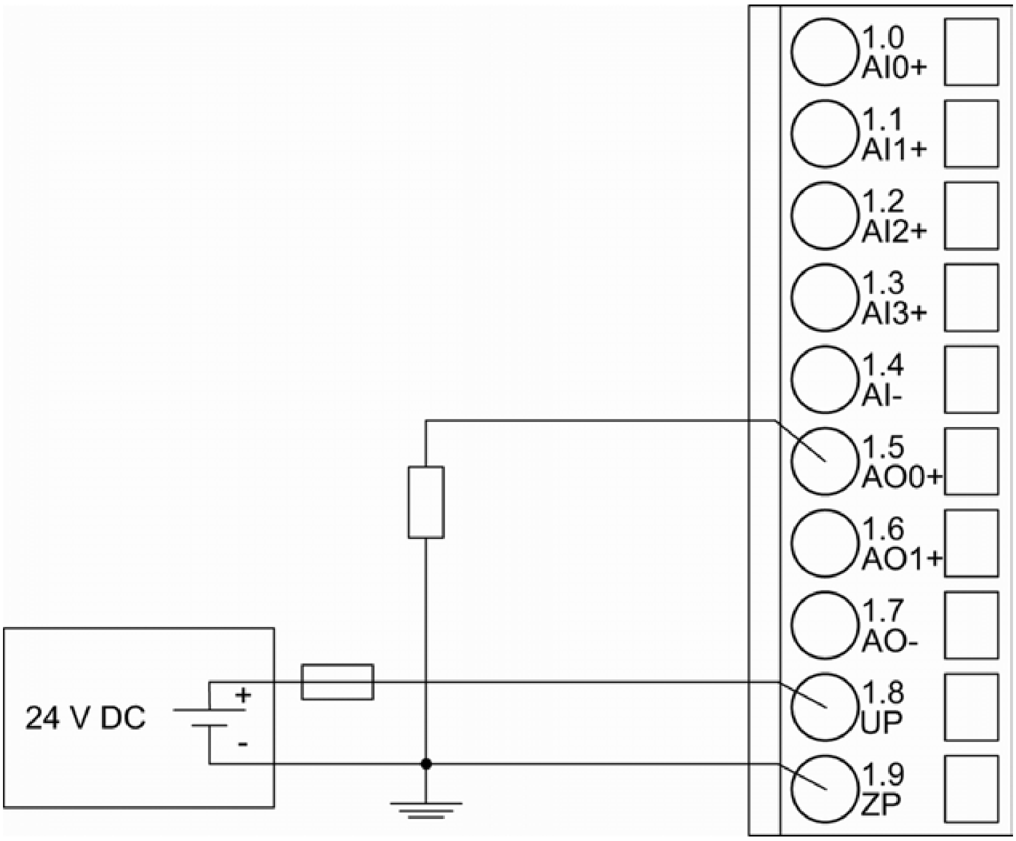


Fig. 195: Connection of analog output loads (current) to the analog outputs (AO0 and AO1)

The following measuring ranges can be configured *Chapter 5.6.4.1.7 “Parameterization” on page 949* *Chapter 5.6.4.1.10 “Measuring ranges” on page 961*:

Current	0 mA ... 20 mA	Load 0 ... 500 Ω	1 channel used
Current	4 ... 20 mA	Load 0 ... 500 Ω	1 channel used

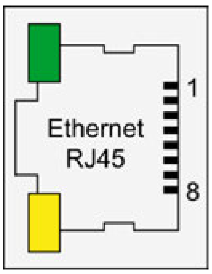
The function of the LEDs is described under Diagnosis and displays / Displays *Chapter 5.6.4.1.8 “Diagnosis” on page 955*.

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.

5.6.4.1.4 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.

5.6.4.1.5 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).

5.6.4.1.6 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 are described in Parameterization ↳ *Chapter 5.6.4.1.7 “Parameterization” on page 949*.

5.6.4.1.7 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 228 “Error LED / Failsafe function” on page 950*	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 228: 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 Operating modes of the analog inputs *Table 229 “Channel configuration” on page 952*	Table Operating modes of the analog inputs *Table 229 “Channel configuration” on page 952*	BYTE	0
Input 0, Check channel	Table Channel montoring *Table 230 “Channel monitoring” on page 952*	Table Channel montoring *Table 230 “Channel monitoring” on page 952*	BYTE	0
:	:	:	:	:
:	:	:	:	:
Input 3, Channel configuration	Table Operating modes of the analog inputs *Table 229 “Channel configuration” on page 952*	Table Operating modes of the analog inputs *Table 229 “Channel configuration” on page 952*	BYTE	0
Input 3, Check channel	Table Channel montoring *Table 230 “Channel monitoring” on page 952*	Table Channel montoring *Table 230 “Channel monitoring” on page 952*	BYTE	0

Table 229: 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
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 230: 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 configu-ration	Table Operating modes of the analog outputs *Table 231 “Channel configuration” on page 953*	Table Operating modes of the analog outputs *Table 231 “Channel configuration” on page 953*	BYTE	0
Output 0, Check channel	Table Channel monitoring *Table 232 “Channel monitoring” on page 953*	Table Channel monitoring *Table 232 “Channel monitoring” on page 953*	BYTE	0

Name	Value	Internal value	Internal value, type	Default
Output 0, Substitute value	Table Substitute value ➪ *Table 233 “Substitute value” on page 953*	Table Substitute value ➪ *Table 233 “Substitute value” on page 953*	WORD	0
Output 1, Channel configuration	Table Operating modes of the analog outputs ➪ *Table 231 “Channel configuration” on page 953*	Table Operating modes of the analog outputs ➪ *Table 231 “Channel configuration” on page 953*	BYTE	0
Output 1, Check channel	Table Channel monitoring ➪ *Table 232 “Channel monitoring” on page 953*	Table Channel monitoring ➪ *Table 232 “Channel monitoring” on page 953*	BYTE	0
Output 1, Substitute value	Table Substitute value ➪ *Table 233 “Substitute value” on page 953*	Table Substitute value ➪ *Table 233 “Substitute value” on page 953*	WORD	0

Table 231: 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 232: Channel monitoring

Internal value	Check channel
0	Plausibility, wire break, short circuit
3	None

Table 233: 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

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"
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 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 *Chapter 5.6.4.1.3 “Connections” on page 931*. 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".

5.6.4.1.8 Diagnosis

Table 234: 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
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
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

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	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
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	-	31	31	31	46	Voltage feedback on activated digital outputs DO0...DO7 on UP3 4)	Check terminals

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	-	31/1...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
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	0...7	46	Externally voltage detected at digital output DO0...DO7 [6])	Check terminals
4	-	31	2	0...7	47	Short circuit at dig-ital output [7])	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

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	3	0..1	4	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 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 *Chapter 5.6.4.1.3 “Connections” on page 931*. 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 on digital outputs DO0...DO7 has overrun the process supply voltage UP3 *Chapter 5.6.4.1.3 “Connections” on page 931*. Diagnosis message appears for the whole module.
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.

5.6.4.1.9 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 235: 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	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 236: 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 fin-ished	--
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

5.6.4.1.10 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
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

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	< 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
			+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
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.

5.6.4.1.11 Technical data

The system data of AC500 and S500 are applicable to the standard version ⇘ *Chapter 4.2 “System data AC500” on page 30*.

The system data of AC500-XC are applicable to the XC version ⇘ *Chapter 4.3 “System data AC500-XC” on page 35*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Technical data of the module

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

Parameter		Value
	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
Setting of the IP address		With ABB IP config tool and 2 rotary switches at the front side of the module
Diagnose		See Diagnosis and Displays *Chapter 5.6.4.1.8 "Diagnosis" on page 955*
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)
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.

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

Parameter	Value
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)
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)

Parameter		Value
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.

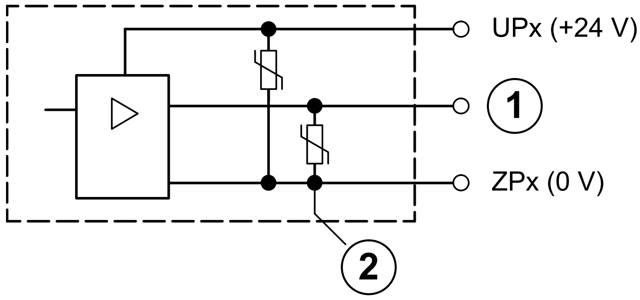


Fig. 196: Digital input/output (circuit diagram)

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

Parameter	Value
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 5.6.4.1.10.2 “Input ranges resistance temperature detector” on page 962*
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

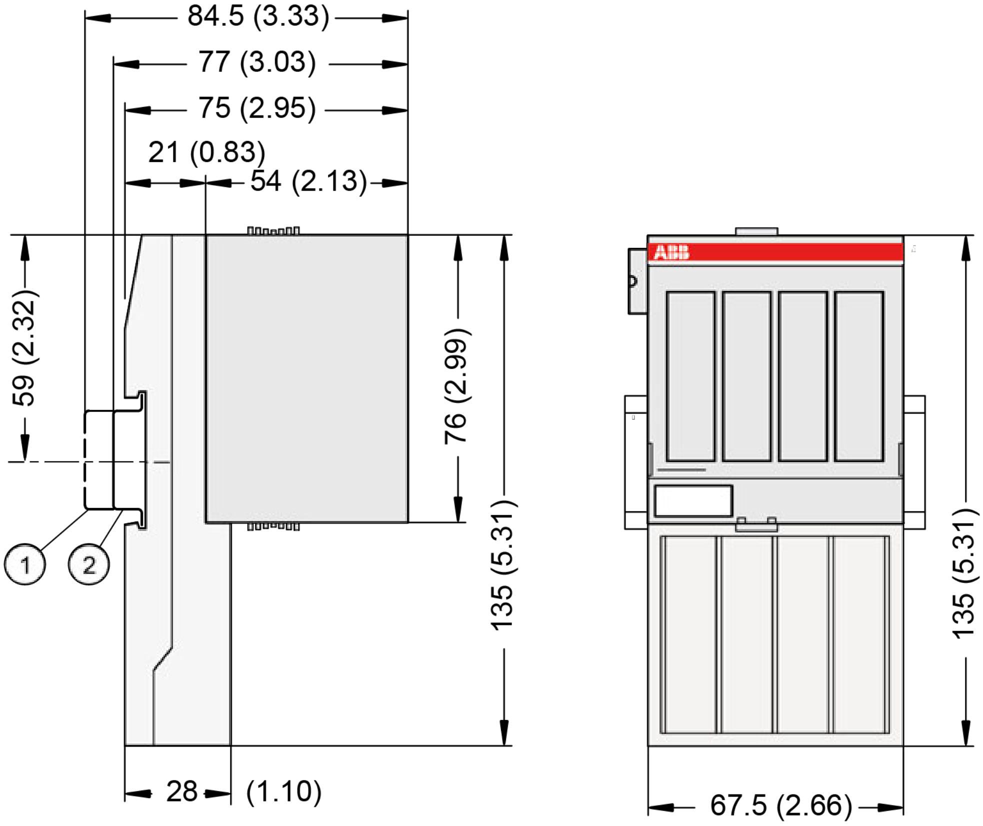
Parameter	Value
Number of channels per module	2
Distribution of channels into groups	1 group for 2 channels
Connection of the channels AO0+ ... AO1+	Terminals 1.5 ... 1.6
Reference potential for AO0+ ... AO1+	Terminal 1.7 (AO-) for voltage outputTerminal 1.9, 2.9 and 3.9 for current output

Parameter		Value
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 5.6.4.1.10.3 “Output ranges voltage and current” on page 963*
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

5.6.4.1.12 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

5.6.4.1.13 Ordering data

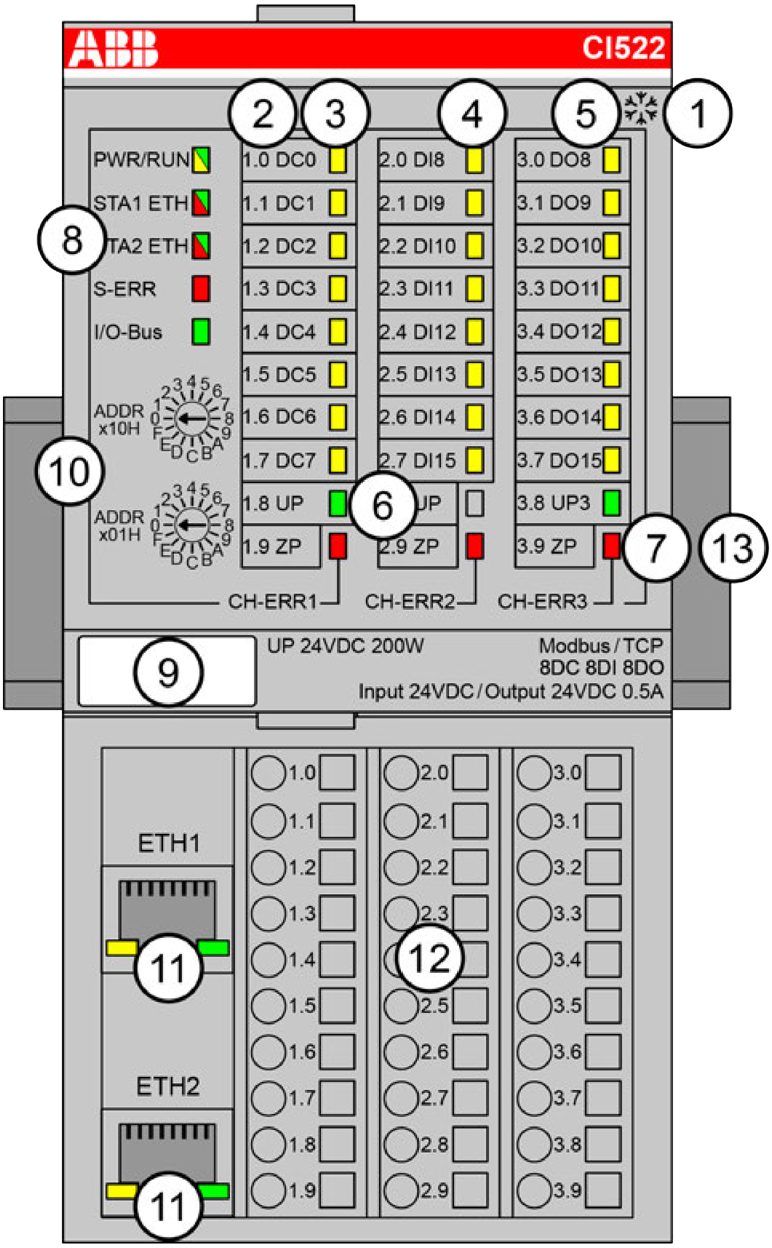
Part no.	Description	Product life cycle phase *)
1SAP 222 100 R0001	CI521-MODTCP, Modbus TCP communication interface module, 4 AI, 2 AO, 8 DI and 8 DO	Active
1SAP 422 100 R0001	CI521-MODTCP-XC, Modbus TCP communication interface module, 4 AI, 2 AO, 8 DI and 8 DO, XC version	Active

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

5.6.4.2 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

5.6.4.2.1 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.

5.6.4.2.2 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 5.7.1 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 1130*

5.6.4.2.3 Connections

The Ethernet communication interface module CI522-MODTCP is plugged on the I/O terminal unit TU507-ETH *Chapter 5.7.1 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 1130* or TU508-ETH *Chapter 5.7.1 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 1130*. 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 5.8.2.5 “TA526 - Wall mounting accessory” on page 1183*.

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
DC523-XC	D0
DC532	D0
DC532-XC	D0
DI524	D0

S500 I/O module type	First index with firmware version above 1.9
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 conncted at the outputs DO8 ... DO15 and DC0 ... DC7.

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
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)

Terminal	Signal	Description
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 you

– 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.

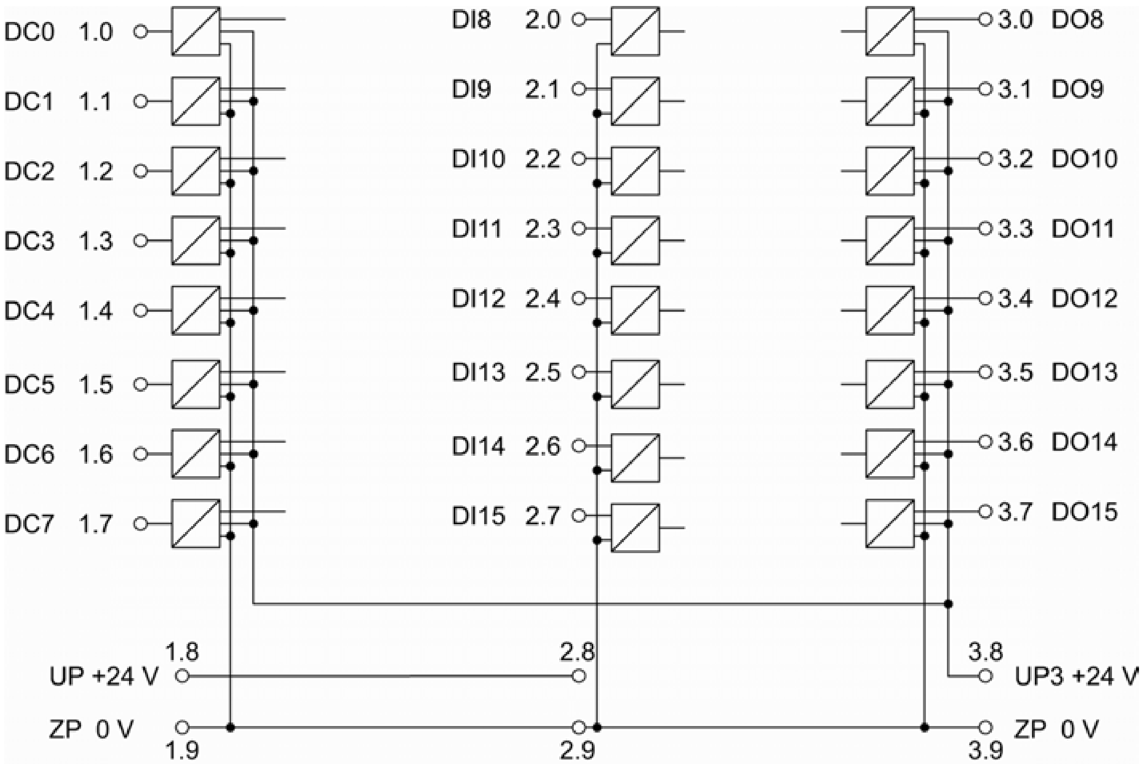


Fig. 197: Connection of the communication interface module CI522-MODTCP

Connection of the digital inputs

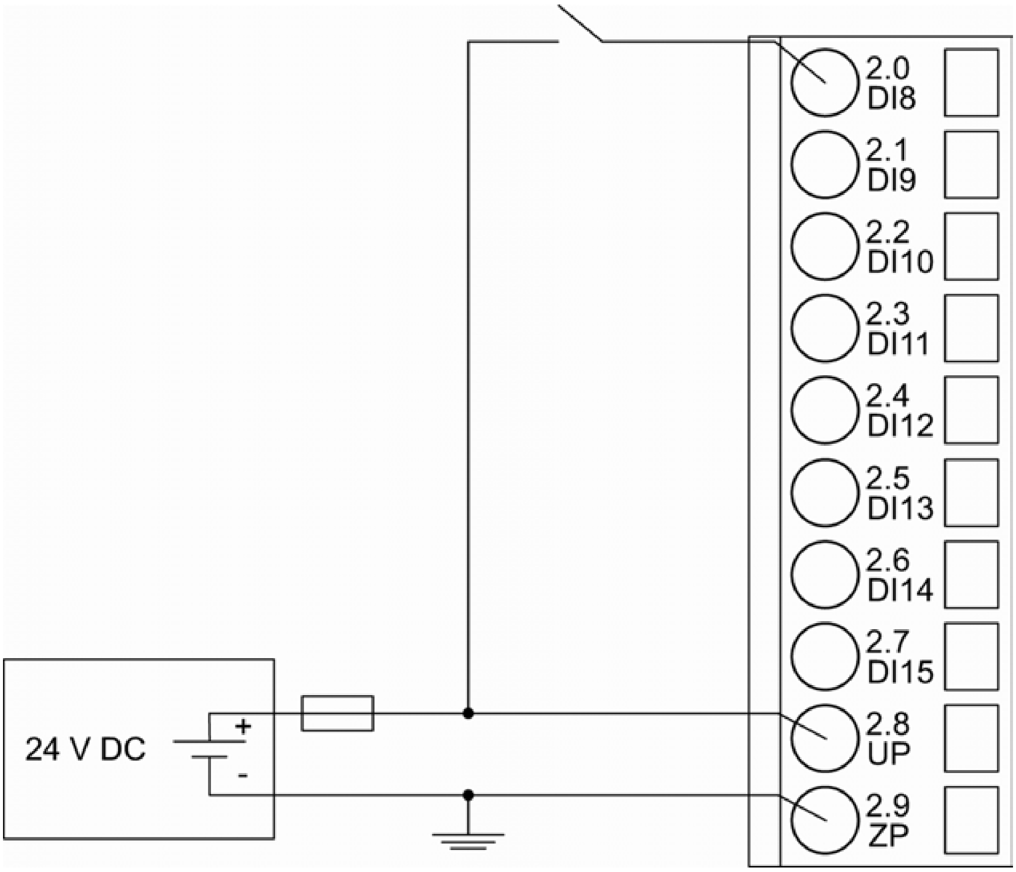


Fig. 198: Connection of the digital inputs (DI8 ... DI15) to the module CI522-MODTCP

The meaning of the LEDs is described in Displays *Chapter 5.6.4.2.9 “State LEDs” on page 987*.

Connection of the digital outputs

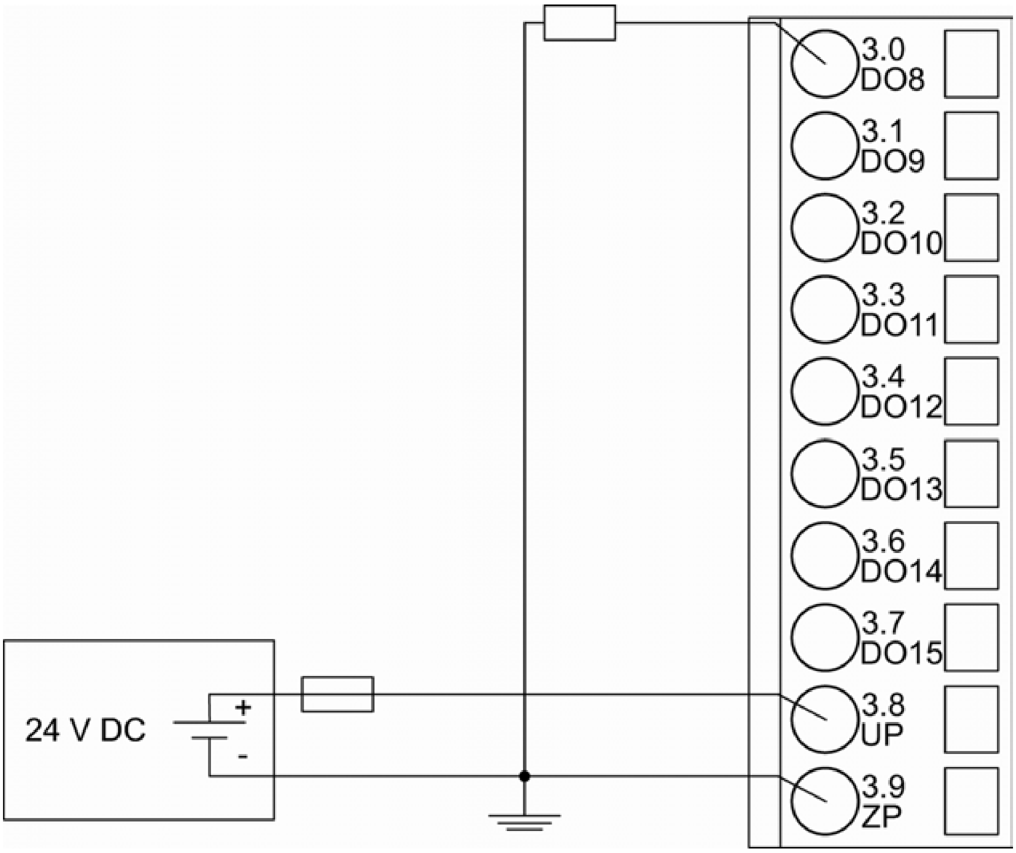


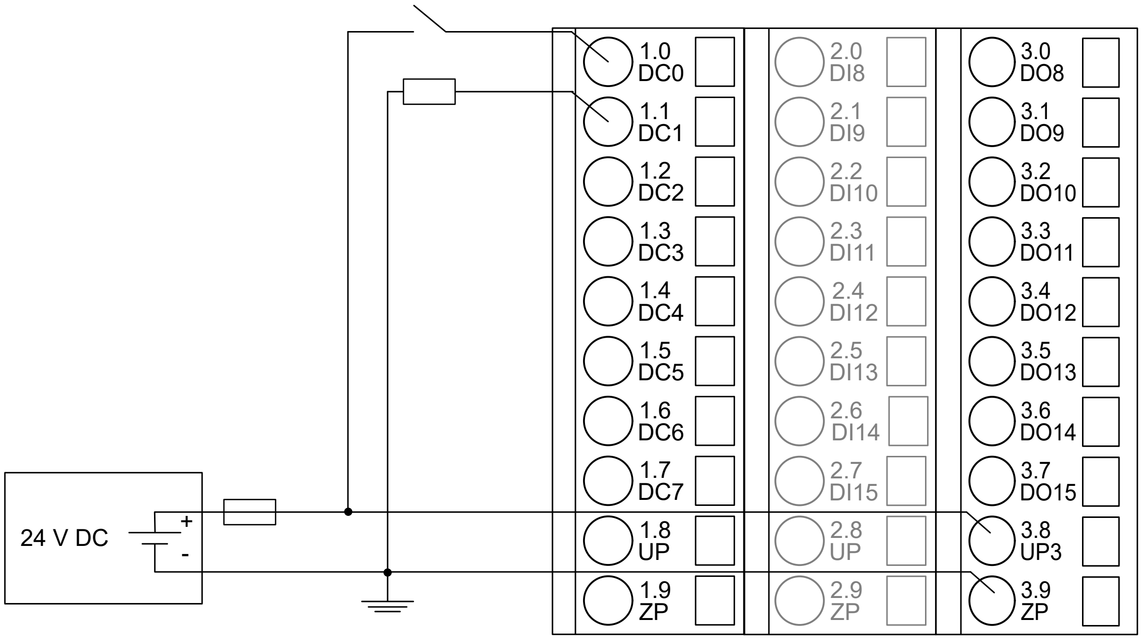
Fig. 199: Connection of the digital output DO8. Proceed with the digital outputs DO9 ... DO15 in the same way

The meaning of the LEDs is described in Displays *Chapter 5.6.4.2.9 “State LEDs” on page 987*.

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 5.6.4.2.3 “Connections” on page 971*.

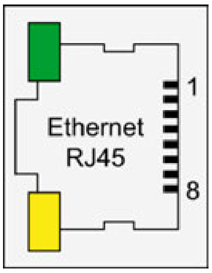


The meaning of the LEDs is described in Displays *Chapter 5.6.4.2.9 “State LEDs” on page 987*.

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.

5.6.4.2.4 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.

5.6.4.2.5 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.

5.6.4.2.6 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 configuration are described in Parameterization *Chapter 5.6.4.2.7 “Parameterization” on page 979*.

5.6.4.2.7 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

Name	Value	Internal value	Internal value, type	Default
Error LED / Fail-safe function (Table Error LED / Failsafe function *Table 237 " Table Error LED / Failsafe function" on page 981*)	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		
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 Map-ping	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 5.4.2.2.9 “Fast counter” on page 464*
[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 237: 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 *Chapter 5.6.4.2.3 "Connections" on page 971*. 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.

5.6.4.2.8 Diagnosis

Table 238: 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, see description in 'Connections' *Chapter 5.6.4.2.3 “Connections” on page 971*. 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 DO8 ... DO15 has exceeded the process supply voltage UP3 *Chapter 5.6.4.2.3 “Connections” on page 971*. Diagnosis message appears for the whole module.
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.

5.6.4.2.9 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 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 239: 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 config- ured, cyclic data exchange run- ning	Device config- ured, acyclic data exchange run- ning
	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 parame- ters
S-ERR	Red	No error	Internal error	--
I/O-Bus	Green	No expansion modules con- nected or com- munication error	Expansion modules con- nected and operational	---
ETH1	Green	No connection at Ethernet inter- face	Connected to Ethernet inter- face	---
	Yellow	---	Device is trans- mitting telegrams	Device is trans- mitting telegrams
ETH2	Green	No connection at Ethernet inter- face	Connected to Ethernet inter- face	---
	Yellow	---	Device is trans- mitting telegrams	Device is trans- mitting telegrams

Table 240: 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 fin- ished	--
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

5.6.4.2.10 Technical data

The system data of AC500 and S500 are applicable to the standard version ➜ *Chapter 4.2 “System data AC500” on page 30*.

The system data of AC500-XC are applicable to the XC version ➜ *Chapter 4.3 “System data AC500-XC” on page 35*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Technical data of the module

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
Diagnosis		See Diagnosis and Displays ➜ *Chapter 5.6.4.2.8 “Diagnosis” on page 982*
Operation and error displays		34 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)
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
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 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

Parameter		Value
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.

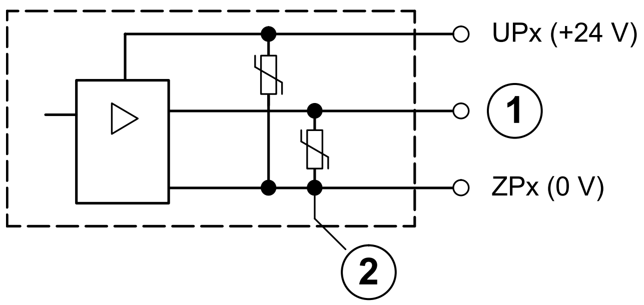


Fig. 200: Digital input/output (circuit diagram)

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.

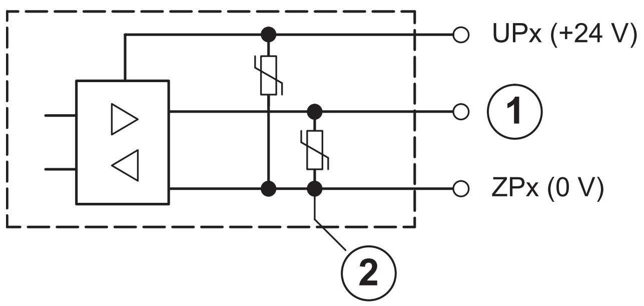


Fig. 201: Digital input/output (circuit diagram)

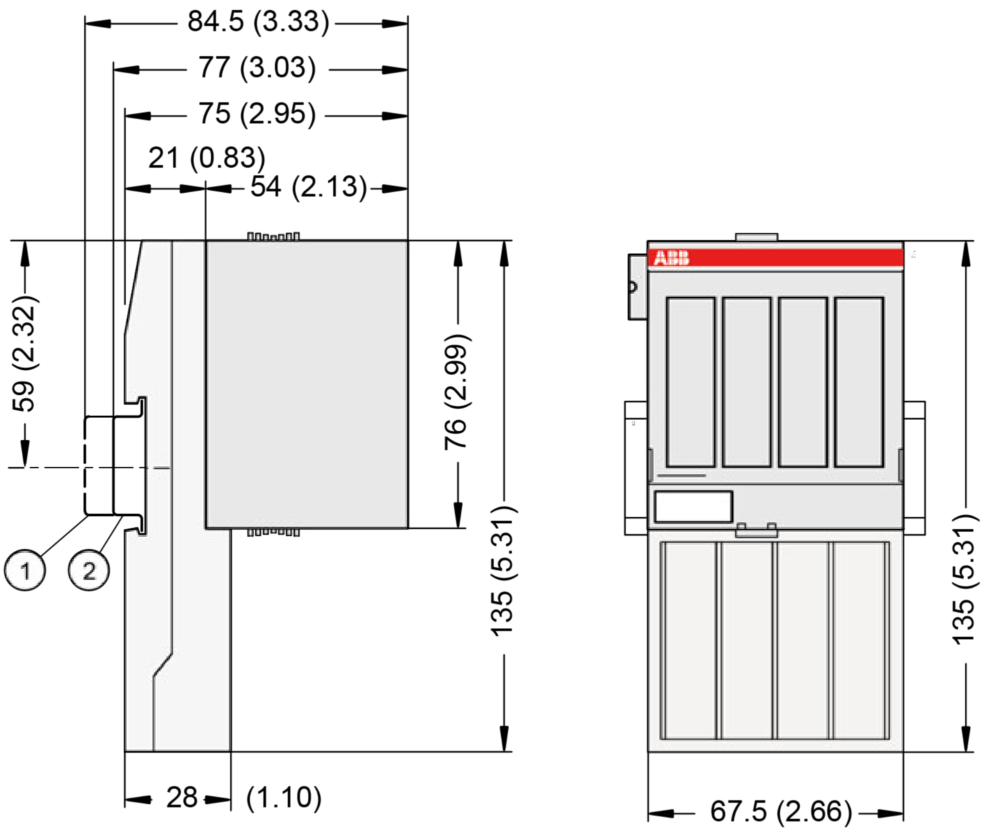
1 Digital input/output
2 For demagnetization when inductive loads are turned off

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*.

5.6.4.2.11 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

> *The dimensions are in mm and in brackets in inch.*

5.6.4.2.12 Ordering data

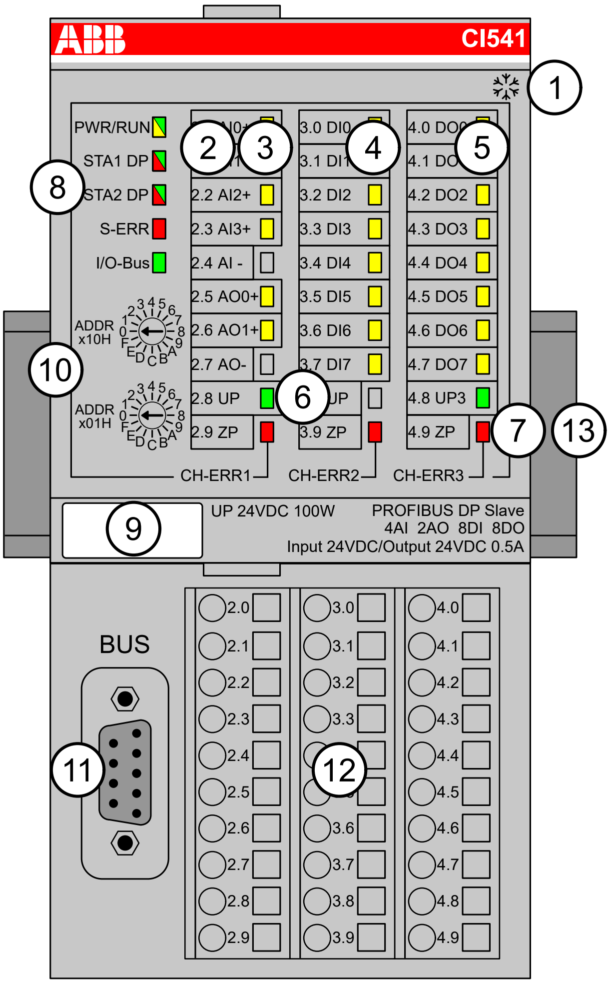
Ordering No.	Scope of delivery	Product life cycle phase *)
1SAP 222 200 R0001	CI522-MODTCP, Modbus TCP communication interface module, 8 DC, 8 DI and 8 DO	Active
1SAP 422 200 R0001	CI522-MODTCP-XC, Modbus TCP communication interface module, 8 DC, 8 DI and 8 DO, XC version	Active

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

5.6.5 PROFIBUS

5.6.5.1 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

5.6.5.1.1 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.

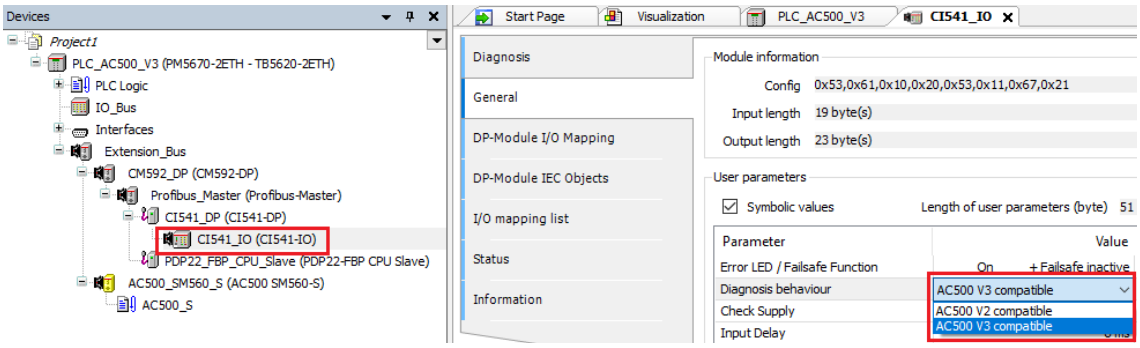
The inputs/outputs are galvanically isolated from the PROFIBUS DP network. There is no potential separation between the channels. The configuration of the analog inputs/outputs is performed by software.

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

5.6.5.1.2 Diagnosis settings

The current CI54x does not run in combination with a V3 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 AC500 V2 compatible).

5.6.5.1.3 Functionality

Parameter	Value
Interface	PROFIBUS
Protocol	PROFIBUS DP (DP-V0 and DP-V1)

Parameter	Value
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 5.7.2 “TU509 and TU510 for communication interface modules” on page 1134* ⇘ *Chapter 5.7.3 “TU517 and TU518 for communication interface modules” on page 1138*

5.6.5.1.4 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 ⇘ *Chapter 5.7.2 “TU509 and TU510 for communication interface modules” on page 1134* or TU510 ⇘ *Chapter 5.7.2 “TU509 and TU510 for communication interface modules” on page 1134* and accordingly TU517 ⇘ *Chapter 5.7.3 “TU517 and TU518 for communication interface modules” on page 1138* or TU518 ⇘ *Chapter 5.7.3 “TU517 and TU518 for communication interface modules” on page 1138*. 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 5.8.2.5 “TA526 - Wall mounting accessory” on page 1183*.

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!

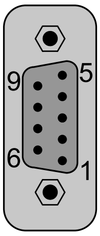
Reason: Externally voltages at an output or several outputs may cause that other outputs are supplied through that voltage instead of voltage UP3 (reverse voltage). This ist not intended usage.

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 conncted at the outputs DO0 ... DO7.

Possibilities of connection

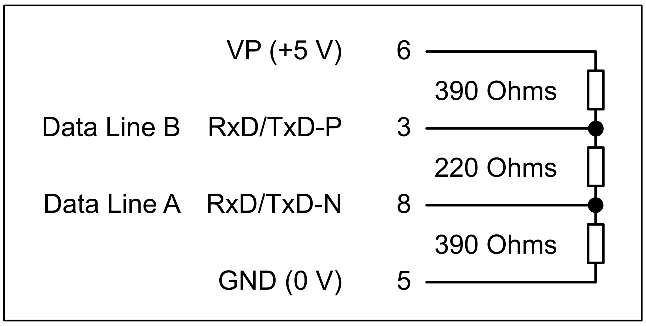
Connection on terminal units TU509 or TU510

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.



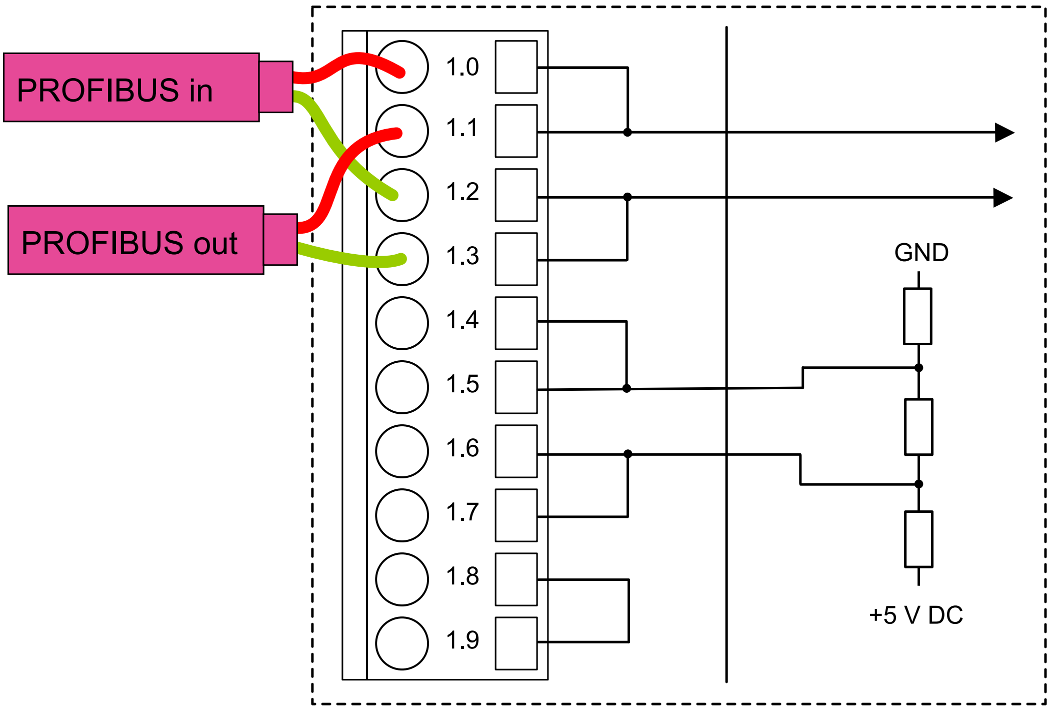
The grounding of the shield should take place at the control cabinet *↯ Chapter 4.2 “System data AC500” on page 30.*

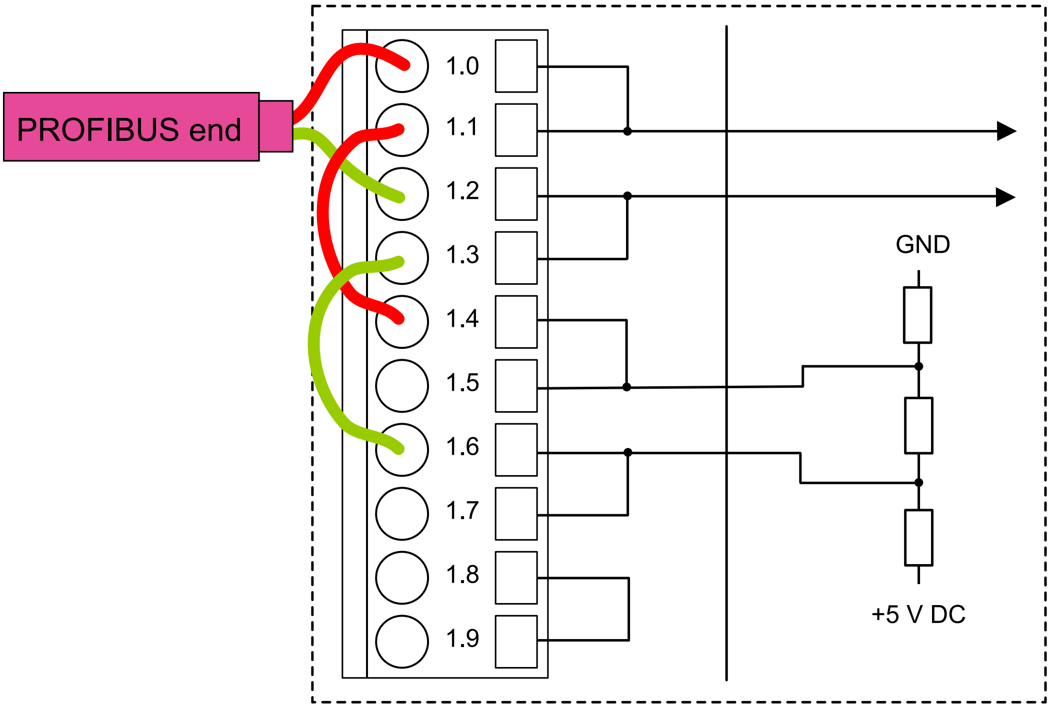
Mounting on terminal units TU517 or TU518

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 30.*

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)
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 you

– 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.

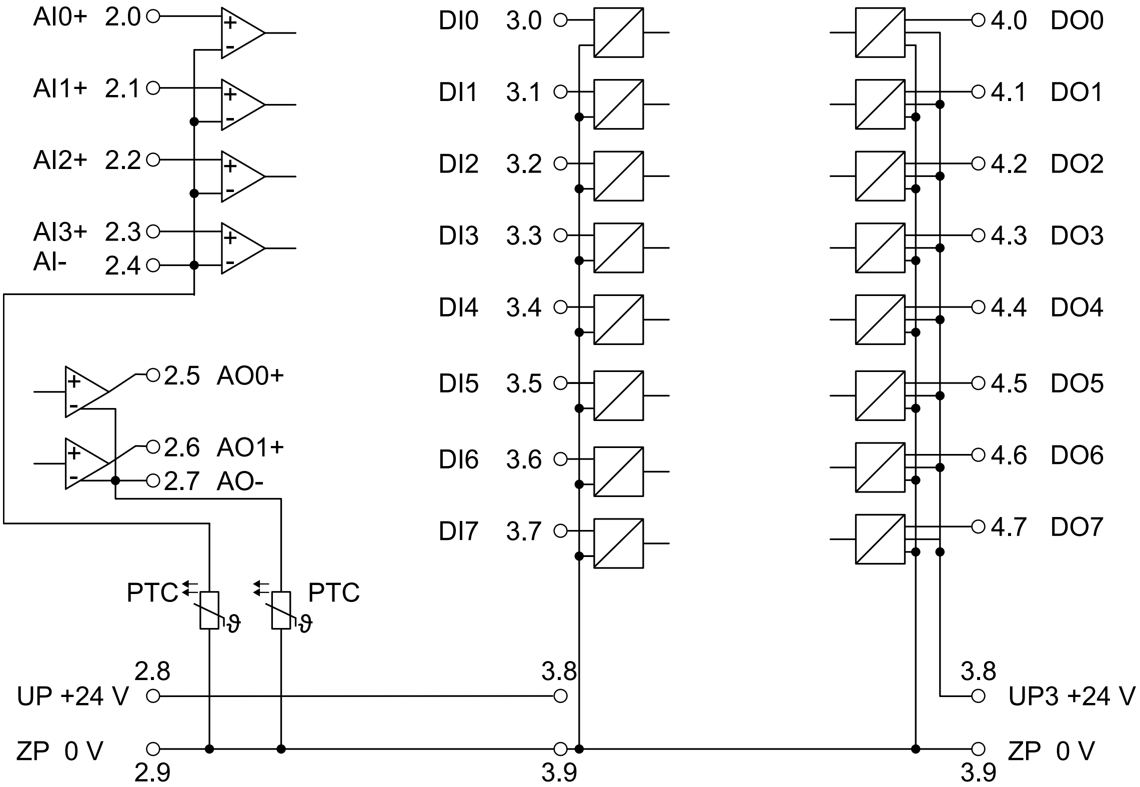


Fig. 202: Connection of the PROFIBUS DP communication interface module CI541-DP

Connection of the digital inputs

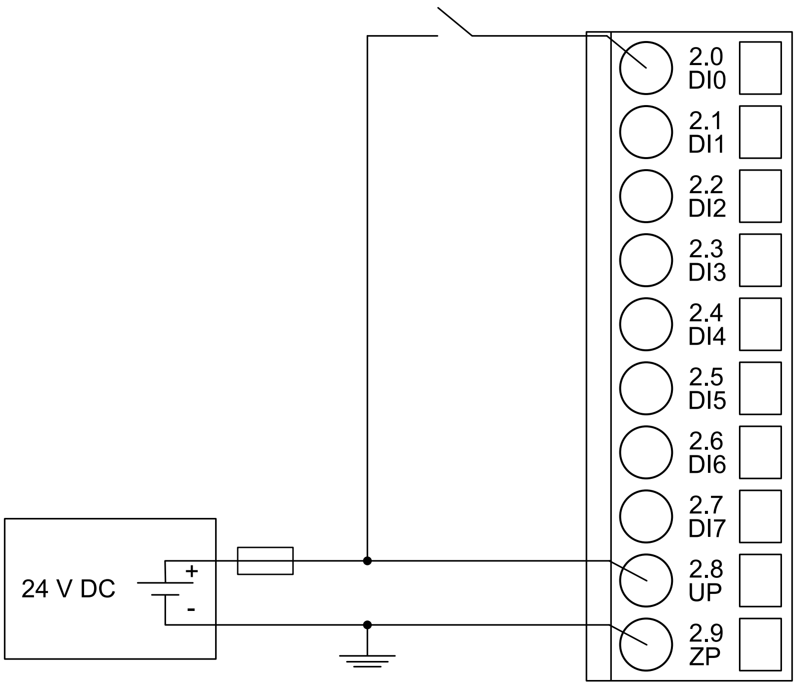


Fig. 203: Connection of the digital input DI0 (Proceed with the digital inputs DI1 ... DI7 in the same way)

The meaning of the LEDs is described in Displays ␦ *Chapter 5.6.5.1.10 “State LEDs” on page 1024*.

Connection of the digital outputs

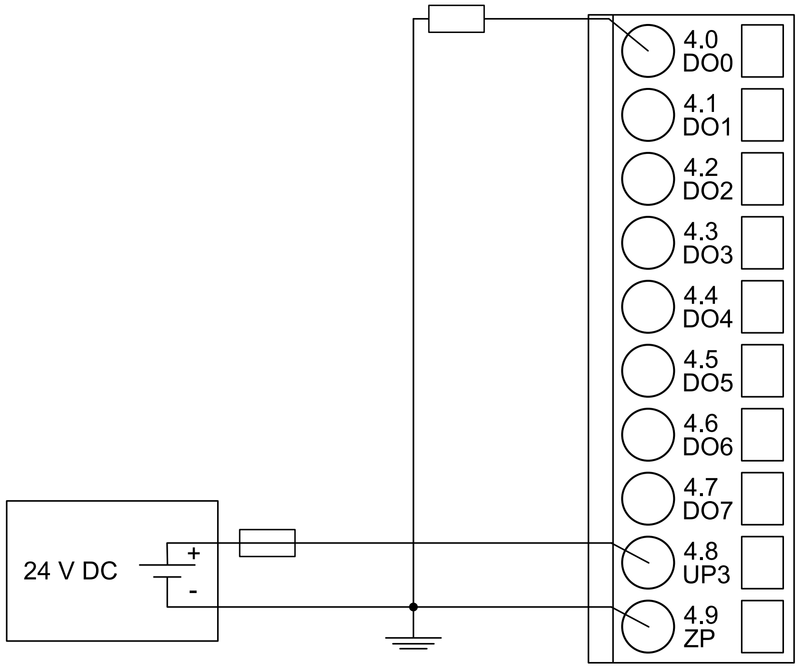


Fig. 204: Connection of the digital output DO0 (Proceed with the digital outputs DO1 ... DO7 in the same way)

The meaning of the LEDs is described in Displays *Chapter 5.6.5.1.10 "State LEDs" on page 1024*.

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.

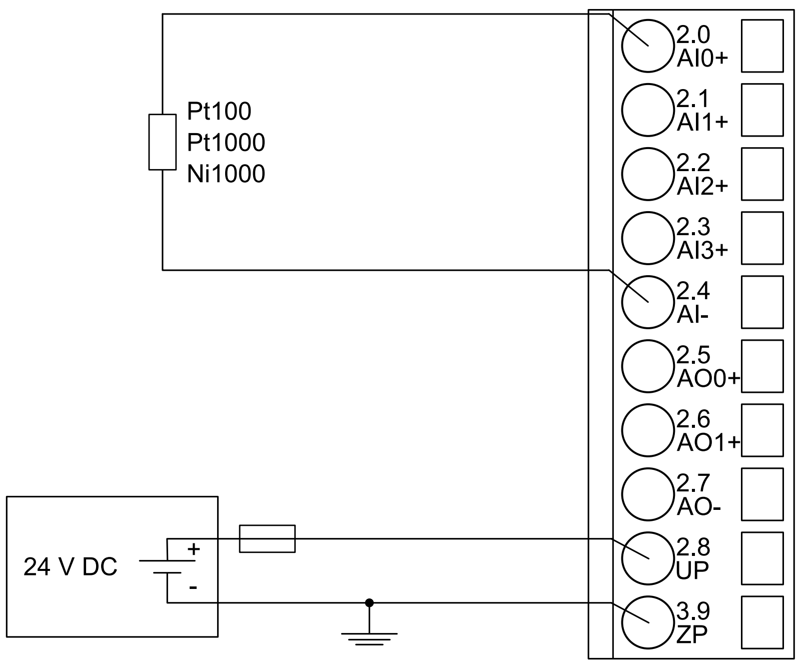


Fig. 205: Connection of resistance thermometers in 2-wire configuration to the analog input AI0 (Proceed with the analog inputs AI1 ... AI3 in the same way)

The following measuring ranges can be configured ↳ *Chapter 5.6.5.1.8 “Parameterization” on page 1014* ↳ *Chapter 5.6.5.1.11 “Measuring ranges” on page 1025*:

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 5.6.5.1.10 “State LEDs” on page 1024*.

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.

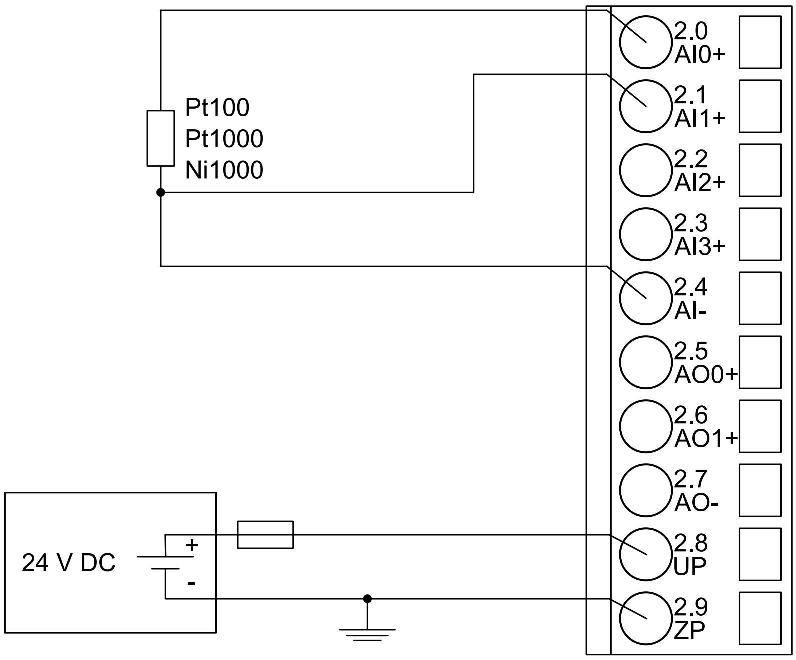


Fig. 206: Connection of resistance thermometers in 3-wire configuration to the analog inputs AI0 and AI1 (Proceed with the analog inputs AI2 and AI3 in the same way)

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 5.6.5.1.8 "Parameterization" on page 1014* *Chapter 5.6.5.1.11 "Measuring ranges" on page 1025*:

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 *Chapter 5.6.5.1.10 "State LEDs" on page 1024*.

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

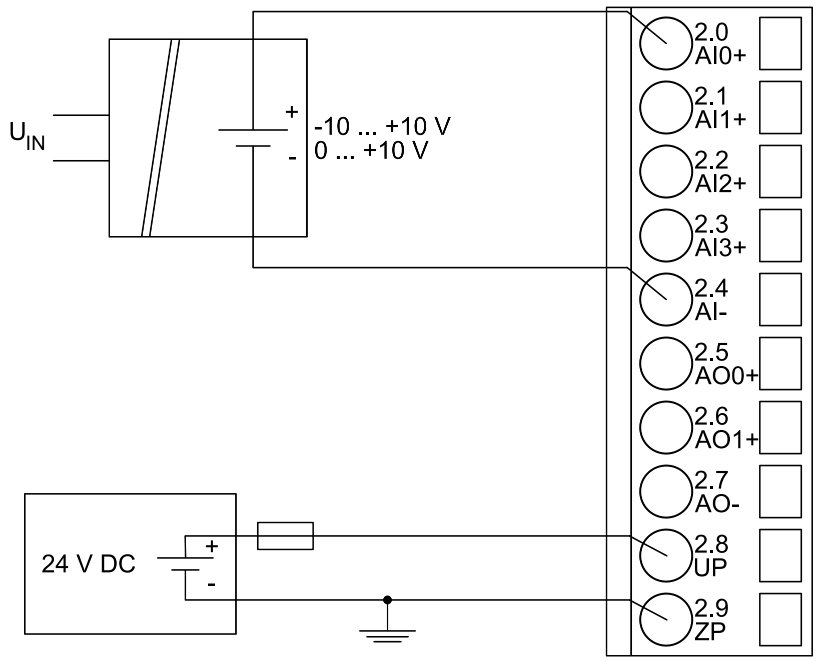


Fig. 207: Connection of active-type analog sensors (voltage) with galvanically isolated power supply to the analog input AI0 (Proceed with the analog inputs AI1 ... AI3 in the same way)

The following measuring ranges can be configured *Chapter 5.6.5.1.8 "Parameterization" on page 1014* *Chapter 5.6.5.1.11 "Measuring ranges" on page 1025*:

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 5.6.5.1.10 "State LEDs" on page 1024*.

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

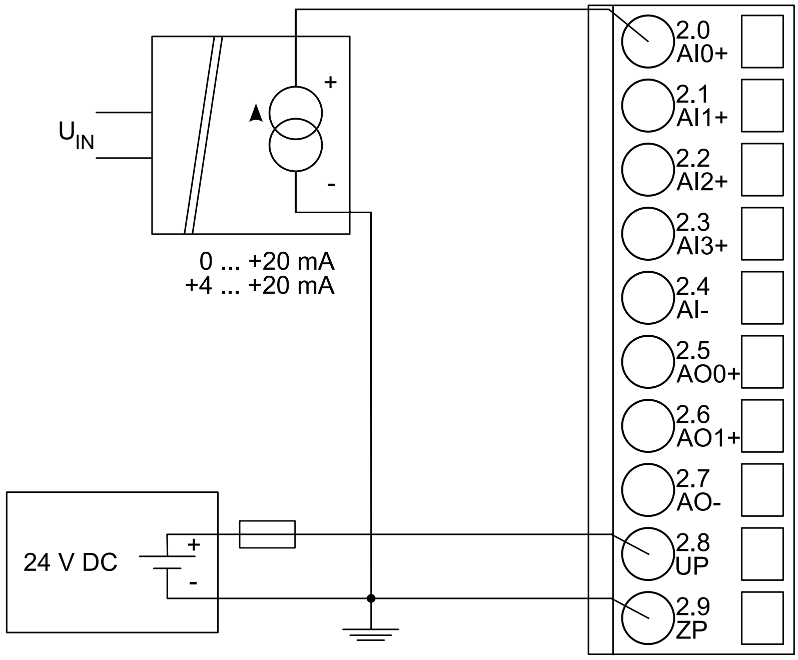


Fig. 208: Connection of active-type analog sensors (current) with galvanically isolated power supply to the analog input AI0 (Proceed with the analog inputs AI1 ... AI3 in the same way)

The following measuring ranges can be configured ↳ *Chapter 5.6.5.1.8 “Parameterization” on page 1014* ↳ *Chapter 5.6.5.1.11 “Measuring ranges” on page 1025*:

Current	0 mA ... 20 mA	1 channel used
Current	4 mA ... 20 mA	1 channel used

The function of the LEDs is described under 'State LEDs' ↳ *Chapter 5.6.5.1.10 “State LEDs” on page 1024*.

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.

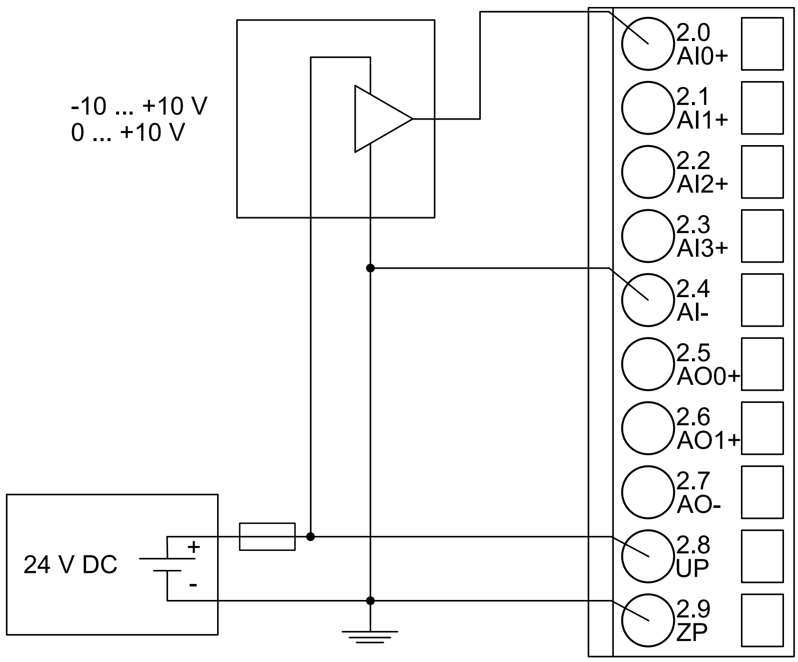


Fig. 209: Connection of active-type analog sensors (voltage) with no galvanically isolated power supply to the analog input AI0 (Proceed with the analog inputs AI1 ... AI3 in the same way)

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 5.6.5.1.8 “Parameterization” on page 1014* ✎ *Chapter 5.6.5.1.11 “Measuring ranges” on page 1025*:

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 5.6.5.1.10 “State LEDs” on page 1024*.

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of passive-type analog sensors (Current) to the analog inputs

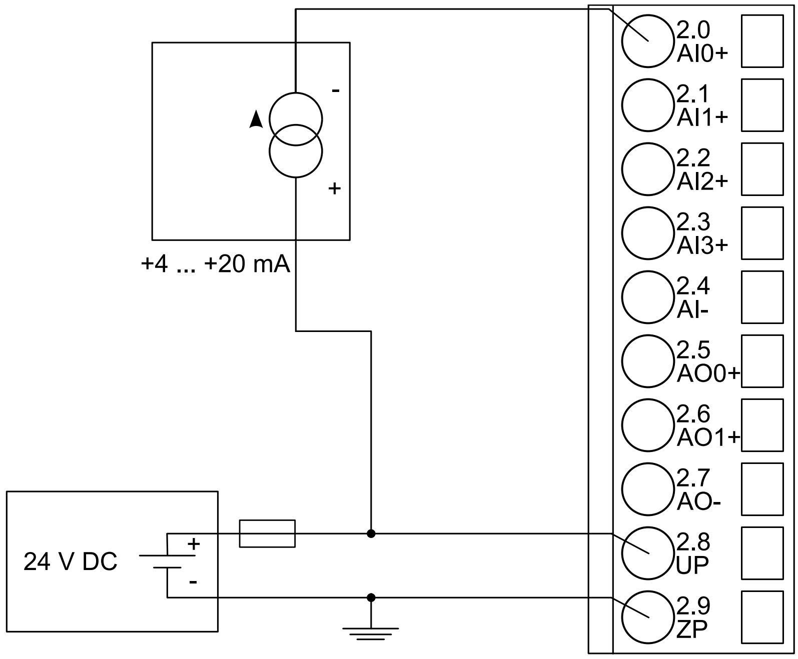


Fig. 210: Connection of passive-type analog sensors (current) to the analog input AI0 (Proceed with the analog inputs AI1 ... AI3 in the same way)

The following measuring ranges can be configured *Chapter 5.6.5.1.8 “Parameterization” on page 1014* *Chapter 5.6.5.1.8 “Parameterization” on page 1014* :

Current	4 mA ... 20 mA	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays *Chapter 5.6.5.1.10 “State LEDs” on page 1024*.

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.

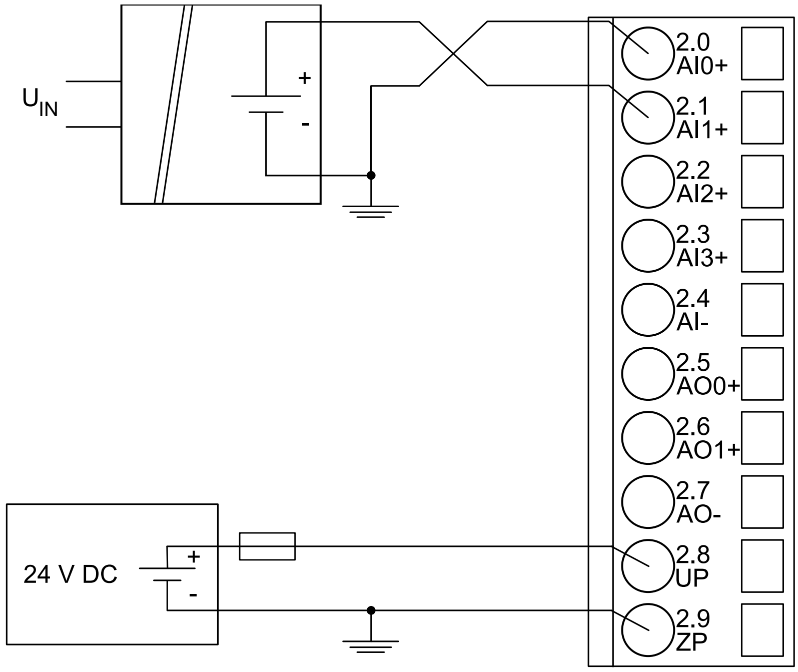


Fig. 211: Connection of active-type analog sensors (voltage) to differential analog inputs AI0 and AI1 (Proceed with AI2 and AI3 in the same way)

The following measuring ranges can be configured *Chapter 5.6.5.1.8 “Parameterization” on page 1014* *Chapter 5.6.5.1.11 “Measuring ranges” on page 1025*:

Voltage	0 V ... 10 V	with differential inputs, 2 channels used
Voltage	-10 V ... +10 V	with differential inputs, 2 channels used

The function of the LEDs is described under Diagnosis and displays / Displays *Chapter 5.6.5.1.10 “State LEDs” on page 1024*.

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.

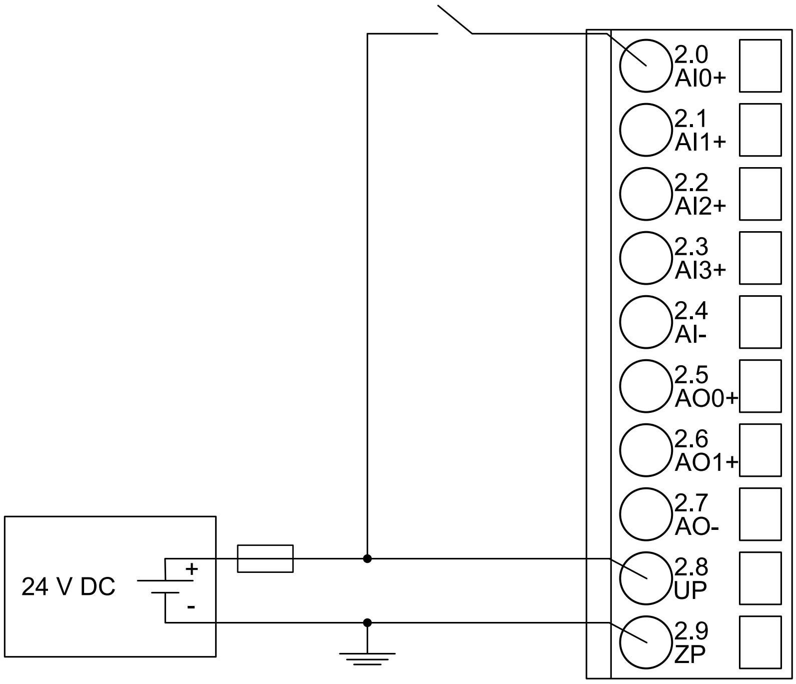


Fig. 212: Connection of digital sensors to the analog input AI0 (Proceed with the analog inputs AI1 ... AI3 in the same way)

The following measuring ranges can be configured ↳ *Chapter 5.6.5.1.8 "Parameterization" on page 1014* ↳ *Chapter 5.6.5.1.11 "Measuring ranges" on page 1025*:

Digital input	24 V	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays ↳ *Chapter 5.6.5.1.10 "State LEDs" on page 1024*.

Connection of analog output loads (Voltage)

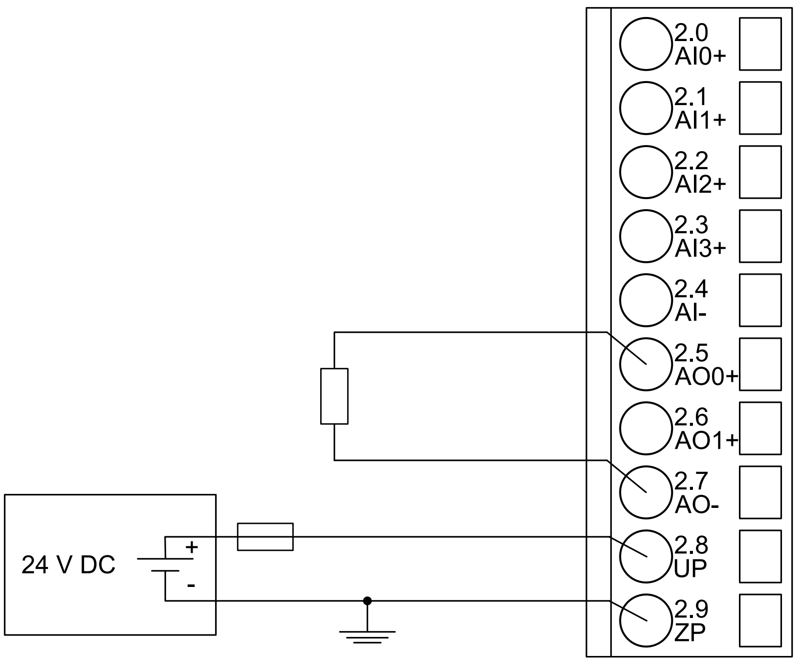


Fig. 213: Connection of analog output loads (voltage) to the analog output AO0 (Proceed with the analog output AO1 in the same way)

The following measuring ranges can be configured ↳ *Chapter 5.6.5.1.8 "Parameterization" on page 1014* ↳ *Chapter 5.6.5.1.11 "Measuring ranges" on page 1025*:

Voltage	-10 V ... +10 V	Load ± 10 mA max.	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays ↳ *Chapter 5.6.5.1.10 "State LEDs" on page 1024*.

Unused analog outputs can be left open-circuited.

Connection of analog output loads (Current)

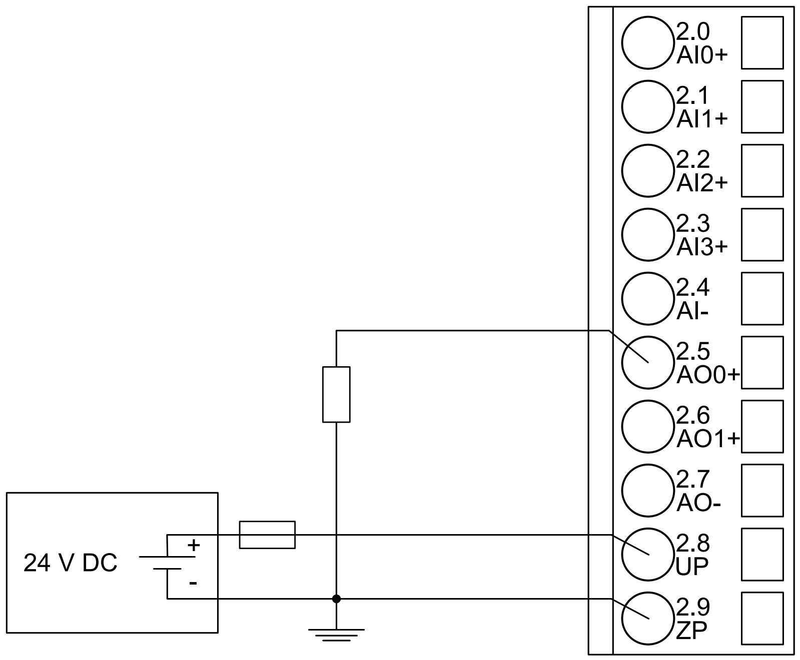


Fig. 214: Connection of analog output loads (current) to the analog output AO0 (Proceed with the analog output AO1 in the same way)

The following measuring ranges can be configured ↳ *Chapter 5.6.5.1.8 "Parameterization" on page 1014* ↳ *Chapter 5.6.5.1.11 "Measuring ranges" on page 1025*:

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

The function of the LEDs is described under Diagnosis and displays / Displays ↳ *Chapter 5.6.5.1.9 "Diagnosis" on page 1019*.

Unused analog outputs can be left open-circuited.

5.6.5.1.5 Internal data exchange

Parameter	Value
Digital inputs (bytes)	3
Digital outputs (bytes)	3
Analog inputs (words)	4
Analog outputs (words)	2

Parameter	Value
Counter input data (words)	4
Counter output data (words)	8

5.6.5.1.6 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.

5.6.5.1.7 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 are described in Parameterization ↬ *Chapter 5.6.5.1.8 “Parameterization” on page 1014*.

5.6.5.1.8 Parameterization

Parameters of the module

Table 241: 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 (see ↬ *Table 242 “Settings "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 + fail-safe	17		
	Off by E3 + fail-safe	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
	:	:		

Name	Value	Internal value	Internal value, type	Default
	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, see description of the fast counter *Chapter 5.4.2.2.9 "Fast counter" on page 464*.				

Table 242: 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)

Name	Value	Internal value	Internal value, type	Default
Input 0, Channel configuration	Operation modes of analog inputs *Table 243 “Operation modes of analog inputs:” on page 1016*	Operation modes of analog inputs *Table 243 “Operation modes of analog inputs:” on page 1016*	BYTE	0
Input 0, Check channel	Settings channel monitoring *Further information on page 1017*	Settings channel monitoring *Further information on page 1017*	BYTE	0
:	:	:	:	:
:	:	:	:	:
Input 3, Channel configuration	Operation modes of analog inputs *Table 243 “Operation modes of analog inputs:” on page 1016*	Operation modes of analog inputs *Table 243 “Operation modes of analog inputs:” on page 1016*	BYTE	0
Input 3, Check channel	Settings channel monitoring *Further information on page 1017*	Settings channel monitoring *Further information on page 1017*	BYTE	0

Channel configuration

Table 243: 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 244: 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 configu-ration	Operation modes of analog outputs *Table 245 “Table operation modes of analog outputs:” on page 1018*	Operation modes of analog outputs *Table 245 “Table operation modes of analog outputs:” on page 1018*	BYTE	0
Output 0, Check channel	Channel moni-toring *Table 246 “Table channel monitoring:” on page 1018*	Channel moni-toring *Table 246 “Table channel monitoring:” on page 1018*	BYTE	0
Output 0, Substi-tute value	Substitute value *Table 247 “Table substitute value:” on page 1018*	Substitute value *Table 247 “Table substitute value:” on page 1018*	WORD	0
Output 1, Channel configu-ration	Operation modes of analog outputs *Table 245 “Table operation modes of analog outputs:” on page 1018*	Operation modes of analog outputs *Table 245 “Table operation modes of analog outputs:” on page 1018*	BYTE	0
Output 1, Check channel	Channel moni-toring *Table 246 “Table channel monitoring:” on page 1018*	Channel moni-toring *Table 246 “Table channel monitoring:” on page 1018*	BYTE	0
Output 1, Substi-tute value	Substitute value *Table 247 “Table substitute value:” on page 1018*	Substitute value *Table 247 “Table substitute value:” on page 1018*	WORD	0

Channel configuration

Table 245: 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 246: Table channel monitoring:

Internal value	Check channel
0	Plausib(ility), cut wire, short circuit
3	None

Substitute value

Table 247: 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	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

Name	Value	Internal value	Internal value, type	Default
Behaviour digital outputs at com-muncation 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 out-puts [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 *Chapter 5.6.5.1.4 “Connec-tions” on page 998*. 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".				

5.6.5.1.9 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
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

Byte Number	Description	Possible Values
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

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	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
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 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	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	-	31	31	31	46	Reverse voltage from digital outputs DO0...DO7 to UP3 [4])	Check connec-tion
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 on outputs (above UP3 level) [5])	Check termi-nals/ 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])				
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 dig-ital output [7])	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	4	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 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, see description in section 'Connection' *Chapter 5.6.5.1.4 “Connections” on page 998*). 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 on digital outputs DO0 ... DO7 has overrun the process supply voltage UP3 (see description in section 'Connection' *Chapter 5.6.5.1.4 “Connections” on page 998*). Diagnosis message appears for the whole module.
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.

5.6.5.1.10 State LEDs

The LEDs are located at the front of module. There are 2 different groups:

- 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 248: 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-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 249: 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 fin-ished	--
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

5.6.5.1.11 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	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
	-0.0004 -1.7593	-0.0004 : : -10,0000		3.9994 1.1858		-1 -4864 : -27648	FFFF ED00 : 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	< 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
		-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

Range	Digital value	
	Decimal	**Hex.**
	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	>11.7589 V	>23.5178 mA	>22.8142 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.

5.6.5.1.12 Technical data

The system data of AC500 and S500 are applicable to the standard version ➡ *Chapter 4.2 “System data AC500” on page 30*.

The system data of AC500-XC are applicable to the XC version ➡ *Chapter 4.3 “System data AC500-XC” on page 35*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Technical data of the module

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

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
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
Diagnose		See Diagnosis ⇘ *Chapter 5.6.5.1.9 “Diagnosis” on page 1019*
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
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 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

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

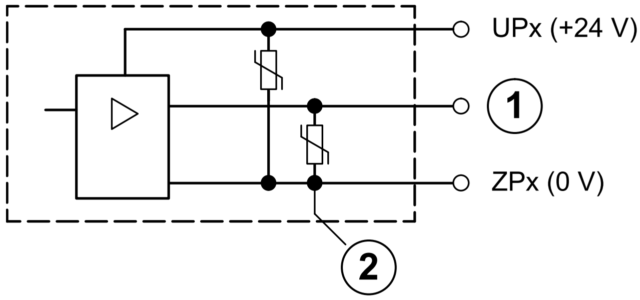
Technical data of the digital outputs

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
	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 module provides several diagnosis functions ↳ *Chapter 5.6.5.1.9 “Diagnosis” on page 1019*.

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
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)

Parameter	Value
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	Tables Input Ranges Voltage, Current and Digital Input and Input range resistance temperature detector *Chapter 5.6.5.1.11 “Measuring ranges” on page 1025*
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
	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

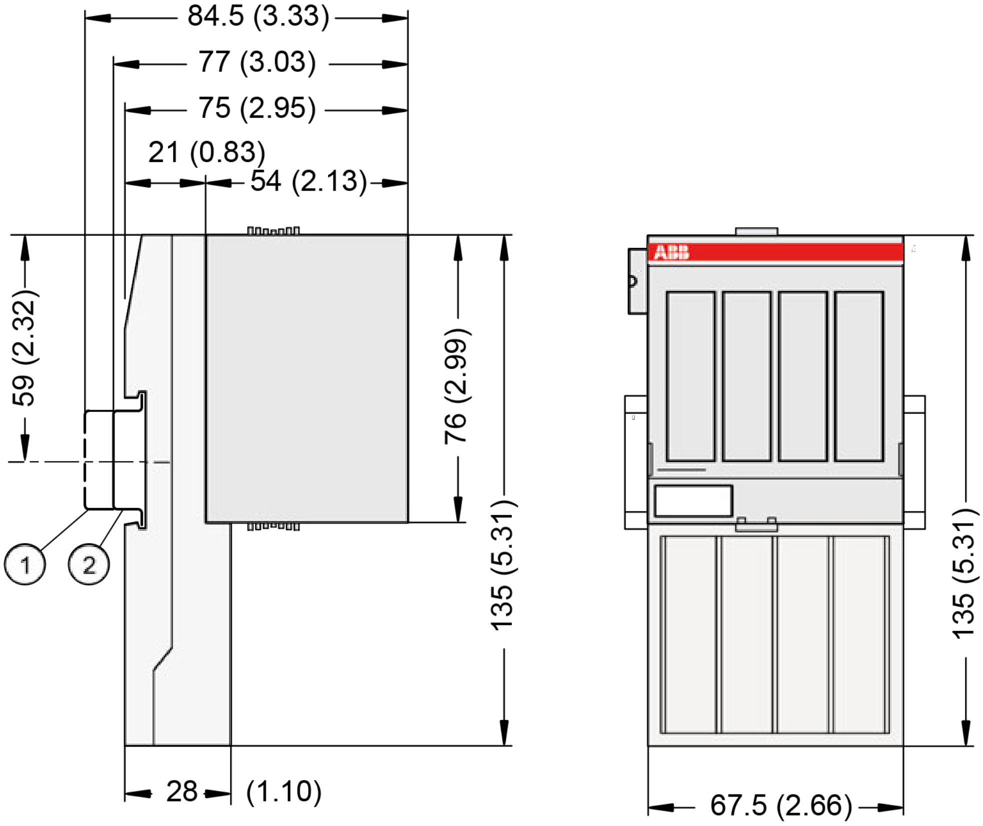
Parameter	Value
Number of channels per module	2
Distribution of channels into groups	1 group for 2 channels

Parameter		Value
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		Table Output Ranges Voltage and Current *Chapter 5.6.5.1.11.3 “Output ranges voltage and current” on page 1027*
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

5.6.5.1.13 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

5.6.5.1.14 Ordering data

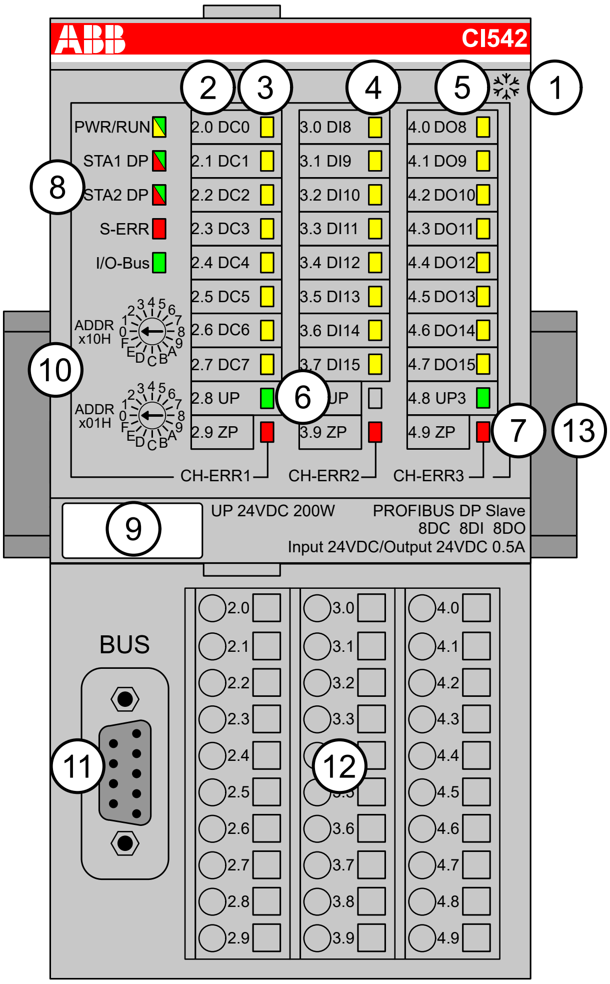
Ordering No.	Scope of delivery	Product life cycle phase *)
1SAP 224 100 R0001	CI541-DP, PROFIBUS DP communication interface module, 8 DI, 8 DO, 4 AI and 2 AO	Active
1SAP 424 100 R0001	CI541-DP-XC, PROFIBUS DP communication interface module, 8 DI, 8 DO, 4 AI and 2 AO, XC version	Active

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

5.6.5.2 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

5.6.5.2.1 Intended purpose

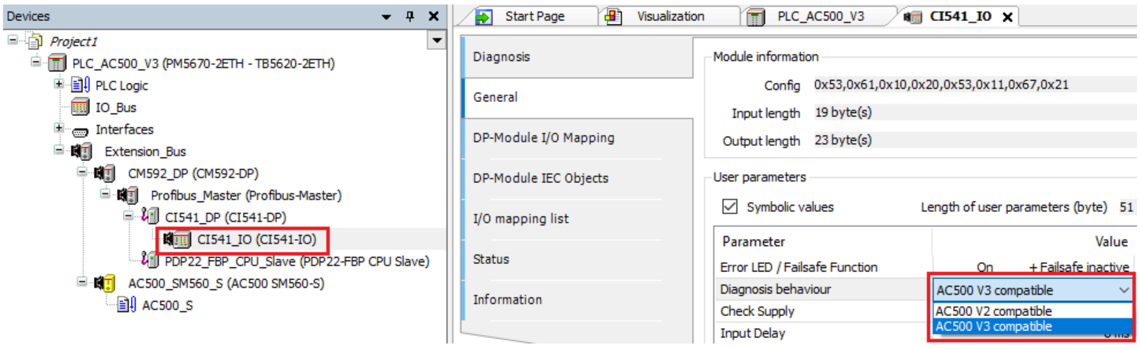
The PROFIBUS DP communication interface module is used as decentralized I/O module in PROFIBUS networks. Depending on the used terminal unit the network connection is performed either via 9-pole female D-sub or via 10 terminals (screw-type or spring terminals) which are integrated in the terminal unit.

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.

5.6.5.2.2 Diagnosis settings

The current CI54x does not run in combination with a V3 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 AC500 V2 compatible).

5.6.5.2.3 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 ↬ *Chapter 5.7.2 “TU509 and TU510 for communication interface modules” on page 1134* or TU510 ↬ *Chapter 5.7.2 “TU509 and TU510 for communication interface modules” on page 1134* and accordingly TU517 ↬ *Chapter 5.7.3 “TU517 and TU518 for communication interface modules” on page 1138* or TU518 ↬ *Chapter 5.7.3 “TU517 and TU518 for communication interface modules” on page 1138*. 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 5.8.2.5 “TA526 - Wall mounting accessory” on page 1183*.

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.

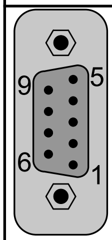
CAUTION!
Risk of malfunction by unintended usage!
If the function cut-off of the digital outputs is to be used by deactivation of the supply voltage UP3, be sure that no external voltage is conncted at the outputs DO0...DO7 and DC0...DC7.

Possibilities of connection

Mounting on terminal units TU509 or TU510:

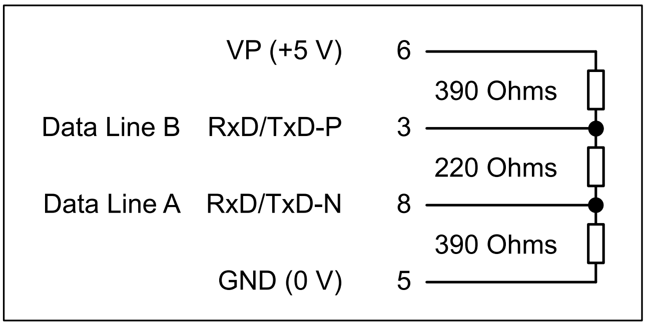
The assignment of the 9-pole female D-sub for the PROFIBUS DP signals.

Serial Interface	Pin	Signal	Description
	1	---	Reserved
	2	---	Reserved
	3	B	PROFIBUS DP signal B
	4	---	Reserved

Serial Interface	Pin	Signal	Description
	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.



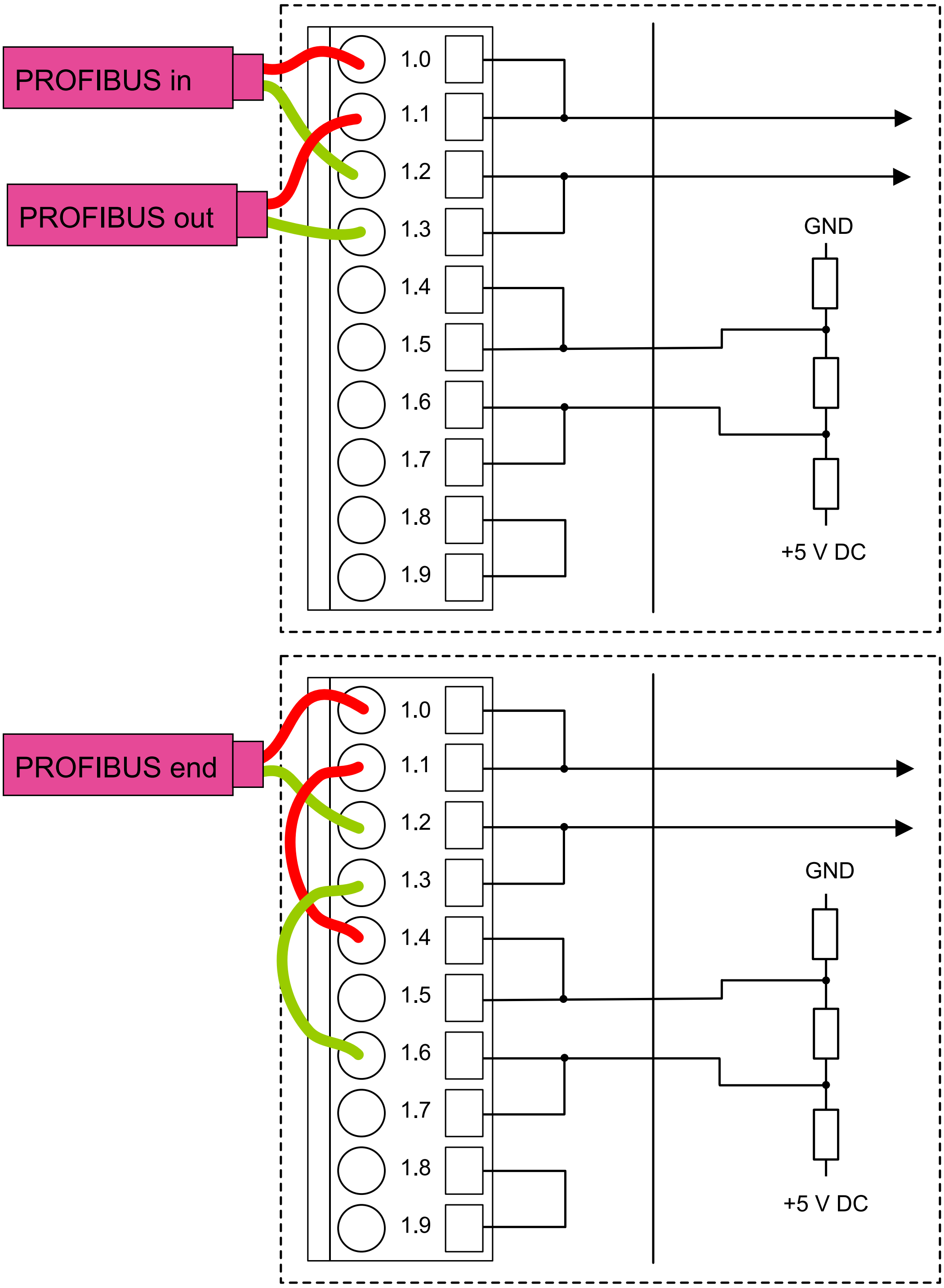
The grounding of the shield should take place at the control cabinet, see System-Data AC500 ⇨ Chapter 4.2 “System data AC500” on page 30.

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 you

– 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.

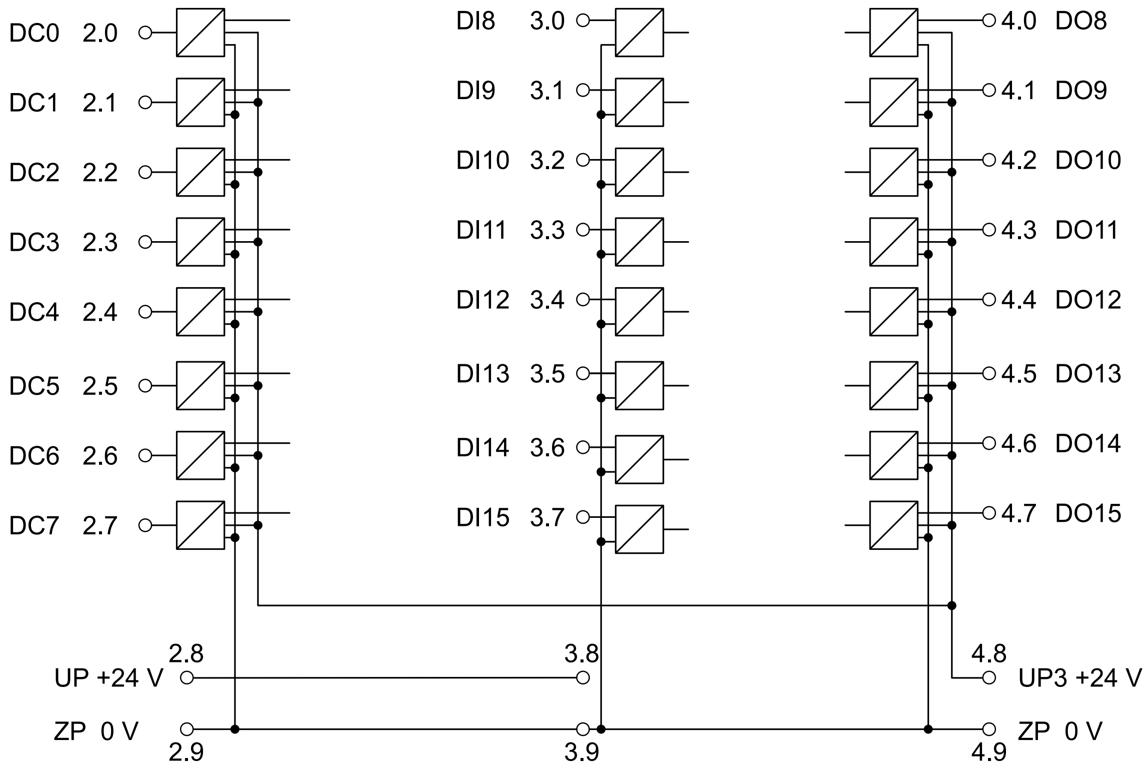


Fig. 215: Connection of the PROFIBUS DP communication interface module CI542-DP

Connection of the digital inputs

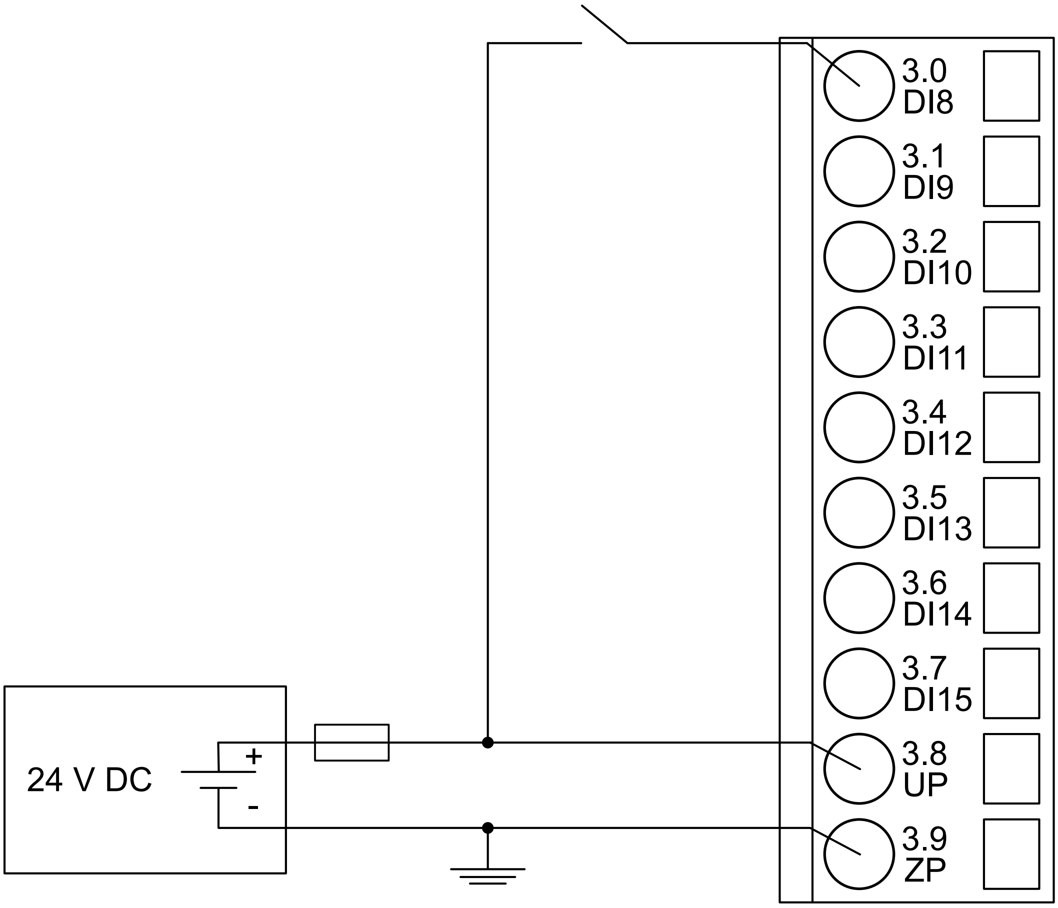


Fig. 216: Connection of the digital input DI8 (Proceed with the digital inputs DI9 to DI15 in the same way)

The meaning of the LEDs is described in Displays ↳ *Chapter 5.6.5.2.9 “State LEDs” on page 1052*.

Connection of the digital outputs

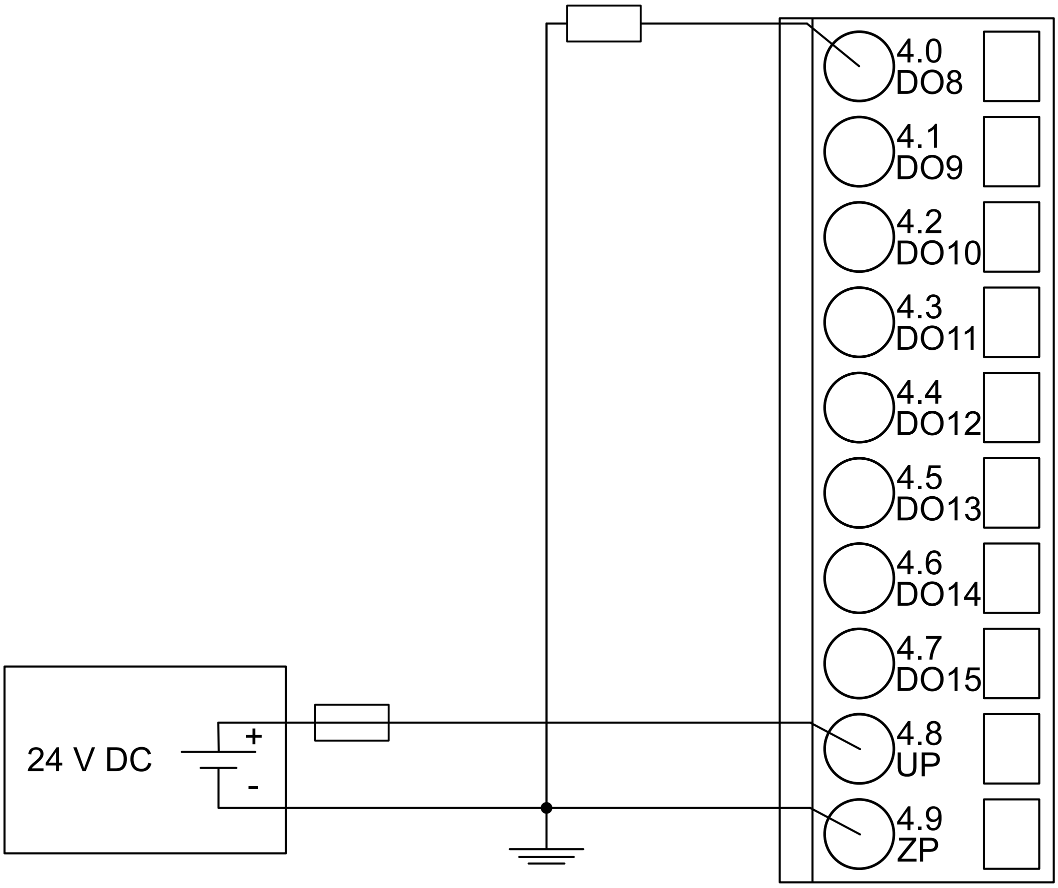


Fig. 217: Connection of the digital output DO8 (Proceed with the digital outputs DO9 - DO15 in the same way)

The meaning of the LEDs is described in Displays ↳ *Chapter 5.6.5.2.9 “State LEDs” on page 1052*.

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 5.6.5.2.3 “Connections” on page 1036*.

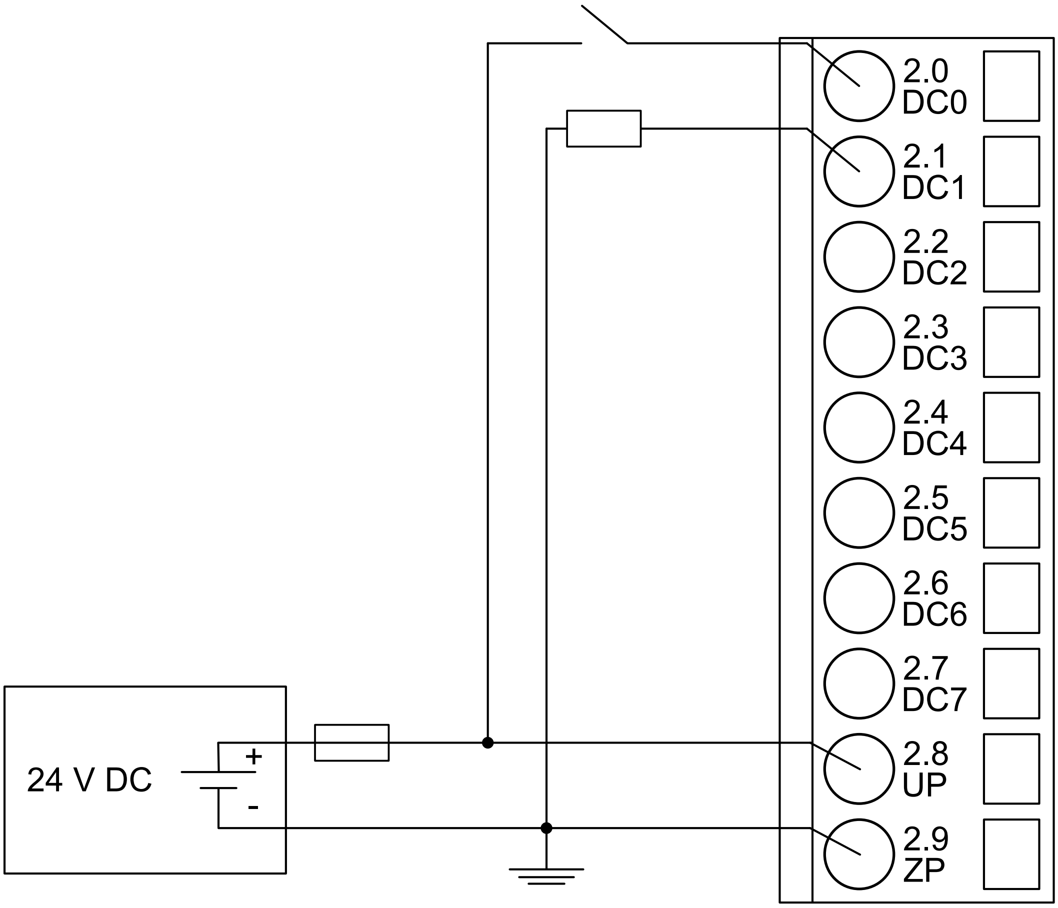


Fig. 218: Connection of the configurable digital input/output DC0 and DC1 (Proceed with the configurable digital inputs/outputs DC2 to DC7 in the same way)

The meaning of the LEDs is described in Displays *Chapter 5.6.5.2.9 “State LEDs” on page 1052*.

5.6.5.2.4 Internal data exchange

Parameter	Value
Digital inputs (bytes)	5
Digital outputs (bytes)	5
Counter input data (words)	4
Counter output data (words)	8

5.6.5.2.5 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.*

5.6.5.2.6 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.

5.6.5.2.7 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 / Fail-safe function ↳ *Table 250 “Settings "Error LED / Failsafe function"” on page 1046* (see table)	On	0	BYTE	0
	Off by E4	1		
	Off by E3	2		
	On + failsafe	16		
	Off by E4 + fail-safe	17		
	Off by E3 + fail-safe	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, see 'Fast Counter' ↳ *Chapter 5.4.2.2.9 “Fast counter” on page 464*.

Table 250: 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 5.6.5.2.3 “Connections” on page 1036*. 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.

5.6.5.2.8 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 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
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	-	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 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 dig-ital output DC0 ... DC7[7])	Check terminals
4	-	31	2	8...15	47	Short circuit at dig-ital 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 *Chapter 5.6.5.2.3 "Connections" on page 1036*. 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 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.

5.6.5.2.9 State LEDs

The LEDs are located at the front of module. There are 2 different groups:

- 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 251: 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-DP	Green	---	PROFIBUS running	Invalid device parameters

LED	Color	OFF	ON	Flashing
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 252: 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

5.6.5.2.10 Technical data

The system data of AC500 and S500 are applicable to the standard version ➡ *Chapter 4.2 “System data AC500” on page 30*.

The system data of AC500-XC are applicable to the XC version ➡ *Chapter 4.3 “System data AC500-XC” on page 35*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Technical data of the module

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

Parameter		Value
	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 5.6.5.2.8 “Diagnosis” on page 1048*
Operation and error displays		34 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
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

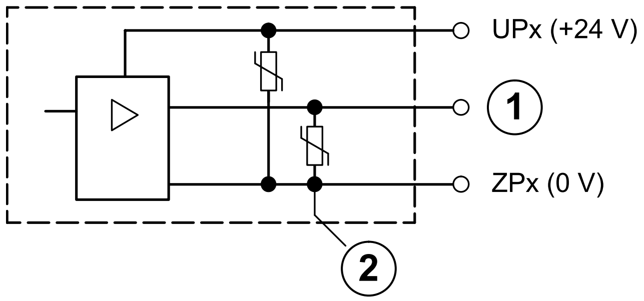
Parameter	Value
Terminals of the channels DI0 ... DI7	Terminals 3.0 ... 3.7
Reference potential for all inputs	Terminals 2.9 ... 4.9 (negative pole of the supply voltage, signal name ZP)
Indication of the input signals	1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input 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
Fuse for UP3	10 A fast
Demagnetization with inductive DC load	Via internal varistors (see figure below this table)
Output switching frequency	

Parameter		Value
	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

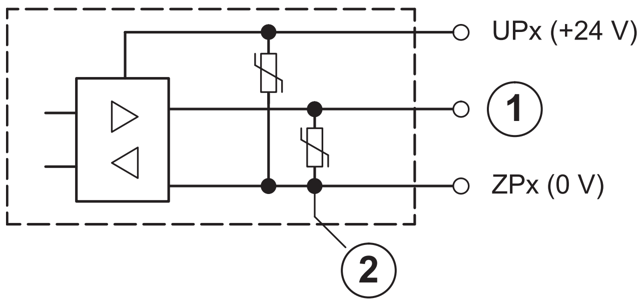
*) Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal may not exceed the clamp voltage of the varistor. The varistor limits the voltage to approx. 36 V. Following this, the 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.

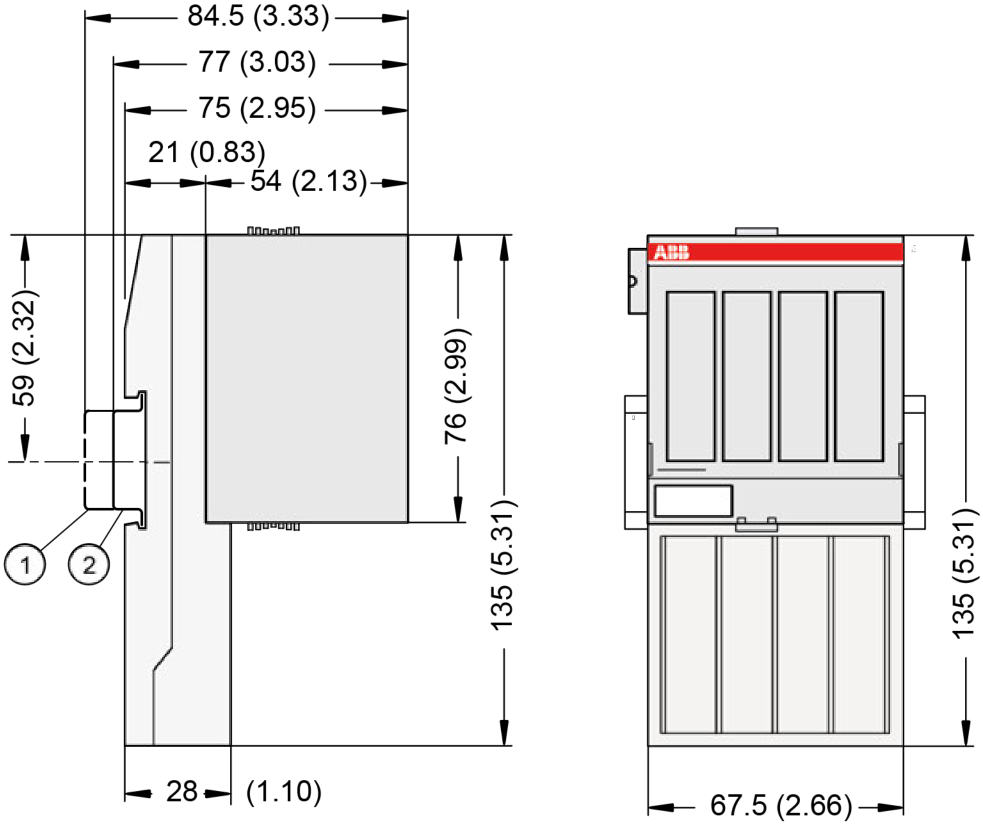


1 Digital input/output
2 For demagnetization when inductive loads are turned off

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

5.6.5.2.11 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

5.6.5.2.12 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.*

5.6.6 PROFINET

5.6.6.1 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 5.6.6.1.1.1 “Characteristics of CI50x-PNIO” on page 1060*.

5.6.6.1.1 PROFINET IO devices CI50x-PNIO

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 A
Protective functions (according to IEC 61131-3)	Protected against: ● short circuit ● reverse supply ● overvoltage ● reverse polarity Galvanic isolation from the rest of the module

*) Priorization with the aid of VLAN-ID including priority level

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.

Input/Output characteristics of CI502-PNIO

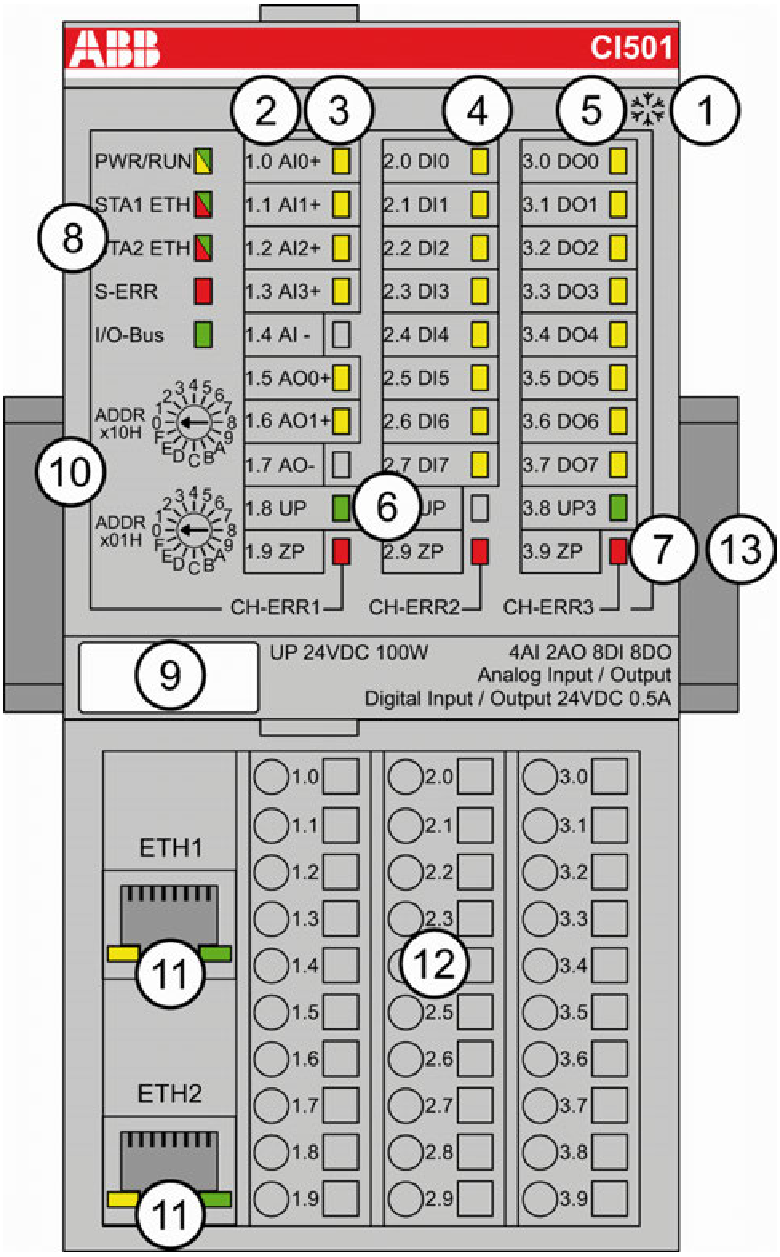
- 8 digital inputs 24 V DC
- 8 digital transistor outputs 24 V DC, 0.5 A max.
- 8 configurable digital inputs/outputs 24 V DC, 0.5 A max.
- Module-wise galvanically isolated
- XC version for usage in extreme ambient conditions available

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

5.6.6.2 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

5.6.6.2.1 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.

5.6.6.2.2 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 5.7.1 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 1130*

5.6.6.2.3 Connections

The Ethernet communication interface module CI501-PNIO is plugged on the I/O terminal unit TU507-ETH or TU508-ETH *Chapter 5.7.1 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 1130*. 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 5.8.2.5 “TA526 - Wall mounting accessory” on page 1183*.

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 DO0 ... DO7.

Table 253: 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
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

Terminal	Signal	Description
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 you

– 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. In order to avoid unacceptable potential differences between different parts of the installation, low resistance equipotential bonding conductors must be laid.

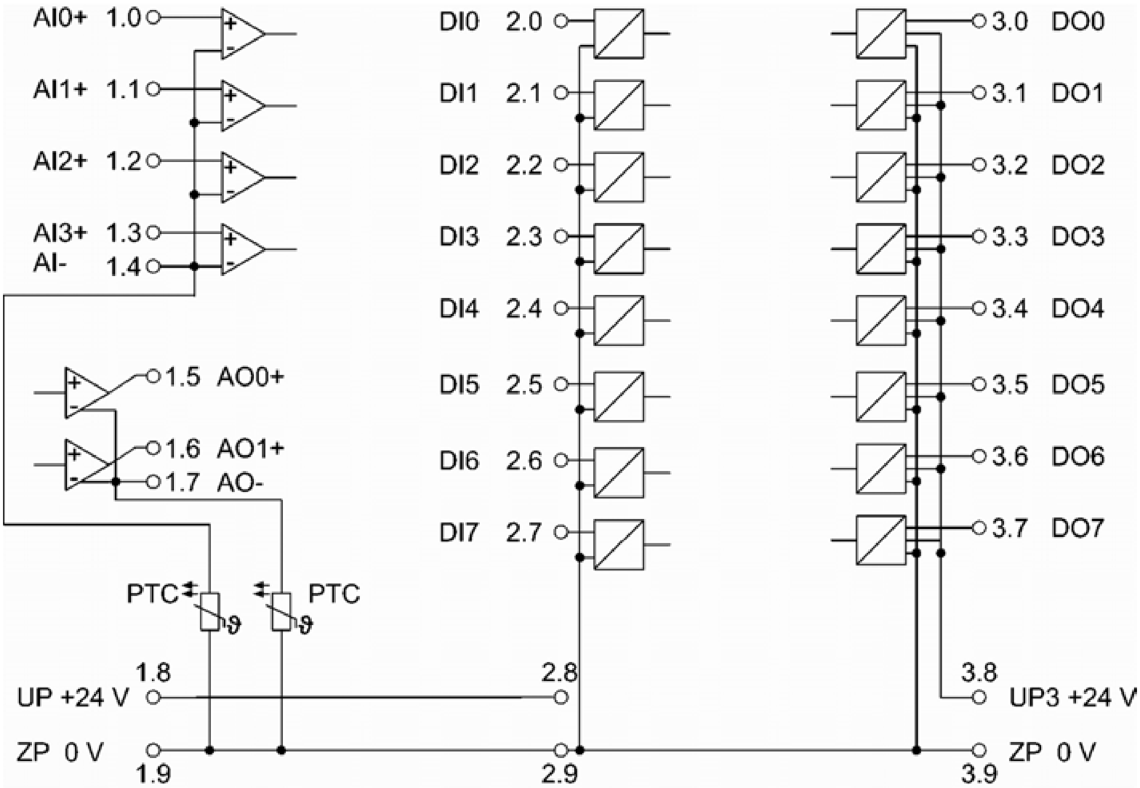


Fig. 219: Connection of the Ethernet bus module CI501-PNIO

Connection of the digital inputs

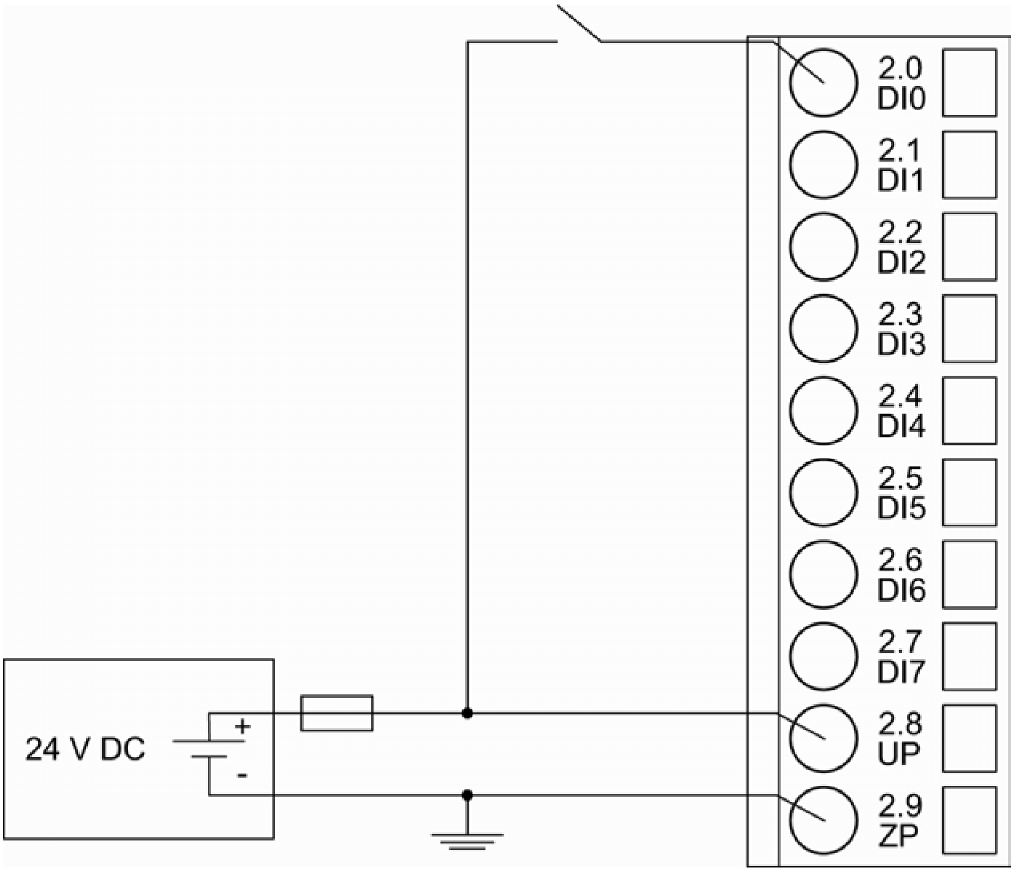


Fig. 220: Connection of the digital inputs (DI0 ... DI7)

Chapter 5.6.6.2.9 "State LEDs" on page 1092

Connection of the digital outputs

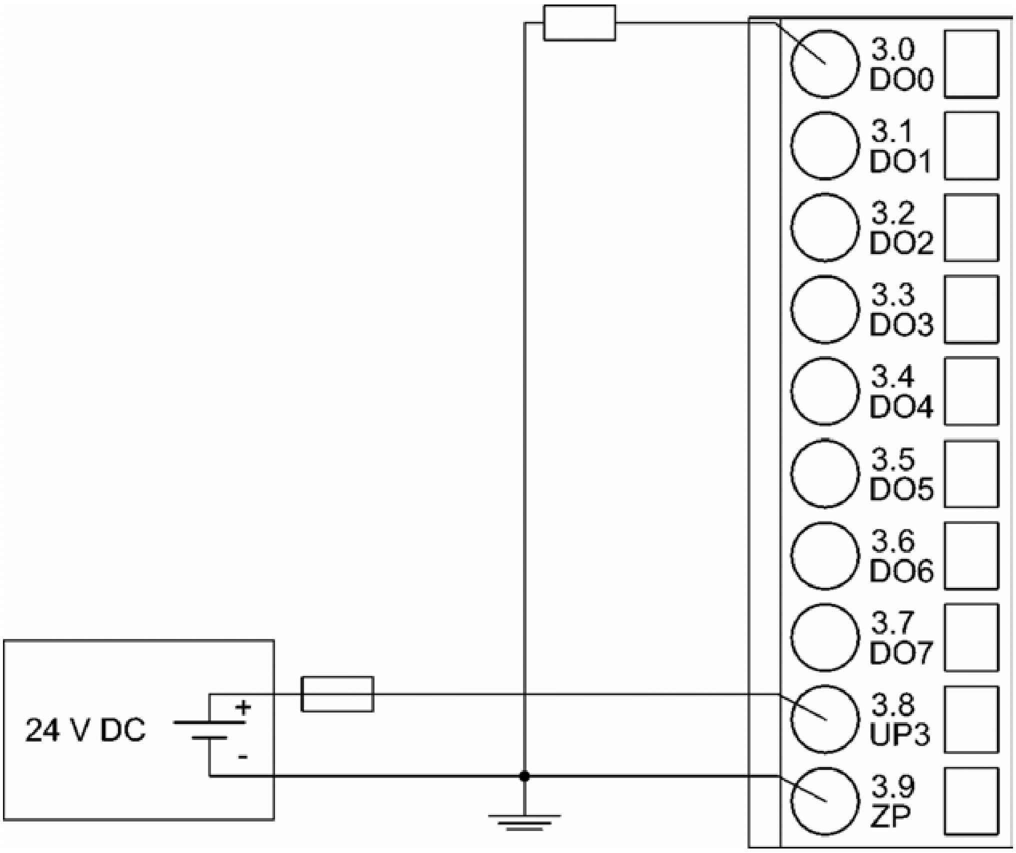


Fig. 221: Connection of the digital output (DO0 ... DO7)

Chapter 5.6.6.2.9 “State LEDs” on page 1092

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.

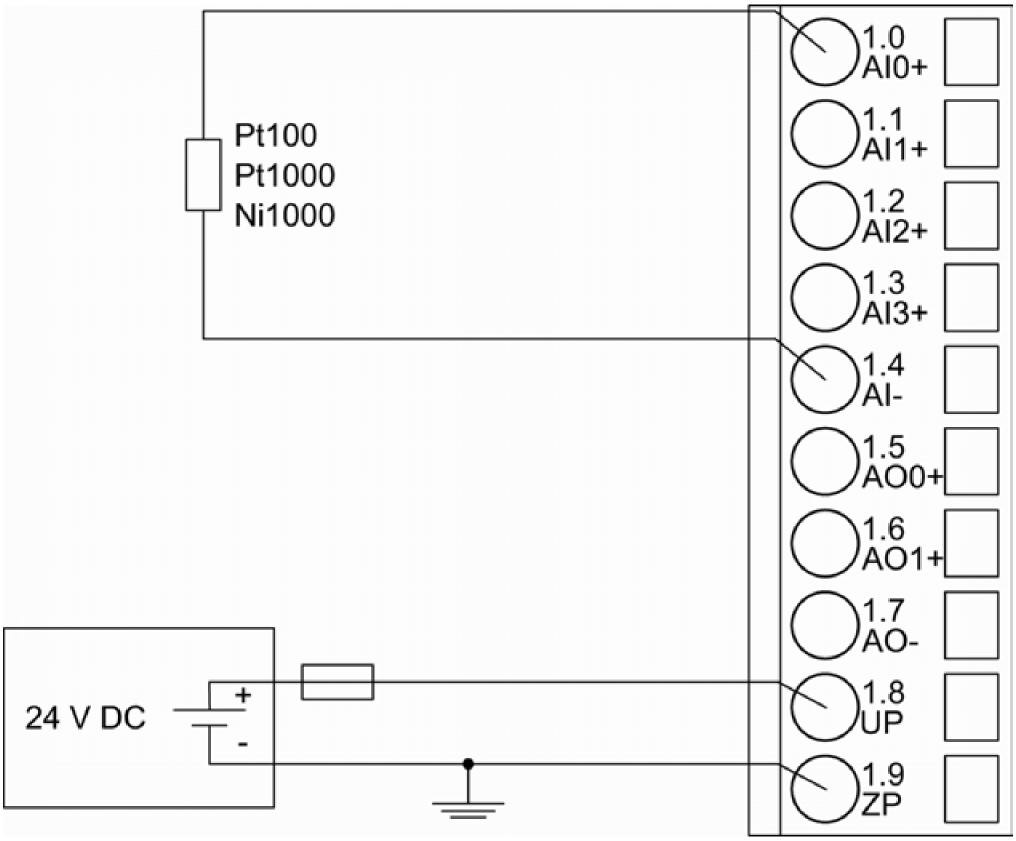


Fig. 222: Connection of resistance thermometers in 2-wire configuration to the analog inputs (AI0 ... AI3)

Table 254: 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 5.6.6.2.7 “Parameterization” on page 1081

Chapter 5.6.6.2.8 “Diagnosis” on page 1087

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.

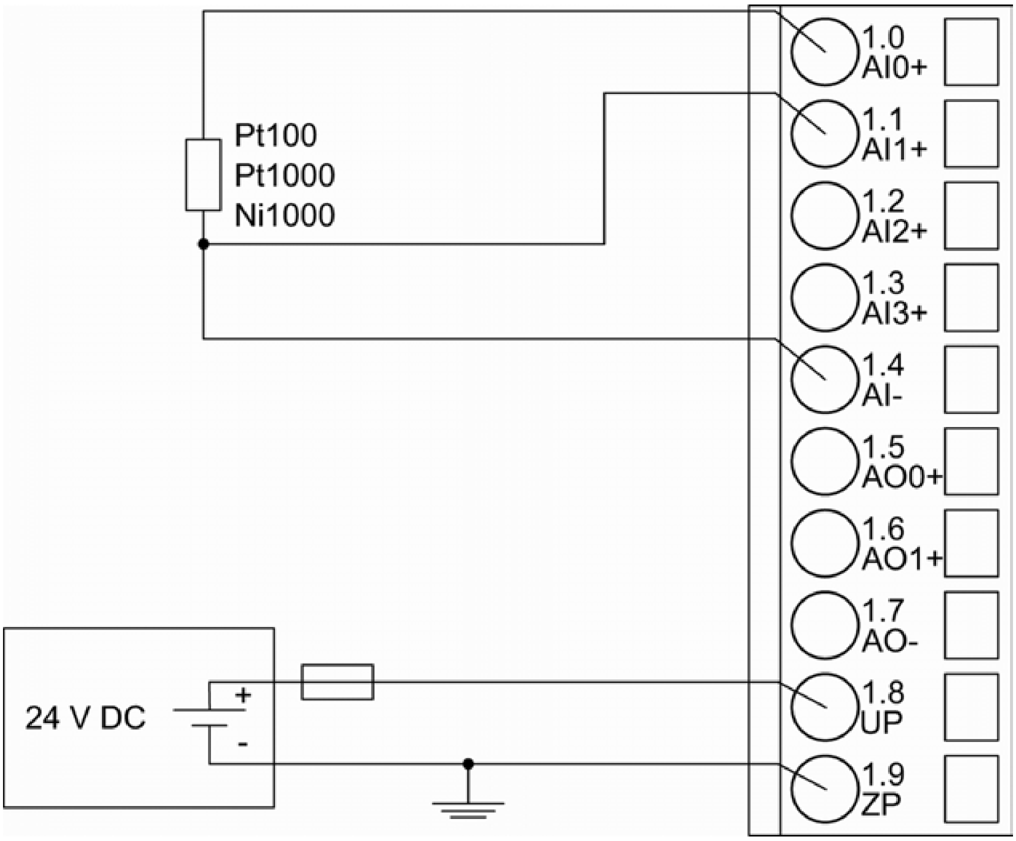


Fig. 223: Connection of resistance thermometers in 3-wire configuration to the analog inputs (AI0 ... AI3)

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 255: 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 5.6.6.2.7 “Parameterization” on page 1081

Chapter 5.6.6.2.8 “Diagnosis” on page 1087

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

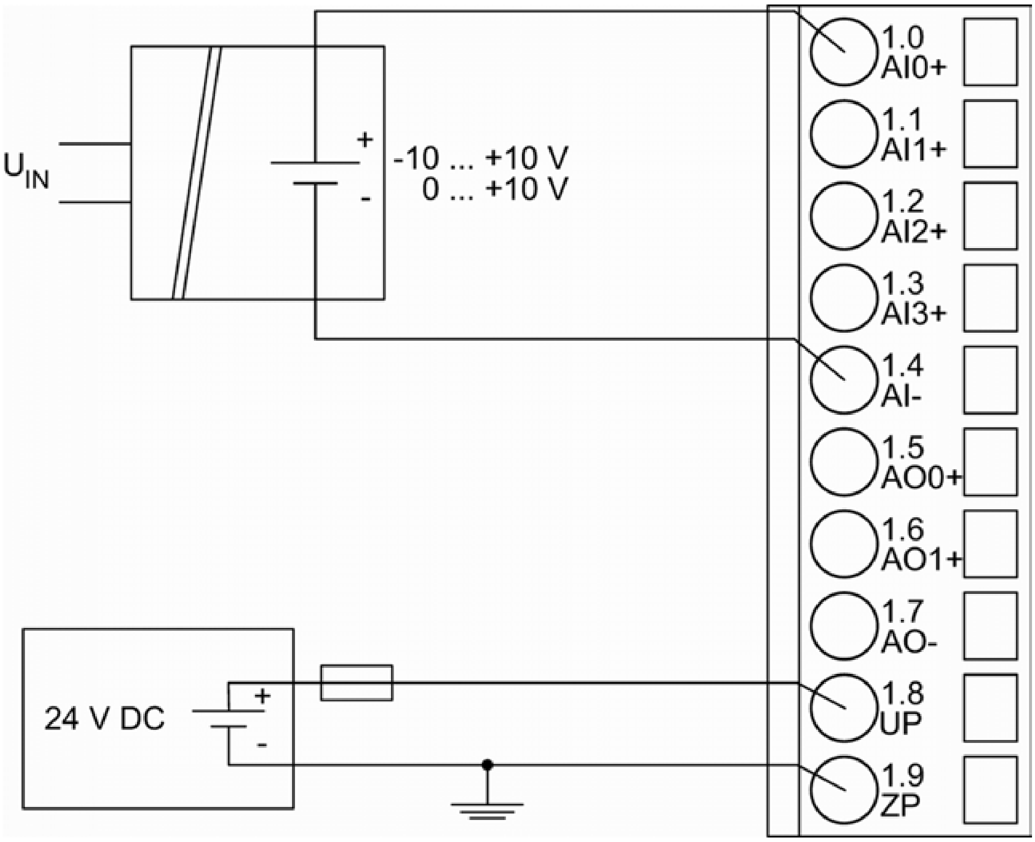


Fig. 224: Connection of active-type analog sensors (voltage) with galvanically isolated power supply to the analog inputs (AI0 ... AI3)

Table 256: Configurable measuring ranges

Voltage	0 V ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

Chapter 5.6.6.2.7 “Parameterization” on page 1081

Chapter 5.6.6.2.8 “Diagnosis” on page 1087

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

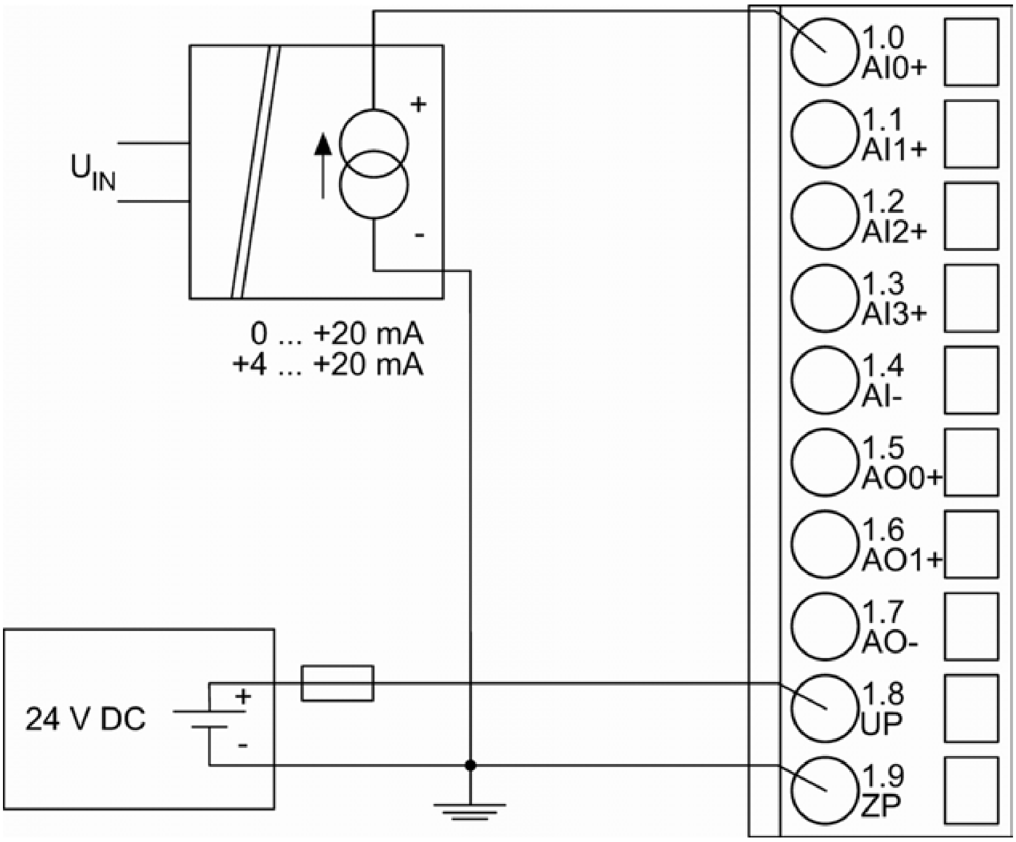


Fig. 225: Connection of active-type analog sensors (current) with galvanically isolated power supply to the analog inputs (AI0 ... AI3)

Table 257: Configurable measuring ranges

Current	0 mA ... 20 mA	1 channel used
Current	4 mA ... 20 mA	1 channel used

Chapter 5.6.6.2.7 “Parameterization” on page 1081

Chapter 5.6.6.2.8 “Diagnosis” on page 1087

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

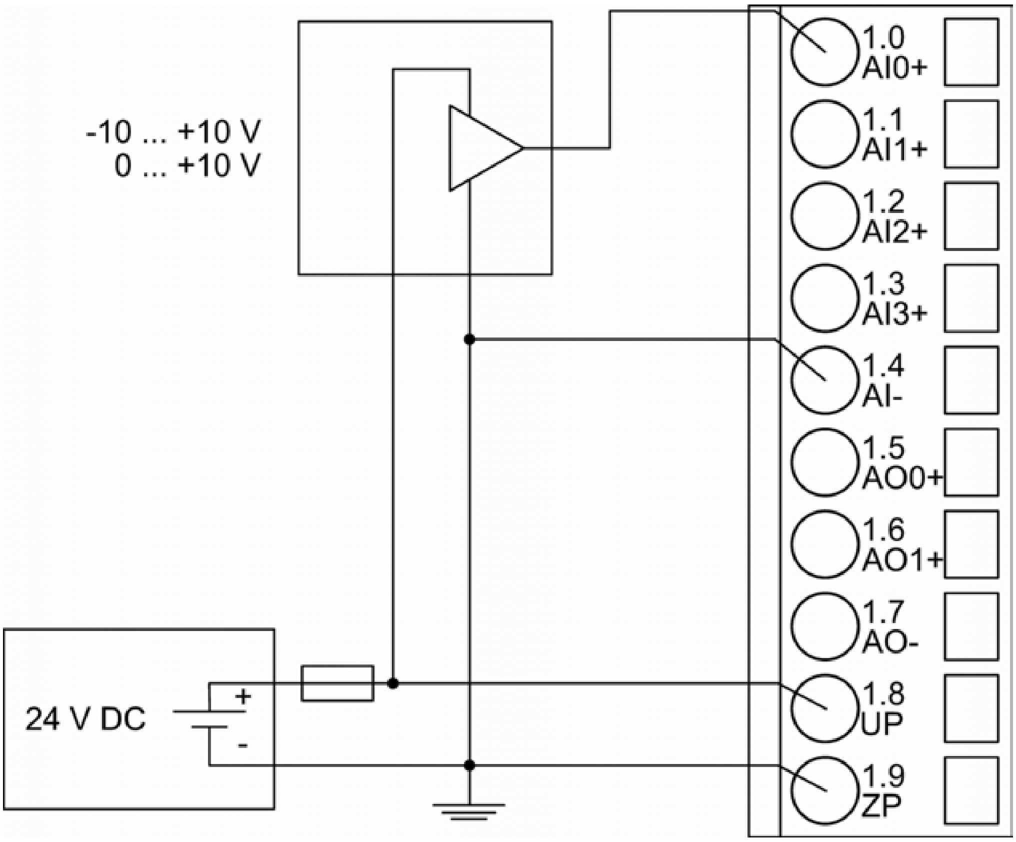


Fig. 226: Connection of active-type analog sensors (voltage) with no galvanically isolated power supply to the analog inputs (AI0 ... AI3)

CAUTION!
Risk of faulty measurements!
The negative 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 258: Configurable measuring ranges

Voltage	0 V ... 10 V	1 channel used
Voltage	-10 V ... +10 V	1 channel used

Chapter 5.6.6.2.7 “Parameterization” on page 1081

Chapter 5.6.6.2.7 “Parameterization” on page 1081

Chapter 5.6.6.2.8 “Diagnosis” on page 1087

To avoid error messages from unused analog input channels, configure them as "unused".

Connection of passive-type analog sensors (Current) to the analog inputs

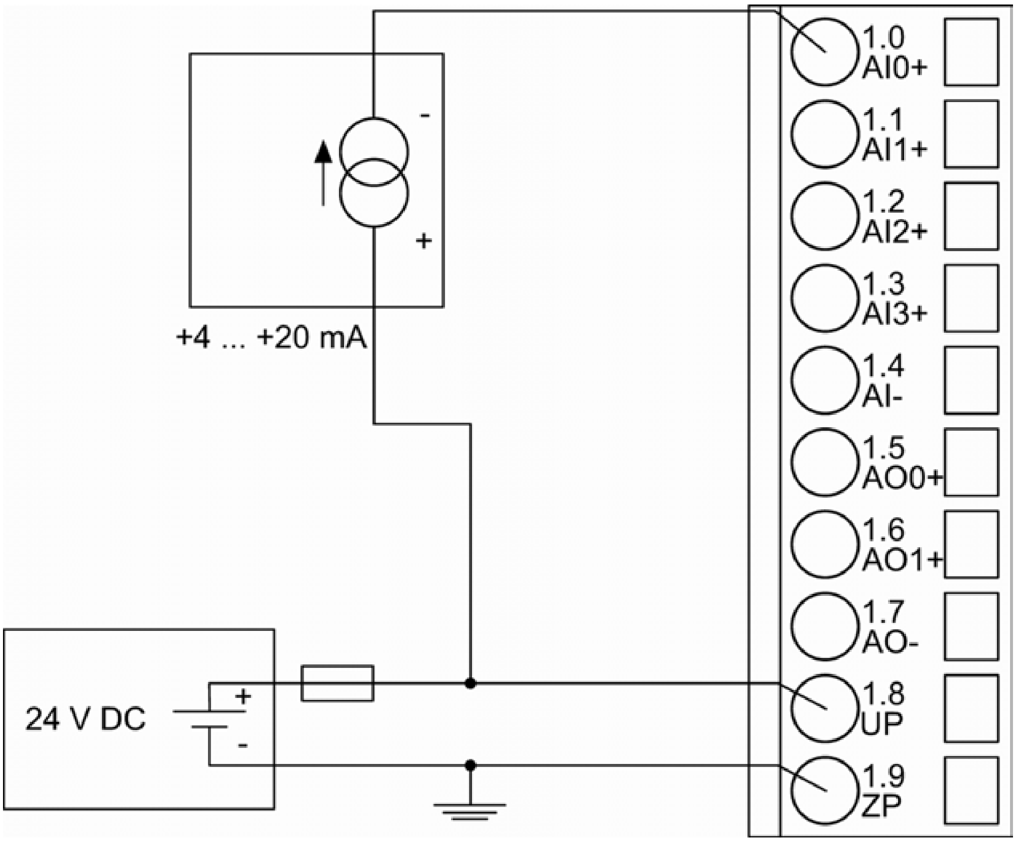


Fig. 227: Connection of passive-type analog sensors (current) to the analog inputs (AI0 ... AI3)

Table 259: Configurable measuring ranges

Current	4 mA ... 20 mA	1 channel used

Chapter 5.6.6.2.7 “Parameterization” on page 1081

Chapter 5.6.6.2.8 “Diagnosis” on page 1087

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.

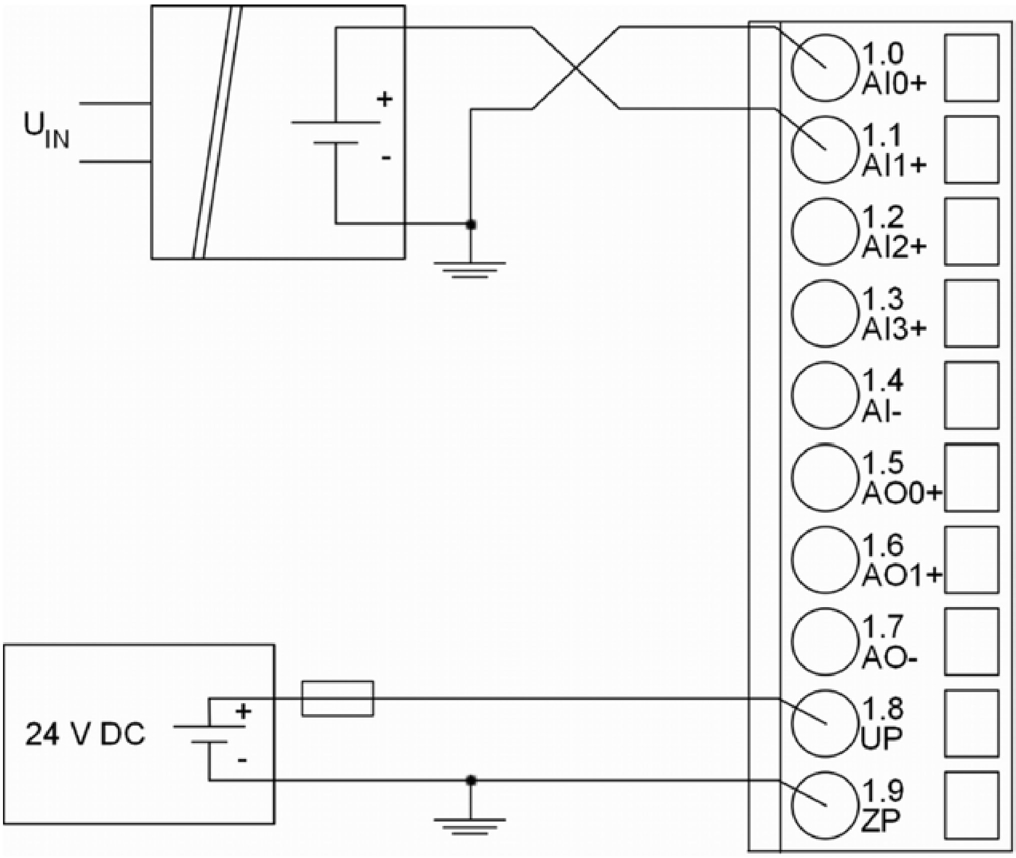


Fig. 228: Connection of active-type analog sensors (voltage) to differential analog inputs (AI0 ... AI3)

Table 260: 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 5.6.6.2.7 “Parameterization” on page 1081

Chapter 5.6.6.2.8 “Diagnosis” on page 1087

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.

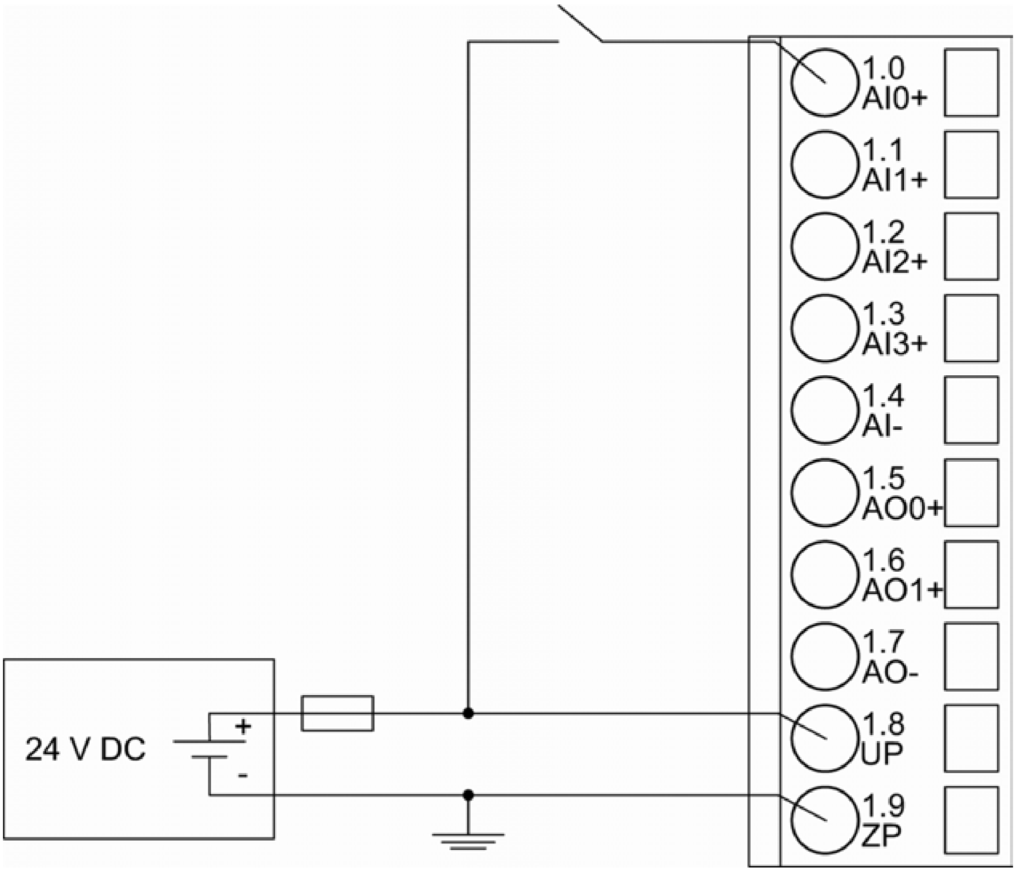


Fig. 229: Connection of digital sensors to the analog inputs (AI0 ... AI3)

Table 261: 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 5.6.6.2.7 “Parameterization” on page 1081*

↳ *Chapter 5.6.6.2.8 “Diagnosis” on page 1087*

Connection of analog output loads (Voltage)

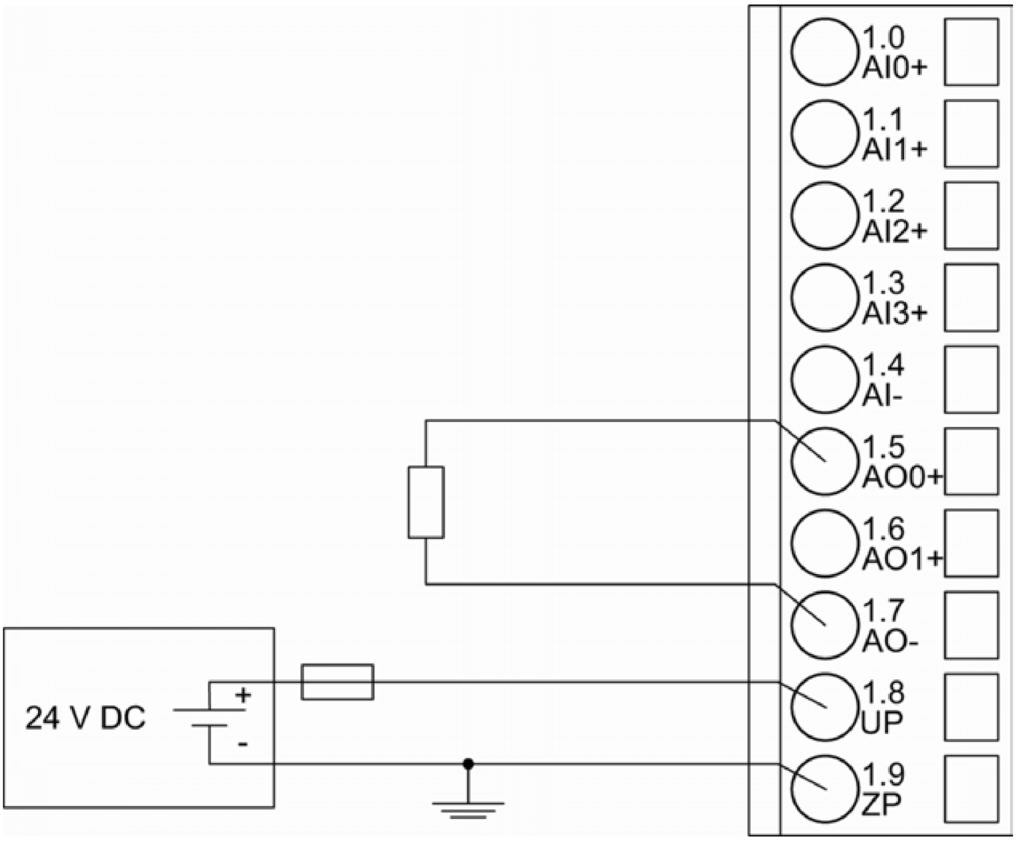


Fig. 230: Connection of analog output loads (voltage) to the analog outputs (AO0 ... AO1)

Table 262: Configurable measuring ranges

Voltage	-10 V ... +10 V	Load ± 10 mA max.	1 channel used

Chapter 5.6.6.2.7 “Parameterization” on page 1081

Chapter 5.6.6.2.8 “Diagnosis” on page 1087

Unused analog outputs can be left open-circuited.

Connection of analog output loads (Current)

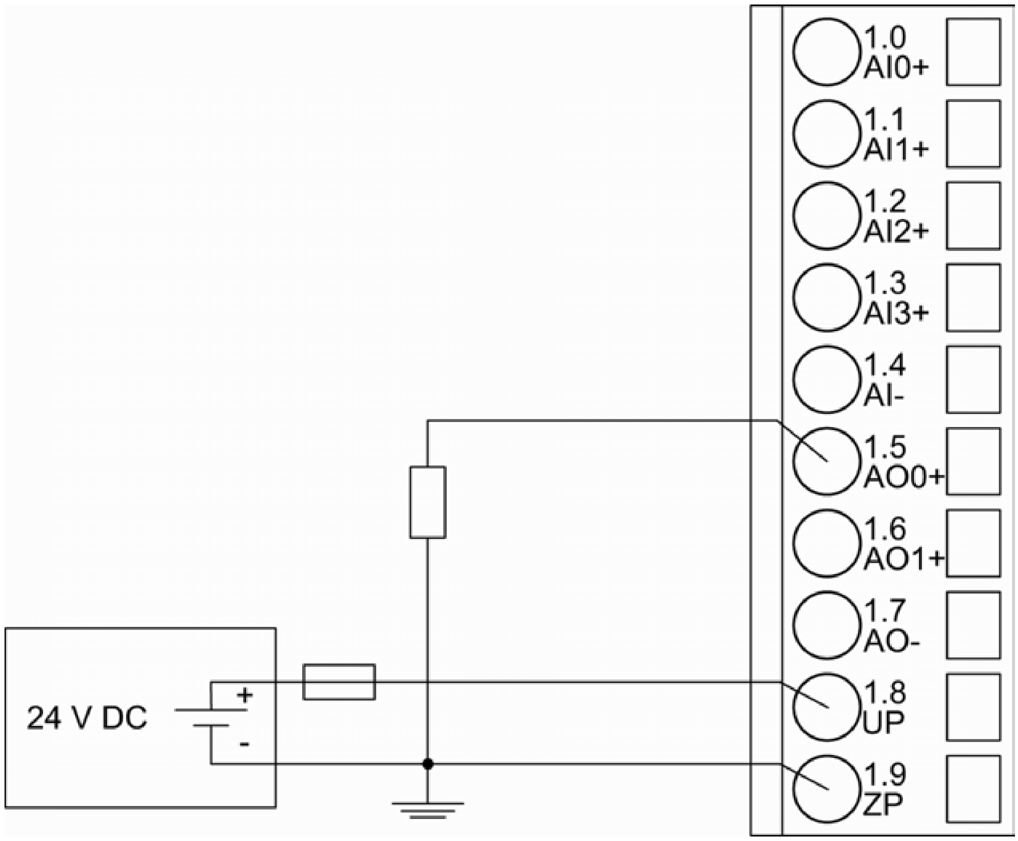


Fig. 231: Connection of analog output loads (current) to the analog otputs (AO0 and AO1)

Table 263: 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 5.6.6.2.7 “Parameterization” on page 1081

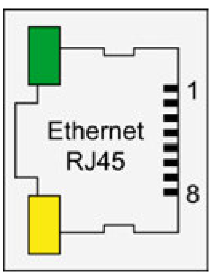
Chapter 5.6.6.2.8 “Diagnosis” on page 1087

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.

5.6.6.2.4 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

5.6.6.2.5 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.

5.6.6.2.6 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 5.6.6.2.7 “Parameterization” on page 1081

5.6.6.2.7 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 / Fail-safe function see table Error LED / Failsafe function *Table 264 "Error LED / Failsafe function" on page 1082*	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 [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 5.4.2.2.9 “Fast counter” on page 464*.

Table 264: 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.

  Note that if the parameter is set to *"On"* then:
  - 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.

  Note that if the parameter is set to *"Off"* then:
  - 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 265 "Channel configuration" on page 1084*	Table Operating modes of the analog inputs *Table 265 "Channel configuration" on page 1084*	BYTE	0
Input 0, Check channel	Table Channel montoring *Table 266 "Channel monitoring" on page 1085*	Table Channel montoring *Table 266 "Channel monitoring" on page 1085*	BYTE	0
:	:	:	:	:
:	:	:	:	:
Input 3, Channel configuration	Table Operating modes of the analog inputs *Table 265 "Channel configuration" on page 1084*	Table Operating modes of the analog inputs *Table 265 "Channel configuration" on page 1084*	BYTE	0
Input 3, Check channel	Table Channel montoring *Table 266 "Channel monitoring" on page 1085*	Table Channel montoring *Table 266 "Channel monitoring" on page 1085*	BYTE	0

Table 265: 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 266: 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 1086*	Table Operating modes of the analog outputs *Further information on page 1086*	BYTE	0
Output 0, Check channel	Table Channel monitoring *Table 268 “Channel monitoring” on page 1086*	Table Channel monitoring *Table 268 “Channel monitoring” on page 1086*	BYTE	0
Output 0, Substitute value	Table Substitute value *Table 269 “Substitute value” on page 1086*	Table Substitute value *Table 269 “Substitute value” on page 1086*	WORD	0
Output 1, Channel configuration	Table Operating modes of the analog outputs *Further information on page 1086*	Table Operating modes of the analog outputs *Further information on page 1086*	BYTE	0
Output 1, Check channel	Table Channel monitoring *Table 268 “Channel monitoring” on page 1086*	Table Channel monitoring *Table 268 “Channel monitoring” on page 1086*	BYTE	0
Output 1, Substitute value	Table Substitute value *Table 269 “Substitute value” on page 1086*	Table Substitute value *Table 269 “Substitute value” on page 1086*	WORD	0

Table 267: 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 268: Channel monitoring

Internal value	Check channel
0	Plausibility, wire break, short circuit
3	None

Table 269: 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 *Chapter 5.6.6.2.3 "Connections" on page 1064*. 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".				

5.6.6.2.8 Diagnosis

Table 270: 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 ter-minal 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 con-nection to the net-work	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 termi-nals/ 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 dig-ital output [7])	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	4	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 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 ✎ *Chapter 5.6.6.2.3 "Connections" on page 1064*. 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 on digital outputs DO0 ... DO7 has overrun the process supply voltage UP3 ✎ *Chapter 5.6.6.2.3 "Connections" on page 1064*. Diagnosis message appears for the whole module.
[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.

5.6.6.2.9 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 271: 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	---

LED	Color	OFF	ON	Flashing
	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 con-nected or com-munication error	Expansion modules con-nected and operational	---
ETH1	Green	No connection at Ethernet inter-face	Connected to Ethernet inter-face	---
	Yellow	---	Device is trans-mitting telegrams	Device is trans-mitting telegrams
ETH2	Green	No connection at Ethernet inter-face	Connected to Ethernet inter-face	---
	Yellow	---	Device is trans-mitting telegrams	Device is trans-mitting telegrams

Table 272: 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 fin-ished	--
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 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
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 ... +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
			+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

Range	Pt100 / Pt1000 -50 ... +70 °C	Pt100 / Pt1000 -50 ... +400 °C	Ni1000 -50 ... +150 °C	Digital value	
				Decimal	Hex.
		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	> 11.7589 V	> 23.5178 mA	> 22.8142 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	< -11.7589 V	0 mA	0 mA	< -32512	< 8100

The represented resolution corresponds to 16 bits.

5.6.6.2.11 Technical data

The system data of AC500 and S500 are applicable to the standard version *Chapter 4.2 “System data AC500” on page 30*.

The system data of AC500-XC are applicable to the XC version *Chapter 4.3 “System data AC500-XC” on page 35*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Technical data of the module

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		2 bytes
Output data length		2 bytes
Reference potential for all digital inputs and outputs		Negative pole 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
Diagnose		See Diagnosis and Displays *Chapter 5.6.6.2.8 “Diagnosis” on page 1087*
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)

Parameter	Value
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
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)
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 A
Protective functions (according to IEC 61131-3)	Protected against: ● short circuit ● reverse supply ● overvoltage ● reverse polarity Galvanic isolation from the rest of the module

*) Priorization with the aid of VLAN-ID including priority level

Technical data of the digital inputs

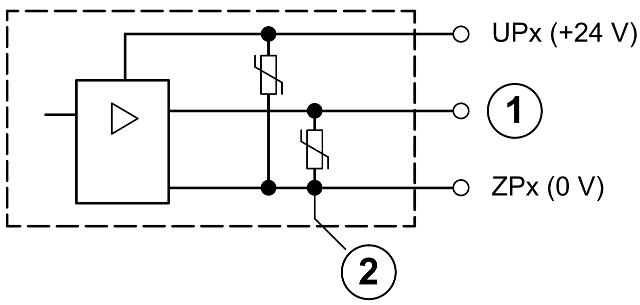
Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DI0 ... DI7		Terminals 2.0 ... 2.7
Reference potential for all inputs		Terminals 1.9 ... 3.9 (negative pole of the supply voltage, signal name ZP)
Indication of 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

Parameter		Value
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.



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

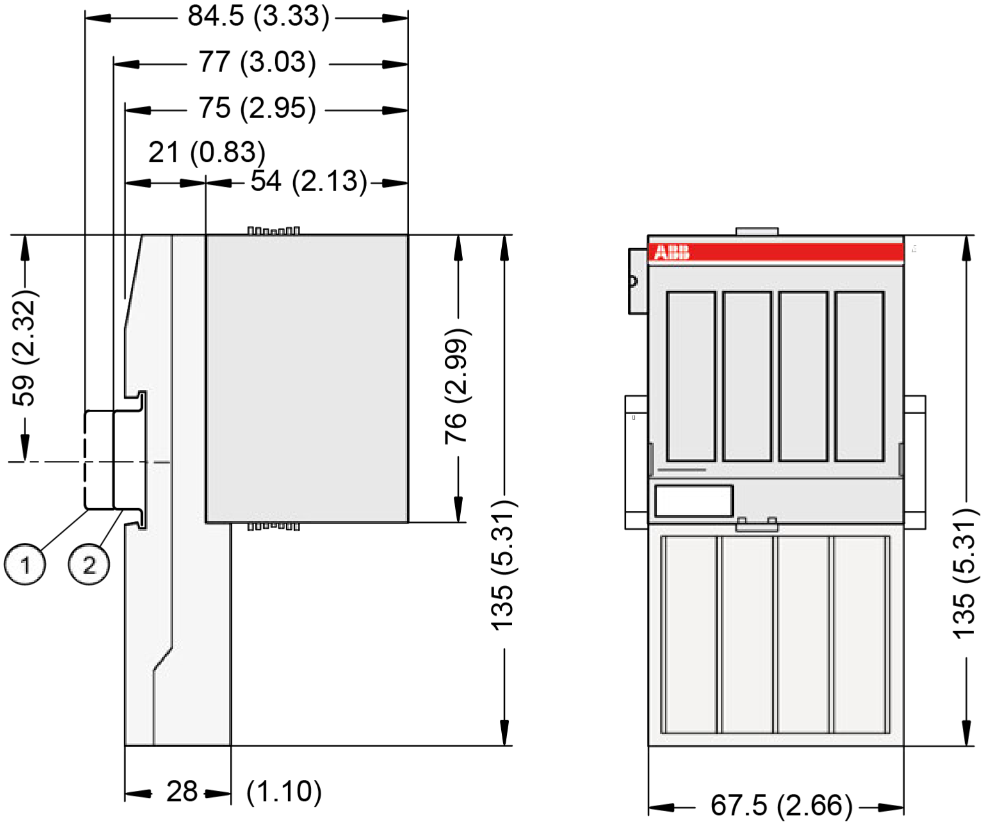
Technical data of the analog outputs

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 5.6.6.2.10.3 “Output ranges voltage and current” on page 1095*
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

5.6.6.2.12 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

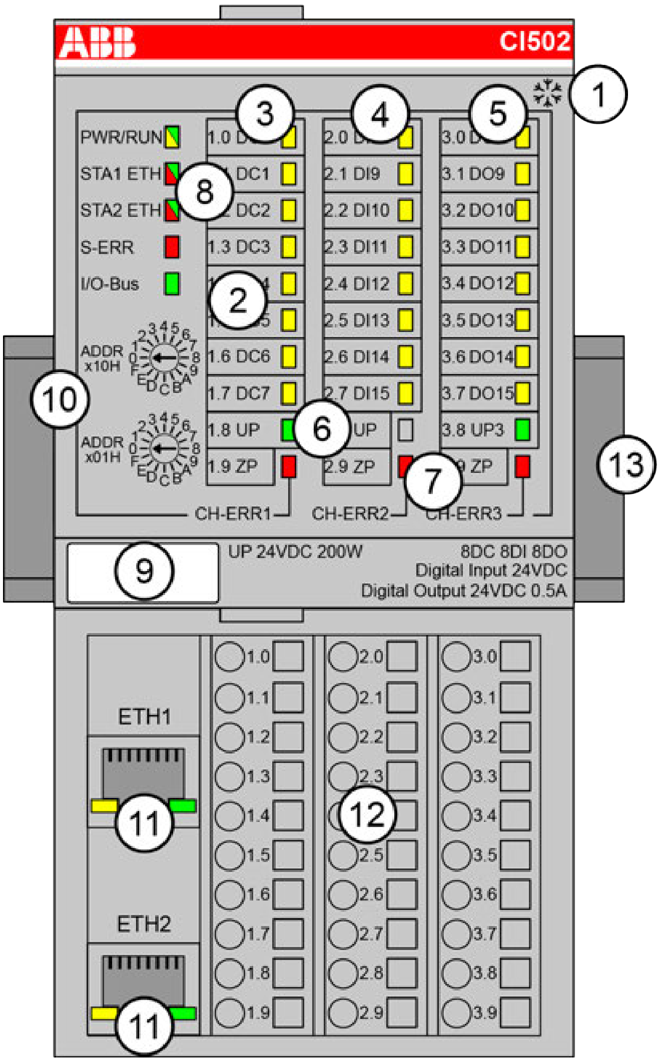
5.6.6.2.13 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 220 600 R0001	CI501-PNIO (V3), PROFINET communication interface module, 8 DI, 8 DO, 4 AI and 2 AO	Active
1SAP 420 600 R0001	CI501-PNIO-XC (V3), 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.*

5.6.6.3 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

5.6.6.3.1 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.

5.6.6.3.2 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 5.7.1 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 1130*

5.6.6.3.3 Connections

The Ethernet communication interface module CI502-PNIO is plugged on the I/O terminal unit TU507-ETH ➥ *Chapter 5.7.1 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 1130* or TU508-ETH ➥ *Chapter 5.7.1 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 1130*. 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 5.8.2.5 “TA526 - Wall mounting accessory” on page 1183*.

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 conncted at the outputs DO0 ... DO7 and DC0 ... DC7.

Table 273: 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
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)

Terminal	Signal	Description
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 you

– 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.

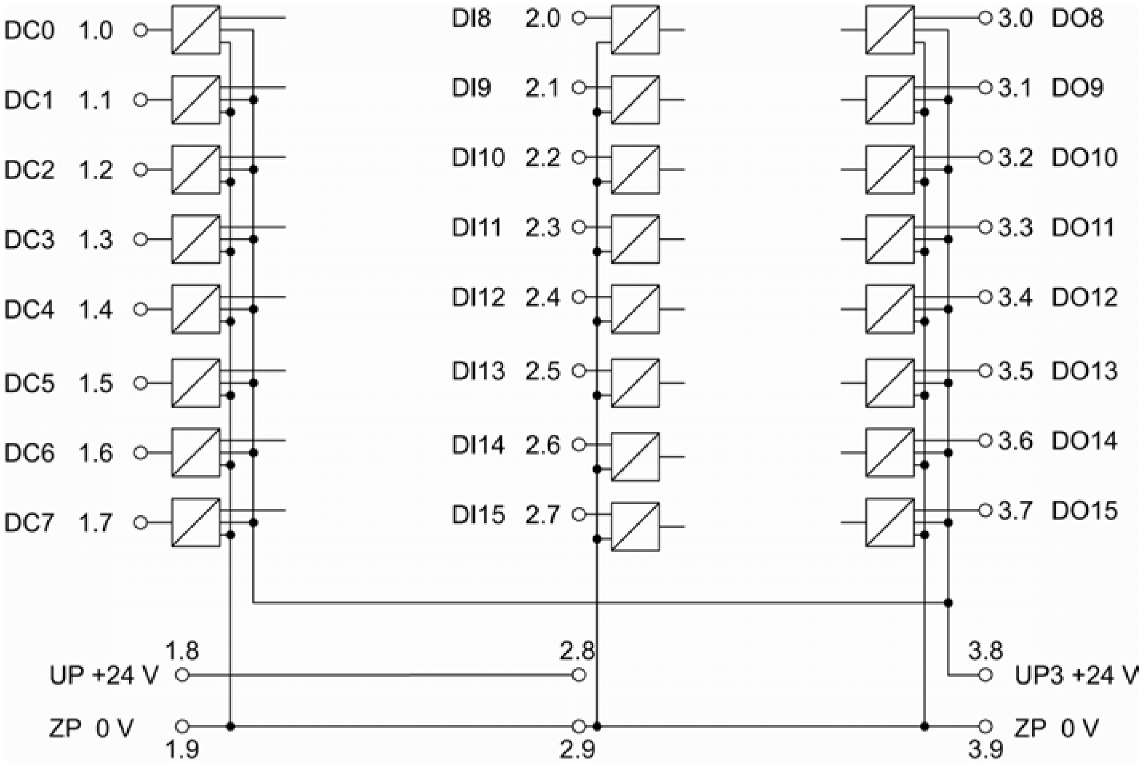


Fig. 232: Connection of the Ethernet communication interface module CI502-PNIO

Connection of the Digital inputs

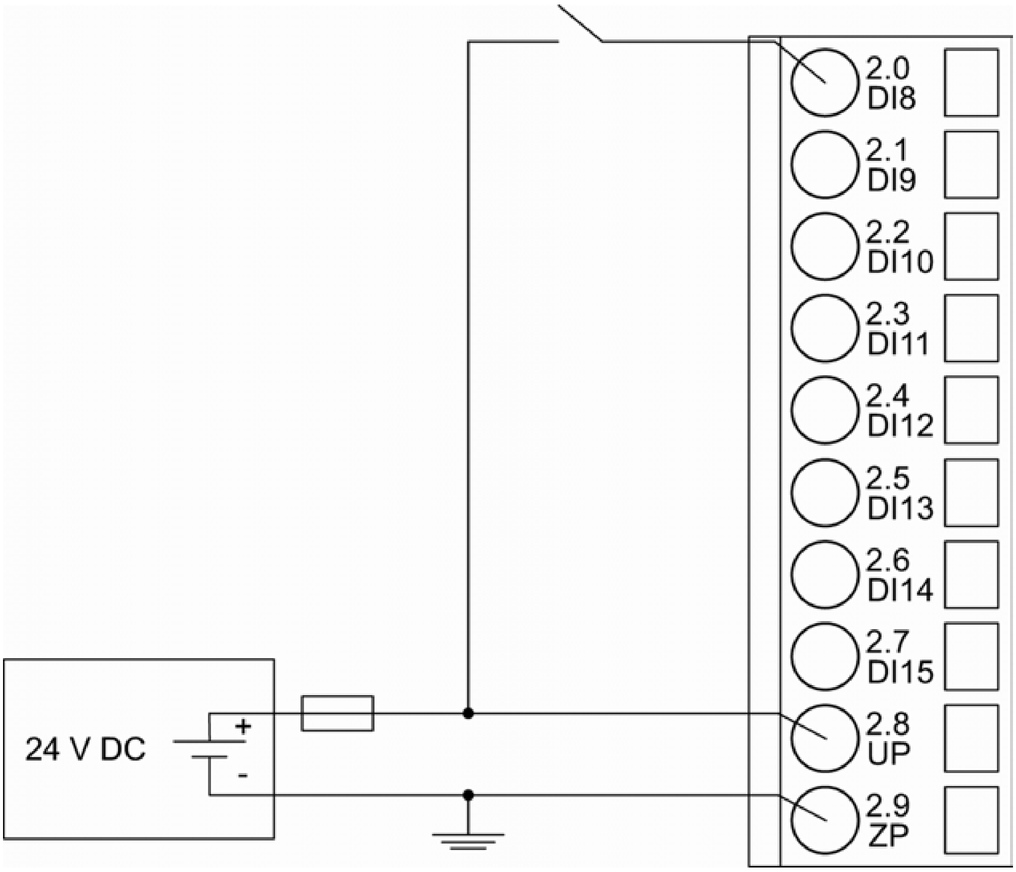


Fig. 233: Connection of the digital inputs (DI8 ... DI15)

The meaning of the LEDs is described in 'Displays' *Chapter 5.6.6.3.9 “State LEDs” on page 1121*.

Connection of the Digital outputs

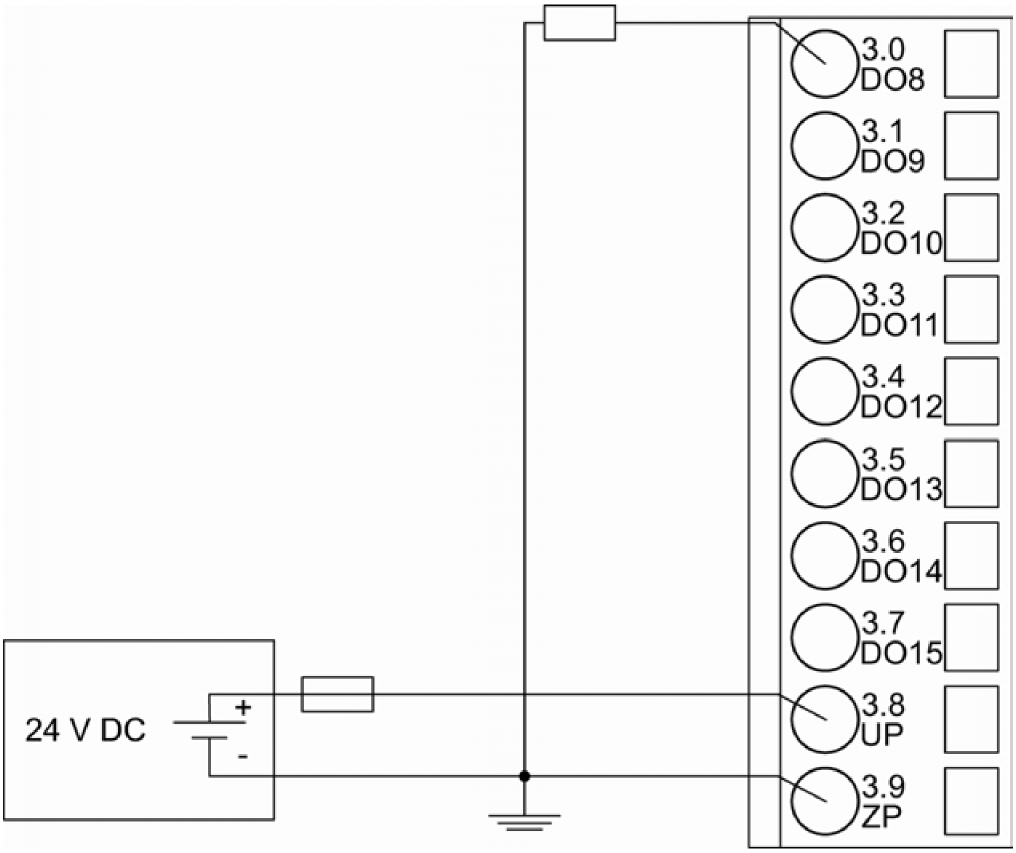


Fig. 234: Connection of the digital outputs (DO8 ... DO15)

The meaning of the LEDs is described in 'Displays' *Chapter 5.6.6.3.9 “State LEDs” on page 1121*.

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 5.6.6.3.3 "Connections" on page 1105*.

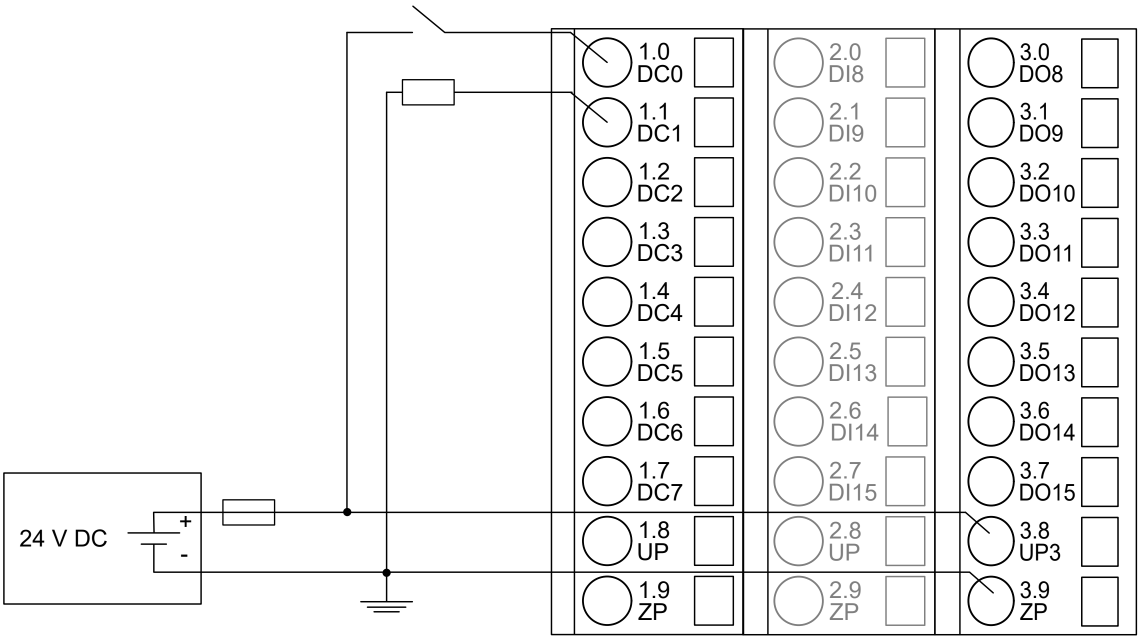


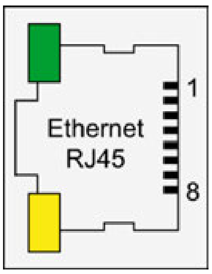
Fig. 235: Connection of the configurable digital inputs/outputs (DC0 ... DC7)(DC0 as input, DC1 as output)

The meaning of the LEDs is described in 'Displays' *Chapter 5.6.6.3.9 "State LEDs" on page 1121*.

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.*

5.6.6.3.4 Internal data exchange

Parameter	Value
Digital inputs (bytes)	5
Digital outputs (bytes)	5
Counter input data (words)	4
Counter output data (words)	8

5.6.6.3.5 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.*

5.6.6.3.6 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 configuration are described in 'Parameterization' *Chapter 5.6.6.3.7 “Parameterization” on page 1113*.

5.6.6.3.7 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 / Failsafe function (Table Error LED / Failsafe function *Further information on page 1113*)	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	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 5.4.2.2.9 “Fast counter” on page 464*				

Table 274: 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.

  Note that if the parameter is set to *"On"* then:
  - 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.

  Note that if the parameter is set to *"Off"* then:
  - 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 *Chapter 5.6.6.3.3 “Connections” on page 1105* (see description in section). 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.

5.6.6.3.8 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 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
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, see description in 'Connections' *Chapter 5.6.6.3.3 “Connections” on page 1105*. 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 *Chapter 5.6.6.3.3 “Connections” on page 1105*. 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 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.

5.6.6.3.9 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 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 275: 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)	---
S-ERR	Red	No error	Internal error	--

LED	Color	OFF	ON	Flashing
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 276: 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

5.6.6.3.10 Technical data

The system data of AC500 and S500 are applicable to the standard version *Chapter 4.2 “System data AC500” on page 30*.

The system data of AC500-XC are applicable to the XC version *Chapter 4.3 “System data AC500-XC” on page 35*.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Technical data of the module

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 pole 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
Diagnosis		See Diagnosis and Displays *Chapter 5.6.6.3.8 “Diagnosis” on page 1116*
Operation and error displays		34 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)
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***
> *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)
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 A
Protective functions (according to IEC 61131-3)	Protected against: ● short circuit ● reverse supply ● overvoltage ● reverse polarity Galvanic isolation from the rest of the module

*) Priorization 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

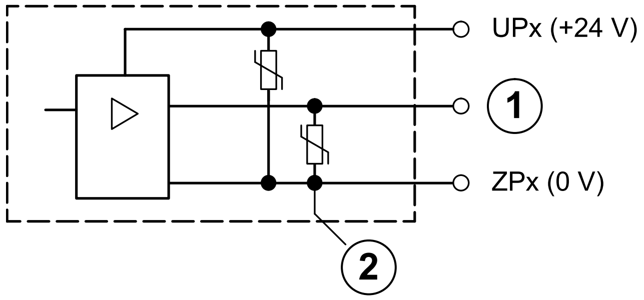
Parameter	Value
Reference potential for all inputs	Terminals 1.9 ... 3.9 (Negative pole of the supply voltage, signal name ZP)
Indication of the input signals	1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)	Type 1
Input delay (0->1 or 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 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

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.



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 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

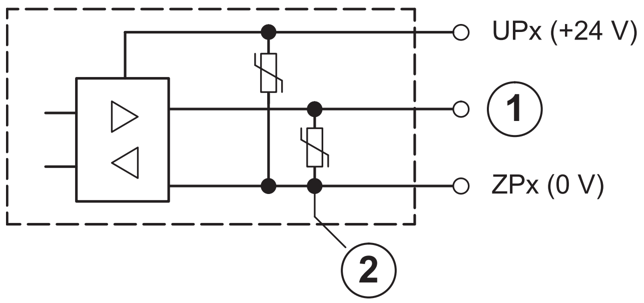
*) Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal may not exceed the clamp voltage of the varistor. The varistor limits the voltage to approx. 36 V. Following this, the 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	

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.

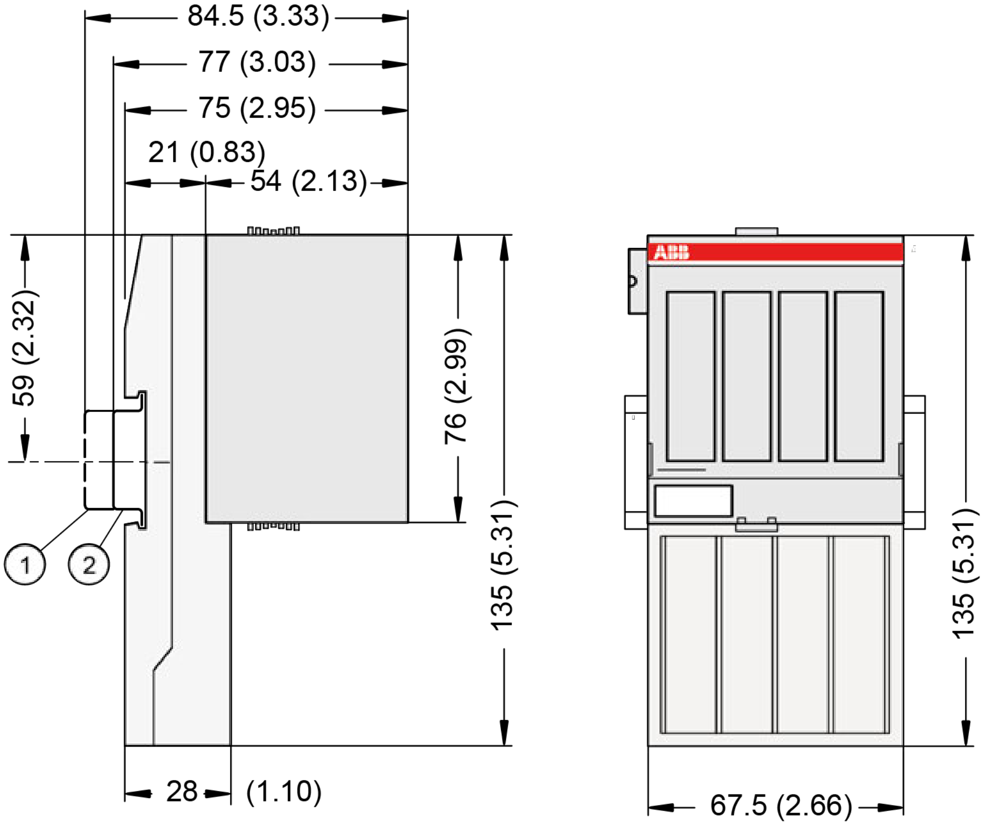


1 Digital input/output
2 For demagnetization when inductive loads are turned off

Technical data of the fast counter

Parameter	Value
Used inputs	Terminal 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

5.6.6.3.11 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

5.6.6.3.12 Ordering data

Active	Active	Product life cycle phase *)
1SAP 220 700 R0001	CI502-PNIO (V3), PROFINET communication interface module, 8 DI, 8 DO and 8 DC	Active
1SAP 420 700 R0001	CI502-PNIO-XC (V3), 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.*

5.7 Terminal units for communication interface modules

Hot swap

System requirements for hot swapping of I/O modules:

- *Types of terminal units that support hot swapping of I/O modules have the appendix TU5xx**-H**.*
- *I/O modules as of index F0.*

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.

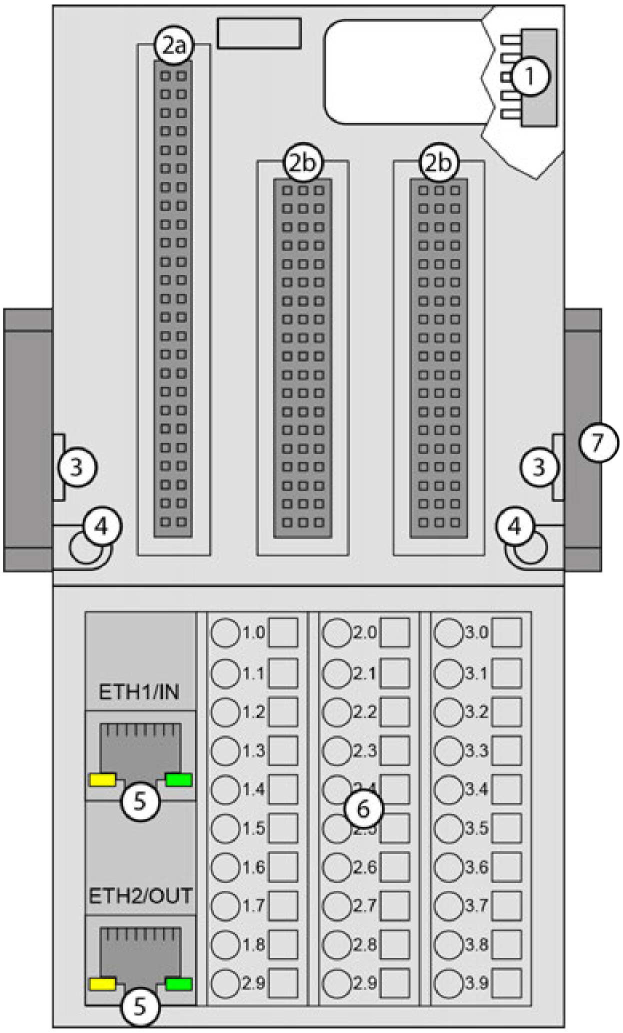
Conditions for hot swapping

- *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.*

.

5.7.1 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

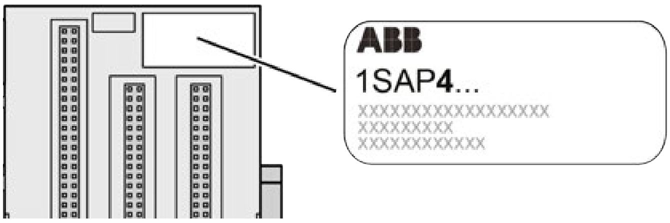


1 I/O bus (10 pins, female) to connect the first terminal unit
2a Plug (2x 25 pins) to connect the inserted Ethernet communication interface module
2b Plug (3x 19 pins) to connect the inserted Ethernet communication interface module
3 With a screwdriver, inserted in this place, the terminal unit and 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.

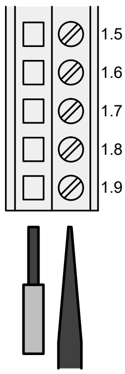
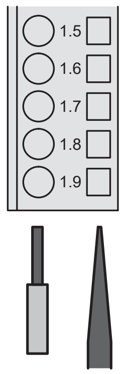
The Ethernet terminal units TU507-ETH and TU508-ETH are specifically designed for use with AC500/S500 Ethernet communication interface modules (e. g. CI501-PNIO).

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 1191*.

5.7.1.1 Technical data

The system data of AC500 and S500 are applicable to the standard version *Chapter 4.2 “System data AC500” on page 30*.

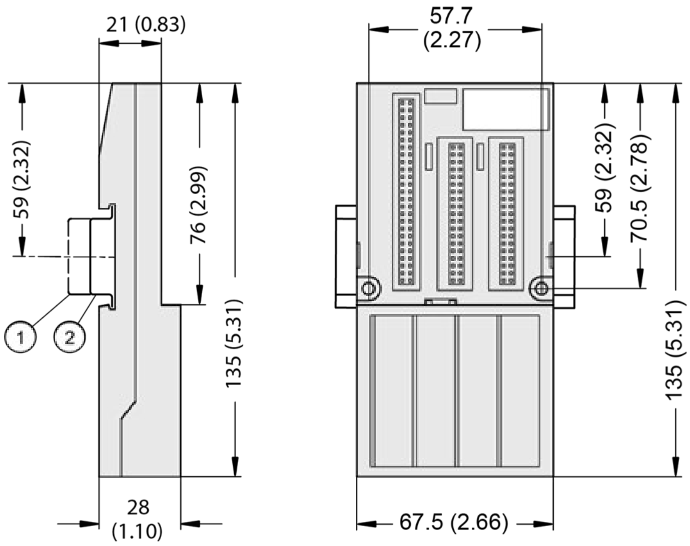
The system data of AC500-XC are applicable to the XC version *Chapter 4.3 “System data AC500-XC” on page 35*.

Only additional details are therefore documented below.

The technical data are 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

5.7.1.2 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

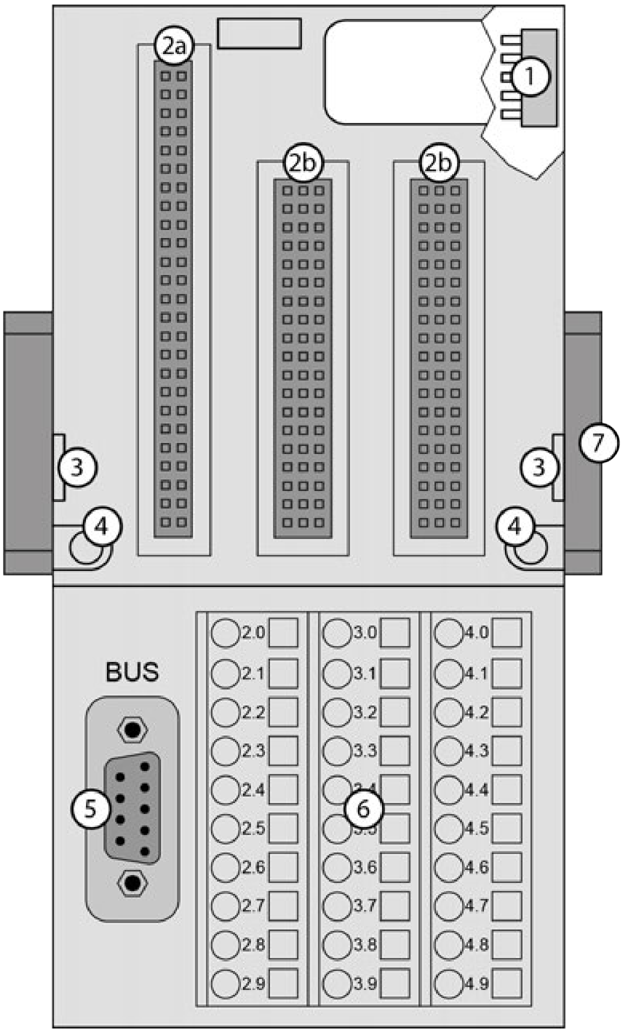
5.7.1.3 Ordering data

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.*

5.7.2 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



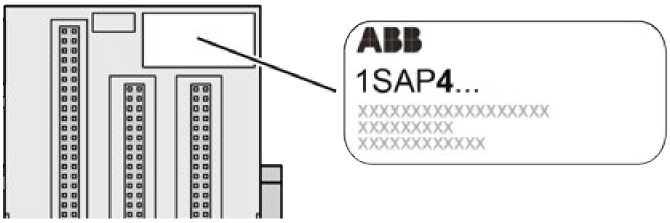
1 I/O bus (10 pins, female) to connect the first terminal unit
2a Plug (2 25 pins) to connect the inserted communication interface module
2b Plug (3 19 pins) to connect the inserted communication interface module
3 With a screwdriver, inserted in this place, the terminal unit and the adjacent terminal 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).

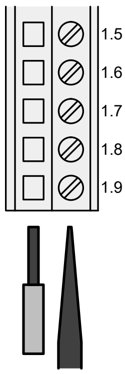
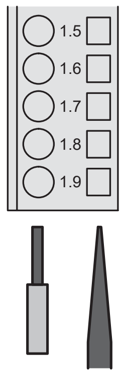
XC version

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 1191*.

5.7.2.1 Technical data

The system data of AC500 and S500 are applicable to the standard version ➡ *Chapter 4.2 “System data AC500” on page 30*.

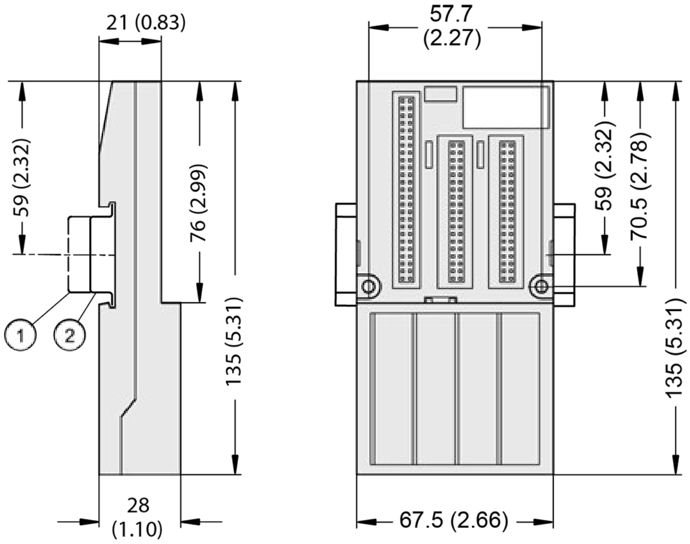
The system data of AC500-XC are applicable to the XC version ↯ *Chapter 4.3 “System data AC500-XC” on page 35*.

Only additional details are therefore documented below.

The technical data are 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

5.7.2.2 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

The dimensions are in mm and in brackets in inch.

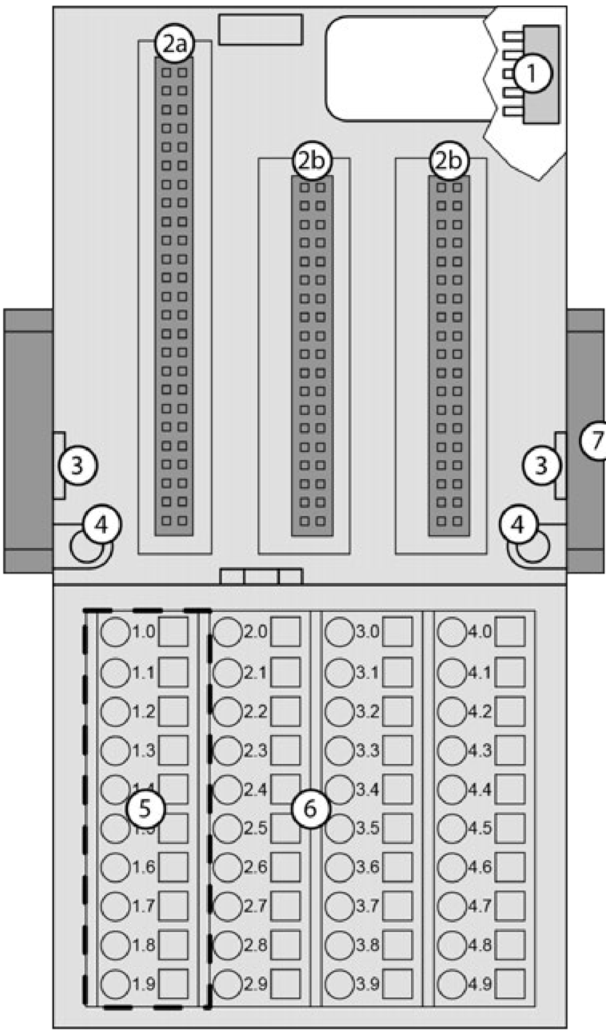
5.7.2.3 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 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.*

5.7.3 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

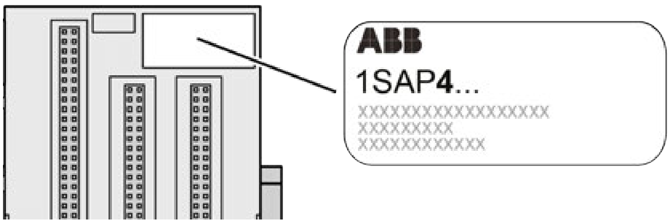
The communication interface modules plug into the terminal unit. When properly plugged-in, they are secured with two mechanical locks. All the connections are established via the terminal unit, which allows removal and replacement of the communication interface modules without disturbing the wiring at the terminal unit.

The terminal units TU517 and TU518 are specifically designed for use with AC500/S500 communication interface modules (e. g. CI581-CN, CI541-DP):

- CANopen communication interface modules
- DeviceNet modules
- PROFIBUS DP communication interface modules

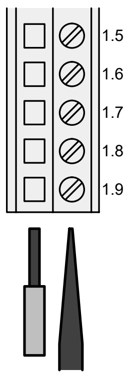
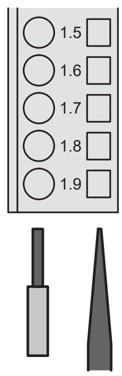
XC version

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 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).

5.7.3.1 Technical data

The system data of AC500 and S500 are applicable to the standard version ↯ *Chapter 4.2 “System data AC500” on page 30*.

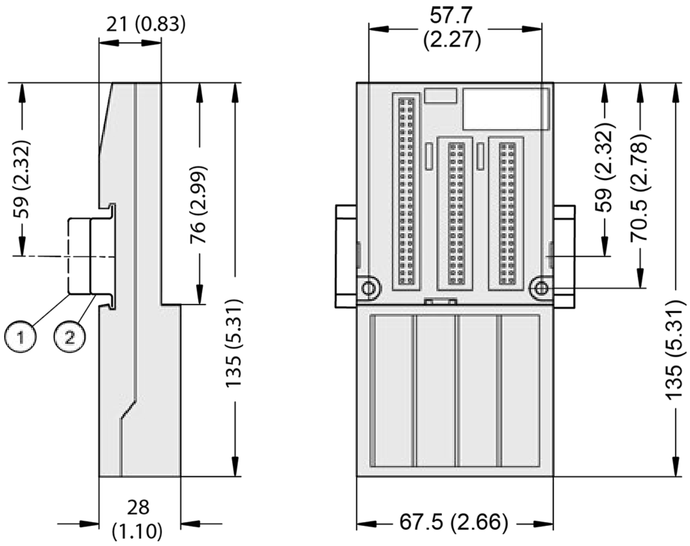
The system data of AC500-XC are applicable to the XC version ↯ *Chapter 4.3 “System data AC500-XC” on page 35*.

Only additional details are therefore documented below.

The technical data are 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

5.7.3.2 Dimensions



1 Din rail 15 mm
2 Din rail 7.5 mm

> *The dimensions are in mm and in brackets in inch.*

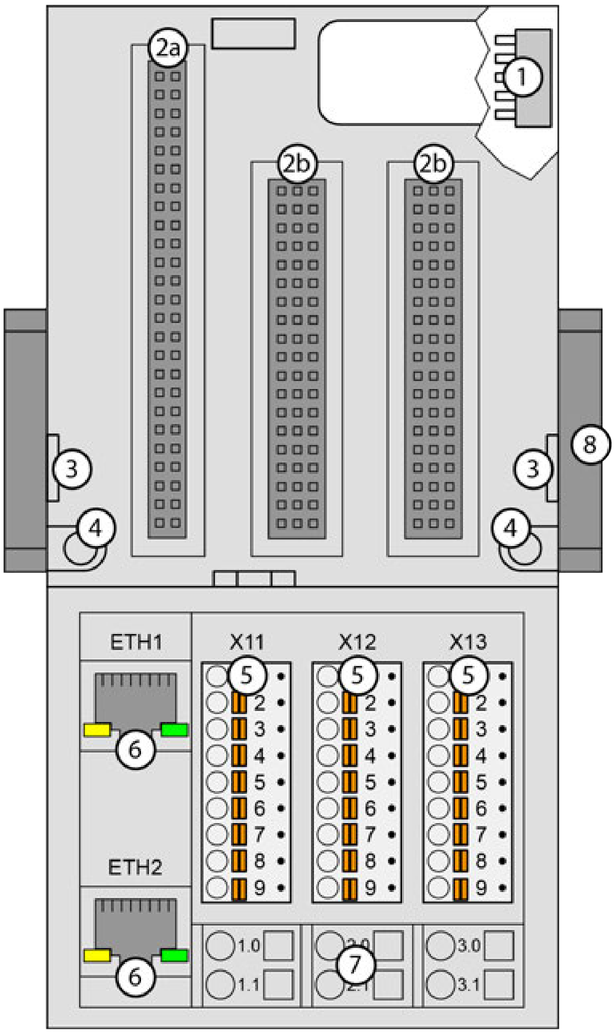
5.7.3.3 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 211 400 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.*

5.7.4 TU520-ETH for PROFINET communication interface modules

- TU520-ETH, 2 RJ45 interfaces for connection to PROFIBUS network, 3 removable connectors for bus systems
- TU520-ETH-XC, 2 RJ45 interfaces for connection to PROFIBUS network, 3 removable connectors for bus systems, XC version



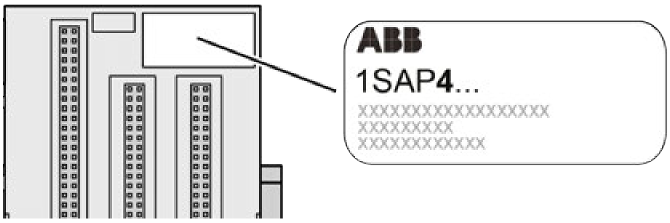
1 I/O bus (10 pins, female) to connect the first terminal unit
2a Plug (2 25 pins) to connect the inserted PROFINET communication interface module
2b Plug (3 19 pins) to connect the inserted PROFINET communication interface module
3 With a screwdriver, inserted in this place, the PROFINET I/O terminal 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

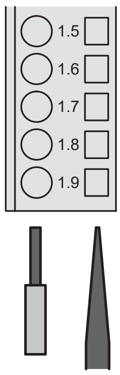
XC = e**X**treme **C**onditions



> ***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 1191*.

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 and 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).

5.7.4.1 Technical data

The system data of AC500 and S500 are applicable to the standard version ⇘ *Chapter 4.2 “System data AC500” on page 30*.

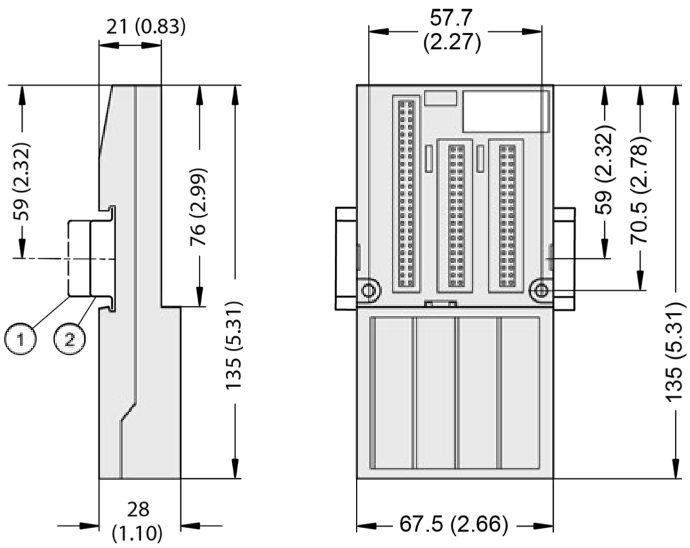
The system data of AC500-XC are applicable to the XC version ⇘ *Chapter 4.3 “System data AC500-XC” on page 35*.

Only additional details are therefore documented below.

The technical data are 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

5.7.4.2 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 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

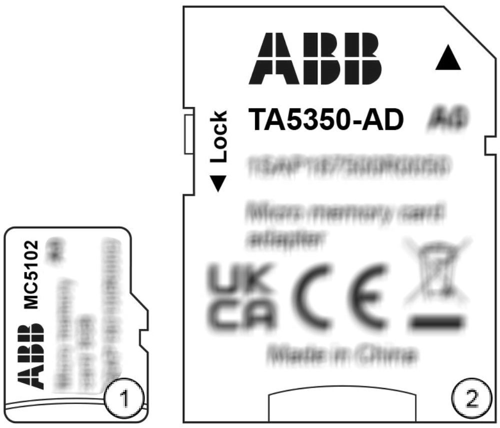
**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

5.8 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-eCo V2 [3])	AC500 V3	AC500-XC V3	AC500-eCo V3
MC5141	x	x	x	x	x	-
MC5102 **with** TA5350-AD micro memory card adapter	x [1])	x [1]) [2])	x [1])	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.

[3]) A memory card can only be inserted when a MC503 memory card adapter is installed in the processor module.

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.

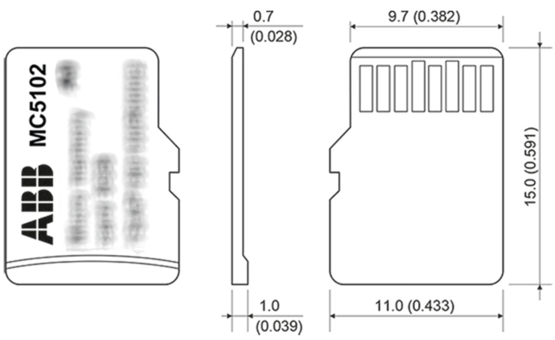
The micro memory card is used to store or backup application data and/or application programs or project source codes as well as to update the internal CPU firmware.

The micro memory card can only be used temporarily in standard and XC applications.

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.

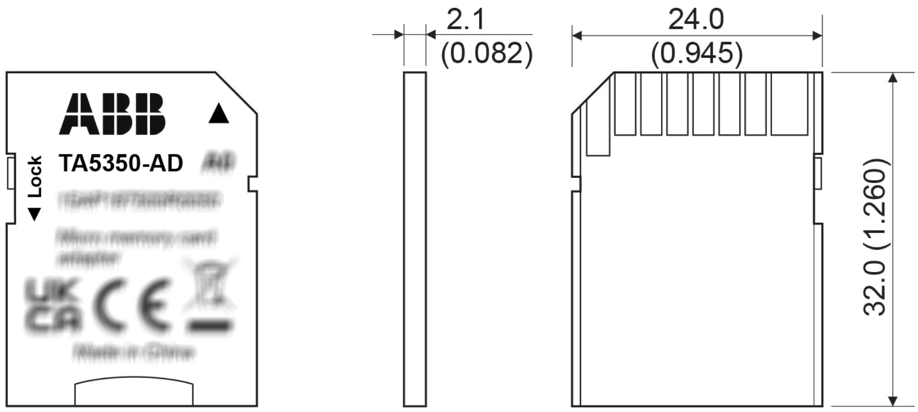
Dimensions

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 V3

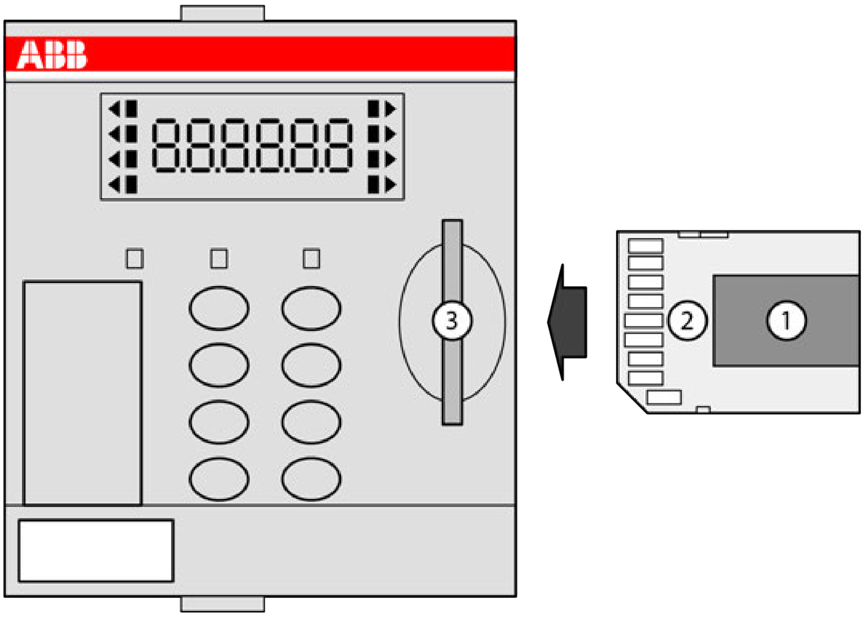
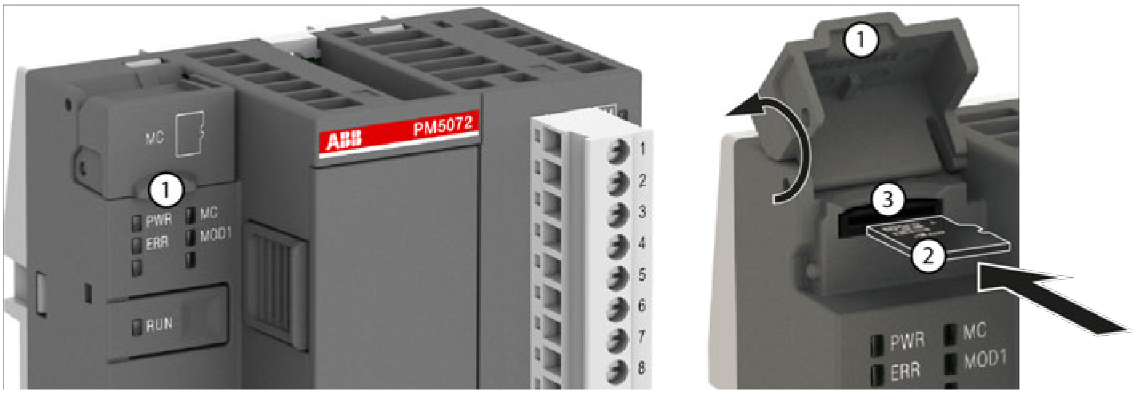


Fig. 236: Insert micro memory card into PM56xx

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 V3



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 V3: Remove the micro memory card only when no black square (■) is shown next to MC in the display.
– AC500-eCo V3: Remove the micro memory card only when the MC LED is not blinking.

AC500 V3

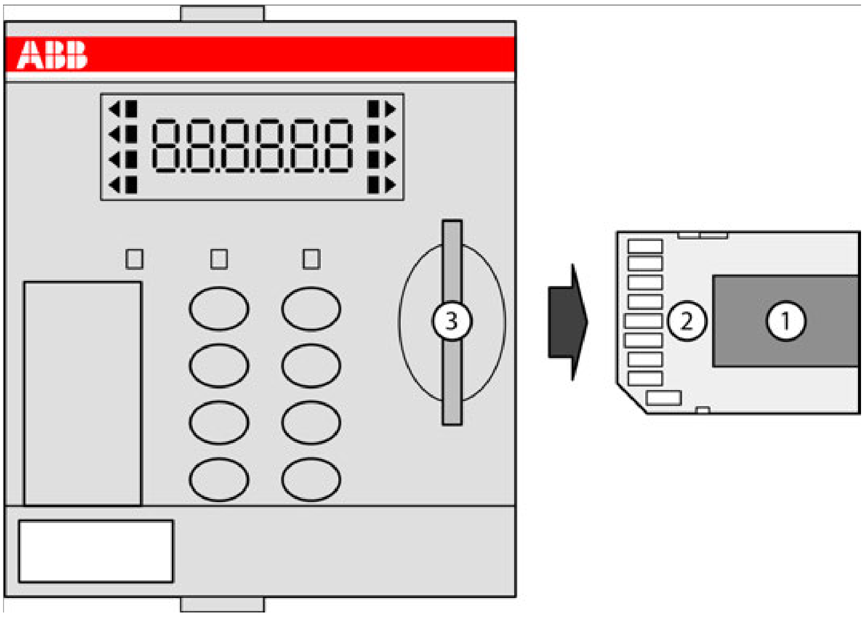


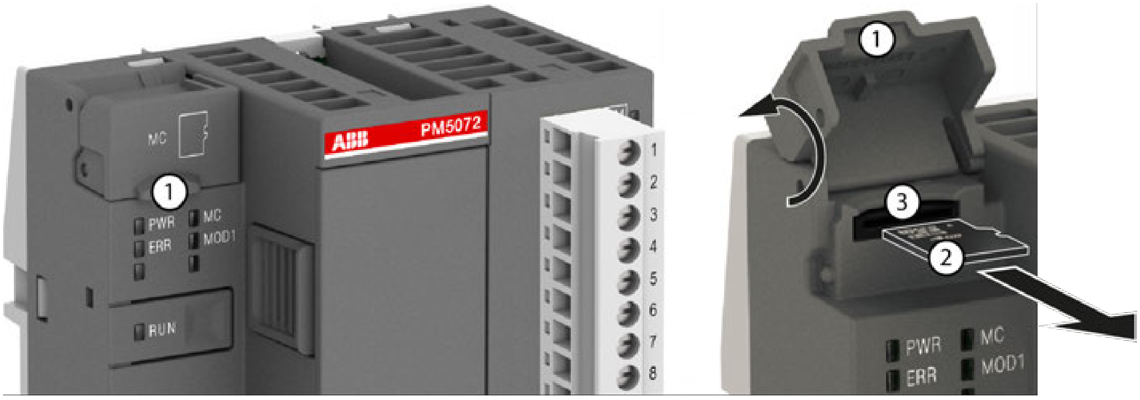
Fig. 237: Remove micro memory card from PM56xx

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 V3

> **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
Total bytes written (TBW)	On request
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.*

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 TA52xx(-x) - Terminal block sets

Intended purpose

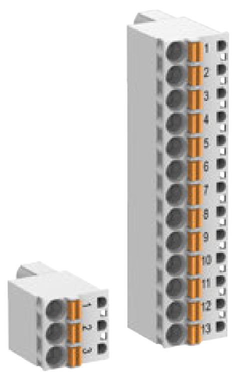
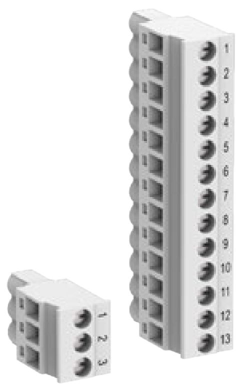
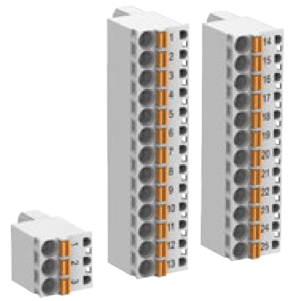
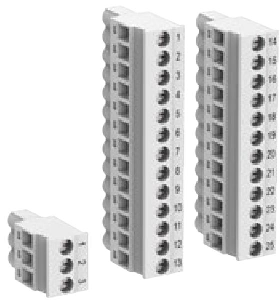
Removable terminal blocks are used for power supply and for I/O connectors on AC500-eCo V3 processor modules PM50x2.

For option boards there are different removable terminal blocks in spring version.

For the AC500-eCo V3 **Basic CPUs** a 3-pin terminal block for power supply and a 13-pin terminal block for I/O connectors are used.

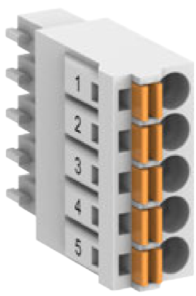
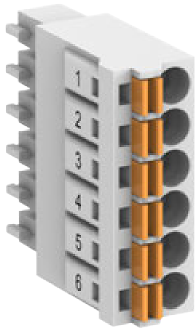
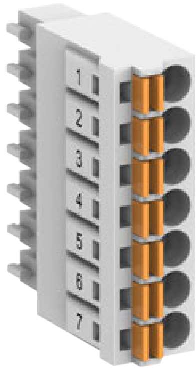
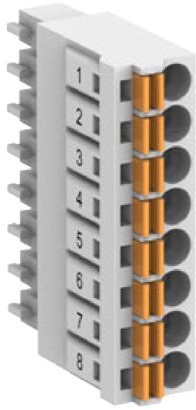
For the AC500-eCo V3 **Standard CPUs** and **Pro CPUs** a 3-pin terminal block for power supply, a 13-pin terminal block and a 12-pin terminal block for I/O connectors are used.

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*

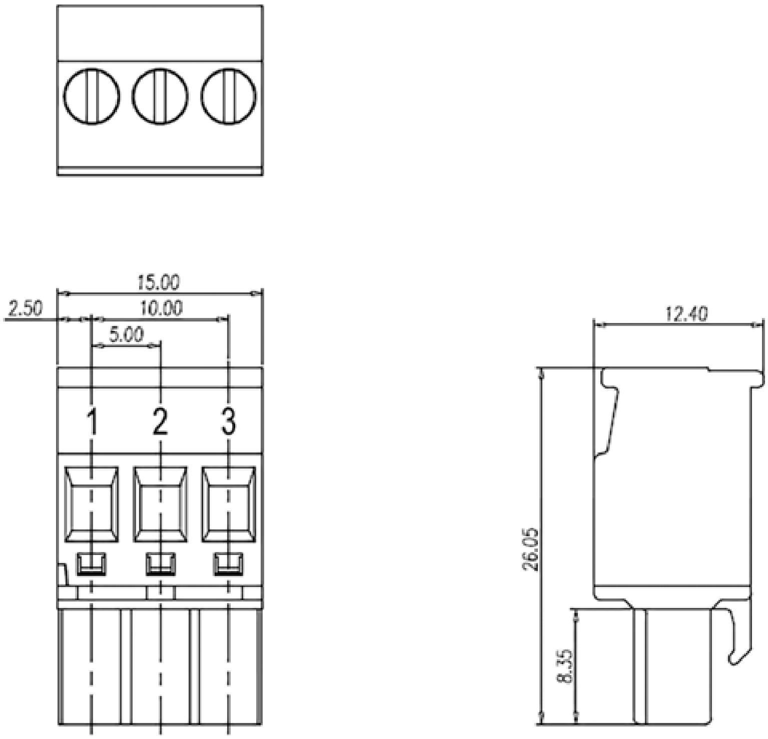
Spring terminal block set:

– *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*

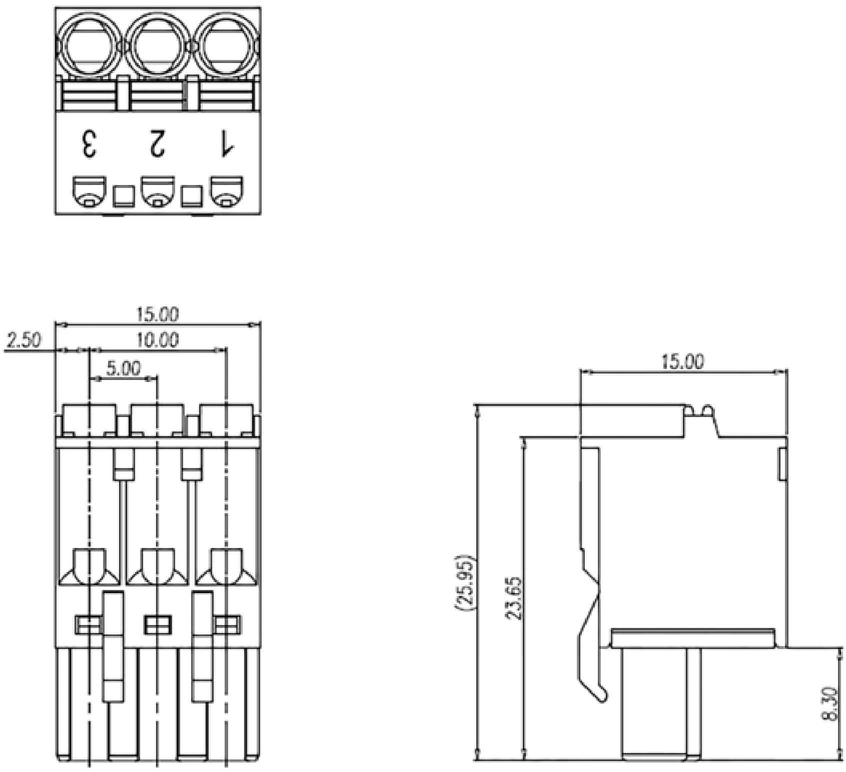
Dimensions

3-pin terminal block for power supply

Screw terminal

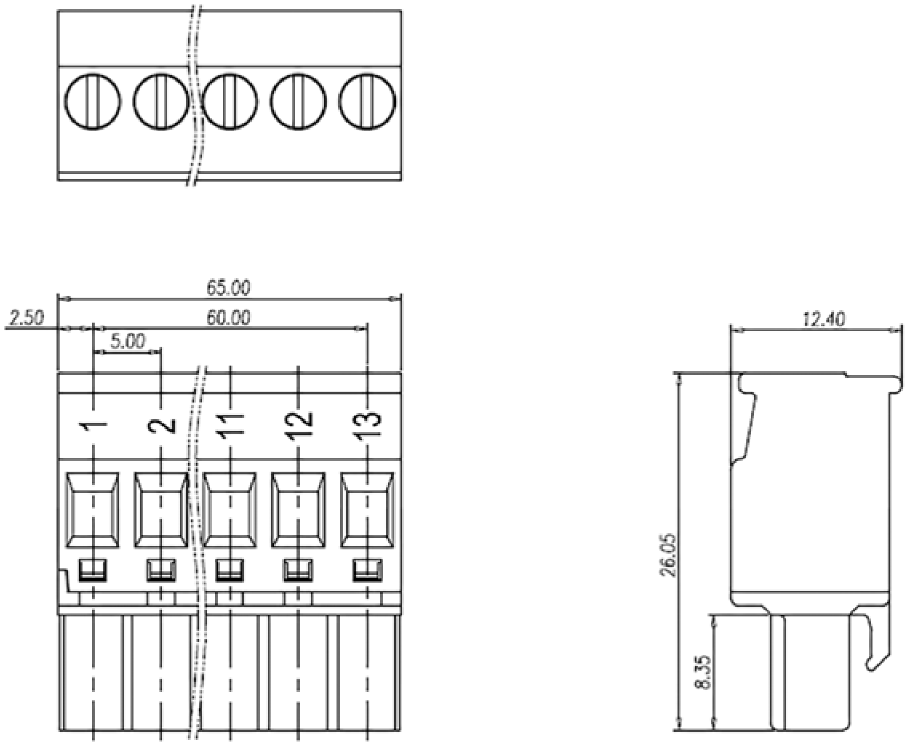


Spring terminal

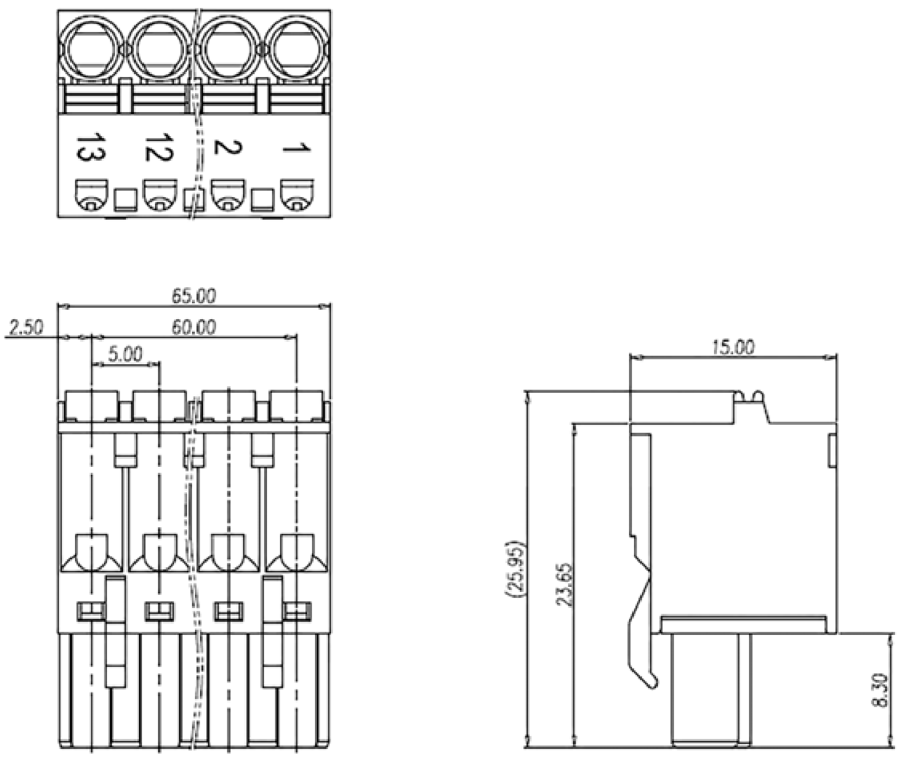


13-pin terminal block for I/O connectors

Screw terminal

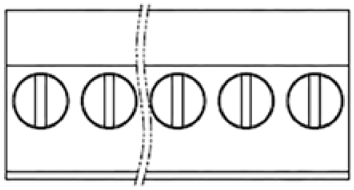


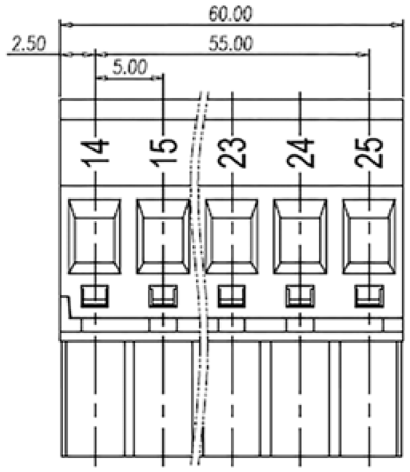
Spring terminal

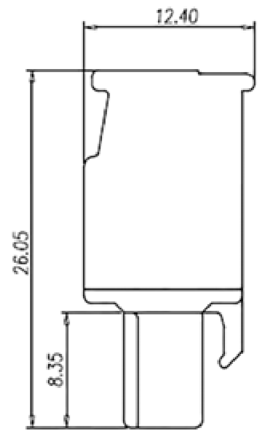


12-pin terminal block for I/O connectors

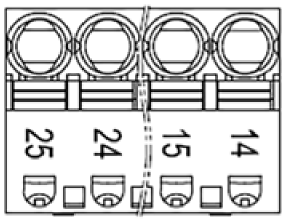
Screw terminal

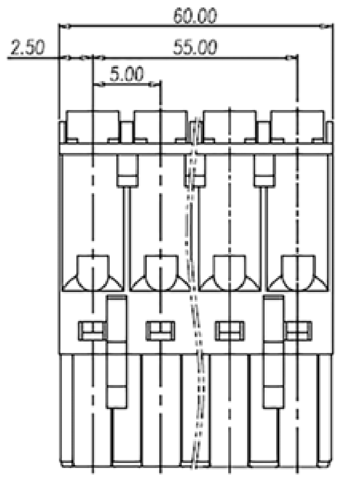


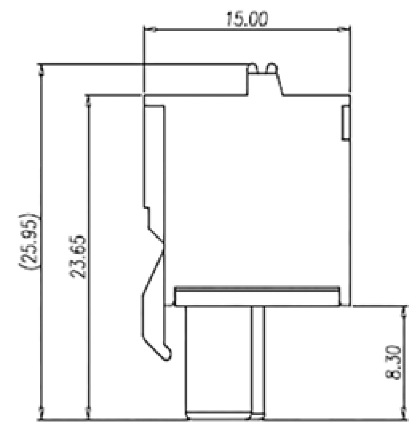




Spring terminal

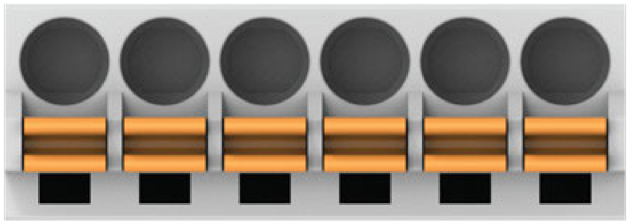


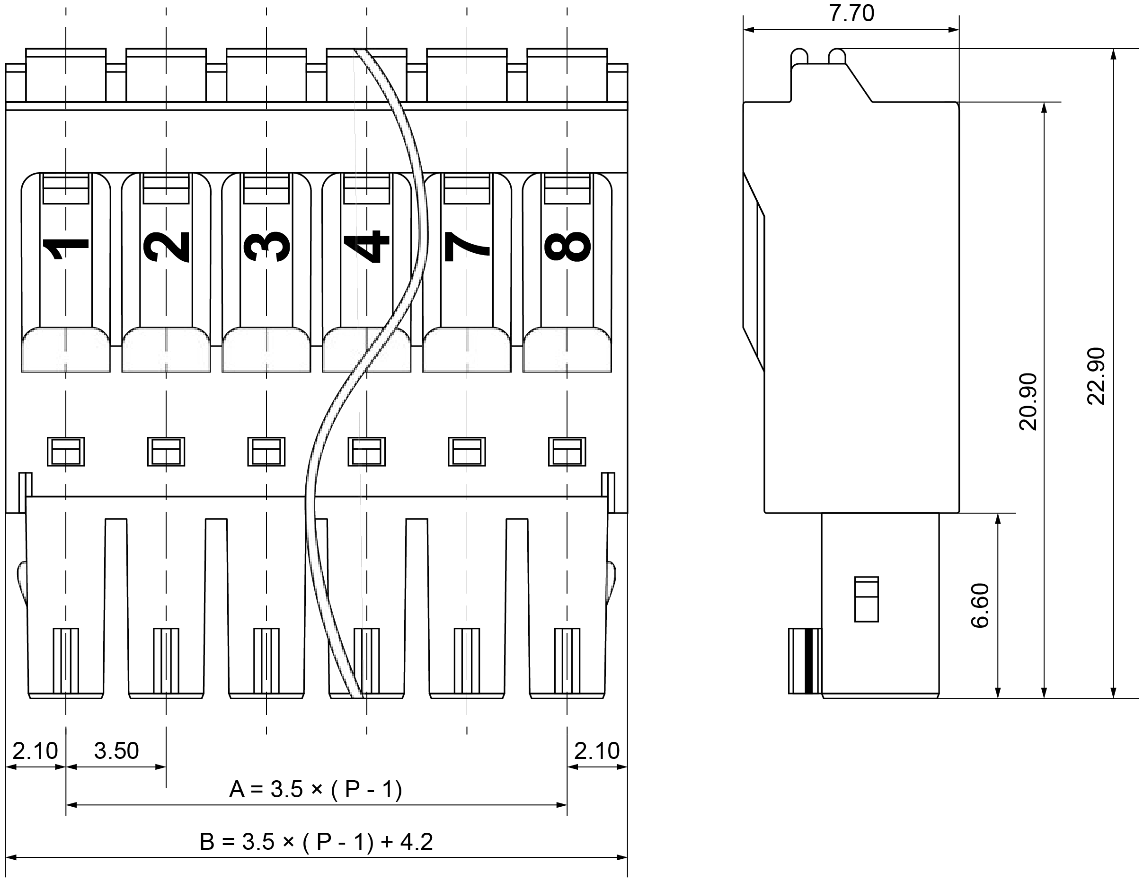




x-PIN terminal blocks for option boards

> *Only these x-pin terminal blocks are available for the option boards.*
>
> *TA5220-SPF**x**, with **x** = 5 ... 8*

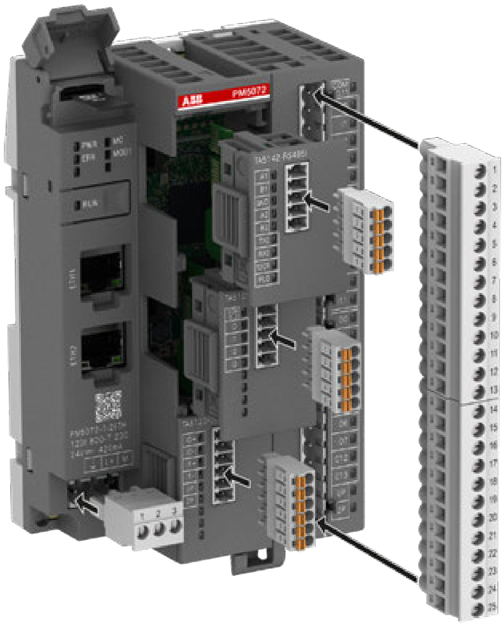




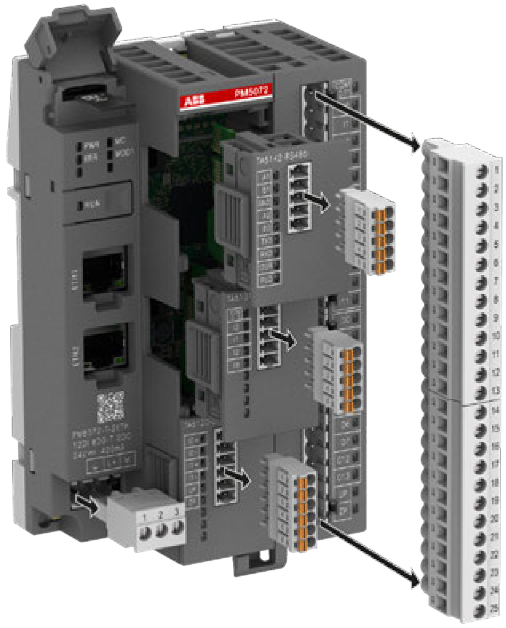
This results in these dimensions for the available spring terminal blocks.

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 277: 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 V3 processor modules
Conductor cross section		
	Solid (copper)	0.5 mm² ... 2.5 mm²
	Flexible (copper)	0.5 mm² ... 2.5 mm²
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 278: 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 V3 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 279: 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 V3 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 280: 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 V3 processor modules
Conductor cross section		
	Solid (copper)	0.5 mm² ... 2.5 mm²
	Flexible (copper)	0.5 mm² ... 2.5 mm²
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 281: 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 V3 option boards
Conductor cross section		
	Solid (copper)	0.2 mm² ... 1.5 mm²
	Flexible (copper)	0.2 mm² ... 1.5 mm²
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

Part no.	Description
1SAP 187 400 R0001	TA5211-TSCL-B: screw terminal block set for AC500-eCo V3 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 V3 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

Part no.	Description
1SAP 187 400 R0004	TA5212-TSCL: screw terminal block set for AC500-eCo V3 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 V3 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

Part no.	Description
Spare parts	
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

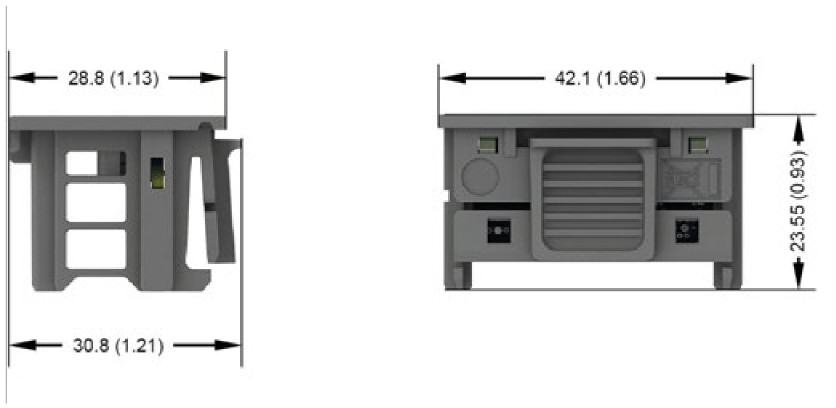
5.8.1.3 TA5300-CVR - Option board slot cover

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.

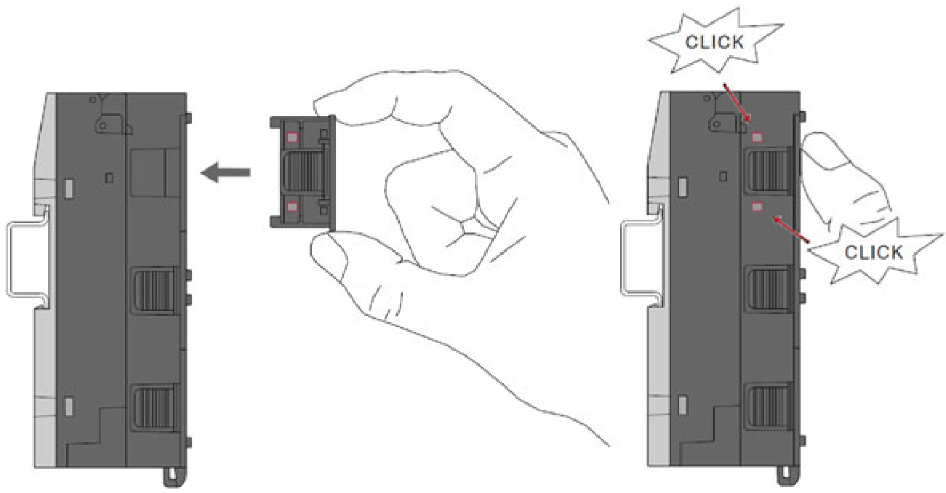
> *The AC500-eCo V3 processor modules are delivered with option board slot cover(s).*
>
> *The option board slot cover has to be removed before inserting an option board.*
>
> *The TA5300-CVR option board slot covers are available as spare parts.*

Dimensions



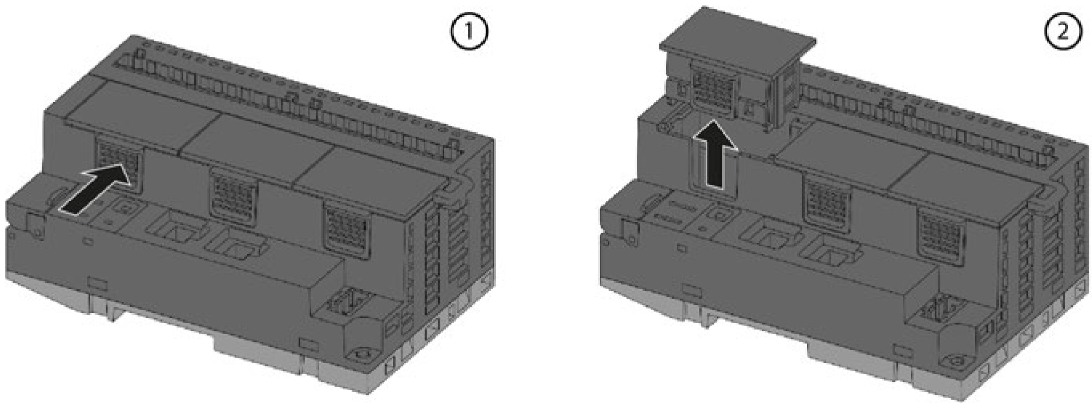
> *The dimensions are in mm and in brackets in inch.*

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 V3 apply ↬ *Chapter 4.1 “System data AC500-eCo” on page 23*

Only additional details are therefore documented below.

Parameter	Value
Weight	47 g
Dimensions	42.1 mm x 30.8 mm x 23.55

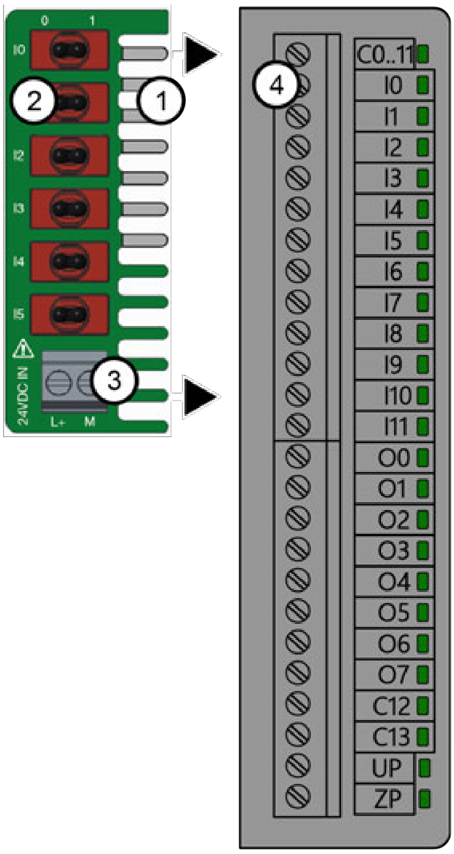
Ordering data

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 V3 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 V3 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:

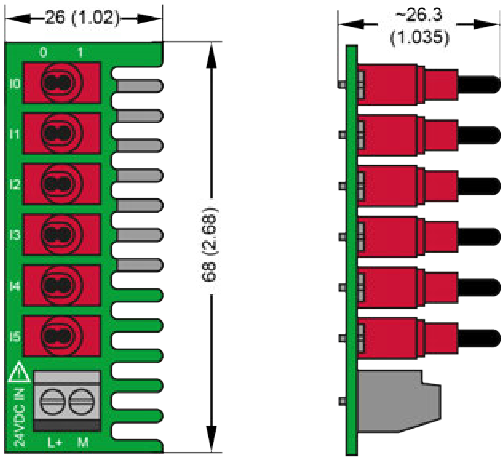
- *temperature*
- *air pressure*
- *humidity*
- *altitude*

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.

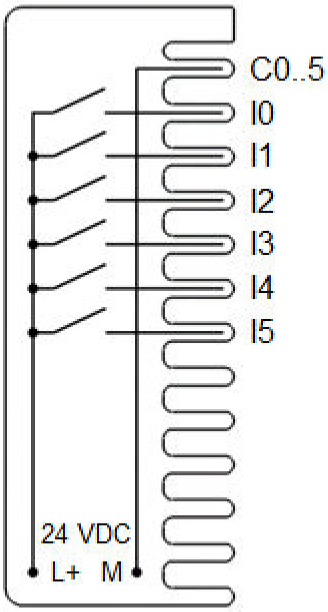
Dimensions



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 you start working on the system.

Never connect voltages > 24 V DC to the terminal block of the TA5400-SIM input simulator.

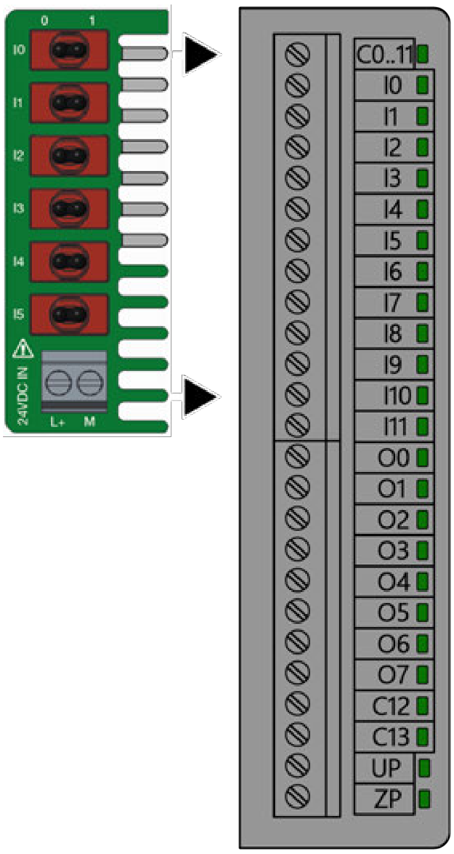
CAUTION!
Risk of damaging the input simulator and/or PLC modules!
The TA5400-SIM input simulator may only be used with AC500-eCo V3 processor modules PM50x2.

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 50*.

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 you start 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 V3 apply *Chapter 4.1 "System data AC500-eCo" on page 23*

Only additional details are therefore documented below.

Table 282: 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

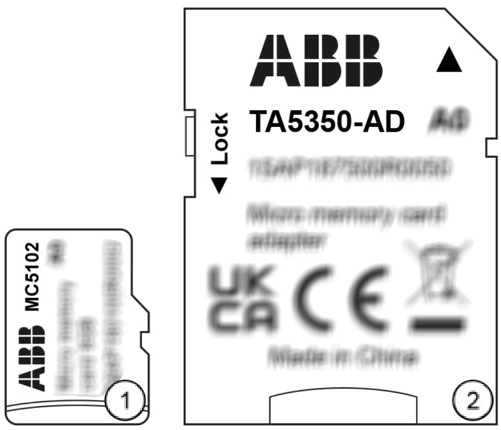
Part no.	Description	Product life cycle phase *)
1SAP 187 600 R0001	TA5400-SIM, input simulator for PM50x2	Active

**) 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-eCo V2 3)	AC500 V3	AC500-XC V3	AC500-eCo V3
MC5141	x	x	x	x	x	-
MC5102 **with** TA5350-AD micro memory card adapter	x 1)	x 1) 2)	x 1)	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.

3) A memory card can only be inserted when a MC503 memory card adapter is installed in the processor module.

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.

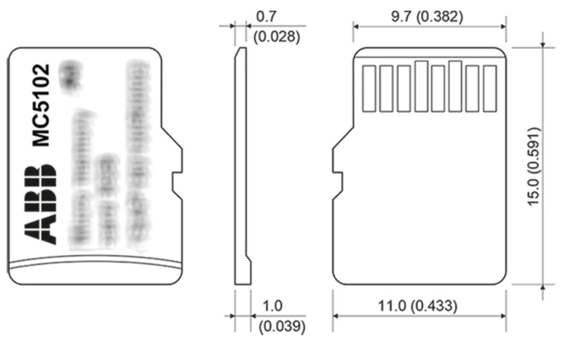
The micro memory card is used to store or backup application data and/or application programs or project source codes as well as to update the internal CPU firmware.

The micro memory card can only be used temporarily in standard and XC applications.

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.

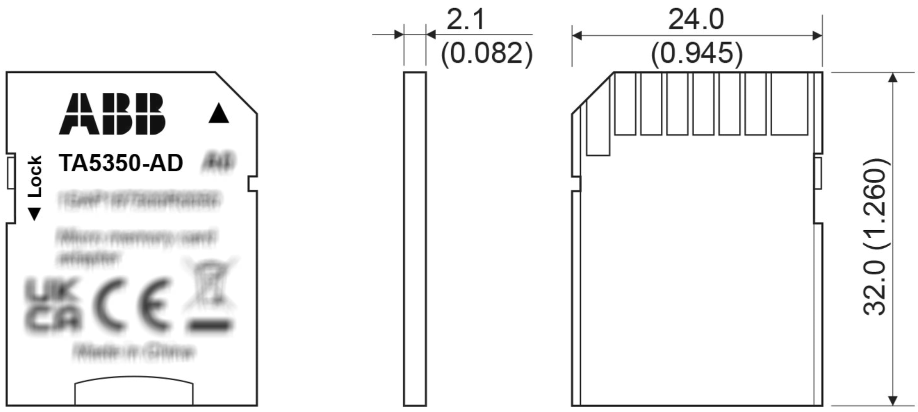
Dimensions

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 V3

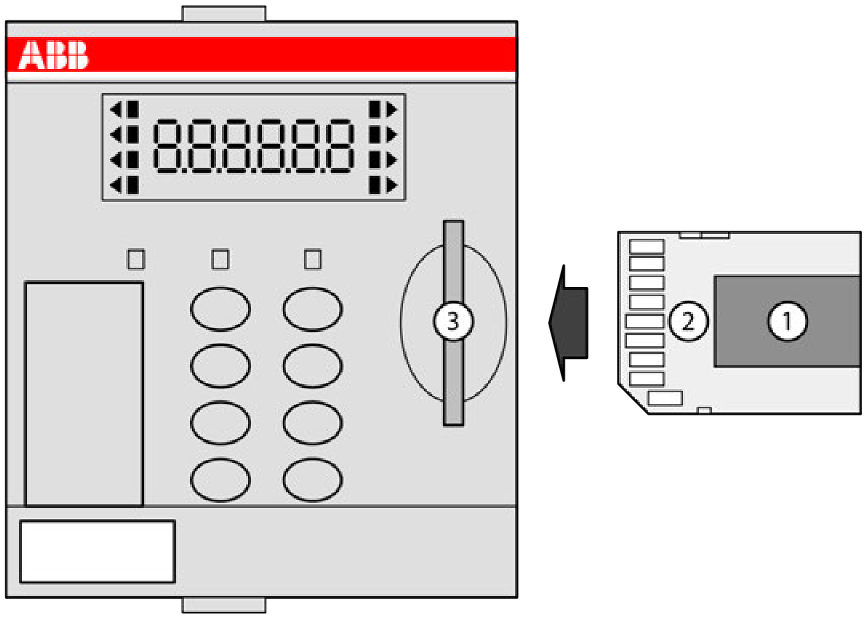
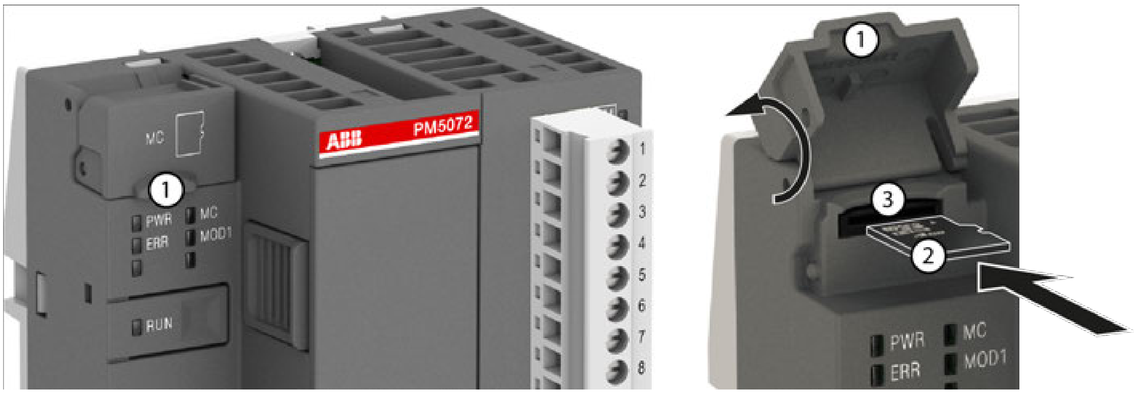


Fig. 238: Insert micro memory card into PM56xx

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 V3



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 V3: Remove the micro memory card only when no black square (■) is shown next to MC in the display.
> – AC500-eCo V3: Remove the micro memory card only when the MC LED is not blinking.

AC500 V3

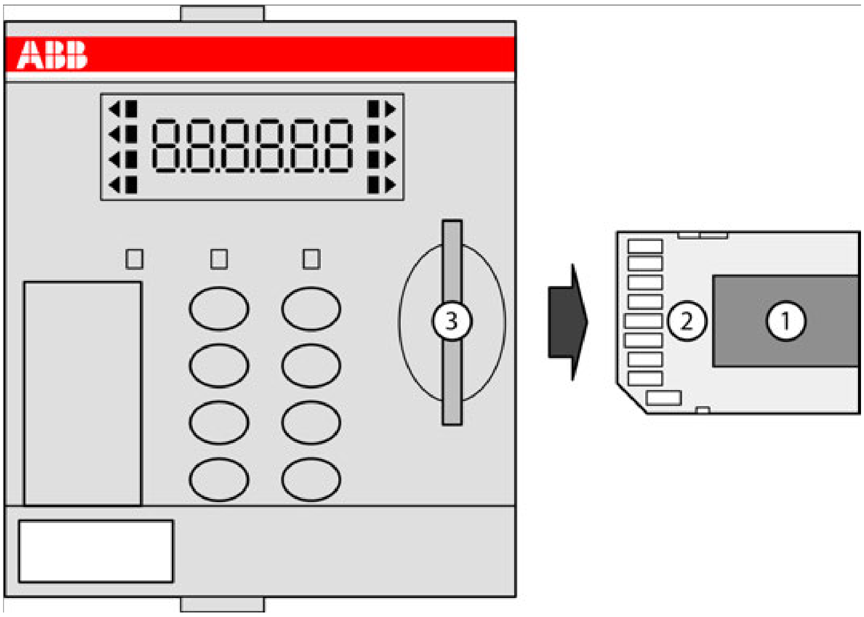


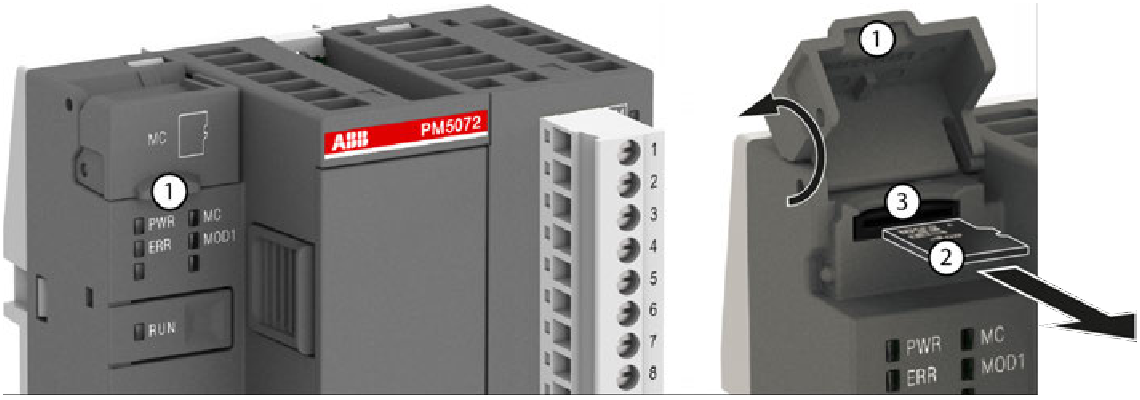
Fig. 239: Remove micro memory card from PM56xx

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 V3

> **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
Total bytes written (TBW)		On request
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.*

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-eCo V2 3)	AC500 V3	AC500-XC V3	AC500-eCo V3
MC5141	x	x	x	x	x	-
MC5102 **with** TA5350-AD micro memory card adapter	x 1)	x 1) 2)	x 1)	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.

3) A memory card can only be inserted when a MC503 memory card adapter is installed in the processor module.

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.

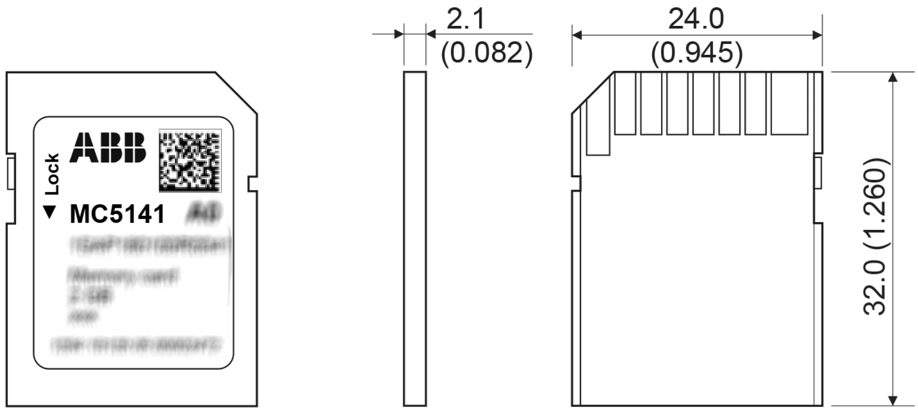
Processor modules are supplied without (micro) memory card. It must be ordered separately.

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

AC500 V3

1. Unpack the memory card.
2. Insert the memory card into the memory card slot of the processor module until locked.

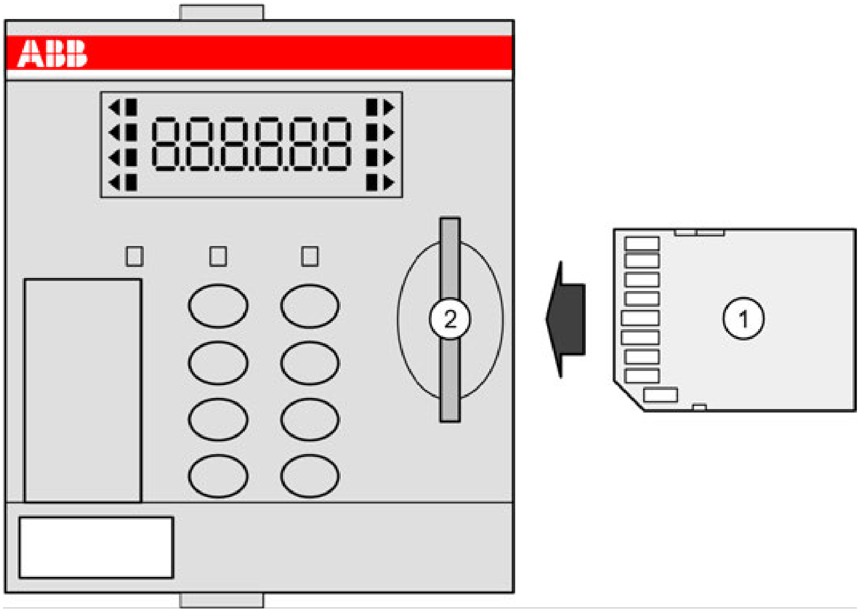


Fig. 240: Insert memory card into PM56xx

1 Memory card
2 Memory card slot

Remove the memory card

AC500 V3

> **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.

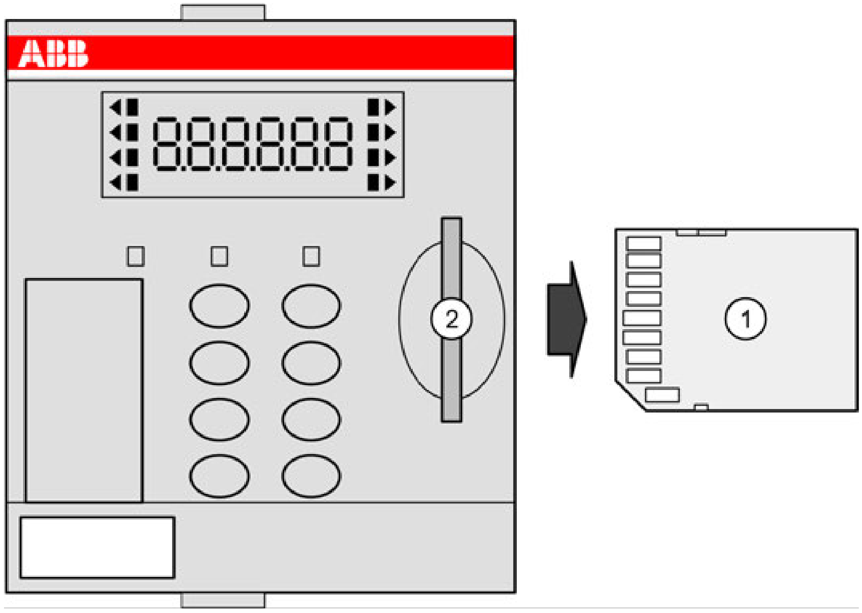


Fig. 241: Remove memory card from PM56xx

1 Memory card
2 Memory card slot

Technical data

Parameter	Value
Memory capacity	2 GB
Total bytes written (TBW)	On request
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.

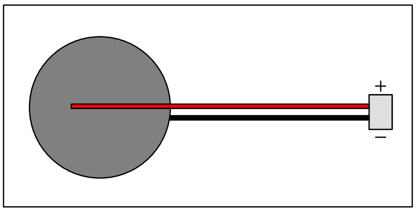
Ordering data

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 - Battery

- Manganese dioxide lithium battery, 3 V, 560 mAh
- Non-rechargeable



Purpose

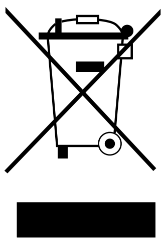
The TA521 battery is the only applicable battery for the AC500 processor modules ↯ *Chapter 5.1.2.2 “PM56xx-2ETH for AC500 V3 products” on page 179*. It cannot be recharged.

The processor modules are supplied without lithium battery. It must be ordered separately. The TA521 lithium battery is used for data (SRAM) and RTC buffering while the processor module is not powered.

The CPU monitors the discharge degree of the battery. A warning is issued before the battery condition becomes critical (about 2 weeks before). Once the warning message appears, the battery should be replaced as soon as possible.

Handling instructions

- Do not short-circuit or re-charge the battery! It can cause excessive heating and explosion.
- Do not disassemble the battery!
- Do not heat up the battery and not put into fire! Risk of explosion.
- Store the battery in a dry place.
- Replace the battery with supply voltage ON in order not to risk data being lost.
- Recycle exhausted batteries meeting the environmental standards.



Battery lifetime

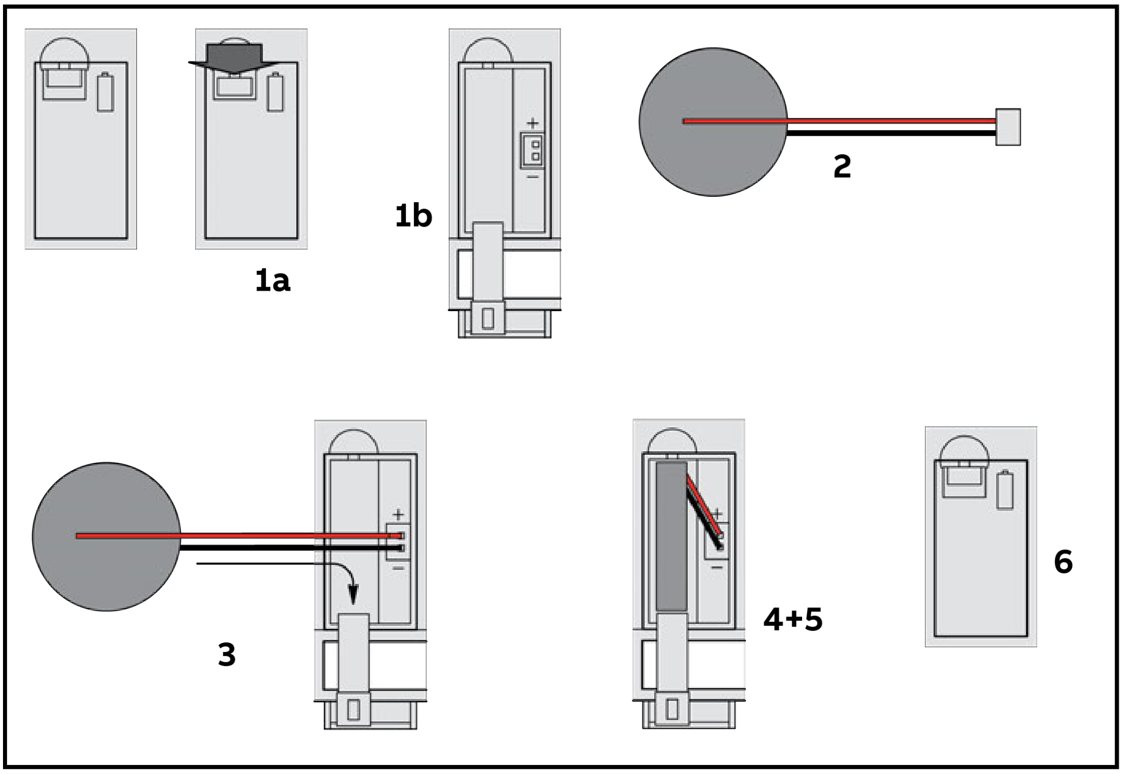
The battery lifetime is the time, the battery can store data while the processor module is not powered. As long as the processor module is powered, the battery will only be discharged by its own leakage current.

> *To avoid a short battery discharge, the battery should always be inserted or replaced while the process module is under power, then the battery is correctly recognized and will not shortly discharged.*

Insertion

> *To ensure propper operation and to prevent data loss, the battery insertion or replacement must be always done with the system under power. Without battery and power supply there is no data buffering possible.*

WARNING!
Risk of fire or explosion!
Use of incorrect Battery may cause fire or explosion.



1. Open the battery compartment with the small locking mechanism, press it down and slip down the door. The door is attached to the front face of the processor module and cannot be removed.
2. Remove the TA521 battery from its package and hold it by the small cable. Remove then the small connector from the socket, do this best by lifting it out with a screwdriver.
3. Insert the battery connector 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 battery 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.

In order to prevent data losses or problems, the battery should be replaced after 3 years of utilisation or at least as soon as possible after receiving the "low battery warning" indication.

Do not use a battery older than 3 years for replacement, do not keep batteries too long in stock.

Replacement of the battery

To ensure propper operation and to prevent data loss, the battery insertion or replacement must be always done with the system under power. Without battery and power supply there is no data buffering possible.

1. Open the battery compartment with the small locking mechanism, press it down and slip down the door. The door is attached to the front view of the processor module and cannot be removed.
2. Remove the old TA521 battery from the battery 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.

3. Follow the previous instructions to insert a new battery.

CAUTION!
Risk of explosion!
Do not open, re-charge or disassemble lithium batteries. Attempting to charge lithium batteries 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 lithium batteries with the polarities reversed. The batteries are likely to overheat and explode. Avoid unintentional short circuiting do not store batteries in metal containers and do not place them on metallic surfaces. Escaping lithium is a health hazard.

In order to prevent data losses or problems, the battery should be replaced after 3 years of utilisation or at least as soon as possible after receiving the "low battery warning" indication.

Do not use a battery older than 3 years for replacement, do not keep batteries too long in stock.

Technical data

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

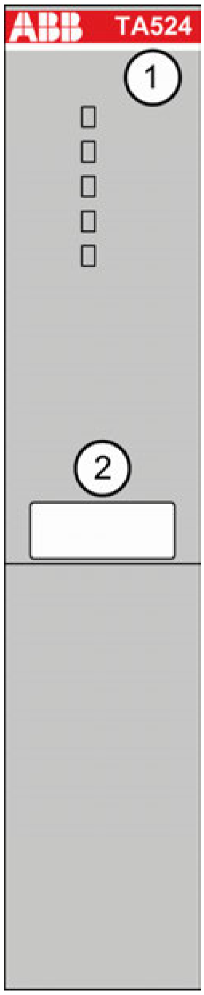
Parameter	Value
Temperature range (index C0 and above)	Operating: -40 °C ... +70 °C Storage: -40 °C ... +85 °C Transport: -40 °C ... +85 °C
Battery lifetime	Typ. 3 years at +25 °C
Self-discharge	2 % per year at +25 °C 5 % per year at +40 °C 20 % per year at +60 °C
Protection against reverse polarity	Yes, by mechanical coding of the plug.
Insulation	The battery is completely insulated.
Connection	Red = positive pole = above at plug, black = negative pole,
Weight	7 g
Dimensions	Diameter of the button cell: 24.5 mm Thickness of the button cell: 5 mm

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 180 300 R0001	TA521, lithium battery	Active

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

5.8.2.4 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 “TB56xx for AC500 V3 products” on page 235

Handling instructions

TA524 is mounted in the same way as a common communication module.

Technical data

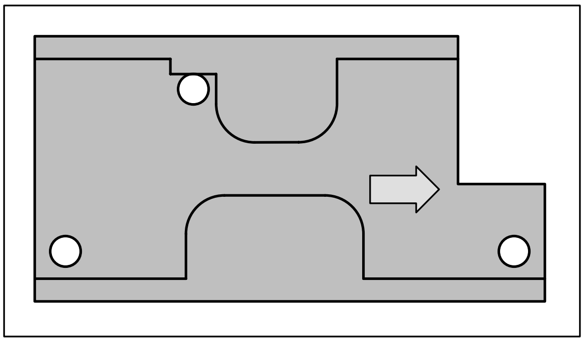
Parameter	Value
Weight	50 g
Dimensions	135 mm x 28 mm x 62 mm

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.*

5.8.2.5 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 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 283: 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.

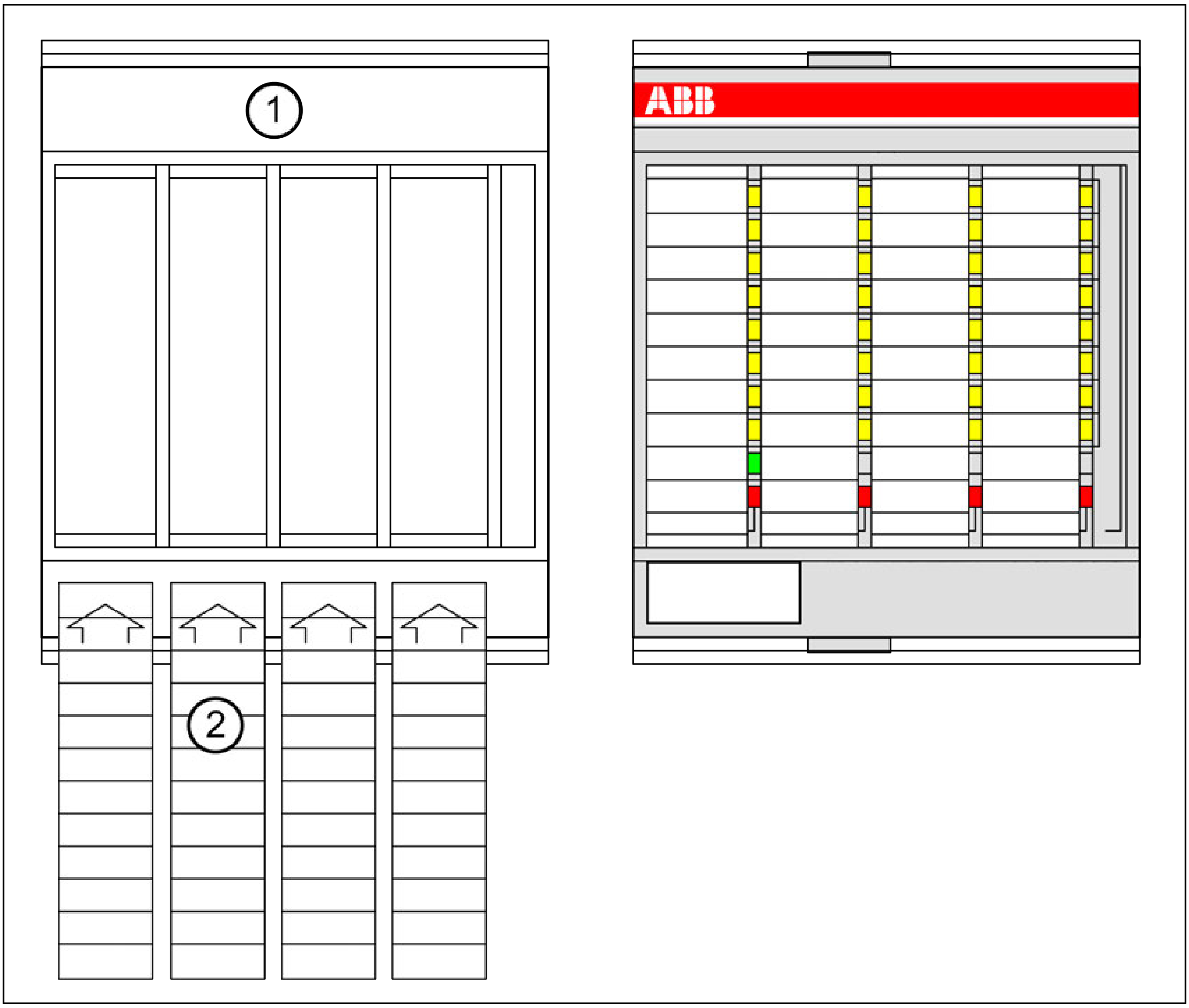
- Typical efficiency of up to 94 %
- Power reserve design delivers up to 150 % of the nominal output current
- Signaling outputs for DC OK and power reserve mode
- High power density leads to very compact and small devices
- No-load-proof, overload-proof, continuous short-circuit-proof
- Active power factor correction (PFC)

Table 284: 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'*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

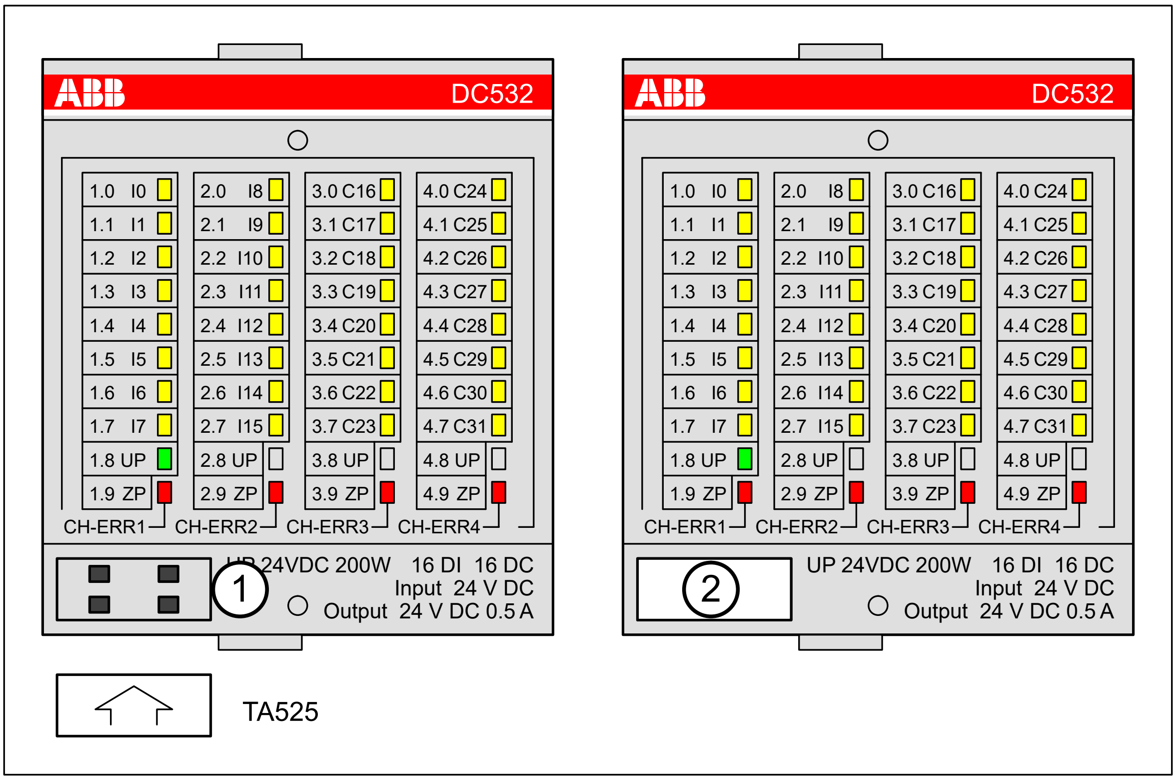
Ordering data

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

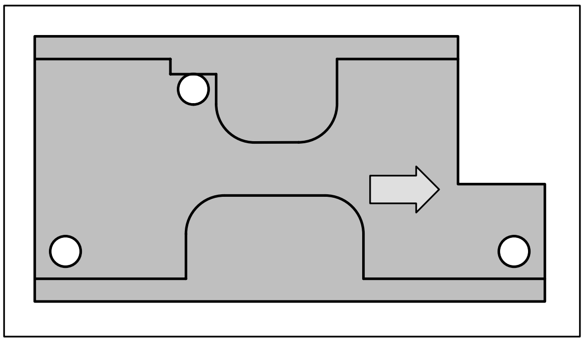
Parameter	Value
Disassembly	With a small screwdriver
Scope of delivery	10 pieces
Weight	1 g per piece
Dimensions	8 mm x 20 mm x 5 mm

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	Battery-buffered device, non-volatile RAM Used for retain/ persistent and ProzM 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	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.

5.9.3 Memory sizes

AC500-eCo V3 processor modules

PLC type	system RAM disk	userdisk PlcLogic ...	Retain, ProzM area	flash disk	memory card
PM5012-x-ETH	Dynamically /max. 7.6 MB	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) ProzM 4 kB	None	*Chapter 5.8.2.1 “MC5102 - Micro memory card with adapter” on page 1168*
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) ProzM 16 kB		
PM5052-x-ETH					
PM5072-T-2ETH(W) PM5082-T-2ETH			100 kB Retain and persistent 36 kB (of which 88 byte are reserved for allocation table and are not available to the user) ProzM 64 kB		

AC500 V3 processor modules

PLC type	system RAM disk	userdisk PlcLogic ...	SRAM Retain, ProzM area	flash disk	memory card
PM5630-2ETH	Dynamically /max. 7.6 MB	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) ProzM 128 kB	None	➔ *Chapter 5.8.2.2 “MC5141 - Memory card” on page 1174* ➔ *Chapter 5.8.2.1 “MC5102 - Micro memory card with adapter” on page 1168*
PM5650-2ETH	Dynamically /max. 16 MB	246 MB (as of V3.0.x) 381 MB (as of V3.1) 285.75 (as of V3.4.0)			
PM5670-2ETH	Dynamically /max. 69 MB	858 MB 643.50 MB (as of V3.4.0)	1536 MB 1 MB retain and persistent (of which 68 byte are reserved for allocation table and are not available to the user) 512 kB ProzM		
PM5675-2ETH				8 GB	

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

This section contains some details on each storage device.

➔ *Further details on the storage device sizes*

5.9.4.1 SRAM

The SRAM is a battery-buffered, nonvolatile RAM and is used for the retain/persistent and the ProzM 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 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 V3 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 285: 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

For monitoring the status

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.

- Max. write speed is 20 MB/s (continuous write of sequential data)
- Read cycles are unlimited.

5.9.4.3 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 1194*

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.

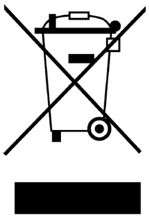
5. If available, remove memory card and battery from CPU.
6. Delete all user accounts and user data.

7. Demount and dispose the hardware modules.

Chapter 7 “Recycling” on page 1199

> *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-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-eCo CPUs
AC500 V3	Range of AC500 and AC500-eCo CPUs
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 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)
  - PERSISTENT area (%R area)
- 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 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 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 ≥ 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 (%M, area, %R area, RETAIN, RETAIN PERSISTENT), 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.

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