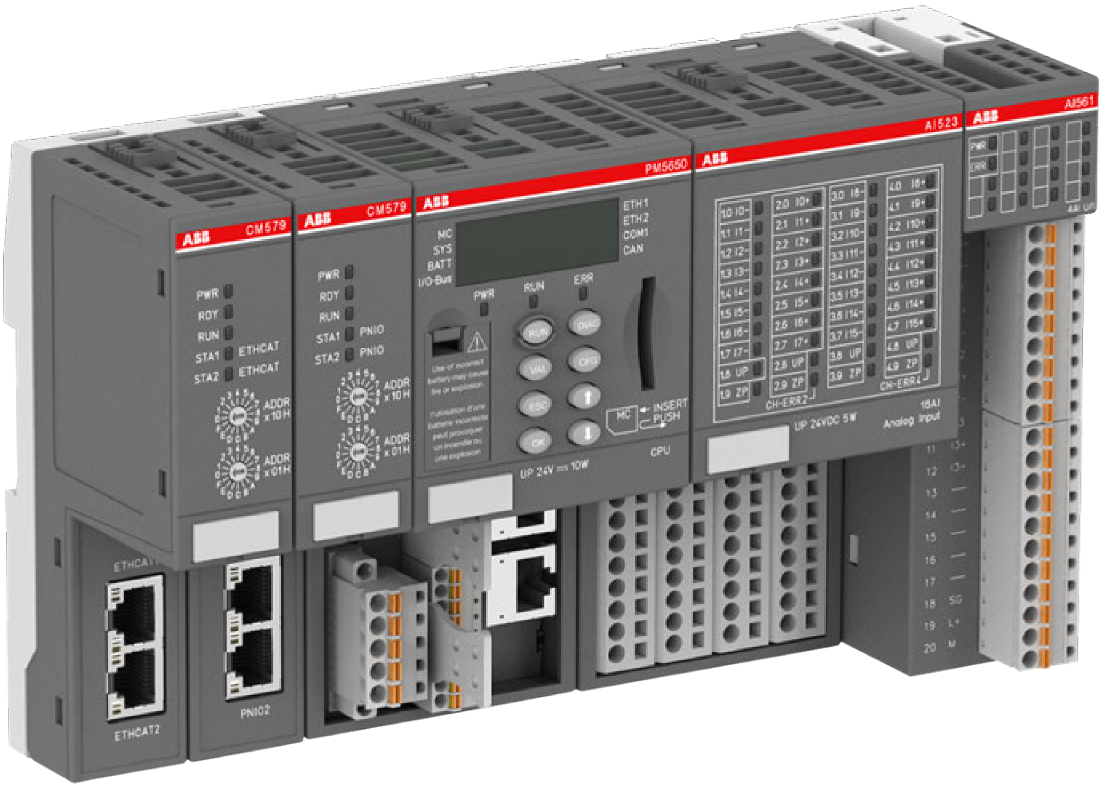
HARDWARE MANUAL

PLC Automation

System assembly and device specifications

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



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1 Device specifications

1.1 Status LEDs, display and control elements

Depending on the device type, various operating elements provided on the front panel can be used to control the devices of the PLC system and/or to change the operating mode.

Operating elements:

- Status LEDs:
  Indicates the availability of devices/components such as communication modules, communication interface modules or function modules. Functionality and diagnosis of the status LEDs depends on the specific module and is described in the device description of the appropriate module. Possible status: on/off/blinking
- I/O LEDs:
  Displays the status of the the inputs and outputs.
- LED display:
  Available for some processor modules. It can be used for simple configurations and for reading out diagnosis information.
- Function keys and switches:
  Allows to change the current operating modes/status manually .

1.2 Terminal bases (AC500 standard)

AC500-eCo V3 processor modules do not have a separate terminal base

1.2.1 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

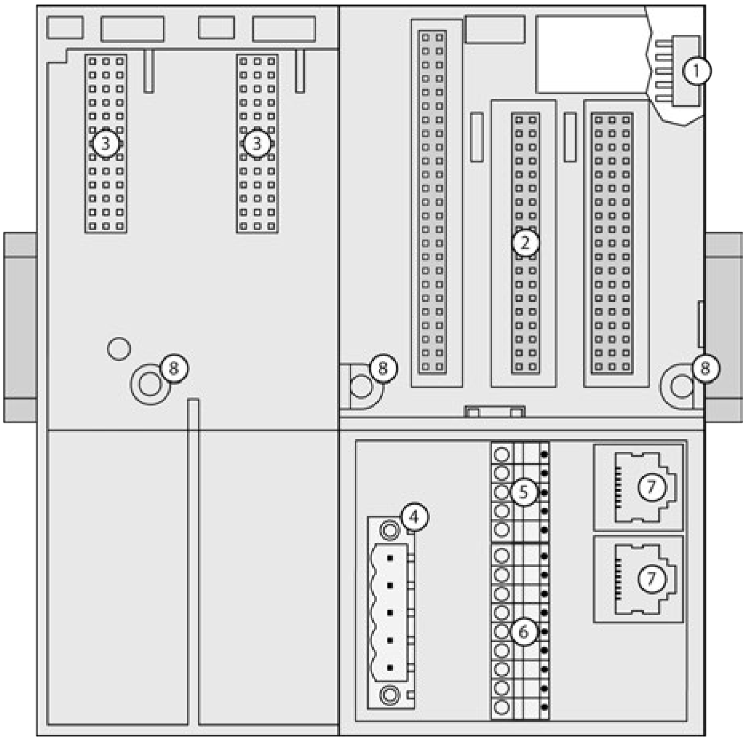
Terminal bases TB56xx-2ETH can only be used with processor modules PM56xx-2ETH.

Table 1: 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

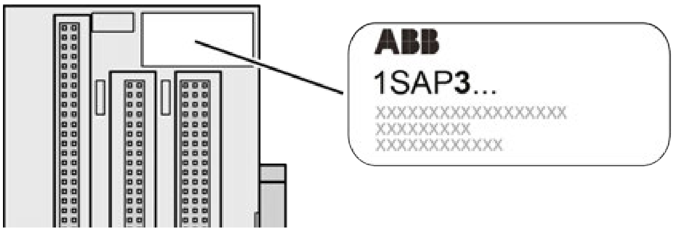
Processor module	PM5630	PM5650	PM5670	PM5675
TB5640-2ETH	-	4 slots	4 slots	4 slots
TB5660-2ETH	-	-	6 slots [1])	6 slots [1])
Remarks: The slots can be used for connecting communication modules or AC500-S modules. Note that only one AC500-S module can be connected at one terminal base. [1]) PM567x must 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.*

1.2.1.1 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 2: 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 1.8.2.5 “TA524 - Dummy communication module” on page 901*.
>
> – I/O bus connectors must not be touched during operation.

1.2.1.2 Connections

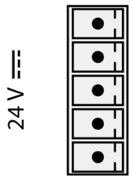
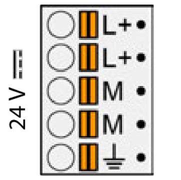
1.2.1.2.1 I/O bus

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 (see description for I/O bus in the system asembly chapter *Chapter 2.4.1 "Serial I/O bus" on page 911*).

1.2.1.2.2 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 processor module and terminal base!**
> Exceeding the maximum voltage could lead to unrecoverable damage to the system.
>
> The system might be destroyed.

> **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).

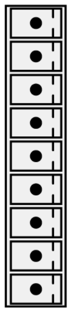
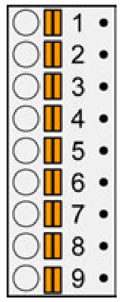
> **NOTICE!**
> **For applications using XC versions!**
> To ensure reliability and proper function, make sure the ambient temperature never exceeds 60 °C when the current flowing through the removable clamps is 8 A (with 1.5 mm^2 conductor).

1.2.1.2.3 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.

For further information on connection and wiring please refer to .

1.2.1.2.4 Ethernet interface

This interface is the connection to a processor module with onboard Ethernet e.g. PM56xx-2ETH.

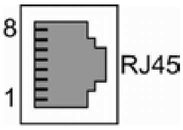
TB56xx-2ETH for processor modules PM56xx-2ETH provide 2 independent Ethernet interfaces.

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
	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 1.8.3.4 “TA535 - Protective caps for XC devices” on page 906*

See supported protocols and used Ethernet ports for AC500 V3 products: .

See communication via Modbus for AC500 V3 products: .

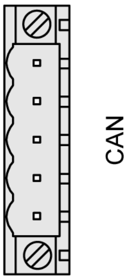
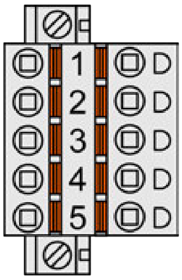
See communication via Modbus for AC500 V3 products: .

1.2.1.2.5 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. See ➪ *Chapter 2.6.4.6 “CANopen field bus” on page 995*.

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). See ➪ *Chapter 2.6.4.6 “CANopen field bus” on page 995*.

1.2.1.3 Technical data

The system data of AC500 and S500 are applicable to the standard version. ➪ *Chapter 2.6.1 “System data AC500” on page 971*

The system data of AC500-XC are applicable to the XC version. ➪ *Chapter 2.7.1 “System data AC500-XC” on page 1023*

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
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 3: 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.				

1.2.1.4 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
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 4: 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

Processor module	PM5630	PM5650	PM5670	PM5675
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 5: Accessories

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

1.3 Processor modules

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 data buffering. 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 involved in factory, process or machinery automation area.
- 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 condition. Further, the devices provide immunity to vibration and hazardous gases. The AC500-XC series is consistent with standard devices in the overall dimensions, control function and software compatibility. *Chapter 2.7.1 “System data AC500-XC” on page 1023*.

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 combined with devices of the AC500 product family in a flexible way.

1.3.1 AC500-eCo

1.3.1.1 PM50xx

The following table lists all AC500-eCo V3 CPUs with their most important properties.

Processor modules	Global user memory	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	2 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	2 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	4 MB thereof 768 kB for user program code and data dynamically allocated	2 (Transistor)	12	8 (Transistor)	24 V DC	1	3
PM5052-R-ETH	4 MB thereof 768 kB for user program code and data dynamically allocated	2 (Transistor)	12	6 (Relay)	24 V DC	1	3
Pro CPUs							

Processor modules	Global user memory	Configurable input/output	Digital inputs	Digital outputs	Power supply	Ethernet interfaces	Option board slots
PM5072-T-2ETH	8 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 *)	8 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

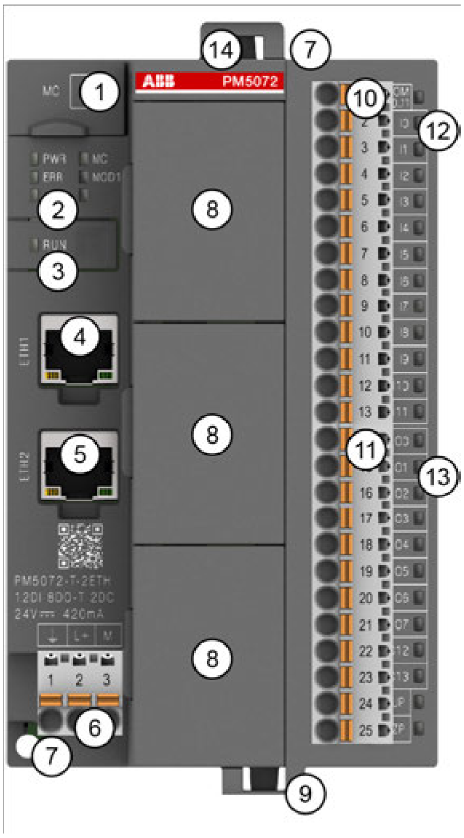


Fig. 1: Example: PM5072-T-2ETH

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 PM5072-T-2ETH(W))
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.

1.3.1.1.1 Short description

The processor modules PM50xx 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 PM5072-T-2ETH)
- 6 digital inputs (PM5012-x-ETH), 12 digital inputs (PM5032-x-ETH, PM5052-x-ETH, PM5072-T-2ETH)
- 4 transistor outputs (PM5012-T-ETH), 8 transistor outputs (PM5032-T-ETH, PM5052-T-ETH, PM5072-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 1.3.1.1.8 “Technical data” on page 46*.

1.3.1.1.2 Assortment

Processor module	Total maximum downloadable application size	Allocated global user memory for user program code and data	Cycle time for 1000 instructions [ns]	Numer digital inputs	Number digital outputs	Type of digital outputs	Configurable digital inputs/ outputs	Number of option board slots	Max. number of I/O modules on I/O bus
PM5012-T-ETH	1 MB	256 kB	Binary: 20 Word: 50 Floating: 600	6	4	Transistor	-	1	-
PM5012-R-ETH	1 MB	256 kB		6	4	Relay	-	1	-
PM5032-T-ETH	2 MB	512 kB		12	8	Transistor	2	2	10 with max. 128 Bytes inputs/ 128 Bytes outputs variables
PM5032-R-ETH	2 MB	512 kB		12	6	Relay	2	2	10 with max. 128 Bytes inputs/ 128 Bytes outputs variables
PM5052-T-ETH	4 MB	768 kB		12	8	Transistor	2	3	10
PM5052-R-ETH	4 MB	768 kB		12	6	Relay	2	3	10
PM5072-T-2ETH	8 MB	1 MB		12	8	Transistor	2	3	10
PM5072-T-2ETHW	8 MB	1 MB		12	8	Transistor	2	3	10

1.3.1.1.3 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 PM5072-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 .

Serial interface

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

- TA5141-RS232I (isolated)
  Chapter 1.3.1.2.6 "TA5141-RS232I - Option board for COMx serial communication" on page 75

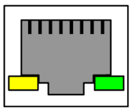
RS-485 communication interface is available by using option boards:

- TA5142-RS485I (isolated)
  Chapter 1.3.1.2.7 "TA5142-RS485I - Option board for COMx serial communication" on page 78
- TA5142-RS485 (non isolated)
  Chapter 1.3.1.2.8 "TA5142-RS485 - Option board for COMx serial communication" on page 84

Ethernet interface

The Ethernet interface is carried out via a RJ45 jack.

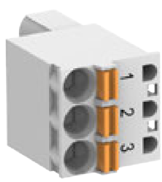
Table 6: Pin assignment of the Ethernet interface

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

1.3.1.1.4 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 7: Removable terminal block for the supply voltage 24 V DC

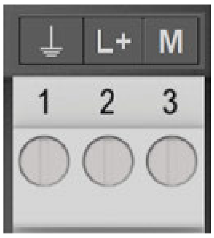
3-pin spring terminal block	3-pin screw terminal block
	

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)	
Spring type	**Screw type**	**Spring type**	**Screw type**
TA5211-TSPF-B	TA5211-TSCL-B	TA5212-TSPF	TA5212-TSCL

Further information on the terminal blocks concerning power supply and onboard inputs/outputs are provided under pluggable connectors for screw and spring connection *Chapter 1.8.1.2 “TA52xx(-x) - Terminal block sets” on page 866*.

Pin assignment

<table>
<tr><th>Pin Assignment</th><th>Pin</th><th>Label</th><th>Function</th><th>Description</th></tr>
<tr><td rowspan="3">

Terminal block inserted</td><td>1</td><td>⏚</td><td>FE</td><td>Functional earth</td></tr>
<tr><td>2</td><td>L+</td><td>+24 V DC</td><td>Positive pin of the power supply voltage</td></tr>
<tr><td>3</td><td>M</td><td>0 V</td><td>Negative pin of the power supply voltage</td></tr>
</table>

Faulty wiring on power supply terminals

> **CAUTION!**
> **Risk of damaging the AC500-eCo V3 processor module and the connected modules!**
> Voltages > 30 V DC might damage the processor module and the connected modules.
>
> Make sure that the supply voltage never exceeds 30 V DC.

1.3.1.1.5 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 processer modules switch between RUN mode and STOP mode. By long-pressing RUN/STOP button during the processor module power on phase, the processor module will be in MOD1.

State LEDs

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

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

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

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

User configurable LEDs

The 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) to display the states of the inputs and outputs.

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

Processor module	LED	State	Color	LED = ON	LED = OFF
PM5072-T-2ETHW	O0..O7	Transistor output	Yellow	Output is ON	Output is OFF
	C12, C13	Digital configurable input/output	Yellow	Input/Output is ON	Input/Output is OFF

Ethernet state LEDs

Table 8: State LEDs at Ethernet connector

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

1.3.1.1.6 Diagnosis

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

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

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

1.3.1.1.7 Onboard I/Os

The AC500-eCo V3 processor modules 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.

Intended purpose

Table 9: Numbers and types of the onboard I/Os

Processor module	No. and type of digital inputs	No. and type of digital outputs	No. and type of configurable inputs/outputs
PM5012-T-ETH	6 24 V DC (one isolation group)	4 0.5 A max., transistor (one isolation group)	None
PM5012-R-ETH	6 24 V DC (one isolation group)	4 2 A max., relay (two isolation groups)	None
PM5032-T-ETH	12 24 V DC (one isolation group)	8 0.5 A max., transistor (one isolation group)	2 24 V DC input or 0.5 A max., transistor output (one isolation group)
PM5032-R-ETH	12 24 V DC (one isolation group)	6 2 A max., relay (two isolation groups)	2 24 V DC input or 0.5 A max., transistor output (one isolation group)
PM5052-T-ETH	12 24 V DC (one isolation group)	8 0.5 A max., transistor (one isolation group)	2 24 V DC input or 0.5 A max., transistor output (one isolation group)
PM5052-R-ETH	12 24 V DC (one isolation group)	6 2 A max., relay (two isolation groups)	2 24 V DC input or 0.5 A max., transistor output (one isolation group)
PM5072-T-2ETH	12 24 V DC (one isolation group)	8 0.5 A max., transistor (one isolation group)	2 24 V DC input or 0.5 A max., transistor output (one isolation group)
PM5072-T-2ETHW	12 24 V DC (one isolation group)	8 0.5 A max., transistor (one isolation group)	2 24 V DC input or 0.5 A max., transistor output (one isolation group)

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)</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 measure-ment 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>

<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)</th><th>PM5032-R-ETH
PM5052-R-ETH</th></tr>
<tr><td rowspan="2">Functionality of digital outputs</td><td rowspan="2">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</td><td rowspan="2">4 DO-R
24 V DC / 240 V AC 2A in 2 groups</td><td>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 kHz Pulse/ Direction using standard output</td><td rowspan="2">6 DO-R
24 V DC / 240 V AC 2A in 2 groups</td></tr>
<tr><td>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.</td></tr>
</table>

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

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.

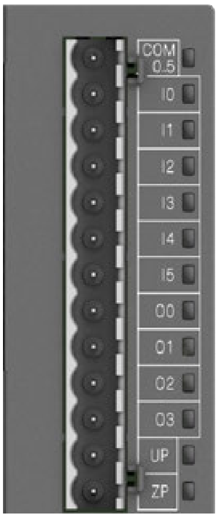


Table 10: Assignment of the terminals for PM5012-T-ETH:

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 11: Assignment of the terminals for PM5012-R-ETH:

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

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

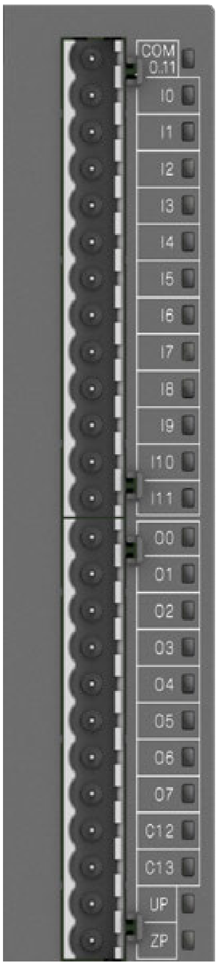


Table 12: Assignment of the terminals for PM5032-T-ETH, PM5052-T-ETH and PM5072-T-2ETH(W):

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

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

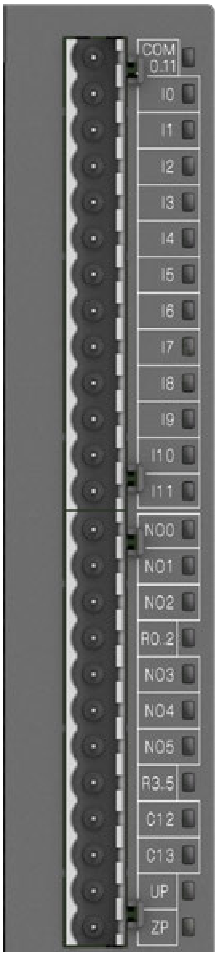
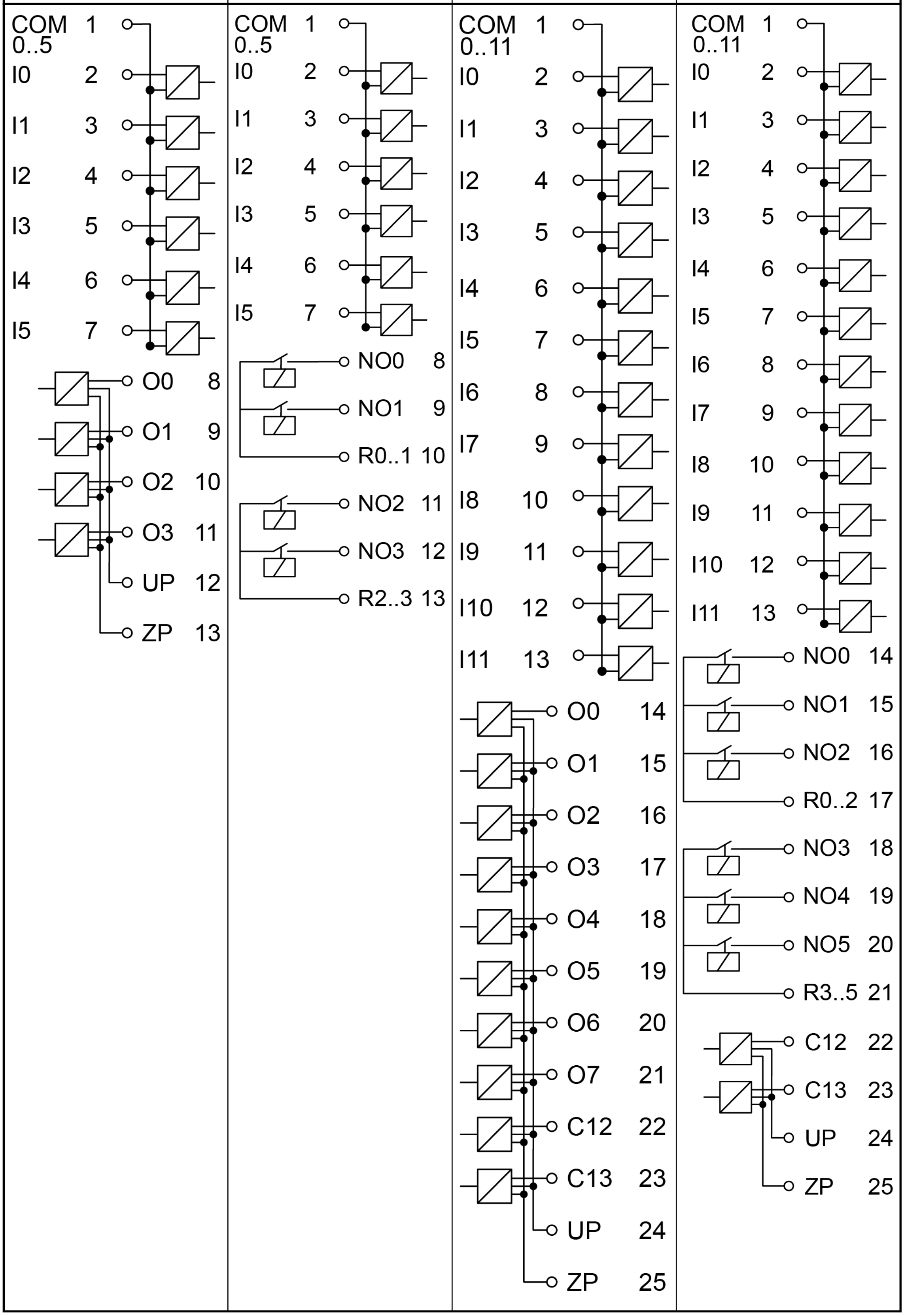


Table 13: Assignment of the terminals for PM5032-R-ETH and PM5052-R-ETH:

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 The following block diagram shows the internal structure of the onboard I/Os.

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

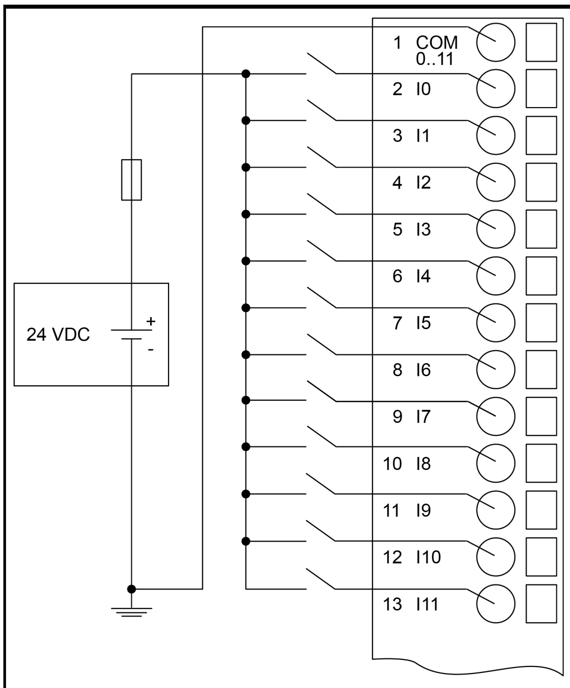


Connection of the digital inputs

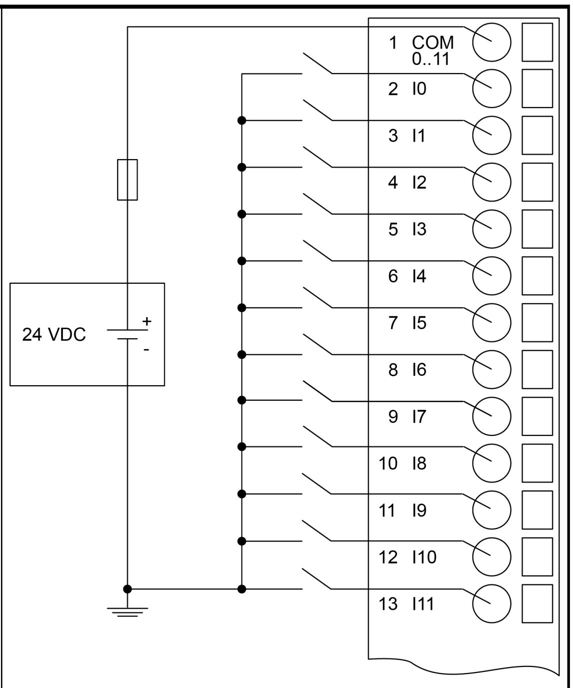
The digital inputs can be used as source inputs or as sink inputs.

> **NOTICE!**
> **Risk of malfunctions in the plant!**
> A ground fault, e. g. caused by a damaged cable insulation, can bridge switches accidentally.
>
> Use sink inputs when possible or make sure that, in case of error, there will be no risks to persons or plant.

The following figure shows the connection of the digital inputs to the PM50x2 processor modules:



Connection of digital inputs (sink inputs)



Connection digital inputs (source inputs)

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

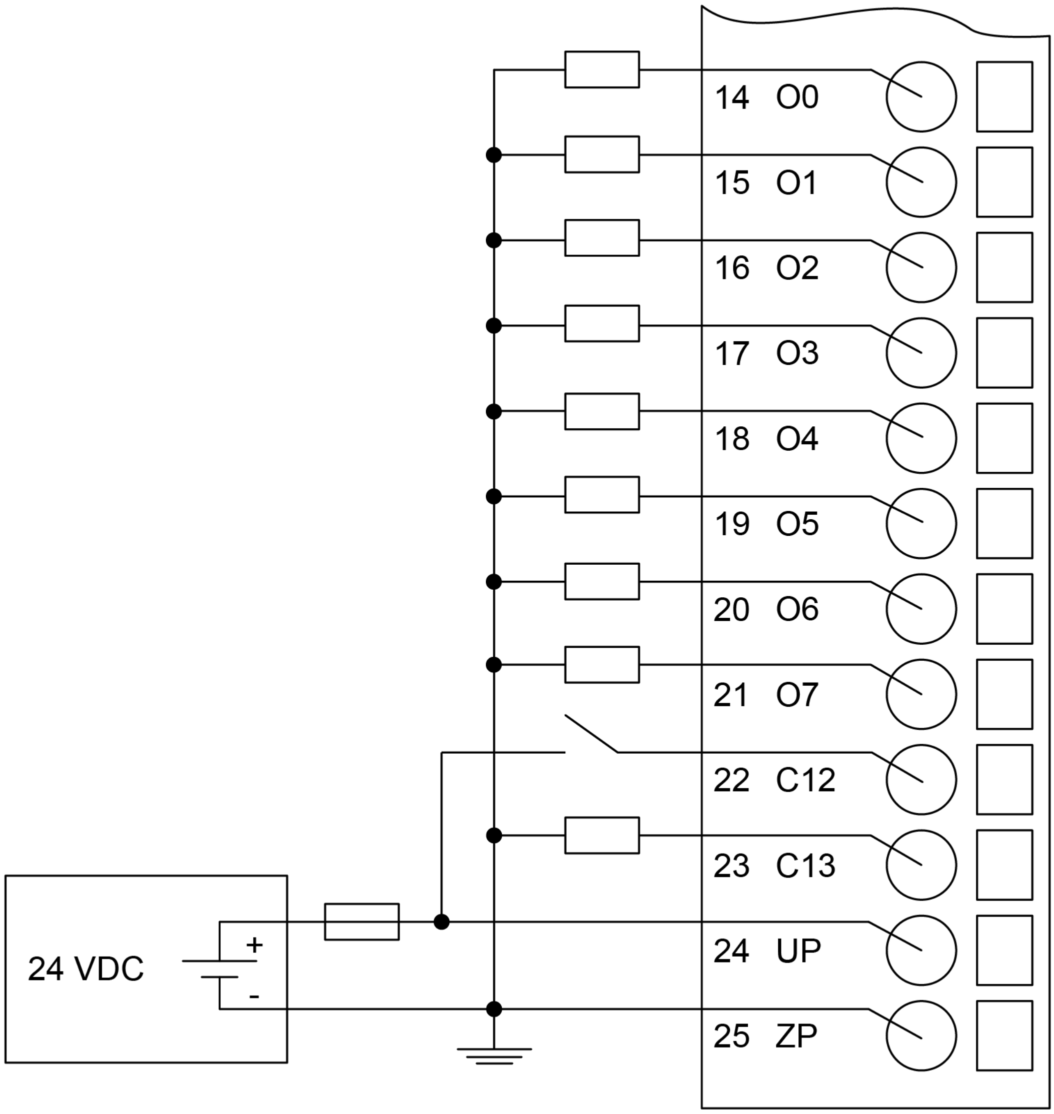


Fig. 2: Connection of digital transistor outputs and configurable digital inputs/outputs

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 the outputs.

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

The following figures show the connection of the digital relay outputs to the processor modules:

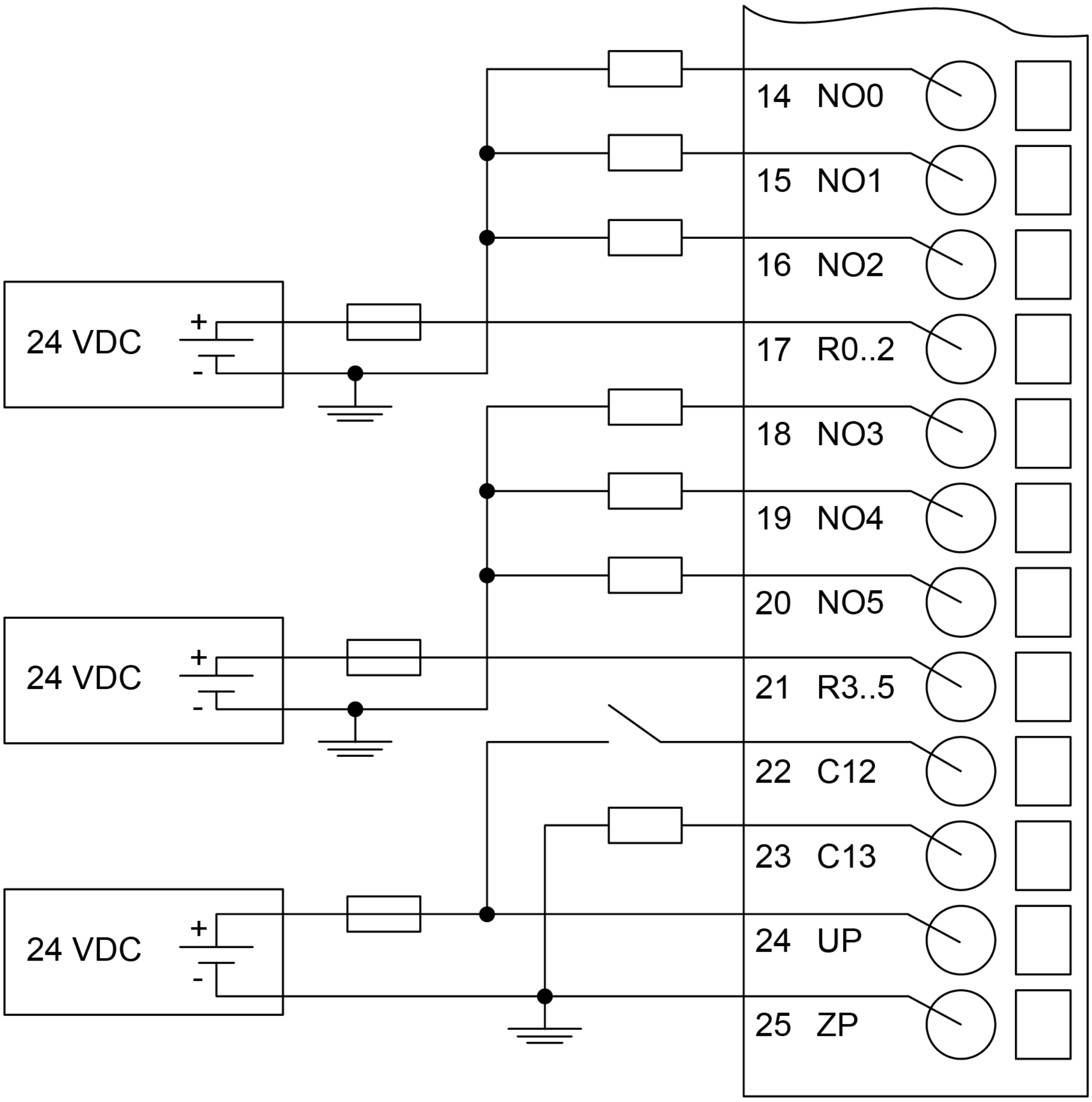


Fig. 3: Connection of digital relay outputs and configurable digital inputs/outputs

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 to protect the outputs.

I/O configuration

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

Parameterization

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

Diagnosis

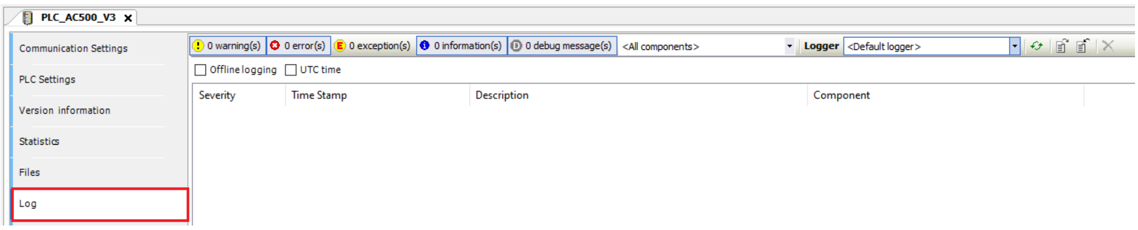
No diagnosis is generated for the onboard I/O.

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.



Displays

Table 14: 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

Technical data

Technical data of the digital inputs

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

Parameter		Value	
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	On request	
	Unshielded	On request	

*) For fast inputs and fast outputs including PTO and PWM, 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.

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.

> ***Further information:***
> *Operating modes of the fast counter:*
> *Configurarion of the fast counter:*

Parameter		PM5012-T-ETH	PM5012-R-ETH	PM5032-T-ETH PM5052-T-ETH PM5072-T-2ETH	PM5032-R-ETH PM5052-R-ETH
Fast counter					
	Useable inputs	2	2	4	4
	Fast input max. 5 kHz	DI4 ... DI5	DI4 ... DI5	-	-
	Fast input, max. 100 kHz	-	-	DI4 … DI7	DI4 … DI7

Technical data of the interrupt inputs

Parameter		PM5012-T-ETH	PM5012-R-ETH	PM5032-T-ETH PM5052-T-ETH PM5072-T-2ETH	PM5032-R-ETH PM5052-R-ETH
Interrupt					
	Useable inputs	4	4	4	4
	Fast input max. 5 kHz	DI0 ... DI3	DI0 ... DI3	DI0 ... DI3	DI0 ... DI3

Technical data of the Touch/Reset inputs

Parameter		PM5012-T-ETH	PM5012-R-ETH	PM5032-T-ETH PM5052-T-ETH PM5072-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	PM5032-R-ETH PM5052-R-ETH
	Fast input max. 5 kHz	-	-	DI0 ... DI3	DI0 ... DI3
	Fast input, max. 100 kHz	-	-	DI6 ... DI7 When using the A/B encoder on DI04...DI05 and the Touch/ Reset inputs on fast inputs	DI6 ... DI7 When using the A/B encoder on DI04...DI05 and the Touch/ Reset inputs on fast inputs

Technical data of the digital transistor outputs

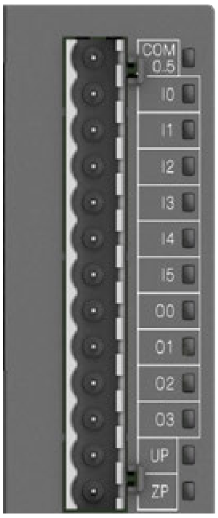


Table 15: PM5012-T-ETH

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 O7		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 group)		On request
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
Short-circuit-proof / Overload-proof		No
Overload message		No

Parameter	Value
Output current limitation	No
Resistance to feedback against 24 V DC	No
Connection of 2 outputs in parallel	Not possible
Max. cable length *)	
Shielded	On request
Unshielded	On request

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

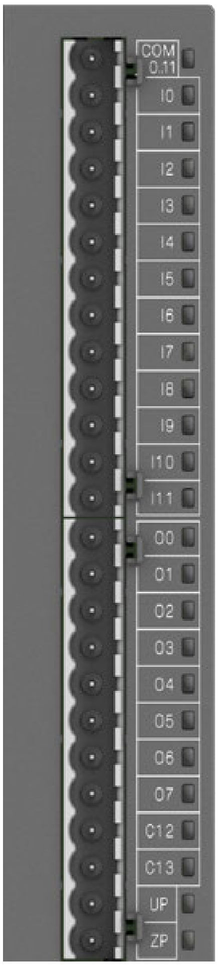


Table 16: PM5032-T-ETH, PM5072-T-2ETH and PM5072-T-2ETHW

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 group)	On request
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	On request
Unshielded	On request

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

Technical data of the digital relay outputs

Table 17: 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
Rated protection fuse	On request
Output current	
Rated current per channel (max.)	2.0 A (24 V DC resistance and general use, 100 V AC...240 V AC, resistance, general use and pilot duty)
Rated current per group (max.)	6 A
Rated current (all channels together, max.)	12 A
Demagnetization when inductive loads are switched off	External demagnetization measures must be implemented when switching inductive loads.
Spark suppression with inductive AC loads	Must be performed externally according to driven load specification
Switching frequencies	

Parameter	Value
With resistive loads	Max. 1 Hz
With inductive loads	On request
With lamp loads	On request
Short-circuit-proof / Overload-proof	No, should be provided by an external fuse or circuit breaker
Rated protection fuse (for each channel)	On request
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	On request
Unshielded	On request

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

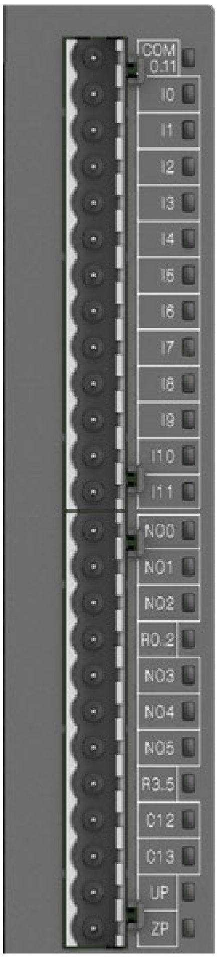


Table 18: PM5032-R-ETH and PM5052-R-ETH

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
Rated protection fuse	On request

Parameter		Value
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
	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)		On request
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	On request
	Unshielded	On request

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

Technical data of the limit switch outputs

Parameter		PM5012-T-ETH	PM5012-R-ETH	PM5032-T-ETH PM5052-T-ETH PM5072-T-2ETH	PM5032-R-ETH PM5052-R-ETH
Limit switch					
	Useable outputs	4	-	8	2
	Fast output max. 5 kHz	DO0 ... DO3	-	DO0 … DO3	-
	Fast output, max. 100 kHz	-	-	DO4 … DO7	DC12 … DC13

Technical data of the PTO outputs

Parameter		PM5012-T-ETH	PM5012-R-ETH	PM5032-T-ETH PM5052-T-ETH PM5072-T-2ETH	PM5032-R-ETH PM5052-R-ETH
PTO					
	Useable outputs	-	-	4	1 pair of output
	Fast output, max. 100 kHz	-	-	DO4 … DO7 For 2 PTO 200 kHz *) Pulse/Direction or CC/Ccw modes as pair of outputs	DC12 … DC13
				DO4 … DO7 as 4 PTO 100 kHz Pulse outputs / Direction using fast output 5kHz DO0...DO3	

*) 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.

Technical data of the PWM outputs

Parameter		PM5012-T-ETH	PM5012-R-ETH	PM5032-T-ETH PM5052-T-ETH PM5072-T-2ETH	PM5032-R-ETH PM5052-R-ETH
PWM					
	Useable outputs	4	-	8	2
	Fast output max. 5 kHz	DO0 ... DO3	-	DO0 … DO3	-
	Fast output, max. 100 kHz	-	-	DO4 … DO7	DC12 … DC13

Ordering data

Table 19: Processor modules for AC500-eCo V3

Part no.	Description	Product life cycle phase *)
1SAP 122 600 R0072	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
1SAP 122 700 R0072	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
1SAP 123 400 R0072	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
1SAP 123 500 R0072	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
1SAP 124 000 R0072	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
1SAP 124 100 R0072	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
1SAP 124 500 R0073	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
1SAP 124 400 R0073	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

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

Table 20: Accessories for AC500-eCo V3

Part no.	Description
1SAP 187 000 R0001	TA5101-4DI: AC500, option board for digital I/O extension, 4DI 24 V DC, spring/cable front terminal 3.50 mm pitch
1SAP 187 000 R0002	TA5105-4DOT: AC500, option board for digital I/O extension, 4DO-T 24 V DC / 0.5 A, spring/cable front terminal 3.50 mm pitch
1SAP 187 000 R0003	TA5110-2DI2DOT: AC500, option board for digital I/O extension, 2DI 24 V DC, 2DO-T 24 V DC / 0.5 A, spring/cable front terminal 3.50 mm pitch
1SAP 187 200 R0001	TA5130-KNXPB: AC500, option board KNX adress push button
1SAP 187 200 R0002	TA5131-RTC:AC500, real-time clock without battery, option board for AC500-eCo V3 Basic CPU
1SAP 187 300 R0001	TA5141-RS232I: AC500, option board for COMx serial communica-tion, spring/cable front terminal 3.50 mm pitch
1SAP 187 300 R0002	TA5142-RS485I: AC500, option board for COMx serial communica-tion, spring/cable front terminal 3.50 mm pitch
1SAP 187 300 R0003	TA5142-RS485: AC500, option board for COMx serial communica-tion, spring/cable front terminal 3.50 mm pitch
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
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
1SAP 187 600 R0001	TA5400-SIM: input simulator (for CPU testing), 6 switches
1SAP 180 100 R0002	MC5102 - Micro memory card with memory card adapter
1SAP 182 800 R0001	TA543: screw mounting accessory, 20 pieces per packing unit
1SAP 187 500 R0003	TA5301-CFA: cable fixing part accessory, 20 pieces per packing unit
Spare parts	
1SAP 187 400 R0012	TA5220-SPF5: spring terminal block, removable, 5-pin, spring front, cable front, 6 pieces per packing unit

Part no.	Description
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
1SAP 187 500 R0001	TA5300-CVR: option board slot cover, removable plastic part, 6 pieces per packing unit

1.3.1.1.8 Technical data

The system data of AC500-eCo V3 apply ↬ *Chapter 2.5.1 “System data AC500-eCo V3” on page 925*

Only additional details are therefore documented below.

General data

Parameter		Value			
		PM5012	PM5032	PM5052	PM5072
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
	Relay version	200 mA	340 mA	400 mA	-
Inrush current at nominal voltage		On request			
Required fuse		On request			
Max. power dissipation within the processor module					
	Transistor version	On request	On request	On request	On request
	Relay version	On request	On request	On request	-
Processor module interfaces		RS485/RS232 (optional), Ethernet			
		-	I/O bus		
Weight					
	Transistor version	300 g	400 g	400 g	400 g
	Relay version	400 g	400 g	400 g	400 g
Mounting position		Horizontal or vertical			

Detailed data

Parameter		Value			
		PM5012	PM5032	PM5052	PM5072
Total maximum downloadable application size 1)		1 MB	5 MB	7 MB	9 MB
	Thereof user program code / data memory dynamically allocated	256 kB	512 kB	768 kB	1 MB

Parameter		Value			
		PM5012	**PM5032**	**PM5052**	**PM5072**
	Thereof user web server memory for web visualization max.	no web	1.5 MB	3.2 MB	7 MB
	User data memory saved in FLASH	8 kB	32 kB	100 kB	
	VAR_RETAIN persistent	4 kB	16 kB	36 kB	
	%MB data	4 kB	16 kB	64 kB	
Data buffering		FRAM memory without battery			
Real-time clock (RTC) (no battery, supercap)		Optional with TA5131-RTC	Built in		
Min. retention time for RTC / accuracy in s/day		On request	On request	On request	On request
Programming languages		● Instruction List (IL) ● Function Block Diagram (FBD) ● Ladder Diagram (LD) ● Sequential Function Chart (SFC) ● Structured Text (ST) ● Continuous Function Chart (CFC)			
Cycle time per instructions (minimum)		PM5012	PM5032	PM5052	PM5072
	Binary	20 ns			
	Word	50 ns			
	Floating point	600 ns			
Program execution		PM5012	PM5032	PM5052	PM5072
	Cyclic min. configurable	10 ms	5 ms	2 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: [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
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				

Data of I/Os	PM5012-x-ETH	PM5032-x-ETH	PM5052-x-ETH	PM5072-T-2ETH
Type of digital outputs	PM5012-T-ETH: Transistor	PM5032-T-ETH: Transistor	PM5052-T-ETH: Transistor	PM5072-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 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
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, TA5122-2AI-TC, TA5123-2AI-RTD, TA5126-2AO-UI			
Max. number of I/O modules on I/O bus	0	10		

Data of I/Os	PM5012-x-ETH	PM5032-x-ETH	PM5052-x-ETH	PM5072-T-2ETH
Digital inputs	Onboard I/O only	128 B	1 kB	
Digital outputs		128 B	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
SNTP client/ server	No	Yes		
HTTPs and Web-Visu number of connections	No	Yes 1	Yes 2	Yes 4
FTPs number of connections	No	Yes 1	Yes 2	
OPC UA server number of free tags	No	Yes 125	Yes 250	Yes 1000
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)

Data of I/Os	PM5012-x-ETH	PM5032-x-ETH	PM5052-x-ETH	PM5072-T-2ETH
IEC 61850 MMS server/goose pub/sub	No			Yes (max. 1000 data attributes)
EtherNet/IP adapter/scanner	No	Yes (in preparation)		

1.3.1.1.9 Ordering Data

Table 21: Processor modules for AC500-eCo V3

Part no.	Description	Product life cycle phase *)
1SAP 122 600 R0072	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
1SAP 122 700 R0072	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
1SAP 123 400 R0072	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
1SAP 123 500 R0072	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
1SAP 124 000 R0072	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
1SAP 124 100 R0072	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
1SAP 124 500 R0073	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
1SAP 124 400 R0073	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

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

Table 22: Accessories for AC500-eCo V3

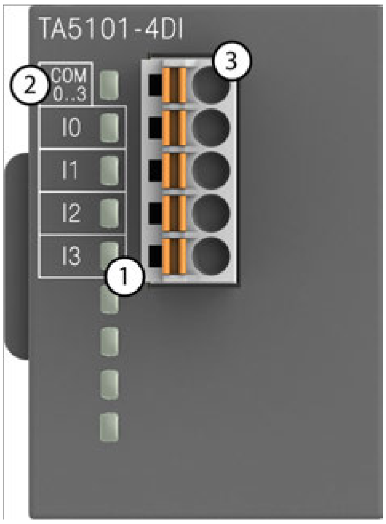
Part no.	Description
1SAP 187 000 R0001	TA5101-4DI: AC500, option board for digital I/O extension, 4DI 24 V DC, spring/cable front terminal 3.50 mm pitch
1SAP 187 000 R0002	TA5105-4DOT: AC500, option board for digital I/O extension, 4DO-T 24 V DC / 0.5 A, spring/cable front terminal 3.50 mm pitch
1SAP 187 000 R0003	TA5110-2DI2DOT: AC500, option board for digital I/O extension, 2DI 24 V DC, 2DO-T 24 V DC / 0.5 A, spring/cable front terminal 3.50 mm pitch
1SAP 187 200 R0001	TA5130-KNXPB: AC500, option board KNX adress push button
1SAP 187 200 R0002	TA5131-RTC:AC500, real-time clock without battery, option board for AC500-eCo V3 Basic CPU
1SAP 187 300 R0001	TA5141-RS232I: AC500, option board for COMx serial communication, spring/cable front terminal 3.50 mm pitch
1SAP 187 300 R0002	TA5142-RS485I: AC500, option board for COMx serial communication, spring/cable front terminal 3.50 mm pitch
1SAP 187 300 R0003	TA5142-RS485: AC500, option board for COMx serial communication, spring/cable front terminal 3.50 mm pitch
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
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
1SAP 187 600 R0001	TA5400-SIM: input simulator (for CPU testing), 6 switches
1SAP 180 100 R0002	MC5102 - Micro memory card with memory card adapter

Part no.	Description
1SAP 182 800 R0001	TA543: screw mounting accessory, 20 pieces per packing unit
1SAP 187 500 R0003	TA5301-CFA: cable fixing part accessory, 20 pieces per packing unit
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
1SAP 187 500 R0001	TA5300-CVR: option board slot cover, removable plastic part, 6 pieces per packing unit

1.3.1.2 Option boards

1.3.1.2.1 TA5101-4DI - Option board for digital I/O extension

- 4 digital inputs 24 V DC (I0 to I3) in 1 group
- Module-wise galvanically isolated



1 4 yellow LEDs to display the signal states of the 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.
> – Never connect any voltages or signals to reserved terminals (marked with "NC"). Reserved terminals may carry internal voltages.

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.

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

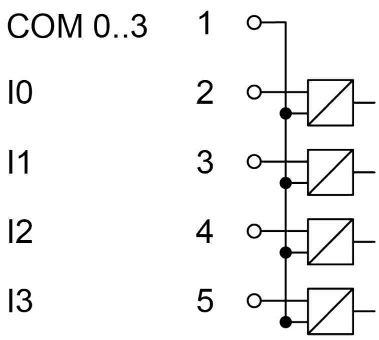


Table 23: Assignment of the terminals:

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 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 "NC"). Reserved terminals may carry internal voltages.

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

NOTICE!

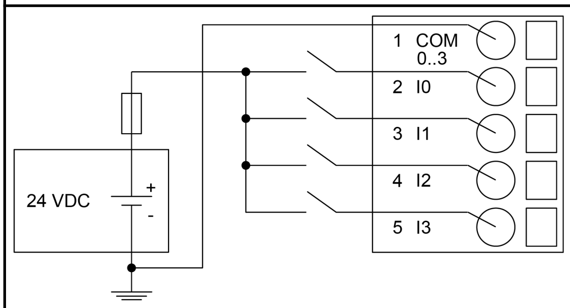
Risk of malfunctions in the plant!

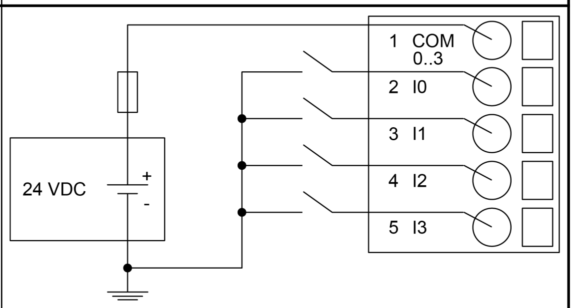
A ground fault, e. g. caused by a damaged cable insulation, can bridge switches accidentally.

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

The following figure shows the 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, see Diagnosis *“Diagnosis” on page 55*.

The meaning of the LEDs is described in the section State LEDs *“State LEDs” on page 55*.

I/O configuration

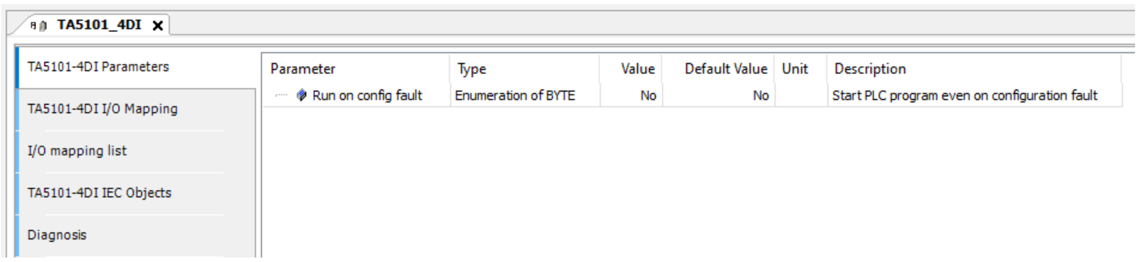
The module itself does not store configuration data. It receives its parameterization data from the CPU module during power-up of the system.

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

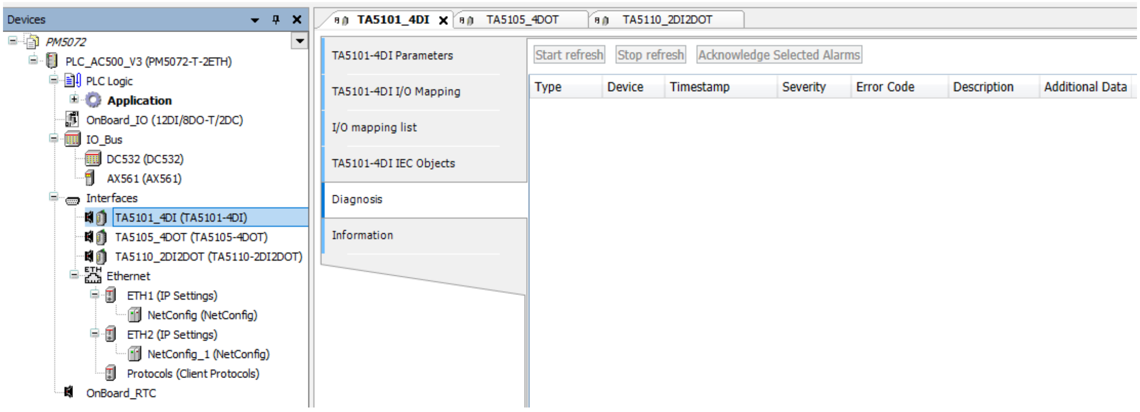
Parameterization

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 24: 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 2.5.1 “System data AC500-eCo V3” on page 925*

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 switchgear cabinet.

Table 25: Technical data of the digital inputs

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

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

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 187 000 R0001	TA5101-4DI: AC500, option board for digital I/O extension, 4DI 24 V DC, spring/cable front terminal 3.50 mm pitch	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

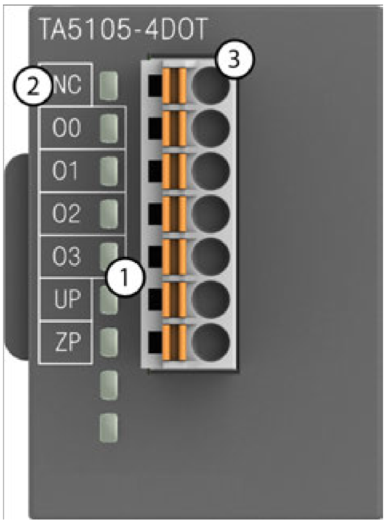
**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

***) 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.

1.3.1.2.2 TA5105-4DOT - Option board for digital I/O extension

- 4 digital outputs 24 V DC (O0 to O3) in 1 group
- Module-wise galvanically isolated



1 4 yellow LEDs to display the signal states of the inputs O0 to 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.
> – Never connect any voltages or signals to reserved terminals (marked with "NC"). Reserved terminals may carry internal voltages.

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.

The following block diagram shows the internal construction of the digital outputs:

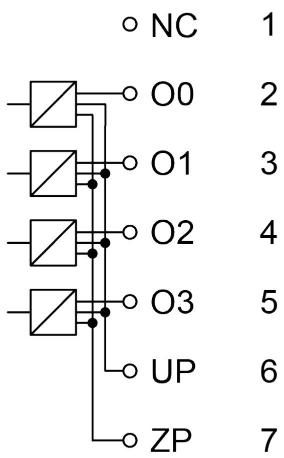


Table 26: Assignment of the terminals:

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 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.

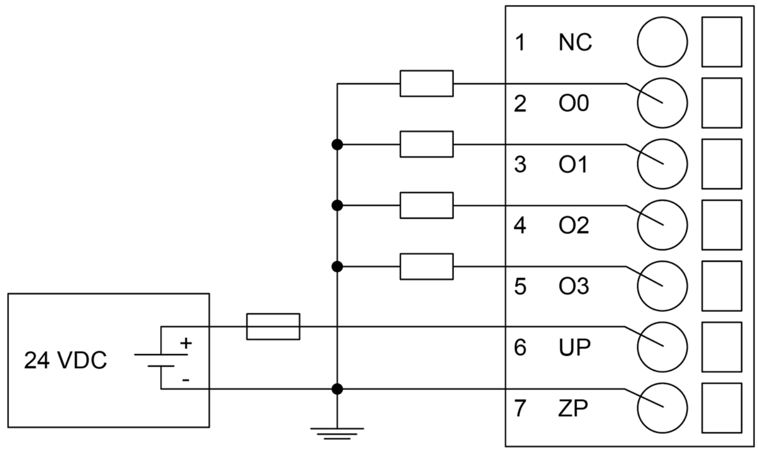
Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

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 "NC"). Reserved terminals may carry internal voltages.

The following figure shows the 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, see Diagnosis *“Diagnosis” on page 61*.

The meaning of the LEDs is described in the section State LEDs *“State LEDs” on page 62*.

I/O configuration

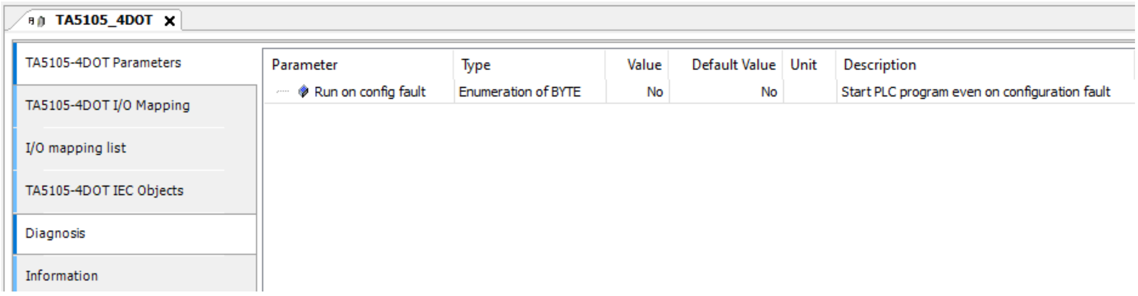
The module itself does not store configuration data. It receives its parameterization data from the CPU module during power-up of the system.

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

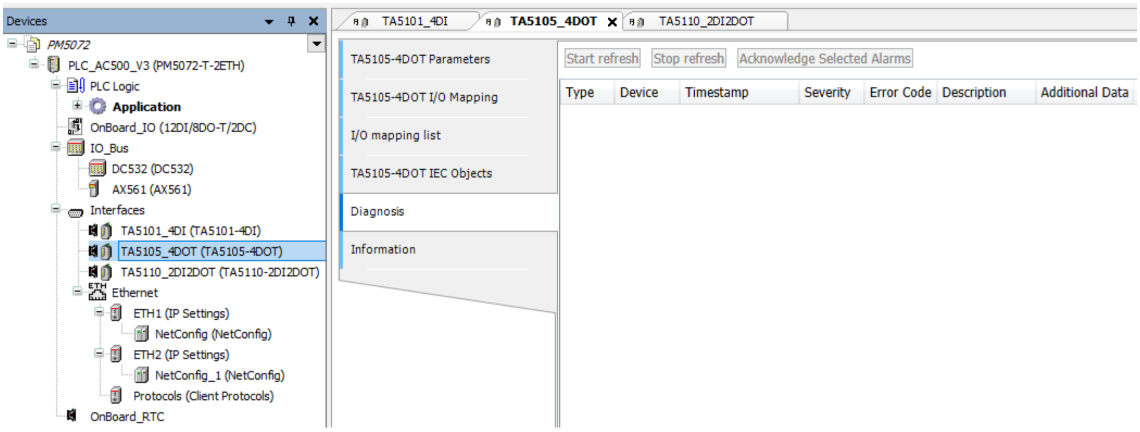
Parameterization

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 27: 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 2.5.1 “System data AC500-eCo V3” on page 925*

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 switchgear cabinet.

Table 28: Technical data of the digital outputs

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

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

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 187 000 R0002	TA5105-4DOT: AC500, option board for digital I/O extension, 4DO-T 24 V DC / 0.5 A, spring/cable front terminal 3.50 mm pitch	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

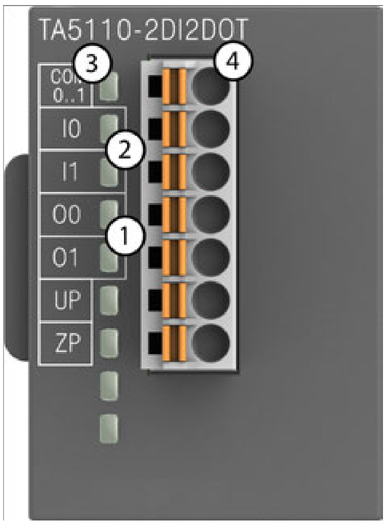
**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

***) 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.

1.3.1.2.3 TA5110-2DI2DOT - Option board for digital I/O extension

- 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



1 2 yellow LEDs to display the signal states of the outputs O0 to O1
2 2 yellow LEDs to display the signal states of the 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.
– Never connect any voltages or signals to reserved terminals (marked with "NC"). Reserved terminals may carry internal voltages.

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.

The following block diagram shows the internal construction of the digital inputs and outputs:

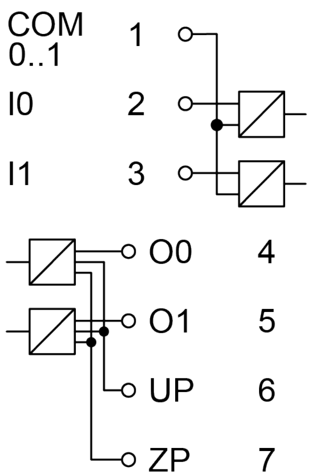


Table 29: Assignment of the terminals:

Terminal	Signal	Description
1	COM 0..1	Input common for signals I0 to I1
2	I0	Input signal I0

Terminal	Signal	Description
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 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 "NC"). Reserved terminals may carry internal voltages.

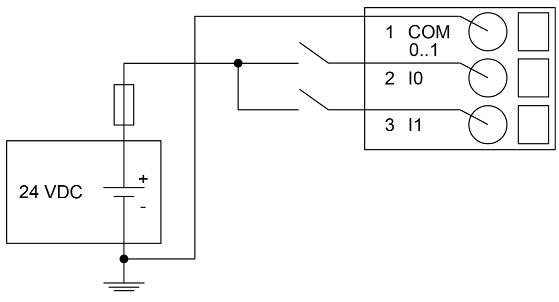
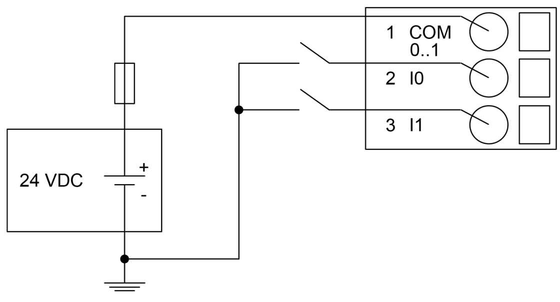
The digital inputs can be used as source inputs or as sink inputs.

NOTICE!
Risk of malfunctions in the plant!

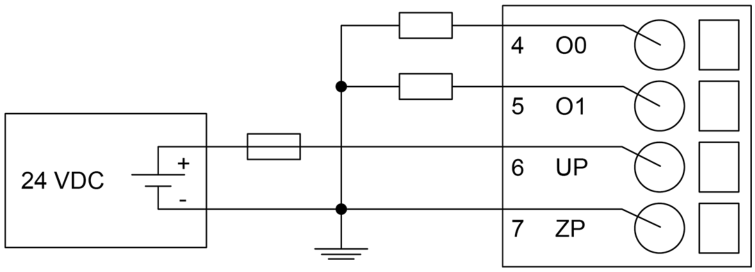
A ground fault, e. g. caused by a damaged cable insulation, can bridge switches accidentally.

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

The following figure shows the connection for inputs of the option board for digital I/O extension TA5110-2DI2DOT:

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

The following figure shows the 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, see Diagnosis ➭ *“Diagnosis” on page 68*.

The meaning of the LEDs is described in the section State LEDs ➭ *“State LEDs” on page 68*.

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.

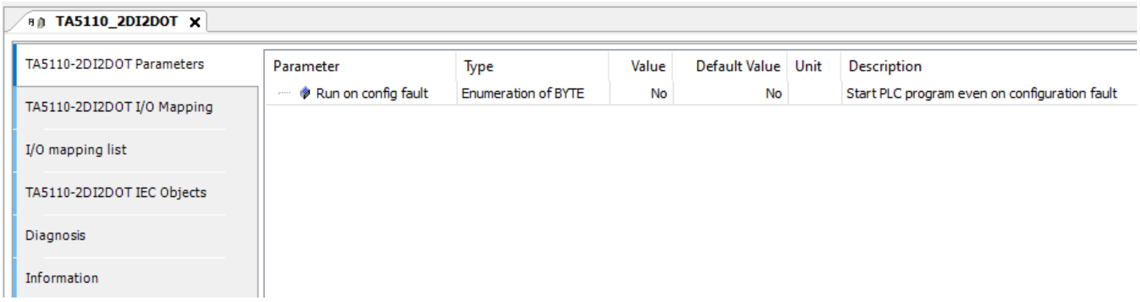
Hence, replacing optional modules is possible without any re-parameterization via software.

> *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.*

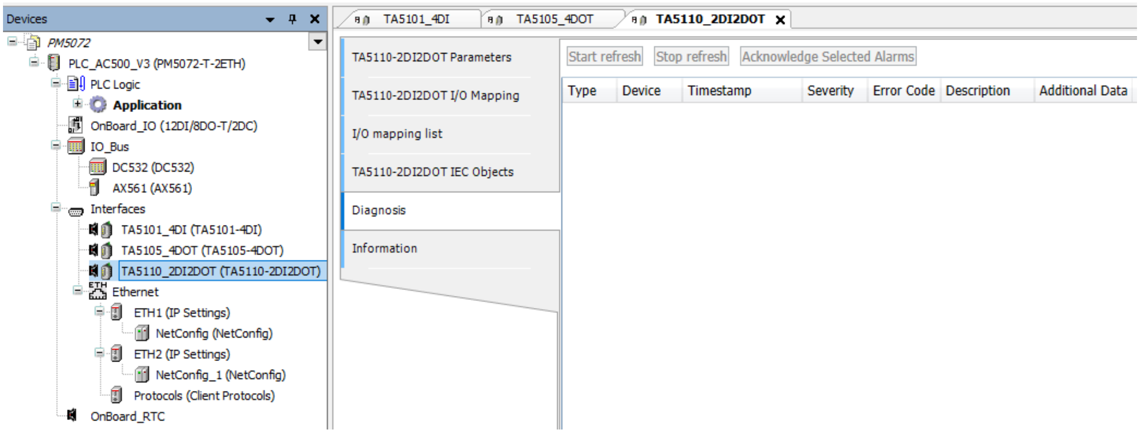
Parameterization

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 30: 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 2.5.1 “System data AC500-eCo V3” on page 925*

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 switchgear cabinet.

Table 31: 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

Parameter		Value	
Undefined signal		-15 V...+ 5 V	+5 V...+15 V
Signal 1		-30 V...-15 V	+15 V...+30 V
Ripple with signal 0		-5 V...+3 V	-3 V...+5 V
Ripple with signal 1		-30 V...-15 V	+15 V...+30 V
Input current per channel			
	Input voltage +24 V	Typ. 5 mA	
	Input voltage +5 V	Typ. 1 mA	
	Input voltage +15 V	< 3 mA	
	Input voltage +30 V	< 7 mA	
Max. permissible leakage current (at 2-wire proximity switches)		1 mA	
Input delay (0->1 or 1->0)		Typ. 8 ms	
Input data length		1 byte	
Max. cable length			
	Shielded	On request	
	Unshielded	On request	

Table 32: 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

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

Ordering data

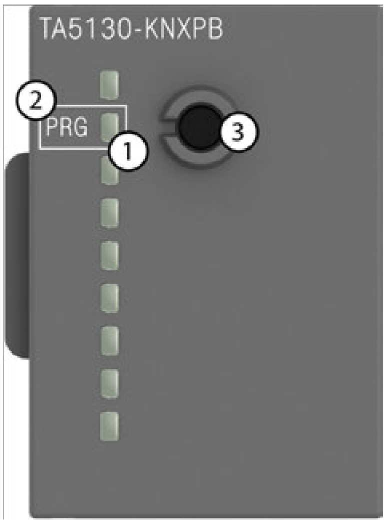
Part no.	Description	Product life cycle phase *)
1SAP 187 000 R0003	TA5110-2DI2DOT: AC500, option board for digital I/O extension, 2DI 24 V DC, 2DO-T 24 V DC / 0.5 A, spring/ cable front terminal 3.50 mm pitch	Active
Spare parts		
1SAP 187 400 R0014 **)	TA5220-SPF7: spring terminal block, removable, 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.

1.3.1.2.4 TA5130-KNXPB - Option board KNX adress push button



1 State LED
2 Allocation of signal name
3 Connector

> *For more information about TA5130-KNXPB, please refer to the Automation Builder online help.*

Intended purpose

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

> *Information can be found in the chapter system technology: see*

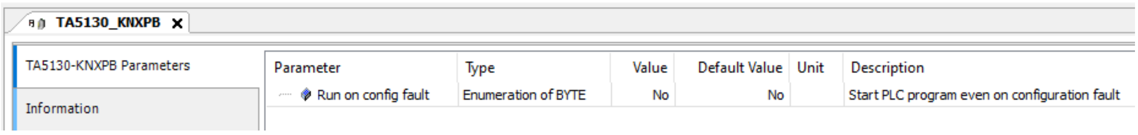
Functionality

> *Information can be found in the chapter system technology: see*
>
> *Information about the integration of the PLC in KNX can be found here:*

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 2.5.1 "System data AC500-eCo V3" on page 925*

Only additional details are therefore documented below.

Parameter	Value
Usable CPUs	PM5072-T-2ETH(W)
Internal power supply	Via internal CPU connection
Additional current consumption from 24 V DC power supply at CPU	Max. 25 mA
Weight	14 g

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 187 200 R0001	TA5130-KNXPB: AC500, option board KNX adress push button	Active

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

1.3.1.2.5 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.*

> *Information can be found in the chapter system technology: see*

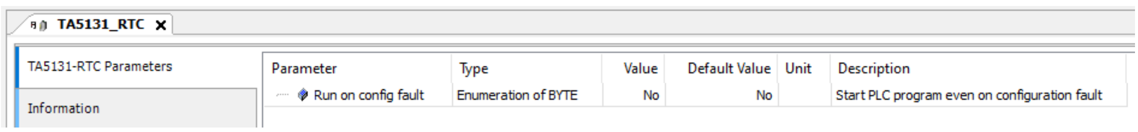
Functionality

> *Information can be found in the chapter system technology: see*

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 2.5.1 “System data AC500-eCo V3” on page 925*

Only additional details are therefore documented below.

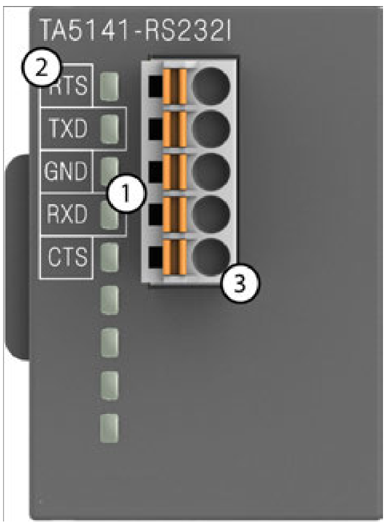
Parameter	Value
Buffering time	7 days at room temperature
Usable CPUs	PM5012
Internal power supply	Via internal CPU connection
Additional current consumption from 24 V DC power supply at CPU	Max. 25 mA
Weight	16 g

Ordering data

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

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

1.3.1.2.6 TA5141-RS232I - Option board for COMx serial communication



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

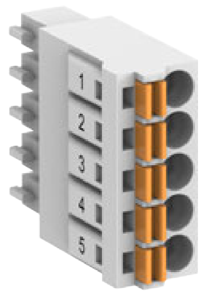
Option board for COMx serial communication TA5141-RS232I is equipped with 1 RS-232 serial interface with handshake.

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 33: TA5141-RS232I

Serial interface	Pin	Signal	Description
	1	RTS	Request To Send DCE is ready to accept data from the DTE
	2	TxD	Transmit data (output)
	3	GND	Common Ground
	4	RxD	Receive data (input)
	5	CTS	Clear To Send (input) DCE is ready to accept data from the DTE

Cable length

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

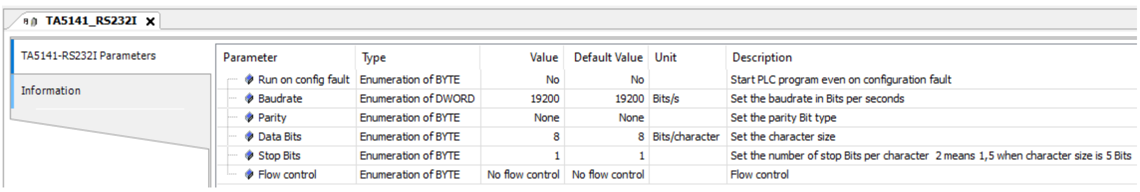
RS-232 for point-to-point connection:

Parameter	Value
Transmission rate	9.6 kBit/s to 115.2 kBit/s
Maximum cable length	On request

Parameterization

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

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



State LEDs

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

Technical data

The system data of AC500-eCo V3 apply ↳ *Chapter 2.5.1 “System data AC500-eCo V3” on page 925*

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	PM50x2
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

Ordering data

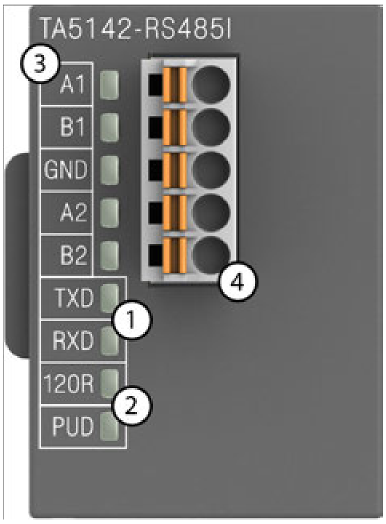
Part no.	Description	Product life cycle phase *)
1SAP 187 300 R0001	TA5141-RS232I: AC500, RS-232 option board for COMx serial communication, spring/cable front terminal, 3.50 mm pitch	Active
Spare parts		
1SAP 187 400 R0012 **)	TA5220-SPF5: spring terminal block, removable, 5-pin, spring front, cable 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.

1.3.1.2.7 TA5142-RS485I - Option board for COMx serial communication



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 board for COMx serial communication TA5142-RS485(I) is 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.

Connections

Serial interfaces

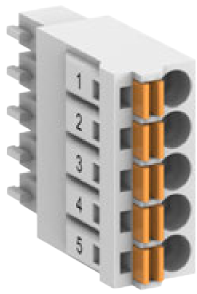
NOTICE!

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 34: 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

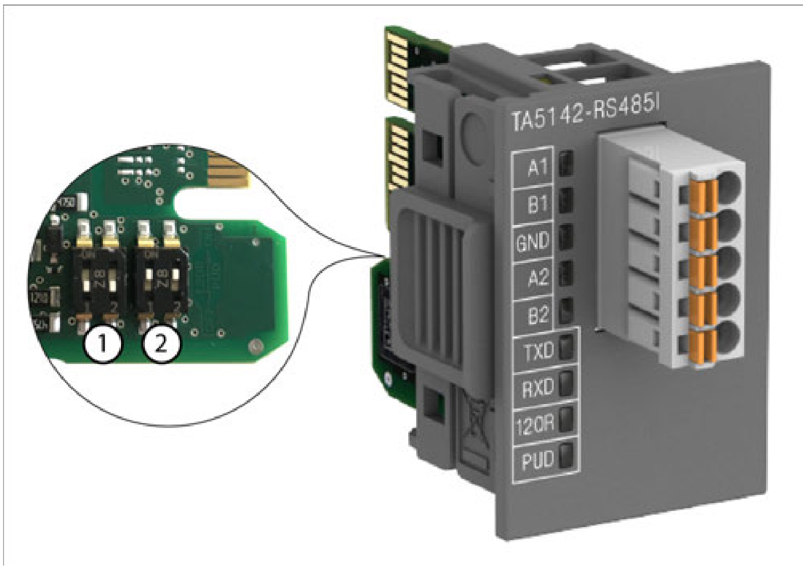
The maximum possible cable length of a serial connection subnet within a segment depends on the transmission rate.

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

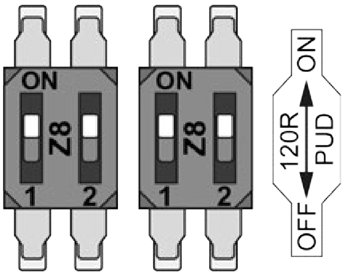
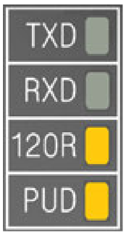
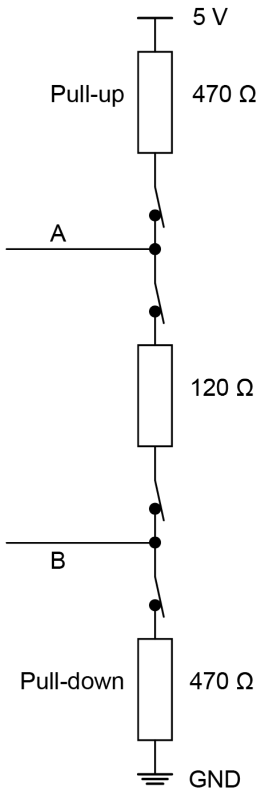
Bus termination

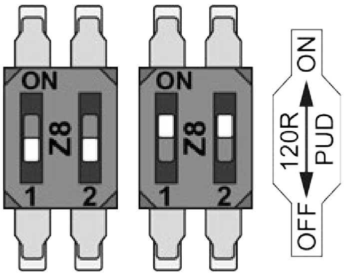
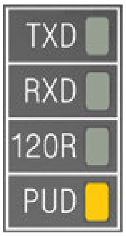
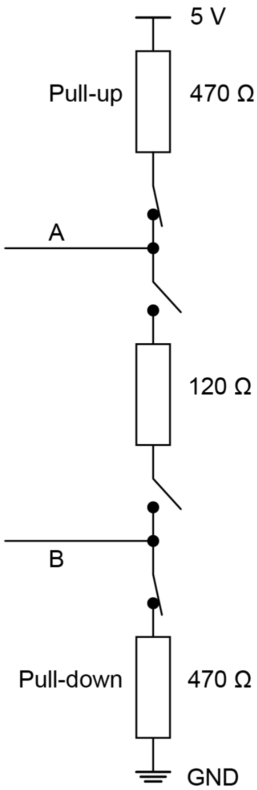
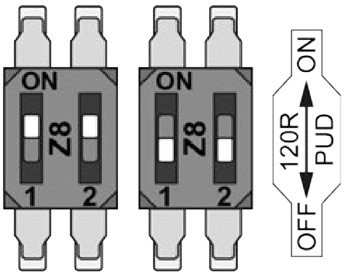
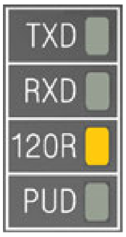
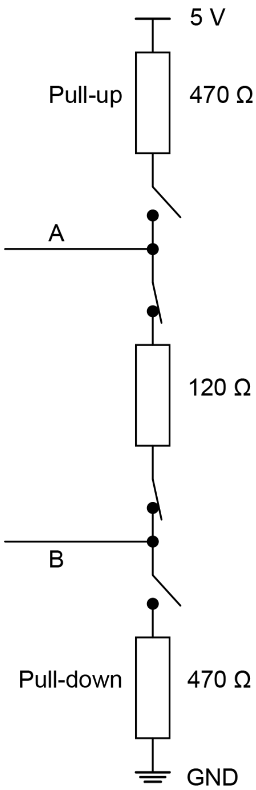
The line ends of the bus segment must be equipped with bus terminating resistors. These resistors are integrated in the module TA5142-RS485I. The pull-up and pull-down settings must also be made on the circuit board of the module.

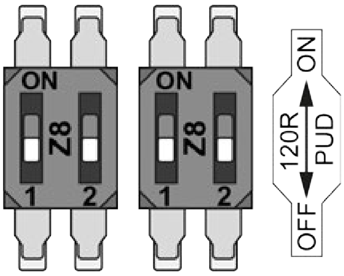
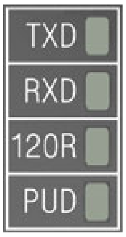
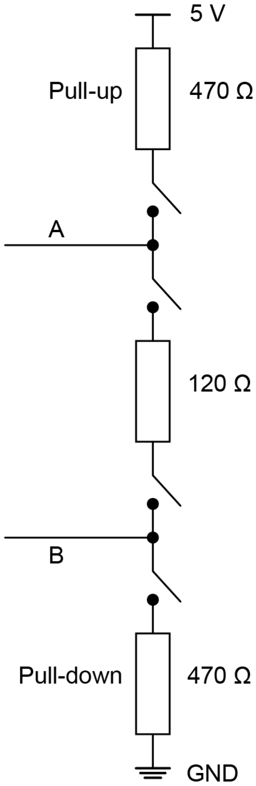


1 Termination resistance settings
2 Pull-up and pull-down settings

Table 35: Configuration

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

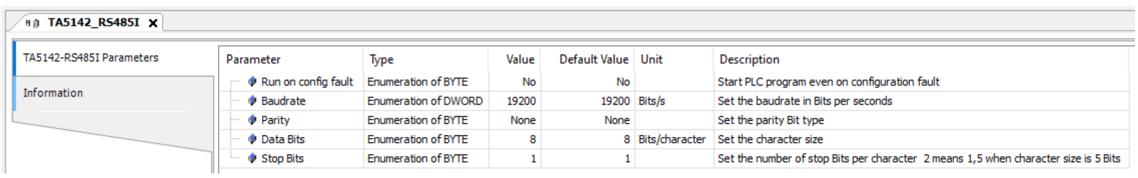
Settings on the module	State of LEDs	Internal wiring diagram	Description
			Master within the bus line, pull-up and pull-down activated
			Slave at the bus line end, bus termination 120 Ω

Settings on the module	State of LEDs	Internal wiring diagram	Description
			Slave within the bus line

Parameterization

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

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



TA5142_RS485I

TA5142-RS485I Parameters

Information

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 2.5.1 “System data AC500-eCo V3” on page 925*

Only additional details are therefore documented below.

Table 36: 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	PM50x2
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

Ordering data

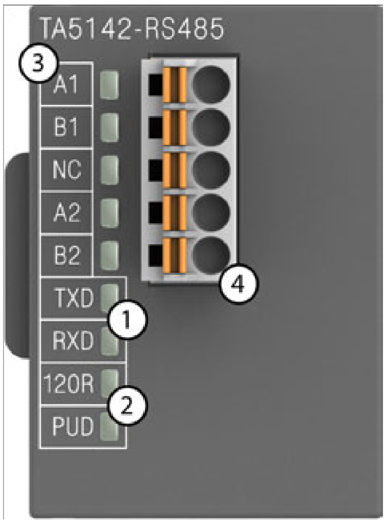
Part no.	Description	Product life cycle phase *)
1SAP 187 300 R0002	TA5142-RS485I: AC500, RS-485 serial adapter isolated option board, spring/cable front terminal, 3.50 mm pitch	Active
Spare parts		
1SAP 187 400 R0012 **)	TA5220-SPF5: spring terminal block, removable, 5-pin, spring front, cable front, 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.

1.3.1.2.8 TA5142-RS485 - Option board for COMx serial communication



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 board for COMx serial communication TA5142-RS485(I) is equipped with 1 RS-485 (2-wire half-duplex) serial interface which can be used for communication via Modbus RTU or CAA SerialCom.

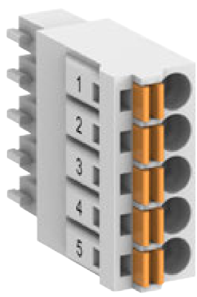
Bus terminations are built-in and configurable.

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 37: TA5142-RS485(I)

Serial interface	Pin	Signal
	1	A1 internally connected to A2
	2	B1 internally connected to B2
	3	GND

Serial interface	Pin	Signal
	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

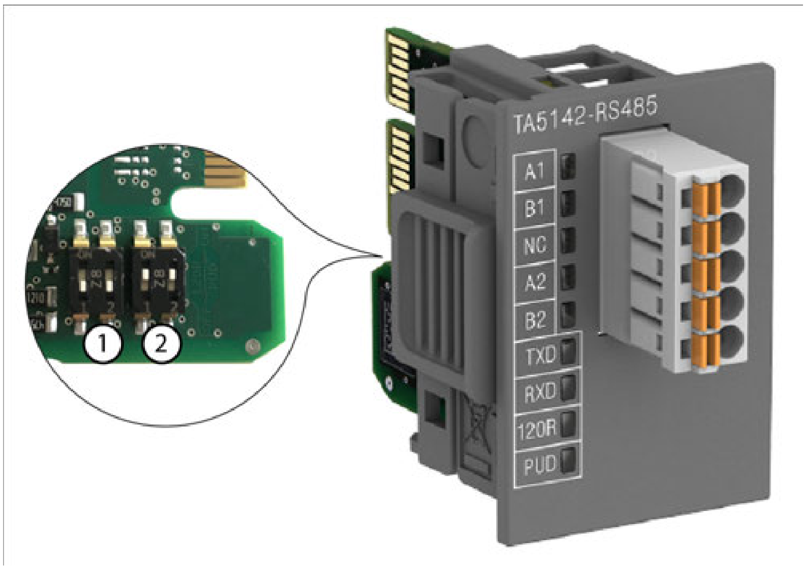
The maximum possible cable length of a serial connection subnet within a segment depends on the transmission rate.

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

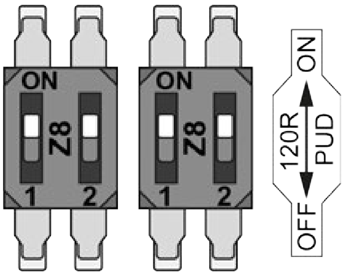
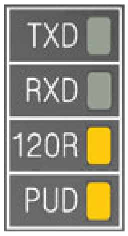
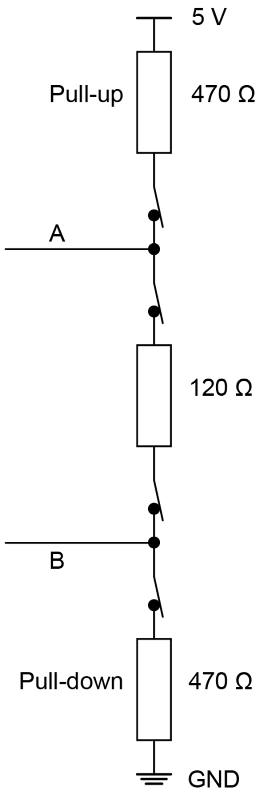
Bus termination

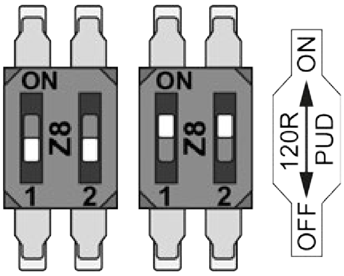
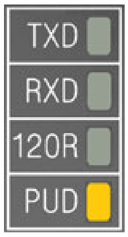
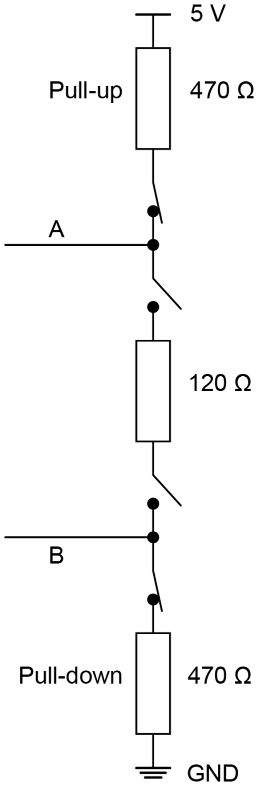
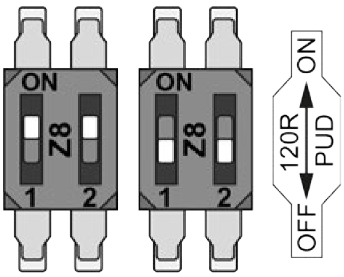
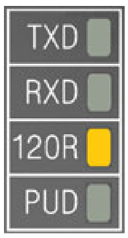
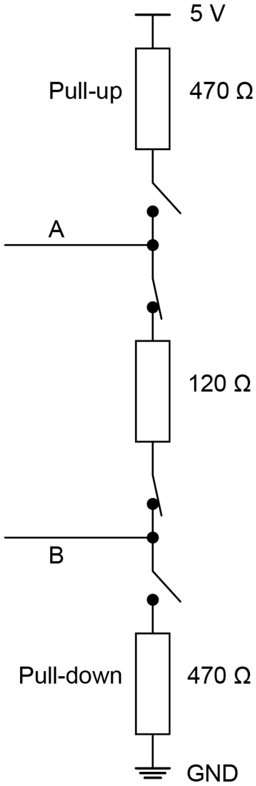
The line ends of the bus segment must be equipped with bus terminating resistors. These resistors are integrated in the module TA5142-RS485. The pull-up and pull-down settings must also be made on the circuit board of the module.

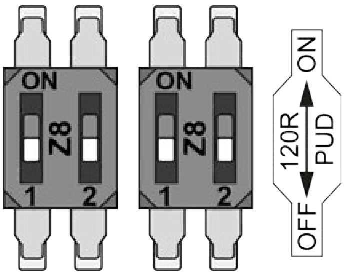
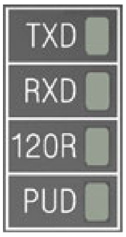
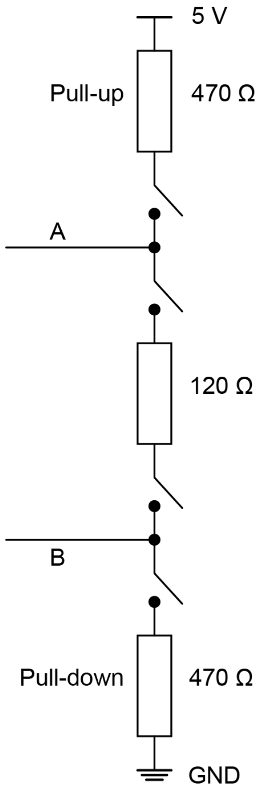


1 Termination resistance settings
2 Pull-up and pull-down settings

Table 38: 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

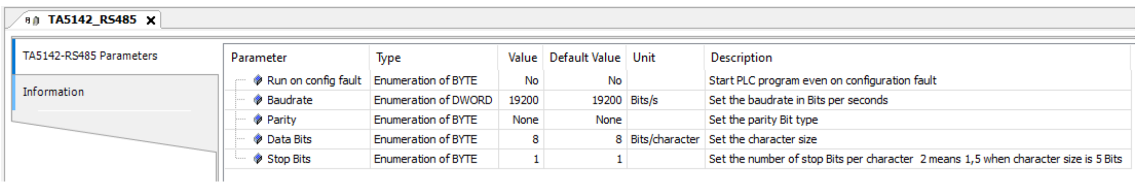
<table>
<tr><th>Settings on the module</th><th>State of LEDs</th><th>Internal wiring diagram</th><th>Description</th></tr>
<tr>
<td>
</td>
<td>
</td>
<td>
</td>
<td>Master within the bus line, pull-up and pull-down activated</td>
</tr>
<tr>
<td>
</td>
<td>
</td>
<td>
</td>
<td>Slave at the bus line end,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

<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 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.



TA5142_RS485

TA5142-RS485 Parameters

Information

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 2.5.1 "System data AC500-eCo V3" on page 925*

Only additional details are therefore documented below.

Table 39: 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	PM50x2
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

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 187 300 R0003	TA5142-RS485: AC500, RS-485 option board for COMx serial communication, spring/cable front terminal, 3.50 mm pitch	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.*

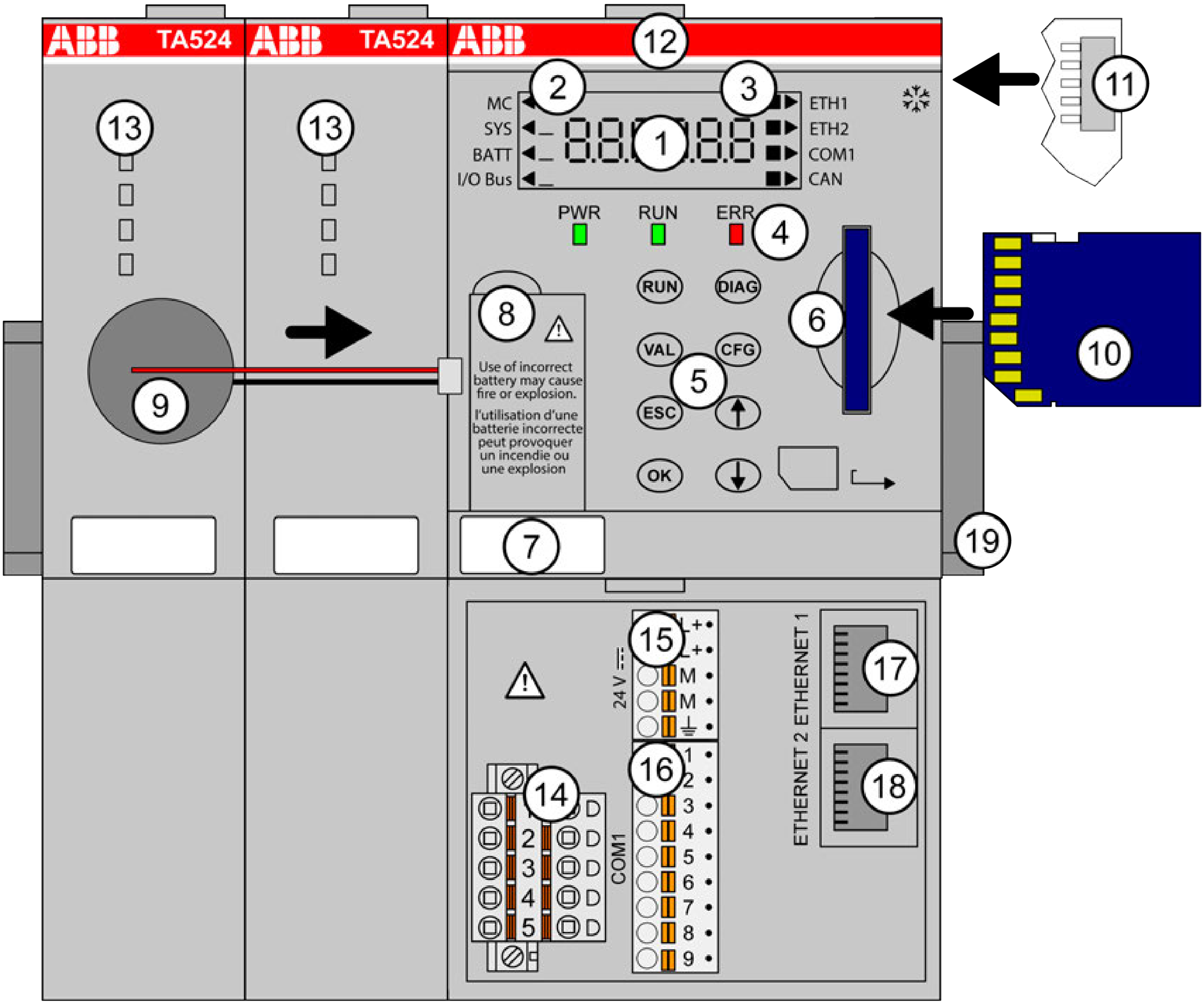
The terminal block listed in the table is for spare part only if needed.

1.3.2 AC500 (standard)

1.3.2.1 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

1.3.2.1.1 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 40: 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
	CM582-DP - PROFIBUS DP V0/V1 slave	No	No	No	No
	CM592-DP - PROFIBUS DP V0/V1 master	1)	1)	1)	1)
	CM579-ETHCAT - EtherCAT master	x	x	x	x
	CM579-PNIO - PROFINET IO RT controller	x	x	x	x
	CM589-PNIO - PROFINET IO RT device	1)	1)	1)	1)
	CM589-PNIO-4 - PROFINET IO RT with 4 devices	1)	1)	1)	1)
	CM597-ETH - Ethernet interface	No	No	No	No
	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	1)	1)	1)	1)
	SM560-S -FD-4 - safety module with F-Device functionality for 1 PROFIsafe network	1)	1)	1)	1)
Remarks: 1) in preparation					

All terminal bases (TB56xx) provide the same communication interfaces (ETH1, ETH2, CAN and COM1). *Chapter 1.2.1.3 “Technical data” on page 11*

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.

1.3.2.1.2 Connections

All terminals for connection are available on the terminal base. For information on connection and available interfaces see the descriptions for

- *Chapter 1.2.1 “TB56xx for AC500 V3 products” on page 4*.

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

Table 41: 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

Processor module	PM5630	PM5650	PM5670	PM5675
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.				

1.3.2.1.3 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.

See system technology - AC500 battery.

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 1.8.2.4 “TA521 - Battery” on page 897*.

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

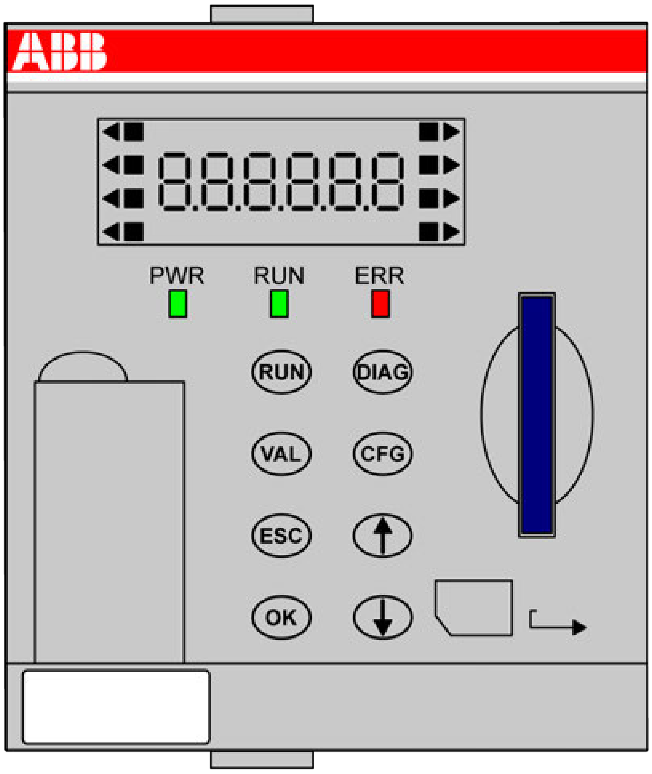
Detailed information can be found in the system technology chapter.

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.

> *Only genuine MC502 memory cards are supported.*

For more information on the technical data, handling instructions and the insertion/replacement of the memory card, please refer to the chapter memory card MC502. ↻ *Chapter 1.8.2.1 “MC502 - Memory card” on page 884*

1.3.2.1.4 LEDs, display and function keys on the front panel



Detailed information on using the LEDs, display and the function keys such as startup procedure and error coding is described in the system technology section .

1.3.2.1.5 Technical data

The system data of AC500 and S500 are applicable to the standard version. *Chapter 2.6.1 "System data AC500" on page 971*

The system data of AC500-XC are applicable to the XC version. *Chapter 2.7.1 "System data AC500-XC" on page 1023*

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: 130 mA PM5675-2ETH: 140 mA

Parameter	Value
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
Connection system	See *Chapter 2.6.4 “Connection and wiring” on page 989*
Weight (processor module without terminal base)	135 g
Mounting position	Horizontal or vertical

Table 42: 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	7 MB	76 MB	144 MB	144 MB
	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		MC502	MC502	MC502	MC502
Processor type		TI ARM Cortex-A9 32-bit-RISC			
Processor 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

Processor module		**PM5630**	**PM5650**	**PM5670**	**PM5675**
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	>32	>32
	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:					
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			

Processor module		PM5630	PM5650	PM5670	PM5675
	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 Inter-faces			
	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 43: 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 44: 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
CM582-DP - PROFIBUS DP V0/V1 slave	No	No	No	No
CM592-DP - PROFIBUS DP V0/V1 master	1)	1)	1)	1)
CM579-ETHCAT - EtherCAT master	x	x	x	x
CM579-PNIO - PROFINET IO RT controller	x	x	x	x
CM589-PNIO - PROFINET IO RT device	1)	1)	1)	1)
CM589-PNIO-4 - PROFINET IO RT with 4 devices	1)	1)	1)	1)
CM597-ETH - Ethernet interface	No	No	No	No
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	1)	1)	1)	1)
SM560-S -FD-4 - safety module with F-Device functionality for 1 PROFIsafe network	1)	1)	1)	1)
Remarks: 1) in preparation				

Communication and onboard protocols

Table 45: OPC UA server / OPC DA server

Processor module	PM5630	PM5650	PM5670	PM5675
OPC UA server	x	x	x	x
Number of free tags + additional license for extension 1)	1.000	5.000	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
Remarks: 1) in preparation				

Table 46: 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 + additional license for extension [1])	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
Remarks: [1]) in preparation					

1.3.2.1.6 Ordering data

Processor modules for AC500 (Standard) V3 products

Part no.	Description	Product life cycle phase *)
1SAP 131 000 R0278	PM5630-2ETH, processor module, memory 8 MB, 24 V DC, memory card slot, interface 1 RS-232/485, display, 2 RJ45 independent onboard Ethernet TCP/IP interfaces with Modbus TCP, web server, IEC60870-5-104 or selectable Ethernet based protocols	Active
1SAP 331 000 R0278	PM5630-2ETH-XC, processor module, memory 8 MB, 24 V DC, memory card slot, interface 1 RS-232/485, display, 2 RJ45 independent onboard Ethernet TCP/IP interfaces with Modbus TCP, web server, IEC60870-5-104 or selectable Ethernet based protocols, XC version	Active
1SAP 141 000 R0278	PM5650-2ETH, processor module, memory 80 MB, 24 V DC, memory card slot, interface 1 RS-232/485, display, 2 RJ45 independent onboard Ethernet TCP/IP interfaces with Modbus TCP, web server, IEC60870-5-104 or selectable Ethernet based protocols	Active
1SAP 341 000 R0278	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

Part no.	Description	Product life cycle phase *)
1SAP 151 000 R0278	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
1SAP 351 000 R0278	PM5670-2ETH-XC, processor module, memory 160 MB, 24 V DC, memory card slot, interface 1 RS-232/485, display, 2 RJ45 independent onboard Ethernet TCP/IP interfaces with Modbus TCP, web server, IEC60870-5-104 or selectable Ethernet based protocols, XC version	Active
1SAP 151 500 R0278	PM5675-2ETH, processor module, memory 160 MB, 8 GB flash disk, 24 V DC, memory card slot, interface 1 RS-232/485, display, 2 RJ45 independent onboard Ethernet TCP/IP interfaces with Modbus TCP, web server, IEC60870-5-104 or selectable Ethernet based protocols	Active
1SAP 351 500 R0278	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

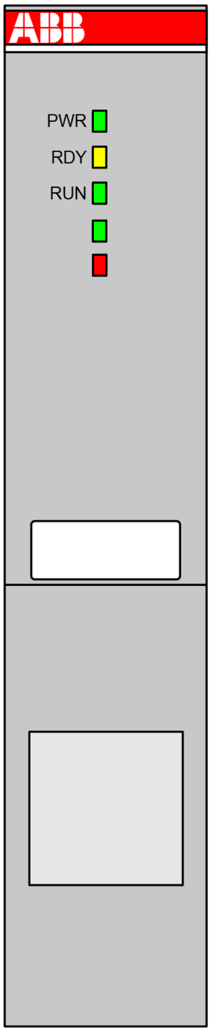
**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

Table 47: Accessories

Part no.	Description
1SAP 180 300 R0001	TA521, lithium battery
1SAP 180 100 R0001	MC502, memory card

1.4 Communication modules (AC500 standard)

1.4.1 Overview



AC500 communication modules are required for

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

AC500 communication modules

- enable communication on different field buses.
- 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.

For information on mounting and demounting, please refer to the chapter mounting and demounting the communication modules *➪ Chapter 2.6.3.5 “Mounting/Demounting the communication modules” on page 987.*

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 1.2.1 “TB56xx for AC500 V3 products” on page 4*

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:

- CMxyz-ETH: Ethernet
- CMxyz-DP: PROFIBUS
- CMxyz-PNIO: PROFINET
- CMxyz-ETHCAT: EtherCAT
- CMxyz-CN: CANopen
- CMxyz-RCOM: RCOM/RCOM+ protocol (and 2 serial interfaces)
- CMxyz-RS: 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.

1.4.1.1 Compatibility of communication modules and communication interface modules

Table 48: 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

Table 49: 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 50: 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 51: 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

1.4.1.2 Technical data (Overview)

Communication module	Field bus	Transmission rate	Field bus connector	Processor	Communication module interface	Current consumption from 24 V DC power supply at the terminal base of the CPU	Internal RAM memory	External RAM memory	External flash memory
CM579-ETHCAT	EtherCAT	10 or 100 MBit/s	2 x RJ45	Hilscher NETX 100	Dual-port memory, 16 kB	Typ. 85 mA	128 kB	8 MB	4 or 8 MB
CM598-CN	CANopen	10 ... 1 MBit/s	COM-BICON 2x 5-pin, bended	Hilscher NETX 100	Dual-port memory, 16 kB	Typ. 65 mA	128 kB	8 MB	8 MB
CM579-PNIO	PROFINET	100 MBit/s	2 x RJ45	Hilscher NETX 100	Dual-port memory, 16 kB	Typ. 85 mA	128 kB	8 MB	4 or 8 MB

1.4.2 Compatibility of communication modules and communication interface modules

Table 52: Modbus TCP

Communication module	Communication interface module	I/O expansion module S500	I/O expansion module S500-eCo	I/O expansion module S500-S	Applications
Onboard Ethernet interface	CI521-MODTCP CI522-MODTCP	x	x	--	high availability, remote I/O

Table 53: 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 54: 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

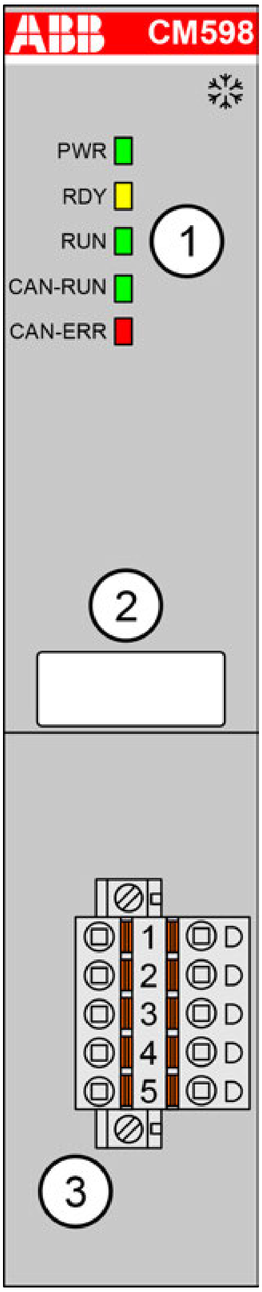
Table 55: EtherCAT

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

1.4.3 CANopen

1.4.3.1 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

1.4.3.1.1 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.*

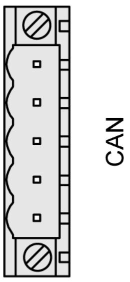
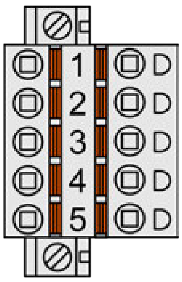
1.4.3.1.2 Connections

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
		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
Terminal block removed	Terminal block inserted			

> **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.

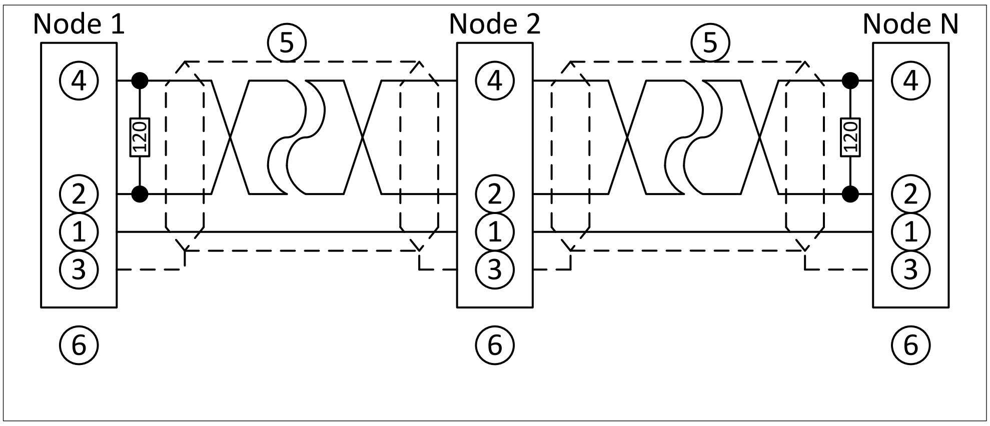


Fig. 4: CANopen interface, bus terminating resistors connected to the line ends

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

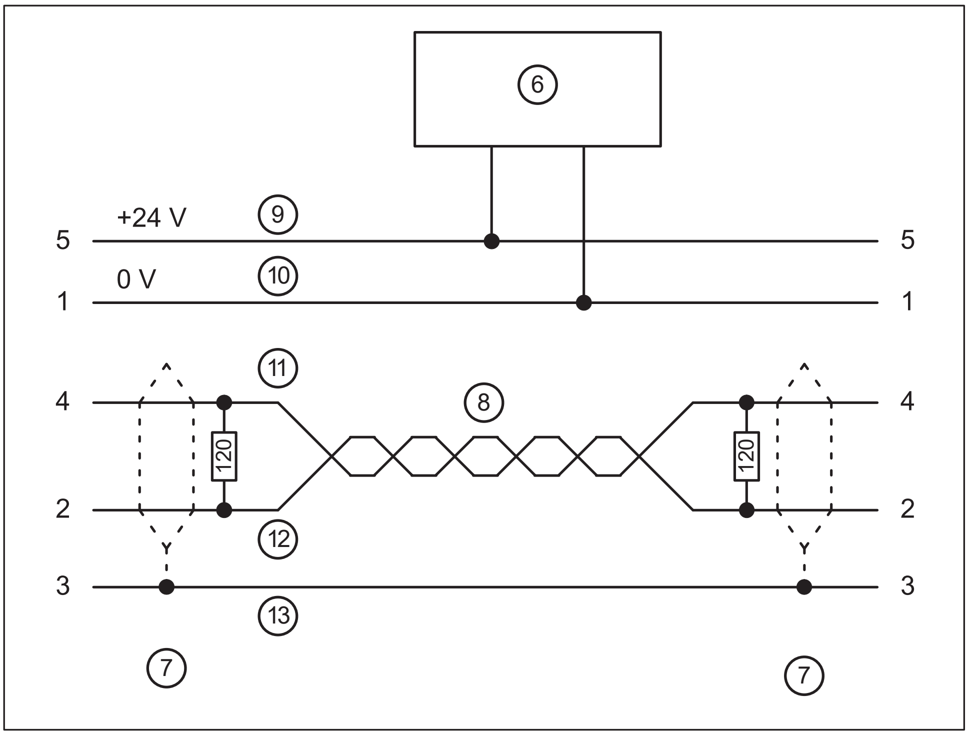


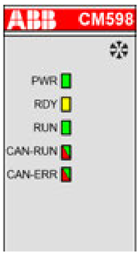
Fig. 5: DeviceNet interface, bus terminating resistors connected to the line ends

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. Please refer to *⇨ Chapter 2.6.1 “System data AC500” on page 971.*

1.4.3.1.3 State LEDs

Table 56: 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!

1.4.3.1.4 Technical data

The system data of AC500 and S500 *Chapter 2.6.1 “System data AC500” on page 971* are applicable to the standard version.

The system data of AC500-XC *Chapter 2.7.1 “System data AC500-XC” on page 1023* are applicable to the XC version.

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 2.6.1 “System data AC500” on page 971* System Data AC500 XC *Chapter 2.7.1 “System data AC500-XC” on page 1023*
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

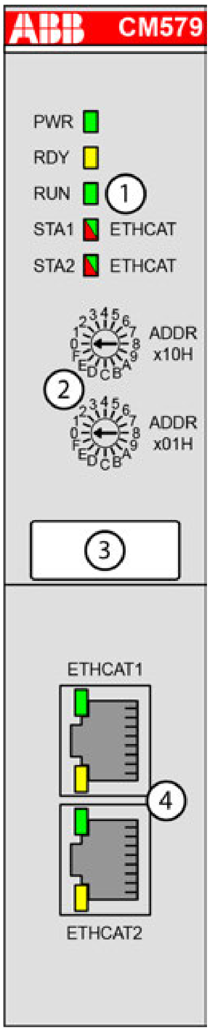
1.4.3.1.5 Ordering data

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.*

1.4.4 EtherCAT

1.4.4.1 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)

1.4.4.1.1 Intended purpose

Communication module CM579-ETHCAT is for EtherCAT communication.

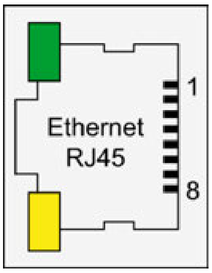
The comunication module is configured via the dual-port memory by means of a system configurator. The configuration is saved on a non-volatile Flash EPROM memory.

1.4.4.1.2 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.

For further information regarding wiring and cable types see chapter Ethernet *➪ Chapter 2.6.4.7 “Ethernet connection details” on page 997.*

The EtherCAT network differentiates between input-connectors (IN) and output-connectors (OUT):

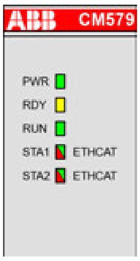
At the EtherCAT slaves (communication interface modules), the ETH1-connector is IN and the ETH2-connector is OUT.

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

1.4.4.1.3 State LEDs

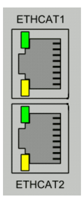
The EtherCAT state is shown by the EtherCAT communication module's LEDs. Some LEDs are two-colored.

Table 57: 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.
	STA2	Red	(alternately)	Do not power off the PLC!

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

Table 58: 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		

1.4.4.1.4 Technical data

The system data of AC500 and S500 ⇘ *Chapter 2.6.1 “System data AC500” on page 971* are applicable to the standard version.

The system data of AC500-XC ⇘ *Chapter 2.7.1 “System data AC500-XC” on page 1023* are applicable to the XC version.

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 1.3.2.1 “PM56xx-2ETH for AC500 V3 products” on page 90*
Usable terminal bases	All TB56xx (not TB5600) ⇘ *Chapter 1.2.1 “TB56xx for AC500 V3 products” on page 4*
Ambient temperature	System data AC500 ⇘ *Chapter 2.6.1 “System data AC500” on page 971* System Data AC500 XC ⇘ *Chapter 2.7.1 “System data AC500-XC” on page 1023*
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

1.4.4.1.5 Ordering data

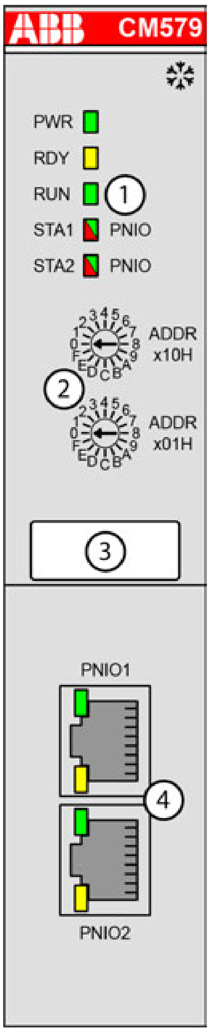
Part no.	Description	Product life cycle phase *)
1SAP 170 902 R0101	CM579-ETHCAT, EtherCAT communication module	Active

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

1.4.5 PROFINET

1.4.5.1 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

1.4.5.1.1 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.

1.4.5.1.2 Functionality

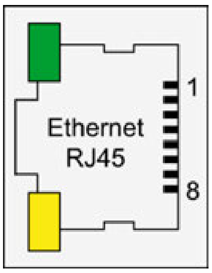
Parameter	Value
Protocol	PROFINET IO RT
Usable CPUs	PM57x, PM58x, PM59x *Chapter 1.3.2.1 “PM56xx-2ETH for AC500 V3 products” on page 90*
Usable terminal bases	All TB56xx (not TB5600) *Chapter 1.2.1 “TB56xx for AC500 V3 products” on page 4*
Field bus connector	2 RJ45 (PNIO1 and PNIO2), with integrated 2-port switch
Internal supply	Via the communication module interface of the terminal base

1.4.5.1.3 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.

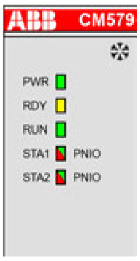
Not supplied with this device.

For further information regarding wiring and cable types see chapter Ethernet *⇘ Chapter 2.6.4.7 “Ethernet connection details” on page 997.*

1.4.5.1.4 State LEDs

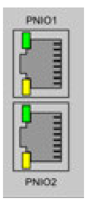
The PROFINET state is shown by the state LEDs.

Table 59: 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 60: 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	---

1.4.5.1.5 Technical data

The system data of AC500 and S500 *Chapter 2.6.1 “System data AC500” on page 971* are applicable to the standard version.

The system data of AC500-XC *Chapter 2.7.1 “System data AC500-XC” on page 1023* are applicable to the XC version.

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 All TB56xx (not TB5600) *Chapter 1.2.1 “TB56xx for AC500 V3 products” on page 4*
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

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".

1.4.5.1.6 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.*

1.5 Terminal units (AC500 standard)

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

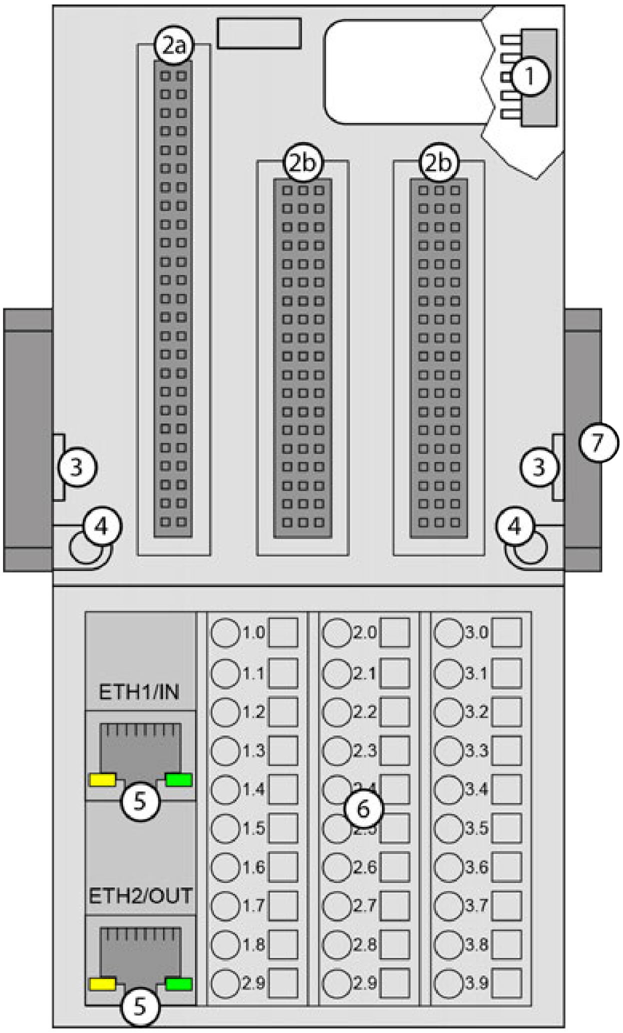
- *Digital outputs are not under load.*
- *Input/output voltages above safety extra low voltage/ protective extra low voltages (SELV/PELV) are switched off.*
- *Modules are completely plugged on the terminal unit with both snap fit engaged before switching on loads or input/output voltage.*

Hot swap

Further information about hot swap: .

1.5.1 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



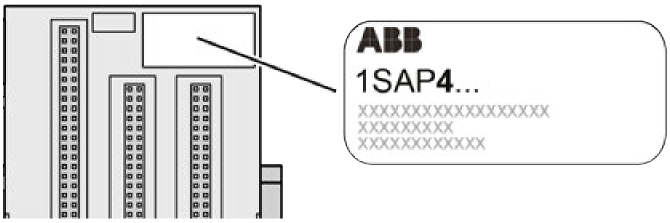
1 I/O bus (10 pins, female) to connect the first terminal unit
2a Plug (2x 25 pins) to connect the inserted Ethernet communication interface module
2b Plug (3x 19 pins) to connect the inserted Ethernet communication interface module
3 With a screwdriver, inserted in this place, the terminal unit and 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).

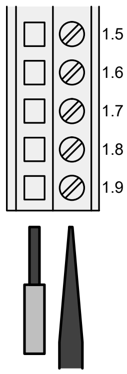
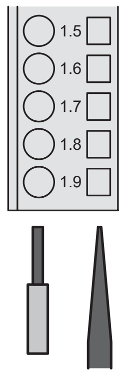
XC version

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)

> – *For information about wiring specifications see the description of the terminal units ⇘ Chapter 2.6.4.3 “Terminals at the terminal unit” on page 990.*
> – *For a detailed description of the mounting, disassembly and connection of the module, please refer to the System Assembly, Construction and Connection chapter ⇘ Chapter 2.6 “AC500 (Standard)” on page 971.*
> – *For information about mechanical dimensions, please refer to the Mechanical dimensions S500 chapter ⇘ Chapter 2.6.2.3 “Mechanical dimensions S500” on page 979*

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 1.8.3.4 “TA535 - Protective caps for XC devices” on page 906*

1.5.1.1 Technical data

The system data of AC500 and S500 *Chapter 2.6.1 “System data AC500” on page 971* are applicable to the standard version.

The system data of AC500-XC *Chapter 2.7.1 “System data AC500-XC” on page 1023* are applicable to the XC version.

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

1.5.1.2 Ordering data

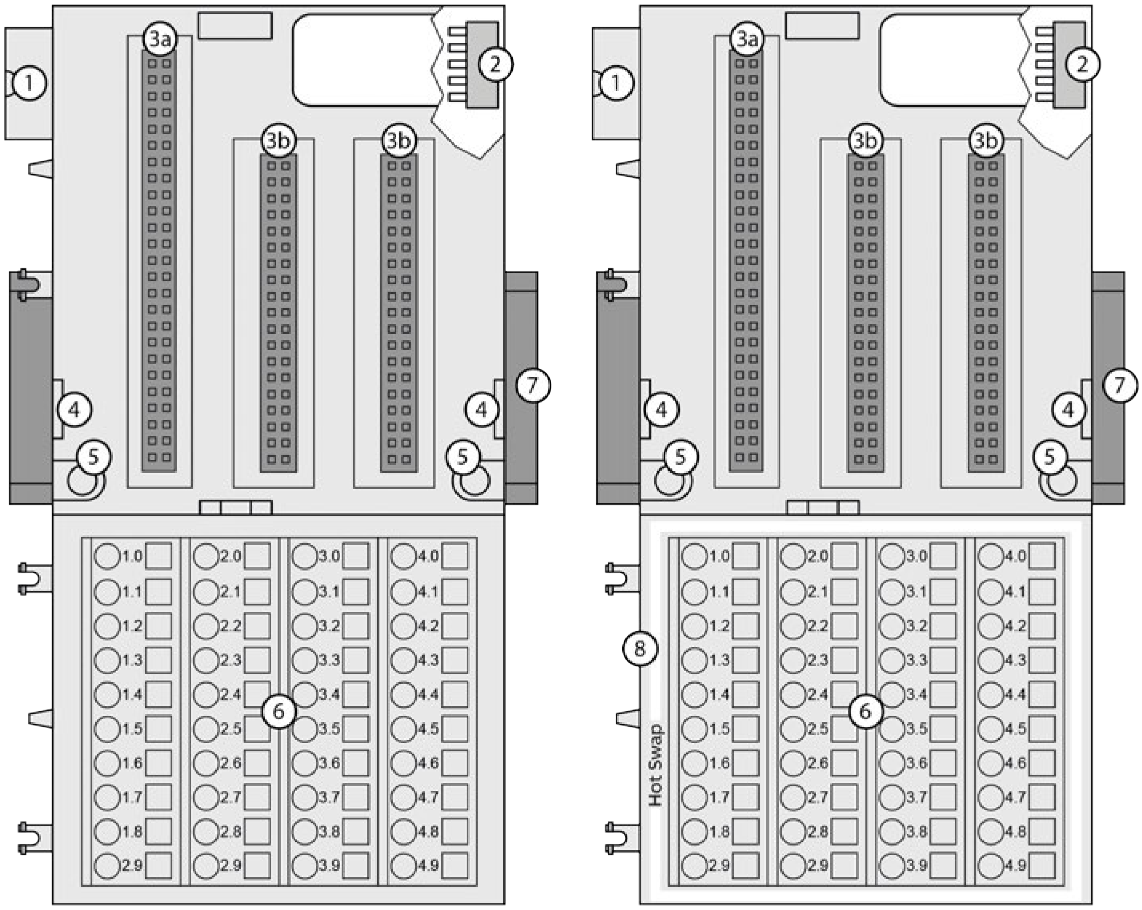
Part no.	Description	Product life cycle phase *)
1SAP 214 200 R0001	TU507-ETH, Ethernet terminal unit, 24 V DC, screw terminals	Active
1SAP 214 000 R0001	TU508-ETH, Ethernet terminal unit, 24 V DC, spring terminals	Active
1SAP 414 000 R0001	TU508-ETH-XC, Ethernet terminal unit, 24 V DC, spring terminals, XC version	Active

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

1.5.2 TU515, TU516, TU541 and TU542 for I/O modules

- TU515, I/O terminal unit, 24 V DC, screw terminals
- TU516, I/O terminal unit, 24 V DC, spring terminals
- TU516-XC, I/O terminal unit, 24 V DC, spring terminals, XC version
- TU516-H, I/O terminal unit, hot swap, 24 V DC, spring terminals
- TU516-H-XC, I/O terminal unit, hot swap, 24 V DC, spring terminals, XC version
- TU541, I/O terminal unit, 24 V DC, screw terminals
- TU542, I/O terminal unit, 24 V DC, spring terminals
- TU542-XC, I/O terminal unit, 24 V DC, spring terminals, XC version
- TU542-H, I/O terminal unit, hot swap, 24 V DC, spring terminals
- TU542-H-XC, I/O terminal unit, hot swap, 24 V DC, spring terminals, XC version

The input/output modules plug into the I/O terminal unit. When properly seated, they are secured with two mechanical locks. All the connections are established via the terminal unit, which allows removal and replacement of the I/O modules without disturbing the wiring at the terminal unit.



1 I/O bus (10 pins, male) to connect the previous terminal unit, the CPU terminal base or the communication interface module to the terminal unit
2 I/O bus (10 pins, female) to connect other terminal units
3a Plug (2 x 25 pins) to connect the inserted I/O modules
3b Plug (2 x 19 pins) to connect the inserted I/O modules
4 With a screwdriver inserted in this place, the terminal unit and the adjacent terminal unit can be shoved from each other
5 Holes for screw mounting
6 40 terminals for signals and process supply voltage
7 DIN rail
8 White border signifies hot swap capability of the terminal unit

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

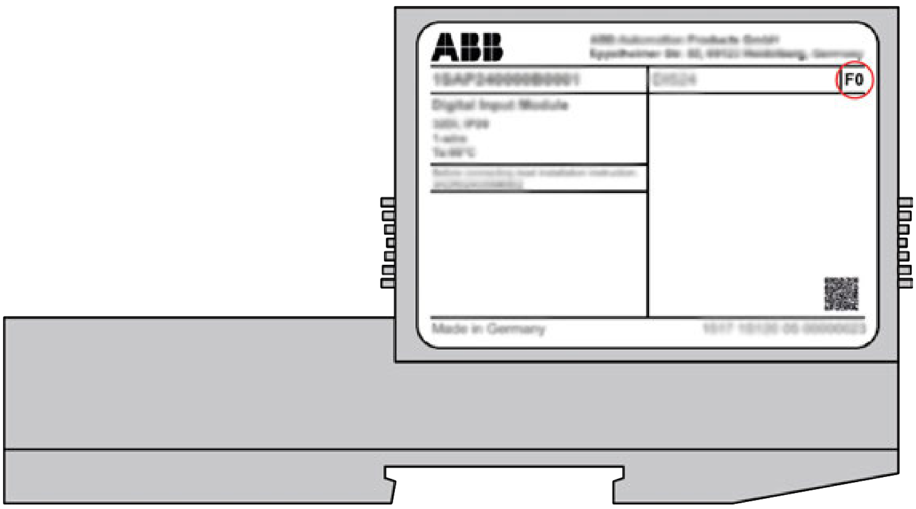
Hot swap
System requirements for hot swapping of I/O modules:

- *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.

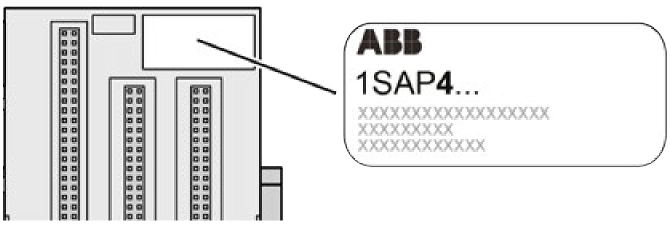
For min. required device index see table below.

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
DC561	B2
DC562	A2
DI524 (-XC)	D2
DI561	B2
DI562	B2
DI571	B2

Device	Min. required device index for I/O module as of FW Version 3.0.14
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

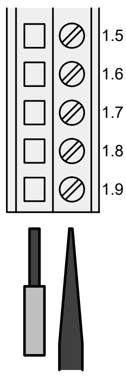
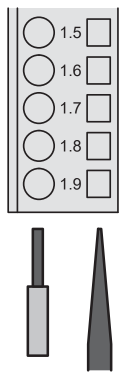
XC version

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)

- *For information about wiring specifications see the description of the terminal units ⇨ Chapter 2.6.4.3 “Terminals at the terminal unit” on page 990.*
- *For a detailed description of the mounting, disassembly and connection of the module, please refer to the System Assembly, Construction and Connection chapter ⇨ Chapter 2.6 “AC500 (Standard)” on page 971.*
- *For information about mechanical dimensions, please refer to the Mechanical dimensions S500 chapter ⇨ Chapter 2.6.2.3 “Mechanical dimensions S500” on page 979*

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).

1.5.2.1 Technical data

The system data of AC500 and S500 ⇨ *Chapter 2.6.1 “System data AC500” on page 971* are applicable to the standard version.

The system data of AC500-XC ⇨ *Chapter 2.7.1 “System data AC500-XC” on page 1023* are applicable to the XC version.

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
Grounding	Direct connection to the grounded DIN rail or via the screws with wall mounting

Parameter	Value
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

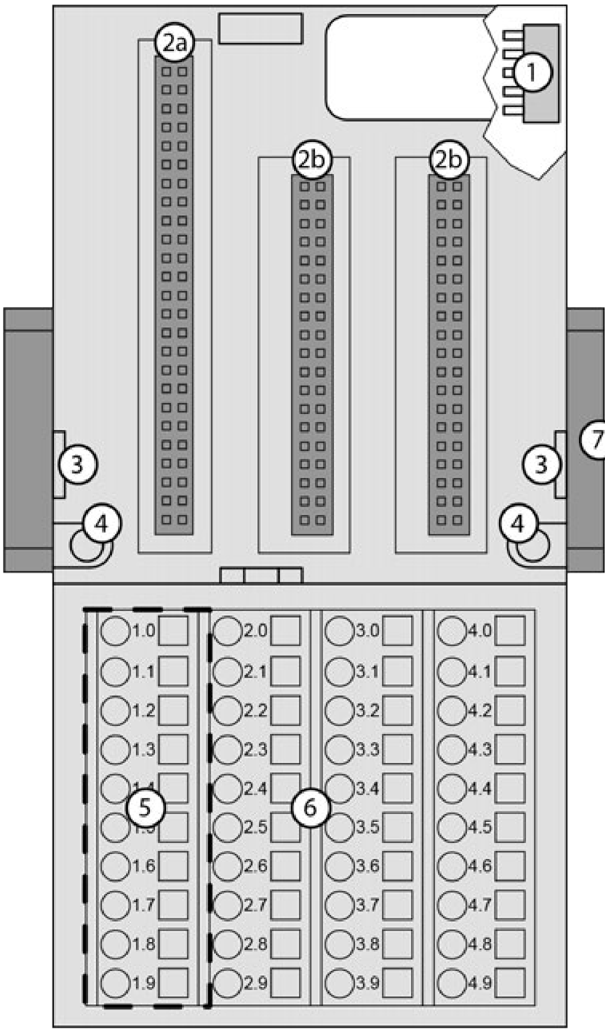
1.5.2.2 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 212 200 R0001	TU515, I/O terminal unit, 24 V DC, screw terminals	Active
1SAP 212 000 R0001	TU516, I/O terminal unit, 24 V DC, spring terminals	Active
1SAP 412 000 R0001	TU516-XC, I/O terminal unit, 24 V DC, spring terminals, XC version	Active
1SAP 215 000 R0001	TU516-H, I/O terminal unit, hot swap, 24 V DC, spring terminals, XC version	Active
1SAP 415 000 R0001	TU516-H-XC, I/O terminal unit, hot swap, 24 V DC, spring terminals	Active
1SAP 213 000 R0001	TU541, I/O terminal unit, 24 V DC, screw terminals	Active
1SAP 213 200 R0001	TU542, I/O terminal unit, 24 V DC, spring terminals	Active
1SAP 413 200 R0001	TU542-XC, I/O terminal unit, 24 V DC, spring terminals, XC version	Active
1SAP 215 200 R0001	TU542-H, I/O terminal unit, hot swap, 24 V DC, spring terminals	Active
1SAP 415 200 R0001	TU542-H-XC, I/O terminal unit, hot swap, 24 V DC, spring terminals, XC version	Active

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

1.5.3 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



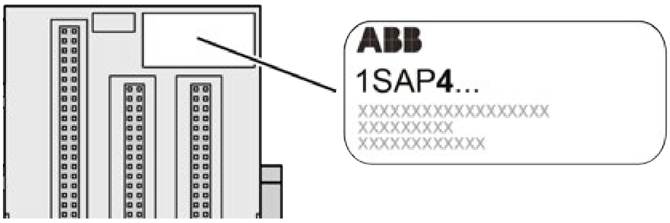
1 I/O bus (10 pins, female) to connect the first terminal unit
2a Plug (2 25 pins) to connect the inserted communication interface module
2b Plug (2 19 pins) to connect the inserted communication interface module
3 With a screwdriver, inserted in this place, the terminal unit and the adjacent I/O terminal 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):

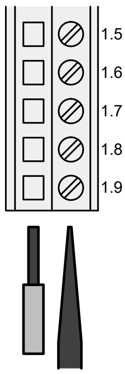
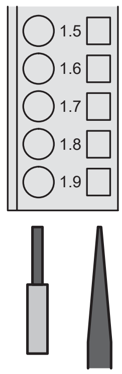
- CANopen communication interface modules
- DeviceNet modules
- PROFIBUS DP communication interface modules

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)

> – *For information about wiring specifications see the description of the terminal units* *↯ Chapter 2.6.4.3 "Terminals at the terminal unit" on page 990.*
> – *For a detailed description of the mounting, disassembly and connection of the module, please refer to the System Assembly, Construction and Connection chapter* *↯ Chapter 2.6 "AC500 (Standard)" on page 971.*
> – *For information about mechanical dimensions, please refer to the Mechanical dimensions S500 chapter* *↯ Chapter 2.6.2.3 "Mechanical dimensions S500" on page 979*

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).

1.5.3.1 Technical data

The system data of AC500 and S500 ↯ *Chapter 2.6.1 "System data AC500" on page 971* are applicable to the standard version.

The system data of AC500-XC ↬ *Chapter 2.7.1 “System data AC500-XC” on page 1023* are applicable to the XC version.

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

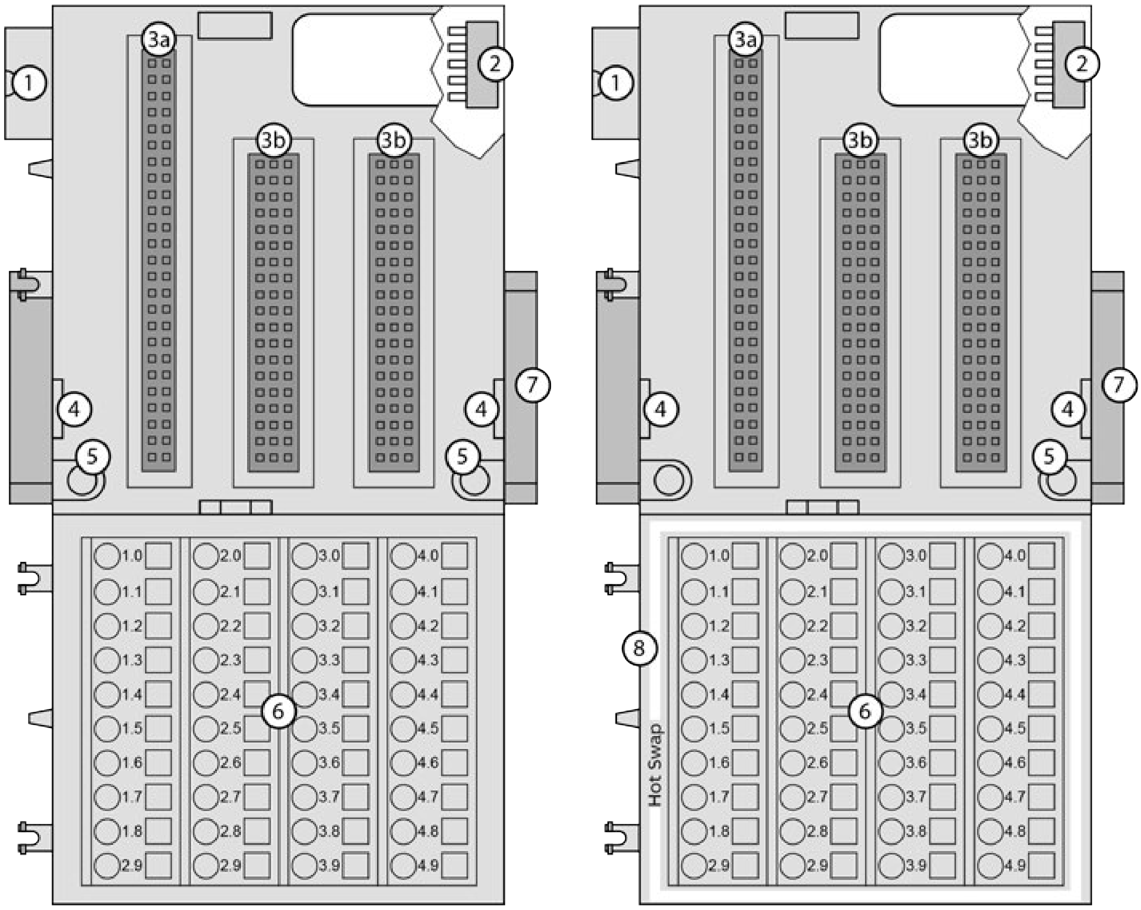
1.5.3.2 Ordering data

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.*

1.5.4 TU531 and TU532 for I/O modules

- TU531, I/O terminal unit, 230 V AC, screw terminals
- TU532, I/O terminal unit, 230 V AC, spring terminals
- TU532-XC, I/O terminal unit, 230 V AC, spring terminals, XC version
- TU532-H, I/O terminal unit, hot swap, 230 V AC, spring terminals
- TU532-H-XC, I/O terminal unit, hot swap, 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 115-230 V AC inputs and/or 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

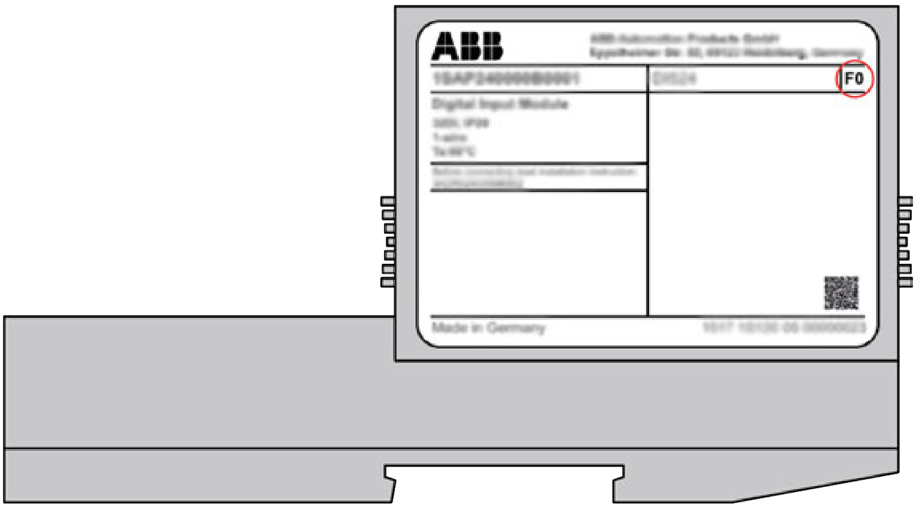
Hot swap
System requirements for hot swapping of I/O modules:

- *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.

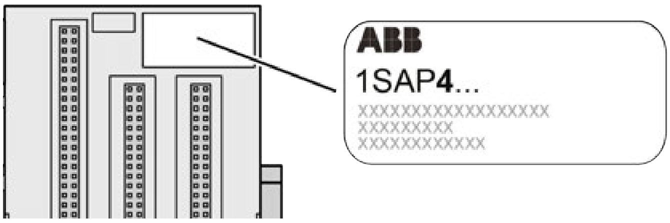
For min. required device index see table below.

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
DC561	B2
DC562	A2
DI524 (-XC)	D2
DI561	B2
DI562	B2
DI571	B2

Device	Min. required device index for I/O module as of FW Version 3.0.14
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

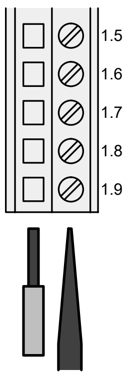
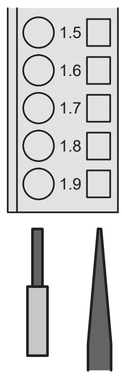


Extreme conditions

Terminal units for use in extreme ambient conditions have no sign for XC version.

*The figure **4** in the Part no. 1SAP**4**... (label) identifies the XC version.*

Terminals

Screw terminals			**Spring terminals**		
Conductor		Screwdriver	Conductor		Screwdriver (opens terminal)

- *For information about wiring specifications see the description of the terminal units* *⇨ Chapter 2.6.4.3 “Terminals at the terminal unit” on page 990.*
- *For a detailed description of the mounting, disassembly and connection of the module, please refer to the System Assembly, Construction and Connection chapter* *⇨ Chapter 2.6 “AC500 (Standard)” on page 971.*
- *For information about mechanical dimensions, please refer to the Mechanical dimensions S500 chapter* *⇨ Chapter 2.6.2.3 “Mechanical dimensions S500” on page 979*

The terminals 1.8 to 4.8 and 1.9 to 4.9 are electrically interconnected within the terminal unit and always have the same assignment, independent of the inserted module:

- Terminals 1.8 to 4.8: process supply voltage UP = +24 V DC
- Terminals 1.9 to 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).

1.5.4.1 Technical data

The system data of AC500 and S500 *⇨ Chapter 2.6.1 “System data AC500” on page 971* are applicable to the standard version.

The system data of AC500-XC *⇨ Chapter 2.7.1 “System data AC500-XC” on page 1023* are applicable to the XC version.

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.

1.5.4.2 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 217 200 R0001	TU531, terminal unit, 230 V AC, relays, screw terminals	Active
1SAP 217 000 R0001	TU532, terminal unit, 230 V AC, relays, spring terminals	Active
1SAP 417 000 R0001	TU532-XC, terminal unit, 230 V AC, relays, spring terminals, XC version	Active
1SAP 215 100 R0001	TU532-H, terminal unit, hot swap, 230 V AC, relays, spring terminals	Active
1SAP 415 100 R0001	TU532-H-XC, terminal unit, hot swap, 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.*

1.6 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.*

Hot swap

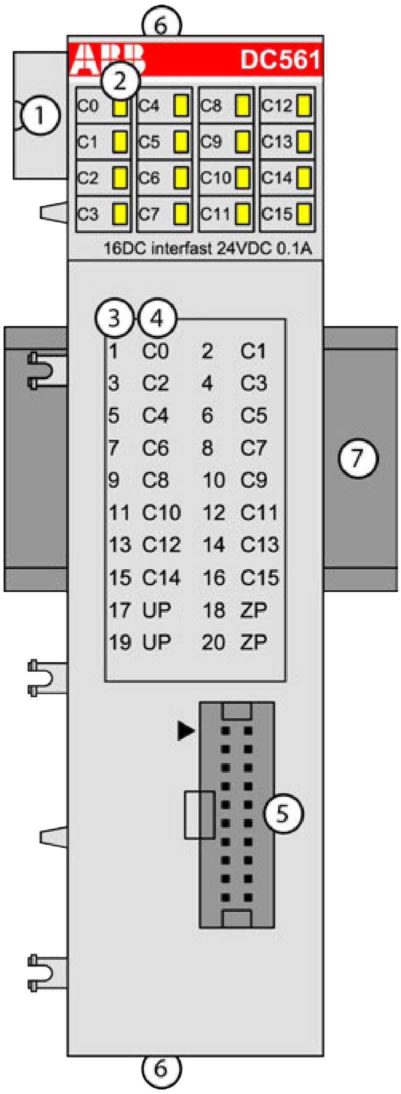
Further information about hot swap: .

1.6.1 Digital I/O modules

1.6.1.1 S500-eCo

1.6.1.1.1 DC561 - Digital input/output module

- 16 configurable digital inputs/outputs 24 V DC,
- Connection via Interfast
- Module-wise galvanically isolated



1 I/O bus
2 16 yellow LEDs to display the states of the inputs/outputs C0 to C15
3 Terminal number
4 Allocation of signal name
5 Interfast connector (20-pin)
6 2 holes for wall-mounting with screws
7 DIN rail

Intended purpose

The digital I/O module DC561 can be connected to the following devices via the I/O bus connector:

- S500 communication interface modules (e. g. CI501-PNIO, CI541-DP, CI581-CN)
- AC500 CPUs
- other AC500 I/O modules

> *The I/O module must not be used as a decentralized I/O module with CI590-CS31-HA communication interface modules.*

The module contains 16 digital channels in 1 group, each channel can be used as a digital 24 V DC input or 24 V DC output.

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
Digital inputs	Max. 16 (24 V DC), can be used as sink inputs
Digital outputs	Max. 16 (transistor outputs 24 V DC, max. 0.1 A)
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)

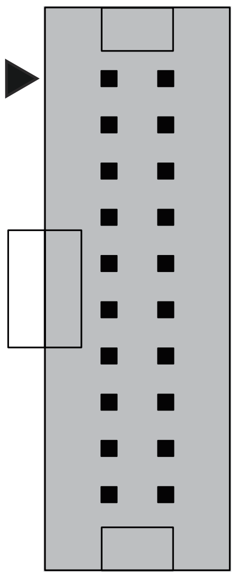
Connections

> *For a detailed description of the mounting, disassembly and connection of the module, please refer to the System Assembly chapter* *➫ Chapter 2.5 “AC500-eCo” on page 925.*

The connection is established out by using the 20-pin Interfast connector. For further information, refer to the Interfast documentation.

The assignment of the terminals:

Table 61: Assignment of the terminals for DC561

	PIN	Signal	Description
	1	C0	Input/output signal C0
	2	C1	Input/output signal C1
	3	C2	Input/output signal C2
	4	C3	Input/output signal C3
	5	C4	Input/output signal C4
	6	C5	Input/output signal C5
	7	C6	Input/output signal C6
	8	C7	Input/output signal C7
	9	C8	Input/output signal C8
	10	C9	Input/output signal C9
	11	C10	Input/output signal C10
	12	C11	Input/output signal C11
	13	C12	Input/output signal C12
	14	C13	Input/output signal C13
	15	C14	Input/output signal C14
	16	C15	Input/output signal C15
	17	UP	Process voltage UP +24 V DC
	18	ZP	Process voltage ZP 0 V DC

	PIN	Signal	Description
	19	UP	Process voltage UP +24 V DC
	20	ZP	Process voltage ZP 0 V DC

The arrow located next to the Interfast connector marks terminal 1.

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 DC561.

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.

If DC561 with index A0 is used, the process supply voltage must stem from the same source as the power supply voltage of the CPU. The index consists of 1 letter, followed by 1 digit, and can be found on the type plate of the module next to the type designator "DC561".

The module provides several diagnosis functions *Chapter 1.6.1.1.1.6 “Diagnosis” on page 147*.

The meaning of the LEDs is described in the section State LEDs *Chapter 1.6.1.1.1.7 “State LEDs” on page 147*.

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	6100 [1])	WORD	6100 0x17D4	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 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) =	0x25, 0x17, 0x00;

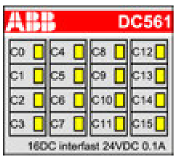
Diagnosis

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 DI571							
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/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 2.5.1 “System data AC500-eCo V3” on page 925*

Only additional details are therefore documented below.

Parameter		Value
Process voltage UP		
	Connections	Terminals 17 and 19 for UP (+24 V DC); terminals 18 and 20 for ZP (0 V)
	Rated value	24 V DC
	Current consumption via UP terminal	10 mA + 0.1 A per output (max.)
	Max. ripple	5 %
	Inrush current	0.000001 A^2s
	Protection against reversed voltage	Yes
	Protection fuse on UP	Recommended; the outputs must be protected by an 1 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/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		On request
Input data length		2 bytes
Output data length		2 bytes
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 switchgear 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	Terminals 18 and 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 via 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		Terminals 18 and 20 (negative pole of the process voltage, signal name ZP)
Common power supply voltage		Terminals 17 and 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 via 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.)	0.1 A at UP 24 V DC
	Rated current per group (max.)	1.6 A

Parameter		Value
	Rated current (all channels together, max.)	1.6 A
	Lamp load (max.)	Not applicable
	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)		1 A fast
Demagnetization when inductive loads are switched off		Must be performed externally according to load specification
Switching frequency		
	With inductive loads	Max. 0.5 Hz
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

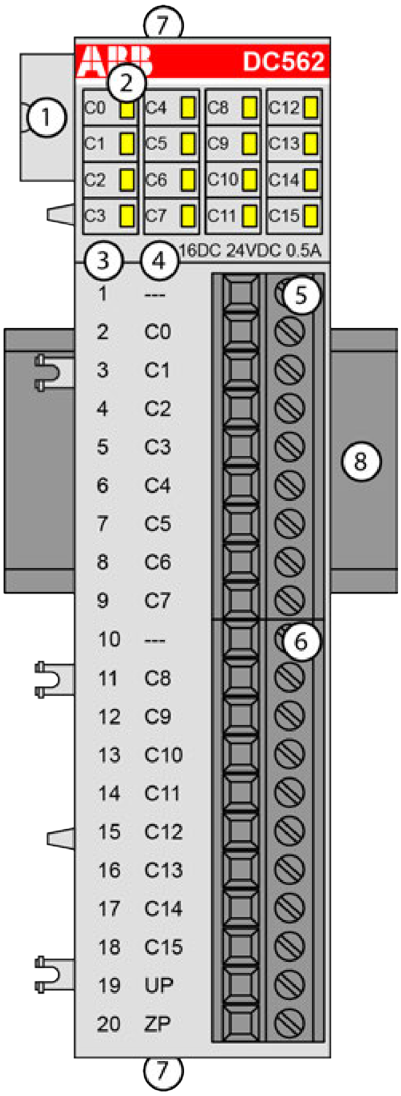
Ordering data

Part no.	Description	Product life cycle phase *)
1TNE 968 902 R2001	DC561, digital input/output module, 16 configurable inputs/outputs, transistor output, interfast connector	Classic

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

1.6.1.1.2 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 to 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 iInterface 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 System Assembly chapter *➮ Chapter 2.5 “AC500-eCo” on page 925.*

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.

The following block diagram shows the internal construction of the digital inputs and outputs:

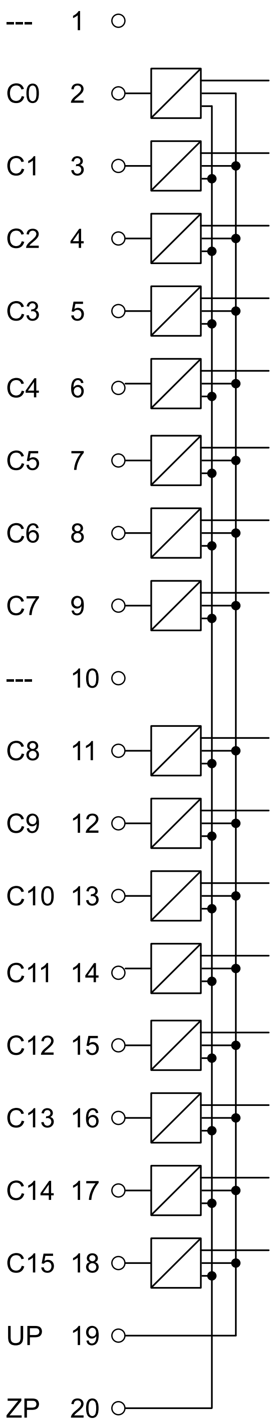


Table 62: Assignment of the terminals:

Terminal	Signal	Description
1	---	Reserved
2	C0	Input/output signal C0
3	C1	Input/output signal C1
4	C2	Input/output signal C2
5	C3	Input/output signal C3
6	C4	Input/output signal C4
7	C5	Input/output signal C5

Terminal	Signal	Description
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!

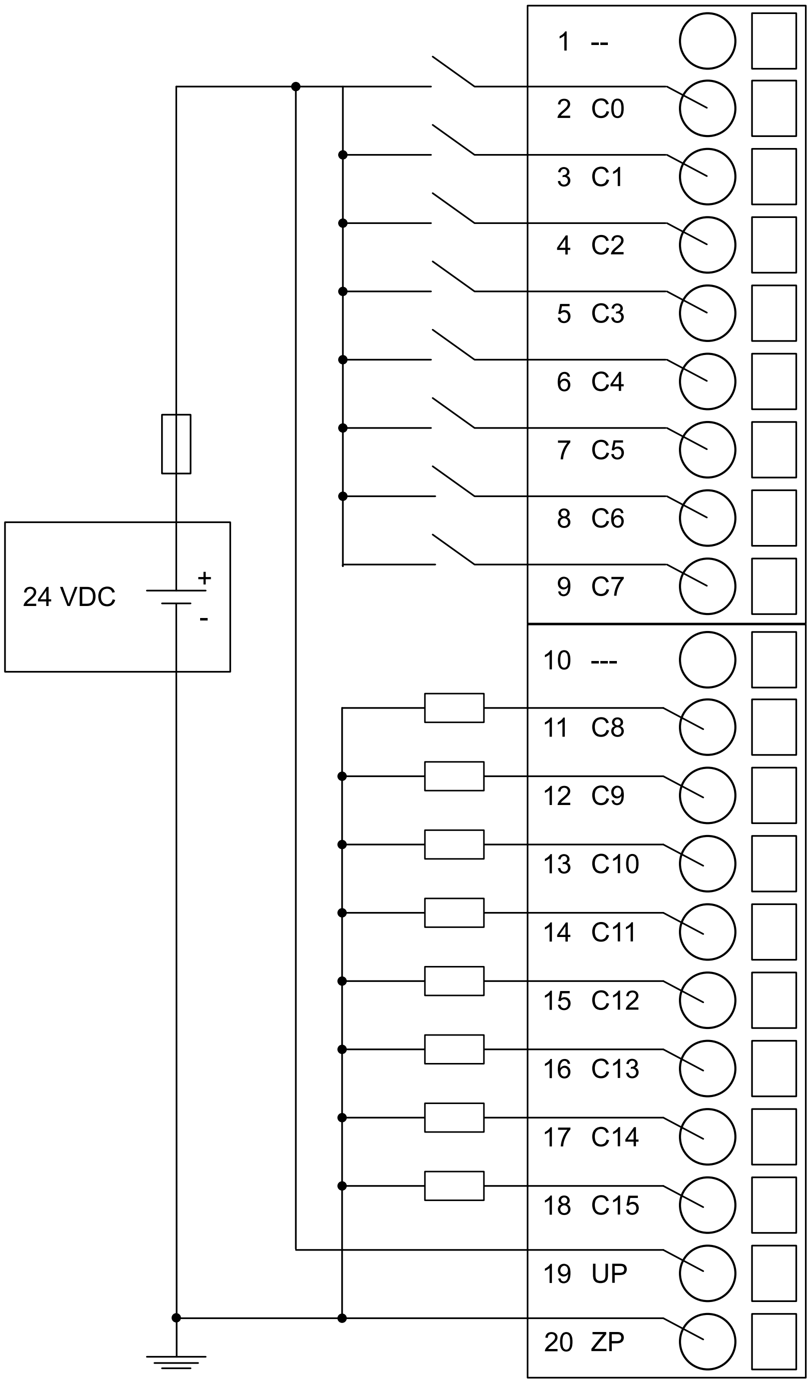
Risk of damaging the PLC modules!

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.

The following figure shows the 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 1.6.1.1.2.6 “Diagnosis” on page 157*.

The meaning of the LEDs is described in the section State LEDs *Chapter 1.6.1.1.2.7 “State LEDs” on page 157*.

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;

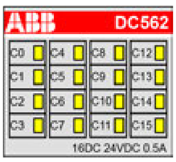
Diagnosis

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 2.5.1 “System data AC500-eCo V3” on page 925*

Only additional details are therefore documented below.

Parameter		Value
Process voltage UP		
	Connections	Terminal 19 for UP (+24 V DC) and terminal 20 for ZP (0 V)
	Rated value	24 V DC
	Current consumption via UP terminal	90 mA + 0.5 A per output (max.)
	Max. ripple	5 %
	Inrush current	0.000001 A^2s
	Protection against reversed voltage	Yes
Current consumption from 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module		Ca. 10 mA
Galvanic isolation		Yes, between the input/output group and the rest of the module
	Isolated groups	1 group for 16 channels
Surge voltage (max.)		35 V DC for 0.5 s
Max. power dissipation within the module		4.8 W
Input data length		2 bytes
Output data length		2 bytes
Weight		Ca. 125 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switchgear 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)
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

Parameter		Value
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
	Rated current (all channels together, max.)	8 A
	Lamp load (max.)	5 W

Parameter		Value
	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

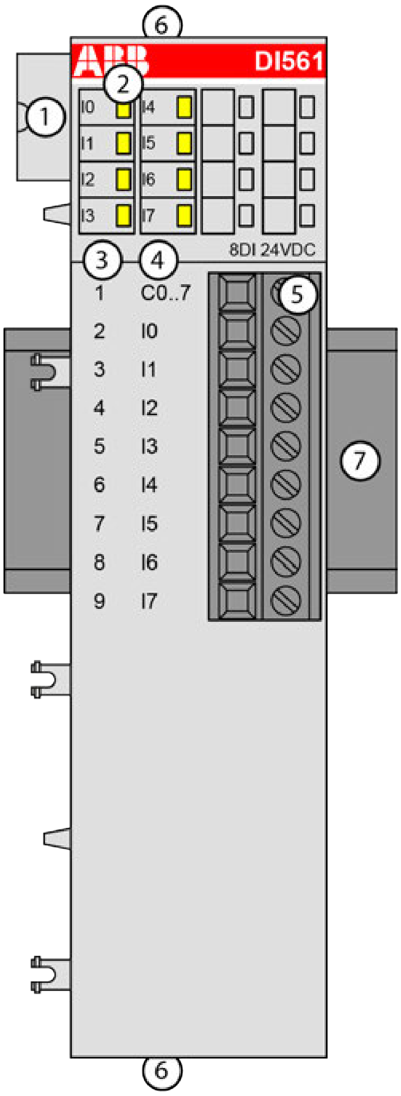
Ordering data

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.*

1.6.1.1.3 DI561 - Digital input module

- 8 digital inputs 24 V DC / 24 V AC (I0 to 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 iInterface 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 System Assembly chapter *⇘ Chapter 2.5 "AC500-eCo" on page 925.*

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.

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

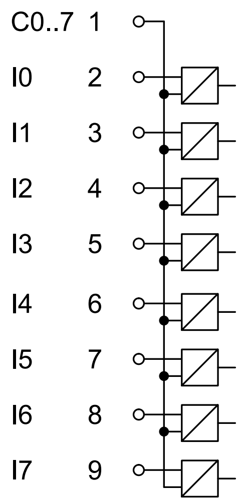


Table 63: Assignment of the terminals:

Terminal	Signal	Description
1	C0...7	Input common for signals I0 to I7
2	I0	Input signal I0
3	I1	Input signal I1

Terminal	Signal	Description
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.

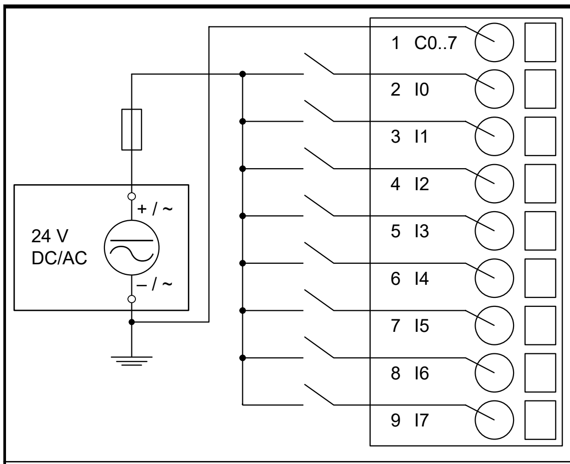
– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

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

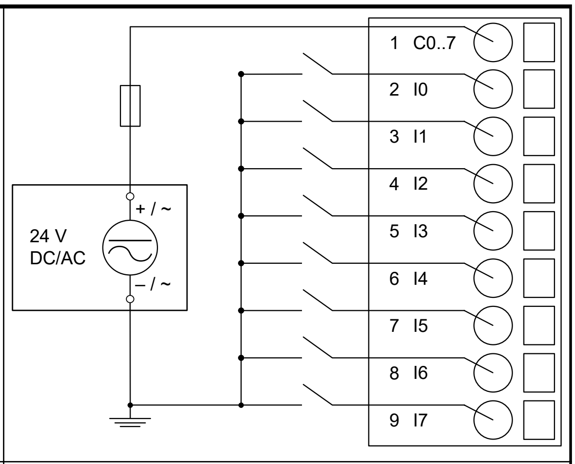
NOTICE!
Risk of malfunctions in the plant!
A ground fault, e. g. caused by a damaged cable insulation, can bridge switches accidentally.

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

The following figure shows the connection of the digital input module DI561:



Connection of DI561 - sink inputs



Connection of DI561 - source inputs

The module provides several diagnosis functions *Chapter 1.6.1.1.3.6 “Diagnosis” on page 165*.

The meaning of the LEDs is described in the section State LEDs *Chapter 1.6.1.1.3.7 “State LEDs” on page 166*.

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;

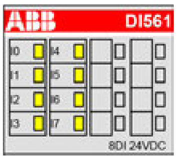
Diagnosis

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 2.5.1 “System data AC500-eCo V3” on page 925*

Only additional details are therefore documented below.

Parameter		Value
Galvanic isolation		Yes, between the input group and the rest of the module
	Isolated groups	1 (8 channels per group)
Current consumption from 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module		Ca. 10 mA
Max. power dissipation within the module		1.6 W
Weight		Ca. 110 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switchgear 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 to 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])

Parameter	Value		
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.

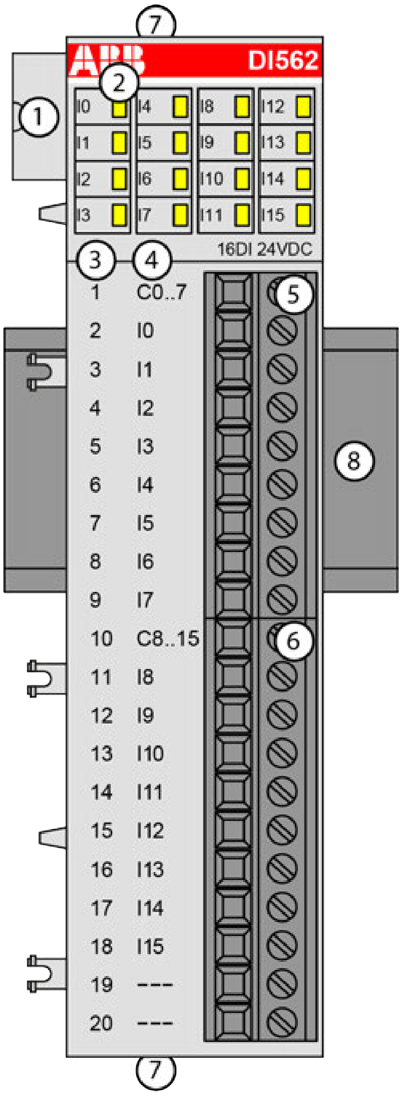
Ordering data

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.*

1.6.1.1.4 DI562 - Digital input module

- 16 digital inputs 24 V DC / 24 V AC (I0 to 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 to 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 iInterface 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

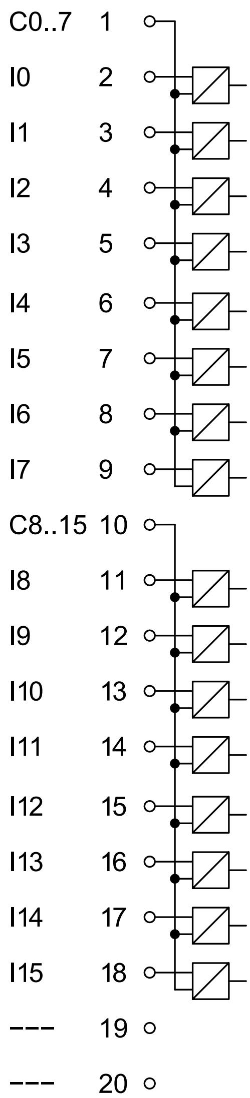
Parameter	Value
LED displays	For signal states
Internal power supply	Via I/O bus
External power supply	Not necessary

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the System Assembly chapter *➪ Chapter 2.5 “AC500-eCo” on page 925.*

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.

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



The 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
10	C8...15	Input common for signals I8 to 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.

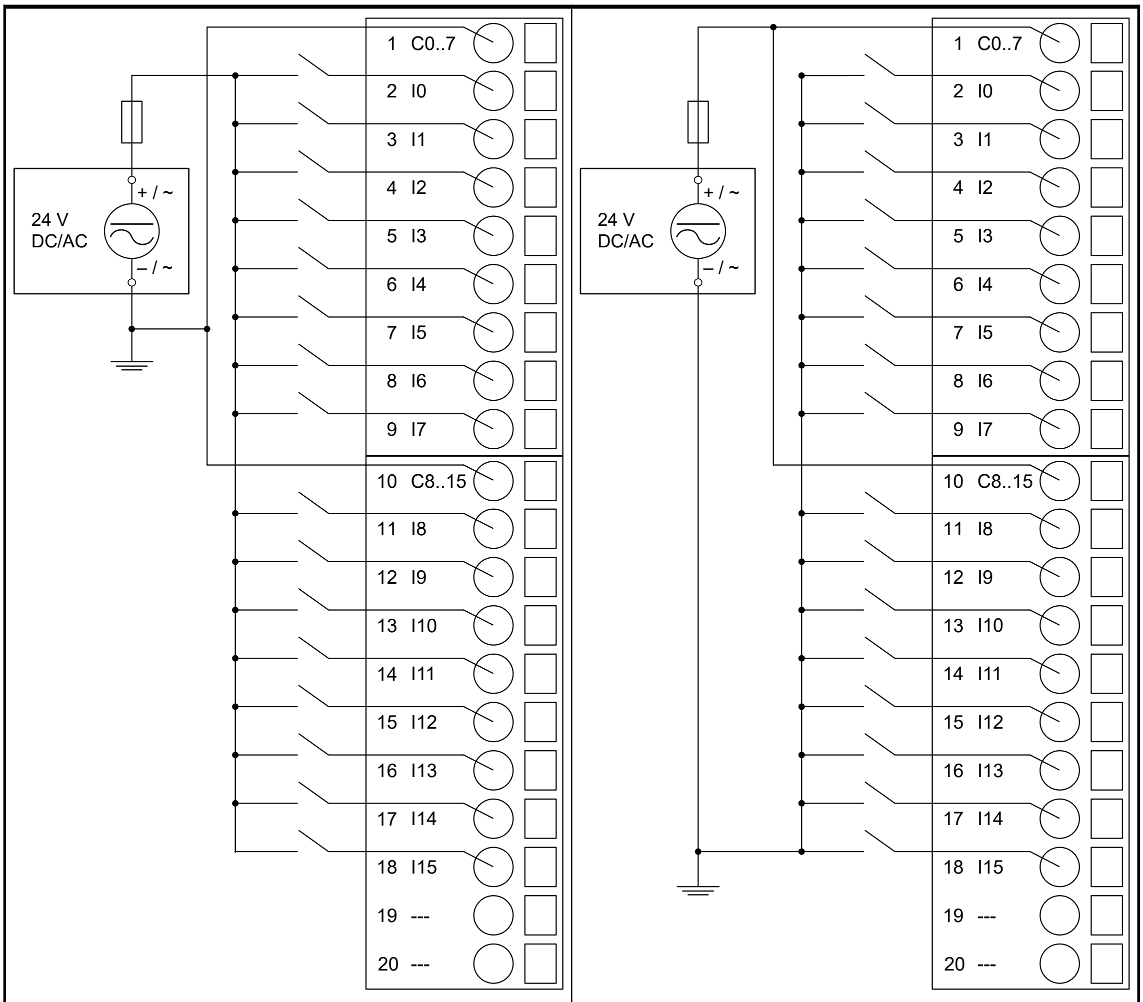
> **NOTICE!**
> **Risk of damaging the PLC modules!**
> Overvoltages and short circuits might damage the PLC modules.
>
> – Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
> – Never connect any voltages or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

The module provides several diagnosis functions *Chapter 1.6.1.1.4.6 “Diagnosis” on page 173*.

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.

The following figure shows the 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 1.6.1.1.4.7 "State LEDs" on page 173*.

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

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

Parameterization

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

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6110 [1])	WORD	6110 0x17DE	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No (0x00)			
Parameter length [2])	Internal	1 - CPU	BYTE	0	0	255	xx02 [3])

Remarks:

[1])	With CS31 and addresses less than 70, the value is increased by 1
[2])	The module has no additional user-configurable parameters
[3])	Value is hexadecimal: HighByte is slot (xx: 0...7), LowByte is index (1...n)

GSD file:

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

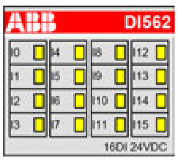
Diagnosis

E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500-Display	<– Display in
Class	Comp	Dev	Mod	Ch	Err	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 2.5.1 “System data AC500-eCo V3” on page 925*

Only additional details are therefore documented below.

Parameter	Value
Galvanic isolation	Yes, between the input groups and the rest of the module
Isolated groups	2 (8 channels per group)
Current consumption from 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module	Ca. 10 mA
Max. power dissipation within the module	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 switchgear 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 to 9		
Connections of the channels I8 to I15	Terminals 11 to 18		
Reference potential for the channels I0 to I7	Terminal 1 (positive or negative pole of the process supply voltage, signal name C0..7)		
Reference potential for the channels I8 to I15	Terminal 10 (positive or negative pole of the process supply voltage, signal name C8..15)		
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

Parameter	Value		
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.

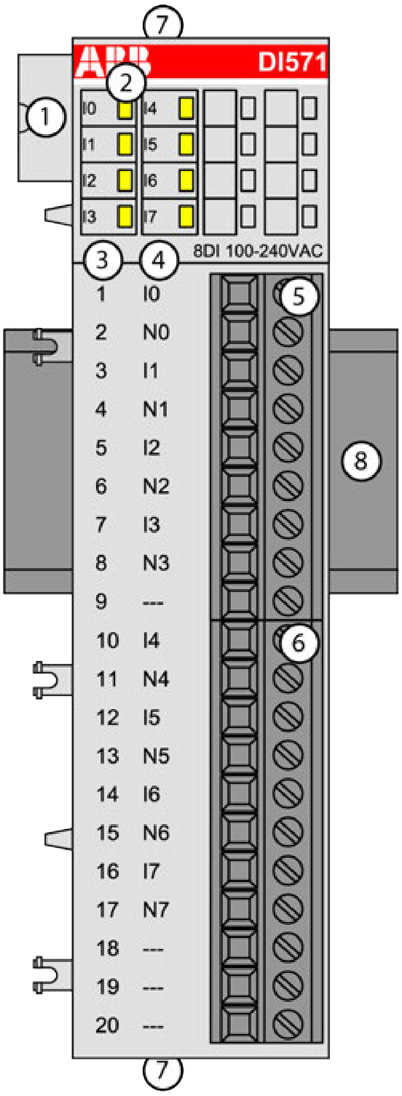
Ordering data

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.*

1.6.1.1.5 DI571 - Digital input module

- 8 digital inputs 100-240 V AC (I0 to 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 to 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 iInterface 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 System Assembly chapter *⇘ Chapter 2.5 "AC500-eCo" on page 925.*

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.

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

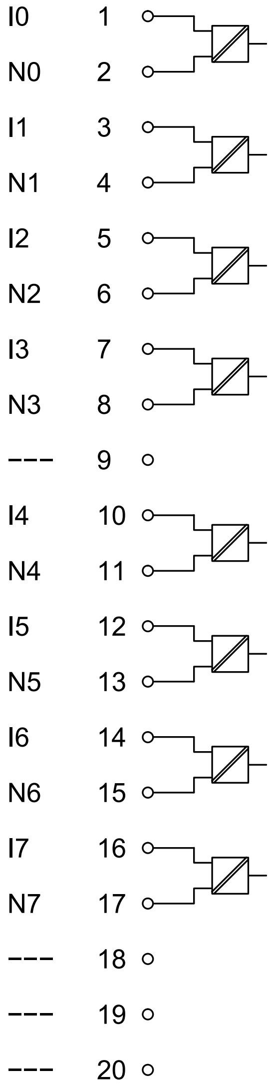


Table 64: Assignment of the terminals:

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
14	I6	Input signal I6

Terminal	Signal	Description
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.

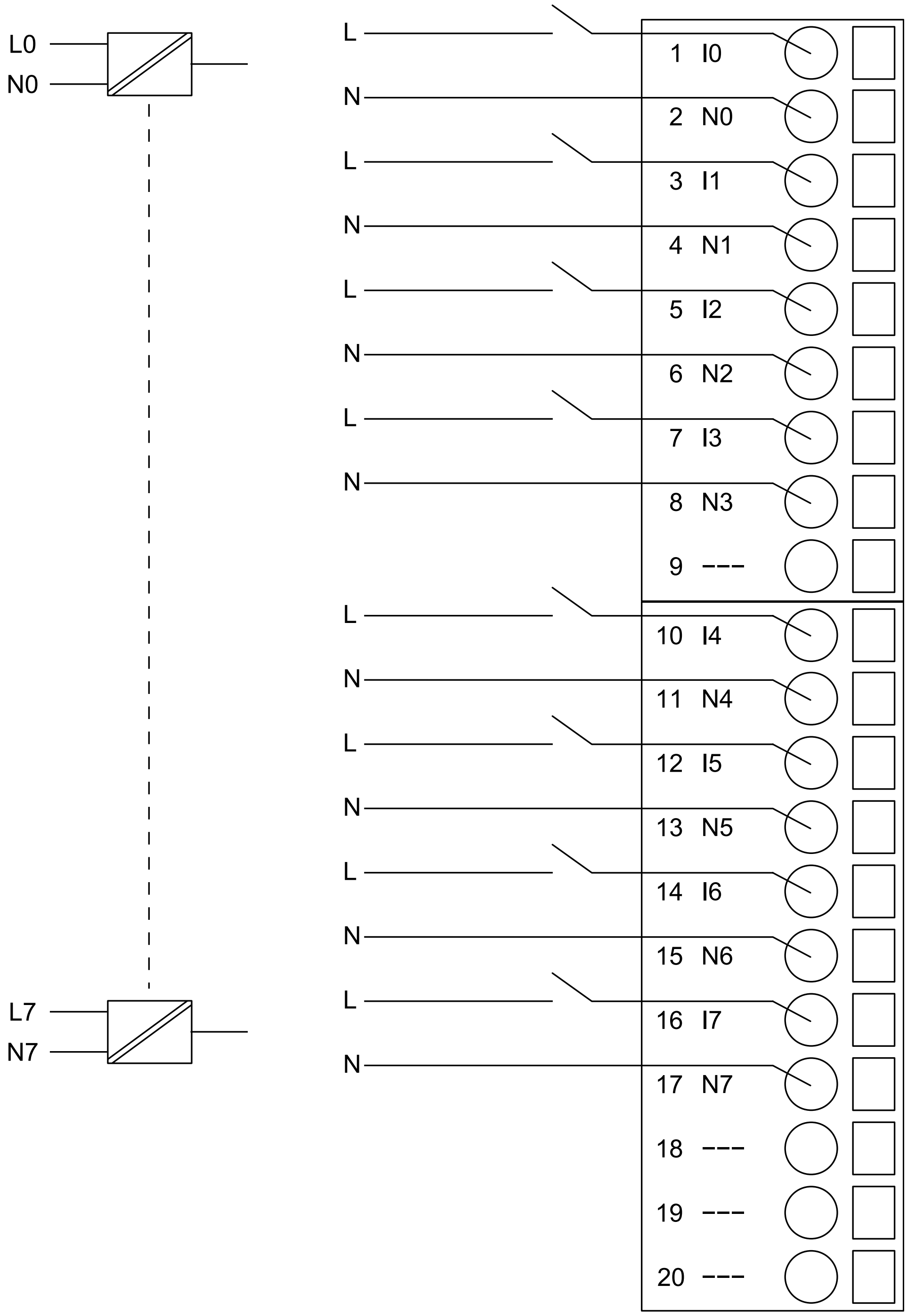
Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

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.

The following figure shows the 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 1.6.1.1.5.7 “Diagnosis” on page 182*.

The meaning of the LEDs is described in the section State LEDs *Chapter 1.6.1.1.5.8 “State LEDs” on page 182*.

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;

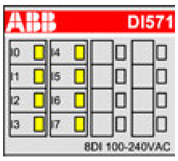
Diagnosis

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 2.5.1 “System data AC500-eCo V3” on page 925*

Only additional details are therefore documented below.

Parameter	Value
Galvanic isolation	Yes, between the channels and the rest of the module
Isolated groups	8 (1 channel per group)
Current consumption from 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module	Ca. 10 mA
Max. power dissipation within the module	On request
Weight	Ca. 135 g
Mounting position	Horizontal or vertical
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the switchgear 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
Max. permissible leakage current (at 2-wire proximity switches)	1 mA
Max. cable length	

Parameter		Value
	Shielded	500 m
	Unshielded	300 m

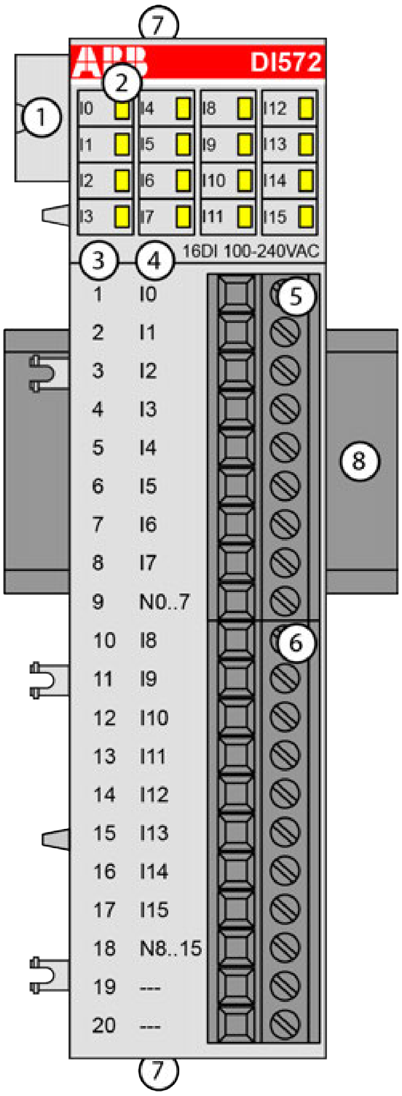
Ordering data

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
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.*

1.6.1.1.6 DI572 - Digital input module

- 16 digital inputs 100-240 V AC (I0 to 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 to 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 iInterface 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 System Assembly chapter *↬ Chapter 2.5 “AC500-eCo” on page 925.*

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.

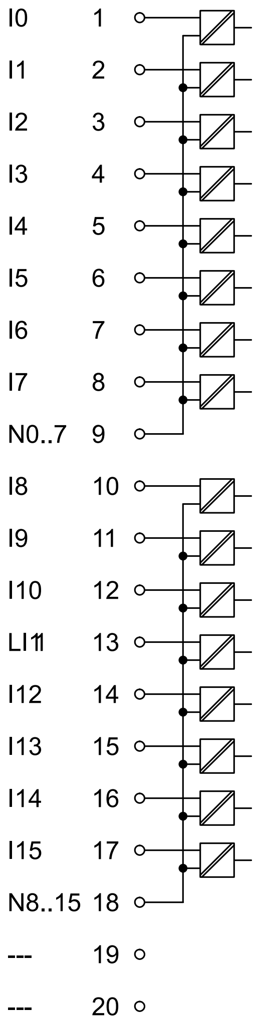


Fig. 6: Block diagram for the internal construction of the digital inputs.

Table 65: 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.

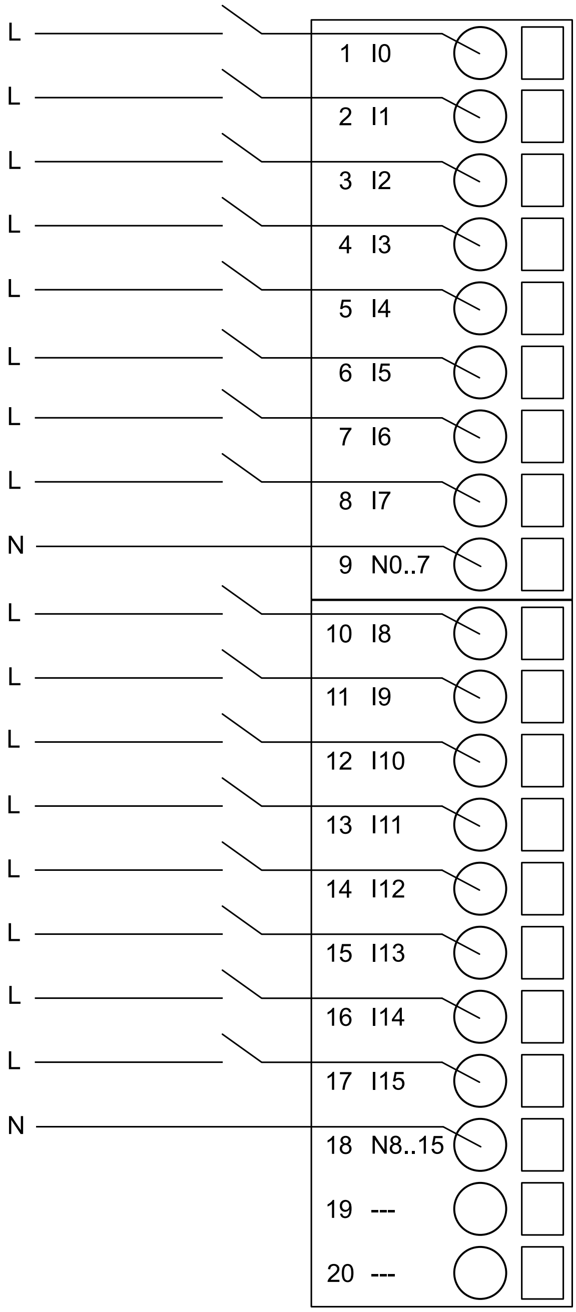
Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

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 1.6.1.1.6.6 “Diagnosis” on page 191*.

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

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

Parameterization

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

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Parameter name	Value	Internal value	Data type of internal value	Default value	Min.	Max.	EDS Slot Index
Module ID	Internal	6160 1)	WORD	6160 0x1810	0	65535	xx01 2)
Ignore module	No	0	BYTE	No 0x00	-	-	-
	Yes	1					
Parameter length	Internal	3	BYTE	3	0	255	xx02 2)
Input delay	20 ms	0	BYTE	20 ms 0x00	0	1	-
	100 ms	1					

1) With CS31 and addresses less than 70, the value is increased by 1.

2) Value is hexadecimal: HighByte is slot (xx: 0...7), LowByte is index (1...n).

GSD file:

Ext_Module_Prm_Data_Len =	7
Ext_User_Prm_Data_Const(0) =	0x18, 0x11, 0x00, 0x03, 0x00, 0x00, 0x00;

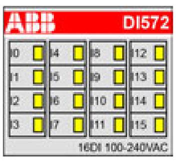
Diagnosis

E1...E4	**d1**	**d2**	**d3**	**d4**	**Identifier 000...063**	**AC500-Display**	**<- Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])			
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1...10				
3	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				

Remarks:

Parameter	**Remark**
[1])	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31-Bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1...10 = decentralized communication interface module 1...10, ADR = hardware address (e.g. of the DC551-CS31)
[3])	With "Module" the following allocation applies depending on the master: module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1...10 = expansion 1...10
[4])	In case of module errors, with channel "31 = module itself" is output.

State LEDs

LED		**State**	**Color**	**LED = OFF**	**LED = ON**
	Inputs I0...I15	Digital input	Yellow	Input is OFF	Input is ON (the input voltage is only displayed if the supply voltage of the module is ON)

Technical data

The System Data of AC500-eCo apply *Chapter 2.5.1 “System data AC500-eCo V3” on page 925*

Only additional details are therefore documented below.

Parameter	Value
Galvanic isolation	Yes, between the input groups and the rest of the module
Isolated groups	2 (8 channels per group)
Current consumption from 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module	Ca. 10 mA
Max. power dissipation within the module	6 W
Weight	Ca. 222 g
Mounting position	Horizontal or vertical
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the switchgear 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
Input data length		2 bytes

Parameter		Value
Max. permissible leakage current (at 2-wire proximity switches)		1 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

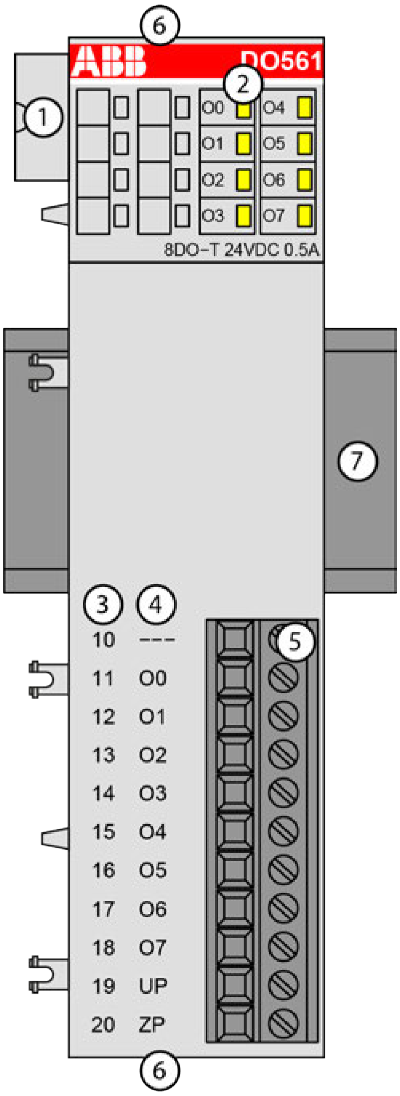
Ordering data

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
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.*

1.6.1.1.7 DO561 - Digital output module

- 8 digital outputs 24 V DC (O0 to 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 to 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 iInterface 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 System Assembly chapter* *➥ Chapter 2.5 "AC500-eCo" on page 925.*

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.

The following block diagram shows the internal construction of the digital outputs:

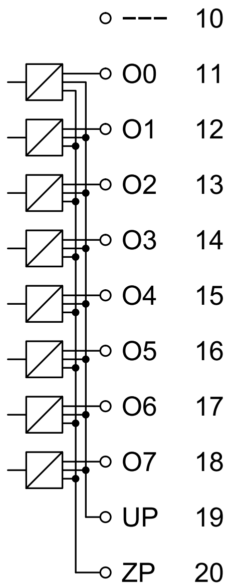


Table 66: Assignment of the terminals:

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.

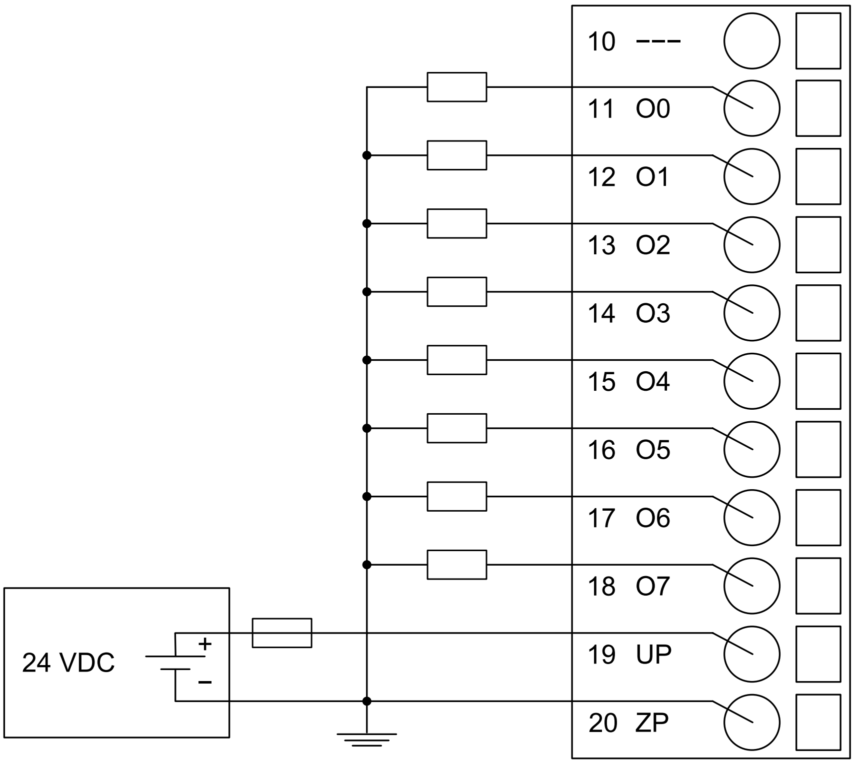
NOTICE!

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.

The following figure shows the 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 (see Diagnosis *Chapter 1.6.1.1.7.6 “Diagnosis” on page 198*).

The meaning of the LEDs is described in the section State LEDs *Chapter 1.6.1.1.7.7 “State LEDs” on page 199*.

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

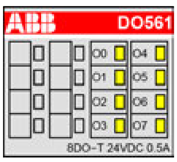
<table>
<tr><th>E1...E4</th><th>d1</th><th>d2</th><th>d3</th><th>d4</th><th>Identifier
000...063</th><th>AC500-Display</th><th colspan="2" rowspan="3"><− Display in</th></tr>
<tr><th>Class</th><th>Comp</th><th>Dev</th><th>Mod</th><th>Ch</th><th>Err</th><th>PS501 PLC Browser</th></tr>
<tr><th>Byte 6
Bit 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 2.5.1 “System data AC500-eCo V3” on page 925*

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage UP		
	Connections	Terminal 19 for UP (+24 V DC) and terminal 20 for ZP (0 V DC)
	Rated value	24 V DC
	Current consumption via UP terminal	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 switchgear 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

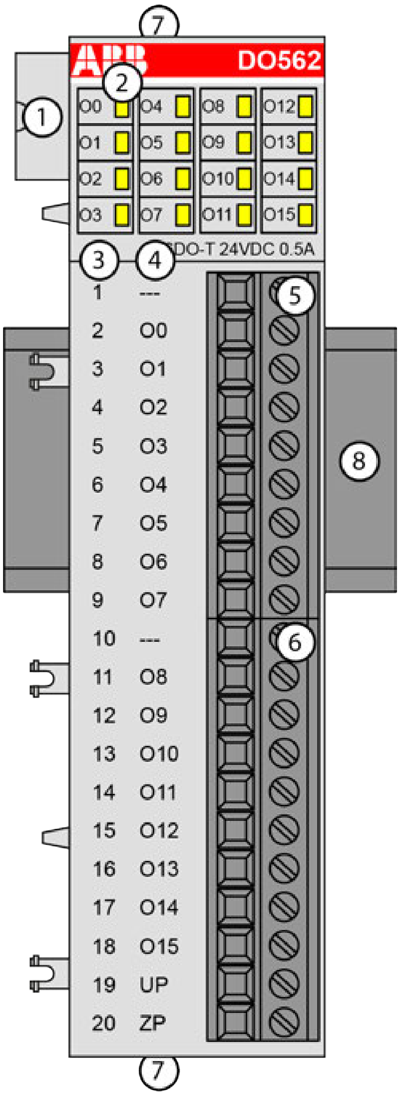
Ordering data

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.*

1.6.1.1.8 DO562 - Digital output module

- 16 digital outputs 24 V DC (O0 to 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 to 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 iInterface 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 System Assembly chapter 🔗 Chapter 2.5 “AC500-eCo” on page 925.*

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.

The following block diagram shows the internal construction of the digital outputs:

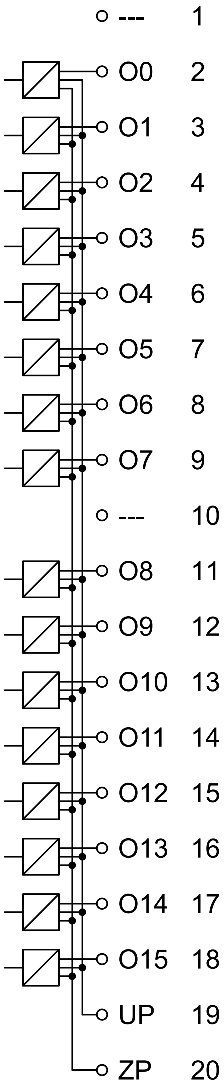


Table 67: Assignment of the terminals:

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
14	O11	Output signal O11

Terminal	Signal	Description
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.

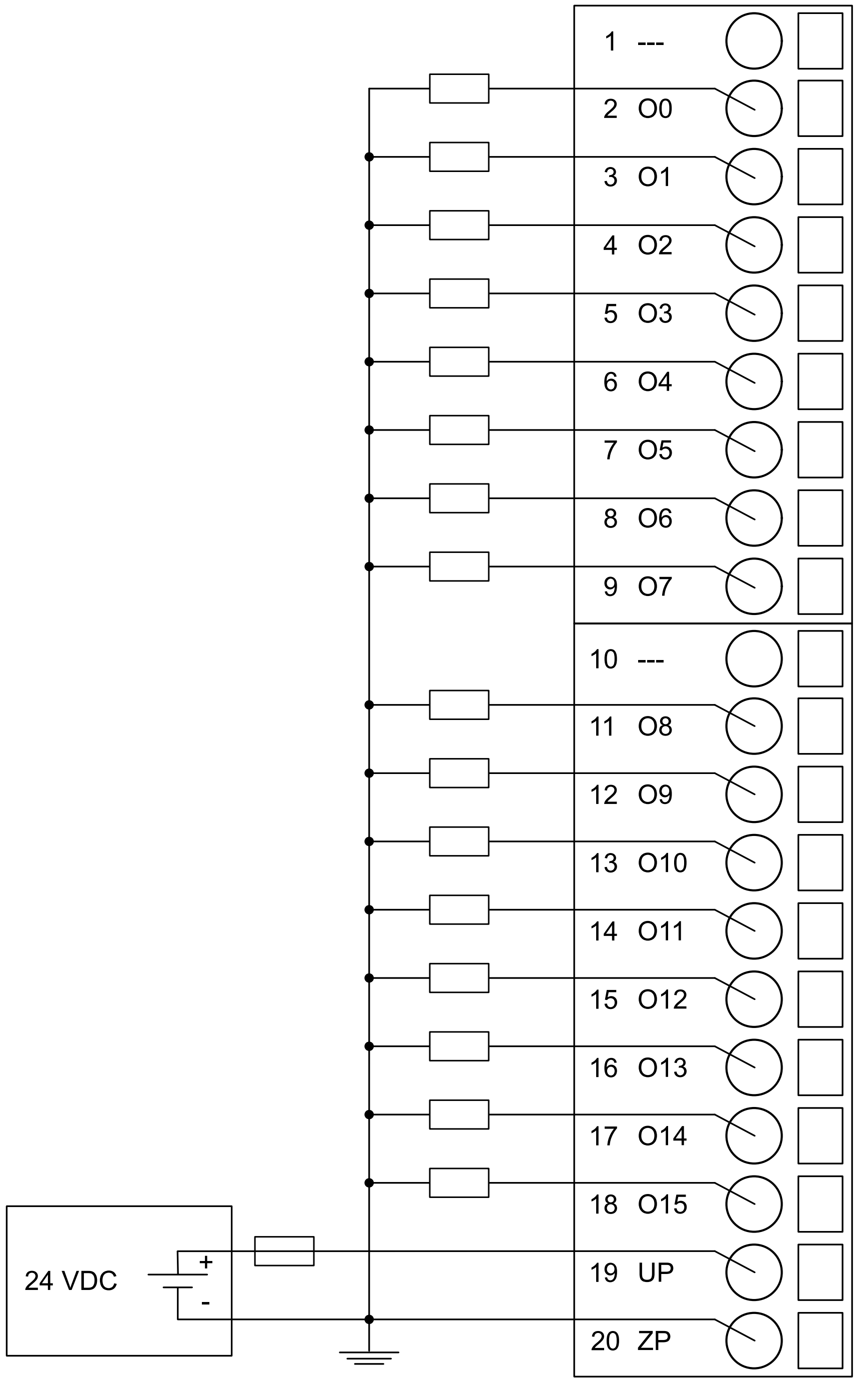
Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

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.

The following figure shows the 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 (see Diagnosis *Chapter 1.6.1.1.8.6 “Diagnosis” on page 208*).

The meaning of the LEDs is described in the section Status LEDs *Chapter 1.6.1.1.8.7 “State LEDs” on page 208*.

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;

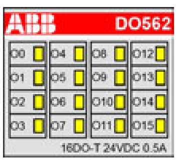
Diagnosis

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 2.5.1 “System data AC500-eCo V3” on page 925*

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage UP		
	Connections	Terminal 19 for UP (+24 V DC) and terminal 20 for ZP (0 V DC)
	Rated value	24 V DC
	Current consumption via UP terminal	20 mA + max. 0.5 A per output
	Max. ripple	5 %
	Inrush current	0.000002 A^2s
	Protection against reversed voltage	Yes
	Rated protection fuse for UP	Recommended; the outputs must be protected by an 3 A fast-acting fuse
Current consumption from 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module		Ca. 10 mA
Galvanic isolation		Yes, between the output group and the rest of the module
Isolated groups		1 (16 channels per group)
Surge-voltage (max.)		35 V DC for 0.5 s
Max. power dissipation within the module		1.4 W
Weight		Ca. 125 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switchgear 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 to O7	Terminals 1 to 9
Connection of the channels O8 to O15	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 O15	Terminal 20 (negative pole of the process voltage, signal name ZP)

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
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

Ordering data

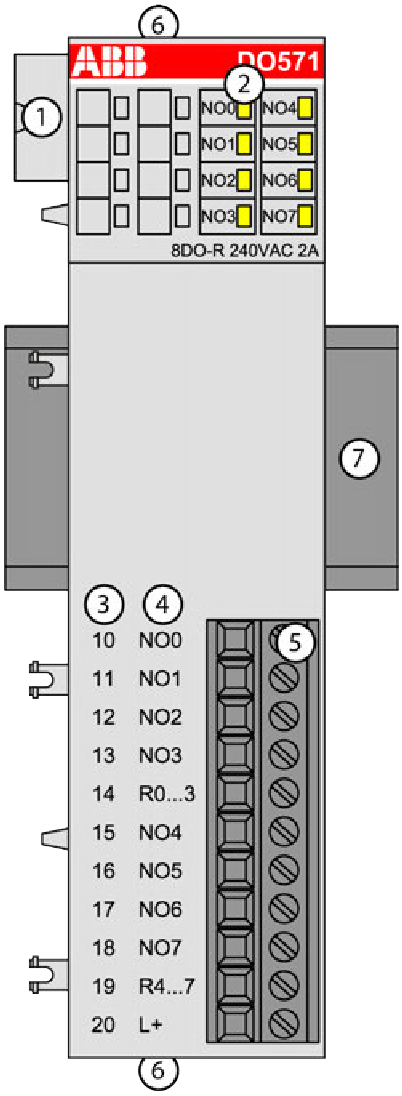
Part no.	Description	Product life cycle phase *)
1SAP 230 900 R0000	DO562, digital output module, 16 DO, transistor output	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active

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.*

1.6.1.1.9 DO571 - Digital output module

- 8 digital normally open relay outputs 24 V DC / 24 V AC or 100-240 V AC, 2 A max. (NO0 to 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 to 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 iInterface 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 System Assembly chapter *Chapter 2.5 "AC500-eCo" on page 925.*

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.

The following block diagram shows the internal construction of the digital outputs:

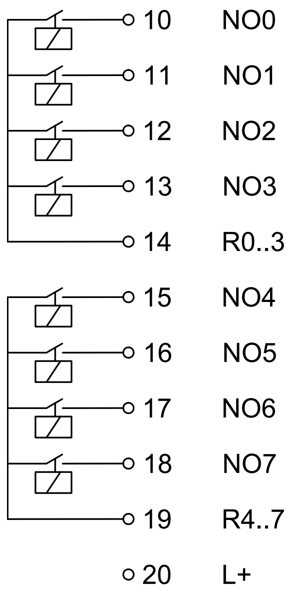


Table 68: Assignment of the terminals:

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

Terminal	Signal	Description
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..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 following figure shows the connection of the module:

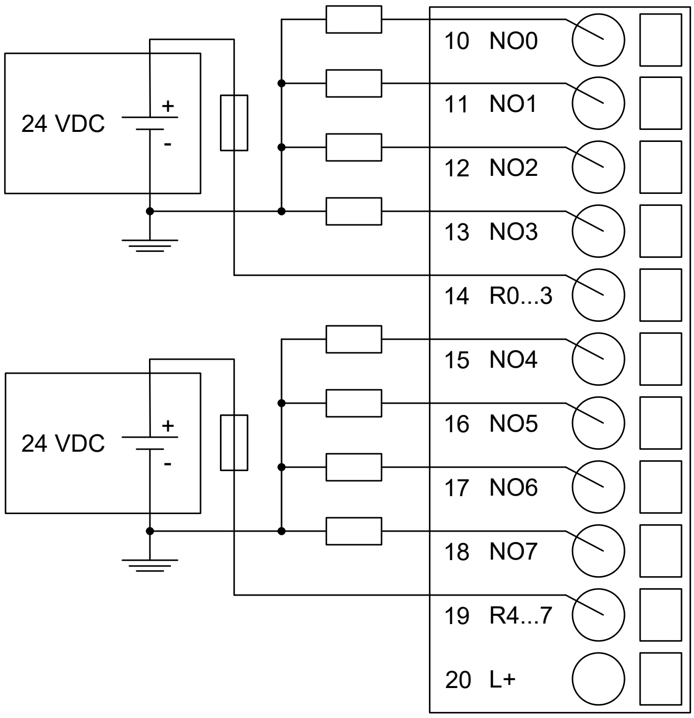


Fig. 7: Connection of 24 V DC actuators

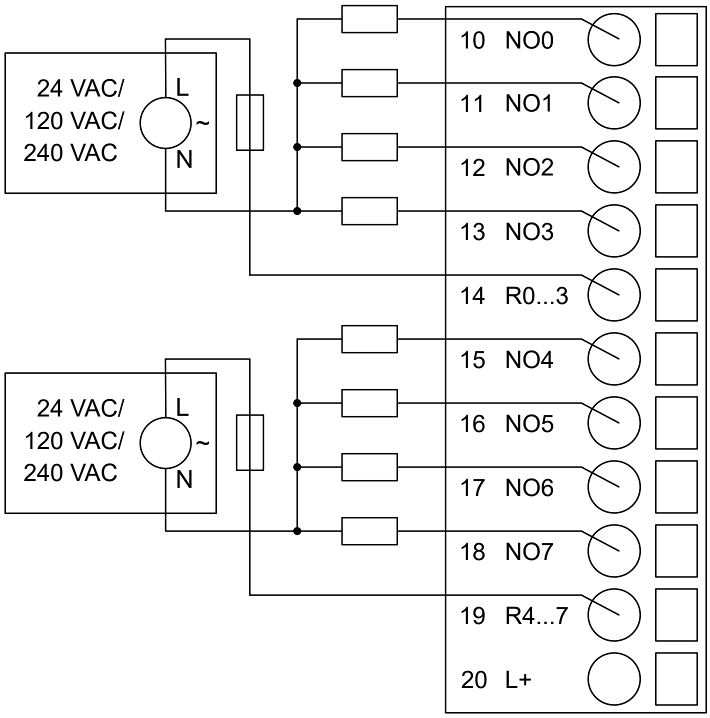


Fig. 8: Connection of 24 V AC or 100-240 V AC actuators

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.

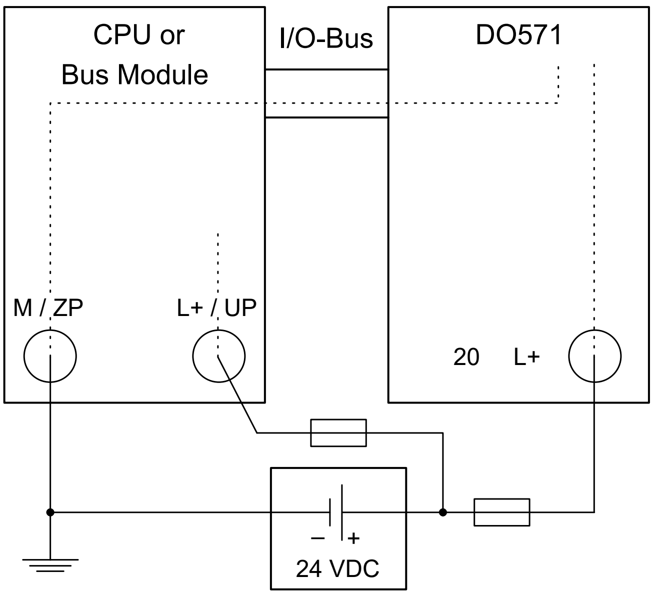


Fig. 9: Power supply - the negative connection is realized via the I/O bus

> *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 (see Diagnosis *Chapter 1.6.1.1.9.6 "Diagnosis" on page 218*).

The meaning of the LEDs is described in the section Status LEDs *Chapter 1.6.1.1.9.7 "State LEDs" on page 219*.

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

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

Parameterization

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

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Internal	6125 [1])	WORD	6125 0x17ED	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No (0x00)			
Parameter length	Internal	1	BYTE	0	0	255	xx02 [2])
Check supply	Off On	0 1	BYTE	On 0x01			

[1]) with CS31 and addresses smaller than 70, the value is increased by 1

[2]) Value is hexadecimal: HighByte is slot (xx: 0...7), LowByte is index (1...n)

GSD file:

Ext_User_Prm_Data_Len =	0x04
Ext_User_Prm_Data_Const(0) =	0xEF, 0x17, 0x00,\ 0x01;

Diagnosis

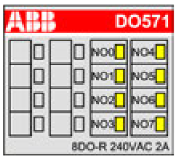
E1...E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier 000...063**	**AC500-Display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**PNIO diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error Identi-fier**	**Error message**	**Remedy**
	[1])	[2])	[3])	[4])			
				Module error			
3	14	1...10	31	31	19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1...10				
4	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				
3	14	1...10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1...10				

Remarks:

[1])	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31-Bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
[2])	With "Device" the following allocation applies: 31 = module itself, 1...10 = decentralized communication interface module 1...10, ADR = Hardware address (e. g. of the DC551-CS31)

3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1...10 = expansion 1...10 Channel error: I/O bus or PNIO = module type (2 = DO); COM1/COM2: 1..10 = expansion 1..10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON
	Outputs O0...O7	Digital output	Yellow	Output is OFF	Output is ON (the output voltage is only displayed if the supply voltage of the module is ON)

Technical data

The System Data of AC500-eCo apply *Chapter 2.5.1 “System data AC500-eCo V3” on page 925*

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage L+		
	Connections	Terminal 20 for L+ (+24 V DC). The negative pole is provided by the I/O bus.
	Rated value	24 V DC
	Current consumption via L+	50 mA
	Inrush current (at power-up)	0.0035 A^2s
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse for UP	Recommended; the outputs must be pro-tected 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 switchgear 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 to O3		Terminals 10 to 13
Connection of the channels O4 to O7		Terminals 15 to 18
Reference potential for the channels O0 to O3		Terminal 14 (signal name R0..3)
Reference potential for the channels O4 to 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 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

Parameter		Value
	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.

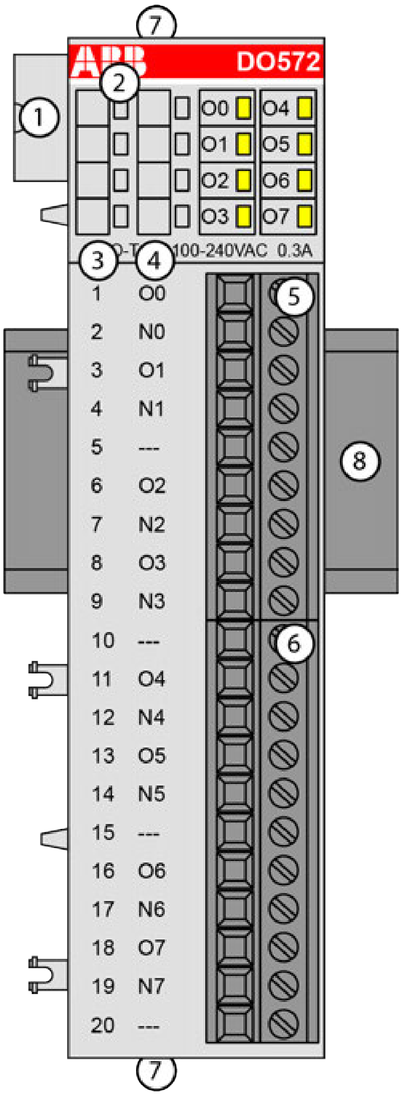
Ordering data

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.*

1.6.1.1.10 DO572 - Digital output module

- 8 digital triac outputs (O0 to O7) in 8 groups
- 240 V AC
- Module-wise galvanically isolated



1 I/O bus
2 8 yellow LEDs to display the signal states of the outputs O0 to 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 iInterface 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 System Assembly chapter *⇘ Chapter 2.5 “AC500-eCo” on page 925.*

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.

The following block diagram shows the internal construction of the digital outputs:

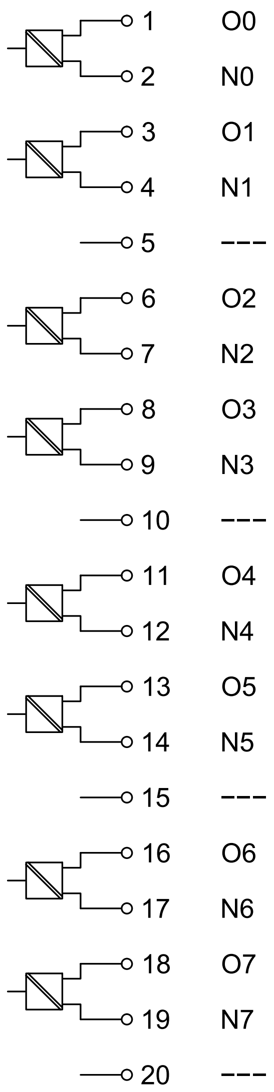


Table 69: Assignment of the terminals:

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.

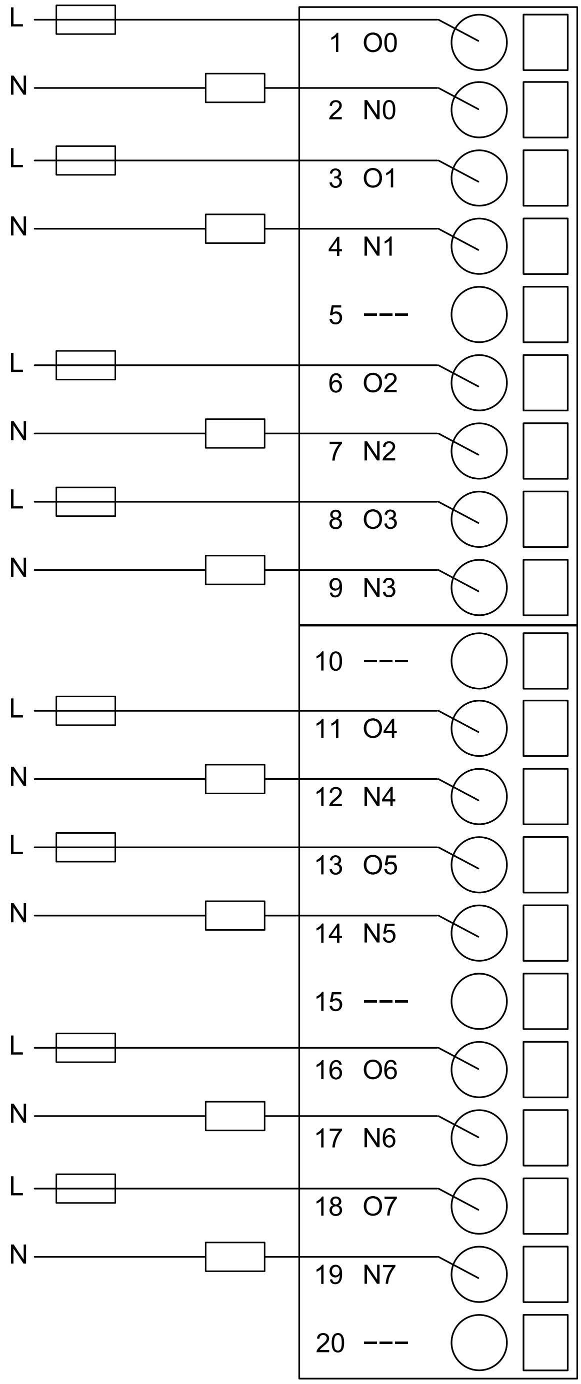
NOTICE!

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.

The following figure shows the 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 (see chapter Diagnosis *Chapter 1.6.1.1.10.6 “Diagnosis” on page 228*).

The meaning of the LEDs is described in the section State LEDs *Chapter 1.6.1.1.10.7 “State LEDs” on page 229*.

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;

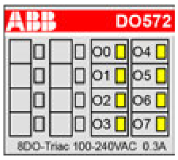
Diagnosis

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 2.5.1 “System data AC500-eCo V3” on page 925*

Only additional details are therefore documented below.

Parameter	Value
Galvanic isolation	Yes, between the channels and the rest of the module
Isolated groups	8 (1 channel per group)
Current consumption from 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module	Ca. 10 mA
Max. power dissipation within the module	On Request
Weight	ca. 120 g
Mounting position	Horizontal or vertical
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the switchgear 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
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
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

Ordering data

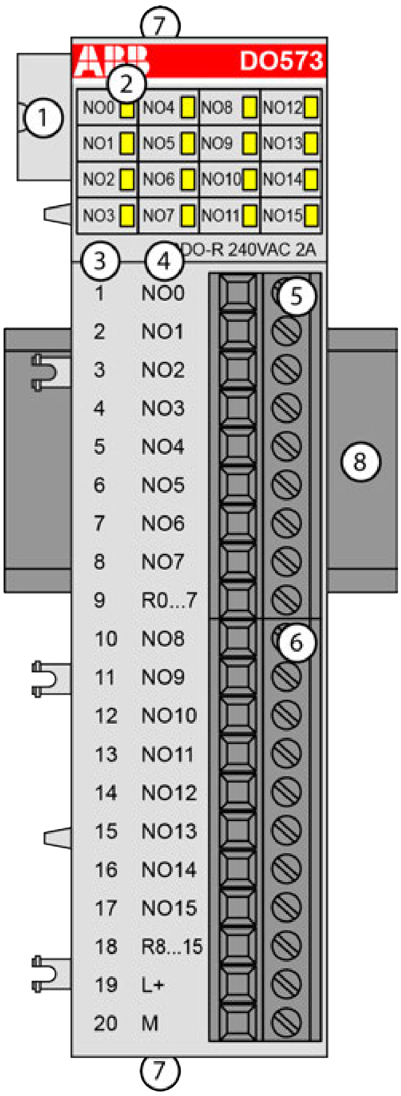
Part no.	Description	Product life cycle phase *)
1TNE 968 902 R2203	DO572, digital output module, 8 DO, triac output	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 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

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.*

1.6.1.1.11 DO573 - Digital output module

- 16 digital normally open relay outputs 24 V DC or 100-240 V AC (NO0 to 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 to 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 iInterface 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 System Assembly chapter *➪ Chapter 2.5 “AC500-eCo” on page 925.*

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.

The following block diagram shows the internal construction of the digital outputs:

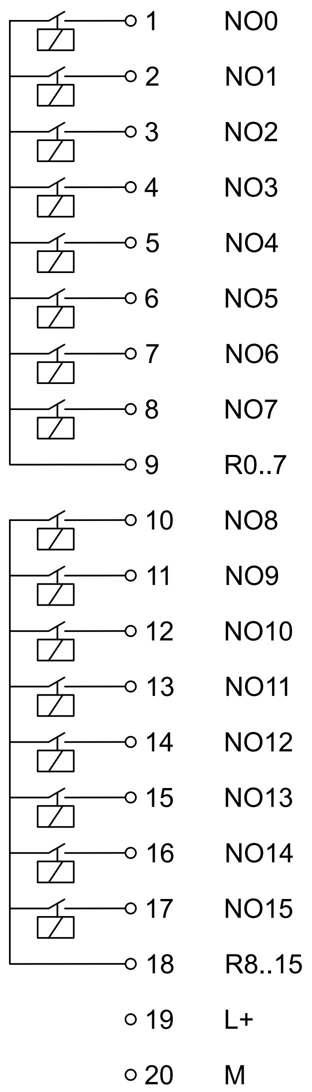


Table 70: Assignment of the terminals:

Terminal	Signal	Description
1	NO0	Normally-open contact of the output NO0
2	NO1	Normally-open contact of the output NO1
3	NO2	Normally-open contact of the output NO2
4	NO3	Normally-open contact of the output NO3
5	NO4	Normally-open contact of the output NO4
6	NO5	Normally-open contact of the output NO5
7	NO6	Normally-open contact of the output NO6
8	NO7	Normally-open contact of the output NO7
9	R0..7	Output common for signals NO0 to NO7
10	NO8	Normally-open contact of the output NO8
11	NO9	Normally-open contact of the output NO9
12	NO10	Normally-open contact of the output NO10
13	NO11	Normally-open contact of the output NO11
14	NO12	Normally-open contact of the output NO12

Terminal	Signal	Description
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:

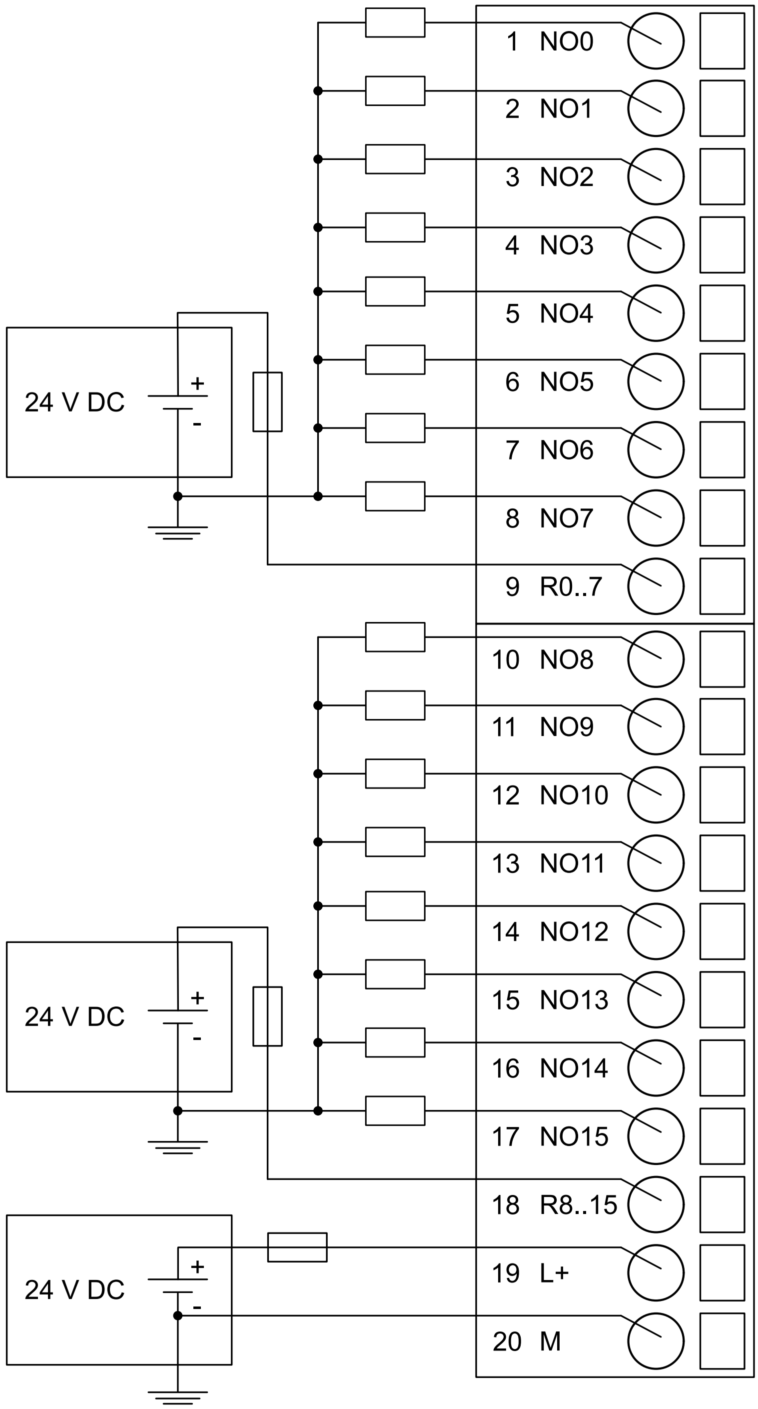


Fig. 10: Connection of 24 V DC actuators

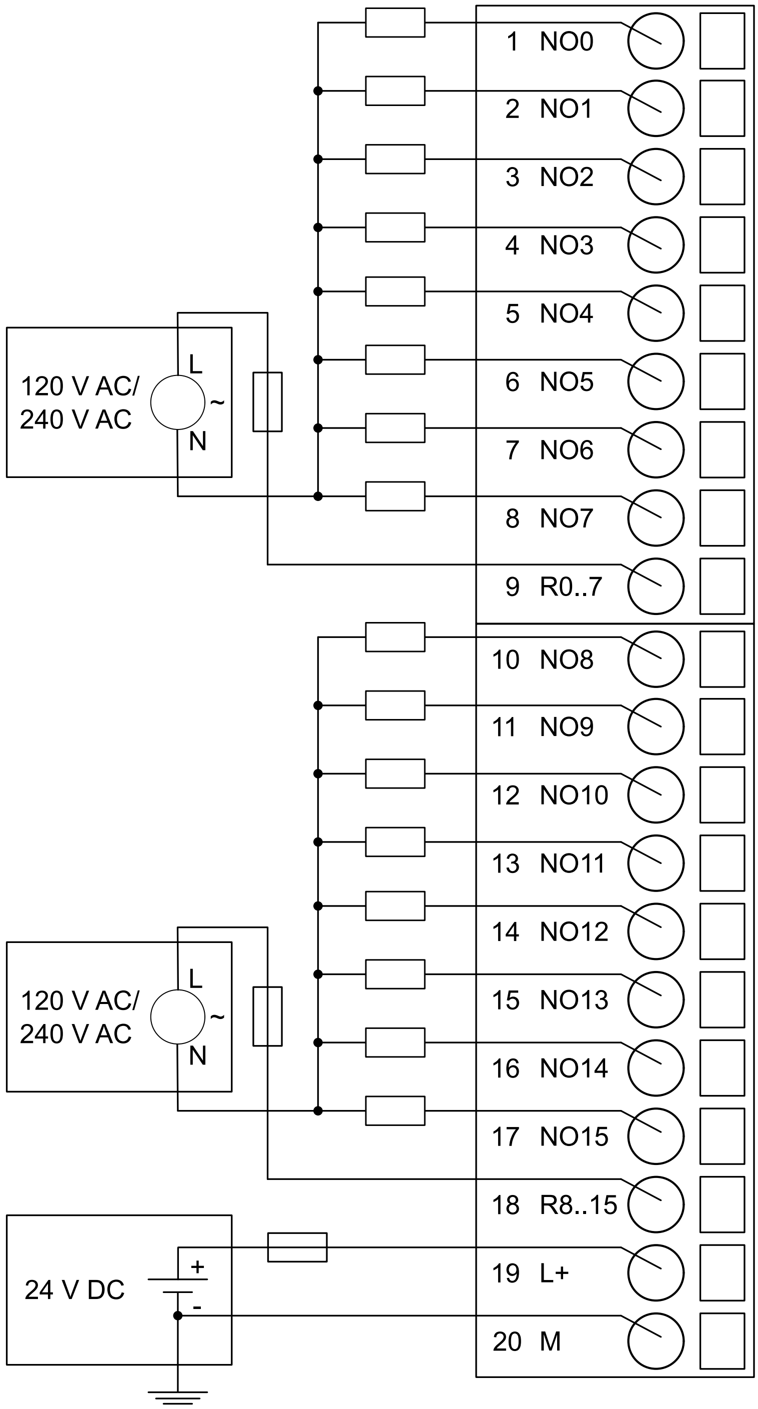


Fig. 11: Connection of 100-240 V AC actuators

The module provides several diagnosis functions (see section Diagnosis *Chapter 1.6.1.1.11.6 “Diagnosis” on page 239*).

The meaning of the LEDs is described in the section State LEDs *Chapter 1.6.1.1.10.7 “State LEDs” on page 229*.

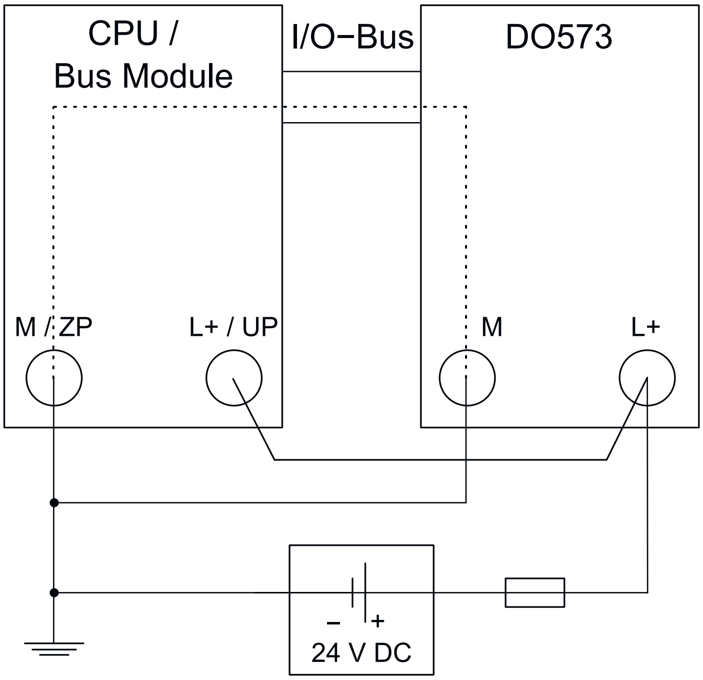


Fig. 12: Power supply - the negative connection is realized via the I/O bus

> *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

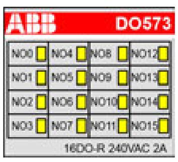
E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500-Display	<- Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error-Identifier**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

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 2.5.1 “System data AC500-eCo V3” on page 925*

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage L+		
	Connections	Terminals 19 for L+ (+24 V DC) and 20 for M (0 V DC)
	Rated value	24 V DC
	Current consumption via L+	50 mA
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse for L+	Recommended; the outputs must be protected by an 5 A fast-acting fuse
Current consumption from 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module		Ca. 5 mA
Galvanic isolation		Yes, between the output groups and the rest of the module
Isolated groups		2 (8 channels per group)
Surge-voltage (max.)		35 V DC for 0.5 s
Max. power dissipation within the module		2.0 W
Weight		Ca. 160 g
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switchgear 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 to NO7	Terminals 1 to 8
Connection of the channels NO8 to NO15	Terminals 10 to 17
Reference potential for the channels NO0 to NO7	Terminal 9 (signal name R0..7)
Reference potential for the channels NO8 to NO15	Terminal 18 (signal name R8..15)
Relay coil power supply	Terminals 19 and 20 (signal names L+ and M)
Indication of the output signals	1 yellow LED per channel; the LED is on when the output signal is high (signal 1) and the module is powered via the I/O bus
Way of operation	Non-latching type

Parameter		Value
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.

Ordering data

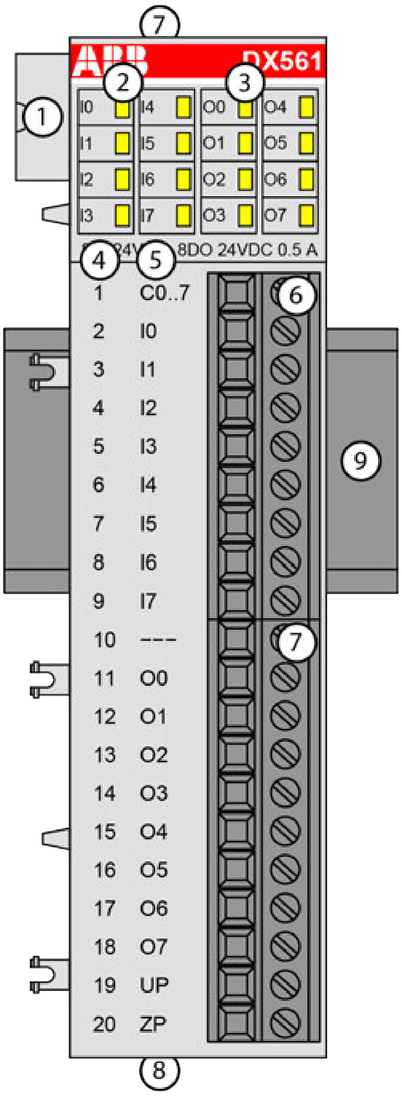
Part no.	Description	Product life cycle phase *)
1SAP 231 300 R0000	DO573, digital output module, 16 DO, relay output	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active

Part no.	Description	Product life cycle phase *)
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

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

1.6.1.1.12 DX561 - Digital input/output module

- 8 digital inputs 24 V DC (I0 to I7) in 1 group
- 8 digital transistor outputs 24 V DC (O0 to 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 to I7
3 8 yellow LEDs to display the signal states of the outputs O0 to 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 iInterface 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 System Assembly chapter *⇘ Chapter 2.5 “AC500-eCo” on page 925.*

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.

The following block diagram shows the internal construction of the digital inputs and outputs:

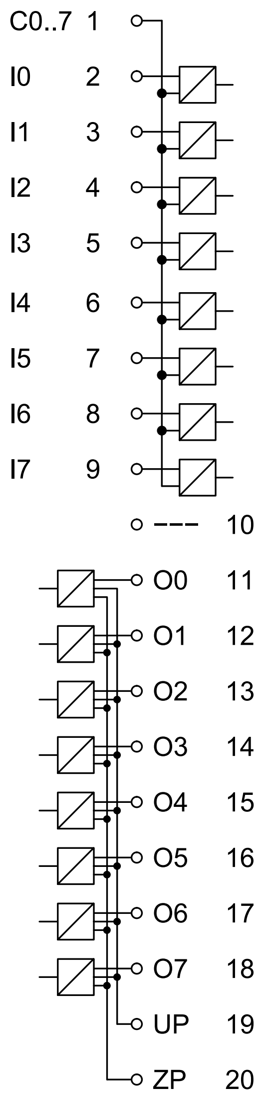


Table 71: Assignment of the terminals:

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
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.

The following figure shows the connection of the inputs to the digital input/output module DX561:

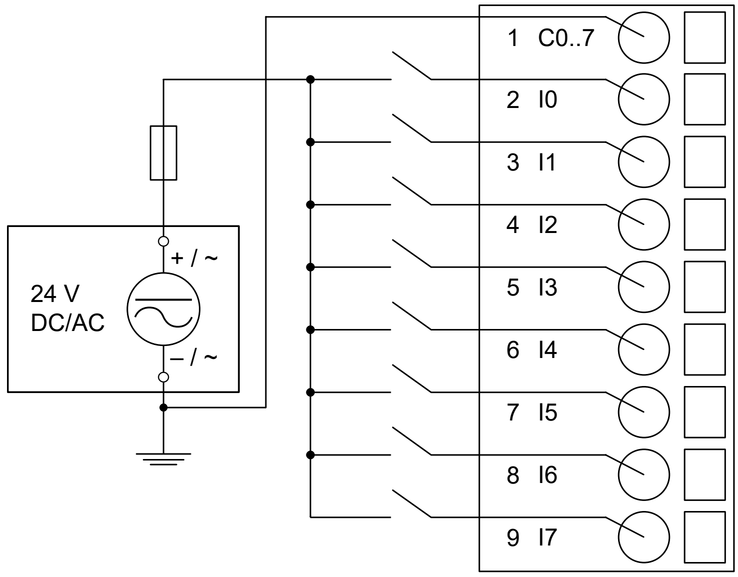


Fig. 13: Connection of inputs - sink inputs

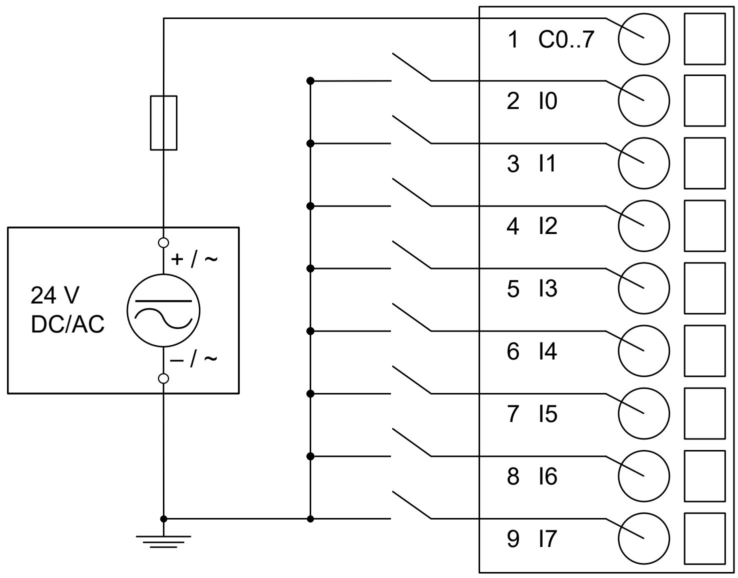


Fig. 14: Connection of inputs - source inputs

The following figure shows the connection of the outputs to the module:

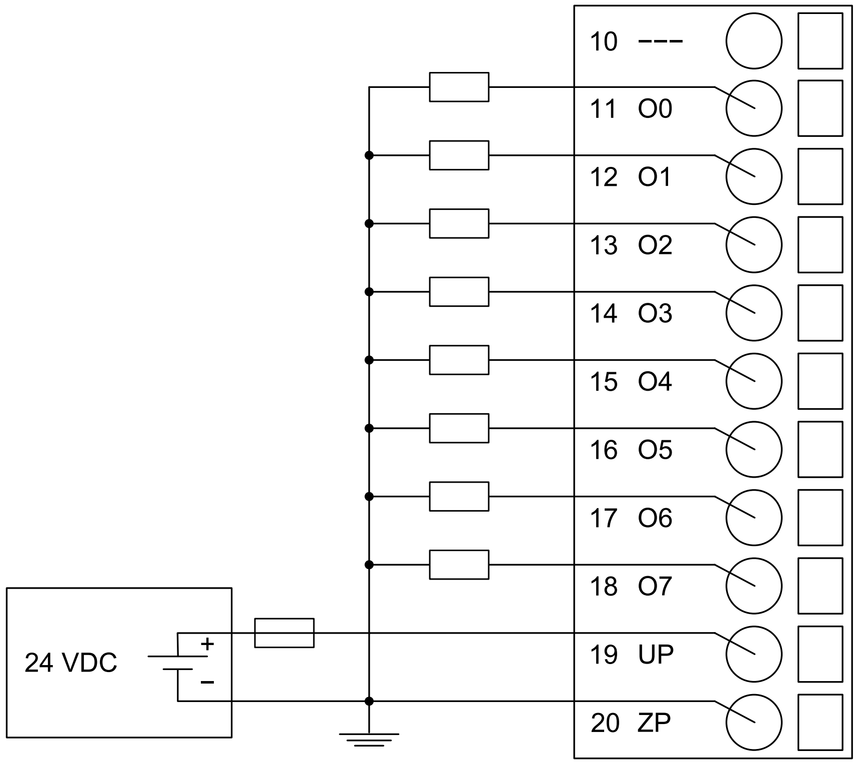


Fig. 15

> **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 (see chapter Diagnosis *Chapter 1.6.1.1.12.6 “Diagnosis” on page 251*).

The meaning of the LEDs is described in the Displays section *Chapter 1.6.1.1.12.7 “State LEDs” on page 252* 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;

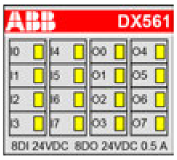
Diagnosis

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 2.5.1 “System data AC500-eCo V3” on page 925*

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage UP		
	Connections	Terminal 19 for UP (+24 V DC) and terminal 20 for ZP (0 V DC)
	Rated value	24 V DC
	Current consumption via UP terminal	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 switchgear 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 to I7		Terminals 2 to 9	
Reference potential for the channels I0 to 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 to O7	Terminals 11 to 18
Reference potential for the channels O0 to 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

Ordering data

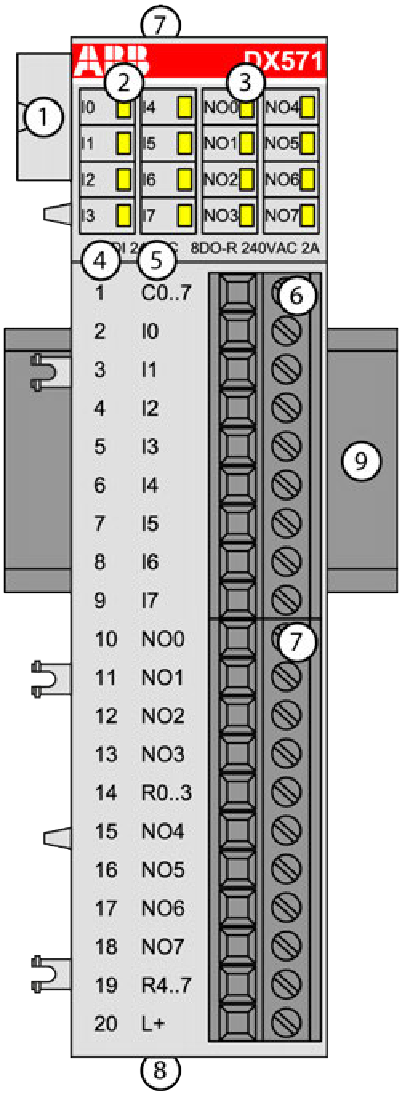
Part no.	Description	Product life cycle phase *)
1TNE 968 902 R2301	DX561, digital input/output module, 8 DI 24 V DC, 8 DO 24 V DC, transistor output	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 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

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.*

1.6.1.1.13 DX571 - Digital input/output module

- 8 digital inputs 24 V DC / 24 V AC (I0 to I7) in 1 group
- 8 digital normally open relay outputs 24 V DC / 24 V AC or 100-240 V AC, 2 A max. (NO0 to 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 to I7
3 8 yellow LEDs to display the signal states of the outputs NO0 to 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 iInterface 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 System Assembly chapter *⇘ Chapter 2.5 “AC500-eCo” on page 925.*

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.

The following block diagram shows the internal construction of the digital inputs and outputs:

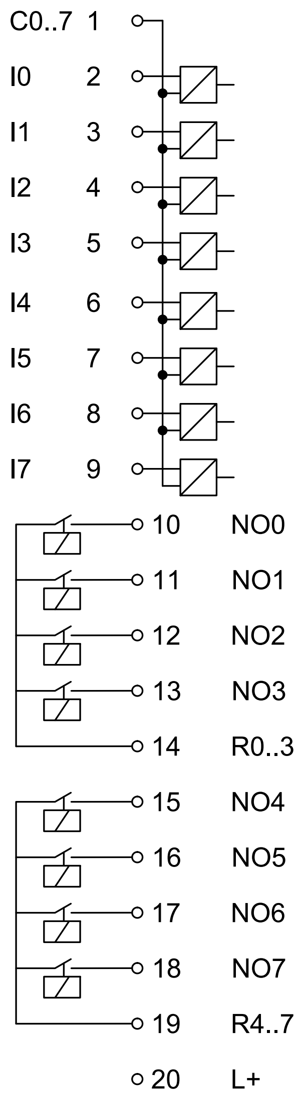


Table 72: Assignment of the terminals:

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
10	NO0	Normally-open contact of the output 0
11	NO1	Normally-open contact of the output 1
12	NO2	Normally-open contact of the output 2

Terminal	Signal	Description
13	NO3	Normally-open contact of the output 3
14	R0...3	Output common for signals O0 to 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 to 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 1.6.1.1.13.6 "Diagnosis" on page 264*).

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.

The following figures show the connection of the inputs to the digital input/output module DX571:

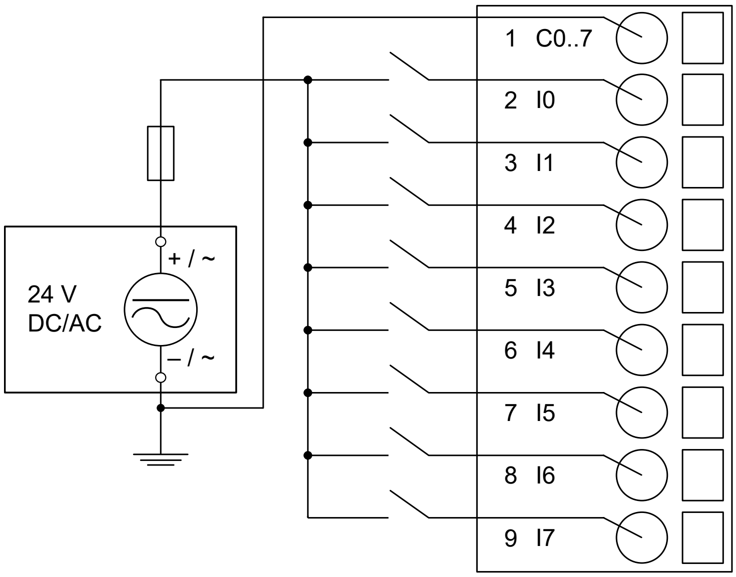


Fig. 16: Connection of inputs - sink inputs

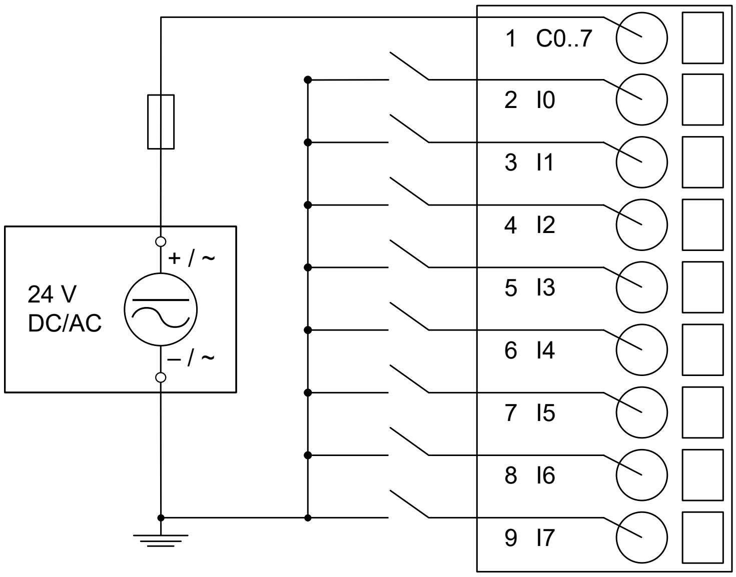


Fig. 17: Connection of inputs - source inputs

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

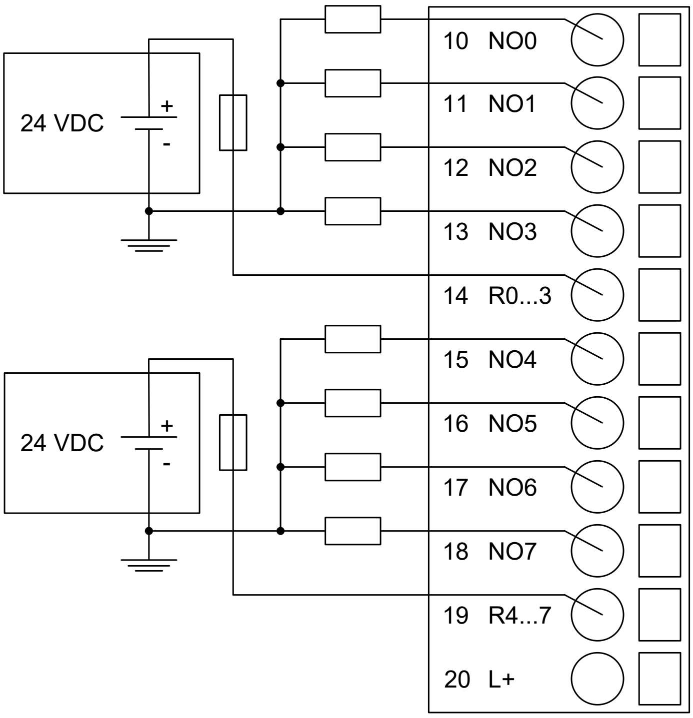


Fig. 18: Connection of 24 V DC actuators

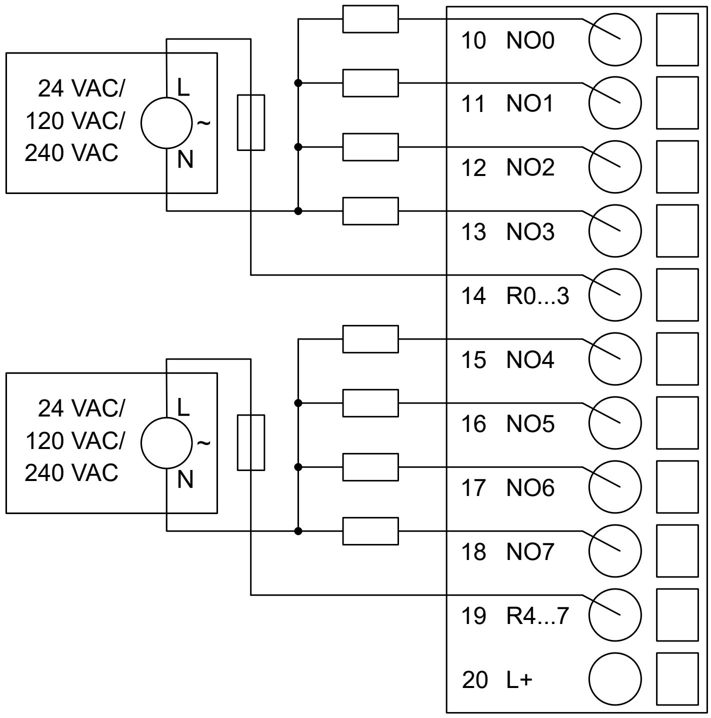


Fig. 19: Connection of 24 V AC or 100-240 V AC actuators

> *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.*

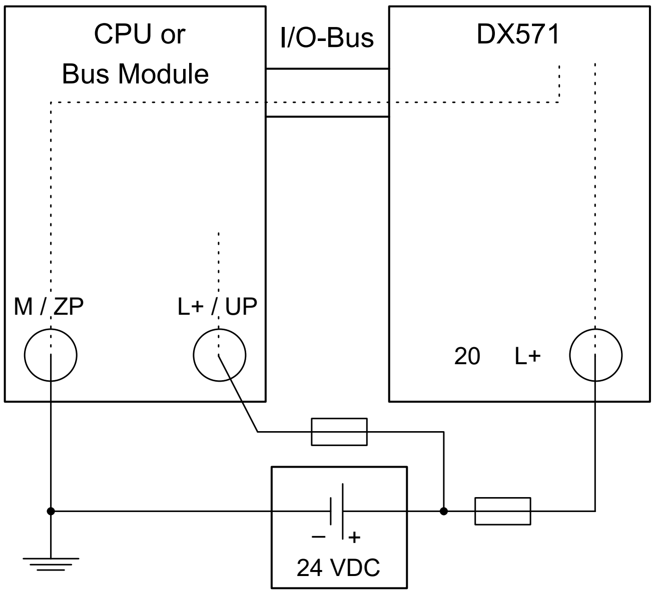


Fig. 20: Power supply - the minus connection is realized via the I/O bus

> **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 1.6.1.1.13.7 "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	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])

Name	Value	Internal Value	Internal Value, Type	Default	Min.	Max.	EDS Slot Index
Check supply	Off	0	BYTE	On			
	On	1		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;

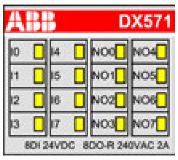
Diagnosis

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 2.5.1 “System data AC500-eCo V3” on page 925*

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage L+		
	Connections	Terminal 20 for L+ (+24 V DC). The negative pole is provided by the I/O bus.
	Rated value	24 V DC
	Current consumption via L+	50 mA
	Inrush current (at power-up)	0.0035 A^2s
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse for L+	Recommended; the outputs must be protected by a 3 A fast-acting fuse

Parameter	Value
Current consumption from 24 V DC power supply at the L+/UP and M/ZP terminals of the CPU/communication interface module	Ca. 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 switchgear 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 to I7		Terminals 2 to 9		
Reference potential for the channels I0 to I7		Terminal 1		
Indication of the input signals		1 yellow LED per channel; the LED is ON when the input signal is high (signal 1)		
Monitoring point of input indicator		LED is part of the input circuitry		
Input type according to EN 61131-2		Type 1 source	Type 1 sink	Type 1 AC [1])
Input signal range		-24 V DC	+24 V DC	24 V AC 50/60 Hz
Signal 0		-5 V...+3 V	-3 V...+5 V	0 V AC...5 V AC
Undefined signal		-15 V...+ 5 V	+5 V...+15 V	5 V AC...14 V AC
Signal 1		-30 V...-15 V	+15 V...+30 V	14 V AC...27 V AC
Input current per channel				
	Input voltage 24 V	Typ. 5 mA		Typ. 5 mA r.m.s.
	Input voltage 5 V	Typ. 1 mA		Typ. 1 mA r.m.s.
	Input voltage 14 V			Typ. 2.7 mA r.m.s.
	Input voltage 15 V	> 2.5 mA		
	Input voltage 27 V			Typ. 5.5 mA r.m.s.
	Input voltage 30 V	< 8 mA		
Max. permissible leakage current (at 2-wire proximity switches)		1 mA		Typ. 1 mA r.m.s.

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

[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 to O3		Terminals 10 to 13
Connection of the channels O4 to O7		Terminals 15 to 18
Reference potential for the channels O0 to O3		Terminal 14 (signal name R0..3)
Reference potential for the channels O4 to O7		Terminal 19 (signal name R4..7)
Relay coil power supply		Terminal 20 (positive pole of the process supply voltage, signal name L+). The negative pole is provided by the I/O bus.
Indication of the output signals		1 yellow LED per channel; the LED is on when the output signal is high (signal 1) and the module is powered through the I/O bus
Monitoring point of output indicator		Controlled together with relay
Way of operation		Non-latching type
Relay output voltage		
	Rated value	24 V DC / 24 V AC or 120/240 V AC
Output delay		
	Switching 0 to 1 (max.)	Typ. 10 ms
	Switching 1 to 0 (max.)	Typ. 10 ms
Output data length		1 byte
Output current		
	Rated current per channel (max.)	2.0 A (24 V DC / 24 V AC / 48 V AC / 120 V AC / 240 V AC, only resistive loads) 2.0 A (24 V AC / 48 V AC / 120 V AC, only pilot duty) 1.5 A (240 V AC, only pilot duty)
	Rated current per group (max.)	8 A
Lamp load (max.)		200 W (230 V AC), 30 W (24 V DC)
Spark suppression with inductive AC loads		Must be performed externally according to driven load specification
Switching Frequencies		
	With resistive loads	Max. 1 Hz

Parameter		Value
	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.

Ordering data

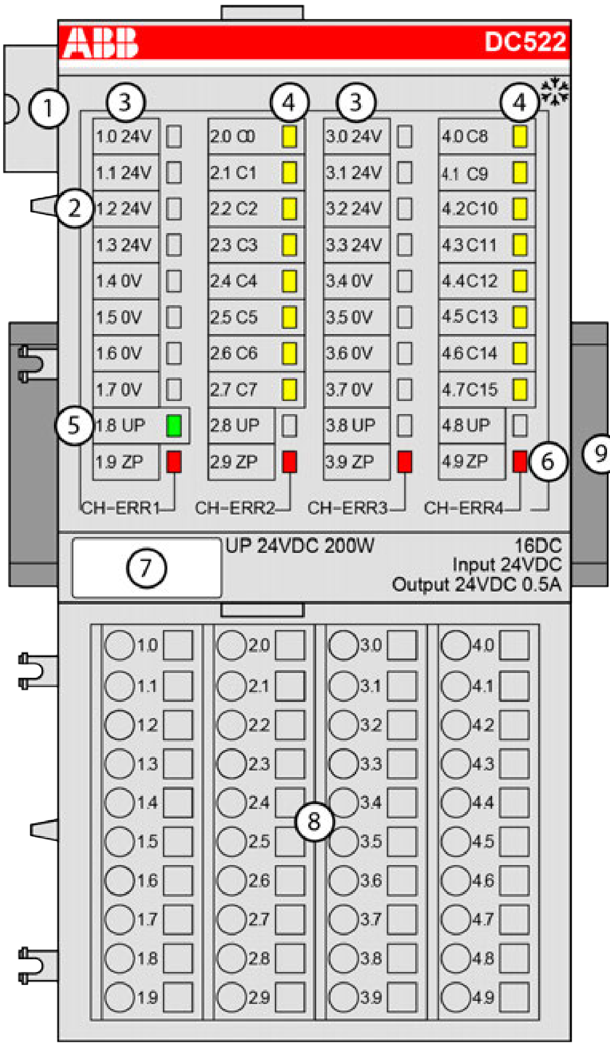
Part no.	Description	Product life cycle phase *)
1TNE 968 902 R2302	DX571, digital input/output module, 8 DI 24 V DC / 24 V AC, 8 DO, relay output	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11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

1.6.1.2 S500

1.6.1.2.1 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 iInterface 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 to 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 1.5.2 “TU515, TU516, TU541 and TU542 for I/O modules” on page 126*
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 1.5.2 “TU515, TU516, TU541 and TU542 for I/O modules” on page 126*. 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 (TA526 *Chapter 1.8.2.6 “TA526 - Wall mounting accessory” on page 902*).

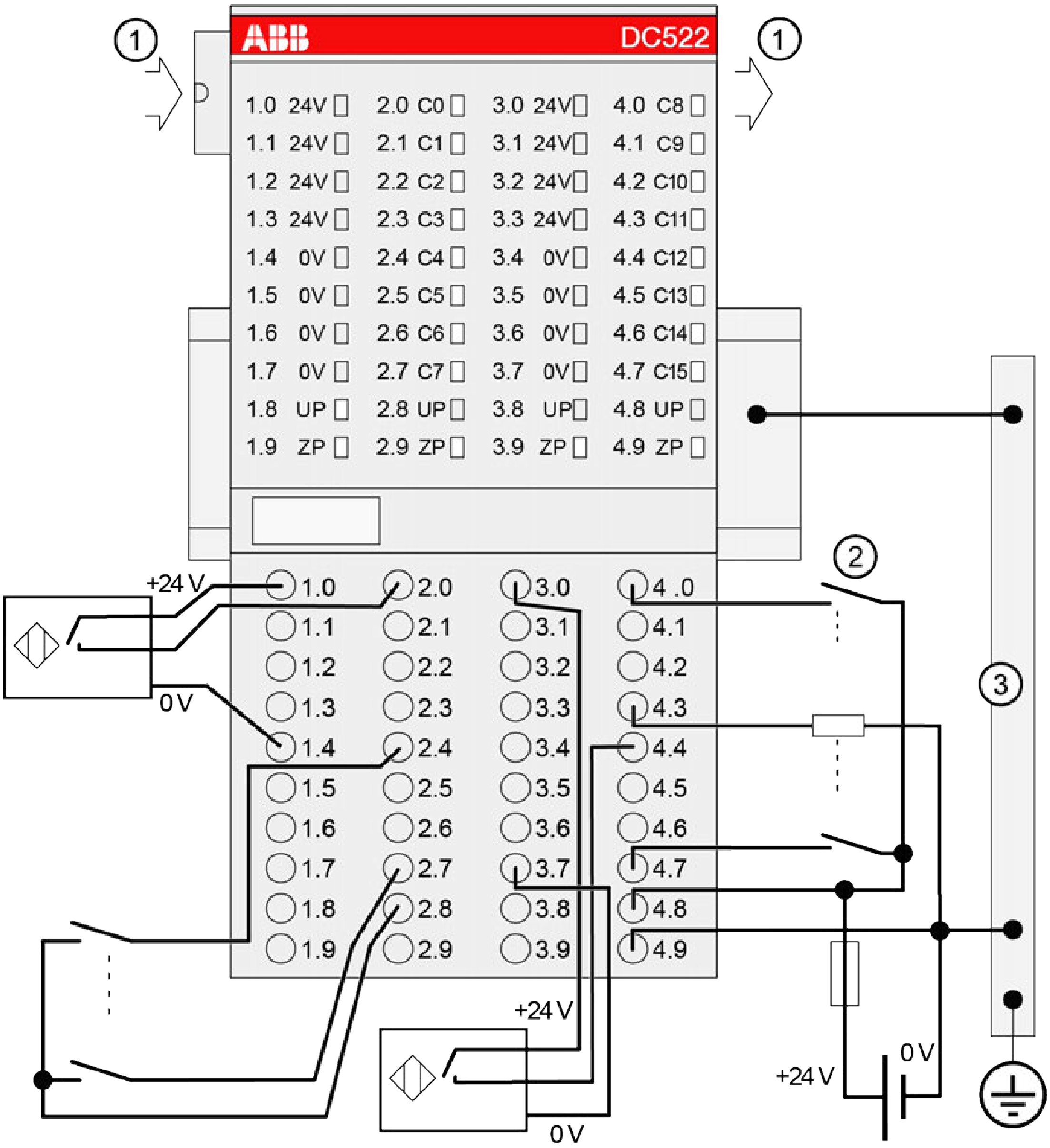
Connections

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 to 4.8 and 1.9 to 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 to 4.8: process voltage UP = +24 V DC

Terminals 1.9 to 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 Switchgear cabinet earth

The assignment of the other terminals:

Terminals	Signal	Description
1.0 to 1.3	+24 V	4 x sensor power supply sources (loadable with 0.5 A in total)
1.4 to 1.7	0 V	0 V (reference potential)
2.0 to 2.7	C0 to C7	8 digital inputs/outputs
3.0 to 3.3	+24 V	4 x sensor power supply sources (loadable with 0.5 A in total)
3.4 to 3.7	0 V	0 V (reference potential)
4.0 to 4.7	C8 to C15	8 digital inputs/outputs

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

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 only permissible under conditions described in Hot Swap chapter *Chapter 1.6 "I/O modules" on page 142*.

The devices are not designed for removal or insertion under power when Hot Swap conditions do not apply. 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 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

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 Bit 15 = Output 15 Bit 0 = Output 0	0... 65535	0... 0xffff	Word	0 0x0000	0	65535	0x0Y07

Remarks:

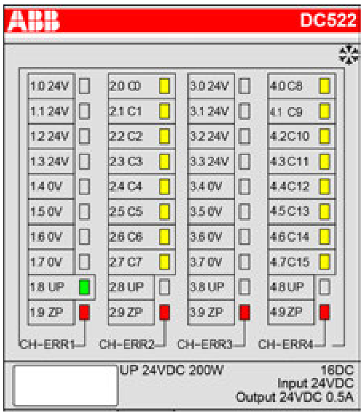
1)	With CS31 and addresses smaller than 70 and FBP, the value is increased by 1
2)	Not with FBP
3)	For a description of the counter operating modes, please refer to the 'Fast Counter' section *Chapter 1.6.1.2.9 “Fast counter” on page 349*
4)	With FBP or CS31 without the parameter Fast Counter

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 *Chapter 2.6.1 “System data AC500” on page 971* are applicable to the standard version.

The system data of AC500-XC *Chapter 2.7.1 “System data AC500-XC” on page 1023* are applicable to the XC version.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

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

Parameter		Value
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 switchgear cabinet.

NOTICE!
Attention:
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous 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		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)

Parameter	Value
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 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 may not exceed the clamp voltage of the varistor. The varistor limits the 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

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)

Parameter		Value
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.

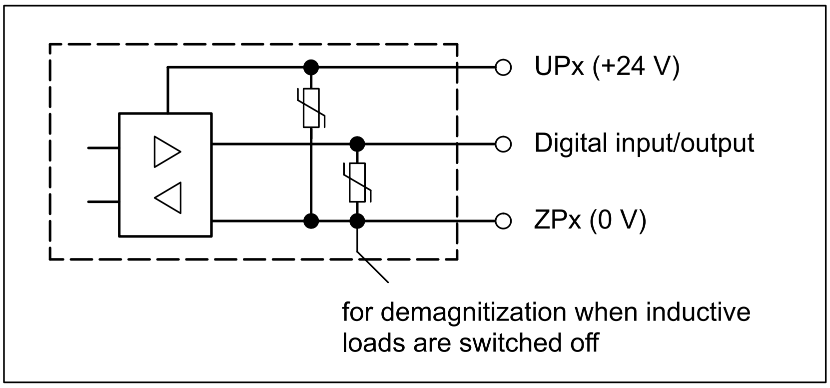


Fig. 21: Digital input/output (circuit diagram)

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

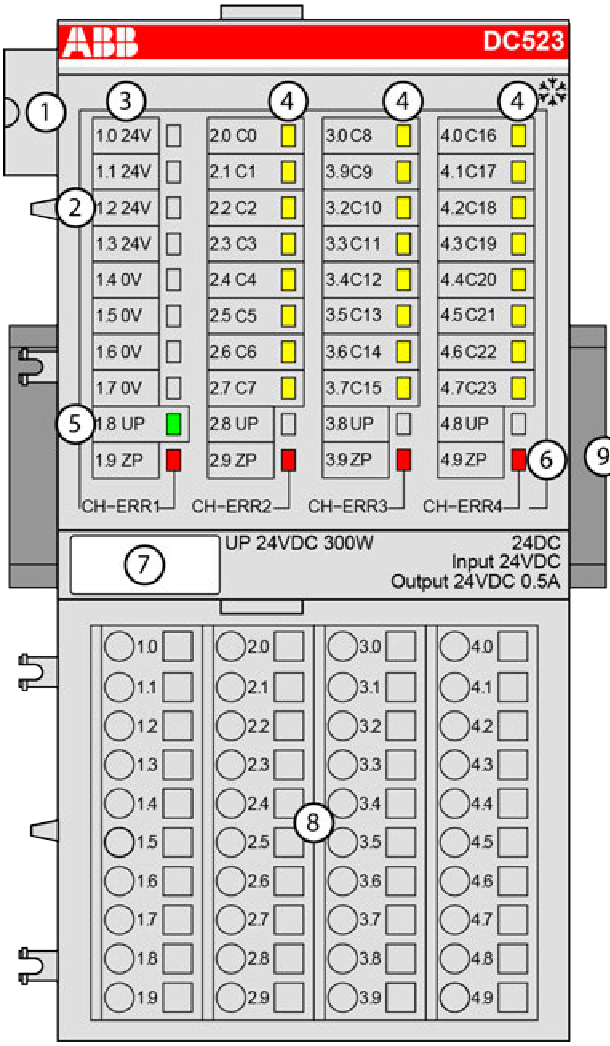
Ordering data

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.*

1.6.1.2.2 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 iInterface 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 to 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 1.5.2 "TU515, TU516, TU541 and TU542 for I/O modules" on page 126*
Effect of incorrect input terminal connection	Wrong or no signal detected, no damage up to 35 V

NOTICE!
Attention:
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 device is plugged on a terminal unit *Chapter 1.5.2 "TU515, TU516, TU541 and TU542 for I/O modules" on page 126*. 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 (TA526 *Chapter 1.8.2.6 "TA526 - Wall mounting accessory" on page 902*).

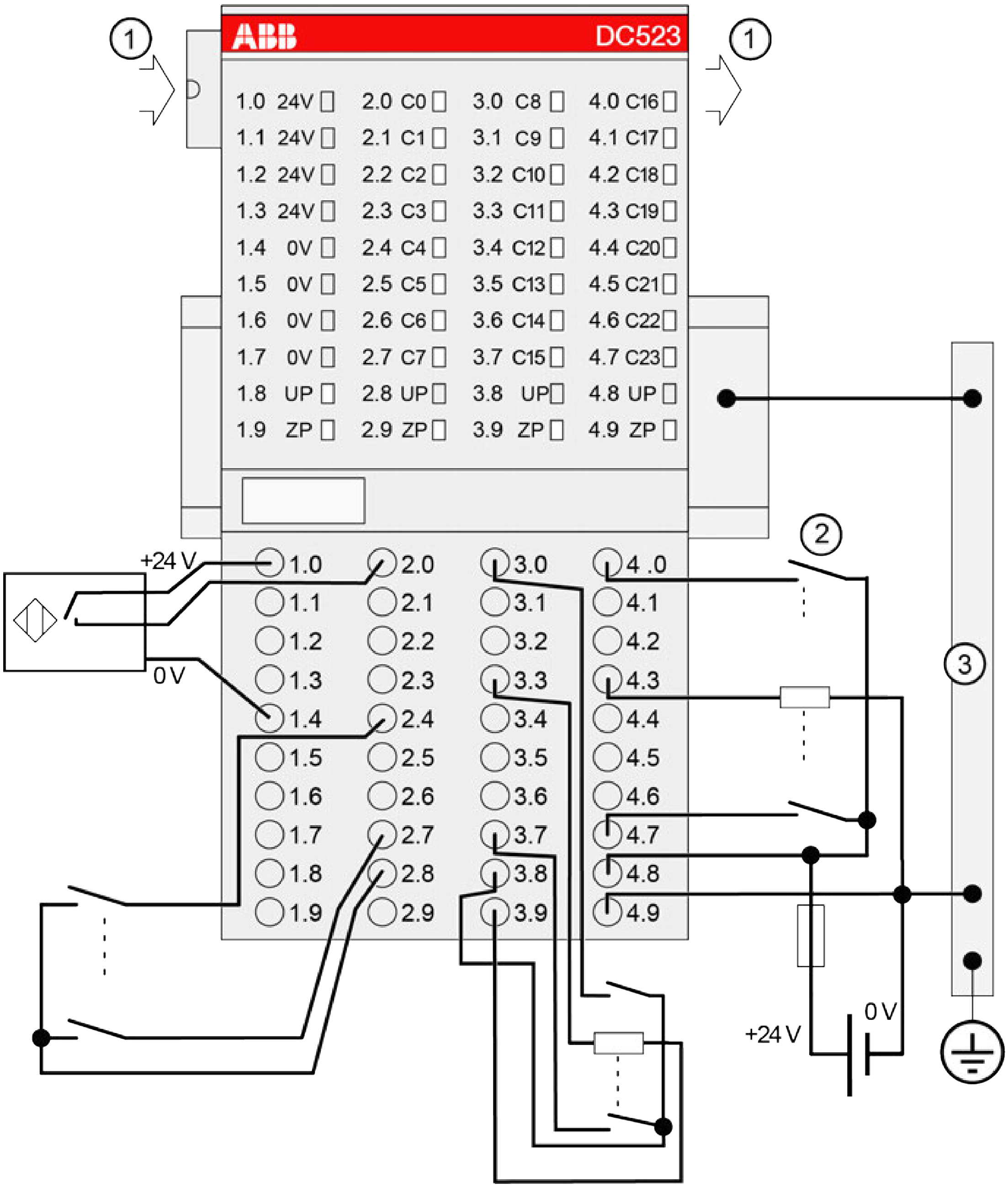
Connections

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 to 4.8 and 1.9 to 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 to 4.8: process voltage UP = +24 V DC

Terminals 1.9 to 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 Switchgear cabinet earth

The assignment of the other terminals:

Terminals	Signal	Description
1.0 to 1.3	+24 V	4 x sensor power supply sources (loadable with 0.5 A in total)
1.4 to 1.7	0 V	0 V (reference potential)
2.0 to 2.7	C0 to C7	8 digital inputs/outputs

Terminals	Signal	Description
3.0 to 3.7	C8 to C15	8 digital inputs/outputs
4.0 to 4.7	C16 to C23	8 digital inputs/outputs

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

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 only permissible under conditions described in Hot Swap chapter *Chapter 1.6 "I/O modules" on page 142*.

The devices are not designed for removal or insertion under power when Hot Swap conditions do not apply. 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 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:

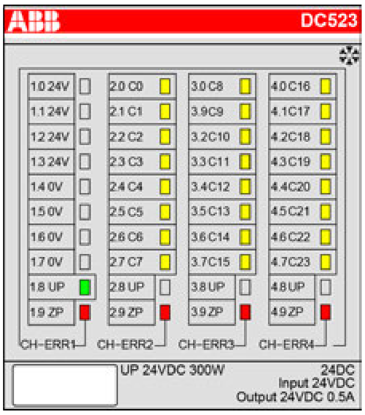
[1])	With CS31 and addresses smaller than 70 and FBP, the value is increased by 1
[2])	Not with FBP
[3])	For a description of the counter operating modes, please refer to the 'Fast Counter' section ↳ *Chapter 1.6.1.2.9 “Fast counter” on page 349*
[4])	With FBP or CS31 without the parameter Fast Counter

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 *Chapter 2.6.1 "System data AC500" on page 971* are applicable to the standard version.

The system data of AC500-XC *Chapter 2.7.1 "System data AC500-XC" on page 1023* are applicable to the XC version.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

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

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 / 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 switchgear cabinet.

NOTICE!
Attention:
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous 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

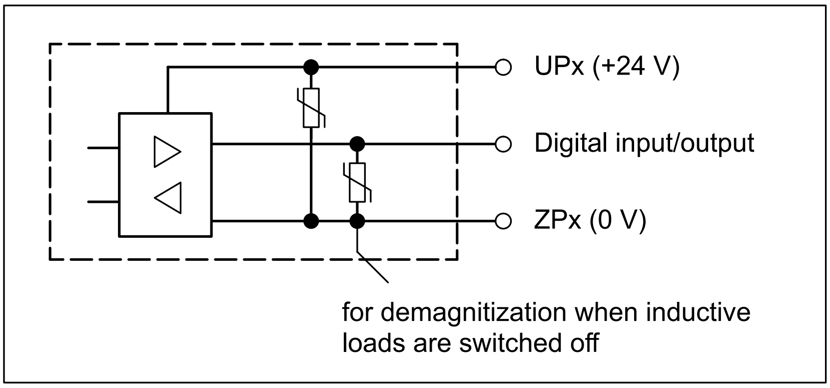
Parameter		Value
Number of channels per module		Max. 24 digital inputs
Reference potential for all inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (negative pole of the process supply voltage, signal name ZP)
Galvanic isolation		From the rest of the module
Indication of the input signals		1 yellow LED per channel, 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 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

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.



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

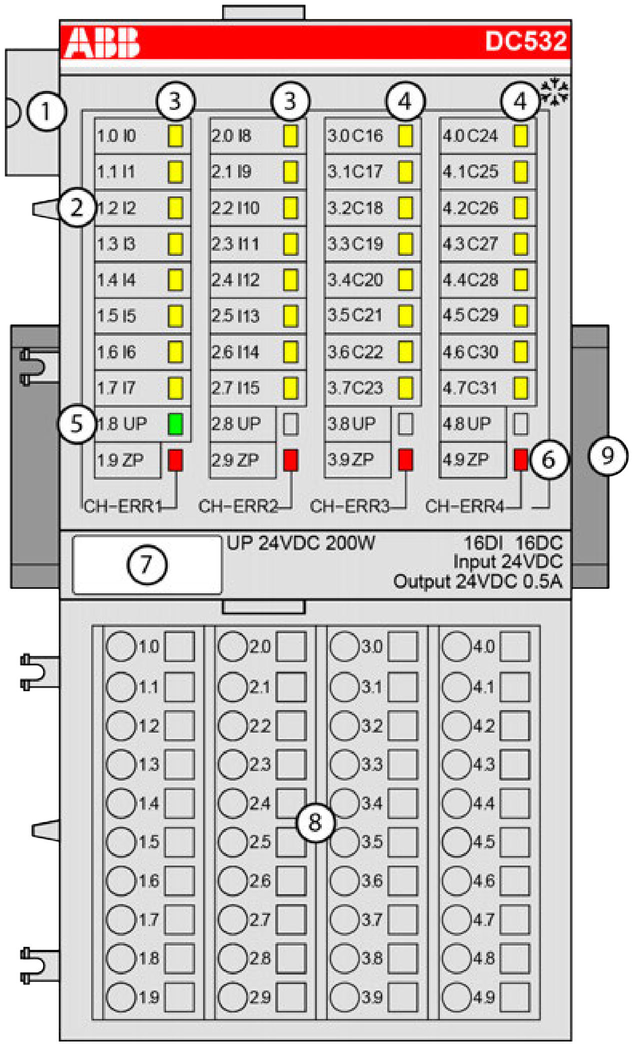
Ordering data

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.*

1.6.1.2.3 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 iInterface 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 to 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 1.5.2 “TU515, TU516, TU541 and TU542 for I/O modules” on page 126*
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 1.5.2 “TU515, TU516, TU541 and TU542 for I/O modules” on page 126*. 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 (TA526 ➔ *Chapter 1.8.2.6 “TA526 - Wall mounting accessory” on page 902*).

For a detailed description of the mounting, disassembly and connection of the module, please refer to the System Assembly, Construction and Connection chapter ➔ Chapter 2.6 “AC500 (Standard)” on page 971.

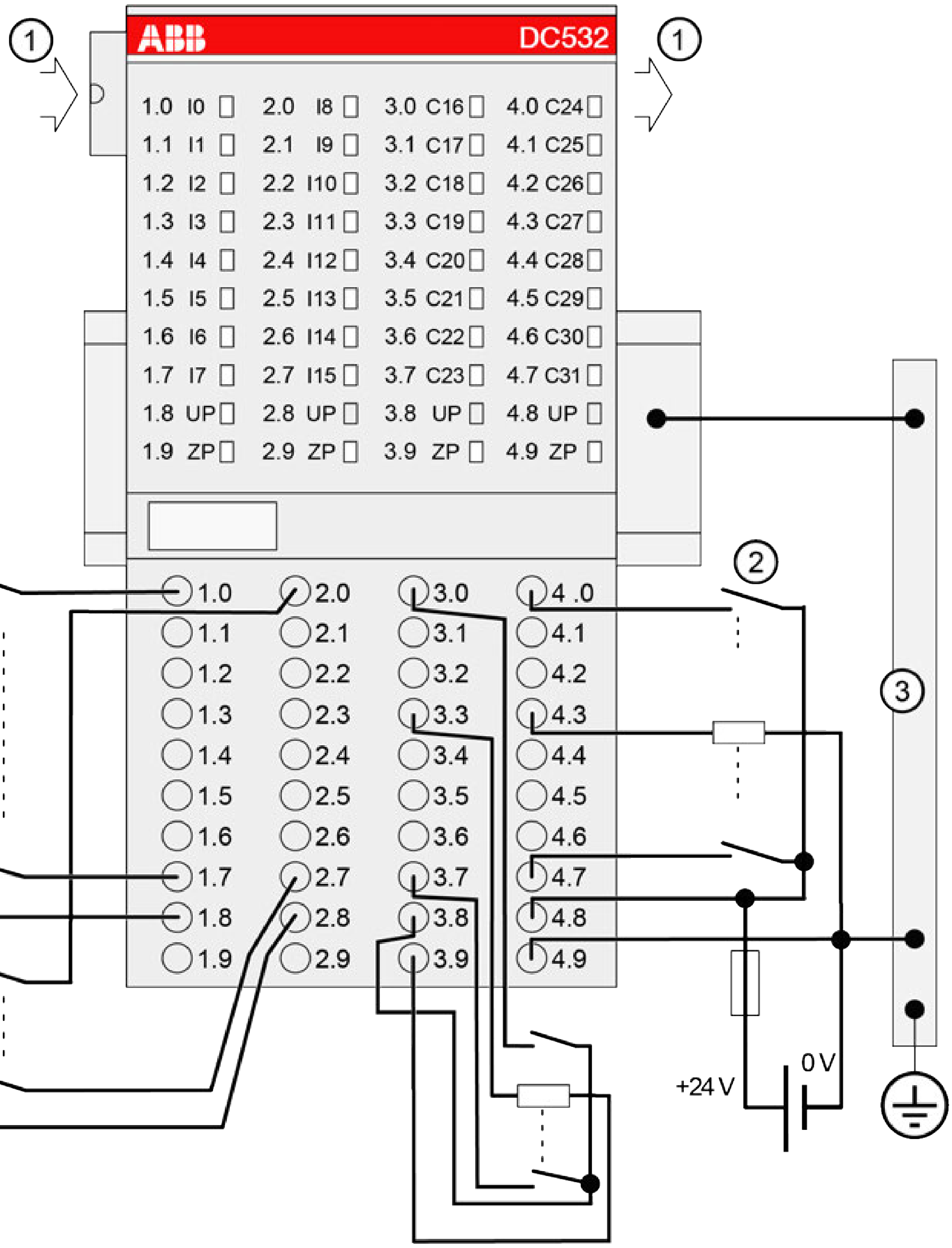
Connections

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 to 4.8 and 1.9 to 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 to 4.8: process voltage UP = +24 V DC

Terminals 1.9 to 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 switchgear cabinet earth

The assignment of the other terminals:

Terminals	Signal	Description
1.0 to 1.7	I0 to I7	8 digital inputs
2.0 to 2.7	I8 to I15	8 digital inputs
3.0 to 3.7	C16 to C23	8 digital inputs/outputs
4.0 to 4.7	C24 to C31	8 digital inputs/outputs

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

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 only permissible under conditions described in Hot Swap chapter *Chapter 1.6 “I/O modules” on page 142.*

The devices are not designed for removal or insertion under power when Hot Swap conditions do not apply. 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 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:

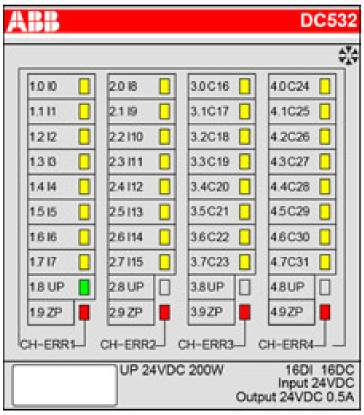
1)	With CS31 and addresses smaller than 70 and FBP, the value is increased by 1
2)	Not with FBP
3)	For a description of the counter operating modes, please refer to the 'Fast Counter' section *Chapter 1.6.1.2.9 “Fast counter” on page 349*
4)	With FBP or CS31 without the parameter Fast Counter

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 *Chapter 2.6.1 “System data AC500” on page 971* are applicable to the standard version.

The system data of AC500-XC *Chapter 2.7.1 “System data AC500-XC” on page 1023* are applicable to the XC version.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter		Value
Process supply voltage UP		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)

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 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 switchgear cabinet.

NOTICE!
Attention:
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous 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 to I7	1.0 to 1.7
Terminals of the channels I8 to I15	2.0 to 2.7
Reference potential for all inputs	Terminals 1.9, 2.8, 3.8 and 4.9 (negative pole of the process supply voltage, signal name ZP)
Galvanic isolation	From the rest of the module (I/O bus)
Indication of the input signals	1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)

Parameter	Value
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 1.6.1.2.3.8.1 “Technical data of the digital inputs” on page 298*
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

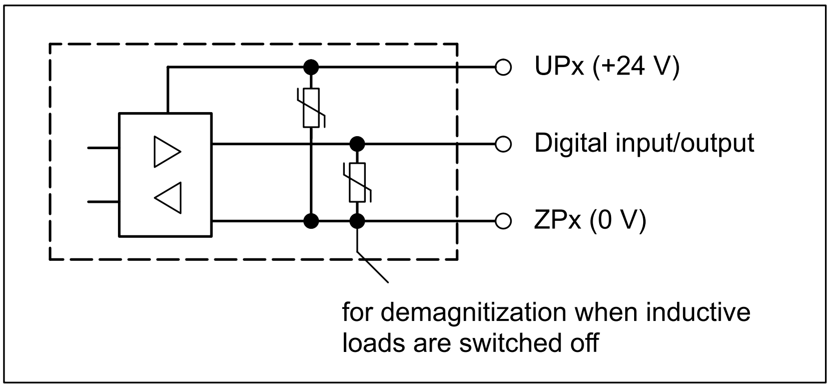
*) Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal must not exceed the clamp voltage of the varistor. The varistor limits the clamp voltage to approx. 36 V. Consequently, the input voltage must range from -12 V 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

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.



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

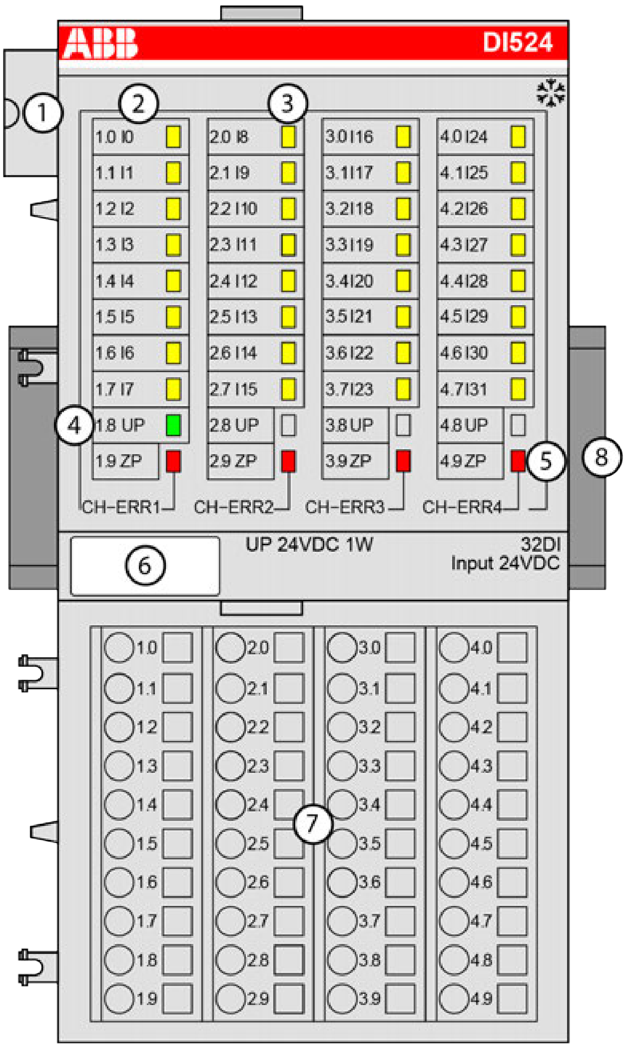
Ordering data

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.*

1.6.1.2.4 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 iInterface 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 1.5.2 “TU515, TU516, TU541 and TU542 for I/O modules” on page 126*
Effect of incorrect input terminal con-nection	Wrong or no signal detected, no damage up to 35 V

The device is plugged on a terminal unit ↯ *Chapter 1.5.2 “TU515, TU516, TU541 and TU542 for I/O modules” on page 126*. 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 (TA526 ↯ *Chapter 1.8.2.6 “TA526 - Wall mounting accessory” on page 902*).

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the System Assembly, Construction and Connection chapter ↯ Chapter 2.6 “AC500 (Standard)” on page 971.

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 to 4.8 and 1.9 to 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 to 4.8: process voltage UP = +24 V DC

Terminals 1.9 to 4.9: process voltage ZP = 0 V DC

Table 73: Assignment of the other terminals:

Terminals	Signal	Description
1.0 to 1.7	I0 to I7	8 digital inputs
2.0 to 2.7	I8 to I15	8 digital inputs
3.0 to 3.7	I16 to I23	8 digital inputs
4.0 to 4.7	I24 to 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 only permissible under conditions described in Hot Swap chapter ↬ *Chapter 1.6 “I/O modules” on page 142*.

The devices are not designed for removal or insertion under power when Hot Swap conditions do not apply. 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.

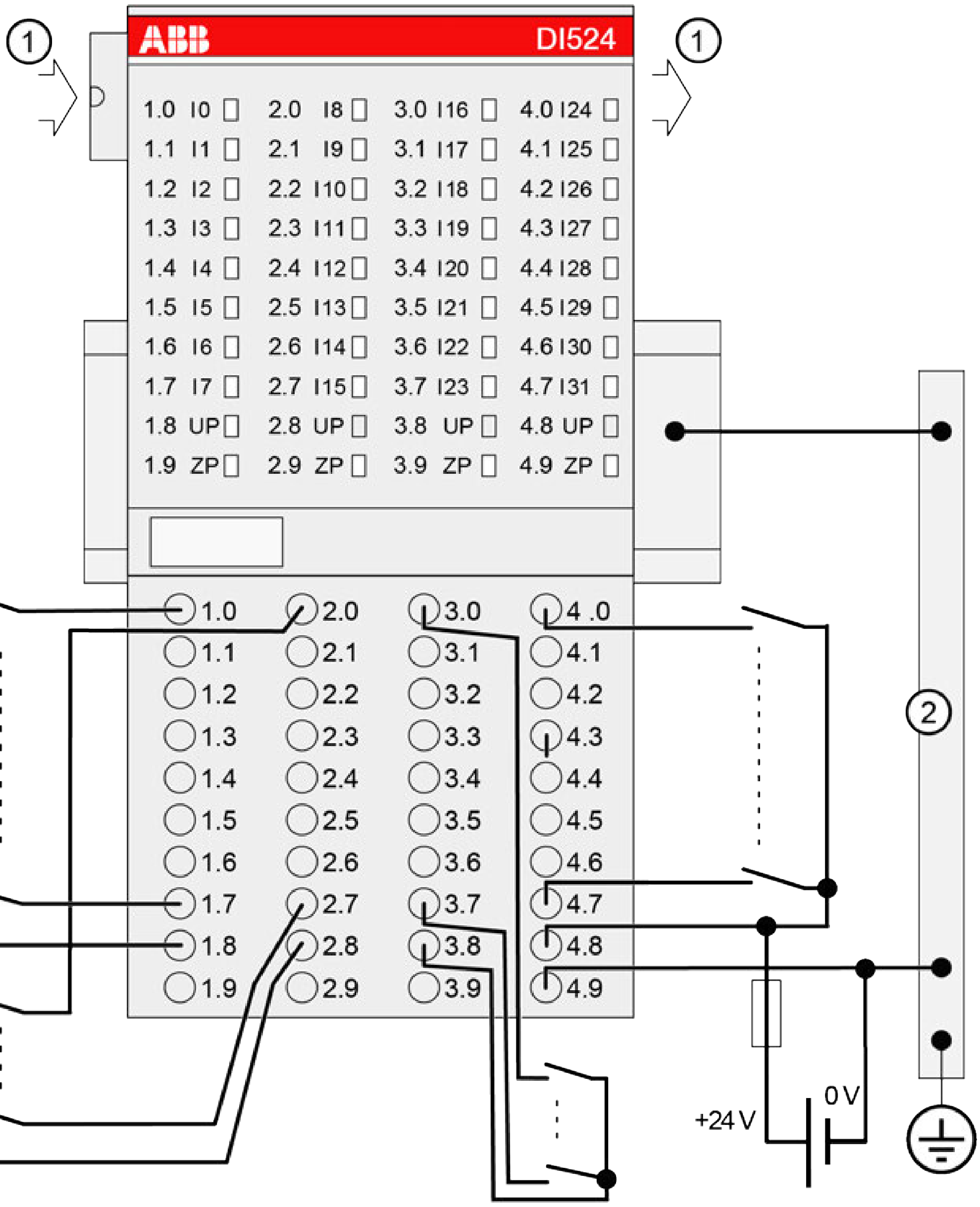
Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

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.



1 I/O bus
2 switchgear cabinet earth

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

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:

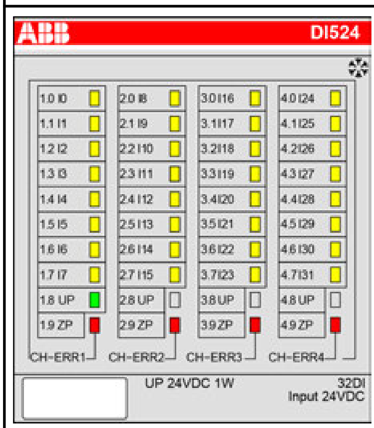
[1]	With CS31 and addresses smaller than 70 and FBP, the value is increased by 1
[2]	Not with FBP
[3]	For a description of the counter operating modes, please refer to the 'Fast Counter' section *Chapter 1.6.1.2.9 “Fast counter” on page 349*
[4]	With FBP or CS31 without the parameter Fast counter

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 ↳ *Chapter 2.6.1 “System data AC500” on page 971* are applicable to the standard version.

The system data of AC500-XC ↳ *Chapter 2.7.1 “System data AC500-XC” on page 1023* are applicable to the XC version.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter		Value
Process supply voltage UP		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 V DC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse for UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/ communication interface module	ca. 2 mA
	From UP at normal operation	0.15 A
	Inrush current from UP (at power up)	0.008 A^2s
Weight (without terminal unit)		ca. 105 g
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 switchgear cabinet.

NOTICE!

Attention:

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

Technical data of the digital inputs

Parameter	Value
Number of channels per module	32
Distribution of the channels into groups	1 group of 32 channels
Terminals of the channels I0 to I7	1.0 to 1.7
Terminals of the channels I8 to I15	2.0 to 2.7
Terminals of the channels I16 to I23	3.0 to 3.7
Terminals of the channels I24 to I31	4.0 to 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 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

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

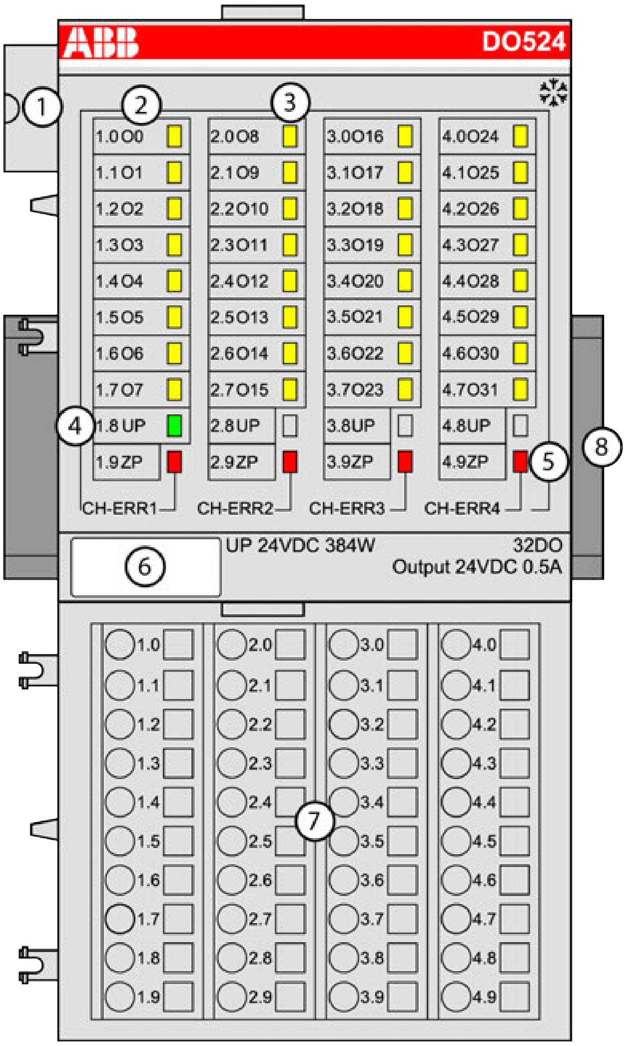
Ordering data

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.*

1.6.1.2.5 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 iInterface 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 1.5.2 “TU515, TU516, TU541 and TU542 for I/O modules” on page 126*

The device is plugged on a terminal unit ➪ *Chapter 1.5.2 “TU515, TU516, TU541 and TU542 for I/O modules” on page 126*. 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 (TA526 ➪ *Chapter 1.8.2.6 “TA526 - Wall mounting accessory” on page 902*).

> ***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 System Assembly, Construction and Connection chapter ➪ Chapter 2.6 “AC500 (Standard)” on page 971.*

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 to 4.8 and 1.9 to 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 to 4.8: process voltage UP = +24 V DC

Terminals 1.9 to 4.9: process voltage ZP = 0 V DC

The assignment of the other terminals:

Terminals	Signal	Description
1.0 to 1.7	O0 to O7	8 digital outputs
2.0 to 2.7	O8 to O15	8 digital outputs
3.0 to 3.7	O16 to O23	8 digital outputs
4.0 to 4.7	O24 to 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 only permissible under conditions described in Hot Swap chapter ➪ *Chapter 1.6 "I/O modules" on page 142*.

The devices are not designed for removal or insertion under power when Hot Swap conditions do not apply. 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.

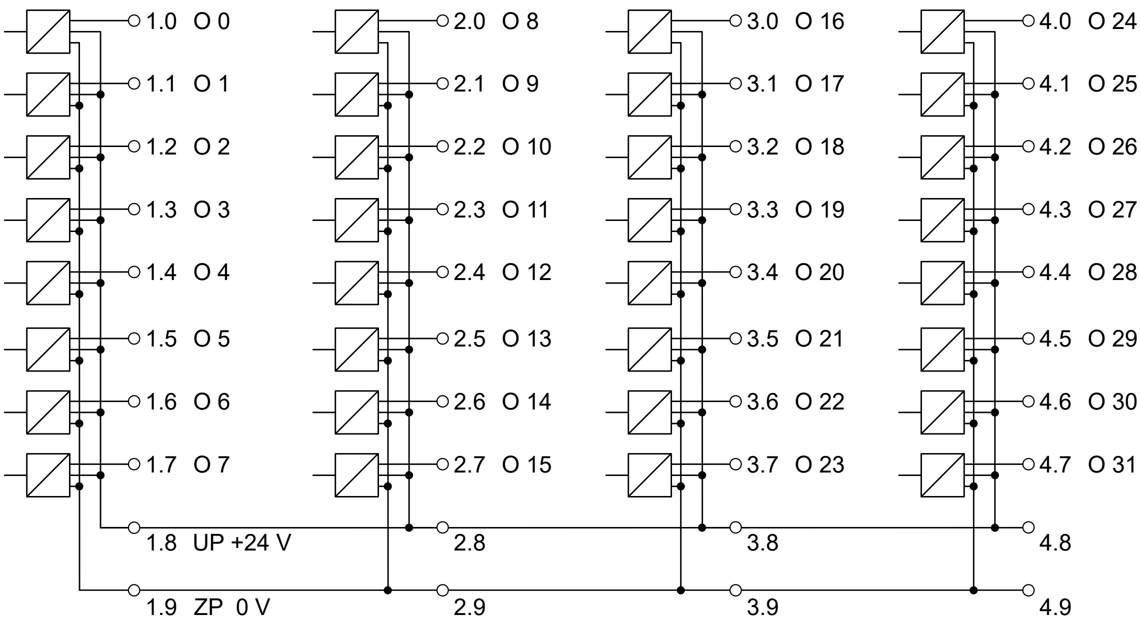
NOTICE!

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 following block diagram shows the 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

Name	Value	Internal value	Internal value, type	Default	Min.	Max.	Max.
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

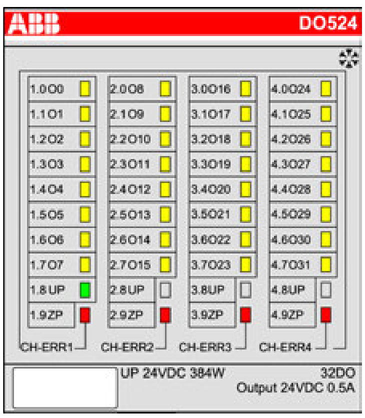
[2]) Not with FBP

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 *Chapter 2.6.1 “System data AC500” on page 971* are applicable to the standard version.

The system data of AC500-XC *Chapter 2.7.1 “System data AC500-XC” on page 1023* are applicable to the XC version.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter		Value
Process supply voltage UP		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 V DC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module	Ca. 2 mA
	From UP at normal operation / with outputs	0.10 A + max. 0.5 A per output
	Inrush current from UP (at power up)	0.005 A^2s
Max. power dissipation within the module		6 W (outputs unloaded)
Weight (without terminal unit)		Ca. 100 g
Mounting position		Horizontal 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 switchgear cabinet.

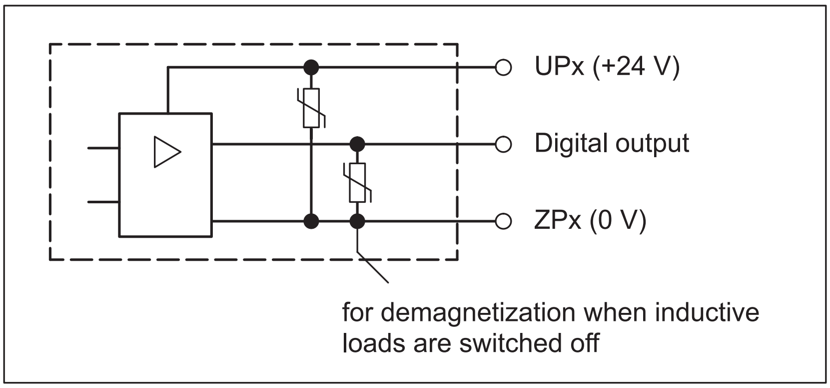
NOTICE!
Attention:
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous overvoltage up to 30 V DC.

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 to O7	Terminals 1.0 to 1.7
	O8 to O15	Terminals 2.0 to 2.7
	O16 to O23	Terminals 3.0 to 3.7
	O24 to O31	Terminals 4.0 to 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 to O15)	4 A
	Maximum value (channels O16 to O31)	4 A
	Maximum value (all channels together)	8 A
Max. leakage current with signal 0		< 0.5 mA
Rated protection fuse on UP		10 A fast
Demagnetization when inductive loads are switched off		With varistors integrated in the module (see figure below)
Switching frequency		
	With resistive load	On request
	With inductive loads	Max. 0.5 Hz
	With lamp loads	Max. 11 Hz with max. 5 W
Short-circuit proof / overload proof		Yes
Overload message (I > 0.7 A)		Yes, after ca. 100 ms
Output current limitation		Yes, automatic reactivation after short-circuit/overload
Resistance to feedback against 24 V signals		Yes
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

The following drawing shows the circuitry of a digital output with the varistors for demagnetization when inductive loads are switched off.



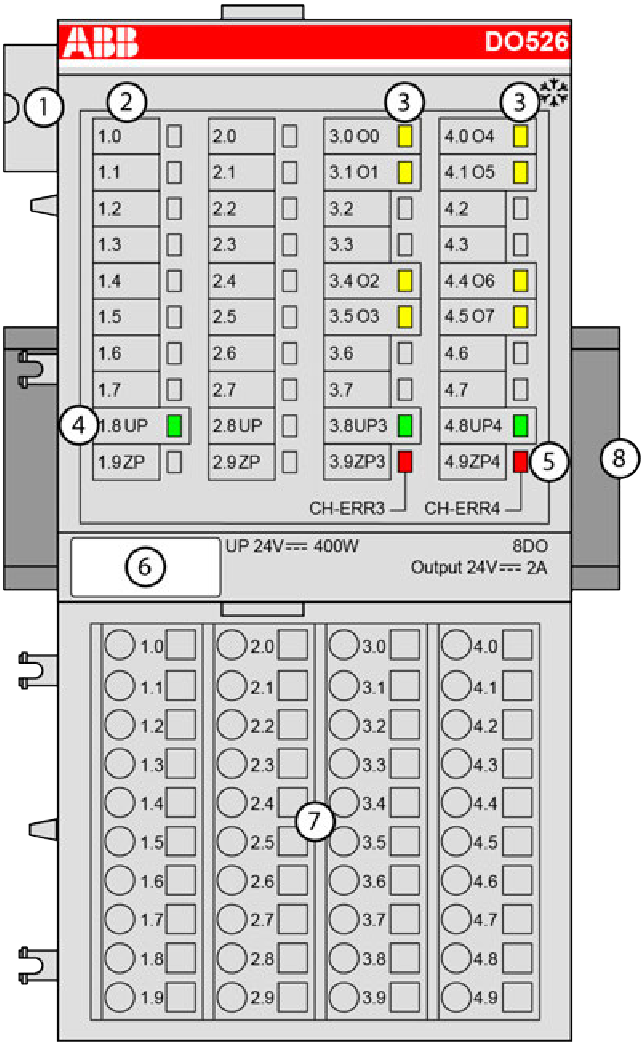
Ordering data

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.*

1.6.1.2.6 DO526 - Digital output module

- 8 digital outputs 24 V DC (O0 to 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 to 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 iInterface 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 1.5.2 "TU515, TU516, TU541 and TU542 for I/O modules" on page 126*

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 (TA526 ↯ *Chapter 1.8.2.6 "TA526 - Wall mounting accessory" on page 902*).

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the System Assembly, Construction and Connection chapter ↯ Chapter 2.6 "AC500 (Standard)" on page 971.

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 to 2.8 and 1.9 to 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 to 2.8:	Process voltage UP = +24 V DC
Terminals 1.9 to 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 to O3	4 digital outputs
4.0, 4.1, 4.4, 4.5	O4 to O7	4 digital outputs

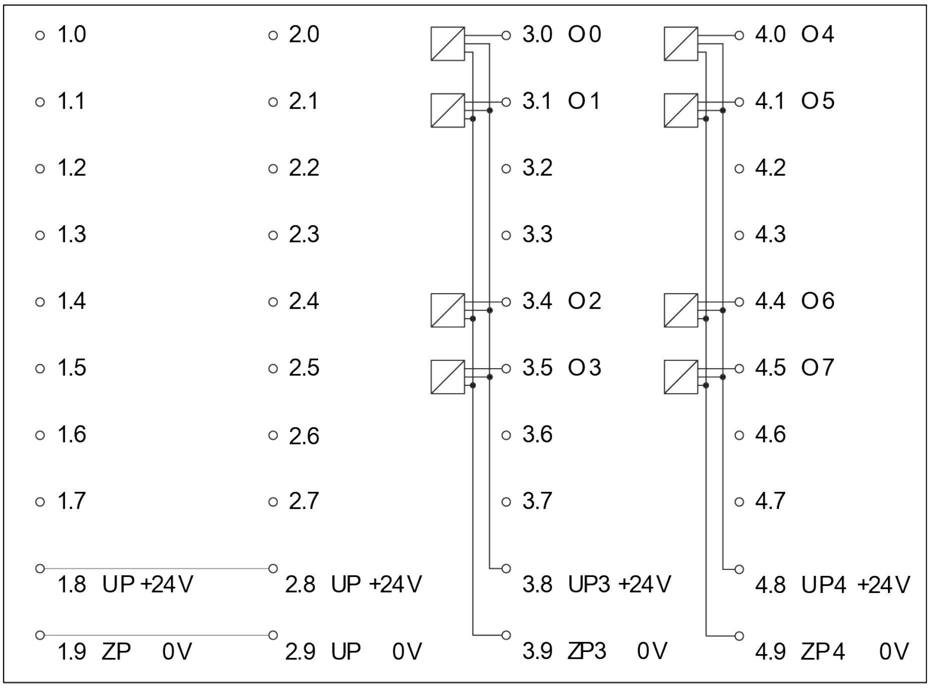
The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals L+/UP and M/ZP of the CPU/communication interface module increases by 2 mA per DO526.

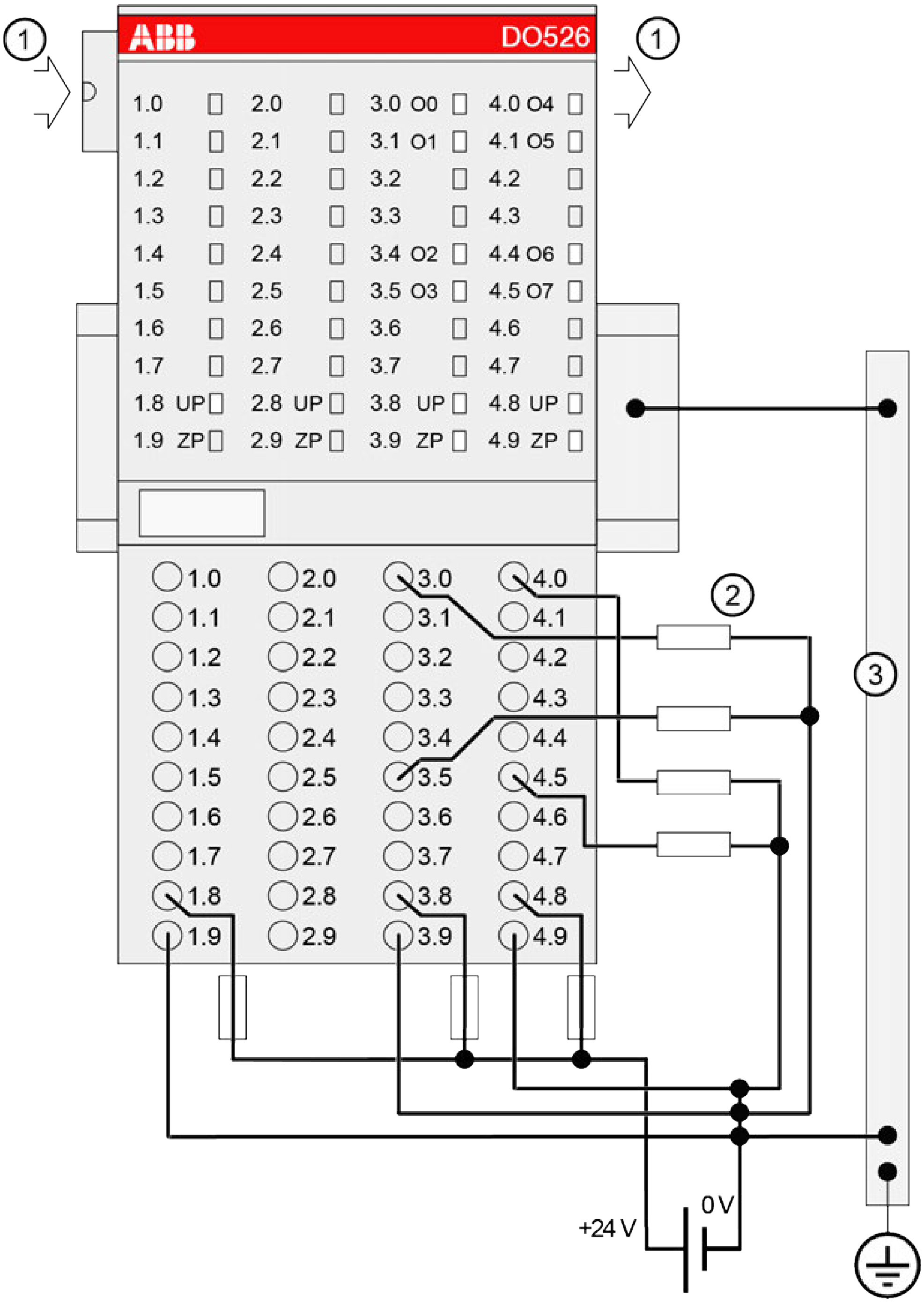
The external power supply connection is carried out via the UP, UP3, UP4 (+24 V DC) and the ZP, ZP3, ZP4 (0 V DC) terminals.

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.

The following block diagram shows the 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 Switchgear cabinet earth

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

The module provides several diagnosis functions .

Internal data exchange

Digital inputs (bytes)	0
Digital outputs (bytes)	1

I/O configuration

The module itself does not store configuration data. It receives its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

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

Parameterization

The arrangement of the parameter data is performed with Automation Builder software, versions ≥ 1.2.3.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1...7

Name	Value	Internal value	Internal value, type	Default	Min.	Max.	Max.
Module ID	Internal	1105 1)	WORD	1105 0x0451	0	65535	0x0Y01
Ignore module 2)	No Yes	0 1	BYTE	No 0x00			not for FBP
Parameter length	Internal	6	BYTE	6-CPU 6-FBP	0	6	0x0Y02
Check supply	Off on	0 1	BYTE	On 0x01	0	1	0x0Y03
Reserve	0...255	0...0xff	BYTE	On 0x01	0	1	0x0Y04
Behaviour of outputs at communication errors	Off Last value Substitute value	0 1+(n*5) 2+(n*5), n ≤ 2	BYTE	Off 0x00	0	2	0x0Y05

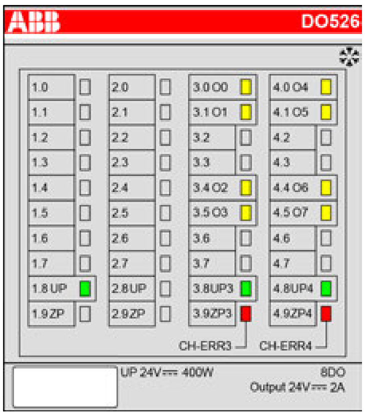
Name	Value	Internal value	Internal value, type	Default	Min.	Max.	Max.
Substitute value at outputs Bit 7 = Output 7 Bit 0 = Output 0	0...255	0...0xff	BYTE	0x00	0	255	0x0Y06
Reserve	0...255	0...0xff	BYTE	0x00	0	255	0x0Y07
Reserve	0...255	0...0xff	BYTE	0x00	0	255	0x0Y08
[1]) With CS31 and addresses smaller than 70 and FBP, the value is increased by 1 [2]) Not with FBP							

GSD file:

Ext_User_Prm_Data_Len =	10
Ext_User_Prm_Data_Const(0) =	0x04, 0x51, 0x00, 0x06, 0x01, 0x01, 0x00, 0x00, 0x00, 0x00

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Outputs O0...O7	Digital output	Yellow	Output = OFF	Output = ON [2])	--
	UP	Process supply voltage 24 V DC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
	UP3	Process supply voltage outputs 0...3 24 V DC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
	UP4	Process supply voltage outputs 4...7 24 V DC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--

LED		State	Color	LED = OFF	LED = ON	LED flashes
	CH-ERR3	Channel Error, error messages in groups (digital outputs combined into the groups 3, 4)	Red	No error or process supply voltage is missing	Severe error within the corresponding group	Error on in the corresponding group
	CH-ERR4		Red			
	CH-ERR [1])	Module Error	Red	--	Internal error	--
	[1]) All of the LEDs CH-ERR3 to CH-ERR4 light up together [2]) The state of the LEDs corresponds to the logic state of the output. In case of missing or low process supply voltage UP3 or UP4, the signal on the output terminal is off even though the LED is on.					

Technical data

The system data of AC500 and S500 *Chapter 2.6.1 "System data AC500" on page 971* are applicable to the standard version.

The system data of AC500-XC *Chapter 2.7.1 "System data AC500-XC" on page 1023* are applicable to the XC version.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter		Value
Process supply voltage UP, UP3 and UP4		
	Connections	Terminals 1.8 and 2.8 for +24 V (UP) as well as 1.9 and 2.9 0 V (ZP) Terminals 3.8 for +24 V (UP3) as well as 3.9 for 0 V (ZP3) Terminals 4.8 for +24 V (UP4) as well as 4.9 for 0 V (ZP4)
	Rated value	24 V DC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP, UP3 and UP4	10 A fast (for each process supply voltage)
	Galvanic isolation	Yes, per module and per output channel groups
Current consumption		
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module	Ca. 2 mA
	From UP at normal operation / with outputs	Ca. 20 mA + 1.5 mA per output
	From UP3 or UP4 at normal operation / with outputs	Ca. 0.01 A + max. 2 A per output
	Inrush current from UP (at power up)	0.015 A^2s

Parameter		Value
	Inrush current from UP3 or UP4 (at power up)	0.005 A^2s (without output load)
Max. power dissipation within the module		6 W
Weight (without terminal unit)		Ca. 135 g
Mounting position		Horizontal 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 switchgear 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 to O3	Terminals 3.0, 3.1, 3.4, 3.5
	O4 to 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		
	Rated value, per channel	2 A at UP3 or UP4 = 24 V

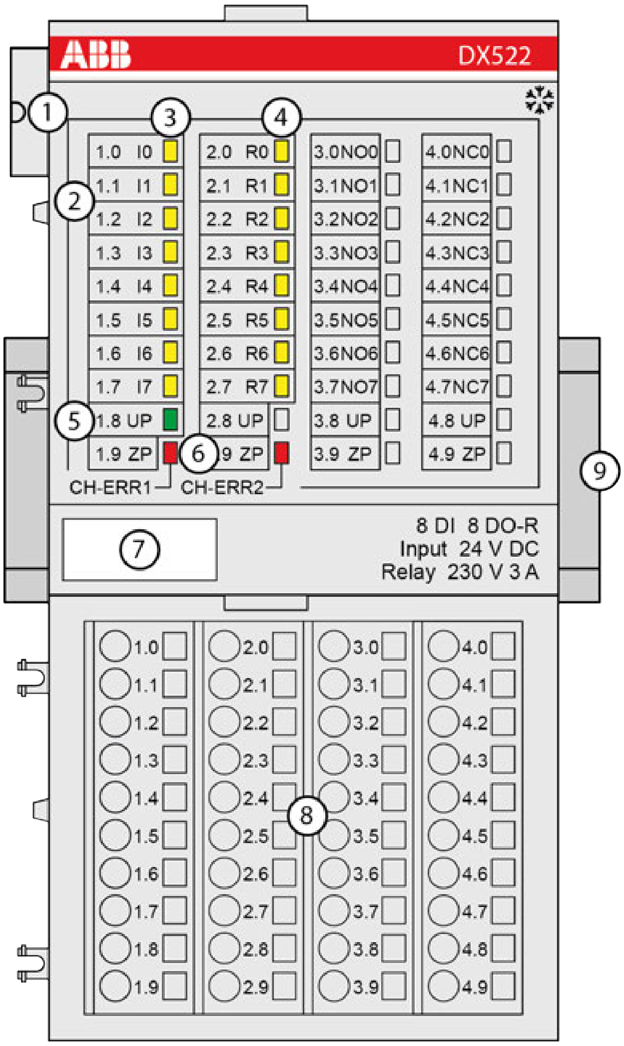
Parameter		Value
	Maximum value (channels O0 to O3)	8 A
	Maximum value (channels O4 to O7)	8 A
Leakage current with signal 0		< 0.1 mA
Rated protection fuse on UP		10 A fast
Demagnetization when inductive loads are switched off		With clamp diode in output high side driver
Switching frequency		
	With 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

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

1.6.1.2.7 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 iInterface 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 1.5.4 "TU531 and TU532 for I/O modules" on page 135*

The device is plugged on a terminal unit *Chapter 1.5.4 "TU531 and TU532 for I/O modules" on page 135*. 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 (TA526 *Chapter 1.8.2.6 "TA526 - Wall mounting accessory" on page 902*).

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 System Assembly, Construction and Connection chapter Chapter 2.6 "AC500 (Standard)" on page 971.

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 to 4.8 and 1.9 to 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 to 4.8: process supply voltage UP = +24 V DC
- Terminals 1.9 to 4.9: process supply voltage ZP = 0 V DC

Table 74: Assignment of the other terminals:

Terminals	Signal	Description
1.0 to 1.7	I0 to I7	Input signals of the 8 digital inputs
1.8 to 4.8	UP	Process supply voltage +24 V DC
1.9 to 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 only permissible under conditions described in Hot Swap chapter *Chapter 1.6 “I/O modules” on page 142*.

The devices are not designed for removal or insertion under power when Hot Swap conditions do not apply. 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 (see Diagnosis and State LEDs).

The following figure shows the connection of the digital input/output module DX522.

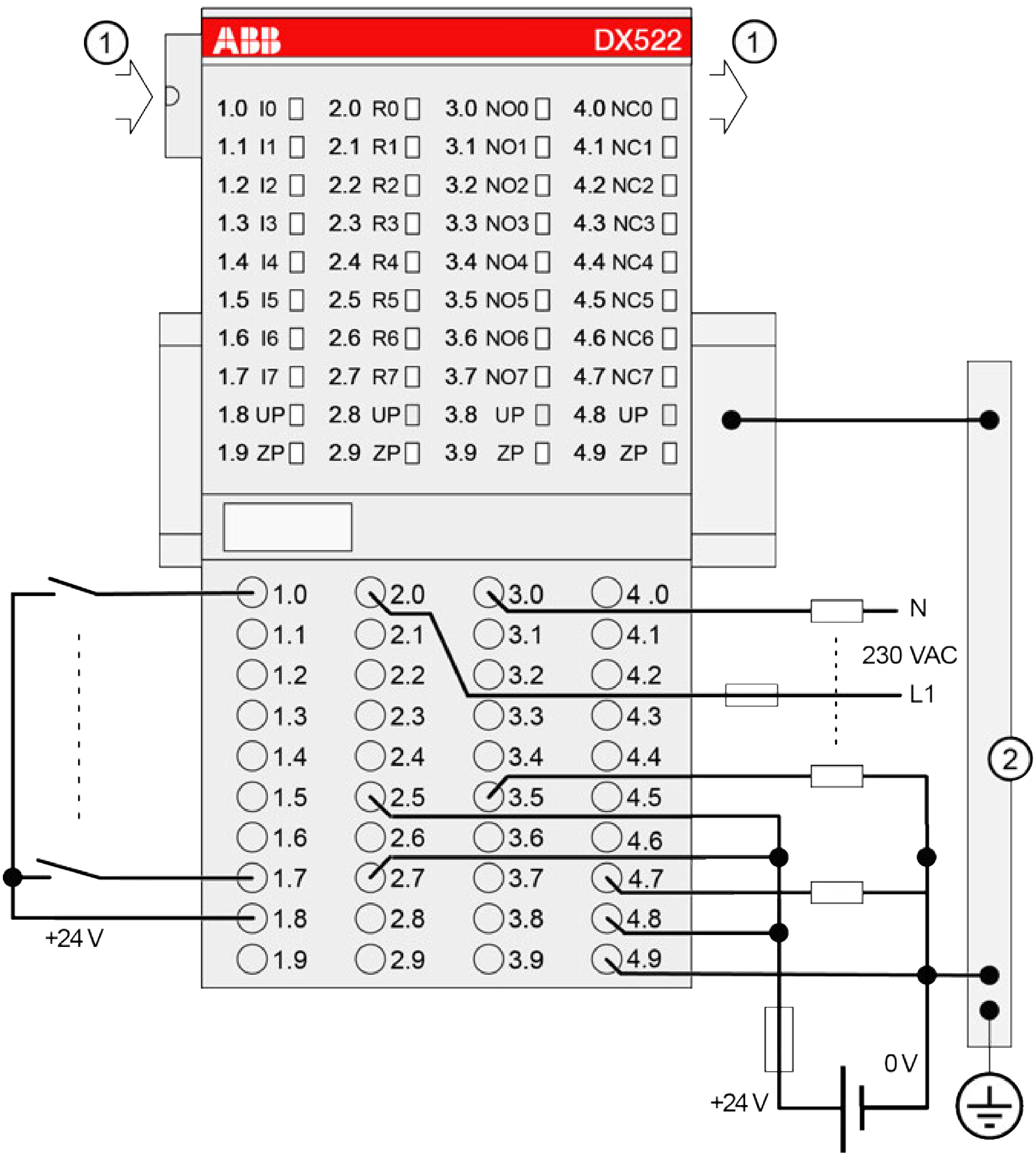


Fig. 22: Connection of the module

1 I/O bus
2 Switchgear 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 pole).

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 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:

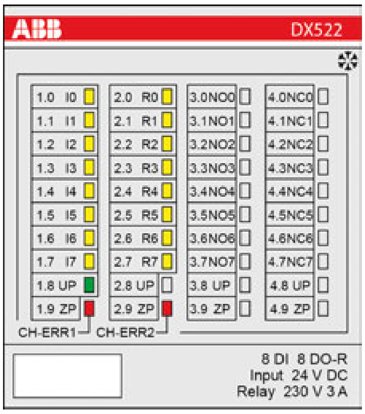
[1])	With CS31 and addresses smaller than 70 and FBP, the value is increased by 1
[2])	Not with FBP
[3])	For a description of the counter operating modes, please refer to the 'Fast Counter' section ↻ *Chapter 1.6.1.2.9 “Fast counter” on page 349*
[4])	With FBP and without the parameter Fast Counter

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
	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 *Chapter 2.6.1 “System data AC500” on page 971* are applicable to the standard version.

The system data of AC500-XC *Chapter 2.7.1 “System data AC500-XC” on page 1023* are applicable to the XC version.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter		Value
Process supply voltage UP		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 V DC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/ communication interface module	ca. 2 mA
	From UP at normal operation / with outputs	0.05 A + output loads
	Inrush current from UP (at power up)	0.010 A^2s
Max. power dissipation within the module		6 W (outputs OFF)
Weight (without terminal unit)		ca. 300 g
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 switchgear cabinet.

NOTICE!
Attention:
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit 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 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 to I7	1.0 to 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 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

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.
Detailed description	See

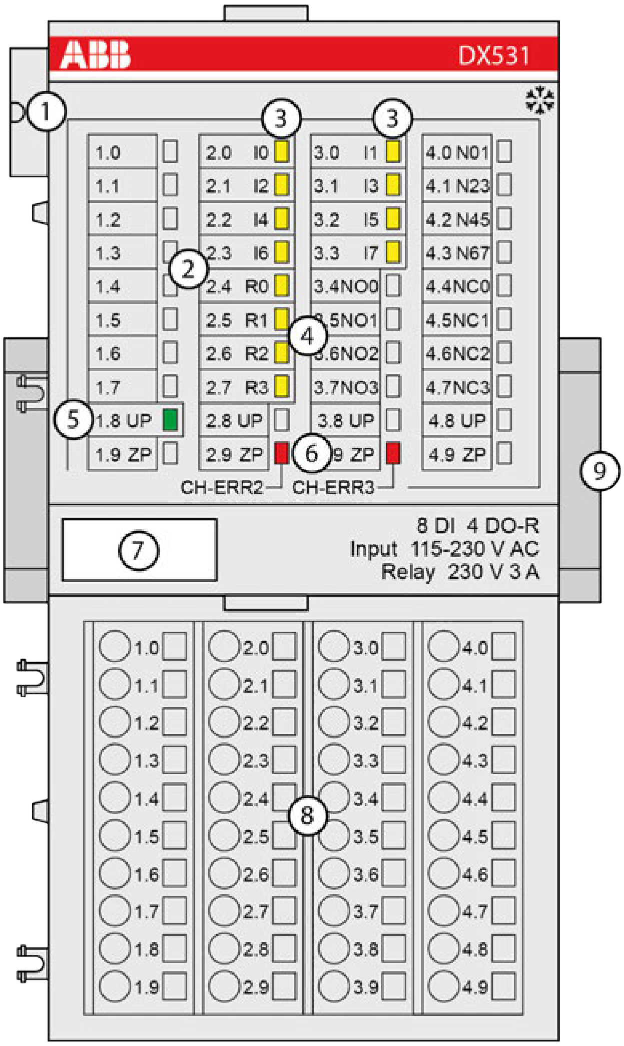
Ordering data

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.*

1.6.1.2.8 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 iInterface 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 1.5.4 “TU531 and TU532 for I/O modules” on page 135*

The device is plugged on a terminal unit ␗ *Chapter 1.5.4 “TU531 and TU532 for I/O modules” on page 135*. 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 (TA526 ␗ *Chapter 1.8.2.6 “TA526 - Wall mounting accessory” on page 902*).

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 System Assembly, Construction and Connection chapter ␗ Chapter 2.6 “AC500 (Standard)” on page 971.

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 to 4.8 and 1.9 to 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 to 4.8: process supply voltage UP = +24 V DC
- Terminals 1.9 to 4.9: process supply voltage ZP = 0 V DC

The assignment of the other terminals:

Terminals	Signal	Description
1.0 to 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

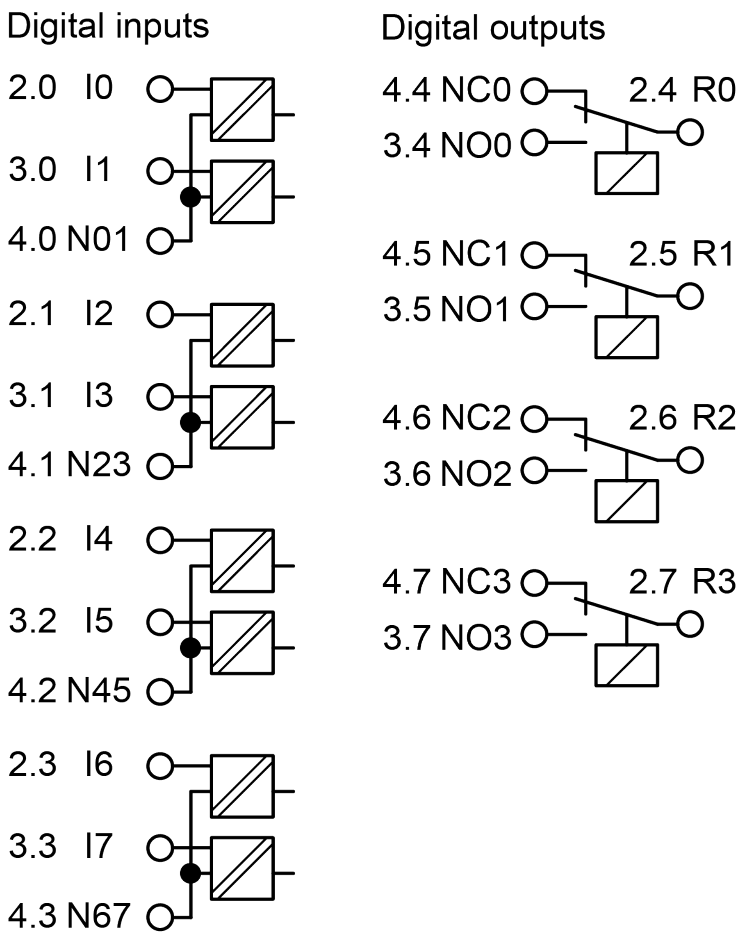


Fig. 23: Internal construction

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 only permissible under conditions described in Hot Swap chapter *Chapter 1.6 “I/O modules” on page 142*.

The devices are not designed for removal or insertion under power when Hot Swap conditions do not apply. 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.

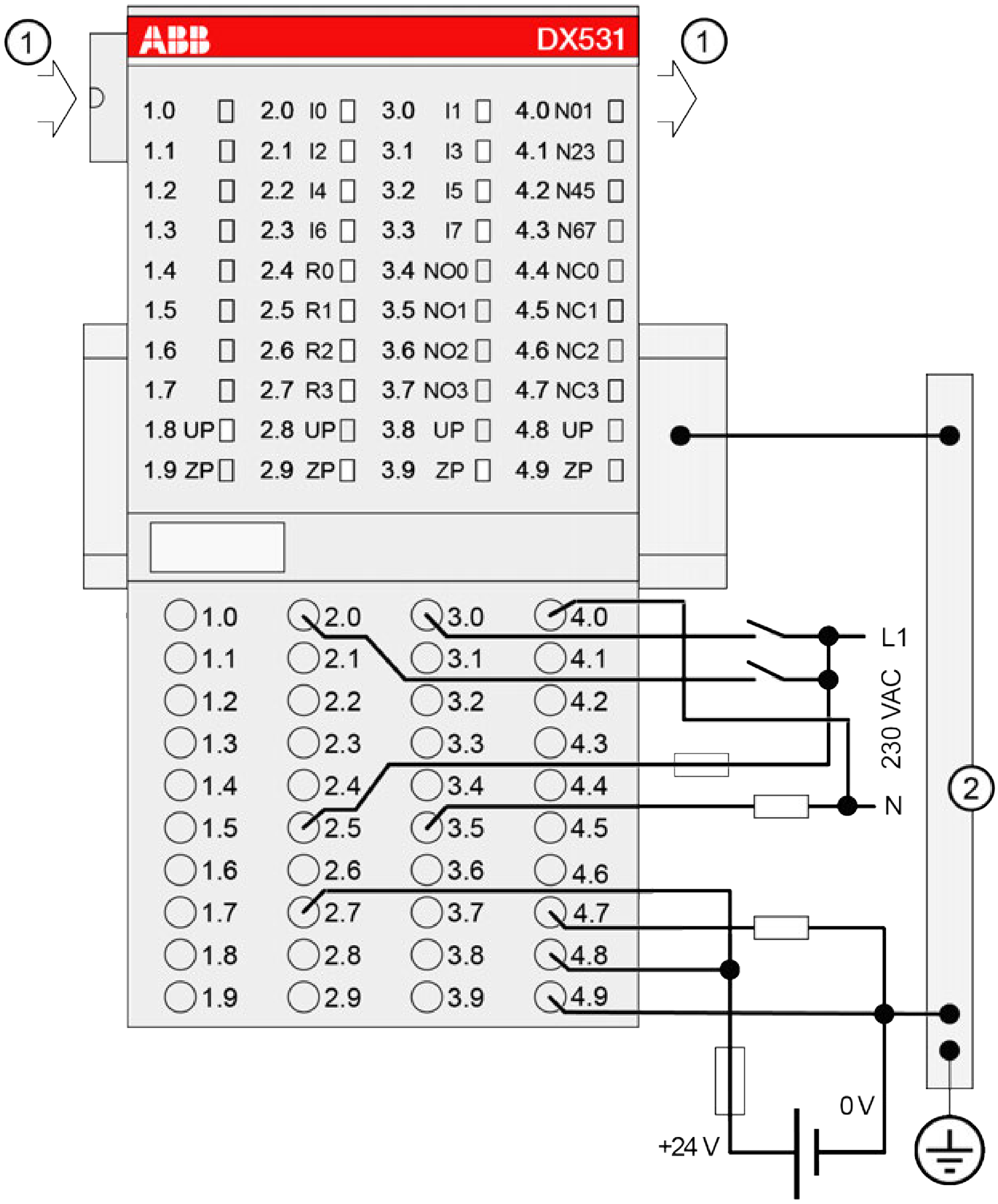
Disconnecting any powered devices while energized in a hazardous location could result in an electric arc, which could create a flammable ignition resulting in fire or explosion.

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 following figure shows the connection of the module:



1 I/O bus
2 Switchgear 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 pole).

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 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 to 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 (see chapter Diagnosis and State LEDs).

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

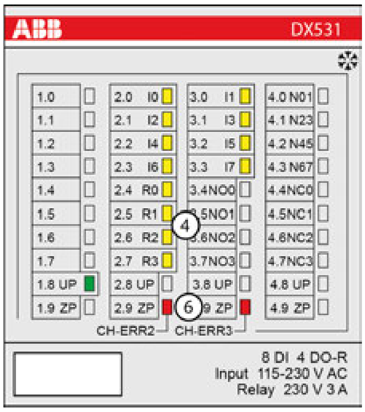
Name	**Value**	**Internal value**	**Internal value, type**	**Default**	**Min.**	**Max.**	**EDS** **Slot/ Index**
Module ID	Internal	1205 [1])	Word	1205 0x04B5	0	65535	0x0Y01
Ignore module [2])	No Yes	0 1	Byte	No 0x00			not for FBP
Parameter length	Internal	4	Byte	4-CPU 4-FBP	0	255	0x0Y02
Check supply	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), $n \leq 2$	Byte	Off 0x00	0	2	0x0Y05
Substitute value at outputs Bit 3 = Output 3 Bit 0 = Output 0	0...15	0... 0x0f	Byte	0 0x00	0	15	0x0Y06
[1]) With CS31 and addresses smaller than 70 and FBP, the value is increased by 1 [2]) Not with FBP							

GSD file:

Ext_User_Prm_Data_Len =	7
Ext_User_Prm_Data_Const	0x04, 0xb6, 0x04, \
(0) =	0x01, 0x00, 0x00, 0x00;

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Inputs I0...I7	Digital input	Yellow	Input = OFF	Input = ON	--
	Outputs R0...R3 (relays)	Digital output	Yellow	Relay output = OFF	Relay output = ON	--
	UP	Process supply voltage 24 V DC via terminal	Green	Process supply voltage is missing	Process supply voltage OK	--
	CH-ERR2	Channel error, error messages in groups (digital inputs/ outputs combined into the groups 2 and 3)	Red	No error or process supply voltage is missing	Severe error within the corresponding group	Error on one channel of the corresponding group
	CH-ERR3		Red			
	CH-ERR *)	Module Error	Red	--	Internal error	--
	*) All of the LEDs CH-ERR2 to CH-ERR3 light up together					

Technical data

The system data of AC500 and S500 *Chapter 2.6.1 “System data AC500” on page 971* are applicable to the standard version.

The system data of AC500-XC *Chapter 2.7.1 “System data AC500-XC” on page 1023* are applicable to the XC version.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter		Value
Process supply voltage UP		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V DC (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V DC (ZP)
	Rated value	24 V DC

Parameter		Value
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module	ca. 2 mA
	From UP at normal operation / with outputs	0.15 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 switchgear cabinet.

> **NOTICE!**
> **Attention:**
> All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit 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 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 1.6.1.2.8.3 “Connections” on page 340*
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

Parameter		Value
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
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 1.6.1.2.8.3 “Connections” on page 340*
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

Parameter		Value
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

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 245 000 R0001	DX531, digital input/output module, 8 DI, 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.*

1.6.1.2.9 Fast counter

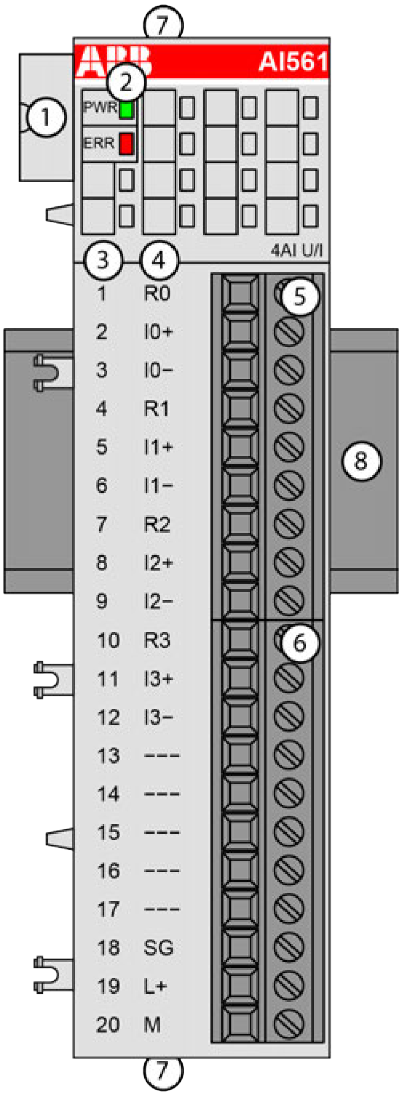
More information can be found in the Automation Builder chapter, *“Fast counters in AC500 devices”*.

1.6.2 Analog I/O modules

1.6.2.1 S500-eCo

1.6.2.1.1 AI561 - Analog input module

- 4 configurable analog inputs (I0 to I3) in 1 group
- Resolution: 11 bits plus sign or 12 bits



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 iInterface 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

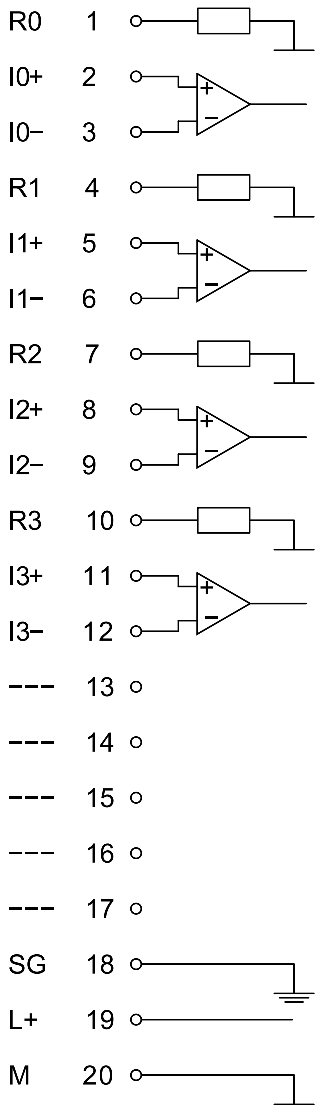
Parameter		Value
Resolution of the analog channels		
	Voltage bipolar (-2.5 V...+2.5 V; -5 V...+5 V)	11 bits plus sign
	Voltage unipolar (0 V...5 V; 0 V...10 V)	12 bits
	Current (0 mA...20 mA; 4 mA...20 mA)	12 bits
LED displays		2 LEDs for process voltage and error messages
Internal supply		Via I/O bus
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 System Assembly chapter *➪ Chapter 2.5 “AC500-eCo” on page 925.*

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.

The following block diagram shows the 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
11	I3+	Positive pole of input signal 3

Terminal	Signal	Description
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

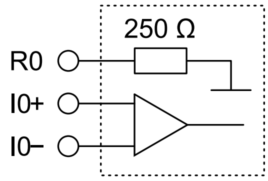
– connect or disconnect any signal or terminal block
– remove or replace a module.

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 1.6.2.1.1.6 “Diagnosis” on page 356*.

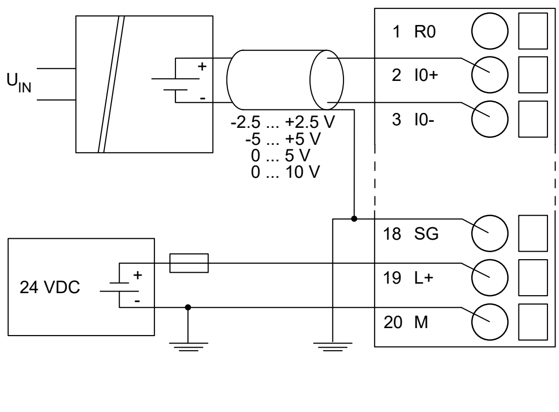
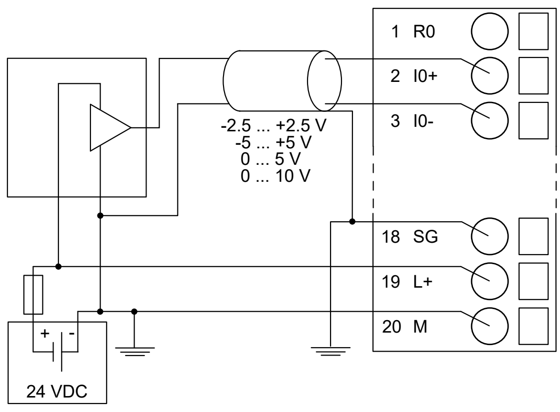
The following figure is an example of the internal construction of the analog input AI0. The analog inputs AI1...AI3 are designed in the same way.



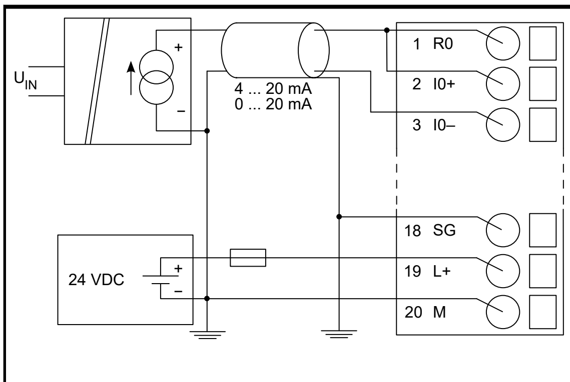
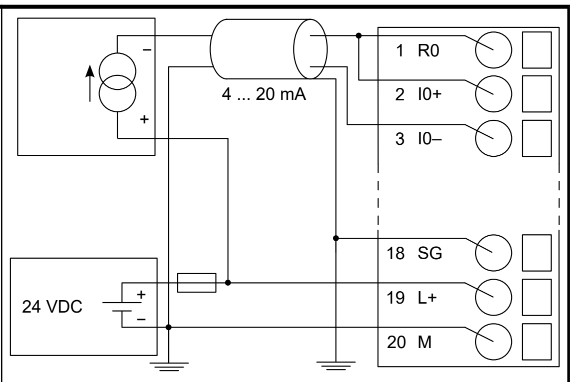
CAUTION!
Risk of damaging the analog input!
The 250 Ω input resistor can be damaged by overcurrent.

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

The following figures are an example of the connection of analog sensors (voltage) to the input I0 of the analog input module AI561. 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)

The following figures are an example of the connection of analog sensors (current) to the input I0 of the analog input module AI561. Proceed with the inputs I1 to I3 in the same way.

	
Connection of active-type analog sensors (current)	Connection of passive-type analog sensors (current)

The meaning of the LEDs is described in the Displays section *Chapter 1.6.2.1.1.7 “State LEDs” on page 357*.

I/O configuration

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

Parameterization

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

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal Value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Intern	6500 [1])	WORD	0x1964	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No 0x00			
Parameter length	Internal	6	BYTE	0	0	255	xx02 [2])
Check Supply	Off On	0 1	BYTE	On 0x01			
Analog Data Format	Default	0	BYTE	Default 0x00		255	

[1]) with CS31 and addresses smaller than 70, the value is increased by 1

[2]) Value is hexadecimal: HighByte is slot (xx: 0 ... 7), LowByte is index (1...n)

GSD file:	Ext_User_Prm_Data_Len = Ext_User_Prm_Data_Const(0) =	0x09 0x65, 0x19, 0x06, \ 0x01, 0x00, \ 0x00, 0x00, 0x00, 0x00;

Input channel (4x)

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.
Channel configuration	see table [2])	see table [2])	BYTE	0 0x00	0	65535

Table 75: 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

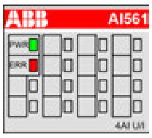
E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500 display	<– Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error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

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
Meas-ured 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 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 respectively 11 bits plus sign.

Technical data

The System Data of AC500-eCo apply *Chapter 2.5.1 "System data AC500-eCo V3" on page 925*

Only additional details are therefore documented below.

Parameter		**Value**
Process supply voltage L+		
	Connections	Terminal 19 for L+ (+24 V DC) and terminal 20 for M (0 V)
	Rated value	24 V DC
	Current consumption via L+ terminal	0.1 A
	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
Mounting position		Horizontal or vertical
Cooling		The natural convection cooling must not be hindered by cable ducts or other parts in the switchgear cabinet.

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

Technical data of the analog inputs

<table>
<tr><th colspan="2">Parameter</th><th colspan="2">Value</th></tr>
<tr><td colspan="2">Number of channels per module</td><td colspan="2">4 individually configurable voltage or current inputs</td></tr>
<tr><td colspan="2">Distribution of channels into groups</td><td colspan="2">1 (4 channels per group)</td></tr>
<tr><td colspan="2">Resolution</td><td colspan="2"></td></tr>
<tr><td></td><td>Unipolar</td><td colspan="2">Voltage: 0 V...+5 V; 0 V...+10 V: 12 bits
Current 0 mA...20 mA; 4 mA...20 mA: 12 bits</td></tr>
<tr><td></td><td>Bipolar</td><td colspan="2">Voltage -2.5 V...+2.5 V; -5 V...+5 V: 11 bits plus sign</td></tr>
<tr><td colspan="2">Connection of the signals I0- to I3-</td><td colspan="2">Terminals 3, 6, 9, 12</td></tr>
<tr><td colspan="2">Connection of the signals I0+ to I3+</td><td colspan="2">Terminals 2, 5, 8, 11</td></tr>
<tr><td colspan="2">Input type</td><td colspan="2">Differential</td></tr>
<tr><td colspan="2">Galvanic isolation</td><td colspan="2">No galvanic isolation between the inputs and the I/O bus</td></tr>
<tr><td colspan="2">Common mode input range</td><td colspan="2">Signal voltage plus common mode voltage must be within ±12 V</td></tr>
<tr><td colspan="2">Indication of the input signals</td><td colspan="2">No</td></tr>
<tr><td colspan="2">Channel input resistance</td><td colspan="2">Voltage: > 1 MΩ
Current: ca. 250 Ω</td></tr>
<tr><td colspan="2" 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 (voltage)
±0.5 % of full scale (current 0 mA...20 mA)
±0.7 % of full scale (current 4 mA...20 mA)
at 25 °C</td></tr>
<tr><td>Max.</td><td>±2 % of full scale (all ranges)
at 0 °C...60 °C or EMC disturbance</td></tr>
<tr><td colspan="2">Time constant of the input filter</td><td colspan="2">Voltage: 300 µs
Current: 300 µs</td></tr>
<tr><td colspan="2">Relationship between input signal and hex code</td><td colspan="2">↬ *Chapter 1.6.2.1.1.8 “Measuring ranges” on page 357*</td></tr>
<tr><td colspan="2">Analog to digital conversion time</td><td colspan="2">Typ. 500 µs per channel</td></tr>
<tr><td colspan="2">Unused inputs</td><td colspan="2">Can be left open and should be configured as "unused"</td></tr>
<tr><td colspan="2">Input data length</td><td colspan="2">8 bytes</td></tr>
<tr><td colspan="2">Overvoltage protection</td><td colspan="2">Yes, up to 30 V DC only for voltage input</td></tr>
</table>

Parameter	Value
Max. cable length (conductor cross section > 0,14 mm²)	
Unshielded wire	10 m
Shielded wire	100 m

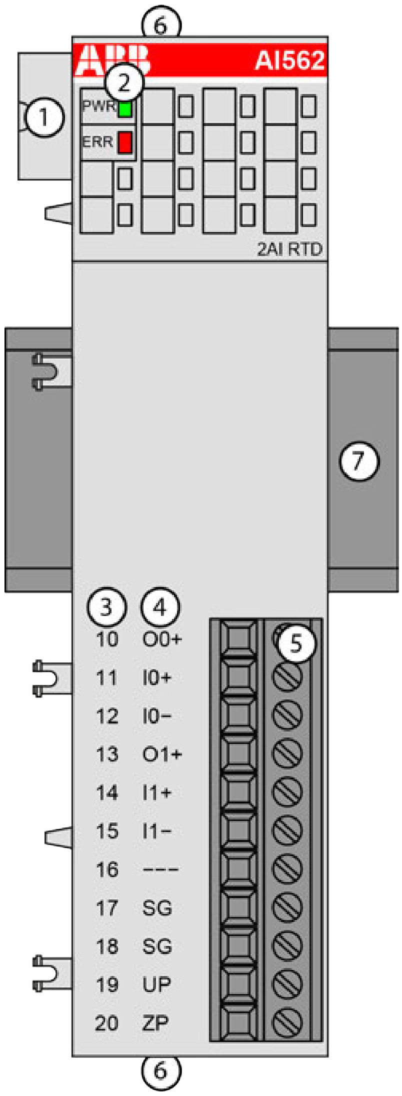
Ordering data

Part no.	Description	Product life cycle phase *)
1TNE 968 902 R1101	AI561, analog input module, 4 AI, U/I	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

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

1.6.2.1.2 AI562 - Analog input module

- 2 configurable analog resistance temperature detector (RTD) inputs (I0 and I1) in 1 group
- Resolution: 15 bits plus 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 iInterface 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

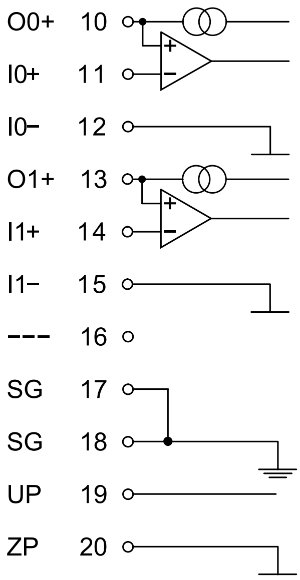
Parameter	Value
Resolution of the analog channels	
Temperature	0.1 °C
LED displays	2 LEDs for process voltage and error messages
Internal supply	Via I/O bus
External supply	Via the terminals UP (process voltage 24 V DC) and ZP (0 V DC)

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the System Assembly chapter *Chapter 2.5 “AC500-eCo” on page 925.*

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.

The following block diagram shows the 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

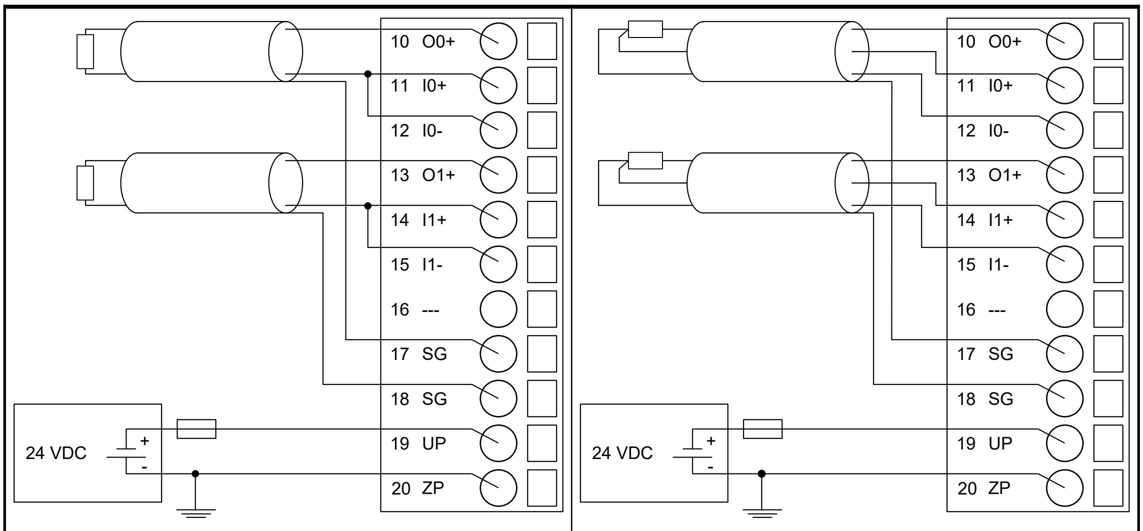
– connect or disconnect any signal or terminal block
– remove or replace a module.

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 1.6.2.1.2.6 “Diagnosis” on page 366*.

The following figures show the connection of RTDs to the inputs of the analog input module AI562.



2-wires input	3-wires input

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 1.6.2.1.2.7 “State LEDs” on page 367*.

I/O configuration

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

Parameterization

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

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Intern	6505 [1])	WORD	0x1969	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No 0x00			
Parameter length	Intern	4	BYTE	0	0	255	xx02 [2])
Check Supply	Off On	0 1	BYTE	On 0x01			
Analog Data Format	Default	0	BYTE	Default 0x00		255	

[1]) with CS31 and addresses less than 70, the value is increased by 1

[2]) Value is hexadecimal: HighByte is slot (xx: 0...7), LowByte is index (1...n)

GSD file:

Ext_User_Prm_Data_Len = Ext_User_Prm_Data_Const(0) =	0x07 0x6A, 0x19, 0x04, \ 0x01, 0x00, \ 0x00, 0x00;

Input channel (2x)

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.
Channel configuration	see table [2])	see table [2])	BYTE	0 0x00 see table [3])	0	65535

Table 76: 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

Internal value	Operating modes for the analog inputs, individually configurable
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

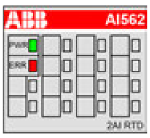
Diagnosis

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 ... +400 °C	Ni1000 / Ni100 -50 ... +150 °C	Digital value	
			Decimal	**Hex.**
Overflow	> 450.0 °C	> 160.0 °C	32767	7FFF
Measured value too high	450.0 °C : 400.1 °C		4500 : 4001	1194 : 0FA1

Range	Pt100 / Pt1000 -50 ... +400 °C	Ni1000 / Ni100 -50 ... +150 °C	Digital value	
			Decimal	**Hex.**
		160.0 °C : 150.1 °C	1600 : 1501	0640 : 05DD
Normal range	400.0 °C : : : : 0.1 °C	 150.0 °C : : 0.1 °C	4000 2000 1500 700 : 1	0FA0 07D0 05DC 02BC : 1
	0,0 °C	0.0 °C	0	0000
	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-1 : -500 -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 ... 150 Ω	Resistance 0 ... 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 2.5.1 “System data AC500-eCo V3” on page 925*

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage UP		
	Connections	Terminal 19 for UP (+24 V DC) and terminal 20 for ZP (0 V)
	Rated value	24 V DC
	Current consumption	0.04 A
	Inrush current (at power-up)	0.05 A^2s
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	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 switchgear cabinet.

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

Technical data of the 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	15 bits + 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

Parameter		Value	
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	
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 1.6.2.1.2.8 “Measuring ranges” on page 367*	
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	

Ordering data

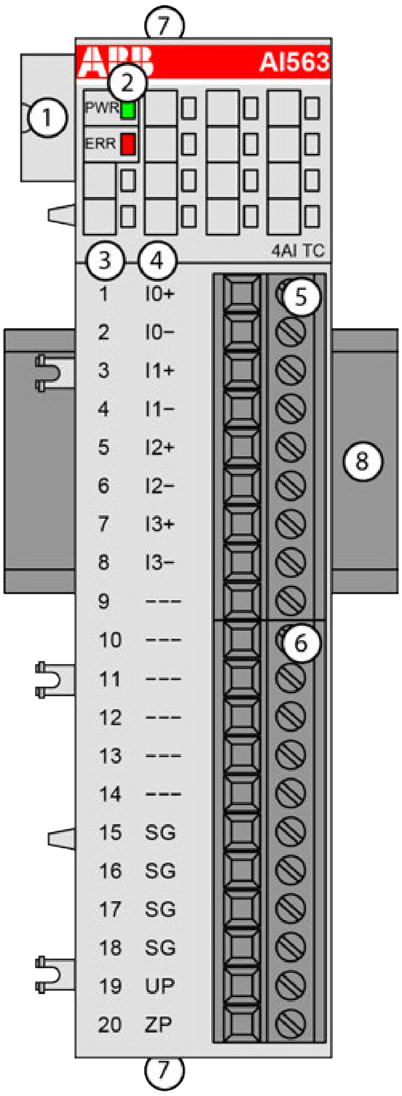
Part no.	Description	Product life cycle phase *)
1TNE 968 902 R1102	AI562, analog input module, 2 AI, RTD	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active

Part no.	Description	Product life cycle phase *)
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

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

1.6.2.1.3 AI563 - Analog input module

- 4 configurable thermocouple (TC) / -80 mV...+80 mV inputs (I0 to I3) in 1 group
- Resolution: 15 bits plus 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 iInterface 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

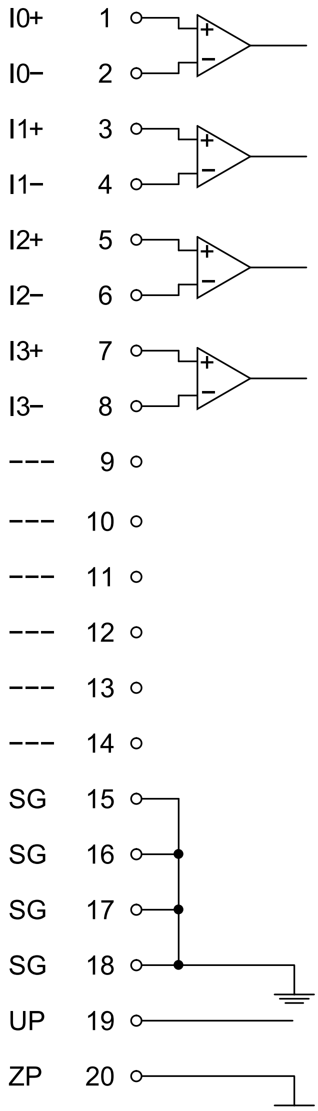
For a detailed description of the mounting, disassembly and connection of the module, please refer to the System Assembly chapter *↬ Chapter 2.5 “AC500-eCo” on page 925.*

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.

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



The assignment of the terminals:

Terminal	Signal	Description
1	I0+	Positive pole of channel 0
2	I0-	Negative pole of channel 0

Terminal	Signal	Description
3	I1+	Positive pole of channel 1
4	I1-	Negative pole of channel 1
5	I2+	Positive pole of channel 2
6	I2-	Negative pole of channel 2
7	I3+	Positive pole of channel 3
8	I3-	Negative pole of channel 3
9	---	Reserved
10	---	Reserved
11	---	Reserved
12	---	Reserved
13	---	Reserved
14	---	Reserved
15	SG	Shield grounding
16	SG	Shield grounding
17	SG	Shield grounding
18	SG	Shield grounding
19	UP	Process voltage UP (24 V DC)
20	ZP	Process voltage ZP (0 V DC)

The internal power supply voltage for the module's circuitry is carried out via the I/O bus (provided by a communication interface module or a CPU). Thus, the current consumption from 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module increases by 5 mA per AI563.

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

NOTICE!
Risk of imprecise and faulty measurements!
Analog signals may be 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.

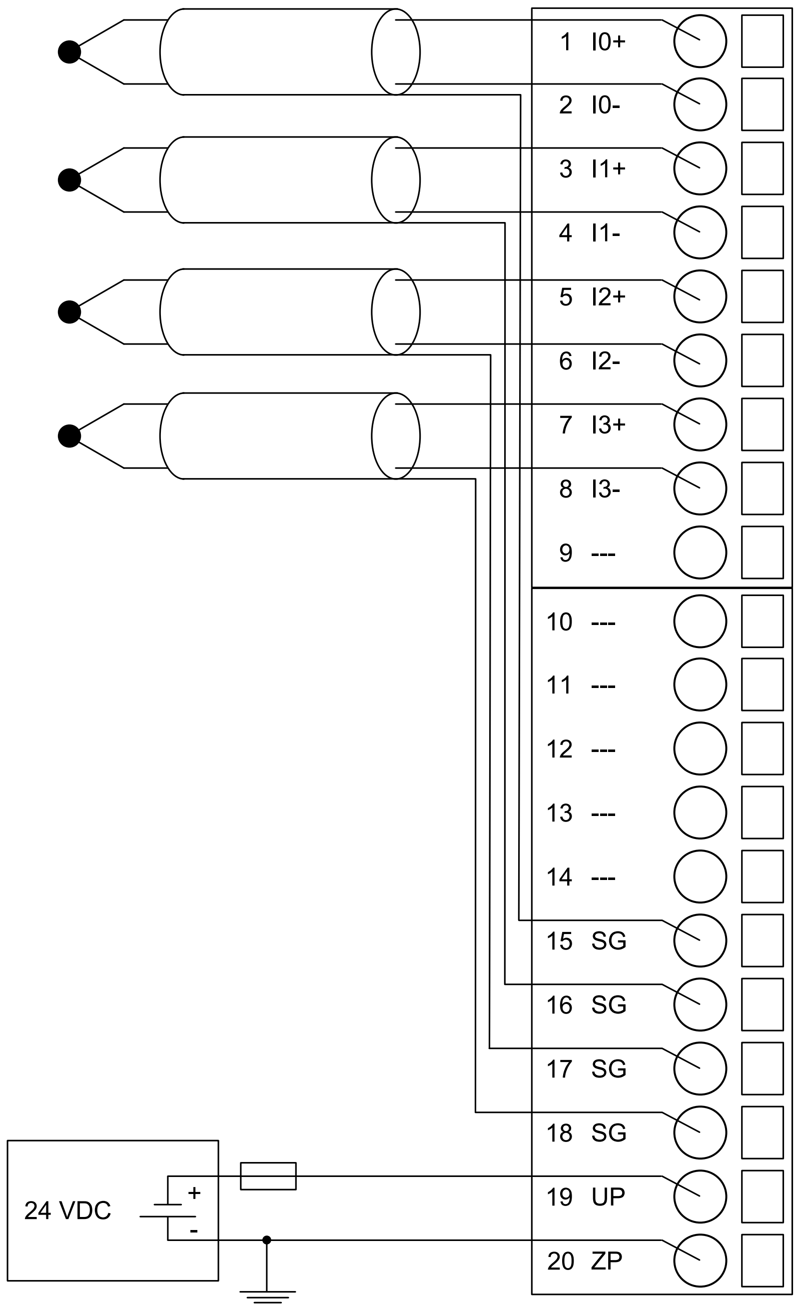
Make sure that all voltage sources (supply and process voltage) are switched off before you

– 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 1.6.2.1.3.6 “Diagnosis” on page 377*.

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



The meaning of the LEDs is described in Displays *Chapter 1.6.2.1.3.7 “State LEDs” on page 378* chapter.

I/O configuration

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

Parameterization

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

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Intern	6510 [1])	WORD	0x196E	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No 0x00			
Parameter length	Intern	6	BYTE	0	0	255	xx02 [2])
Check Supply	Off On	0 1	BYTE	On 0x01			
Analog Data Format	Default	0	BYTE	Default 0x00		255	
[1]) with CS31 and addresses less than 70, the value is increased by 1 [2]) Value is hexadecimal: HighByte is slot (xx: 0...7), LowByte is index (1...n)							

GSD file:

Ext_User_Prm_Data_Len =	0x09
Ext_User_Prm_Data_Const(0) =	0x6F, 0x19, 0x06, \ 0x01, 0x00, \ 0x00, 0x00, 0x00, 0x00;

Input channel (4x)

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.
Channel configuration	see table [2])	see table [2])	BYTE	0 0x00 see table [2])	0	65535

Table 77: 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

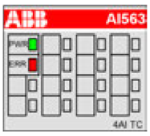
Diagnosis

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 channels of the module

Measuring ranges

AI563 needs typ. 6 to 8 seconds for initialization after applying the process supply voltage to clamp UP/ZP. During this time, the accuracy of the measurement values is not within specification. After that, valid measurement values are provided by the module. After that, valid measurement values are provided by the module.

After an interruption of the process supply voltage > 10 ms, a re-initialization is performed by AI563.

Risk of invalid analog input values!
The analog input values may be invalid if the measuring range of the inputs is exceeded.

Make sure that the analog signal at the connection terminals is always within the signal range.

When a wire break occurs on a sensor wire, the temperature measurement value of the corresponding channel changes to Overflow (Hexadecimal 7FFF).

Range	**Type J** **-210 ... +1200 °C**	**Type K** **-270 ... +1372 °C**	**Type N** **-270 ... +1300 °C**	**Type T** **-270 ... +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
	:	:	:	:	:	:
	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 ... +1000 °C**	**Types R, S** **-50 ... +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

Range	-80 mV ... +80 mV	Type E -270 ... +1000 °C	Types R, S -50 ... +1768 °C	Digital value	
				Decimal	**Hex.**
	-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 2.5.1 “System data AC500-eCo V3” on page 925*

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage UP		
	Connections	Terminal 19 for UP (+24 V DC) and terminal 20 for ZP (0 V)
	Rated value	24 V DC
	Current consumption	0.10 A
	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 switchgear cabinet.

NOTICE!

Attention:

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

Technical data of the 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	15 bits plus 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	
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 *Chapter 1.6.2.1.3.9.1.1 “Accuracy of thermocouple ranges at 25 °C (with cold junction compensation)” on page 382* at 25 °C
	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 1.6.2.1.3.8 “Measuring ranges” on page 378*	
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.

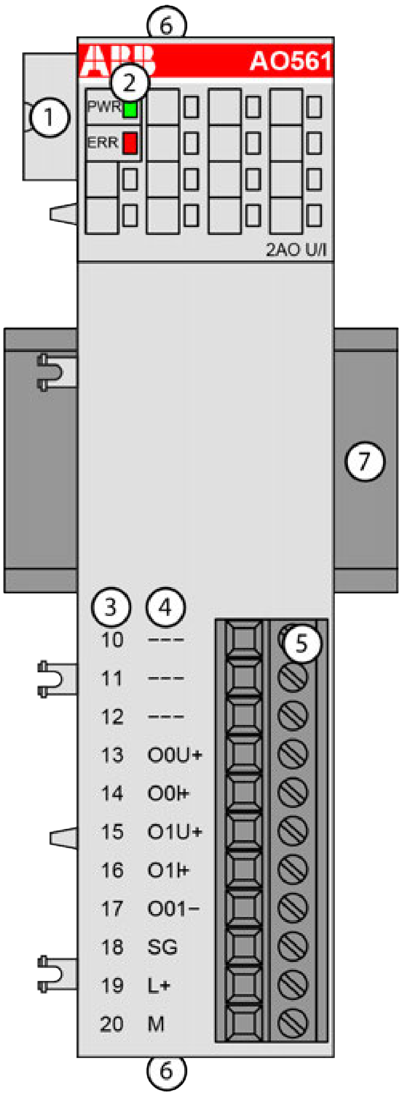
Ordering data

Part no.	Description	Product life cycle phase *)
1TNE 968 902 R1103	AI563, analog input module, 4 AI, thermocouple	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3105	Terminal block TA565-9, 9 pins, spring front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

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

1.6.2.1.4 AO561 - Analog output module

- 2 configurable analog outputs (O0 and O1) in 1 group
- Resolution: 11 bits plus sign or 12 bit



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 iInterface 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)	11 bits plus 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

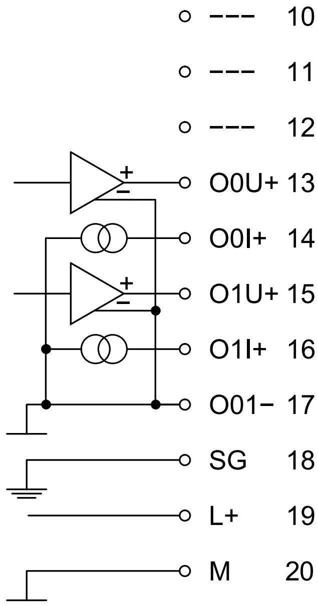
Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the System Assembly chapter *Chapter 2.5 “AC500-eCo” on page 925.*

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.

The following block diagram shows the 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.

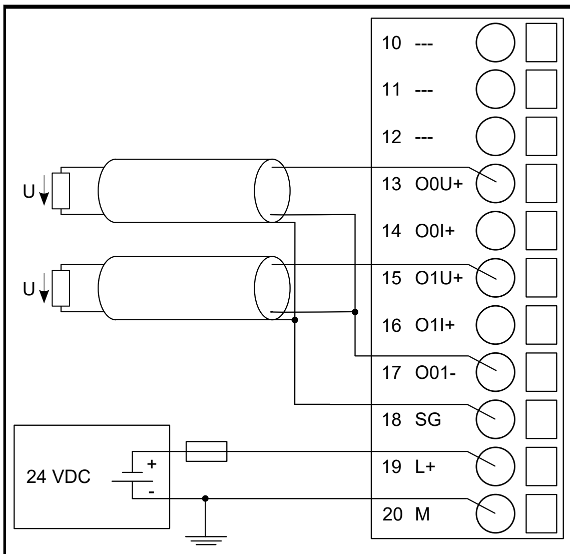
> **!**
>
> **NOTICE!**
>
> **Risk of imprecise and faulty measurements!**
>
> Analog signals may be distorted seriously by external electromagnetic influences.
>
> Use shielded wires when wiring analog signal sources. The cable shield must be grounded at both ends of the cable. Provide a potential equalisation 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.

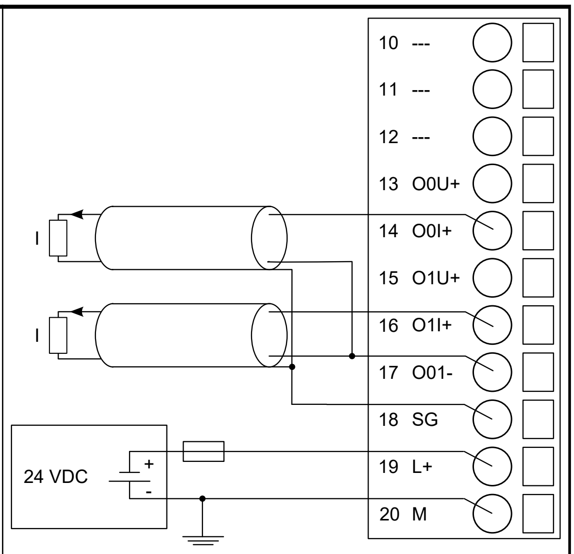
> **NOTICE!**
> **Risk of damaging the PLC modules!**
> Overvoltages and short circuits might damage the PLC modules.
>
> – Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
> – Never connect any voltages or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

The module provides several diagnosis functions *Chapter 1.6.2.1.4.6 “Diagnosis” on page 388*.

The following figures show the connection of analog actuators to the analog output module AO561.



Connection of analog voltage actuators



Connection of analog current actuators

> *The output signal is undefined if the supply voltage at the L+ terminal is below 10 V. This can, for example, occur if the supply voltage has a slow ramp-up / ramp-down behavior and must be foreseen when planning the installation.*

> *If the output is configured in current mode, the voltage output signal is undefined and must not be connected.*
>
> *If the output is configured in voltage mode, the current output signal is undefined and must not be connected.*

I/O configuration

The analog output module AO561 does not store configuration data itself.

Parameterization

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

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.	EDS Slot Index
Module ID	Intern	6515 1)	WORD	0x1973	0	65535	xx01
Ignore module	No Yes	0 1	BYTE	No 0x00			
Parameter length	Intern	4	BYTE	0	0	255	xx02 2)
Check Supply	Off On	0 1	BYTE	On 0x01			
Analog Data Format	Default	0	BYTE	Default 0x00		255	
1) with CS31 and addresses less than 70, the value is increased by 1 2) Value is hexadecimal: HighByte is slot (xx: 0...7), LowByte is index (1...n)							

GSD file:

Ext_User_Prm_Data_Len =	0x07
Ext_User_Prm_Data_Const(0) =	0x74, 0x19, 0x04, \ 0x01, 0x00, \ 0x00, 0x00, 0x00, 0x00;

Output channel (2x)

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.
Channel configuration	see table 2)	see table 2)	BYTE	0 0x00 see table 2)	0	65535

Table 78: 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

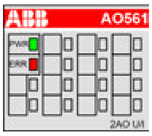
Diagnosis

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	3	0...1	48	Analog value overflow at an analog output	Check output value or terminal
	11 / 12	ADR	1...10				
4	14	1...10	3	0...1	7	Analog value underflow at an analog output	Check output value
	11 / 12	ADR	1...10				

Remarks:

1)	In AC500 the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The PNIO diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1...10 = expansion module 1...10, ADR = hardware address (e. g. of the DC551-CS31)
3)	With "Module" the following allocation applies depending on the master: Module error: I/O bus or PNIO: 31 = module itself; COM1/COM2: 1...10 = expansion 1...10 Channel error: I/O bus or PNIO = module type (3 = AO); COM1/COM2: 1...10 = expansion 1...10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

LED		State	Color	LED = OFF	LED = ON	LED flashes
	PWR	Process voltage 24 V DC via terminal	Green	CPU module voltage or external 24 V DC supply voltage is missing	3.3 V system voltage (I/O bus) and external 24 V DC supply voltage are present	---
	ERR	Channel or module error	Red	No error or process voltage is missing	Severe error in the module	Error on 1 or more channels of the module

Output ranges

Range	-10 ... +10 V	0 ... 20 mA	4 ... 20 mA	Digital value	
				Decimal	Hex.
Overflow	>11.7589	>23.5178	>22.8142	32767	7FFF
Value too high	11.7589	23.5178	22.8142	32511	7EFF
	:	:	:	:	:
	10.0058	:	:	27664	6C10
	:	:	20.0058	27658	6C0A
	:	20.0058	:	27656	6C08
Normal range	10.0000	20.0000	20.0000	27648	6C00
Normal range or value too low	:	:	:	:	:
	0.0058	:	:	16	0010
	:	:	4.0058	10	000A
	:	0.0058		8	0008
	0.0000	0	4	0	0000

Range	-10 ... +10 V	0 ... 20 mA	4 ... 20 mA	Digital value	
				Decimal	Hex.
	: -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 bit respectively 11 bit plus sign.

Technical data

The System Data of AC500-eCo apply *Chapter 2.5.1 “System data AC500-eCo V3” on page 925*

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage L+		
	Connections	Terminal 19 for L+ (+24 V DC) and terminal 20 for M (0 V)
	Rated value	24 V DC
	Current consumption	0.1 A + output load
	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 switchgear cabinet.

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

Technical data of the analog outputs

<table>
<tr><th colspan="2">Parameter</th><th colspan="2">Value</th></tr>
<tr><td colspan="2">Number of channels per module</td><td colspan="2">2 configurable voltage or current outputs</td></tr>
<tr><td colspan="2">Distribution of channels into groups</td><td colspan="2">1 (2 channels per group)</td></tr>
<tr><td colspan="2">Connection of the signals O0U- and O1U+</td><td colspan="2">Terminals 13 and 15</td></tr>
<tr><td colspan="2">Connection of the signals O0I+ and O1I+</td><td colspan="2">Terminals 14 and 16</td></tr>
<tr><td colspan="2">Output type</td><td colspan="2">Bipolar with voltage, unipolar with current</td></tr>
<tr><td colspan="2">Resolution</td><td colspan="2">12 bits or 11 bits plus sign</td></tr>
<tr><td colspan="2" 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>±2 % of full scale
at 0 °C...+60 °C or EMC disturbances</td></tr>
<tr><td colspan="2">Indication of the output signals</td><td colspan="2">No</td></tr>
<tr><td colspan="2">Output Resistance (load) as current output</td><td colspan="2">0 Ω...500 Ω</td></tr>
<tr><td colspan="2">Output load ability as voltage output</td><td colspan="2">±2 mA max.</td></tr>
<tr><td colspan="2">Output data length</td><td colspan="2">4 bytes</td></tr>
<tr><td colspan="2">Relationship between output signal and hex code</td><td colspan="2">➥ Chapter 1.6.2.1.4.8 “Output ranges” on page 389</td></tr>
<tr><td colspan="2">Unused outputs</td><td colspan="2">Must not be connected and must be configured as "unused"</td></tr>
<tr><td colspan="2">Overvoltage protection</td><td colspan="2">Yes, up to 30 V DC</td></tr>
<tr><td colspan="2">Max. cable length (conductor cross section > 0.14 mm²)</td><td colspan="2"></td></tr>
<tr><td></td><td>Unshielded wire</td><td colspan="2">10 m</td></tr>
<tr><td></td><td>Shielded wire</td><td colspan="2">100 m</td></tr>
</table>

Ordering data

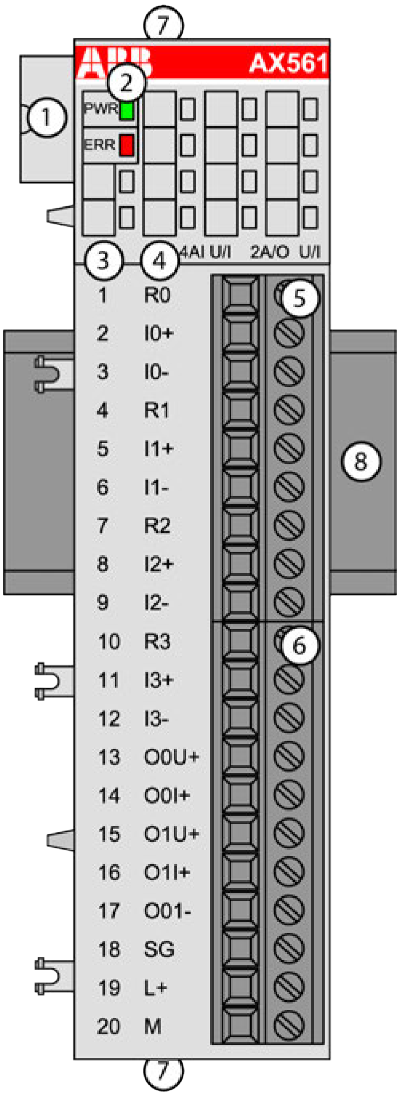
Part no.	Description	Product life cycle phase *)
1TNE 968 902 R1201	AO561, analog output module, 2 AO, U/I	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active

Part no.	Description	Product life cycle phase *)
1TNE 968 901 R3104	Terminal block TA564-11, 11 pins, screw front, cable front, 6 pieces per unit	Active
1TNE 968 901 R3106	Terminal block TA565-11, 11 pins, spring front, cable front, 6 pieces per unit	Active

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

1.6.2.1.5 AX561 - Analog input/output module

- 4 configurable analog inputs (I0 to I3) in 1 group
- 2 configurable analog outputs (O0 and O1) in 1 group
- Resolution: 11 bits plus sign or 12 bits



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 iInterface 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)	11 bits plus 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

Parameter	Value
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

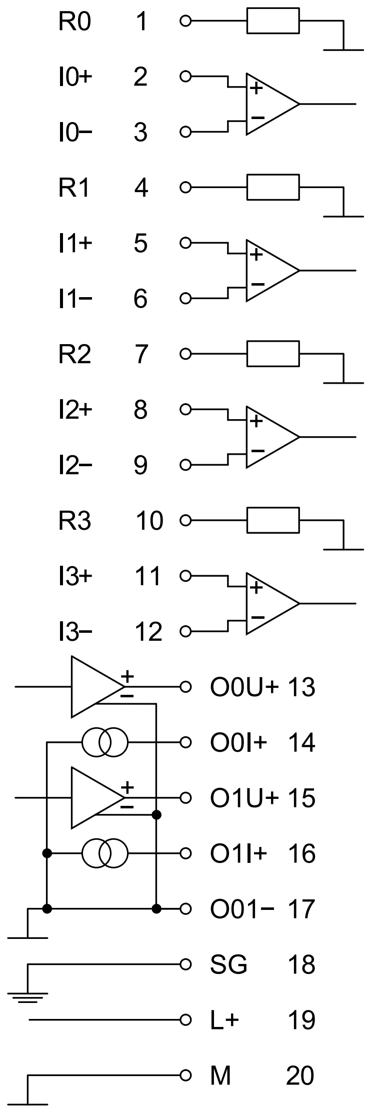
Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the System Assembly chapter *Chapter 2.5 “AC500-eCo” on page 925.*

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.

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



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
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

Terminal	Signal	Description
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!

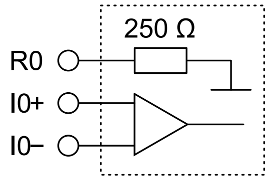
Risk of damaging the PLC modules!

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.

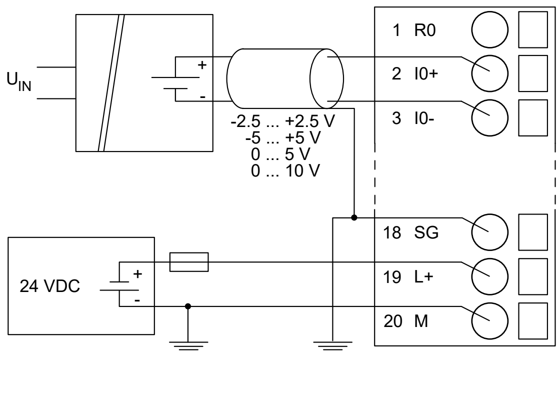
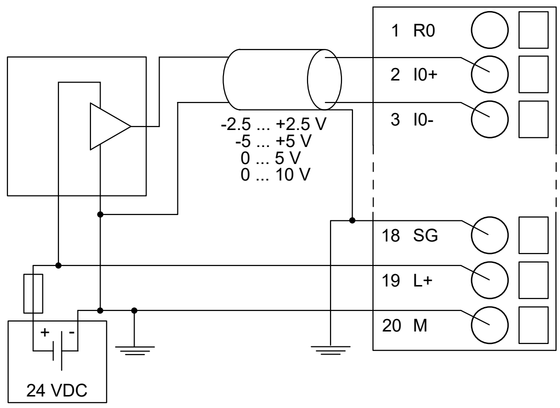
The module provides several diagnosis functions *Chapter 1.6.2.1.5.6 “Diagnosis” on page 400*.

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.

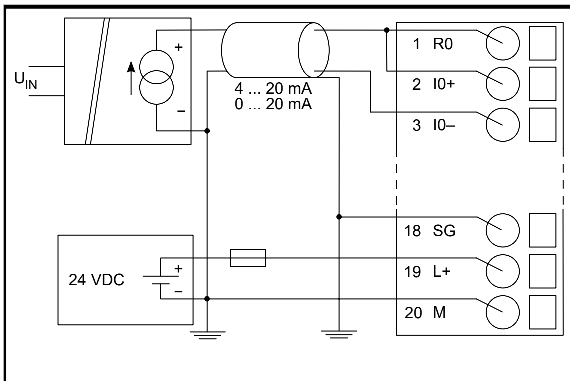
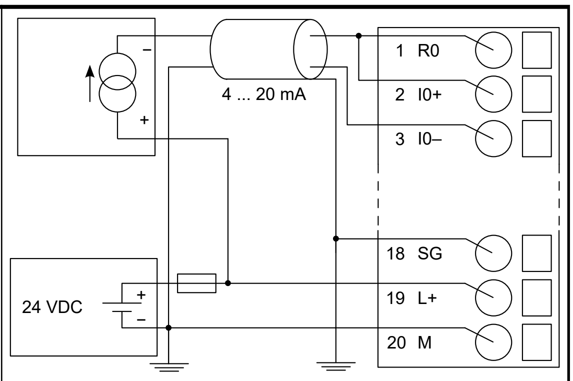


> **CAUTION!**
> **Risk of damaging the analog input!**
> The 250 Ω input resistor can be damaged by overcurrent.
>
> Make sure that the current through the resistor never exceeds 30 mA.

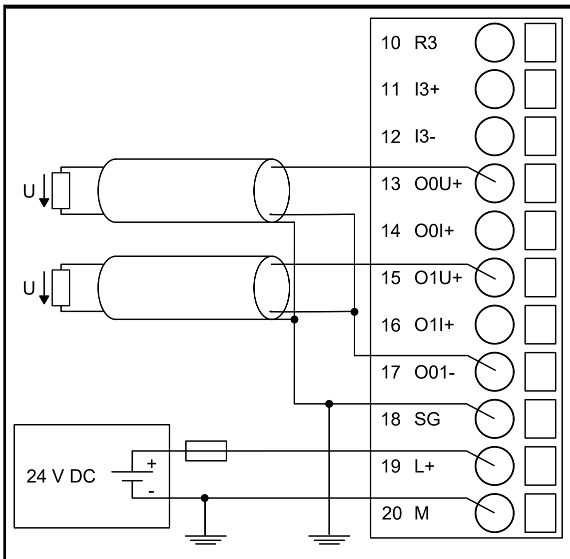
The following figures are an example of the connection of analog sensors (voltage) to the input I0 of the analog input/output module AX561. Proceed with the inputs I1 to I3 in the same way.

	
Connection of active-type analog sensors (voltage)	Connection of passive-type analog sensors (voltage)

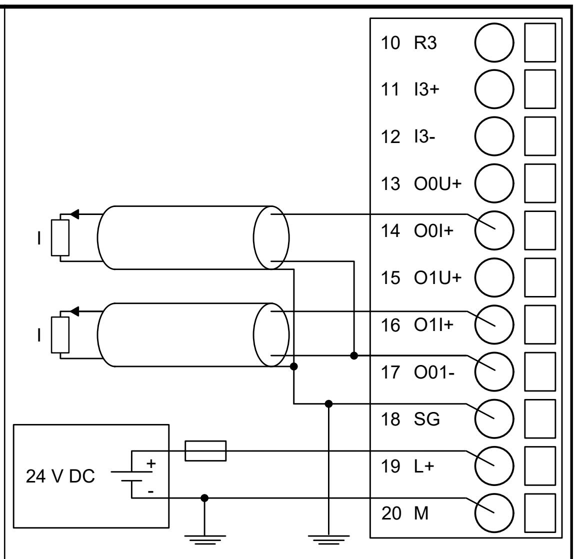
The following figures are an example of the connection of analog sensors (current) to the input I0 of the analog input/output module AX561. Proceed with the inputs I1 to I3 in the same way.

	
Connection of active-type analog sensors (current)	Connection of passive-type analog sensors (current)

The following figures are an example of the connection of analog actuators to the analog input/output module AX561.



Connection of analog voltage actuators



Connection of analog current actuators

The output signal is undefined if the supply voltage at the L+ terminal is below 10 V. This can, for example, occur if the supply voltage has a slow ramp-up / ramp-down behavior and must be foreseen when planning the installation.

If the output is configured in current mode, the voltage output signal is undefined and must not be connected.

If the output is configured in voltage mode, the current output signal is undefined and must not be connected.

The meaning of the LEDs is described in the displays chapter *Chapter 1.6.2.1.5.7 “State LEDs” on page 401*.

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 = Ext_User_Prm_Data_Const(0) =	0x0B 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 79: 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 80: 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

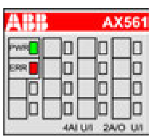
E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500 display	<– Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error 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 ... +2.5 V	-5 ... +5 V	0 ... 5 V	0 ... 10 V	0 ... 20 mA	4 ... 20 mA	Digital value	
							Decimal	**Hex.**
Overflow	>2.9397	>5.8795	>5.8795	>11.7589	>23.5178	>22.8142	32767	7FFF
Measured value too high	2.9397	5.8795	5.8795	11.7589	23.5178	22.8142	32511	7EFF
	:	:	:	:	:	:	:	:
	2.5014	5.0029	:	:	:	:	27664	6C10
			:	:	:	20.0058	27658	6C0A
			5.0015	10.0029	20.0058		27656	6C08
Normal range	2.5000	5.0000	5.0000	10.0000	20.0000	20.0000	27648	6C00
	:	:	:	:	:	:	:	:
Normal range or measured value too low	0.0014	0.0029	:	:	:	:	16	0010
			:	:	:	4.0058	10	000A
			0.0015	0.0029	0.0058		8	0008
	0.0000	0.0000	0.0000	0.0000	0	4	0	0000
	:	:				3.9942	-10	FFF6
	-0.0014	-0.0029				:	-16	FFF0
	:	:				:	-4864	ED00
	:	:				0	-6912	E500
	:	:					:	:
	-2.5000	-5.0000					-27648	9400
Measured value too low	-2.5014	-5.0029					-27664	93F0
	:	:					:	:
	-2.9398	-5.8795					-32512	8100
Underflow	<-2.9398	<-5.8795	<-0.0300	<-0.0600	<-0.1200	<-0.1200	-32768	8000

The represented resolution corresponds to 12 bits respectively 11 bits plus sign.

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
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 respectively 11 bits plus sign.

Technical data

The System Data of AC500-eCo apply *Chapter 2.5.1 “System data AC500-eCo V3” on page 925*

Only additional details are therefore documented below.

Parameter		Value
Process supply voltage L+		
	Connections	Terminal 19 for L+ (+24 V DC) and terminal 20 for M (0 V)
	Rated value	24 V DC
	Current consumption via L+ terminal	0.14 A + output load
	Inrush current (at power-up)	0.05 A
	Max. ripple	5 %
	Protection against reversed voltage	Yes

Parameter		Value
	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 switchgear cabinet.

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

Technical data of the 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: 11 bits plus 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

Parameter	Value	
	Max.	±2 % of full scale (all ranges) at 0 °C...60 °C or EMC disturbance
Time constant of the input filter	Voltage: 300 µs Current: 300 µs	
Relationship between input signal and hex code	*Table on page 402*	
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 or 11 bits plus 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 403*	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ.	±0.5 % of full scale (voltage) ±0.5 % of full scale (current 0 mA...20 mA) ±0.7 % of full scale (current 4 mA...20 mA) at 25°C
	Max.	±2 % of full scale (all ranges) at 0 °C...60 °C or EMC disturbance
Unused outputs	Can be left open and should be configured as "unused"	
Output data length	4 bytes	
Overvoltage protection	Yes, up to 30 V DC	
Max. cable length (conductor cross section > 0.14 mm²)		

Parameter		Value
	Unshielded wire	10 m
	Shielded wire	100 m

Ordering data

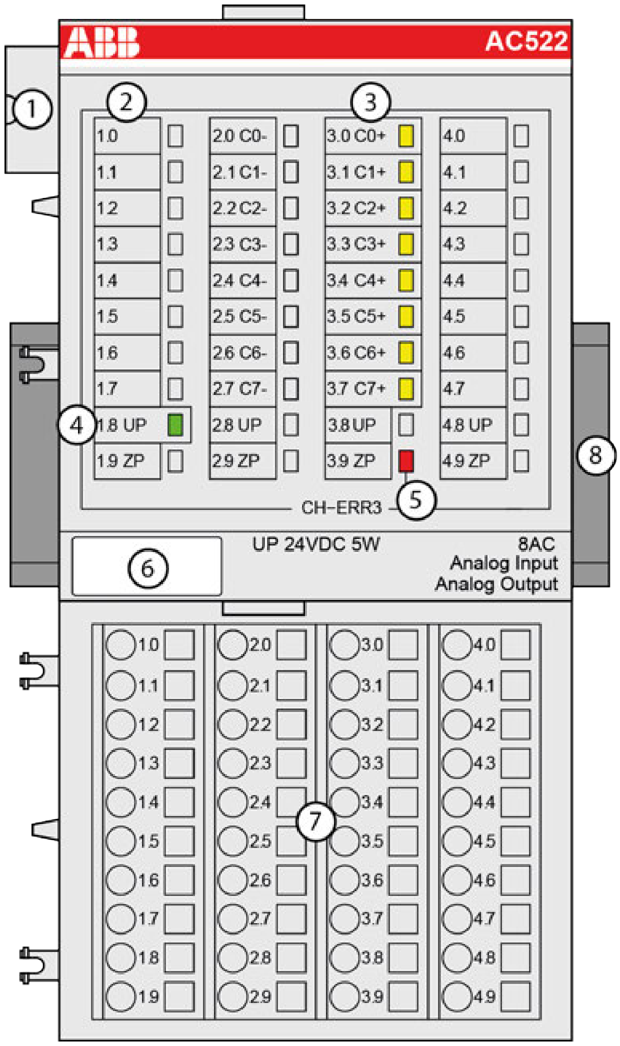
Part no.	Description	Product life cycle phase *)
1TNE 968 902 R1301	AX561, analog input/output module, 4 AI, 2 AO, U/I	Active
1TNE 968 901 R3101	Terminal block TA563-9, 9 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3102	Terminal block TA563-11, 11 pins, screw front, cable side, 6 pieces per unit	Active
1TNE 968 901 R3103	Terminal block TA564-9, 9 pins, screw front, cable front, 6 pieces per unit	Active
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.*

1.6.2.2 S500

1.6.2.2.1 AC522 - Analog input/output module

- 8 configurable analog inputs/outputs in one group (2.0...2.7 and 3.0...3.7)
- Resolution 12 bits plus 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 iInterface 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 analog inputs (I0...I7), 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 (O0...O3), individually configurable for

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

4 analog outputs (O4...O7), individually configurable for

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

Parameter		Value
Resolution of the analog channels		
	Voltage -10 V...+10 V	12 bits plus 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 1.5.2 “TU515, TU516, TU541 and TU542 for I/O modules” on page 126*

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the System Assembly, Construction and Connection chapter *Chapter 2.6 “AC500 (Standard)” on page 971.*

The modules are plugged on an I/O terminal unit *Chapter 1.5.2 “TU515, TU516, TU541 and TU542 for I/O modules” on page 126*. 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 (TA526 *Chapter 1.8.2.6 “TA526 - Wall mounting accessory” on page 902*).

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 to 1.7	Unused	Unused
2.0 to 2.7	C0- to C7-	Negative poles of the 8 analog inputs/outputs
3.0 to 3.7	C0+ to C7+	Positive poles of the analog inputs/outputs
4.0 to 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 (cut wire), 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 only permissible under conditions described in Hot Swap chapter ↪ *Chapter 1.6 “I/O modules” on page 142*.

The devices are not designed for removal or insertion under power when Hot Swap conditions do not apply. 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!

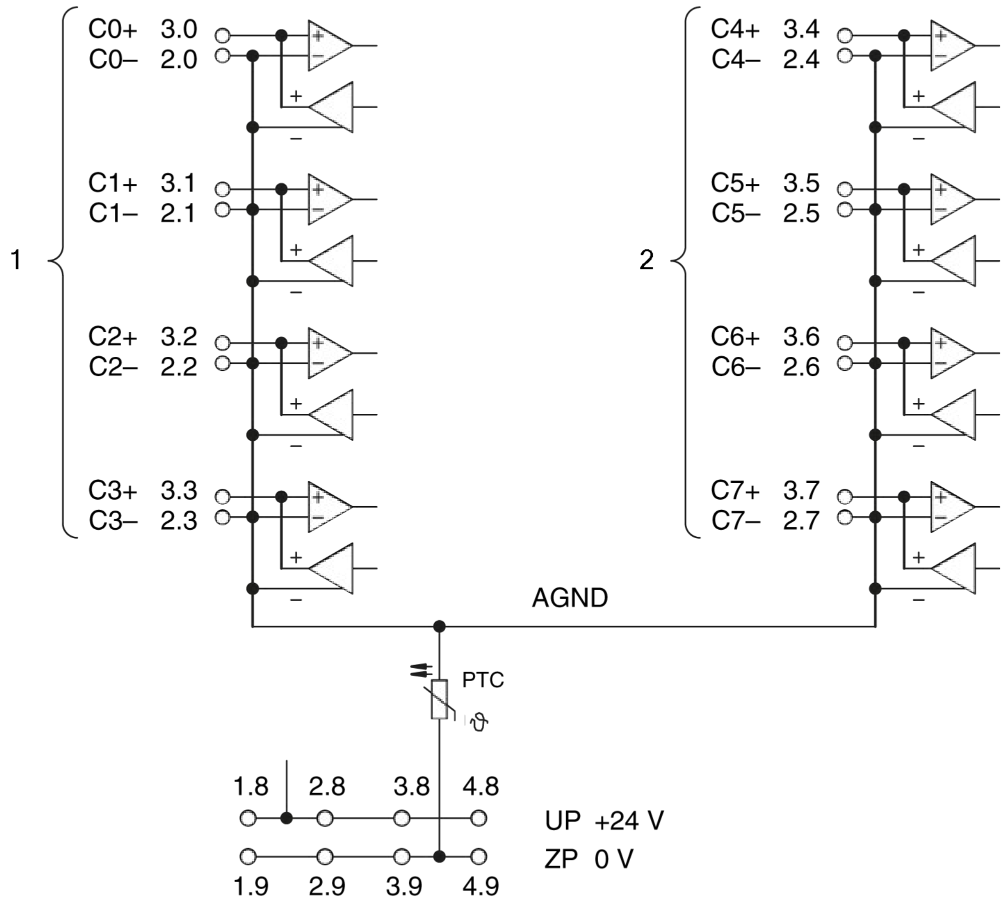
Overvoltages and short circuits might damage the PLC modules.

– 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.

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.

Only for simple applications (low electromagnetic disturbances, no high requirement on precision), the shielding can also be omitted.

The following figure shows the 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

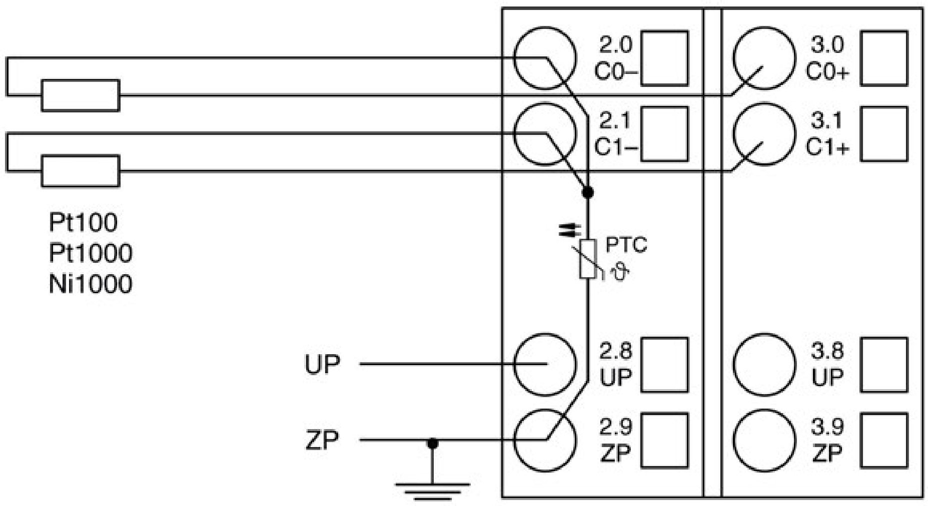
2 4 analog I/O channels
as inputs for 0 V...10 V, -10 V...+10 V, 0 mA...20 mA, 4 mA...20 mA, Pt100/Pt1000/Ni1000 digital signals
as outputs for -10 V...+10 V

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.



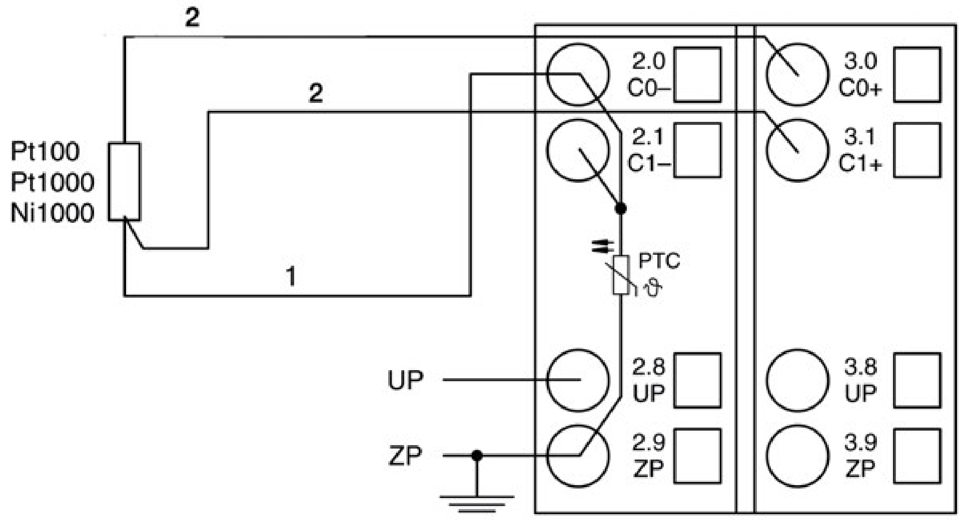
Pt100	-50 °C...+70 °C	2-wire configuration, one channel used
Pt100	-50 °C...+400 °C	2-wire configuration, one channel used
Pt1000	-50 °C...+400 °C	2-wire configuration, one channel used
Ni1000	-50 °C...+150 °C	2-wire configuration, one channel used

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).

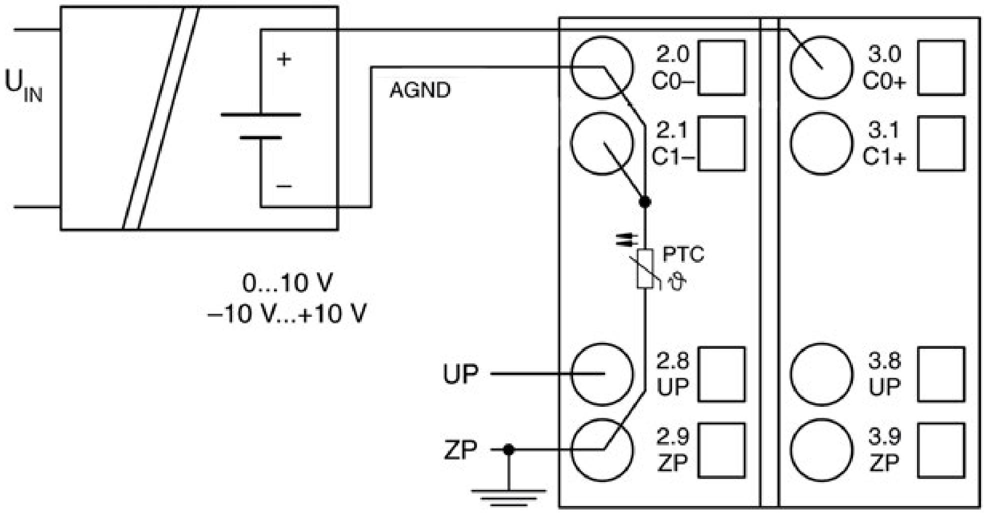
In order to keep measuring errors as small as possible, it is necessary to have all the involved conductors in the same cable. All the conductors must have the same cross section.

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.*

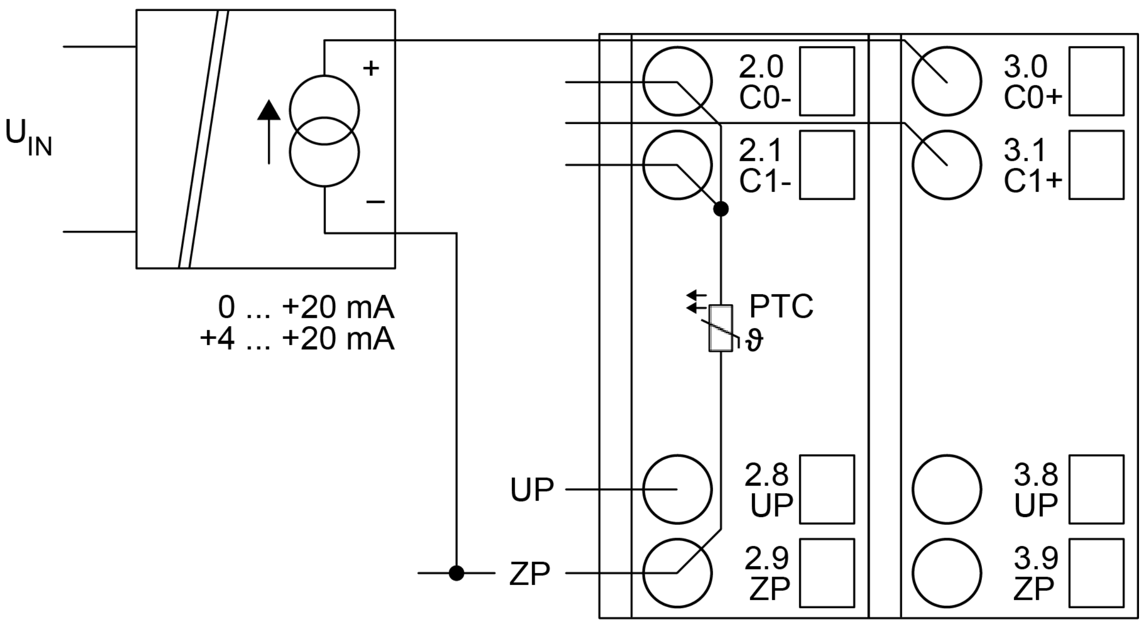
By connecting to AGND the galvanically isolated voltage source of the sensor is referred to ZP.

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

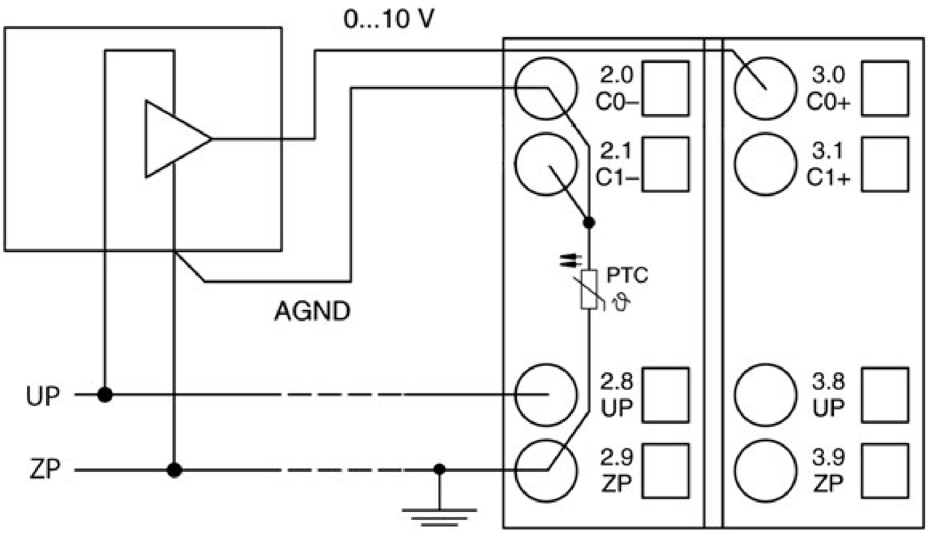


The following measuring ranges can be configured:

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



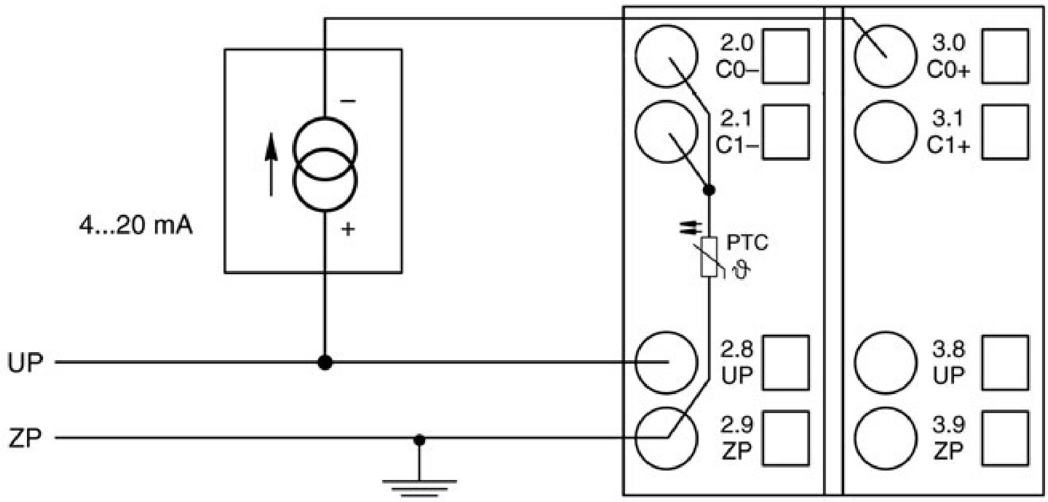
CAUTION!
The potential difference between AGND and ZP at the module must not be greater than 1V, not even in case of long lines (see figure Terminal Assignment).

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 I-). 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).

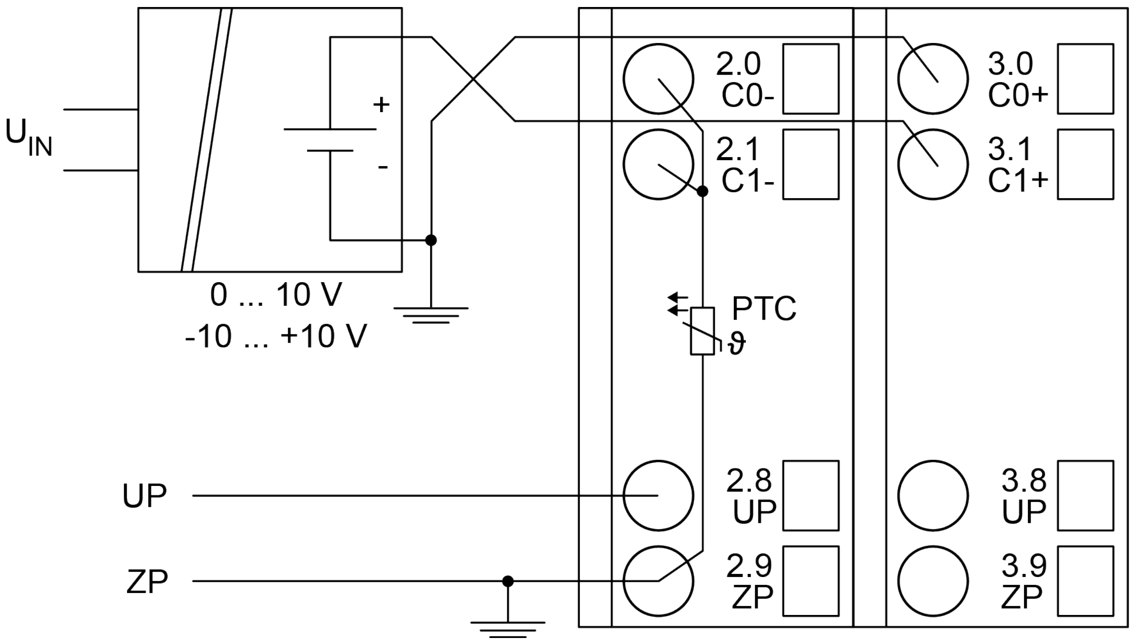
The use of differential inputs helps to considerably increase the measuring accuracy and to avoid ground loops.

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



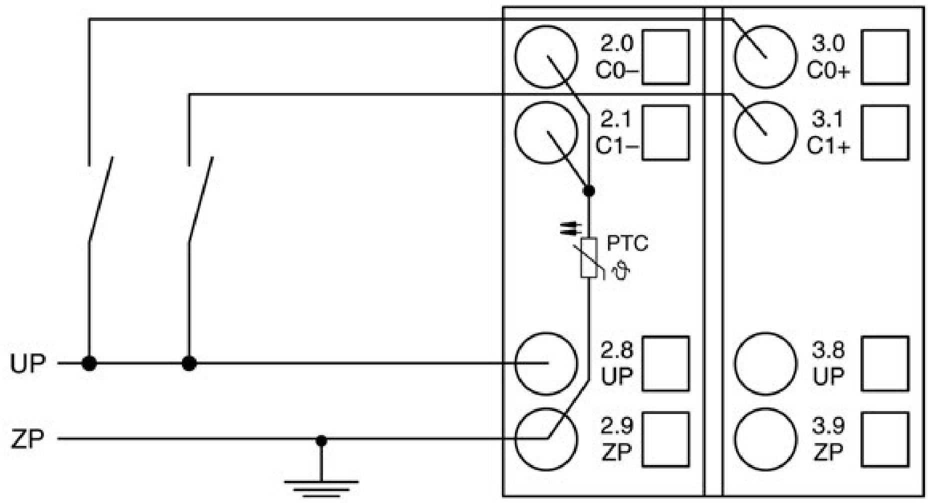
The negative pole of the sensor must be grounded next to the sensor.

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

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

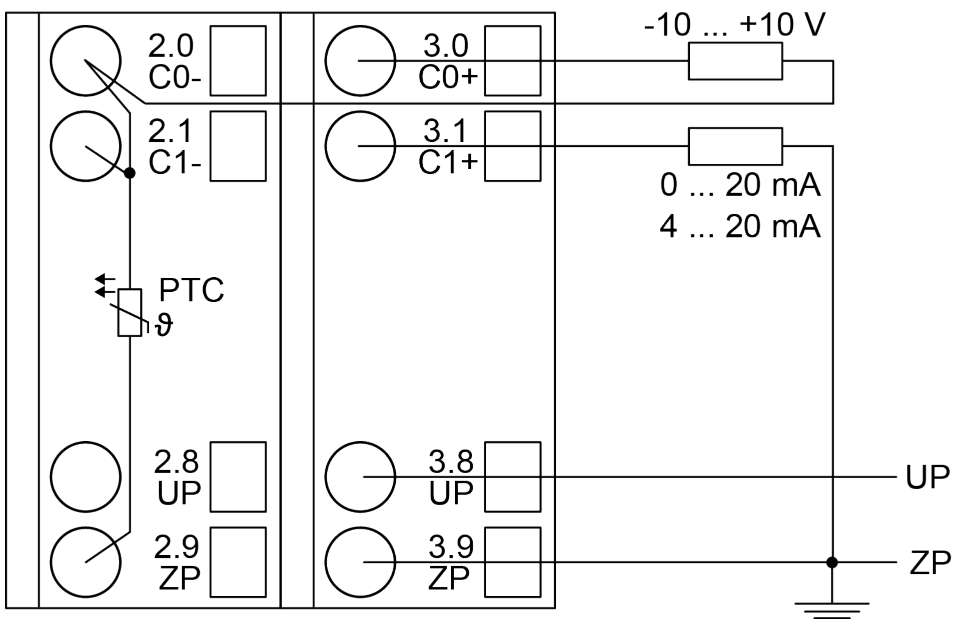
Use of analog inputs as digital inputs

Several (or all) analog inputs can be configured as digital inputs. The inputs are not galvanically isolated against the other analog channels.



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

Connection of analog output loads (Voltage, current)



Voltage	-10 V...+10 V	Load max. ±10 mA	1 channel used
Current	0 mA...20 mA	Load 0 Ω...500 Ω	1 channel used
Current	4 mA...20 mA	Load 0 Ω...500 Ω	1 channel used

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

Unused analog outputs can be left open-circuited.

Internal data exchange

Analog inputs (words)	8
Analog outputs (words)	8

I/O configuration

The module does not store configuration data itself. The 8 configurable analog channels are defined as inputs or outputs by the configuration, i.e. each of the configurable channels can used as input or output (or re-readable output in case of voltage input/output).

When a channel is used as input, the corresponding output must be configured unused.

When a channel is used as output, the corresponding input must be configured unused.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1...10

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
1	Module ID	Internal	1520 [1])	Word	1520 0x05f0	0	65535	0x0Y01
2	Ignore module [2])	No Yes	0 1	Byte	No 0x00			not for FBP
3	Parameter length in bytes	Internal	37	Byte	37-CPU 37-FBP	0	255	0x0Y02
4	Check supply	Off On	0 1	Byte	On 0x01	0	1	0x0Y03
5	Analog data format	Default	0	Byte	Default 0x00			0x0Y04
6	Behaviour of outputs at communication errors	Off Last value Substitute value	0 1+(n*5) 2+(n*5), $n \le 2$	Byte	Off 0x00	0	2	0x0Y05

No.	**Name**	**Value**	**Internal value**	**Internal value, type**	**Default**	**Min.**	**Max.**	**EDS Slot/ Index**
7	Channel configuration Input channel 0	see table Channel configuration		Byte	Default 0x00	0	19	0x0Y06
8	Channel monitoring Input channel 0	see table Channel monitoring		Byte	Default 0x00	0	3	0x0Y07
9 to 22	Channel configuration and channel monitoring of the input channels 1 to 7	see tables channel configuration and channel monitoring		Byte Byte	Default 0x00 0x00	0 0	19 3	0x0Y08 to 0x0Y15
23	Channel configuration Output channel 0	see table Channel configuration		Byte	Default 0x00	0	130	0x0Y16
24	Channel monitoring Output channel 0	see table Channel monitoring		Byte	Default 0x00	0	3	0x0Y17
25	Substitute value Output channel 0	only valid for output channel 0	0...0xffff	Word	Default 0x0000	0	65535	0x0Y18
26 to 31	Channel configuration and channel monitoring of the output channels 1 to 3	see tables channel configuration and channel monitoring		Byte Byte	Default 0x00 0x00	0 0	130 3	0x0Y19 to 0x0Y1E

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
32	Channel configuration Output channel 4	see table Channel configuration		Byte	Default 0x00	0	128	0x0Y1F
33	Channel monitoring Output channel 4	see table Channel monitoring		Byte	Default 0x00	0	3	0x0Y20
34 to 39	Channel configuration and channel monitoring of the output channels 5 to 7	see tables channel configuration and channel monitoring		Byte Byte	Default 0x00 0x00	0 0	128 3	0x0Y21 to 0x0Y26

[1]) With CS31 and addresses less than 70 and FBP, the value is increased by 1

[2]) Not with FBP

GSD file:

Ext_User_Prm_Data_Len =	40
Ext_User_Prm_Data_Const(0) =	0x05, 0xf1, 0x25, \
	0x01, 0x00, 0x00, \
	0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \
	0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \
	0x00, 0x00, 0x00, 0x00, \
	0x00, 0x00, 0x00, 0x00, 0x00, 0x00, \
	0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00;

Table 81: 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 82: 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 83: 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 84: Output channel 0 (1 channel)

No.	Name	Value	Internal value	Internal value, type	Default
1	Channel con-figuration	see table [4])	see table [4])	Byte	see table [4])
2	Channel mon-itoring	see table [5])	see table [5])	Byte	see table [5])
3	Substitute value see table [6])	0...65535	0... 0xffff	Word	0

Table 85: Output channels 1...7 (7x)

No.	Name	Internal value, type	Default
1	Channel configura-tion see table [4])	Byte	see table [4])
2	Channel monitoring see table [5])	Byte	see table [5])

Table 86: 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 87: 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 88: Substitute value [6])

Intended behavior of output channel when the control system stops	Required setting of the module parameter "Behav-iour of outputs in case of a communication error"	Required setting of the channel parameter "Substi-tute value"
Output OFF	Off	0
Last value	Last value	0
Substitute value	Off or last value	1...65535

Diagnosis

Table 89: Possible diagnosis of I/O channels

Output range	Condition	
	Output value in the PLC underflow	**Output value in the PLC overflow**
0..20 mA	Error identifier = 7	Error identifier = 4
4..20 mA		
-10..+10 V		

Input range	Condition			
	Short circuit	**Wire break**	**Input value under-flow**	**Input value over-flow**
0..20 mA	no diagnosis possible	no diagnosis possible	no diagnosis possible	Error identifier = 48
4..20 mA	Error identifier = 7	Error identifier = 7	Error identifier = 7	Error identifier = 48
-10..+10 V	no diagnosis possible	Error identifier = 48	Error identifier = 7	Error identifier = 48

Table 90: 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				

E1...E4	**d1**	**d2**	**d3**	**d4**		**Identifier 000...063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**		**Err**	**PS501 PLC browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**		**Byte 6 Bit 0...5**	**FBP diag-nosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**		**Error Identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**				
3	14	1...10	31	31		26	Parameter error	Check master
	11 / 12	ADR	1...10					
3	14	1...10	31	31		11	Process voltage too low	Check process voltage
	11 / 12	ADR	1...10					
4	14	1...10	31	31		45	Process voltage is switched off (ON −> OFF)	Process voltage ON
	11 / 12	ADR	1...10					
Channel error								
				AX521	AX522			
4	14	1...10	1	0...3	0...7	48	Analog value over-flow or broken wire at an analog input	Check input value or terminal
	11 / 12	ADR	1...10					
4	14	1...10	1	0...3	0...7	7	Analog value under-flow at an analog input	Check input value
	11 / 12	ADR	1...10					
4	14	1...10	1	0...3	0...7	47	Short circuit at an analog input	Check terminal
	11 / 12	ADR	1...10					
4	14	1...10	3	4...7	8...15	4	Analog value over-flow at an analog output	Check output value
	11 / 12	ADR	1...10					
4	14	1...10	3	4...7	8...15	7	Analog value under-flow at an analog output	Check output value
	11 / 12	ADR	1...10					

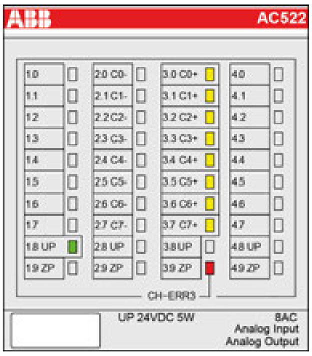
Remarks:

1)	In AC500, the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1...10 = expansion module 1...10, ADR = hardware address (e.g. of the DC551)

[3])	With "Module" the following allocation applies depending on the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1...10 = expansion 1...10 Channel error: I/O bus or FBP = module type (1 = AI, 3 = AO); COM1/COM2: 1...10 = expansion 1...10
[4])	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Inputs/ outputs 00...07	Analog input/ output	Yellow	Input/output is OFF	Input/output is ON (brightness depends on the value of the analog signal)	--
	UP	Process voltage 24 V DC via terminal	Green	Process voltage is missing	Process voltage OK	--
	CH-ERR3	Channel error, error messages combined into group 3	Red	No error or process voltage is missing	Severe error within the corresponding group	Error on one channel of the group

Measuring ranges

Input ranges of voltage, current and digital input

The represented resolution corresponds to 16 bits.

Range	0...10 V	-10...+10 V	0...20 mA	4...20 mA	Digital input	Digital value	
						Decimal	**Hex.**
Overflow	>11.7589	>11.7589	>23.5178	>22.8142		32767	7FFF
Measured value too high	11.7589 : 10.0004	11.7589 : 10.0004	23.5178 : 20.0007	22.8142 : 20.0006		32511 : 27649	7EFF : 6C01
Normal range	10.0000 : 0.0004	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	ON	27648 : 1	6C00 : 0001
Normal range or measured value too low	0.0000	0.0000	0	4	OFF	0	0000

Range	0...10 V	-10...+10 V	0...20 mA	4...20 mA	Digital input	Digital value	
						Decimal	**Hex.**
	-0.0004 -1.7593	-0.0004 : : : -10.0000		3.9994 : 0		-1 -4864 -6912 : -27648	FFFF ED00 E500 : 9400
Measured value too low		-10.0004 : -11.7589				-27649 : -32512	93FF : 8100
Underflow	<0.0000	<-11.7589	<0.0000	<0.0000		-32768	8000

Input ranges resistance temperature detector

Range	Pt100 / Pt 1000 -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		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...+10 V	0...20 mA	4...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 *Chapter 2.6.1 “System data AC500” on page 971* are applicable to the standard version.

Only additional details are therefore documented below.

Parameter		Value
Process voltage		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 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

Parameter	Value
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 switch-gear cabinet.

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

Technical data of the analog inputs

Parameter	Value	
Number of channels per module	8	
Distribution of channels into groups	1 group of 8 channels	
Connections of the channels C0- to C7-	Terminals 2.0 to 2.7	
Connections of the channels C0+ to C7+	Terminals 3.0 to 3.7	
Input type	Bipolar (not with current or Pt100/Pt1000/Ni1000)	
Galvanic isolation	Against internal supply and other modules	
Configurability	0 V...10 V, -10 V...+10 V, 0 mA...20 mA, 4 mA...20 mA, Pt100/1000, Ni1000 (each input can be configured individually)	
Channel input resistance	Voltage: > 100 kΩ Current: ca. 330 Ω	
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 + sign Range 0 mA...20 mA: 12 bits Range 4 mA...20 mA: 12 bits	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ.	±0.5 % of full scale at 25 °C
	Max.	±1 % of full scale (all ranges) at 0 °C...60 °C or EMC disturbance
Relationship between input signal and hex code	See table *Chapter 1.6.2.2.1.9.1 “Input ranges of voltage, current and digital input” on page 426*	

Parameter	Value
Unused inputs	Must be configured as "unused".
Overvoltage protection	Yes

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

Parameter		Value
Number of channels per module		Max. 8
Distribution of channels into groups		1 group of 8 channels
Connections of the channels C0+ to C7+		Terminals 3.0 to 3.7
Reference potential for the inputs		Terminals 1.9 to 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 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 (+ sign)

Parameter	Value	
Settling time for full range change (resistive load, output signal within specified tolerance)	Typ. 5 ms	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ.	±0.5 % of full scale at 25 °C
	Max.	±1 % of full scale (all ranges) at 0 °C...60 °C or EMC disturbance
Relationship between output signal and hex code	See table *Chapter 1.6.2.2.1.9.3 “Output ranges voltage and current” on page 428*	
Unused outputs	Must be configured as "unused".	

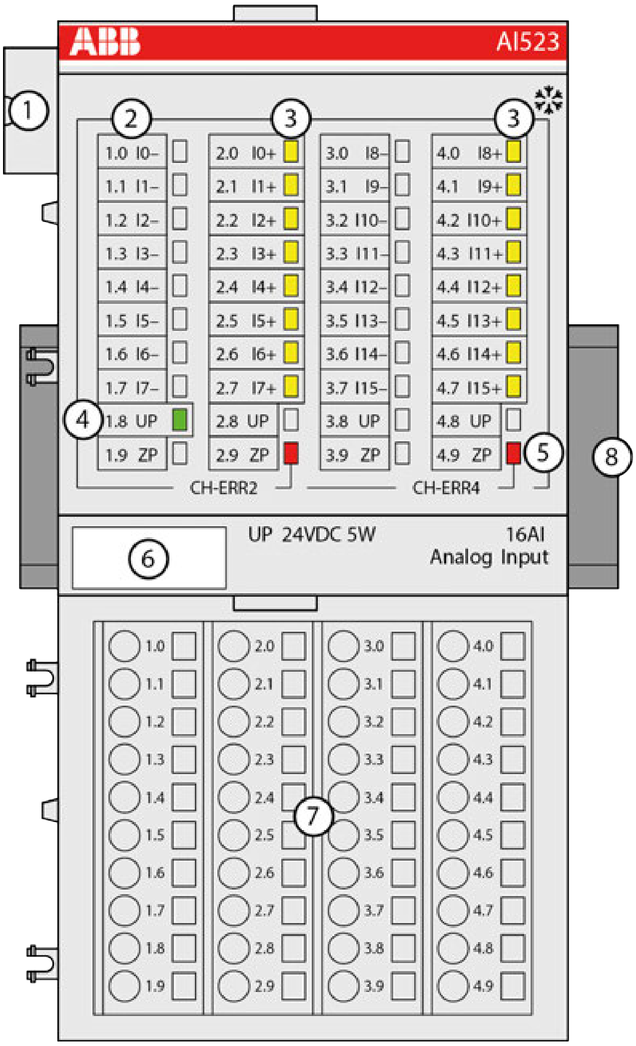
Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 250 500 R0001	AC522, analog input/output module, 8 AC, U/I/RTD, 12 bits + sign, 2-wires	Active
1SAP 450 500 R0001	AC522-XC, analog input/output module, 8 AC, U/I/RTD, 12 bits + sign, 2-wires, XC version	Active

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

1.6.2.2.2 AI523 - Analog input module

- 16 configurable analog inputs (I0 to I15) in 2 groups (1.0...2.7 and 3.0...4.7)
  Resolution 12 bits plus 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 iInterface 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 plus 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 1.5.2 "TU515, TU516, TU541 and TU542 for I/O modules" on page 126*

Connections

The modules are plugged on an I/O terminal unit *Chapter 1.5.2 "TU515, TU516, TU541 and TU542 for I/O modules" on page 126*. 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 (TA526 *Chapter 1.8.2.6 "TA526 - Wall mounting accessory" on page 902*).

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 System Assembly, Construction and Connection chapter Chapter 2.6 "AC500 (Standard)" on page 971.

The terminals 1.8 to 4.8 and 1.9 to 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 to 4.8: process voltage UP = +24 V DC

Terminals 1.9 to 4.9: process voltage ZP = 0 V

The assignment of the other terminals:

Terminals	Signal	Description
1.0 to 1.7	I0- to I7-	Negative poles of the first 8 analog inputs
2.0 to 2.7	I0+ to I7+	Positive poles of the first 8 analog inputs
3.0 to 3.7	I8- to I15-	Negative poles of the following 8 analog inputs
4.0 to 4.7	I8+ to 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 (cut wire), 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 only permissible under conditions described in Hot Swap chapter *Chapter 1.6 "I/O modules" on page 142*.

The devices are not designed for removal or insertion under power when Hot Swap conditions do not apply. 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.

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.

Only for simple applications (low electromagnetic disturbances, no high requirement on precision), the shielding can also be omitted.

The following figure shows the connection of the module:

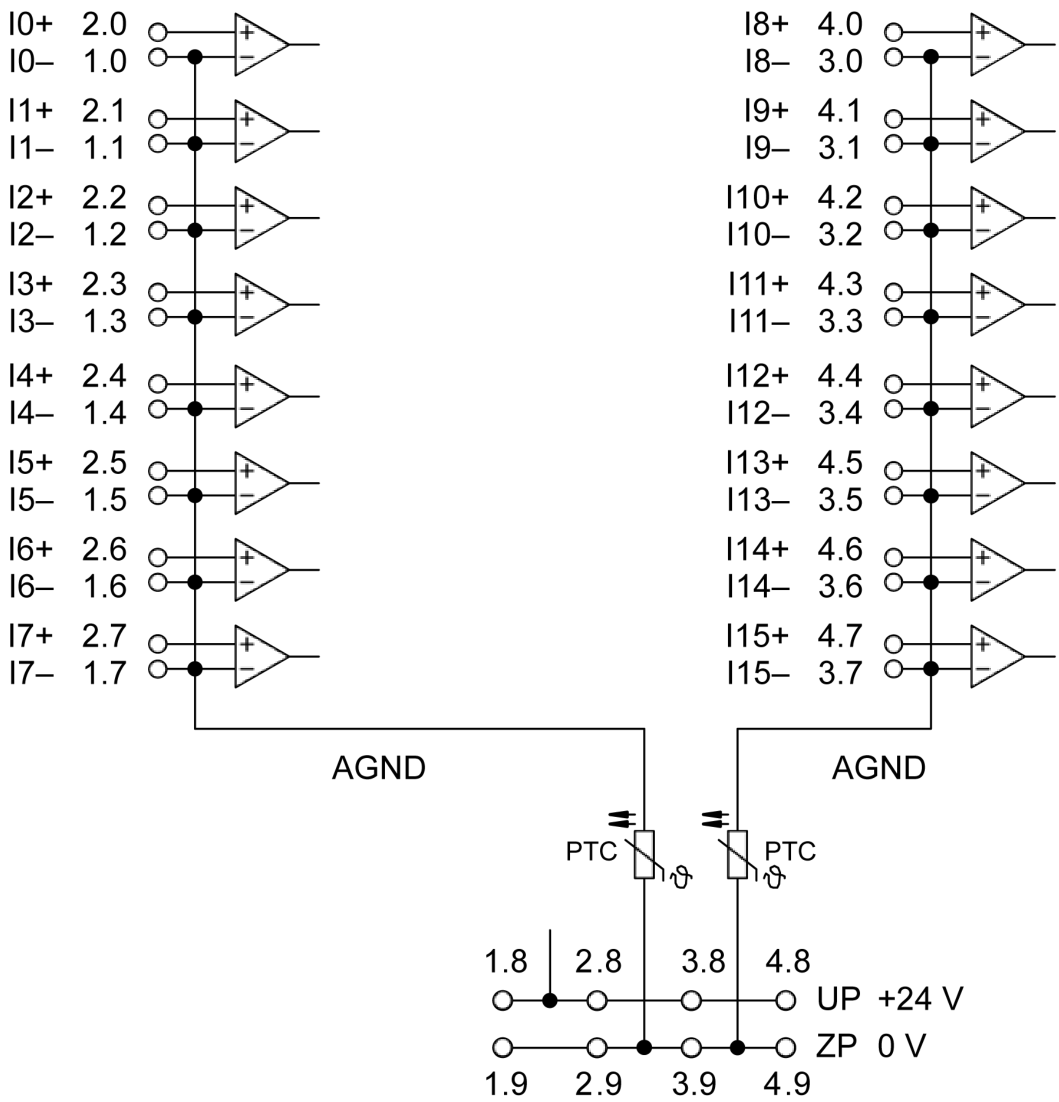


Fig. 24: 16 analog inputs in two groups, individually configurable ✎ *Chapter 1.6.2.2.2.2 "Functionality" on page 432*

> **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 pole).

The modules provide several diagnosis functions ✎ *Chapter 1.6.2.2.2.7 "Diagnosis" on page 447*.

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.

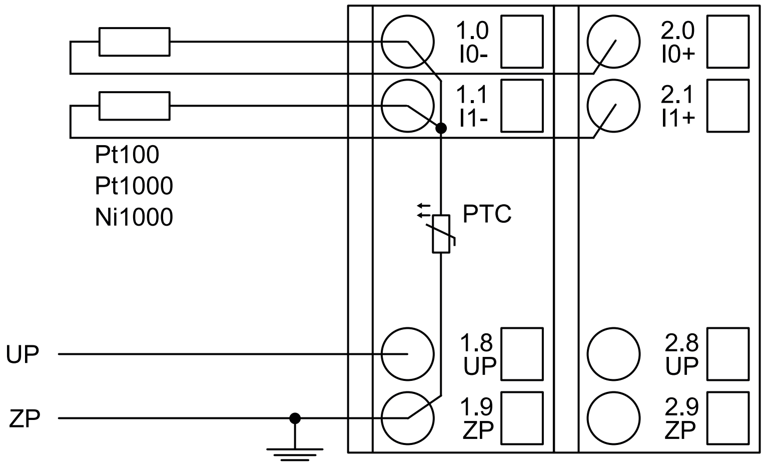


Fig. 25: Connection example

The following measuring ranges can be configured *Chapter 1.6.2.2.2.6 “Parameterization” on page 444*.

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 1.6.2.2.2.7 “Diagnosis” on page 447*.

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.

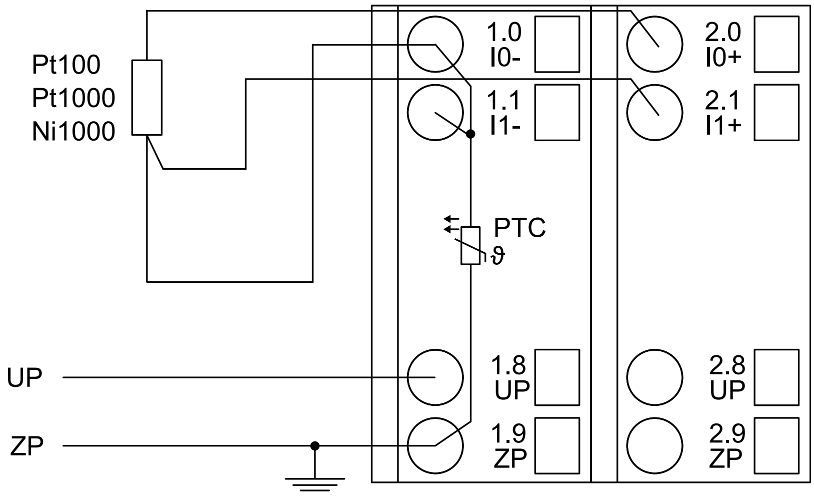


Fig. 26: Connection example

> *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 1.6.2.2.2.6 “Parameterization” on page 444*

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 1.6.2.2.2.7 “Diagnosis” on page 447*.

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

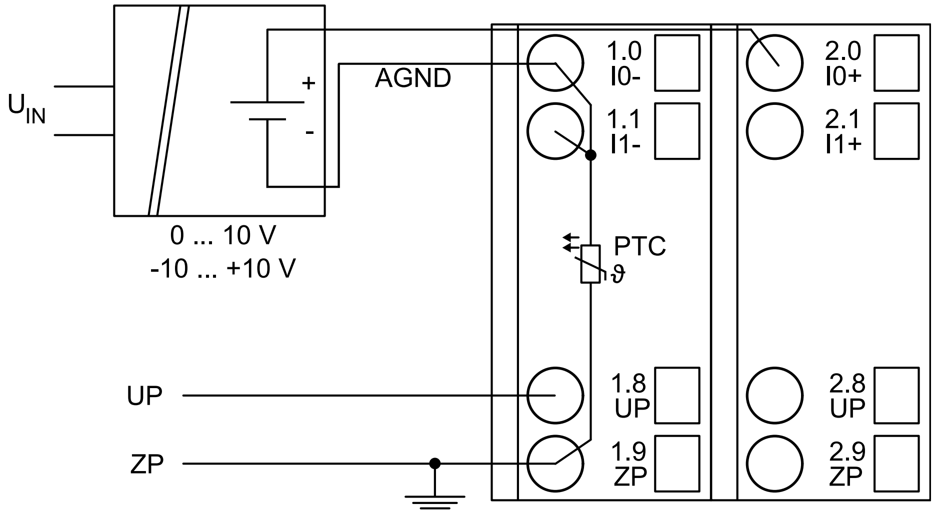


Fig. 27: Connection example

> *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 1.6.2.2.2.6 “Parameterization” on page 444* *Chapter 1.6.2.2.2.9 “Measuring ranges” on page 449*

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 1.6.2.2.2.7 “Diagnosis” on page 447*.

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

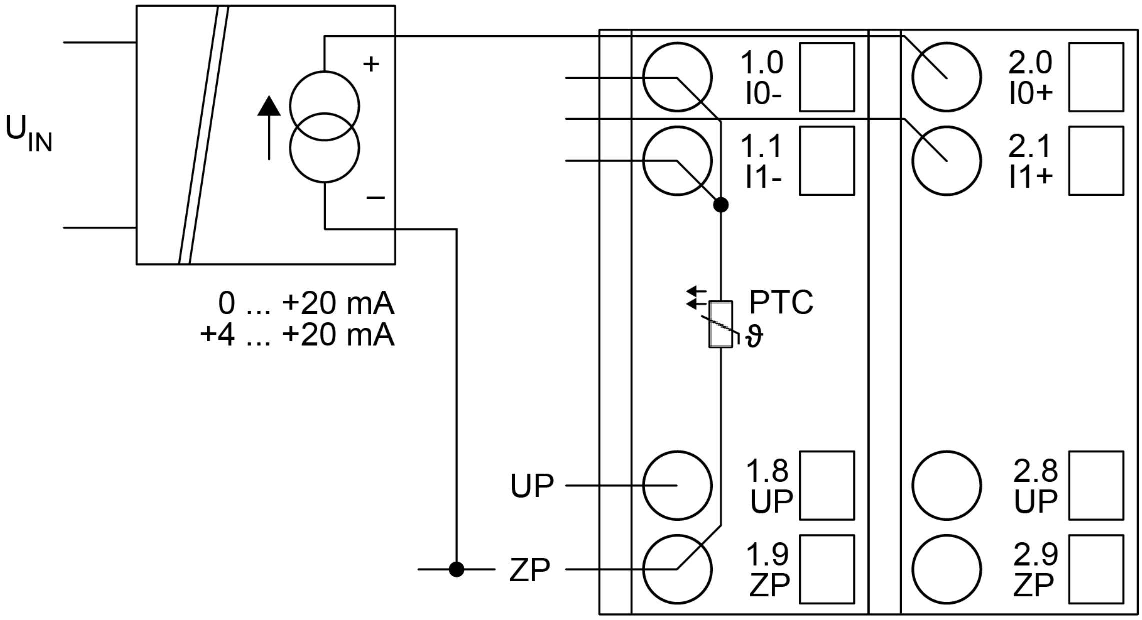


Fig. 28: Connection example

The following measuring ranges can be configured ➙ *Chapter 1.6.2.2.2.6 “Parameterization” on page 444* ➙ *Chapter 1.6.2.2.2.9 “Measuring ranges” on page 449*

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 1.6.2.2.2.7 “Diagnosis” on page 447*.

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

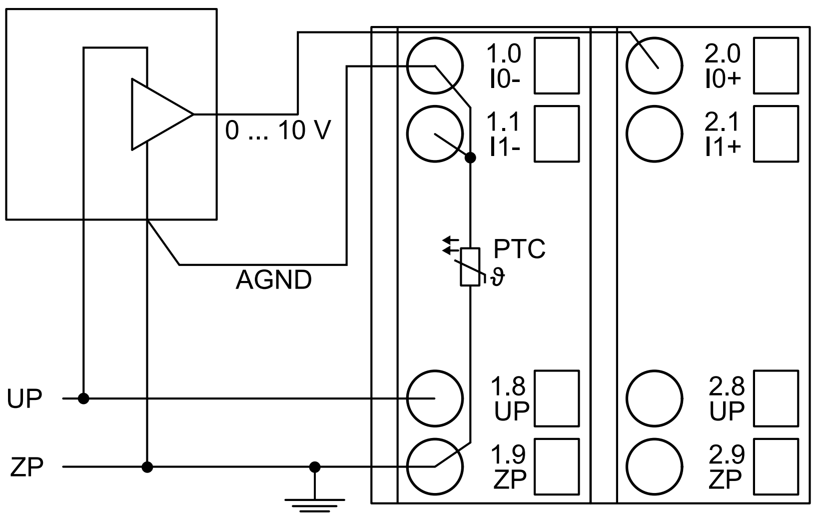


Fig. 29: Connection example

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

If AGND does not get connected to ZP, the sensor current flows to ZP via the AGND line. The measuring signal is distorted, as a very 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 1.6.2.2.2.9 "Measuring ranges" on page 449*

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 1.6.2.2.2.7 "Diagnosis" on page 447*.

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)

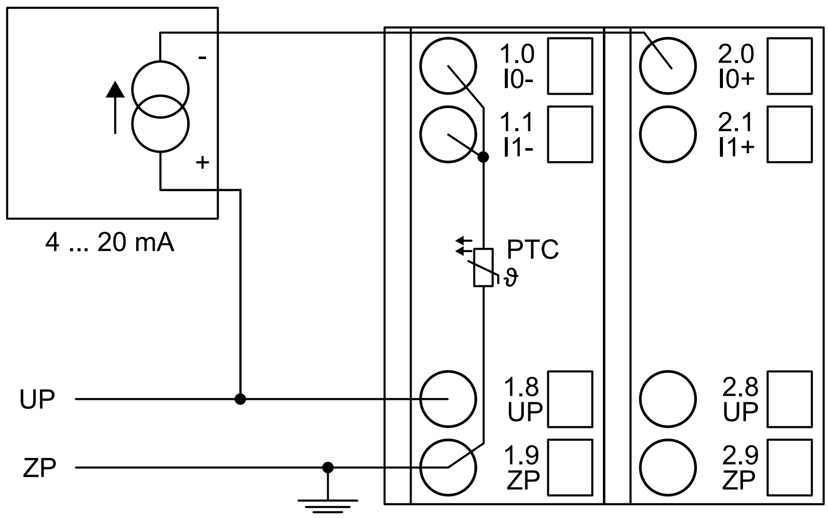


Fig. 30: Connection example

The following measuring ranges can be configured *Chapter 1.6.2.2.2.6 "Parameterization" on page 444* *Chapter 1.6.2.2.2.9 "Measuring ranges" on page 449*

Current	4 mA...20 mA	1 channel used

The function of the LEDs is described under Displays *Chapter 1.6.2.2.2.7 "Diagnosis" on page 447*.

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 I-). 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.

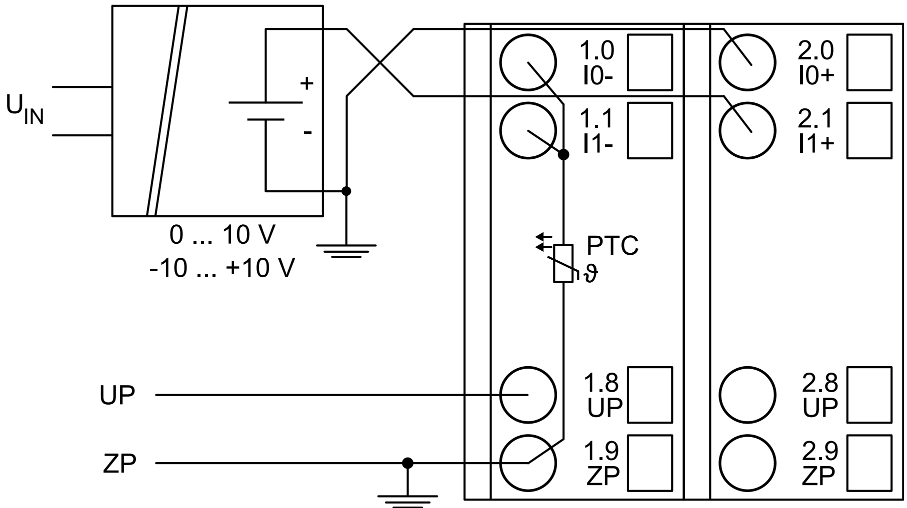


Fig. 31: Connection example

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

The following measuring ranges can be configured *Chapter 1.6.2.2.2.6 “Parameterization” on page 444* *Chapter 1.6.2.2.2.9 “Measuring ranges” on page 449*:

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 1.6.2.2.2.7 “Diagnosis” on page 447*.

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.

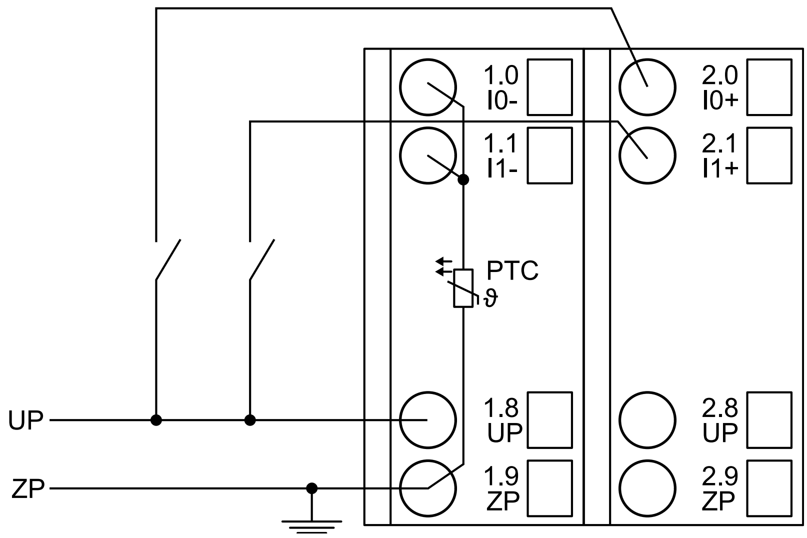


Fig. 32: Connection example

The following operating mode can be configured *Chapter 1.6.2.2.2.6 “Parameterization” on page 444* *Chapter 1.6.2.2.2.9 “Measuring ranges” on page 449*

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
6	Channel configuration Input channel 0	See *Table 91 “Channel configuration [2])” on page 446*		Byte	Default 0x00	0	19	0x0Y05

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
7	Channel monitoring Input channel 0	See ➡ *Table 92 “Channel monitoring 4)” on page 446*		Byte	Default 0x00	0	3	0x0Y06
8 to 35	Channel configuration and channel monitoring of the input channels 1 to 14	See ➡ *Table 91 “Channel configuration 2)” on page 446* and ➡ *Table 92 “Channel monitoring 4)” on page 446*		Byte Byte	Default 0x00 0x00	0 0	19 3	0x0Y07 to 0x0Y22
36	Channel configuration Input channel 15	See ➡ *Table 91 “Channel configuration 2)” on page 446*		Byte	Default 0x00	0	19	0x0Y23
37	Channel monitoring Input channel 15	See ➡ *Table 92 “Channel monitoring 4)” on page 446*		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 91: 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)
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 92: 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

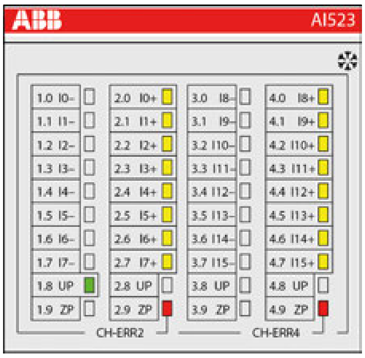
E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500 display	<− Display in
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC browser	
Byte 6 Bit 6...7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0...5	FBP diagnosis block	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**	**Remedy**
	1)	2)	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
	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 terminal
	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

Range	0...10 V	-10...+10 V	0...20 mA	4...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 -4864 -6912 : -27648	FFFF ED00 E500 : 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

The resolution corresponds to 16 bits.

Range	Pt100 / Pt 1000 -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		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...70 °C	Pt100 / Pt1000 -50...400 °C	Ni1000 -50...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 *Chapter 2.6.1 “System data AC500” on page 971* are applicable to the standard version.

The system data of AC500-XC *Chapter 2.7.1 “System data AC500-XC” on page 1023* are applicable to the XC version.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter		Value
Process voltage		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 V DC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module	Ca. 2 mA
	From UP at normal operation / with outputs	0.15 A + output loads
Inrush current from UP (at power up)		0.050 A^2s

Parameter	Value
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 switchgear cabinet.

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

Technical data of the 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- to I7- Connections of the channels I0+ to I7+	Terminals 1.0 to 1.7 Terminals 2.0 to 2.7	
Connections of the channels I8- to I15- Connections of the channels I8+ to I15+	Terminals 3.0 to 3.7 Terminals 4.0 to 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 + 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
Relationship between input signal and hex code	*Chapter 1.6.2.2.2.9.1 “Input ranges of voltage, current and digital input” on page 449* *Chapter 1.6.2.2.2.9.2 “Input ranges resistance temperature detector” on page 449*	
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+ to I7+ Connections of the channels I8+ to I15+		Terminals 2.0 to 2.7 Terminals 4.0 to 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 to 32 ms
Indication of the input signals		1 LED per channel
Input signal voltage		24 V DC
	Signal 0	-30 V...+5 V
	Undefined signal	+5 V...+13 V
	Signal 1	+13 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 7 mA
	Input voltage +5 V	Typ. 1.4 mA
	Input voltage +15 V	Typ. 4.3 mA
	Input voltage +30 V	< 9 mA
Input resistance		Ca. 3.5 kΩ

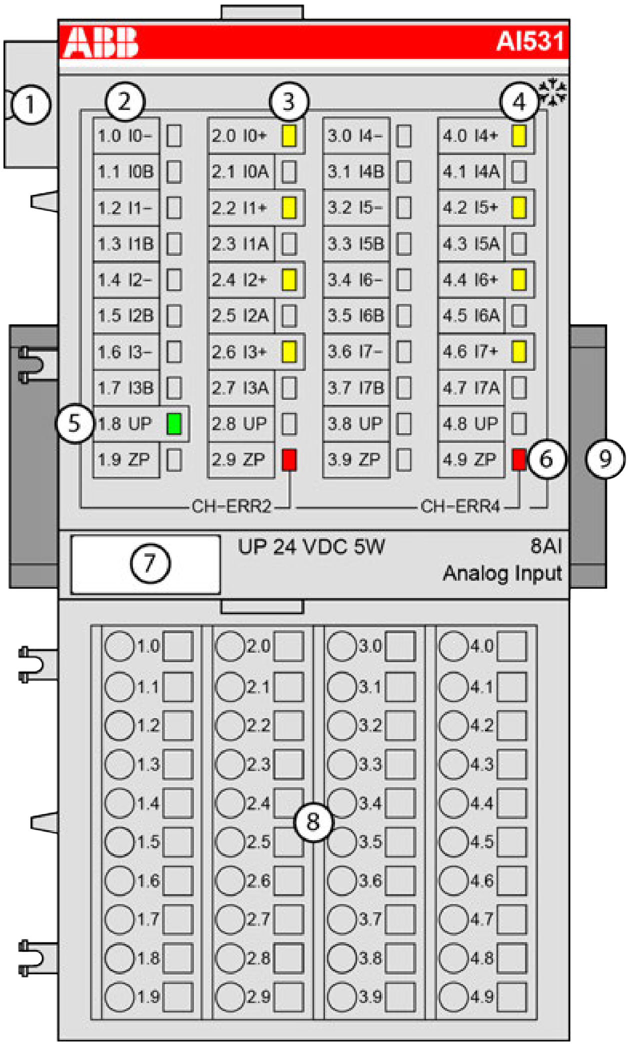
Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 250 300 R0001	AI523, analog input module, 16 AI, U/I/Pt100, 12 bits + sign, 2-wires	Active
1SAP 450 300 R0001	AI523-XC, analog input module, 16 AI, U/I/Pt100, 12 bits + sign, 2-wires, XC version	Active

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

1.6.2.2.3 AI531 - Analog input module

- 8 configurable analog inputs (I0 to 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 15 bits plus 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 to I3
4 4 yellow LEDs to display the states at the inputs I4 to 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 iInterface 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, bipolar	15 bits plus sign
Voltage and current, unipolar	15 bits
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 1.5.2 “TU515, TU516, TU541 and TU542 for I/O modules” on page 126*

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the System Assembly, Construction and Connection chapter ⇘ Chapter 2.6 “AC500 (Standard)” on page 971.

The modules are plugged on an I/O terminal unit ↬ *Chapter 1.5.2 “TU515, TU516, TU541 and TU542 for I/O modules” on page 126*. 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 (TA526 ↬ *Chapter 1.8.2.6 “TA526 - Wall mounting accessory” on page 902*).

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+ to I3+	Positive poles of the first 4 analog inputs
1.0, 1.2, 1.4, 1.6	I0- to I3-	Negative poles of the first 4 analog inputs
2.1, 2.3, 2.5, 2.7	I0A to I3A	Connections A (supply) of the first 4 analog inputs
1.1, 1.3, 1.5, 1.7	I0B to I3B	Connections B (analog ground) of the first 4 analog inputs
4.0, 4.2, 4.4, 4.6	I4+ to I7+	Positive poles of the following 4 analog inputs
3.0, 3.2, 3.4, 3.6	I4- to I7-	Negative poles of the following 4 analog inputs
4.1, 4.3, 4.5, 4.7	I4A to I7A	Connections A (supply) of the following 4 analog inputs
3.1, 3.3, 3.5, 3.7	I4B to 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 (cut wire), 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 cut wire 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 only permissible under conditions described in Hot Swap chapter *Chapter 1.6 "I/O modules" on page 142*.

The devices are not designed for removal or insertion under power when Hot Swap conditions do not apply. 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.

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.

Only for simple applications (low electromagnetic disturbances, no high requirement on precision), the shielding can also be omitted.

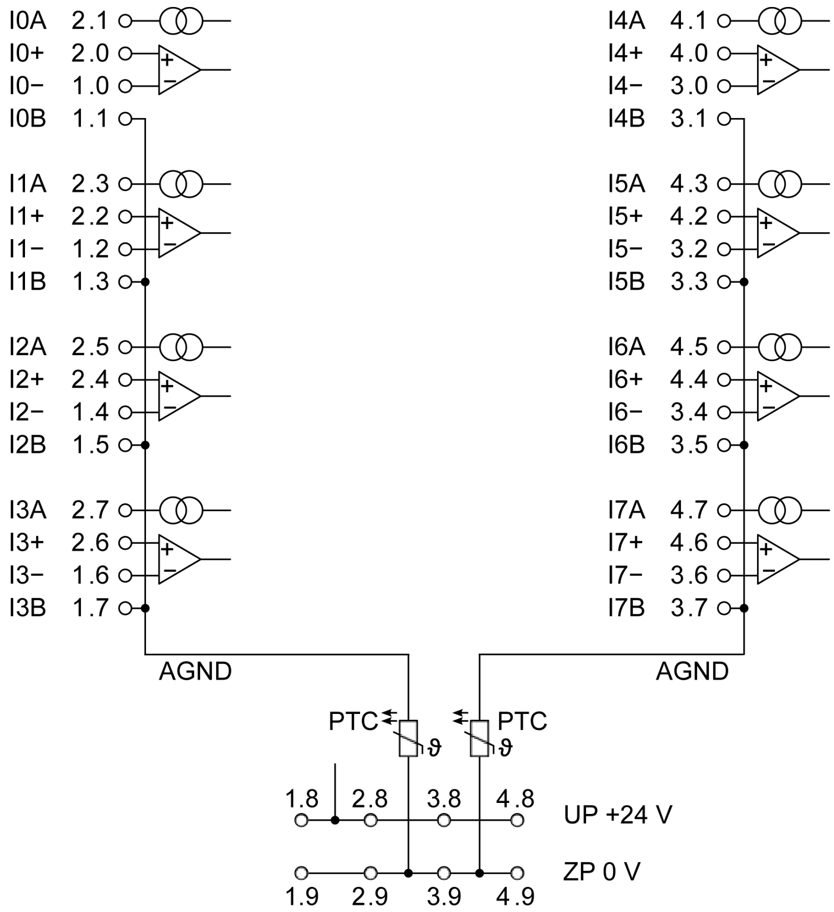


Fig. 33: 8 analog inputs in two groups, individually configurable *Chapter 1.6.2.2.3.2 "Functionality" on page 454*

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 pole).

The module provides several diagnosis functions *Chapter 1.6.2.2.3.7 "Diagnosis" on page 475*.

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

Standard ranges

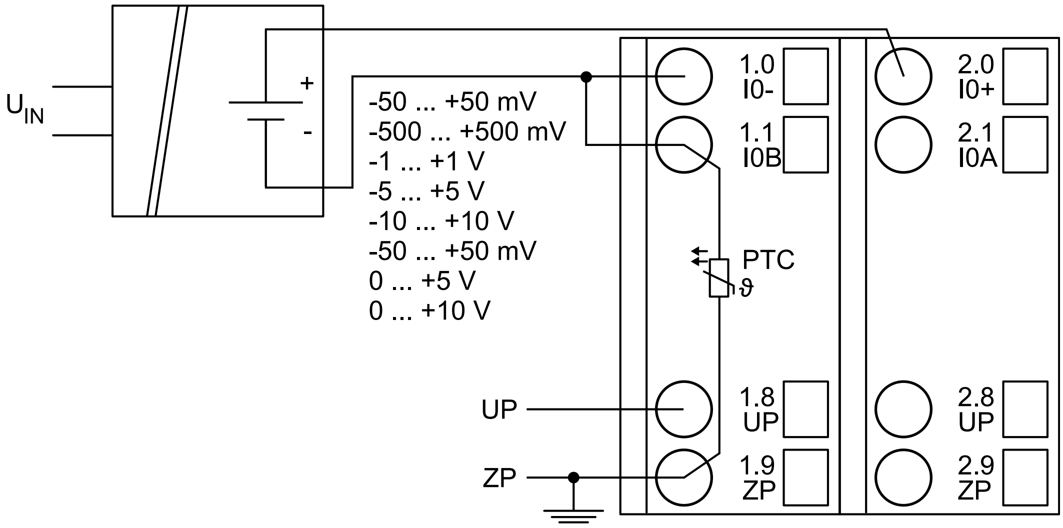


Fig. 34: Connection example

The measuring ranges can be configured ✎ *Chapter 1.6.2.2.3.6 “Parameterization” on page 472*:

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)

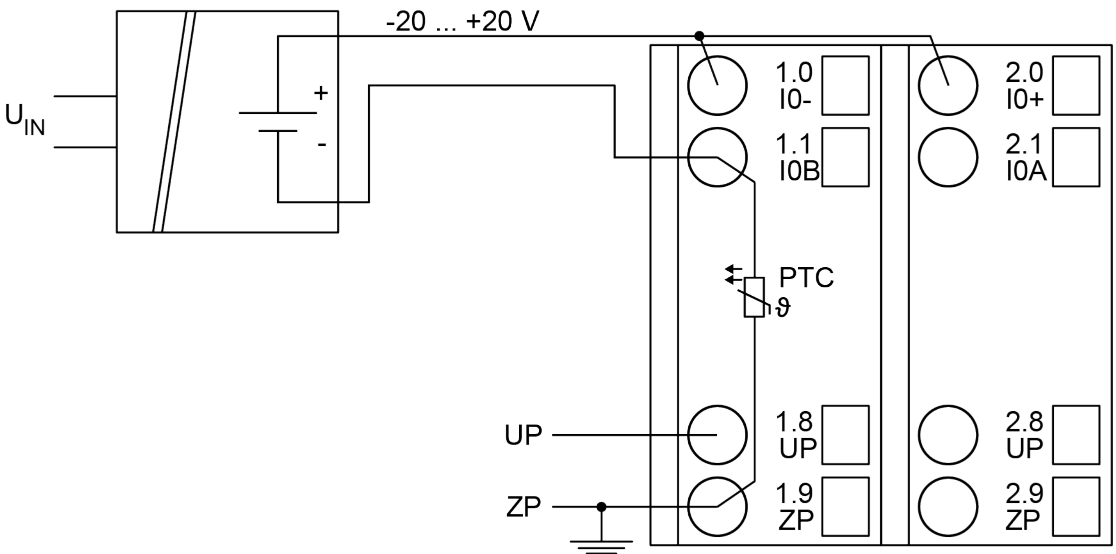


Fig. 35: Connection example

The measuring range can be configured ✎ *Chapter 1.6.2.2.3.6 “Parameterization” on page 472*:

Voltage	Common mode voltage	1 channel used

The function of the LEDs is described under Diagnosis and displays / displays ↳ *Chapter 1.6.2.2.3.7 “Diagnosis” on page 475*.

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

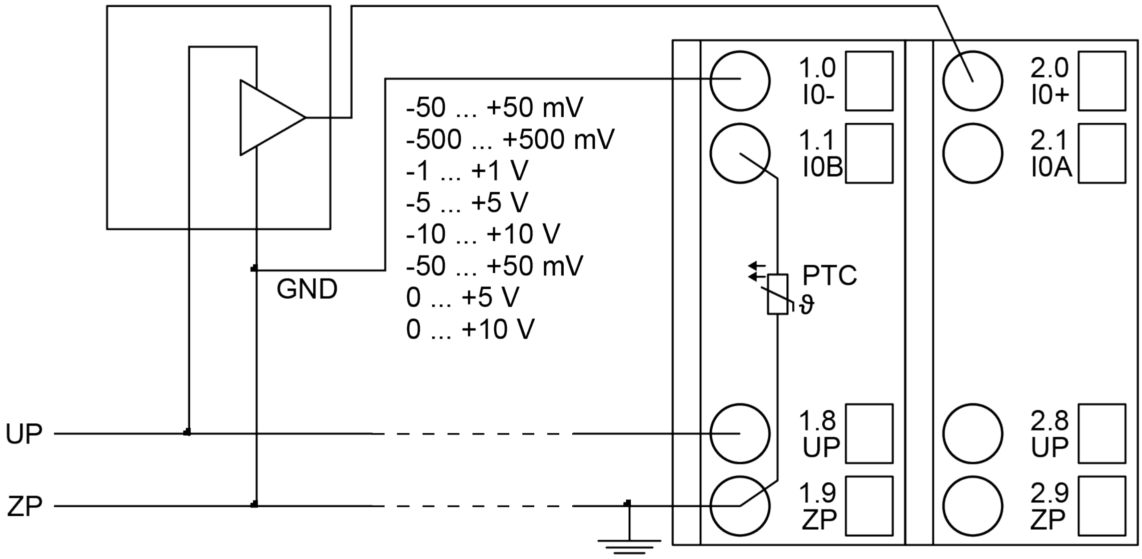


Fig. 36: Connection example

> **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 1.6.2.2.3.6 “Parameterization” on page 472* :

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)

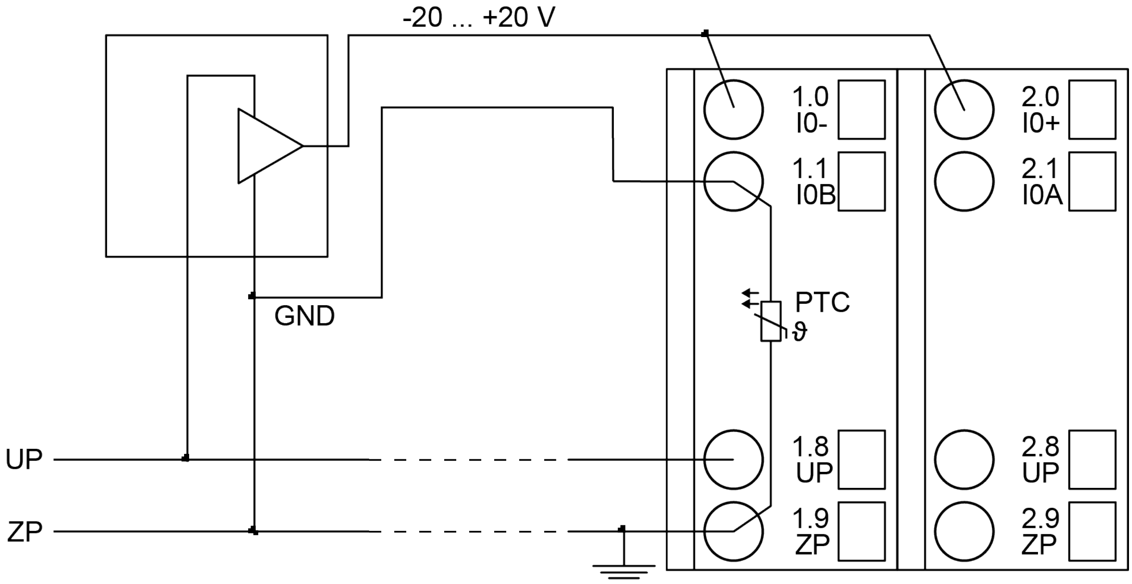


Fig. 37: Connection example

> **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 1.6.2.2.3.6 "Parameterization" on page 472*:

Voltage	Common mode voltage	1 channel used

The function of the LEDs is described under Diagnosis and displays / displays ✎ *Chapter 1.6.2.2.3.7 "Diagnosis" on page 475*.

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

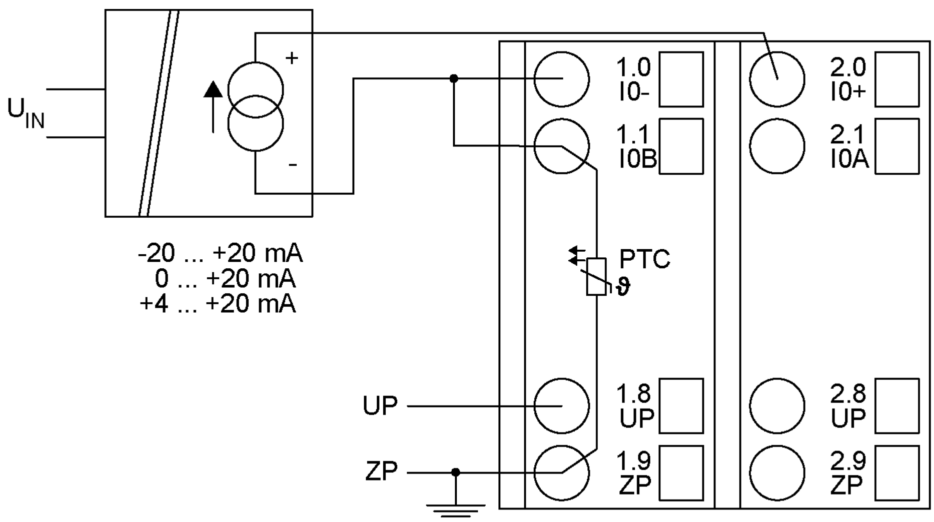


Fig. 38: Connection example

Figure:

The following measuring ranges can be configured ➪ *Chapter 1.6.2.2.3.6 “Parameterization” on page 472*:

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 1.6.2.2.3.7 “Diagnosis” on page 475*.

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

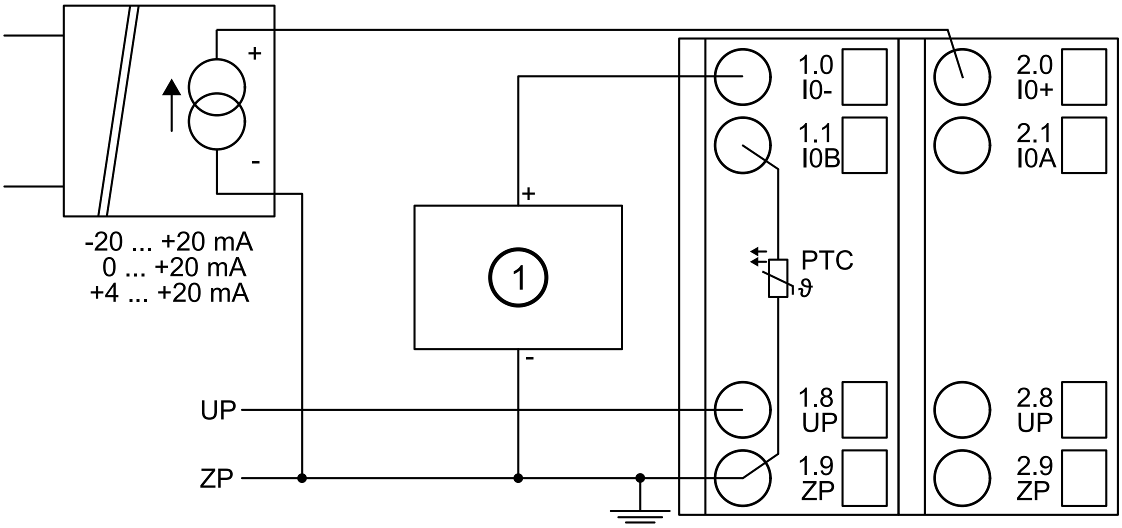


Fig. 39: Connection example

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 1.6.2.2.3.6 “Parameterization” on page 472*:

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 1.6.2.2.3.7 “Diagnosis” on page 475*.

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

Connection of passive-type analog sensors (Current)

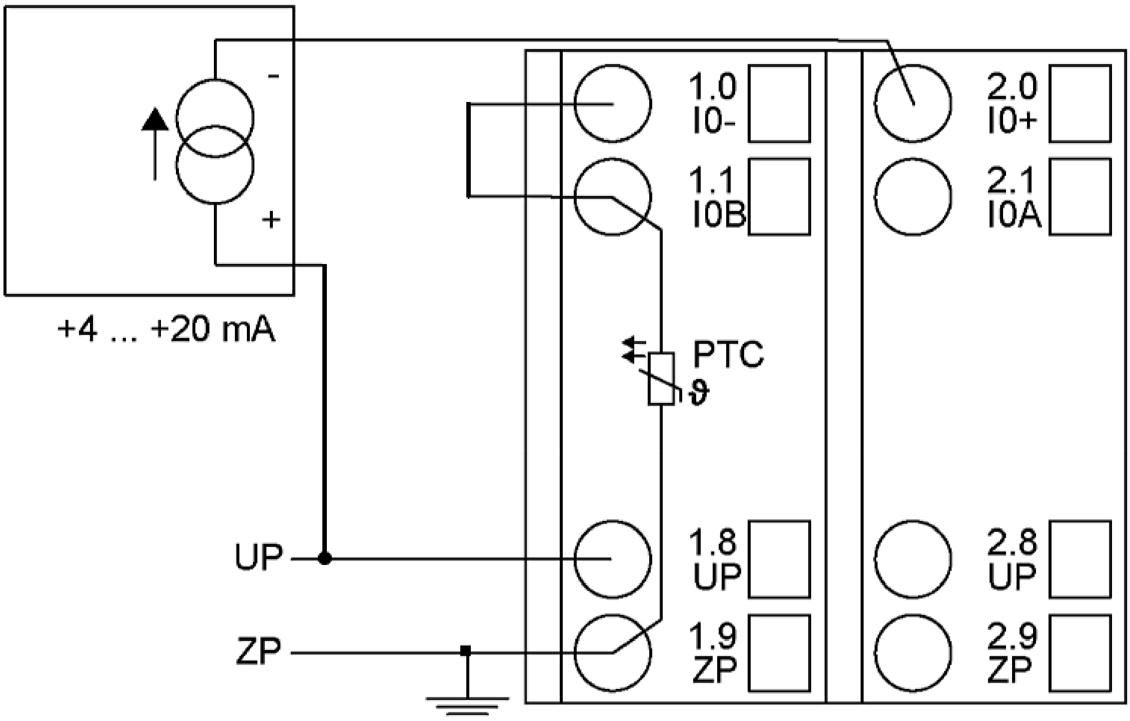


Fig. 40: Connection example

The following measuring ranges can be configured *Chapter 1.6.2.2.3.6 “Parameterization” on page 472*:

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 1.6.2.2.3.7 “Diagnosis” on page 475*.

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

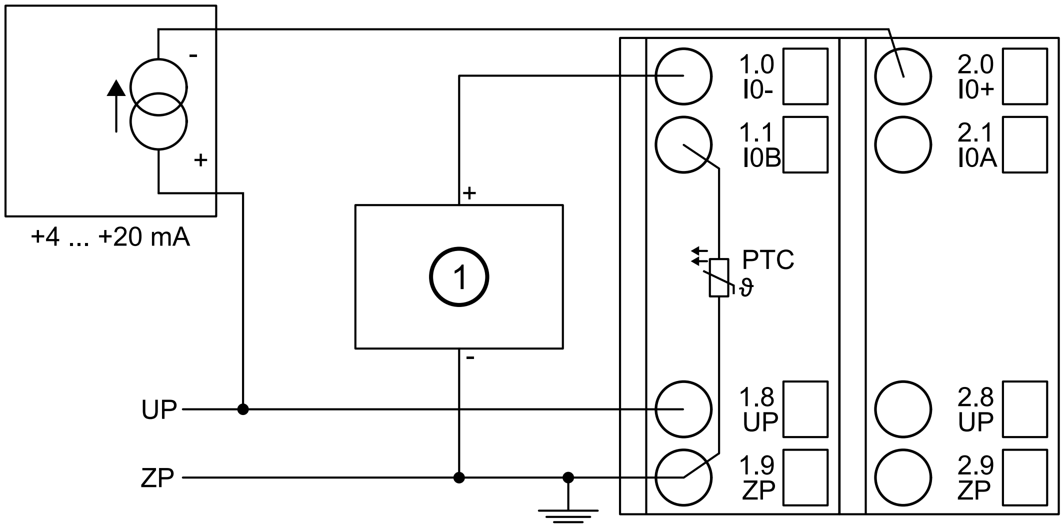


Fig. 41: Connection example

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 1.6.2.2.3.6 "Parameterization" on page 472*:

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 1.6.2.2.3.7 "Diagnosis" on page 475*.

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.

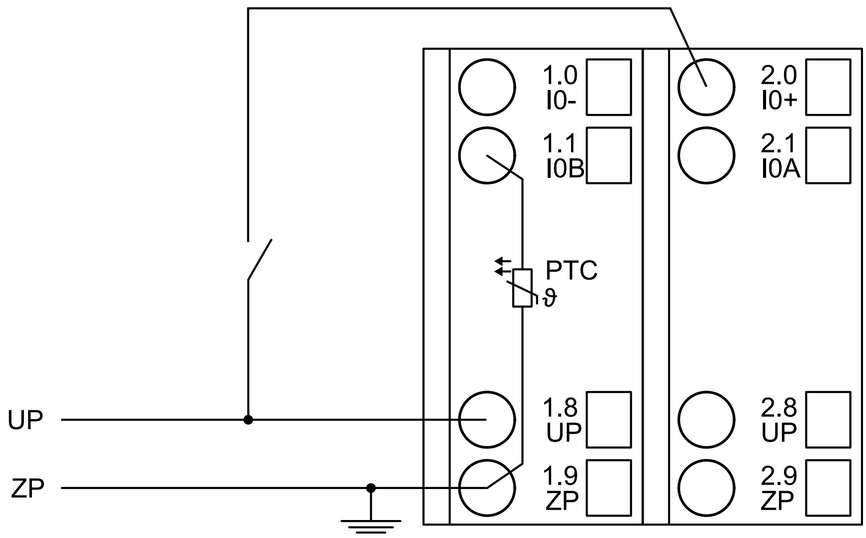


Fig. 42: Connection example

The following operating mode can be configured *Chapter 1.6.2.2.3.6 “Parameterization” on page 472* :

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 1.6.2.2.3.7 “Diagnosis” on page 475*.

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.

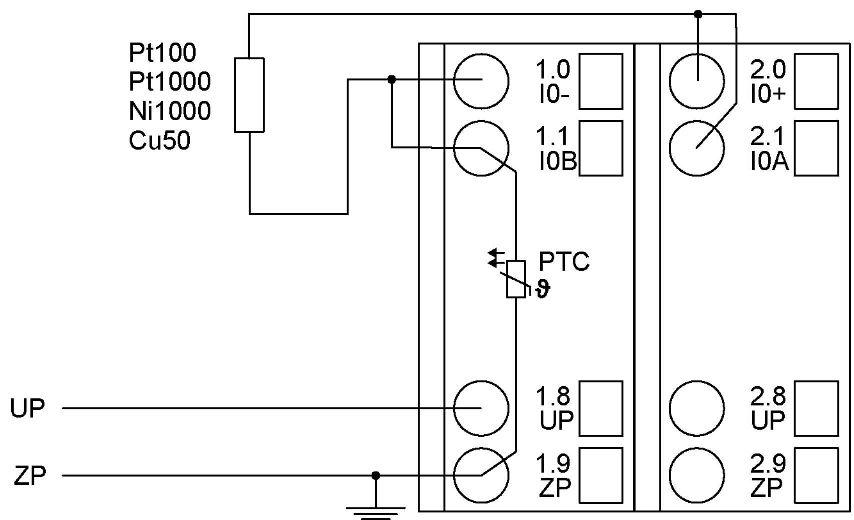


Fig. 43: Connection example

The following measuring ranges can be configured *Chapter 1.6.2.2.3.6 “Parameterization” on page 472*:

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 1.6.2.2.3.7 "Diagnosis" on page 475*.

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.

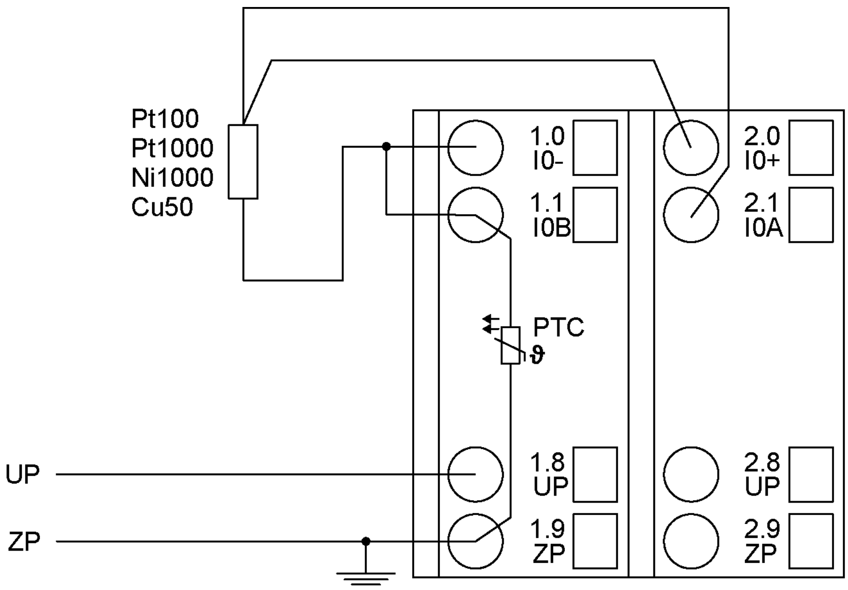


Fig. 44: Connection example

The following measuring ranges can be configured *Chapter 1.6.2.2.3.6 "Parameterization" on page 472*:

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 1.6.2.2.3.7 "Diagnosis" on page 475*.

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.

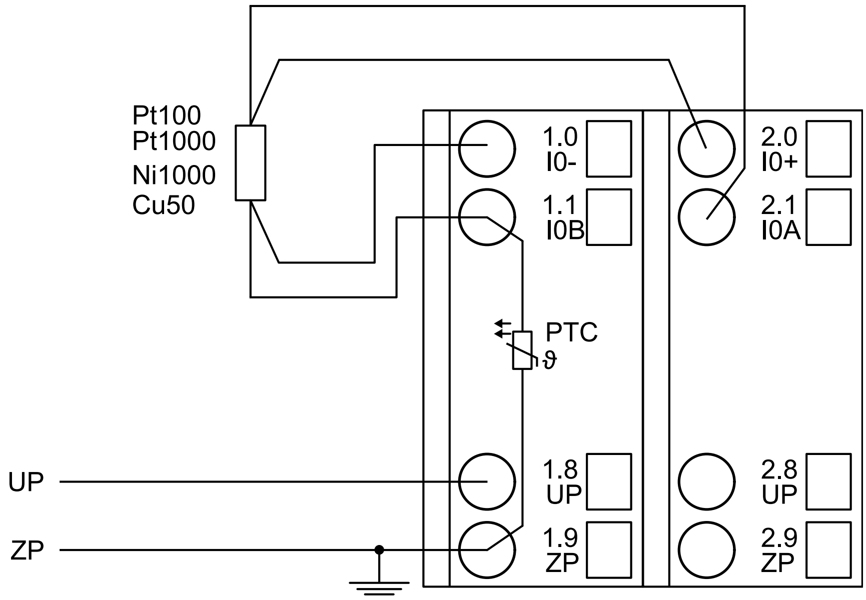


Fig. 45: Connection example

The following measuring ranges can be configured *Chapter 1.6.2.2.3.6 “Parameterization” on page 472*:

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 1.6.2.2.3.7 “Diagnosis” on page 475*.

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.

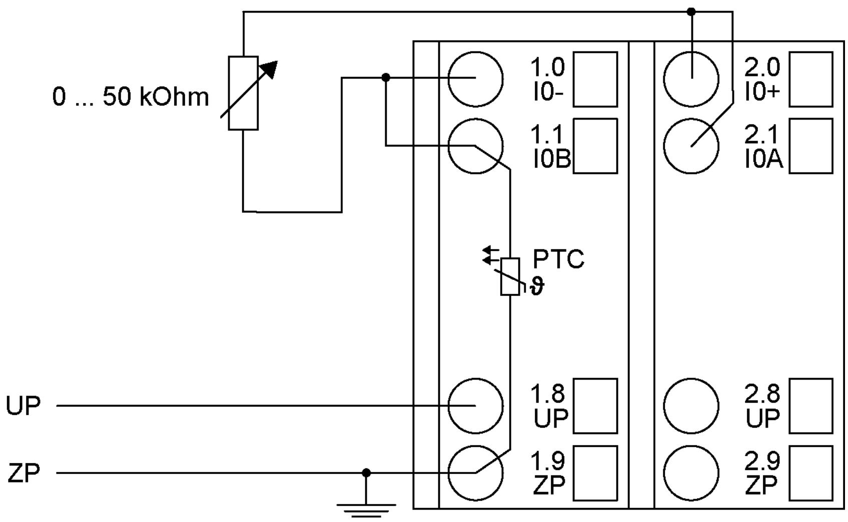


Fig. 46: Connection example

The following measuring ranges can be configured ✎ *Chapter 1.6.2.2.3.6 “Parameterization” on page 472* :

Resistor	50 kΩ	1 channel used

For a description of the function of the LEDs, please refer to Diagnosis and displays / displays ✎ *Chapter 1.6.2.2.3.7 “Diagnosis” on page 475*.

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.

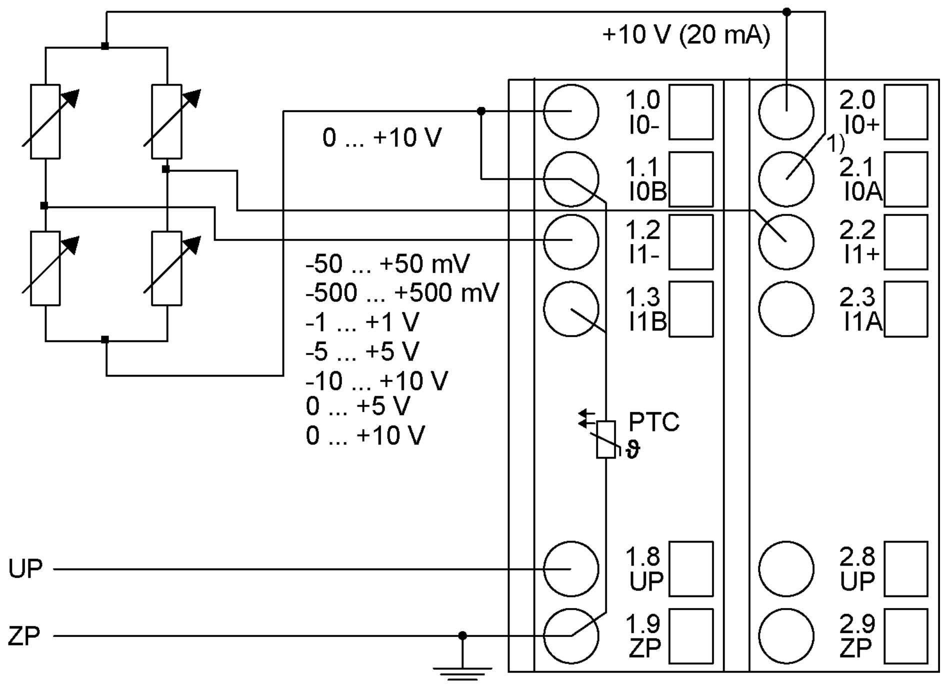


Fig. 47: Connection example

1 Internal supply

All voltage measuring ranges can be configured ⇨ *Chapter 1.6.2.2.3.6 "Parameterization" on page 472*.

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.

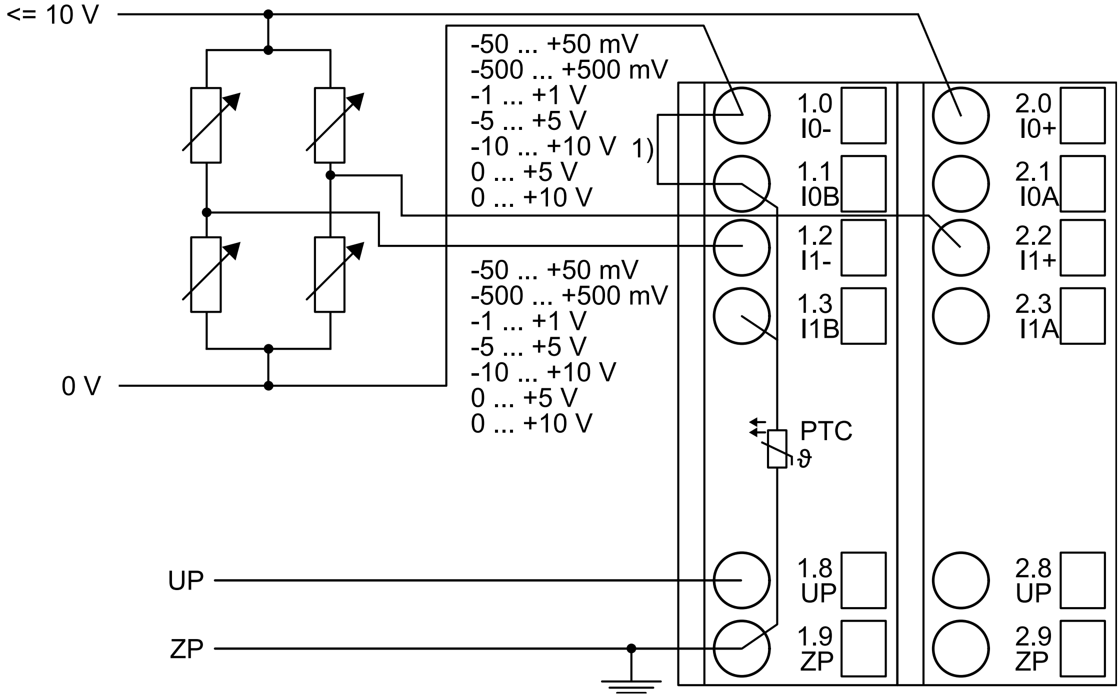


Fig. 48: Connection example

1 Bridge to IxB necessary with galvanically isolated supply

All voltage measuring ranges can be configured *Chapter 1.6.2.2.3.6 “Parameterization” on page 472* .

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

Connection of thermocouples

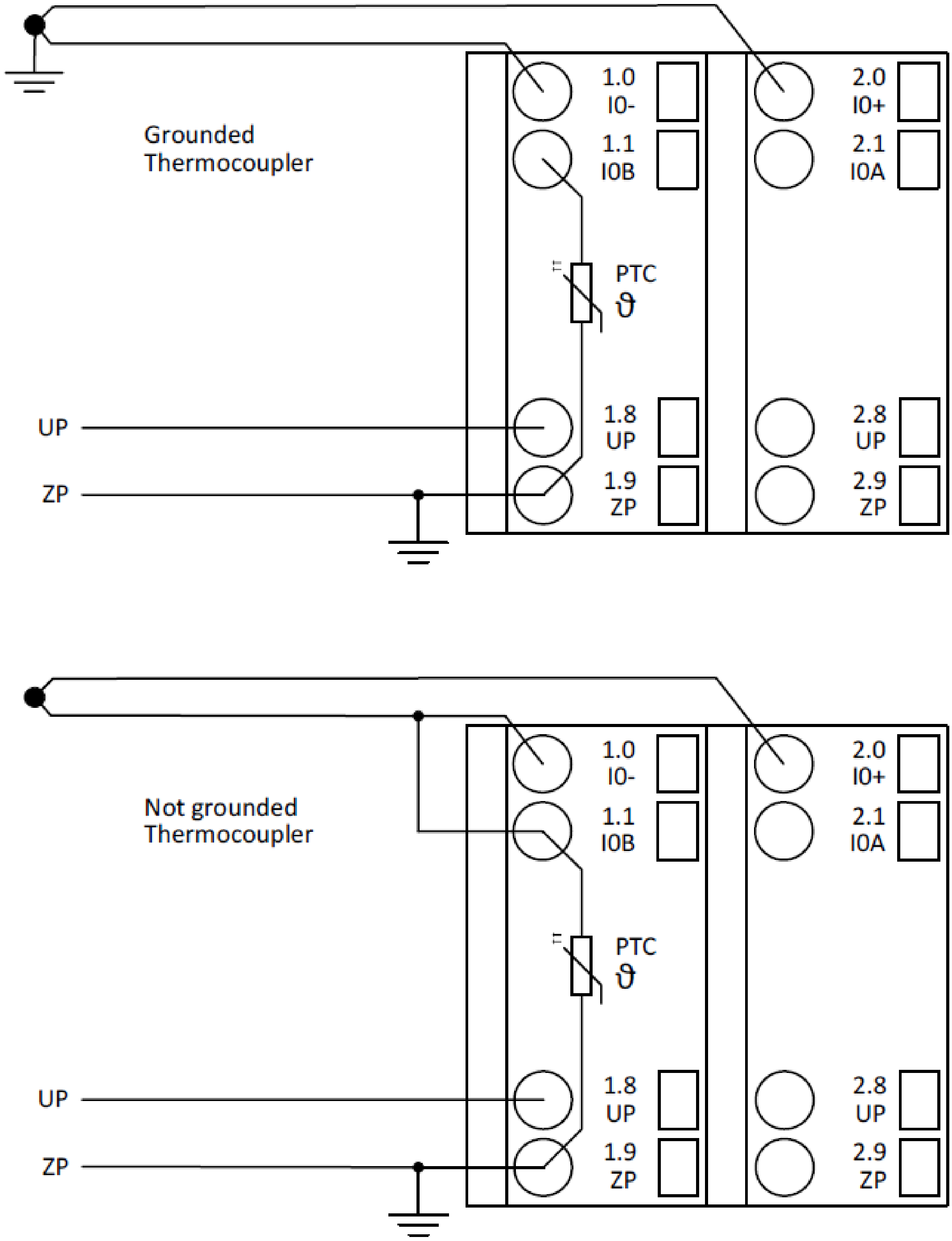


Fig. 49: Connection example

The following measuring ranges can be configured *Chapter 1.6.2.2.3.6 “Parameterization” on page 472* :

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 1.6.2.2.3.7 “Diagnosis” on page 475*.

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 from -25 °C to +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 ➪ *Chapter 1.6.2.2.3.6 “Parameterization” on page 472* for possible settings.

In order to avoid error messages from unused analog input channels, it is useful to configure them as "unused".

Internal data exchange

Digital inputs (bytes)	0
Digital outputs (bytes)	0
Analog inputs (words)	8
Analog outputs (words)	1

I/O configuration

The module does not store configuration data itself. It gets its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

This means that replacing I/O modules is possible without any re-parameterization via software.

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

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1...10

Name	Value	Internal value	Internal value, Type	Default	Min.	Max.	EDS Slot/ Index
Module ID	Internal	1535 [1])	Word	1535 0x05ff	0	65535	0x0Y01
Ignore module [2])	No Yes	0 1	Byte	No 0x00			Not for FBP
Parameter length in bytes	Internal	36	Byte	36	0	255	0x0Y02
Check supply	Off On	0 1	Byte	On 0x01			0x0Y03
Analog data format	Default	0	Byte	Default 0x00			0x0Y04

[1]) With CS31 and addresses smaller than 70 and FBP, the value is increased by 1

[2]) Not with FBP

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 93 "Channel configuration" on page 473*	see *Table 93 "Channel configuration" on page 473*	Byte	0 0x00	0x0Y07
2	Channel monitoring	see *Table 94 "Channel monitoring" on page 475*	see *Table 94 "Channel monitoring" on page 475*	Byte	0 0x03	
3	Line frequency suppression	see *Further information on page 475*	see *Further information on page 475*	Byte	0 0x00	
4	Compensation channel	see *Further information on page 475*	see *Further information on page 475*	Byte	0 0x00	

Table 93: 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

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

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

Table 95: Line frequency suppression

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

Table 96: 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

<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>FBP diag-nosis 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 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**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
3	14	1...10	31	31	3	Timeout in the I/O module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	40	Different hard-/firmware versions in the module	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	43	Internal error in the module, e.g. internal analog voltage is not correct	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	36	Internal data exchange failure	Replace I/O module
	11 / 12	ADR	1...10				
3	14	1...10	31	31	9	Overflow diagnosis buffer	Restart
	11 / 12	ADR	1...10				
3	14	1...10	31	31	26	Parameter error	Check master
	11 / 12	ADR	1...10				
3	14	1...10	31	31	11	Process voltage too low	Check process voltage
	11 / 12	ADR	1...10				
4	14	1...10	31	31	45	Process voltage is switched OFF (ON –> OFF)	Process voltage ON
	11 / 12	ADR	1...10				
Channel error							
4	14	1...10	1	0...7	48	Analog value overflow or broken wire at an analog input	Check input value or terminal
	11 / 12	ADR	1...10				
4	14	1...10	1	0...7	7	Analog value underflow at an analog input	Check input value
	11 / 12	ADR	1...10				
4	14	1...10	1	0...7	47	Short circuit at an analog input	Check terminal
	11 / 12	ADR	1...10				
4	14	1...10	1	0...7	1	Possibly wrong measured value caused by inadmissible temperature of the compensation channel	Check the temperature compensation 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 diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**			
4	14	1...10	1	0...7	2	Invalid measured value of the channel caused by overly high voltage difference	Check voltage difference; install equalizing conductors if necessary
	11 / 12	ADR	1...10				
4	14	1...10	1	0...7	11	Output voltage 10 V faulty	Check output load
	11 / 12	ADR	1...10				

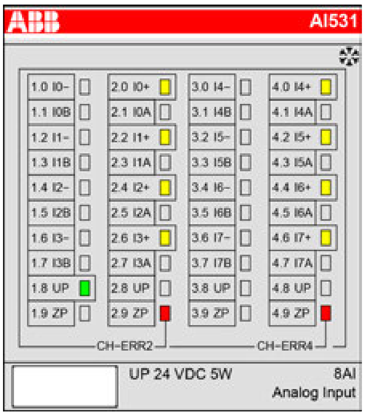
Remarks:

1)	In AC500, the following interface identifier applies: 14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. The FBP diagnosis block does not contain this identifier.
2)	With "Device" the following allocation applies: 31 = module itself, 1...10 expansion module 1...10, ADR = hardware address (e.g. of the DC551)
3)	With "Module" the following allocation applies dependent of the master: Module error: I/O bus or FBP: 31 = module itself; COM1/COM2: 1...10 = expansion 1...10 Channel error: I/O bus or FBP = module type (1 = AI); COM1/COM2: 1...10 = expansion 1...10
4)	In case of module errors, with channel "31 = Module itself" is output.

State LEDs

During the power ON procedure, the module initializes automatically. All LEDs (except the channel LEDs) are ON during this time.

States of the LEDs (see also section Diagnosis LEDs in the S500 system data):

LED		State	Color	LED = OFF	LED = ON	LED flashes
	Inputs I0...I3 and I4...I7	Analog input	Yellow	Input is OFF	Input is ON (brightness depends on the value of the analog signal)	--
	UP	Process voltage 24 V DC via terminal	Green	Process voltage is missing	Process voltage OK	--
	CH-ERR2	Channel error, messages in groups (analog inputs combined into the groups 2 and 4)	Red	No error, or process voltage is missing	Severe error within the corresponding group	Error on one channel of the group
	CH-ERR4		Red			
	CH-ERR *)	Module error	Red	--	Internal error	--
	*) Both LEDs CH-ERR2 and CH-ERR4 light up together					

Measuring ranges

Voltage input ranges

Bipolar voltage input range, measuring bridge

The represented resolution corresponds to 16 bits.

Range	-50 ... +50 mV	-500 ... +500 mV	-1 ... +1 V	-5 ... +5 V	-10 ... +10 V	Common Mode Voltage	Digital value	
							Decimal	Hex.
Overflow	> 58.7945	> 587.9449	> 1.17589	> 5.8794	> 11.7589	> 20.0000	32767	7FFF
Measured value too high	58.7945 : 50.0018	587.9449 : 500.0181	1.17589 : 1.00004	5.8794 : 5.0002	11.7589 : 10.0004		32511 : 27649	7EFF : 6C01
Normal range	50.0000 : 0.0018	500.0000 : 0.0181	1.00000 : 0.00004	5.0000 : 0.0002	10.0000 : 0.0004	20.0000 : 0.0008	27648 : 1	6C00 : 0001
Normal range or Measured value too low	0.0000	0.0000	0.0000	0.00000	0.0000	0.0000	0	0000
	-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

Range	-50 ... +50 mV	-500 ... +500 mV	-1 ... +1 V	-5 ... +5 V	-10 ... +10 V	Common Mode Voltage	Digital value	
							Decimal	Hex.
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 ... +5 V	0 ... +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 ... +20 mA	0 ... +20 mA	4 ... 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
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

Range	-20 ... +20 mA	0 ... +20 mA	4 ... 20 mA	Digital value	
				Decimal	Hex.
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 ... +70 °C 1)	Pt100 / Pt1000 -50 ... +400 °C	Pt100 -200 ... +850 °C	Ni1000 -50 ... +150 °C	Cu50 -200 ... +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
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

Range	Pt100 -50 ... +70 °C [1])	Pt100 / Pt1000 -50 ... +400 °C	Pt100 -200 ... +850 °C	Ni1000 -50 ... +150 °C	Cu50 -200 ... +200 °C	Digital value	
						Decimal	Hex.
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C		-50.1 °C : -60.0 °C		-501 : -600	FE0B : FDA8
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 ... +1200 °C	Typ K -270 ... +1372 °C	Typ N -270 ... +1300 °C	Typ S -50 ... +1768 °C	Typ T -270 ... +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
	:	:	:	:	:	:	:

Range	Typ J -210 ... +1200 °C	Typ K -270 ... +1372 °C	Typ N -270 ... +1300 °C	Typ S -50 ... +1768 °C	Typ T -270 ... +400 °C	Digital value	
						Decimal	Hex.
	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 ⇘ *Chapter 2.6.1 “System data AC500” on page 971* are applicable to the standard version.

The system data of AC500-XC ⇘ *Chapter 2.7.1 “System data AC500-XC” on page 1023* are applicable to the XC version.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

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

Parameter		Value
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module	Ca. 2 mA
	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 switchgear cabinet.

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

Technical data of the analog inputs

Parameter	Value
Number of channels per module	8
Distribution of channels into groups	2 groups of 4 channels each
Connections of the channels I0 to I3	Terminals 1.0 to 1.7 and terminals 2.0 to 2.7
Connections of the channels I4 to I7	Terminals 3.0 to 3.7 and terminals 4.0 to 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

<table>
<tr><th colspan="2">Parameter</th><th colspan="3">Value</th></tr>
<tr><td colspan="2">Conversion time</td><td colspan="3">1 ms (none),
100 ms (50 Hz / 60 Hz) per channel</td></tr>
<tr><td colspan="2" rowspan="2">Resolution</td><td rowspan="2">Range</td><td>unipolar</td><td>15 bits</td></tr>
<tr><td>bipolar</td><td>15 bits + sign</td></tr>
<tr><td colspan="2" 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 colspan="2">±0.1 % (voltage)
±0.3 % (current, resistor)
at 25 °C</td></tr>
<tr><td>Max.</td><td colspan="2">±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</td></tr>
<tr><td colspan="2">Maximum permanent allowed overload (no damage)</td><td colspan="3"></td></tr>
<tr><td></td><td>Current input</td><td colspan="3">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.</td></tr>
<tr><td></td><td>Voltage input</td><td colspan="3">30 V</td></tr>
<tr><td colspan="2">Relationship between input signal and hex code</td><td colspan="3">↳ *Table 94 “Channel monitoring” on page 475*</td></tr>
<tr><td colspan="2">Unused voltage inputs</td><td colspan="3">Are configured as "unused"</td></tr>
<tr><td colspan="2">Unused current inputs</td><td colspan="3">Have a low resistance, can be left open-circuited</td></tr>
<tr><td colspan="2">Overvoltage protection</td><td colspan="3">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	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)

Parameter	Value
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

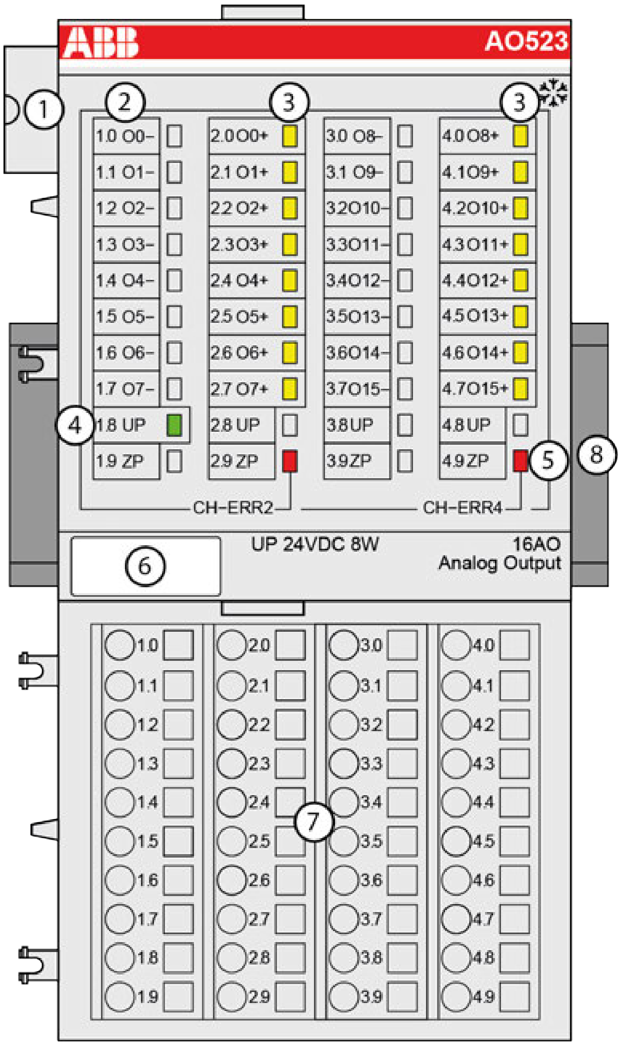
Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 250 600 R0001	AI531, analog input module, 8 AI, U/I/Pt100, TC, 15 bits + sign, 4-wires	Active
1SAP 450 600 R0001	AI531-XC, analog input module, 8 AI, U/I/Pt100, TC, 15 bits + sign, 4-wires, XC version	Active

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

1.6.2.2.4 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 iInterface 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 plus sign

Parameter		Value
Resolution of the analog channels		
	Voltage -10 V...+10 V	12 bits plus 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 1.5.2 “TU515, TU516, TU541 and TU542 for I/O modules” on page 126*

Connections

> *For a detailed description of the mounting, disassembly and connection of the module, please refer to the System Assembly, Construction and Connection chapter ⇘ Chapter 2.6 “AC500 (Standard)” on page 971.*

The modules are plugged on an I/O terminal unit ⇘ *Chapter 1.5.2 “TU515, TU516, TU541 and TU542 for I/O modules” on page 126*. 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 (TA526 ⇘ *Chapter 1.8.2.6 “TA526 - Wall mounting accessory” on page 902*).

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 to 4.8 and 1.9 to 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 to 4.8: process voltage UP = +24 V DC

Terminals 1.9 to 4.9: process voltage ZP = 0 V DC

The assignment of the other terminals:

Terminals	Signal	Description
1.0 to 1.7	O0- to O7-	Negative poles of the first 8 analog outputs
2.0 to 2.7	O0+ to O7+	Positive poles of the first 8 analog outputs
3.0 to 3.7	O8- to O15-	Negative poles of the fol-lowing 8 analog outputs
4.0 to 4.7	O8+ to O15+	Positive poles of the following 8 analog outputs

> *For the open-circuit detection (cut wire), 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 only permissible under conditions described in Hot Swap chapter *Chapter 1.6 "I/O modules" on page 142*.

The devices are not designed for removal or insertion under power when Hot Swap conditions do not apply. 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.

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.

Only for simple applications (low electromagnetic disturbances, no high requirement on precision), the shielding can also be omitted.

The following figure shows the connection of the module:

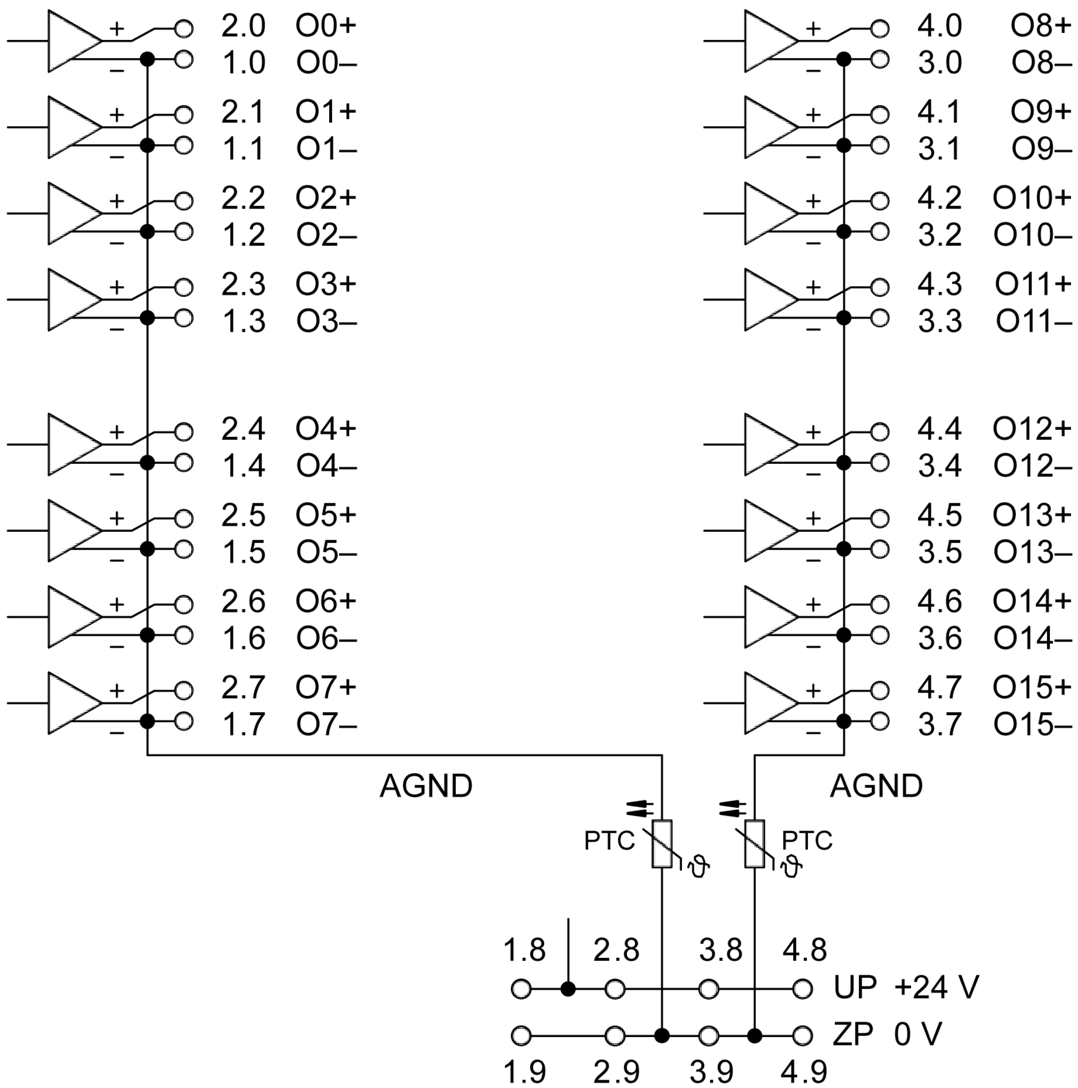


Fig. 50: 16 analog outputs in two groups ✎ Chapter 1.6.2.2.4.2 “Functionality” on page 486

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 pole).

The modules provide several diagnosis functions ✎ *Chapter 1.6.2.2.4.7 “Diagnosis” on page 495.*

Connection of analog output loads (Voltage, current)

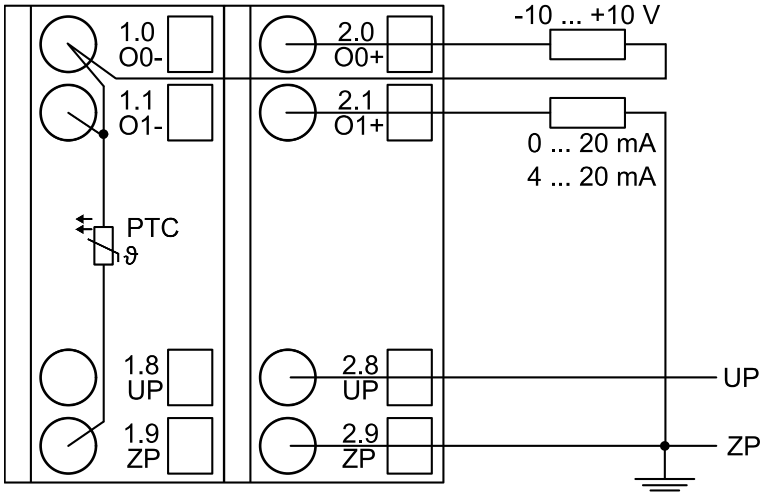


Fig. 51: Connection example

The following measuring ranges can be configured *Chapter 1.6.2.2.4.6 “Parameterization” on page 491*:

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	Parameter 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	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 Output channel 0	See *Table 97 “Channel configuration 3)” on page 494*		Byte	Default 0x00	0	130	0x0Y06
8	Channel monitoring Output channel 0	See *Table 98 “Channel monitoring 4)” on page 494*		Byte	Default 0x00	0	3	0x0Y07

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
9	Substi-tute value Output channel 0	Output channel 0!	0...0xffff	Word	Default 0x0000	0	65535	0x0Y08
10 to 15	Channel configu-ration and channel moni-toring of the output channels 1 to 3	See *Table 97 “Channel configuration 3)” on page 494* and *Table 98 “Channel monitoring 4)” on page 494*		Byte Byte	Default 0x00 0x00	0 0	130 3	0x0Y09 to 0x0Y0E
16 to 23	Channel configu-ration and channel moni-toring of the output channels 4 to 7	See *Table 97 “Channel configuration 3)” on page 494* and *Table 98 “Channel monitoring 4)” on page 494*		Byte Byte	Default 0x00 0x00	0 0	128 3	0x0Y0F to 0x0Y16
24	Channel con-figura tion Output channel 8	See *Table 97 “Channel configuration 3)” on page 494*		Byte	Default 0x00	0	130	0x0Y17
25	Channel moni-toring Output channel 8	See *Table 98 “Channel monitoring 4)” on page 494*		Byte	Default 0x00	0	3	0x0Y18
26	Substi-tute 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 to 32	Channel configu-ration and channel moni-toring of the output channels 9 to 11	See *Table 97 "Channel configuration 3)" on page 494* and *Table 98 "Channel monitoring 4)" on page 494*		Byte Byte	Default 0x00 0x00	0 0	130 3	0x0Y1A to 0x0Y1F
33 to 40	Channel configu-ration and channel moni-toring of the output channels 12 to 15	See *Table 97 "Channel configuration 3)" on page 494* and *Table 98 "Channel monitoring 4)" on page 494*		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 97 "Channel configuration 3)" on page 494*	see below ⇨ *Table 97 "Channel configuration 3)" on page 494*	Byte	see below ⇨ *Table 97 "Channel configuration 3)" on page 494*
2	Channel monitoring	see below ⇨ *Table 98 "Channel monitoring 4)" on page 494*	see below ⇨ *Table 98 "Channel monitoring 4)" on page 494** 8)	Byte	see below ⇨ *Table 98 "Channel monitoring 4)" on page 494*
3	Substitute value ⇨ *Table 99 "Substitute value" on page 495*	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 97: 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 98: 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 99: 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

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
	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

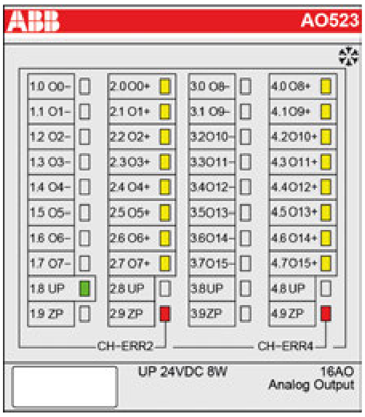
E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500 display	<– Display in	
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC browser		
Byte 6 Bit 6...7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0...5	FBP diagnosis block		
Class	Interface	Device	Module	Channel	Error Identifier	Error message		Remedy
	1)	2)	3)	4)				
	11 / 12	ADR	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 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					

Output ranges

Output ranges voltage and current

The represented resolution corresponds to 16 bits.

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
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 *Chapter 2.6.1 “System data AC500” on page 971* are applicable to the standard version.

The system data of AC500-XC *Chapter 2.7.1 “System data AC500-XC” on page 1023* are applicable to the XC version.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter		Value
Process voltage		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 V DC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module	Ca. 2 mA
	Current consumption from UP 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 switchgear cabinet.

NOTICE!

Attention:

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

Technical data of the 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 (+ 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 1.6.2.2.4.9 “Output ranges” on page 497*
Unused outputs	Can be left open-circuited

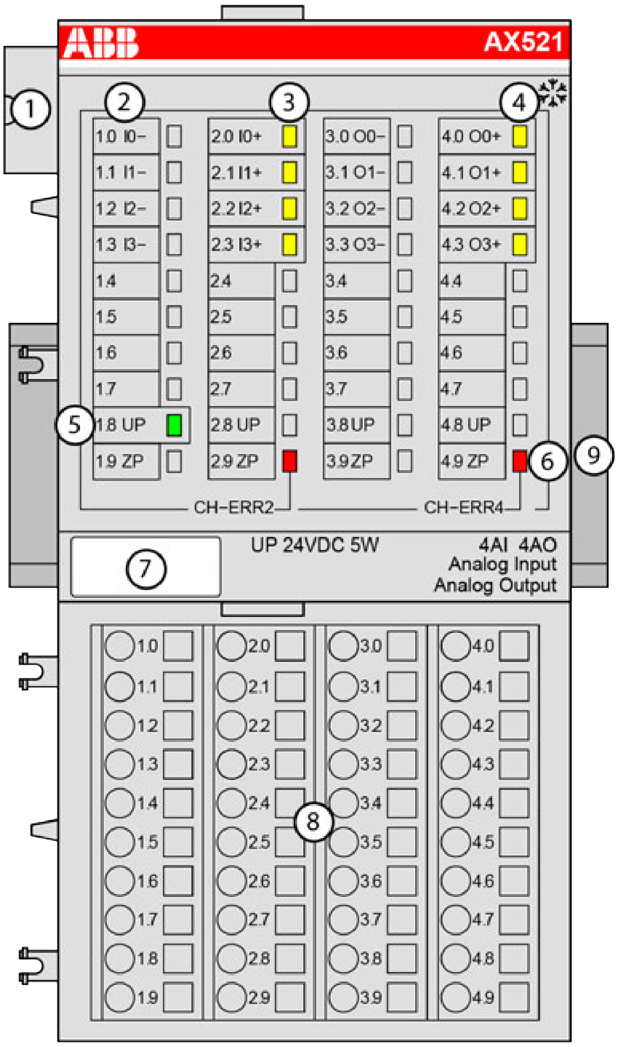
Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 250 200 R0001	AO523, analog output module, 16 AO, U/I, 12 bits + sign, 2-wires	Active
1SAP 450 200 R0001	AO523-XC, analog output module, 16 AO, U/I, 12 bits + sign, 2-wires, XC version	Active

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

1.6.2.2.5 AX521 - Analog input/output module

- 4 configurable analog inputs (I0 to I3) in 1 group (1.0...2.3)
  Resolution 12 bits plus sign
- 4 configurable analog outputs (O0 to O3) in 1 group (3.0...4.3)
  Resolution 12 bits plus 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 iInterface 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 (I0...I3), 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 (O0...O3), 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 plus 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 1.5.2 “TU515, TU516, TU541 and TU542 for I/O modules” on page 126*

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the System Assembly, Construction and Connection chapter Chapter 2.6 “AC500 (Standard)” on page 971.

The modules are plugged on an I/O terminal unit *Chapter 1.5.2 “TU515, TU516, TU541 and TU542 for I/O modules” on page 126*. 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 (TA526 *Chapter 1.8.2.6 “TA526 - Wall mounting accessory” on page 902*).

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

The assignment of the other terminals:

Terminals	Signal	Description
1.0 to 1.3	I0- to I3-	Negative poles of the 4 analog inputs
2.0 to 2.3	I0+ to I3+	Positive poles of the 4 analog inputs
3.0 to 3.3	O0- to O3-	Negative poles of the 4 analog outputs
4.0 to 4.3	O0+ to 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 (cut wire), 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 only permissible under conditions described in Hot Swap chapter ↬ *Chapter 1.6 “I/O modules” on page 142*.

The devices are not designed for removal or insertion under power when Hot Swap conditions do not apply. 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.

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.

Only for simple applications (low electromagnetic disturbances, no high requirement on precision), the shielding can also be omitted.

The following figure shows the connection of the I/O module.

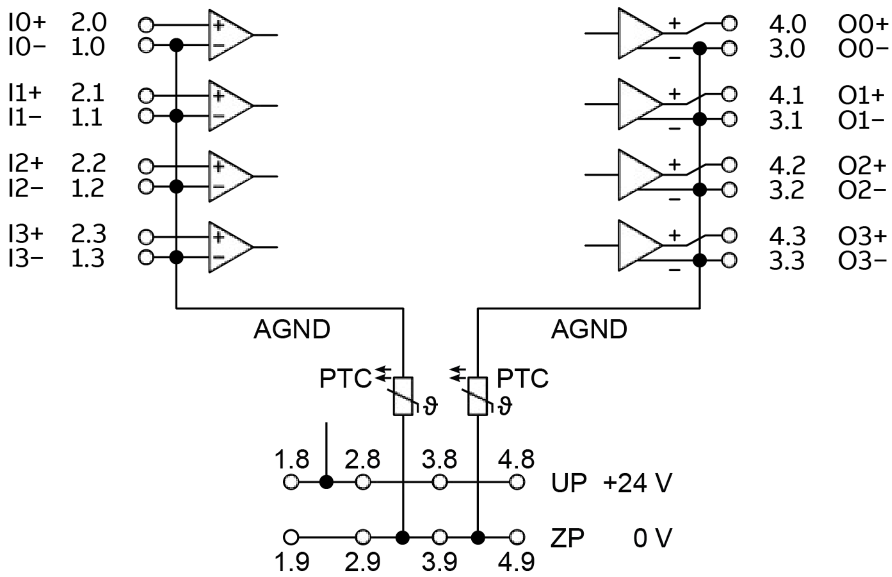


Fig. 52: 4 analog inputs and 4 analog outputs, individually configurable *↳ Chapter 1.6.2.2.5.2 "Functionality" on page 501*

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 pole).

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.

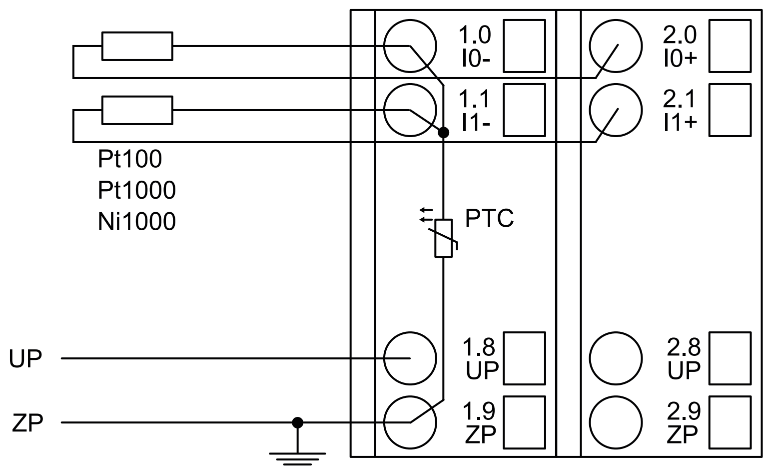


Fig. 53: Connection example

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.

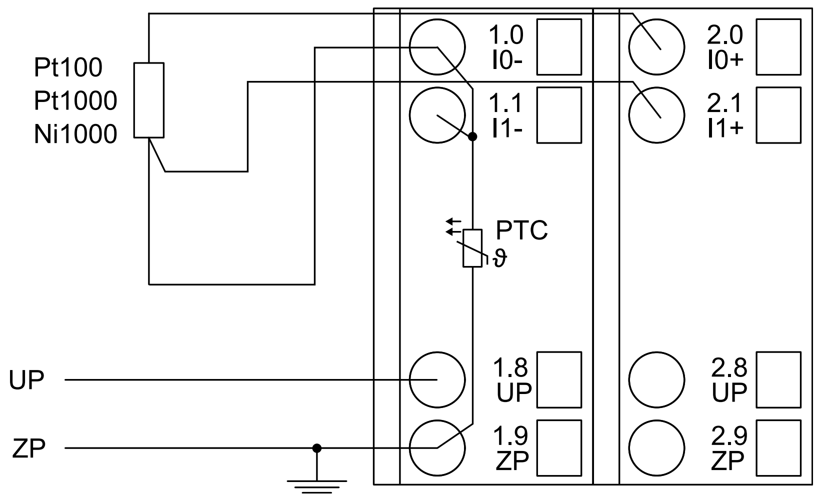


Fig. 54: Connection example

> *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

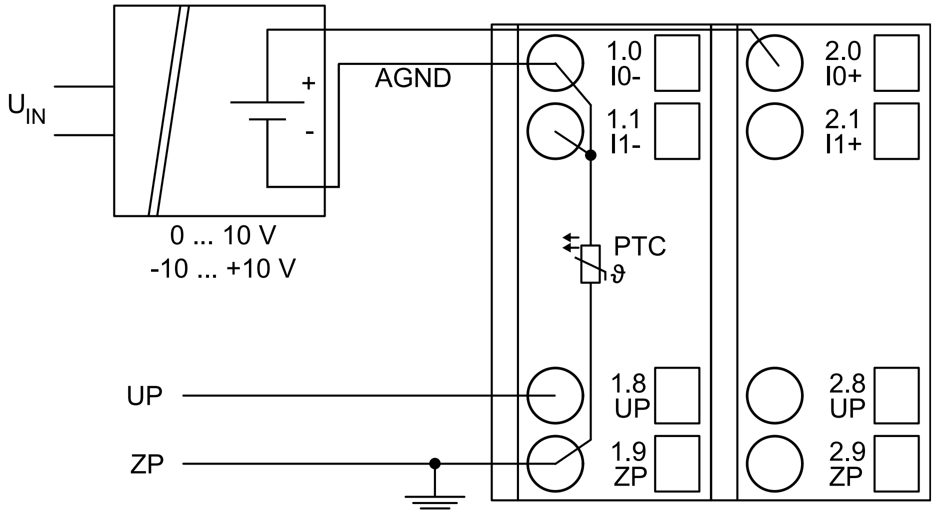


Fig. 55: Connection example

> *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 1.6.2.2.5.6 “Parameterization” on page 511* and for AX522 *Chapter 1.6.2.2.6.6 “Parameterization” on page 536*:

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

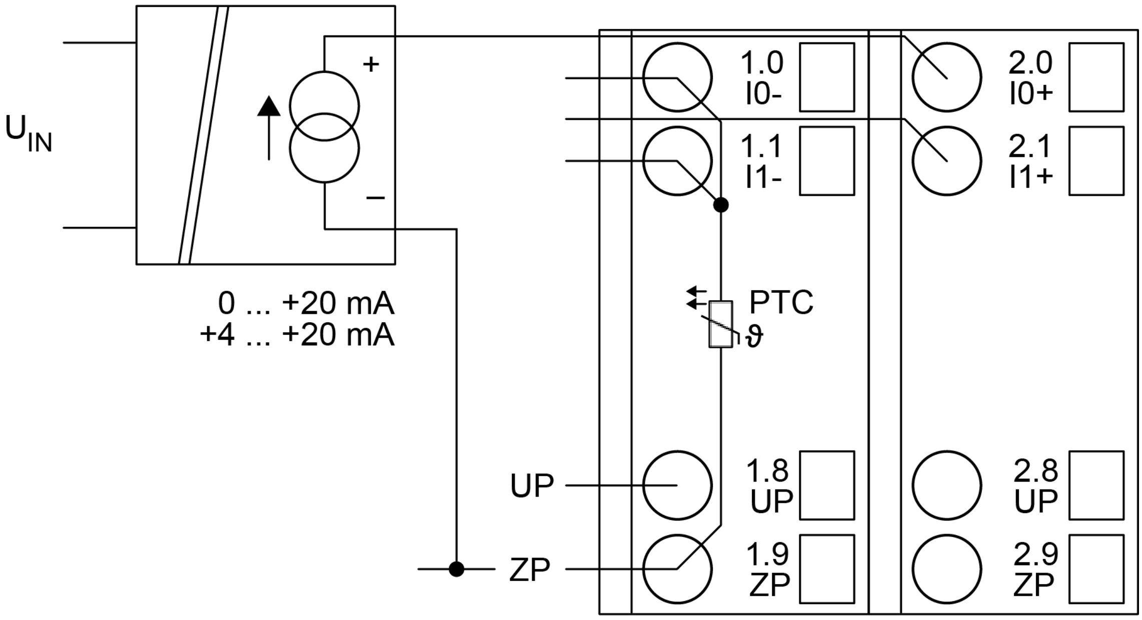


Fig. 56: Connection example

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

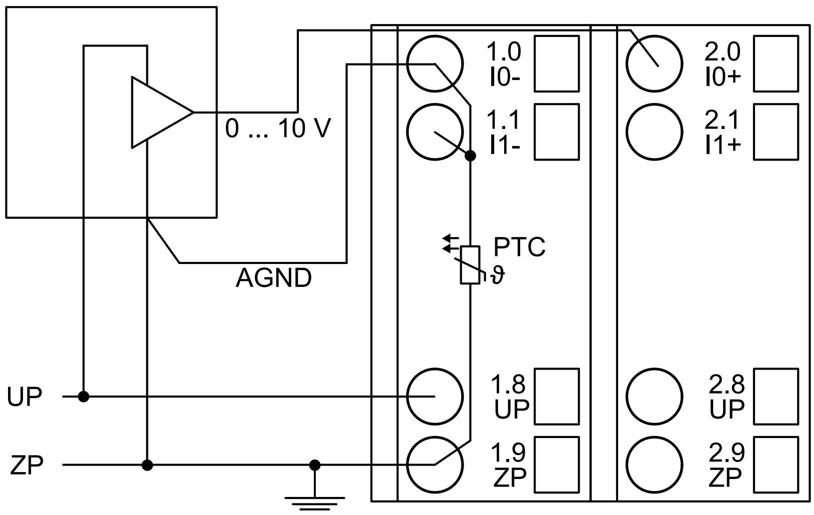


Fig. 57: Connection example

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)

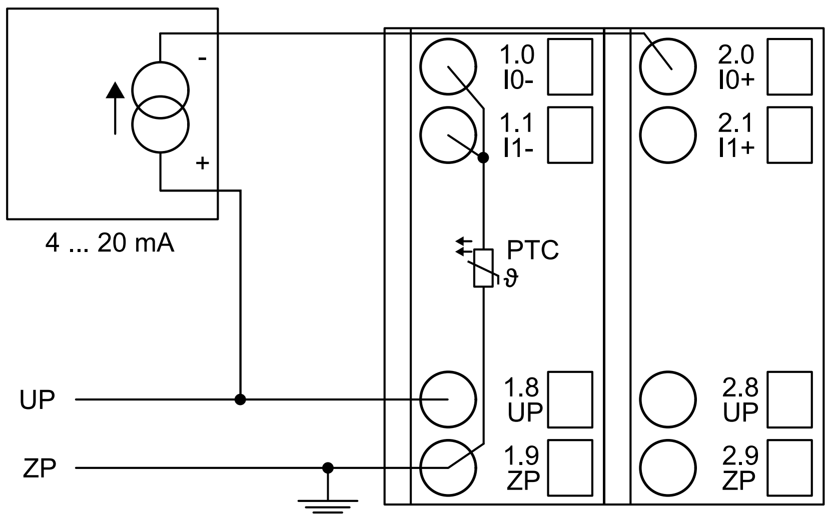


Fig. 58: Connection example

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 I-). 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.

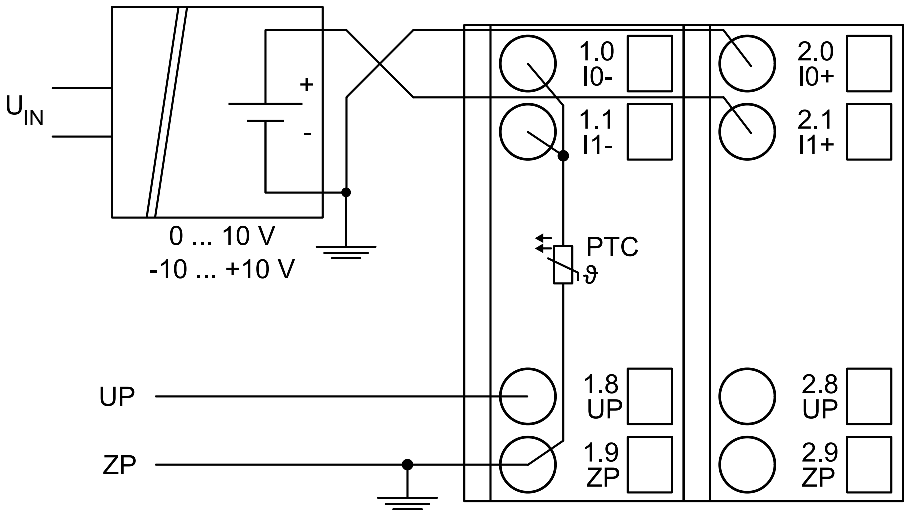


Fig. 59: Connection example

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.

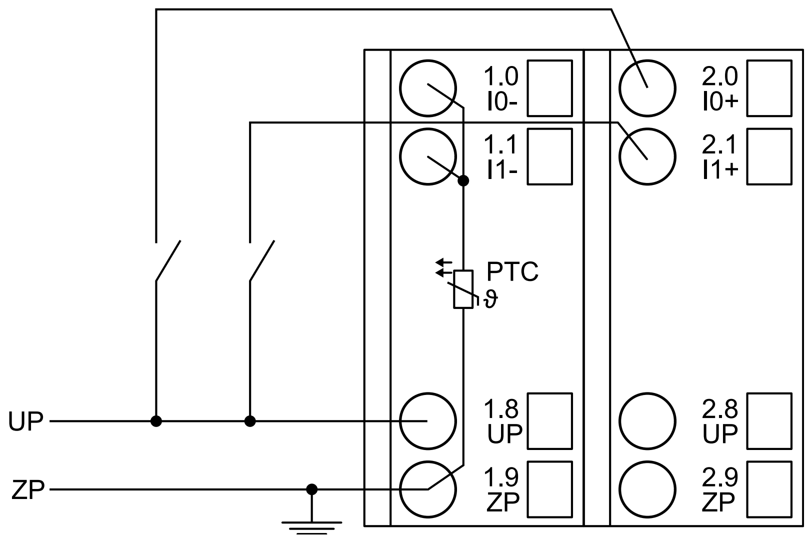


Fig. 60: Connection example

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)

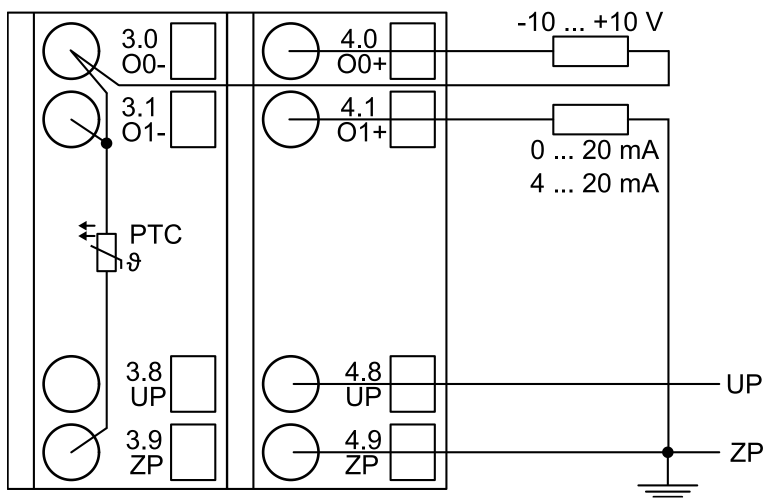


Fig. 61: Connection example

Voltage	-10 V...+10 V	Load max. ±10 mA	1 channel used
Current	0 mA...20 mA	Load 0 Ω...500 Ω	1 channel used
Current	4 mA...20 mA	Load 0 Ω...500 Ω	1 channel used

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

Unused analog outputs can be left open-circuited.

Internal data exchange

Digital inputs (bytes)	0
Digital outputs (bytes)	0
Counter input data (words)	4
Counter output data (words)	4

I/O configuration

The module does not store configuration data itself. It gets its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1...10

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
1	Module ID	Internal	1505 [1])	Word	1505 0x05E1	0	65535	0x0Y01
2	Ignore module [2])	No Yes	0 1	Byte	No 0x00			Not for FBP
3	Parameter length in bytes	Internal	21	Byte	21-CPU 21-FBP	0	255	0x0Y02
4	Check supply	Off On	0 1	Byte	On 0x01	0	1	0x0Y03
5	Analog data format	Default	0	Byte	Default 0x00			0x0Y04
6	Behaviour of outputs at communication errors	Off Last value Substitute value	0 1+(n*5) 2+(n*5), $n \leq 2$	Byte	Off 0x00	0	2	0x0Y05

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
7	Channel configu-ration Input channel 0	See table ⇨ *Table 101 “Channel configuration 2)” on page 513*		Byte	Default 0x00	0	19	0x0Y06
8	Channel moni-toring Input channel 0	See table ⇨ *Table 102 “Channel monitoring 3)” on page 514*		Byte	Default 0x00	0	3	0x0Y07
9 to 14	Channel configu-ration and channel moni-toring of the input channels 1 to 3	See tables ⇨ *Table 101 “Channel configuration 2)” on page 513* and ⇨ *Table 102 “Channel monitoring 3)” on page 514*		Byte Byte	Default 0x00 0x00	0 0	19 3	0x0Y08 to 0x0Y0D
15	Channel configu-ration Output channel 0	See table ⇨ *Table 101 “Channel configuration 2)” on page 513*		Byte	Default 0x00	0	130	0x0Y0E
16	Channel moni-toring Output channel 0	See table ⇨ *Table 102 “Channel monitoring 3)” on page 514*		Byte	Default 0x00	0	3	0x0Y0F
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 ⇨ *Table 101 “Channel configuration 2)” on page 513* and ⇨ *Table 102 “Channel monitoring 3)” on page 514*		Byte Byte	Default 0x00 0x00	0 0	130 3	0x0Y11 to 0x0Y14

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
22	Channel configu-ration Output channel 3	See table ⇨ *Table 101 “Channel configuration 2)” on page 513*		Byte	Default 0x00	0	130	0x0Y15
23	Channel moni-toring Output channel 3	See table ⇨ *Table 102 “Channel monitoring 3)” on page 514*		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 100: 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 101: 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)

Internal value	Operating modes of the analog inputs, individually configurable
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 102: Channel monitoring [3])

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

Table 103: 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 104: 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 105: Channel configuration [4])

Internal value	Operating modes of the analog outputs, individually configurable
0	Unused (default)
128	Analog output -10 V...+10 V

Internal value	Operating modes of the analog outputs, individually configurable
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 106: Channel monitoring [5])

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

Table 107: Substitute value [6])

Intended behaviour of output channel when the control system stops	Required setting of the module parameter "Behaviour of outputs in case of a communication error"	Required setting of the channel parameter "Substitute value"
Output OFF	Off	0
Last value infinite	Last value	0
Last value for 5 s and then turn off	Last value 5 sec	0
Last value for 10 s and then turn off	Last value 10 sec	0
Substitute value infinite	Substitute value	Depending on configuration
Substitute value for 5 s and then turn off	Substitute value 5 sec	Depending on configuration
Substitute value for 10 s and then turn off	Substitute value 10 sec	Depending on configuration

Diagnosis

Table 108: Possible diagnosis of I/O channels

Output range	Condition	
	Output value in the PLC underflow	Output value in the PLC overflow
0..20 mA	Error identifier = 7	Error identifier = 4
4..20 mA		
-10..+10 V		

Input range	Condition			
	Short circuit	Wire break	Input value underflow	Input value overflow
0..20 mA	no diagnosis possible	no diagnosis possible	no diagnosis possible	Error identifier = 48
4..20 mA	Error identifier = 7	Error identifier = 7	Error identifier = 7	Error identifier = 48
-10..+10 V	no diagnosis possible	Error identifier = 48	Error identifier = 7	Error identifier = 48

Table 109: Content of diagnosis messages

E1...E4	d1	d2	d3	d4		Identifier 000...063	AC500 display	<− Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**		**Err**	**PS501 PLC browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**		**Byte 6 Bit 0...5**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**		**Error Identifier**	**Error message**	**Remedy**
	1)	2)	3)	4)				
Module error								
3	14	1...10	31	31		19	Checksum error in the I/O module	Replace I/O module
	11 / 12	ADR	1...10					
3	14	1...10	31	31		3	Timeout in the I/O module	Replace I/O module
	11 / 12	ADR	1...10					
3	14	1...10	31	31		40	Different hard-/firmware versions in the module	Replace I/O module
	11 / 12	ADR	1...10					
3	14	1...10	31	31		43	Internal error in the module	Replace I/O module
	11 / 12	ADR	1...10					
3	14	1...10	31	31		36	Internal data exchange failure	Replace I/O module
	11 / 12	ADR	1...10					
3	14	1...10	31	31		9	Overflow diagnosis buffer	New start
	11 / 12	ADR	1...10					
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					

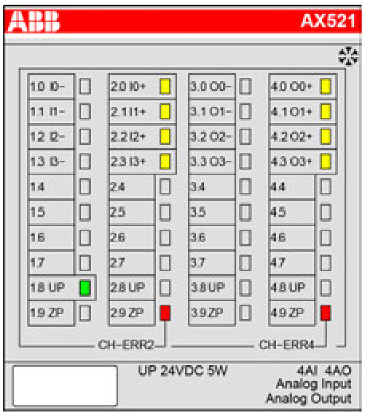
E1...E4	**d1**	**d2**	**d3**	**d4**		**Identifier 000...063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**		**Err**	**PS501 PLC browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**		**Byte 6 Bit 0...5**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**		**Error Identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**				
4	14	1...10	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 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...10 V	-10...+10 V	0...20 mA	4...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	4	OFF	0	0000
	0.0000	-0.0004 : :		3.9994		-1 -4864 -6912	FFFF ED00 E500

Range	0...10 V	-10...+10 V	0...20 mA	4...20 mA	Digital input	Digital value	
						Decimal	Hex.
	-0.0004 -1.7593	: -10.0000				: -27648	: 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...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		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...+10 V	0...20 mA	4...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 *Chapter 2.6.1 “System data AC500” on page 971* are applicable to the standard version.

The system data of AC500-XC *Chapter 2.7.1 “System data AC500-XC” on page 1023* are applicable to the XC version.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter		Value
Process voltage		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 V DC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module	Ca. 2 mA
	From UP at normal operation	0.15 A + output loads
Inrush current from UP (at power up)		0.020 A^2s

Parameter	Value
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 switchgear cabinet.

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

Technical data of the analog inputs

Parameter	Value	
Number of channels per module	4	
Distribution of channels into groups	1 group of 4 channels	
Connections of the channels I0- to I3-	Terminals 1.0 to 1.3	
Connections of the channels I0+ to I3+	Terminals 2.0 to 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 + sign Range 0 mA...20 mA: 12 bits Range 4 mA...20 mA: 12 bits	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ.	±0.5 % of full scale at 25 °C
	Max.	±1 % of full scale (all ranges) at 0 °C...60 °C or EMC disturbance
Relationship between input signal and hex code	See tables ⇨ *Chapter 1.6.2.2.5.9.1 “Input ranges of voltage, current and digital input” on page 518*	

Parameter	Value
Unused voltage inputs	Are configured as "unused"
Unused current inputs	Have a low resistance, can be left open-circuited
Overvoltage protection	Yes

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

Parameter		Value
Number of channels per module		Max. 4
Distribution of channels into groups		1 group of 4 channels
Connections of the channels I0+ to I3+		Terminals 2.0 to 2.3
Reference potential for the inputs		Terminals 1.9, 2.9, 3.9 and 4.9 (ZP)
Input signal delay		Typ. 8 ms, configurable from 0.1 to 32 ms
Indication of the input signals		1 LED per channel
Input signal voltage		24 V DC
	Signal 0	-30 V...+5 V
	Undefined signal	+5 V...+13 V
	Signal 1	+13 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 7 mA
	Input voltage +5 V	Typ. 1.4 mA
	Input voltage +15 V	Typ. 4.3 mA
	Input voltage +30 V	< 9 mA
Input resistance		ca. 3.5 kΩ

Technical data of the analog outputs

Parameter		Value
Number of channels per module		4, all channels for voltage and current
Distribution of channels into groups		1 group of 4 channels
	Channels O0-...O3-	Terminals 3.0...3.3
	Channels O0+...O3+	Terminals 4.0...4.3
Output type		Bipolar with voltage, unipolar with current
Galvanic isolation		Against internal supply and other modules
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 (+ sign)

Parameter	Value	
Settling time for full range change (resistive load, output signal within specified tolerance)	Typ. 5 ms	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ.	±0.5 % of full scale at 25 °C
	Max.	±1 % of full scale (all ranges) at 0 °C...60 °C or EMC disturbance
Relationship between output signal and hex code	See table ↳ *Chapter 1.6.2.2.5.9.3 “Output ranges voltage and current” on page 519*	
Unused outputs	Can be left open-circuited	

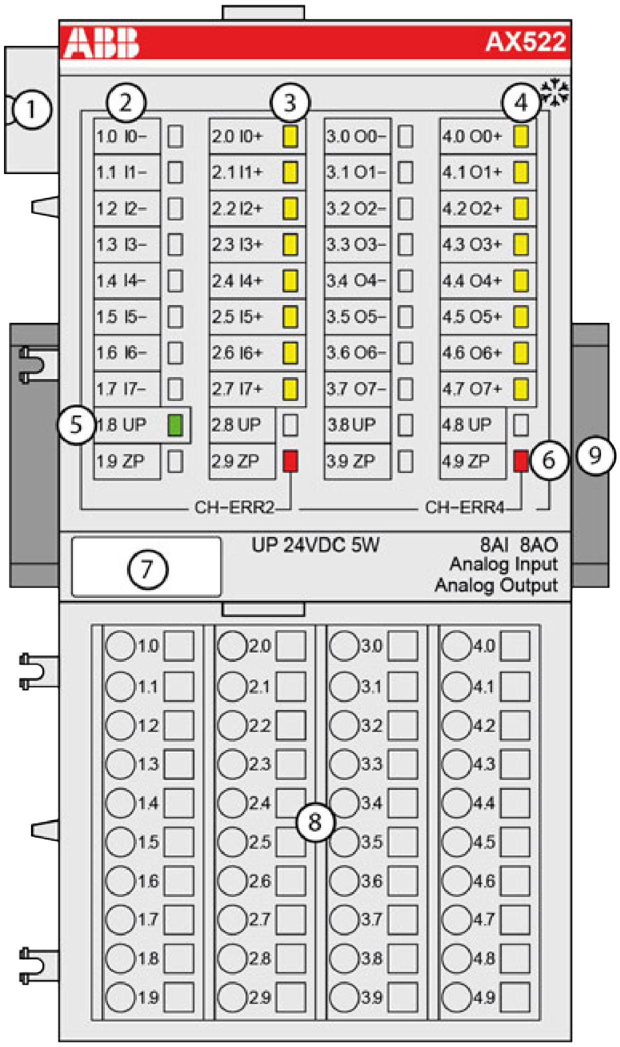
Ordering Data

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 + sign, 2-wires	Active
1SAP 450 100 R0001	AX521-XC, analog input/output module, 4 AI, 4 AO, U/I/Pt100, 12 bits + sign, 2-wires, XC version	Active

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

1.6.2.2.6 AX522 - Analog input/output module

- 8 configurable analog inputs (I0 to I7) in 1 group (1.0...2.7)
  Resolution 12 bits plus sign
- 8 configurable analog outputs (O0 to O7) in 1 group (3.0...4.7)
  Resolution 12 bits plus 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 iInterface modules (e. g. CI592-CS31, CI501-PNIO, CI541-DP, CI581-CN) or as a centralized extension module for AC500 CPUs.

Functionality

8 analog inputs (I0...I7), 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 (O0...O3), individually configurable for

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

4 analog outputs (O4...O7), individually configurable for

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

Parameter		**Value**
Resolution of the analog channels		
	Voltage -10 V...+10 V	12 bits plus 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 1.5.2 “TU515, TU516, TU541 and TU542 for I/O modules” on page 126*

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the System Assembly, Construction and Connection chapter ➪ Chapter 2.6 “AC500 (Standard)” on page 971.

The modules are plugged on an I/O terminal unit ➪ *Chapter 1.5.2 “TU515, TU516, TU541 and TU542 for I/O modules” on page 126*. 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 (TA526 ➪ *Chapter 1.8.2.6 “TA526 - Wall mounting accessory” on page 902*).

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 to 1.7	I0- to I7-	Negative poles of the 8 analog inputs
2.0 to 2.7	I0+ to I7+	Positive poles of the 8 analog inputs
3.0 to 3.7	O0- to O7-	Negative poles of the 8 analog outputs
4.0 to 4.7	O0+ to 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 (cut wire), 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 only permissible under conditions described in Hot Swap chapter *Chapter 1.6 “I/O modules” on page 142*.

The devices are not designed for removal or insertion under power when Hot Swap conditions do not apply. 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.

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.

Only for simple applications (low electromagnetic disturbances, no high requirement on precision), the shielding can also be omitted.

The following figure shows the connection of the I/O module.

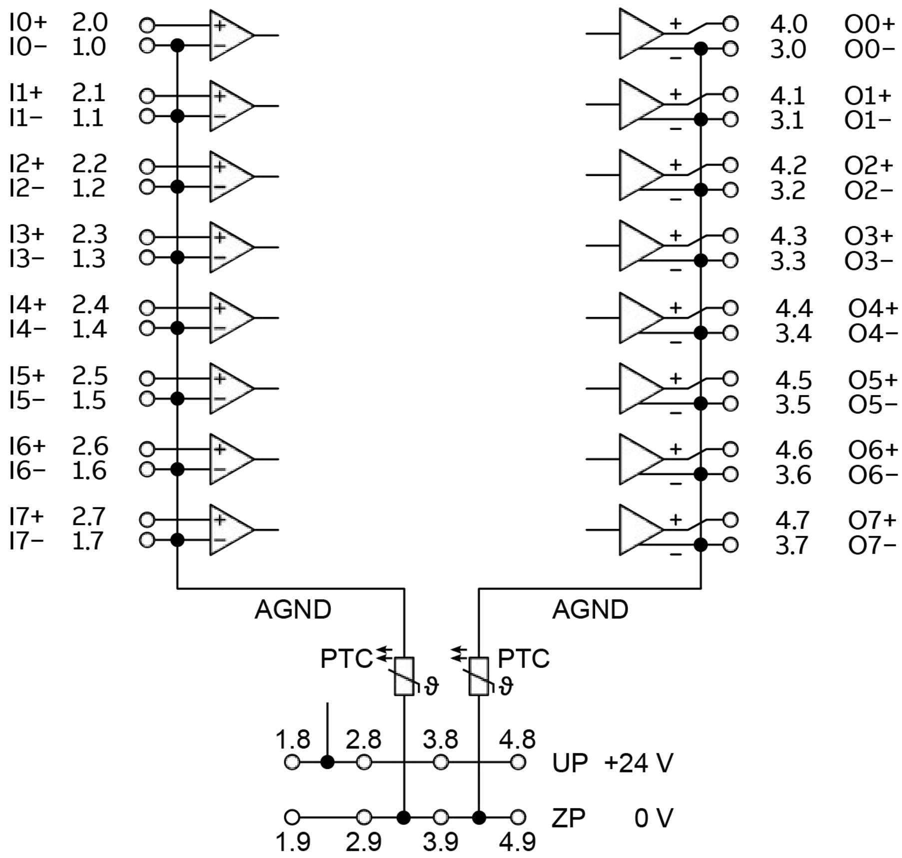


Fig. 62: 8 analog inputs and 8 analog outputs, individually configurable *Chapter 1.6.2.2.6.2 “Functionality” on page 524*

> **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 pole).

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.

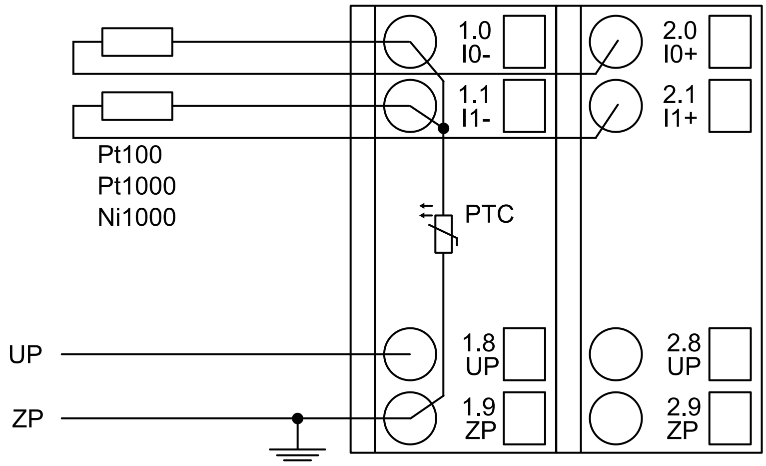


Fig. 63: Connection example

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.

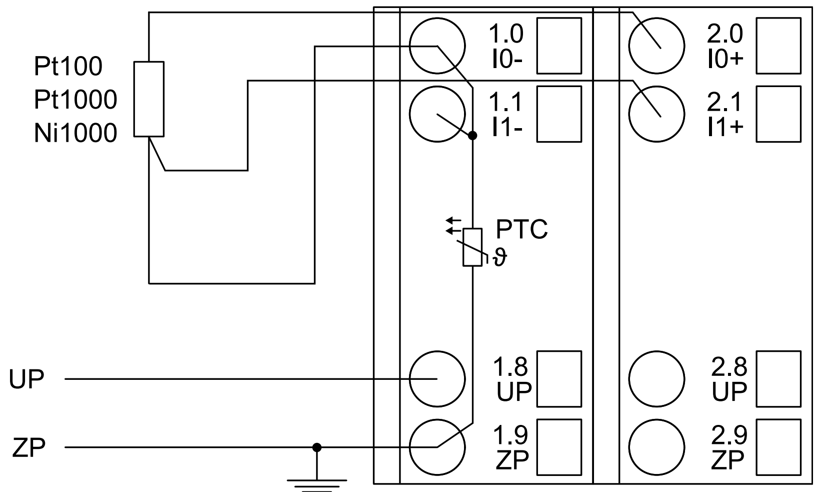


Fig. 64: Connection example

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

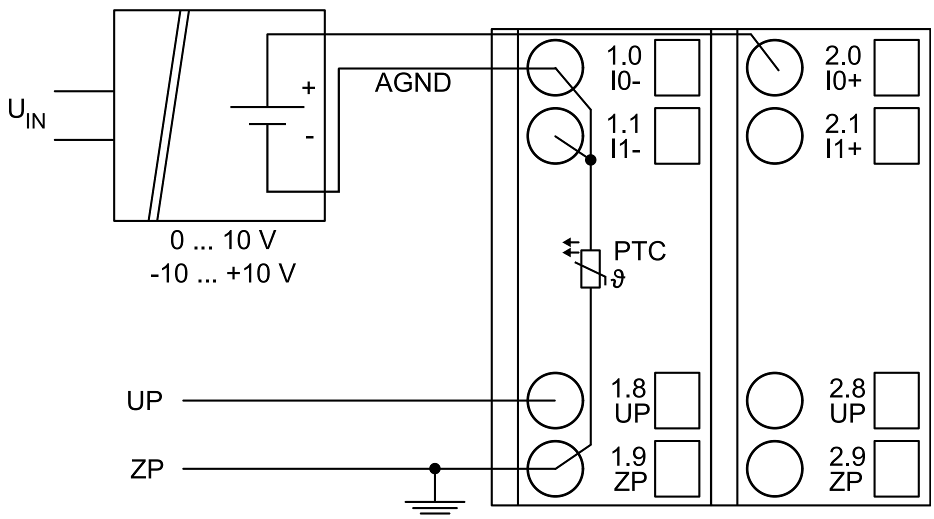


Fig. 65: Connection example

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 1.6.2.2.5.6 "Parameterization" on page 511* and for AX522 ↻ *Chapter 1.6.2.2.6.6 "Parameterization" on page 536*:

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

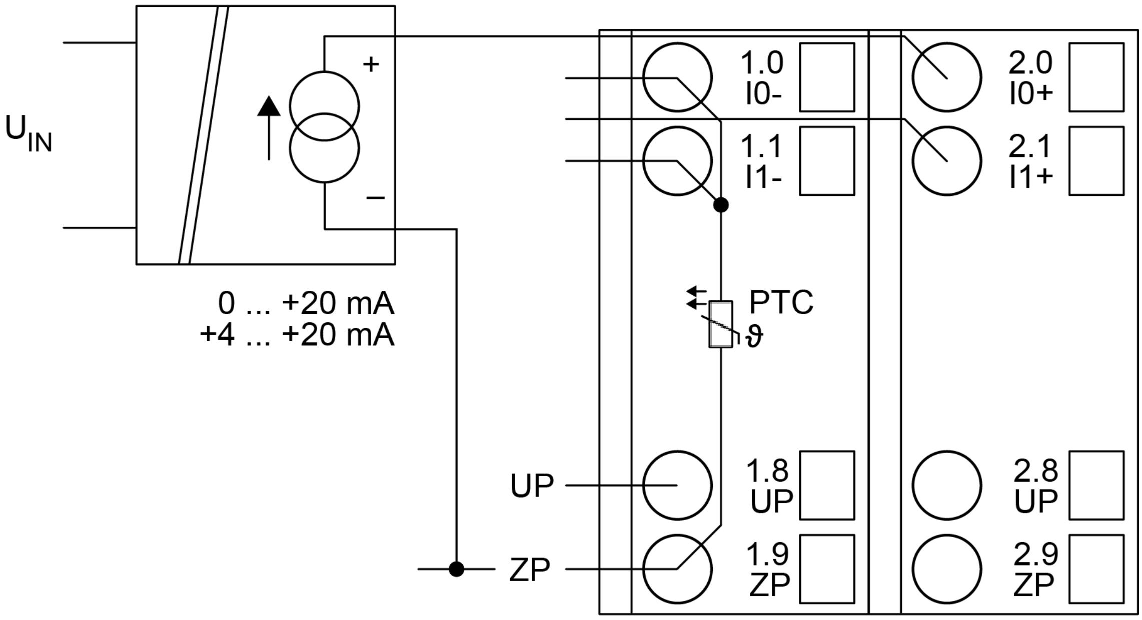


Fig. 66: Connection example

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

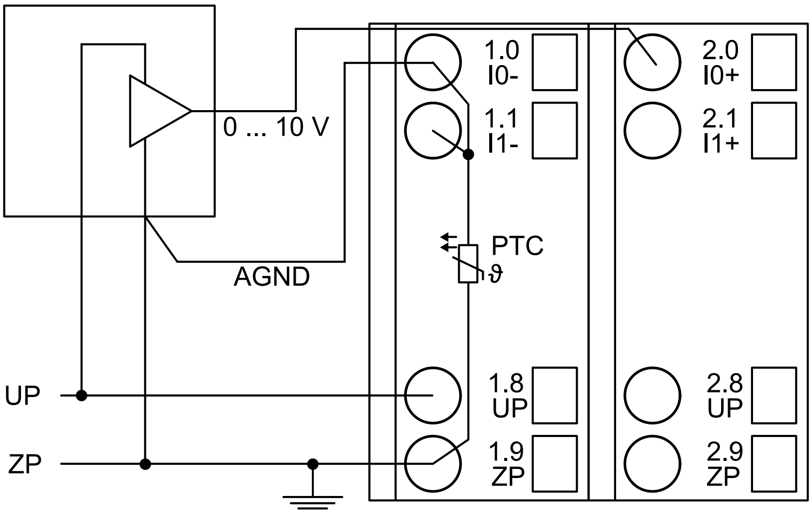


Fig. 67: Connection example

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)

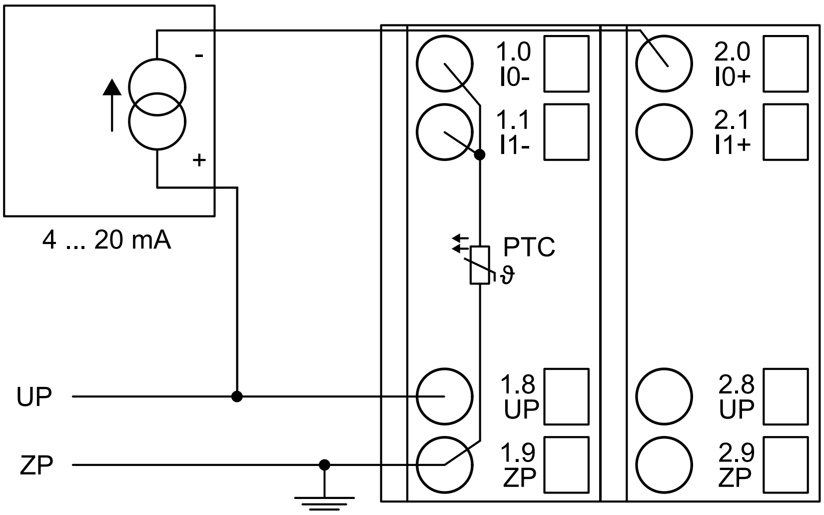


Fig. 68: Connection example

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 I-). 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.

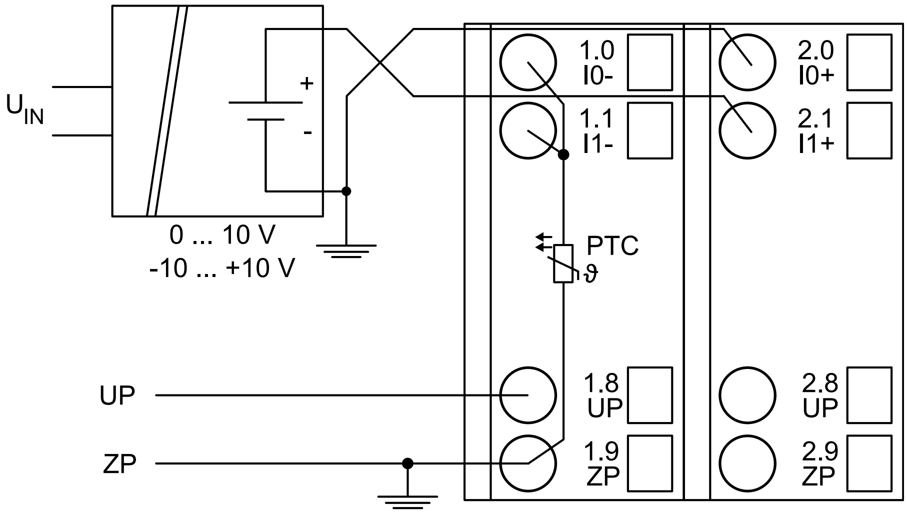


Fig. 69: Connection example

> *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.

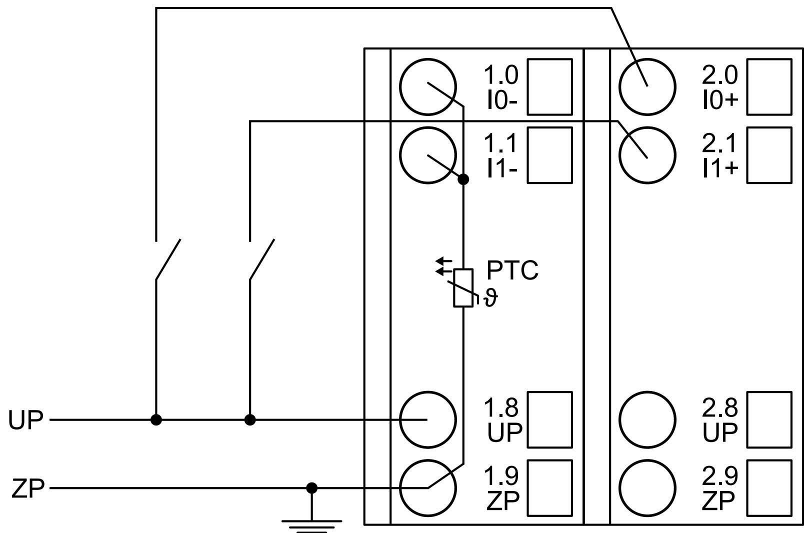


Fig. 70: Connection example

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)

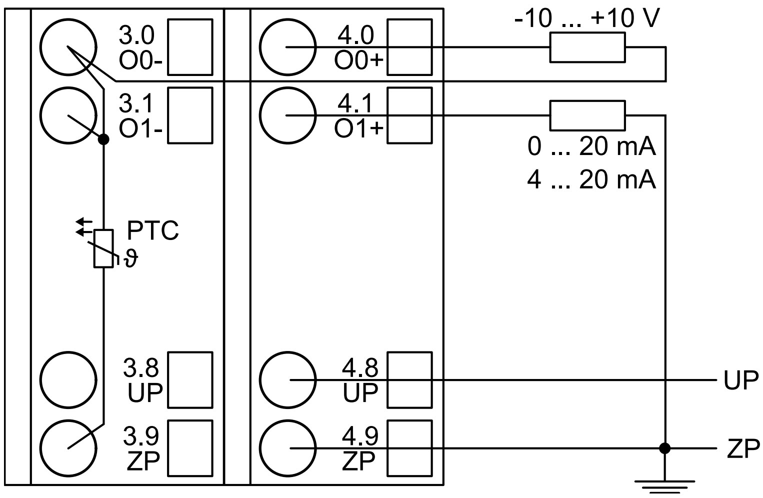


Fig. 71: Connection example

Voltage	-10 V...+10 V	Load max. ±10 mA	1 channel used
Current	0 mA...20 mA	Load 0 Ω...500 Ω	1 channel used
Current	4 mA...20 mA	Load 0 Ω...500 Ω	1 channel used

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

Unused analog outputs can be left open-circuited.

Internal data exchange

Digital inputs (bytes)	0
Digital outputs (bytes)	0
Counter input data (words)	8
Counter output data (words)	8

I/O configuration

The module does not store configuration data itself. It gets its parameterization data from the master device of the I/O bus (CPU or communication interface module) during power-up of the system.

Hence, replacing I/O modules is possible without any re-parameterization via software.

Parameterization

Firmware version	Configuration
Firmware version > V2.0.0	The arrangement of the parameter data is performed by Control Builder Plus/ Automation Builder software.

The parameter data directly influences the functionality of modules.

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module: Module slot address: Y = 1...10

For non-standard applications, it is necessary to adapt the parameters to your system configuration.

Module slot address: Y = 1...7

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
1	Module ID	Internal	1500 [1])	Word	1500 0x05dc	0	65535	0x0Y01
2	Ignore module [2])	No Yes	0 1	Byte	No 0x00			not for FBP
3	Parameter length in bytes	Internal	37	Byte	37-CPU 37-FBP	0	255	0x0Y02
4	Check supply	Off On	0 1	Byte	On 0x01	0	1	0x0Y03
5	Analog data format	Default	0	Byte	Default 0x00			0x0Y04
6	Behaviour of outputs at communication errors	Off Last value Substitute value	0 1+(n*5) 2+(n*5), n ≤ 2	Byte	Off 0x00	0	2	0x0Y05
7	Channel configuration Input channel 0	See ➡ *Table 111 “Channel configuration [2])” on page 538*		Byte	Default 0x00	0	19	0x0Y06
8	Channel monitoring Input channel 0	See ➡ *Table 112 “Channel monitoring [3])” on page 539*		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 ⇘ *Table 111 "Channel configuration 2)" on page 538* and ⇘ *Table 112 "Channel monitoring 3)" on page 539*		Byte Byte	Default 0x00 0x00	0 0	19 3	0x0Y08 to 0x0Y15
23	Channel configuration Output channel 0	See ⇘ *Table 111 "Channel configuration 2)" on page 538*		Byte	Default 0x00	0	130	0x0Y16
24	Channel monitoring Output channel 0	See ⇘ *Table 112 "Channel monitoring 3)" on page 539*		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 ⇘ *Table 111 "Channel configuration 2)" on page 538* and ⇘ *Table 112 "Channel monitoring 3)" on page 539*		Byte Byte	Default 0x00 0x00	0 0	130 3	0x0Y19 to 0x0Y1E
32	Channel configuration Output channel 4	See ⇘ *Table 111 "Channel configuration 2)" on page 538*		Byte	Default 0x00	0	128	0x0Y1F

No.	Name	Value	Internal value	Internal value, type	Default	Min.	Max.	EDS Slot/ Index
33	Channel monitoring Output channel 4	See ⇨ *Table 112 “Channel monitoring [3])” on page 539*		Byte	Default 0x00	0	3	0x0Y20
34 to 39	Channel configuration and channel monitoring of the output channels 5 to 7	See ⇨ *Table 111 “Channel configuration [2])” on page 538* and ⇨ *Table 112 “Channel monitoring [3])” on page 539*		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) =	24 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 110: 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 111: 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

Internal value	Operating modes of the analog inputs, individually configurable
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 112: Channel monitoring [3])

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

Table 113: 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 114: 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 115: 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 116: Channel monitoring [5])

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

Table 117: Substitute value [6])

Intended behaviour of output channel when the control system stops	Required setting of the module parameter "Behaviour of outputs in case of a communication error"	Required setting of the channel parameter "Substitute value"
Output OFF	Off	0
Last value infinite	Last value	0
Last value for 5 s and then turn off	Last value 5 sec	0
Last value for 10 s and then turn off	Last value 10 sec	0
Substitute value infinite	Substitute value	Depending on configuration
Substitute value for 5 s and then turn off	Substitute value 5 sec	Depending on configuration
Substitute value for 10 s and then turn off	Substitute value 10 sec	Depending on configuration

Diagnosis

Table 118: 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..20 mA</td><td rowspan="3">Error identifier = 7</td><td rowspan="3">Error identifier = 4</td></tr>
<tr><td>4..20 mA</td></tr>
<tr><td>-10..+10 V</td></tr>
</table>

Input range	Condition			
	Short circuit	**Wire break**	**Input value under-flow**	**Input value over-flow**
0..20 mA	no diagnosis possible	no diagnosis possible	no diagnosis possible	Error identifier = 48
4..20 mA	Error identifier = 7	Error identifier = 7	Error identifier = 7	Error identifier = 48
-10..+10 V	no diagnosis possible	Error identifier = 48	Error identifier = 7	Error identifier = 48

Table 119: 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 11 / 12	1...10 ADR	31 1...10	31	19	Checksum error in the I/O module	Replace I/O module
3	14 11 / 12	1...10 ADR	31 1...10	31	3	Timeout in the I/O module	Replace I/O module
3	14 11 / 12	1...10 ADR	31 1...10	31	40	Different hard-/firm-ware versions in the module	Replace I/O module
3	14 11 / 12	1...10 ADR	31 1...10	31	43	Internal error in the module	Replace I/O module
3	14 11 / 12	1...10 ADR	31 1...10	31	36	Internal data exchange failure	Replace I/O module
3	14 11 / 12	1...10 ADR	31 1...10	31	9	Overflow diagnosis buffer	New start
3	14 11 / 12	1...10 ADR	31 1...10	31	26	Parameter error	Check master
3	14 11 / 12	1...10 ADR	31 1...10	31	11	Process voltage too low	Check process voltage
4	14 11 / 12	1...10 ADR	31 1...10	31	45	Process voltage is switched off (ON −> OFF)	Process voltage ON
Channel error							
				AX521 AX522			

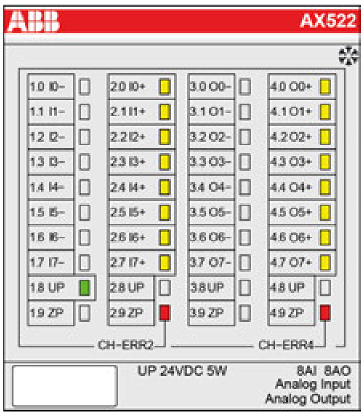
E1...E4	d1	d2	d3	d4		Identifier 000...063	AC500 display	<− Display in
Class	Comp	Dev	Mod	Ch		Err	PS501 PLC browser	
Byte 6 Bit 6...7	-	Byte 3	Byte 4	Byte 5		Byte 6 Bit 0...5	FBP diagnosis block	
Class	Interface	Device	Module	Channel		Error Identifier	Error message	Remedy
	1)	2)	3)	4)				
4	14	1...10	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 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)	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...10 V	-10...+10 V	0...20 mA	4...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 . .	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	ON	27648 : 1	6C00 : 0001
Normal range or measured value too low	0.0004	0.0000	0	4	OFF	0	0000
	0.0000	-0.0004 : :		3.9994		-1 -4864 -6912	FFFF ED00 E500

Range	0...10 V	-10...+10 V	0...20 mA	4...20 mA	Digital input	Digital value	
						Decimal	Hex.
	-0.0004 -1.7593	: -10.0000				: -27648	: 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...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		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...+10 V	0...20 mA	4...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 *Chapter 2.6.1 “System data AC500” on page 971* are applicable to the standard version.

The system data of AC500-XC *Chapter 2.7.1 “System data AC500-XC” on page 1023* are applicable to the XC version.

Only additional details are therefore documented below.

The technical data are also applicable to the XC version.

Parameter		Value
Process voltage		
	Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
	Rated value	24 V DC
	Max. ripple	5 %
	Protection against reversed voltage	Yes
	Rated protection fuse on UP	10 A fast
	Galvanic isolation	Yes, per module
Current consumption		
	From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module	Ca. 2 mA
	From UP at normal operation	0.15 A + output loads
Inrush current from UP (at power up)		0.020 A^2s

Parameter	Value
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 switchgear cabinet.

NOTICE!

Attention:

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

Technical data of the 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- to I7-	Terminals 1.0 to 1.7	
Connections of the channels I0+ to I7+	Terminals 2.0 to 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 + 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
Unused voltage inputs	Are configured as "unused"	

Parameter	Value
Unused current inputs	Have a low resistance, can be left open-circuited
Overvoltage protection	Yes

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

Parameter		Value
Number of channels per module		Max. 8
Distribution of channels into groups		1 group of 8 channels
Connections of the channels I0+ to I7+		Terminals 2.0 to 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 to 32 ms
Indication of the input signals		1 LED per channel
Input signal voltage		24 V DC
	Signal 0	-30 V...+5 V
	Undefined signal	+5 V...+13 V
	Signal 1	+13 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 7 mA
	Input voltage +5 V	Typ. 1.4 mA
	Input voltage +15 V	Typ. 4.3 mA
	Input voltage +30 V	< 9 mA
Input resistance		Ca. 3.5 kΩ

Technical data of the analog outputs

Parameter		Value
Number of channels per module		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
Output loadability, as voltage output		Max. ±10 mA
Indication of the output signals		One LED per channel
Resolution		12 bits (+ sign)

Parameter	Value	
Settling time for full range change (resistive load, output signal within specified tolerance)	Typ. 5 ms	
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ.	±0.5 % of full scale at 25 °C
	Max.	±1 % of full scale (all ranges) at 0 °C...60 °C or EMC disturbance
Relationship between output signal and hex code	See table, *Chapter 1.6.2.2.6.9.3 “Output ranges voltage and current” on page 544*	
Unused outputs	Can be left open-circuited	

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 + sign, 2-wires	Active
1SAP 450 000 R0001	AX522-XC, analog input/output module, 8 AI, 8 AO, U/I/Pt100, 12 bits + sign, 2-wires, XC version	Active

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

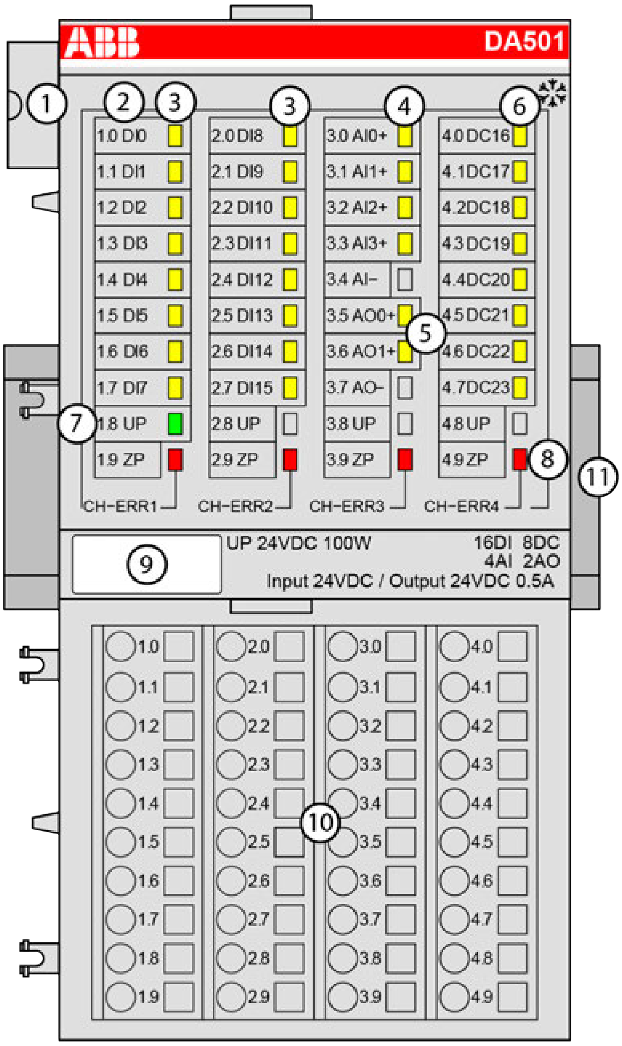
1.6.3 Digital/Analog I/O modules

1.6.3.1 S500

1.6.3.1.1 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 plus sign
- 2 analog outputs, voltage and current
  Resolution 12 bits plus 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 to DI15
4 4 yellow LEDs to display the signal states of the analog inputs AI0 to AI3
5 2 yellow LEDs to display the signal states of the analog outputs AO0 to AO1
6 8 yellow LEDs to display the signal state of the configurable digital inputs/outputs DC16 to 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 iInterface 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 plus sign
- 2 analog outputs, voltage and current
  Resolution 12 bits plus 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 1.5.2 “TU515, TU516, TU541 and TU542 for I/O modules” on page 126*

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the System Assembly, Construction and Connection chapter ⇘ Chapter 2.6 “AC500 (Standard)” on page 971.

The connection is carried out by using the 40 terminals of the terminal unit TU515/TU516 ⇘ *Chapter 1.5.2 “TU515, TU516, TU541 and TU542 for I/O modules” on page 126*.

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 only permissible under conditions described in Hot Swap chapter *Chapter 1.6 “I/O modules” on page 142*.

The devices are not designed for removal or insertion under power when Hot Swap conditions do not apply. 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 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.

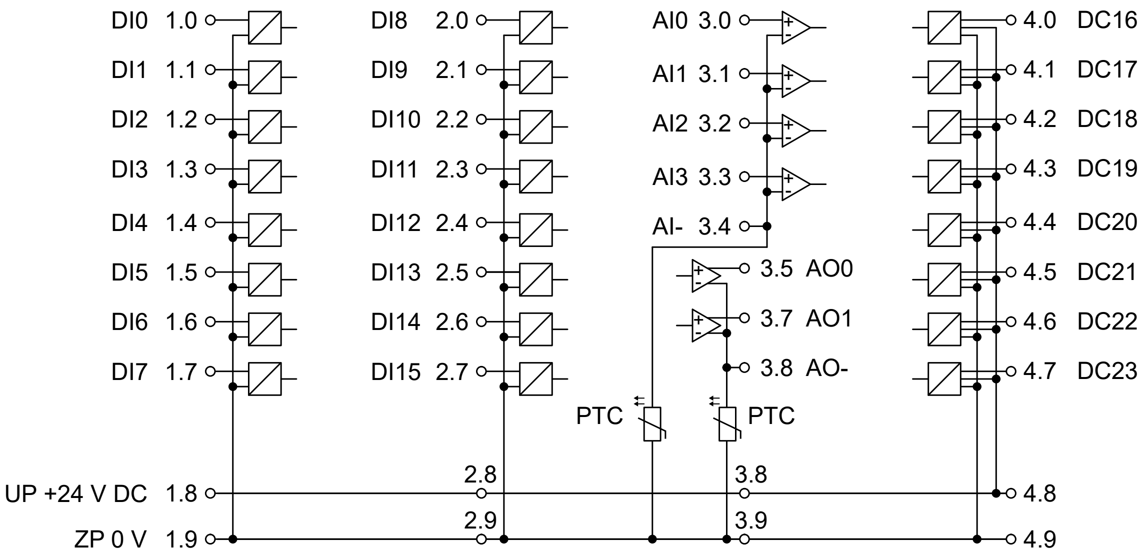


Fig. 72: Terminal assignment of the module

The module provides several diagnosis functions ↬ *Chapter 1.6.3.1.1.7 “Diagnosis” on page 569*.

Connection of the digital inputs

The following figure shows the connection of the digital input DI0. Proceed with the digital inputs DI1 to DI15 in the same way.

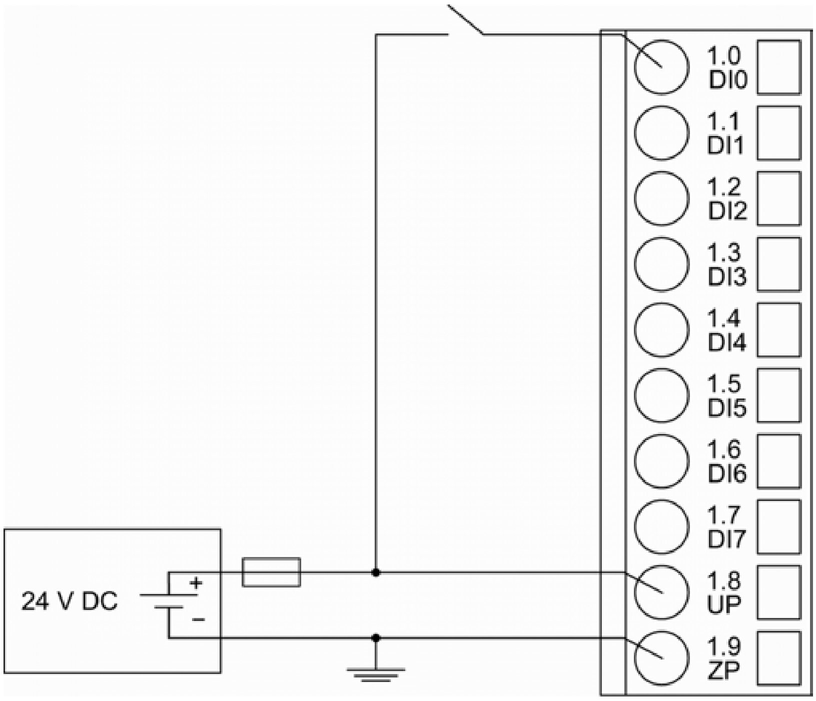


Fig. 73: Connection of the module

The meaning of the LEDs is described in the Displays ↬ *Chapter 1.6.3.1.1.8 “State LEDs” on page 572* chapter.

Connection of the configurable digital inputs/outputs

The following figure shows the connection of the configurable digital input/output DC16 and DC17. DC16 is connected as an input and DC17 is connected as an output. Proceed with the configurable digital inputs/outputs DC18 to DC23 in the same way.

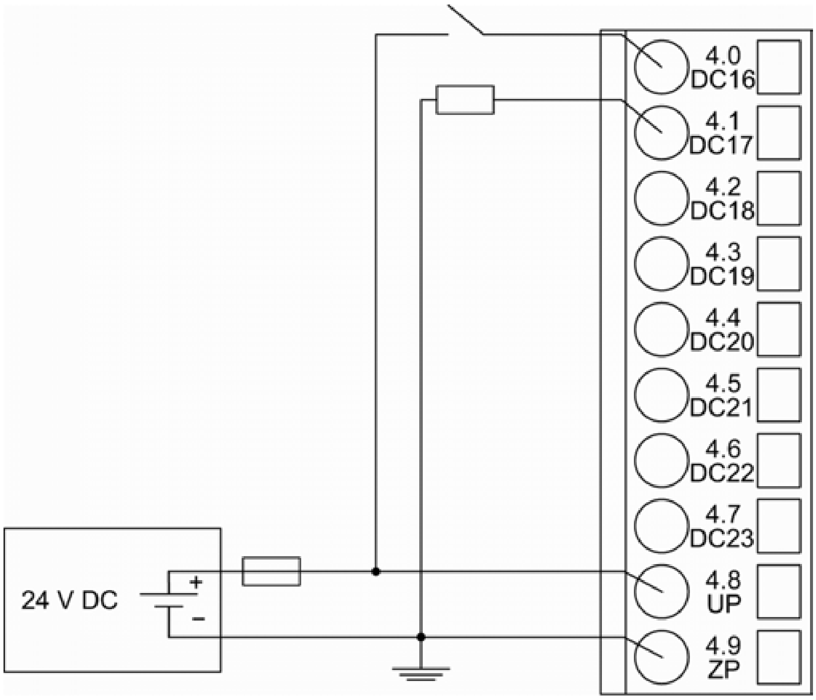


Fig. 74: Connection of configurable digital inputs/outputs to the module

> **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.

The following figure shows the connection of resistance thermometers in 2-wire configuration to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

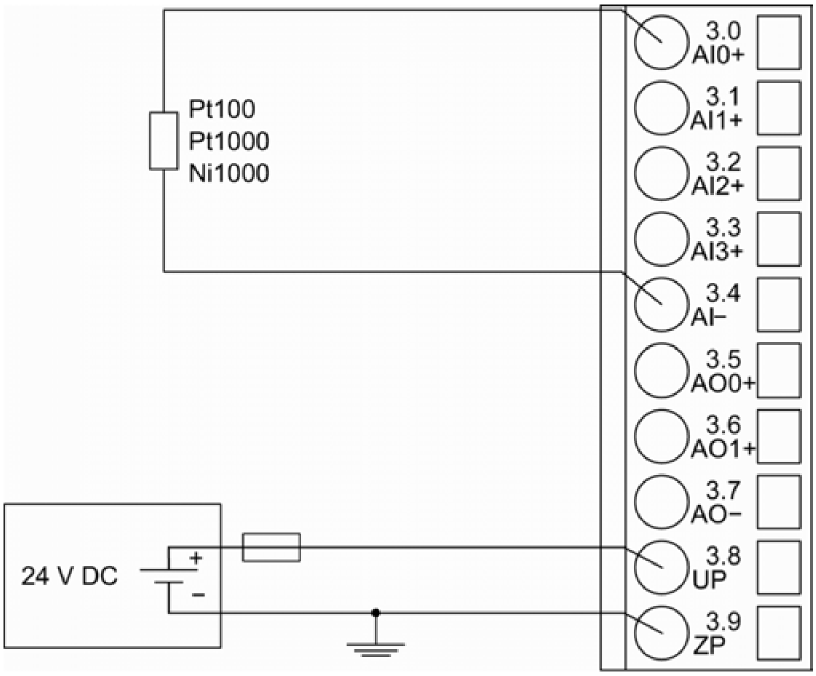


Fig. 75: Connection of resistance thermometers in 2-wire configuration to the analog inputs

The following measuring ranges can be configured *Chapter 1.6.3.1.1.6 “Parameterization” on page 565*:

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 1.6.3.1.1.8 “State LEDs” on page 572*.

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.

0

The following figure shows the 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.

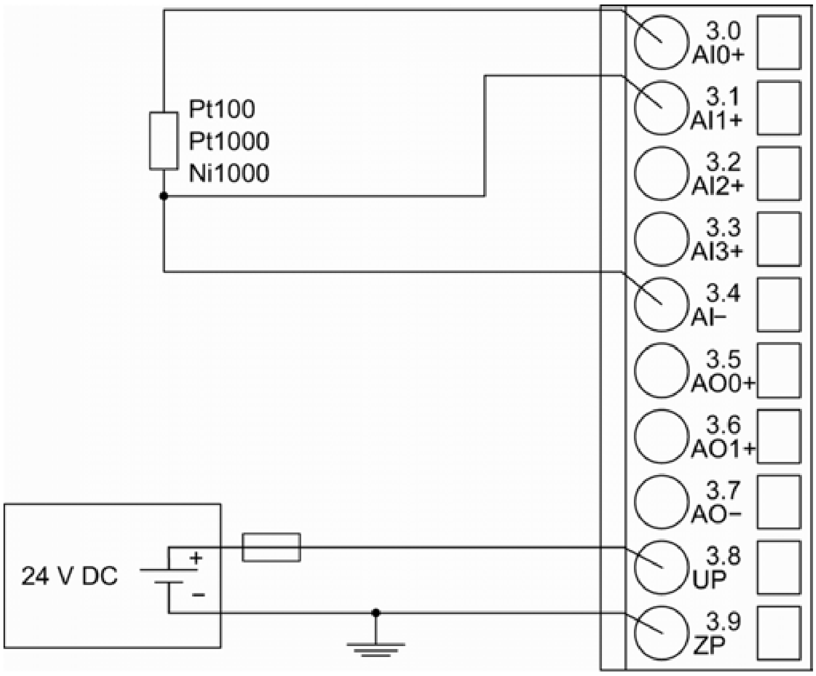


Fig. 76: Connection of resistance thermometers in 3-wire configuration to the analog inputs

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.

The following measuring ranges can be configured *Chapter 1.6.3.1.1.6 “Parameterization” on page 565*:

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 1.6.3.1.1.7 “Diagnosis” on page 569*.

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

The following figure shows the connection of active-type analog sensors (voltage) with galvanically isolated power supply to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

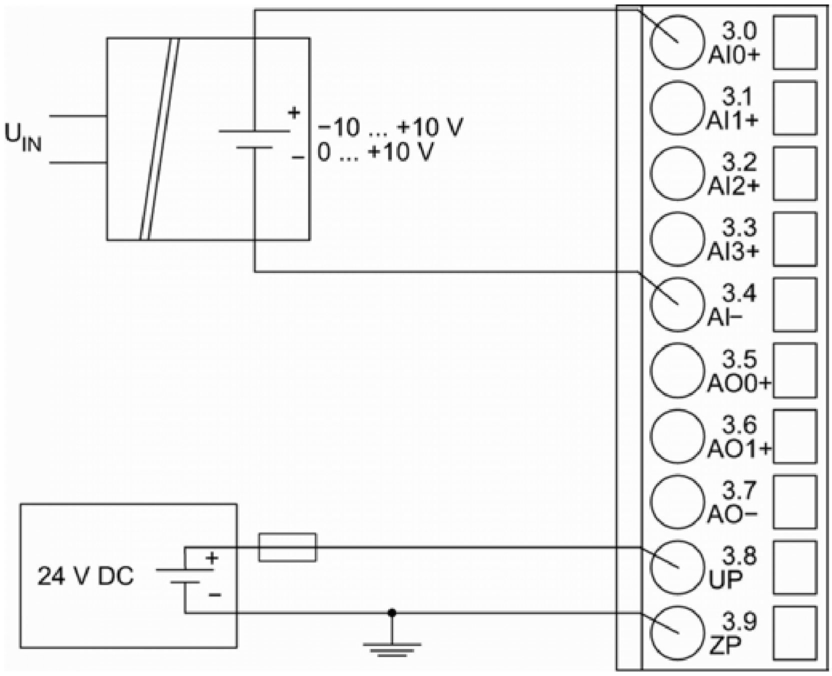


Fig. 77: Connection of active-type analog sensors (voltage) with galvanically isolated power supply to the analog inputs

The following measuring ranges can be configured ✎ *Chapter 1.6.3.1.1.6 “Parameterization” on page 565*:

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 1.6.3.1.1.8 “State LEDs” on page 572*.

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

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

The following figure shows the connection of active-type analog sensors (current) with galvanically isolated power supply to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

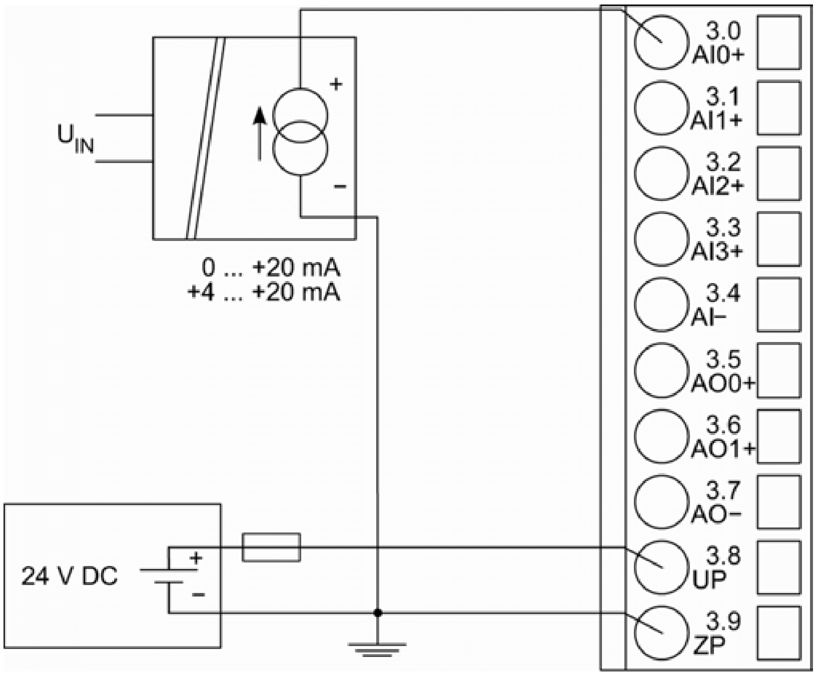


Fig. 78: Connection of active-type analog sensors (current) with galvanically isolated power supply to the analog inputs

The following measuring ranges can be configured *Chapter 1.6.3.1.1.6 "Parameterization" on page 565*:

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 1.6.3.1.1.8 "State LEDs" on page 572*.

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

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 to AI3 in the same way.

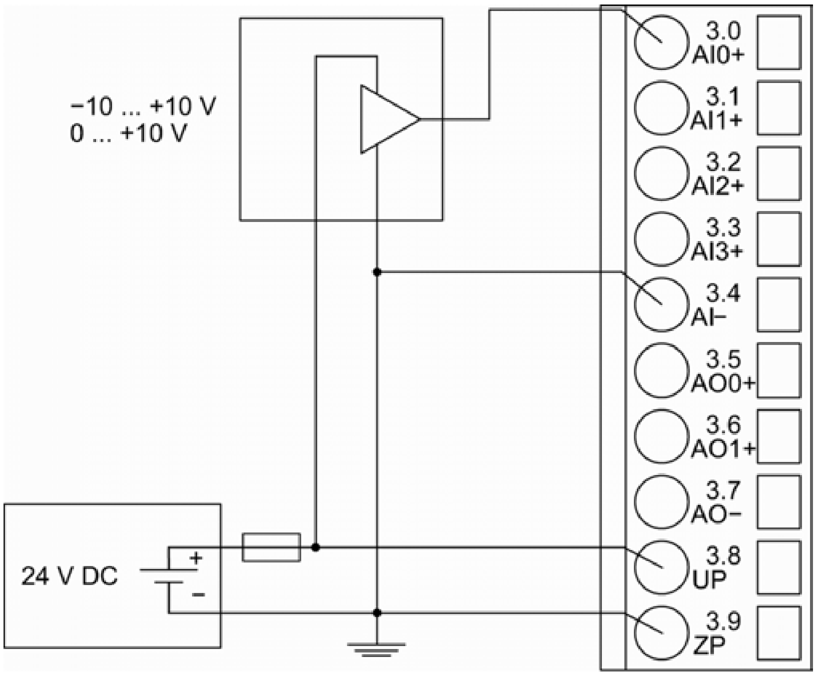


Fig. 79: Connection of active-type sensors (voltage) with no galvanically isolated power supply to the analog inputs

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 1.6.3.1.1.6 “Parameterization” on page 565*:

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 1.6.3.1.1.8 “State LEDs” on page 572*.

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 to AI3 in the same way.

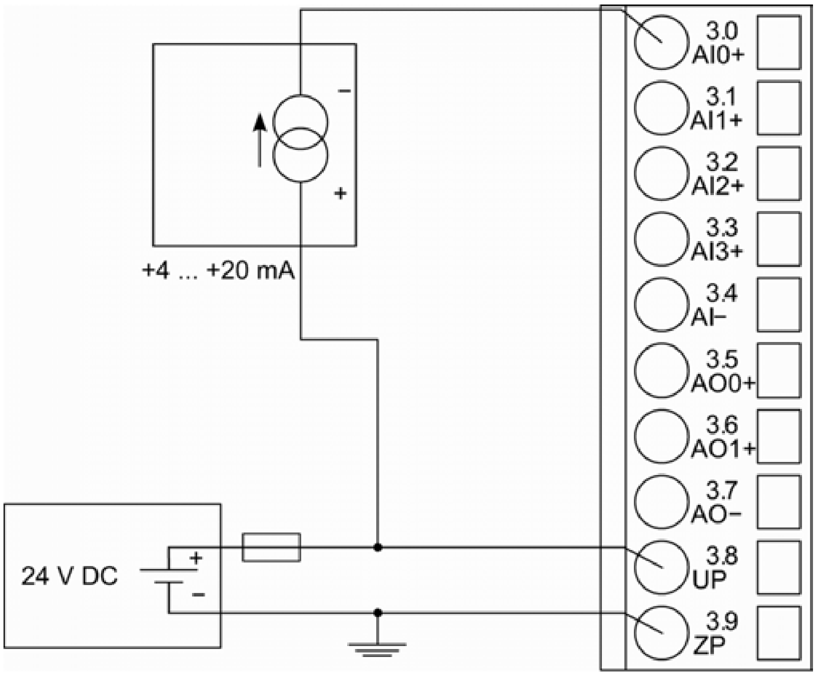


Fig. 80: Connection of passive-type analog sensors (current) to the analog inputs

The following measuring ranges can be configured *Chapter 1.6.3.1.1.6 "Parameterization" on page 565*:

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 1.6.3.1.1.8 "State LEDs" on page 572*.

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).

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.

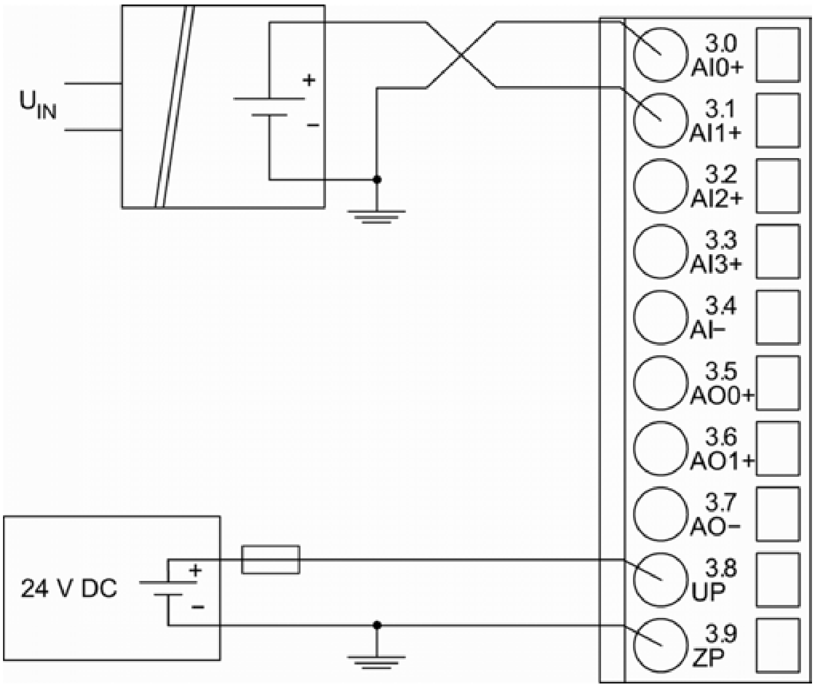


Fig. 81: Connection of active-type analog sensors (voltage) to differential analog inputs

The following measuring ranges can be configured *Chapter 1.6.3.1.1.6 “Parameterization” on page 565*:

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

For a description of the function of the LEDs, please refer to the Diagnosis and displays / Displays chapter *Chapter 1.6.3.1.1.8 “State LEDs” on page 572*.

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.

The following figure shows the connection of digital sensors to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

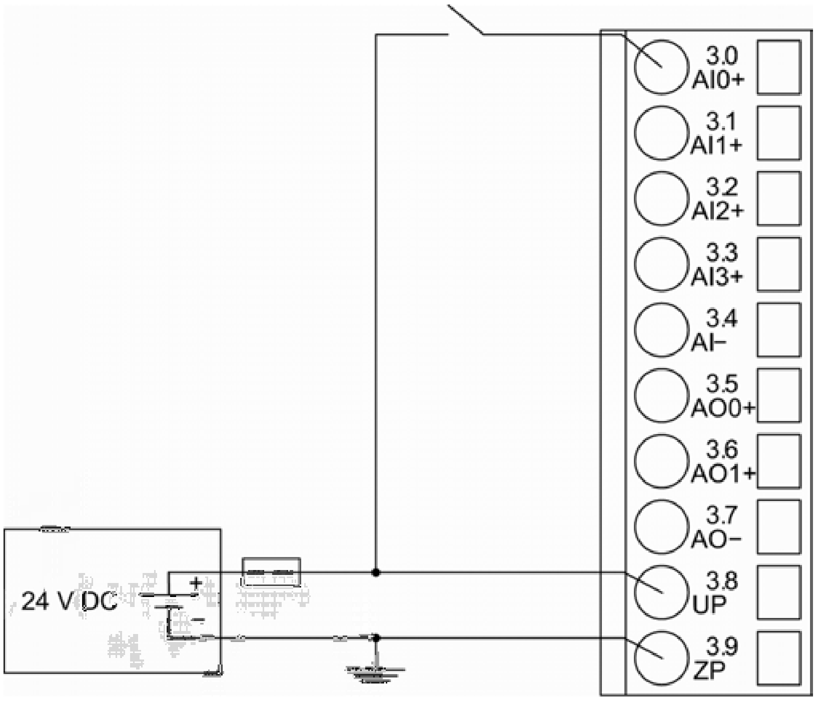


Fig. 82: Use of analog inputs as digital inputs

The following measuring ranges can be configured *Chapter 1.6.3.1.1.6 “Parameterization” on page 565*:

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 1.6.3.1.1.8 “State LEDs” on page 572*.

Connection of analog output loads (Voltage)

The following figure shows the connection of output loads to the analog output AO0. Proceed with the analog output AO1 in the same way.

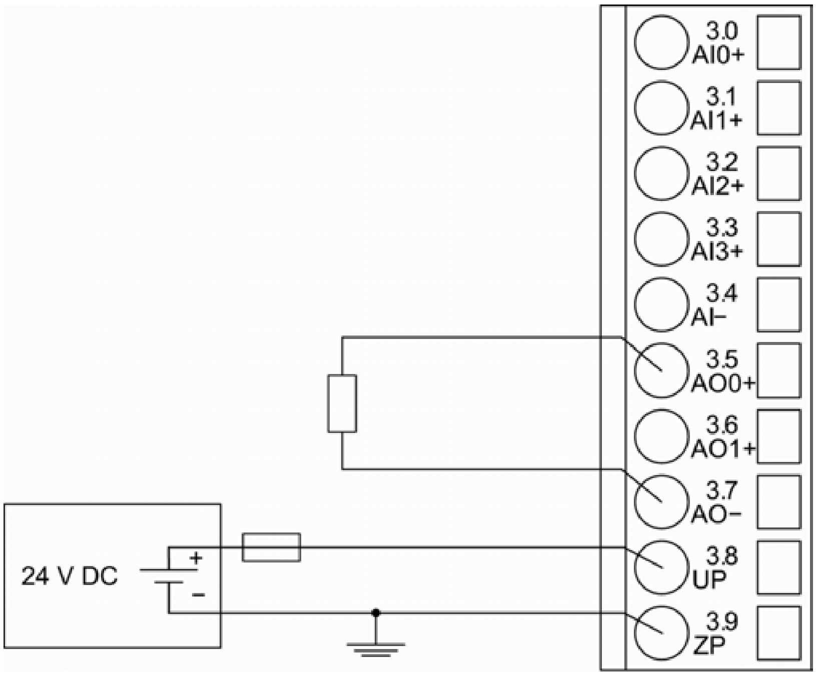


Fig. 83: Connection of analog output loads (voltage)

The following measuring ranges can be configured ⇘ *Chapter 1.6.3.1.1.6 “Parameterization” on page 565* :

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 1.6.3.1.1.8 “State LEDs” on page 572*.

Unused analog outputs can be left open-circuited.

Connection of analog output loads (Current)

The following figure shows the connection of output loads to the analog output AO0. Proceed with the analog output AO1 in the same way.

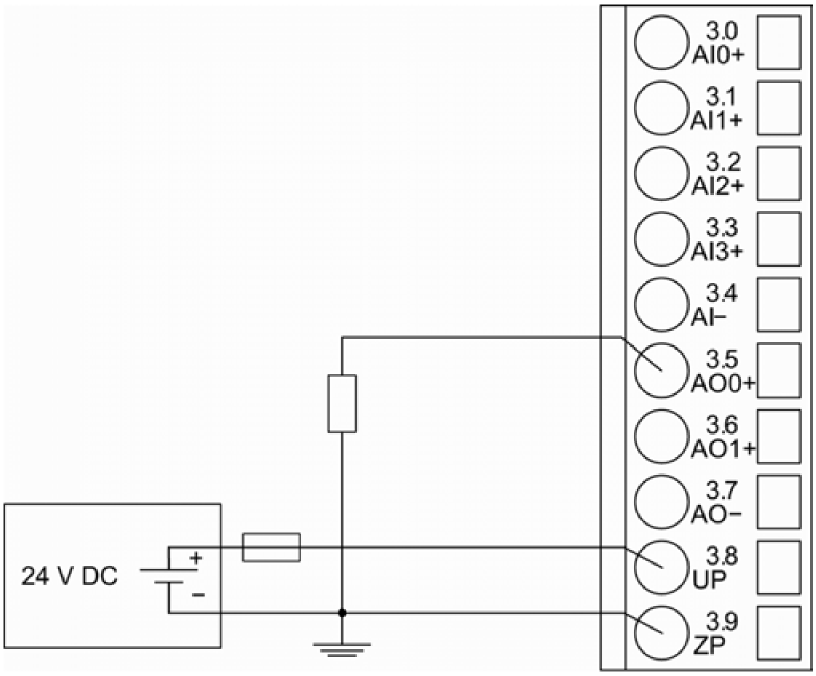


Fig. 84: Connection of analog output loads (current)

The following measuring ranges can be configured *Chapter 1.6.3.1.1.6 “Parameterization” on page 565*:

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 1.6.3.1.1.8 “State LEDs” on page 572*.

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
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			
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 *)

[2])	Setting	Description
	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 1.6.1.2.9 "Fast counter" on page 349*

[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 120 " Channel configuration" on page 567*	see *Table 120 " Channel configuration" on page 567*	BYTE	0	0x0Y09
Input 0, Check channel	see *Table 121 " Channel monitoring" on page 568*	see *Table 121 " Channel monitoring" on page 568*	BYTE	0	0x0Y0A
:	:	:	:	:	
:	:	:	:	:	
Input 3, Channel configuration	see *Table 120 " Channel configuration" on page 567*	see *Table 120 " Channel configuration" on page 567*	BYTE	0	0x0Y0F
Input 3, Check channel	see *Table 121 " Channel monitoring" on page 568*	see *Table 121 " Channel monitoring" on page 568*	BYTE	0	0x0Y10

Table 120: 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 121: 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	EDS Slot / Index
0 Output 0, Channel configuration	see *Table 122 “ Channel configuration” on page 569*	see *Table 122 “ Channel configuration” on page 569*	BYTE	0	0x0Y11
Output 0, Check channel	see *Table 123 “ Channel monitoring” on page 569*	see *Table 123 “ Channel monitoring” on page 569*	BYTE	0	0x0Y12
Output 0, Substitute value	see *Table 124 “ Substitute value” on page 569*	see *Table 124 “ Substitute value” on page 569*	WORD	0	0x0Y13
Output 1, Channel configuration	see *Table 122 “ Channel configuration” on page 569*	see *Table 122 “ Channel configuration” on page 569*	BYTE	0	0x0Y14
Output 1, Check channel	see *Table 123 “ Channel monitoring” on page 569*	see *Table 123 “ Channel monitoring” on page 569*	BYTE	0	0x0Y15
Output 1, Substitute value	see *Table 124 “ Substitute value” on page 569*	see *Table 124 “ Substitute value” on page 569*	WORD	0	0x0Y16

Table 122: 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 123: Channel monitoring

Internal value	Check channel
0	Plausib(ility), cut wire, short circuit
3	None

Table 124: 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.

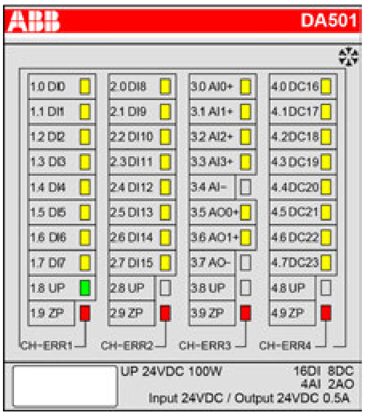
E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500 display	<− Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 Bit 6...7	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6 Bit 0...5**	**FBP diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error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

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	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 to DI15	Digital input	Yellow	Input is OFF	Input is ON [1])	--
DC16 to DC23	Digital input/ output	Yellow	Input/output is OFF	Input/output is ON [1])	--
AI0 to AI3	Analog input	Yellow	Input is OFF	Input is ON [2])	--
AO0 to 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...10 V	-10...+10 V	0...20 mA	4...20 mA	Digital input
Overflow	> 11.7589	> 11.7589	> 23.5178	> 22.8142	
Measured value too high	11.7589 : 10.0004	11.7589 : 10.0004	23.5178 : 20.0007	22.8142 : 20.0006	
Normal range Normal range or measured value too low	10.0000 : 0.0004	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	on
	0.0000	0.0000	0	4	off
	-0.0004 -1.7593	-0.0004 : : : -10.0000		3.9994 : 0	

Range	0...10 V	-10...+10 V	0...20 mA	4...20 mA	Digital input
Measured value too low		-10.0004 : -11.7589			
Underflow	< 0.0000	< -11.7589	< 0.0000	< 0.0000	

Range	Digital value	
	Decimal	**Hex.**
Overflow	32767	7FFF
Measured value too high	32511 : 27649	7EFF : 6C01
Normal range Normal range or measured value too low	27648 : 1	6C00 : 0001
	0	0000
	-1 -4864 -6912 : -27648	FFFF ED00 E500 : 9400
Measured value too low	-27649 : -32512	93FF : 8100
Underflow	-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
	80.0 °C : 70.1 °C		

Range	**Pt100 / Pt1000** **-50...70 °C**	**Pt100 / Pt1000** **-50...400 °C**	**Ni1000** **-50...150 °C**
Normal range	: : 70.0 °C : 0.1 °C	400.0 °C : : : 0.1 °C	150.0 °C : : 0.1 °C
	0.0 °C	0.0 °C	0.0 °C
	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C	-0.1 °C : -50.0 °C
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...+10 V	0...20 mA	4...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 ⇨ *Chapter 2.6.1 “System data AC500” on page 971* are applicable to the standard version.

The system data of AC500-XC *Chapter 2.7.1 “System data AC500-XC” on page 1023* are applicable to the XC version.

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 switchgear cabinet.

NOTICE!
Attention:
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous 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
Terminals of the channels DI0 to DI7		Terminals 1.0 to 1.7
Terminals of the channels DI8 to DI15		Terminals 2.0 to 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)

Parameter	Value
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 to DC23		Terminals 4.0 to 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...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 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

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DC16 to DC23	Terminals 4.0 to 4.7

Parameter		Value
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.

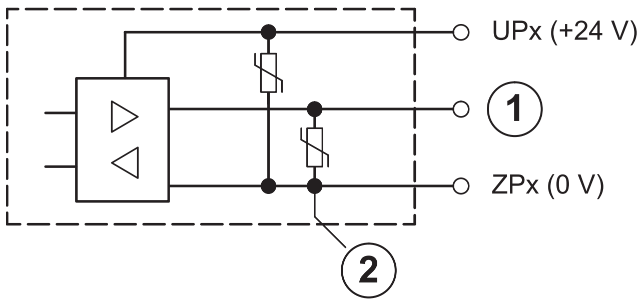


Fig. 85: Digital input/output (circuit diagram)

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+ to AI3+		Terminals 3.0 to 3.3
Reference potential for AI0+ to 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 + sign Range 0 mA...20 mA: 12 bits Range 4 mA...20 mA: 12 bits Range RTD (Pt100, PT1000, Ni1000): 0.1 °C

Parameter	Value
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ. 0.5 %, max. 1 % For XC version below 0 °C and above 60 °C: on request
Relationship between input signal and hex code	*Chapter 1.6.3.1.1.9.1 “Input ranges voltage, current and digital input” on page 572* *Chapter 1.6.3.1.1.9.2 “Input ranges resistance temperature detector” on page 573*
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 3.0 to 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+ to 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

Parameter	Value
Galvanic isolation	Against internal supply and other modules
Configurability	-10 V...+10 V, 0 mA...20 mA, 4 mA...20 mA (each output can be configured individually)
Output resistance (load) as current output	0 Ω...500 Ω
Output loadability as voltage output	±10 mA max.
Indication of the output signals	1 LED per channel (brightness depends on the value of the analog signal)
Resolution	12 bits (+ sign)
Settling time for full range change (resistive load, output signal within specified tolerance)	Typ. 5 ms
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code	*Chapter 1.6.3.1.1.9.3 “Output ranges voltage and current” on page 575*
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

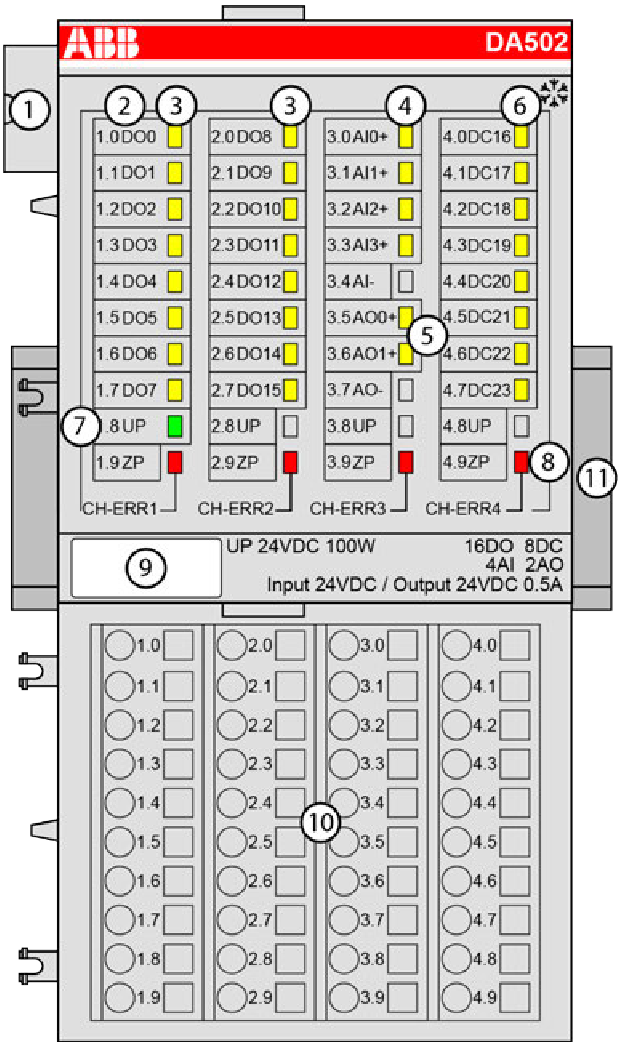
Ordering data

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.*

1.6.3.1.2 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 plus sign
- 2 analog outputs, voltage and current, resolution 12 bits plus 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 to DO15
4 4 yellow LEDs to display the signal states of the analog inputs AI0 to AI3
5 2 yellow LEDs to display the signal states of the analog outputs AO0 to AO1
6 8 yellow LEDs to display the signal states of the configurable digital inputs/outputs DC16 to 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 iInterface 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 1.5.2 “TU515, TU516, TU541 and TU542 for I/O modules” on page 126*

Connections

For a detailed description of the mounting, disassembly and connection of the module, please refer to the System Assembly, Construction and Connection chapter *Chapter 2.6 “AC500 (Standard)” on page 971.*

The connection is carried out by using the 40 terminals of the terminal unit TU515/TU516 *Chapter 1.5.2 “TU515, TU516, TU541 and TU542 for I/O modules” on page 126*.

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

Terminal	Signal	Description
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
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 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	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 only permissible under conditions described in Hot Swap chapter *Chapter 1.6 “I/O modules” on page 142*.

The devices are not designed for removal or insertion under power when Hot Swap conditions do not apply. 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 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.

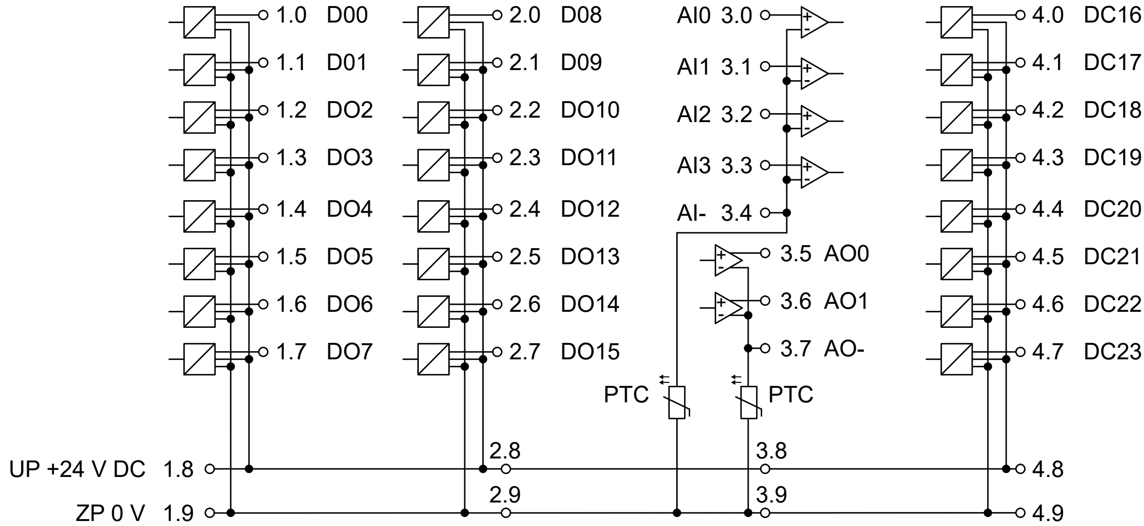
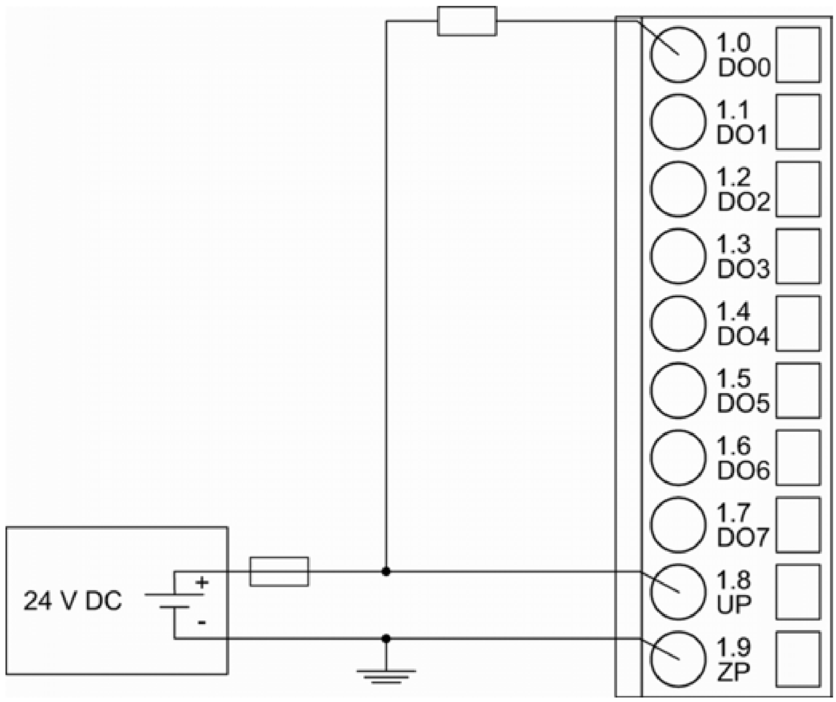


Fig. 86: Terminal assignment of the module

The module provides several diagnosis functions *Chapter 1.6.3.1.2.7 “Diagnosis” on page 603*.

Connection of the digital outputs

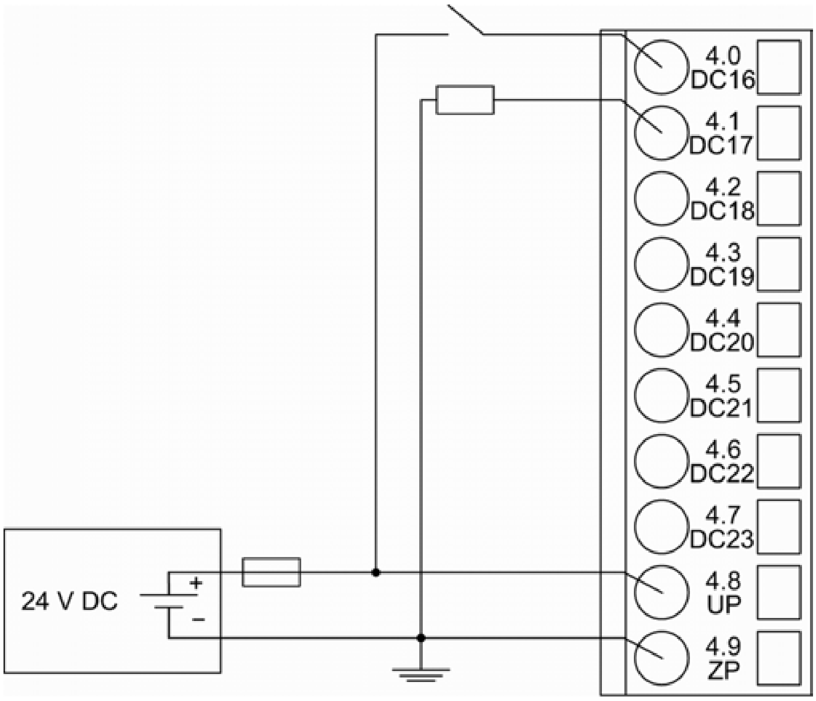
The following figure shows the connection of the digital output DO0. Proceed with the digital outputs DO1 to DO15 in the same way.



For a description of the meaning of the LEDs, please refer to the Displays chapter *Chapter 1.6.3.1.2.8 “State LEDs” on page 606*.

Connection of the configurable digital inputs/outputs

The following figure shows the connection of the configurable digital input/output DC16 and DC17. DC16 is connected as an input and DC17 is connected as an output. Proceed with the configurable digital inputs/outputs DC18 to DC23 in the same way.



> **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 1.6.3.1.2.8 “State LEDs” on page 606* 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.

The following figure shows the connection of resistance thermometers in 2-wire configuration to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

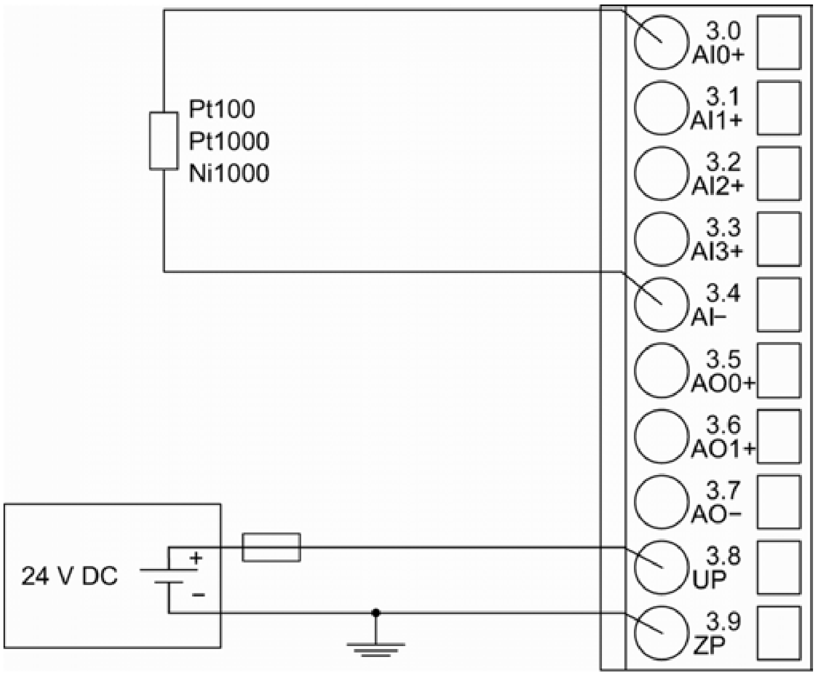


Fig. 87: Connection of resistance thermometers in 2-wire configuration to the analog inputs

The following measuring ranges can be configured ⇘ *Chapter 1.6.3.1.2.6 “Parameterization” on page 599* ⇘ *Chapter 1.6.3.1.2.9 “Measuring ranges” on page 606*:

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 1.6.3.1.2.8 “State LEDs” on page 606*.

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.

The following figure shows the 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.

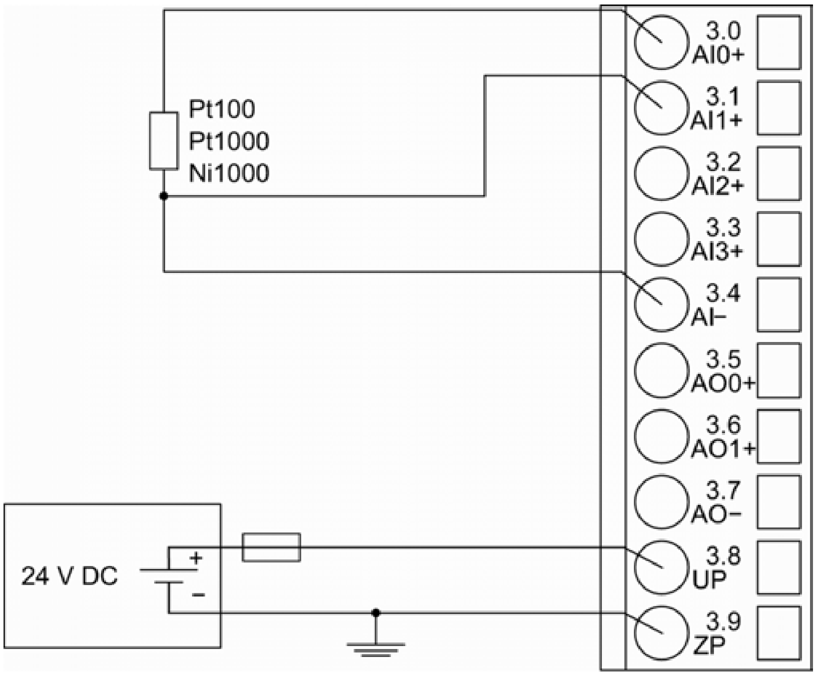


Fig. 88: Connection of resistance thermometers in 3-wire configuration to the analog inputs

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.

The following measuring ranges can be configured *Chapter 1.6.3.1.2.6 “Parameterization” on page 599* *Chapter 1.6.3.1.2.9 “Measuring ranges” on page 606*:

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 1.6.3.1.2.8 “State LEDs” on page 606*.

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

The following figure shows the connection of active-type analog sensors (voltage) with galvanically isolated power supply to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

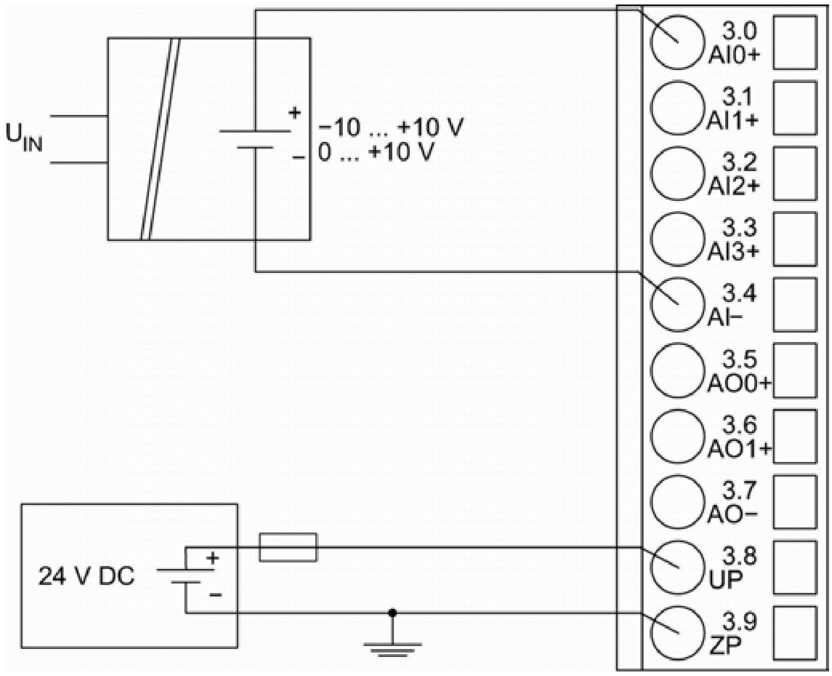


Fig. 89: Connection of active-type analog sensors (voltage) with galvanically isolated power supply to the analog inputs

The following measuring ranges can be configured ␥ *Chapter 1.6.3.1.2.6 “Parameterization” on page 599* ␥ *Chapter 1.6.3.1.2.9 “Measuring ranges” on page 606*:

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 1.6.3.1.2.8 “State LEDs” on page 606*.

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

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

The following figure shows the connection of active-type analog sensors (current) with galvanically isolated power supply to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

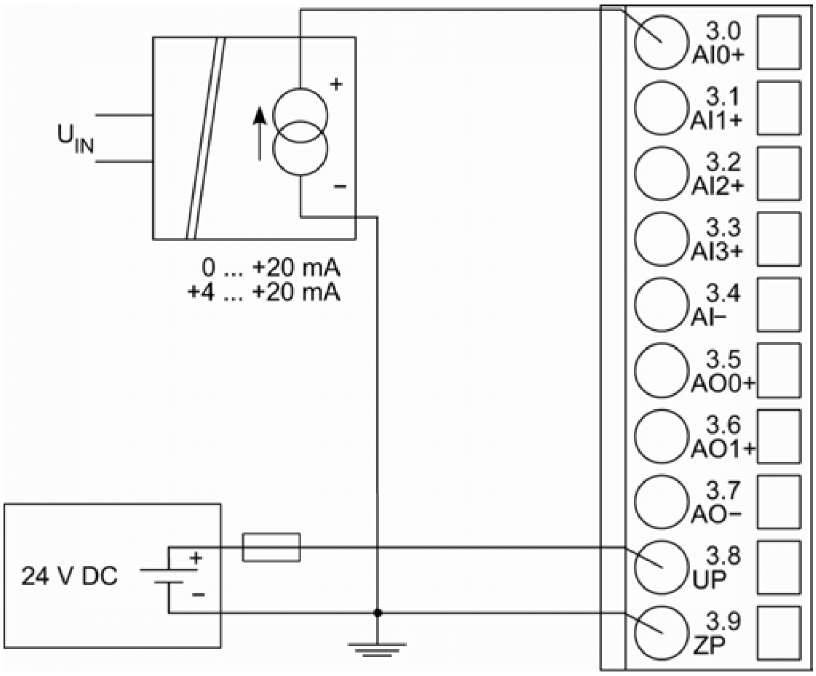


Fig. 90: Connection of active-type analog sensors (current) with galvanically isolated power supply to the analog inputs

The following measuring ranges can be configured *Chapter 1.6.3.1.2.6 "Parameterization" on page 599* *Chapter 1.6.3.1.2.9 "Measuring ranges" on page 606*:

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 1.6.3.1.2.8 "State LEDs" on page 606*.

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

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 to AI3 in the same way.

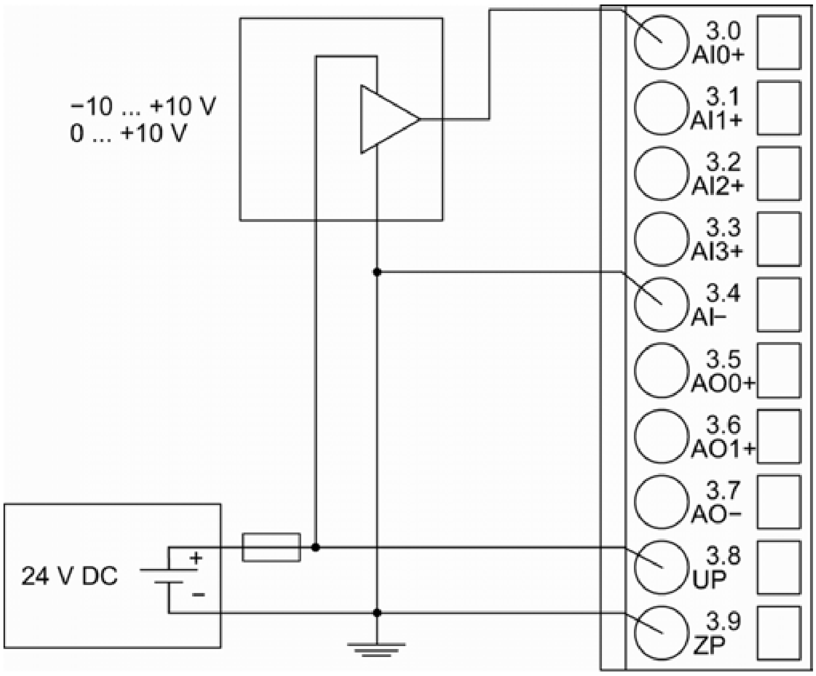


Fig. 91: Connection of active-type sensors (voltage) with no galvanically isolated power supply to the analog inputs

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 1.6.3.1.2.6 "Parameterization" on page 599* *Chapter 1.6.3.1.2.9 "Measuring ranges" on page 606*:

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 1.6.3.1.2.8 "State LEDs" on page 606*.

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 to AI3 in the same way.

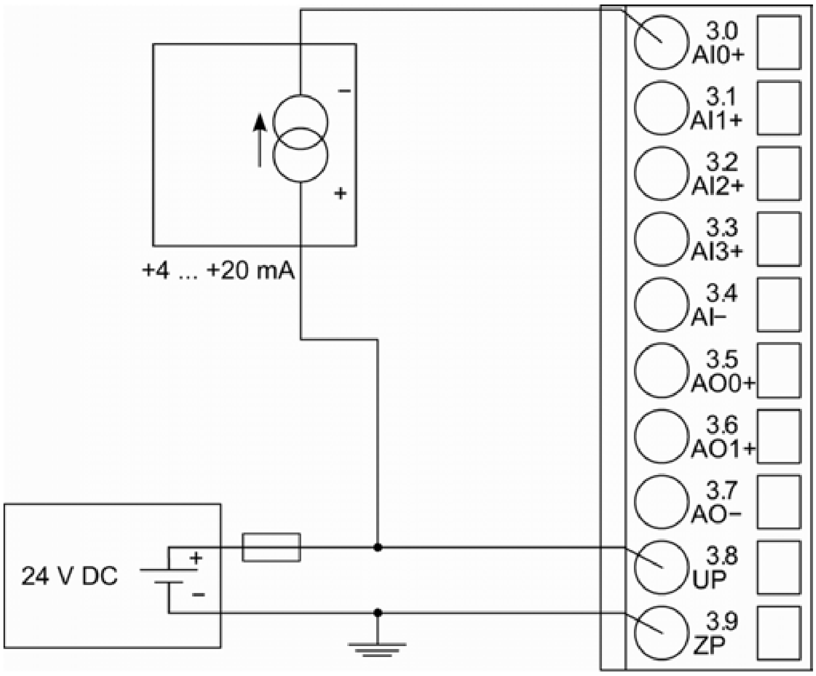


Fig. 92: Connection of passive-type analog sensors (current) to the analog inputs

The following measuring ranges can be configured *Chapter 1.6.3.1.2.6 "Parameterization" on page 599* *Chapter 1.6.3.1.2.9 "Measuring ranges" on page 606*:

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 1.6.3.1.2.8 "State LEDs" on page 606*.

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 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).

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.

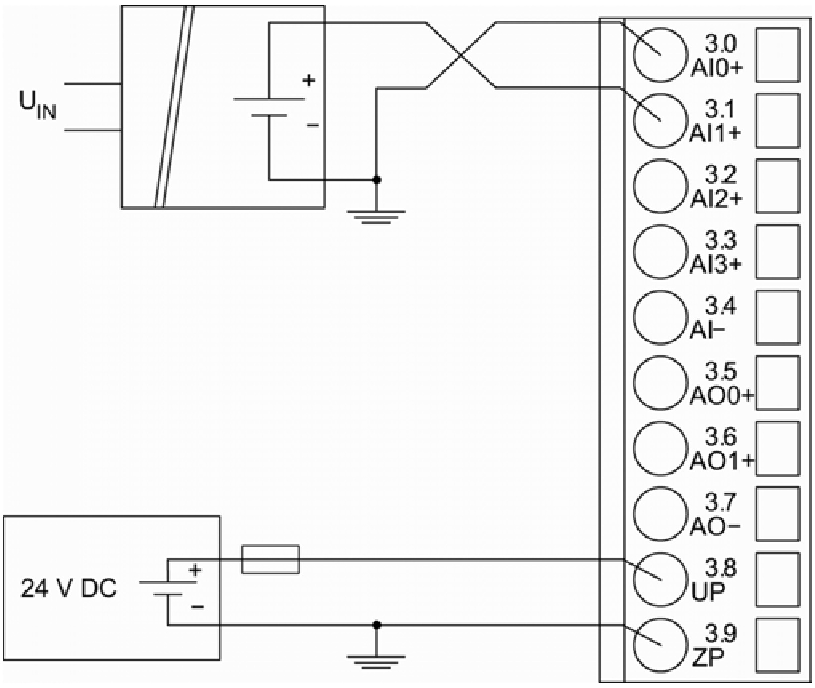


Fig. 93: Connection of active-type analog sensors (voltage) to differential analog inputs

The following measuring ranges can be configured *Chapter 1.6.3.1.2.6 “Parameterization” on page 599* *Chapter 1.6.3.1.2.9 “Measuring ranges” on page 606*:

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 1.6.3.1.2.8 “State LEDs” on page 606.*

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.

The following figure shows the connection of digital sensors to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

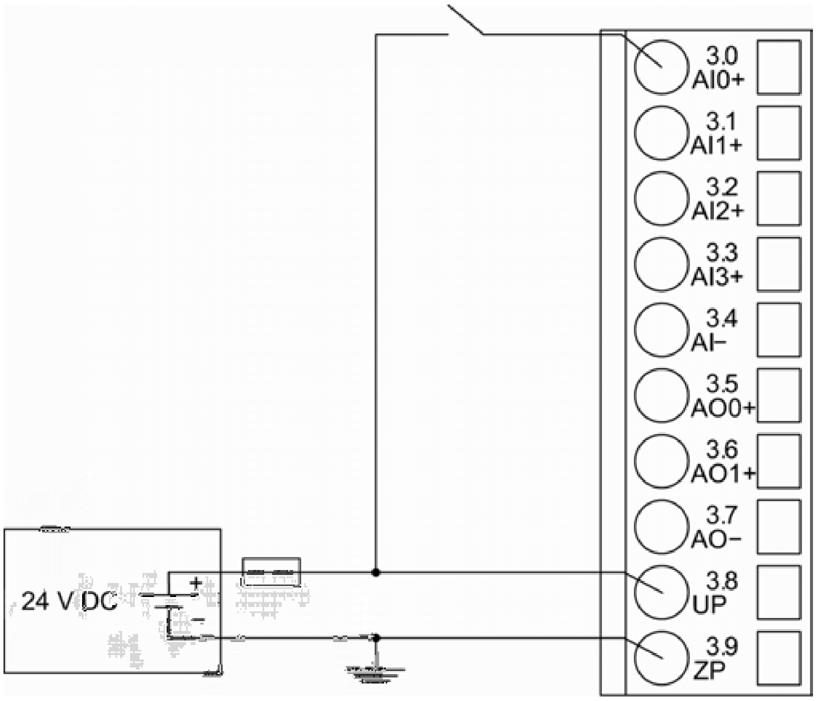


Fig. 94: Use of analog inputs as digital inputs

The following measuring ranges can be configured ⇘ *Chapter 1.6.3.1.2.6 "Parameterization" on page 599* ⇘ *Chapter 1.6.3.1.2.9 "Measuring ranges" on page 606* :

Digital input	24 V	1 channel used

For a description of the function of the LEDs, please refer to Diagnosis and displays / Displays ⇘ *Chapter 1.6.3.1.2.8 "State LEDs" on page 606*.

Connection of analog output loads (Voltage)

The following figure shows the connection of output loads to the analog output AO0. Proceed with the analog output AO1 in the same way.

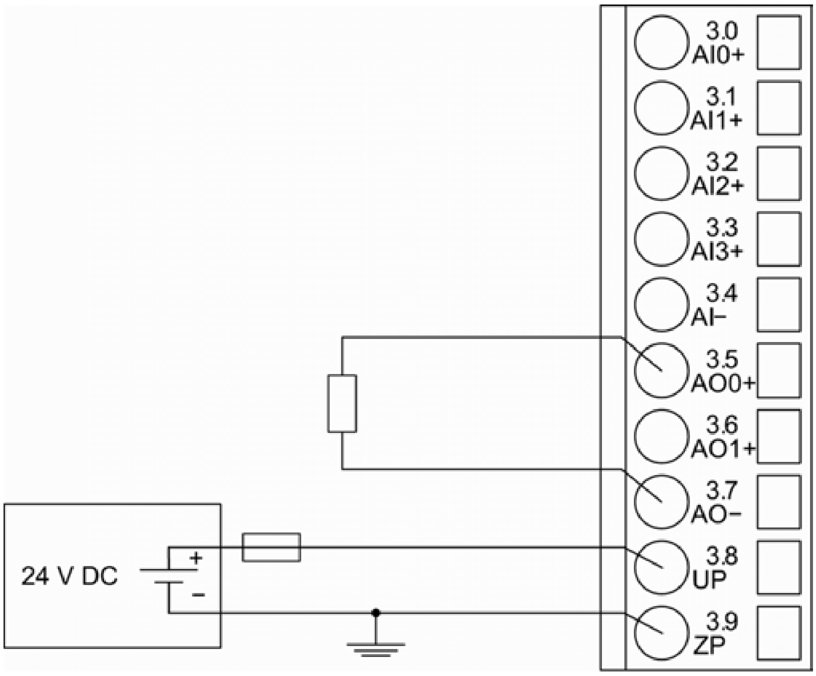


Fig. 95: Connection of analog output loads (voltage)

The following measuring ranges can be configured ➮ *Chapter 1.6.3.1.2.6 “Parameterization” on page 599* ➮ *Chapter 1.6.3.1.2.9 “Measuring ranges” on page 606*:

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 1.6.3.1.2.8 “State LEDs” on page 606*.

Unused analog outputs can be left open-circuited.

Connection of analog output loads (Current)

The following figure shows the connection of output loads to the analog output AO0. Proceed with the analog output AO1 in the same way.

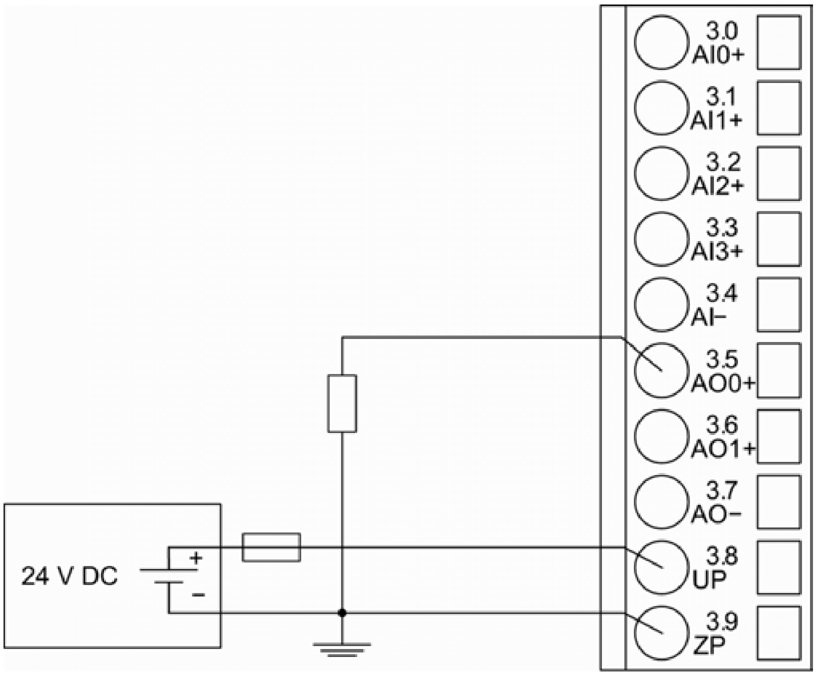


Fig. 96: Connection of analog output loads (current)

The following measuring ranges can be configured ✎ *Chapter 1.6.3.1.2.6 “Parameterization” on page 599* ✎ *Chapter 1.6.3.1.2.9 “Measuring ranges” on page 606*:

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 1.6.3.1.2.8 “State LEDs” on page 606*.

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
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			
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

2)	Setting	Description
	On +Failsafe	Error LED lights up at errors of all error classes, Failsafe mode on *)
	Off by E4 + Failsafe	Error LED lights up at errors of error classes E1, E2 and E3, Failsafe mode on *)
	Off by E3 + Failsafe	Error LED lights up at errors of error classes E1 and E2, Failsafe mode on *)

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 1.6.1.2.9 “Fast counter” on page 349*

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 125 "Channel configuration" on page 601*	see *Table 125 "Channel configuration" on page 601*	BYTE	0	0x0Y09
Input 0, Check channel	see *Table 126 "Channel monitoring" on page 602*	see *Table 126 "Channel monitoring" on page 602*	BYTE	0	0x0Y0A
:	:	:	:	:	
:	:	:	:	:	
Input 3, Channel configuration	see *Table 125 "Channel configuration" on page 601*	see *Table 125 "Channel configuration" on page 601*	BYTE	0	0x0Y0F
Input 3, Check channel	see *Table 126 "Channel monitoring" on page 602*	see *Table 126 "Channel monitoring" on page 602*	BYTE	0	0x0Y10

Table 125: 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 126: 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	EDS Slot / Index
0 Output 0, Channel configuration	see *Table 127 "Channel configuration" on page 603*	see *Table 127 "Channel configuration" on page 603*	BYTE	0	0x0Y11
Output 0, Check channel	see *Table 128 "Channel monitoring" on page 603*	see *Table 128 "Channel monitoring" on page 603*	BYTE	0	0x0Y12
Output 0, Substitute value	see *Table 129 "Substitute value" on page 603*	see *Table 129 "Substitute value" on page 603*	WORD	0	0x0Y13
Output 1, Channel configuration	see *Table 127 "Channel configuration" on page 603*	see *Table 127 "Channel configuration" on page 603*	BYTE	0	0x0Y14
Output 1, Check channel	see *Table 128 "Channel monitoring" on page 603*	see *Table 128 "Channel monitoring" on page 603*	BYTE	0	0x0Y15
Output 1, Substitute value	see *Table 129 "Substitute value" on page 603*	see *Table 129 "Substitute value" on page 603*	WORD	0	0x0Y16

Table 127: 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 128: Channel monitoring

Internal value	Check channel
0	Plausib(ility), cut wire, short circuit
3	None

Table 129: 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.

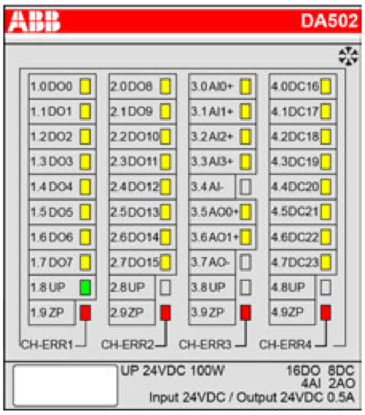
E1...E4	d1	d2	d3	d4	Identifier 000...063	AC500 display	<– Display in
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC browser	
Byte 6 Bit 6...7	-	Byte 3	Byte 4	Byte 5	Byte 6 Bit 0...5	FBP diag-nosis block	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	[1])	[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	
	11 / 12	ADR	1...10				
3	14	1...10	31	31	40	Different hard-/firmware versions in the module	
	11 / 12	ADR	1...10				
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				

E1...E4	**d1**	**d2**	**d3**	**d4**	**Identifier** **000...063**	**AC500 display**	**<− Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC browser**	
Byte 6 **Bit 6...7**	**-**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6** **Bit 0...5**	**FBP diag-nosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error Identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**			
4	14	1...10	3	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 to DO15	Digital output	Yellow	Output is OFF	Output is ON	--
	DC16 to DC23	Digital input/ output	Yellow	Input/output is OFF	Input/output is ON [1])	--
	AI0 to AI3	Analog input	Yellow	Input is OFF	Input is ON [2])	--
	AO0 to 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...10 V	-10...+10 V	0...20 mA	4...20 mA	Digital input	Digital value	
						Decimal	Hex.
Overflow	> 11.7589	> 11.7589	> 23.5178	> 22.8142		32767	7FFF
Measured value too high	11.7589 : 10.0004	11.7589 : 10.0004	23.5178 : 20.0007	22.8142 : 20.0006		32511 : 27649	7EFF : 6C01
Normal range	10.0000 : 0.0004	10.0000 : 0.0004	20.0000 : 0.0007	20.0000 : 4.0006	On	27648 : 1	6C00 : 0001
Normal range or measured value too low	0.0000	0.0000	0	4	Off	0	0000

Range	0...10 V	-10...+10 V	0...20 mA	4...20 mA	Digital input	Digital value	
						Decimal	Hex.
	-0.0004 -1.7593	-0.0004 : : : -10,0000		3.9994 : 0		-1 -4864 -6912 : -27648	FFFF ED00 E500 : 9400
Measured value too low		-10.0004 : -11.7589				-27649 : -32512	93FF : 8100
Underflow	< 0.0000	< -11.7589	< 0.0000	< 0.0000		-32768	8000

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		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

Range	Pt100 / Pt1000 -50...70 °C	Pt100 / Pt1000 -50...400 °C	Ni1000 -50...150 °C	Digital value	
				Decimal	**Hex.**
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-501 : -600	FE0B : FDA8
Underflow	< -60.0 °C	< -60.0 °C	< -60.0 °C	-32768	8000

Output ranges voltage and current

Range	-10...+10 V	0...20 mA	4...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 *Chapter 2.6.1 “System data AC500” on page 971* are applicable to the standard version.

The system data of AC500-XC *Chapter 2.7.1 “System data AC500-XC” on page 1023* are applicable to the XC version.

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 switchgear cabinet.

NOTICE!
Attention:
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous 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 to DO7	Terminals 1.0 to 1.7
	DO8 to DO15	Terminals 2.0 to 2.7

Parameter		Value
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

Parameter	Value
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 to DC23		Terminals 4.0 to 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...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 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

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DC16 to DC23		Terminals 4.0 to 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.

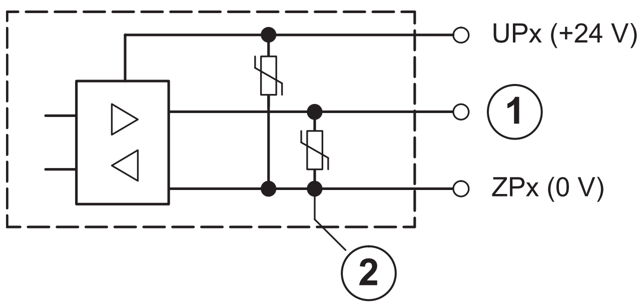


Fig. 97: Digital input/output (circuit diagram)

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+ to AI3+	Terminals 3.0 to 3.3
Reference potential for AI0+ to 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 + 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

Parameter	Value
Relationship between input signal and hex code	*Chapter 1.6.3.1.2.9.1 “Input ranges voltage, current and digital input” on page 606* *Chapter 1.6.3.1.2.9.2 “Input ranges resistance temperature detector” on page 607*
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 3.0 to 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+ to 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)

Parameter	Value
Output resistance (load), as current output	0 Ω...500 Ω
Output loadability, as voltage output	±10 mA max.
Indication of the output signals	1 LED per channel (brightness depends on the value of the analog signal)
Resolution	12 bits (+ sign)
Settling time for full range change (resistive load, output signal within specified tolerance)	Typ. 5 ms
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code	*Chapter 1.6.3.1.2.9.3 "Output ranges voltage and current" on page 608*
Unused outputs	Are configured as "unused" (default value) and can be left open-circuited

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.*

1.7 Communication interface modules (S500)

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.*

Hot swap

Further information about hot swap: .

1.7.1 Compatibility of communication modules and communication interface modules

Table 130: 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

Table 131: 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 132: 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 133: 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

1.7.2 CANopen

1.7.2.1 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)
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

Parameter	**Value**
Processor	Hilscher NETX 100
Expandability	CI58x can only be used on onboard CAN interface and without any I/O expansion module ➡ *Table 132 “CANopen” on page 617*.
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 2.6.1 “System data AC500” on page 971* System data AC500 XC ➡ *Chapter 2.7.1 “System data AC500-XC” on page 1023*
Current consumption	UP: 0.2 A UP3: 0.06 A + 0.5 A max. per output
Weight (without terminal unit)	Ca. 125 g
Process supply voltages UP/UP3	
Rated value	24 V DC (for inputs and outputs)
Max. load for the terminals	10 A
Protection against reversed voltage	Yes
Rated protection fuse on UP/UP3	10 A fast
Galvanic isolation	CANopen interface against the rest of the module
Inrush current from UP (at power up)	On request
Current consumption via UP (normal operation)	0.2 A
Current consumption via UP3	0.06 A + 0.5 A max. per output
Connections	Terminals 2.8 and 3.8 for +24 V (UP) Terminal 4.8 for +24 V (UP3) Terminals 2.9, 3.9 and 4.9 for 0 V (ZP)
Max. power dissipation within the module	6 W
Reference potential for all digital inputs and outputs	Negative pole of the supply voltage, signal name ZP
Setting of the CANopen Node ID identifier	With 2 rotary switches at the front side of the module
Mounting position	Horizontal 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 switchgear 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 1.5.3 “TU517 and TU518 for communication interface modules” on page 132*

> *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

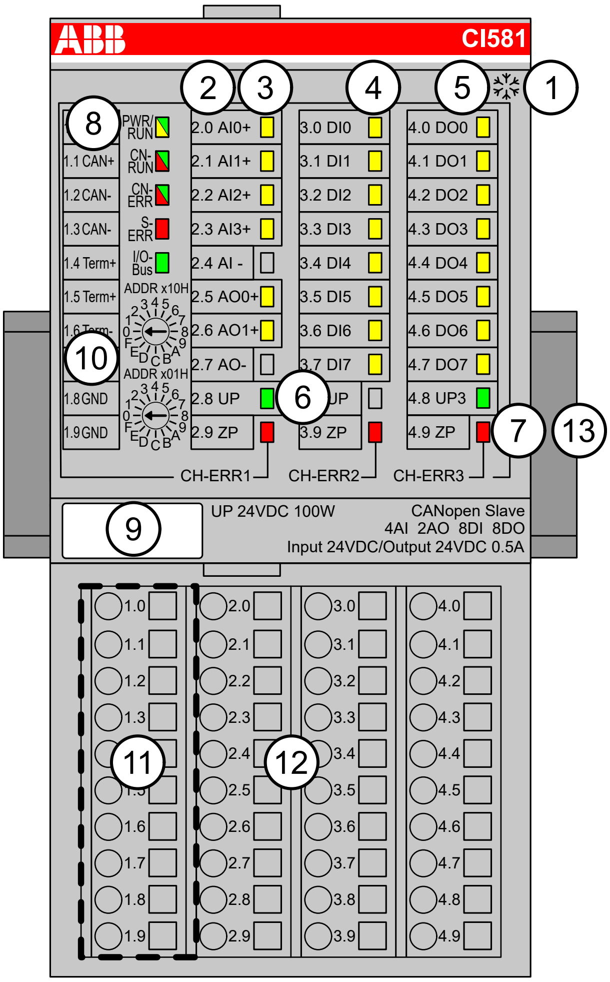
Parameter	Value
Inputs and outputs	8 digital inputs (24 V DC; delay time configurable via software) 8 digital transistor outputs (24 V DC, 0.5 A max.) 4 analog inputs, configurable as: ● -10 V...+10 V ● 0 V...+10 V ● -10 V...+10 V (differential voltage) ● 0 mA...20 mA ● 4 mA...20 mA ● Pt100 , Pt1000, 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.)

1.7.2.2 CI581-CN

- 4 analog inputs (resolution 12 bits plus sign)
- 2 analog outputs (resolution 12 bits plus 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

1.7.2.2.1 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.

1.7.2.2.2 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 132 “CANopen” on page 617*.
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 2.6.1 “System data AC500” on page 971* System data AC500 XC *Chapter 2.7.1 “System data AC500-XC” on page 1023*
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 switchgear 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 1.5.3 “TU517 and TU518 for communication interface modules” on page 132*

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

1.7.2.2.3 Connections

The CANopen communication interface module is plugged on the I/O terminal units TU517 ⇘ *Chapter 1.5.3 "TU517 and TU518 for communication interface modules" on page 132* or TU518 ⇘ *Chapter 1.5.3 "TU517 and TU518 for communication interface modules" on page 132* 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 System Assembly, Construction and Connection chapter ⇘ Chapter 2.6 "AC500 (Standard)" on page 971.

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!

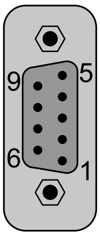
Reason: External voltages at an output or several outputs may cause other outputs to be supplied via that voltage instead of voltage UP3 (reverse voltage). This ist not the intended use.

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.

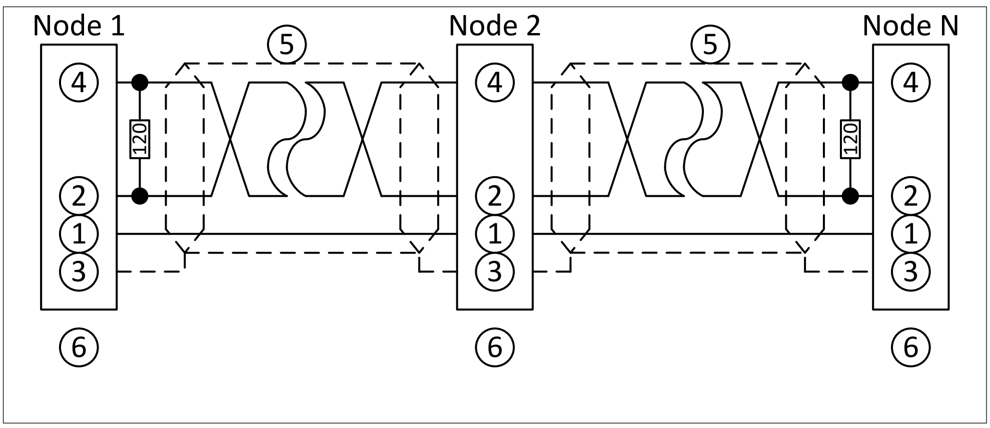


Fig. 98: CANopen interface, bus terminating resistors connected to the line ends

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

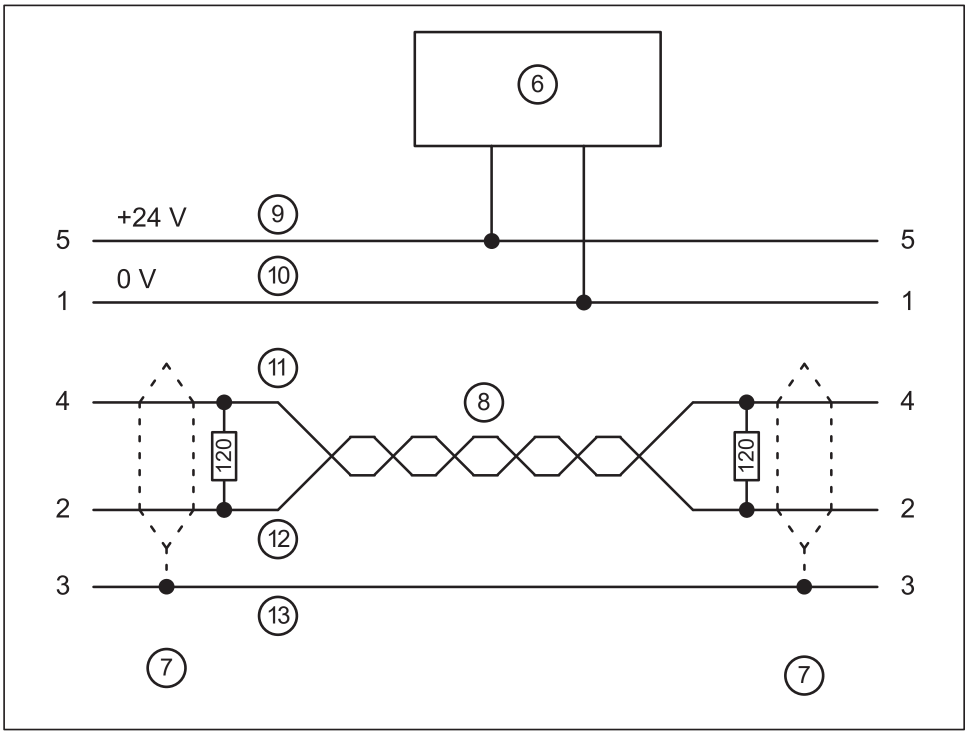


Fig. 99: DeviceNet interface, bus terminating resistors connected to the line ends

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. Please refer to *⇘ Chapter 2.6.1 “System data AC500” on page 971.*

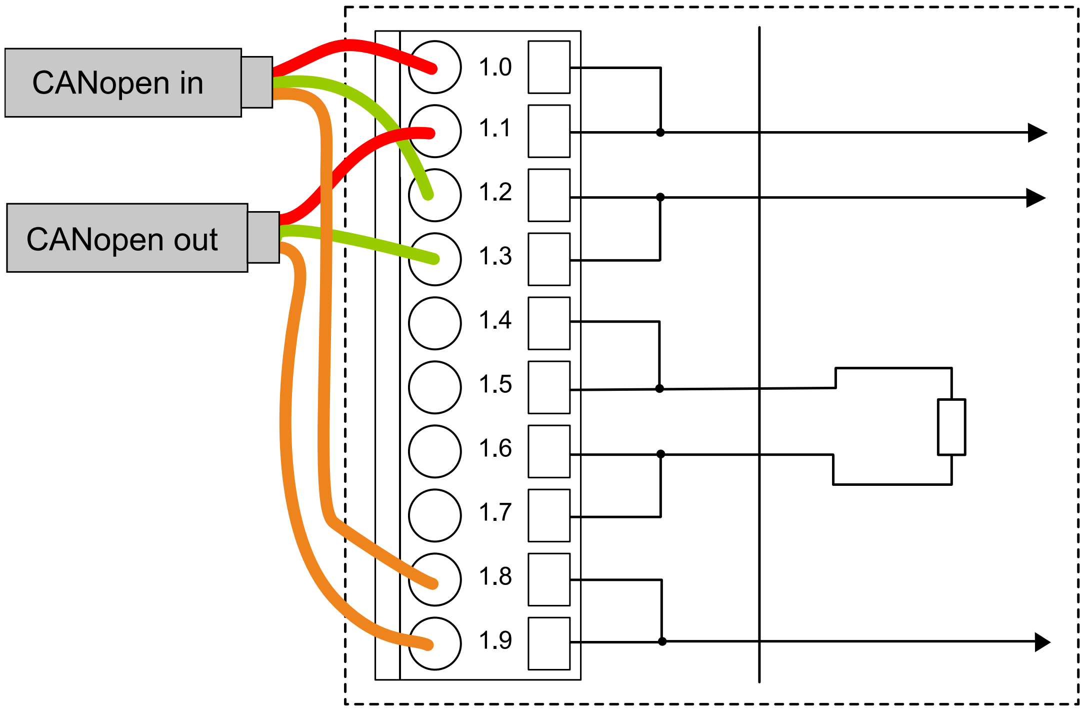
Mounting on terminal units TU517 or TU518

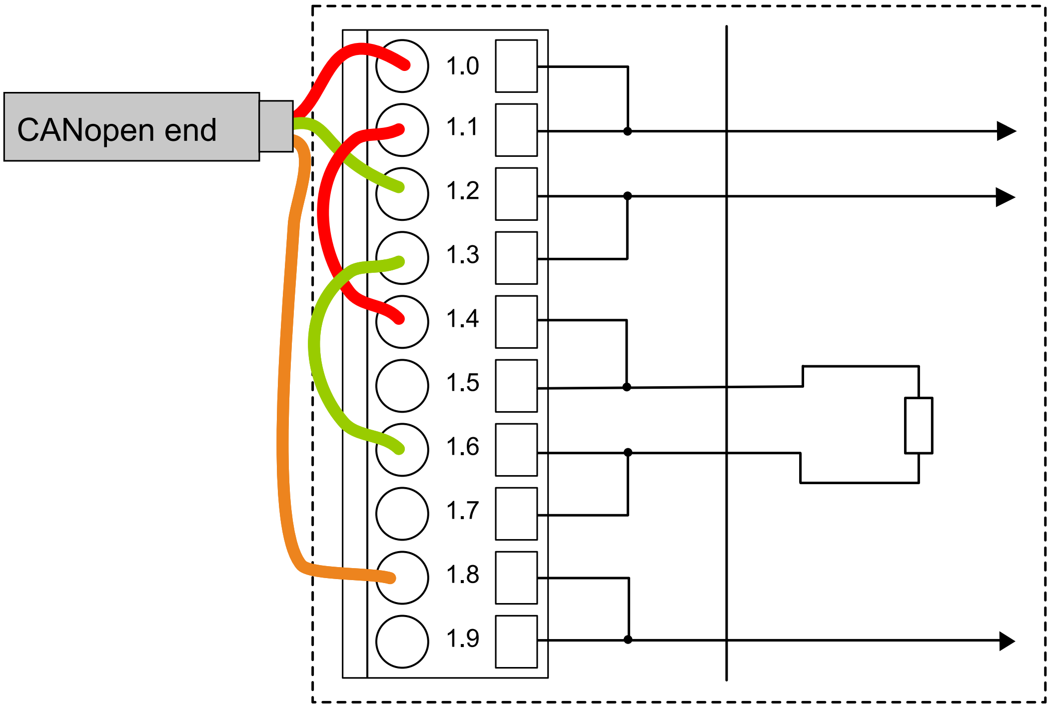
Table 134: Assignment of the terminals

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 switchgear cabinet. Please refer to the AC500 System-Data *➪ Chapter 2.6.1 "System data AC500" on page 971**.*

Table 135: 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 (cut wire), 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.

Only for simple applications (low electromagnetic disturbances, no high requirement on precision), the shielding can also be omitted.

Connection of CANopen communication interface module CI581-CN:

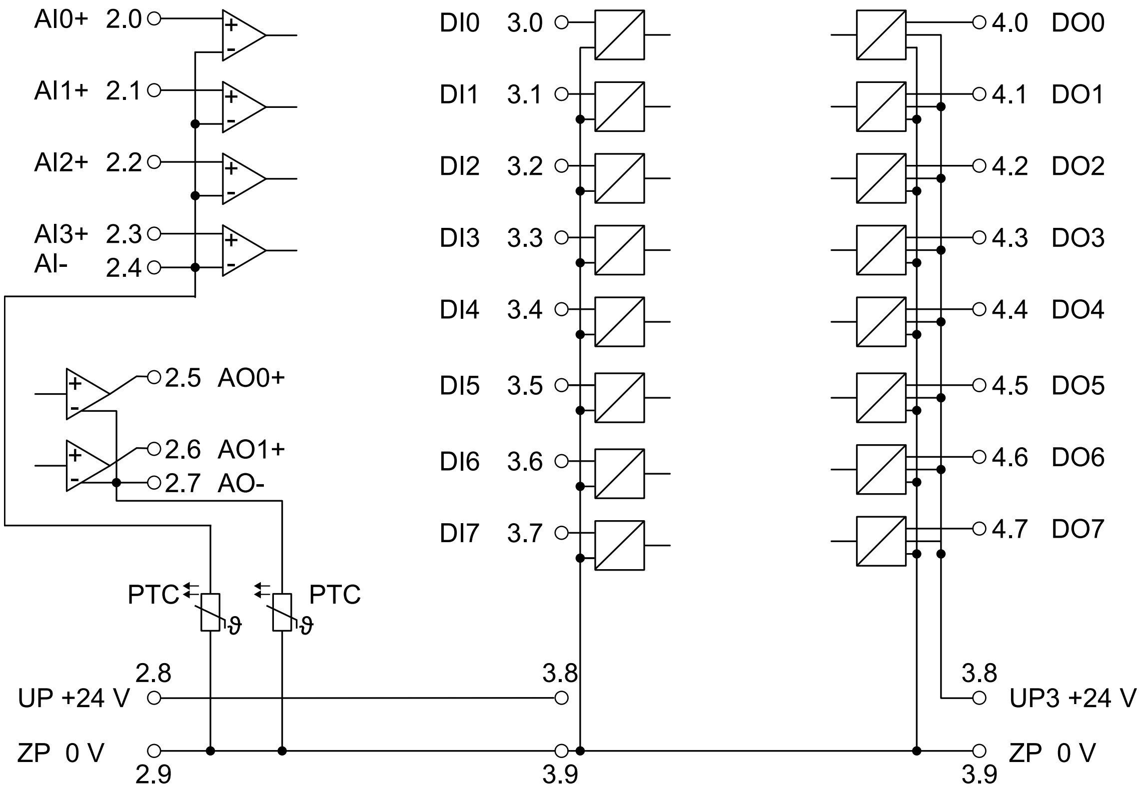


Fig. 100: Connection of the communication interface module CI581-CN

The module provides several diagnosis functions *Chapter 1.7.2.2.8 “Diagnosis” on page 645*.

For the measuring ranges that can be configured, please refer to the sections Measuring Ranges *Chapter 1.7.2.2.10 “Measuring ranges” on page 650* and Parameterization *Chapter 1.7.2.2.7 “Parameterization” on page 640*.

The meaning of the LEDs is described in the section for the state LEDs *Chapter 1.7.2.2.9 “State LEDs” on page 648*.

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

The following figure shows the connection of the digital input DI0. Proceed with the digital inputs DI1 to DI7 in the same way.

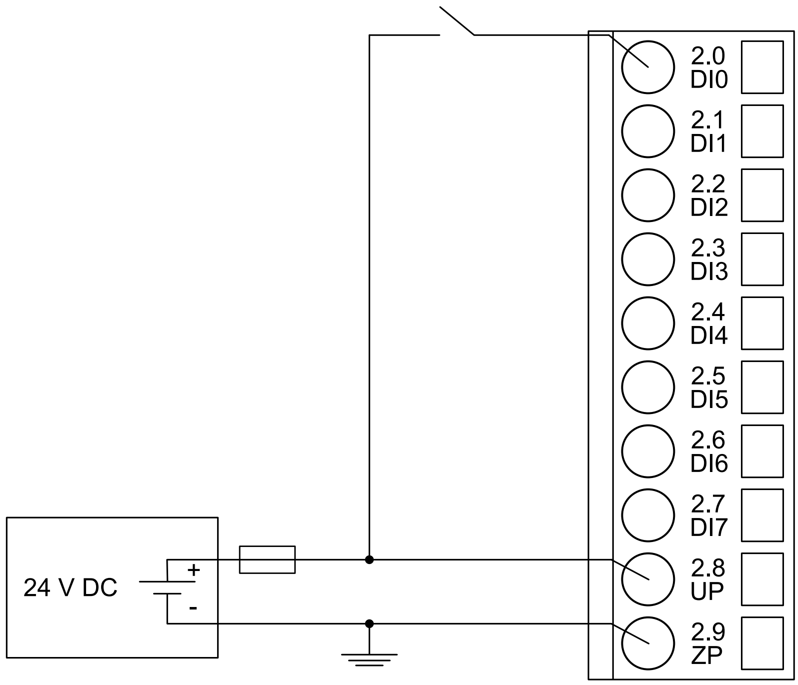


Fig. 101: Connection of the digital inputs to the module CI581-CN

Connection of the digital outputs

The following figure shows the connection of the digital output DO0. Proceed with the digital outputs DO1 - DO7 in the same way.

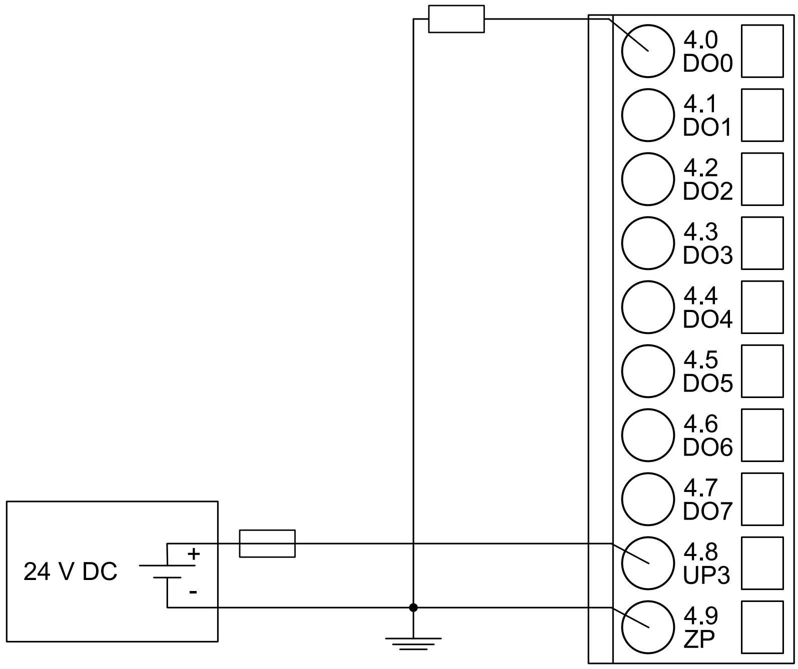


Fig. 102: Connection of configurable digital inputs/outputs to the module CI581-CN

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.

The following figure shows the connection of resistance thermometers in 2-wire configuration to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

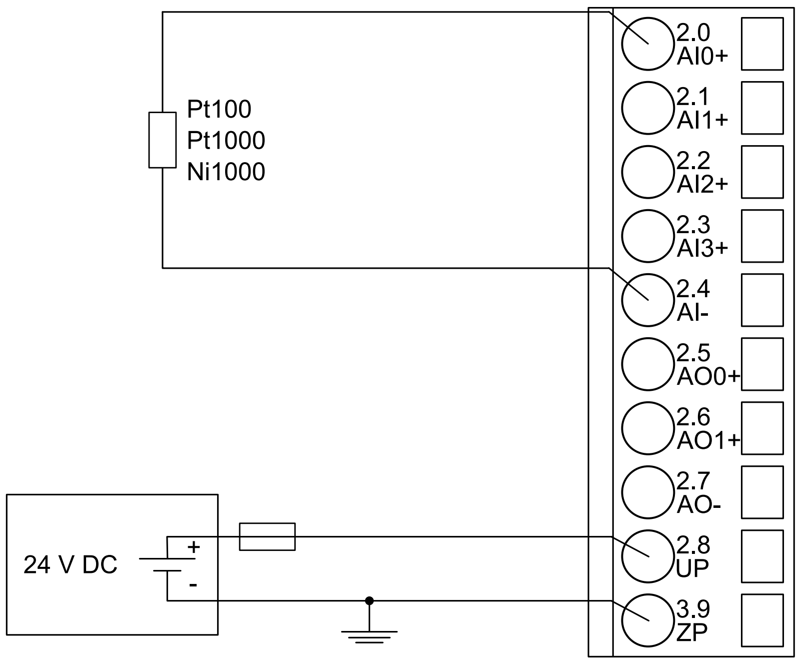


Fig. 103: Connection of resistance thermometers in 2-wire configuration to the analog inputs

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 1.7.2.2.10 “Measuring ranges” on page 650* and Parameterization ↬ *Chapter 1.7.2.2.7 “Parameterization” on page 640*.

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.

The following figure shows the 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.

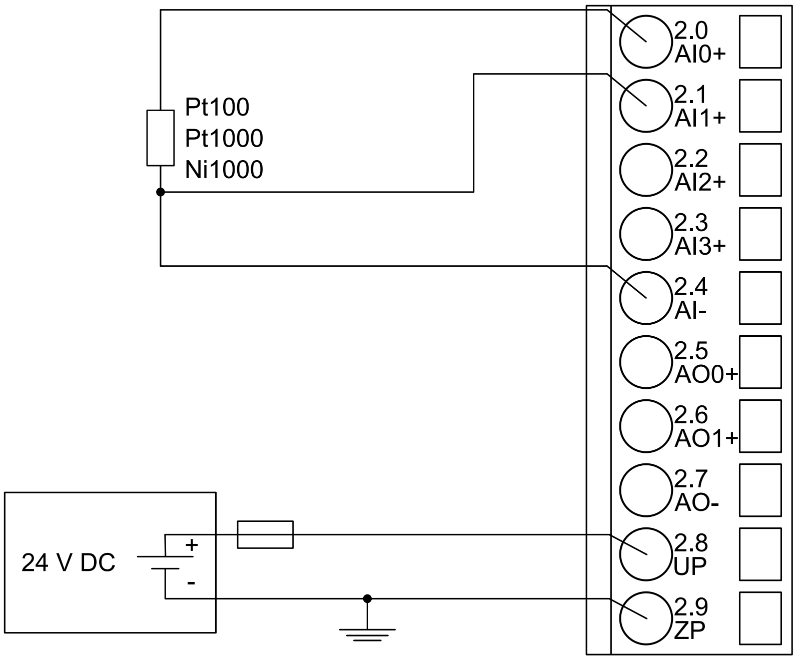


Fig. 104: Connection of resistance thermometers in 3-wire configuration to the analog inputs

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 1.7.2.2.10 “Measuring ranges” on page 650* and Parameterization *Chapter 1.7.2.2.7 “Parameterization” on page 640*.

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

The following figure shows the connection of active-type analog sensors (voltage) with galvanically isolated power supply to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

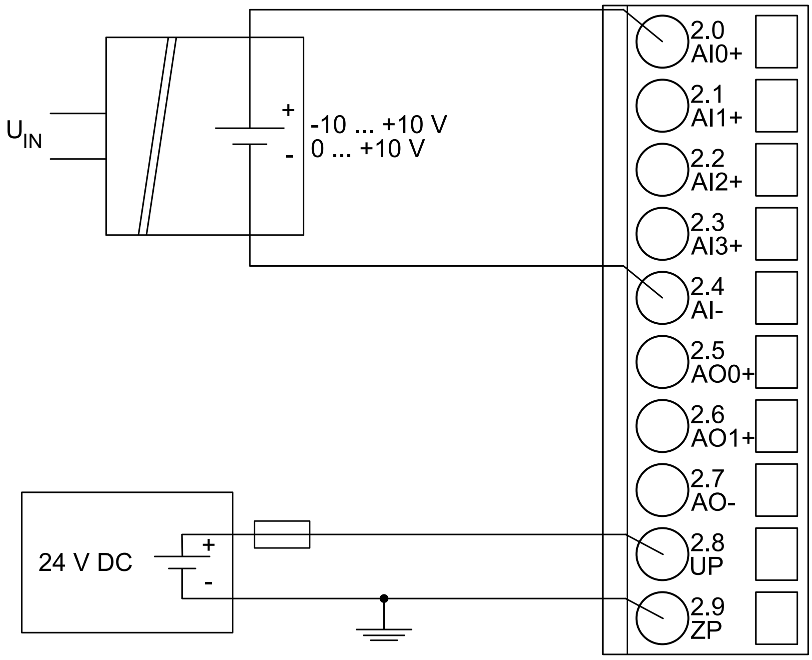


Fig. 105: Connection of active-type analog sensors (voltage) with galvanically isolated power supply to the analog inputs

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 1.7.2.2.10 “Measuring ranges” on page 650* and Parameterization *Chapter 1.7.2.2.7 “Parameterization” on page 640*.

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

The following figure shows the connection of active-type analog sensors (current) with galvanically isolated power supply to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

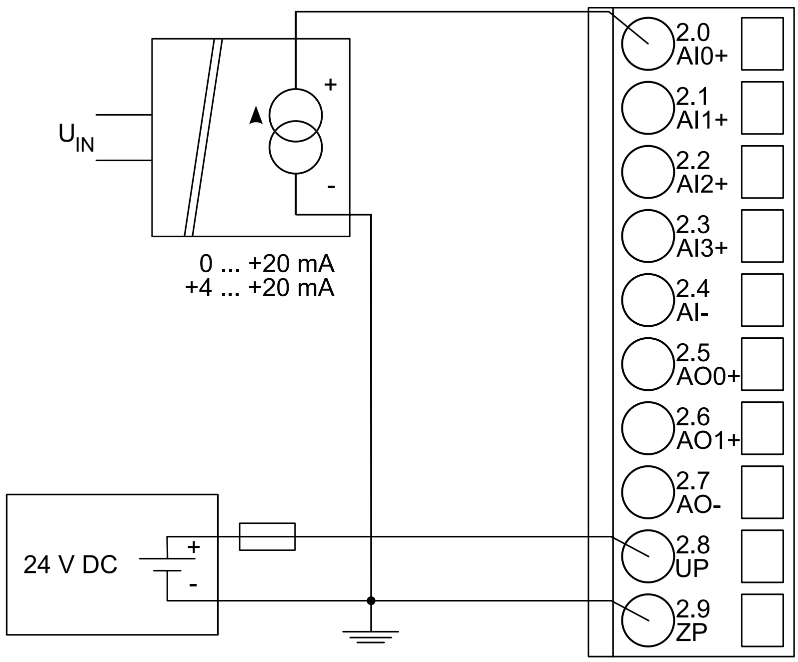


Fig. 106: Connection of active-type analog sensors (current) with galvanically isolated power supply to the analog inputs

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 1.7.2.2.10 “Measuring ranges” on page 650* and Parameterization ♘ *Chapter 1.7.2.2.7 “Parameterization” on page 640*.

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

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 to AI3 in the same way.

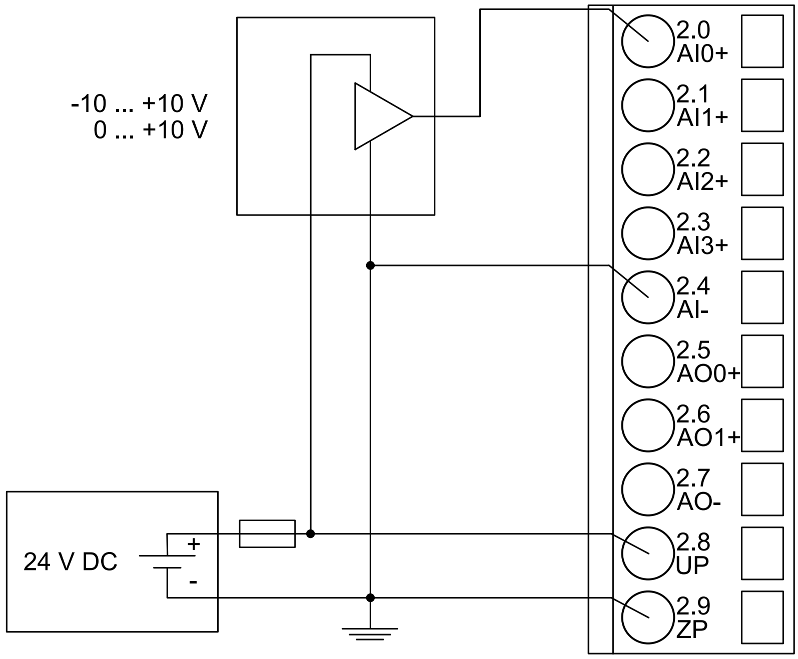


Fig. 107: Connection of active-type sensors (voltage) with no galvanically isolated power supply to the analog inputs

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 1.7.2.2.10 “Measuring ranges” on page 650* and Parameterization *Chapter 1.7.2.2.7 “Parameterization” on page 640*.

To avoid error messages, configure unused analog input channels 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 to AI3 in the same way.

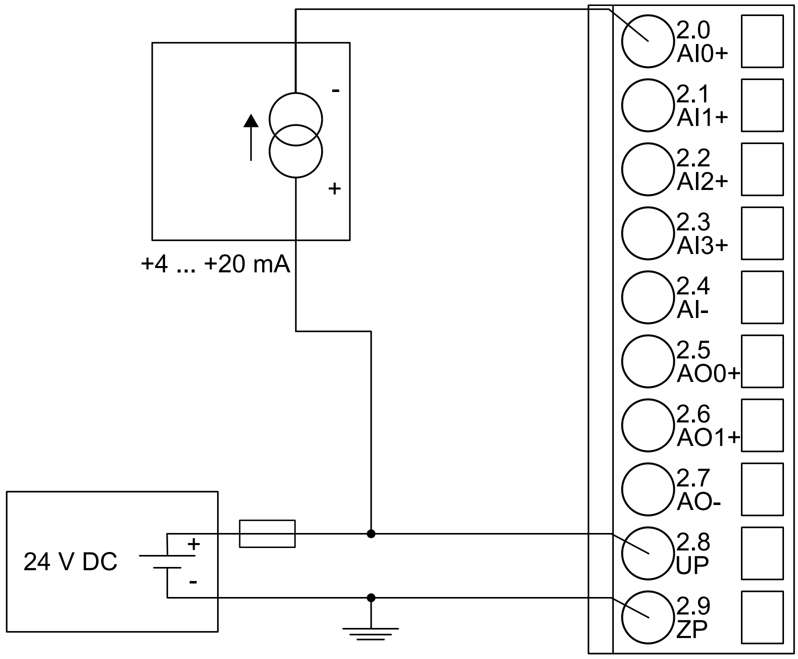


Fig. 108: Connection of passive-type analog sensors (current) to the analog inputs

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.

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.

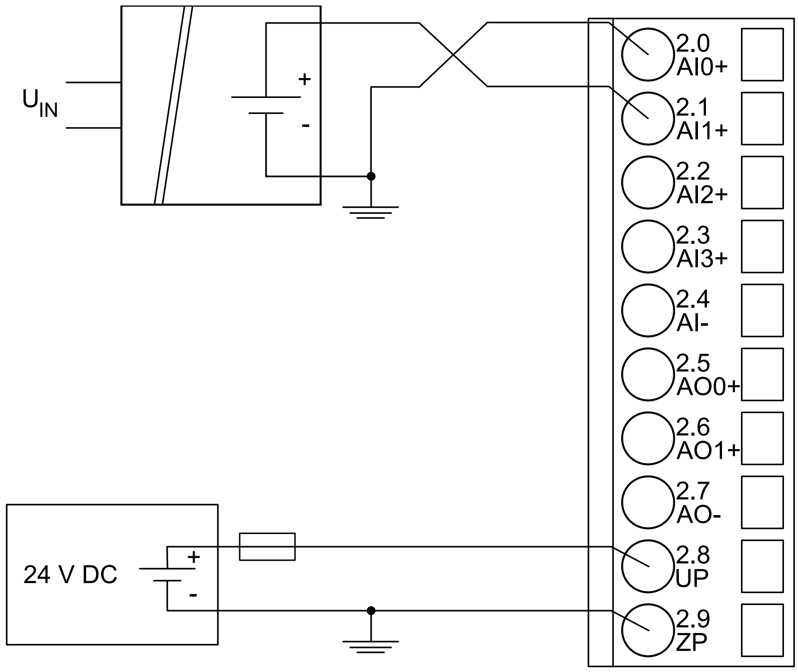


Fig. 109: Connection of active-type analog sensors (voltage) to differential analog inputs

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 1.7.2.2.10 “Measuring ranges” on page 650* and Parameterization *Chapter 1.7.2.2.7 “Parameterization” on page 640*.

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.

The following figure shows the connection of digital sensors to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

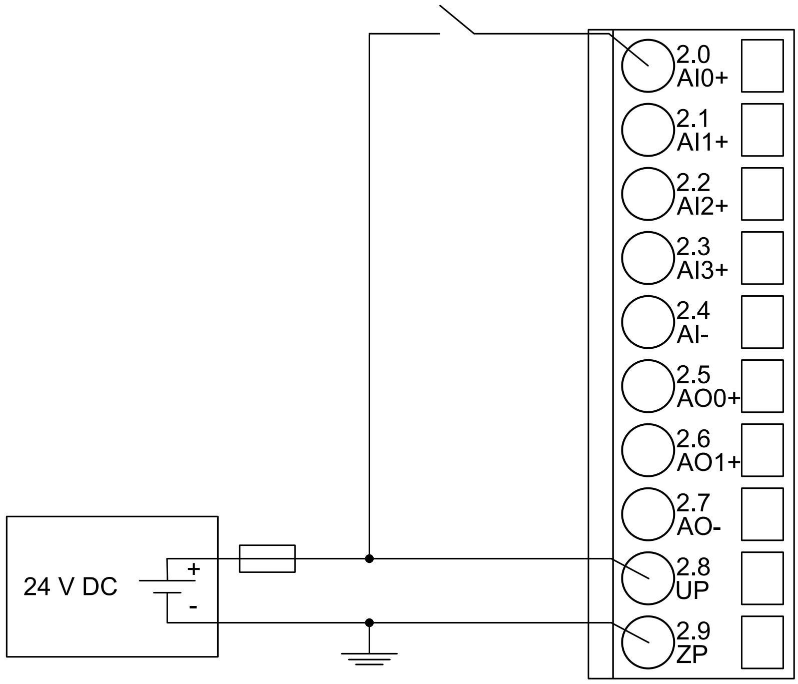


Fig. 110: Use of analog inputs as digital inputs

Digital input	24 V	1 channel used

For the measuring ranges that can be configured, please refer to the sections Measuring Ranges *Chapter 1.7.2.2.10 “Measuring ranges” on page 650* and Parameterization *Chapter 1.7.2.2.7 “Parameterization” on page 640*.

Connection of analog output loads (Voltage)

The following figure shows the connection of output loads to the analog output AO0. Proceed with the analog output AO1 in the same way.

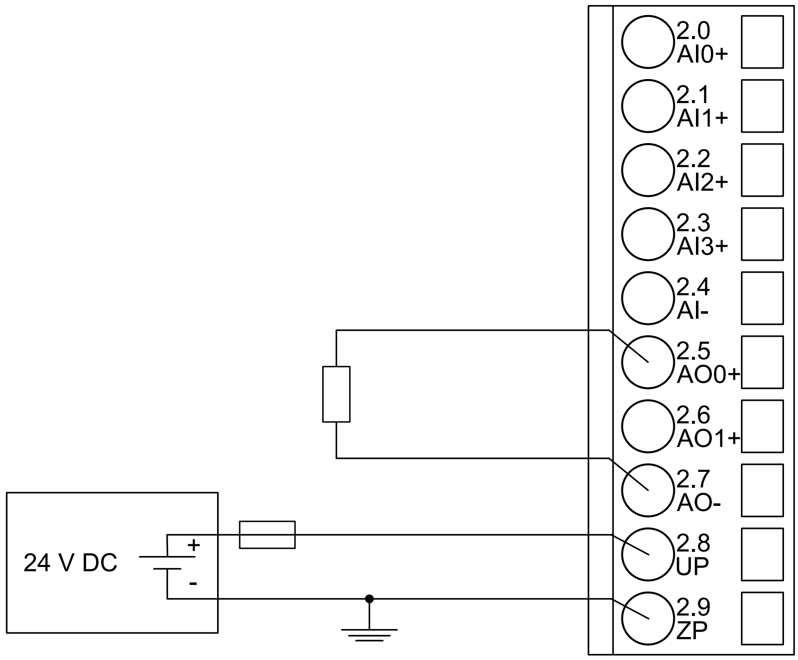


Fig. 111: Connection of analog output loads (voltage)

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 1.7.2.2.10 “Measuring ranges” on page 650* and Parameterization ↳ *Chapter 1.7.2.2.7 “Parameterization” on page 640*.

Unused analog outputs can be left open-circuited.

Connection of analog output loads (Current)

The following figure shows the connection of output loads to the analog output AO0. Proceed with the analog output AO1 in the same way.

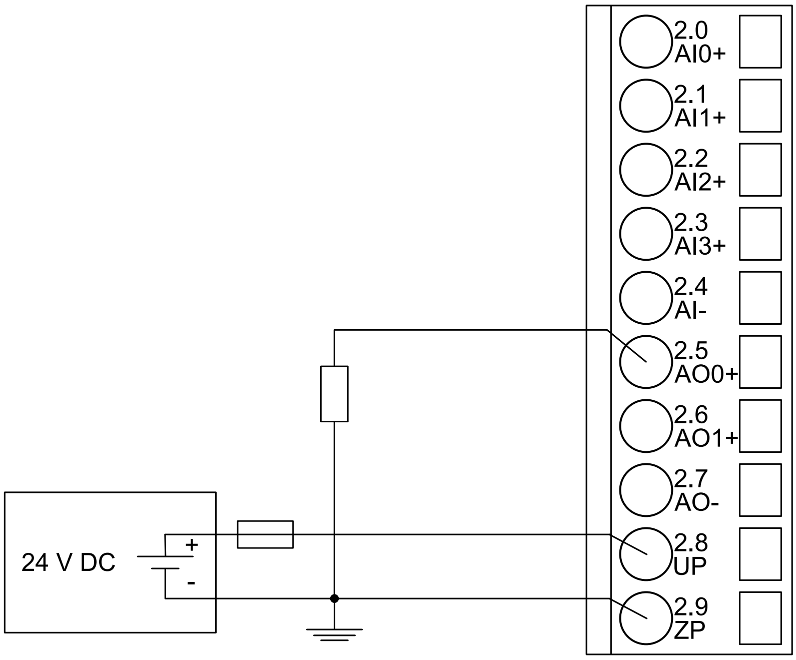


Fig. 112: Connection of analog output loads (current)

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 1.7.2.2.10 “Measuring ranges” on page 650* and Parameterization ↳ *Chapter 1.7.2.2.7 “Parameterization” on page 640*.

Unused analog outputs can be left open-circuited.

1.7.2.2.4 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

1.7.2.2.5 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.*

1.7.2.2.6 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.

1.7.2.2.7 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 640*)	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 1.6.1.2.9 “Fast counter” on page 349*.

Table 136: 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 137: 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...+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 138: Channel monitoring

Internal Value	Check Channel
0 (default)	Plausib(ility), cut wire, short circuit
3	Not used

Channel parameters for the analog outputs (2x)

Name	Value	Internal value	Internal value, type	Default
Output 0, Channel configuration	Operation modes of analog outputs	Operation modes of analog outputs	BYTE	0
Output 0, Check channel	Channel monitoring	Channel monitoring	BYTE	0
Output 0, Substitute value	Substitute value	Substitute value	WORD	0
Output 1, Channel configuration	Operation modes of analog outputs	Operation modes of analog outputs	BYTE	0
Output 1, Check channel	Channel monitoring	Channel monitoring	BYTE	0
Output 1, Substitute value	Substitute value	Substitute value	WORD	0

Table 139: Channel configuration - Operating modes of the analog outputs

Internal value	Operating Modes (individually configurable)
0 (default)	Not used
128	-10 V...+10 V
129	0...20 mA
130	4...20 mA

Table 140: Channel monitoring

Internal value	Check channel
0	Plausib(ility), cut wire, short circuit
3	None

Table 141: Substitute value

Intended Behavior of Output Channel when the Control System Stops	Required Setting of the Module Parameter "Behavior of Outputs in Case of a Communication Error"	Required Setting of the Channel Parameter "Substitute value"
Output OFF	Off	0
Last value infinite	Last value	0
Last value for 5 s and then turn off	Last value 5 sec	0
Last value for 10 s and then turn off	Last value 10 sec	0
Substitute value infinite	Substitute value	Depending on configuration

Intended Behavior of Output Channel when the Control System Stops	Required Setting of the Module Parameter "Behavior of Outputs in Case of a Communication Error"	Required Setting of the Channel Parameter "Substitute value"
Substitute value for 5 s and then turn off	Substitute value 5 sec	Depending on configuration
Substitute value for 10 s and then turn off	Substitute value 10 sec	Depending on configuration

Group parameters for the digital part

Name	Value	Internal value	Internal value, type	Default
Input delay	0.1 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.1 ms 0x00
Detect short circuit at outputs	Off On	0 1	BYTE	On 0x01
Behavior digital outputs at communcation error [1])	Off Last value Last value 5 sec Last value 10 sec Substitute value Substitute value 5 sec Substitute value 10 sec	0 1 6 11 2 7 12	BYTE	Off 0x00
Substitute value at output	0 ... 255	00h ... FFh	BYTE	0 0x00
Detect voltage overflow at outputs [2])	Off On	0 1	BYTE	Off 0x00
[1]) The parameter Behavior digital outputs at communcation error is only analyzed if the failsafe mode is ON. [2]) The state "externally voltage detected" appears if the output of a channel DC0..DC7 is to be switched on while an external voltage is connected *Chapter 1.7.2.2.3 "Connections" on page 623*. 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".				

1.7.2.2.8 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	Identi-fier 000..063	AC500-Display	<− Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 Bit 6..7	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4 Bit 0..5**	**CANopen diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-Identi-fier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
3	-	31	31	31	43	Internal error in the module	
3	-	31	31	31	36	Internal data exchange failure	
3	-	31	31	31	9	Overflow diagnosis buffer	Restart
3	-	31	31	31	26	Parameter error	Check Master
3	-	31	31	31	11	Process voltage UP too low	Check process supply voltage
3	-	31	31	31	45	Process voltage UP gone	Check process supply voltage
3	-	31/1...10	31	31	17	No communication with I/O module	Replace I/O module
3	-	1...10	31	31	32	Wrong I/O module type on socket	Replace I/O module / check configu-ration
4	-	1...10	31	31	31	At least one module does not support failsafe function	Check modules and parame-terization
4	-	31	31	31	46	Voltage feedback on activated digital outputs 4)	Check terminals
4	-	31/1...10	31	31	34	No response during initialization of the I/O module	Replace I/O module
4	-	31	31	31	11	Process voltage UP3 too low	Check process supply voltage

E1..E4	d1	d2	d3	d4	Identi-fier 000..063	AC500-Display	<− Display in
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 Bit 6..7	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4 Bit 0..5**	**CANopen diag-nosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error-Identi-fier**	**Error message**	**Remedy**
	[1])	**[2])**	**[3])**	**[4])**			
4	-	31	31	31	45	Process voltage UP3 gone	Check process supply voltage
4	-	31	31	31	10	Voltage overflow on outputs (above UP3 level) [5])	Check 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 (voltage feedback, description in 'Connections' *Chapter 1.7.2.2.3 “Connections” on page 623*). 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 (description in 'Connections' *Chapter 1.7.2.2.3 “Connections” on page 623*). 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.

1.7.2.2.9 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	---	---	---

LED	Color	OFF	ON	Flashing
CN-RUN	Green	---	Device configured, CANopen bus in OPERATIONAL state and cyclic data exchange running	Flashing: CANopen bus in PRE-OPERATIONAL state and slave is being configured Single flash: CANopen bus in STOPPED state. Flickering: Autodetect is active
CN-ERR	Red	No system error	CANopen Bus is OFF	Flashing: Configuration error Single flash: error counter overflow due to too many error frames Double flash: A node-guard or a heartbeat event occurred Flickering: Autodetect is active
S-ERR	Red	No error	Internal error	--
I/O bus	Green	No decentralized I/O modules connected or communication error	Decentralized I/O modules connected and operational	---

States of the 27 process LEDs:

LED	Color	OFF	ON	Flashing
AI0 to AI3	Yellow	Input is OFF	Input is ON (brightness depends on the value of the analog signal)	--
AO0 to AO1	Yellow	Output is OFF	Output is ON (brightness depends on the value of the analog signal)	--
DI0 to DI7	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--
DO0 toDO7	Yellow	Output is OFF	Output is ON	--
UP	Green	Process supply voltage missing	Process supply voltage OK and initialization finished	--

LED	Color	OFF	ON	Flashing
UP3	Green	Process supply voltage missing	Process supply voltage OK	--
CH-ERR1 to CH-ERR3	Red	No error or process supply voltage missing	Internal error	Error on one channel of the corresponding group

1.7.2.2.10 Measuring ranges

Input ranges voltage, current and digital input

Range	0...10 V	-10...+10 V	0...20 mA	4...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

The represented resolution corresponds to 16 bits.

Input ranges resistance temperature detector

Range	Pt100 / Pt1000 -50...400 °C	Ni1000 -50...150 °C	Digital value	
			Decimal	Hex.
Overflow	> 450.0 °C	> 160.0 °C	32767	7FFF
Measured value too high	450.0 °C : 400.1 °C		4500 : 4001	1194 : 0FA1

Range	**Pt100 / Pt1000** **-50...400 °C**	**Ni1000** **-50...150 °C**	**Digital value**	
			Decimal	**Hex.**
		160.0 °C : 150.1 °C	1600 : 1501	0640 : 05DD
			800 : 701	0320 : 02BD
Normal range	400.0 °C : : : 0.1 °C	150.0 °C : : 0.1 °C	4000 1500 700 : 1	0FA0 05DC 02BC : 0001
	0.0 °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...+10 V**	**0...20 mA**	**4...20 mA**	**Digital value**	
				Decimal	**Hex.**
Overflow	0 V	0 mA	0 mA	> 32511	> 7EFF
Measured value too high	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA	32511 : 27649	7EFF : 6C01
Normal range	10.0000 V : 0.0004 V	20.0000 mA : 0,0007 mA	20.0000 mA : 4.0006 mA	27648 : 1	6C00 : 0001
	0.0000 V	0.0000 mA	4.0000 mA	0	0000
	-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA	-1 -6912 -27648	FFFF E500 9400

Range	-10...+10 V	0...20 mA	4...20 mA	Digital value	
				Decimal	**Hex.**
Measured value too low	-10.0004 V : -11.7589 V	0 mA : 0 mA	0 mA : 0 mA	-27649 : -32512	93FF : 8100
Underflow	0 V	0 mA	0 mA	< -32512	< 8100

The represented resolution corresponds to 16 bits.

1.7.2.2.11 Technical data

The system data of AC500 and S500 ↯ *Chapter 2.6.1 "System data AC500" on page 971* are applicable to the standard version.

The system data of AC500-XC ↯ *Chapter 2.7.1 "System data AC500-XC" on page 1023* are applicable to the XC version.

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 to DI7	Terminals 3.0 to 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...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

Parameter	Value
Input voltage +15 V	> 2 mA
Input voltage +30 V	< 8 mA
Max. cable length	
Shielded	1000 m
Unshielded	600 m

Technical data of the digital outputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DO0 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

The following drawing shows the circuitry of a digital input/output with the varistors for demagnetization when inductive loads are switched off.

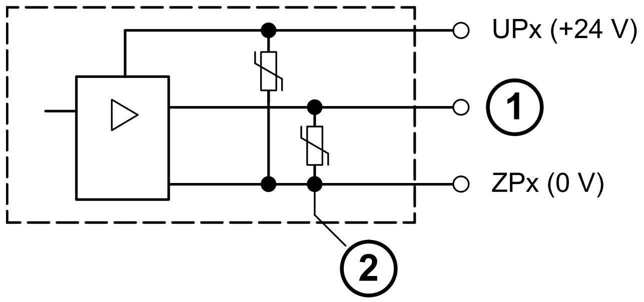


Fig. 113: Digital input/output (circuit diagram)

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+ 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 + sign Range 0...20 mA: 12 bits Range 4...20 mA: 12 bits Range RTD (Pt100, PT1000, Ni1000): 0.1 °C

Parameter	Value
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ. 0.5 %, max. 1 %
Relationship between input signal and hex code	Tables Input Ranges Voltage, Current ➪ *Chapter 1.7.2.2.10.1 “Input ranges voltage, current and digital input” on page 650* and Digital Input and IInput range resistance temperature detector ➪ *Chapter 1.7.2.2.10.2 “Input ranges resistance temperature detector” on page 650*
Unused inputs	Are configured as "unused" (default value)
Overvoltage protection	Yes

Technical data of the analog inputs if used as digital inputs

Parameter		Value
Number of channels per module		Max. 4
Distribution of channels into groups		1 group of 4 channels
Connections of the channels AI0+ to AI3+		Terminals 2.0 to 2.3
Reference potential for the inputs		Terminals 2.9, 3.9 and 4.9 (ZP)
Indication of the input signals		1 LED per channel
Input signal voltage		24 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

Parameter		Value
	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 (+ 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		See *Chapter 1.7.2.2.10.3 “Output ranges voltage and current” on page 651*
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 1.6.1.2.9 “Fast counter” on page 349*
Operating modes	Operating modes *Chapter 1.6.1.2.9 “Fast counter” on page 349*

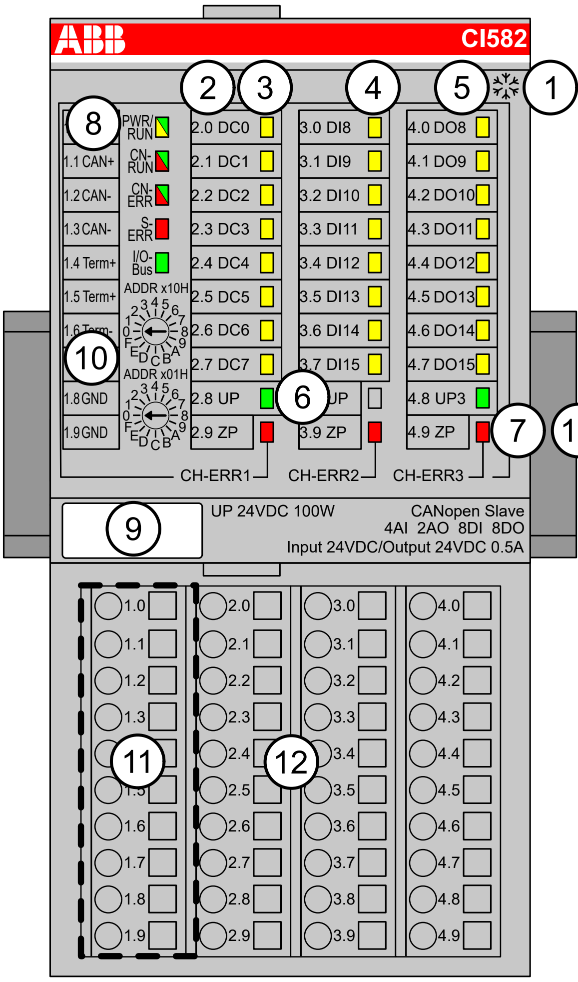
1.7.2.2.12 Ordering data

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.

1.7.2.3 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

1.7.2.3.1 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.

1.7.2.3.2 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 132 “CANopen” on page 617*.
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

Parameter		**Value**
Ambient temperature		System data AC500 *Chapter 2.6.1 “System data AC500” on page 971* System data AC500 XC *Chapter 2.7.1 “System data AC500-XC” on page 1023*
Current consumption		UP: 0.2 A UP3: 0.06 A + 0.5 A max. per output
Weight (without terminal unit)		Ca. 125 g
Process supply voltages UP/UP3		
	Rated value	24 V DC (for inputs and outputs)
	Max. load for the terminals	10 A
	Protection against reversed voltage	Yes
	Rated protection fuse on UP/UP3	10 A fast
	Galvanic isolation	CANopen interface against the rest of the module
	Inrush current from UP (at power up)	On request
	Current consumption via UP (normal operation)	0.2 A
	Current consumption via UP3	0.06 A + 0.5 A max. per output
	Connections	Terminals 2.8 and 3.8 for +24 V (UP) Terminal 4.8 for +24 V (UP3) Terminals 2.9, 3.9 and 4.9 for 0 V (ZP)
Max. power dissipation within the module		6 W
Reference potential for all digital inputs and outputs		Negative pole of the supply voltage, signal name ZP
Setting of the CANopen Node ID identifier		With 2 rotary switches at the front side of the module
Mounting position		Horizontal 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 switchgear 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 1.5.3 “TU517 and TU518 for communication interface modules” on page 132*

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.)

1.7.2.3.3 Connections

The CANopen communication interface module is plugged on the I/O terminal units TU517 ↳ *Chapter 1.5.3 “TU517 and TU518 for communication interface modules” on page 132* or TU518 ↳ *Chapter 1.5.3 “TU517 and TU518 for communication interface modules” on page 132* 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

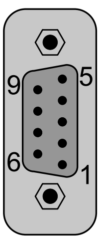
> *For a detailed description of the mounting, disassembly and connection of the module, please refer to the System Assembly, Construction and Connection chapter ↳ Chapter 2.6 “AC500 (Standard)” on page 971.*

> *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.

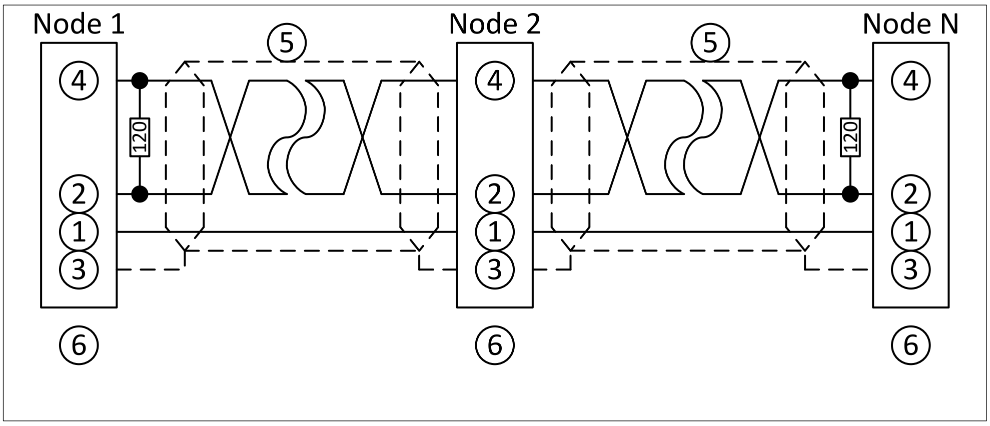


Fig. 114: CANopen interface, bus terminating resistors connected to the line ends

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

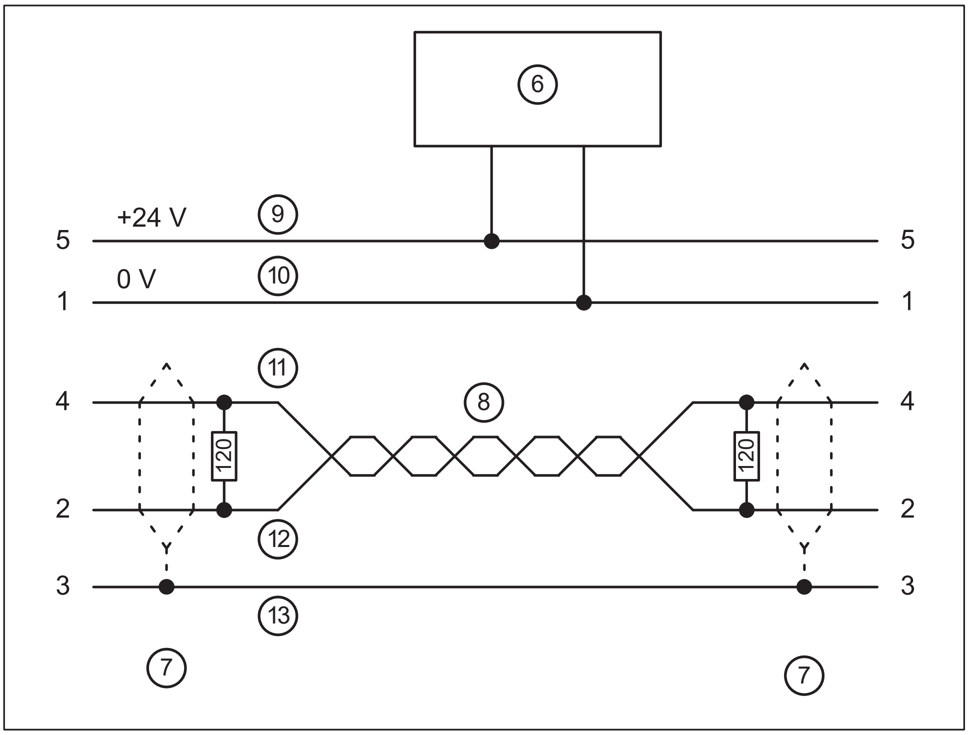


Fig. 115: DeviceNet interface, bus terminating resistors connected to the line ends

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. Please refer to *Chapter 2.6.1 “System data AC500” on page 971.*

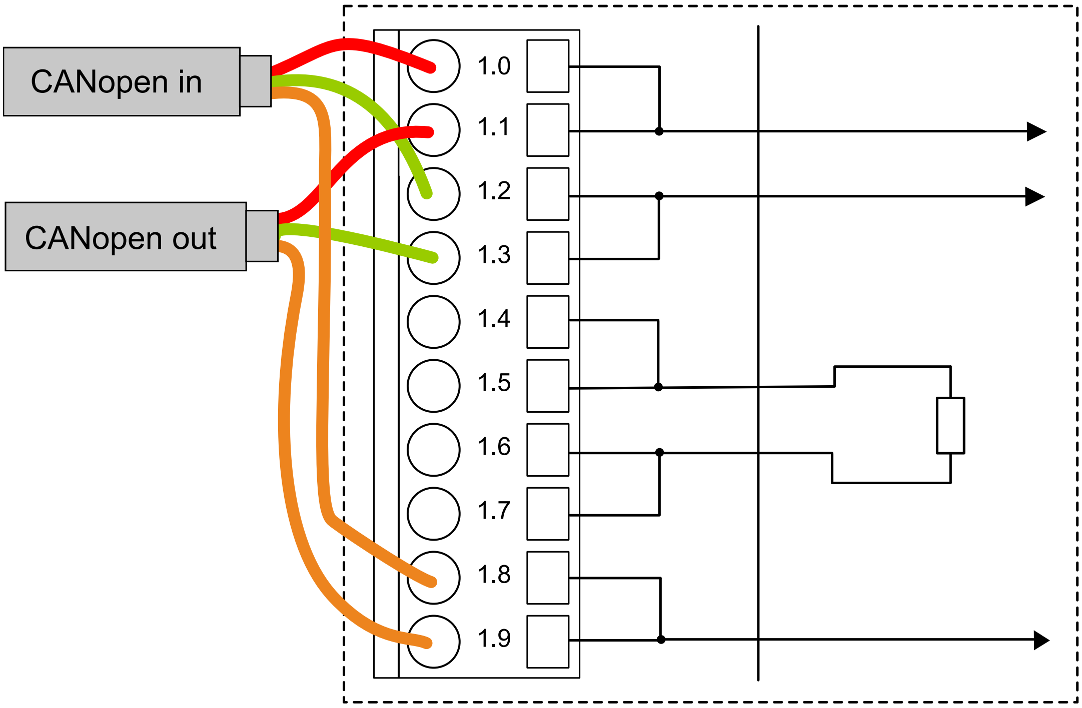
Mounting on terminal units TU517 or TU518

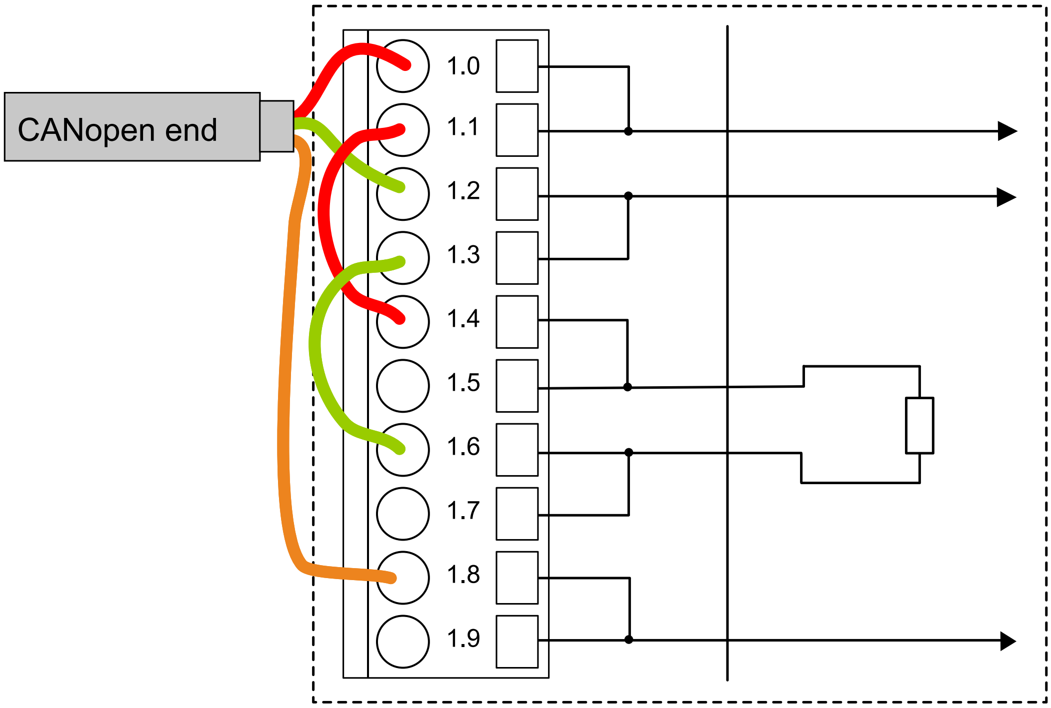
Table 142: Assignment of the terminals

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 switchgear cabinet. Please refer to the AC500 System-Data *Chapter 2.6.1 “System data AC500” on page 971**.*

Table 143: Assignment of the other terminals

Terminal	Signal	Description
2.0	DC0	Signal of the configurable digital input/output DC0
2.1	DC1	Signal of the configurable digital input/output DC1
2.2	DC2	Signal of the configurable digital input/output DC2
2.3	DC3	Signal of the configurable digital input/output DC3
2.4	DC4	Signal of the configurable digital input/output DC4
2.5	DC5	Signal of the configurable digital input/output DC5
2.6	DC6	Signal of the configurable digital input/output DC6
2.7	DC7	Signal of the configurable digital input/output DC7
2.8	UP	Process voltage UP (24 V DC)
2.9	ZP	Process voltage ZP (0 V DC)
3.0	DI8	Signal of the digital input DI8
3.1	DI9	Signal of the digital input DI9
3.2	DI10	Signal of the digital input DI10
3.3	DI11	Signal of the digital input DI11
3.4	DI12	Signal of the digital input DI12
3.5	DI13	Signal of the digital input DI13
3.6	DI14	Signal of the digital input DI14
3.7	DI15	Signal of the digital input DI15
3.8	UP	Process voltage UP (24 V DC)
3.9	ZP	Process voltage ZP (0 V DC)
4.0	DO8	Signal of the digital output DO8
4.1	DO9	Signal of the digital output DO9
4.2	DO10	Signal of the digital output DO10
4.3	DO11	Signal of the digital output DO11
4.4	DO12	Signal of the digital output DO12
4.5	DO13	Signal of the digital output DO13
4.6	DO14	Signal of the digital output DO14
4.7	DO15	Signal of the digital output DO15
4.8	UP3	Process voltage UP3 (24 V DC)
4.9	ZP	Process voltage ZP (0 V DC)

WARNING!

Removal/Insertion under power

The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

Make sure that all voltage sources (supply and process voltage) are switched off before 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 CANopen communication interface module CI582-CN:

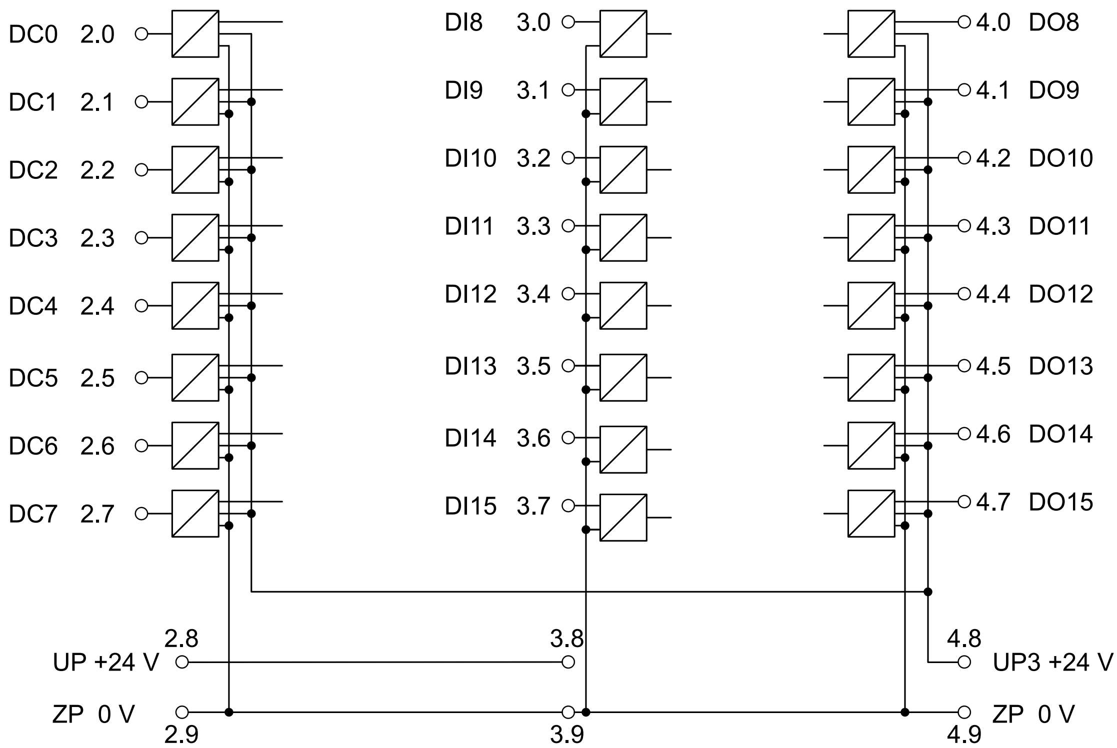


Fig. 116: Connection of the communication interface module CI582-CN

For a description of the meaning of the LEDs, please refer to the section for the state LEDs
Chapter 1.7.2.3.9 “State LEDs” on page 674.

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

The following figure shows the connection of the digital input DI8. Proceed with the digital inputs DI9 to DI15 in the same way.

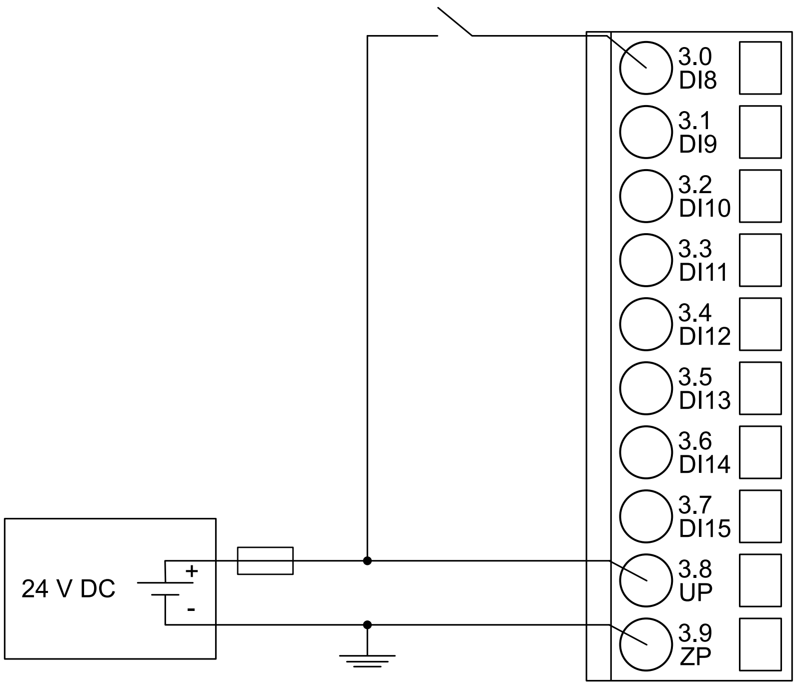


Fig. 117: Connection of the digital inputs to the module CI582-CN

Connection of the digital outputs

The following figure shows the connection of the digital output DO8. Proceed with the digital outputs DO9 - DO15 in the same way.

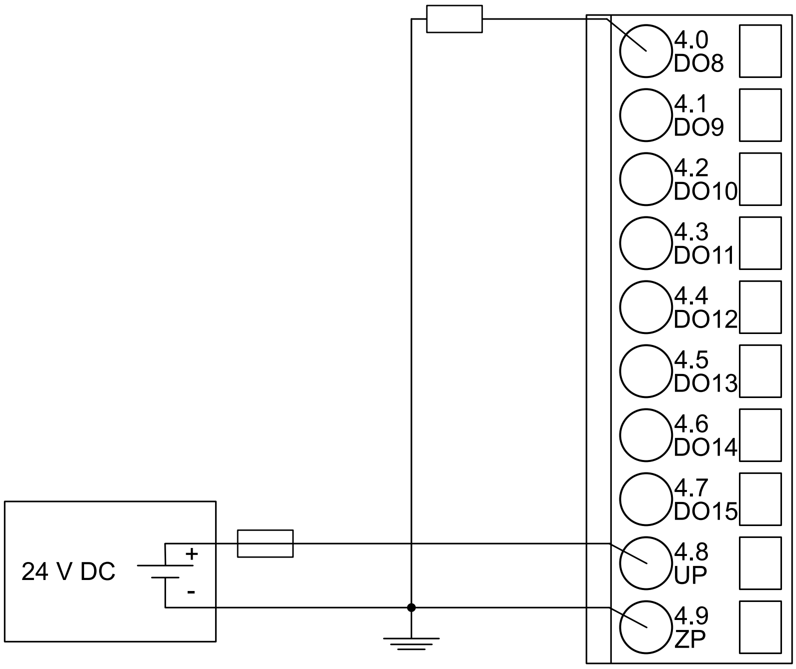


Fig. 118: Connection of configurable digital inputs/outputs to the module CI582-CN

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 to DC7 in the same way.

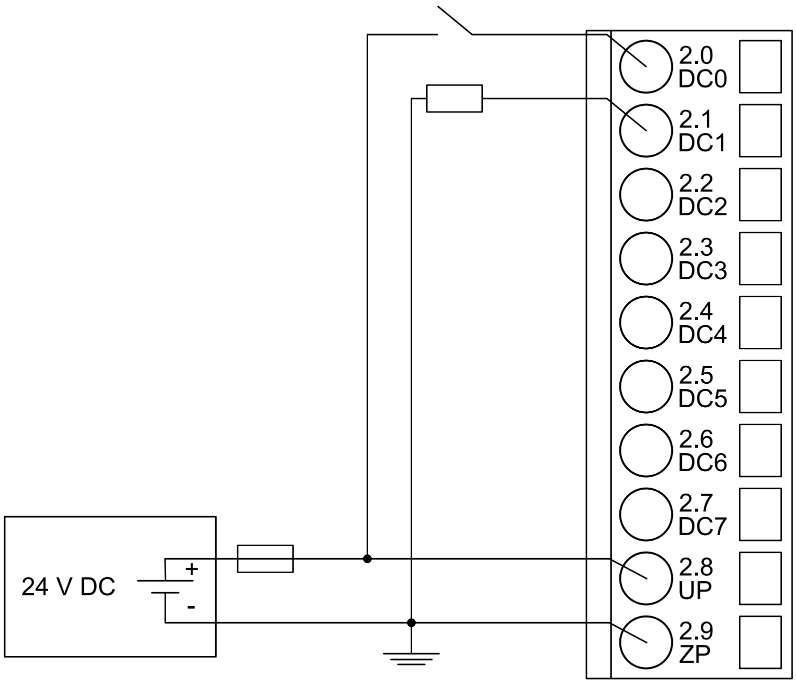


Fig. 119: Connection of configurable digital inputs/outputs to the module CI582-CN

1.7.2.3.4 Internal data exchange

Parameter	Value
Digital inputs (bytes)	5
Digital outputs (bytes)	5
Counter input data (words)	4
Counter output data (words)	8

1.7.2.3.5 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.*

1.7.2.3.6 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.

1.7.2.3.7 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 / failsafe function table error LED / failsafe function ↳ *Table 144 “Error LED / Failsafe function” on page 669*)	On	0	BYTE	0
	Off by E4	1		
	Off by E3	2		
	On + failsafe	16		
	Off by E4 + failsafe	17		
	Off by E3 + failsafe	18		
Reserved	0	0	ARRAY of 24 BYTES	
Check supply	On	0	BYTE	
	Off	1		1

Name	Value	Internal value	Internal value, type	Default
Fast counter	0	0	BYTE	0
	:	:		
	10 [2])	10		

[1]) With a faulty ID, the module reports a "parameter error" and does not perform cyclic process data transmission.

[2]) For a description of the counter operating modes, please refer to the 'Fast Counter' section *Chapter 1.6.1.2.9 “Fast counter” on page 349*.

Table 144: Error LED / Failsafe function

Setting	Description
On	Error LED (S-ERR) lights up at errors of all error classes, failsafe mode off
Off by E4	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, failsafe mode off
Off by E3	Error LED (S-ERR) lights up at errors of error classes E1 and E2, failsafe mode off
On + Failsafe	Error LED (S-ERR) lights up at errors of all error classes, failsafe mode on *)
Off by E4 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1, E2 and E3, failsafe mode on *)
Off by E3 + Failsafe	Error LED (S-ERR) lights up at errors of error classes E1 and E2, failsafe mode on *)
*) The parameter Behavior DO at comm. error is only analyzed if the failsafe mode is ON.	

Group parameters for the digital part

Name	Value	Internal value	Internal value, type	Default
Input delay	0.1 ms	0	BYTE	0.1 ms
	1 ms	1		0x00
	8 ms	2		
	32 ms	3		
Detect short circuit at outputs	Off	0	BYTE	On
	On	1		0x01
Behavior DO at comm. error [1])	Off	0	BYTE	Off
	Last value	1		0x00
	Last value 5 sec	6		
	Last value 10 sec	11		
	Substitute value	2		
	Substitute value 5 sec	7		
	Substitute value 10 sec	12		

Name	Value	Internal value	Internal value, type	Default
Substitute value at output	0 ... 65535	0000h ... FFFFh	WORD	0 0x0000
Preventive voltage feedback monitoring for DC0..DC7 [2])	Off On	0 1	BYTE	Off 0x00
Detect voltage overflow at outputs [3])	Off On	0 1	BYTE	Off 0x00

Remarks:

[1])	The parameter Behavior DO at comm. error is applied to DC and DO channels and only analyzed if the failsafe mode is ON.
[2])	The state "externally voltage detected" appears if the output of a channel DC0..DC7 is to be switched on while an external voltage is connected. In this case, start-up is disabled while the externally voltage is connected. The monitoring of this state and the resulting diagnosis message can be disabled by setting the parameters to "OFF".
[3])	The error state "voltage overflow at outputs" appears if external voltage at digital outputs DC0..DC7 and DO0..DO7 has exceeded the process supply voltage UP3 (see 'Connections' *Chapter 1.7.2.3.3 "Connections" on page 660*). 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.

1.7.2.3.8 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

Byte Number	Description	Possible Values
4	Diagnosis byte, error code	According to the I/O bus specification Bit 7 and bit 6, coded error class 0 = E1 1 = E2 2 = E3 3 = E4 Bit 0 to Bit 5, coded error description
5	Diagnosis byte, flags	According to the I/O bus specification Bit 7: 1 = coming error Bit 6: 1 = leaving error

In cases of short circuit or overload, the digital outputs are turned off. The module performs reactivation automatically. Thus, an acknowledgement of the errors is not necessary. The error message is stored via the LED.

E1..E4	d1	d2	d3	d4	Identi-fier 000..063	AC500 display	<− Display in
Class	Comp	Dev	Mod	Ch	Err	PS501 PLC Browser	
Byte 4 Bit 6..7	-	Byte 1	Byte 2	Byte 3	Byte 4 Bit 0..5	CANopen diag-nosis block	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error identi-fier**	**Error message**	**Remedy**
	1)	2)	3)	4)			
Module errors							
3	-	31	31	31	19	Checksum error in the I/O module	Replace I/O module
3	-	31	31	31	3	Timeout in the I/O module	
3	-	31	31	31	40	Different hard-/firm-ware versions in the module	
3	-	31	31	31	43	Internal error in the module	
3	-	31	31	31	36	Internal data exchange failure	
3	-	31	31	31	9	Overflow diagnosis buffer	Restart
3	-	31	31	31	26	Parameter error	Check Master

E1..E4	**d1**	**d2**	**d3**	**d4**	**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	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	45	Process voltage UP3 too low	Check process voltage
4	-	31	31	31	46	Voltage feedback on activated digital outputs 4)	Check terminals
4	-	31/1...10	31	31	34	No response during initialization of the I/O module	Replace I/O module
4	-	31	31	31	11	Process voltage UP3 too low	Check process supply voltage
4	-	31	31	31	45	Process voltage UP3 gone	Check process supply voltage

E1..E4	**d1**	**d2**	**d3**	**d4**	**Identi-fier** **000..063**	**AC500 display**	**<- Display in**
Class	**Comp**	**Dev**	**Mod**	**Ch**	**Err**	**PS501 PLC Browser**	
Byte 4 **Bit 6..7**	**-**	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4** **Bit 0..5**	**CANopen diagnosis block**	
Class	**Inter-face**	**Device**	**Module**	**Channel**	**Error** **identi-fier**	**Error message**	**Remedy**
	1)	**2)**	**3)**	**4)**			
4	-	31	31	31	10	Voltage overflow on outputs (above UP3 level) 5)	Check termi-nals/ check process supply voltage
Channel error digital							
4	-	31	2	8...15	46	Externally voltage detected at digital output DO0..DO7 6)	Check terminals
4	-	31	4	0...7	46	Externally voltage detected at digital output DC0..DC7 6)	Check terminals
4	-	31	4	0...7	47	Short circuit at digital output DC0..DC7 7)	Check terminals
4	-	31	2	8...15	47	Short circuit at digital output DO0..DO7 7)	Check terminals

Remarks:

1)	In AC500, the following interface identifier applies: "-" = Diagnosis via bus-specific function blocks; 0 ... 4 or 10 = position of the communication module;14 = I/O bus; 31 = module itself The identifier is not contained in the CI542-DP diagnosis block.
2)	With "Device" the following allocation applies: 31 = module itself, 1..10 = expansion module
3)	With "Module" the following allocation applies depending on the master: Module error: 31 = module itself Channel error: module type (1 = AI, 2 = DO, 3 = AO)
4)	This message appears if external voltages at one or more terminals DC0..DC7 or DO0..DO7 cause other digital outputs to be supplied by that voltage (voltage feedback, see 'Connections' *Chapter 1.7.2.3.3 “Connections” on page 660*). 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 (see 'Connections' *Chapter 1.7.2.3.3 “Connections” on page 660*). 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.

1.7.2.3.9 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
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

LED	Color	OFF	ON	Flashing
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 to DC7	Yellow	Input/output is OFF	Input/output is ON	--
DI8 to DI15	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--
DO8 to 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

1.7.2.3.10 Technical data

The system data of AC500 and S500 *Chapter 2.6.1 “System data AC500” on page 971* are applicable to the standard version.

The system data of AC500-XC *Chapter 2.7.1 “System data AC500-XC” on page 1023* are applicable to the XC version.

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 to DI7	Terminals 3.0 to 3.7
Reference potential for all inputs	Terminals 2.9 ... 4.9 (negative pole of the supply voltage, signal name ZP)

Parameter	Value
Indication of the input signals	1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)	Type 1
Input delay (0->1 or 1->0)	Typ. 0.1 ms, configurable from 0.1...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

Parameter	Value
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.

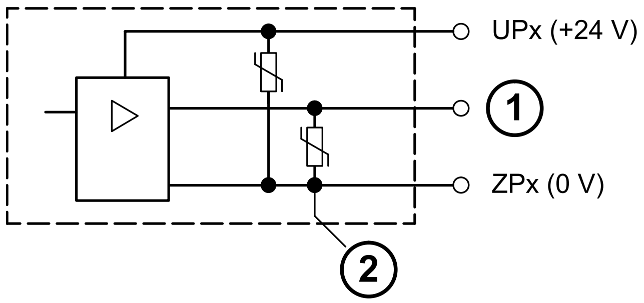


Fig. 120: Digital input/output (circuit diagram)

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...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 1.7.2.3.10 “Technical data” on page 675*. 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 1.7.2.3.10 “Technical data” on page 675*. 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.

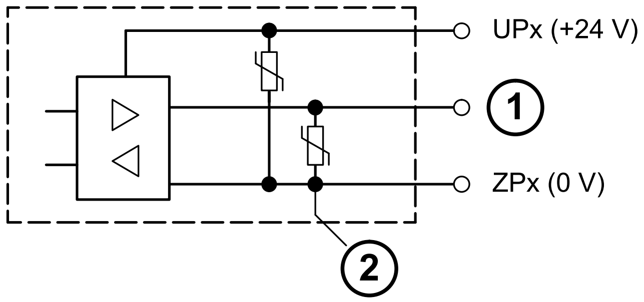


Fig. 121: Digital input/output (circuit diagram)

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 1.6.1.2.9 “Fast counter” on page 349*
Operating modes	Operating modes *Chapter 1.6.1.2.9 “Fast counter” on page 349*

1.7.2.3.11 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

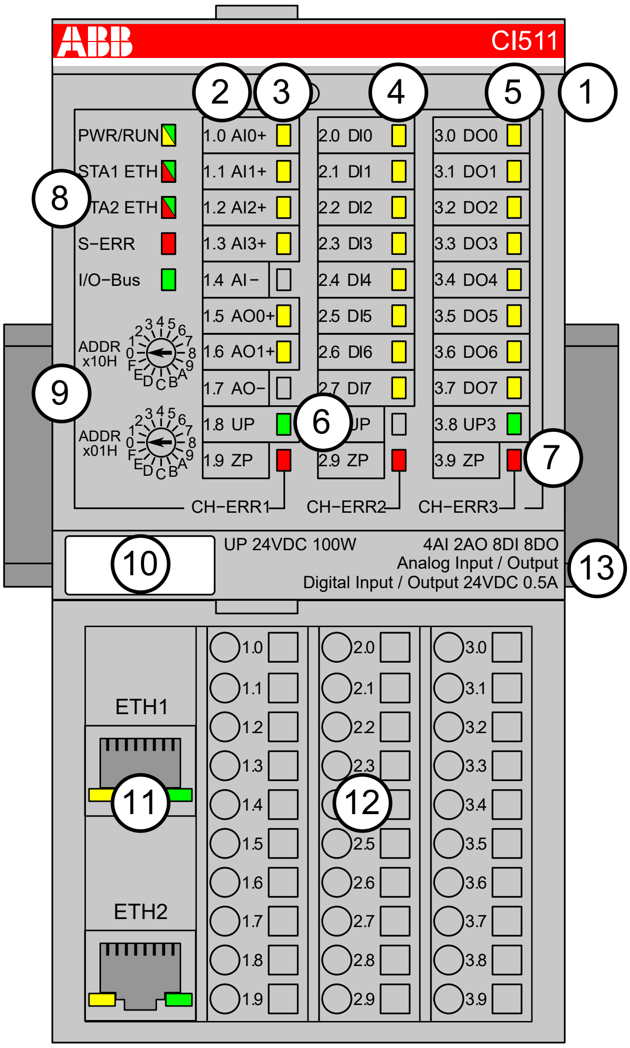
**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.7.3 EtherCAT

1.7.3.1 CI511-ETHCAT

- 4 analog inputs (resolution 12 bits plus sign)
- 2 analog outputs (resolution 12 bits plus 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

1.7.3.1.1 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.

1.7.3.1.2 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 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 1.5.1 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 122*

1.7.3.1.3 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 System Assembly, Construction and Connection chapter* *Chapter 2.6 “AC500 (Standard)” on page 971.*

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 to 1.3	AI0 to AI3	Positive pole of the 4 analog inputs
1.4	AI-	Negative pole of the analog inputs
1.5 to 1.6	AO0 to AO1	Positive pole of the 2 analog outputs
1.7	AO-	Negative pole of the analog outputs
2.0 to 2.7	DI0 to DI7	8 digital inputs
3.0 to 3.7	DO0 to 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 (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 disturbances, no high requirement on precision), the shielding can also be omitted.

The following figures show the connection of the Ethernet communication interface module CI511-ETHCAT.

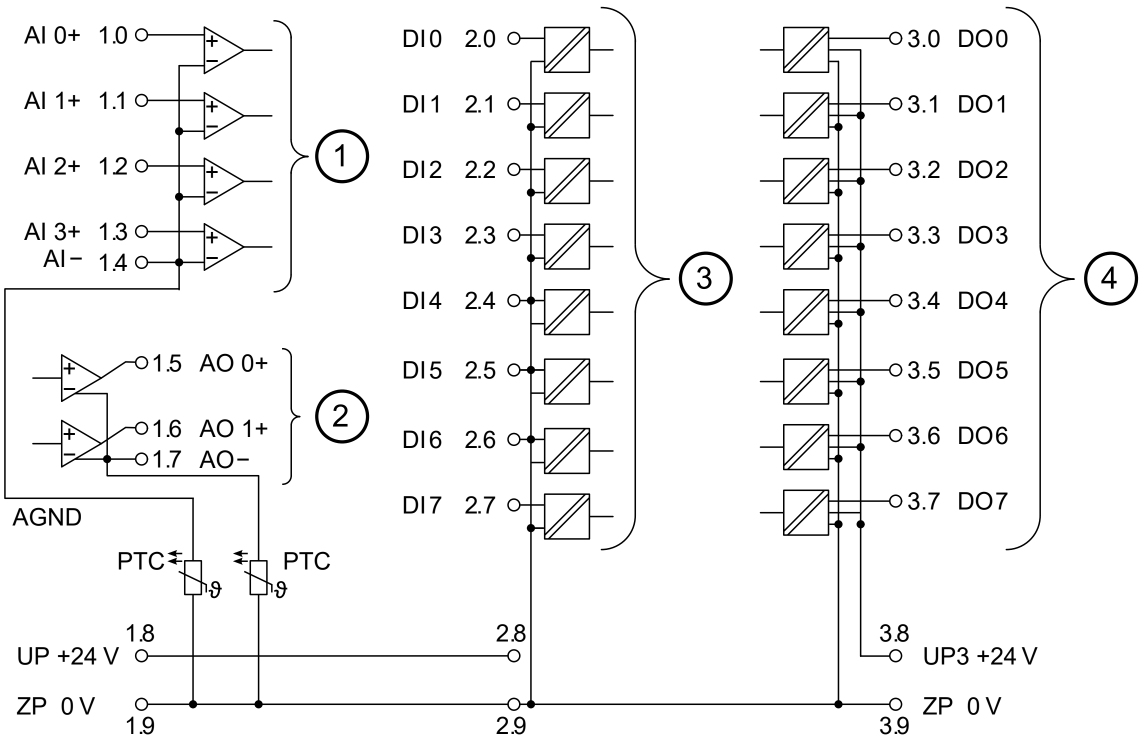


Fig. 122: Connection of the communication interface module CI511-ETHCAT

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 1.7.3.1.8 “Diagnosis” on page 700*.

The measuring ranges are described in the section Measuring Ranges ␦ *Chapter 1.7.3.1.7 “Parameterization” on page 694* ␦ *Chapter 1.7.3.1.10 “Measuring ranges” on page 703*.

The function of the LEDs is described in the section State LEDs ␦ *Chapter 1.7.3.1.8 “Diagnosis” on page 700*.

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.

The following figure shows the connection of resistance thermometers in 2-wire configuration.

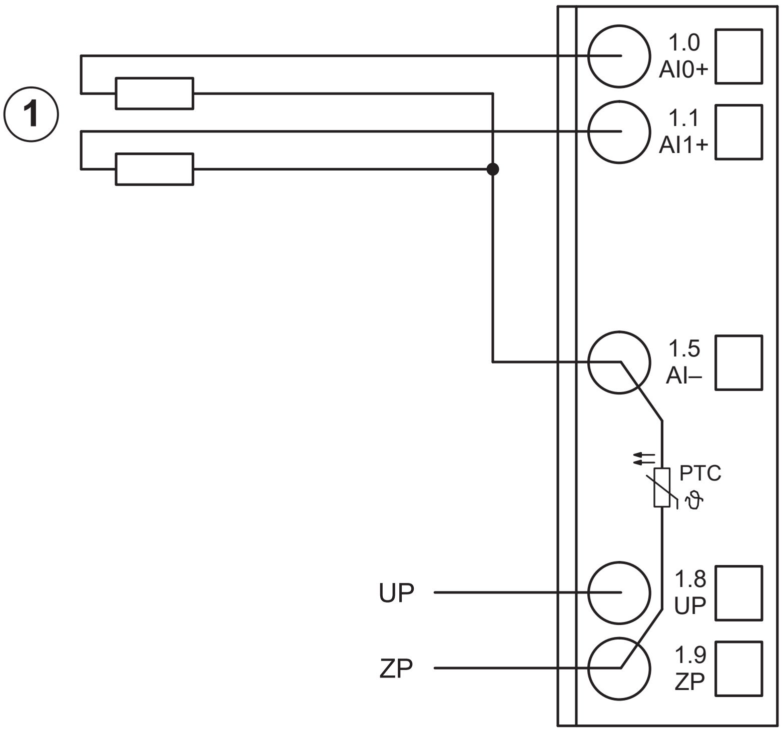


Fig. 123: Connection of resistance thermometers in 2-wire configuration

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 1.7.3.1.7 “Parameterization” on page 694* ␗ *Chapter 1.7.3.1.10 “Measuring ranges” on page 703*.

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.

The following figure shows the connection of resistance thermometers in 3-wire configuration.

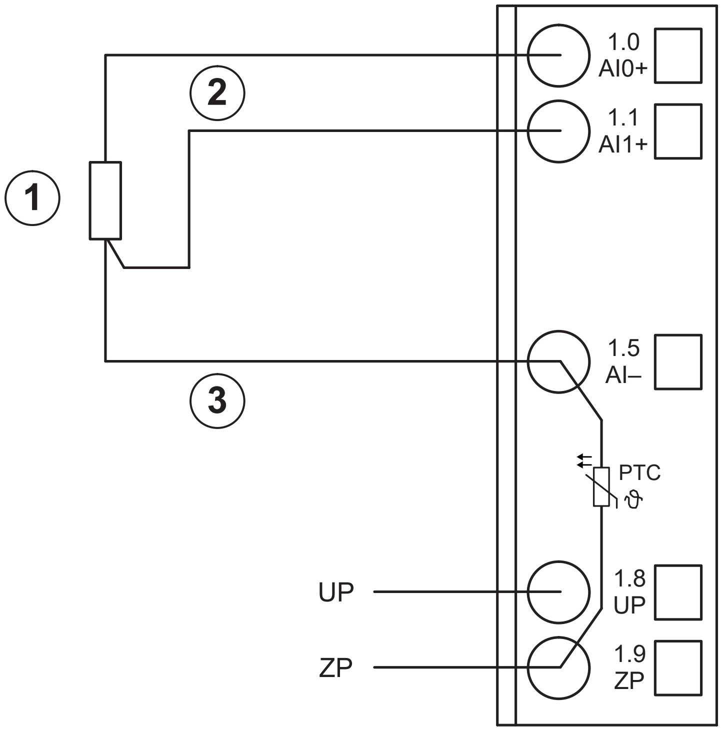


Fig. 124: Connection of resistance thermometers in 3-wire configuration

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 1.7.3.1.7 “Parameterization” on page 694* *Chapter 1.7.3.1.10 “Measuring ranges” on page 703*.

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

The following figure shows the connection of active-type analog sensors (voltage) with galvanically isolated power supply

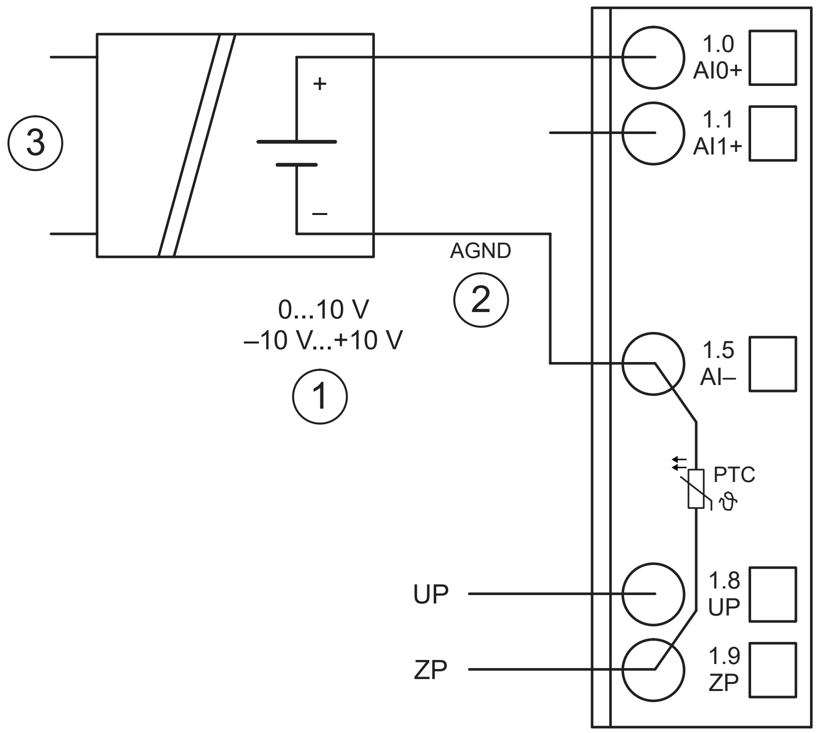


Fig. 125: Connection of active-type analog sensors (voltage) with galvanically isolated power supply

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 1.7.3.1.7 “Parameterization” on page 694* ⇘ *Chapter 1.7.3.1.10 “Measuring ranges” on page 703*.

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 figure shows the connection of active-type analog sensors (current) with galvanically isolated power supply.

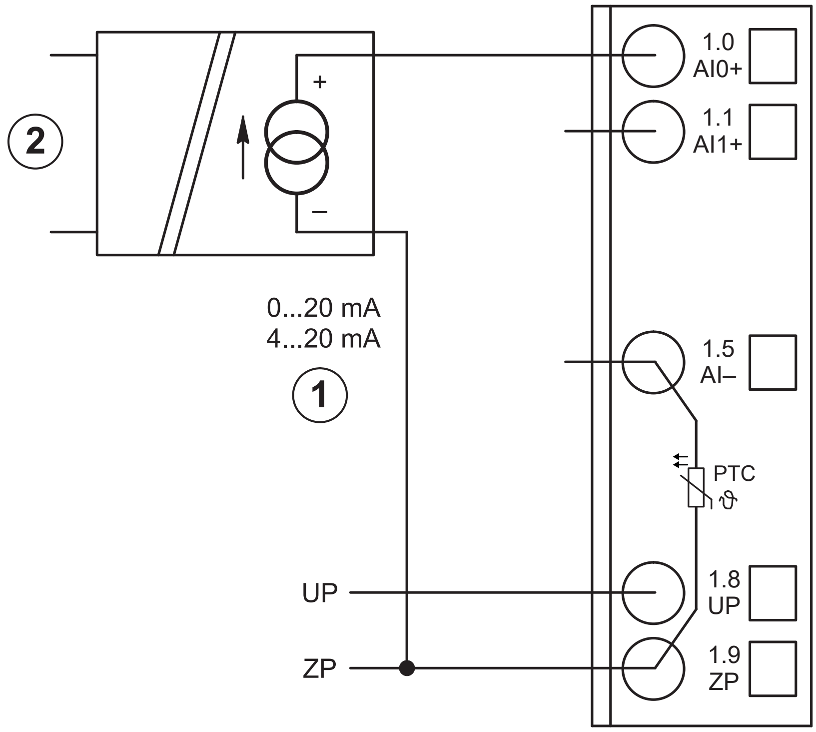


Fig. 126: Connection of active-type analog sensors (current) with galvanically isolated power supply

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 1.7.3.1.7 “Parameterization” on page 694* ⇘ *Chapter 1.7.3.1.10 “Measuring ranges” on page 703*.

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

The following figure shows the connection of active-type sensors (voltage) with no galvanically isolated power supply.

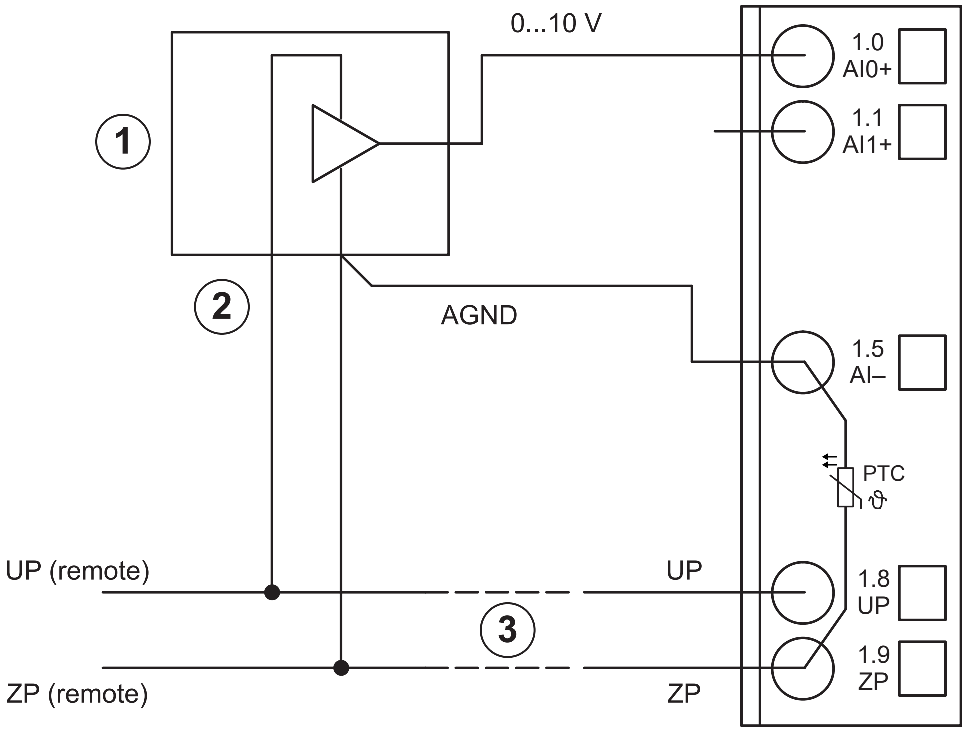


Fig. 127: Connection of active-type sensors (voltage) with no galvanically isolated power supply

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 1.7.3.1.7 “Parameterization” on page 694* *Chapter 1.7.3.1.10 “Measuring ranges” on page 703*.

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)

The following figure shows the connection of passive-type analog sensors (current).

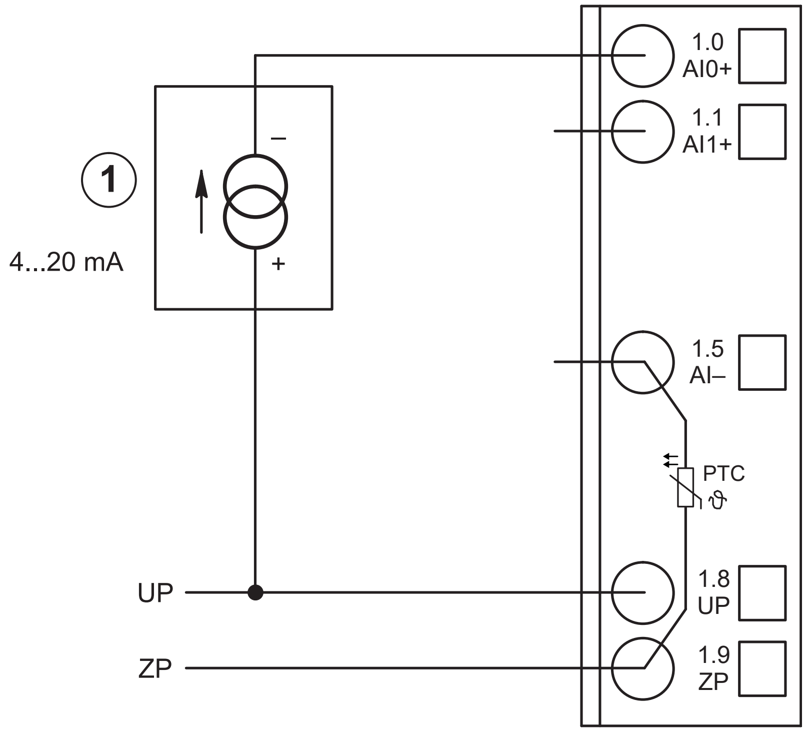


Fig. 128: Connection of passive-type analog sensors (current)

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 1.7.3.1.7 "Parameterization" on page 694* ➪ *Chapter 1.7.3.1.10 "Measuring ranges" on page 703*.

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 I-). 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

The following figure shows the connection of active-type analog sensors (voltage) to differential inputs.

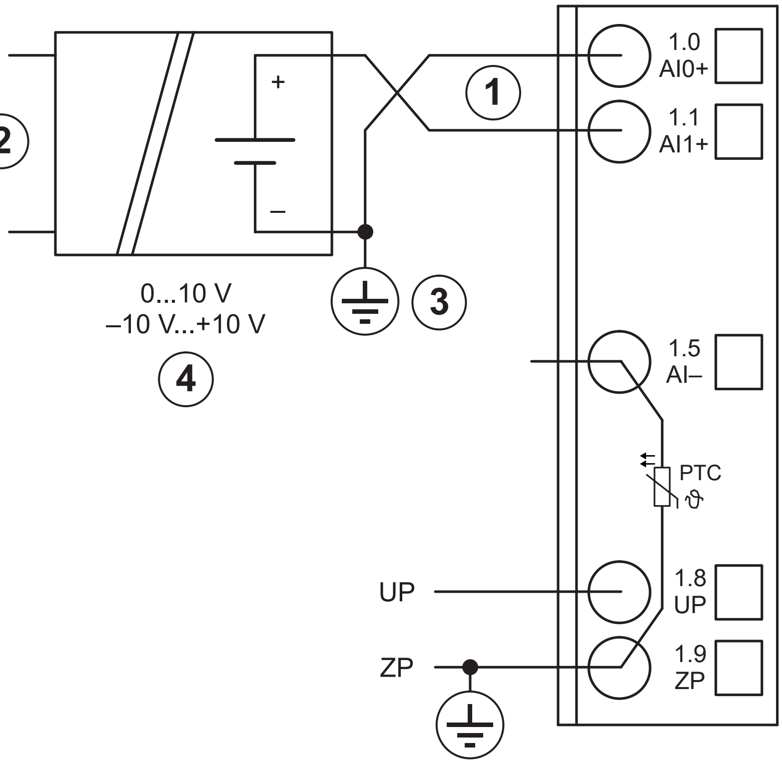


Fig. 129: Connection of active-type analog sensors (voltage) to differential inputs

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 1.7.3.1.7 “Parameterization” on page 694* *Chapter 1.7.3.1.10 “Measuring ranges” on page 703*.

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.

The following figure shows the use of analog inputs as digital inputs.

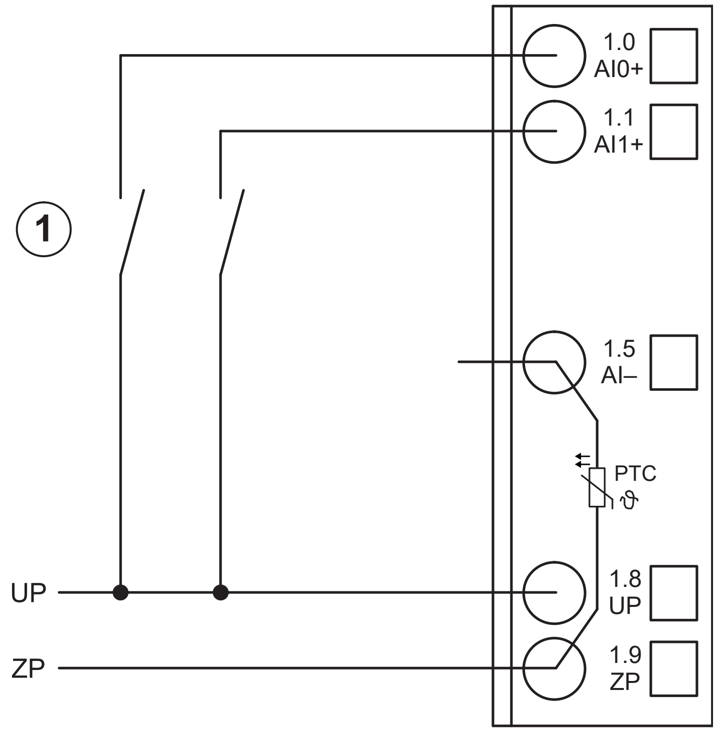


Fig. 130: Use of analog inputs as digital inputs

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 1.7.3.1.7 “Parameterization” on page 694* *Chapter 1.7.3.1.10 “Measuring ranges” on page 703*.

Connection of analog output loads (Voltage, current)

The following figure shows the connection of analog output loads (voltage, current).

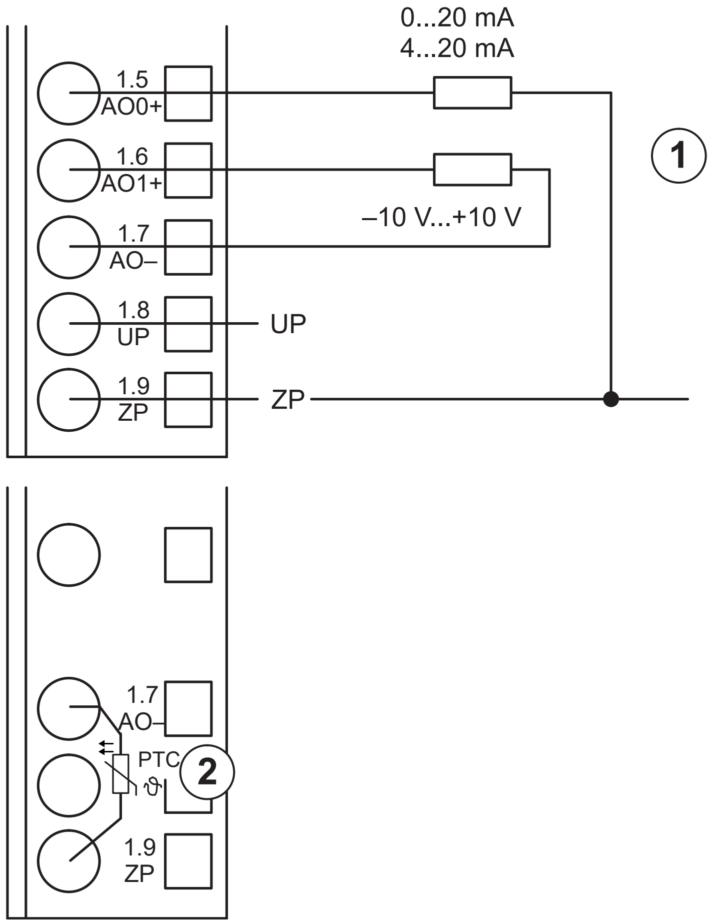


Fig. 131: Connection of analog output loads (voltage, current)

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...500 Ω	1 channel used
Current	4...20 mA	Load 0...500 Ω	1 channel used

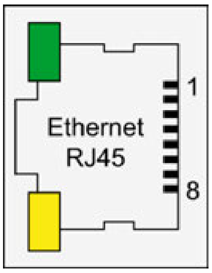
The measuring ranges are described in the section Measuring Ranges *Chapter 1.7.3.1.7 “Parameterization” on page 694* *Chapter 1.7.3.1.10 “Measuring ranges” on page 703*.

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.

For further information regarding wiring and cable types see chapter Ethernet *Chapter 2.6.4.7 "Ethernet connection details" on page 997.*

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.

1.7.3.1.4 Internal data exchange

Parameter	Value
Digital inputs (bytes)	1
Digital outputs (bytes)	1
Analog inputs (words)	4
Analog outputs (words)	2

1.7.3.1.5 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.

1.7.3.1.6 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.

1.7.3.1.7 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 145: Error LED / Failsafe function [1])

Setting	Description
On	Error LED lights up at errors of all error classes, Failsafemode off
Off by E4	Error LED lights up at errors of error classes E1, E2 and E3, Failsafemode off
Off by E3	Error LED lights up at errors of error classes E1 and E2 auf, Failsafemode off
On + failsafe	Error LED lights up at errors of all error classes, Failsafemode on *)
Off by E4 + failsafe	Error LED lights up at errors of error classes E1, E2 and E3, Failsafemode on *)
Off by E3 + failsafe	Error LED lights up at errors of error classes E1 and E2, Failsafemode on *)

*) The parameters behaviourAOatCommunicationFault and behaviourDOatCommunicationFault are only analyzed if the Failsafe-mode is ON.

Group parameters of the cam switch

Name	Value	Internal value	Internal value, type	Default
numOfUsed-Cams 1)	0 ... 32 128...160	0 ... 32 218...160	WORD	0
resolution 2)	0 ... 2 -1	0 ... 2 -1	DWORD	36000
zeroShift 3)	0 ... 2 -1	0 ... 2 -1	DWORD	0
EncoderBitReso-lution 4)	8 ... 32	8 ... 32	WORD	18
Reserve	-	-	WORD	-

1) The parameter numOfUsedCams defines the interrupt cycle time (Therefore, it takes effect to the accuracy of the track) and the behavior of the module if the DC information is lost.

Parameter setting for numOfUsed-Cams	Number of cams used	Interrupt cycle time	Behavior if DC information is lost
0	0	50 µs	Module changes to "safe-operational" state; the outputs are activated trough the user program
1...8	1...8	80 µs	
9...16	9...16	100 µs	
17...32	17...32	200 µs	
128	0	50 µs	Module keeps in "operational" state; the outputs are activated trough the user program
129...136	1...8	80 µs	Module keeps in "operational" state; the cam switch outputs are activated according to an interpolated timing information
137...144	9...16	100 µs	
145...170	17...32	200 µs	

2) The parameter resolution defines the angle resolution of the track. The value gives the number of increments related to 360°; e. g. the value 36,000 corresponds to an angle resolution of 0.01°.

3) The parameter zeroShift defines the zero shift. With it the encoder can be adjusted to the mounting position. The value of zeroShift is set in encoder-increments. It is not assigned to the parameter resolution of the cam switch.

4) The parameter EncoderBitResolution defines the resolution of the used encoder (in bits), e. g. with the default setting 18 bits the encoder has 196,608 divisions.

Channel parameters for the cam switch (max. 32x)

Name	Value	Internal value	Internal value, type	Default
camToTrack0 *)	Digital Output 0 ... 7, none	0 ... 7, FF	BYTE	FF
:	:	:	:	:
camToTrack31	Digital Output 0 .. .7, none	0 ... 7, FF	BYTE	FF

*) The value of the parameter camToTrack# defines which DO (digital output) is assigned to the track. camToTrack0 = 3 for example means that track 0 is assigned to the digital output 3. If the value FFh is set to a track, no digital output is assigned to it.

Name	Value	Referred FB from extended Cam Switch Library [2])	Internal value	Internal value, type	Default
cam-Type[0] [1]) ...	Common 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...+400 °C
9	3-wire Pt100 -50...+400 °C *)
10	0 V...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 *)

Internal value	Operating modes of the analog inputs, individually configurable
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 146: Channel monitoring [2])

Internal Value	Check channel
0	Plausib(ility), cut wire, short circuit
3	not used

Channel parameters for the analog outputs (2x)

Name	Value	Internal value	Internal value, type	Default
Output 0, channel configuration	see [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 147: 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 148: Channel monitoring [4])

Internal value	Check channel
0	Plausib(ility), cut wire, short circuit
3	None

Table 149: Substitute value [5])

Intended behavior of output channel when the control system stops	Required setting of the module parameter "Behaviour of outputs in case of a communication error"	Required setting of the channel parameter "Substitute value"
Output OFF	Off	0
Last value infinite	Last value	0
Last value for 5 s	Last value 5 s	0
Last value for 10 s	Last value 10 s	0
Substitute value infinite	Substitute value	Depending on configuration
Substitute value for 5 s	Substitute value 5 s	Depending on configuration
Substitute value for 10 s	Substitute value 10 s	Depending on configuration

Group parameters for the digital part

Name	Value	Internal value	Internal value, type	Default
Input delay	0.01 ms 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.01 ms 0x00
Detect short circuits at outputs	Off On	0 1	BYTE	On 0x01
Behaviour DO at comm. error *)	Off Last value Last value 5 sec Last value 10 sec Substitute value Substitute 5 sec Substitute 10 sec	0 1 6 11 2 7 12	BYTE	Off 0x00
Substitute value at output	0 ... 255	00h ... FFh	BYTE	0 0x0000

*) The parameter behaviourDOatCommunicationFault is only analyzed if the Failsafe-mode is ON.

1.7.3.1.8 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.

1.7.3.1.9 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 150: 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 151: 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

1.7.3.1.10 Measuring ranges

Input ranges voltage, current and digital input

Range	0...10 V	-10...+10 V	0...20 mA	4...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...10 V	-10...+10 V	0...20 mA	4...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 : 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

The represented resolution corresponds to 16 bits.

Input ranges resistance temperature detector

Range	Pt100 / Pt1000 -50...400 °C	Ni1000 -50...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

Range	Pt100 / Pt1000 -50...400 °C	Ni1000 -50...150 °C	Digital value	
			Decimal	**Hex.**
Measured value too low	-50.1 °C : -60.0 °C	-50.1 °C : -60.0 °C	-501 : -600	FE0B : FDA8
Underflow	< -60.0 °C	< -60.0 °C	-32768	8000

Output ranges voltage and current

Range	-10...+10 V	0...20 mA	4...20 mA	Digital value	
				Decimal	**Hex.**
Overflow	0 V	0 mA	0 mA	> 32511	> 7EFF
Measured value too high	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA	32511 : 27649	7EFF : 6C01
Normal range	10.0000 V : 0.0004 V	20.0000 mA : 0,0007 mA	20.0000 mA : 4.0006 mA	27648 : 1	6C00 : 0001
	0.0000 V	0.0000 mA	4.0000 mA	0	0000
	-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA	-1 -6912 -27648	FFFF E500 9400
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.

1.7.3.1.11 Technical data

The system data of AC500 and S500 *Chapter 2.6.1 “System data AC500” on page 971* are applicable to the standard version.

The system data of AC500-XC *Chapter 2.7.1 “System data AC500-XC” on page 1023* are applicable to the XC version.

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)

Parameter	Value
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
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

Parameter	Value
Reference potential for all digital inputs and outputs	Negative pole of the supply voltage, signal name ZP
Diagnosis	See Diagnosis and Displays ↳ *Chapter 1.7.3.1.8 “Diagnosis” on page 700*
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 switchgear cabinet.

NOTICE!
Attention:
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous 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 to DI7		Terminals 2.0 to 2.7
Reference potential for all inputs		Terminals 1.9...3.9 (Negative pole of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1...32 ms
Input signal voltage		24 V DC
	0-Signal	-3 V...+5 V
	Undefined Signal	> +5 V...< +15 V
	1-Signal	+15 V...+30 V
Ripple with signal 0		Within -3 V...+5 V
Ripple with signal 1		Within +15 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA

Parameter		Value
	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 3.0 to 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.

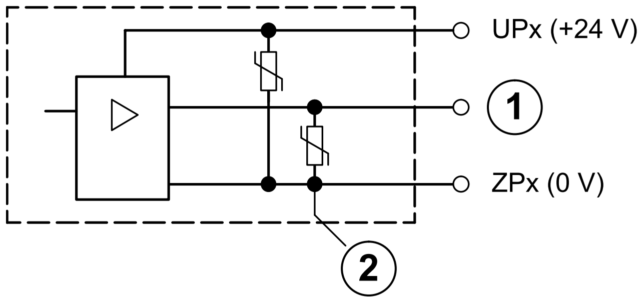


Fig. 132: Digital input/output (circuit diagram)

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+ to AI3+		Terminals 1.0 to 1.3
Reference potential for AI0+ to 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 + sign Range 0...20 mA: 12 bits Range 4...20 mA: 12 bits Range RTD (Pt100, PT1000, Ni1000): 0.1 °C
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range		Typ. 0.5 %, max. 1 %

Parameter	Value
Relationship between input signal and hex code	Tables Input Ranges Voltage, Current and Digital Input ↳ *Chapter 1.7.3.1.10.1 "Input ranges voltage, current and digital input" on page 703* and Input range resistance temperature detector ↳ *Chapter 1.7.3.1.10.2 "Input ranges resistance temperature detector" on page 704*
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 1.0 to 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+ to 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)

Parameter	Value
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 (+ 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 1.7.3.1.10.3 “Output ranges voltage and current” on page 705*
Unused outputs	Are configured as unused (default value) and can be left open-circuited

1.7.3.1.12 Ordering data

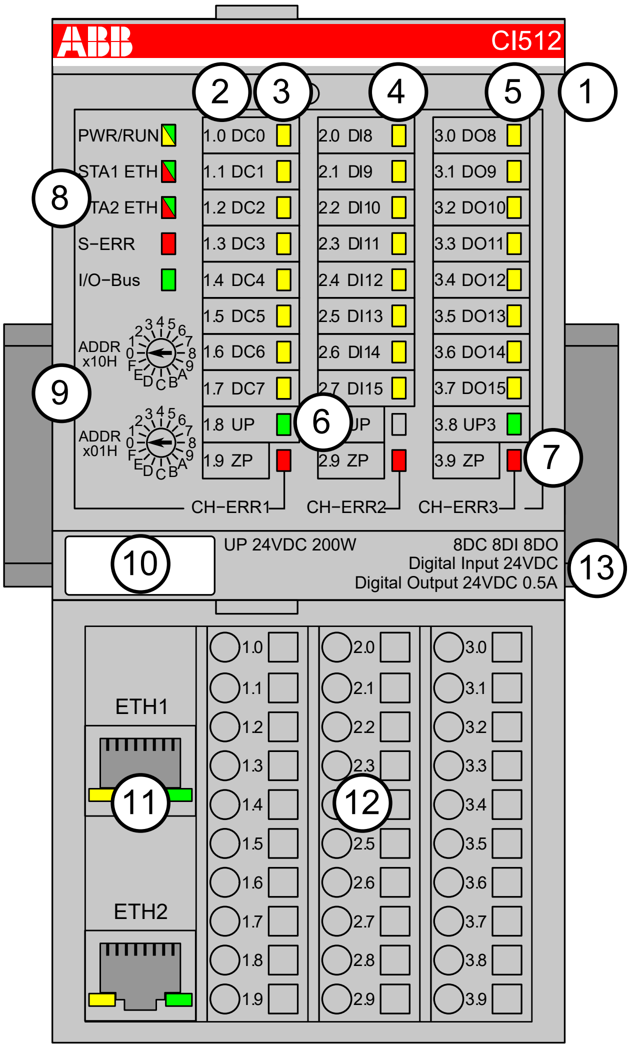
Part no.	Description	Product life cycle phase *)
1SAP 220 900 R0001	CI511-ETHCAT, EtherCAT communication interface module, 8 DI, 8 DO, 4 AI and 2 AO	Active

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

1.7.3.2 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

1.7.3.2.1 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.

1.7.3.2.2 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 1.5.1 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 122*

1.7.3.2.3 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 System Assembly chapter *Chapter 2.5 “AC500-eCo” on page 925.*

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 to 1.7	DC0 to DC7	8 digital inputs/outputs (con-figurable via software)
2.0 to 2.7	DI0 to DI7	8 digital inputs (delay time configurable via software)
3.0 to 3.7	DO0 to 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.

The following figures show the connection of the Ethernet communication interface module CI512-ETHCAT.

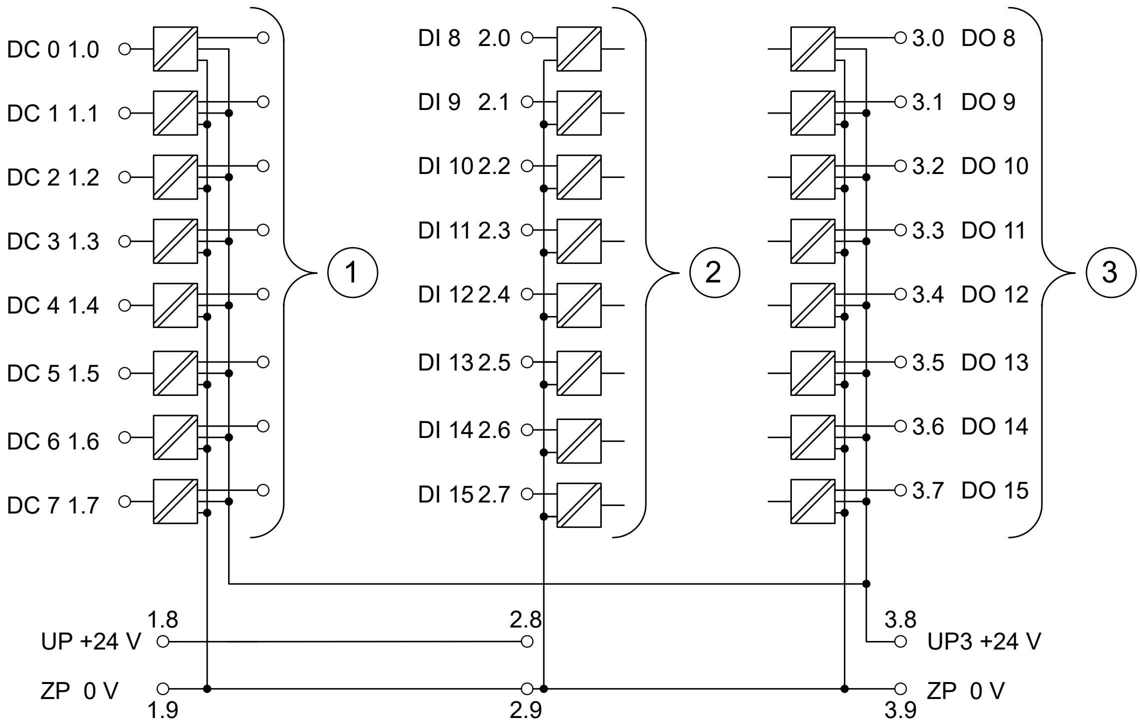


Fig. 133: Connection of the communication interface module CI512-ETHCAT

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.

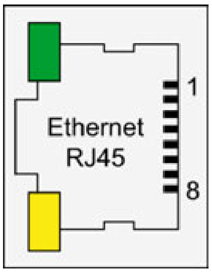
CAUTION!
The process supply voltage must be included within the grounding concept of the plant (e. g. grounding of the negative pole).

The module provides several diagnosis functions *Chapter 1.7.3.2.9 “Diagnosis” on page 720*.

1.7.3.2.4 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.

For further information regarding wiring and cable types see chapter Ethernet ↳ Chapter 2.6.4.7 “Ethernet connection details” on page 997.

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.

1.7.3.2.5 Internal data exchange

Parameter	Value
Digital inputs (bytes)	1
Digital outputs (bytes)	1
Configurable digital inputs/outputs (bytes)	1 + 1

1.7.3.2.6 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.

1.7.3.2.7 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.

1.7.3.2.8 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 152: 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
camType[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_CamSwitchMultiTimed_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 1 ms 8 ms 32 ms	0 1 2 3	BYTE	0.01 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 *)	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.				

1.7.3.2.9 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.

1.7.3.2.10 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 153: 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 154: States of the 29 process LEDs

LED	Color	OFF	ON	Flashing
DC0 to DC7	Yellow	Input/Output is OFF	Input/Output is ON	--
DI8 to DI15	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--
DO8 to 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

1.7.3.2.11 Technical data

The system data of AC500 and S500 ⮩ *Chapter 2.6.1 “System data AC500” on page 971* are applicable to the standard version.

The system data of AC500-XC ⮩ *Chapter 2.7.1 “System data AC500-XC” on page 1023* are applicable to the XC version.

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 1.7.3.2.9 “Diagnosis” on page 720*
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 switchgear cabinet.

NOTICE!
Attention:
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous 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 to DI7		Terminals 2.0 to 2.7
Reference potential for all inputs		Terminals 1.9...3.9 (negative pole of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1...32 ms
Input signal voltage		24 V DC
	0-Signal	-3 V...+5 V
	undefined Signal	> +5 V...< +15 V
	1-Signal	+15 V...+30 V
Ripple with signal 0		Within -3 V...+5 V
Ripple with signal 1		Within +15 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	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 3.0 to 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.

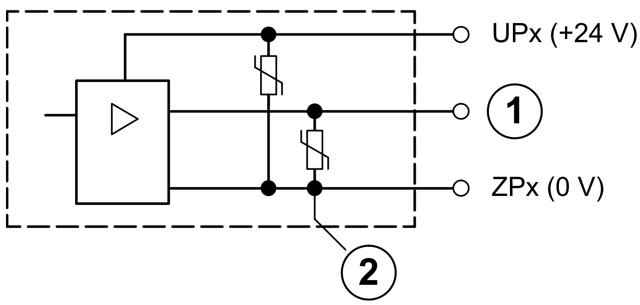


Fig. 134: Digital input/output (circuit diagram)

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 to DC7		Terminals 1.0 to 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...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 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

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DC0 to DC7		Terminals 1.0 to 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.

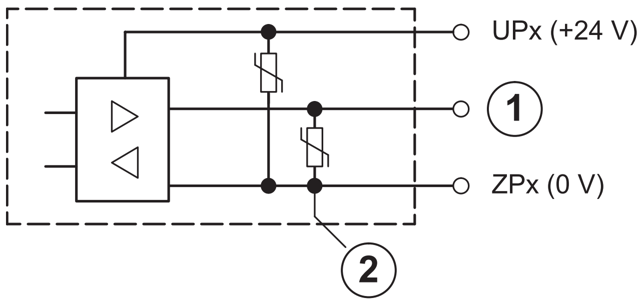


Fig. 135: Digital input/output (circuit diagram)

1 Digital input/output
2 For demagnetization when inductive loads are turned off

1.7.3.2.12 Ordering data

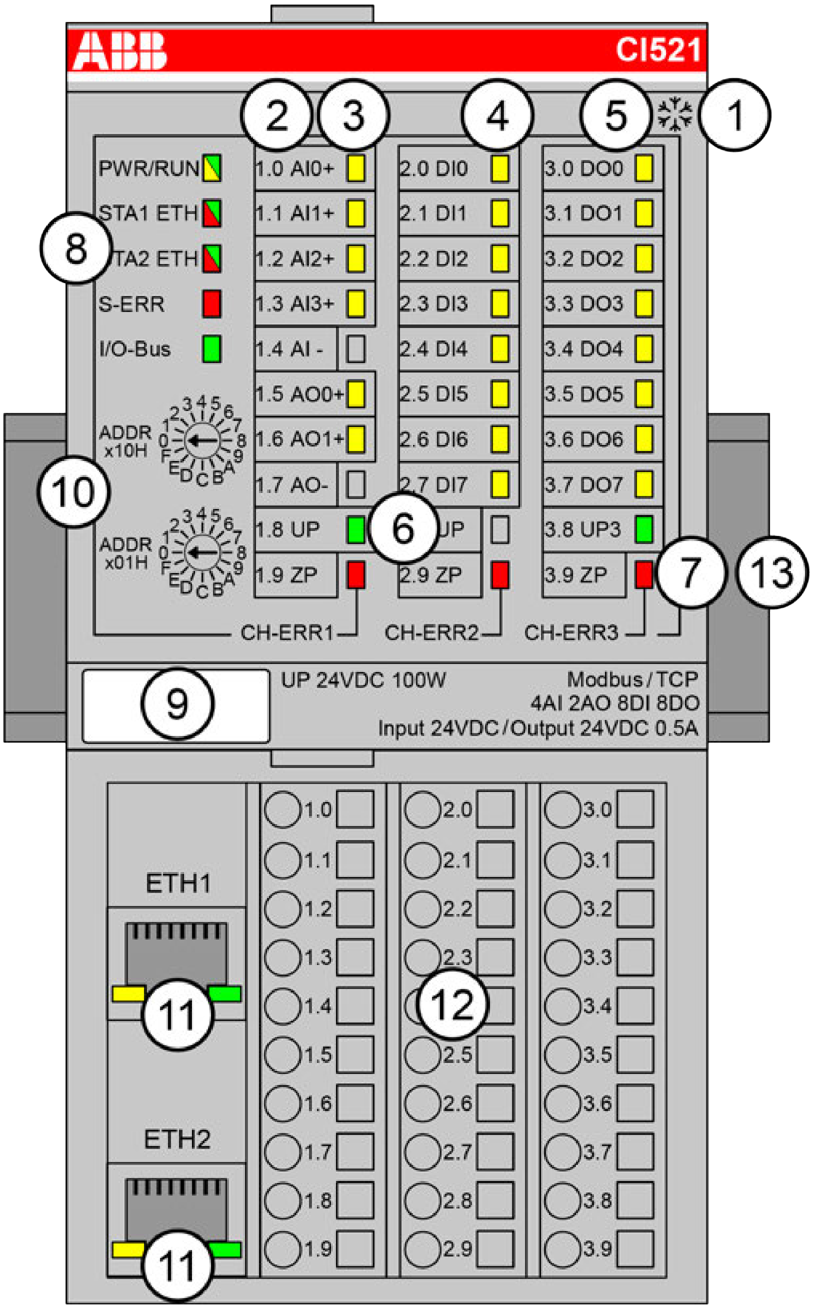
Part no.	Description	Product life cycle phase *)
1SAP 221 000 R0001	CI512-ETHCAT, EtherCAT communication interface module, 8 DI, 8 DO and 8 DC	Active

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

1.7.4 Modbus

1.7.4.1 CI521-MODTCP

- 4 analog inputs (resolution 12 bits plus sign)
- 2 analog outputs (resolution 12 bits plus 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

1.7.4.1.1 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.

1.7.4.1.2 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 1.5.1 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 122*

1.7.4.1.3 Connections

The Ethernet communication interface module CI521-MODTCP is plugged on the I/O terminal unit TU507-ETH or TU508-ETH *Chapter 1.5.1 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 122*. 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 *Chapter 1.8.2.6 “TA526 - Wall mounting accessory” on page 902*).

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 System Assembly, Construction and Connection chapter *⇘ Chapter 2.6 "AC500 (Standard)" on page 971.*

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.

The 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 (cut wire), 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.

Only for simple applications (low electromagnetic disturbances, no high requirement on precision), the shielding can also be omitted.

The following figures show the connection of the Ethernet communication interface module CI521-MODTCP.

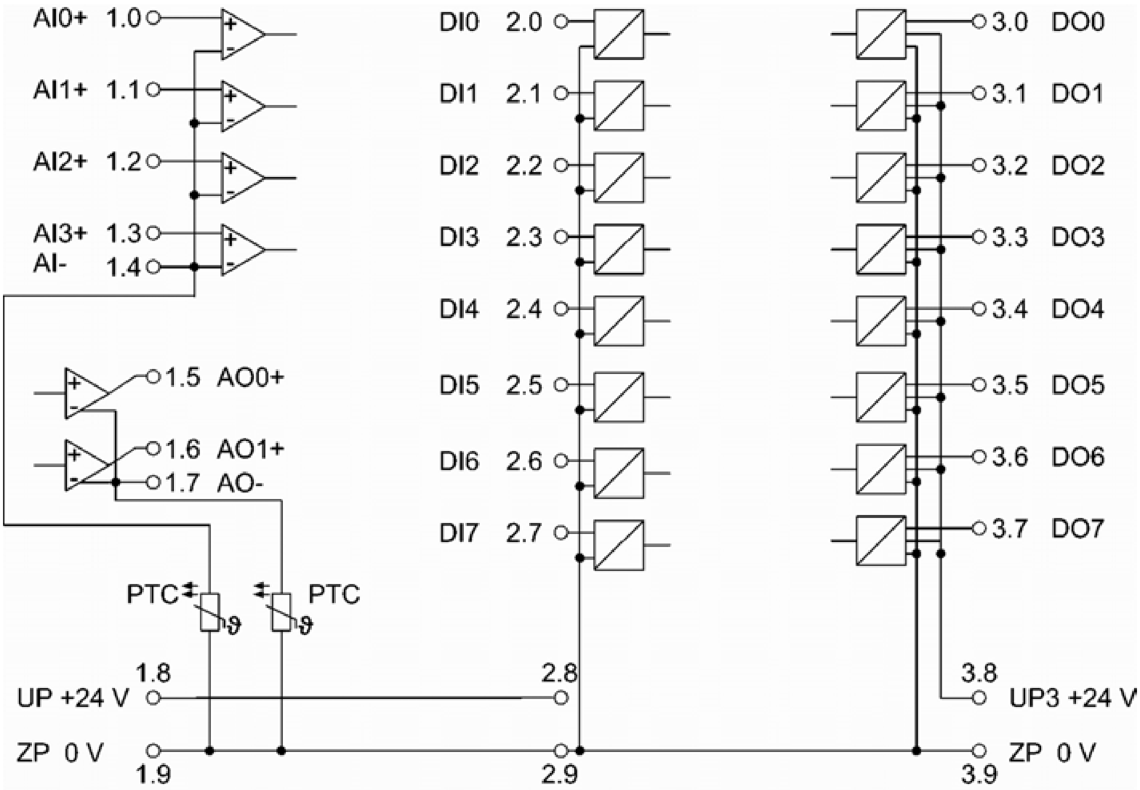


Fig. 136: Connection of the communication interface module CI521-MODTCP

Further information is provided in the System Technology chapter .

Connection of the digital inputs

The following figure shows the connection of the digital input DI0. Proceed with the digital inputs DI1 to DI7 in the same way.

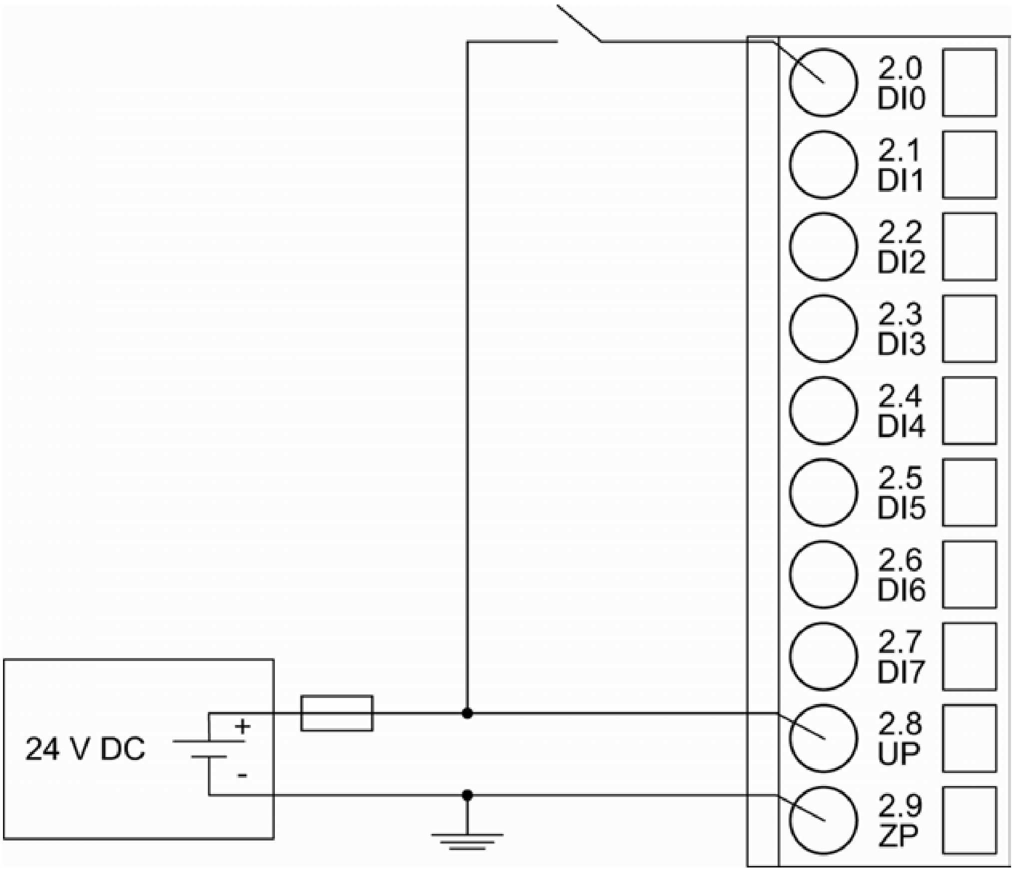


Fig. 137: Connection of the digital inputs to the module CI521-MODTCP

The meaning of the LEDs is described in Displays *Chapter 1.7.4.1.8.2 “State LEDs” on page 760*.

Connection of the digital outputs

The following figure shows the connection of the digital output DO0. Proceed with the digital outputs DO1 - DO7 in the same way.

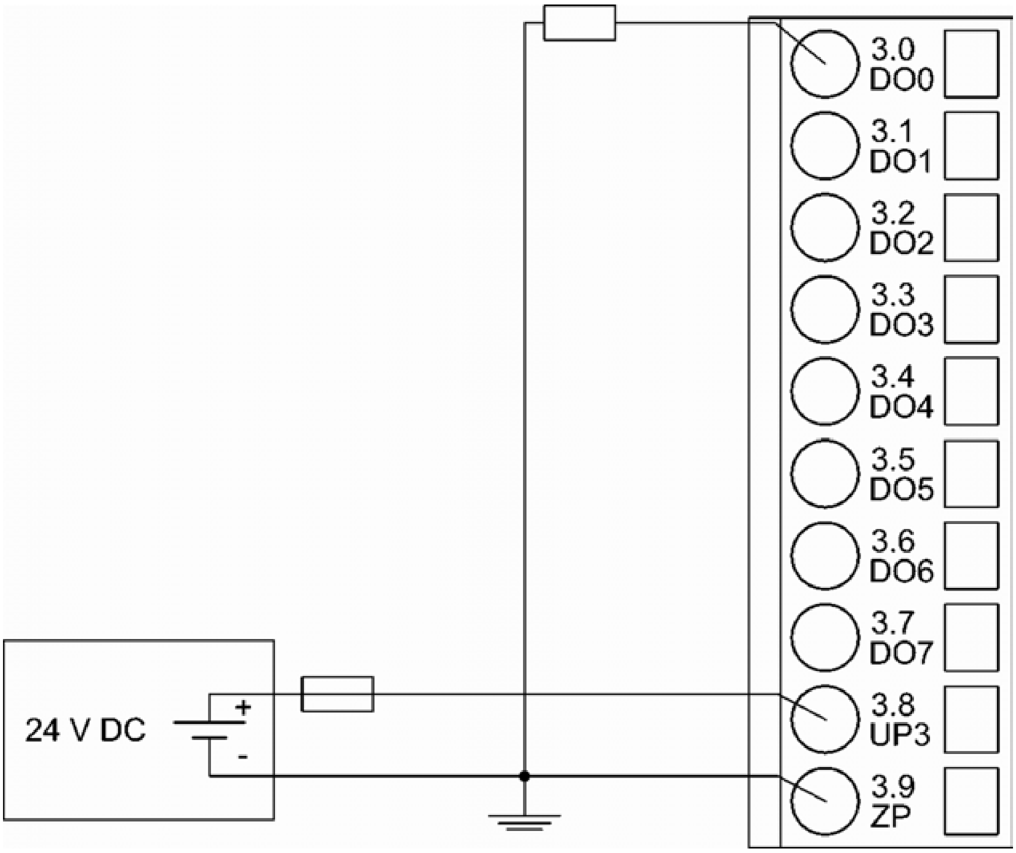


Fig. 138: Connection of configurable digital inputs/outputs to the module CI521-MODTCP

The meaning of the LEDs is described in Displays ↻ *Chapter 1.7.4.1.8.2 “State LEDs” on page 760*.

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.

The following figure shows the connection of resistance thermometers in 2-wire configuration to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

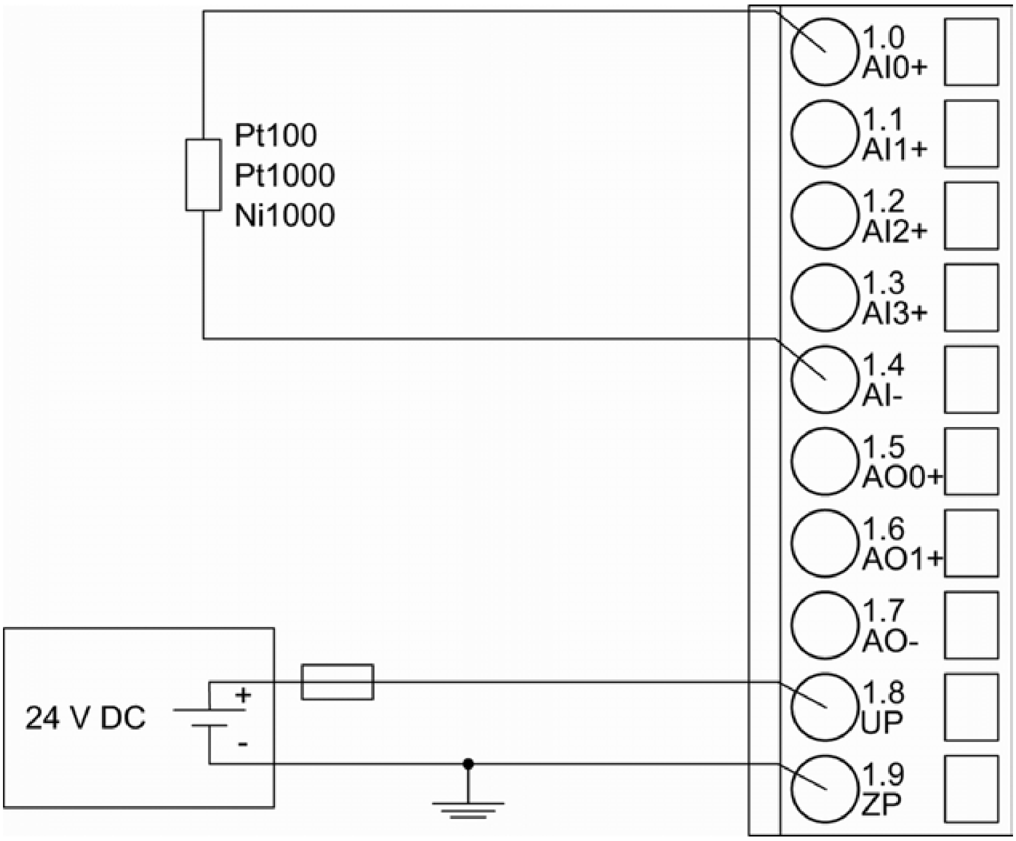


Fig. 139: Connection of resistance thermometers in 2-wire configuration to the analog inputs

The following measuring ranges can be configured *Chapter 1.7.4.1.7 “Parameterization” on page 749* and *Chapter 1.7.4.1.9 “Measuring ranges” on page 761*:

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 1.7.4.1.8 “Diagnosis and state LEDs” on page 755*.

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.

The following figure shows the 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.

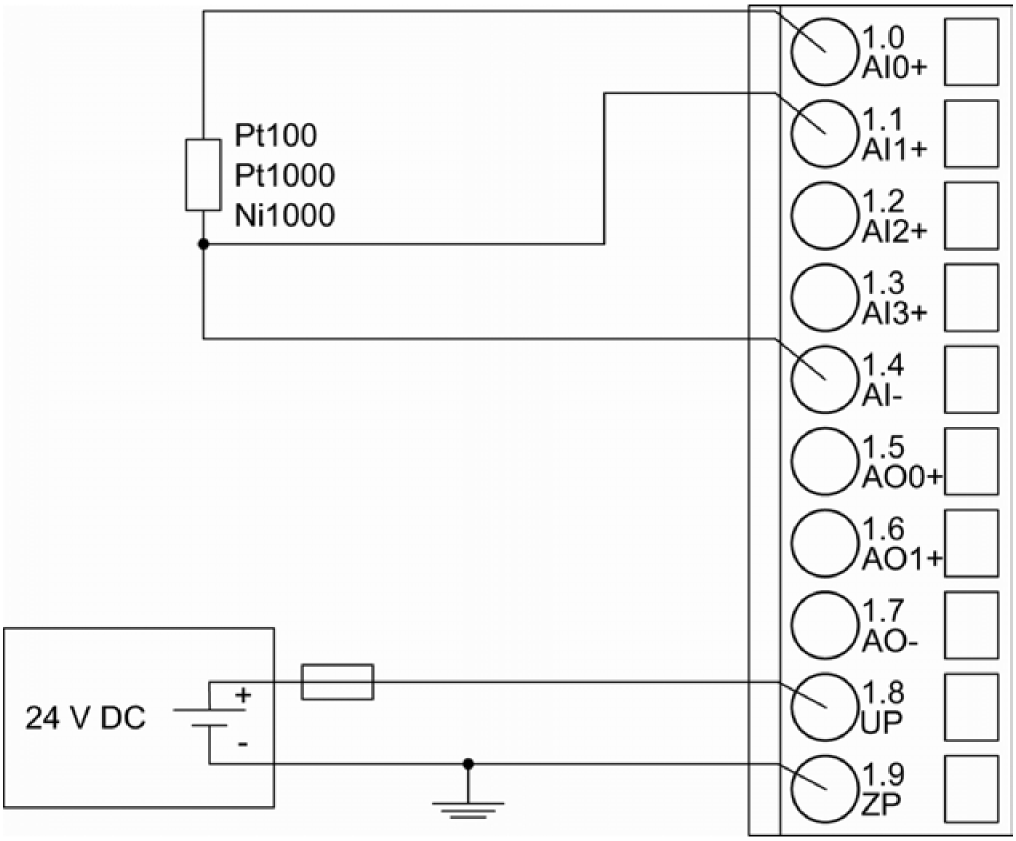


Fig. 140: Connection of resistance thermometers in 3-wire configuration to the analog inputs

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.

The following measuring ranges can be configured *Chapter 1.7.4.1.7 “Parameterization” on page 749* and *Chapter 1.7.4.1.9 “Measuring ranges” on page 761*:

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 1.7.4.1.8 “Diagnosis and state LEDs” on page 755*.

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

The following figure shows the connection of active-type analog sensors (voltage) with galvanically isolated power supply to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

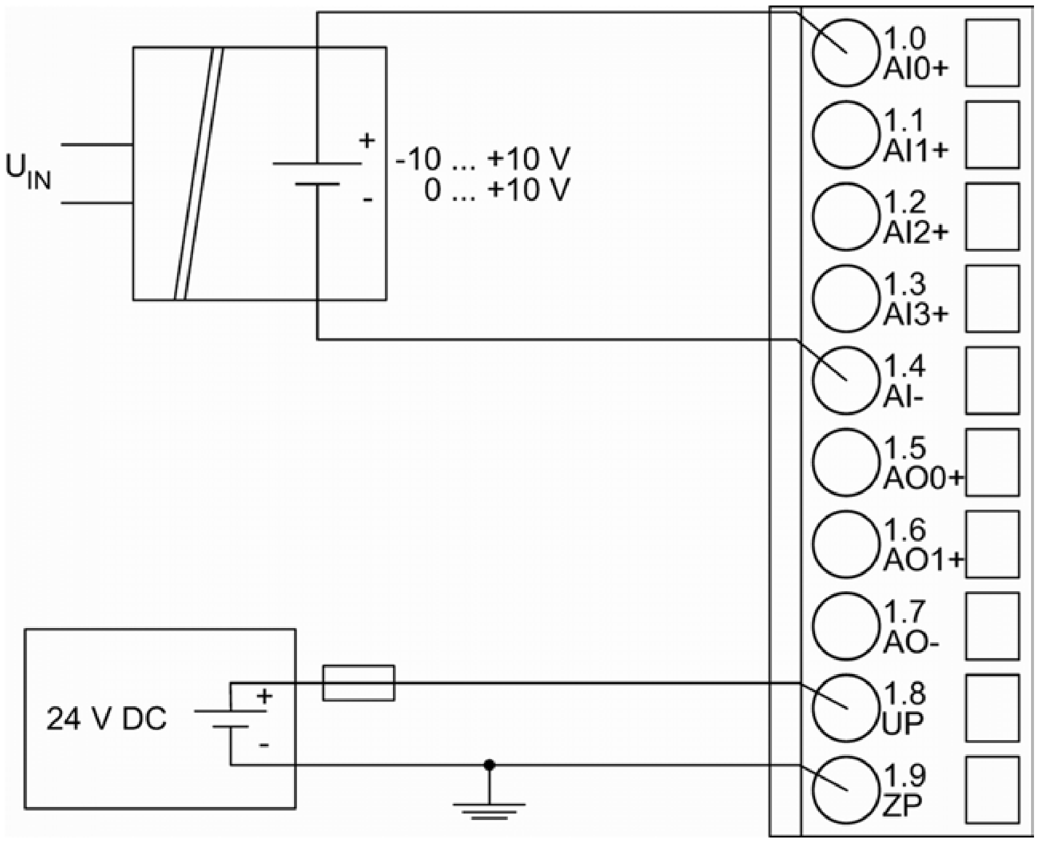


Fig. 141: Connection of active-type analog sensors (voltage) with galvanically isolated power supply to the analog inputs

The following measuring ranges can be configured *Chapter 1.7.4.1.7 “Parameterization” on page 749* *Chapter 1.7.4.1.9 “Measuring ranges” on page 761*:

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 1.7.4.1.8 “Diagnosis and state LEDs” on page 755*.

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

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

The following figure shows the connection of active-type analog sensors (current) with galvanically isolated power supply to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

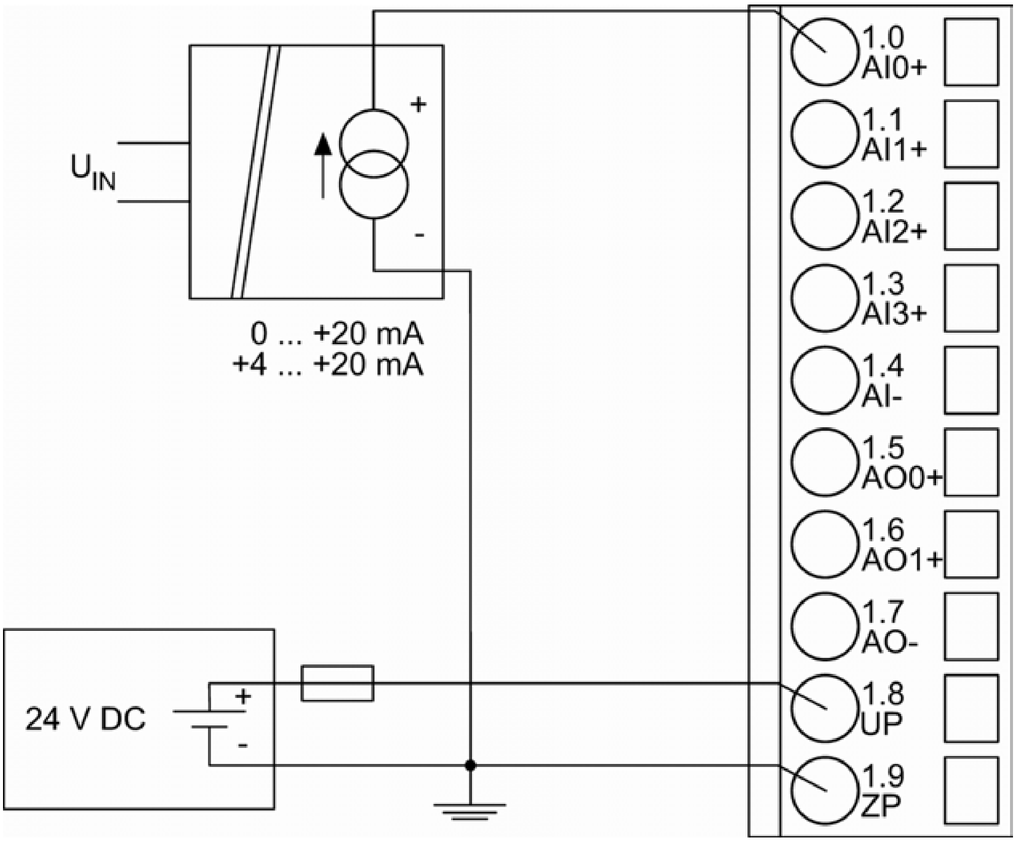


Fig. 142: Connection of active-type analog sensors (current) with galvanically isolated power supply to the analog inputs

The following measuring ranges can be configured *Chapter 1.7.4.1.7 “Parameterization” on page 749* *Chapter 1.7.4.1.9 “Measuring ranges” on page 761*:

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

The function of the LEDs is described under Diagnosis and displays / Displays *Chapter 1.7.4.1.8 “Diagnosis and state LEDs” on page 755*.

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 to AI3 in the same way.

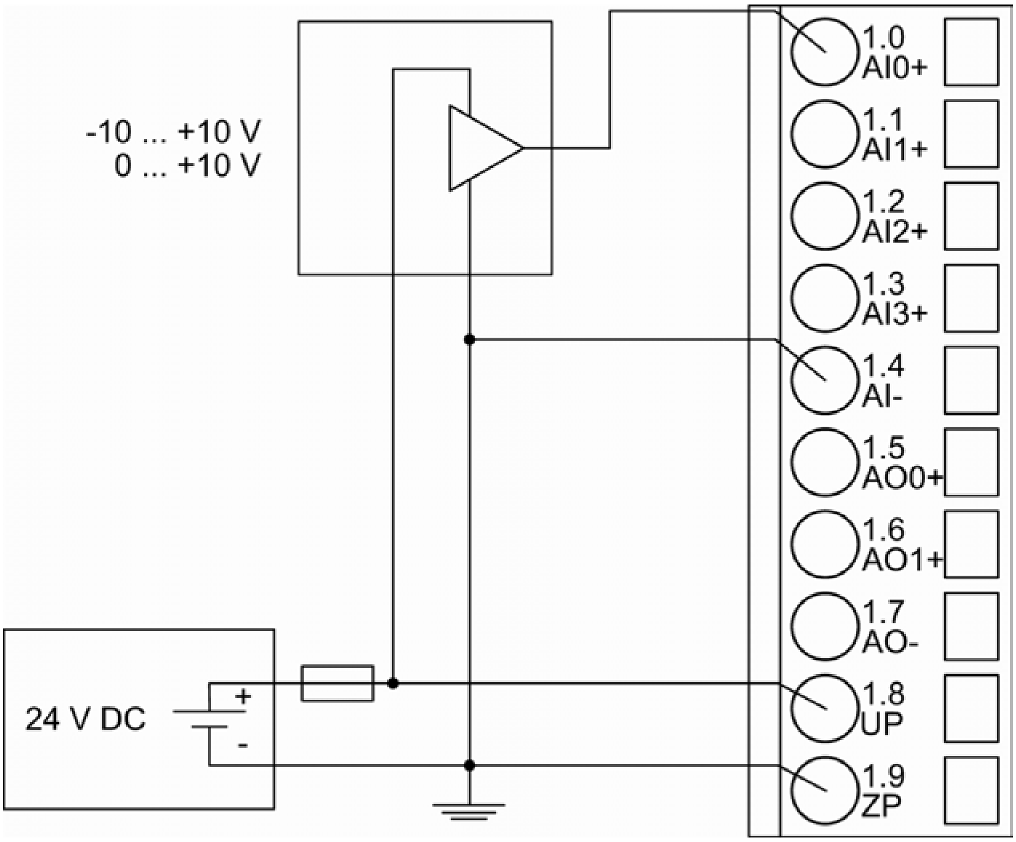


Fig. 143: Connection of active-type sensors (voltage) with no galvanically isolated power supply to the analog inputs

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 1.7.4.1.7 “Parameterization” on page 749* and *Chapter 1.7.4.1.9 “Measuring ranges” on page 761*.

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 1.7.4.1.8 “Diagnosis and state LEDs” on page 755*.

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 to AI3 in the same way.

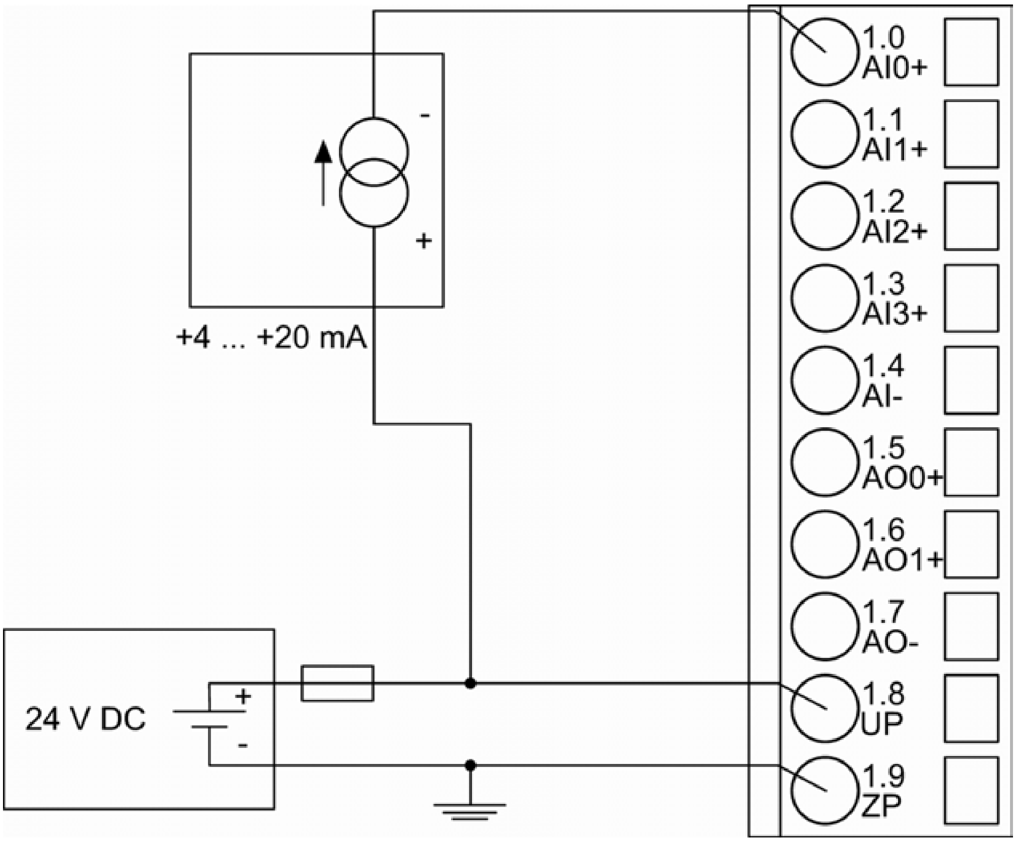


Fig. 144: Connection of passive-type analog sensors (current) to the analog inputs

The following measuring ranges can be configured *Chapter 1.7.4.1.7 "Parameterization" on page 749* and *Chapter 1.7.4.1.9 "Measuring ranges" on page 761*:

Current	4...20 mA	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays *Chapter 1.7.4.1.8 "Diagnosis and state LEDs" on page 755*.

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...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.

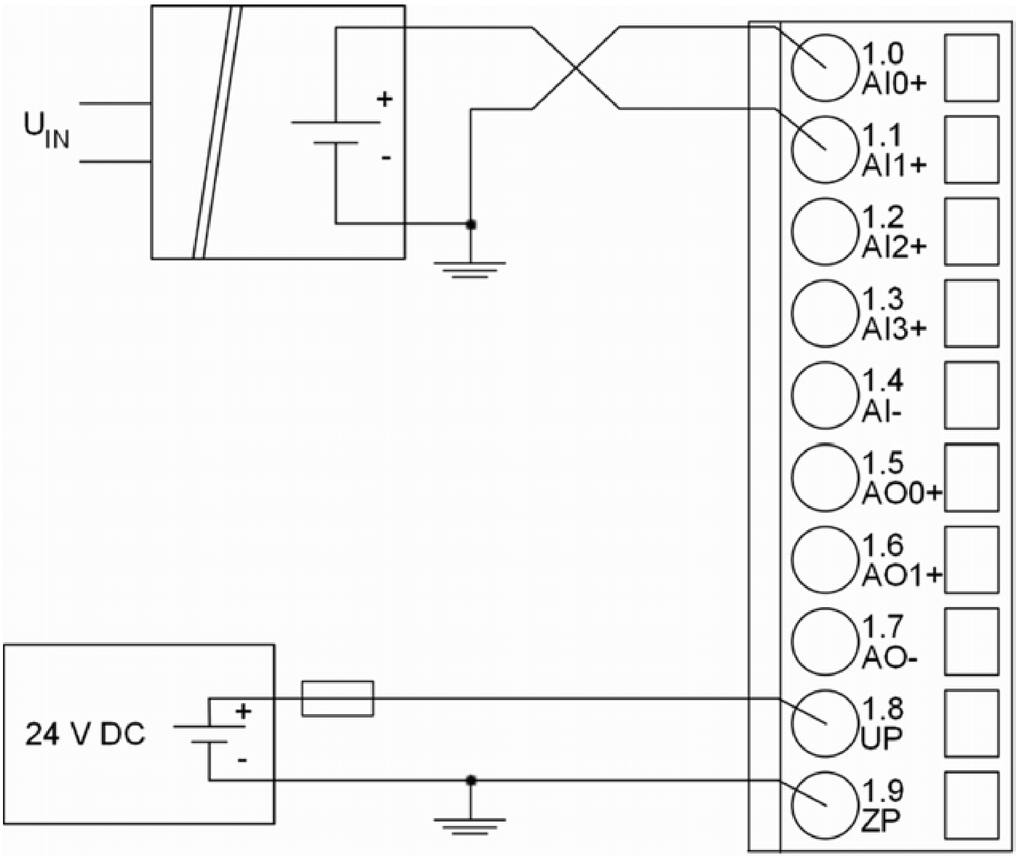


Fig. 145: Connection of active-type analog sensors (voltage) to differential analog inputs

The following measuring ranges can be configured ✎ *Chapter 1.7.4.1.7 "Parameterization" on page 749* and ✎ *Chapter 1.7.4.1.9 "Measuring ranges" on page 761*:

Voltage	0...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 1.7.4.1.8 "Diagnosis and state LEDs" on page 755*.

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 1.7.4.1.10.5 “Technical data of the analog inputs if used as digital inputs” on page 767*. The inputs are not galvanically isolated against the other analog channels.

The following figure shows the connection of digital sensors to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

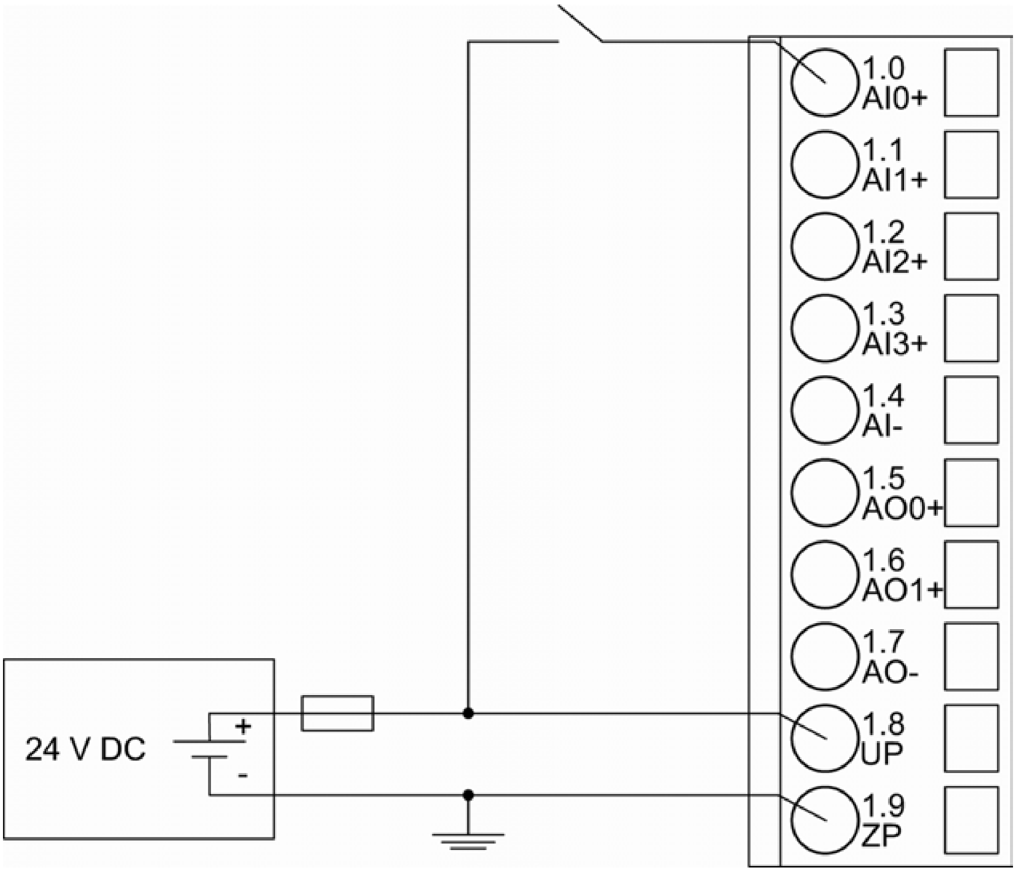


Fig. 146: Use of analog inputs as digital inputs

The following measuring ranges can be configured ↳ *Chapter 1.7.4.1.7 “Parameterization” on page 749* and ↳ *Chapter 1.7.4.1.9 “Measuring ranges” on page 761* :

Digital input	24 V	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays ↳ *Chapter 1.7.4.1.8 “Diagnosis and state LEDs” on page 755*.

Connection of analog output loads (Voltage)

The following figure shows the connection of output loads to the analog output AO0. Proceed with the analog output AO1 in the same way.

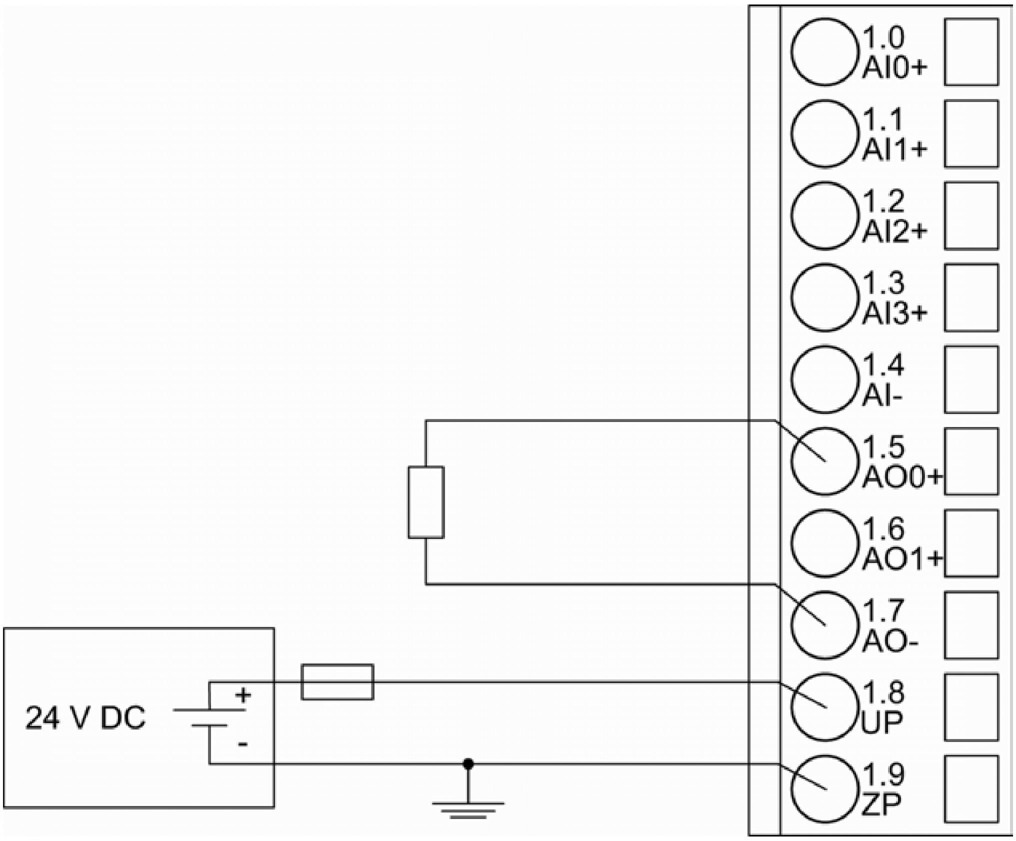


Fig. 147: Connection of analog output loads (voltage)

The following measuring ranges can be configured ➪ *Chapter 1.7.4.1.7 “Parameterization” on page 749* and ➪ *Chapter 1.7.4.1.9 “Measuring ranges” on page 761*

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 1.7.4.1.8 “Diagnosis and state LEDs” on page 755*.

Unused analog outputs can be left open-circuited.

Connection of analog output loads (Current)

The following figure shows the connection of output loads to the analog output AO0. Proceed with the analog output AO1 in the same way.

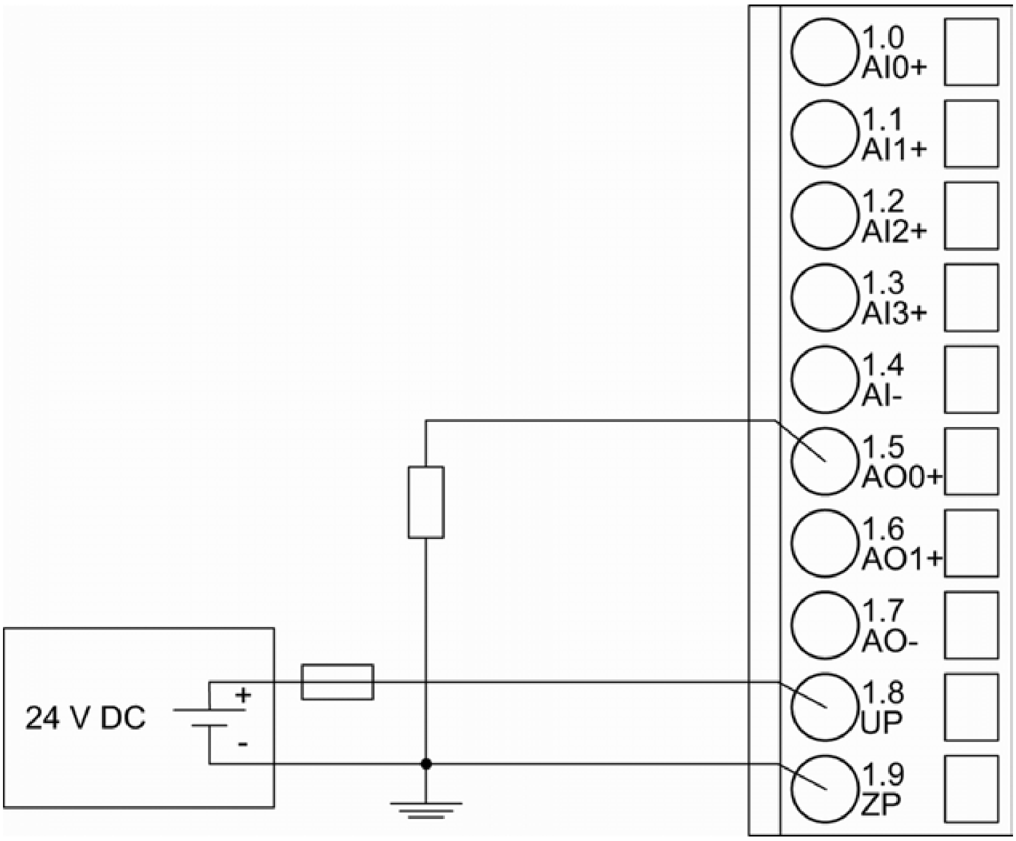


Fig. 148: Connection of analog output loads (current)

The following measuring ranges can be configured ➪ *Chapter 1.7.4.1.7 “Parameterization” on page 749* and ➪ *Chapter 1.7.4.1.9 “Measuring ranges” on page 761*:

Current	0...20 mA	Load 0...500 Ω	1 channel used
Current	4...20 mA	Load 0...500 Ω	1 channel used

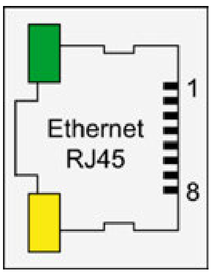
The function of the LEDs is described under Diagnosis and displays / Displays ➪ *Chapter 1.7.4.1.8 “Diagnosis and state LEDs” on page 755*.

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.

For further information regarding wiring and cable types see chapter Ethernet *↳ Chapter 2.6.4.7 “Ethernet connection details” on page 997.*

1.7.4.1.4 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

1.7.4.1.5 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).

1.7.4.1.6 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 1.7.4.1.7 “Parameterization” on page 749*.

1.7.4.1.7 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 155 “Error LED / Failsafe function” on page 750*	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
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

Name	Value	Internal value	Internal value, type	Default
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, see description of the . [3]) Fixed Mapping means each module has its own Modbus registers for data transfer independent of the IO bus constellation. For details see . 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 adress. [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 155: 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 156 "Channel configuration" on page 752*	Table Operating modes of the analog inputs *Table 156 "Channel configuration" on page 752*	BYTE	0
Input 0, Check channel	Table Channel montoring *Table 157 "Channel monitoring" on page 752*	Table Channel montoring *Table 157 "Channel monitoring" on page 752*	BYTE	0
:	:	:	:	:
:	:	:	:	:
Input 3, Channel configuration	Table Operating modes of the analog inputs *Table 156 "Channel configuration" on page 752*	Table Operating modes of the analog inputs *Table 156 "Channel configuration" on page 752*	BYTE	0
Input 3, Check channel	Table Channel montoring *Table 157 "Channel monitoring" on page 752*	Table Channel montoring *Table 157 "Channel monitoring" on page 752*	BYTE	0

Table 156: 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 157: 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	Table Operating modes of the analog outputs *Table 158 “Channel configuration” on page 753*	Table Operating modes of the analog outputs *Table 158 “Channel configuration” on page 753*	BYTE	0
Output 0, Check channel	Table Channel monitoring *Table 159 “Channel monitoring” on page 753*	Table Channel monitoring *Table 159 “Channel monitoring” on page 753*	BYTE	0

Name	Value	Internal value	Internal value, type	Default
Output 0, Substi-tute value	Table Substitute value *Table 160 “Substitute value” on page 753*	Table Substitute value *Table 160 “Substitute value” on page 753*	WORD	0
Output 1, Channel configu-ration	Table Operating modes of the analog outputs *Table 158 “Channel configura-tion” on page 753*	Table Operating modes of the analog outputs *Table 158 “Channel configura-tion” on page 753*	BYTE	0
Output 1, Check channel	Table Channel monitoring *Table 159 “Channel monitoring” on page 753*	Table Channel monitoring *Table 159 “Channel monitoring” on page 753*	BYTE	0
Output 1, Substi-tute value	Table Substitute value *Table 160 “Substitute value” on page 753*	Table Substitute value *Table 160 “Substitute value” on page 753*	WORD	0

Table 158: Channel configuration

Internal value	Operating modes of the analog outputs, individually configu-rable
0 (default)	Not used
128	-10 V...+10 V
129	0...20 mA
130	4...20 mA

Table 159: Channel monitoring

Internal value	Check channel
0	Plausib(ility), cut wire, short circuit
3	None

Table 160: Substitute value

Intended behavior of output channel when the control system stops	Required setting of the module parameter "Behav-iour 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 "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	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
Behaviour DO at comm. error [1])	Off	0	BYTE	Off
	Last value	1		0x00
	Last value 5 sec	6		
	Last value 10 sec	11		
	Substitute value	2		
	Substitute value 5 sec	7		
	Substitute value 10 sec	12		
Substitute value at output	0 ... 255	00h ... FFh	BYTE	0
				0x0000
Detect voltage overflow at outputs [2])	Off	0	BYTE	On
	On	1		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 1.7.4.1.3 “Connections” on page 731*. 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".				

1.7.4.1.8 Diagnosis and state LEDs

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 1.7.4.1.3 “Connections” on page 731*. 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 1.7.4.1.3 “Connections” on page 731*. 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.

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 161: 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 162: 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

1.7.4.1.9 Measuring ranges

Input ranges voltage, current and digital input

Range	0...10 V	-10...+10 V	0...20 mA	4...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
Normal range or measured value too low	-0.0004 -1.7593	-0.0004 : : : -10,0000		3.9994 : 0		-1 -4864 -6912 : -27648	FFFF ED00 E500 : 9400

Range	**0...10 V**	**-10...+10 V**	**0...20 mA**	**4...20 mA**	**Digital input**	**Digital value**	
						Decimal	**Hex.**
Measured value too low		-10.0004 : -11.7589				-27649 : -32512	93FF : 8100
Underflow	<0.0000	<-11.7589	<0.0000	<0.0000		-32768	8000

The represented resolution corresponds to 16 bits.

Input 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		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...+10 V	0...20 mA	4...20 mA	Digital value	
				Decimal	Hex.
Overflow	0 V	0 mA	0 mA	> 32511	> 7EFF
Measured value too high	11.7589 V : 10.0004 V	23.5178 mA : 20.0007 mA	22.8142 mA : 20.0006 mA	32511 : 27649	7EFF : 6C01
Normal range	10.0000 V : 0.0004 V	20.0000 mA : 0,0007 mA	20.0000 mA : 4.0006 mA	27648 : 1	6C00 : 0001
	0.0000 V	0.0000 mA	4.0000 mA	0	0000
	-0.0004 V : -10.0000 V	0 mA : 0 mA	3.9994 mA 0 mA 0 mA	-1 -6912 -27648	FFFF E500 9400
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.

1.7.4.1.10 Technical data

The system data of AC500 and S500 ↬ *Chapter 2.6.1 “System data AC500” on page 971* are applicable to the standard version.

The system data of AC500-XC ↬ *Chapter 2.7.1 “System data AC500-XC” on page 1023* are applicable to the XC version.

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 1.7.4.1.8 “Diagnosis and state LEDs” on page 755*
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 switchgear cabinet.

!

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

Technical data of the digital inputs

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DI0 to DI7	Terminals 2.0 to 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

Parameter		Value
	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 to DO7		Terminals 3.0 to 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

Parameter		Value
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.

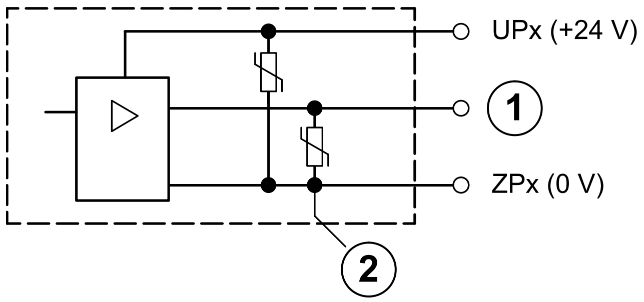


Fig. 149: Digital input/output (circuit diagram)

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+ to AI3+		Terminals 1.0 to1.3
Reference potential for AI0+ to 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 ... 10 V, current or Pt100/Pt1000/Ni1000
	Bipolar	Voltage -10 ... +10 V
Galvanic isolation		Against Ethernet network
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

Parameter	Value
Resolution	Range 0...10 V: 12 bits Range -10...+10 V: 12 bits + 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	Tables Input ranges voltage, current and digital input *Chapter 1.7.4.1.9.1 “Input ranges voltage, current and digital input” on page 761* Input range resistance temperature detector *Chapter 1.7.4.1.9.2 “Input ranges resistance temperature detector” on page 762*
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 1.0 to 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

Parameter		Value
Reference potential for AO0+ to AO1+		Terminal 1.7 (AO-) for voltage outputTerminal 1.9, 2.9 and 3.9 for current output
Output type		
	Unipolar	Current
	Bipolar	Voltage
Galvanic isolation		Against internal supply and other modules
Configurability		-10...+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 (+ 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 1.7.4.1.9.3 “Output ranges voltage and current” on page 763*
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
Detailed description	See

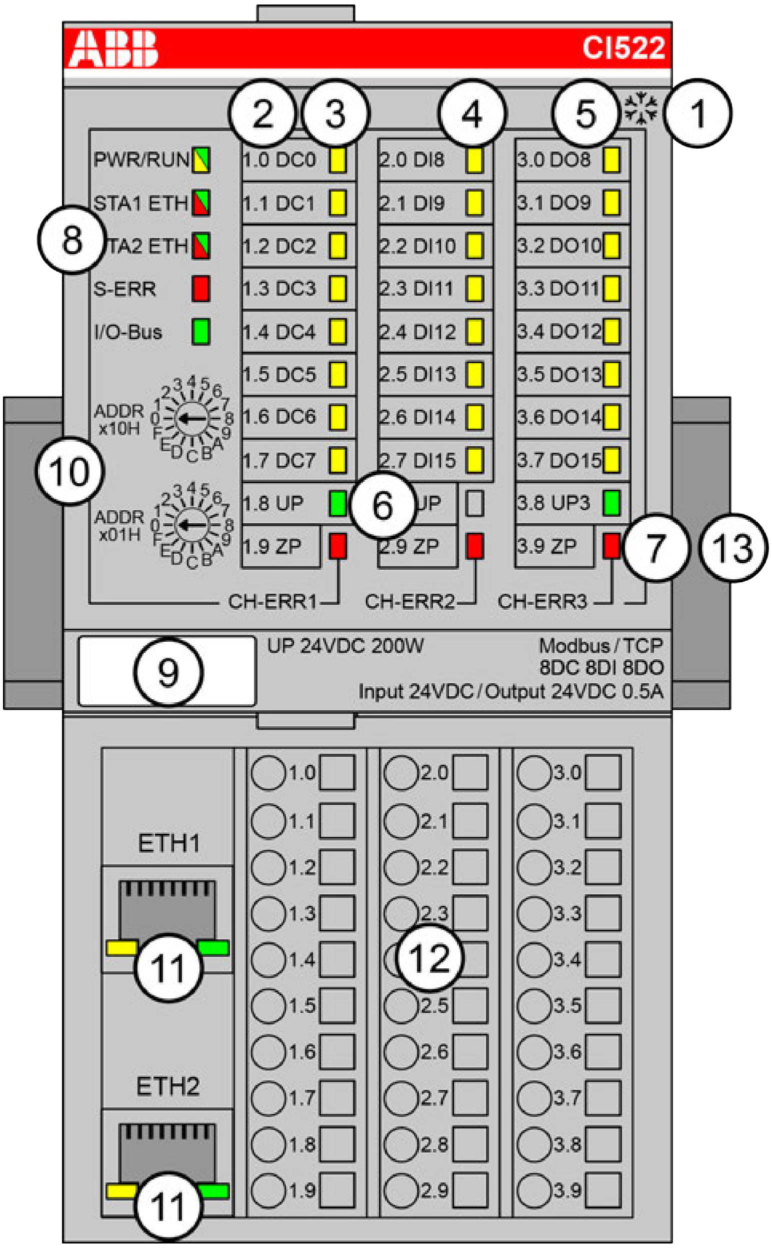
1.7.4.1.11 Ordering data

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.*

1.7.4.2 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

1.7.4.2.1 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.

1.7.4.2.2 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 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)
Required terminal unit	TU507 or TU508 *Chapter 1.5.1 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 122*

1.7.4.2.3 Connections

The Ethernet bus module CI522-MODTCP is plugged on the I/O terminal unit TU507-ETH *Chapter 1.5.1 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 122* or TU508-ETH *Chapter 1.5.1 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 122*. 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 *Chapter 1.8.2.6 “TA526 - Wall mounting accessory” on page 902*).

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 System Assembly, Construction and Connection chapter Chapter 2.6 “AC500 (Standard)” on page 971.

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.

The following figure shows the connection of the Ethernet bus module CI522-MODTCP.

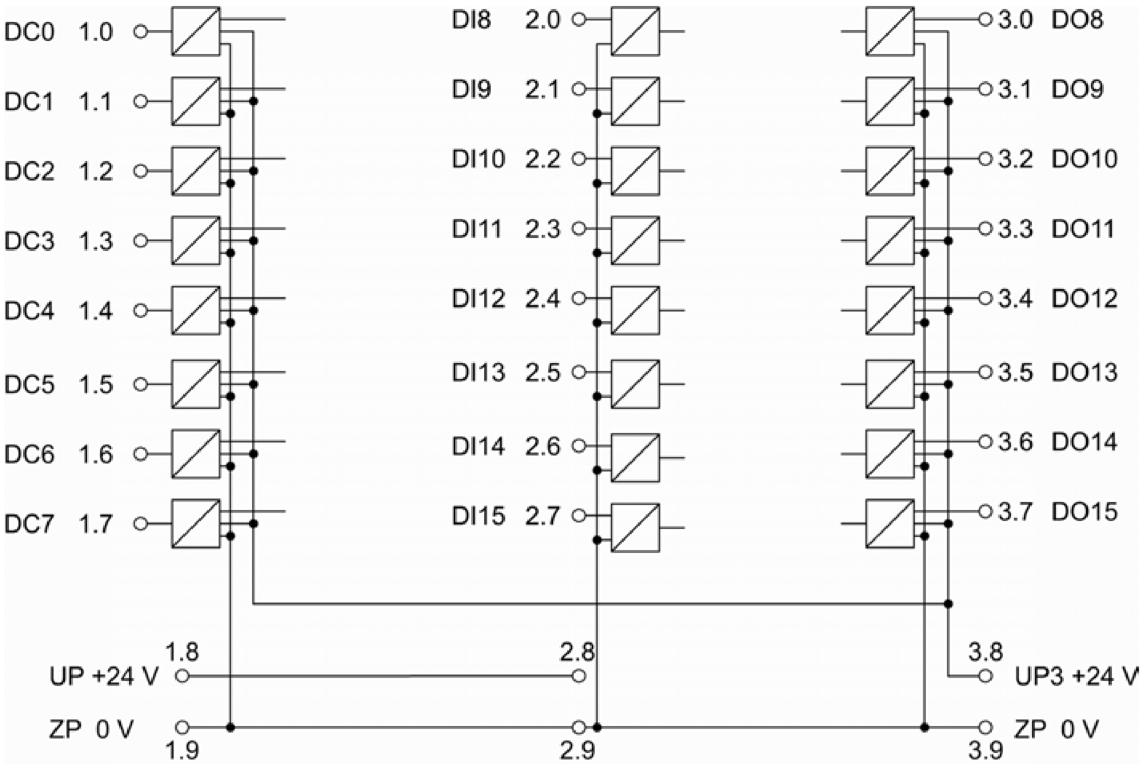


Fig. 150: Connection of the communication interface module CI522-MODTCP

Further information is provided in the System Technology chapter .

Connection of the digital inputs

The following figure shows the connection of the digital input DI8. Proceed with the digital inputs DI9 to DI15 in the same way.

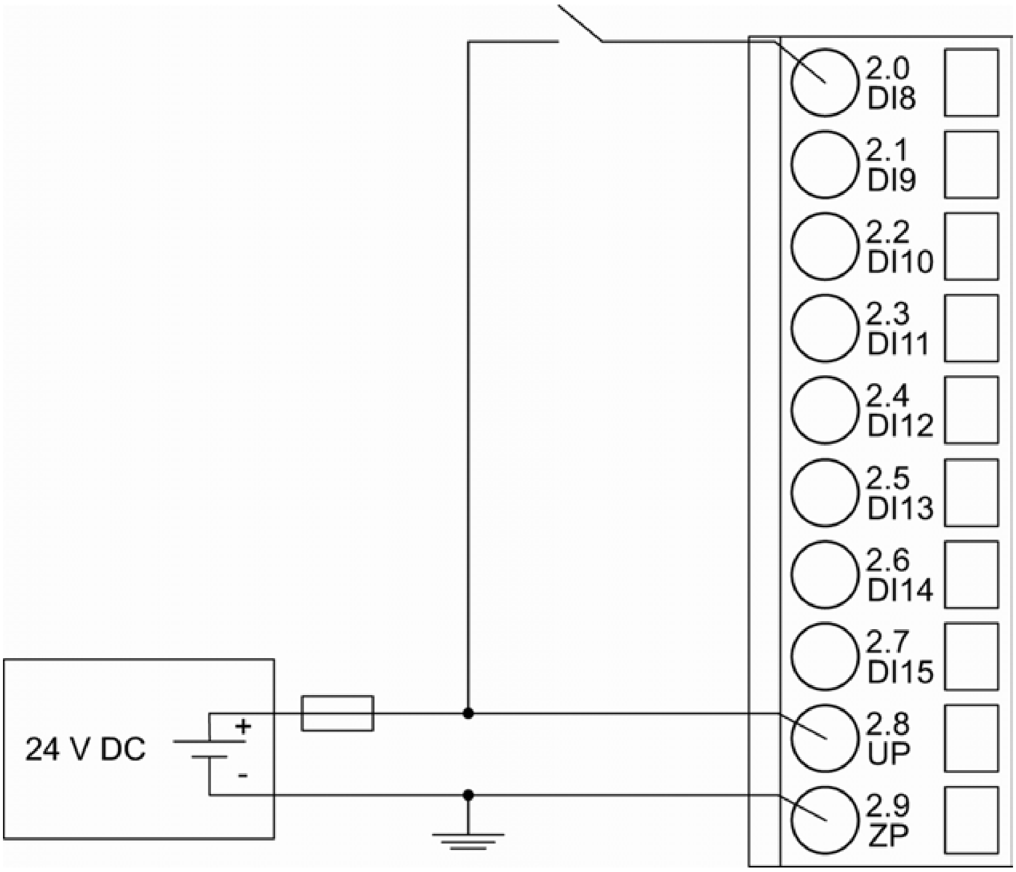
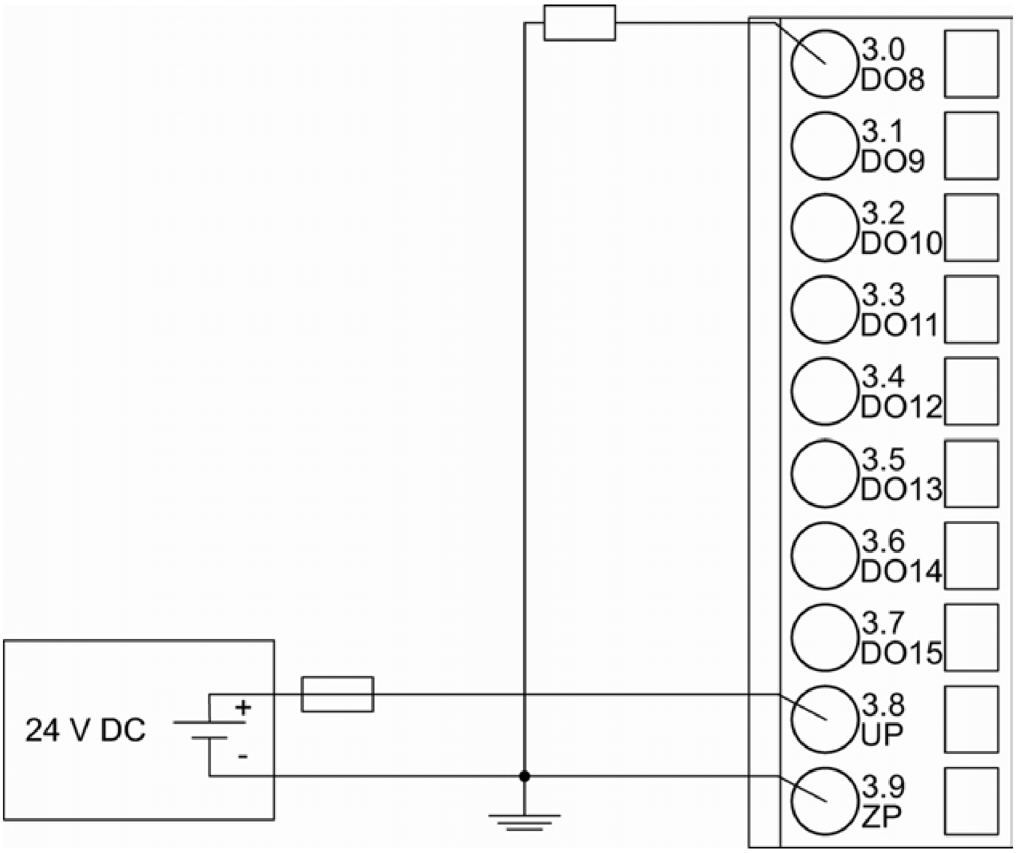


Fig. 151: Connection of the digital inputs to the module CI522-MODTCP

The meaning of the LEDs is described in Displays *Chapter 1.7.4.2.8.1 “State LEDs” on page 787*.

Connection of the digital outputs

The following figure shows the connection of the digital output DO8. Proceed with the digital outputs DO9 - DO15 in the same way.

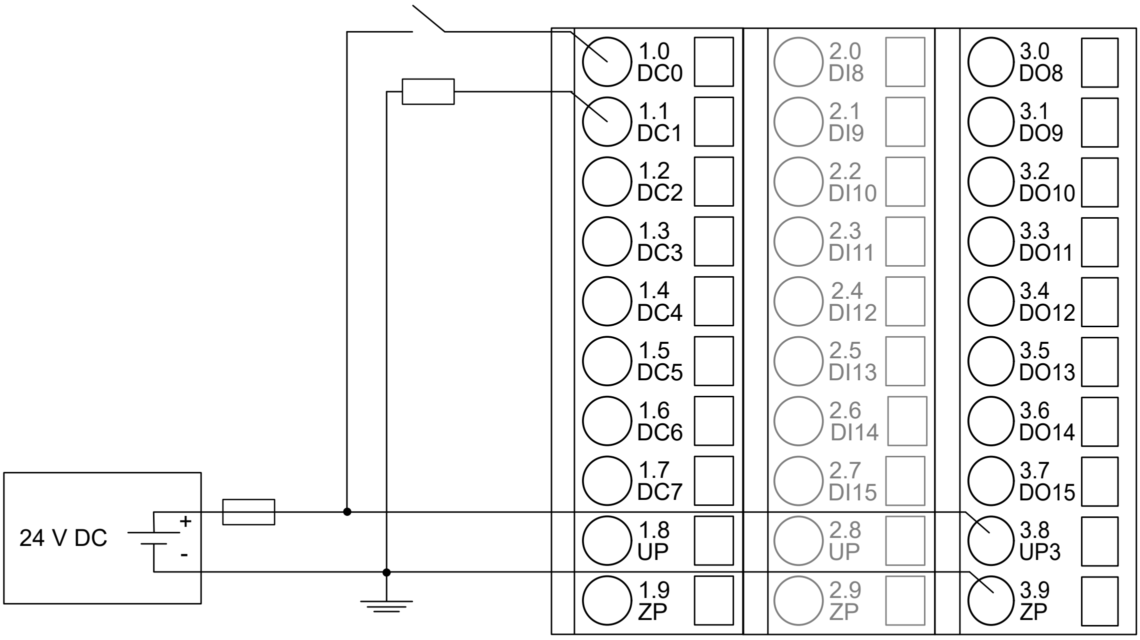


The meaning of the LEDs is described in Displays ➪ *Chapter 1.7.4.2.8.1 “State LEDs” on page 787*.

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 to 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 1.7.4.2.3 “Connections” on page 771*.

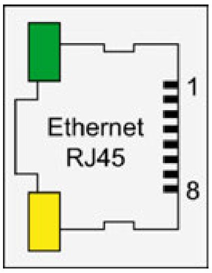


The meaning of the LEDs is described in Displays ↯ *Chapter 1.7.4.2.8.1 "State LEDs" on page 787*.

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.

For further information regarding wiring and cable types see chapter Ethernet ↯ *Chapter 2.6.4.7 "Ethernet connection details" on page 997.*

1.7.4.2.4 Internal data exchange

Digital inputs (bytes)	5
Digital outputs (bytes)	5
Counter input data (words)	4
Counter output data (words)	8

1.7.4.2.5 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.

1.7.4.2.6 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 1.7.4.2.7 “Parameterization” on page 779*.

1.7.4.2.7 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
Error LED / Failsafe function (Table Error LED / Failsafe function *Table 163 “Table Error LED / Failsafe function” on page 781*)	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		

Name	Value	Internal value	Internal value, type	Default
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Master IP for Write restriction [4])	No master IP Master IP	0,0,0,0 W,X,y,z	ARRAY[0..3] OF BYTE	0,0,0,0
Timeout for Bus supervision	No supervision 10 ms timeout 20 ms timeout	0 1 2	BYTE	No supervision
IO Mapping Structure [3])	Fixed Mapping Dynamic Mapping	0 1	BYTE	0
Reserved	Internal	0	ARRAY[0..2] OF BYTE	0,0,0
Check supply	off on	0 1	BYTE	1
Fast counter	0 : 10 [2])	0 : 10	BYTE	0

Remarks:

[1])	With a faulty ID, the module reports a "parameter error" and does not perform cyclic process data transmission.
[2])	Counter operating modes *Chapter 1.6.1.2.9 “Fast counter” on page 349*

3)	Fixed Mapping means each module has its own Modbus registers for data transfer independent of the I/O bus constellation description. For details see. 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 adress.
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 163: 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 1.7.4.2.3 “Connections” on page 771* (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.

1.7.4.2.8 Diagnosis

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
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	
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 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	1...6	255	2	0	45	The connected Communication Module has no con-nection to the net-work	Check cabeling

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	45	Process voltage UP3 too low	Check process voltage
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 1.7.4.2.3 “Connections” on page 771*. 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 1.7.4.2.3 “Connections” on page 771*. 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.

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 164: States of the 5 system LEDs

LED	Color	OFF	ON	Flashing
PWR/RUN	Green	Process supply voltage missing	Internal supply voltage OK, module ready for communication with I/O Controller	Start-up / preparing communication
	Yellow	---	---	---

LED	Color	OFF	ON	Flashing
STA1 ETH (System LED "BF")	Green	---	Device configured, cyclic data exchange running	Device configured, acyclic data exchange running
	Red	---	Communication error (timeout) appeared	IP address error
STA2 ETH (System LED "SF")	Green	Device has valid parameters	Device is running parameterization sequenze	Device has no parameters
	Red	---	---	Device has invalid parameters
S-ERR	Red	No error	Internal error	--
I/O-Bus	Green	No expansion modules connected or communication error	Expansion modules connected and operational	---
ETH1	Green	No connection at Ethernet interface	Connected to Ethernet interface	---
	Yellow	---	Device is transmitting telegrams	Device is transmitting telegrams
ETH2	Green	No connection at Ethernet interface	Connected to Ethernet interface	---
	Yellow	---	Device is transmitting telegrams	Device is transmitting telegrams

Table 165: States of the 29 process LEDs

LED	Color	OFF	ON	Flashing
DC0 to DC7	Yellow	Input/Output is OFF	Input/Output is ON	--
DI8 to DI15	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--
DO8 to 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

1.7.4.2.9 Technical data

The system data of AC500 and S500 ↬ *Chapter 2.6.1 “System data AC500” on page 971* are applicable to the standard version.

The system data of AC500-XC ↬ *Chapter 2.7.1 “System data AC500-XC” on page 1023* are applicable to the XC version.

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 1.7.4.2.8 “Diagnosis” on page 782*
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 switchgear cabinet.

NOTICE!
Attention:
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous 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 to DI15		Terminals 2.0 to 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
	Signal 0	-3 V...+5 V
	Undefined Signal	> +5 V...< +15 V
	Signal 1	+15 V...+30 V
Ripple with signal 0		Within -3 V...+5 V
Ripple with signal 1		Within +15 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	Input voltage +15 V	> 2 mA
	Input voltage +30 V	< 8 mA
Max. cable length		
	Shielded	1000 m
	Unshielded	600 m

Technical data of the digital outputs

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DO8 to DO15		Terminals 3.0 to 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.

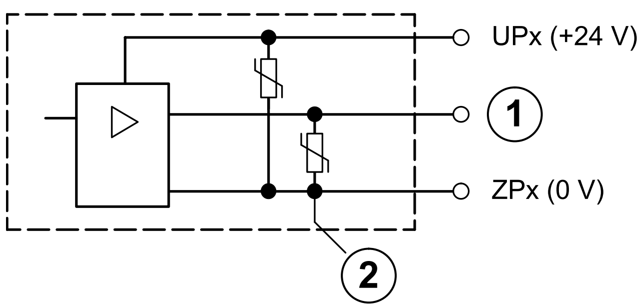


Fig. 152: Digital input/output (circuit diagram)

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 to DC7		Terminals 1.0 to 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...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 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

Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DC0 to DC7		Terminals 1.0 to 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.

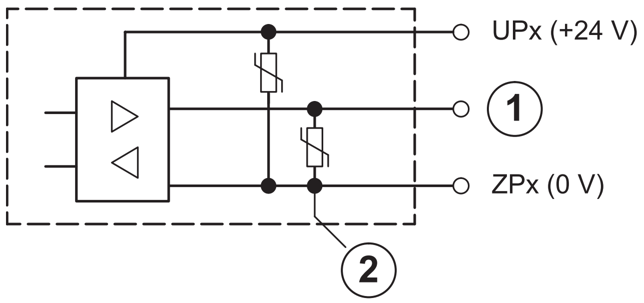


Fig. 153: Digital input/output (circuit diagram)

1 Digital input/output
2 For demagnetization when inductive loads are turned off

Technical data of the fast counter

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
Detailed description	See

1.7.4.2.10 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.*

1.7.5 PROFINET

1.7.5.1 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 1.7.5.1.1.1 “Characteristics of CI50x-PNIO” on page 795*.

1.7.5.1.1 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
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 ... +10 V
  - 0 ... +10 V
  - -10 ... +10 V (differential voltage)
  - 0 ... 20 mA
  - 4 ... 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 ... +10 V
  - 0 ... 20 mA
  - 4 ... 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

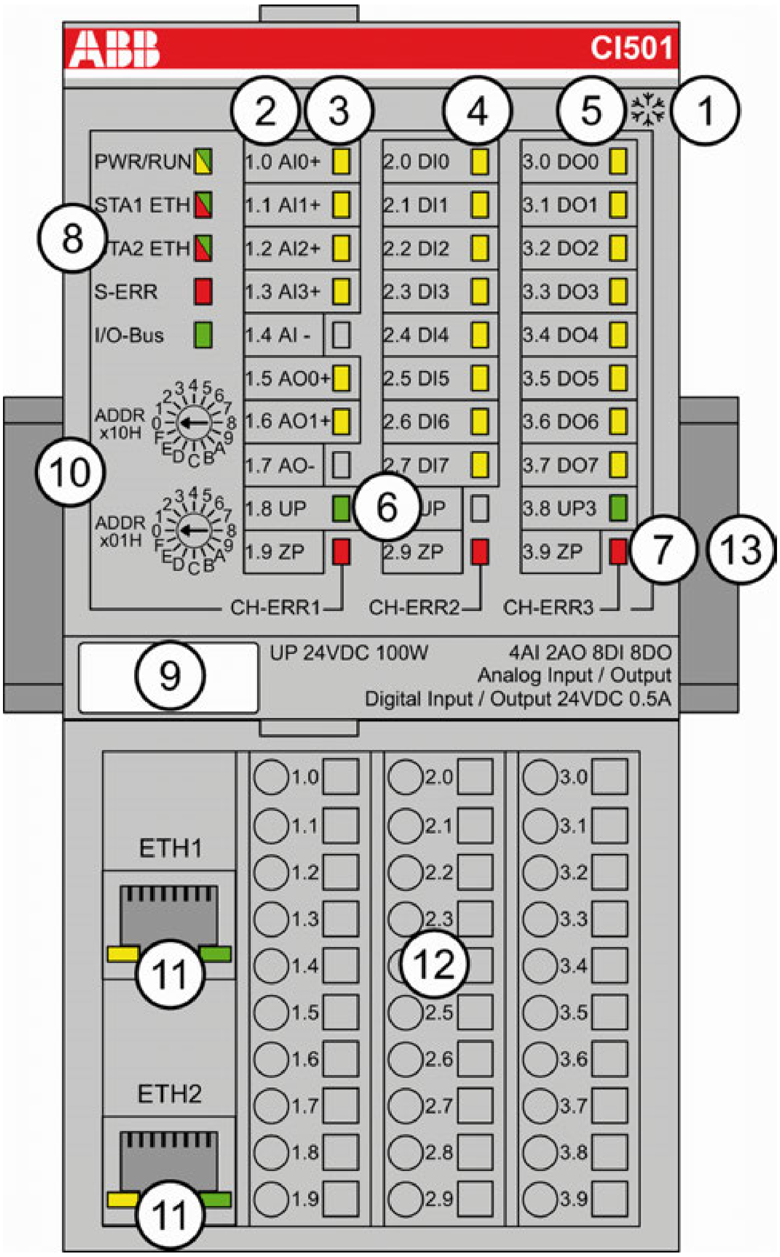
- 8 digital inputs 24 V DC
- 8 digital transistor outputs 24 V DC, 0.5 A max.
- 8 configurable digital inputs/outputs 24 V DC, 0.5 A max.
- Module-wise galvanically isolated
- XC version for usage in extreme ambient conditions available

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

1.7.5.2 CI501-PNIO

- 4 analog inputs, 2 analog outputs, 8 digital inputs, 8 digital outputs
- Resolution 12 bits plus 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

1.7.5.2.1 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.

1.7.5.2.2 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 1.5.1 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 122*

1.7.5.2.3 Connections

The Ethernet communication interface module CI501-PNIO is plugged on the I/O terminal unit TU507-ETH or TU508-ETH *Chapter 1.5.1 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 122*. 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 *Chapter 1.8.2.6 “TA526 - Wall mounting accessory” on page 902*).

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 System Assembly, Construction and Connection chapter *Chapter 2.6 “AC500 (Standard)” on page 971.*

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.

The 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

Terminal	Signal	Description
2.4	DI4	Signal of the digital input DI4
2.5	DI5	Signal of the digital input DI5
2.6	DI6	Signal of the digital input DI6
2.7	DI7	Signal of the digital input DI7
2.8	UP	Process voltage UP (24 V DC)
2.9	ZP	Process voltage ZP (0 V DC)
3.0	DO0	Signal of the digital output DO0
3.1	DO1	Signal of the digital output DO1
3.2	DO2	Signal of the digital output DO2
3.3	DO3	Signal of the digital output DO3
3.4	DO4	Signal of the digital output DO4
3.5	DO5	Signal of the digital output DO5
3.6	DO6	Signal of the digital output DO6
3.7	DO7	Signal of the digital output DO7
3.8	UP3	Process voltage UP3 (24 V DC)
3.9	ZP	Process voltage ZP (0 V DC)

WARNING!
Removal/Insertion under power
The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

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

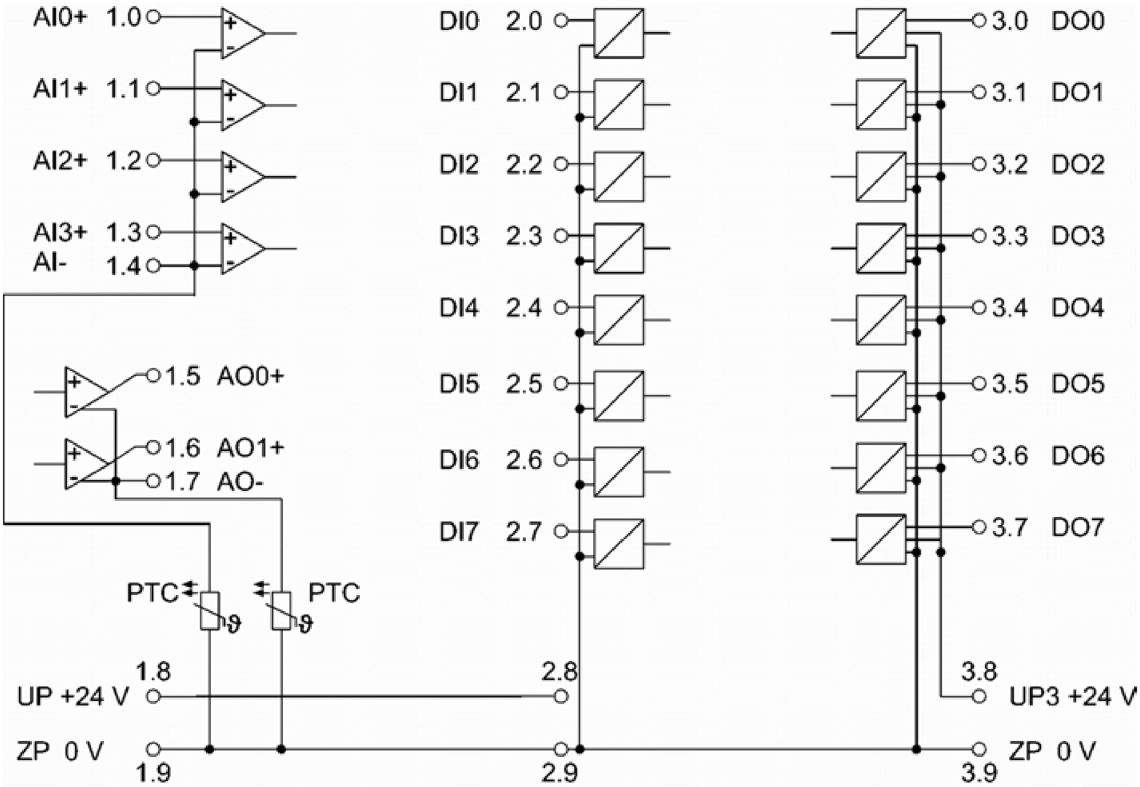
– Make sure that all voltage sources (supply voltage and process supply voltage) are switched off before you begin with operations on the system.
– Never connect any voltages or signals to reserved terminals (marked with ---). Reserved terminals may carry internal voltages.

For the open-circuit detection (cut wire), each 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.

Only for simple applications (low electromagnetic disturbances, no high requirement on precision), the shielding can also be omitted.

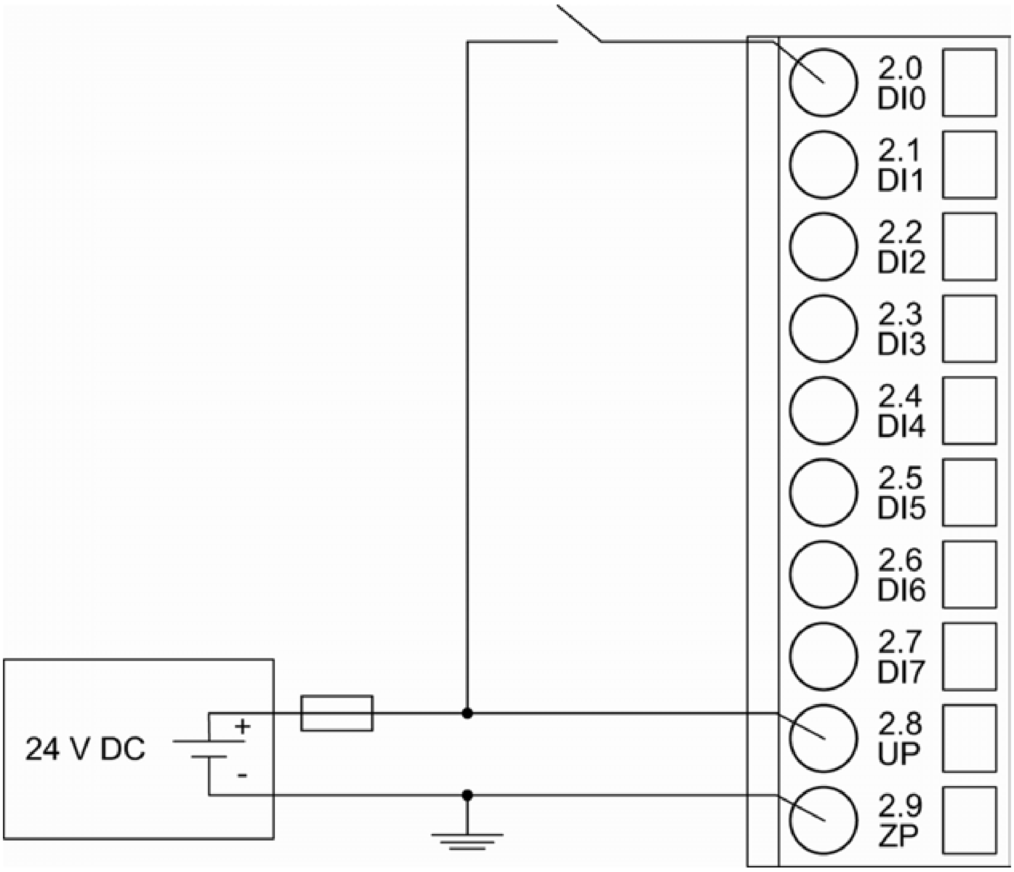
The following figures show the connection of the Ethernet bus module CI501-PNIO.



Further information is provided in the System Technology chapter .

Connection of the digital inputs

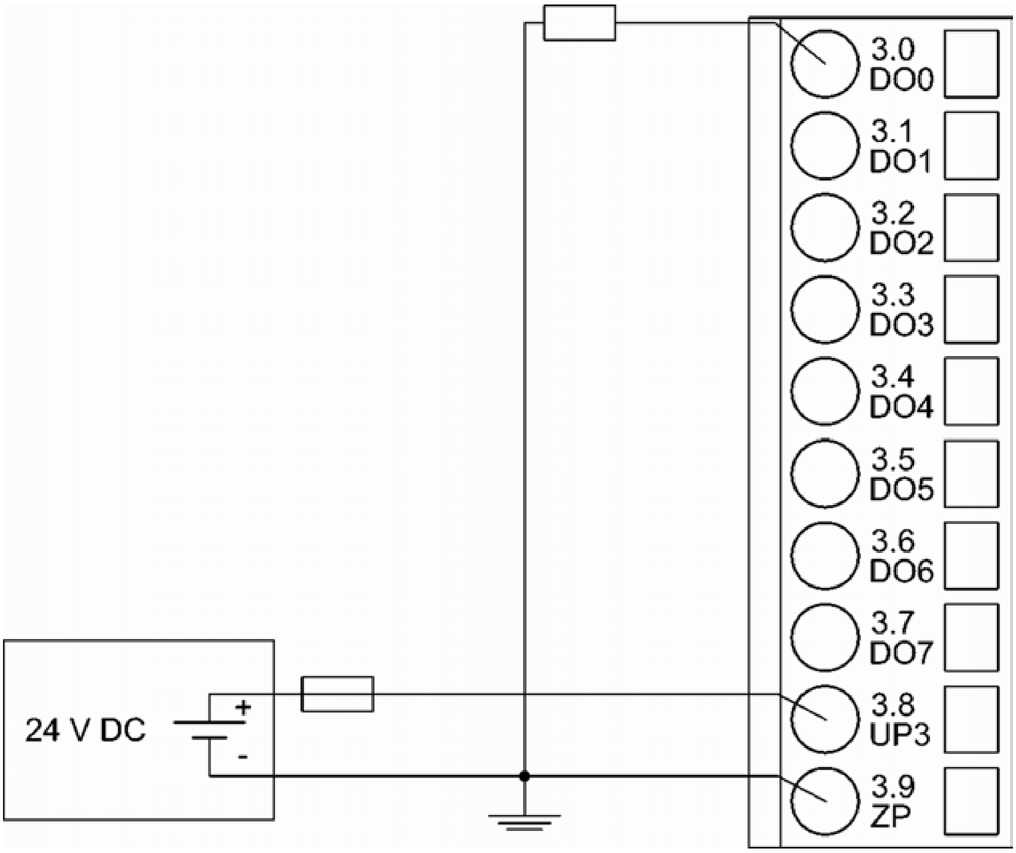
The following figure shows the connection of the digital input DI0. Proceed with the digital inputs DI1 to DI7 in the same way.



The meaning of the LEDs is described in Displays *Chapter 1.7.5.2.8.2 “State LEDs” on page 826*.

Connection of the digital outputs

The following figure shows the connection of the digital output DO0. Proceed with the digital outputs DO1 - DO7 in the same way.

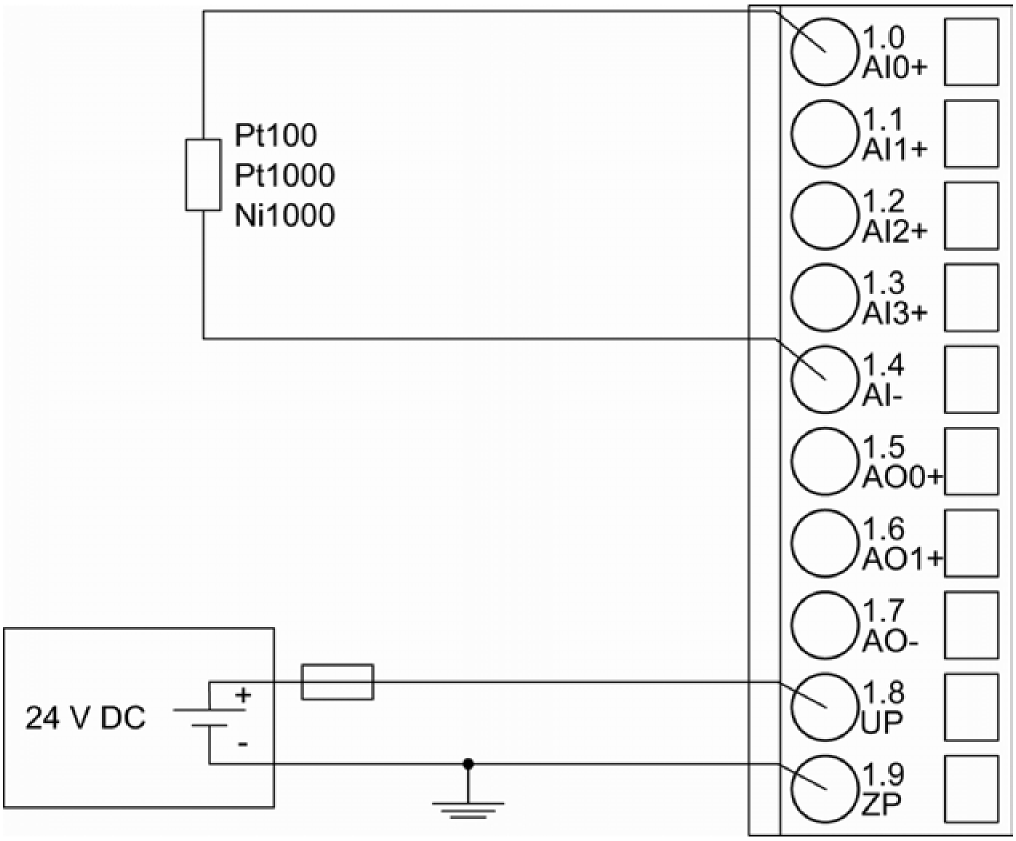


The meaning of the LEDs is described in Displays ↻ *Chapter 1.7.5.2.8.2 “State LEDs” on page 826*.

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.

The following figure shows the connection of resistance thermometers in 2-wire configuration to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.



The following measuring ranges can be configured ✎ *Chapter 1.7.5.2.7 “Parameterization” on page 815* ✎ *Chapter 1.7.5.2.9.1 “Input ranges voltage, current and digital input” on page 828*:

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 1.7.5.2.8 “Diagnosis and state LEDs” on page 821*.

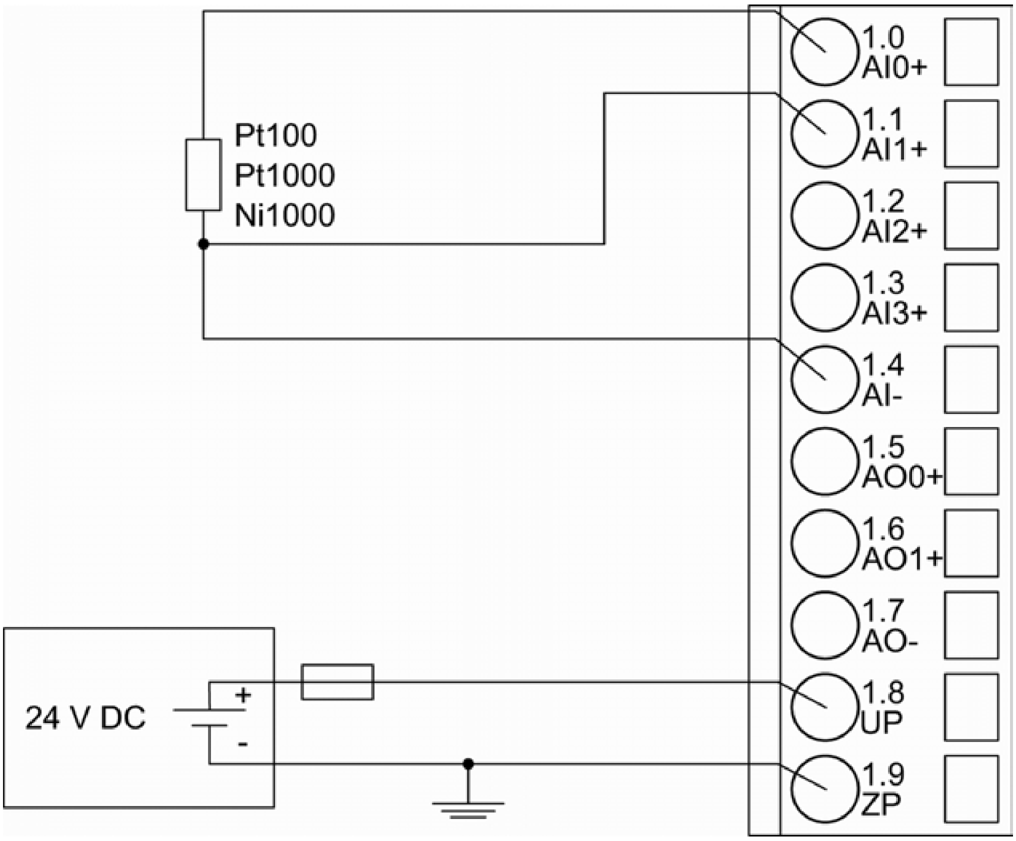
The module CI501-PNIO performs a linearization of the resistance characteristic.

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.

The following figure shows the 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 1.7.5.2.7 “Parameterization” on page 815* *Chapter 1.7.5.2.9.1 “Input ranges voltage, current and digital input” on page 828*:

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

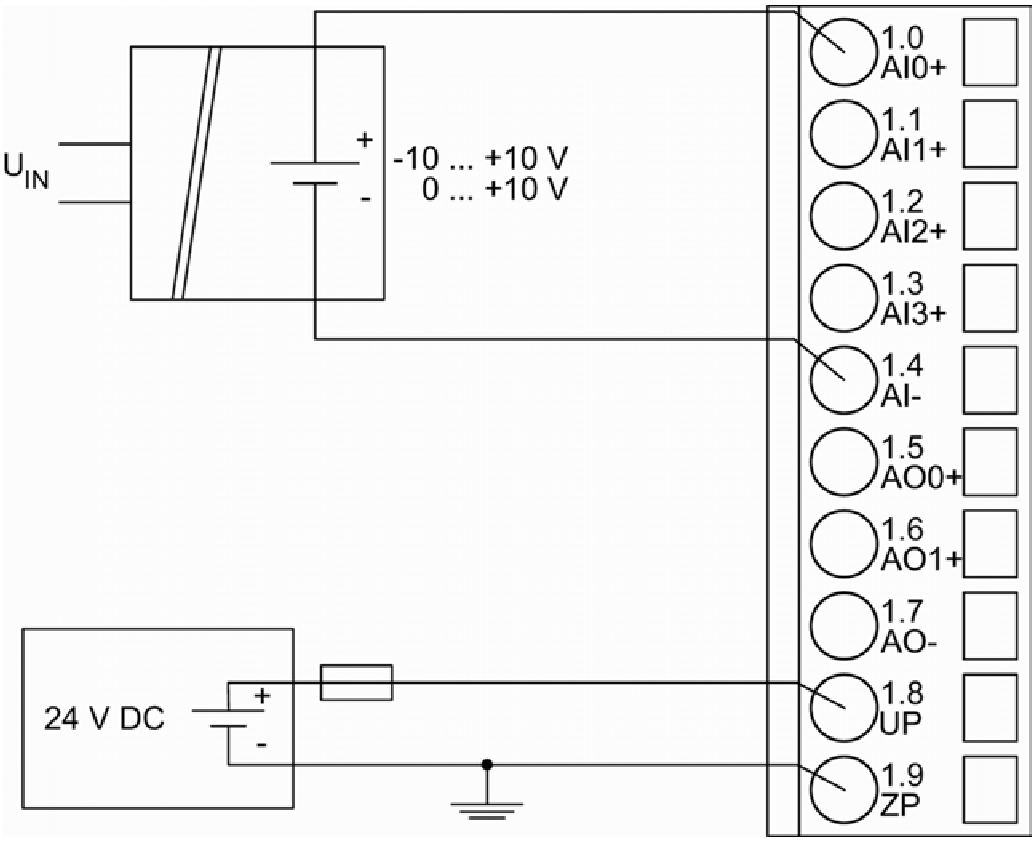
The function of the LEDs is described under Diagnosis and displays / Displays *Chapter 1.7.5.2.8 “Diagnosis and state LEDs” on page 821*.

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

The following figure shows the connection of active-type analog sensors (voltage) with galvanically isolated power supply to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.



The following measuring ranges can be configured ⇘ *Chapter 1.7.5.2.7 “Parameterization” on page 815* ⇘ *Chapter 1.7.5.2.9.1 “Input ranges voltage, current and digital input” on page 828*:

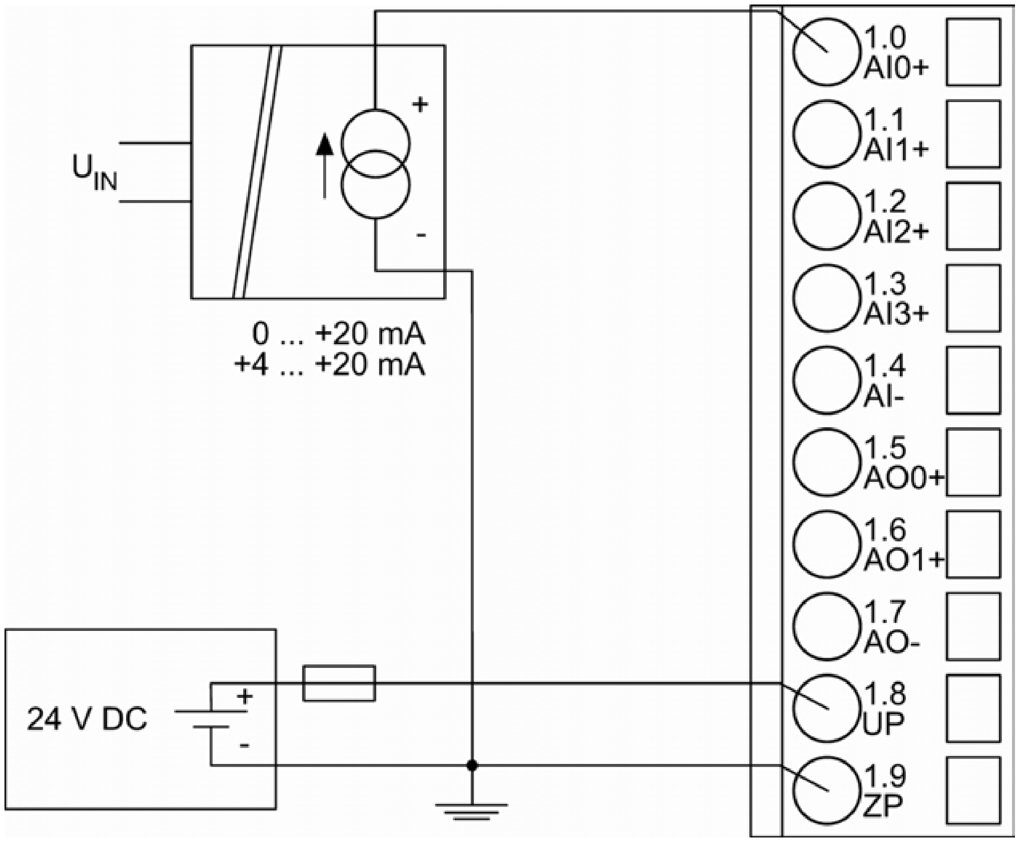
Voltage	0 V...10 V	1 channel used
Voltage	-10 V...+10 V	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays ⇘ *Chapter 1.7.5.2.8 “Diagnosis and state LEDs” on page 821*.

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

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

The following figure shows the connection of active-type analog sensors (current) with galvanically isolated power supply to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.



The following measuring ranges can be configured ✎ *Chapter 1.7.5.2.7 “Parameterization” on page 815* ✎ *Chapter 1.7.5.2.9.1 “Input ranges voltage, current and digital input” on page 828*:

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

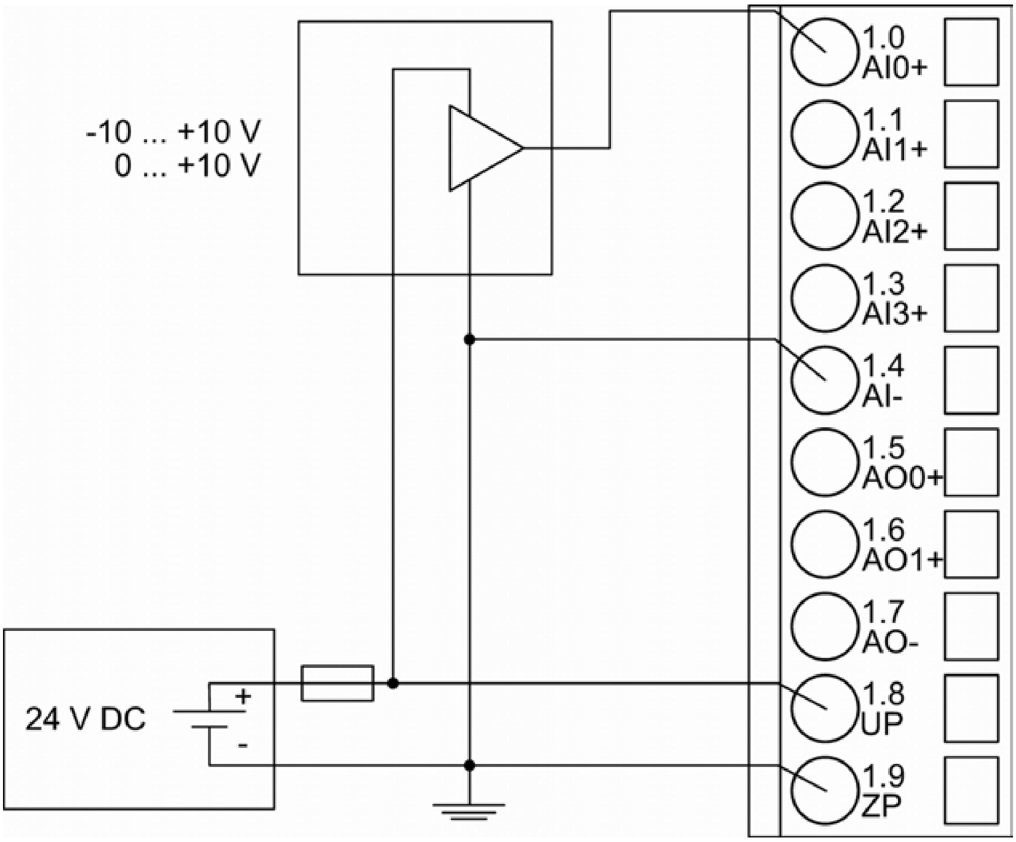
The function of the LEDs is described under Diagnosis and displays / Displays ✎ *Chapter 1.7.5.2.8 “Diagnosis and state LEDs” on page 821*.

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

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 to 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 1.7.5.2.7 "Parameterization" on page 815* ⇨ *Chapter 1.7.5.2.7 "Parameterization" on page 815*:

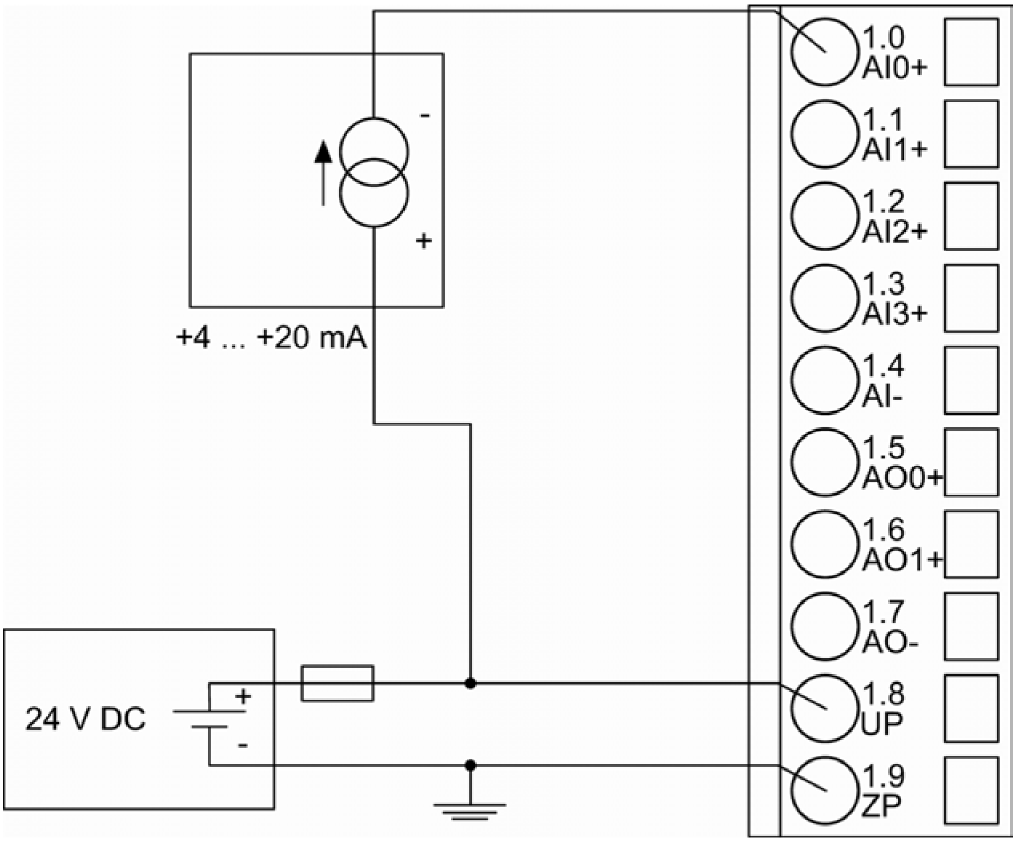
Voltage	0 V...10 V	1 channel used
Voltage	-10 V...+10 V	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays ⇨ *Chapter 1.7.5.2.8 "Diagnosis and state LEDs" on page 821*.

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 to AI3 in the same way.



The following measuring ranges can be configured ⇘ *Chapter 1.7.5.2.7 “Parameterization” on page 815* ⇘ *Chapter 1.7.5.2.9.1 “Input ranges voltage, current and digital input” on page 828*:

Current	4 mA...20 mA	1 channel used

The function of the LEDs is described under Diagnosis and displays / Displays ⇘ *Chapter 1.7.5.2.8 “Diagnosis and state LEDs” on page 821*.

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).

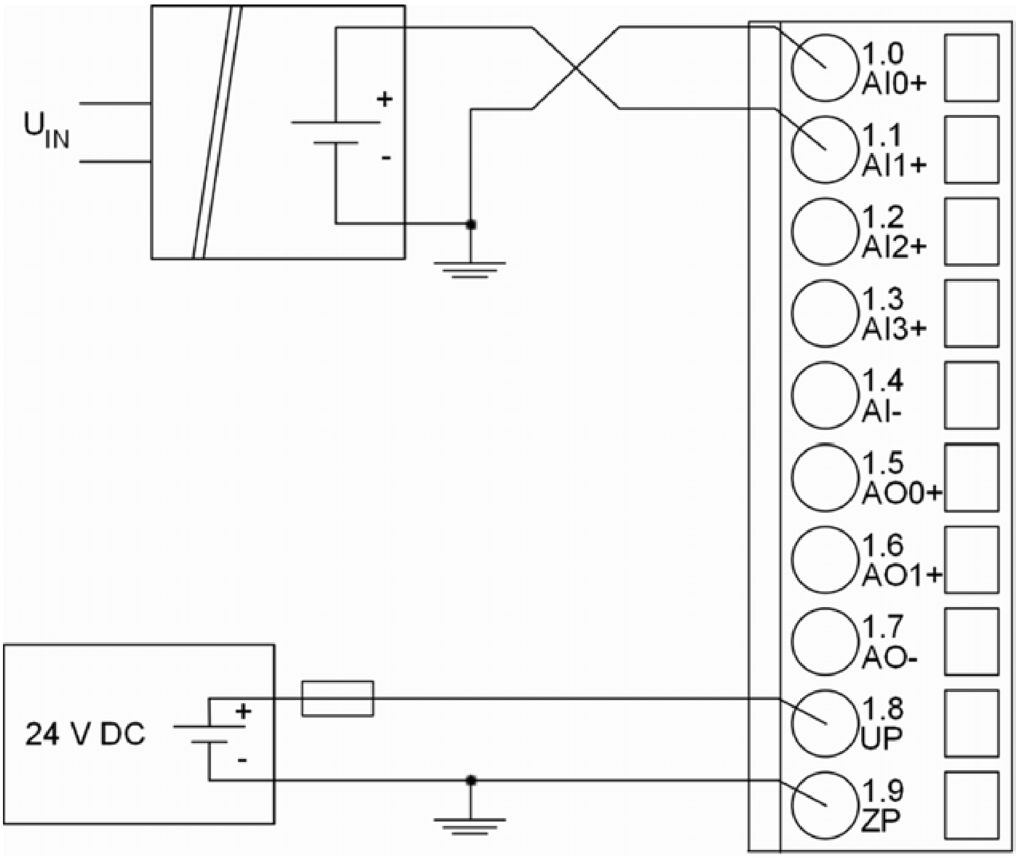
CAUTION!

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.



The following measuring ranges can be configured *Chapter 1.7.5.2.7 “Parameterization” on page 815* *Chapter 1.7.5.2.9.1 “Input ranges voltage, current and digital input” on page 828*:

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 1.7.5.2.8 “Diagnosis and state LEDs” on page 821*.

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.

The following figure shows the connection of digital sensors to the analog input AI0. Proceed with the analog inputs AI1 to AI3 in the same way.

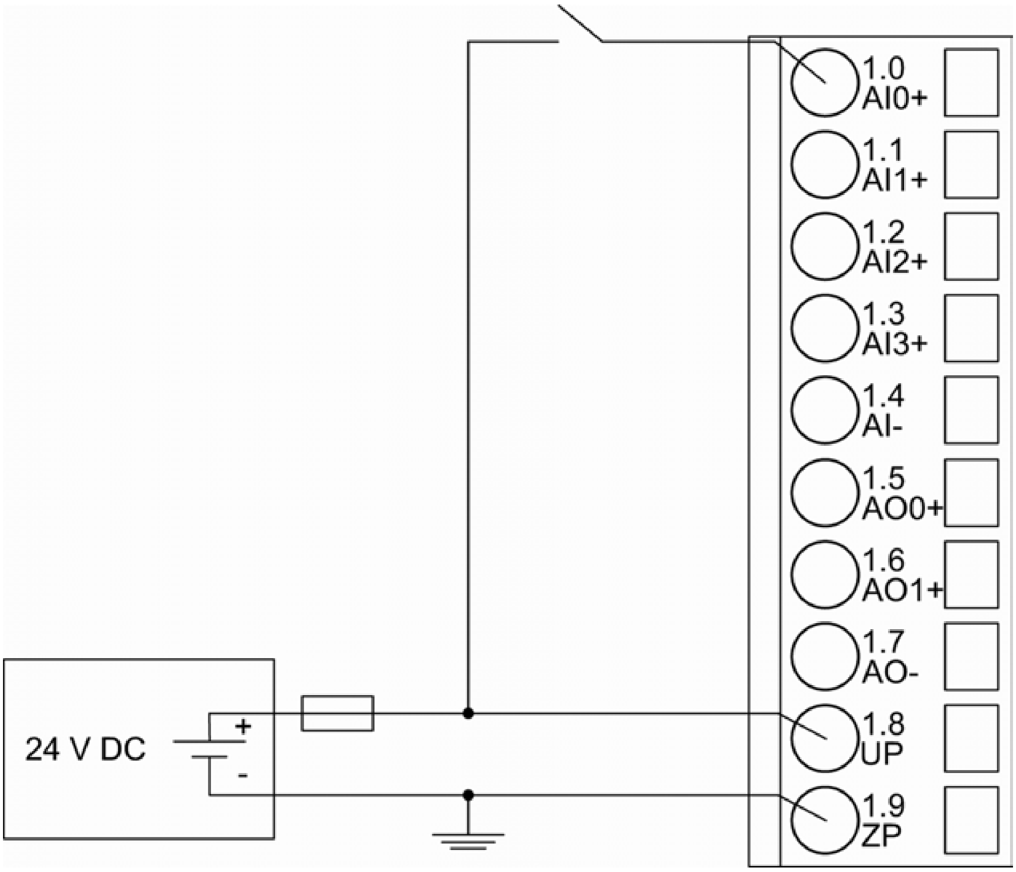


Fig. 154: Use of analog inputs as digital inputs

The following measuring ranges can be configured *Chapter 1.7.5.2.7 “Parameterization” on page 815* *Chapter 1.7.5.2.9.1 “Input ranges voltage, current and digital input” on page 828* :

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 Diagnosis and displays / Displays *Chapter 1.7.5.2.8 “Diagnosis and state LEDs” on page 821*.

Connection of analog output loads (Voltage)

The following figure shows the connection of output loads to the analog output AO0. Proceed with the analog output AO1 in the same way.

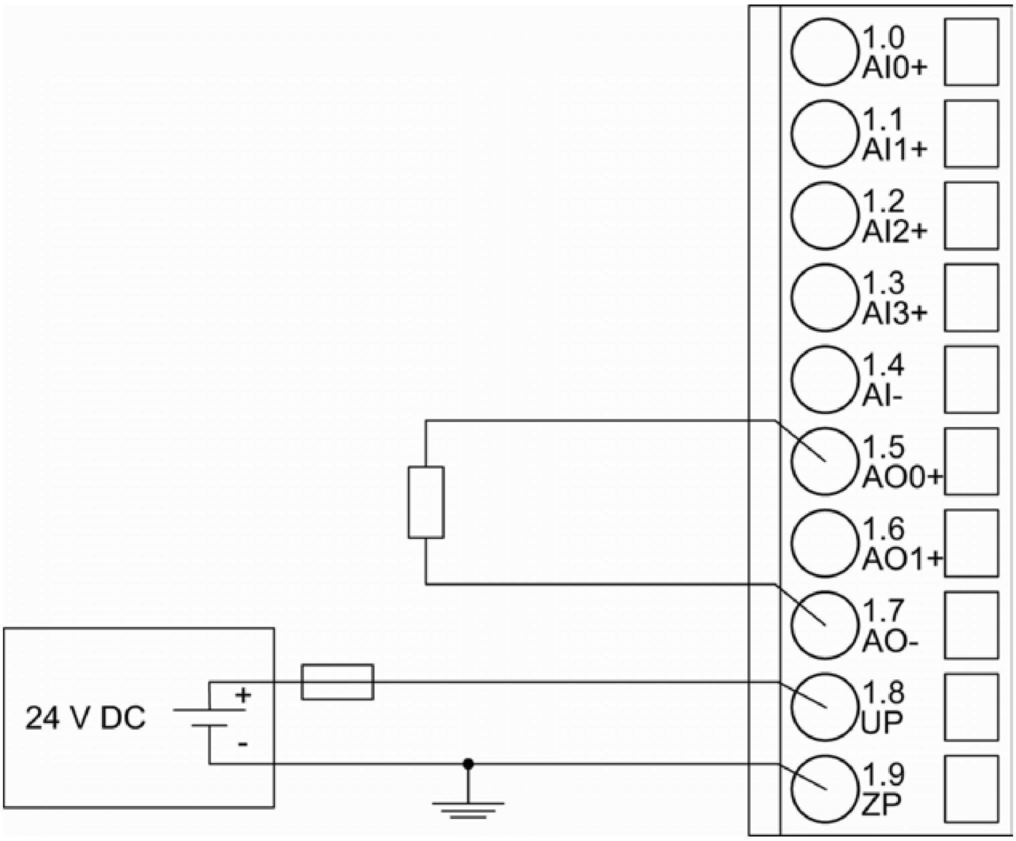


Fig. 155: Connection of analog output loads (voltage)

The following measuring ranges can be configured *Chapter 1.7.5.2.7 "Parameterization" on page 815* *Chapter 1.7.5.2.9.1 "Input ranges voltage, current and digital input" on page 828*

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 1.7.5.2.8 "Diagnosis and state LEDs" on page 821*.

Unused analog outputs can be left open-circuited.

Connection of analog output loads (Current)

The following figure shows the connection of output loads to the analog output AO0. Proceed with the analog output AO1 in the same way.

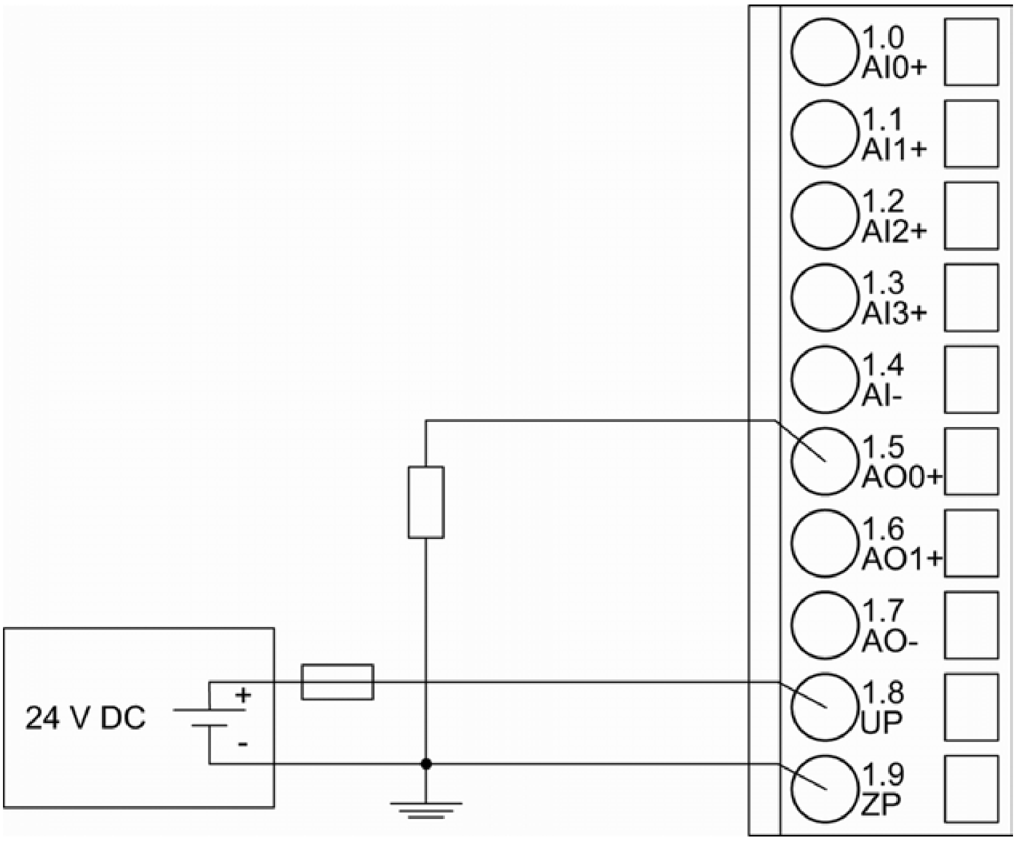


Fig. 156: Connection of analog output loads (current)

The following measuring ranges can be configured *Chapter 1.7.5.2.7 “Parameterization” on page 815* *Chapter 1.7.5.2.9.1 “Input ranges voltage, current and digital input” on page 828*:

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

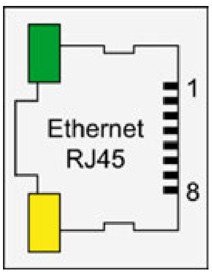
The function of the LEDs is described under Diagnosis and displays / Displays *Chapter 1.7.5.2.8 “Diagnosis and state LEDs” on page 821*.

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.

For further information regarding wiring and cable types see chapter Ethernet *Chapter 2.6.4.7 "Ethernet connection details" on page 997.*

1.7.5.2.4 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

1.7.5.2.5 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.

1.7.5.2.6 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.

Details about configuration are described in Parameterization *Chapter 1.7.5.2.7 "Parameterization" on page 815*.

1.7.5.2.7 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 166 "Error LED / Failsafe function" on page 816*	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 1.6.1.2.9 “Fast counter” on page 349*.

Table 166: 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	0	BYTE	0
	Reserved	255		
Behaviour AO at comm. error *)	Off	0	BYTE	0
	Last value	1		
	Last value 5 s	6		
	Last value 10 s	11		
	Substitute value	2		
	Substitute value 5 s	7		
	Substitute value 10 s	12		
*) 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 167 “Channel configuration” on page 818*	Table Operating modes of the analog inputs *Table 167 “Channel configuration” on page 818*	BYTE	0
Input 0, Check channel	Table Channel montoring *Table 168 “Channel monitoring” on page 819*	Table Channel montoring *Table 168 “Channel monitoring” on page 819*	BYTE	0
:	:	:	:	:
:	:	:	:	:
Input 3, Channel configuration	Table Operating modes of the analog inputs *Table 167 “Channel configuration” on page 818*	Table Operating modes of the analog inputs *Table 167 “Channel configuration” on page 818*	BYTE	0
Input 3, Check channel	Table Channel montoring *Table 168 “Channel monitoring” on page 819*	Table Channel montoring *Table 168 “Channel monitoring” on page 819*	BYTE	0

Table 167: 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 168: Channel monitoring

Internal Value	Check Channel
0 (default)	Plausib(ility), cut wire, short circuit
3	Not used

Channel parameters for the analog outputs (2x)

Name	Value	Internal value	Internal value, type	Default
Output 0, Channel configuration	Table Operating modes of the analog outputs *Further information on page 820*	Table Operating modes of the analog outputs *Further information on page 820*	BYTE	0
Output 0, Check channel	Table Channel monitoring *Table 170 “Channel monitoring” on page 820*	Table Channel monitoring *Table 170 “Channel monitoring” on page 820*	BYTE	0
Output 0, Substitute value	Table Substitute value *Table 171 “Substitute value” on page 820*	Table Substitute value *Table 171 “Substitute value” on page 820*	WORD	0
Output 1, Channel configuration	Table Operating modes of the analog outputs *Further information on page 820*	Table Operating modes of the analog outputs *Further information on page 820*	BYTE	0
Output 1, Check channel	Table Channel monitoring *Table 170 “Channel monitoring” on page 820*	Table Channel monitoring *Table 170 “Channel monitoring” on page 820*	BYTE	0
Output 1, Substitute value	Table Substitute value *Table 171 “Substitute value” on page 820*	Table Substitute value *Table 171 “Substitute value” on page 820*	WORD	0

Table 169: 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 170: Channel monitoring

Internal value	Check channel
0	Plausib(ility), cut wire, short circuit
3	None

Table 171: 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 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 1.7.5.2.3 “Connections” on page 798*. 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".				

1.7.5.2.8 Diagnosis and state LEDs

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**	**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**	**PNIO diagnosis block**	
Class	**Interface**	**Device**	**Module**	**Channel**	**Error-Identifier**	**Error message**	**Remedy**
	1)	**2)**	**3)**				
4	-	31	31	31	10	Voltage overflow on outputs (above UP3 level) 5)	Check terminals/ check process supply voltage
Channel error digital							
4	-	31	2	0...7	46	Externally voltage detected at digital output DO0...DO7 6)	Check terminals
4	-	31	2	0...7	47	Short circuit at digital output 7)	Check terminals
Channel error analog							
4	-	31	1	0...3	48	Analog value overflow or broken wire at an analog input	Check value or check terminals
4	-	31	1	0...3	7	Analog value underflow at an analog input	Check value
4	-	31	1	0...3	47	Short circuit at an analog input	Check terminals
4	-	31	3	0...1	4	Analog value overflow at an analog output	Check output value
4	-	31	3	0...1	7	Analog value underflow at an analog output	Check output value

Remarks:

[1])	In AC500 the following interface identifier applies: "-" = Diagnosis via bus-specific function blocks; 0...4 or 10 = Position of the communication module;14 = I/O bus; 31 = Module itself The identifier is not contained in the CI501-PNIO diagnosis block.
[2])	With "Device" the following allocation applies: 31 = Module itself; 1...10 = Expansion module
[3])	With "Module" the following allocation applies: 31 = Module itself Module type (1 = AI, 2 = DO, 3 = AO)
[4])	This message appears, if externally voltages at one or more terminals DO0...DO7 cause that other digital outputs are supplied through that voltage *Chapter 1.7.5.2.3 "Connections" on page 798*. 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 1.7.5.2.3 "Connections" on page 798*. 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.

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 172: 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 173: 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 to 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

1.7.5.2.9 Measuring ranges

Input ranges voltage, current and digital input

Range	0...10 V	-10...+10 V	0...20 mA	4...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
Under-flow	<0.0000	<-11.7589	<0.0000	<0.0000		-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.

1.7.5.2.10 Technical data

The system data of AC500 and S500 ⇘ *Chapter 2.6.1 “System data AC500” on page 971* are applicable to the standard version.

The system data of AC500-XC ⇘ *Chapter 2.7.1 “System data AC500-XC” on page 1023* are applicable to the XC version.

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 1.7.5.2.8 “Diagnosis and state LEDs” on page 821*
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 switchgear cabinet.

NOTICE!
Attention:
All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous 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

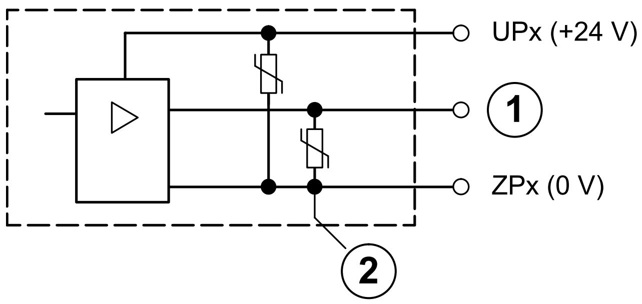
Parameter		Value
Number of channels per module		8
Distribution of the channels into groups		1 group of 8 channels
Terminals of the channels DI0 to DI7		Terminals 2.0 to 2.7
Reference potential for all inputs		Terminals 1.9...3.9 (negative pole of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1...32 ms
Input signal voltage		24 V DC
	0-Signal	-3 V...+5 V
	Undefined Signal	> +5 V...< +15 V
	1-Signal	+15 V...+30 V
Ripple with signal 0		Within -3 V...+5 V
Ripple with signal 1		Within +15 V...+30 V
Input current per channel		
	Input voltage +24 V	Typ. 5 mA
	Input voltage +5 V	> 1 mA
	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 to DO7	Terminals 3.0 to 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+ to AI3+	Terminals 1.0 to1.3
Reference potential for AI0+ to 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 + 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 1.7.5.2.9.1 "Input ranges voltage, current and digital input" on page 828*
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

Parameter		Value
Connections of the channels AI0+ to AI3+		Terminals 1.0 to 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+ to 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 (+ 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 1.7.5.2.9.3 “Output ranges voltage and current” on page 829*
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

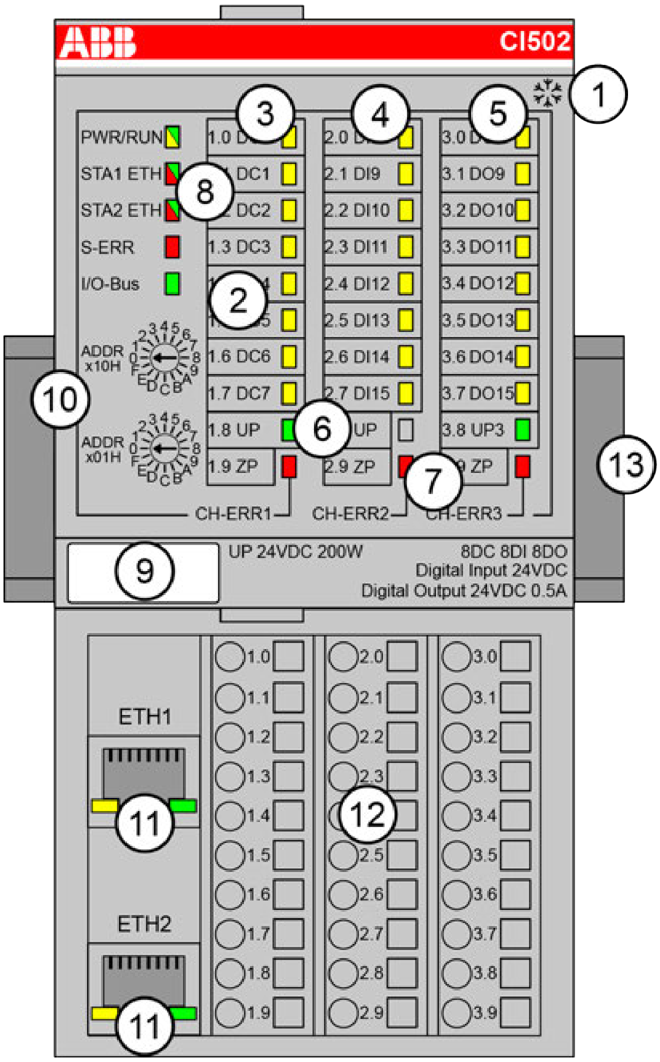
1.7.5.2.11 Ordering data

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.*

1.7.5.3 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

1.7.5.3.1 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.

1.7.5.3.2 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 1.5.1 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 122*

1.7.5.3.3 Connections

The Ethernet communication interface module CI502-PNIO is plugged on the I/O terminal unit TU507-ETH *Chapter 1.5.1 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 122* or TU508-ETH *Chapter 1.5.1 “TU507-ETH and TU508-ETH for Ethernet communication interface modules” on page 122*. 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 *Chapter 1.8.2.6 “TA526 - Wall mounting accessory” on page 902*).

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 System Assembly, Construction and Connection chapter Chapter 2.6 “AC500 (Standard)” on page 971.*

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.

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)
2.0	DI8	Signal of the digital input DI8

Terminal	Signal	Description
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.

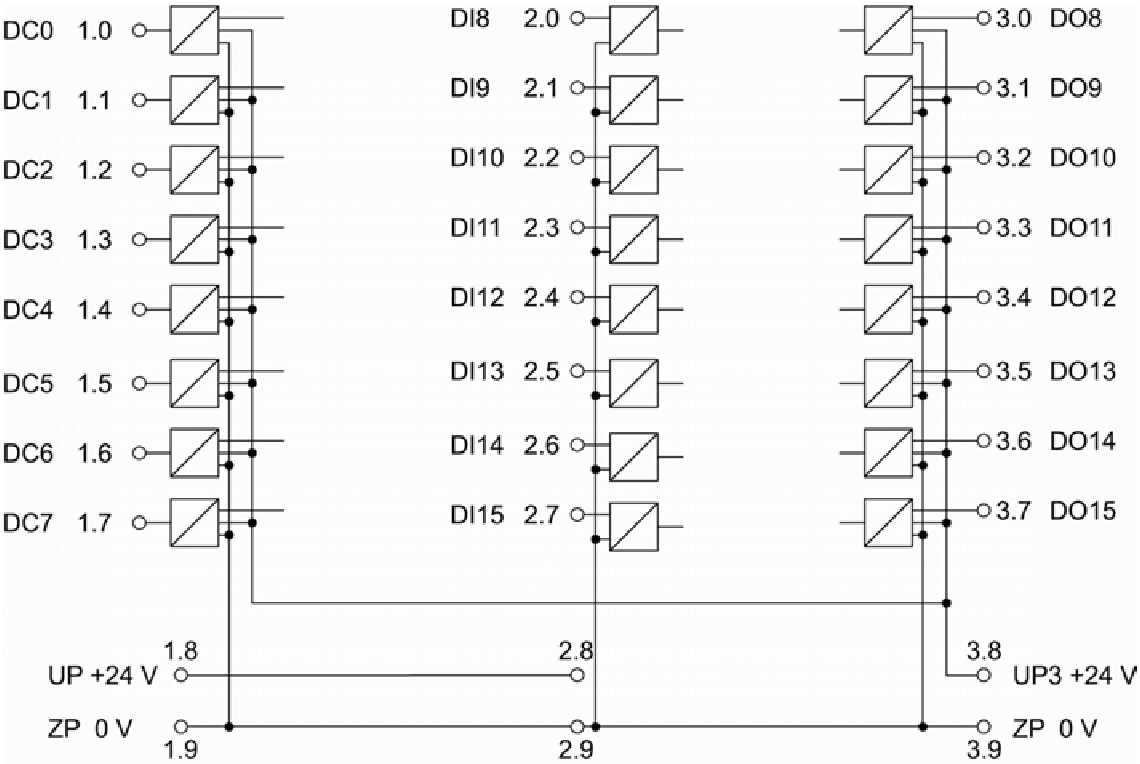
Make sure that power is removed and that the area has been thoroughly checked to ensure that flammable materials are not present prior to proceeding.

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.

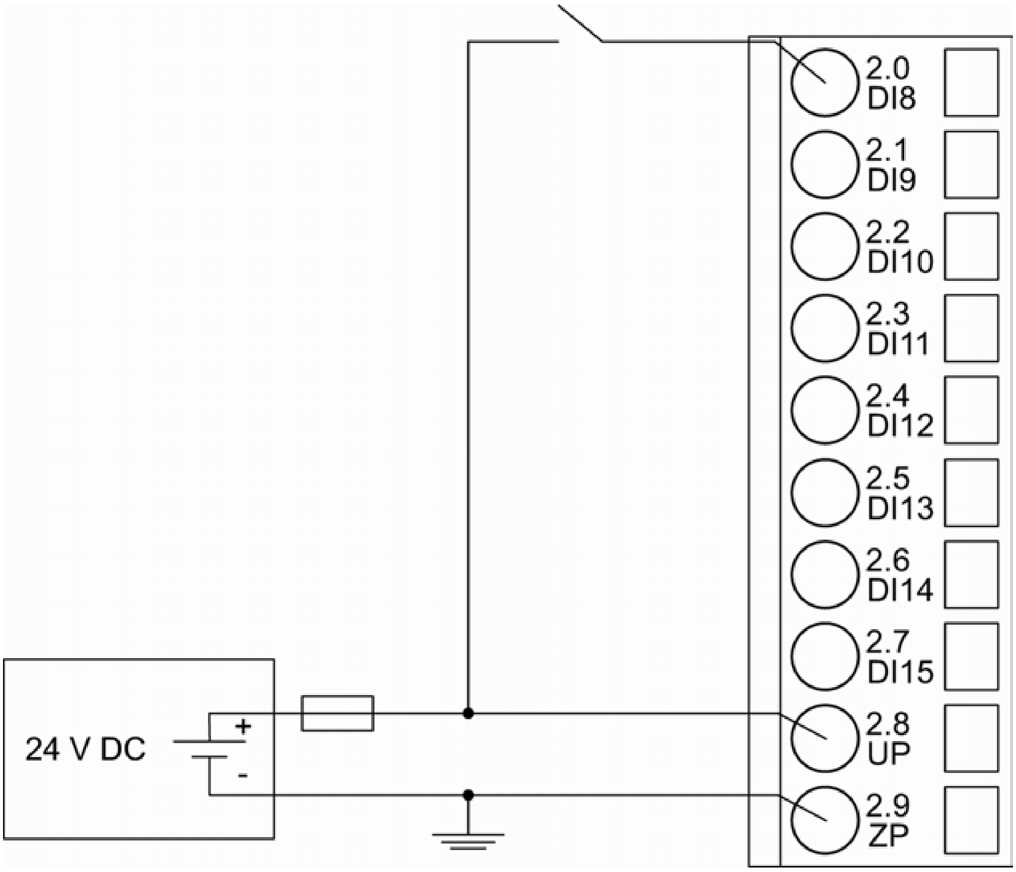
The following figure shows the connection of the Ethernet communication interface module CI502-PNIO.



Further information is provided in the System Technology chapter PROFINET.

Connection of the Digital inputs

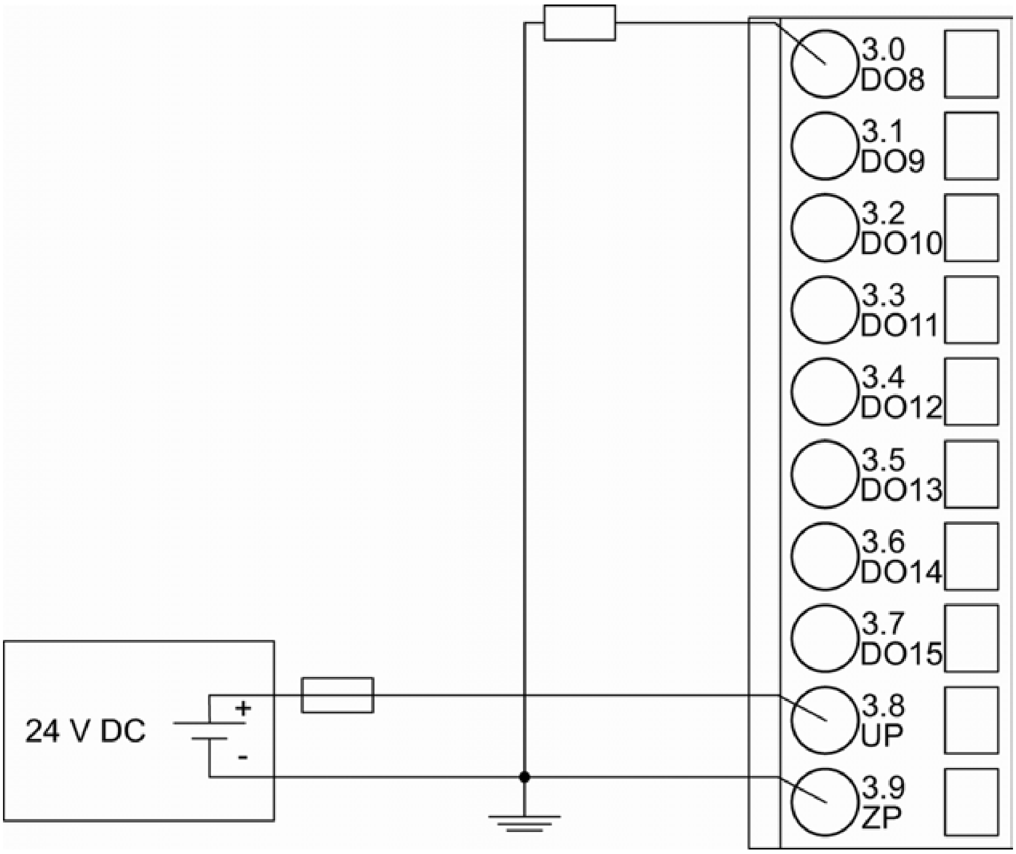
The following figure shows the connection of the digital input DI8. Proceed with the digital inputs DI9 to DI15 in the same way.



The meaning of the LEDs is described in Displays *Chapter 1.7.5.3.8.1 "State LEDs" on page 853*.

Connection of the Digital outputs

The following figure shows the connection of the digital output DO8. Proceed with the digital outputs DO9 - DO15 in the same way.

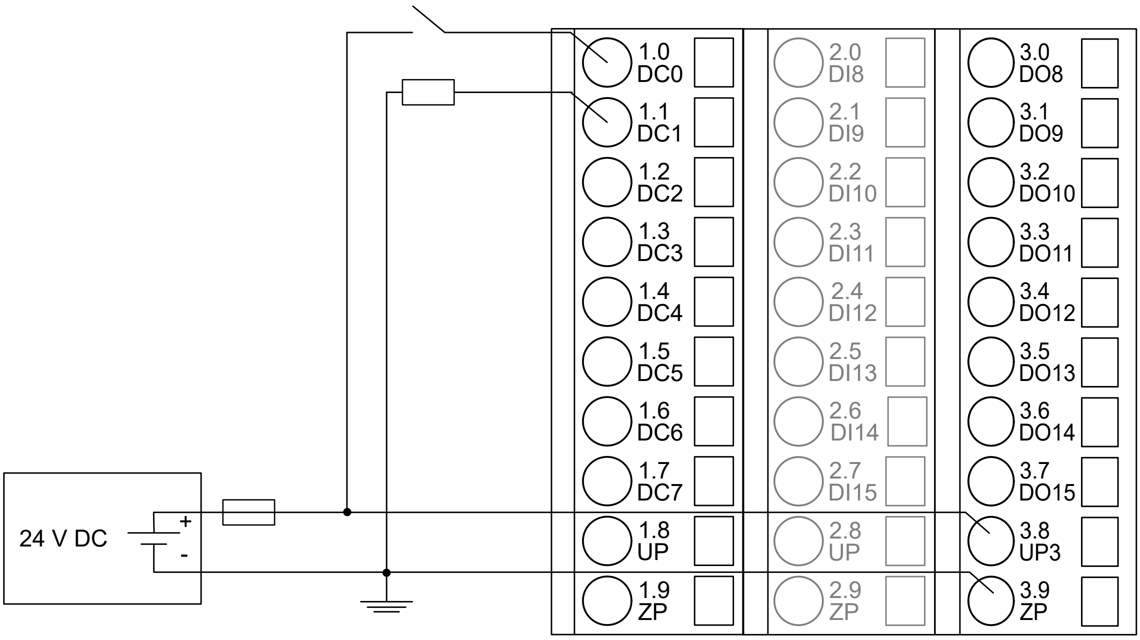


The meaning of the LEDs is described in Displays *Chapter 1.7.5.3.8.1 “State LEDs” on page 853*.

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 to 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 1.7.5.3.3 “Connections” on page 838*.

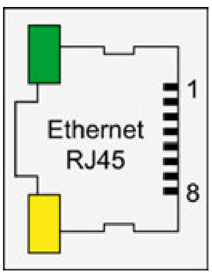


The meaning of the LEDs is described in Displays *Chapter 1.7.5.3.8.1 “State LEDs” on page 853*.

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.

For further information regarding wiring and cable types see chapter Ethernet ⇨ Chapter 2.6.4.7 "Ethernet connection details" on page 997.

1.7.5.3.4 Internal data exchange

Parameter	Value
Digital inputs (bytes)	5
Digital outputs (bytes)	5
Counter input data (words)	4
Counter output data (words)	8

1.7.5.3.5 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.

1.7.5.3.6 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 1.7.5.3.7 "Parameterization" on page 845*.

1.7.5.3.7 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

Name	Value	Internal value	Internal value, type	Default
Error LED / Fail-safe function (Table Error LED / Failsafe function *Further information on page 845*)	On	0	BYTE	0
	Off by E4	1		
	Off by E3	3		
	On + failsafe	16		
	Off by E4 + fail-safe	17		
	Off by E3 + fail-safe	19		
Process cycle time	1 ms process cycle time	1	BYTE	1 ms
	2 ms process cycle time	2		
	3 ms process cycle time	3		
	4 ms process cycle time	4		
	5 ms process cycle time	5		
	6 ms process cycle time	6		
	7 ms process cycle time	7		
	8 ms process cycle time	8		
	9 ms process cycle time	9		
	10 ms process cycle time	10		
	11 ms process cycle time	11		
	12 ms process cycle time	12		
	13 ms process cycle time	13		
	14 ms process cycle time	14		
	15 ms process cycle time	15		
	16 ms process cycle time	16		
Check supply	Off On	0 1	BYTE	1
Fast counter	0 : 10 [2])	0 : 10	BYTE	0
I/O-Bus reset	Off	0	BYTE	Off

Name	Value	Internal value	Internal value, type	Default
	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 1.6.1.2.9 “Fast counter” on page 349*				

Table 174: 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
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 1.7.5.3.3 “Connections” on page 838* (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.

1.7.5.3.8 Diagnosis

Structure of the Diagnosis Block via PNIO_DEV_ALARM function 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
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.

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	

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	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 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

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 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 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 1.7.5.3.3 "Connections" on page 838*. 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 1.7.5.3.3 "Connections" on page 838*. 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.

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 175: 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	---

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 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 176: States of the 29 process LEDs

LED	Color	OFF	ON	Flashing
DC0 to DC7	Yellow	Input/Output is OFF	Input/Output is ON	--
DI8 to DI15	Yellow	Input is OFF	Input is ON (the input voltage is even displayed if the supply voltage is OFF)	--
DO8 to 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

1.7.5.3.9 Technical data

The system data of AC500 and S500 ➮ *Chapter 2.6.1 “System data AC500” on page 971* are applicable to the standard version.

The system data of AC500-XC ➮ *Chapter 2.7.1 “System data AC500-XC” on page 1023* are applicable to the XC version.

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 1.7.5.3.8 “Diagnosis” on page 848*
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 switchgear cabinet.

NOTICE!

Attention:

All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and continuous 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 to DI7	Terminals 2.0 to 2.7

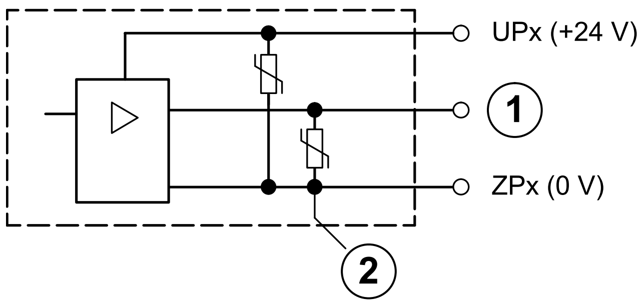
Parameter		Value
Reference potential for all inputs		Terminals 1.9...3.9 (Negative pole of the supply voltage, signal name ZP)
Indication of the input signals		1 yellow LED per channel, the LED is ON when the input signal is high (signal 1)
Input type (according EN 61131-2)		Type 1
Input delay (0->1 or 1->0)		Typ. 0.1 ms, configurable from 0.1...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 3.0 to 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 to DC7		Terminals 1.0 to 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...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

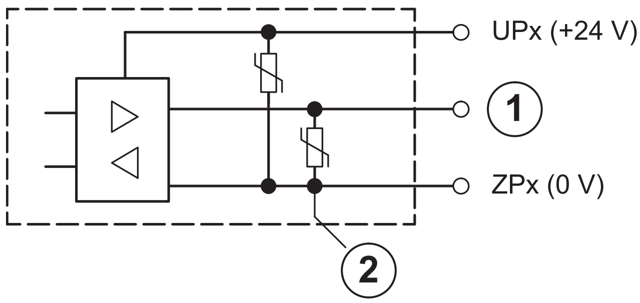
*) Due to the direct connection to the output, the demagnetizing varistor is also effective at the input (see figure) above. This is why the difference between UPx and the input signal may not exceed the clamp voltage of the varistor. The varistor limits the voltage to approx. 36 V. Following this, the input voltage must range from -12 V 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

Parameter	Value
Number of channels per module	8
Distribution of the channels into groups	1 group of 8 channels
Terminals of the channels DC0 to DC7	Terminals 1.0 to 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

1.7.5.3.10 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

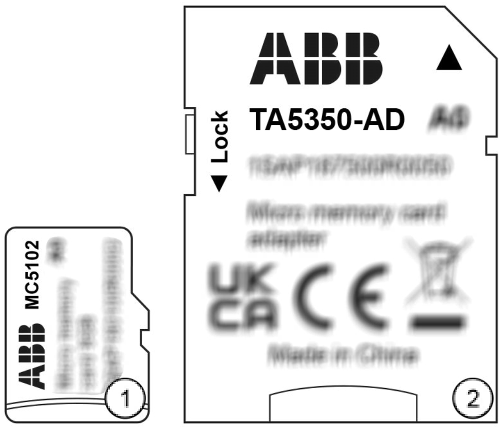
**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

1.8 Accessories

1.8.1 AC500-eCo

1.8.1.1 MC5102 - Micro memory card with micro memory card adapter

- Solid state flash memory storage



1 Micro memory card
2 TA5350-AD micro memory card adapter

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
MC502	x	x	x	x	x	-
MC5141	x	x	x	x	x	-

Memory card type	AC500 V2	AC500-XC V2	AC500-eCo V2 3)	AC500 V3	AC500-XC V3	AC500-eCo V3
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.

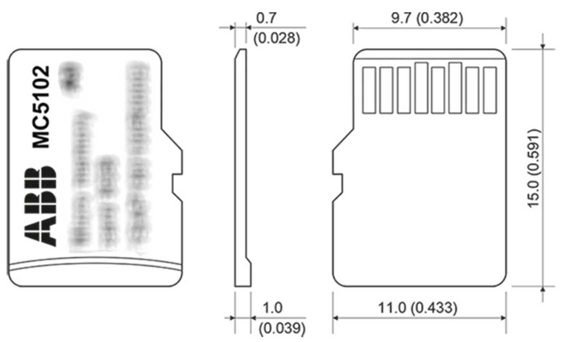
The micro memory card is used to store or backup application data and/or application programs or project source codes as well as to update the internal CPU firmware.

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.

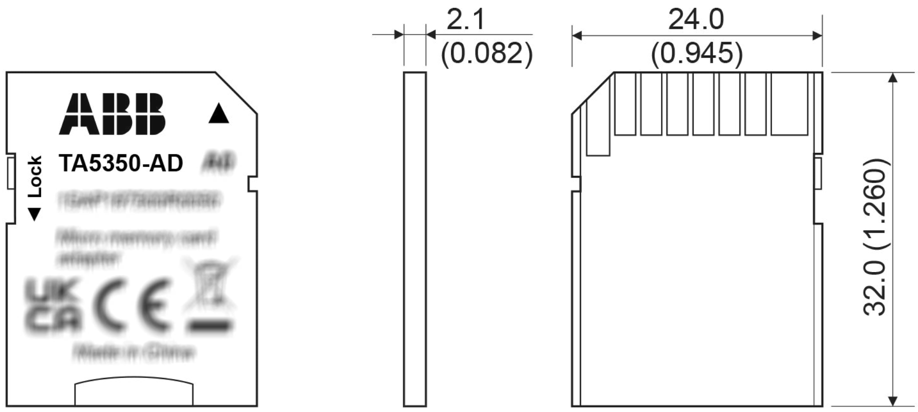
Dimensions

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

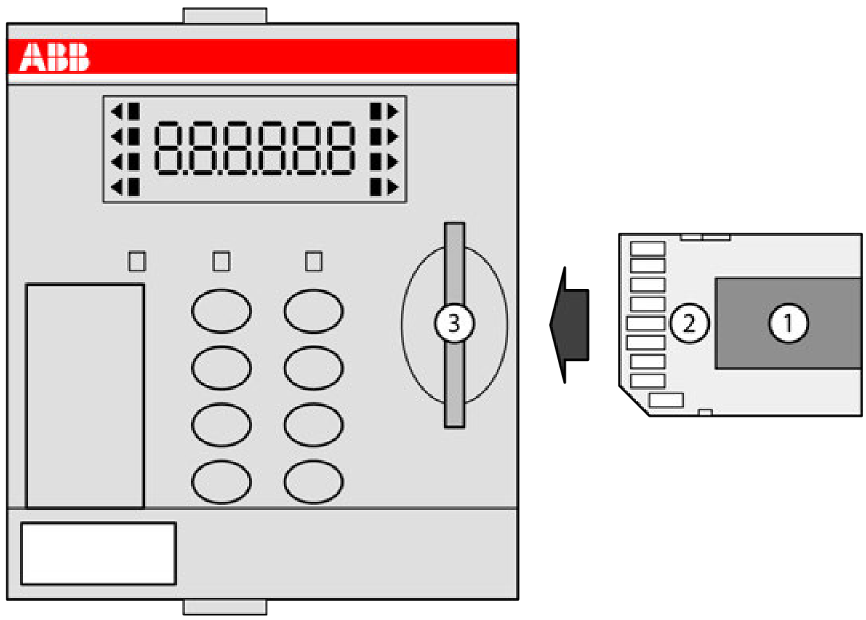
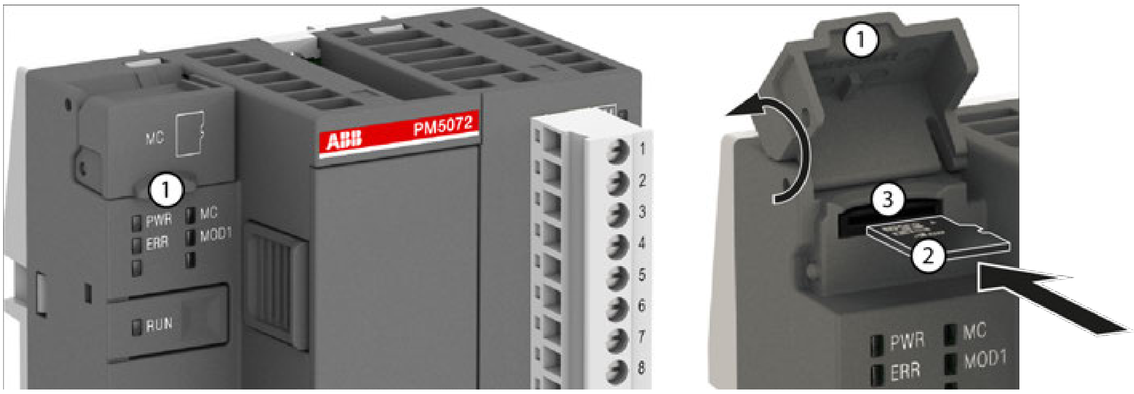


Fig. 157: Insert micro memory card into PM56xx

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!
Removal of the micro memory card
Do not remove the micro memory card when it is working!

AC500 V3: Remove the micro memory card with micro memory card adapter 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.

Otherwise the micro memory card and/or files on it might get corrupted and/or normal PLC operation might be disturbed.

AC500 V3

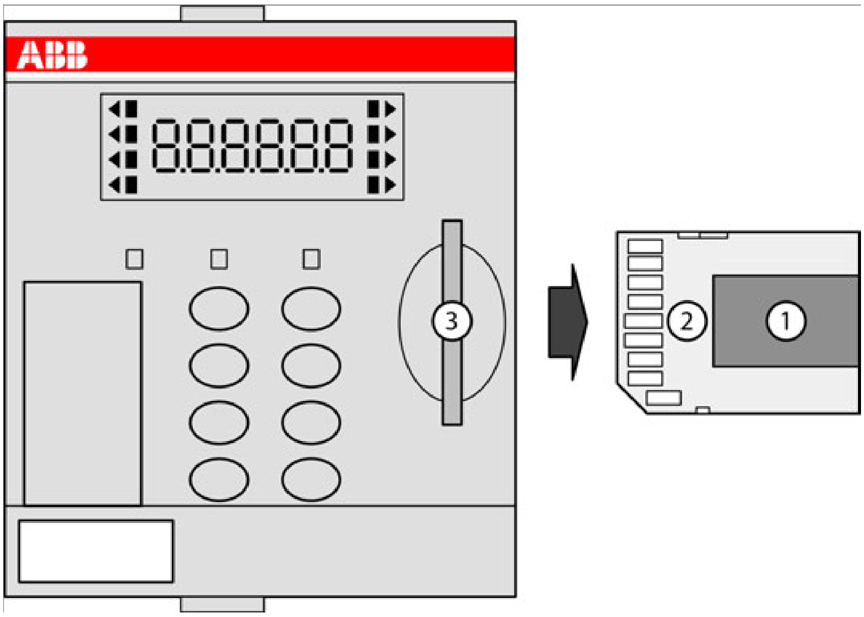
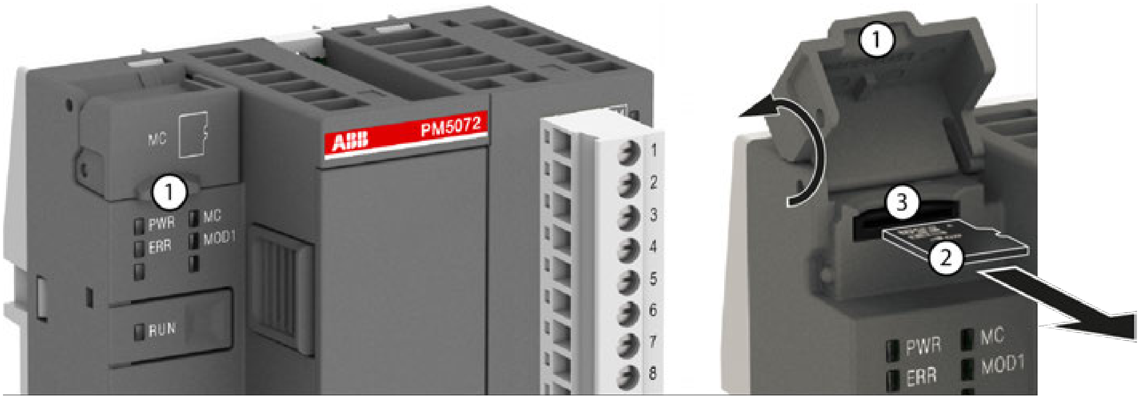


Fig. 158: Remove micro memory card from PM56xx

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



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

Parameter		Value
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.

Further information on using the micro memory card in AC500 PLCs is provided in the chapter .

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.*

1.8.1.2 TA52xx(-x) - Terminal block sets

Intended purpose

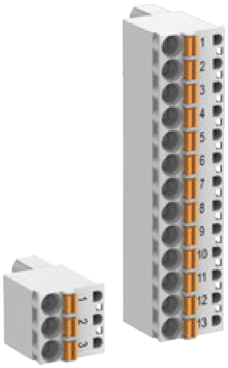
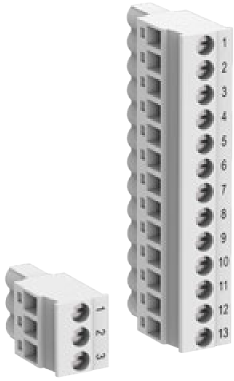
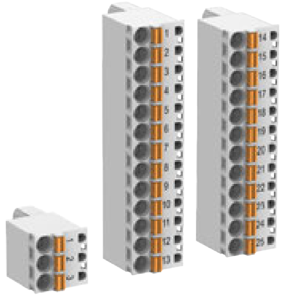
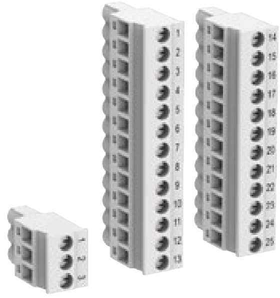
Removable terminal blocks are used for power supply and for I/O connectors on AC500-eCo V3 processor modules PM50x2.

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.

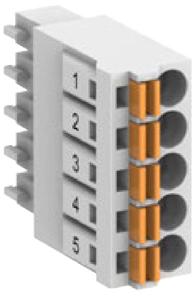
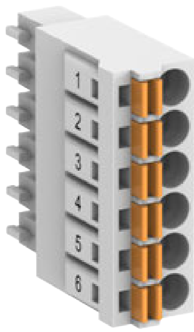
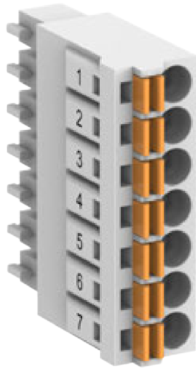
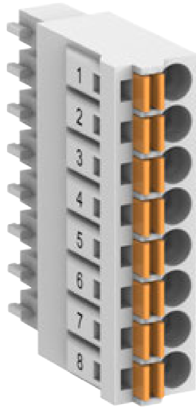
For the AC500-eCo V3 **Standard CPUs** and **Pro CPUs** a 3-pin terminal block for power supply, a 13-pin terminal block and a 12-pin terminal block for I/O connectors are used.

For all CPUs there is a screw and a spring variant available.

Basic CPU		**Standard and Pro CPUs**	
Spring type **TA5211-TSPF-B**	**Screw type** **TA5211-TSCL-B**	**Spring type** **TA5212-TSPF**	**Screw type** **TA5212-TSCL**
			

Various removable spring-type terminal blocks are available for option boards.

The following spare parts are available (depending on the number of pins).

Spring type			
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 processor module when using unapproved terminal blocks!

Only use terminal blocks approved by ABB to avoid injury and damage to the processor module.

Terminal block set for PM50x2

Processor modules PM50x2 CPU are not delivered with terminal blocks.

Screw type 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)*

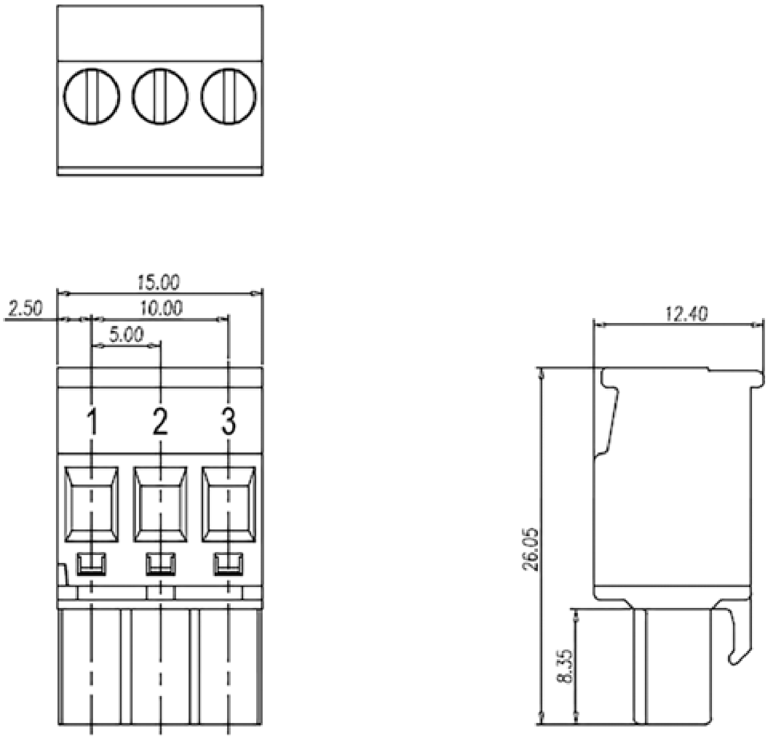
Spring type terminal block set:

– *TA5211-TSPF-B (1SAP187400R0002) for PM5012-x-ETH*
– *TA5212-TSPF (1SAP187400R0005) for PM5032-x-ETH, PM5052-x-ETH, PM5072-T-2ETH(W)*

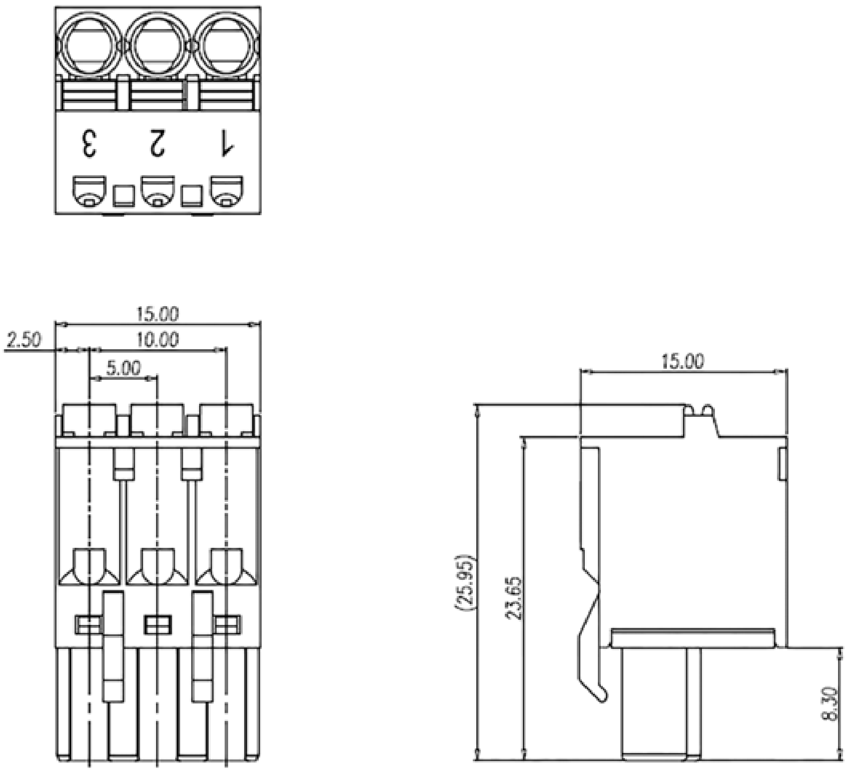
Dimensions

3-pin terminal block for power supply

Screw type

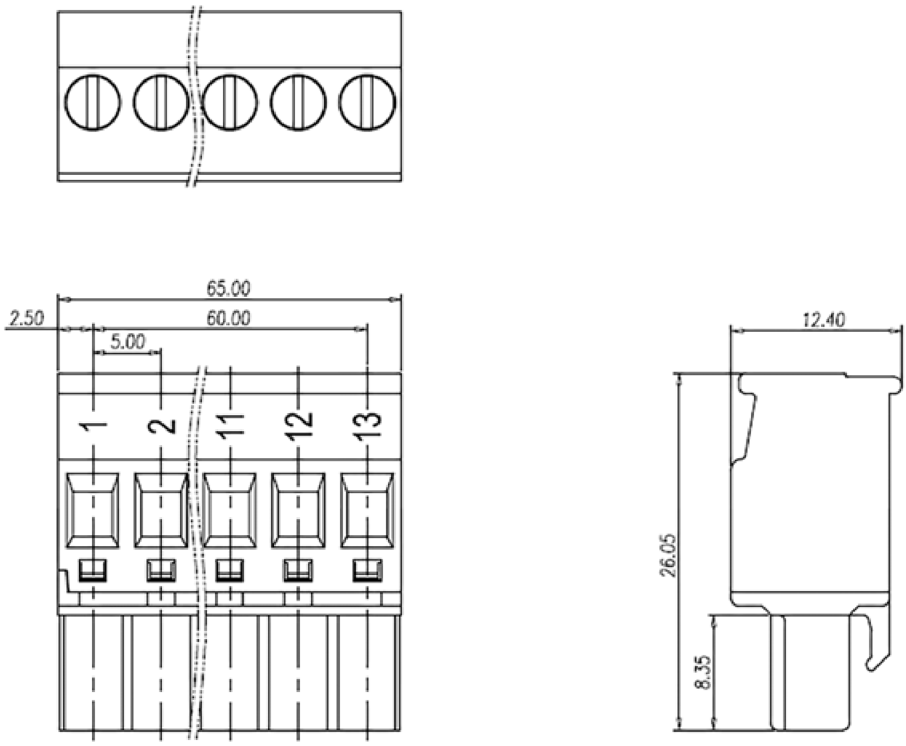


Spring type

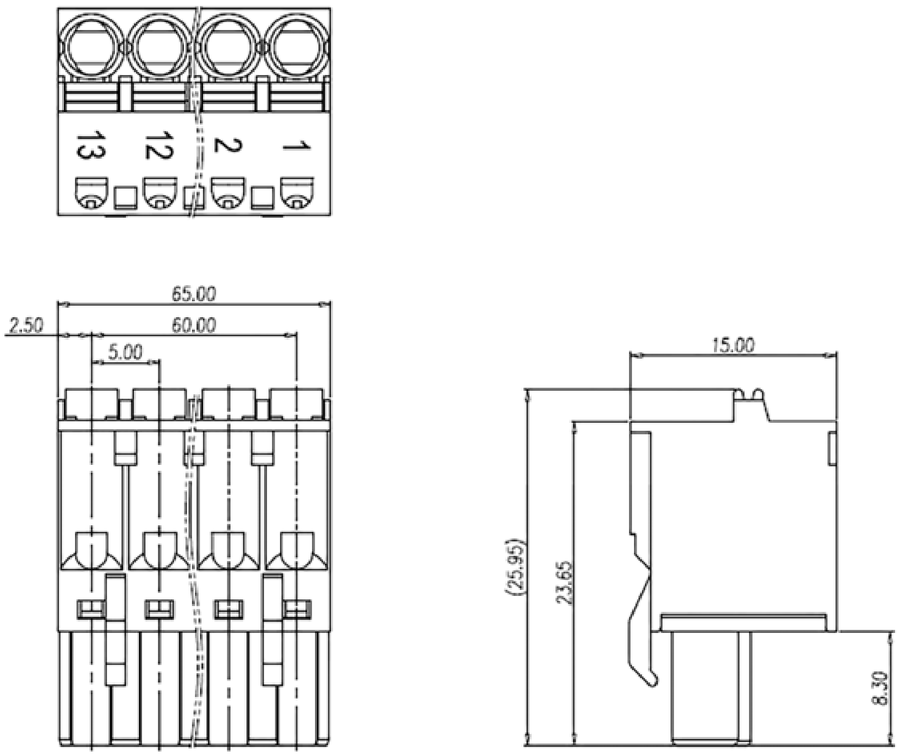


13-pin terminal block for I/O connectors

Screw type

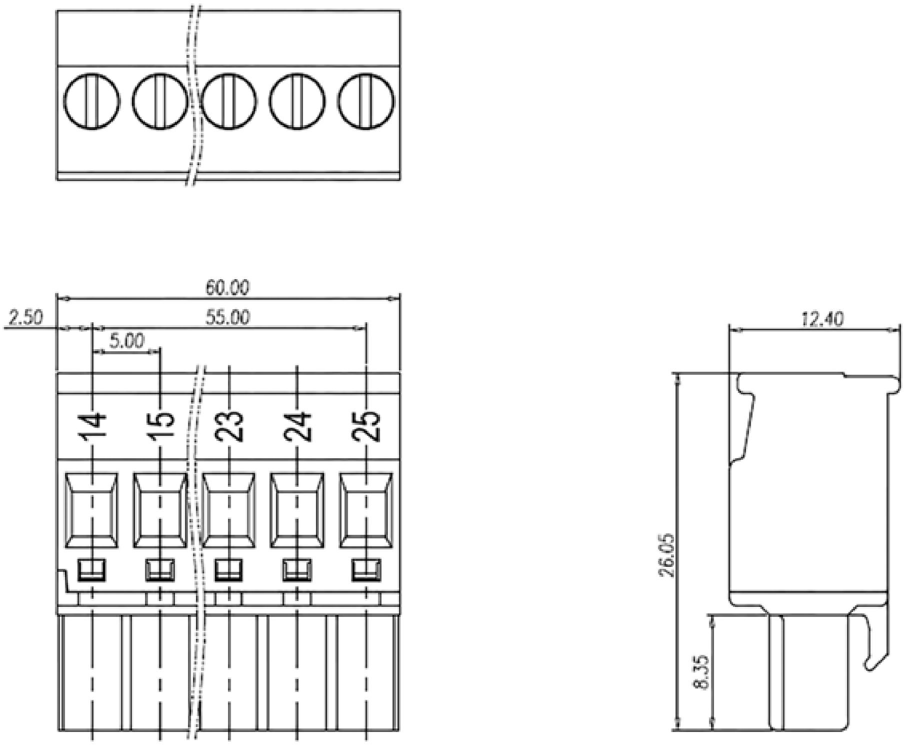


Spring type

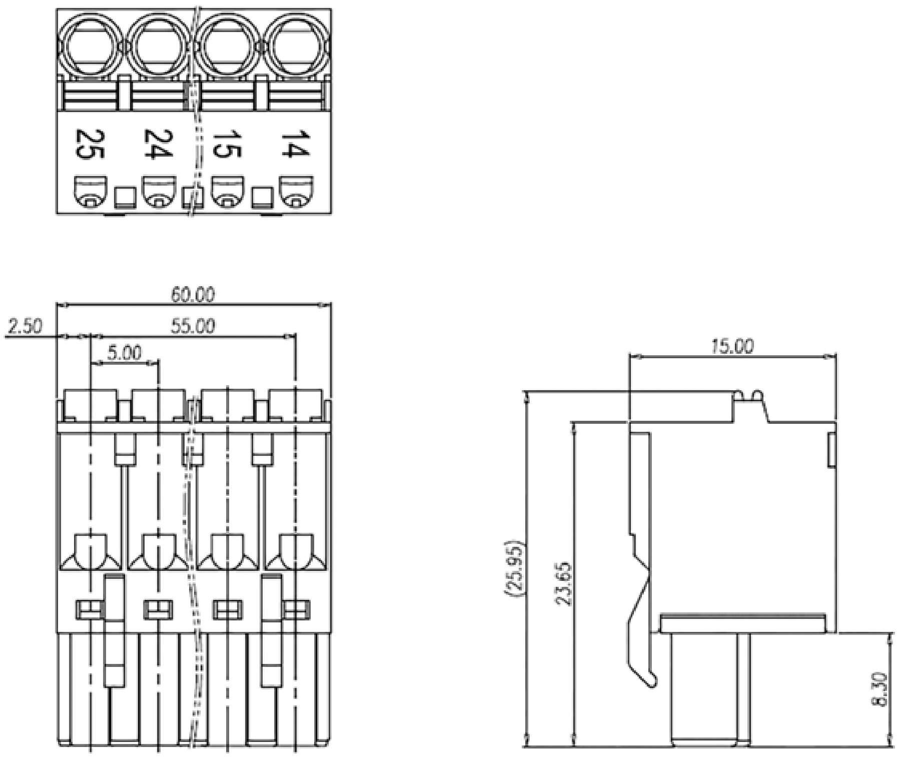


12-pin terminal block for I/O connectors

Screw type

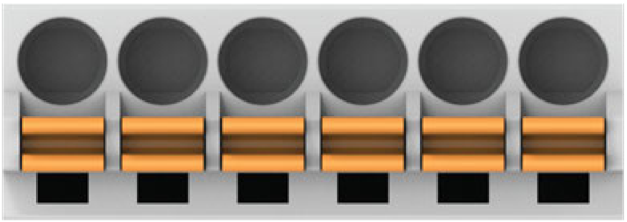


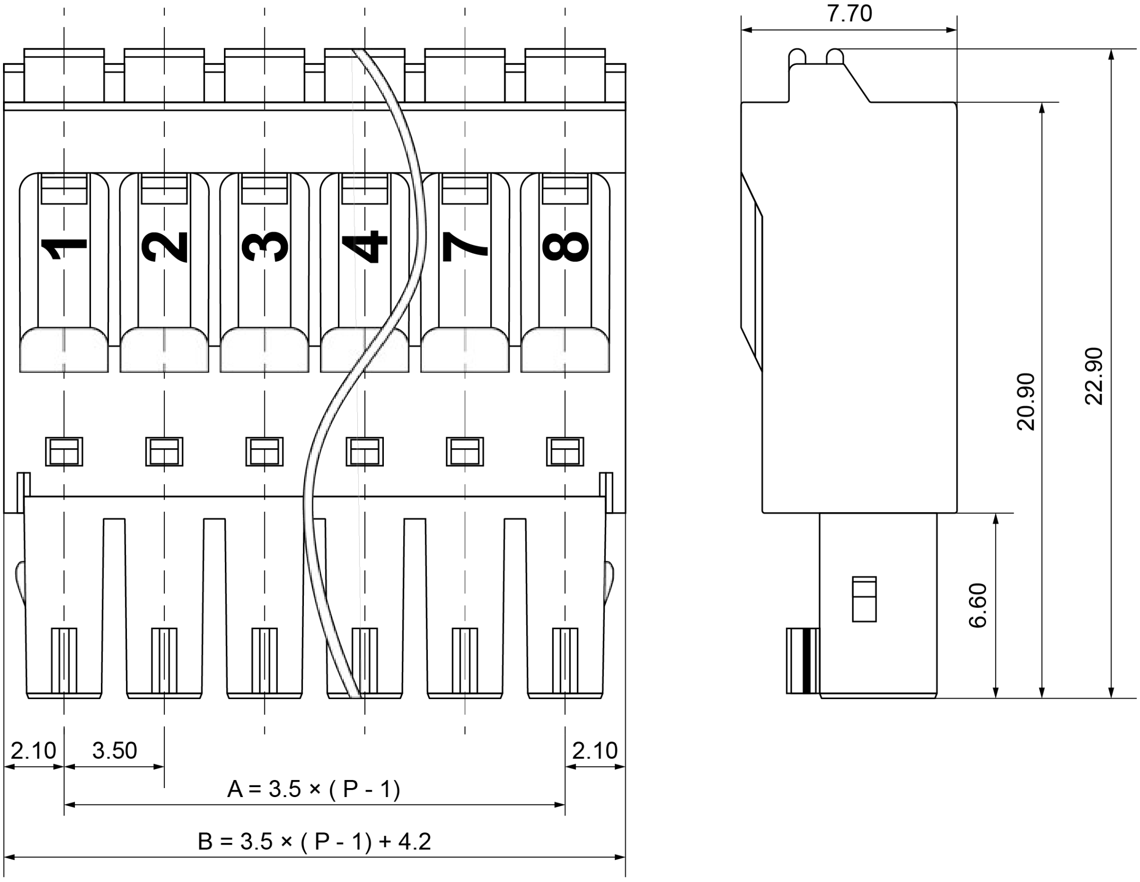
Spring type



x-PIN terminal blocks for option boards

> *Only these x-pin blocks are available for the option boards.*
>
> *TA5220-SPF**x**, with **x** = 5...8*

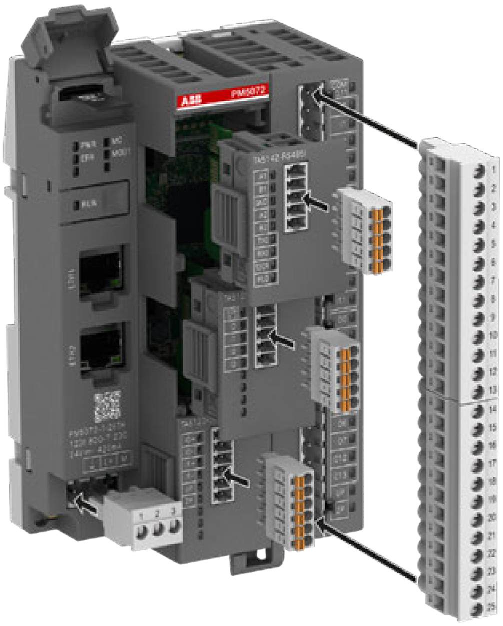




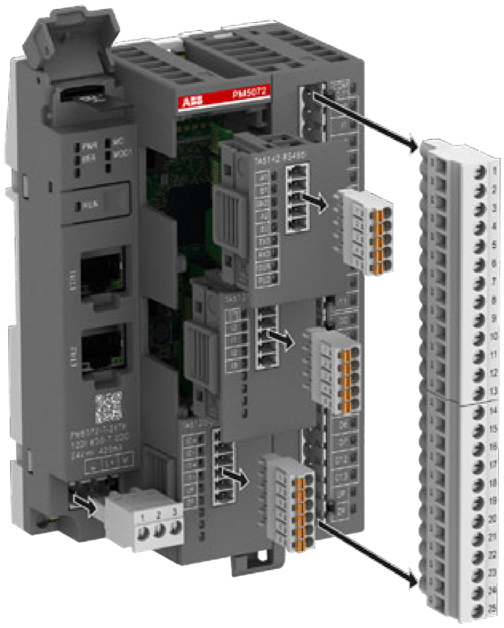
This results in these dimensions for the available spring terminal blocks.

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 177: Screw type 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 178: Spring type 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 179: Screw type 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 180: Spring type 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 mm^2...2.5 mm^2
	Flexible (copper)	0.5 mm^2...2.5 mm^2
Stripped conductor end		11 mm
Dimensions		
	13-pin terminal block	65 mm x 15 mm x 25.95 mm
	12-pin terminal block	60 mm x 15 mm x 25.95 mm
Weight		
	TA5211-TSPF-B	150 g (2 terminal blocks)
	TA5212-TSPF	200 g (3 terminal blocks)

Table 181: Spring type 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 mm^2...1.5 mm^2
	Flexible (copper)	0.2 mm^2...1.5 mm^2
Stripped conductor end		8 mm...10 mm
Dimensions		
	TA5220-SPF5	18.2 mm x 7.7 mm x 22.9 mm
	TA5220-SPF6	21.7 mm x 7.7 mm x 22.9 mm

Parameter		Value
	TA5220-SPF7	25.2 mm x 7.7 mm x 22.9 mm
	TA5220-SPF8	28.7 mm x 7.7 mm x 22.9 mm
Weight		
	TA5220-SPF5	150 g
	TA5220-SPF6	170 g
	TA5220-SPF7	180 g
	TA5220-SPF8	200 g

Ordering data

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

1.8.1.3 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).

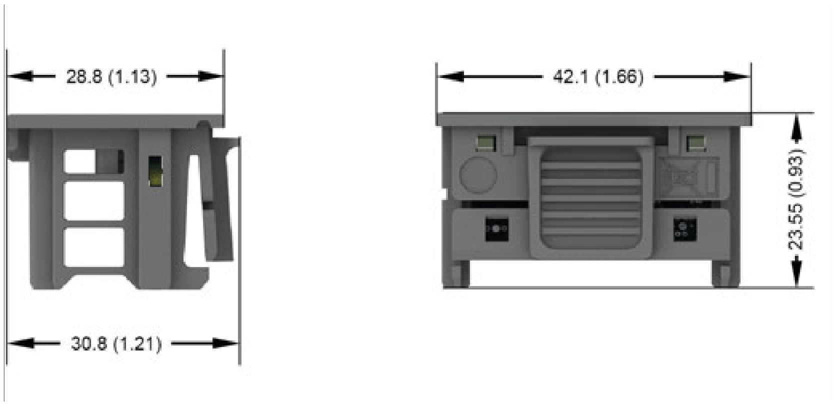
Never power up the CPU with uncovered option board slot, otherwise it may cause serious injury and/or damage the product.

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.

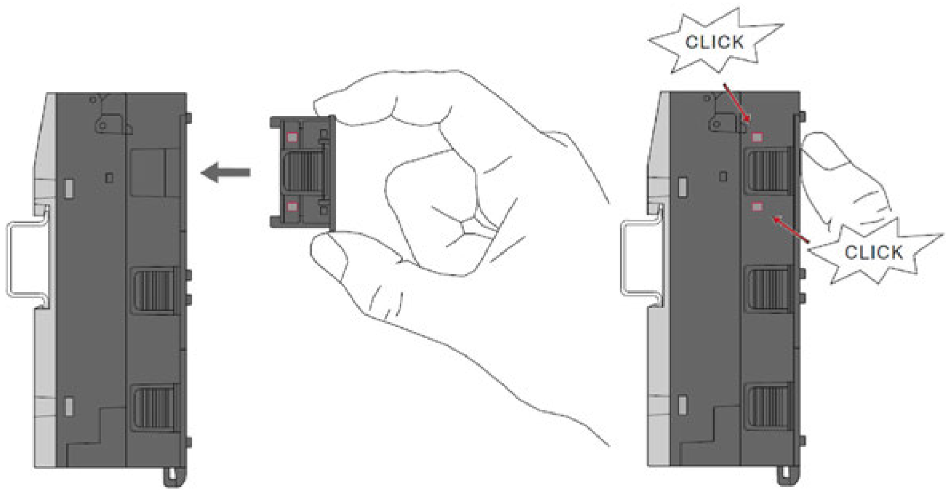
The TA5300-CVR option board slot covers are available as spare parts.

Dimensions



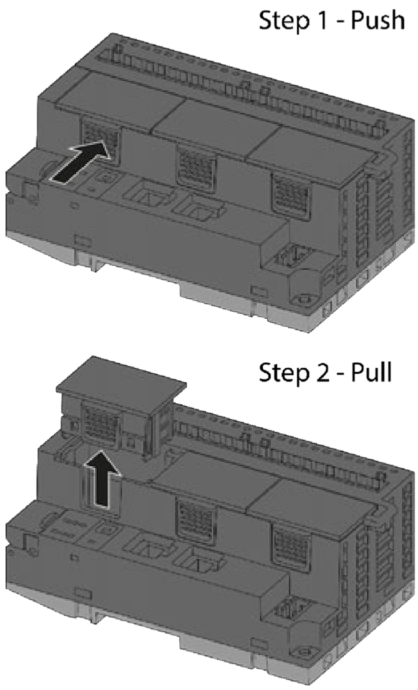
The dimensions are in mm and in brackets in inch.

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 2.5.1 “System data AC500-eCo V3” on page 925*

Only additional details are therefore documented below.

Parameter	Value
Weight	47 g
Dimensions	42.1 mm x 30.8 mm x 23.55

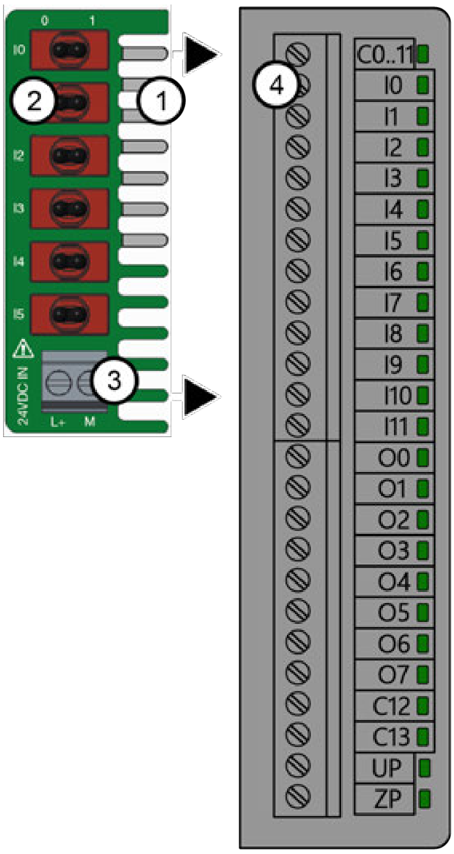
Ordering data

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.*

1.8.1.4 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.*

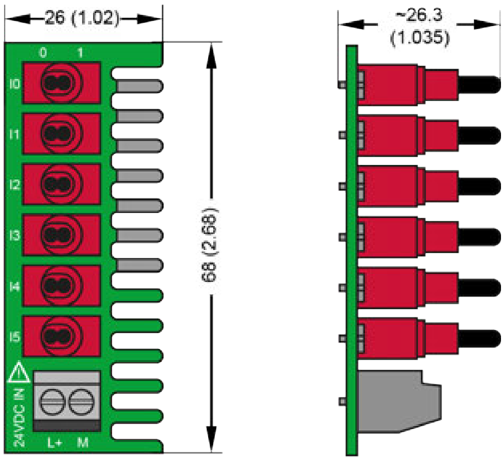
> ***Environmental conditions for testing and training purposes***
>
> *In order not to impair the functionality of the product, avoid any kind of disturbing environmental influences:*
>
> – *mechanical disturbances*
> – *climatic influences*
>
> *Make sure that the parameters are within the normal range:*
>
> – *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.

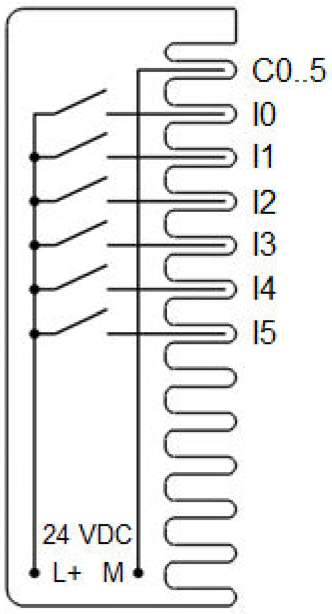
Dimensions



> *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.

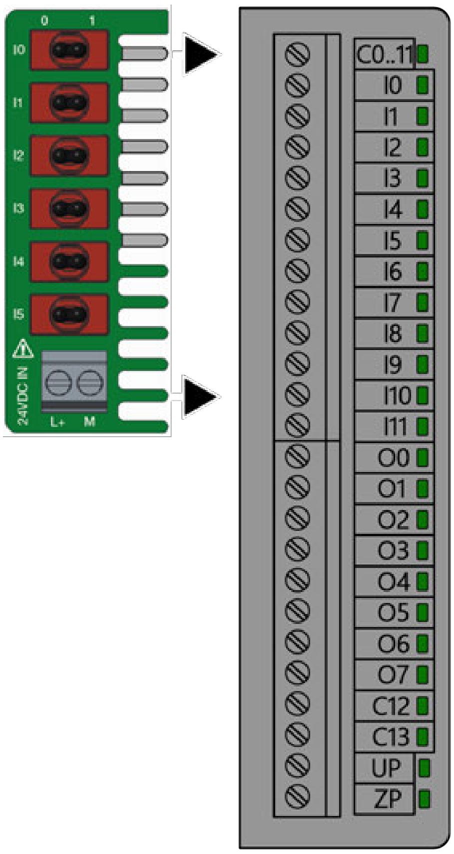
CAUTION!
Risk of damaging the input simulator and/or PLC modules!
The TA5400-SIM input simulator may only be used with AC500-eCo V3 processor modules PM50x2.

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). See PM50xx *"Pin assignment" on page 944*.

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 2.5.1 "System data AC500-eCo V3" on page 925*

Only additional details are therefore documented below.

Table 182: 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 %
	Protection against reversed voltage	Yes
Galvanic isolation		Yes (on processor module PM50xx)
Isolated Groups		1 (6 channels per group)
Weight		18 g
Mounting position		Horizontal or vertical

Table 183: Technical data of the inputs

Parameter	Value
Number of channels per module	6 digital input channels (+24 V DC)
Distribution of the channels into groups	1 (6 channels per group)
Connections of channels I0 to I5	Terminals 2...7
Reference potential for the channels I0 to I5	Terminal 1 (negative pole of the process supply voltage, signal name C0...5)
Input current per active channel (at input voltage +24 V DC) The current is given through the used processor module.	Typ. 5 mA
Inrush current per active channel The current is given through the used processor module.	Typ. 5 mA

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.*

1.8.2 AC500 (standard)

1.8.2.1 MC502 - Memory card

- Solid state flash memory storage

1 MC502 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
MC502	x	x	x	x	x	-
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

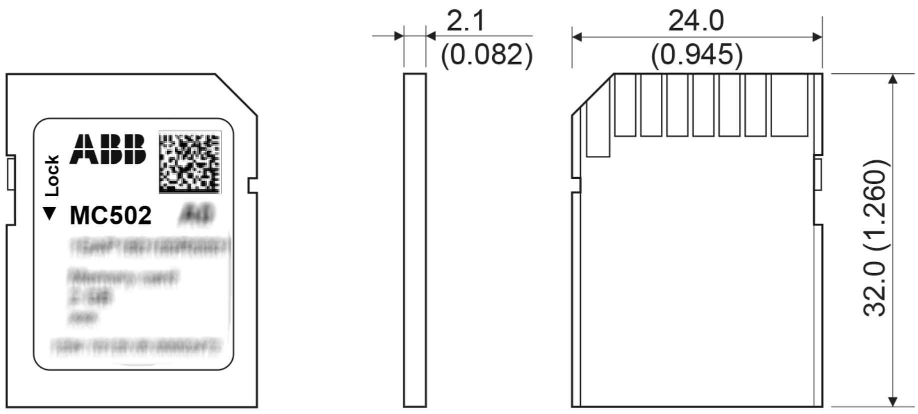
> *Processor modules can be operated with and without (micro) memory card.*
>
> *Processor modules are supplied without (micro) memory card. It must be ordered separately.*

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.

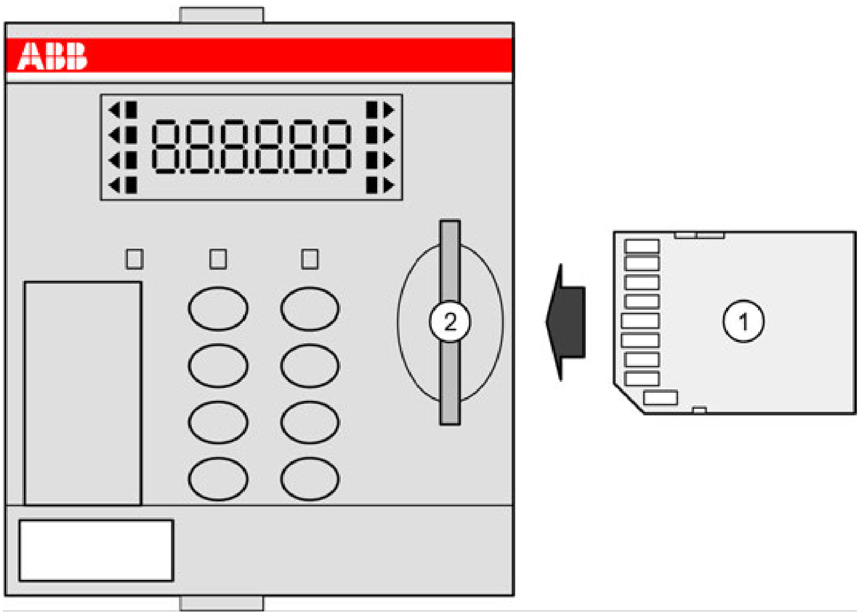


Fig. 159: Insert memory card into PM56xx

1 Memory card
2 Memory card slot

Remove the memory card

AC500 V3

> **NOTICE!**
> **Removal of the memory card**
> Do not remove the memory card when it is working!
>
> Remove the memory card only when no black square (■) is shown next to MC in the display.
>
> Otherwise the memory card and/or files on it might get corrupted and/or normal PLC operation might be disturbed.

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.

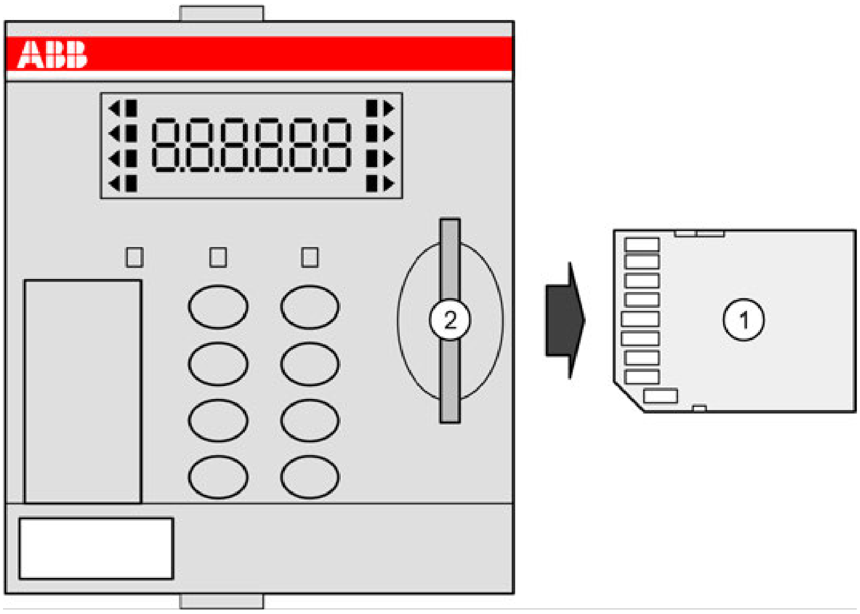


Fig. 160: Remove memory card from PM56xx

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.

Further information on using the memory card in AC500 PLCs is provided in the chapter .

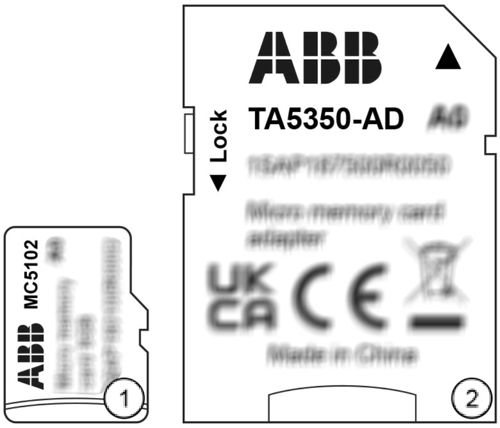
Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 180 100 R0001	MC502, memory card	Classic

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

1.8.2.2 MC5102 - Micro memory card with micro memory card adapter

- Solid state flash memory storage



1 Micro memory card
2 TA5350-AD micro memory card adapter

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
MC502	x	x	x	x	x	-
MC5141	x	x	x	x	x	-

Memory card type	AC500 V2	AC500-XC V2	AC500-eCo V2 3)	AC500 V3	AC500-XC V3	AC500-eCo V3
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.

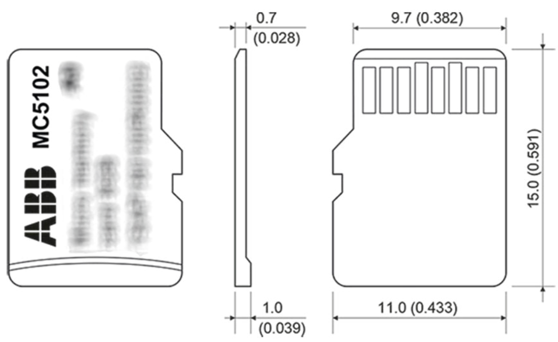
The micro memory card is used to store or backup application data and/or application programs or project source codes as well as to update the internal CPU firmware.

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.

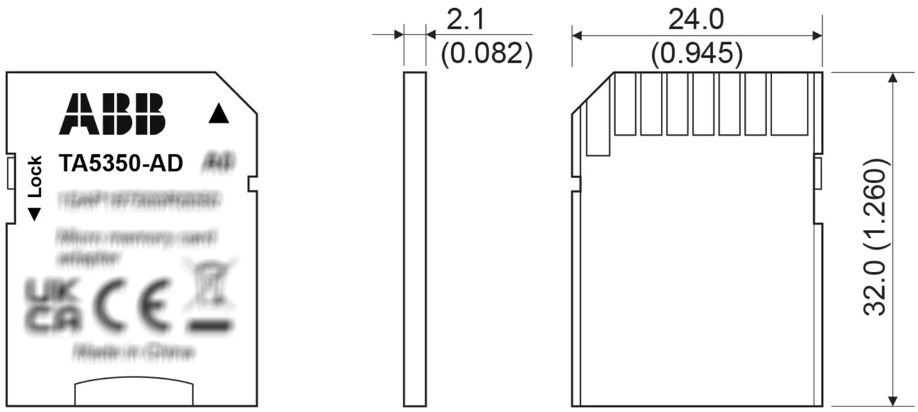
Dimensions

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

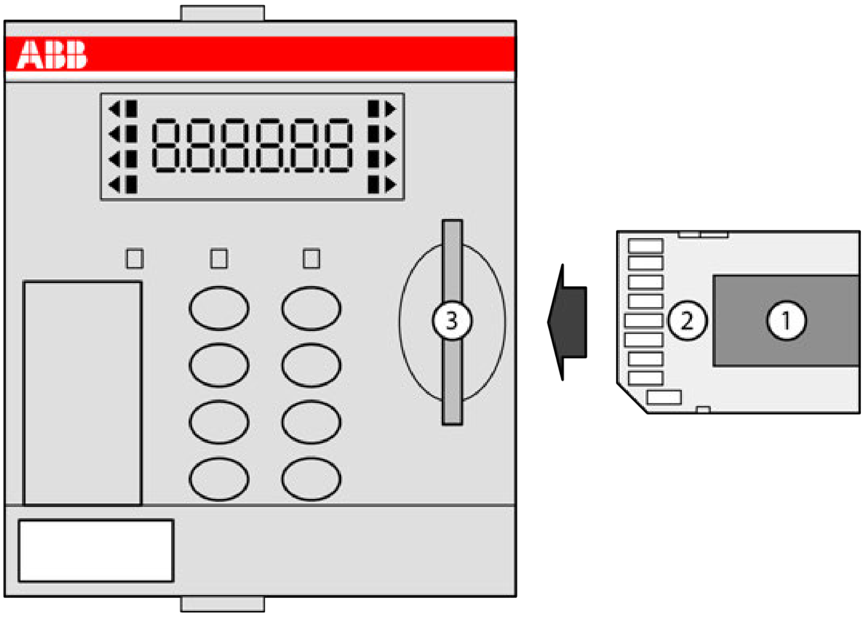
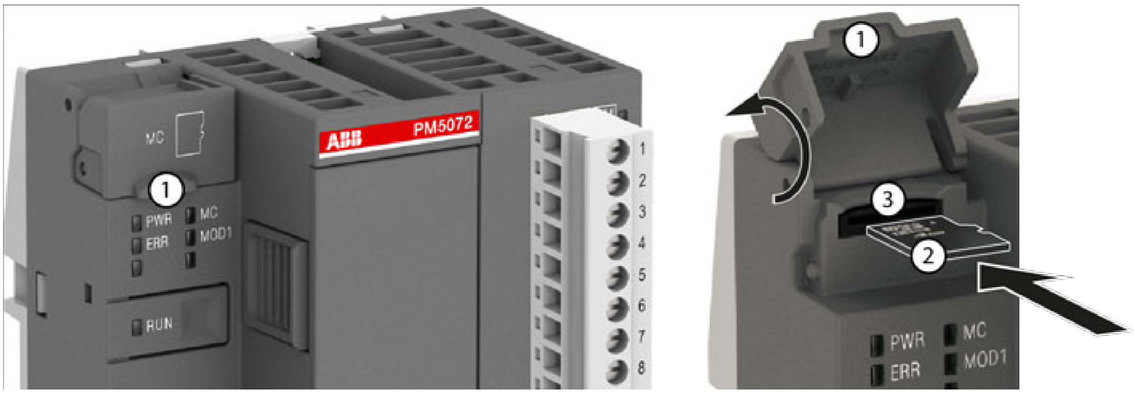


Fig. 161: Insert micro memory card into PM56xx

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!**
> **Removal of the micro memory card**
> Do not remove the micro memory card when it is working!
>
> AC500 V3: Remove the micro memory card with micro memory card adapter 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.
>
> Otherwise the micro memory card and/or files on it might get corrupted and/or normal PLC operation might be disturbed.

AC500 V3

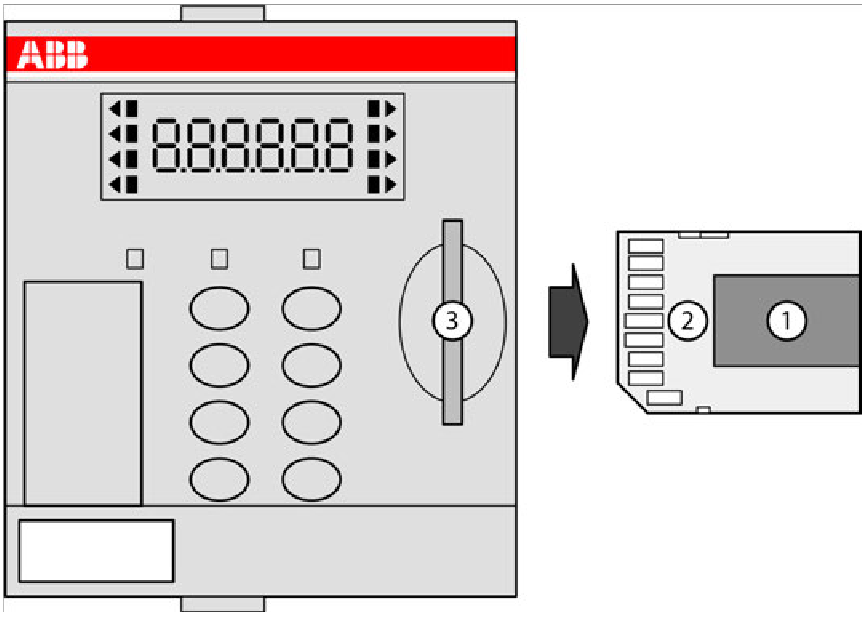
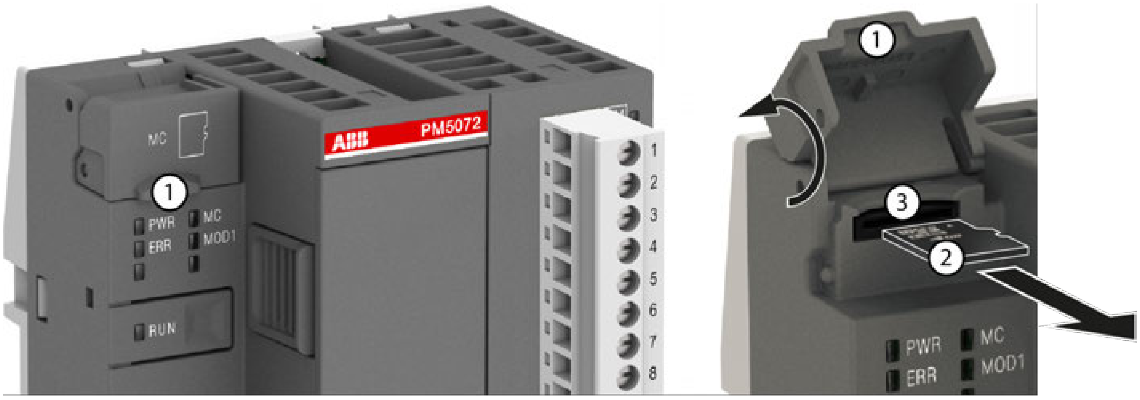


Fig. 162: Remove micro memory card from PM56xx

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



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

Parameter	Value
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.

Further information on using the micro memory card in AC500 PLCs is provided in the chapter .

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.*

1.8.2.3 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
MC502	x	x	x	x	x	-
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.

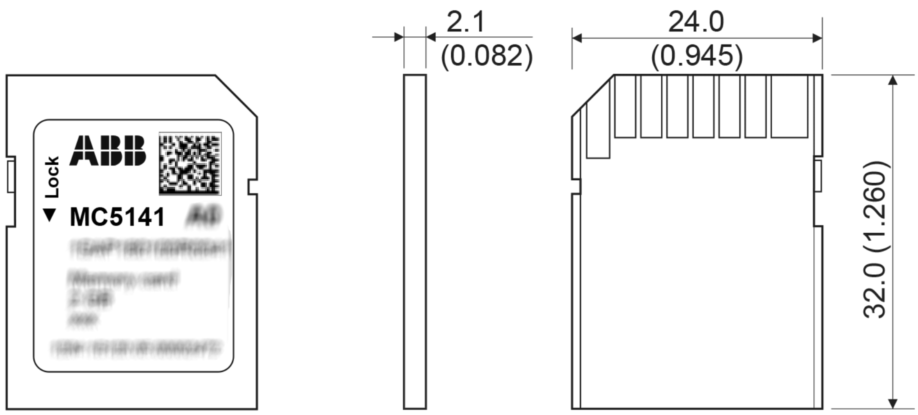
Processor modules are supplied without (micro) memory card. It must be ordered separately.

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.

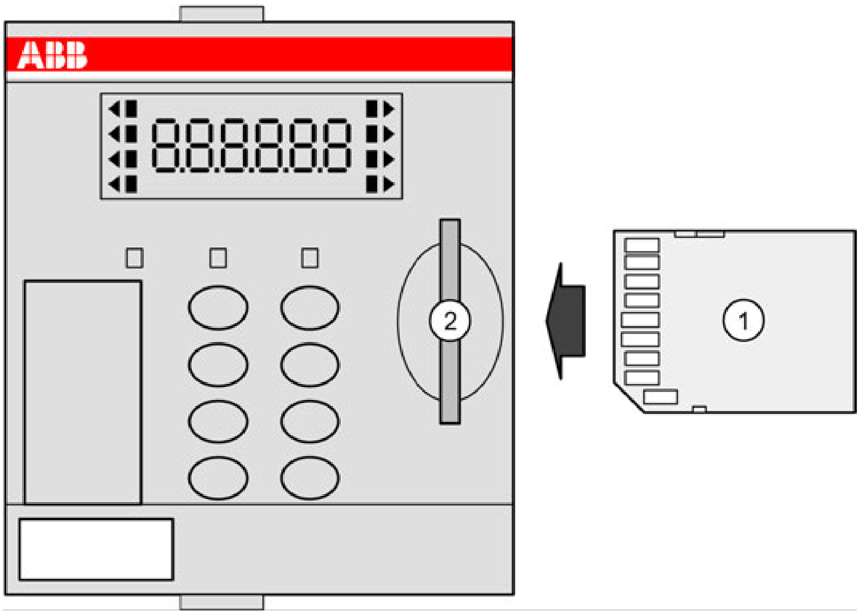


Fig. 163: Insert memory card into PM56xx

1 Memory card
2 Memory card slot

Remove the memory card

AC500 V3

NOTICE!
Removal of the memory card
Do not remove the memory card when it is working!

Remove the memory card only when no black square (■) is shown next to MC in the display.

Otherwise the memory card and/or files on it might get corrupted and/or normal PLC operation might be disturbed.

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.

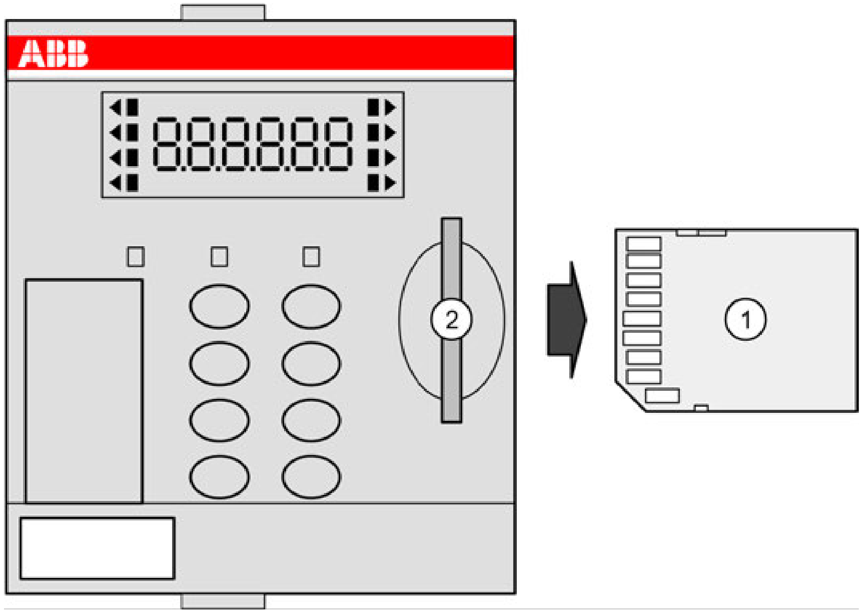


Fig. 164: Remove memory card from PM56xx

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.

Further information on using the memory card in AC500 PLCs is provided in the chapter .

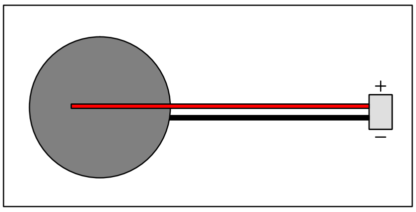
Ordering data

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.*

1.8.2.4 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 1.3.2.1 “PM56xx-2ETH for AC500 V3 products” on page 90*. It cannot be recharged.

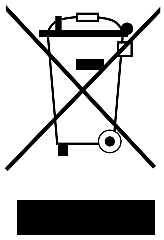
The processor modules are supplied without lithium battery. It must be ordered separately. The TA521 lithium battery is used for data (SRAM) and RTC buffering while the processor module is not powered.

See system technology - AC500 battery.

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

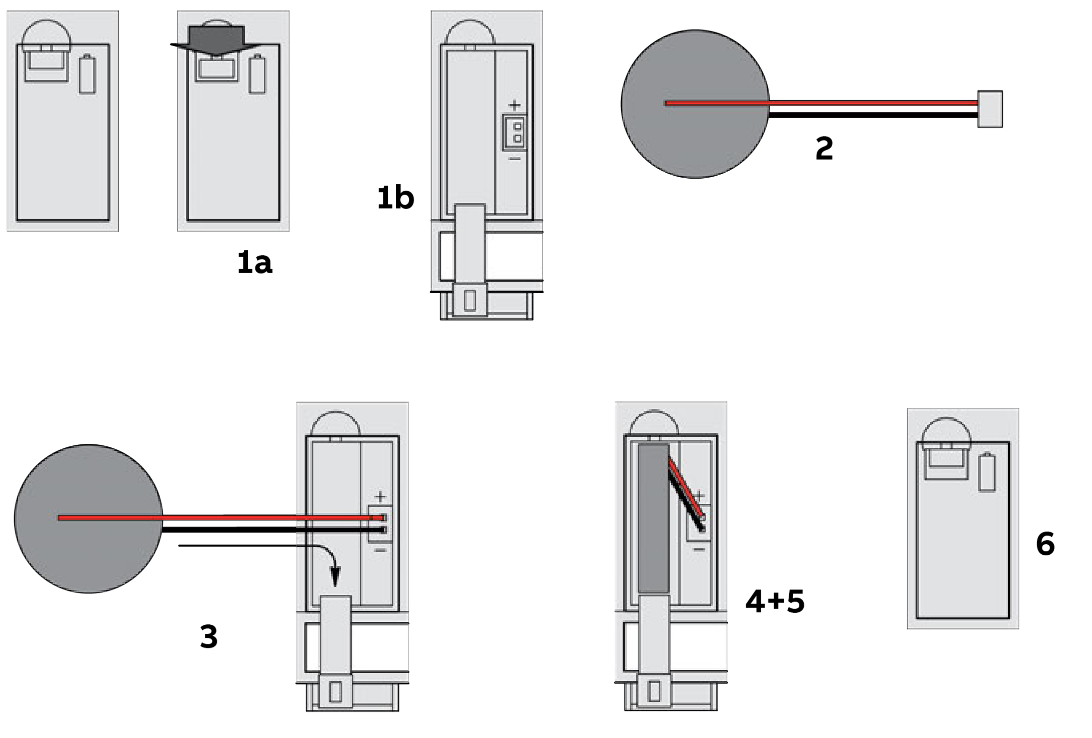
The battery lifetime is the time, the battery can store data while the processor module is not powered. As long as the processor module is powered, the battery will only be discharged by its own leakage current.

> *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 a lithium battery. Attempts to charge lithium batteries lead to overheating and possible 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 chance short circuiting and therefore 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

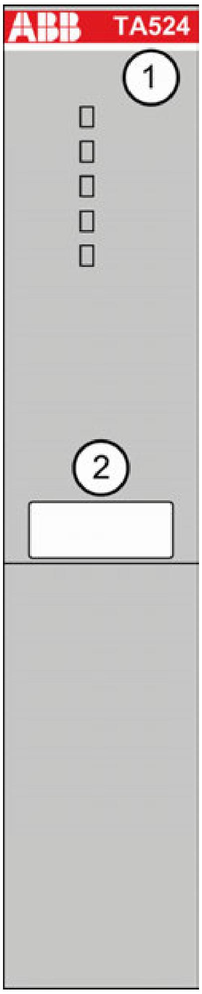
Parameter	Value
Nominal voltage	3 V
Nominal capacity	560 mAh
Temperature range (index below C0)	Operating: 0 °C...+60 °C Storage: -20 °C...+60 °C Transport: -20 °C...+60 °C
Temperature range (index C0 and above)	Operating: -40 °C...+70 °C Storage: -40 °C...+85 °C Transport: -40 °C...+85 °C
Battery lifetime	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.*

1.8.2.5 TA524 - Dummy communication module



1 Type
2 Label

Purpose

TA524 is used to cover an unused communication module slot of a terminal base *Chapter 1.2.1 “TB56xx for AC500 V3 products” on page 4*. It protects the terminal base from dust and inadvertent touch.

Handling instructions

TA524 is mounted in the same way as a common communication module *Chapter 2.6.3.5 “Mounting/Demounting the communication modules” on page 987*.

Technical data

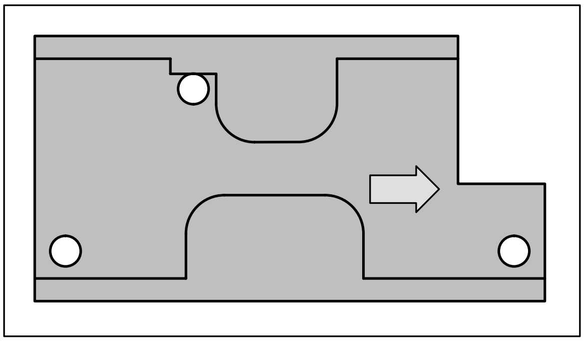
Parameter	Value
Weight	50 g
Dimensions	135 mm x 28 mm x 62 mm

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.

1.8.2.6 TA526 - Wall mounting accessory



Purpose

If a terminal base TB5xx or a terminal unit TU5xx 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.

Handling instructions

Handling of the wall mounting accessory is described in detail in the section *Mounting and disassembling the terminal unit* *"Mounting with screws" on page 984* and *Mounting/Disassembling Terminal Bases and Function Module Terminal Bases* *"Mounting with screws" on page 982*.

Technical data

Parameter	Value
Weight	5 g
Dimensions	67 mm x 35 mm x 5,5 mm

Ordering data

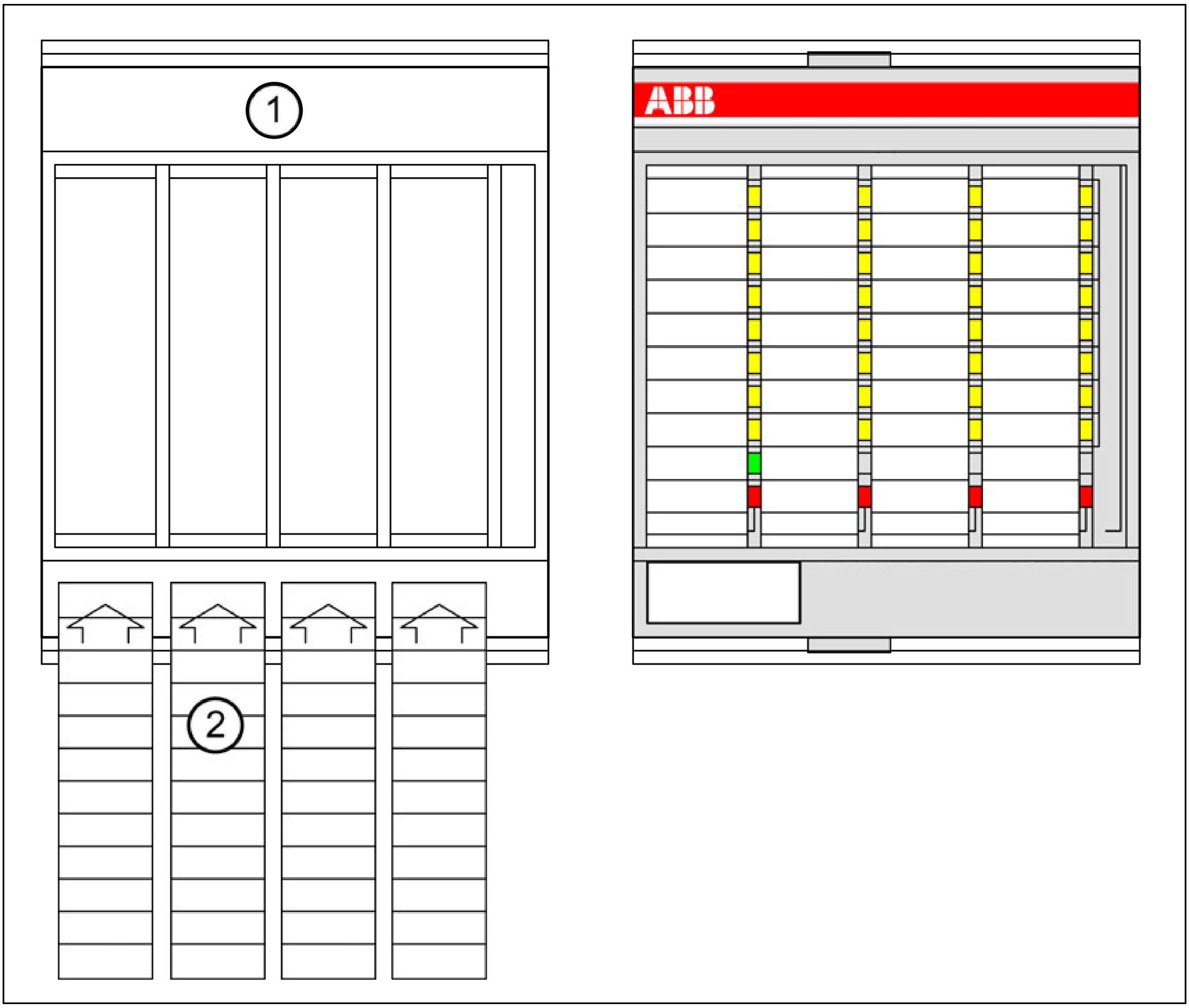
Part no.	Description	Product life cycle phase *)
1SAP 180 800 R0001	TA526, wall mounting accessory	Active

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

1.8.3 S500

1.8.3.1 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 TA563.doc *http://new.abb.com/products/ABB1SAP180500R0001*.

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

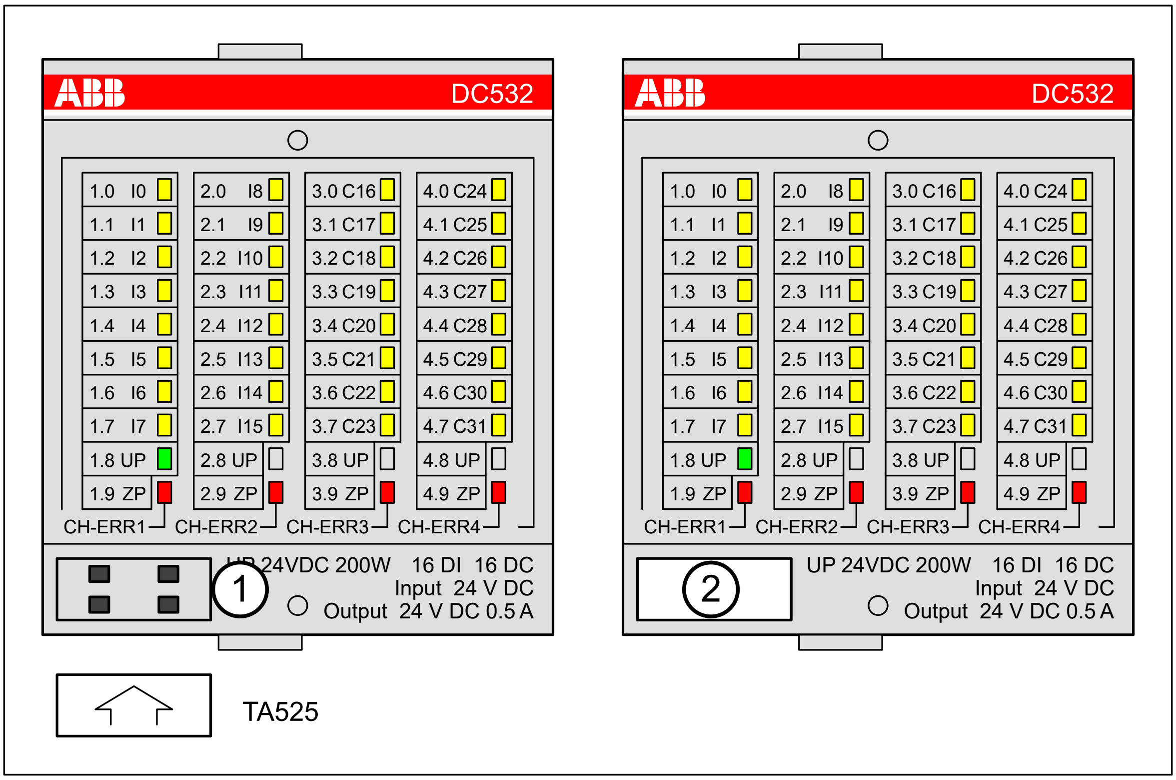
Ordering data

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.*

1.8.3.2 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

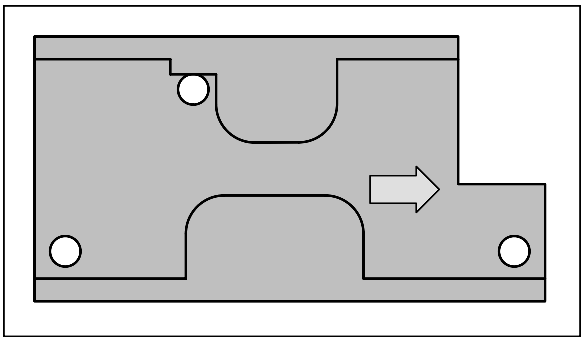
Parameter	Value
Disassembly	With a small screwdriver
Scope of delivery	10 pieces
Weight	1 g per piece
Dimensions	8 mm x 20 mm x 5 mm

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.*

1.8.3.3 TA526 - Wall mounting accessory



Purpose

If a terminal base TB5xx or a terminal unit TU5xx 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.

Handling instructions

Handling of the wall mounting accessory is described in detail in the section *Mounting and disassembling the terminal unit* *➪ "Mounting with screws" on page 984* and *Mounting/Disassembling Terminal Bases and Function Module Terminal Bases* *➪ "Mounting with screws" on page 982*.

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.*

1.8.3.4 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.*

2 System assembly, construction and connection

2.1 Introduction

This chapter provides information on assembly, construction and connection of control systems of the product family AC500.

The AC500 product family consists of the sub-families:

- AC500 (standard): standard PLC that offers a wide range of performance levels and scalability.
- AC500-eCo: cost-effective PLC that offers total inter-operability with the core AC500 range.
- AC500-S: PLC for special safety requirements in all functional safety applications.

AC500 (standard) and AC500-S provide devices with -XC extension as a product variant. Those devices operate mainly identical to the appropriate AC500 product family, however, can be operated under extreme conditions *Chapter 2.7.1 “System data AC500-XC” on page 1023*.

AC500 product family is characterized by functional modularity, i.e. the devices of all AC500 sub-families can be combined flexible.

As assembly, construction and connection for the devices of the AC500 product family is similar, information that is valid for all sub-families is provided within an overall section. Details that are only valid for a specific AC500 sub-family are described in separate sections.

As assembly, construction and connection for the devices of the AC500 product family is similar, information that is valid for all sub-families is provided within an overall section *Chapter 2.4 “Overall information (valid for complete AC500 product family)” on page 911*. Details that are only valid for a specific AC500 sub-family are described in separate sections.

> ***Consider the safety instructions***
> *In the description, special attention must be paid to designs using galvanic isolation, grounding and EMC measures for the reasons stated. Consider the safety instructions for AC500 product family* *Chapter 2.3 “Safety instructions” on page 908.*

2.2 Regulations

Appropriate system setup

The following regulations have to be taken into due consideration:

- DIN VDE 0100: "Regulations for the Setting up of Power Installations"
- DIN VDE 0110 Part 1 and Part 2: "The Rating of Creepage Distances and Clearances"
- DIN VDE 0160 and DIN VDE 0660 Part 500: "The Equipment of Power Installations with Electrical Components"

To ensure project success and proper installation of all systems, customers must be familiar and proficient with the following standards and must comply with their directives:

- DIN VDE 0113 Part 1 & Part 200: "Working & Process Machinery"
- DIN VDE 0106 Part 100: "Close proximity to dangerous voltages"
- DIN VDE 0160, DIN VDE 0110 Part 1: "Protection against direct contact"

The user has to guarantee that the devices and the components are mounted following these regulations. For operating the machines and installations, other national and international relevant regulations, concerning prevention of accidents and using technical working means, also have to be met.

AC500 devices are designed according to IEC 1131 Part 2 under overvoltage category II per DIN VDE 0110 Part 2.

For direct connection of AC Category III overvoltages provide protection measures for overvoltage category II according to IEC-Report 664/1980 and DIN VDE 0110 Part 1.

Equivalent standards:

- DIN VDE 0110 Part 1 ↔ IEC 664
- DIN VDE 0113 Part 1 ↔ EN 60204 Part 1
- DIN VDE 0660 Part 500 ↔ EN 60439-1 ↔ IEC 439-1

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Qualified personnel

Both the control system AC500 and other components in the vicinity are operated with dangerous contact voltages. Touching parts, which are under such voltages, can cause grave damage to health.

In order to avoid such risks and the occurrence of material damage, persons involved with the assembly, starting up and servicing must possess pertinent knowledge of the following:

- Automation technology sector
- Dealing with dangerous voltages
- Using standards and regulations, in particular VDE, accident prevention regulations and regulations concerning special ambient conditions (e.g. areas potentially endangered by explosive materials, heavy pollution or corrosive influences).

2.3 Safety instructions

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.

No patent liability is assumed by ABB with respect to use of information, circuits, equipment or software described in this manual. No liability is assumed for the direct or indirect consequences of the improper use, improper application or inadequate maintenance of these devices. In no event will ABB be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

PLC specific safety notices

The product family AC500 control system is designed according to EN 61131-2 IEC 61131-2 standards. Data, different from IEC 61131, are caused by 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!
PLC damage due to operation conditions
Protect the devices from dampness, dirt and damage during transport, storage and operation!

NOTICE!
PLC damage due to wrong enclosures
Due to their construction (degree of protection IP 20 according to EN 60529) and their connection technology, the devices are suitable only for operation in enclosed switchgear cabinets.

Cleaning instruction
Do not use cleaning agent for cleaning the device.

Use a damp cloth instead.

Connection plans and user software must be created so that all technical safety aspects, legal regulations and standards are observed. In practice, possible shortcircuits and breakages must not be able to lead to dangerous situations. The extent of resulting errors must be kept to a minimum.

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

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

NOTICE!
PLC damage due to missing grounding
– Ensure to earth the devices.
– The grounding (switch cabinet grounding, PE) is supplied both by the mains connection (or 24 V supply voltage) and via DIN rail. The DIN rail must be connected to the ground before the device is subjected to any power. The grounding may be removed only if it is certain that no more power is being supplied to the control system.

In the description for the devices (operating manual or AC500 system description), reference is made at several points to grounding, galvanic isolation and EMC measures. One of the EMC measures consists of discharging interference voltages into the grounding via Y-type capacitors. Capacitor discharge currents must basically be able to flow off to the grounding (in this respect, see also VBG 4 and the relevant VDE regulations).

CAUTION!
Do not obstruct the ventilation for cooling!
The ventilation slots on the upper and lower side 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!
Labels on or inside the device alert people that dangerous voltage may be present or that surfaces may have dangerous temperatures.

WARNING!
Splaying of strands can cause hazards!
During wiring of terminals with stranded conductors, splaying of strands shall be avoided.

– Ferrules can be used to prevent splaying.

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.

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 a lithium battery. Attempts to charge lithium batteries lead to overheating and possible 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 chance short circuiting and therefore 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 batteries in an environmentally conscious manner, in accordance to local-authority regulations.

Environment and enclosure information

This equipment is intended for use in a Pollution Degree 2 industrial environment, in overvoltage Category II applications (as defined in IEC publication 60664-1), at altitudes up to 2.000 meters without derating.

This equipment is considered Group 1, Class A industrial equipment according to IEC/CISPR Publication 11. Without appropriate precautions, there may be potential difficulties ensuring electromagnetic compatibility in other environments due to conducted as well as radiated disturbance.

This equipment is supplied as "open type" equipment. It must be mounted within an enclosure that is suitably designed for those specific environmental conditions that will be present and appropriately designed to prevent personal injury resulting from accessibility to live parts. The interior of the enclosure must be accessible only by the use of a tool. Subsequent sections of this publication may contain additional information regarding specific enclosure type ratings that are required to comply with certain product safety certifications.

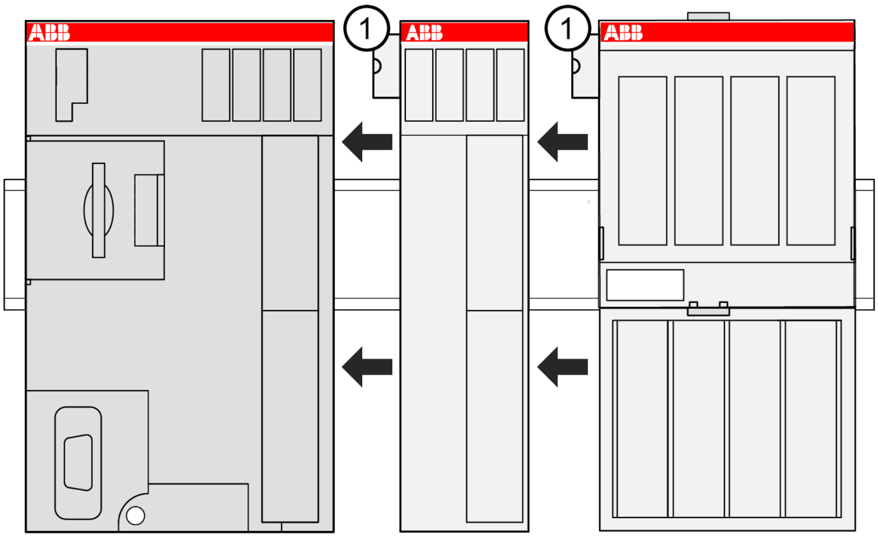
Refer to NEMA Standards publication 250 and IEC publication 60529, as applicable, for explanations of the degrees of protection provided by different types of enclosure. Also see the appropriate sections in this manual.

2.4 Overall information (valid for complete AC500 product family)

2.4.1 Serial I/O bus

The synchronized serial 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.

Up to 10 I/O terminal units (for 1 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.



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!
The I/O bus is not designed for plugging and unplugging modules while in operation. If a module is plugged or replaced while the bus is in operation, the following consequences are possible

- reset of the station or of the CPU
- system lockup
- damage of the module

WARNING!
Removal/Insertion under power
The devices are not designed for removal or insertion under power. Because of unforeseeable consequences, it is not allowed to plug or unplug devices with the power being ON.

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

With its fast data transmission, the I/O bus obtains very low reaction times. Depending on the device and on the version of firmware and Automation Builder, the following numbers of I/O devices 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

Table 184: General data

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
Bus data transmission speed	1.8 Mb/s
Minimum bus cycle time	500 μs [1])
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.
Max. bus length	1 m
[1]) Minimum bus cycle time: This value is valid for all module combinations (from 1 to 10 I/O modules)	

Table 185: 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

2.4.2 Mechanical encoding

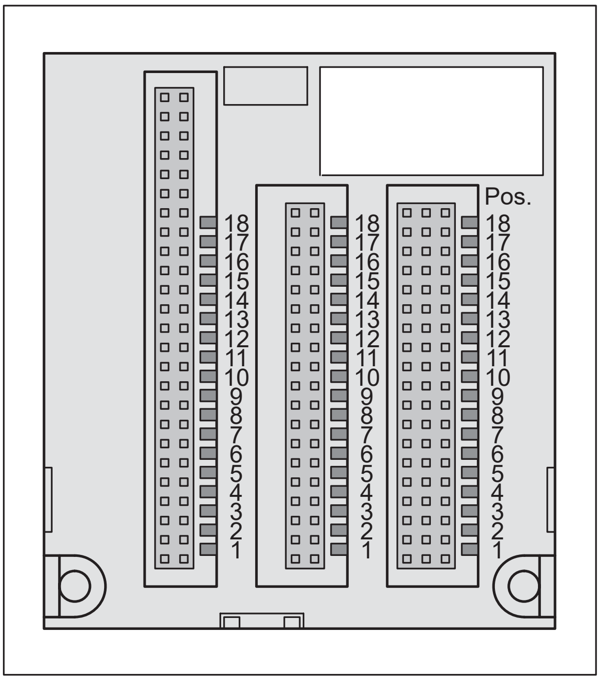


Fig. 165: Possible positions for mechanical encoding (1 to 18)

> **NOTICE!**
> Terminal units and terminal bases have a mechanical coding which prevents modules (from) being inserted into the wrong places for cases that might result in dangerous parasitic voltages or if modules could be destroyed.

The coding either makes it impossible to insert the module to the wrong place or blocks its electrical function (outputs are not activated).

The following figures show the possible encodings.

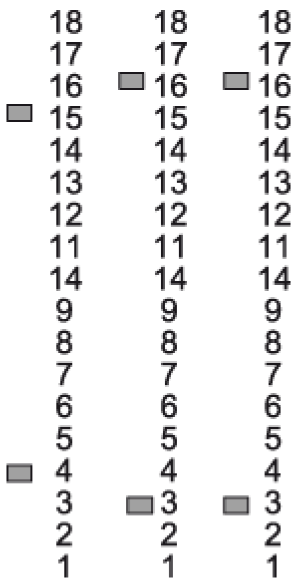


Fig. 166: Encoding for processor modules with Ethernet interface

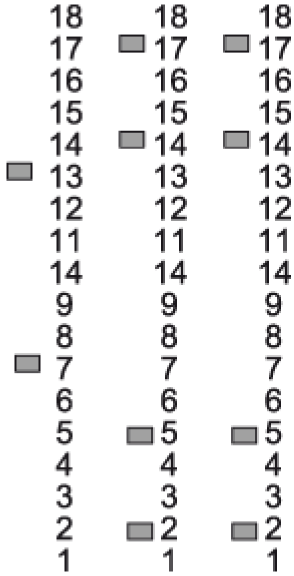


Fig. 167: Encoding for real-time Ethernet modules

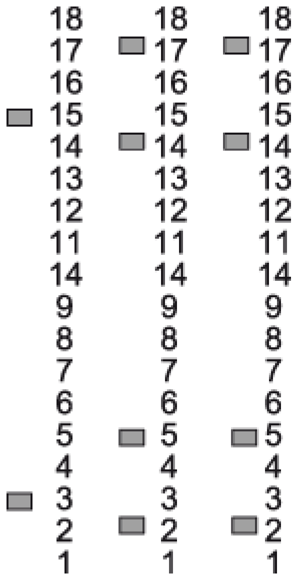


Fig. 168: Encoding for communication interface modules

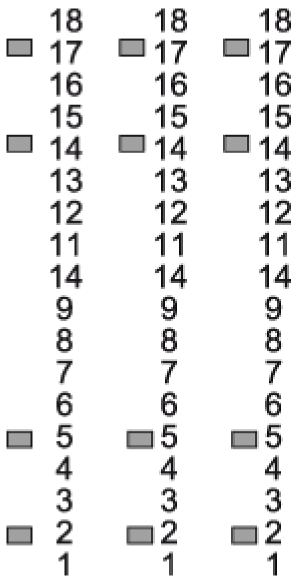


Fig. 169: Encoding for I/O modules (24 VDC)

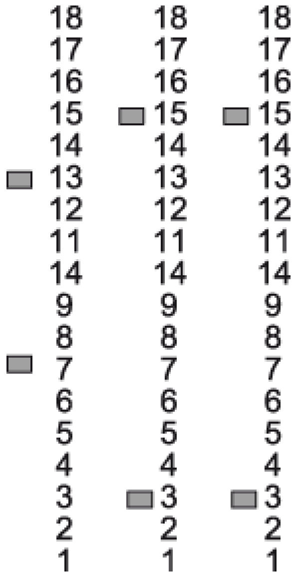


Fig. 170: Encoding for communication interface modules with PROFINET interface

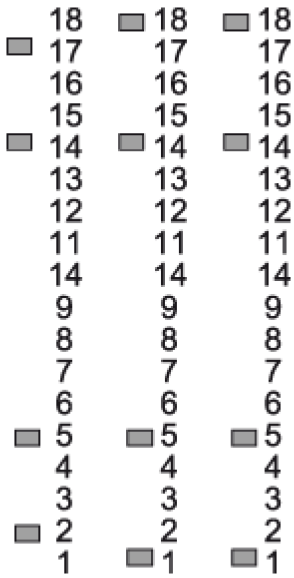


Fig. 171: Encoding for I/O modules (120 VAC / 230 VAC)

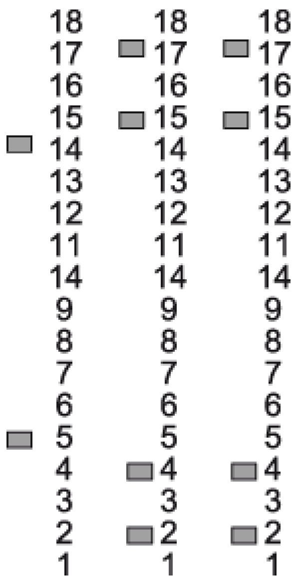
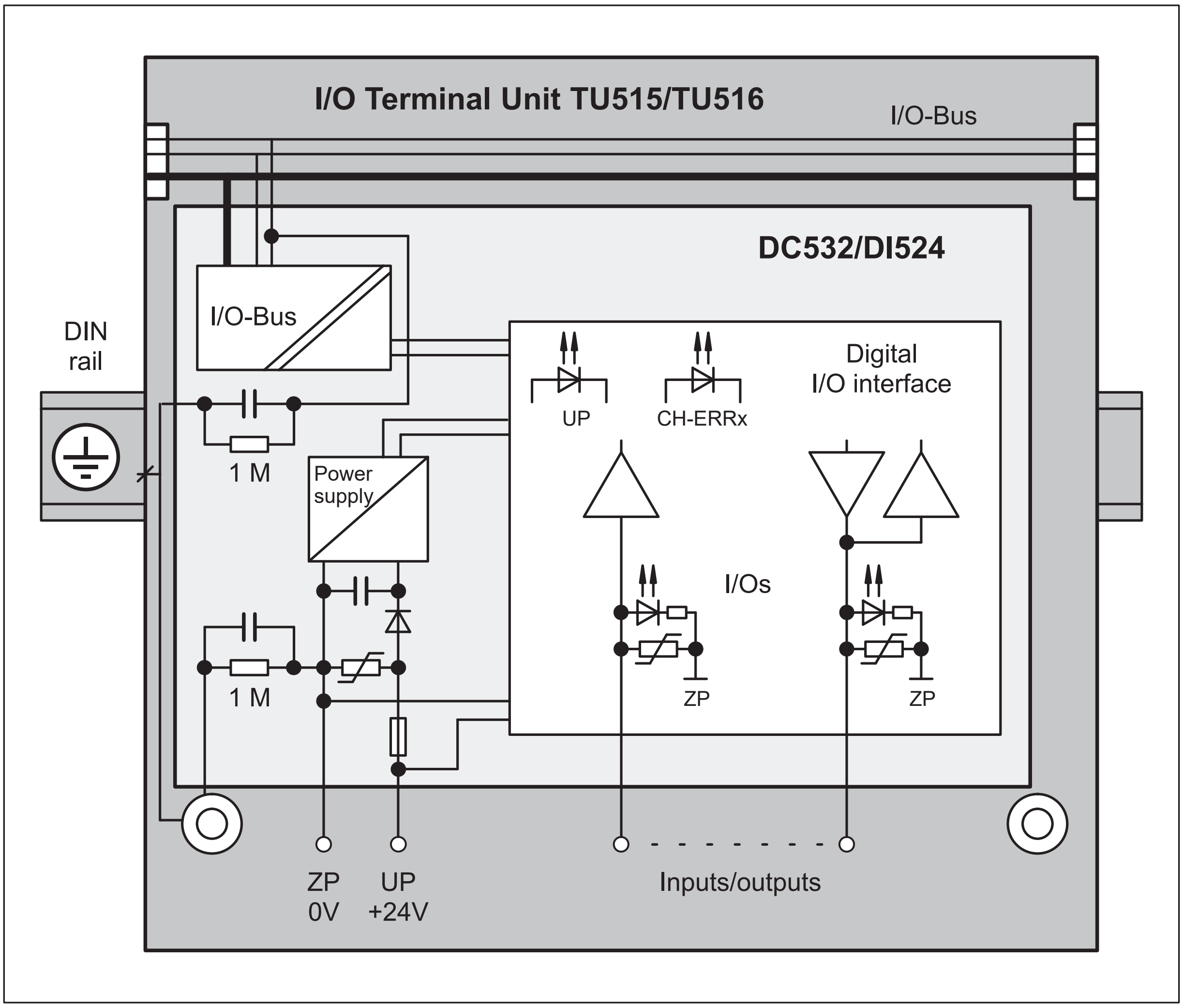


Fig. 172: Encoding for positioning modules

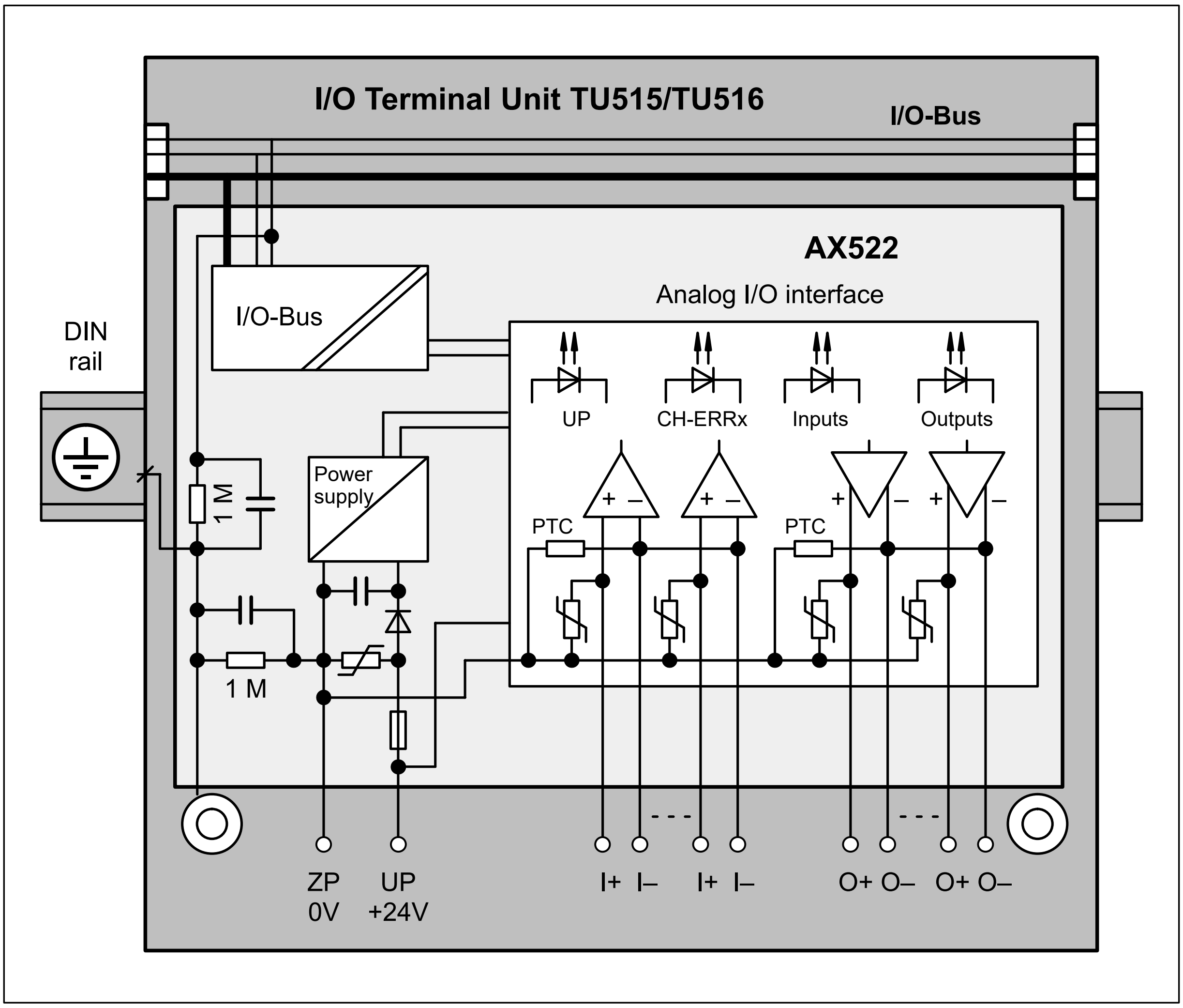
2.4.3 Earthing concept (Block diagrams)

> **NOTICE!**
> **PLC damage due to missing grounding**
> – Ensure to earth the devices.
> – The grounding (switch cabinet grounding, PE) is supplied both by the mains connection (or 24 V supply voltage) and via DIN rail. The DIN rail must be connected to the ground before the device is subjected to any power. The grounding may be removed only if it is certain that no more power is being supplied to the control system.

Block diagram: Digital I/O modules



Block diagram: Analog I/O modules



2.4.4 EMC-conforming assembly and construction

2.4.4.1 General principles

General considerations

Electric and electronical devices have to work correctly on site. This is also valid when electro-magnetic influences affect them in defined and/or expected strength. The devices themselves must not emit electro-magnetic noises.

Advant Controller components have a very high noise immunity.

When the wiring and grounding instructions are met, an error-free operation is given.

High electro-magnetic noises of nearby mounted applications must be taken in consideration during the planning phase.

An EMC compatible earthing concept will also guarantee an error-free operation here.

There are three important principles to be especially considered:
- *Keep all connections as short as possible (in particular the grounding conductors)*
- *Use large conductor cross sections (in particular for the grounding conductors)*
- *Create low-impedance, i.e. good and large-sized contacts (in particular for the grounding conductors)*

Pay attention to the following:
- *Use vibration-resistant connections*
- *Clean metallic contact areas*
- *Use solid plug and screw-type connections*
- *Use earth cable shields with clips on a well-grounded metallic surface*
- *Do not use aluminium parts*
- *Do not use sheath wires*
- *Do not use toothed lock washers under screw connections*

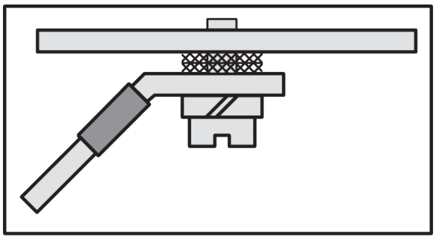


Fig. 173: Assembly: wrong

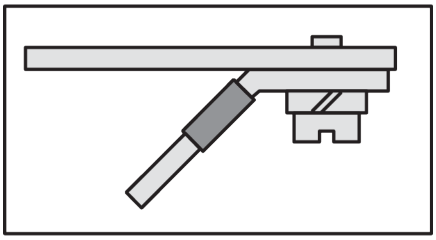


Fig. 174: Assembly: correct

Make a connection between the DIN rails and PE (Protective Earth). For this, use an grounding wire with a minimum conductor cross section of 10 mm².

The wire is connected to the DIN rail with an M6 screw.

A large-area contact of the DIN rail with the metallic mounting plate improves the EMC behavior significantly, as the disturbances can be discharged more effective.

2.4.4.2 Cable routing

- Route cables meeting the standards.
- Sort the cables into cable groups:
  - Power current cables
  - Power supply cables
  - Signal cables
  - Data cables

- Rout signal cables and data cables separately from the power cables.
  – Separate cable ducts or cable bundles.
  – The distance should be 20 cm or greater.
- Lay signal and data cables close to earthed surfaces.

2.4.4.3 Cable shields

- Use only shielded data cables. The shield should be grounded at both ends.
  A cable shield only grounded at one end can only protect from capacitively coupled interference and low-frequency disturbances (50 Hz hum).
- Avoid parasitic currents flowing through the cable shields.
  This can be done by installing current-carrying equipotential bondings.
- Use only cables with braided shields.
  Foil shields are not robust enough, cannot be contacted well and have poor HF properties.
- Use only metallic or [metal]-plated plugs for shielded data cables.
- Use only shielded cables for analog signals.
  For small signals ground the shield only at one end.
- Ground the cable shield directly with a clip when entering the switchgear cabinet.
  Do not cut the shield until the cable reaches the module connected.

> *The connection between the PE bar and the shield bar must have a low impedance.*

2.4.4.4 Switchgear cabinet

> *According to DNV GL mounting in a seperate metall cabinet is required for:*
> – *SM560-S-FD-1*
> – *CI521-MODTCP*
> – *CI522-MODTCP*

Connections The connections between the switchgear cabinet, the mounting plates, the PE bar and the shield bar must have a low impedance.

Grounding Ground the switchgear cabinet doors with short and highly flexible conductors.

Illumination Only use filament lamps (bulbs) or fluorescent tubes with interference suppression.

For supplying the PC Use the mains socket which is located inside the switchgear cabinet.

Chapter 2.6.2.1 “Switchgear cabinet assembly” on page 976

2.4.4.5 Reference potential

- Provide a uniform reference potential in the entire installation and ground all electrical appliances if possible.
- Route your grounding conductors in a star configuration so that no ground loops can occur.

2.4.4.6 Equipotential bonding

The Installation of equipotential bondings are necessary if there are present or expected potential differences between parts of your application.

- *The impedance of equipotential bonding must be equal or lower than 10 % of the shield impedance of the shielded signal cables between the same points.*
- *The conductor cross section of a equipotential bonding must be 16 mm² to withstand the maximum possible compensating current.*
- *Equipotential bondings and shielded signal cables should be laid close to each other.*
- *Equipotential bondings must be connected to PE with low impedance.*

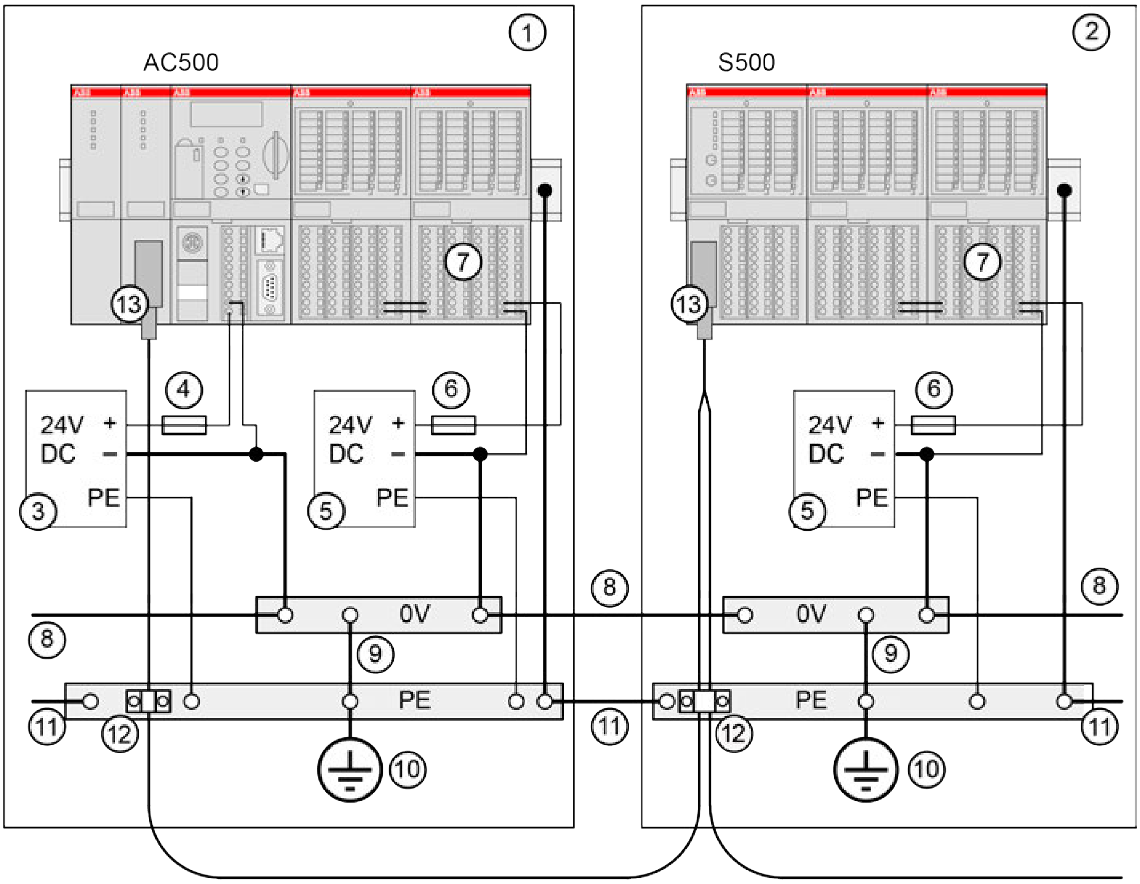


Fig. 175: AC500, equipotential bonding

1 Cabinet 1
2 Cabinet 2
3 Power supply for the CPU
4 Fuse for the CPU power
5 Power supply for the I/Os
6 Fuse for the I/O power
7 For fuses for the contacts of the relay outputs
8 0V rail
9 Grounding of the 0V rail
10 Cabinet grounding
11 Equipotential bonding between the cabinets min. 16 mm^2
12 Cable shields grounding
13 Fieldbus connection (e.g. Ethernet)

2.4.5 Power consumption of an entire station

The power consumption of a complete station consists of the sum of all individual consumptions.

- Consumers over terminals L+ and M on the AC500 terminal base/AC500-eCo CPU:
  - CPU itself
  - I/O modules attached on the I/O bus
  - Communication modules attached (AC500 terminal base)
- Consumers over the process supply voltage terminals ZP and UP of the AC500 terminal units / the L+/M or UP/ZP terminals of the AC500-eCo I/O modules:
  - Digital I/O modules
  - Analog I/O modules

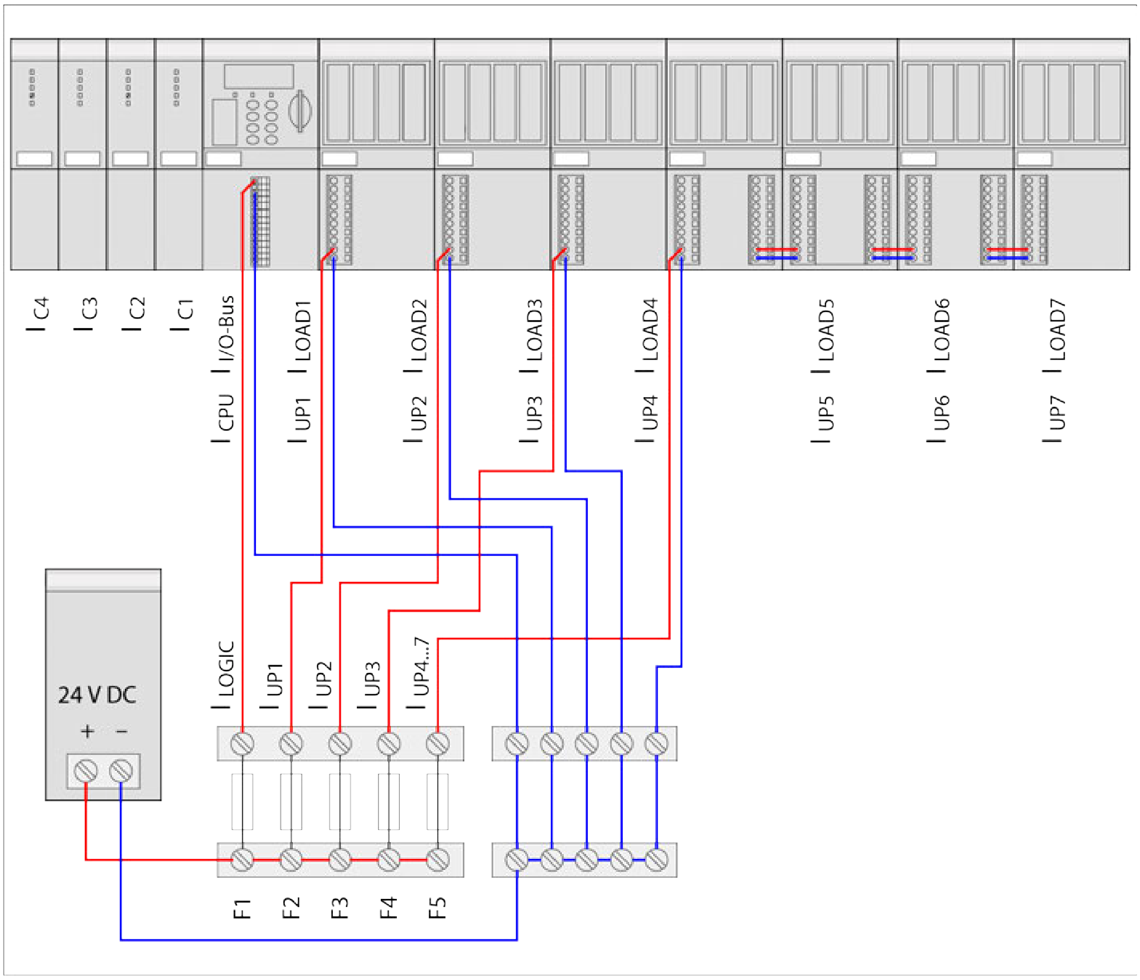
The two supply voltages can be provided by the same power supply unit. The CPU and the I/O modules should, however, be fused separately. Of course also separate power supplies are possible.

2.4.5.1 Calculation of the total current consumption

Example

In the example, the AC500 control system consists of the following devices:

- AC500 CPU with Ethernet interface
- 4 communication modules
- 7 I/O modules (digital and analog)
- As well as the required terminal bases and terminal units



Because of the high total current consumption of the digital I/O modules (from UP = 24 V DC), the supply is divided up into several electric circuits fused separately.

The maximum permitted total current over the supply terminals of the I/O terminal units is 8 A.

The total current can be calculated as follows:

$I_{Total} = I_{LOGIC} + I_{UP}$

with the assumptions

$I_{LOGIC} = I_{CPU} + I_{I/O\ bus} + I_{C1} + I_{C2} + I_{C3} + I_{C4}$ (CPU + communication modules + I/O bus)

$I_{I/O\ bus}$ = Number of expansion modules × Current consumption through the I/O bus per module

and

$I_{UP} = I_{UP1} + I_{LOAD1} + I_{UP2} + I_{LOAD2} + I_{UP3} + I_{LOAD3} + I_{UP4} + I_{LOAD4} + I_{UP5} + I_{LOAD5} + I_{UP6} + I_{LOAD6} + I_{UP7} + I_{LOAD7}$

If one assumes that all outputs are switched on and are operated with their maximum permitted load currents (under compliance with the maximum permitted currents at the supply terminals), then the following values are the result for an example shown above:

	I_{CPU} *)	I_{Cx} *)	$I_{I/O\ bus}$ *)	I_{UPx} *)	I_{LOADx} *)
CPU / communication module part					
CPU	0.110 A	-	-	-	-
C1	-	0.050 A	-	-	-
C2	-	0.085 A	-	-	-
C3	-	0.050 A	-	-	-
C4	-	0.050 A	-	-	-
I/O module part					
Analog1	-	-	0.002 A	0.150 A	-
Analog2	-	-	0.002 A	0.150 A	0.160 A
Analog3	-	-	0.002 A	0.100 A	0.080 A
Analog4	-	-	0.002 A	0.100 A	0.080 A
Digital1	-	-	0.002 A	0.050 A	8.000 A
Digital2	-	-	0.002 A	0.050 A	8.000 A
Digital3	-	-	0.002 A	0.050 A	8.000 A
Σ columns	0.110 A	0.235 A	0.014 A	0.650 A	24.320 A
	$\Sigma I_{LOGIC} \approx 0.4$ A			$\Sigma I_{UP} \approx 25$ A	
	$I_{Total} \approx 25.4$ A				
*) All values in this column are exemplary values					

2.4.5.2 Dimensioning of the fuses

To be able to select the fuses for the station correctly, both the current consumption and the inrush currents (melting integral for the series-connected fuse) must be taken into consideration.

Fuse	for	Σ of the melting integrals in A^2s	$I_{Logic\ A}$	$I_{UPx\ A}$	Recommended fuse	
					Type	Value
F1	CPU logic	1.000	≈ 0.4	-	Quick	10 A
F2	Module Digital1	0.005	-	8.050	Quick	10 A
F3	Module Digital2	0.008	-	8.050	Quick	10 A
F4	Module Digital3	0.007	-	8.050	Quick	10 A
F5	Modules Analog1 + Analog2 + Analog3 + Analog4	0.130	-	0.820	Quick	10 A

2.4.6 Decommissioning

Secure decommissioning of a functional CPU

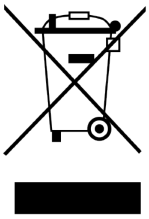
1. Delete the runtime licenses.
2. Delete certificates available on the CPU.
3. Delete applications.
4. Delete applications from memory card, if available.
5. If available, remove memory card and battery from CPU.
6. Delete all user accounts and user data.
7. Demount and dispose the hardware modules *Chapter 2.5.3 “Mounting and demounting” on page 933* *Chapter 2.6.3 “Mounting and demounting” on page 981* *Chapter 2.4.7 “Recycling” on page 925*.

Secure decommissioning of a not functional CPU

▷ 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.

2.4.7 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.

2.5 AC500-eCo

2.5.1 System data AC500-eCo V3

2.5.1.1 Environmental conditions

Table 186: 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

NOTICE!
Exceeding the maximum power supply voltage (> 30 V DC) for process or supply voltages could lead to unrecoverable damage of the system. The system might be destroyed.

Parameter	Value				
	PM5012-x-ETH	**PM5032-x-ETH**	**PM5052-x-ETH**	**PM5072-T-2ETH**	**PM5072-T-2ETHW**
Temperature					
Operating					
Horizontal mounting					
Standard temperature range	0 °C...+55 °C	0 °C...+60 °C			-
Wide temperature range	-				-20 °C...+70 °C I/O derating in range 60 °C…70 °C: 75 %
Vertical mounting (output load reduced to 50 % per group)					
Standard temperature range	0 °C...+40 °C				-
Wide temperature range	-				-20 °C...+40 °C
Storage	-40 °C...+70 °C				
Transport	-40 °C...+70 °C				
Humidity	Max. 95 %, without condensation				
Air pressure					
Operating	> 800 hPa / < 2000 m				
Storage	> 660 hPa / < 3500 m				
Ingress protection	PLC System: IP 20 in accordance with IEC 60529 ● with all modules or option boards plugged in ● with all terminal blocks plugged in ● with all covers closed				

Option boards	Temperature range
TA5101-4DI	0 °C... 60 °C
TA5105-4DOT	0 °C... 60 °C
TA5110-2DI2DOT	0 °C... 60 °C
TA530-KNXPB	0 °C... 60 °C
TA5131-RTC	0 °C...+55 °C
TA5141-RS232I	0 °C... 60 °C
TA5142-RS485I	0 °C... 60 °C
TA5142-RS485	0 °C... 60 °C

2.5.1.2 Creepage distances and clearances

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

2.5.1.3 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.

2.5.1.4 Electromagnetic compatibility

Electromagnetic Compatibility		
Device suitable for:		
	Industrial applications	Yes
	Domestic applications	Yes
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
	Supply voltage units (DC)	2 kV
	Digital inputs/outputs (24 V DC)	1 kV

Electromagnetic Compatibility		
	Digital inputs/outputs (100 V AC...240 V AC)	Relay 2 kV
	Ethernet	1 kV
	Serial interfaces	1 kV
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

2.5.1.5 Mechanical data

Parameter	**Value**
Mounting	Horizontal
Degree of protection	EN61131-2: IP20 with all option boards or option board slot covers attached (and all terminal screws are tightened)
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

2.5.1.6 Approvals and certifications

Information on approvals and certificates can be found in the corresponding chapter of the *Main catalog, PLC Automation*.

2.5.2 Mechanical dimensions

2.5.2.1 Switchgear cabinet assembly (indoor use)

Information on EMC-conforming assembly and construction is provided within the overall functions section *Chapter 2.4.4 "EMC-conforming assembly and construction" on page 918**.*

PLC enclosure

To protect PLCs against:

- unauthorized access,
- dusting and pollution,
- moisture and wetness and
- mechanical damage,

switchgear cabinet IP54 for common dry factory floor environment is suitable.

Maintain spacing from:

- enclosure walls
- wireways
- adjacent equipment

Allow a minimum of 20 mm clearance on all sides. This provides ventilation and galvanic isolation.

It is recommended to mount the modules on an grounded mounting plate, or an grounded DIN rail, independent of the mounting location.

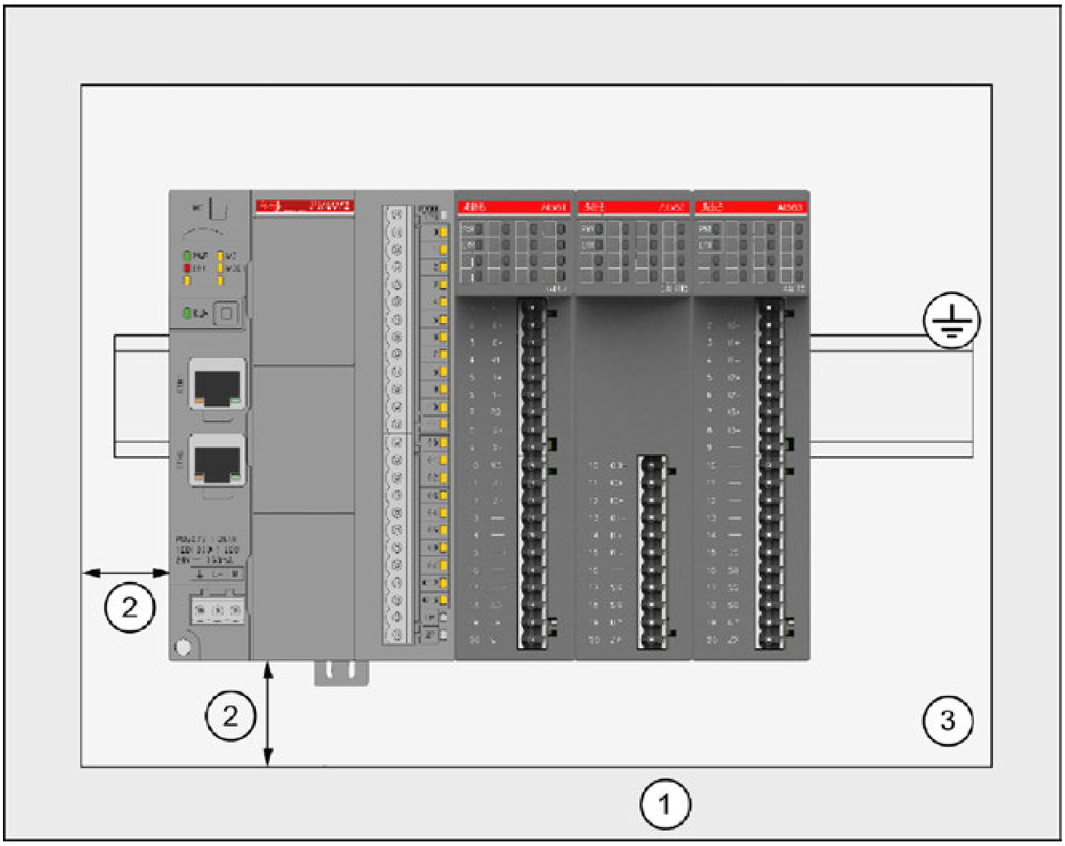


Fig. 176: Installation of AC500-eCo V3 CPU/S500 modules in a switchgear cabinet

1 Cable duct
2 Distance from cable duct ≥20 mm
3 Mounting plate, grounded

NOTICE!
Horizontal mounting is highly recommended.

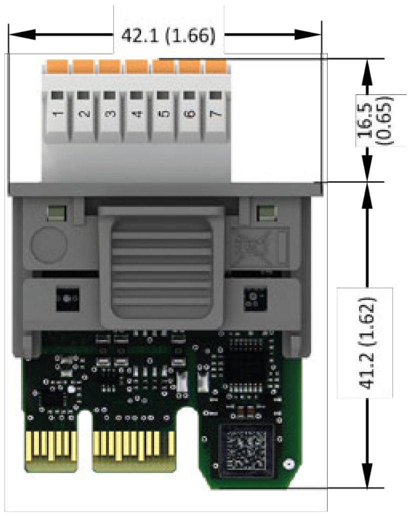
Vertical mounting is possible, however, derating consideration should be made to avoid problems with poor air circulation and overheating.

When vertically mounted, always place an end-stop terminal block (e.g. type BADL, P/N: 1SNA399903R0200) on the bottom and on the top of the modules to properly secure the modules.

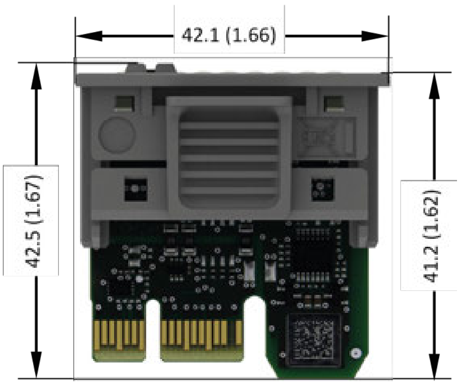
With high vibration applications and horizontal mounting, we also recommend to place end-stop terminals at the right and left side of the device to properly secure the modules, e.g. type BADL, P/N: 1SNA399903R0200.

2.5.2.2 Mechanical dimensions AC500-eCo V3 option boards

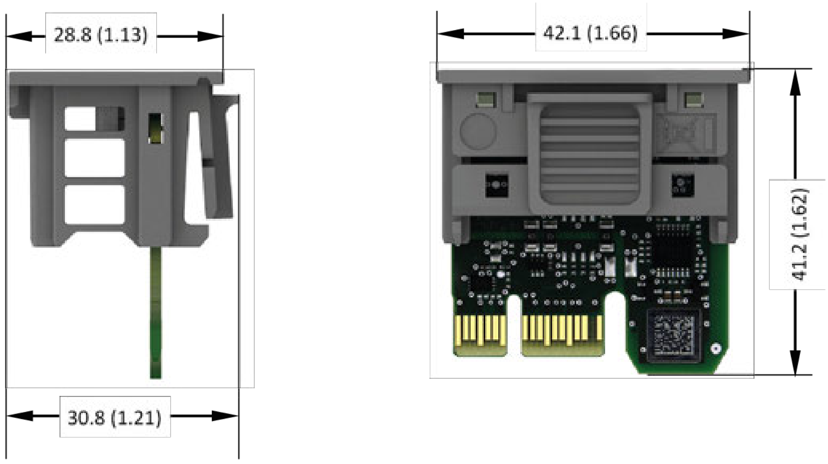
TA5105, TA5110



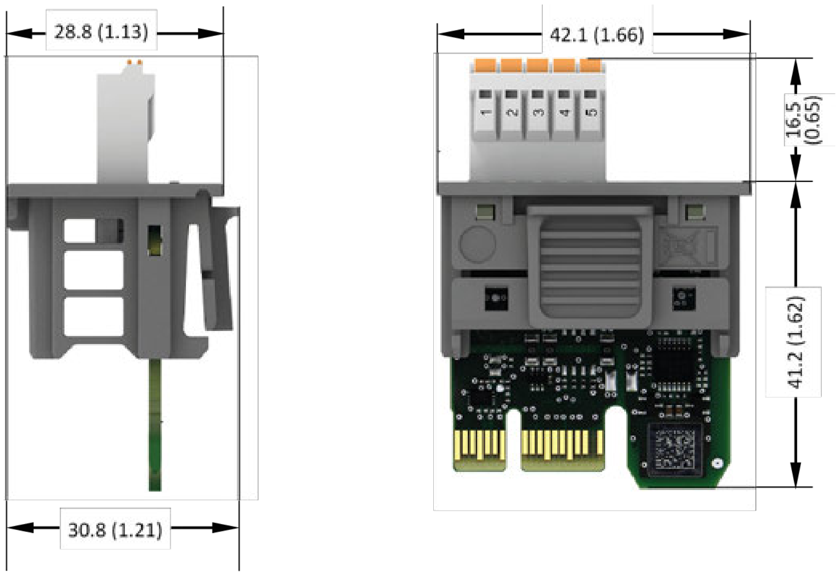
TA5130



TA5131-RTC



TA5101, TA514x



2.5.2.3 Mechanical dimensions AC500-eCo V3

> *All mechanical dimensions are given in millimeters and inches. The value in brackets is the inch-value.*

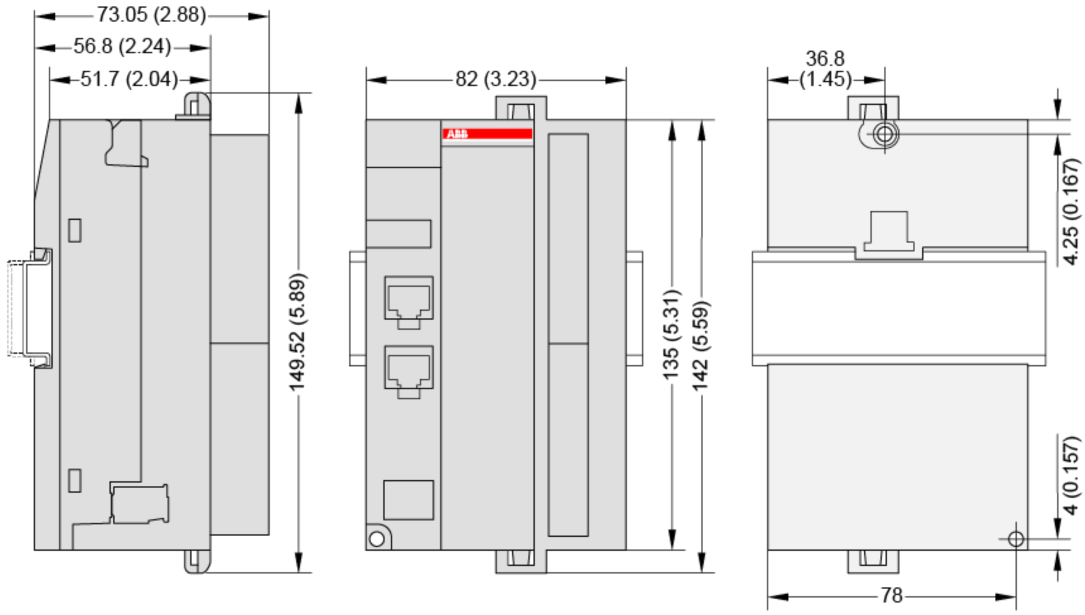


Fig. 177: Side, front and back view

2.5.2.4 Mechanical dimensions S500-eCo

> *All mechanical dimensions are given in millimeters and inches. The value in brackets is the inch-value.*

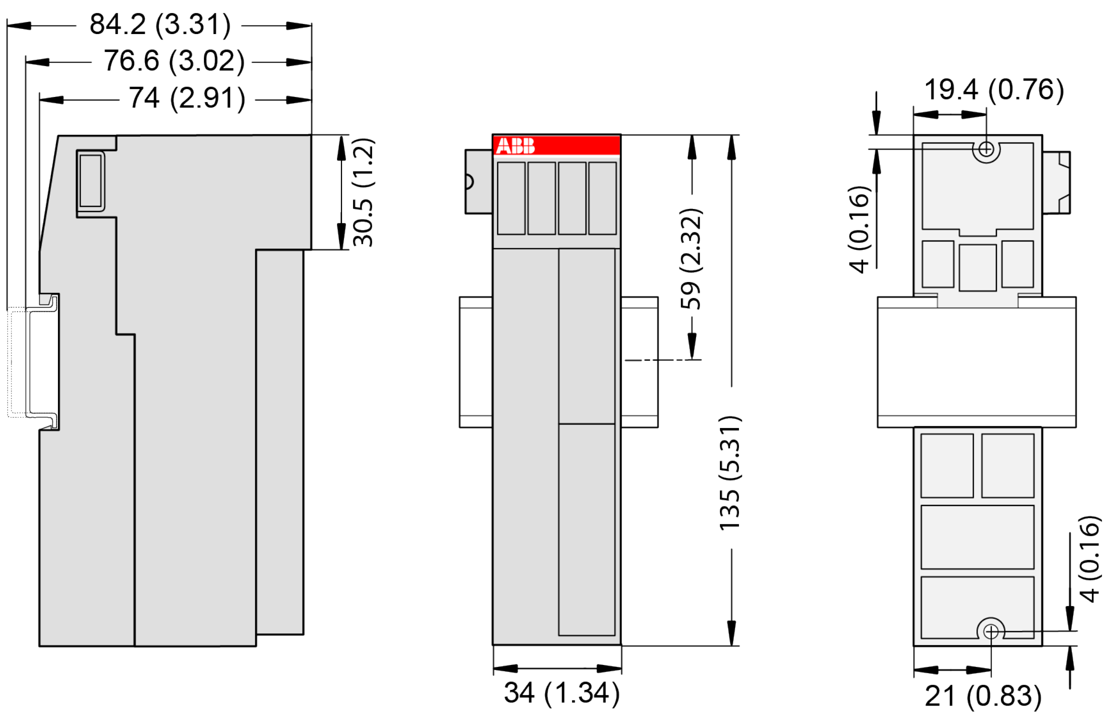


Fig. 178: Side, front and back view

2.5.3 Mounting and demounting

The control system is designed to be mounted to a well-grounded mounting surface such as a metal panel. Additional grounding connections from the mounting tabs or DIN rail (if used), are not required unless the mounting surface cannot be grounded.

During panel or DIN rail mounting of all devices, be sure that all debris (metal chips, wire strands, etc.) is kept from falling into the controller. Debris that falls into the controller could cause damage while the controller is energized.

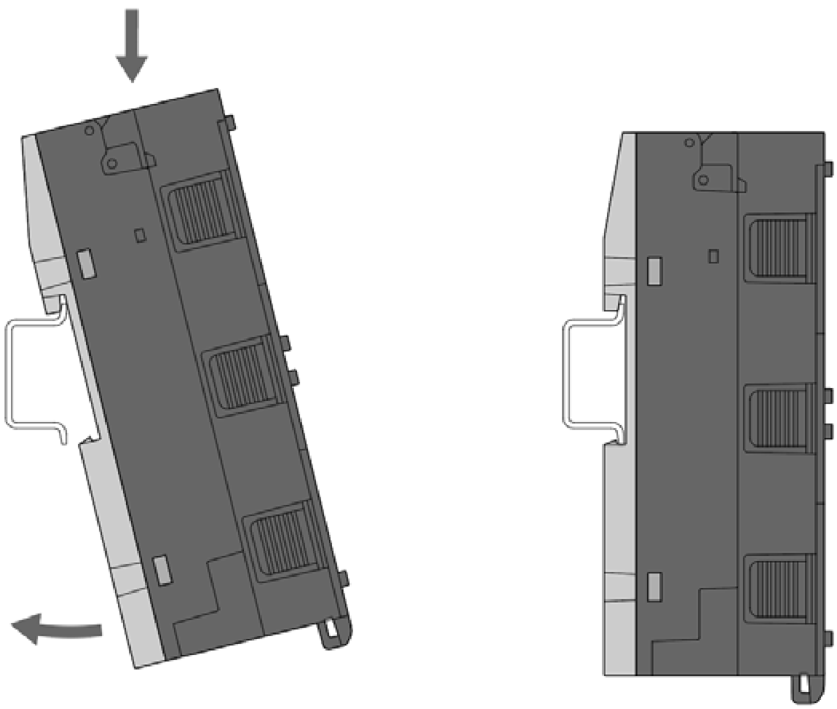
All devices are grounded through the DIN rail to chassis ground. Use zinc plated yellow-chromate stell DIN rail to assure proper grounding. The use of other DIN rail materials (e.g. aluminium, plastic, etc.) that can corrode, oxidize, or are poor conductors, can result in improper or intermittent grounding.

2.5.3.1 Mounting and demounting of the AC500-eCo V3 CPUs

2.5.3.1.1 Mounting a processor module on a DIN rail

NOTICE!
Risk of function faults!
The processor module is grounded via DIN rail.

The DIN rail must be included into the earthing conception of the plant.

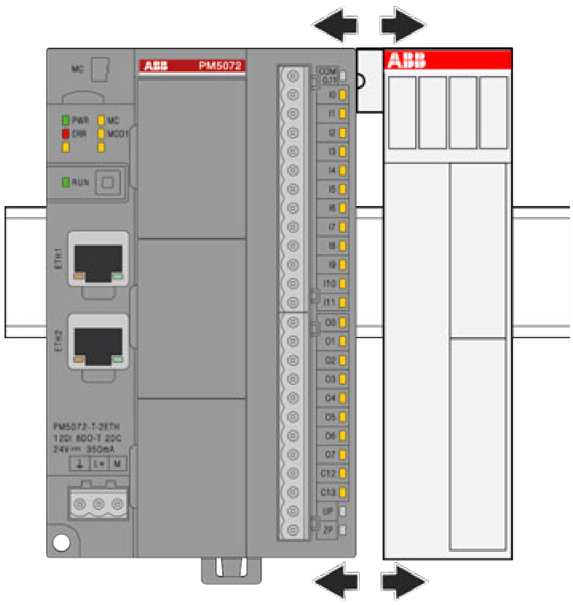


Mount the processor module at the top of the DIN rail, then snap it in below.

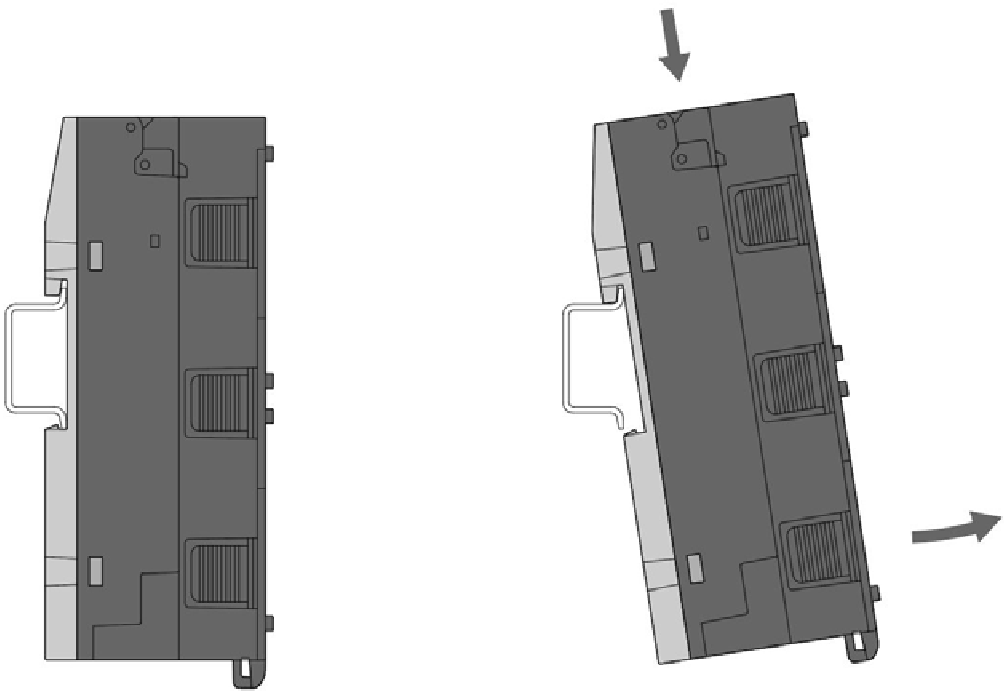
See hardware description of PM50xx *Chapter 1.3.1.1 “PM50xx” on page 14* *for connection.*

2.5.3.1.2 Demounting a processor module mounted on a DIN rail

1. Remove I/O modules if connected.



2. While pressing down processor module pull it away from DIN rail.



2.5.3.1.3 Mounting a processor module on a metal plate

NOTICE!
Risk of function faults!
Missing electrical contact by isolating screws or washers!

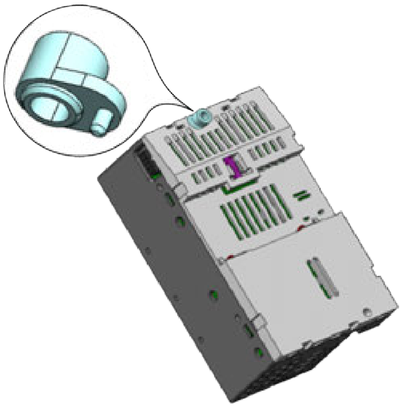
Use metal screws on the metal plate.

The metal plate must be included into the earthing concept of the plant.

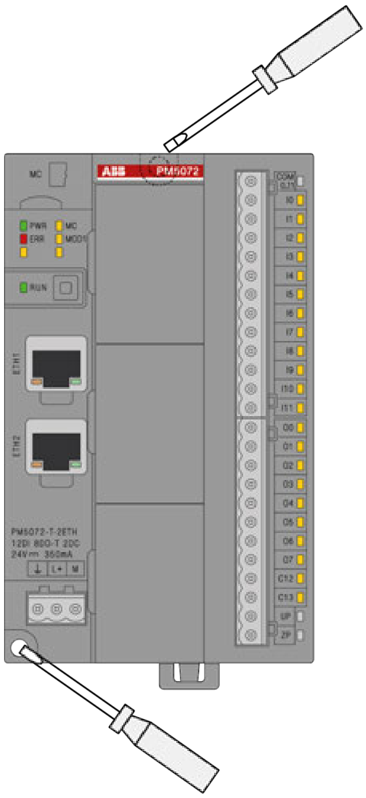
Do NOT use insulating washers!

One TA543 wall mounting accessory ✎ Chapter 2.5.5.5 "TA543 - Screw mounting accessory" on page 969 is needed per processor module.

1. Snap in the TA543 at the back side of the processor module.



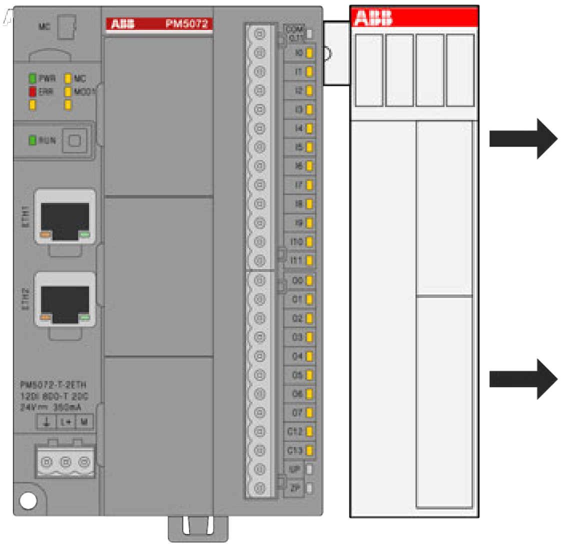
2. Fasten the processor module with two screws (max. diameter: 4 mm) to the metal plate.



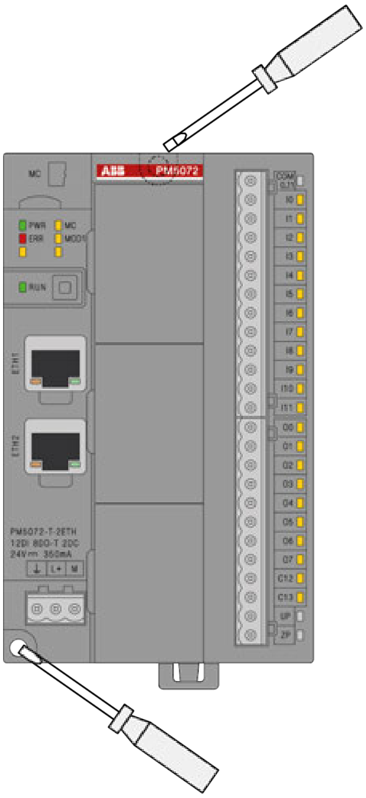
> *See hardware description of PM50xx* *Chapter 1.3.1.1 “PM50xx” on page 14* *for connection.*

2.5.3.1.4 Demounting a processor module mounted on a metal plate

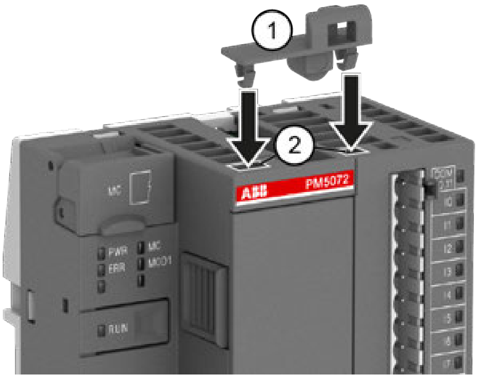
1. Remove I/O modules if connected.



2. Remove the 2 screws.



2.5.3.1.5 Mounting of TA5301-CFA



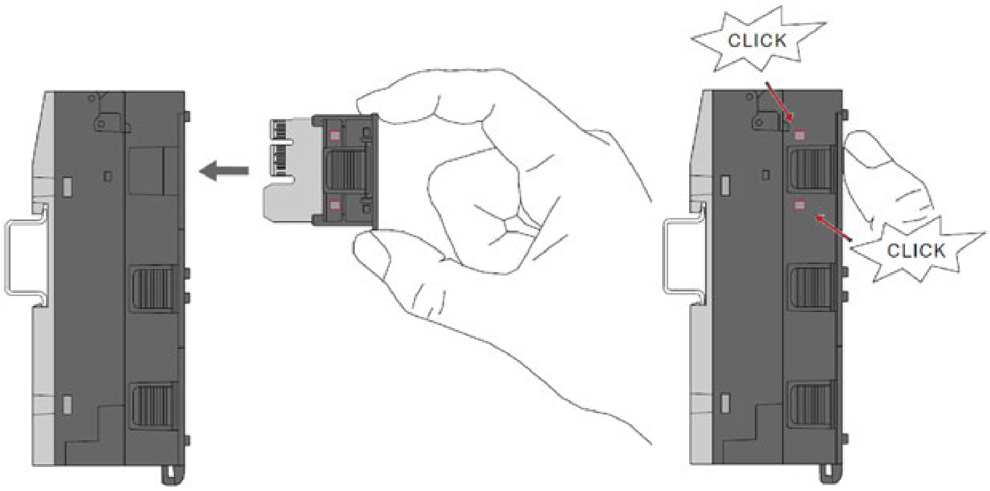
1 TA5301-CFA cable fixing accessory
2 2 openings on the PM50x2 processor module

▷ Insert the TA5301-CFA cable fixing accessory into the two openings on the PM50x2 processor module marked white in the figure.

2.5.3.2 Mounting and demounting option boards

2.5.3.2.1 Inserting the option board

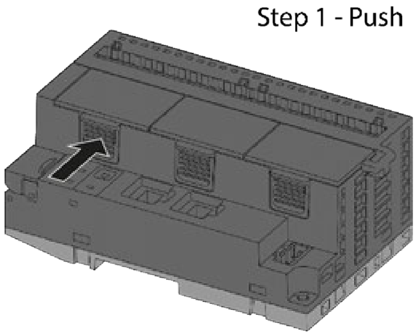
After mounting the PM50x2 processor module on the DIN rail, mount the option board.

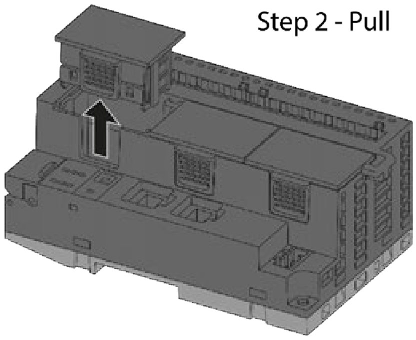


▷ Press the option board TA51xx (or TA5300-CVR) into the slot of the processor module PM50x2 until it locks in place.

The option board must click into the slot of the processor module.

2.5.3.2.2 Removing the option board





1. Push the option board on the side to release the lock.
2. At the same time, pull the option board out of the slot.

> **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.

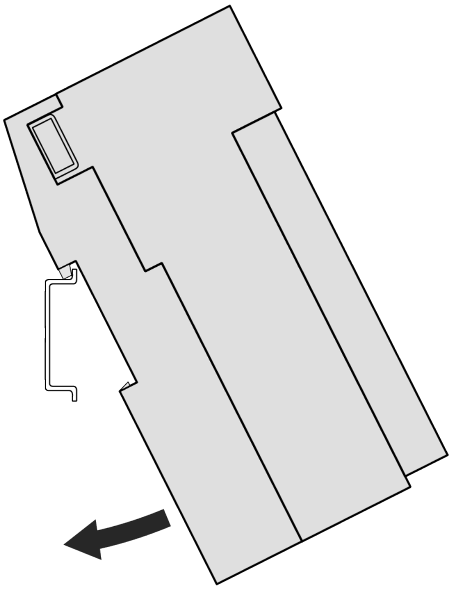
2.5.3.3 Mounting and demounting of S500-eCo I/O modules

S500-eCo I/O modules can be mounted either on a DIN rail or with screws on a metal plate.

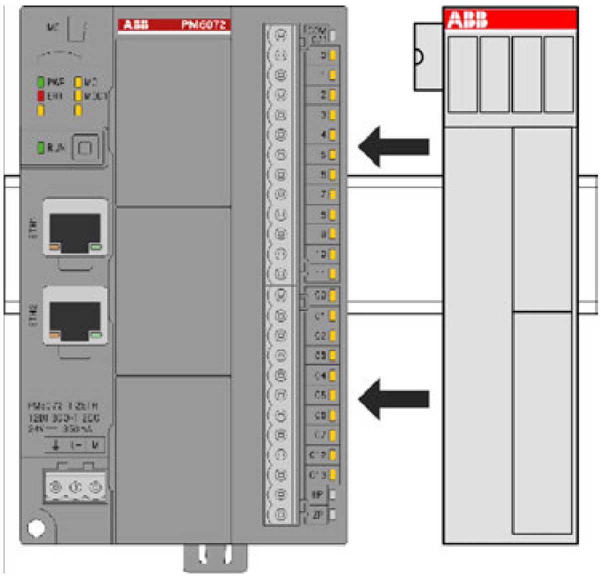
Mounting I/O modules on a DIN rail

> **NOTICE!**
> **Risk of function faults!**
> The S500-eCo I/O modules are grounded via the DIN rail.
>
> The DIN rail must be included into the earthing concept of the plant.
>
> Use only metal screws.

1. Mount I/O module at the top of the DIN rail, then snap it in below.

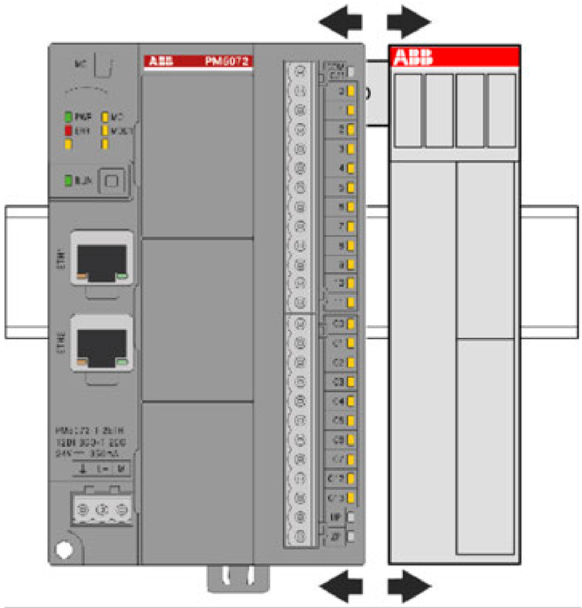


2. Attach I/O module by hand to an other module. The serial I/O bus is connected automatically.

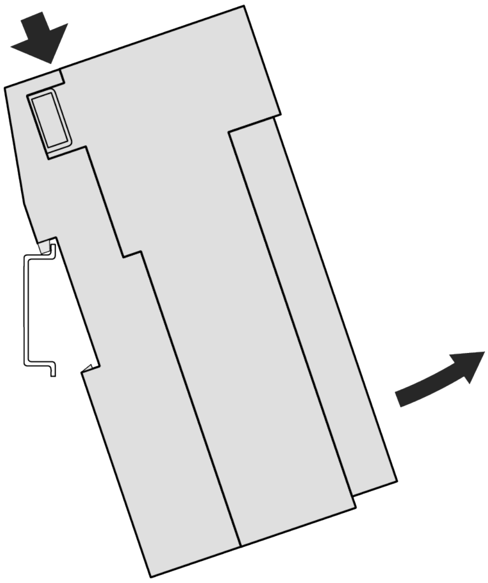


Demounting I/O modules mounted on a DIN rail

1. Remove I/O module by hand if connected.



2. While pressing down I/O module pull it away from DIN rail.

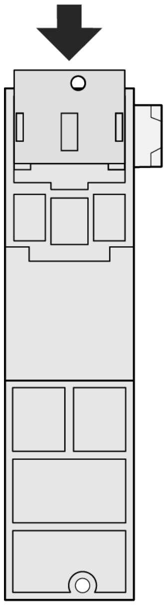


Mounting I/O modules on a metal plate

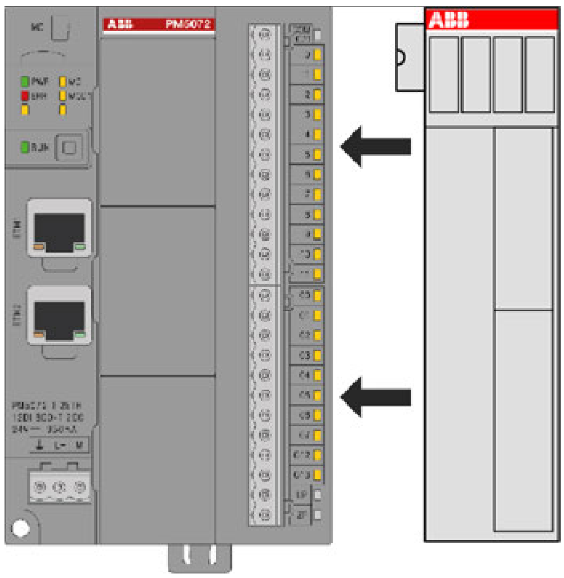
> **NOTICE!**
> **Risk of function faults!**
> Missing electrical contact by isolating screws or washers!
>
> Use metal screws on the metal plate.
>
> The metal plate must be included into the earthing concept of the plant.
>
> Do NOT use insulating washers!

> *One TA566 wall mounting accessory ♆ Chapter 2.5.5.6 “ TA566 - Wall mounting accessory” on page 970 is needed per S500-eCo I/O module.*

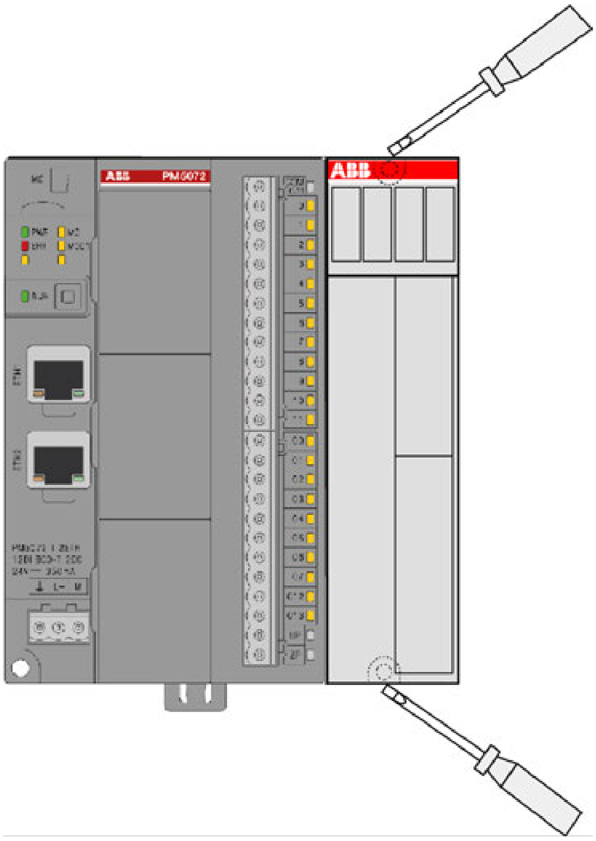
1. Snap in the TA566 at the back side of the I/O module.



2. Attach the I/O module by hand to an other module. The serial I/O bus is connected automatically.

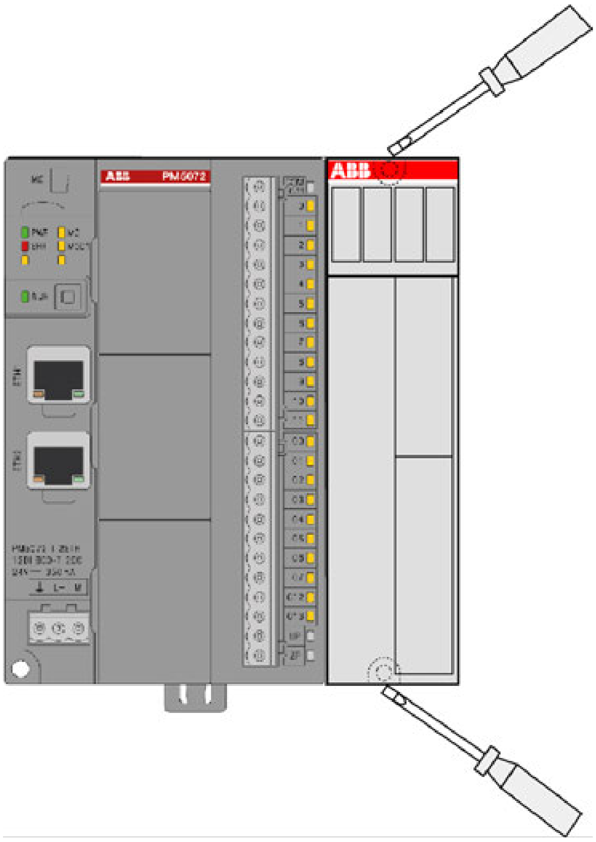


3. Fasten the I/O module with two screws (max. diameter: 4 mm) to the metal plate.

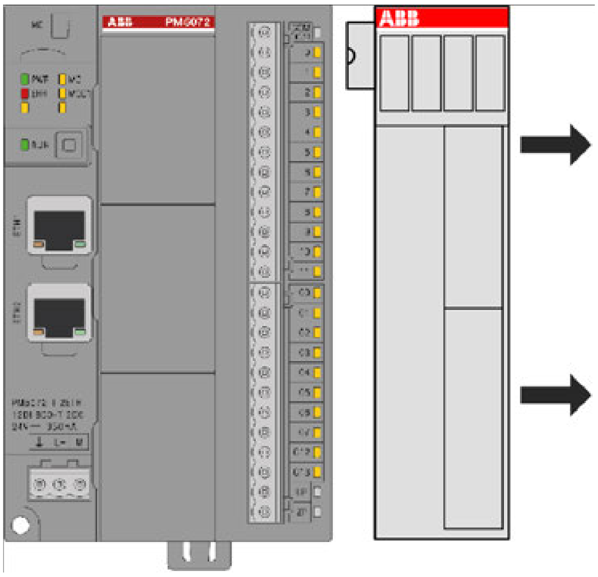


Demounting I/O modules mounted on a metal plate

1. Remove the 2 screws.



2. Remove the I/O module from the connected module by hand.



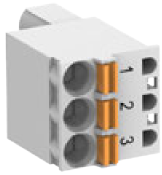
2.5.4 Connection and wiring

For detailed information such as technical data of your mounted devices (AC500 product family) refer to the hardware device specification of the appropriate device.

2.5.4.1 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 187: Removable terminal block for the supply voltage 24 V DC

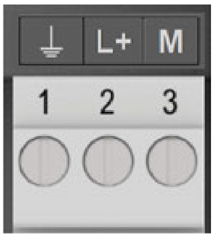
3-pin spring terminal block	3-pin screw terminal block
	

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)**	
Spring type	**Screw type**	**Spring type**	**Screw type**
TA5211-TSPF-B	TA5211-TSCL-B	TA5212-TSPF	TA5212-TSCL

Further information on the terminal blocks concerning power supply and onboard inputs/outputs are provided under pluggable connectors for screw and spring connection ↳ *Chapter 2.5.5.2 "TA52xx(-x) - Terminal block sets" on page 952*.

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

Faulty wiring on power supply terminals

> **CAUTION!**
> **Risk of damaging the AC500-eCo V3 processor module and the connected modules!**
> Voltages > 30 V DC might damage the processor module and the connected modules.
>
> Make sure that the supply voltage never exceeds 30 V DC.

2.5.4.2 Processor module 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 PM5072-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 .

Serial interface

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

- TA5141-RS232I (isolated)
  Chapter 1.3.1.2.6 “TA5141-RS232I - Option board for COMx serial communication” on page 75

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

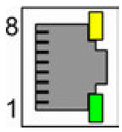
- TA5142-RS485I (isolated)
  Chapter 1.3.1.2.7 “TA5142-RS485I - Option board for COMx serial communication” on page 78
- TA5142-RS485 (non isolated)
  Chapter 1.3.1.2.8 “TA5142-RS485 - Option board for COMx serial communication” on page 84

2.5.4.2.1 Ethernet

> *Ethernet is also used for Modbus TCP connection.*

Ethernet interface

The Ethernet interface is carried out via a RJ45 jack. The pin assignment of the Ethernet interface:

Interface	Pin	Description	
	1	Tx+	Transmit Data +
	2	Tx-	Transmit Data -
	3	Rx+	Receive data +
	4	NC	Not connected
	5	NC	Not connected
	6	Rx-	Receive data -
	7	NC	Not connected

Interface	Pin	Description	
	8	NC	Not connected
	Shield	Cable shield	Functional earth

2.5.4.2.2 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 188: Description of the Modbus protocol

Parameter	Value
Supported standard	See *Serial interface*
Number of connection points	1 client Max. 1 server with RS-232 interface Max. 31 servers with RS-485
Protocol	Modbus
Operating mode	Client/server
Address	Server only
Data transmission control	CRC16
Data transmission speed	From 9,600 bits/s to 115,200 bits/s (see *Serial interface*)
Encoding	1 start bit 8 data bits 1 or 2 stop bits 1 parity bit (see *Serial interface*)
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.

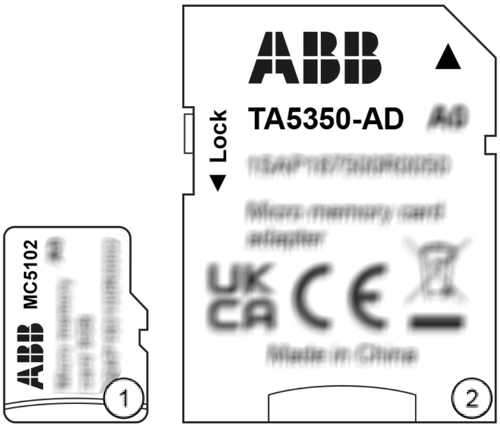
For further information on Modbus see chapter .

2.5.5 Handling of accessories

This section only describes accessories that are frequently used for system assembly, connection and construction. A description of all additional accessories that can be used to supplement AC500 system can be found in the Hardware PLC device description.

2.5.5.1 MC5102 - Micro memory card with micro memory card adapter

- Solid state flash memory storage



1 Micro memory card
2 TA5350-AD micro memory card adapter

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
MC502	x	x	x	x	x	-
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.

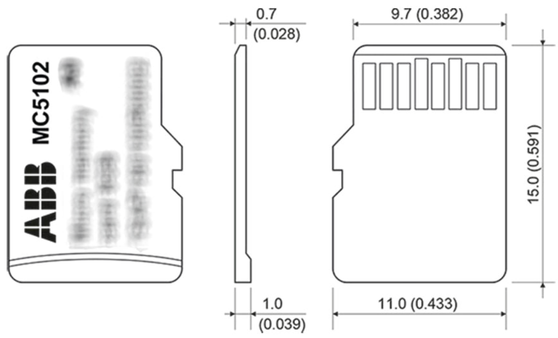
The micro memory card is used to store or backup application data and/or application programs or project source codes as well as to update the internal CPU firmware.

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.

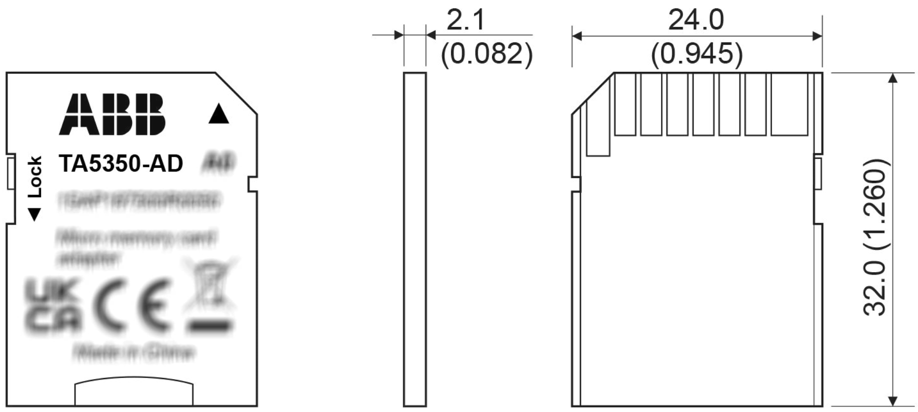
Dimensions

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

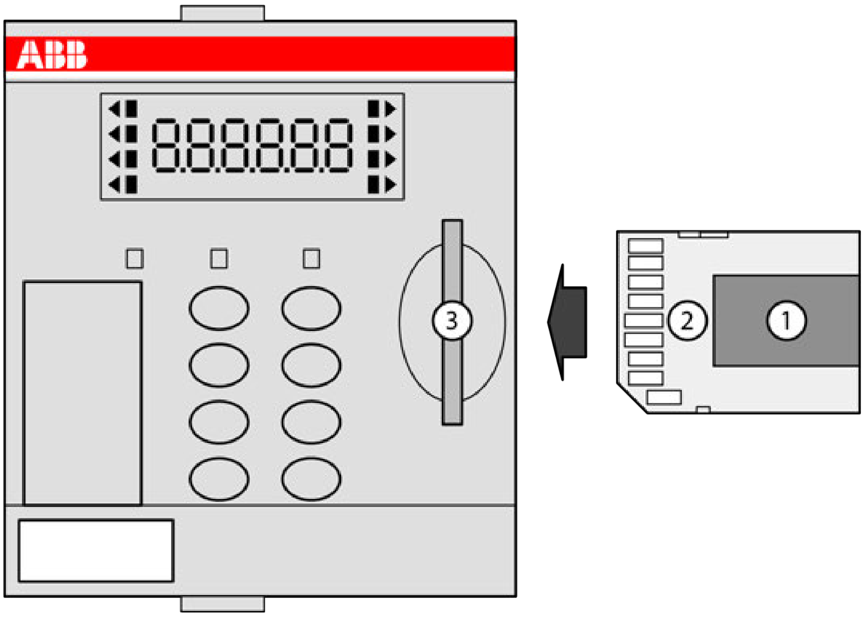
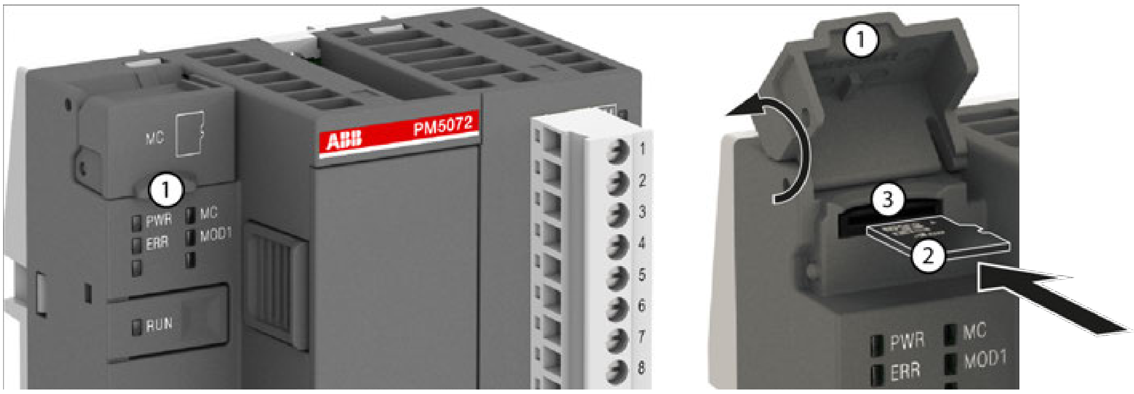


Fig. 179: Insert micro memory card into PM56xx

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!**
> **Removal of the micro memory card**
> Do not remove the micro memory card when it is working!
>
> AC500 V3: Remove the micro memory card with micro memory card adapter 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.
>
> Otherwise the micro memory card and/or files on it might get corrupted and/or normal PLC operation might be disturbed.

AC500 V3

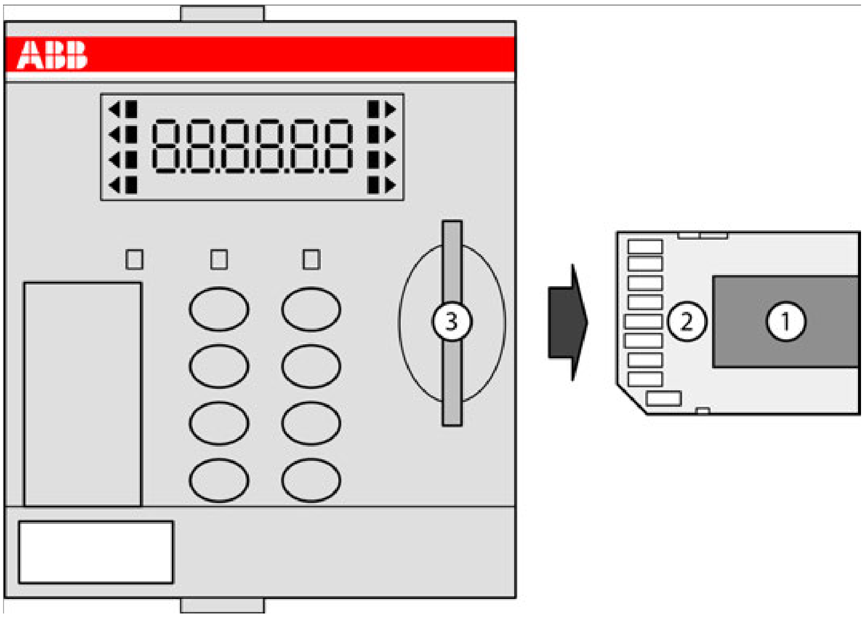
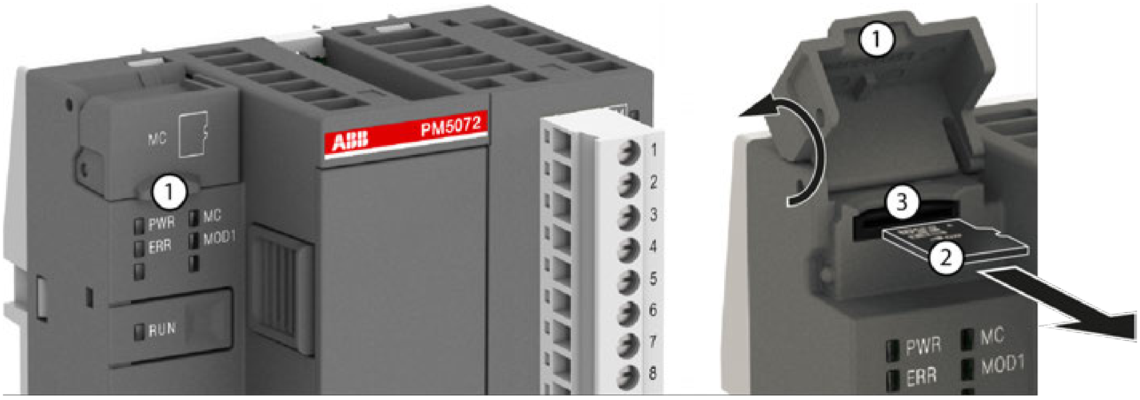


Fig. 180: Remove micro memory card from PM56xx

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



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.

Further information on using the micro memory card in AC500 PLCs is provided in the chapter .

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.*

2.5.5.2 TA52xx(-x) - Terminal block sets

Intended purpose

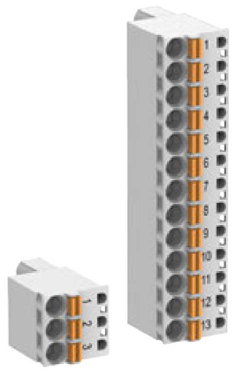
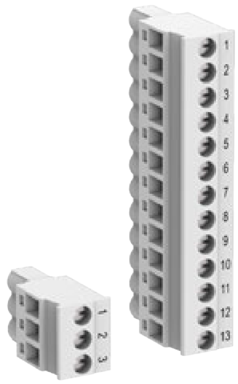
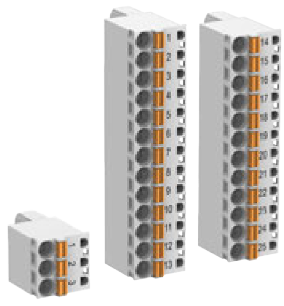
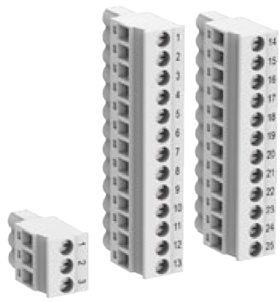
Removable terminal blocks are used for power supply and for I/O connectors on AC500-eCo V3 processor modules PM50x2.

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.

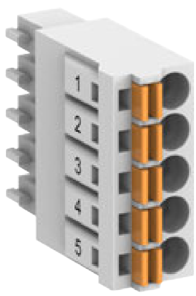
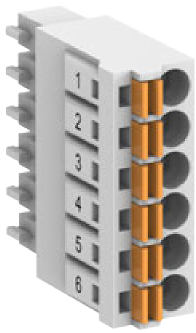
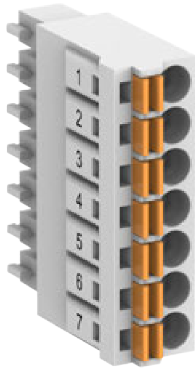
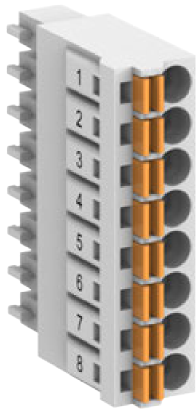
For the AC500-eCo V3 **Standard CPUs** and **Pro CPUs** a 3-pin terminal block for power supply, a 13-pin terminal block and a 12-pin terminal block for I/O connectors are used.

For all CPUs there is a screw and a spring variant available.

Basic CPU		**Standard and Pro CPUs**	
Spring type **TA5211-TSPF-B**	**Screw type** **TA5211-TSCL-B**	**Spring type** **TA5212-TSPF**	**Screw type** **TA5212-TSCL**
			

Various removable spring-type terminal blocks are available for option boards.

The following spare parts are available (depending on the number of pins).

Spring type			
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 processor module when using unapproved terminal blocks!
Only use terminal blocks approved by ABB to avoid injury and damage to the processor module.

Terminal block set for PM50x2
Processor modules PM50x2 CPU are not delivered with terminal blocks.

Screw type 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)*

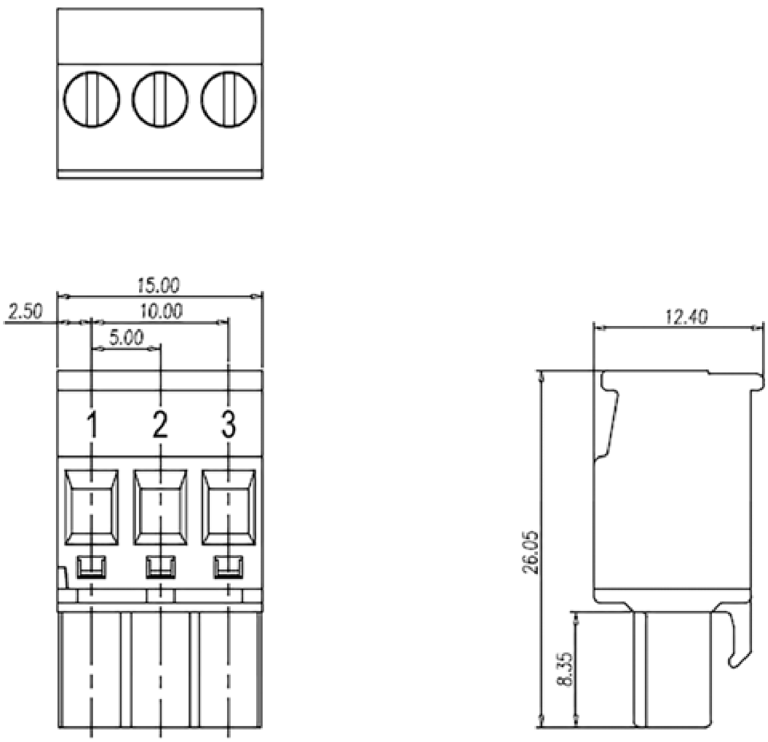
Spring type terminal block set:

– *TA5211-TSPF-B (1SAP187400R0002) for PM5012-x-ETH*
– *TA5212-TSPF (1SAP187400R0005) for PM5032-x-ETH, PM5052-x-ETH, PM5072-T-2ETH(W)*

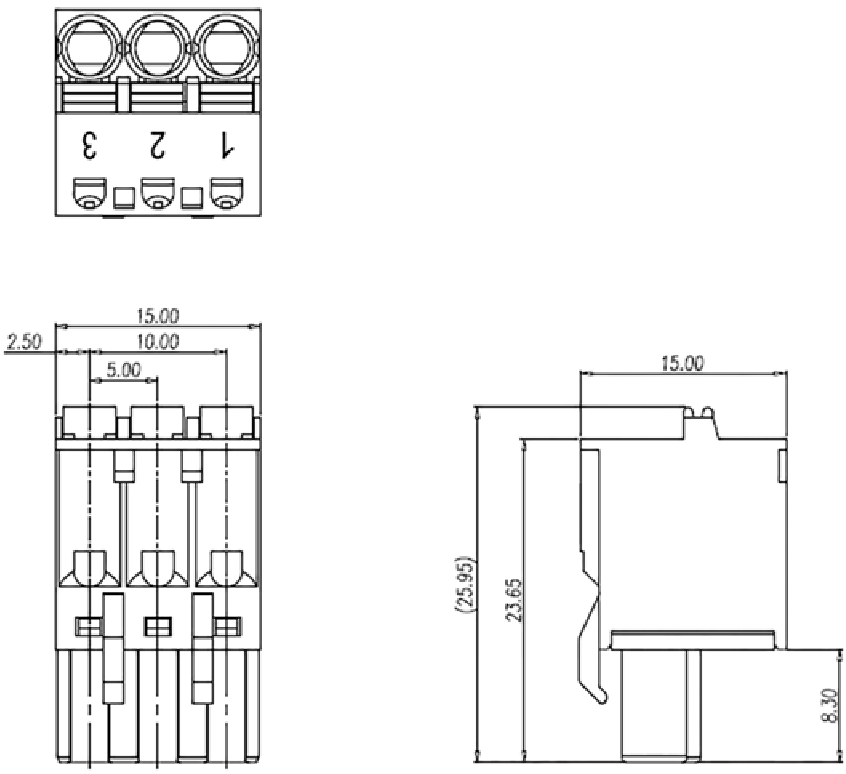
Dimensions

3-pin terminal block for power supply

Screw type

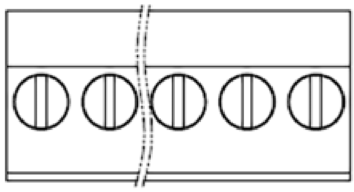


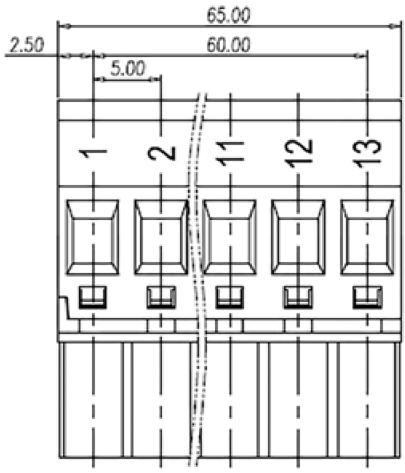
Spring type

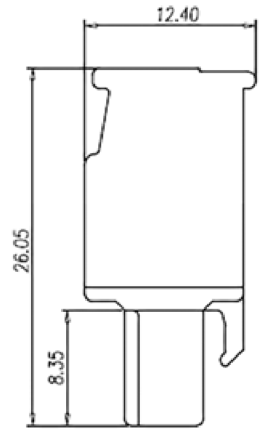


13-pin terminal block for I/O connectors

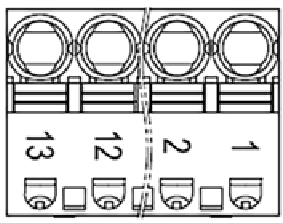
Screw type

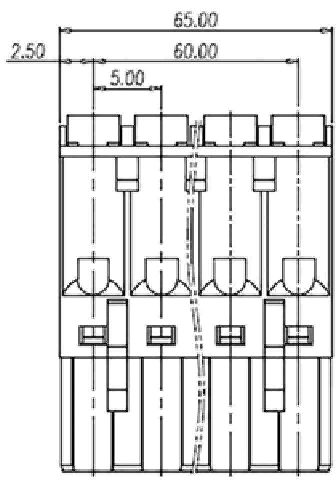


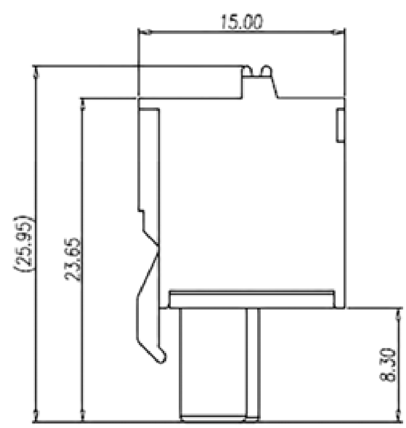




Spring type

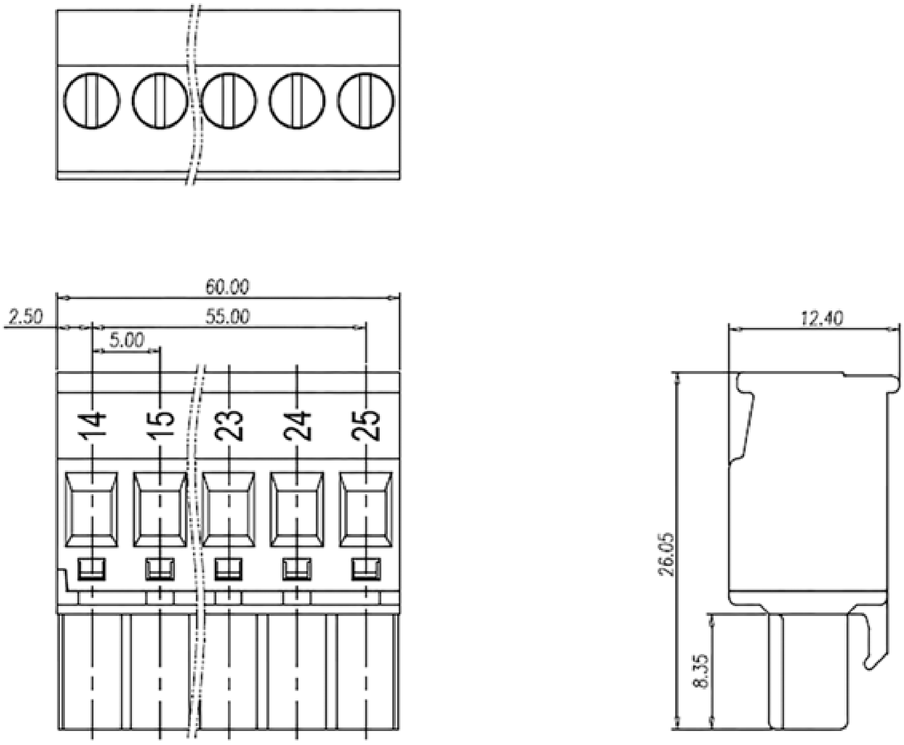




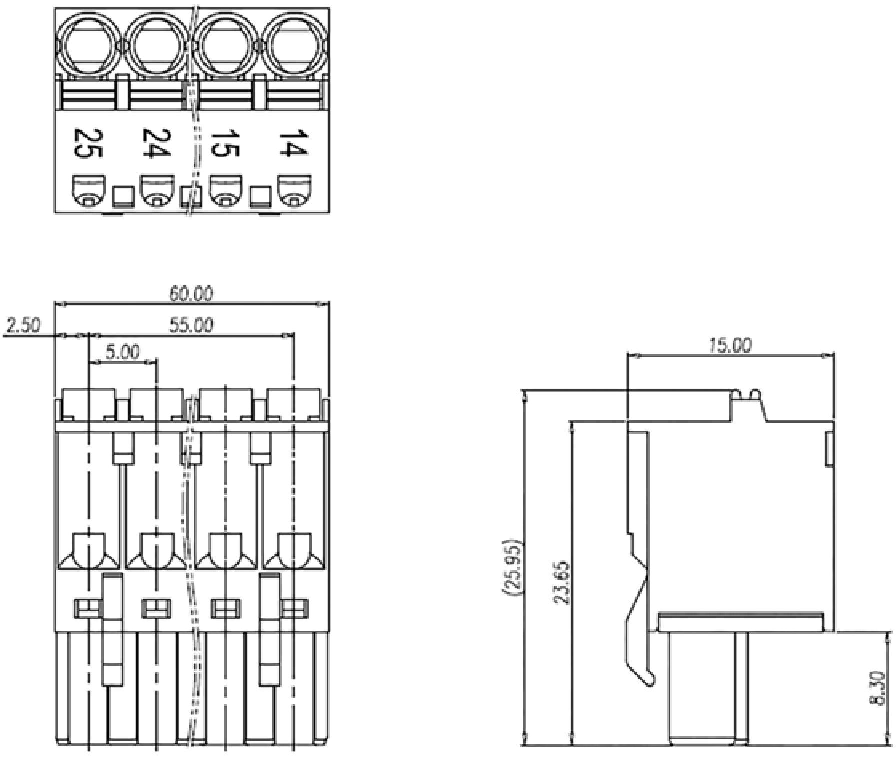


12-pin terminal block for I/O connectors

Screw type

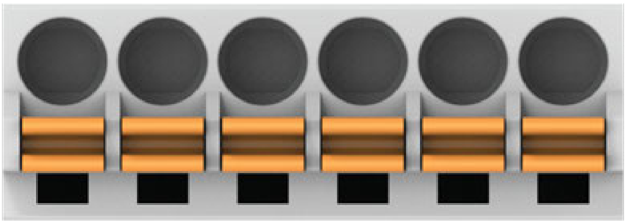


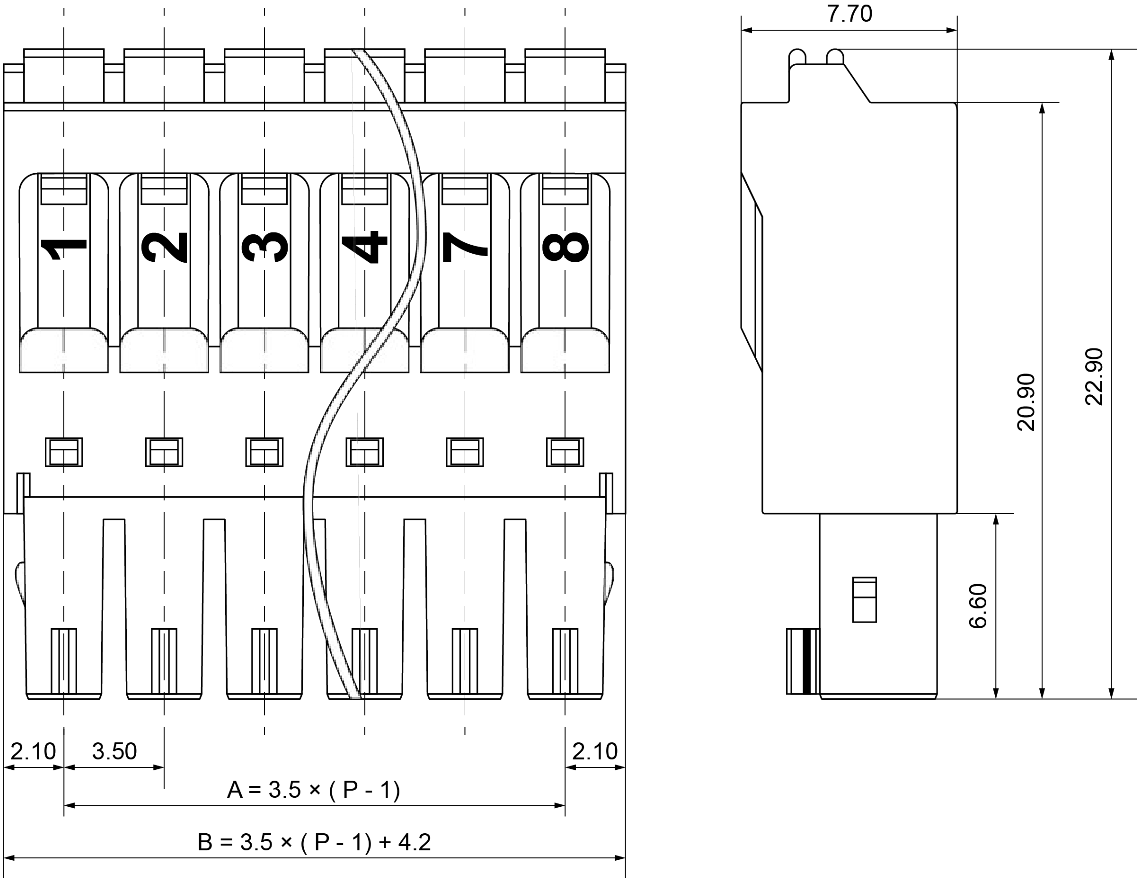
Spring type



x-PIN terminal blocks for option boards

> *Only these x-pin blocks are available for the option boards.*
>
> *TA5220-SPF**x**, with **x** = 5...8*

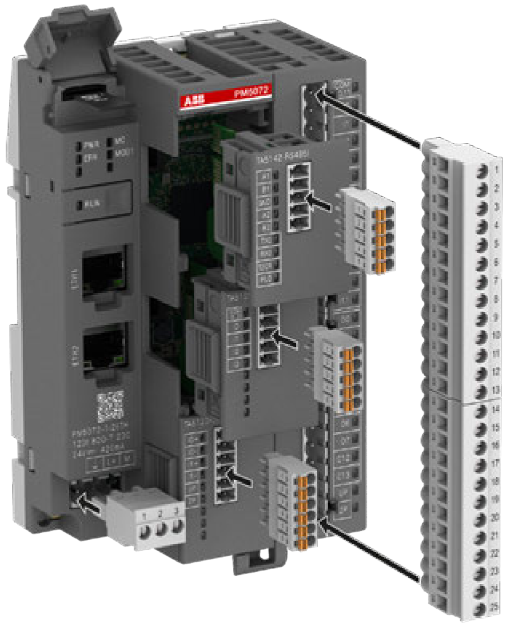




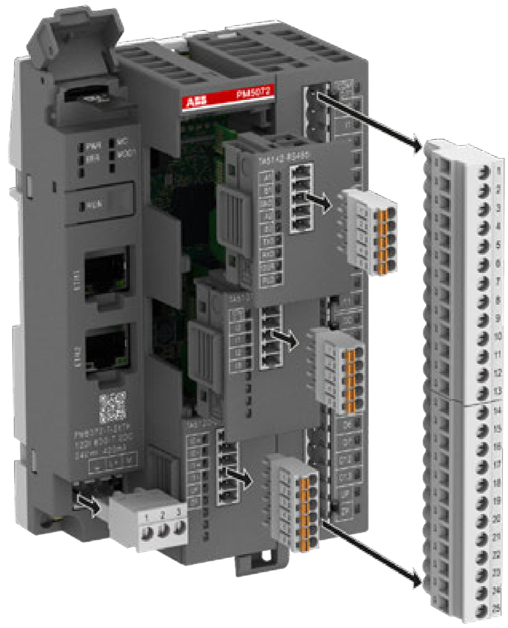
This results in these dimensions for the available spring terminal blocks.

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 189: Screw type 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 190: Spring type terminal block for power supply

Parameter		Value
Type		
	TA5211-TSPF-B	Removable 3-pin terminal block: spring front/cable front 5.00 mm pitch
	TA5212-TSPF	
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 191: Screw type 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 192: Spring type 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 mm^2...2.5 mm^2
	Flexible (copper)	0.5 mm^2...2.5 mm^2
Stripped conductor end		11 mm
Dimensions		
	13-pin terminal block	65 mm x 15 mm x 25.95 mm
	12-pin terminal block	60 mm x 15 mm x 25.95 mm
Weight		
	TA5211-TSPF-B	150 g (2 terminal blocks)
	TA5212-TSPF	200 g (3 terminal blocks)

Table 193: Spring type 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 mm^2...1.5 mm^2
	Flexible (copper)	0.2 mm^2...1.5 mm^2
Stripped conductor end		8 mm...10 mm
Dimensions		
	TA5220-SPF5	18.2 mm x 7.7 mm x 22.9 mm
	TA5220-SPF6	21.7 mm x 7.7 mm x 22.9 mm

Parameter		Value
	TA5220-SPF7	25.2 mm x 7.7 mm x 22.9 mm
	TA5220-SPF8	28.7 mm x 7.7 mm x 22.9 mm
Weight		
	TA5220-SPF5	150 g
	TA5220-SPF6	170 g
	TA5220-SPF7	180 g
	TA5220-SPF8	200 g

Ordering data

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

2.5.5.3 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).

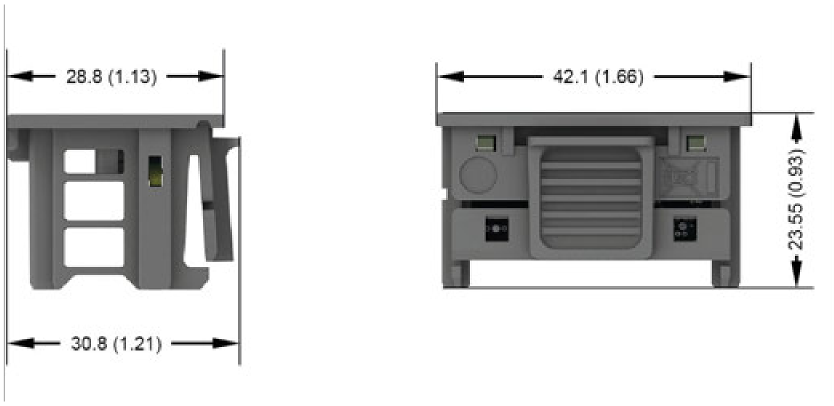
Never power up the CPU with uncovered option board slot, otherwise it may cause serious injury and/or damage the product.

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.

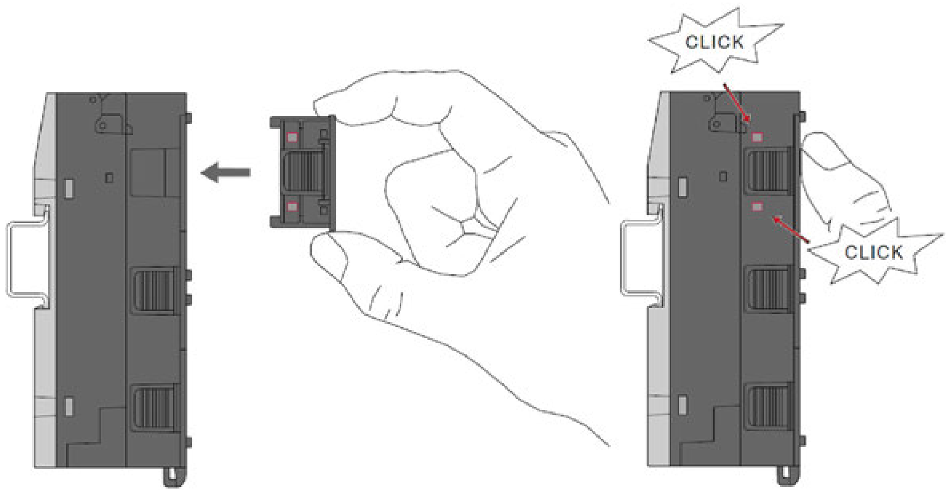
The TA5300-CVR option board slot covers are available as spare parts.

Dimensions



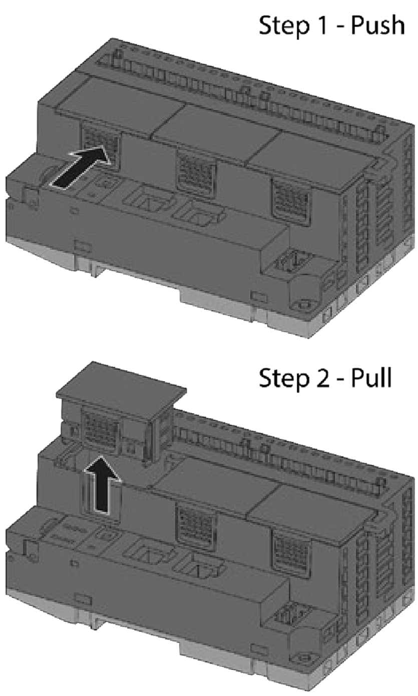
The dimensions are in mm and in brackets in inch.

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 2.5.1 “System data AC500-eCo V3” on page 925*

Only additional details are therefore documented below.

Parameter	Value
Weight	47 g
Dimensions	42.1 mm x 30.8 mm x 23.55

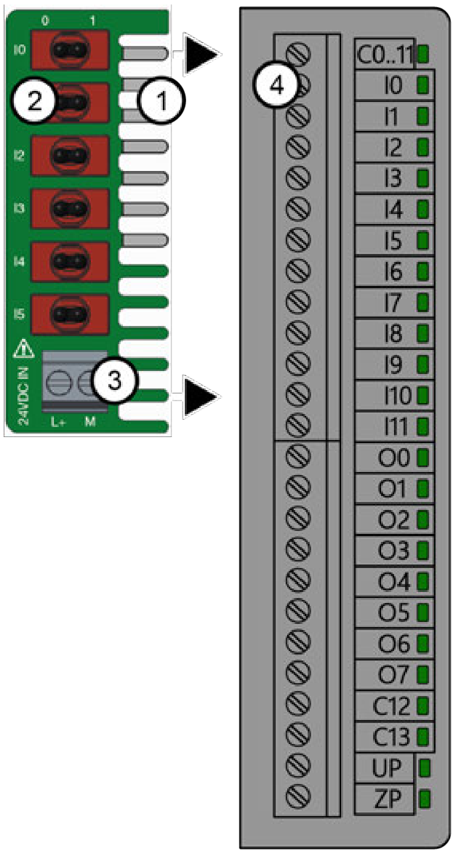
Ordering data

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.*

2.5.5.4 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:

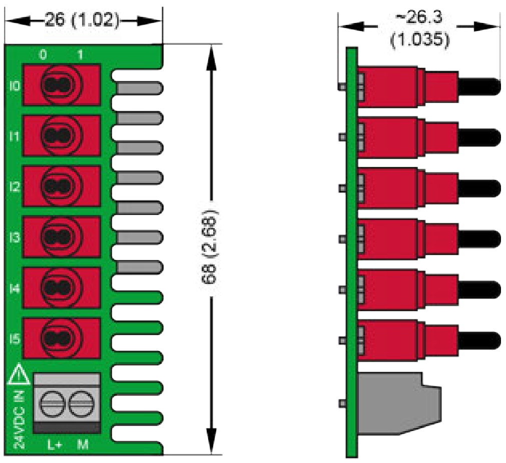
- *temperature*
- *air pressure*
- *humidity*
- *altitude*

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.

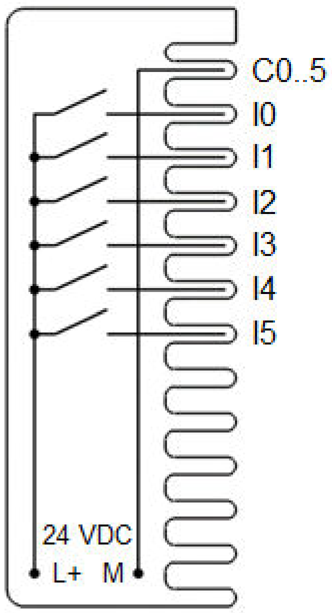
Dimensions



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.

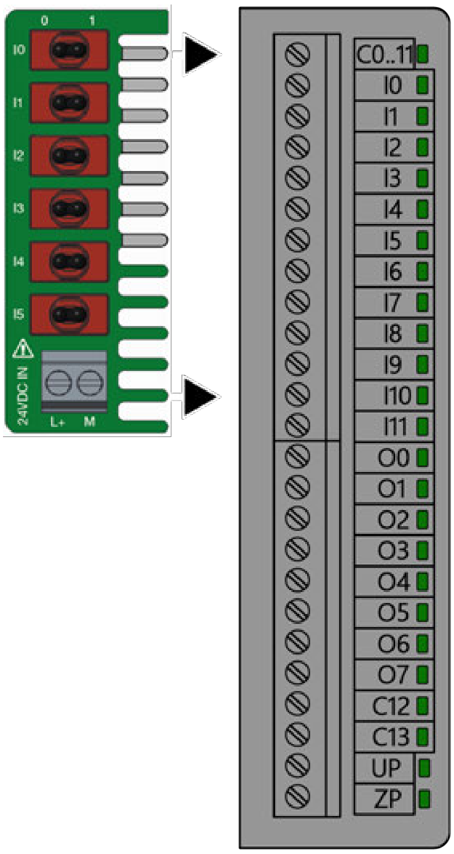
CAUTION!
Risk of damaging the input simulator and/or PLC modules!
The TA5400-SIM input simulator may only be used with AC500-eCo V3 processor modules PM50x2.

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). See PM50xx *"Pin assignment" on page 944*.

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 2.5.1 "System data AC500-eCo V3" on page 925*

Only additional details are therefore documented below.

Table 194: 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 %
	Protection against reversed voltage	Yes
Galvanic isolation		Yes (on processor module PM50xx)
Isolated Groups		1 (6 channels per group)
Weight		18 g
Mounting position		Horizontal or vertical

Table 195: Technical data of the inputs

Parameter	Value
Number of channels per module	6 digital input channels (+24 V DC)
Distribution of the channels into groups	1 (6 channels per group)
Connections of channels I0 to I5	Terminals 2...7
Reference potential for the channels I0 to I5	Terminal 1 (negative pole of the process supply voltage, signal name C0...5)
Input current per active channel (at input voltage +24 V DC) The current is given through the used processor module.	Typ. 5 mA
Inrush current per active channel The current is given through the used processor module.	Typ. 5 mA

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 187 600 R0001	TA5400-SIM, input simulator for PM50x2	Active

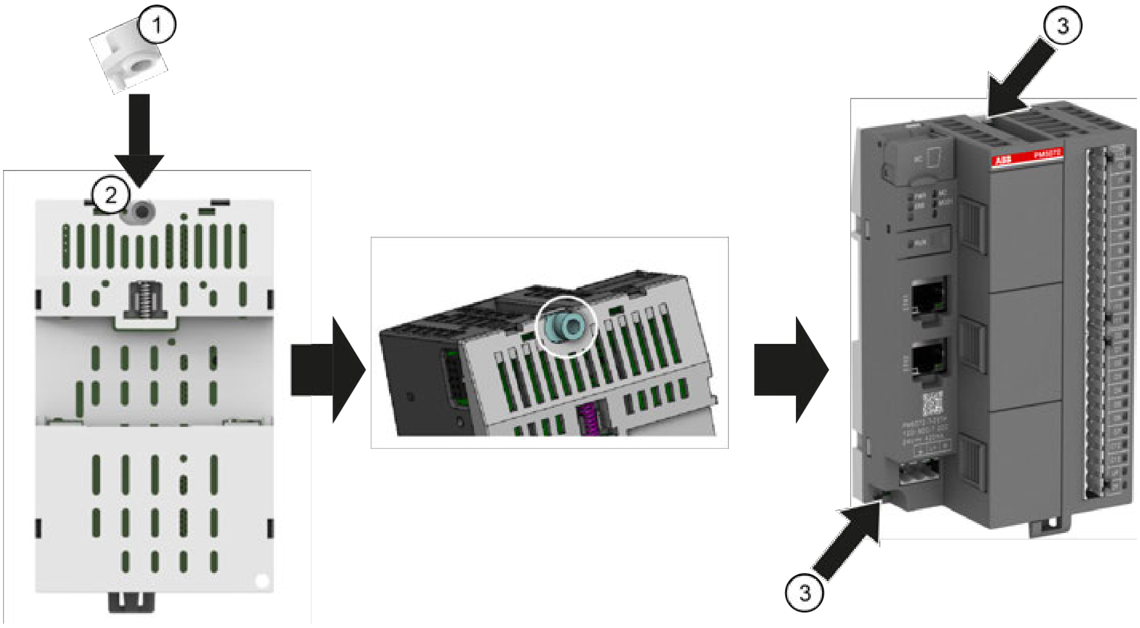
**) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.*

2.5.5.5 TA543 - Screw mounting accessory

Intended purpose The TA543 screw mounting accessory is used for mounting the processor module PM50xx without DIN rail.

Handling instruction

TA543 must be snapped on the backside of PM50xx *Chapter 2.5.3.1.3 “Mounting a processor module on a metal plate” on page 935*.



1 Screw mounting accessory TA543
2 Slot for screw mounting accessory TA543
3 2 holes for screw mounting

Technical data

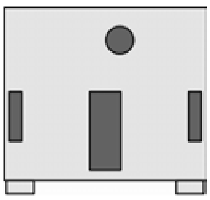
Parameter	Value
Weight	5 g
Dimensions	12 mm x 8.5 mm x 10 mm

Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 182 800 R0001	TA543, screw mounting accessory for PM50x2	Active

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

2.5.5.6 TA566 - Wall mounting accessory



Intended purpose

The TA566 wall mounting accessory is used for mounting S500-eCo I/O modules without DIN rail.

Handling instruction

The TA566 is snapped into the back side of the device's housing *“Mounting I/O modules on a metal plate” on page 940*.

Technical data

Parameter	Value
Weight	5 g
Dimensions	29 mm x 28 mm x 5 mm

Ordering data

Part no.	Description	Product life cycle phase *)
1TNE 968 901 R3107	TA566, wall mounting accessory, 100 pieces	Active

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

2.6 AC500 (Standard)

2.6.1 System data AC500

2.6.1.1 Environmental conditions

Table 196: 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!
Exceeding the maximum power supply voltage for process or supply voltages could lead to unrecoverable damage of the system. The system might be destroyed.

> **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
Ingress protection		IP20

2.6.1.2 Creepage distances and clearances

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

2.6.1.3 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

Parameter	Value	
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
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
	Not applicable	Not applicable
Ethernet	350 V	AC 2 s

According to IEC 61010-2-201

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

Table 197: 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

2.6.1.4 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.

2.6.1.5 Electromagnetic compatibility

Table 198: Range of use

Parameter	Value
Industrial applications	Yes
Domestic applications	No

Table 199: 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 switchgear 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 200: 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 201: Immunity against fast transient interference voltages (burst), according to IEC 61000-4-4, zone B, criterion B

Parameter	Value
Supply voltage units (DC)	2 kV
Supply voltage units (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, not for PM55x and PM56x)	1 kV
Ethernet	1 kV
I/O supply (DC-out)	1 kV

Table 202: 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.

2.6.1.6 Mechanical data

Parameter	Value
Mounting	Horizontal
Degree of protection	IP 20
Housing	Classification V-2 according to UL 94

Parameter	Value
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)
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

2.6.1.7 Approvals and certifications

Information on approvals and certificates can be found in the corresponding chapter of the *Main catalog, PLC Automation*.

2.6.2 Mechanical dimensions

2.6.2.1 Switchgear cabinet assembly

Information on EMC-conforming assembly and construction is provided within the overall functions section *↳ Chapter 2.4.4 “EMC-conforming assembly and construction” on page 918.*

PLC enclosure

NOTICE!

PLC damage due to wrong enclosures

Due to their construction (degree of protection IP 20 according to EN 60529) and their connection technology, the devices are suitable only for operation in enclosed switchgear cabinets.

To protect PLCs against:

- unauthorized access,
- dusting and pollution,
- moisture and wetness and
- mechanical damage,

switchgear cabinet IP54 for common dry factory floor environment is suitable.

Maintain spacing from:

- enclosure walls
- wireways
- adjacent equipment

Allow a minimum of 20 mm clearance on all sides. This provides ventilation and galvanic isolation.

It is recommended to mount the modules on an grounded mounting plate, or an grounded DIN rail, independent of the mounting location.

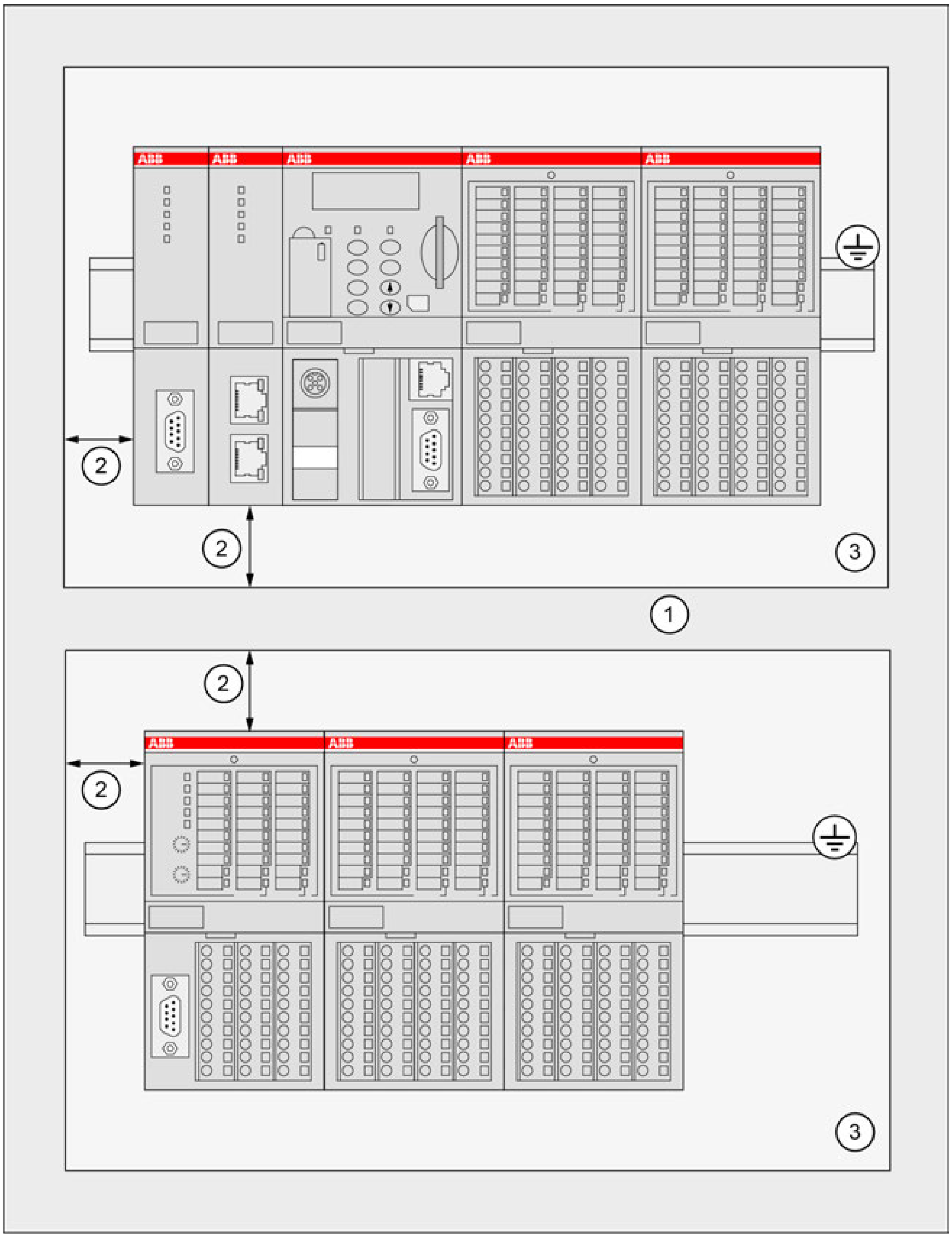


Fig. 181: Installation of AC500/S500 modules in a switchgear cabinet

1 Cable duct
2 Distance from cable duct ≥20 mm
3 Mounting plate, grounded

NOTICE!

Horizontal mounting is highly recommended.

Vertical mounting is possible, however, derating consideration should be made to avoid problems with poor air circulation and overheating (see *Chapter 2.6.1.1 “Environmental conditions” on page 971*).

When vertically mounted, always place an end-stop terminal block (e.g. type BADL, P/N: 1SNA399903R0200) on the bottom and on the top of the modules to properly secure the modules.

With high vibration applications and horizontal mounting, we also recommend to place end-stop terminals at the right and left side of the device to properly secure the modules, e.g. type BADL, P/N: 1SNA399903R0200.

2.6.2.2 Mechanical dimensions AC500

Dimensions: terminal bases

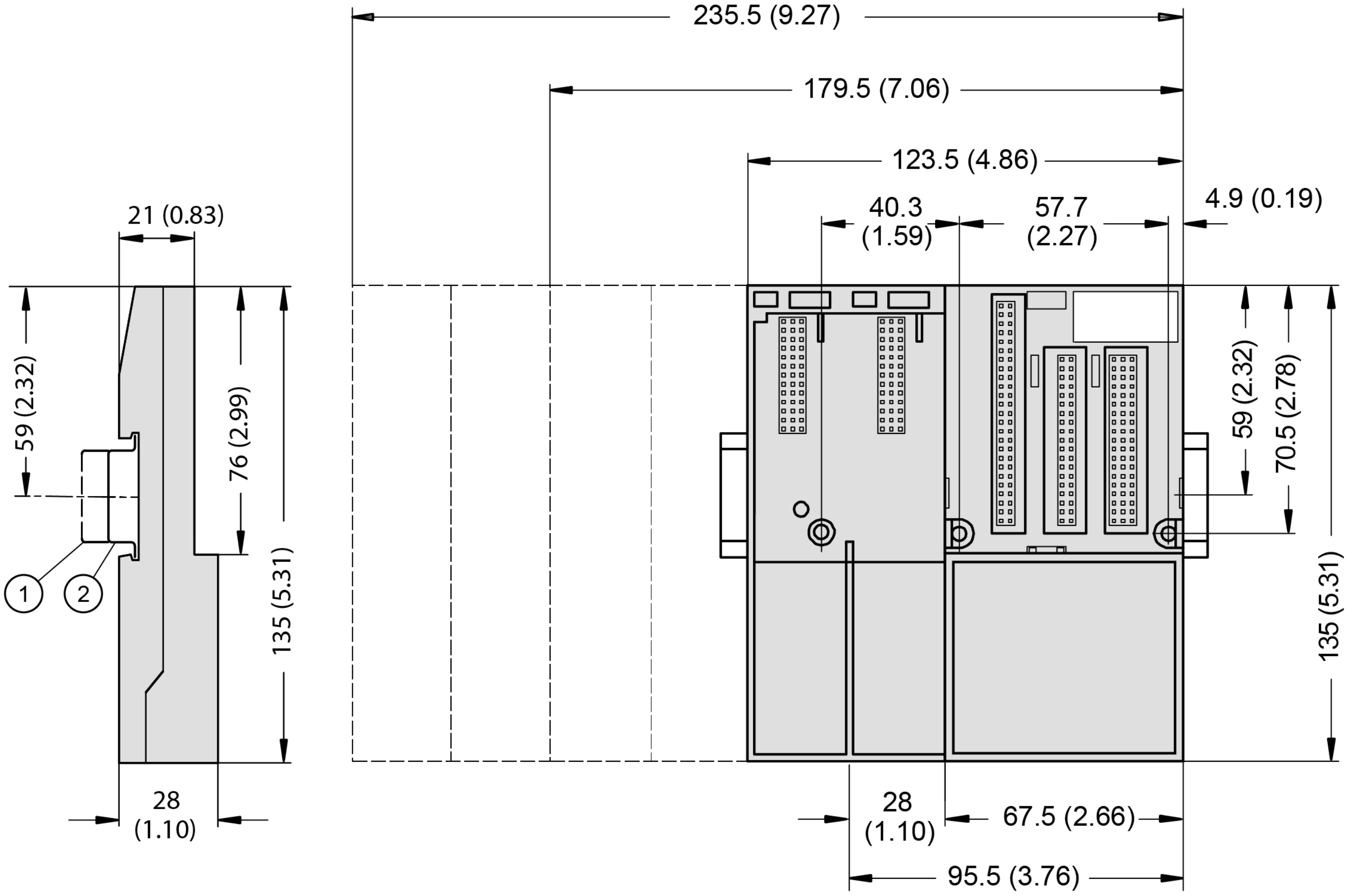


Fig. 182: Terminal bases, side view and front view

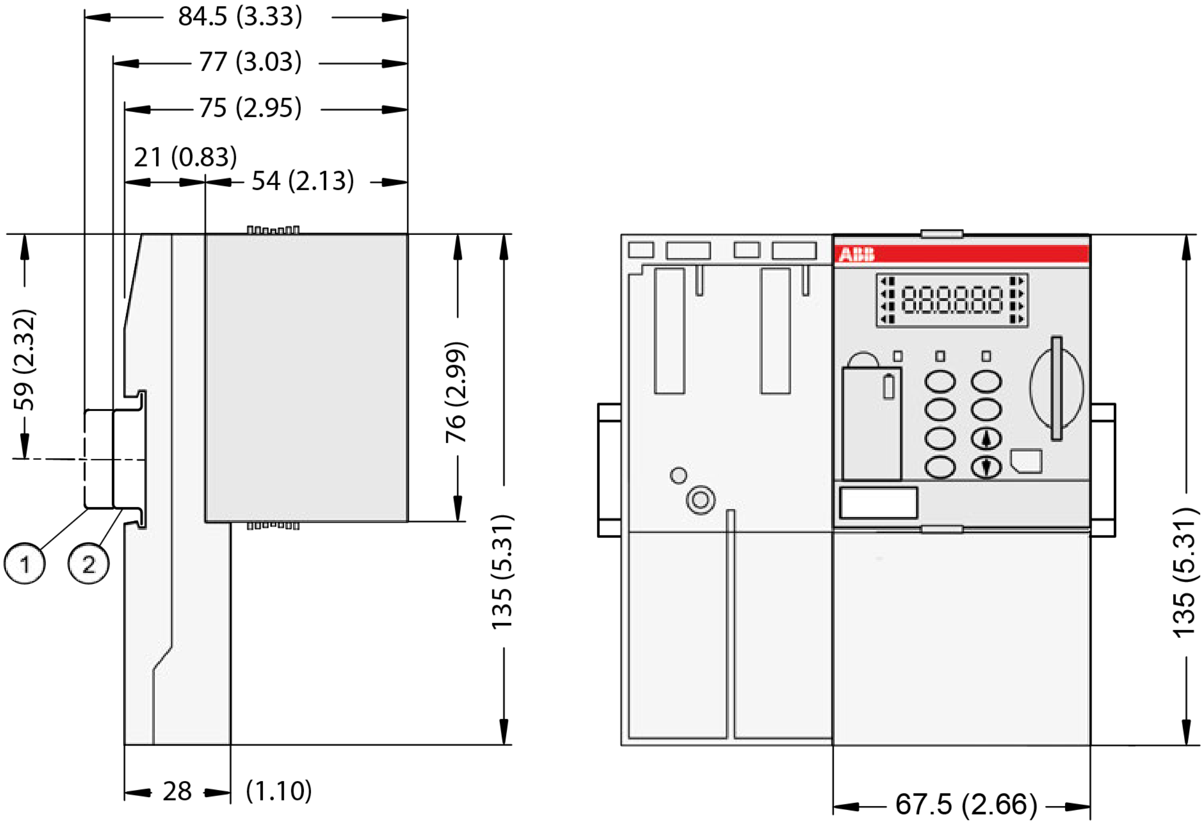


Fig. 183: Terminal bases with processor modules, side view and front view

2.6.2.3 Mechanical dimensions S500

Dimensions:
Terminal units

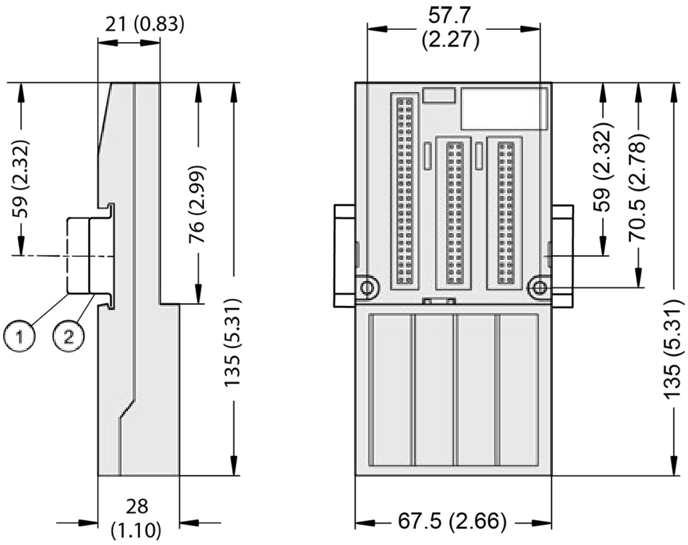


Fig. 184: Terminal units, side view and front view

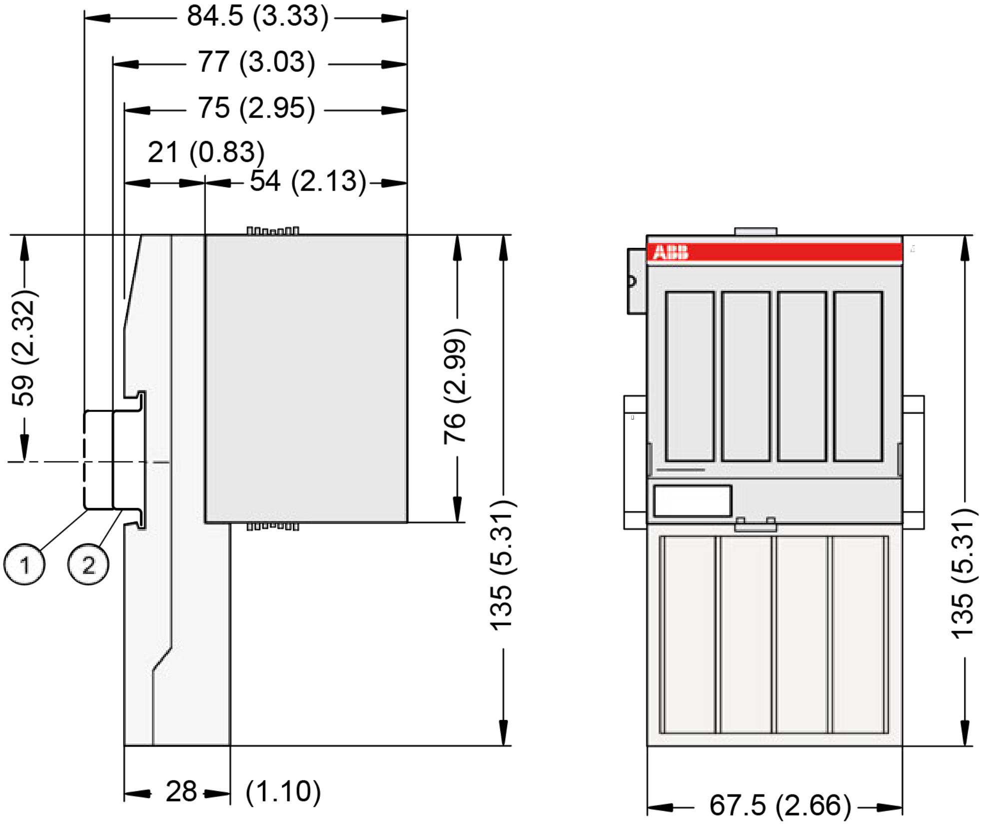


Fig. 185: Terminal units and S500 modules, side view and front view

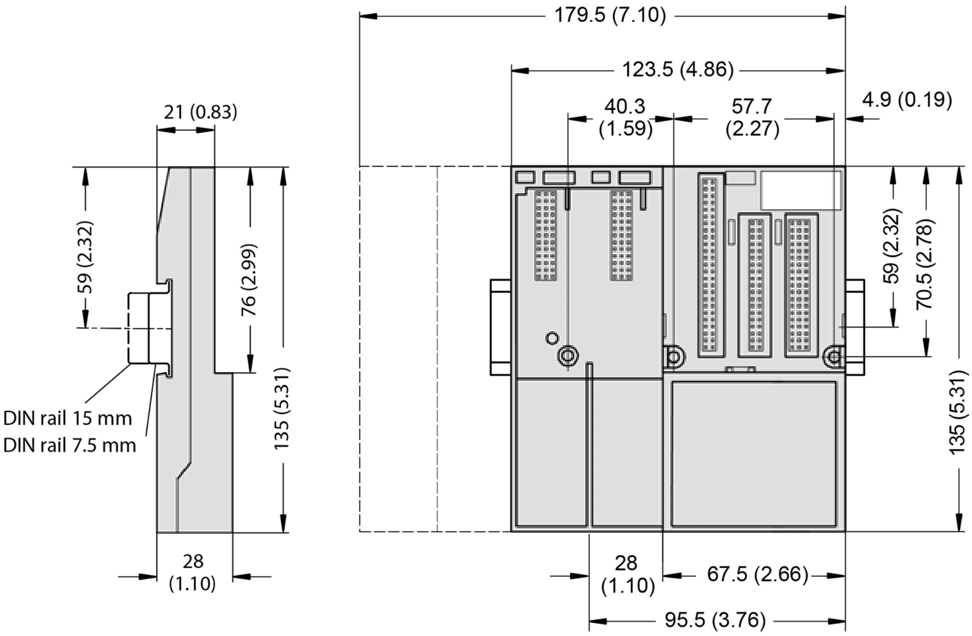


Fig. 186: Terminal base (for comparison)

All dimensions are in mm (in.). Hole spacing tolerance: ±0.4 mm (0.016 in.)

2.6.3 Mounting and demounting

The control system is designed to be mounted to a well-grounded mounting surface such as a metal panel. Additional grounding connections from the mounting tabs or DIN rail (if used), are not required unless the mounting surface cannot be grounded.

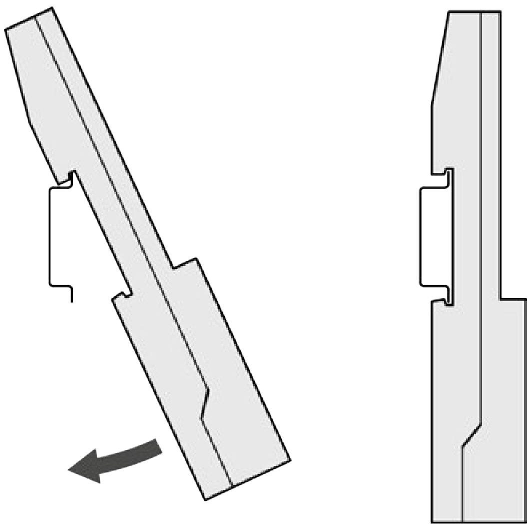
During panel or DIN rail mounting of all devices, be sure that all debris (metal chips, wire strands, etc.) is kept from falling into the controller. Debris that falls into the controller could cause damage while the controller is energized.

All devices are grounded through the DIN rail to chassis ground. Use zinc plated yellow-chromate stell DIN rail to assure proper grounding. The use of other DIN rail materials (e.g. aluminium, plastic, etc.) that can corrode, oxidize, or are poor conductors, can result in improper or intermittent grounding.

2.6.3.1 Mounting/Demounting terminal bases and function module terminal bases

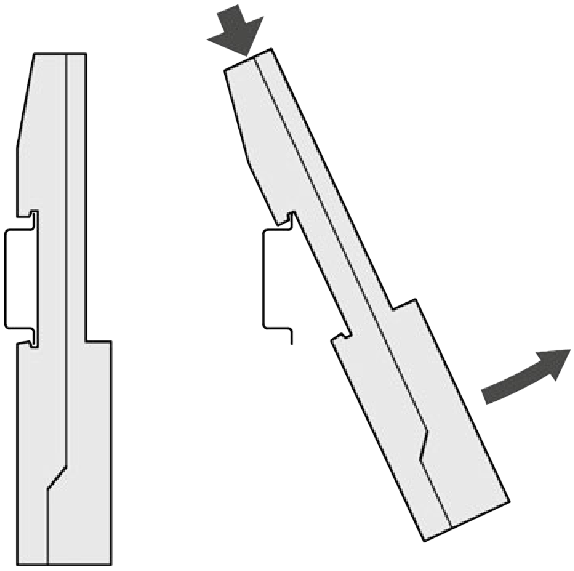
Demounting on DIN rail

1. Mount DIN rail 7.5 mm or 15 mm.
2. Mount the terminal base/function module terminal base:



⇨ The terminal base is put on the DIN rail above and then snapped-in below.

3. The demounting is carried out in a reversed order.



Mounting with screws

If the terminal base should be mounted with screws, wall mounting accessories TA526 ⇘ *Chapter 2.6.5.5 “TA526 - Wall mounting accessory” on page 1018* must be inserted at the rear side first. These plastic parts prevent bending of the terminal base while screwing on. TB560x and TB561x need one TA526, TB562x, TB564x and TB566x need two TA526.

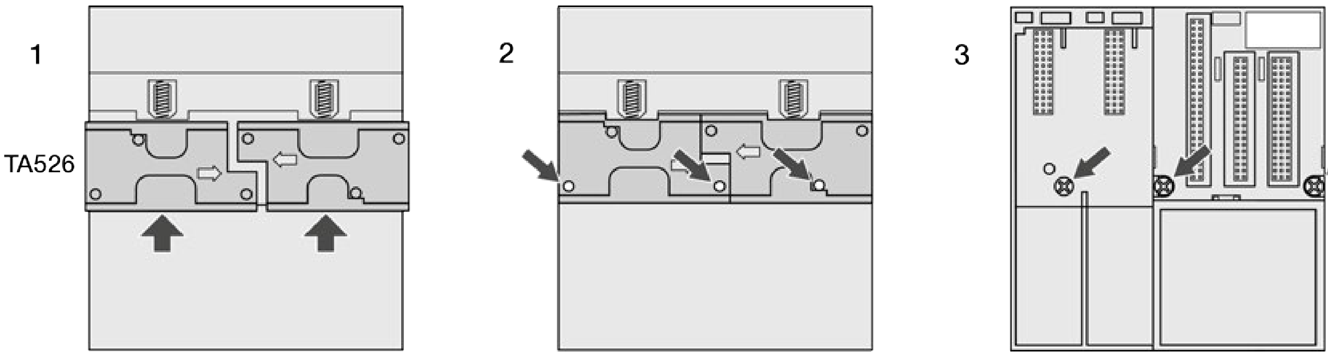


Fig. 187: Terminal bases, Fastening with screws

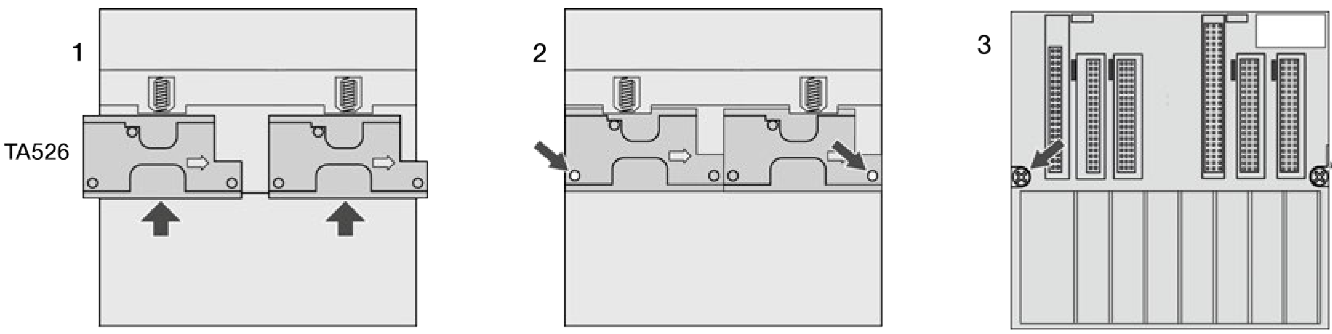


Fig. 188: Function module terminal bases, Fastening with screws

> *By wall mounting, the terminal base is grounded through the screws. It is necessary that*
>
> – *the screws have a conductive surface (e.g. steel zinc-plated or brass nickel-plated)*
> – *the mounting plate is grounded*
> – *the screws have a good electrical contact to the mounting plate*

Practical tip

The following procedure allows you to use the mounted modules as a template for drilling holes in the panel. Due to module mounting hole tolerance, it is important to follow these procedures:

1. On a clean work surface, mount no more than 3 modules (e.g. one terminal base and two terminal units).
2. Using the mounted modules as a template, carefully mark the center of all module-mounting holes on the panel.
3. Return the mounted modules to the clean work surface, including any previously mounted modules.
4. Drill and tap the mounting holes for the screws (M4 or #8 recommended).
5. Place the modules back on the panel and check for proper hole alignment.
6. Attach the modules to the panel using the mounting screws.

> *If mounting more modules, mount only the last one of this group and put the others aside. This reduces remounting time during drilling and tapping of the next group.*

7. Repeat the steps for all remaining modules.

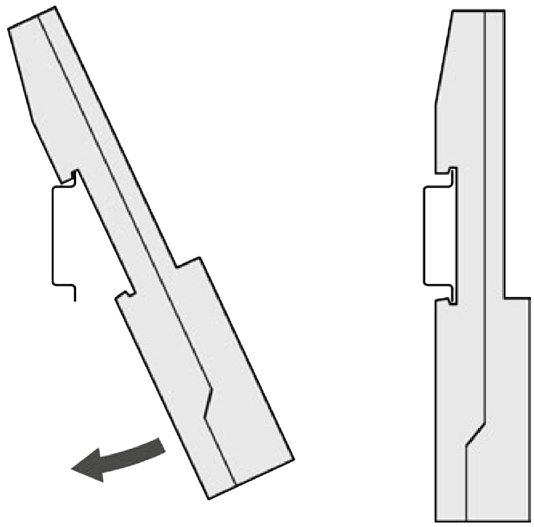
2.6.3.2 Mounting/Demounting the terminal unit

Mounting on DIN rail

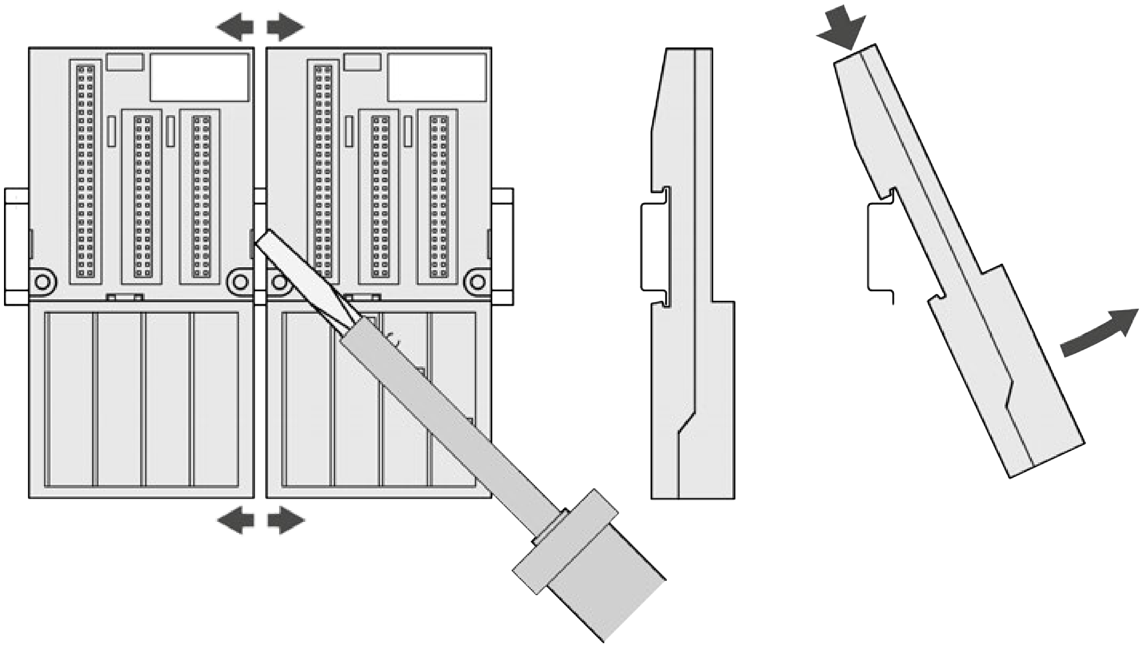
1. Mount DIN rail 7.5 mm or 15 mm.
2. Mount the terminal unit.

   The terminal unit is snapped into the DIN rail in the same way as the Terminal Base. Once secured to the DIN rail, slide the terminal unit to the left until it fully locks into place creating a solid mechanical and connection.

> *When attaching the devices, make sure the bus connectors are securely locked together to ensure proper connection. Max. 10 terminal units can be attached.*



3. Demounting: A screwdriver is inserted in the indicated place to separate the terminal units.



Mounting with screws

If the terminal unit should be mounted with screws, wall mounting accessories TA526 *Chapter 2.6.5.5 "TA526 - Wall mounting accessory" on page 1018* must be inserted at the rear side first. These plastic parts prevent bending of the Terminal Base while screwing on.

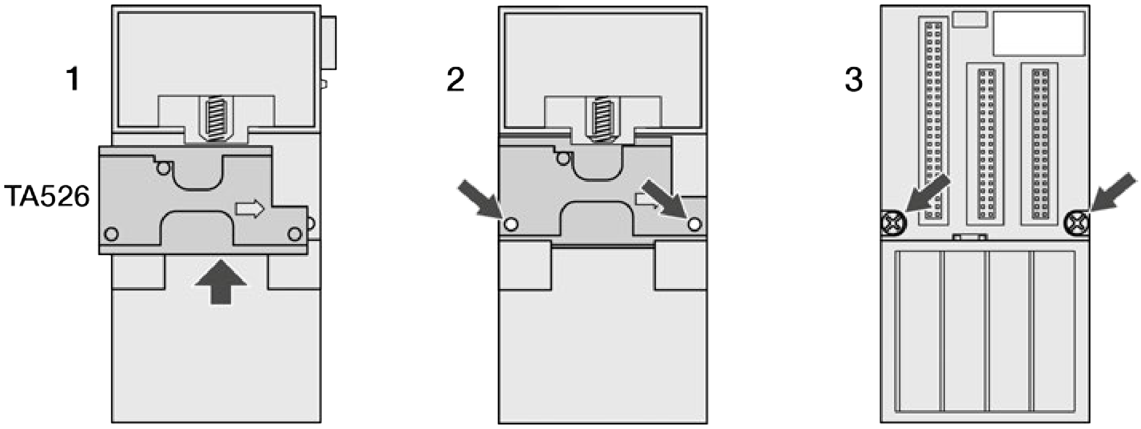


Fig. 189: Fastening with screws

By wall mounting, the terminal unit is grounded through the screws. It is necessary that

- *the screws have a conductive surface (e.g. steel zinc-plated or brass nickel-plated)*
- *the mounting plate is grounded*
- *the screws have a good electrical contact to the mounting plate*

Practical tip

The following procedure allows you to use the mounted modules as a template for drilling holes in the panel. Due to module mounting hole tolerance, it is important to follow these procedures:

1. On a clean work surface, mount no more than 3 modules (e.g. one terminal base and two terminal units).
2. Using the mounted modules as a template, carefully mark the center of all module-mounting holes on the panel.

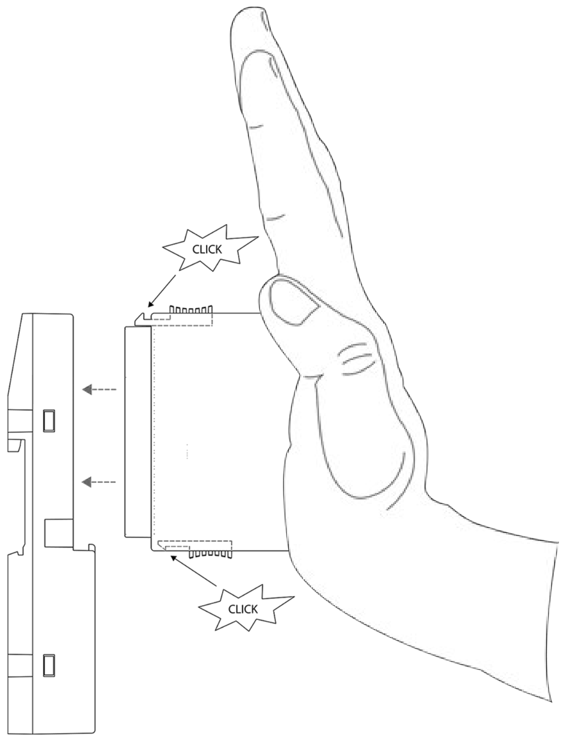
3. Return the mounted modules to the clean work surface, including any previously mounted modules.
4. Drill and tap the mounting holes for the screws (M4 or #8 recommended).
5. Place the modules back on the panel and check for proper hole alignment.
6. Attach the modules to the panel using the mounting screws.

> *If mounting more modules, mount only the last one of this group and put the others aside. This reduces remounting time during drilling and tapping of the next group.*

7. Repeat the steps for all remaining modules.

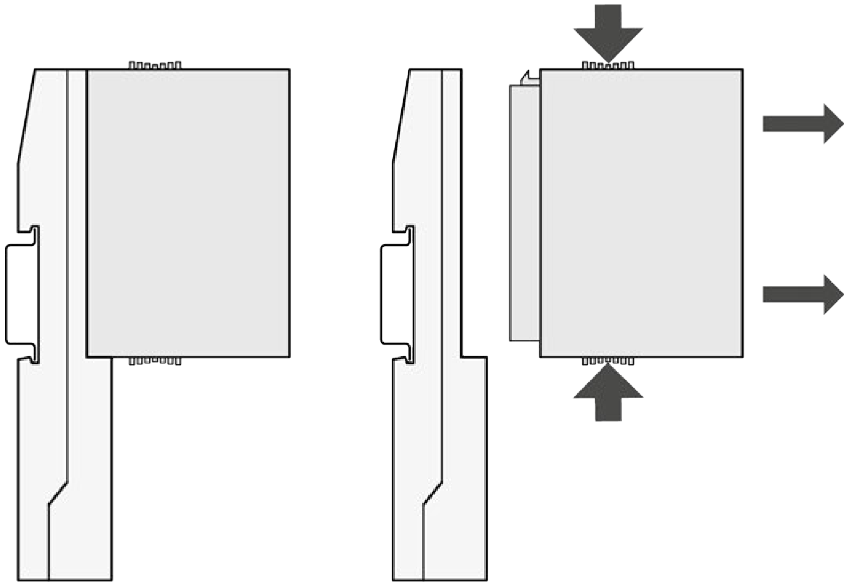
2.6.3.3 Mounting processor modules PM57x, PM58x, PM59x and PM56xx

1. After mounting the Terminal Base on the DIN rail, mount the processor module.



2. Press the processor module into the Terminal Base until it locks in place.

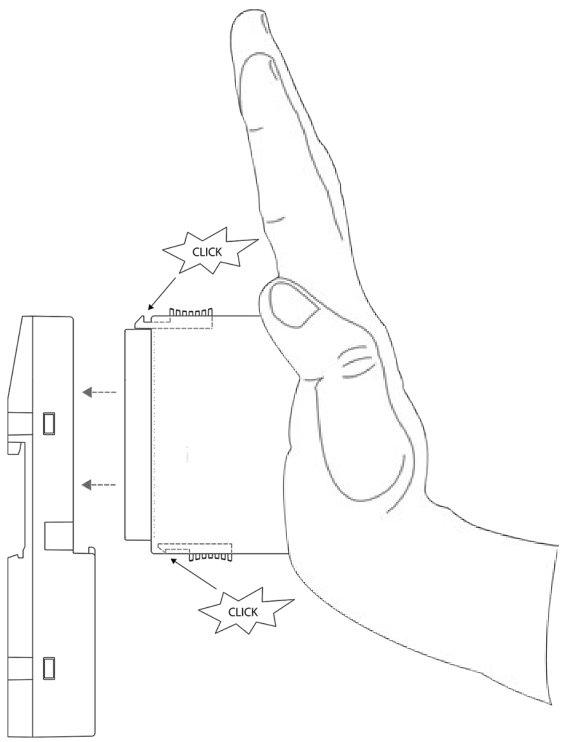
3. The demounting is carried out in a reversed order. Press above and below, then remove the processor module.



2.6.3.4 Mounting/Demounting the I/O modules

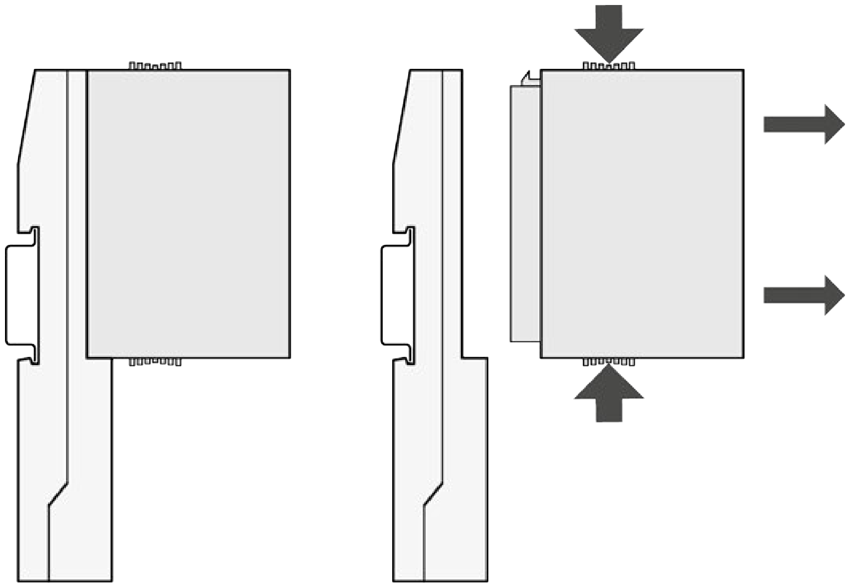
After mounting the terminal unit, mount the I/O modules.

1. Press the I/O module into the terminal unit until it locks in place.



2. The demounting is carried out in a reversed order.

   Press above and below, then remove the module.



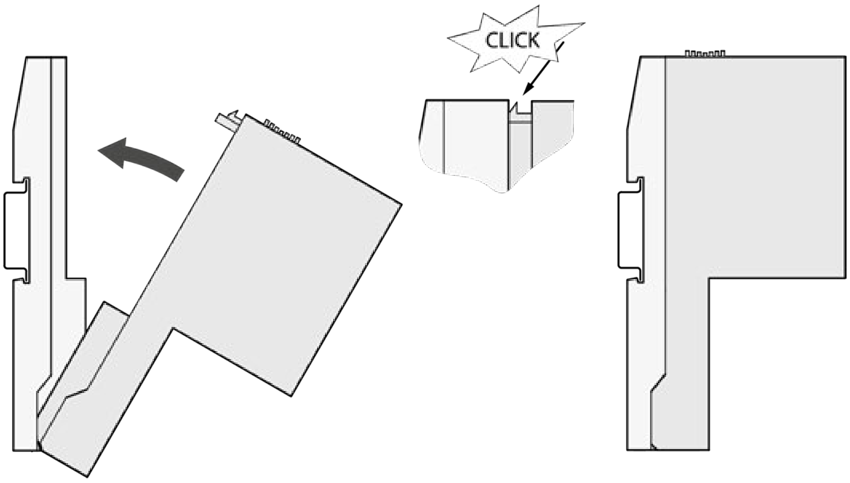
2.6.3.5 Mounting/Demounting the communication modules

Communication modules are mounted on the left side of the processor module on the same terminal base. The connection is established automatically when mounting the communication 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.

After mounting the terminal base, mount the communication modules.

1. First insert the bottom nose of the communication module into the dedicated holes of the terminal base. Then, rotate the communication module on the dedicated terminal base slot until it is locked in place.

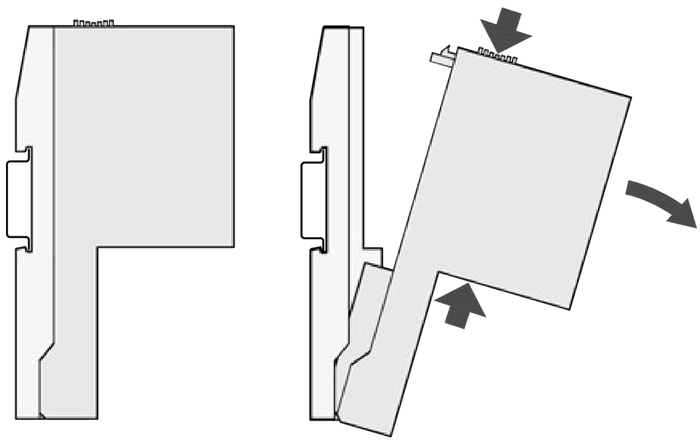


⇨

> **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 2.6.5.6 “TA524 - Dummy communication module” on page 1019*.
> – I/O bus connectors must not be touched during operation.

2. The demounting is carried out in a reversed order.

   Press above and below, then rotate the communication module and remove it.



2.6.3.6 Mounting/Demounting the accessories

Additional components such as batteries, cables, etc. are required for commissioning the PLC system. Information on assembly, replacement or basic use of the orderable components can be found in the description of the respective accessory.

🔗 *Chapter 2.6.5 “Handling of accessories” on page 1001*

Hardware details can be found in the device specifications of the accessory.

🔗 *Chapter 1.8 “Accessories” on page 861*

2.6.4 Connection and wiring

For detailed information such as technical data of your mounted devices (AC500 product family) refer to the hardware device description of the appropriate device.

> **NOTICE!**
> **Attention:**
> The devices should be installed by experts who are trained in wiring electronic devices. In case of bad wiring, the following problems could occur:
>
> – On the terminal base, the terminals L+ and M are doubled. If the power supply is badly connected, a short circuit could happen and lead to a destruction of the power supply or its fuse. If no suitable fuse exists, the terminal base itself might be destroyed.
> – The terminal bases and all electronic modules and terminal units are protected against reverse polarity.
> – All necessary measures should be carried out to avoid damages to modules and wiring. Notice the wiring plans and connection examples.

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

> **NOTICE!**
> **Attention:**
> Due to possible loss of communcation, the communication cables should be fixed with cable duct or bracket or clamp during application.

2.6.4.1 Power supply

AC500 system power supply

As soon as the power supply of the processor module (CPU) is higher than the minimum Process and supply voltage (see *Chapter 2.6.1.1 “Environmental conditions” on page 971*), the power supply detection is activated and the processor module is started. Power supply of processor module and I/O modules should be powered on the same time, otherwise the processor module will not switch to run after startup.

When during operation the power supply is going down lower than the minimum Process and supply voltage (see *Chapter 2.6.1.1 “Environmental conditions” on page 971*) for more than 10 ms, the processor module is switched to safety mode (display shows “AC500”). A restart of the processor module only occurs by switching the power supply off and on again.

If an I/O module is disconnected during normal operation from power supply while processor module is still powered, the processor module will continue its normal operation on all other powered peripherals (I/O modules, communication modules and communication interfaces), but freezes the input image. After recovery of I/O Module power supply it will continue normal operation and inputs and outputs were updated.

Logic Controller Supply: AC500 logic controller power supply is provided through terminals L+ / M.

Process Power Supply: S500 process power supply is provided through terminals UP / ZP.

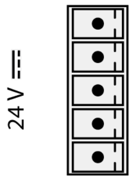
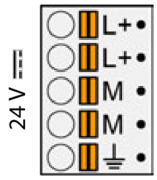
Logic Controller Supply is galvanic isolated from Process Power Supply.

As system power supply for AC500/S500, the ABB CP power supply series can be used.

2.6.4.1.1 Power supply for processor modules

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.

Pin assignment

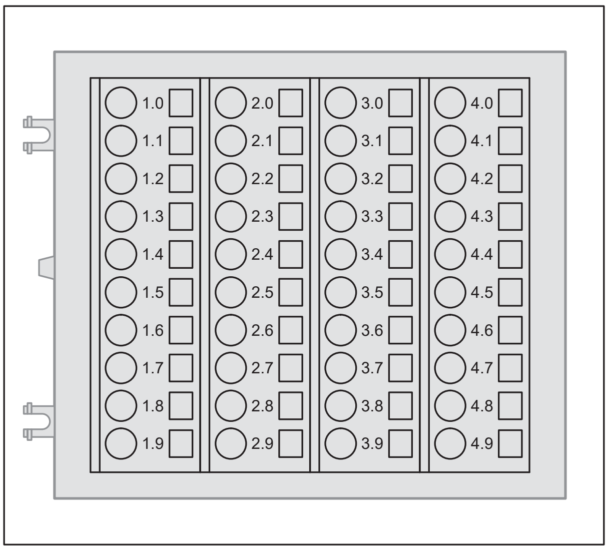
<table>
<tr><th colspan="2">Pin Assignment</th><th>Label</th><th>Function</th><th>Description</th></tr>
<tr><td rowspan="5">
Terminal block removed</td><td rowspan="5">
Terminal block inserted</td><td>L+</td><td>+24 V DC</td><td>Positive pin of the power supply voltage</td></tr>
<tr><td>L+</td><td>+24 V DC</td><td>Positive pin of the power supply voltage</td></tr>
<tr><td>M</td><td>0 V</td><td>Negative pin of the power supply voltage</td></tr>
<tr><td>M</td><td>0 V</td><td>Negative pin of the power supply voltage</td></tr>
<tr><td>⏚</td><td>FE</td><td>Functional earth</td></tr>
</table>

2.6.4.2 Terminals for power supply and the COM1 interface

Terminal type: Spring terminal

Number of cores per terminal	Conductor type	Cross section
1	Solid	0.08 mm^2 to 1.5 mm^2
1	Flexible	0.08 mm^2 to 1.5 mm^2
1 with wire-end ferrule (without plastic sleeve)	Flexible	0.25 mm^2 to 1.5 mm^2
1 with wire-end ferrule (with plastic sleeve)	Flexible	0.25 mm^2 to 0.5 mm^2
1 (TWIN wire end ferrule)	Flexible	0.5 mm^2

2.6.4.3 Terminals at the terminal unit



Terminal type: Screw-type terminal

Front terminal, conductor connection vertically with respect to the printed circuit board.

Parameter	Value
Type	Front terminal
Degree of protection	IP 20
Stripped conductor end	9 mm, min. 8 mm
Fastening torque	0.6 Nm
Needed tool	Slotted screwdriver
Dimensions	Blade diameter 3.5 mm

Terminal units with product index < C0 e. g. 1SAP 212 200 R0001 B0

Number of cores per terminal	Conductor type	Cross section
1	Solid	0.08 mm^2 to 2.5 mm^2
1	Flexible	0.08 mm^2 to 2.5 mm^2
1 with wire-end ferrule	Flexible	0.25 mm^2 to 1.5 mm^2
2	Solid	Not intended
2	Flexible	Not intended
2 with TWIN wire end ferrule (length 10 mm) with plastic sleeve	Flexible	2 x 0.25 mm^2 or 2 x 0.5 mm^2 or 2 x 0.75 mm^2, with square cross-section of the wire-end ferrule also 2 x 1.0 mm^2

Terminal units with product index ≥ C0 e. g. 1SAP 212 200 R0001 C0

Number of cores per terminal	Conductor type	Cross section
1	Solid	0.08 mm^2 to 2.5 mm^2
1	Flexible	0.08 mm^2 to 2.5 mm^2
1 with wire-end ferrule without plastic sleeve	Flexible	0.08 mm^2 to 2.5 mm^2
1 with wire-end ferrule with plastic sleeve	Flexible	0.14 mm^2 to 1.5 mm^2
2	Solid	0.08 mm^2 to 1.5 mm^2
2	Flexible	0.08 mm^2 to 1.5 mm^2
2 with TWIN wire end ferrule (length 10 mm) with plastic sleeve	Flexible	2 x 0.5 mm^2 to 2 x 1.0 mm^2
2 with separate wire-end ferrule without plastic sleeve	Flexible	0.08 mm^2 to 0.75 mm^2

Terminal type: Spring terminal

Front terminal, conductor connection vertically with respect to the printed circuit board.

Parameter	Value
Type	Front terminal
Degree of protection	IP 20
Stripped conductor end	9 mm, min. 8 mm
Needed tool	Slotted screwdriver
Dimensions	2.5 x 0.4 to 3.5 x 0.5 mm, screwdriver must be at least 15 mm free of insulation at the tip

Number of cores per terminal	Conductor type	Cross section
1	Solid	$0.08\ mm^2$ to $2.5\ mm^2$
1	Flexible	$0.08\ mm^2$ to $2.5\ mm^2$
1 with wire-end ferrule	Flexible	$0.25\ mm^2$ to $1.5\ mm^2$
2	Solid	Not intended
2	Flexible	Not intended
2 with TWIN wire end ferrule (length 10 mm) with plastic sleeve	Flexible	2 x $0.25\ mm^2$ or 2 x $0.5\ mm^2$ or 2 x $0.75\ mm^2$, with square cross-section of the wire-end ferrule also 2 x $1.0\ mm^2$

2.6.4.4 Connection of wires at the spring terminals

Connection

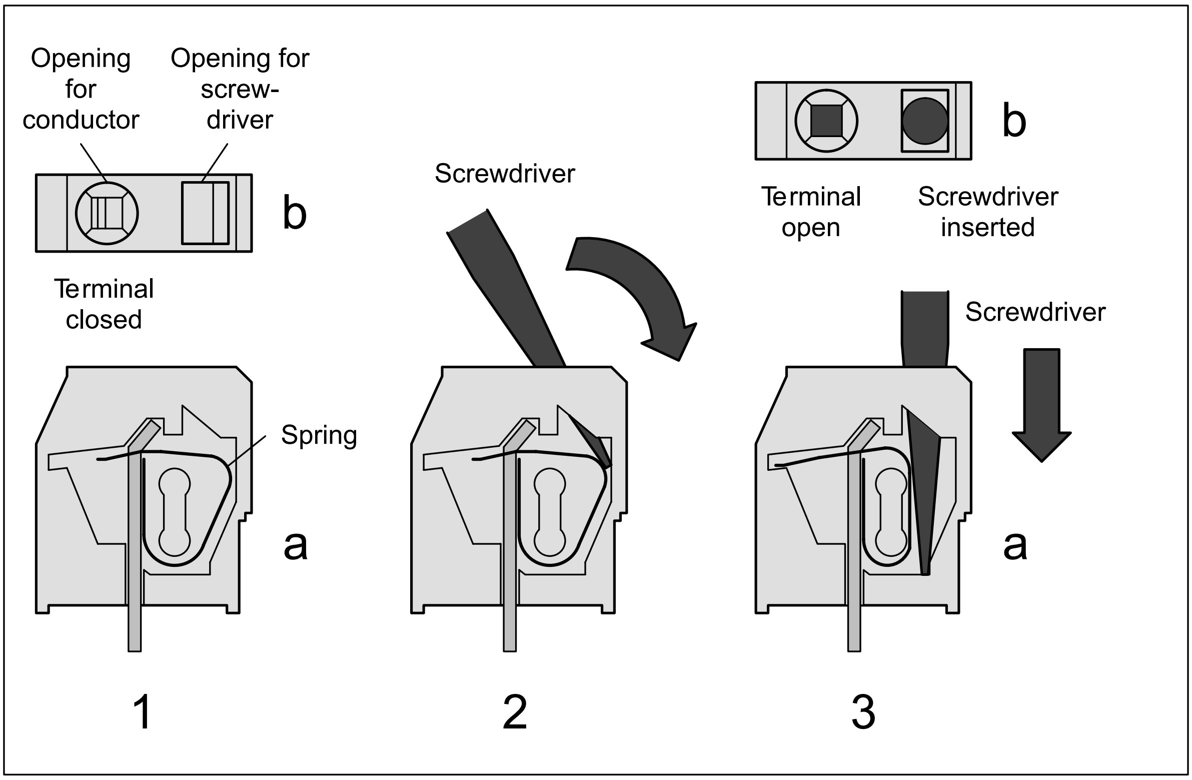


Fig. 190: Connect the wire to the spring terminal (steps 1 to 3)

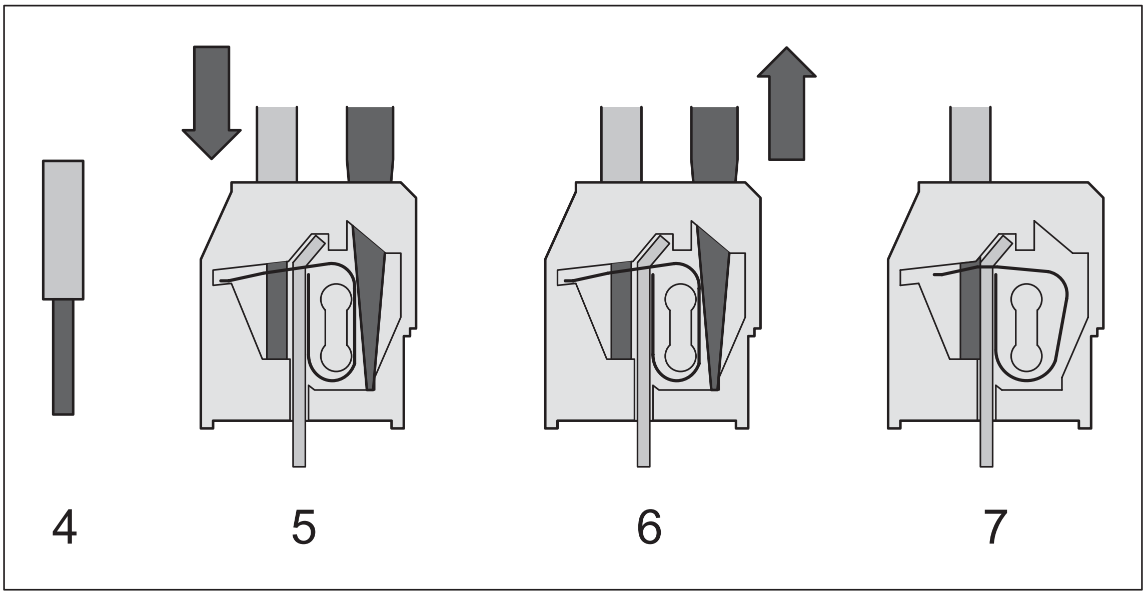


Fig. 191: Connect the wire to the spring terminal (steps 4 to 7)

1. Side view (open terminal drawn for illustration)
2. The top view shows the openings for wire and screwdriver
3. Insert screwdriver (2.5 x 0.4 to 3.5 x 0.5 mm) at an angle, screwdriver must be at least 15 mm free of insulation at the tip
4. While erecting the screwdriver, insert it until the stop (requires a little strength)
5. Screwdriver inserted - terminal open
6. Strip the wire for 7 mm (and put on wire-end ferrule)
7. Insert wire into the open terminal
8. Done

Disconnection

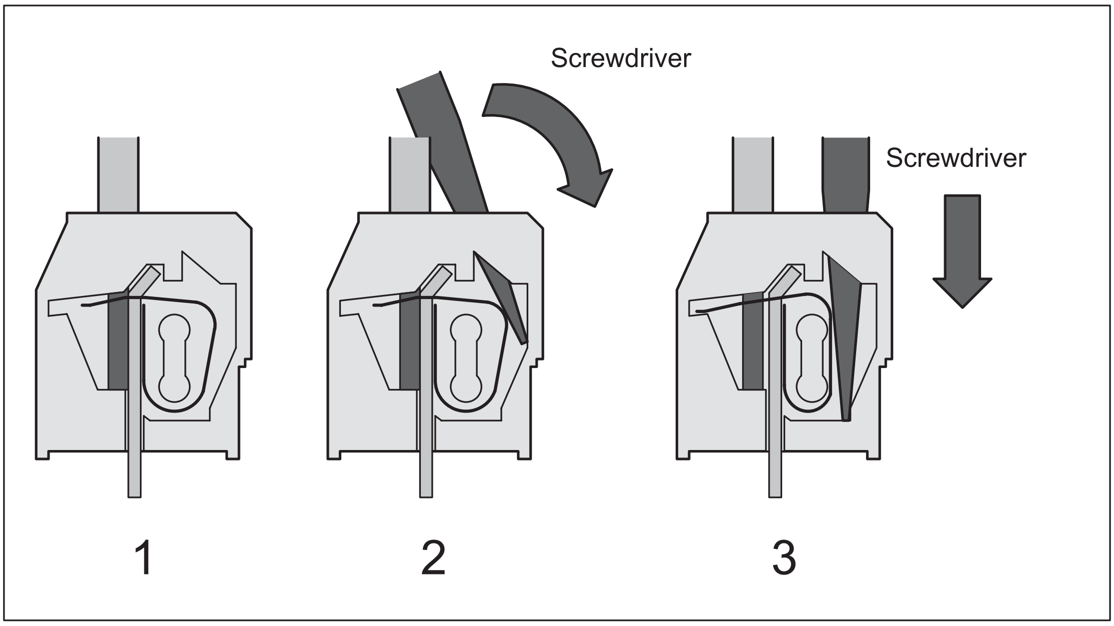


Fig. 192: Disconnect wire from the spring terminal (steps 1 to 3)

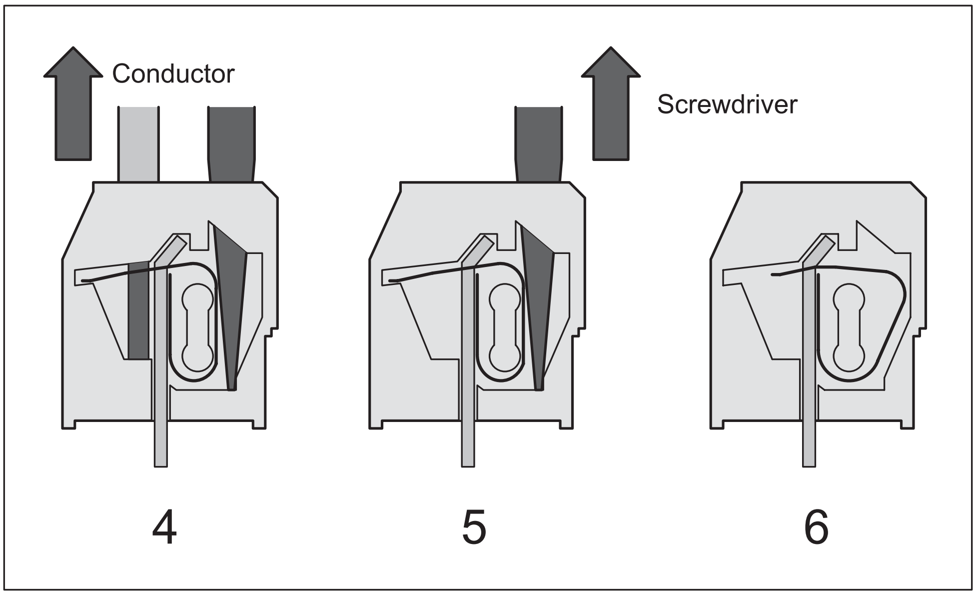


Fig. 193: Disconnect wire from the spring terminal (steps 4 to 6)

1. Terminal with wire connected
2. Insert screwdriver (2.5 x 0.4 to 3.5 x 0.5 mm) at an angle, screwdriver must be at least 15 mm free of insulation at the tip
3. While erecting the screwdriver, insert it until the stop (requires a little strength) - terminal is now open
4. Remove wire from the open terminal
5. Done

2.6.4.5 Terminals for CANopen/DeviceNet communication modules

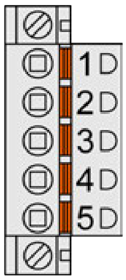


Fig. 194: Combicon, 5-pole, female, removable plug with spring terminals

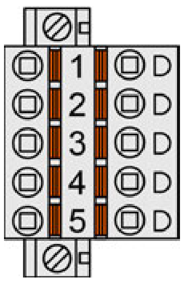


Fig. 195: Combicon, 5-pole, female, removable plug with spring terminals

Terminal type: Spring terminal

Number of cores per terminal	Conductor type	Cross section	Stripped conductor end
1	solid	0.2 mm^2 to 2.5 mm^2	10 mm
1	flexible	0.2 mm^2 to 2.5 mm^2	10 mm
1 with wire-end fer-rule (without plastic sleeve)	flexible	0.25 mm^2 to 2.5 mm^2	10 mm
1 with wire-end fer-rule (with plastic sleeve)	flexible	0.25 mm^2 to 2.5 mm^2	10 mm

2.6.4.6 CANopen field bus

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 seg-ment [m]	Bus cable (shielded, twisted pair)			Max. transmis-sion rate [kbit/s]
	Conductor cross section [mm^2]	**Line resistance [Ω/km]**	**Wave impe-dance [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

> **NOTICE!**
> **Risk of telegram and data errors!**
> The use of wrong cable type and quality could lead to limitations in cable length, causing telegram and data errors.

> **NOTICE!**
> **Risk of damaging the terminating resistor!**
> A bus-line short-circuit to the 24 V DC power supply can cause damage by exceeding the power rating of the terminating resistor.

NOTICE!

Risk of telegram and data errors!

Miss- or unterminated data lines can cause reflections on the bus, leading to telegram and data errors. For maximum cable length and transmission rate, the bus must always be terminated on both ends with the characteristic impedance of the cable type.

NOTICE!

Verification of termination (Make sure the power supply on all CAN nodes is turned off)!

To verify the termination, the DC resistance between CAN_H and CAN_L can be measured. The value should be between 50 Ω and 70 Ω.

Check for correct resistor values, short circuits and correct number of terminating resistors, if the measurement is showing deviations.

Installation hint

Ensure that the termination and FE connection will not be removed when removing CAN modules from the bus.

Branches are not allowed in a CAN network. Stubs should be avoided or kept as short as possible (< 0.3 m).

When connecting the cable take care to use one dedicated twisted pair for the CAN signals (CAN_L and CAN_H) and another free wire for CAN_GND. CAN_GND must be connected as reference, to avoid common mode problems causing telegram errors.

Keep the CAN bus wiring away from electrical disturbance and close to earth potential to minimize interference.

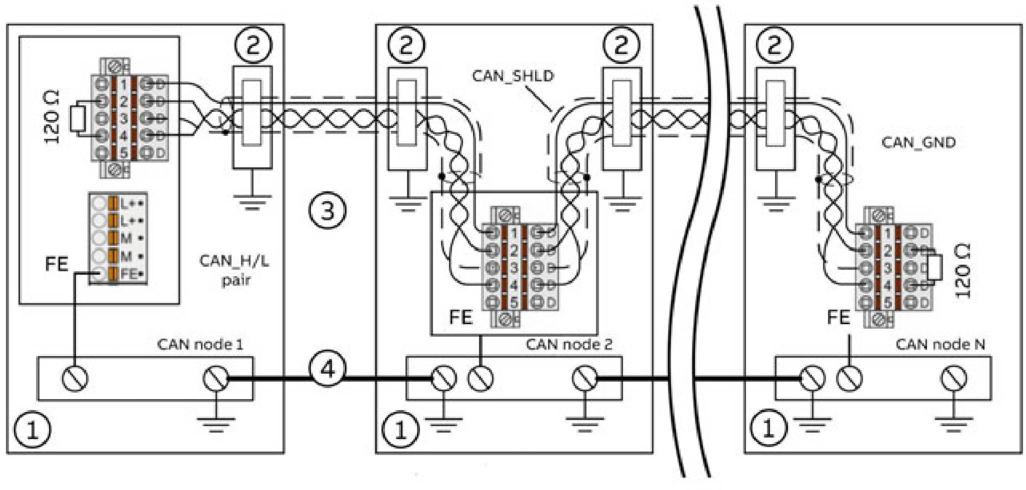


Fig. 196: CAN bus, connection and wiring

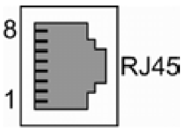
1 Cabinet
2 Direct earthing of shields when entering the cabinet
3 CAN bus segment
4 Current-carrying connection

2.6.4.7 Ethernet connection details

> *Ethernet is also used for PROFINET, EtherCAT and Modbus TCP connection.*

2.6.4.7.1 Ethernet interface

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
	6	RxD-	Receive data -
	7	NU	Not used
	8	NU	Not used
	Shield	Cable shield	Functional earth

See supported protocols and used Ethernet ports:.

See communication via Modbus TCP/IP: .

See communication via Modbus RTU: .

2.6.4.7.2 Wiring

Cable length restrictions

For the maximum possible cable lengths within an Ethernet network, various factors have to be taken into account. Twisted pair cables (TP cables) are used as transmission medium for 10 Mbit/s Ethernet (10Base-T) as well as for 100 Mbit/s (Fast) Ethernet (100Base-TX). For a transmission rate of 10 Mbit/s, cables of at least category 3 (IEA/TIA 568-A-5 Cat3) or class C (according to European standards) are allowed. For fast Ethernet with a transmission rate of 100 Mbit/s, cables of category 5 (Cat5) or class D or higher have to be used. The maximum length of a segment, which is the maximum distance between two network components, is restricted to 100 m due to the electric properties of the cable.

Furthermore, the length restriction for one collision domain has to be observed. A collision domain is the area within a network which can be affected by a possibly occurring collision (i.e. the area the collision can propagate over). This, however, only applies if the components operate in half-duplex mode since the CSMA/CD access method is only used in this mode. If the components operate in full-duplex mode, no collisions can occur. Reliable operation of the collision detection method is important, which means that it has to be able to detect possible collisions even for the smallest possible frame size of 64 bytes (512 bits). But this is only guaranteed if the first bit of the frame arrives at the most distant subscriber within the collision domain before the last bit has left the transmitting station. Furthermore, the collision must be able to propagate to both directions at the same time. Therefore, the maximum distance between two ends must not be longer than the distance corresponding to the half signal propagation time of 512 bits. Thus, the resulting maximum possible length of the collision domain is 2000 m for a transmission rate of 10 Mbit/s and 200 m for 100 Mbit/s. In addition, the bit delay times caused by the passed network components also have to be considered.

The following table shows the specified properties of the respective cable types per 100 m.

Table 203: Specified cable properties:

Parameter	10Base-T [10 MHz]	100Base-TX [100 MHz]
Attenuation [dB / 100m]	10.7	23.2
NEXT [dB / 100m]	23	24
ACR [dB / 100m]	N/A	4
Return loss [dB / 100m]	18	10
Wave impedance [Ohms]	100	100
Category	3 or higher	5
Class	C or higher	D or higher

TP cable

The TP cable has eight wires arranged in four pairs of twisted wires. Different color codes exist for the coding of the wires, the coding according to EIA/TIA 568, version 1, being the one most commonly used. In this code, the individual pairs are coded with blue, orange, green and brown color. One wire of a pair is unicolored and the corresponding second wire is striped, the respective color alternating with white. For shielded cables, a distinction is made between cables that have one single shield around all pairs of wires and cables that have an additional individual shield for each pair of wires. The following table shows the different color coding systems for TP cables:

Table 204: Color coding of TP cables:

Pairs	EIA/TIA 568 Version 1		EIA/TIA 568 Version 2		DIN 47100		IEC 189.2	
Pair 1	white/ blue	blue	green	red	white	brown	white	blue
Pair 2	white/ orange	orange	black	yellow	green	yellow	white	orange

Pairs	EIA/TIA 568 Version 1		EIA/TIA 568 Version 2		DIN 47100		IEC 189.2	
Pair 3	white/ green	green	blue	orange	grey	pink	white	green
Pair 4	white/ brown	brown	brown	slate	blue	red	white	brown

Two general variants are distinguished for the pin assignment of the normally used RJ45 connectors: EIA/TIA 568 version A and version B. The wiring according to EIA/TIA 568 version B is the one most commonly used.

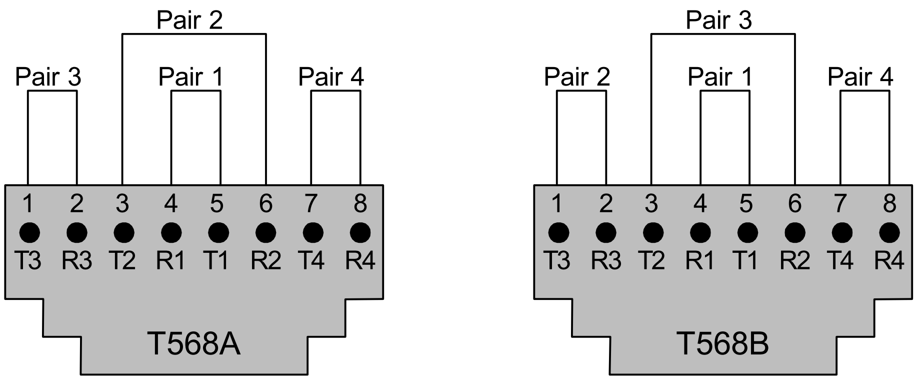


Fig. 197: Pin assignment of RJ45 sockets

2.6.4.7.3 Cable types

Crossover cable

> ***Particular use***
> *Crossover cables are needed only for a direct Ethernet connection without crossover functionality. In particular for AC500 modules in product life cycle phase "Classic".*

Crossover cables are for a direct Ethernet connection of two terminal devices as the simplest variant of a network. From transmission lines of the first station to the reception lines of the second station.

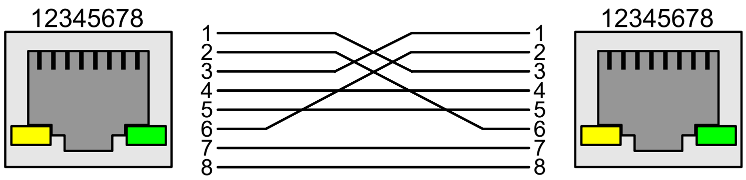


Fig. 198: Wiring of a crossover cable

Straight-through cable

For networks with more than two subscribers, hubs or switches have to be used additionally for distribution. These active devices already have the crossover functionality implemented which allows a direct connection of the terminal devices using straight-through cables.

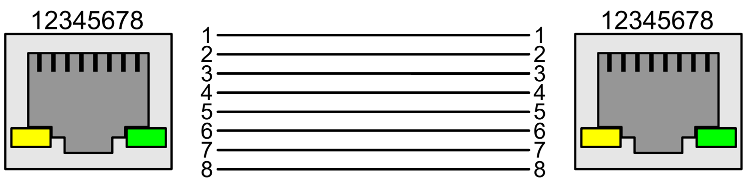


Fig. 199: Wiring of a straight-through cable

CAUTION!
Risk of communication faults!
When using inappropriate cables, malfunctions in communication may occur.

Only use network cables of the categories 5 (Cat 5, Cat 5e, Cat 6 or Cat 7) or higher within PROFINET networks.

2.6.4.8 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

The Modbus operating mode and the interface parameters are set in the .

Table 205: Description of the Modbus protocol

Parameter	Value
Supported standard	See
Number of connection points	1 client Max. 1 server with RS-232 interface Max. 31 servers with RS-485
Protocol	Modbus
Operating mode	Client/server
Address	Server only
Data transmission control	CRC16
Data transmission speed	From 9,600 bits/s to 115,200 bits/s
Encoding	1 start bit 8 data bits 1 or 2 stop bits 1 parity bit)
Max. cable length for RS-485 on COM1 for AC500 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.

For further information on Modbus see chapter .

2.6.5 Handling of accessories

This section only describes accessories that are frequently used for system assembly, connection and construction. A description of all additional accessories that can be used to supplement AC500 system can be found in the Hardware PLC device description.

2.6.5.1 MC502 - Memory card

- Solid state flash memory storage

1 MC502 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**
MC502	x	x	x	x	x	-
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.

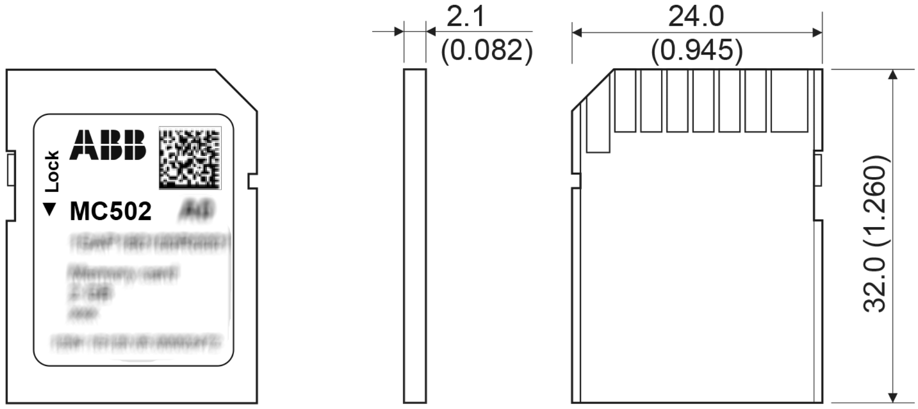
Processor modules are supplied without (micro) memory card. It must be ordered separately.

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.

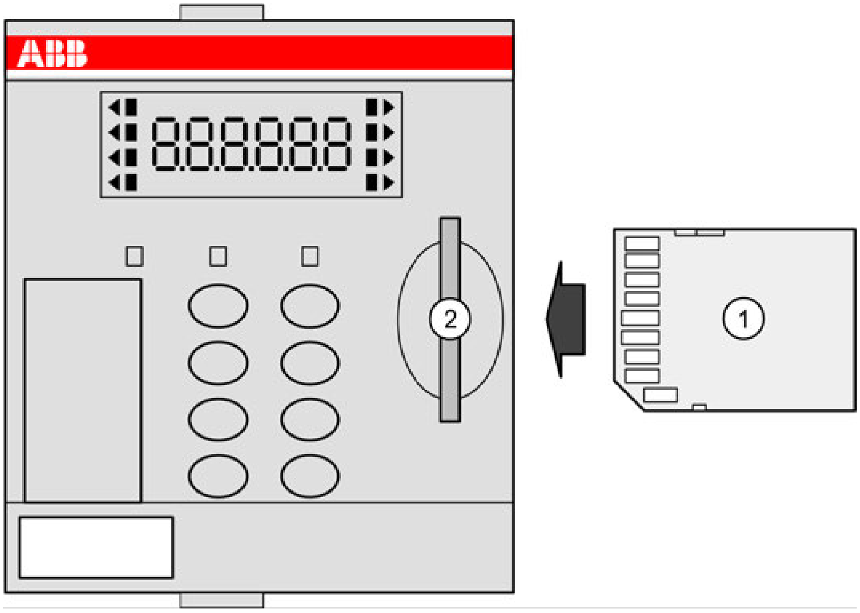


Fig. 200: Insert memory card into PM56xx

1 Memory card
2 Memory card slot

Remove the memory card

AC500 V3

> **NOTICE!**
> **Removal of the memory card**
> Do not remove the memory card when it is working!
>
> Remove the memory card only when no black square (■) is shown next to MC in the display.
>
> Otherwise the memory card and/or files on it might get corrupted and/or normal PLC operation might be disturbed.

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.

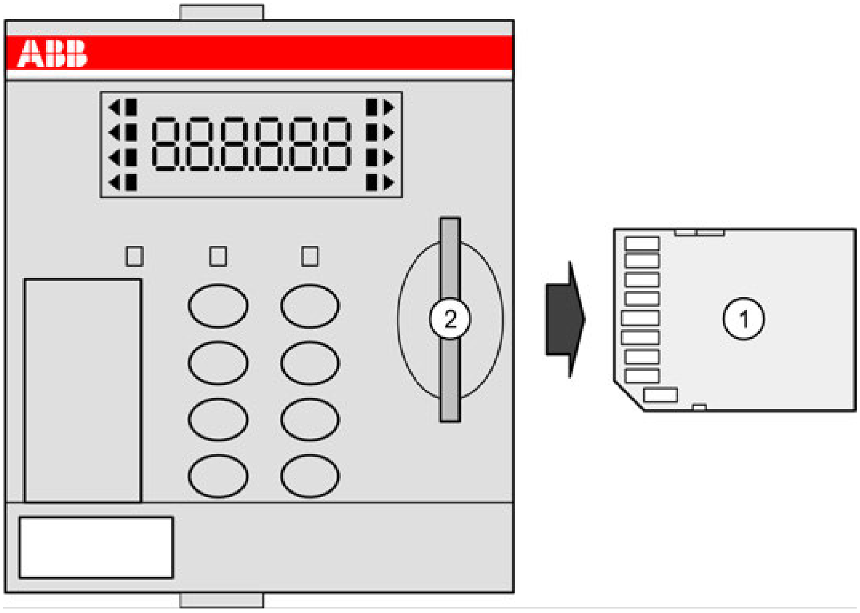


Fig. 201: Remove memory card from PM56xx

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.

Further information on using the memory card in AC500 PLCs is provided in the chapter .

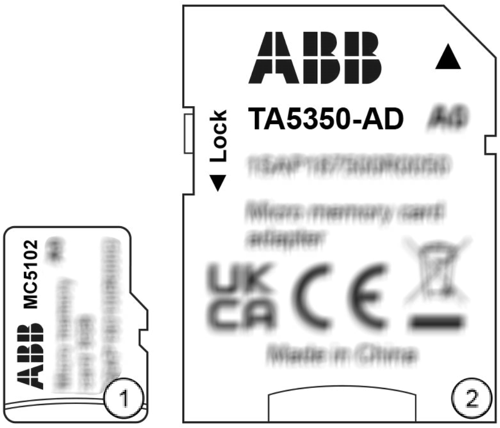
Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 180 100 R0001	MC502, memory card	Classic

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

2.6.5.2 MC5102 - Micro memory card with micro memory card adapter

- Solid state flash memory storage



1 Micro memory card
2 TA5350-AD micro memory card adapter

> *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
MC502	x	x	x	x	x	-
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.

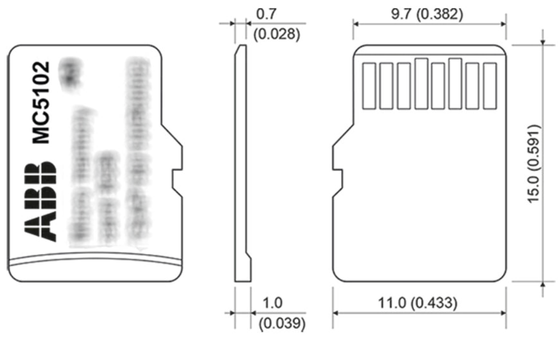
The micro memory card is used to store or backup application data and/or application programs or project source codes as well as to update the internal CPU firmware.

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.

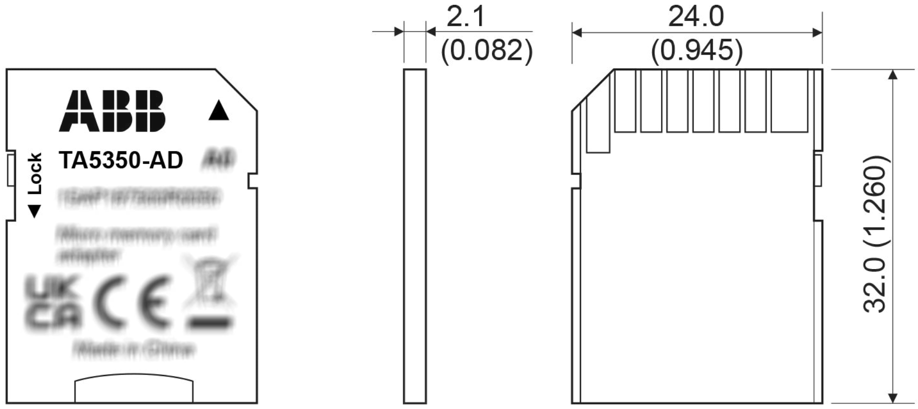
Dimensions

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

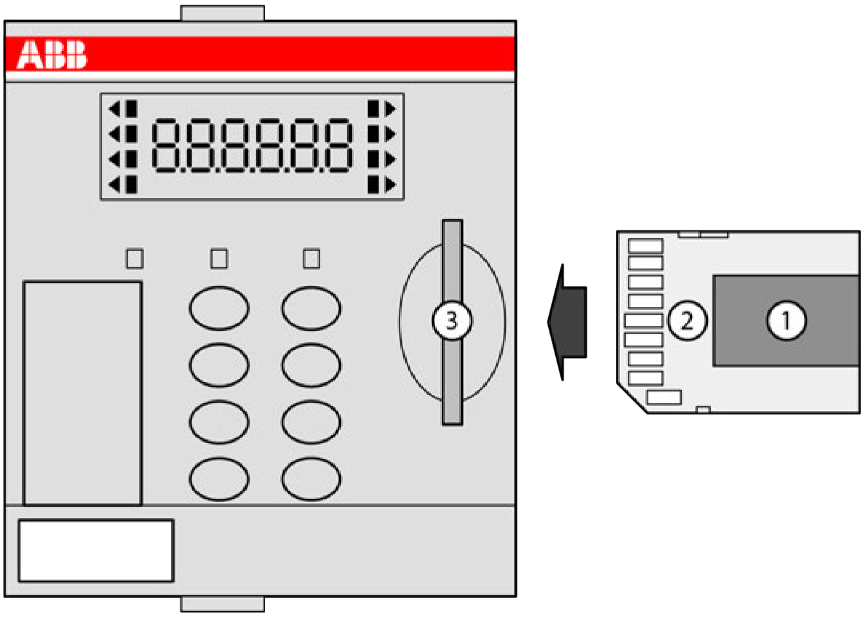
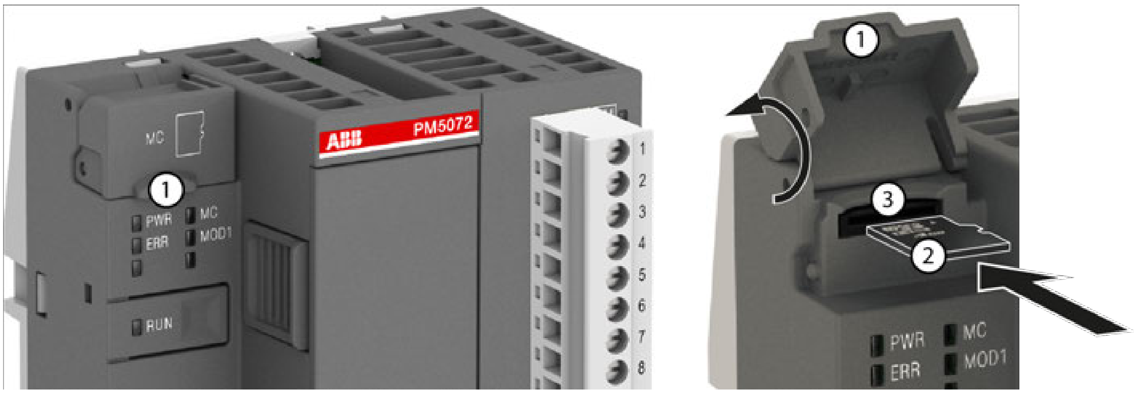


Fig. 202: Insert micro memory card into PM56xx

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!**
> **Removal of the micro memory card**
> Do not remove the micro memory card when it is working!
>
> AC500 V3: Remove the micro memory card with micro memory card adapter 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.
>
> Otherwise the micro memory card and/or files on it might get corrupted and/or normal PLC operation might be disturbed.

AC500 V3

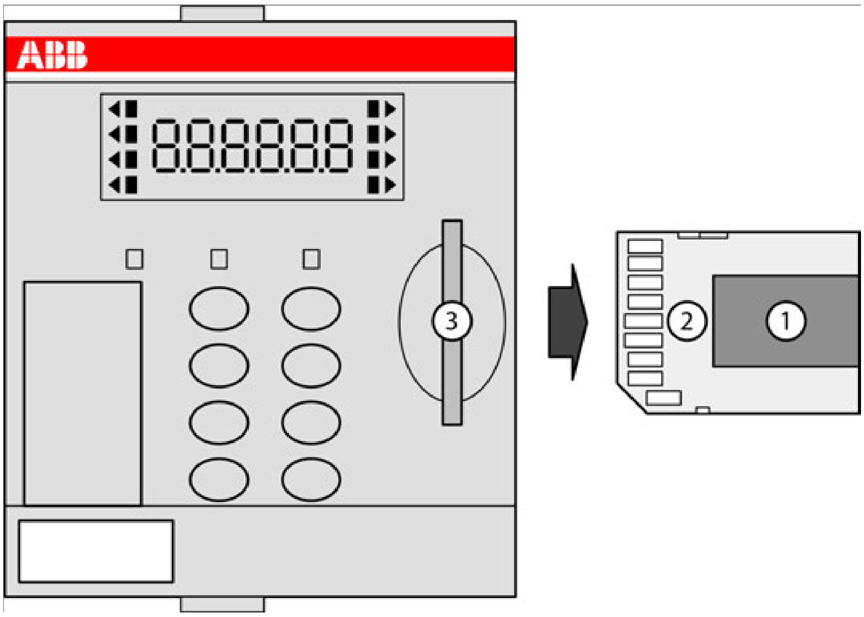
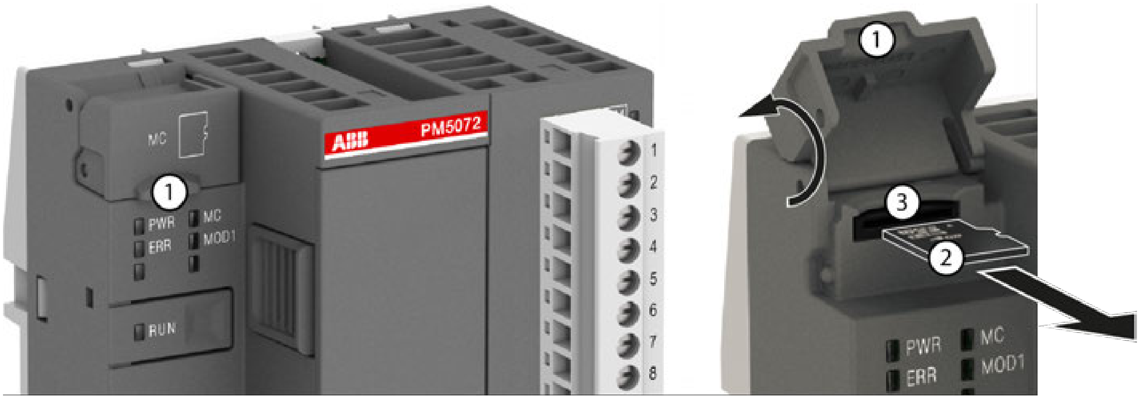


Fig. 203: Remove micro memory card from PM56xx

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



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

Parameter		Value
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.

Further information on using the micro memory card in AC500 PLCs is provided in the chapter .

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.*

2.6.5.3 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**
MC502	x	x	x	x	x	-
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.

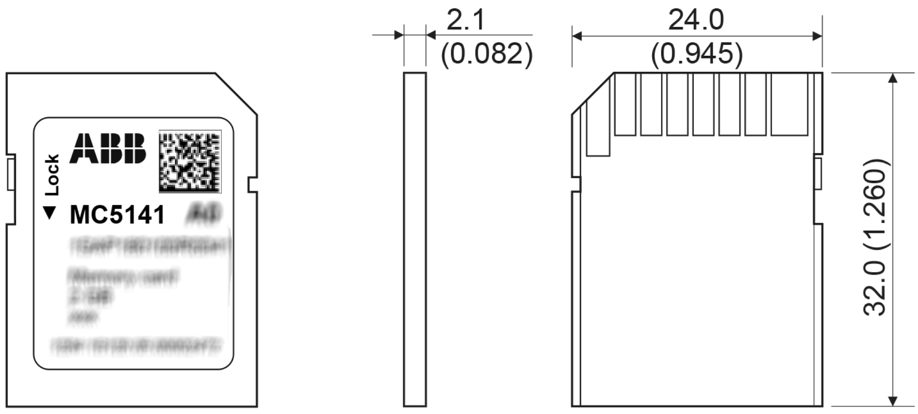
Processor modules are supplied without (micro) memory card. It must be ordered separately.

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.

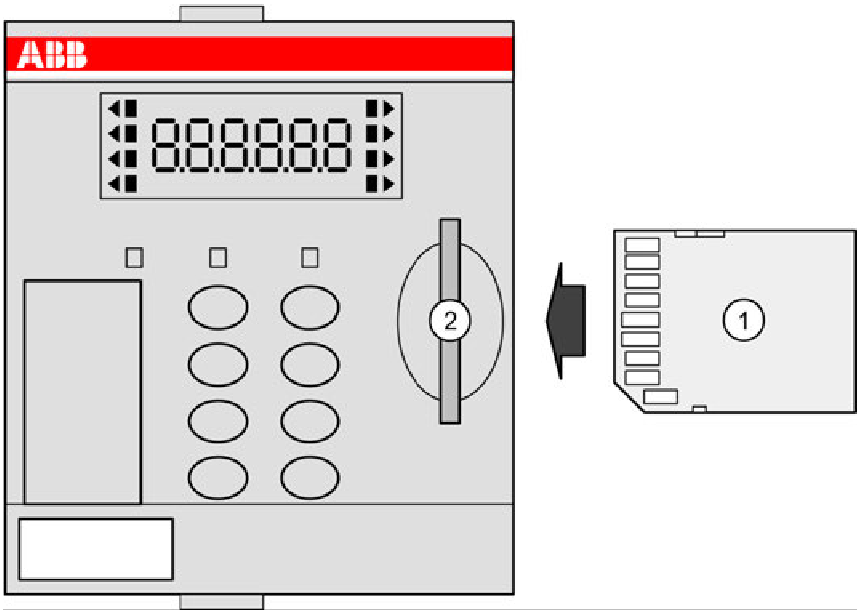


Fig. 204: Insert memory card into PM56xx

1 Memory card
2 Memory card slot

Remove the memory card

AC500 V3

> **NOTICE!**
> **Removal of the memory card**
> Do not remove the memory card when it is working!
>
> Remove the memory card only when no black square (■) is shown next to MC in the display.
>
> Otherwise the memory card and/or files on it might get corrupted and/or normal PLC operation might be disturbed.

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.

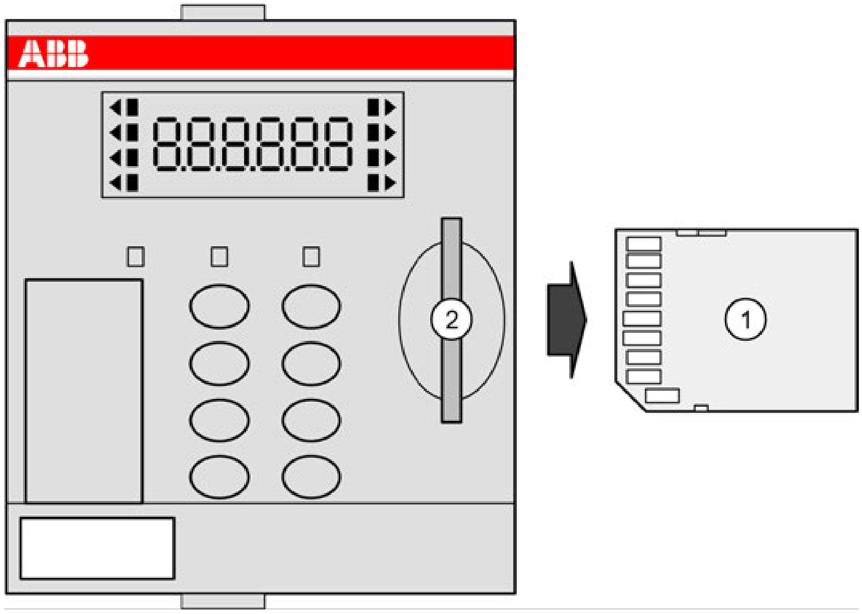


Fig. 205: Remove memory card from PM56xx

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.*

Further information on using the memory card in AC500 PLCs is provided in the chapter .

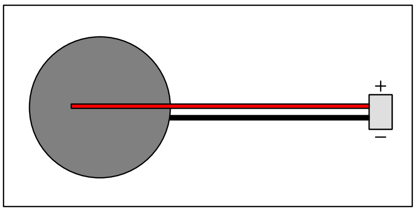
Ordering data

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.*

2.6.5.4 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 1.3.2.1 “PM56xx-2ETH for AC500 V3 products” on page 90*. It cannot be recharged.

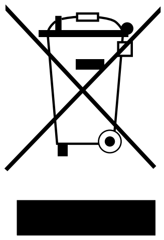
The processor modules are supplied without lithium battery. It must be ordered separately. The TA521 lithium battery is used for data (SRAM) and RTC buffering while the processor module is not powered.

See system technology - AC500 battery.

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

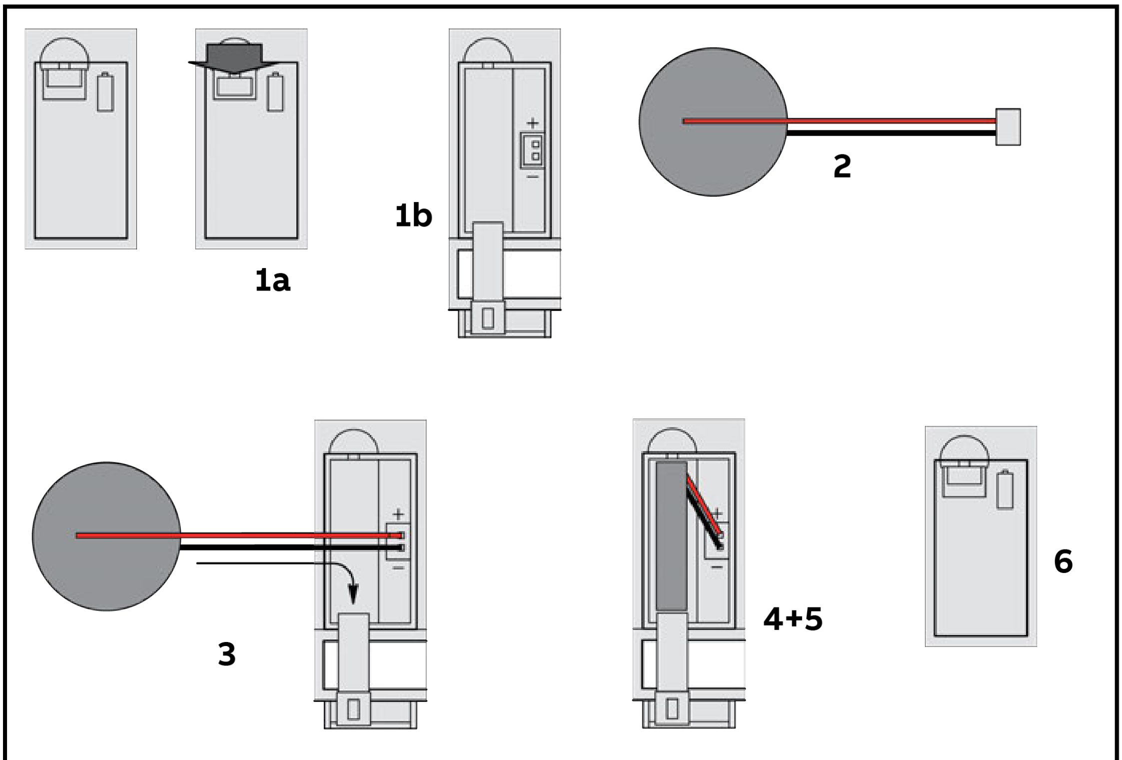
The battery lifetime is the time, the battery can store data while the processor module is not powered. As long as the processor module is powered, the battery will only be discharged by its own leakage current.

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 a lithium battery. Attempts to charge lithium batteries lead to overheating and possible 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 chance short circuiting and therefore 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

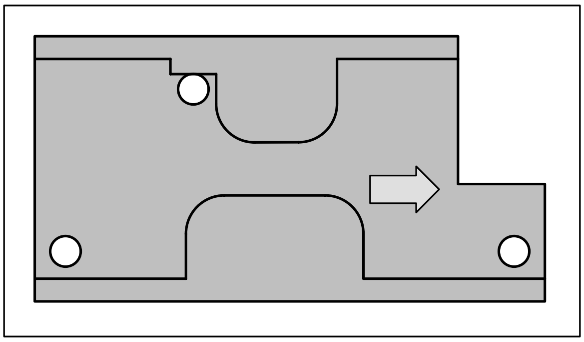
Parameter	Value
Nominal voltage	3 V
Nominal capacity	560 mAh
Temperature range (index below C0)	Operating: 0 °C...+60 °C Storage: -20 °C...+60 °C Transport: -20 °C...+60 °C
Temperature range (index C0 and above)	Operating: -40 °C...+70 °C Storage: -40 °C...+85 °C Transport: -40 °C...+85 °C
Battery lifetime	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.*

2.6.5.5 TA526 - Wall mounting accessory



Purpose

If a terminal base TB5xx or a terminal unit TU5xx 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.

Handling instructions

Handling of the wall mounting accessory is described in detail in the section *Mounting and disassembling the terminal unit* *"Mounting with screws" on page 984* and *Mounting/Disassembling Terminal Bases and Function Module Terminal Bases* *"Mounting with screws" on page 982*.

Technical data

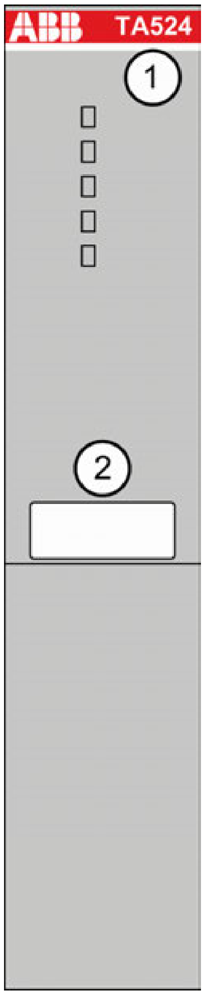
Parameter	Value
Weight	5 g
Dimensions	67 mm x 35 mm x 5,5 mm

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.*

2.6.5.6 TA524 - Dummy communication module



1 Type
2 Label

Purpose

TA524 is used to cover an unused communication module slot of a terminal base ⇨ *Chapter 1.2.1 “TB56xx for AC500 V3 products” on page 4*. It protects the terminal base from dust and inadvertent touch.

Handling instructions

TA524 is mounted in the same way as a common communication module ⇨ *Chapter 2.6.3.5 “Mounting/Demounting the communication modules” on page 987*.

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.*

2.6.5.7 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 206: 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	100-240 V AC or 90-375 V DC	24 V DC, 1.25 A	-	40.5
1SVR427032R0000	CP-E 24/2.5	100-240 V AC or 90-375 V DC	24 V DC, 2.5 A	-	40.5
1SVR427034R0000	CP-E 24/5.0	115/230 V AC auto select or 210-370 V DC	24 V DC, 5 A	-	63.2
1SVR427035R0000	CP-E 24/10.0	115/230 V AC auto select or 210-370 V DC	24 V DC, 10 A	-	83
1SVR427036R0000	CP-E 24/20.0	115-230 V AC or 120-370 V DC	24 V DC, 20 A	-	175

2.6.5.8 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 207: Ordering data

Order No.	Type	Input	Output	Overload capacity	Module width [mm]
1SVR360563R1001	CP-C.1 24/5.0	110-240 V AC or 90-300 V DC	24 V DC, 5 A	+50 %	40
1SVR360663R1001	CP-C.1 24/10.0	110-240 V AC or 90-300 V DC	24 V DC, 10 A	+50 %	60
1SVR360763R1001	CP-C.1 24/20.0	110-240 V AC or 90-300 V DC	24 V DC, 20 A	+30 %	82

2.7 AC500-XC

2.7.1 System data AC500-XC

Assembly, construction and connection of devices of the variant AC500-XC is identical to AC500 (standard) *✎ Chapter 2.6 “AC500 (Standard)” on page 971.* *The following description provides information on general technical data of AC500-XC system.*

2.7.1.1 Environmental conditions

Table 208: 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!
Exceeding the maximum power supply voltage for process or supply voltages could lead to unrecoverable damage of the system. The system might be destroyed.

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

The creepage distances and clearances meet the requirements of the over-voltage 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 ● Applications certified for cULus up to +60 °C ● Digital inputs: maximum number of simultaneously switched on input channels limited to 75 % per group (e.g. 8 channels => 6 channels) ● Digital outputs: output current maximum value (all channels together) limited to 75 % per group (e.g. 8 A => 6 A) ● Analog outputs only if configured as voltage output: maximum total output current per group is limited to 75 % (e.g. 40 mA => 30 mA) ● Analog outputs only if configured as current output: maximum number of simultaneously used output channels limited to 75 % per group (e.g. 4 channels => 3 channels)
	Storage / Transport	-40 °C...+85 °C
Humidity		Operating / Storage: 100 % r. H. with condensation
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 to 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 1.8.3.4 "TA535 - Protective caps for XC devices" on page 906*

Table 209: Electromagnetic compatibility

Parameter		Value
Device suitable for:		
	Industrial applications	Yes
	Domestic applications	No
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
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 2.6.5.6 "TA524 - Dummy communication module" on page 1019*.
– I/O bus connectors must not be touched during operation.

2.7.1.2 Mechanical data

Parameter	Value
Wiring method	Spring terminals
Degree of protection	IP 20
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

2.7.1.3 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

Parameter	Value
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 210: 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)	Supply voltage units (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)	Supply voltage units (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

2.8 AC500-S

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

In order to have always the latest version and due to a different lifecycle compared to Automation Builder help, the *AC500-S safety user manual* is only available on our website.

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

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