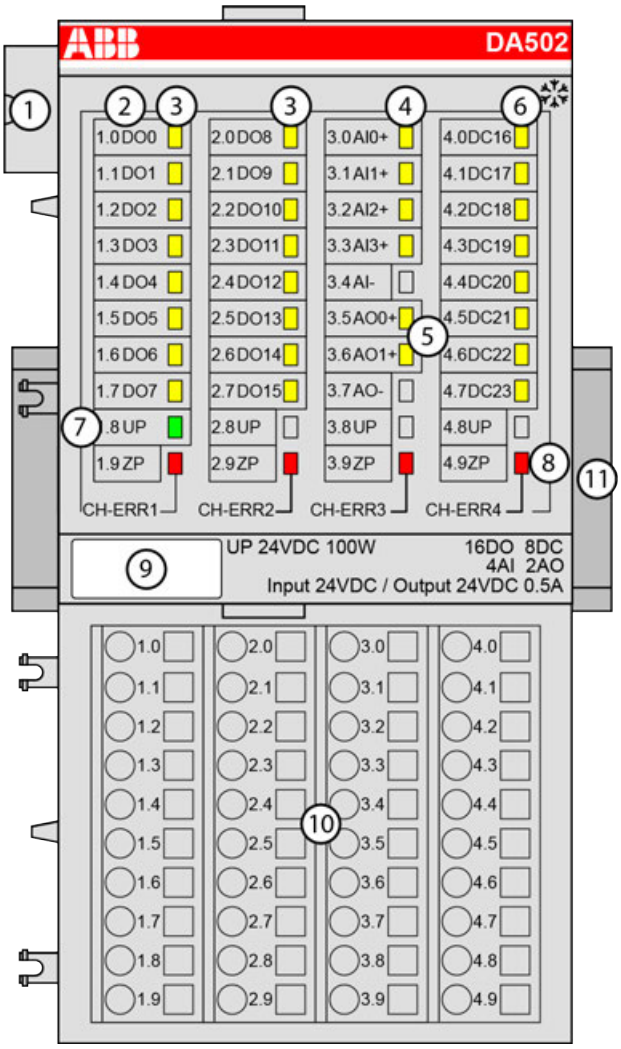
### 1.6.3.1.2 DA502 - Digital/Analog input/output module

- 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.

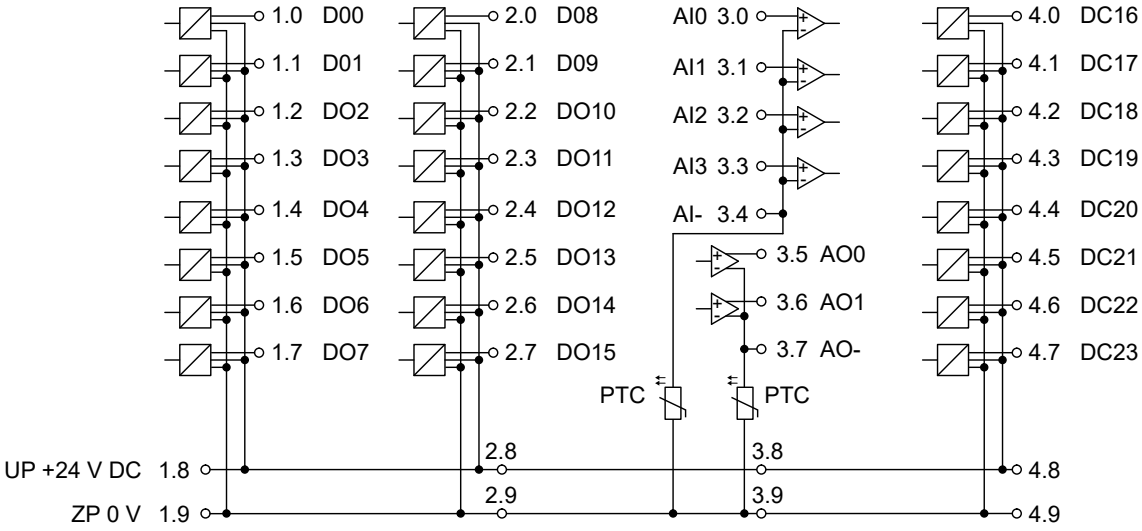
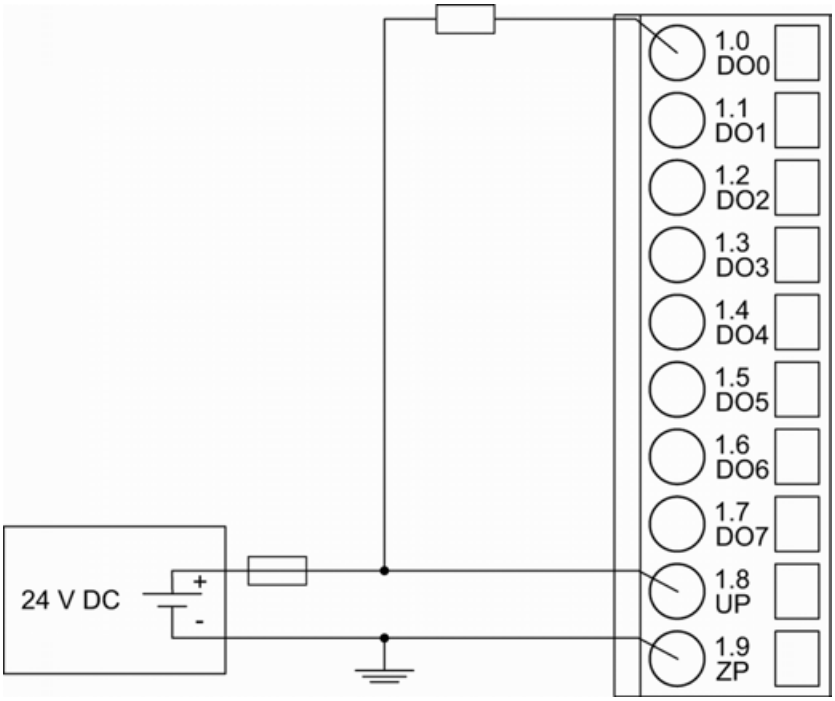



*Fig. 86: Terminal assignment of the module*

The module provides several diagnosis functions *Chapter 1.6.3.1.2.7 “Diagnosis” on page 603*.

### Connection of the digital outputs

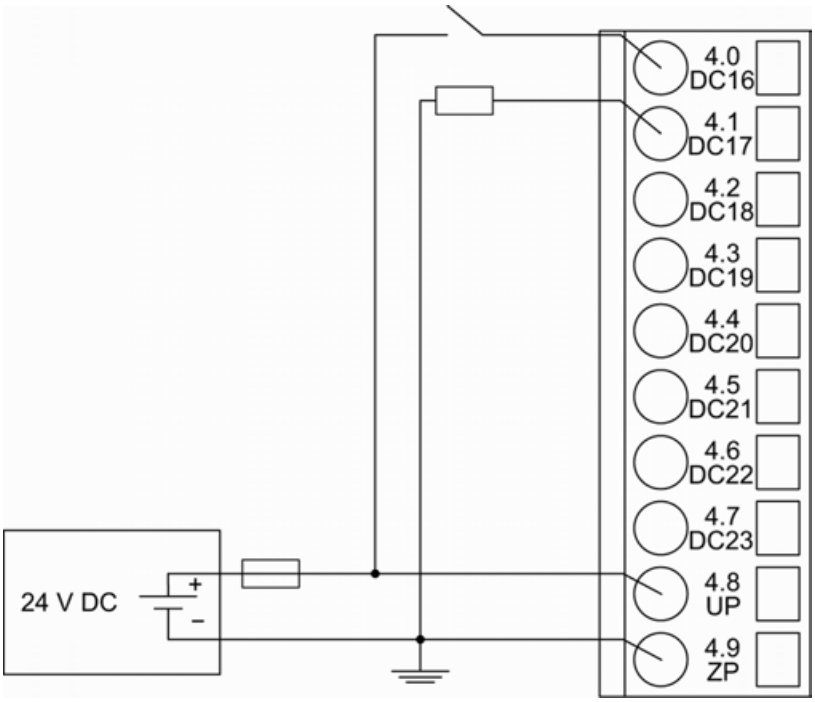
The following figure shows the connection of the digital output DO0. Proceed with the digital outputs DO1 to DO15 in the same way.




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.

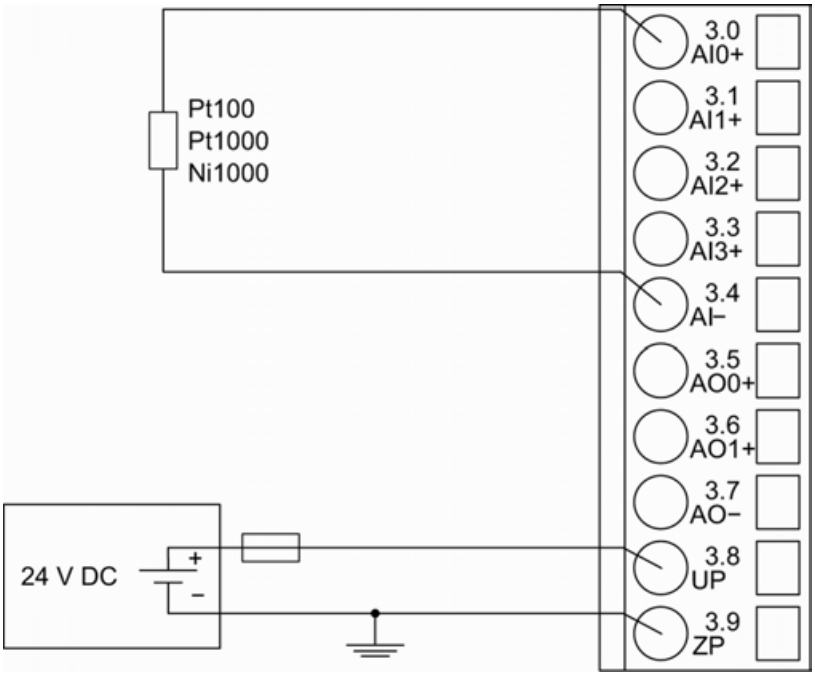



*Fig. 87: Connection of resistance thermometers in 2-wire configuration to the analog inputs*

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.

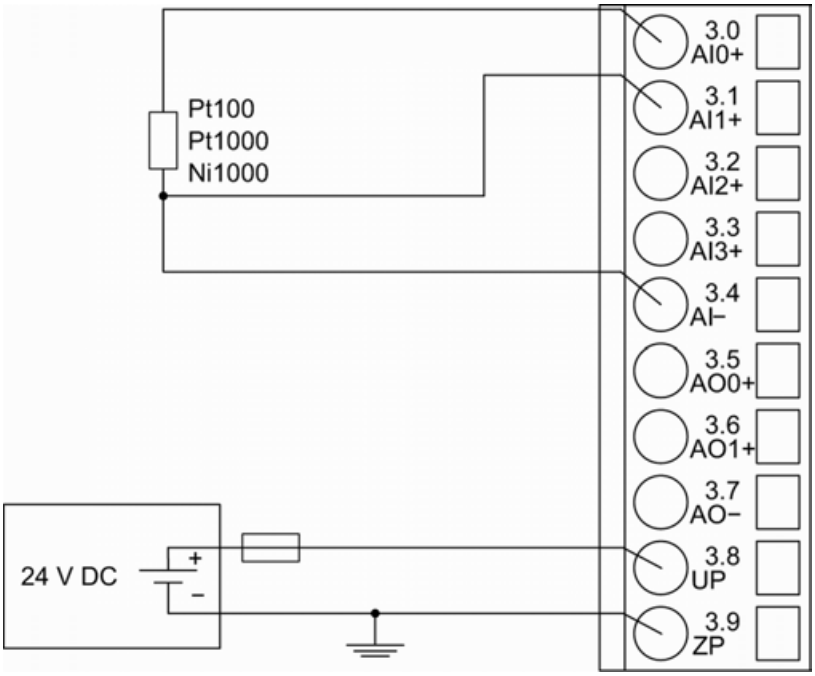



*Fig. 88: Connection of resistance thermometers in 3-wire configuration to the analog inputs*

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.

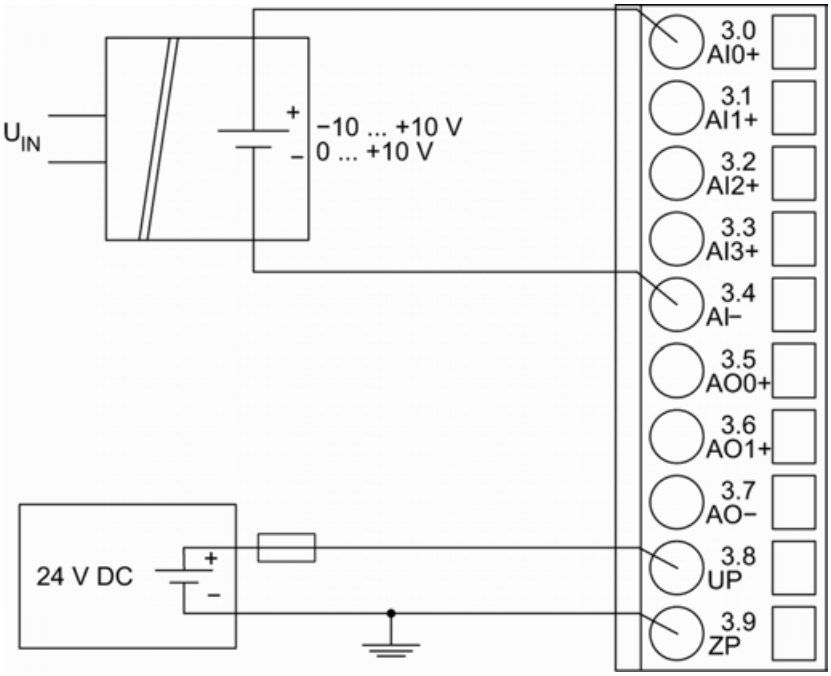



*Fig. 89: Connection of active-type analog sensors (voltage) with galvanically isolated power supply to the analog inputs*

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.

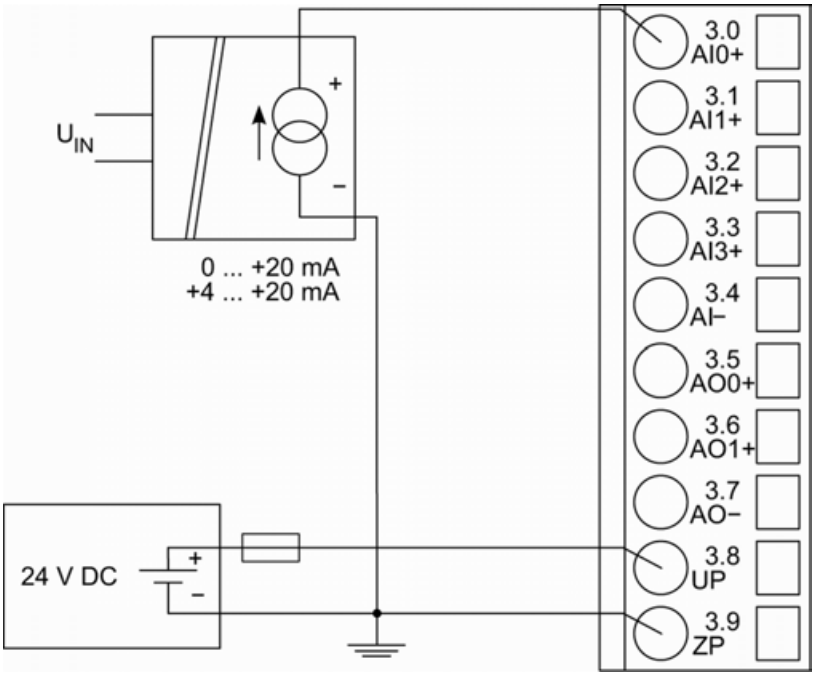



*Fig. 90: Connection of active-type analog sensors (current) with galvanically isolated power supply to the analog inputs*

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.

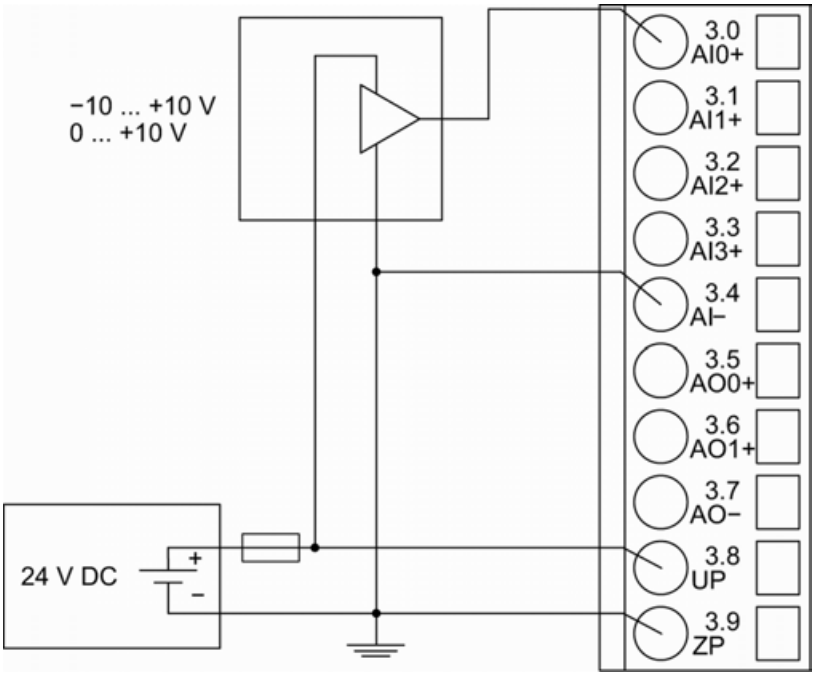



*Fig. 91: Connection of active-type sensors (voltage) with no galvanically isolated power supply to the analog inputs*

**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.

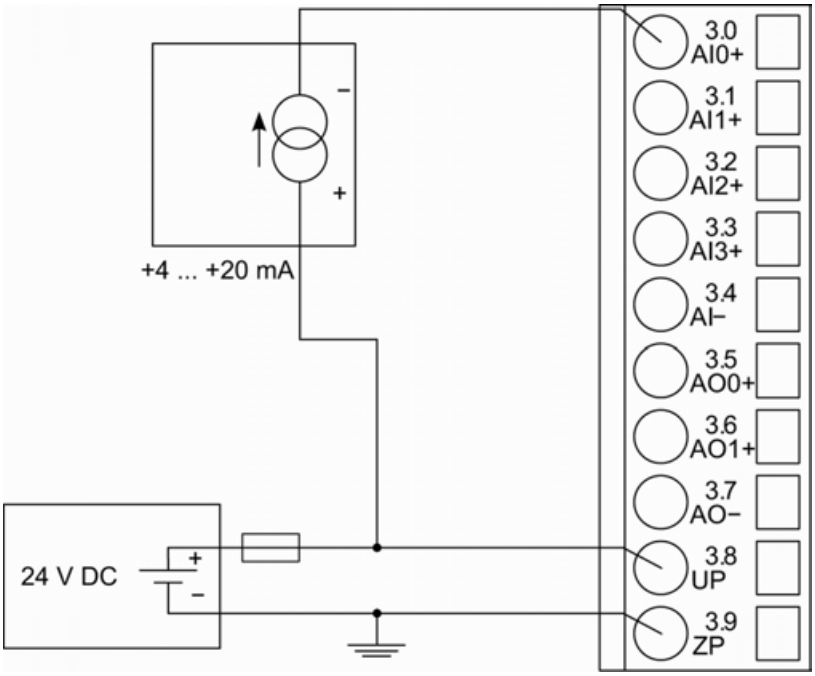



*Fig. 92: Connection of passive-type analog sensors (current) to the analog inputs*

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.

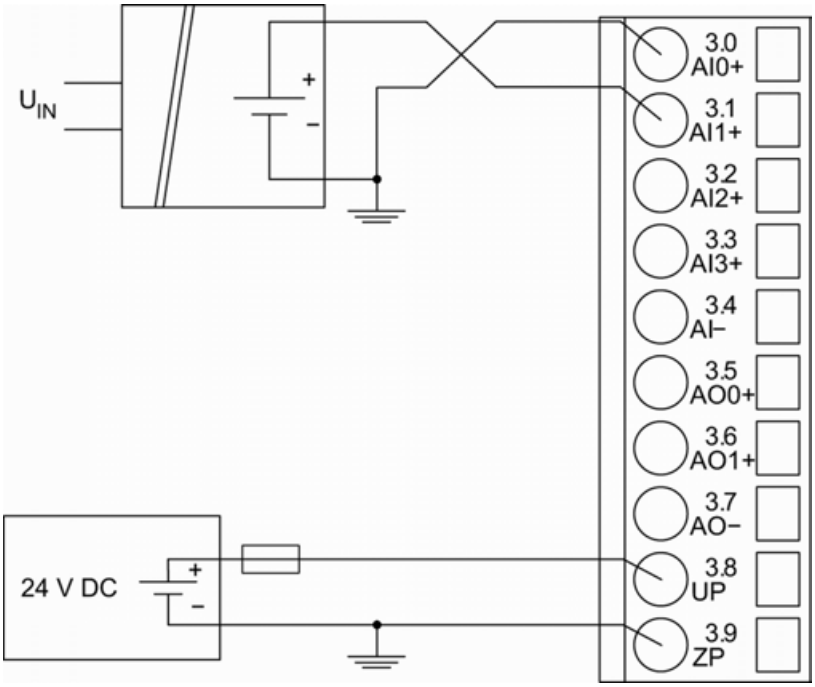



*Fig. 93: Connection of active-type analog sensors (voltage) to differential analog inputs*

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.

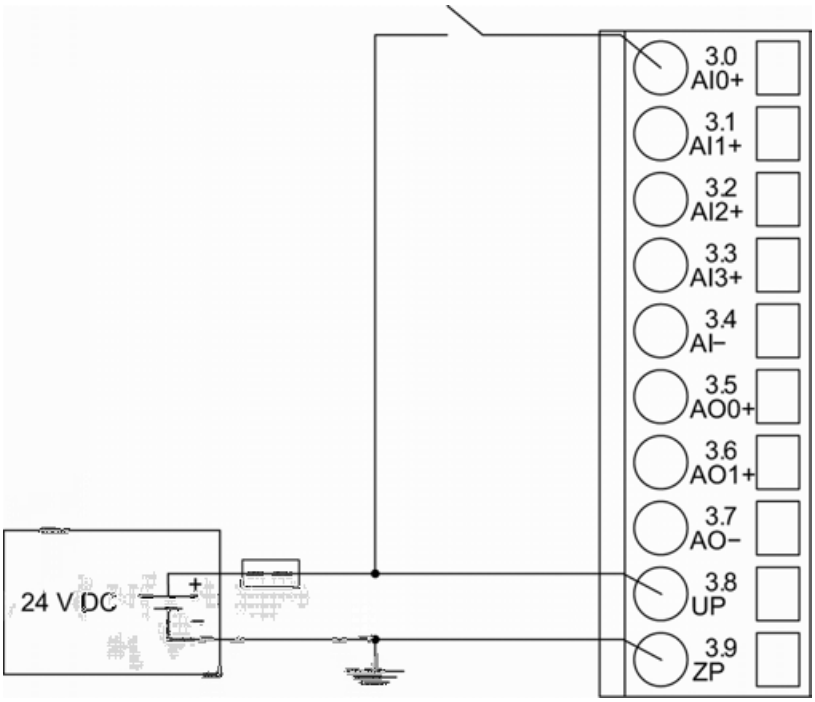



*Fig. 94: Use of analog inputs as digital inputs*

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.

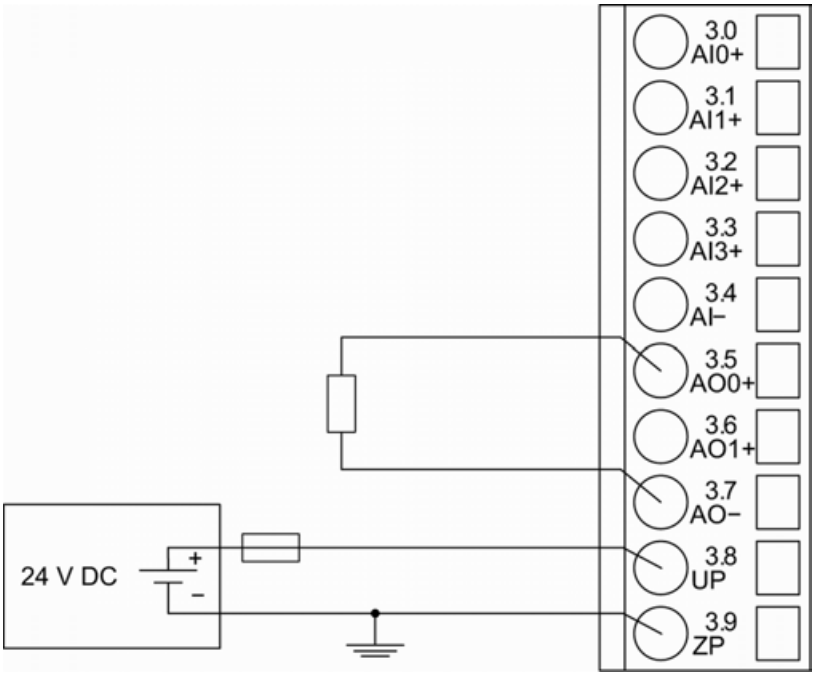



*Fig. 95: Connection of analog output loads (voltage)*

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.

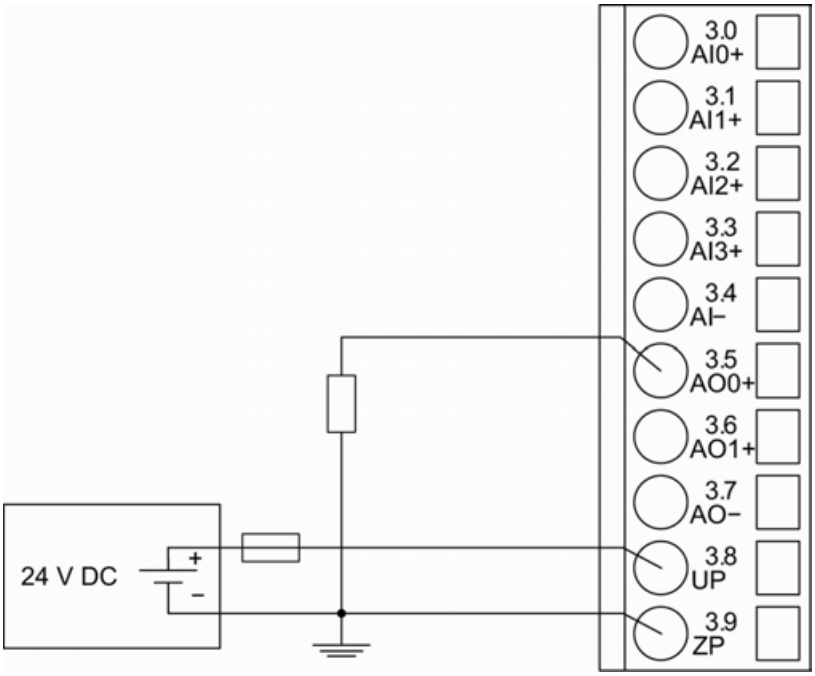



*Fig. 96: Connection of analog output loads (current)*

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<br>No | BYTE | No | |
| Parameter length | Internal | 8 | BYTE | 8 | 0xY02 |
| Check supply | off | 0 | BYTE | 1 | 0xY03 |
| | on | 1 | | | |
| Fast counter [3]) | 0<br>:<br>10 [2]) | 0<br>:<br>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<br>Substitute value 5 s<br>Substitute value 10 s | 0<br>1 6<br>11<br>2<br>7<br>12 | BYTE | Off<br>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<br>1 ms<br>8 ms<br>32 ms | 0<br>1<br>2<br>3 | BYTE | 0.1 ms<br>0x00 | 0x0Y05 |
| Detect short circuit at outputs | Off<br>On | 0<br>1 | BYTE | On<br>0x01 | 0x0Y06 |
| Substitute value at output | 0...255 | 00h...FFh | BYTE | 0<br>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<br>Reserved | 0<br>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<br>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.

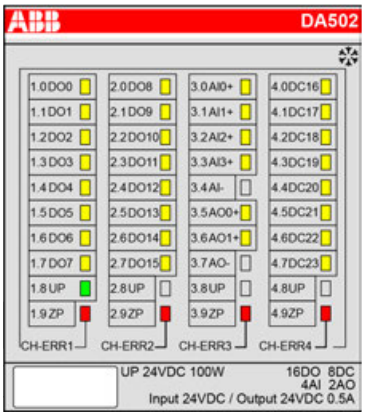
| **E1...E4** | **d1** | **d2** | **d3** | **d4** | **Identifier 000...063** | **AC500 display** | **<− Display in** | |
|---|---|---|---|---|---|---|---|---|
| **Class** | **Comp** | **Dev** | **Mod** | **Ch** | **Err** | **PS501 PLC browser** | | |
| **Byte 6 Bit 6...7** | **-** | **Byte 3** | **Byte 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:<br>14 = I/O bus, 11 = COM1 (e.g. CS31 bus), 12 = COM2. |
| [2]) | With "Device" the following allocation applies:<br>31 = module itself,<br>1...10 = communication interface module 1...10,<br>ADR = hardware address (e.g. of the DC551) |
| [3]) | With "Module" the following allocation applies depending on the master:<br>Module error: I/O bus: 31 = Module itself; COM1/COM2: 1...10 = expansion 1...10<br>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<br>:<br>10.0004 | 11.7589<br>:<br>10.0004 | 23.5178<br>:<br>20.0007 | 22.8142<br>:<br>20.0006 | | 32511<br>:<br>27649 | 7EFF<br>:<br>6C01 |
| Normal range<br>Normal range or measured value too low | 10.0000<br>:<br>0.0004 | 10.0000<br>:<br>0.0004 | 20.0000<br>:<br>0.0007 | 20.0000<br>:<br>4.0006 | On | 27648<br>:<br>1 | 6C00<br>:<br>0001 |
| | 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<br>-1.7593 | -0.0004<br>:<br>:<br>:<br>-10,0000 | | 3.9994<br>:<br>0 | | -1<br>-4864<br>-6912<br>:<br>-27648 | FFFF<br>ED00<br>E500<br>:<br>9400 |
| Measured value too low | | -10.0004<br>:<br>-11.7589 | | | | -27649<br>:<br>-32512 | 93FF<br>:<br>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<br>-50...70 °C | Pt100 / Pt1000<br>-50...400 °C | Ni1000<br>-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<br>:<br>400.1 °C | | 4500<br>:<br>4001 | 1194<br>:<br>0FA1 |
| | | | 160.0 °C<br>:<br>150.1 °C | 1600<br>:<br>1501 | 0640<br>:<br>05DD |
| | 80.0 °C<br>:<br>70.1 °C | | | 800<br>:<br>701 | 0320<br>:<br>02BD |
| Normal range | :<br>:<br>70.0 °C<br>:<br>0.1 °C | 400.0 °C<br>:<br>:<br>:<br>0.1 °C | 150.0 °C<br>:<br>:<br>:<br>0.1 °C | 4000<br>1500<br>700<br>:<br>1 | 0FA0<br>05DC<br>02BC<br>:<br>0001 |
| | 0.0 °C | 0.0 °C | 0.0 °C | 0 | 0000 |
| | -0.1 °C<br>:<br>-50.0 °C | -0.1 °C<br>:<br>-50.0 °C | -0.1 °C<br>:<br>-50,0 °C | -1<br>:<br>-500 | FFFF<br>:<br>FE0C |

| Range | Pt100 / Pt1000<br>-50...70 °C | Pt100 / Pt1000<br>-50...400 °C | Ni1000<br>-50...150 °C | Digital value | |
|---|---|---|---|---|---|
| | | | | Decimal | Hex. |
| Measured value too low | -50.1 °C<br>:<br>-60.0 °C | -50.1 °C<br>:<br>-60.0 °C | -50.1 °C<br>:<br>-60.0 °C | -501<br>:<br>-600 | FE0B<br>:<br>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<br>:<br>10.0004 V | 23.5178 mA<br>:<br>20.0007 mA | 22.8142 mA<br>:<br>20.0006 mA | 32511<br>:<br>27649 | 7EFF<br>:<br>6C01 |
| Normal range | 10.0000 V<br>:<br>0.0004 V | 20.0000 mA<br>:<br>0.0007 mA | 20.0000 mA<br>:<br>4.0006 mA | 27648<br>:<br>1 | 6C00<br>:<br>0001 |
| | 0.0000 V | 0.0000 mA | 4.0000 mA | 0 | 0000 |
| | -0.0004 V<br>:<br>-10.0000 V | 0 mA<br>:<br>0 mA | 3.9994 mA<br>0 mA<br>0 mA | -1<br>-6912<br>-27648 | FFFF<br>E500<br>9400 |
| Value too low | -10.0004 V<br>:<br>-11.7589 V | 0 mA<br>:<br>0 mA | 0 mA<br>:<br>0 mA | -27649<br>:<br>-32512 | 93FF<br>:<br>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.

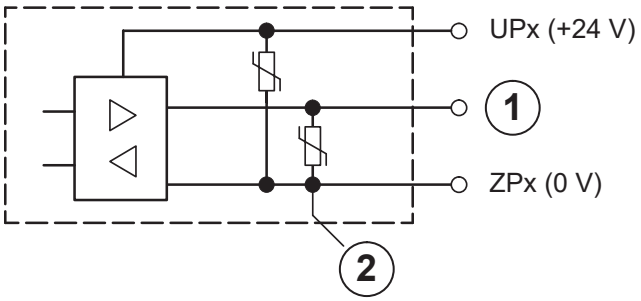



*Fig. 97: Digital input/output (circuit diagram)*

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<br>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<br>Current: ca. 330 Ω |
| Time constant of the input filter | | Voltage: 100 µs<br>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<br>Range -10 V...+10 V: 12 bits + sign<br>Range 0 mA...20 mA: 12 bits<br>Range 4 mA...20 mA: 12 bits<br>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 %<br>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*<br>↳ *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<br>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),<br>as current output | 0 Ω...500 Ω |
| Output loadability,<br>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.*

**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.<br>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 |

*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<br>2 Hz...8.4 Hz, continuous 3.5 mm<br>8.4 Hz...150 Hz, continuous 1 g (higher values on request) |
| Shock test | All three axes<br>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.

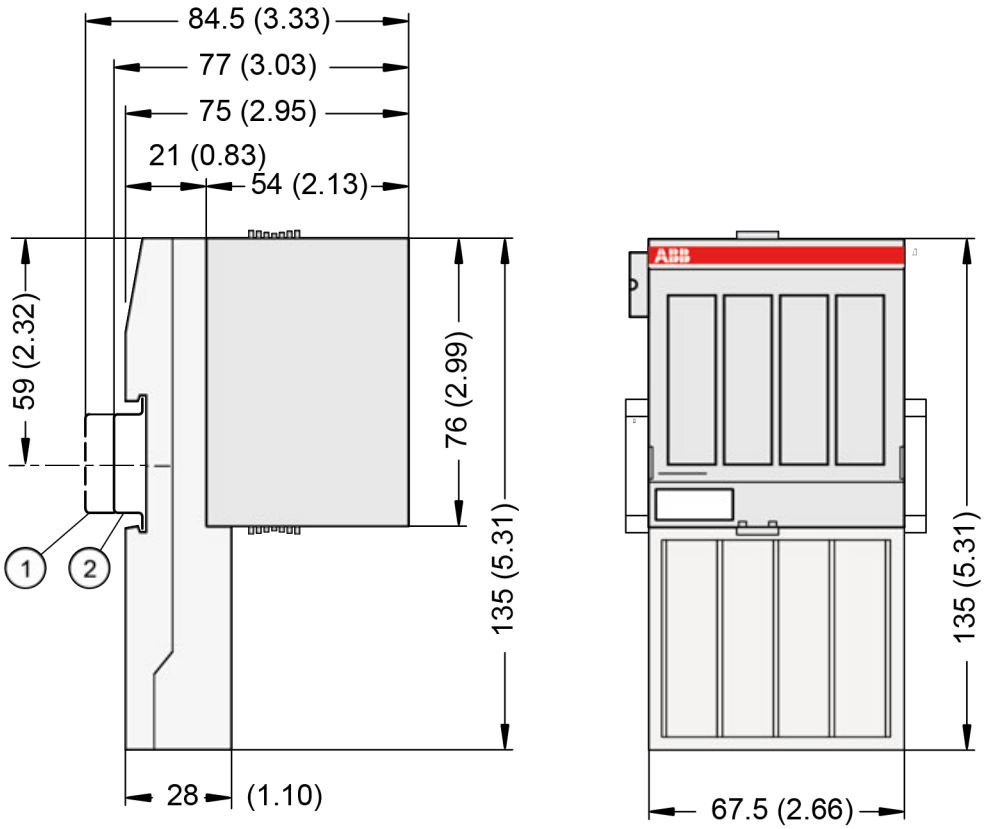



*Fig. 185: Terminal units and S500 modules, side view and front view*

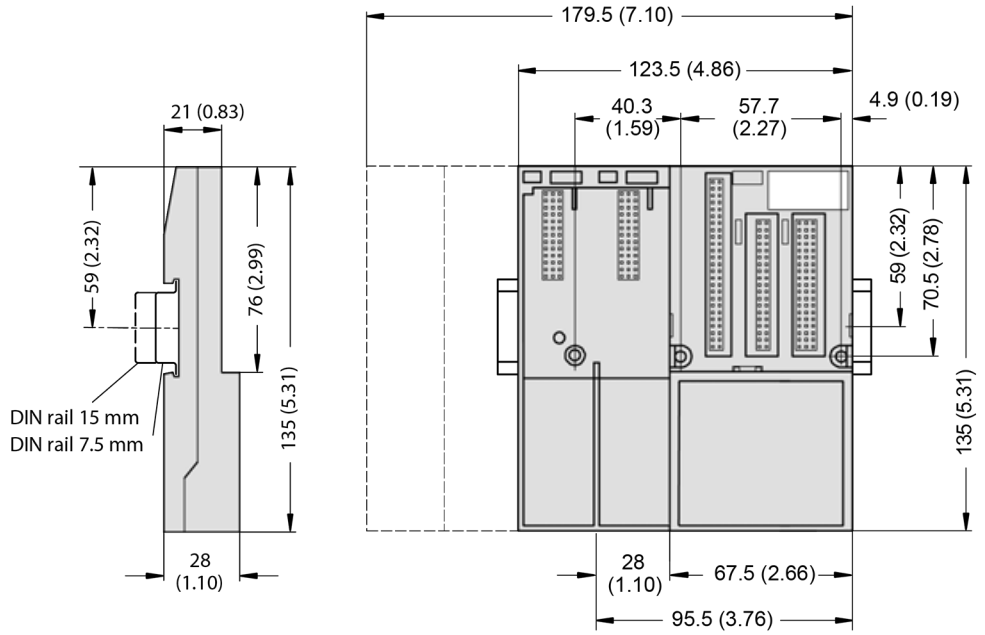



*Fig. 186: Terminal base (for comparison)*

*All dimensions are in mm (in.). Hole spacing tolerance: ±0.4 mm (0.016 in.)*