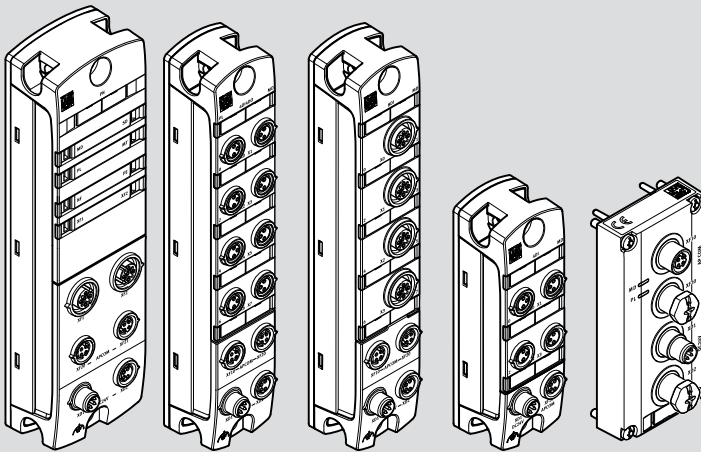


# CPX-AP-I

## Remote I/O system

# FESTO

Operating instruction



8235913

8235913  
2025-05d  
[8235915]

## Original instructions

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# 1 About this document

## 1.1 Applicable documents



All available documents for the product → [www.festo.com/sp](http://www.festo.com/sp).

| Document                                                               | Contents                         |
|------------------------------------------------------------------------|----------------------------------|
| Operating instructions for the modules in a remote I/O system CPX-AP-I | Information on using the modules |

Tab. 1: Applicable documents

## 1.2 Product version

This document refers to the remote I/O system CPX-AP-I.

The product version can be determined from the product labelling.



There may be an updated version of this document for this or later product versions → [www.festo.com/sp](http://www.festo.com/sp).

## 1.3 Product labelling

The product labelling and the Data Matrix Code are printed on the housings of the modules. Scanning the Data Matrix Code with an appropriate device opens the Festo Internet page with documents appropriate for the product. Alternatively, the Product Key (11-digit alphanumeric code on the product labelling) can be entered in the search field → [www.festo.com/sp](http://www.festo.com/sp).

## 1.4 Specified standards

| Version               |                         |
|-----------------------|-------------------------|
| IEC 60204-1:2016-10   | DIN 46211:1965-03       |
| EN 60068-2-6:2008-02  | DIN 46225:1976-12       |
| EN 60068-2-27:2009-05 | DIN 46234:1980-03       |
| EN 60204-1:2018-09    | DIN EN ISO 4762:2004-06 |
| EN 60529:1991-10      | –                       |

Tab. 2: Standards specified in the document

# 2 Safety

## 2.1 Safety instructions

- Only use the product if it is in perfect technical condition.
- Observe the identifications on the product.
- Store the product in a cool, dry environment protected from UV and corrosion. Keep storage times short.
- Before working on the product, switch off the power supply and secure it against being switched on again.

## 2.2 Intended use

The product described in this document is intended exclusively for control tasks on machines or automation systems.

Use the product only as follows:

- Use only in an industrial environment. Outside of industrial environments, e.g. in commercial and mixed-residential areas, actions to suppress interference may have to be taken.
- Use only in combination with modules and components that are approved for the applicable product variant → [www.festo.com/catalogue](http://www.festo.com/catalogue).

## 2.3 Training of qualified personnel

Work on the product may only be carried out by qualified personnel who can evaluate the work and detect dangers. The qualified personnel have skills and experience in dealing with electrical (open-loop) control technology.

## 2.4 UL certification

In combination with the UL inspection mark on the product, the information in this section must also be observed in order to comply with the certification conditions of Underwriters Laboratories Inc. (UL) for USA and Canada.

| UL approval information |                                                                                    |
|-------------------------|------------------------------------------------------------------------------------|
| Product category code   | NRAQ, NRAQ7                                                                        |
| File number             | E239998                                                                            |
| Considered standards    | UL 61010-1; UL 61010-2-201; CAN/CSA C22.2 No. 61010-1-12; CAN/CSA-IEC 61010-2-201  |
| UL mark                 |  |
| UL control number       | 29TS                                                                               |

Tab. 3: UL certification information

- Technical data and environmental conditions may be subject to change in order to comply with Underwriters Laboratories Inc. (UL) certification requirements for the USA and Canada.  
Deviating values → 12.4 Technical data for UL certification.
- The unit shall be supplied by a power source which fulfils the requirements on a limited-energy circuit in accordance to IEC/EN/UL/CSA 61010-1 or on a Limited Power Source (LPS) in accordance to IEC/EN/UL/CSA 60950-1 or IEC/EN/UL/CSA 62368-1 or a Class 2 circuit in accordance to NEC or CEC.
- UL: The integrated semiconductor short-circuit protection does not protect the downstream power circuit. The power circuit must be protected in conformity with the National Electrical Code and all other local regulations.  
cUL: The integrated semiconductor short-circuit protection does not protect the downstream power circuit. The power circuit must be protected in conformity with the Canadian Electrical Code, part I.
- If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.
- External backup fuses: use UL-certified fuses that are designed in accordance with UL 61010-1.

## 3 Additional information

- Contact the regional Festo contact if you have technical problems  
→ [www.festo.com](http://www.festo.com).
- Accessories → [www.festo.com/catalogue](http://www.festo.com/catalogue).

## 4 Product overview

### 4.1 System structure

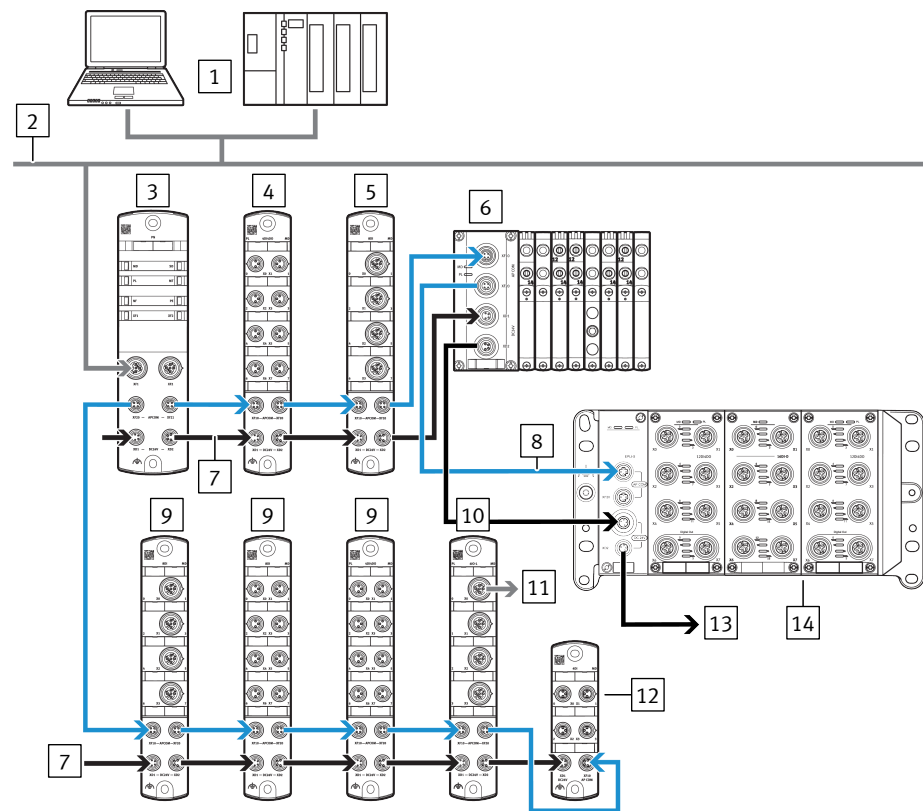


Fig. 1: System structure (example for PROFINET interface and electrical interface for VTUG)

- |                                                          |                                                |
|----------------------------------------------------------|------------------------------------------------|
| 1 Higher-order controller                                | 9 Digital input/output module                  |
| 2 Network                                                | 10 IO-Link master                              |
| 3 Interface (example for PROFINET)                       | 11 IO-Link device                              |
| 4 Digital input/output module                            | 12 Digital input module (without transmission) |
| 5 Digital input module or analogue input module          | 13 Forwarding supply to CPX-AP-A-EPLI          |
| 6 Electrical interface (example for valve terminal VTUG) | 14 CPX-AP-A terminal                           |
| 7 Power supply                                           |                                                |
| 8 AP system communication (example for CPX-AP-A)         |                                                |

### 4.2 CPX-AP-A and CPX-AP-I combination options

The modules of the remote I/O system CPX-AP-A and CPX-AP-I can be combined. Modules up to the maximum permissible number of modules including a bus interface are possible in any combination.

| Module             | Combination options                                                                                                                                                                                       |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CPX-AP-A interface | XF20 connection:<br><ul style="list-style-type: none"> <li>– connect CPX-AP-I modules directly</li> <li>– connect additional CPX-AP-A terminals using CPX-AP-A-EPLI or CPX-AP-A-EPLI-S</li> </ul>         |
| CPX-AP-EPLI/EPLI-S | XF20 connection:<br><ul style="list-style-type: none"> <li>– connect CPX-AP-I modules directly</li> <li>– connect additional CPX-AP-A terminals using CPX-AP-A-EPLI or CPX-AP-A-EPLI-S</li> </ul>         |
| CPX-AP-I interface | XF20 or XF21 connection:<br><ul style="list-style-type: none"> <li>– connect CPX-AP-I modules directly</li> <li>– connect additional CPX-AP-A terminals using CPX-AP-A-EPLI or CPX-AP-A-EPLI-S</li> </ul> |

Tab. 4: Combination options

**Exception for the combination of CPX-AP-A and CPX-AP-I**

CPX-AP-I and CPX-AP-A cannot be combined with a CPX-AP-I-PB interface.



If a bus interface and a CPX-AP-A-EPLI or CPX-AP-A-EPLI-S are used in a CPX-AP-A remote I/O system, the connection [XF10] of the CPX-AP-A-EPLI or CPX-AP-A-EPLI-S must not be used.

The combination of a bus interface and a CPX-AP-A-EPLI or CPX-AP-A-EPLI-S is only necessary if 2 AP-Out ports are required.

### 4.3 Product variants

#### Interfaces

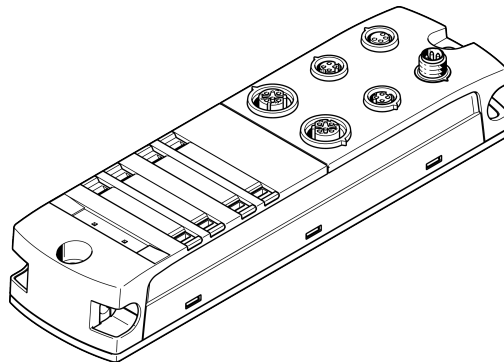


Fig. 2: Example for CPX-AP-I-PN-M12

An interface is the interface of the remote I/O system CPX-AP-I to the network and has the following functions:

- Connecting the remote I/O system CPX-AP-I to the network
- Data transfer between the remote I/O system CPX-AP-I and the higher-order controller
- Transmission of control signals to the connected modules
- Monitoring the functionality of the connected modules
- Access to system parameters (read/write), input/output signals and diagnostic data (depending on the interface)
- Control of the remote I/O system CPX-AP-I

## Input/output modules

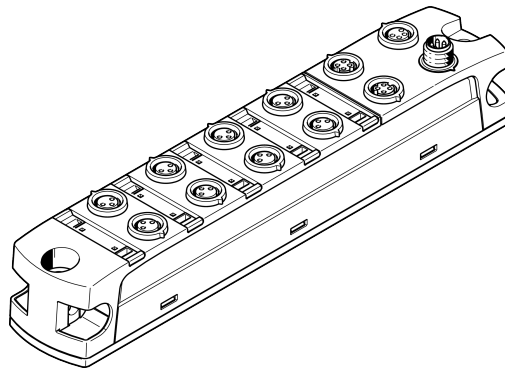


Fig. 3: example for CPX-AP-I-8DI-M8-3P

The input/output modules include various module types:

- Digital input/output modules can be used, for example, to query sensor signals or to control actuators.
- An analogue input module records analogue input signals in a remote I/O system CPX-AP-I.
- A IO-Link master in a remote I/O system CPX-AP-I provides multiple IO-Link Ports for integration of IO-Link Devices.

## Electrical interfaces

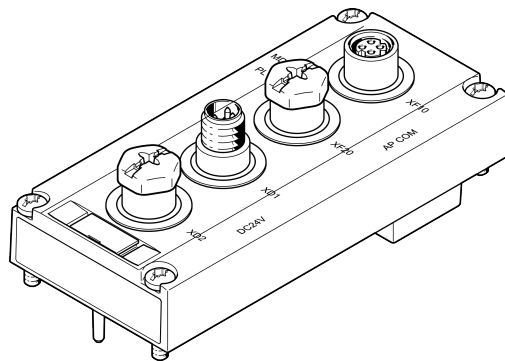


Fig. 4: example for VAEM-L1-S-...-AP

With electrical interfaces, valve terminals, e.g. VTUG or MPAL, can be controlled via the remote I/O system CPX-AP-I.

### 4.4 LED indicators

Depending on the module, the modules have various LED displays for visualising status and diagnostics.



Detailed information on the LED displays of the individual modules  
→ Product-specific documentation

### 4.5 Labelling elements

The same clip-on inscription label is available for all modules. The inscription label is in two parts and can be divided into two smaller units if necessary.

## 5 Function

The remote I/O system CPX-AP-I is a decentralized system for connecting electrical peripherals. Different module types with different connection technology are available. A remote I/O system CPX-AP-I consists of an interface and at least one other module. For system communication, the individual modules in a remote I/O system CPX-AP-I are connected to each other by connecting cables. The process data is exchanged cyclically.

The remote I/O system CPX-AP-I is connected to a higher-order controller via an interface. The response of the remote I/O system CPX-AP-I can be adapted to the specific requirements by access to internal parameters. Various diagnostic functions are also available.

## 6 System communication and address assignment

For internal system communication between the modules, two strings can be implemented via the connections [XF20] and [XF21] of the interfaces with connecting cables. The connecting cables are connected to the individual modules via connection [XF10]. Connection [XF20] is available for transmission to another module.

The addresses of the modules are automatically allocated every time the remote I/O system CPX-AP-I is started. The interface is assigned address 1. The modules are addressed at terminals [XF20] and [XF21] in ascending order for each string, starting with the string at terminal [XF20].

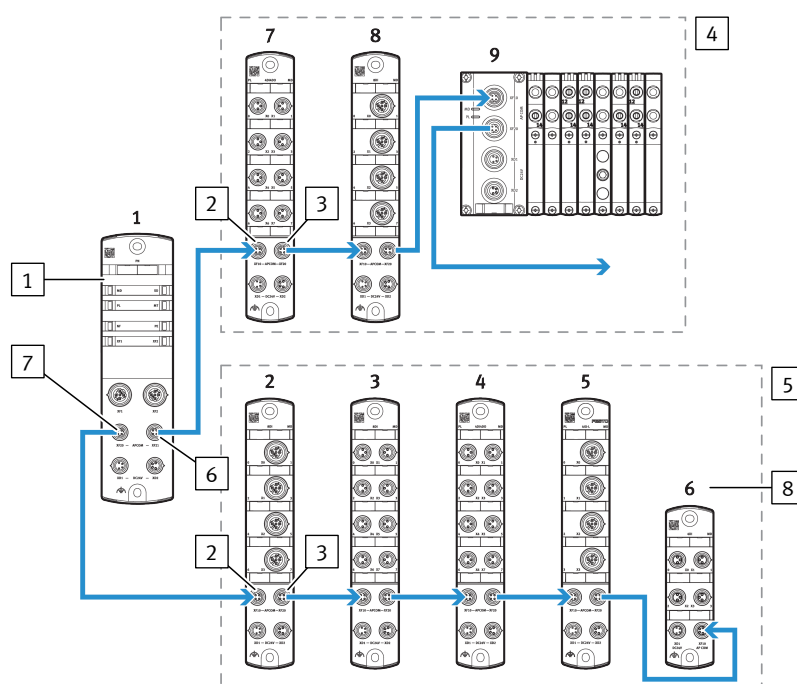


Fig. 5: System communication and addressing

- |                                                  |                                                           |
|--------------------------------------------------|-----------------------------------------------------------|
| 1 Interface                                      | 5 String 1                                                |
| 2 Connection for system communication [XF10] IN  | 6 Connection for system communication string 2 [XF21]     |
| 3 Connection for system communication [XF20] OUT | 7 Connection for system communication string 1 [XF20] OUT |
| 4 String 2                                       | 8 Module address                                          |

## Addressing example with CPX-AP-A

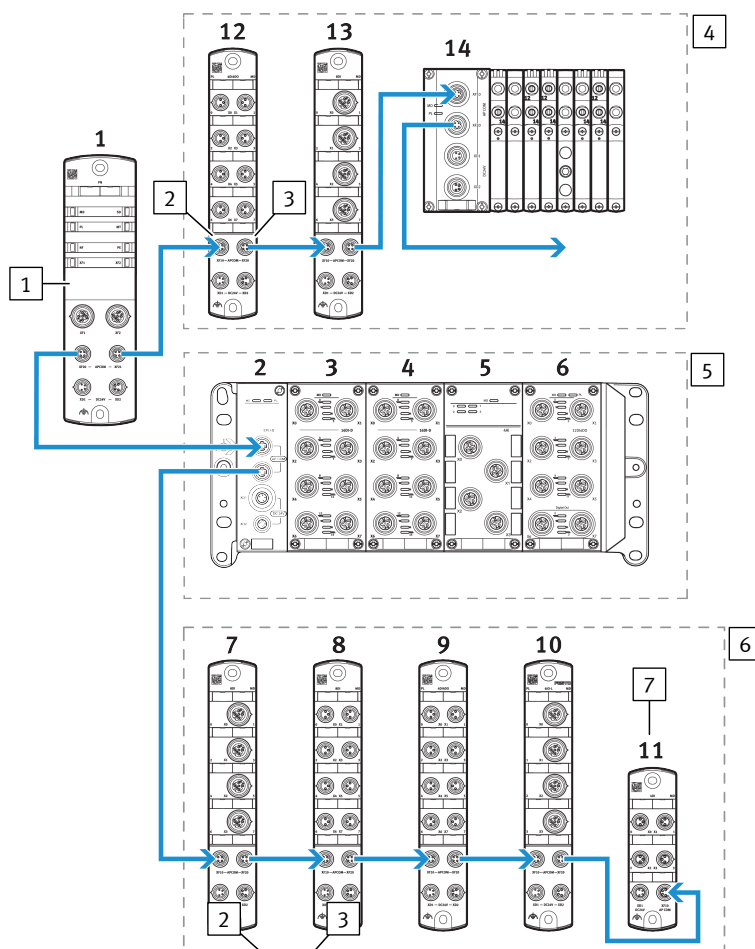


Fig. 6: Addressing example with CPX-AP-A

- |                                                  |                                          |
|--------------------------------------------------|------------------------------------------|
| 1 Interface                                      | 5 String 1 - CPX-AP-A                    |
| 2 Connection for system communication [XF10] IN  | 6 Continuation of string 1 with CPX-AP-I |
| 3 Connection for system communication [XF20] OUT | 7 Module address                         |
| 4 String 3 - CPX-AP-I                            |                                          |

### NOTICE

#### Loss of function due to incorrectly connected or impermissible connecting cables.

- Always connect the connecting cables for the modules to the connection [XF10].
- Always connect the forwarding of the connecting cables to the connection [XF20].
- Only use permissible connecting cables from the Festo catalogue  
➔ [www.festo.com/catalogue](http://www.festo.com/catalogue).

**Behaviour in the event of incorrect configuration after restart**

When establishing a connection with the higher-order controller, the configuration is checked for the following criteria, depending on the network protocol of the interface:

- Total number of input and output bytes
- Module codes and sequence of modules
- Length and format of the start-up parameterisation

If there are deviations, the connection to the higher-order controller is rejected and a network-specific error message is generated.

**Behaviour when changing the configuration during operation**

- If a module is removed during operation, process data are not transferred to the higher-order controller for this module and all downstream modules. The failure of the module is signalled via a diagnostic message and, if necessary, network-specific status bytes in the process data.
- If an additional module is added after the connection is established with the higher-order controller or an existing module is replaced, this module is not included in the active configuration and data exchange with this module is not possible.

In order for changes to the configuration to become active, the system must be restarted (switched off/on).

## **7 Mounting**

### **7.1 Mounting distances and installation space**

Certain minimum distances must be observed when installing the modules to ensure sufficient space for the connecting cables. The minimum distances to be observed depend on the modules and the type of connectors used (straight or angled).

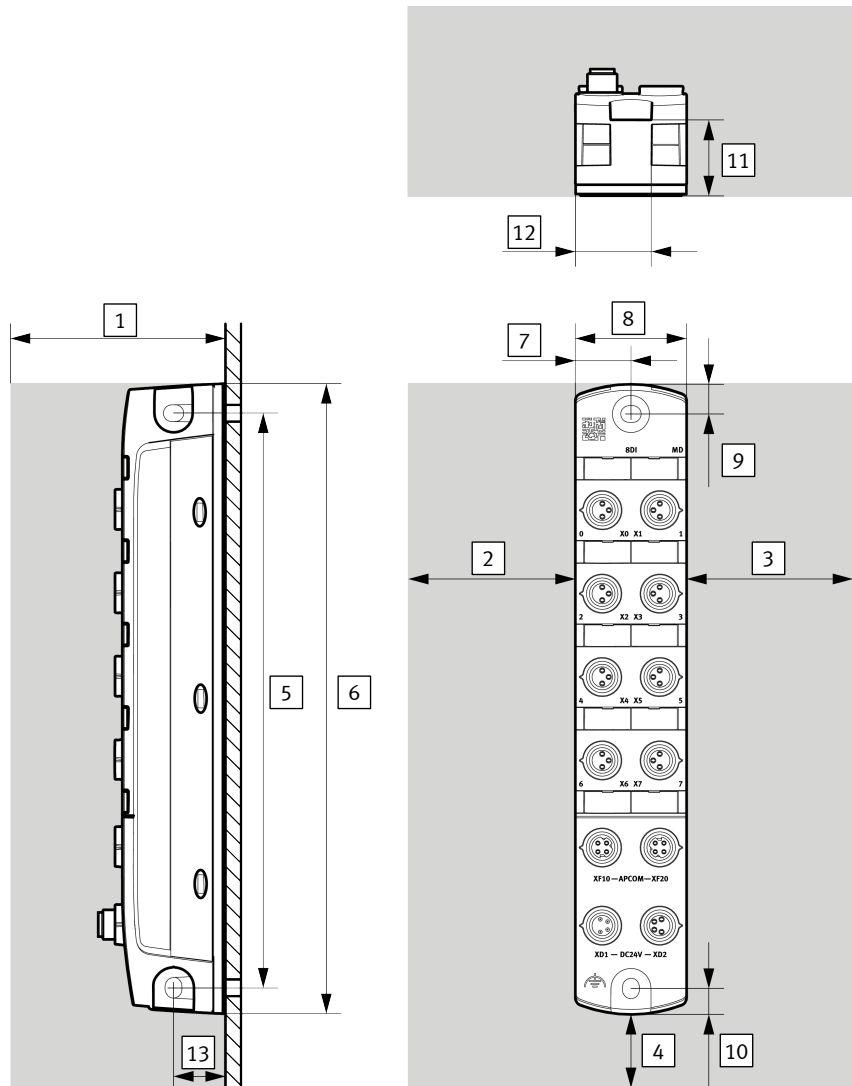


Fig. 7: Mounting distances and installation space (example: CPX-AP-I-8DI-M8-3P)

| Item no.<br>→ Fig. 7                 | Interfaces     |        | Input/output modules<br>IO-Link Master |        |
|--------------------------------------|----------------|--------|----------------------------------------|--------|
|                                      | Connector plug |        | Connector plug                         |        |
|                                      | straight       | angled | straight                               | angled |
| Minimum distances [mm]               |                |        |                                        |        |
| 1                                    | 103            | 62     | 108                                    | 66     |
| 2                                    | 0              | 56     | 0                                      | 54     |
| 3                                    | 0              | 56     | 0                                      | 54     |
| 4                                    | 64             |        | 64                                     |        |
| Distance between mounting holes [mm] |                |        |                                        |        |
| 5                                    | 155            |        | 155<br>87.5 (CPX-AP-I-4DI-M8-3P)       |        |
| 6                                    | 170            |        | 170<br>102.5 (CPX-AP-I-4DI-M8-3P)      |        |
| 7                                    | 22.5           |        | 15                                     |        |
| 8                                    | 45             |        | 30                                     |        |
| 9                                    | 8              |        | 8                                      |        |
| 10                                   | 7              |        | 7                                      |        |
| 11                                   | 20.5           |        | 20.5                                   |        |
| 12                                   | 35.5           |        | 20.5                                   |        |
| 13                                   | 13.8           |        | 13.8                                   |        |

Tab. 5: Mounting distances and installation space



Mounting distances of the electrical interfaces  
→ Product-specific documentation

## 7.2 Direct mounting

The modules are installed directly via the fastening interfaces with two M4 socket head screws with internal hexagon in accordance with DIN EN ISO 4762.

When installing the modules, note the following:

- Always use two retaining screws.
- Use suitable washers.
- Observe a tightening torque of 1.2 Nm.
- Functional earth connection → 8.2 Functional earth FE

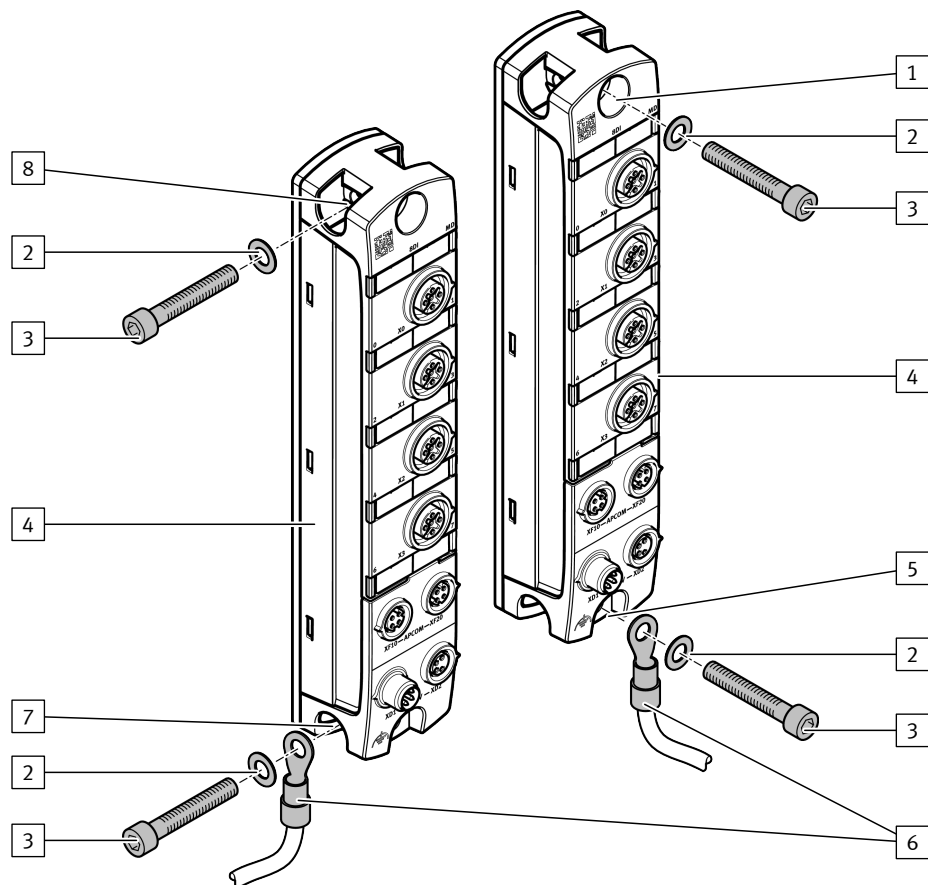


Fig. 8: Direct mounting

- |                                                                                |                                                                             |
|--------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| 1 Mounting interface connection side top                                       | 6 Cable lug with earthing cable (optional)                                  |
| 2 Washer                                                                       | 7 Mounting interface, lateral bottom and connection for functional earth FE |
| 3 Socket head screw M4                                                         | 8 Mounting interface, side top                                              |
| 4 Module (example for CPX-AP-I-8DI-M12-5POL)                                   |                                                                             |
| 5 Mounting interface connection side bottom and functional earth FE connection |                                                                             |

## 8 Installation

### 8.1 Power supply

#### 8.1.1 Power supply concept

The remote I/O system CPX-AP-I uses two separate voltages:

- Logic supply PS: power supply for the internal electronics and sensors
- Load supply PL: power supply for the electrical outputs and valves

The voltages can be supplied jointly by one fixed power supply or separately by two fixed power supplies.

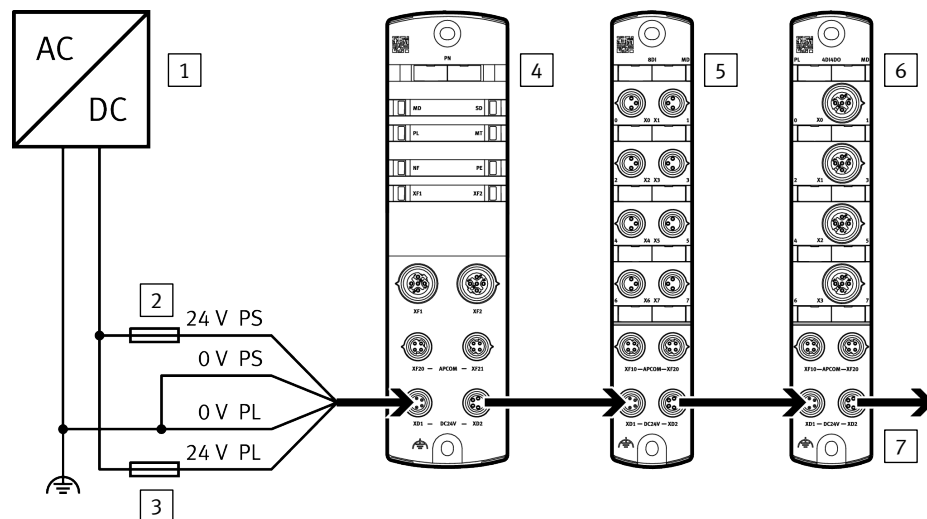


Fig. 9: Power supply concept

- |                                                       |                                     |
|-------------------------------------------------------|-------------------------------------|
| 1 SELV/PELV fixed power supply                        | 4 Interface                         |
| 2 Fuse for logic supply PS line protection (max. 4 A) | 5 Digital input module              |
| 3 Fuse for load supply PL line protection (max. 4 A)  | 6 Digital input/output module       |
|                                                       | 7 Power transmission (if necessary) |

**NOTICE****Property damage due to overload of the cables.**

- Observe the maximum acceptable current load of the cables.
- Only use permissible cables from the Festo catalogue for the power supply  
→ [www.festo.com/catalogue](http://www.festo.com/catalogue).

**NOTICE****Loss of function due to voltage drop.**

- Take into account the voltage drop at the supply feed and in the voltage forwarding → 8.1.2 Voltage drop.



The load supply PL can be switched on and off at any time. When switched off, the electrical outputs or valves are not active, even if they are actuated.

**Supply**

Power is supplied to each module at connection [XD1]. The voltages can be forwarded to other modules via the connection [XD2].

Each module can also be powered directly from the fixed power supply, e.g.

- to reduce voltage drops,
- to form voltage zones,
- if the maximum current is exceeded.

**NOTICE****Loss of function if logic supply PS is switched on late.**

If the modules are supplied by different fixed power supplies, the interface must be switched on last, as otherwise they will not be detected by the interface when the remote I/O system CPX-AP starts up.

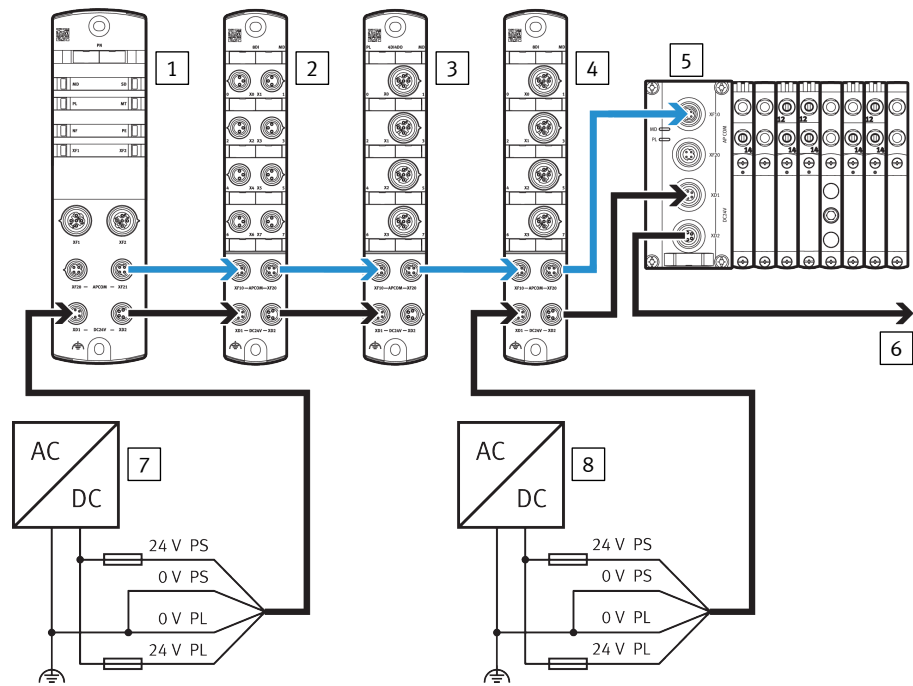


Fig. 10: Voltage zones

- |                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                           |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>1 Interface</li> <li>2 Digital input module</li> <li>3 Digital input module/output module</li> <li>4 Digital input module</li> <li>5 Electrical interface (example for valve terminal VTUG)</li> </ul> | <ul style="list-style-type: none"> <li>6 Power transmission (if necessary)</li> <li>7 SELV/PELV fixed power supply for feeding the power supply to the interface</li> <li>8 SELV/PELV fixed power supply for separate feed of the power supply</li> </ul> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## 8.1.2 Voltage drop

The connecting cables for the power supply and power transmission between the modules and the modules themselves cause a voltage drop that must be taken into account in the project engineering.



Determination of the voltage drop based on the cable length and current  
 ➔ Tab. 6 Determination of voltage drop in the cables. The values specified here are valid for approved cables with a core cross-section of 0.5 mm<sup>2</sup> from the Festo catalogue.  
 Information for the exact calculation ➔ 8.1.2.1 Calculating the voltage drop.

|                         | Cable length [m] |     |     |     |     |     |      |      |      |
|-------------------------|------------------|-----|-----|-----|-----|-----|------|------|------|
|                         | 0.3              | 0.5 | 1.0 | 2.0 | 5.0 | 7.5 | 10.0 | 15.0 | 20.0 |
| Voltage drop at 1 A [V] | 0.0              | 0.1 | 0.1 | 0.2 | 0.4 | 0.5 | 0.7  | 1.1  | 1.4  |
| Voltage drop at 2 A [V] | 0.1              | 0.1 | 0.2 | 0.3 | 0.7 | 1.1 | 1.4  | 2.1  | 2.8  |
| Voltage drop at 3 A [V] | 0.1              | 0.2 | 0.3 | 0.5 | 1.1 | 1.6 | 2.2  | 3.2  | 4.3  |
| Voltage drop at 4 A [V] | 0.2              | 0.2 | 0.4 | 0.6 | 1.5 | 2.2 | 2.9  | 4.3  | 5.7  |

Tab. 6: Determination of voltage drop in the cables

### 8.1.2.1 Calculating the voltage drop

With the steps described, the specific voltage drop for PL and PS can be calculated for each string. To do this, the power requirement of the modules with peripherals and the line resistance in the cable are combined.



The specification of the line resistance in the table comprises the forward and return line including the forward resistance of the modules. The specified values are valid for approved connecting cables with a core cross-section of 0.5 mm<sup>2</sup> from the Festo catalogue.

|                     | Cable length [m] |      |      |      |      |      |      |      |      |
|---------------------|------------------|------|------|------|------|------|------|------|------|
|                     | 0.3              | 0.5  | 1.0  | 2.0  | 5.0  | 7.5  | 10.0 | 15.0 | 20.0 |
| Line resistance [Ω] | 0.04             | 0.06 | 0.09 | 0.16 | 0.37 | 0.55 | 0.72 | 1.07 | 1.42 |

Tab. 7: Line resistance depending on the cable length

1. Calculate the current consumption of the modules in the string for PL and PS.
2. Calculate the line resistance of the supply cable or connecting cable to the module.
3. Calculate the expected power requirements of the external sensors, the electrical outputs and the valves.
4. From the previous steps calculate the resulting sum of the power requirements of each module.
5. Add the power requirements of the modules in the string. The values result from adding the power requirement of the module itself to the power requirement of the following modules in the string.
6. Determine the voltage drop per cable. The voltage drop on the cable can be calculated from the current consumption of a module.  
Formula: voltage drop = line resistance × current
7. Determine the minimum voltage at the module from the voltage of the fixed power supply.
8. Compare the result with the permitted voltage range of the last module in the string from the technical data. The voltage drops of every connecting cable must be added up to the last module and subtracted from the minimum voltage of the power supply.

Sample calculation → 8.1.2.2 Example for calculation of the voltage drop.

#### 8.1.2.2 Example for calculation of the voltage drop

In the example, the voltage drop on a string with 3 modules is calculated.

The current consumption of the VTUG valve terminal at PL for step 3 was calculated separately as follows:

- Inrush current (0 ... 20 ms): 47 mA  
Holding current (> 20 ms): 15.5 mA
- Number of valve solenoids: 12
- Maximum current consumption when switching on, here assuming that all coils are switched on at the same time:  $12 \times 47 \text{ mA} = 564 \text{ mA}$



With the result in the example, it is advisable to slightly increase the output voltage on the fixed power supply so that the voltage drops on the connecting cables are compensated. At the same time, it must be ensured that the maximum permissible voltage on the module or on the valve terminal is not exceeded at minimum load.

| Step | Modules                                                                                                                                                                                                                                                                          |                               |                                                |                                     |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|------------------------------------------------|-------------------------------------|
|      | No.                                                                                                                                                                                                                                                                              | 1                             | 2                                              | 3                                   |
|      | Type                                                                                                                                                                                                                                                                             | Bus interface CPX-AP-I-PN-M12 | Digital input/output module CPX-AP-I-4DI4DO-xx | Valve terminal VTUG VAEM-L1-S-12-AP |
| 1    | Intrinsic current consumption                                                                                                                                                                                                                                                    |                               |                                                |                                     |
|      | PS [mA]                                                                                                                                                                                                                                                                          | 80                            | 35                                             | 34                                  |
|      | PL [mA]                                                                                                                                                                                                                                                                          | 5                             | 10                                             | 15                                  |
| 2    | Line resistance to the module from → Tab. 6 Determination of voltage drop in the cables                                                                                                                                                                                          |                               |                                                |                                     |
|      | Cable                                                                                                                                                                                                                                                                            | Supply line                   | Connecting cable                               | Connecting cable                    |
|      | Length [m]                                                                                                                                                                                                                                                                       | 10                            | 2                                              | 5                                   |
|      | Line resistance [Ω]                                                                                                                                                                                                                                                              | 0.72                          | 0.16                                           | 0.37                                |
| 3    | Power requirements of external sensors, electrical outputs and valves assumed in the example                                                                                                                                                                                     |                               |                                                |                                     |
|      | PS [mA]                                                                                                                                                                                                                                                                          | 0                             | 750                                            | 0                                   |
|      | PL [mA]                                                                                                                                                                                                                                                                          | 0                             | 1500                                           | 564                                 |
| 4    | Total power requirement per module                                                                                                                                                                                                                                               |                               |                                                |                                     |
|      | PS [mA]                                                                                                                                                                                                                                                                          | 80                            | 785                                            | 34                                  |
|      | PL [mA]                                                                                                                                                                                                                                                                          | 5                             | 1510                                           | 579                                 |
| 5    | Addition of power requirements of the modules in the string                                                                                                                                                                                                                      |                               |                                                |                                     |
|      | The values result from adding the power requirement of the module itself to the power requirement of the following modules in the string. E.g. 785 mA + 34 mA = 819 mA                                                                                                           |                               |                                                |                                     |
|      | PS [mA]                                                                                                                                                                                                                                                                          | 899                           | 819                                            | –                                   |
|      | PL [mA]                                                                                                                                                                                                                                                                          | 2094                          | 2089                                           | –                                   |
| 6    | Voltage drop per connecting cable                                                                                                                                                                                                                                                |                               |                                                |                                     |
|      | The voltage drop on the cable can be calculated from the current consumption of a module:<br>$U = R \times I$                                                                                                                                                                    |                               |                                                |                                     |
|      | PS [mV]                                                                                                                                                                                                                                                                          | 647                           | 131                                            | 13                                  |
|      | PL [mV]                                                                                                                                                                                                                                                                          | 1508                          | 334                                            | 214                                 |
| 7    | Minimum voltage on the module at nominal voltage on the fixed power supply = 24 V                                                                                                                                                                                                |                               |                                                |                                     |
|      | PS [V]                                                                                                                                                                                                                                                                           | 23.4                          | 23.2                                           | 23.2                                |
|      | PL [V]                                                                                                                                                                                                                                                                           | 22.5                          | 22.2                                           | 21.9                                |
| 8    | Permissible voltage range of the last module from the technical data                                                                                                                                                                                                             |                               |                                                |                                     |
|      | PS [V]                                                                                                                                                                                                                                                                           | –                             | –                                              | 18                                  |
|      | PL [V]                                                                                                                                                                                                                                                                           | –                             | –                                              | 21.6                                |
|      | The voltage drops of every connecting cable must be added up to the last module and subtracted from the minimum voltage of the power supply. Result here: VTUG requires at least 21.6 V for PL. In the worst case, at least 21.9 V are available here, so operation is possible. |                               |                                                |                                     |

Tab. 8: Example for calculation of the voltage drop

### 8.1.3 Electrical isolation

There is potential separation between the internal electronics and the following interfaces in the modules of the CPX-AP-I remote I/O system:

- Network interfaces of the interfaces,
- System communication
- Load supply PL



Information on the potential separations of the inputs and outputs of the modules → Technical data of the product-specific documentation

## 8.2 Functional earth FE

### NOTICE

#### Malfunction due to electromagnetic interference.

Depending on the substrate of the mounting surface, the modules must be connected to the functional earth with low impedance.

The general rule is:

- Remove paint, corrosion and anodised layers.
- Earthing cables should be as short as possible.
- Screws, slot nuts, profiles etc. must have a high electrical conductivity.

#### For installation on conductive substrates:

- Establish a low impedance connection between the module and conductive substrate as well as between the conductive substrate and functional earth.
- Establish equipotential bonding between different system components on which the modules are mounted.
- Avoid interference voltages on the conductive substrate.

#### For installation on an insulated substrate:

- Establish a low impedance connection between the module and functional earth via an earthing cable.
- Use an earthing cable with a nominal cross section of 4 ... 6 mm<sup>2</sup>.
- Use a suitable cable lug according to DIN 46234, DIN 46225, DIN 46211.

## 8.3 Connecting cables

### ⚠ WARNING

#### Risk of injury due to electric shock.

- For the electric power supply, use SELV or PELV circuits that guarantee a reliable electric disconnection from the mains network.
- Observe IEC 60204-1/EN 60204-1.

1. Switch off the power supply.
2. Use a suitable torque screwdriver with socket to tighten union nuts.
  - For example, use PHOENIX CONTACT SAC BIT M8-D10 with a tightening torque of 0.4 Nm ± 15% for M8. Different from the information for connecting cables.
  - For example, use PHOENIX CONTACT SAC BIT M12-D15 with a tightening torque of 0.6 Nm ± 10% for M12. Different from the information for connecting cables.
3. Seal unused connections with cover caps.

## 8.4 Disconnecting the cables

1. Switch off the power supply.
2. Disconnect the cables.

## 9 Commissioning

The remote I/O system CPX-AP-I must be commissioned in stages to prevent connection and addressing errors:

1. Check assembly and connections.
2. Configure the settings at the interface.
3. Check function of remote I/O system CPX-AP-I (without higher-order controller).
4. Commissioning in network (with higher-order controller).

### 9.1 Checking assembly and connections

1. Check that the modules are installed securely.
2. Check connection of functional earth FE.
3. Check that connected cables are seated firmly.

### 9.2 Configuring the settings at the interface

- If necessary, configure the settings using the control elements on the interface.



Detailed information on the control elements of the applicable interface  
→ Product-specific documentation

### 9.3 Check function of remote I/O system CPX-AP-I (without higher-order controller)

1. Switch on PS and PL power supplies.
2. Check the response of the remote I/O system CPX-AP-I:
  - Connected actuators
  - LED indicators

The following LED displays must be green:

  - [SD] system diagnostics (only available for interfaces)
  - [MD] module diagnostics (available for all modules)
  - [PL] voltage PL (only available for interfaces, electrical interfaces and modules with outputs)

### 9.4 Commissioning in network (with higher-order controller)



Information on commissioning on the network → Instruction manual for the applicable interface

## 10 Parameterisation

Various parameters are available to adapt the remote I/O system CPX-AP and the modules to the application and to access the corresponding data.



Detailed information on the parameters → Product-specific documentation

## 11 Diagnostics

### 11.1 Diagnostics information

#### 11.1.1 Diagnostics options

Various options are available for error diagnostics, depending on the parameterisation and network protocol used:

- LED displays on the product
- Internal System Diagnostics
- Diagnostics via the host system

#### 11.1.2 Diagnostic status

The degree of severity of a diagnostic message is indicated by the diagnostic status.

| Status      | Description                                                                                                             |
|-------------|-------------------------------------------------------------------------------------------------------------------------|
| Error       | Error<br>The remote I/O system/module is no longer operational.<br>Urgent troubleshooting action required.              |
| Warning     | Warning<br>The remote I/O system/module cannot be operated with its full functions.<br>Troubleshooting action required. |
| Maintenance | Maintenance<br>Maintenance required.                                                                                    |
| Information | Information<br>No action required.                                                                                      |

Tab. 9: Diagnostic status

#### 11.1.3 Grouping and overview of the diagnostics messages

The diagnostics messages are grouped according to their cause.

This grouping is visible in the corresponding overview:

– Grouped overview:

Main group | Sub-group | Error number

e.g. 02 | 01 | 0022

– Ungrouped overview:

diagnostics number

e.g. 33619990

The diagnostics messages are mapped within the Interfaces corresponding profiles of the Host-Systeme and device profiles in use. If the Host-System or device profile only allows 16 bits, only the unique error number is transferred (e.g. 0022). The diagnostics number of the ungrouped overview is determined from the grouped overview as follows:

1. Combine main group, sub-group and error number byte by byte as a hexadecimal 4-byte value:
  - Main group = byte 4
  - Sub-group = byte 3
  - Error number = byte 2 and 1
2. The resultant hexadecimal 4-byte number displayed as a decimal number equals the diagnostics number in the ungrouped overview.

The diagnostic categories listed are used in several products → Tab. 10 Grouping of the diagnostics messages. Depending on the specific product used, only parts of this complete list will be used.

| Main group |                                | Subgroup |                      |
|------------|--------------------------------|----------|----------------------|
| 1          | Current                        | 1        | Short circuit        |
|            |                                | 2        | I <sup>2</sup> t     |
|            |                                | 3        | Braking resistor     |
| 2          | Voltage                        | 1        | Supply               |
|            |                                | 2        | DC link circuit      |
|            |                                | 3        | Principal voltage    |
|            |                                | 4        | Encoder supply       |
|            |                                | 5        | Battery              |
| 3          | Temperature                    | 1        | Device               |
|            |                                | 2        | Output stage         |
|            |                                | 3        | Motor                |
| 4          | Pressure                       | 0        | No allocation        |
| 5          | Motion                         | 1        | Homing               |
|            |                                | 2        | Motion control       |
| 6          | Configuration/parameterization | 0        | No allocation        |
|            |                                | 2        | Critical limits      |
|            |                                | 5        | Parameter set        |
| 7          | Monitoring                     | 1        | Limitations          |
|            |                                | 2        | Motion monitoring    |
|            |                                | 3        | Critical limits      |
|            |                                | 4        | Zero angle detection |
|            |                                | 5        | Analogue input       |
|            |                                | 6        | Valve                |
| 8          | Communication                  | 0        | No allocation        |
|            |                                | 1        | AP                   |
|            |                                | 2        | PROFIBUS             |
|            |                                | 3        | PROFINET             |
|            |                                | 4        | EtherCAT             |
|            |                                | 5        | DEVICENET            |
|            |                                | 6        | Ethernet             |
|            |                                | 7        | SERCOS               |
|            |                                | 8        | CBUS                 |
|            |                                | 9        | PROFIdrive           |
|            |                                | 10       | IO-Link              |
|            |                                | 11       | I-Port               |
|            |                                | 12       | CiA 402              |
| 9          | Safety engineering             | 0        | No allocation        |
|            |                                | 1        | STO                  |
|            |                                | 2        | SBC                  |
| 10         | Internal hardware              | 1        | Module error         |
| 11         | Software                       | 1        | Exception            |
|            |                                | 2        | Task                 |
|            |                                | 3        | File system          |

| Main group |                 | Subgroup |                                  |
|------------|-----------------|----------|----------------------------------|
| 11         | Software        | 4        | Firmware update                  |
|            |                 | 5        | Device configuration             |
|            |                 | 6        | LibRTE                           |
|            |                 | 7        | Warm start                       |
|            |                 | 8        | Version management               |
|            |                 | 9        | Device description               |
| 12         | Maintenance     | 1        | Operating time                   |
| 13         | Various         | 1        | Diagnostics                      |
|            |                 | 2        | Auto-tuning                      |
| 16         | External device | 1        | CDSB                             |
|            |                 | 2        | IO-Link device                   |
| 17         | Security (data) | 1        | User login                       |
| 18         | Encoder         | 0        | No allocation                    |
|            |                 | 1        | EnDat                            |
|            |                 | 2        | Hiperface                        |
|            |                 | 3        | Quadrature (incremental encoder) |
|            |                 | 4        | Nikon A                          |
|            |                 | 6        | Sin/Cos                          |

Tab. 10: Grouping of the diagnostics messages

#### 11.1.4 Load voltage monitoring

The load voltage monitoring distinguishes between "undervoltage/overvoltage PL" and "shutdown PL". The distinction between "undervoltage PL" and "shutdown PL" is helpful if a deliberate shutdown, e.g. emergency stop, should not trigger an error message in the higher-order controller. A critical undervoltage, e.g. due to an excessively high voltage drop in the cable, is always reported as an error.

A "shutdown PL" is detected by the module if the load supply PL falls below the permissible tolerance range and then drops to a residual voltage of < 5 V within 250 ms.

The behaviour of the load supply monitoring can be set with the "diagnostics undervoltage load supply" parameter.

The diagnostics are displayed as a combination of the LED displays [MD] and [PL] and a diagnostics message is generated depending on the parameter setting.

**Load voltage monitoring  
– inactive (0)**

| LED [MD]                                                                                         | LED [PL]                                                                                            | Meaning                   | Diagnostics |
|--------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|---------------------------|-------------|
| <br>Green light | <br>Green light    | Permissible voltage range | –           |
| <br>Green light | <br>Flashing red   | Overvoltage PL            | –           |
| <br>Green light | <br>Flashing red   | Undervoltage PL           | –           |
| <br>Green light | <br>Flashing green | Switch off PL             | –           |

Tab. 11: Load voltage monitoring - inactive (0)

**Load voltage monitoring  
– active, with suppression  
of diagnostics at  
switch off (1)**

| LED [MD]                                                                                              | LED [PL]                                                                                              | Meaning                   | Diagnostics                                                            |
|-------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|---------------------------|------------------------------------------------------------------------|
| <br>Green light      | <br>Green light      | Permissible voltage range | –                                                                      |
| <br>Red light       | <br>Flashing red    | Overvoltage PL            | 02   01   013F (error)<br>Overvoltage load supply PL<br>24 V DC        |
| <br>Red light      | <br>Flashing red   | Undervoltage PL           | 02   01   0105 (Error)<br>Undervoltage load supply PL<br>24 V DC       |
| <br>Flashing green | <br>Flashing green | Switch off PL             | 02   01   0106 (Information)<br>Shut down of load supply PL<br>24 V DC |

Tab. 12: Load voltage monitoring - active, with suppression of diagnostics at switch off (1)

**Load voltage monitoring  
– active (2)**

| LED [MD]                                                                                           | LED [PL]                                                                                            | Meaning                   | Diagnostics                                                      |
|----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|---------------------------|------------------------------------------------------------------|
| <br>Green light | <br>Green light  | Permissible voltage range | –                                                                |
| <br>Red light   | <br>Flashing red | Overvoltage PL            | 02   01   013F (error)<br>Overvoltage load supply PL<br>24 V DC  |
| <br>Red light   | <br>Flashing red | Undervoltage PL           | 02   01   0105 (Error)<br>Undervoltage load supply PL<br>24 V DC |
| <br>Red light   | <br>Flashing red | Switch off PL             | 02   01   0105 (Error)<br>Undervoltage load supply PL<br>24 V DC |

Tab. 13: Load voltage monitoring - active (2)

## 11.2 Diagnostic messages

The following table contains the diagnostic messages of all CPX-AP modules.

The %d or %u outputs are replaced by concrete values when the device outputs the diagnostic message.

See the operating instructions for the IO-Link Master for further specific diagnostic messages from the IO-Link devices as well as the mapping of the IO-Link event codes to the diagnostic IDs.

| ICP ID (hex)   | ICP ID (dec) | Message                                   | Description                                                                                                                     | Remedy                                                                                                                                                                                                                                         | Diagnostic status |
|----------------|--------------|-------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| 02   01   0016 | 33619990     | Undervoltage in logic supply (PS) 24 V DC | Undervoltage of the logic supply (PS) 24 V DC was detected.                                                                     | – Check the power supply (logic)                                                                                                                                                                                                               | Error             |
| 02   01   0017 | 33619991     | Overvoltage in logic supply (PS) 24 V DC  | Overvoltage of the logic supply (PS) 24 V DC was detected.                                                                      | – Check the power supply (logic)                                                                                                                                                                                                               | Error             |
| 03   01   002D | 50397229     | Device undertemperature                   | Device undertemperature                                                                                                         | – Check ambient conditions                                                                                                                                                                                                                     | Error             |
| 03   01   002F | 50397231     | Device overtemperature                    | Device overtemperature                                                                                                          | – Check warning threshold parameterisation<br>– Device fan defective?<br>– Device overloaded?<br>– Check installation conditions; control cabinet fan filter dirty?<br>– Check drive layout (possible overloading during continuous operation) | Error             |
| 06   05   0062 | 100991074    | Parameter set invalid                     | Parameter set invalid                                                                                                           | Overwrite parameter set (save)                                                                                                                                                                                                                 | Error             |
| 0B   03   00B0 | 184746160    | CRC error in user file                    | A CRC error was detected in the user file.                                                                                      | – Restarting device<br>– Service case                                                                                                                                                                                                          | Error             |
| 0B   04   00B7 | 184811703    | Firmware invalid                          | Firmware invalid                                                                                                                | – Repeat transmission of firmware package                                                                                                                                                                                                      | Error             |
| 0B   07   00CC | 185008332    | Initialisation failed                     | Initialisation of the device failed.                                                                                            | – Check whether additional diagnostic messages are pending<br>– Reset device to factory settings                                                                                                                                               | Error             |
| 0A   01   00F9 | 167837945    | RTE module watchdog monitoring error      | RTE module watchdog monitoring error is triggered                                                                               | – Restarting device<br>– Update firmware<br>– Service case                                                                                                                                                                                     | Error             |
| 02   01   0105 | 33620229     | Undervoltage in load supply (PL) 24 V DC  | Undervoltage in the load supply (PL) 24 V DC was detected.                                                                      | – Check power supply (load)<br>– Check for short circuit                                                                                                                                                                                       | Error             |
| 02   01   0106 | 33620230     | Shutdown of load supply (PL) 24 V DC      | A shutdown of the load voltage supply PL was detected. The cause can be a deliberate shutdown by emergency stop.                | – Check whether emergency stop was activated<br>– Check the load voltage supply                                                                                                                                                                | Information       |
| 08   0A   0108 | 134873352    | IO-Link event                             | An IO-Link diagnostic event (note, warning or error) has occurred. IO-Link event-specific details are attached to this message. | – See documentation of the IO-Link master or device                                                                                                                                                                                            | Error             |
| 06   00   0109 | 100663561    | Startup parameter rejected by device      | The startup parameter specified in the AP device description does not exist in the device or deviates from the specification.   | – Check firmware version                                                                                                                                                                                                                       | Error             |
| 06   00   010A | 100663562    | Start-up parameter deviation in length    | The length of the start-up parameter in the device differs from the specified length in the AP device description.              | – Check firmware version                                                                                                                                                                                                                       | Error             |

| ICP ID (hex)   | ICP ID (dec) | Message                                                   | Description                                                                       | Remedy                                                                                                                                                                                                                                                                                    | Diagnostic status |
|----------------|--------------|-----------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| 01   01   010B | 16843019     | Short circuit/overload in sensor supply                   | A short-circuit/overload of the sensor supply was detected                        | <ul style="list-style-type: none"> <li>– Check sensor for correct function, in particular for current consumption.</li> <li>– Check sensor wiring.</li> </ul>                                                                                                                             | Error             |
| 01   01   010C | 16843020     | Short circuit/overload output signal                      | Connected digital output load is too high for the channel.                        | <ul style="list-style-type: none"> <li>– Check connected load for correct function, in particular for current consumption.</li> <li>– Check wiring. The output must be reset after the malfunction has been cleared.</li> </ul>                                                           | Error             |
| 0B   00   010E | 184549646    | General software error                                    | An error has occurred that could not be assigned to any other specific diagnosis. | <ul style="list-style-type: none"> <li>– Check that you are using the latest firmware version.</li> <li>– Please contact Festo Support</li> </ul>                                                                                                                                         | Error             |
| 08   01   0124 | 134283556    | Communication to AP master interrupted                    | The communication to the AP Master is aborted.                                    | <ul style="list-style-type: none"> <li>– Restart AP Master.</li> <li>– Check communication AP connecting cable.</li> </ul>                                                                                                                                                                | Error             |
| 07   06   0125 | 117834021    | Valve coil not connected                                  | The valve coil for switching is not connected or is defective.                    | <ul style="list-style-type: none"> <li>– Do not switch unused channels.</li> <li>– Check or replace valve</li> </ul>                                                                                                                                                                      | Error             |
| 08   01   0127 | 134283559    | Communication to AP module interrupted                    | The AP system communication to a module is aborted.                               | <ul style="list-style-type: none"> <li>– Restart AP system.</li> <li>– Check communication AP connecting cable.</li> </ul>                                                                                                                                                                | Error             |
| 0B   09   0128 | 185139496    | APDD invalid                                              | The AP device description file is invalid or missing.                             | <ul style="list-style-type: none"> <li>– Restart device.</li> <li>– Check communication lines (AP).</li> <li>– Check firmware version.</li> <li>– In the event of repeated errors contact Festo Service.</li> </ul>                                                                       | Error             |
| 0B   09   0129 | 185139497    | Start-up APDD invalid                                     | The Startup AP device description file is invalid or missing.                     | <ul style="list-style-type: none"> <li>– Restart device.</li> <li>– Check communication lines (AP).</li> <li>– Check firmware version.</li> <li>– In the event of repeated errors contact Festo Service.</li> </ul>                                                                       | Error             |
| 08   00   012E | 134218030    | Device address invalid                                    | Transferred device address is invalid.                                            | <ul style="list-style-type: none"> <li>– Check address configuration. Is the configuration set via software or hardware (DIL switch)?</li> <li>– Check the assigned address for the device.</li> <li>– Check multiple address assignment.</li> <li>– Check DIL switch setting.</li> </ul> | Warning           |
| 08   01   0130 | 134283568    | Output process data watchdog of the AP module expired     | Output process data watchdog of the AP module expired                             | <ul style="list-style-type: none"> <li>– Restart AP system.</li> <li>– Check cable.</li> </ul>                                                                                                                                                                                            | Error             |
| 08   01   0132 | 134283570    | Output process data watchdog of the bus interface expired | The process data watchdog for the output data in the bus interface has expired.   | <ul style="list-style-type: none"> <li>– Match cycle time and watchdog parameters.</li> <li>– Restart AP system.</li> <li>– Check cable.</li> </ul>                                                                                                                                       | Error             |
| 08   01   0133 | 134283571    | Input process data watchdog of the bus interface expired  | The process data watchdog for the input data in the bus interface has expired.    | <ul style="list-style-type: none"> <li>– Match cycle time and watchdog parameters.</li> <li>– Restart AP system.</li> <li>– Check cable.</li> </ul>                                                                                                                                       | Error             |
| 08   01   0134 | 134283572    | AP Master toggle bit error                                | A module has not mirrored the toggle bit in the process data.                     | <ul style="list-style-type: none"> <li>– Match cycle time and toggle timeout parameters.</li> <li>– Restart AP system.</li> <li>– Check cable.</li> </ul>                                                                                                                                 | Error             |
| 08   00   0135 | 134218037    | Wire break detected                                       | A wire break was detected for the channel.                                        | <ul style="list-style-type: none"> <li>– Check wiring</li> </ul>                                                                                                                                                                                                                          | Error             |

| ICP ID (hex)   | ICP ID (dec) | Message                                     | Description                                                                                | Remedy                                                                                                                                | Diagnostic status    |
|----------------|--------------|---------------------------------------------|--------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| 06   02   0136 | 100794678    | Upper critical limit overshoot              | A channel has exceeded the upper critical limit.                                           | <ul style="list-style-type: none"> <li>– Check parameters</li> <li>– Check sensor</li> </ul>                                          | Error                |
| 06   02   0137 | 100794679    | Lower critical limit undershoot             | A channel has undershot the lower critical limit.                                          | <ul style="list-style-type: none"> <li>– Check parameters</li> <li>– Check sensor</li> </ul>                                          | Error                |
| 06   02   0138 | 100794680    | Signal range is exceeded or undershot       | A channel has overshoot or undershot the set signal range.                                 | <ul style="list-style-type: none"> <li>– Check signal range parameters</li> <li>– Check sensor</li> </ul>                             | Warning              |
| 08   01   013A | 134283578    | Multiple AP masters detected                | Another AP master with higher priority was detected.                                       | <ul style="list-style-type: none"> <li>– Check the structure, only one AP master is permitted</li> <li>– Restart AP Master</li> </ul> | Error                |
| 08   01   013B | 134283579    | System startup failed                       | AP startup failed. AP system communication in emergency mode                               | <ul style="list-style-type: none"> <li>– Check firmware versions and update if necessary</li> <li>– Restart AP system</li> </ul>      | Error                |
| 08   01   013C | 134283580    | Topology discovery failed                   | AP topology discovery failed                                                               | <ul style="list-style-type: none"> <li>– Check firmware versions and update if necessary</li> <li>– Restart AP system</li> </ul>      | Error                |
| 0C   00   013D | 201326909    | Firmware update mode                        | AP system communication in firmware update mode                                            | <ul style="list-style-type: none"> <li>– Install firmware updates</li> <li>– Restart AP system</li> </ul>                             | Maintenance required |
| 02   01   013F | 33620287     | Overvoltage in load supply (PL) 24 V DC     | Overvoltage in load supply (PL) 24 V DC                                                    | <ul style="list-style-type: none"> <li>– Check power supply</li> </ul>                                                                | Error                |
| 0B   00   0140 | 184549696    | System start                                | The system starts.                                                                         | <ul style="list-style-type: none"> <li>– None</li> </ul>                                                                              | Information          |
| 0D   00   0141 | 218104129    | General malfunction of IO-Link device       | General malfunction unknown IO-Link device error. Corresponds to IO-Link EventCode 0x1000. | <ul style="list-style-type: none"> <li>– Check IO-Link device</li> </ul>                                                              | Information          |
| 03   01   0142 | 50397506     | Temperature error overload                  | Temperature error overload                                                                 | <ul style="list-style-type: none"> <li>– Device-specific</li> </ul>                                                                   | Error                |
| 10   02   0145 | 268566853    | Device hardware error                       | Hardware error of the IO-Link device                                                       | <ul style="list-style-type: none"> <li>– Repair or replace IO-Link device</li> </ul>                                                  | Error                |
| 10   02   0146 | 268566854    | Malfunction of a device component           | Malfunction of a component of the IO-Link device                                           | <ul style="list-style-type: none"> <li>– Repair or replace IO-Link device</li> </ul>                                                  | Error                |
| 02   05   0147 | 33882439     | Memory error                                | Data loss in remanent memory                                                               | <ul style="list-style-type: none"> <li>– Check batteries</li> </ul>                                                                   | Error                |
| 02   05   0148 | 33882440     | Batteries weak                              | Batteries weak                                                                             | <ul style="list-style-type: none"> <li>– Check batteries</li> </ul>                                                                   | Warning              |
| 02   01   0149 | 33620297     | General power supply error                  | General power supply error                                                                 | <ul style="list-style-type: none"> <li>– Check power supply</li> </ul>                                                                | Error                |
| 0A   00   014A | 167772490    | Fuse blown/opened                           | Fuse blown/opened                                                                          | <ul style="list-style-type: none"> <li>– Replace fuse</li> <li>– Eliminate cause of defective fuse</li> </ul>                         | Error                |
| 08   0A   014C | 134873420    | Invalid cycle time                          | Invalid cycle time of IO-Link communication                                                | <ul style="list-style-type: none"> <li>– Adjust cycle time to the permissible value</li> </ul>                                        | Error                |
| 08   0A   014D | 134873421    | Version error incompatible protocol version | Version error incompatible IO-Link protocol version                                        | <ul style="list-style-type: none"> <li>– Device not compatible</li> </ul>                                                             | Error                |
| 08   0A   014E | 134873422    | ISDU batch failed                           | ISDU batch failed parameter inconsistency?                                                 | <ul style="list-style-type: none"> <li>– Check parameters</li> </ul>                                                                  | Error                |
| 06   00   014F | 100663631    | Parameter error                             | Parameter was written with invalid value.                                                  | <ul style="list-style-type: none"> <li>– Check datasheet and parameter values</li> </ul>                                              | Error                |
| 06   00   0150 | 100663632    | Parameter missing in the device             | Parameter missing in the device                                                            | <ul style="list-style-type: none"> <li>– Check datasheet and parameter values</li> </ul>                                              | Error                |
| 10   02   0152 | 268566866    | Wire break at lower-level device 1          | Wire break at lower-level IO-Link device 1                                                 | <ul style="list-style-type: none"> <li>– Check wiring</li> </ul>                                                                      | Error                |
| 10   02   0153 | 268566867    | Wire break at lower-level device 2          | Wire break at lower-level IO-Link device 2                                                 | <ul style="list-style-type: none"> <li>– Check wiring</li> </ul>                                                                      | Error                |

| ICP ID (hex)   | ICP ID (dec) | Message                                           | Description                                                           | Remedy                                                                              | Diagnostic status |
|----------------|--------------|---------------------------------------------------|-----------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------|
| 10   02   0154 | 268566868    | Wire break at lower-level device 3                | Wire break at lower-level IO-Link device 3                            | – Check wiring                                                                      | Error             |
| 10   02   0155 | 268566869    | Wire break at lower-level device 4                | Wire break at lower-level IO-Link device 4                            | – Check wiring                                                                      | Error             |
| 10   02   0156 | 268566870    | Wire break at lower-level device 5                | Wire break at lower-level IO-Link device 5                            | – Check wiring                                                                      | Error             |
| 10   02   0157 | 268566871    | Wire break at lower-level device 6                | Wire break at lower-level IO-Link device 6                            | – Check wiring                                                                      | Error             |
| 10   02   0158 | 268566872    | Wire break at lower-level device 7                | Wire break at lower-level IO-Link device 7                            | – Check wiring                                                                      | Error             |
| 10   02   0159 | 268566873    | Wire break at lower-level device 8                | Wire break at lower-level IO-Link device 8                            | – Check wiring                                                                      | Error             |
| 10   02   015A | 268566874    | Wire break at lower-level device 9                | Wire break at lower-level IO-Link device 9                            | – Check wiring                                                                      | Error             |
| 10   02   015B | 268566875    | Wire break at lower-level device 10               | Wire break at lower-level IO-Link device 10                           | – Check wiring                                                                      | Error             |
| 10   02   015C | 268566876    | Wire break at lower-level device 11               | Wire break at lower-level IO-Link device 11                           | – Check wiring                                                                      | Error             |
| 10   02   015D | 268566877    | Wire break at lower-level device 12               | Wire break at lower-level IO-Link device 12                           | – Check wiring                                                                      | Error             |
| 10   02   015E | 268566878    | Wire break at lower-level device 13               | Wire break at lower-level IO-Link device 13                           | – Check wiring                                                                      | Error             |
| 10   02   015F | 268566879    | Wire break at lower-level device 14               | Wire break at lower-level IO-Link device 14                           | – Check wiring                                                                      | Error             |
| 10   02   0160 | 268566880    | Wire break at lower-level device 15               | Wire break at lower-level IO-Link device 15                           | – Check wiring                                                                      | Error             |
| 01   01   0161 | 16843105     | Short circuit check installation                  | Short circuit check installation                                      | – Check installation                                                                | Error             |
| 01   01   0162 | 16843106     | Earth fault check installation                    | Earth fault check installation                                        | – Check installation                                                                | Error             |
| 0D   00   0164 | 218104164    | Simulation active                                 | Simulation active                                                     | – Check operating mode                                                              | Warning           |
| 07   07   0165 | 117899621    | Process variable range overflow                   | Overflow of the process variable range process data uncertain         | – Check input signal<br>– Check parameters and configuration                        | Warning           |
| 07   05   0166 | 117768550    | Measuring range exceeded                          | Measuring range exceeded                                              | – Check application<br>– Check input signal<br>– Check parameters and configuration | Error             |
| 07   07   0167 | 117899623    | Underflow of the process variable range           | Underflow of the process variable area process data uncertain         | – Check input signal<br>– Check parameters and configuration                        | Warning           |
| 0C   01   0168 | 201392488    | Cleaning maintenance required                     | Cleaning maintenance required                                         | – Cleaning the device                                                               | Warning           |
| 0C   00   0169 | 201326953    | Refill maintenance requirement                    | Refill maintenance requirement                                        | – Refill                                                                            | Warning           |
| 0C   01   016A | 201392490    | Maintenance required replacement of wearing parts | Maintenance required replacement of wearing parts                     | – Check wearing parts and replace if necessary                                      | Warning           |
| 08   0A   016B | 134873451    | Wrong VendorID deviation of the inspection level  | The recognised IO-Link device does not match the configured VendorID. | – Check that the correct IO-Link device is connected.                               | Error             |
| 08   0A   0177 | 134873463    | Backup inconsistency upload error                 | IO-Link backup/restore failed. Error uploading                        | – Device-specific                                                                   | Error             |

| ICP ID (hex)   | ICP ID (dec) | Message                                                     | Description                                                                     | Remedy                                                                                                      | Diagnostic status |
|----------------|--------------|-------------------------------------------------------------|---------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|-------------------|
| 08   0A   0178 | 134873464    | Parameter inconsistency download error                      | IO-Link backup/restore failed. Download error                                   | – Device-specific                                                                                           | Error             |
| 01   01   0179 | 16843129     | Load supply short circuit/overload                          | The connected consumer is defective or exceeds the permitted power consumption. | – Check the connected consumer for proper functioning, especially for current consumption<br>– Check wiring | Error             |
| 01   01   017A | 16843130     | Short circuit on I/Q                                        | Short circuit on I/Q (IO-Link)                                                  | – Check wiring                                                                                              | Error             |
| 01   01   017B | 16843131     | Short circuit on C/Q (if digital output)                    | Short circuit on C/Q (if digital output)                                        | – Check wiring                                                                                              | Error             |
| 01   01   017C | 16843132     | Overload on I/Q                                             | Overload on I/Q                                                                 | – Check load                                                                                                | Error             |
| 01   01   017D | 16843133     | Overload on C/Q (if digital output)                         | Overload on C/Q (if digital output)                                             | – Check load                                                                                                | Error             |
| 08   0A   017F | 134873471    | Process data configuration error                            | Reserved process data length for the IO-Link device too small                   | – Set the module variant to a larger process data length                                                    | Error             |
| 08   0A   0180 | 134873472    | Short circuit C/Q                                           | Short circuit C/Q signal (IO-Link)                                              | – Check wiring                                                                                              | Error             |
| 03   01   0181 | 50397569     | PHY overtemperature                                         | PHY overtemperature                                                             | – Eliminate heat source                                                                                     | Error             |
| 08   0A   0182 | 134873474    | IO-Link events overflow                                     | IO-Link events overflow. Data loss of the events possible.                      | – Device-specific                                                                                           | Error             |
| 08   0A   0183 | 134873475    | Backup inconsistency memory out of range (2048 octets)      | IO-Link backup/restore failed. Memory out of range (2048 octets)                | – Device-specific                                                                                           | Error             |
| 08   0A   0184 | 134873476    | Backup inconsistency DataStorageIndex not available         | IO-Link backup/restore failed. DataStorageIndex not available                   | – Device-specific                                                                                           | Error             |
| 08   0A   0185 | 134873477    | Backup inconsistency non-specific error during data storage | IO-Link backup/restore failed. Non-specific error in data memory                | – Device-specific                                                                                           | Error             |
| 06   00   0188 | 100663688    | Module identification check skipped                         | No check of the target slot configuration for the actual slot configuration     | – Download slot configuration                                                                               | Warning           |
| 06   00   0189 | 100663689    | Module identification check failed                          | Module identification failed for slot %u (detected %u - configured %u)          | – Download current slot configuration                                                                       | Error             |
| 0B   08   018F | 185074063    | Unsupported Full Diagnostic Image version                   | The Diagnostic Full Image version is not supported.                             | – Check and synchronise firmware versions of master and devices.                                            | Error             |
| 0B   08   0190 | 185074064    | Unsupported diagnostic version                              | The diagnostic version is not supported.                                        | – Check and synchronise firmware versions of master and devices.                                            | Error             |
| 08   04   0191 | 134480273    | Status change request                                       | Status change request from: %d to: %d                                           | – None                                                                                                      | Error             |
| 08   00   0192 | 134218130    | Invalid cycle time                                          | Calculation of bus cycle time failed (local timer too slow)                     | – Increase cycle time                                                                                       | Error             |
| 08   04   0193 | 134480275    | Sync Manager invalid address                                | Sync Manager %d invalid address (%d)                                            | – Set correct Sync Manager address                                                                          | Error             |
| 08   04   0194 | 134480276    | Sync Manager invalid I/O size                               | Sync Manager %d invalid I/O size (%d)                                           | – Correct I/O size                                                                                          | Error             |
| 08   04   0195 | 134480277    | Sync Manager invalid configuration                          | Sync Manager %d invalid configuration (%d)                                      | – Check and correct configuration                                                                           | Error             |

| ICP ID (hex)   | ICP ID (dec) | Message                                              | Description                                                                                                                                        | Remedy                                                                                                                                        | Diagnostic status |
|----------------|--------------|------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| 08   04   0196 | 134480278    | DC activation register invalid                       | DC activation register invalid                                                                                                                     | – Correct DC activation register                                                                                                              | Error             |
| 08   04   0197 | 134480279    | SyncType not supported                               | The configured SyncType (0x1C32.1 or 0x1C33.1) is not supported. Check DC registers and supported SyncTypes (0x1C32.4 and 0x1C33.4).               | – Check DC registers and supported SyncTypes (0x1C32.4 and 0x1C33.4).                                                                         | Error             |
| 09   03   0198 | 151191960    | Short circuit to 24V                                 | Short circuit to 24V                                                                                                                               | – Check wiring                                                                                                                                | Error             |
| 09   03   0199 | 151191961    | Short circuit to external cycle                      | Short circuit to external cycle                                                                                                                    | – Check wiring                                                                                                                                | Error             |
| 09   03   019A | 151191962    | No signal at the input                               | No signal at the input                                                                                                                             | – Check wiring                                                                                                                                | Error             |
| 09   03   019B | 151191963    | Signal discrepancy at inputs                         | Signal discrepancy at inputs, different input signals                                                                                              | – Check wiring                                                                                                                                | Error             |
| 09   04   019C | 151257500    | Error cross circuit P channel                        | Cross circuit test on P channel failed. When the output driver is switched off, there is a connection to 24V at the output.                        | – Check wiring<br>– Acknowledgement and reintegration of the module<br>– If the problem persists replace the module and contact Festo Service | Error             |
| 09   04   019D | 151257501    | Error cross circuit M channel                        | Cross-circuit test on M channel failed. When the output driver is switched off, the output is connected to 0V.                                     | – Check wiring<br>– Acknowledgement and reintegration of the module<br>– If the problem persists replace the module and contact Festo Service | Error             |
| 08   08   019F | 134742431    | General CBUS error                                   | Diagnostics is pending on the CBUS master.                                                                                                         | – Contact Festo Service                                                                                                                       | Error             |
| 08   01   01A2 | 134283682    | System state emergency operation mode                | System initialisation (module detection) has failed. The system is in maintenance mode. I/O function is not available.                             | – Restart system<br>– Update firmware to the latest version<br>– Contact Festo Service                                                        | Error             |
| 08   01   01A4 | 134283684    | Incorrect device variant set                         | The currently set device variant does not match the system configuration. The device variant is automatically adapted to the system configuration. | – If the device variant was not automatically adjusted, set the configured device variant in the device.                                      | Information       |
| 07   0A   01A5 | 118096293    | Minimum pulse length undershot                       | The parameterised minimum pulse length was undershot.                                                                                              | – None                                                                                                                                        | Warning           |
| 07   0A   01A6 | 118096294    | Maximum pulse length overshoot                       | The parameterised maximum pulse length was overshoot.                                                                                              | – None                                                                                                                                        | Warning           |
| 0A   00   01A7 | 167772583    | Remanent memory fault                                | Remanent memory fault                                                                                                                              | – Restarting device<br>– If the problem persists, contact Festo Service                                                                       | Error             |
| 08   0A   01A8 | 134873512    | Incorrect DeviceID deviation of the inspection level | The detected IO-Link device does not match the configured DeviceID.                                                                                | – Check that the correct IO-Link device is connected.                                                                                         | Error             |
| 08   0A   01A9 | 134873513    | No device connected                                  | No IO-Link device connected                                                                                                                        | – Check that the correct IO-Link device is connected.                                                                                         | Error             |
| 07   0A   01AA | 118096298    | New smallest measured pulse length                   | The pulse length is shorter than the last measured minimum value.                                                                                  | – None                                                                                                                                        | Information       |

| ICP ID (hex)   | ICP ID (dec) | Message                                   | Description                                                                        | Remedy                                                                                                                   | Diagnostic status    |
|----------------|--------------|-------------------------------------------|------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|----------------------|
| 07   0A   01AB | 118096299    | New longest measured pulse length         | The pulse length is longer than the last measured maximum value.                   | – None                                                                                                                   | Information          |
| 08   01   01AD | 134283693    | Switch to operating mode operation failed | The AP device could not change the operating mode from Configuration to Operation. | – Restart system<br>– Update firmware to the latest version<br>– Contact Festo Service                                   | Warning              |
| 08   01   01AE | 134283694    | AP device detected invalid                | The “device invalid” device status was detected for the AP device.                 | – Check AP device<br>– Restart system                                                                                    | Error                |
| 08   01   01B1 | 134283697    | AP system startup delayed                 | Unexpected error during system startup. Startup is repeated.                       | – Check communication AP connecting cable<br>– Check AP devices<br>– Check that current firmware versions are being used | Warning              |
| 0C   01   01B3 | 201392563    | Lifecycle Counter threshold reached       | The set threshold of the lifecycle counter for the valve has been reached.         | – Replace valve<br>– Increase lifecycle counter threshold                                                                | Maintenance required |
| 0C   01   01B4 | 201392564    | Wrong valve connected                     | The target/actual comparison for the valve failed.                                 | – Adjust configuration<br>– Connect the correct valve                                                                    | Maintenance required |
| 0C   01   01B5 | 201392565    | Condition counter for valve coil reached  | The condition counter limit for the valve coil has been reached.                   | – Perform maintenance<br>– Reset condition counter                                                                       | Maintenance required |
| 08   01   01C4 | 134283716    | AP module(s) detected                     | One or more new AP modules were detected in the system.                            | – None                                                                                                                   | Information          |
| 09   05   01C5 | 151323077    | Overvoltage channel A                     | Overvoltage channel A                                                              | – Restarting device<br>– Service case                                                                                    | Error                |
| 09   05   01C6 | 151323078    | Overvoltage channel B                     | Overvoltage channel B                                                              | – Restarting device<br>– Service case                                                                                    | Error                |
| 09   05   01C7 | 151323079    | Undervoltage channel A                    | Undervoltage channel A                                                             | – Restarting device<br>– Service case                                                                                    | Error                |
| 09   05   01C8 | 151323080    | Undervoltage channel B                    | Undervoltage channel B                                                             | – Restarting device<br>– Service case                                                                                    | Error                |
| 09   06   01CB | 151388619    | Main switch channel A error               | Main switch channel A error                                                        | – Restarting device<br>– Service case                                                                                    | Error                |
| 09   06   01CC | 151388620    | Main switch channel B error               | Main switch channel B error                                                        | – Restarting device<br>– Service case                                                                                    | Error                |
| 09   00   01D5 | 150995413    | Incorrect safety version channel A        | Incorrect safety version channel A                                                 | – Restarting device<br>– Service case<br>– Check that current firmware versions are being used                           | Error                |
| 09   00   01D6 | 150995414    | Incorrect safety version channel B        | Incorrect safety version channel B                                                 | – Restarting device<br>– Service case<br>– Check that current firmware versions are being used                           | Error                |
| 0D   01   01DD | 218169821    | Diagnostic trace reset                    | The diagnostic trace has been reset and all diagnostics removed.                   | – None                                                                                                                   | Information          |
| 08   01   01FF | 134283775    | Device not ready                          | A device delays the start-up for a disproportionately long time.                   | – Contact Festo Support                                                                                                  | Error                |

| ICP ID (hex)   | ICP ID (dec) | Message                                        | Description                                                                                                                                                       | Remedy                                                                                                                                                                                                                                                               | Diagnostic status    |
|----------------|--------------|------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| 09   05   0200 | 151323136    | Overtemperature safety part channel A          | Overtemperature safety part channel A                                                                                                                             | <ul style="list-style-type: none"> <li>– Device fan defective?</li> <li>– Device overloaded?</li> <li>– Check installation conditions; control cabinet fan filter dirty?</li> <li>– Check drive layout (possible overloading during continuous operation)</li> </ul> | Error                |
| 09   05   0201 | 151323137    | Overtemperature safety part channel B          | Overtemperature safety part channel B                                                                                                                             | <ul style="list-style-type: none"> <li>– Device fan defective?</li> <li>– Device overloaded?</li> <li>– Check installation conditions; control cabinet fan filter dirty?</li> <li>– Check drive layout (possible overloading during continuous operation)</li> </ul> | Error                |
| 09   05   0202 | 151323138    | Undertemperature safety part channel A         | Undertemperature safety part channel A                                                                                                                            | <ul style="list-style-type: none"> <li>– Device fan defective?</li> <li>– Device overloaded?</li> <li>– Check installation conditions; control cabinet fan filter dirty?</li> <li>– Check drive layout (possible overloading during continuous operation)</li> </ul> | Error                |
| 09   05   0203 | 151323139    | Undertemperature safety part channel B         | Undertemperature safety part channel B                                                                                                                            | <ul style="list-style-type: none"> <li>– Device fan defective?</li> <li>– Device overloaded?</li> <li>– Check installation conditions; control cabinet fan filter dirty?</li> <li>– Check drive layout (possible overloading during continuous operation)</li> </ul> | Error                |
| 06   00   0211 | 100663825    | Parameters changed                             | The value of the parameter has been changed.                                                                                                                      | <ul style="list-style-type: none"> <li>– Check configuration</li> </ul>                                                                                                                                                                                              | Error                |
| 08   00   0212 | 134218258    | Send failed                                    | Sending data failed after a number of retries.                                                                                                                    | <ul style="list-style-type: none"> <li>– Check connection</li> <li>– Increase the number of send attempts</li> </ul>                                                                                                                                                 | Information          |
| 08   01   0215 | 134283797    | Communication failure to the downstream module | The device was forced into loopback by the master due to communication errors (AP Out Port disabled). This has interrupted communication with downstream modules. | <ul style="list-style-type: none"> <li>– Check wiring</li> </ul>                                                                                                                                                                                                     | Maintenance required |
| 08   00   0216 | 134218262    | IMA timeout                                    | The IMA timeout of the W-Master has exceeded the configured value.                                                                                                | <ul style="list-style-type: none"> <li>– Increase IMA timeout</li> <li>– Improve radio connection</li> <li>– Check for interference with other wireless networks</li> </ul>                                                                                          | Warning              |
| 06   00   0217 | 100663831    | Pairing button pressed                         | The pairing button was pressed.                                                                                                                                   | <ul style="list-style-type: none"> <li>– None</li> </ul>                                                                                                                                                                                                             | Information          |
| 04   01   0223 | 67174947     | Diagnosis of supply pressure                   | Fluctuations in supply pressure signalled.                                                                                                                        | <ul style="list-style-type: none"> <li>– Check the hose connection between the supply and the valve.</li> </ul>                                                                                                                                                      | Warning              |
| 04   02   0224 | 67240484     | Leakage diagnostics of working pressures       | Displays the value of the leakage at the corresponding working port of the cylinder.                                                                              | <ul style="list-style-type: none"> <li>– Check the tubing connections between valve and cylinder</li> </ul>                                                                                                                                                          | Maintenance required |
| 08   01   0225 | 134283813    | Illegal topology                               | The existing topology includes illegal connections.                                                                                                               | <ul style="list-style-type: none"> <li>– Check wiring</li> </ul>                                                                                                                                                                                                     | Maintenance required |

| ICP ID (hex)   | ICP ID (dec) | Message                                       | Description                                                                          | Remedy                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Diagnostic status |
|----------------|--------------|-----------------------------------------------|--------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| 02   01   0230 | 33620528     | Overload shutdown power supply forwarding PL  | The power forwarding PL to XD2 was switched off.                                     | <ul style="list-style-type: none"> <li>– Eliminate the cause and switch the PL supply off and on again. Possible causes:</li> <li>– Overload/short circuit present: reduce load or eliminate short circuit.</li> <li>– Voltage drop: use a greater power supply or increase the current limit of the fixed power supply.</li> <li>– Voltage drop: use a shorter supply cable or a larger cable cross-section.</li> <li>– Voltage drop: reduce load on power out.</li> <li>– Minimum switch-off time not observed: wait for the minimum switch-off time before switching on again.</li> <li>– Service case</li> </ul> | Error             |
| 02   01   0231 | 33620529     | Overload shutdown, power supply forwarding PS | The power forwarding PS to XD2 was switched off.                                     | <ul style="list-style-type: none"> <li>– Eliminate the cause and switch the PS supply off and on again. Possible causes:</li> <li>– Overload/short circuit present: reduce load or eliminate short circuit.</li> <li>– Voltage drop: use a greater power supply or increase the current limit of the fixed power supply.</li> <li>– Voltage drop: use a shorter supply cable or a larger cable cross-section.</li> <li>– Voltage drop: reduce load on power out.</li> <li>– Minimum switch-off time not observed: wait for the minimum switch-off time before switching on again.</li> <li>– Service case</li> </ul> | Error             |
| 09   05   0240 | 151323200    | Error diagnostic capability P channel         | The test for diagnosing cross-circuits on the P channel failed.                      | <ul style="list-style-type: none"> <li>– Check wiring</li> <li>– Acknowledgement and reintegration of the module</li> <li>– If the problem persists replace the module and contact Festo Service</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                          | Error             |
| 09   05   0241 | 151323201    | Error diagnostic capability M channel         | The test of the diagnostic capability of cross-circuits on the M channel failed.     | <ul style="list-style-type: none"> <li>– Check wiring</li> <li>– Acknowledgement and reintegration of the module</li> <li>– If the problem persists replace the module and contact Festo Service</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                          | Error             |
| 09   04   0242 | 151257666    | Error resting potential too high P channel    | The P channel resting potential test failed. The open-circuit potential is too high. | <ul style="list-style-type: none"> <li>– Check wiring</li> <li>– Acknowledgement and reintegration of the module</li> <li>– If the problem persists replace the module and contact Festo Service</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                          | Error             |
| 09   04   0243 | 151257667    | Error resting potential too low P channel     | The P channel resting potential test failed. The resting potential is too low.       | <ul style="list-style-type: none"> <li>– Check wiring</li> <li>– Acknowledgement and reintegration of the module</li> <li>– If the problem persists replace the module and contact Festo Service</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                          | Error             |
| 01   01   0244 | 16843332     | Short circuit to 0V (GND) P channel           | Short circuit to 0V (GND) / overload detected in the P channel.                      | <ul style="list-style-type: none"> <li>– Check wiring</li> <li>– Acknowledgement and reintegration of the module</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Error             |

| ICP ID (hex)   | ICP ID (dec) | Message                                                 | Description                                                                                                                                                                                     | Remedy                                                                                                                                                                      | Diagnostic status    |
|----------------|--------------|---------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| 01   01   0245 | 16843333     | Short circuit to 24V M channel                          | Short circuit to 24V / overload detected in M channel.                                                                                                                                          | <ul style="list-style-type: none"> <li>– Check wiring</li> <li>– Acknowledgement and reintegration of the module</li> </ul>                                                 | Error                |
| 04   01   0246 | 67174982     | Vacuum not reached                                      | The vacuum could not be generated.                                                                                                                                                              | <ul style="list-style-type: none"> <li>– Check for leakage.</li> </ul>                                                                                                      | Warning              |
| 04   01   0247 | 67174983     | Controller error or air saving function error           | Malfunction in the controller function (e.g. set-point value cannot be reached) or Malfunction of the air saving function, vacuum suction nozzle goes into “continuous suction” operating mode. | <ul style="list-style-type: none"> <li>– Check pressure and actuator supply</li> <li>– Check for leakage</li> <li>– if applicable deactivate air saving function</li> </ul> | Warning              |
| 07   03   0248 | 117637704    | Pressurisation or evacuation time exceeded              | The evacuation or pressurisation time was at least doubled.                                                                                                                                     | <ul style="list-style-type: none"> <li>– Check for leakage.</li> <li>– Extend pressurisation time.</li> <li>– Check throttle setting.</li> </ul>                            | Error                |
| 07   03   0249 | 117637705    | Process quality below critical limit                    | The process quality is below the critical limit.                                                                                                                                                | <ul style="list-style-type: none"> <li>– Check for leakage.</li> </ul>                                                                                                      | Warning              |
| 08   00   024A | 134218314    | Module unknown                                          | The type of module cannot be determined or the master does not support the module.                                                                                                              | <ul style="list-style-type: none"> <li>– Check module</li> <li>– Update software</li> <li>– Contact Festo Service</li> </ul>                                                | Error                |
| 08   00   024B | 134218315    | Too many modules connected                              | The maximum number of supported modules that can be connected to the system has been exceeded.                                                                                                  | <ul style="list-style-type: none"> <li>– Remove modules</li> <li>– Change topology, use multiple gateways</li> <li>– Contact Festo Service</li> </ul>                       | Error                |
| 08   08   024C | 134742604    | CPX classic diagnostics                                 | A CPX classic diagnostics is pending.                                                                                                                                                           | <ul style="list-style-type: none"> <li>– see CPX manual</li> </ul>                                                                                                          | Warning              |
| 09   08   024E | 151519822    | Safety addressing procedure failed                      | The safety addressing procedure (PROFIsafe Type 1 or Type 2) failed.                                                                                                                            | <ul style="list-style-type: none"> <li>– Contact Festo Service</li> </ul>                                                                                                   | Error                |
| 0B   09   024F | 185139791    | Device inconsistency detected                           | Different device data sources have inconsistencies for the same target data.                                                                                                                    | <ul style="list-style-type: none"> <li>– Possible error in the device detected. Please contact Festo Service.</li> </ul>                                                    | Maintenance required |
| 09   06   0252 | 151388754    | Self-test of logic channel A failed                     | The test pulse check on logic channel A failed                                                                                                                                                  | <ul style="list-style-type: none"> <li>– none</li> </ul>                                                                                                                    | Error                |
| 09   06   0253 | 151388755    | Self-test of logic channel B failed                     | The test pulse check on logic channel B failed                                                                                                                                                  | <ul style="list-style-type: none"> <li>– none</li> </ul>                                                                                                                    | Error                |
| 09   06   0254 | 151388756    | Communication between LA and FSU failed                 | The communication between LA and FSU has failed                                                                                                                                                 | <ul style="list-style-type: none"> <li>– none</li> </ul>                                                                                                                    | Error                |
| 09   06   0255 | 151388757    | Communication between LB and FSU failed                 | The communication between LB and FSU has failed                                                                                                                                                 | <ul style="list-style-type: none"> <li>– none</li> </ul>                                                                                                                    | Error                |
| 09   06   0256 | 151388758    | Incompatible software/hardware versions of LA and FSU   | The software/hardware versions of logic channel A and FSU are incompatible                                                                                                                      | <ul style="list-style-type: none"> <li>– none</li> </ul>                                                                                                                    | Error                |
| 09   06   0257 | 151388759    | Incompatible software/hardware versions of LB and FSU   | The software/hardware versions of logic channel B and FSU are incompatible                                                                                                                      | <ul style="list-style-type: none"> <li>– none</li> </ul>                                                                                                                    | Error                |
| 09   00   0258 | 150995544    | Error memory threshold value reached on logic channel A | The threshold value of the error memory on channel A has been reached.                                                                                                                          | <ul style="list-style-type: none"> <li>– none</li> </ul>                                                                                                                    | Error                |

| ICP ID (hex)   | ICP ID (dec) | Message                                                 | Description                                                                                                                               | Remedy                                                                                                                  | Diagnostic status    |
|----------------|--------------|---------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|----------------------|
| 09   00   0259 | 150995545    | Error memory threshold value reached on logic channel B | The threshold value of the error memory on channel B has been reached.                                                                    | – none                                                                                                                  | Error                |
| 09   03   025A | 151192154    | Failed test of the digital input on LA                  | The test of the digital input on LA failed.                                                                                               | – none                                                                                                                  | Error                |
| 09   03   025B | 151192155    | Failed test of the digital input on LB                  | The test of the digital input on LB failed.                                                                                               | – none                                                                                                                  | Error                |
| 09   06   025C | 151388764    | Application-specific FSUCom error with reference to LA  | An error is detected with reference to the communication from the FSU to channel A when receiving the application-specific extended data. | – Restart device, service case                                                                                          | Error                |
| 09   06   025D | 151388765    | Application-specific FSUCom error with reference to LA  | An error is detected with reference to the communication from the FSU to channel B when receiving the application-specific extended data. | – Restart device, service case                                                                                          | Error                |
| 07   06   0268 | 117834344    | Valve fault                                             | A fault in the valve was detected.                                                                                                        | – Check and/or replace valve                                                                                            | Error                |
| 06   00   026A | 100663914    | Invalid safety input configuration                      | The configuration for the safety inputs is invalid.                                                                                       | – Module is passivated, reintegration is then possible, selection of valid input modes                                  | Error                |
| 09   00   027B | 150995579    | Operating mode change timeout La                        | Timeout when enabling the mode change on channel A                                                                                        | – none                                                                                                                  | Error                |
| 09   00   027C | 150995580    | Operating mode change timeout Lb                        | Timeout when enabling the mode change on channel B                                                                                        | – none                                                                                                                  | Error                |
| 07   03   02AD | 117637805    | Output pressure error                                   | The output pressure of the valve is already present before switching on.                                                                  | – Check for leakage.<br>– Check manual override                                                                         | Error                |
| 08   00   02B2 | 134218418    | Parameter access failed                                 | Parameter access failed.                                                                                                                  | – Check data, try parameter access again                                                                                | Information          |
| 09   08   02B3 | 151519923    | F Parameters cannot be written                          | F Parameters (PROFIsafe) cannot be written in the current state.                                                                          | – If F parameters are to be written: abort PROFIsafe communication, only then perform write access.                     | Information          |
| 09   08   02B4 | 151519924    | Safety parameters are not written                       | Safety parameters are not written.                                                                                                        | – none                                                                                                                  | Information          |
| 0B   00   02B6 | 184550070    | AddressMapper addition failed                           | Adding an entry in AddressMapper failed.                                                                                                  | – none                                                                                                                  | Information          |
| 0B   00   02B7 | 184550071    | AddressMapper application failed                        | Applying the default in AddressMapper failed.                                                                                             | – none                                                                                                                  | Information          |
| 02   01   02B8 | 33620664     | Fault in actuator supply                                | Fault in the actuator supply                                                                                                              | – Check actuator supply<br>– Clear short circuit/overload<br>– Check connected actuators                                | Error                |
| 0C   01   02B9 | 201392825    | Application condition counter threshold reached         | The set threshold of the application has been reached.                                                                                    | – Perform application-dependent maintenance work and reset condition counters<br>– Increase condition counter threshold | Maintenance required |
| 08   01   880F | 134318095    | Internal AP process data error                          | The AP process data controller returned an error.                                                                                         | – Restart device                                                                                                        | Error                |

| ICP ID (hex)   | ICP ID (dec) | Message                                                  | Description                                                                     | Remedy                                                                                                                                                                                                                                     | Diagnostic status    |
|----------------|--------------|----------------------------------------------------------|---------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| 01   01   0104 | 16843012     | Short circuit/overload output signal                     | Output was overloaded.                                                          | <ul style="list-style-type: none"> <li>– Check connected load for correct function, in particular for current consumption.</li> <li>– Check wiring.</li> <li>– The output must be reset after the malfunction has been cleared.</li> </ul> | Error                |
| 04   03   030C | 67306252     | Pressure: setpoint value exceeded                        | Max. setpoint value of pressure switch exceeded                                 | -                                                                                                                                                                                                                                          | Warning              |
| 04   03   030D | 67306253     | Pressure: setpoint value undershot                       | Pressure switch minimum setpoint value undershot                                | -                                                                                                                                                                                                                                          | Warning              |
| 04   01   030E | 67175182     | Check supply pressure                                    | Supply pressure outside 4..7 bar range                                          | – The function is being operated outside the specification. Expect restricted performance and accuracy                                                                                                                                     | Warning              |
| 04   01   030F | 67175183     | Supply pressure drops                                    | Regular pressure drops in the supply. Repetition accuracy may not be optimal    | – If accuracy is insufficient, increase supply cross-sections.                                                                                                                                                                             | Information          |
| 04   01   0310 | 67175184     | No supply pressure                                       | Switch on compressed air supply                                                 | – During pressurisation <3 bar, the smart functions are in soft-start mode to enable slow machine start-up.                                                                                                                                | Information          |
| 04   04   0311 | 67371793     | Pressure peaks in the exhaust                            | Backflow in the exhaust. Repetition accuracy and performance may not be optimal | – If accuracy is insufficient, increase the exhaust cross-sections. Replace contaminated silencer.                                                                                                                                         | Maintenance required |
| 04   01   0312 | 67175186     | Control pressure unsuitable for efficient valve function | Reliable operation requires the pilot air to correspond to the supply pressure. | The switching response suggests a deviation in the pilot air level. <ul style="list-style-type: none"> <li>– Please check.</li> <li>– Restart terminal to reset sensor offset.</li> <li>– Replace valve if necessary.</li> </ul>           | Error                |
| 04   02   0313 | 67240723     | Leakage above threshold value                            | Pressure loss detected at the working port                                      | – Check actuator, ports and valve                                                                                                                                                                                                          | Maintenance required |
| 04   02   0314 | 67240724     | Leakage in the actuator                                  | Leakage in the actuator                                                         | – Check actuator, replace if necessary                                                                                                                                                                                                     | Maintenance required |
| 04   02   0315 | 67240725     | Internal valve leakage                                   | Internal valve leakage                                                          | – Check mounting, seal and valve. Replace if necessary.                                                                                                                                                                                    | Maintenance required |
| 06   02   0316 | 100795158    | Target pressure too low                                  | Target pressure setting too low. The minimum permissible value is used.         | -                                                                                                                                                                                                                                          | Warning              |
| 05   02   0317 | 84017943     | Poor movement quality                                    | Suspected jerky movement                                                        | – Increase the target pressure, check throttle position and cushioning.                                                                                                                                                                    | Maintenance required |
| 05   02   0318 | 84017944     | End position probably not reached                        | If necessary, increase target pressure                                          | – Target pressure should include a safety buffer that is greater than the hysteresis                                                                                                                                                       | Maintenance required |
| 05   02   0319 | 84017945     | Hysteresis not sustainable                               | Hysteresis not sustainable, efficient valve function stopped.                   | Choose a greater hysteresis range, <ul style="list-style-type: none"> <li>– use a higher target pressure,</li> <li>– use a small fixed flow control valve</li> <li>– or increase the system volume.</li> </ul>                             | Error                |
| 05   02   031A | 84017946     | End position not detected                                | End position not detected even though the movement has ended.                   | <ul style="list-style-type: none"> <li>– a) Actuator has met an obstacle</li> <li>– b) Boundary conditions unclear, e.g. during soft start</li> <li>– c) Acoustic end position detection unreliable</li> </ul>                             | Warning              |

| ICP ID (hex)   | ICP ID (dec) | Message                                              | Description                                                                                                      | Remedy                                                                                                                                                                  | Diagnostic status |
|----------------|--------------|------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| 0D   02   031B | 218235675    | Connection closed, regulation deactivated            | Working port appears unused, the regulation is deactivated.                                                      | – To reactivate, set "EVF function mode" to 0 and then to the desired value.                                                                                            | Information       |
| 0D   03   031C | 218301212    | Valve unsuitable for the efficient valve function    | The pressure reduction remains switched off.                                                                     | – Install a suitable 5/4 valve in order to use it.                                                                                                                      | Error             |
| 07   06   031D | 117834525    | No pressurisation at the working port                | No pressure rise within 50 ms.                                                                                   | – Check the auxiliary pilot air, tubing and manual override before suspecting a valve fault.                                                                            | Error             |
| 07   08   031E | 117965598    | Input signal does not correlate with valve actuation | no temporal relationship was found between the input signal and the switching signal. TravelTimeLog deactivated. | – The runtime monitoring only works if the proximity switch is connected to the corresponding valve.                                                                    | Error             |
| 0D   03   031F | 218301215    | System size outside the specification                | Actuator and tubing volume appear to be outside the specification. Possible restricted performance or accuracy.  | – Use flexible integrated flow control valve<br>– Connection of min. 20 ml (tube+cylinder)!<br>– less than 20 ml: with fixed flow control valves (0.8-1.2 mm)           | Warning           |
| 0D   03   0320 | 218301216    | Slow pressurisation                                  | Pressurisation not complete after 4 seconds. Application outside the specifications.                             | – Performance and accuracy may be restricted.                                                                                                                           | Warning           |
| 0D   01   0321 | 218170145    | End position detection is not reliable.              | End position detection is not reliable. It is deactivated.                                                       | – Check the user manual for possible causes and troubleshooting.                                                                                                        | Warning           |
| 0D   03   0322 | 218301218    | Use suitable integrated flow control valves          | We recommend using suitable flow control valves in the connection plate. Accuracy probably limited.              | – Use flexible integrated flow control valve<br>– Connection of minimum volume 20 ml (tube+cylinder)!<br>– less than 20 ml: with fixed flow control valves (0.8-1.2 mm) | Warning           |
| 0D   02   0323 | 218235683    | Pressure target was adjusted to switching accuracy   | Poor pressure accuracy, internal target was adjusted to switching response.                                      | -                                                                                                                                                                       | Information       |
| 0D   02   0324 | 218235684    | Pressure target was adjusted to movement quality     | Suspected poor movement quality, internal target was adjusted.                                                   | – To set a specific pressure, use the "Fixed Pressure Preset" function mode                                                                                             | Information       |
| 0D   02   0325 | 218235685    | Target pressure increased (end position)             | Target pressure was increased to reach the final position.                                                       | -                                                                                                                                                                       | Information       |
| 08   00   008C | 134217868    | Failure of synchronisation signal fieldbus           | Failure of synchronisation signal fieldbus                                                                       | – Check wiring<br>– Check controller configuration                                                                                                                      | Error             |
| 08   01   0336 | 134284086    | AP device port communication error                   | An AP device that is not communicating was detected in the system.                                               | – Check firmware versions and update if necessary<br>– Check wiring<br>– Restart AP system                                                                              | Error             |
| 06   00   0337 | 100664119    | Invalid fieldbus selection                           | Invalid fieldbus selection (invalid switch position or incorrect parameterisation)                               | – Check switch position for fieldbus selection, if available<br>– Check parameters/configuration for setting the fieldbus selection                                     | Error             |

| ICP ID (hex)   | ICP ID (dec) | Message                                         | Description                                                                               | Remedy                                                                                                                                                                                                      | Diagnostic status |
|----------------|--------------|-------------------------------------------------|-------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| 09   04   0338 | 151257912    | Error open-circuit potential too high M channel | The M channel open-circuit potential test failed. The open-circuit potential is too high. | <ul style="list-style-type: none"> <li>– Check wiring</li> <li>– Acknowledgement and reintegration of the module</li> <li>– If the problem persists replace the module and contact Festo Service</li> </ul> | Error             |
| 06   05   0339 | 100991801    | Teach-in process active                         | The teach-in process is active.                                                           | <ul style="list-style-type: none"> <li>– Terminate teach-in process</li> </ul>                                                                                                                              | Information       |

Tab. 14: Diagnostic messages

## 12 Technical data

### 12.1 General technical data

| General technical data                                                             |                                                                                                                                                                            |
|------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Certificates, declaration of conformity                                            | ➔ <a href="http://www.festo.com/sp">www.festo.com/sp</a>                                                                                                                   |
| Ambient temperature [°C]                                                           | –20 ... +50                                                                                                                                                                |
| Storage temperature [°C]                                                           | –40 ... +70                                                                                                                                                                |
| Humidity (non-condensing) [%]                                                      | 5 ... 95                                                                                                                                                                   |
| Max. setup altitude [m]                                                            | 2000<br>Observe the restrictions of the individual modules and components ➔ Operating Instructions for the applicable module.                                              |
| Number of modules per interface                                                    | Depending on the interface ➔ Operating instructions for the applicable interface.                                                                                          |
| Max. cable length for system communication between 2 modules [m]                   | 50<br>Available cable lengths ➔ <a href="http://www.festo.com/catalogue">www.festo.com/catalogue</a>                                                                       |
| Address volume of the inputs/outputs [Byte]                                        | 2048/2048, depending on the interface                                                                                                                                      |
| Degree of protection in accordance with EN 60529                                   | IP65/IP67, if all cables are connected and connections that are not required are closed with a cover cap.<br>The degree of protection may differ for some valve terminals. |
| Protection against electric shock (protection against direct and indirect contact) | by the use of SELV/PELV circuits<br>(safe extra-low voltage/protected extra-low voltage)                                                                                   |
| Electromagnetic compatibility                                                      | See declaration of conformity ➔ <a href="http://www.festo.com/sp">www.festo.com/sp</a>                                                                                     |
| Mounting position                                                                  | Any                                                                                                                                                                        |

Tab. 15: General technical data

### 12.2 Technical data, mechanical

| Vibration and shock resistance in accordance with EN 60068      |                     |
|-----------------------------------------------------------------|---------------------|
| Vibration (part 2-6) ➔ Tab. 17<br>Vibration load                | Direct mounting SG2 |
| Shock (part 2-27) ➔ Tab. 18<br>Shock load                       | Direct mounting SG2 |
| Continuous shock (part 2-27) ➔ Tab. 19<br>Continuous shock load | Direct mounting SG1 |

Tab. 16: Vibration and shock resistance in accordance with EN 60068

| Vibration load       |            |                                  |     |                 |       |
|----------------------|------------|----------------------------------|-----|-----------------|-------|
| Frequency range [Hz] |            | Acceleration [m/s <sup>2</sup> ] |     | Deflection [mm] |       |
| SL1                  | SL2        | SL1                              | SL2 | SL1             | SL2   |
| 2 ... 9              | 2 ... 9    | –                                | –   | ±3.5            | ±3.5  |
| 9 ... 200            | 9 ... 200  | 10                               | 10  | –               | –     |
| 10 ... 58            | 10 ... 60  | –                                | –   | ±0.15           | ±0.35 |
| 58 ... 150           | 60 ... 150 | 20                               | 50  | –               | –     |

Tab. 17: Vibration load

| Shock load                       |      |               |     |                      |     |
|----------------------------------|------|---------------|-----|----------------------|-----|
| Acceleration [m/s <sup>2</sup> ] |      | Duration [ms] |     | Shocks per direction |     |
| SL1                              | SL2  | SL1           | SL2 | SL1                  | SL2 |
| ±150                             | ±300 | 11            | 11  | 3                    | 3   |

Tab. 18: Shock load

| Continuous shock load            |               |                      |
|----------------------------------|---------------|----------------------|
| Acceleration [m/s <sup>2</sup> ] | Duration [ms] | Shocks per direction |
| SL1                              | SL1           | SL1                  |
| ±150                             | 6             | 1000                 |

Tab. 19: Continuous shock load

## 12.3 Technical data, electrical

| Power supply                                                  |        |                                                                            |
|---------------------------------------------------------------|--------|----------------------------------------------------------------------------|
| Logic supply PS                                               |        |                                                                            |
| Logic supply PS                                               | [V DC] | 24 ± 25 %                                                                  |
| Trigger level, undervoltage identification in logic supply PS | [V]    | Depending on the module → Operating instructions for the applicable module |
| Max. acceptable current load, logic supply PS                 | [A]    | 4                                                                          |
| Mains buffering time, logic supply PS                         | [ms]   | 10                                                                         |
| Load supply PL                                                |        |                                                                            |
| Load supply PL                                                | [V DC] | 24 ± 25%, may differ for some modules                                      |
| Trigger level, undervoltage identification in logic supply PL | [V]    | Depending on the module → Operating instructions for the applicable module |
| Max. acceptable current load, load supply PL                  | [A]    | 4                                                                          |

Tab. 20: Power supply



The tolerance specifications of the voltage values are valid for the voltages at the applicable supply port of the modules.

- Observe the voltage drop in the voltage transmission lines.

12.4 Technical data for UL certification

In combination with the UL inspection mark on the product, the information in this section must also be observed in order to comply with the certification conditions of Underwriters Laboratories Inc. (UL) for USA and Canada.

| Electrical data and ambient conditions UL |                                                                                                                                                                                                                                                                                                           |
|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Overvoltage category                      | II<br>The unit shall be supplied by a power source which fulfils the requirements on a limited-energy circuit in accordance to IEC/EN/UL/CSA 61010-1 or on a Limited Power Source (LPS) in accordance to IEC/EN/UL/CSA 60950-1 or IEC/EN/UL/CSA 62368-1 or a Class 2 circuit in accordance to NEC or CEC. |
| Pollution degree                          | 2<br>Use in an environment with pollution degree 2 (or better).                                                                                                                                                                                                                                           |
| Installation site                         | for indoor use only                                                                                                                                                                                                                                                                                       |
| NEMA Type Rating for Enclosure            | 1                                                                                                                                                                                                                                                                                                         |
| Supply voltage                            | max. 30 V DC, Class 2                                                                                                                                                                                                                                                                                     |
| Maximum fluid temperature/ambient         | 50 °C/120 °F                                                                                                                                                                                                                                                                                              |

Tab. 21: Electrical data and ambient conditions UL

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