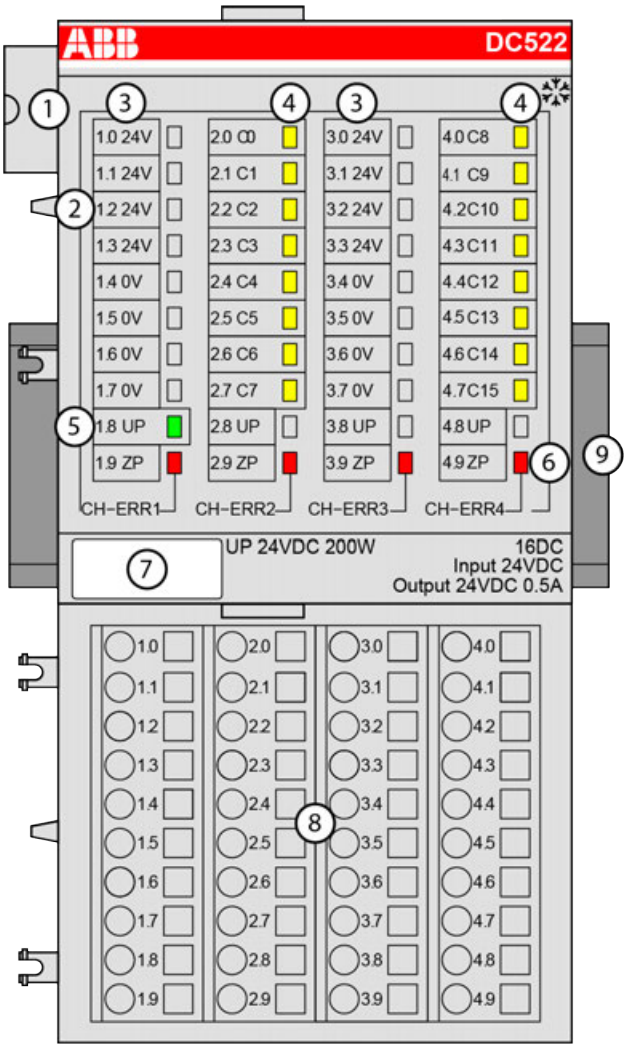
### 1.6.1.2 S500

#### 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*).

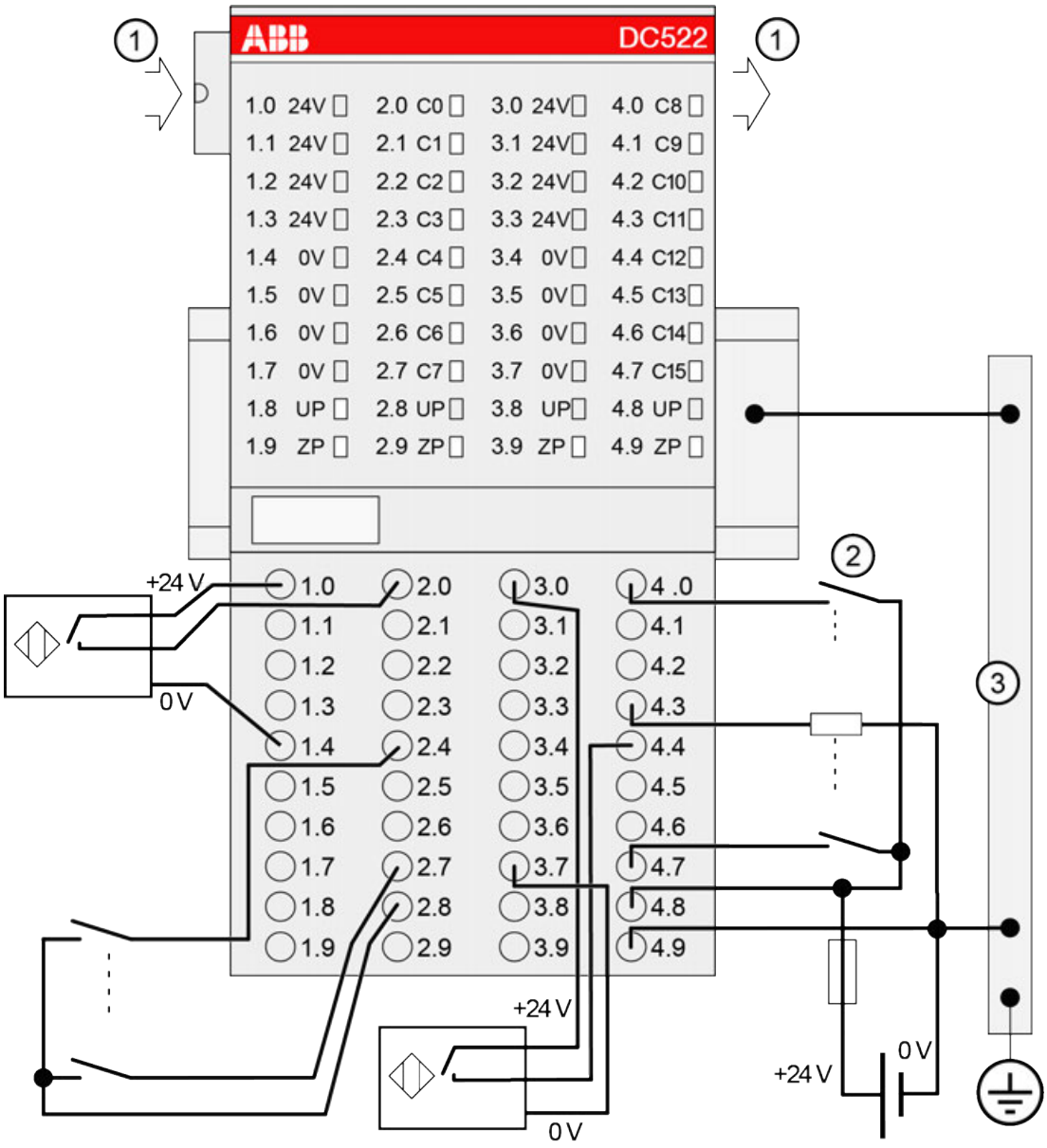
### Connections

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<br>[1]) | Word | 1220<br>0x04C4 | 0 | 65535 | 0x0Y01 |
| Ignore module<br>[2]) | No<br>Yes | 0<br>1 | Byte | No<br>0x00 | | | Not for FBP |
| Parameter length | Internal | 7 | Byte | 7-CPU<br>6-FBP | 0 | 255 | 0x0Y02 |
| Check supply | Off<br>On | 0<br>1 | Byte | On<br>0x01 | 0 | 1 | 0x0Y03 |

| Name | Value | Internal value | Internal value, type | Default | Min. | Max. | 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 | 8 ms<br>0x02 | 0 | 3 | 0x0Y04 |
| Fast counter [4]) | 0<br>:<br>10 [3]) | 0<br>:<br>10 | Byte | Mode 0<br>0x00 | | | Not for FBP |
| Short-circuit detection of output or sensor supply | Off<br>On | 0<br>1 | Byte | On<br>0x01 | 0 | 1 | 0x0Y05 |
| Behaviour of outputs at communication errors | Off<br>Last value<br>Substitute value | 0<br>1+(n*5)<br>2+(n*5),<br>n ≤ 2 | Byte | Off<br>0x00 | 0 | 2 | 0x0Y06 |
| Substitute value at outputs<br>Bit 15 = Output 15<br>Bit 0 = Output 0 | 0...<br>65535 | 0...<br>0xffff | Word | 0<br>0x0000 | 0 | 65535 | 0x0Y07 |

Remarks:

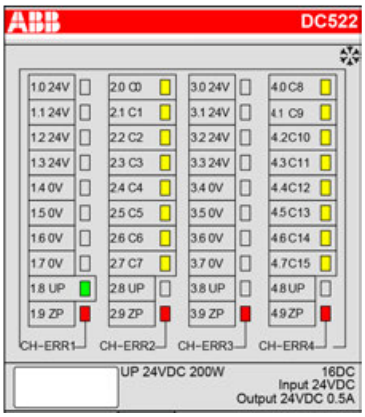
| | |
|---|---|
| [1]) | With CS31 and addresses smaller than 70 and FBP, the value is increased by 1 |
| [2]) | Not with FBP |
| [3]) | For a description of the counter operating modes, please refer to the 'Fast Counter' section *Chapter 1.6.1.2.9 “Fast counter” on page 349* |
| [4]) | With FBP or CS31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

GSD file:

| | |
|---|---|
| Ext_User_Prm_Data_Len =<br>Ext_User_Prm_Data_Const(0) = | 9<br>0x04, 0xc5, 0x06, \<br>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<br>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<br>Terminals 3.0...3.3, in total max. 0.5 A |
| Weight (without terminal unit) | | Ca. 125 g |
| Mounting position | | Horizontal<br>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.

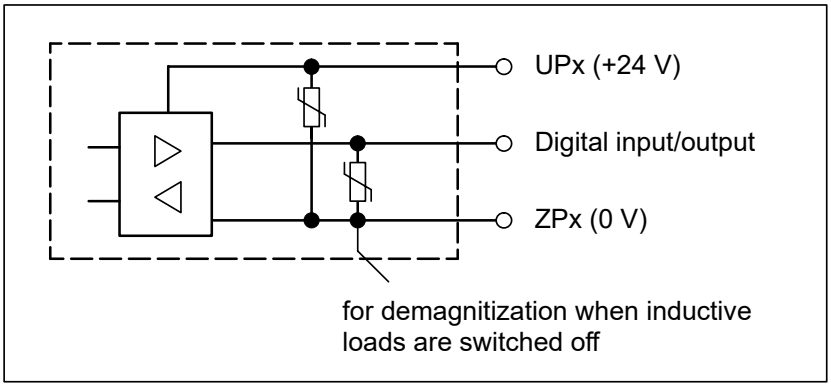



*Fig. 21: Digital input/output (circuit diagram)*

**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

**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.

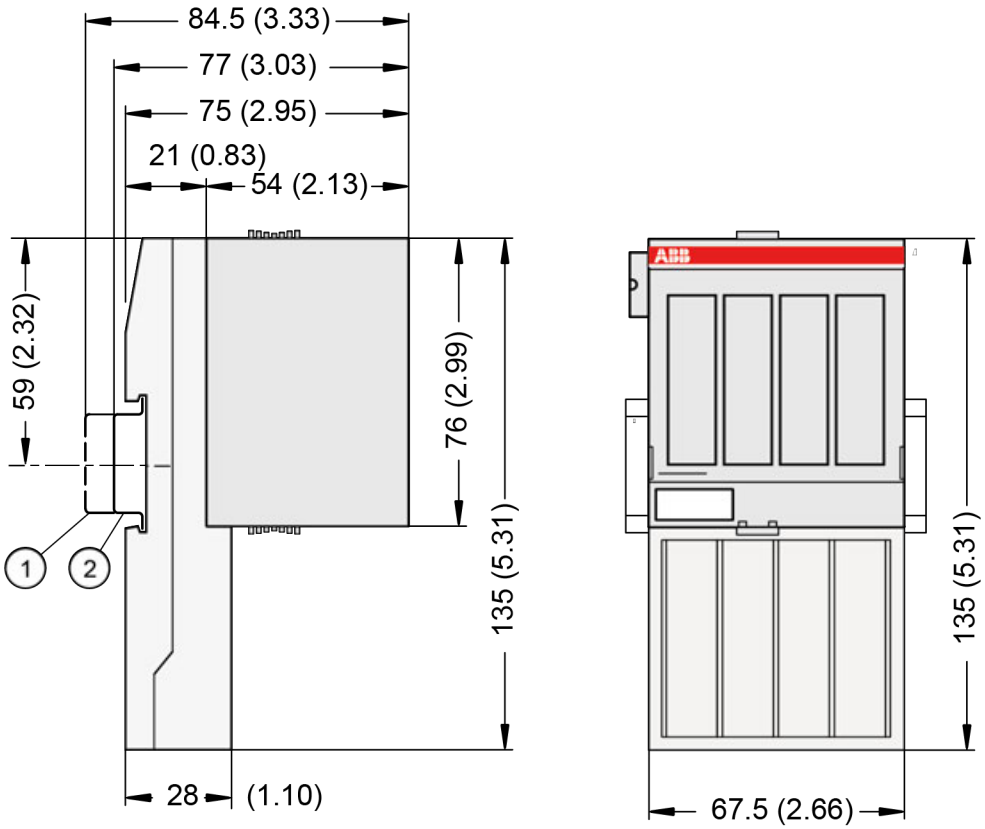



*Fig. 185: Terminal units and S500 modules, side view and front view*

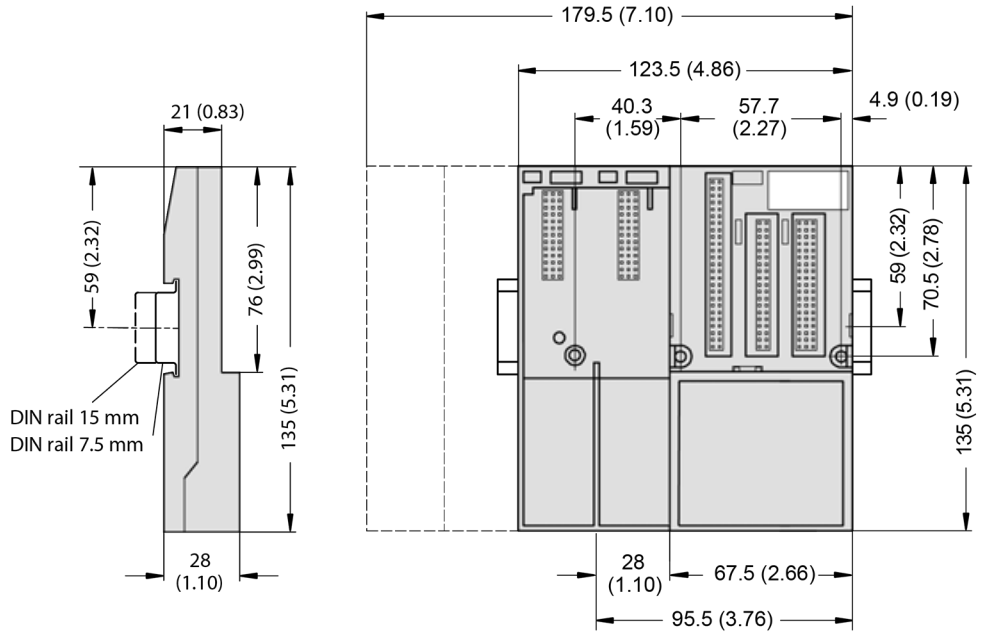



*Fig. 186: Terminal base (for comparison)*

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