CPX(-M)-FB33/34/35/43/44/45

Bus node
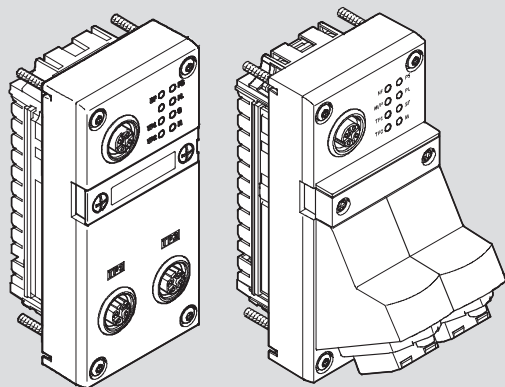
FESTO

Translation of the original instructions

PI PROFIBUS PROFINET is a registered trademark of its respective trademark holder in certain countries.

Table of contents

1 About this document

1.1 Applicable documents

ⓘ

All available documents for the product ➔ www.festo.com/sp.

Document	Contents
CPX system description CPX-SYS-…	Detailed information on the CPX terminal
Brief instructions for bus node	Essential information on the product
Operating instructions for bus node	Detailed information on the product

Tab. 1: Applicable documents

1.2 Product version

This document refers to the following hardware version of the specified product:

Product	Version
CPX-FB33	Bus node CPX-FB33 from revision 07
CPX(-M)-FB34	Bus node CPX(-M)-FB34 from revision 07
CPX(-M)-FB35	Bus node CPX(-M)-FB35 from revision 07
CPX-FB43	Bus node CPX-FB45 from revision 45
CPX(-M)-FB44	Bus node CPX(-M)-FB45 from revision 45
CPX(-M)-FB45	Bus node CPX(-M)-FB45 from revision 45

Tab. 2: Product versions

Information on the revision levels of the product ➔ 4.2.2 Product variants.

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There may be an updated version of this document for this or later product versions
➔ www.festo.com/sp.

2 Safety

2.1 Safety instructions

– Only use the product in its original condition without unauthorised modifications.
– 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.

- The product may generate high frequency interference, which may require interference suppression measures in residential areas.
- Comply with the handling specifications for electrostatically sensitive devices.

2.2   Intended use

The bus node is intended for operation as a station (IO Device) in the Industrial Ethernet system PROFINET IO.

When the additional Message Queuing Telemetry Transport (MQTT) function is activated, the bus node can be used as a gateway between Industrial Ethernet networks and an on-premise MQTT broker.

The product may only be used in combination with the CPX Terminal in an industrial environment.

2.3   Training of qualified personnel

This description is intended exclusively for technicians trained in control and automation technology, who have experience in installation, commissioning, programming and diagnostics of programmable logic controllers (PLC) and fieldbus systems.

3   Additional information

- Contact the regional Festo contact if you have technical problems ➔ www.festo.com.
- Accessories and spare parts ➔ www.festo.com/catalogue.

4   Product overview

4.1   Function

The bus node as a device in a PROFINET IO network establishes the connection to the higher-order controller. The PROFINET communicates in real-time with the Real-Time Protocol (RT) or the Isochronous Real-Time Protocol (IRT). The switch integrated in the bus node enables division of the network into several segments. The number of segments in the network can be increased with the use of additional switches and routers.

The bus node can be used in two different operating modes:
- Remote I/O
- Remote controller

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Particular functions are only available from a specific revision➔ 4.2.2 Product variants.

Priority start-up (Fast Start-up)

The Prioritised Start-up function is also referred to as "fast start-up" or "fast restart" and ensures a fast start-up of the CPX terminal.

Requirements for using the function Fast Start-up:
- Intermediate switches and routers must must also support the Fast Start-up function.

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Fast Start-up can be combined with the Remote I/O operating mode.

Deactivation of the crossover function speeds up the Fast Start-up function.

The Fast Start-up function is switched over in the control software at two configuration levels:
– Basic hardware configuration in the properties for the CPX terminal
– CPX terminal configuration with allocation of the configuration table

Identification & Maintenance (I&M)
This function serves as an electronic rating plate and offers uniform, manufacturer-independent access to device-specific online information over the internet.

PROFIenergy
The function supports targeted shut-off of consumers that are not required in order to reduce the power demand.

Media Redundancy Protocol (MRP)
Redundant PROFINET communication can be set up with MRP. Ring topology increases the reliability of high-availability networks.

Media Redundancy for Planned Duplication (MRPD)
Redundant PROFINET communication can be set up with MRPD. The ring topology means that there is no time delay due to switchover times.

S2 system redundancy
The bus node maintains communications with two redundant controllers. In the event of communication faults with the primary controller, the system switches automatically to the standby connection.

Crossover detection (Crossover Detection)
The function supports the use of patch cables and crossover cables in the same system.

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• The product can be connected to the network or a PC using either a patch cable or crossover cable.
• The crossover detection function must be activated in the control software if patch and crossover cables are used in the same system.

Message Queuing Telemetry Transport (MQTT)
MQTT enables specific data to be read from valve terminals, e.g. asset data, diagnostic data and status messages of the CPX terminal and the valve terminal. The data are transmitted via a second communication channel of the bus node in parallel and without impairing the PROFINET communication.
The following safety aspects must be observed:
– The MQTT telegrams are not transmitted under real-time conditions.
– The contents of the MQTT telegrams should not be used for process-critical decisions.
– MQTT telegrams may contain confidential data and are not encrypted. Therefore, MQTT data and the connection to the broker may only be transmitted over private/local networks.
– The process data telegrams transmitted via MQTT are only snapshots. Not all I/O cycles of the PROFINET are transferred.

Device description file
A device description file in XML format (GSDML) is required for configuration and programming of the CPX terminal. The GSDML contains all the information required for configuring and setting up the CPX terminal using control software.

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The current GSDML file is required to be able to use all functions of the bus node.

The current GSDML file for CPX terminals is located in the Festo Support Portal:

➔ www.festo.com/sp

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Consult your local Festo repair service if you have any questions or technical problems.
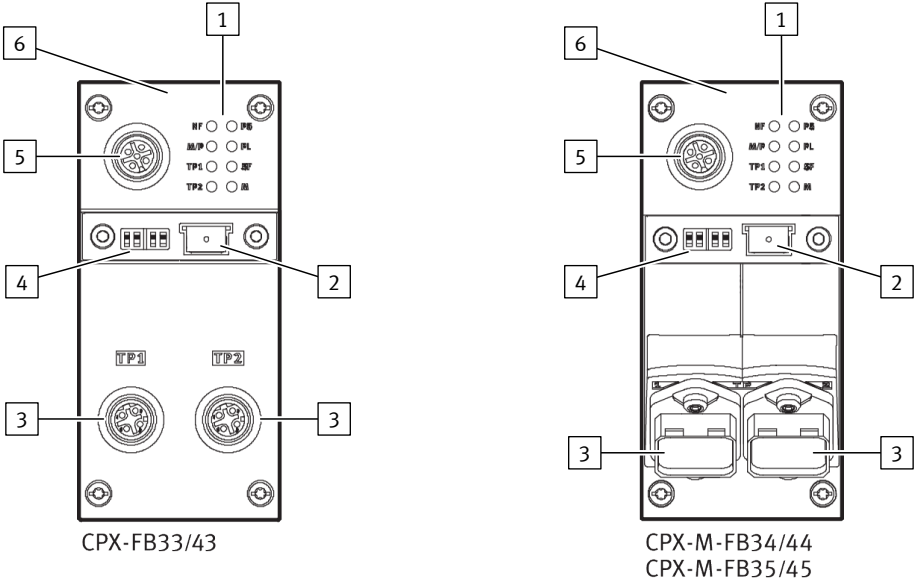
4.2   Structure

4.2.1   Product design

CPX-FB33/43

CPX-M-FB34/44
CPX-M-FB35/45

Fig. 1: Connection and display elements

1	LED indicators		4	DIL switches
2	Memory card, FB33/34/35 only		5	Service interface
3	Network port		6	Product labelling

4.2.2   Product variants

The following software and hardware revisions are a prerequisite for using the functions:

Function	Bus bus node revision number	
	Software	Hardware
Priority start-up (Fast Start-up)	from Rev 12	from Rev 11
Identification & Maintenance (I&M)	from Rev 14	from Rev 1
PROFIenergy	from Rev 20	from Rev 1
Media Redundancy Protocol (MRP)	from Rev 20	from Rev 1
Media Redundancy for Planned Duplication (MRPD)	from Rev 50	from Rev 45
S2 system redundancy	from Rev 50	from Rev 45
Isochronous real time (IRT)	from Rev 21	from Rev 1
Message Queuing Telemetry Transport (MQTT)	from Rev 53	from Rev 45

Tab. 3: Required revision numbers for using the functions

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The bus nodes CPX(-M)-FB33/34/35 do not support MQTT.

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The revision numbers of the hardware and software for the bus node can be checked with the control software, the Festo Maintenance Tool (FMT) or the Festo Field Device Tool (FFT).

4.2.3 LED displays

LED	Network status LEDs		LED	CPX-specific LEDs	
◯	NF	Network Failure, red	◯	PS	Power System, green
◯	M/P	Maintenance/PROFIenergy, green or yellow	◯	PL	Power Load, green
◯	TP1	Link/Traffic 1, green	◯	SF	System Failure, red
◯	TP2	Link/Traffic 2, green	◯	M	Modify, yellow

Tab. 4: LEDs on the bus node

4.2.4 Control elements

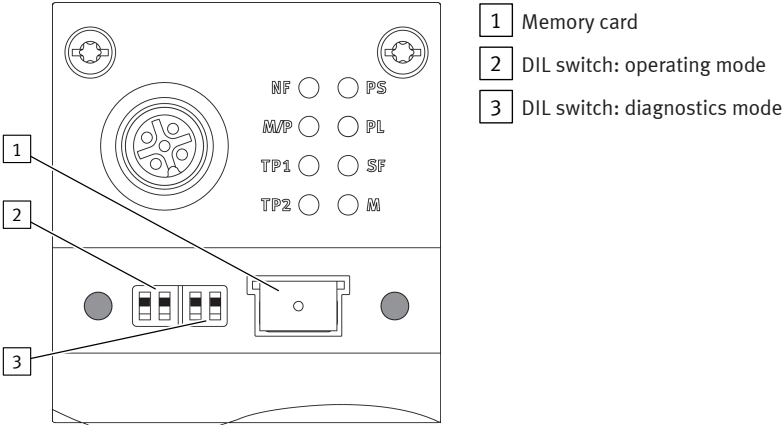1 Memory card

2 DIL switch: operating mode

3 DIL switch: diagnostics mode

Fig. 2: Control elements for PROFINET

DIL switches

A bus node must be operated as a master in the CPX terminal. The "Remote I/O" operating mode must be set on this bus node. The "Remote Controller " operating mode must be set on all other bus nodes. The [2] DIL switch is used to set the operating mode :

DIL switch [2]		Description
	Factory setting: 1: OFF 2: OFF	Remote I/O operating mode All functions of the CPX terminal are controlled by the PROFINET IO controller.
	1: ON 2: OFF	Remote controller operating mode A CPX-CEC-xx takes over the I/O open-loop control. Requirement: CPX Terminal with CEC.

Tab. 5: Setting the operating mode

The diagnostics mode or the data field size is set with the [3] DIL switch depending on the operating mode:

DIL switch [3]		Description	
		Remote I/O	Remote controller
	Factory setting: 1: OFF 2: OFF	Diagnostics switched off.	Data field size: 8 bytes I/8 bytes O
	1: OFF 2: ON	Status bits switched on.	Data field size: 16 bytes I/16 bytes O

DIL switch [3]		Description	
		Remote I/O	Remote controller
ON ▯▮ 1 2	1: ON 2: OFF	I/O diagnostics interface switched on.	Data field size: 32 bytes I/32 bytes O
ON ▮▮ 1 2	1: ON 2: ON	Position is reserved.	Position is reserved.

Tab. 6: Setting the diagnostics mode

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Reserved DIL switches are blocked for future functions and must not be used.

ℹ️

The setting of the DIL switches for operating mode and diagnostics mode must match the settings in the open-loop control.

Memory card

ℹ️

The bus nodes CPX-(M)-FB43/44/45 do not support memory cards.

The memory card serves as a carrier for configuration data, such as the fieldbus device name. This makes it easy to replace a bus node. Detailed information on use ➜ Bus node operating instructions. The memory card holds configuration data for the PROFINET addressing:
– Fieldbus device name
– IP address
The configuration data can be transferred to the new bus node with the memory card when replacing a bus node.

ℹ️

The data on the memory card have priority over other configuration data. e.g. data stored in the bus node memory or in the control system.

NOTICE

Malfunction or Damage to the Memory Card.
Inserting or removing the memory card while the power supply is switched on can result in malfunctions of or damage to the memory card.
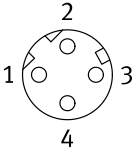• Disconnect the power supply before you insert or remove the memory card.

The various bus node revisions are only compatible with the corresponding memory card:

Memory card	Bus bus node revision number
CPX-SK	from Rev 07
CPX-SK-2	from Rev 12
CPX-SK-3	from Rev 30

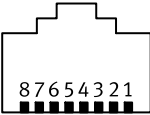Tab. 7: Compatibility of the memory cards depending on the bus node revision

4.2.5 Connecting elements

Pin allocation of the network interface of the bus node CPX-FB33/43

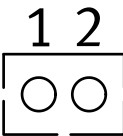| Socket	Pin	Signal	Explanation
M12, D-coded	1	TD+	Transmitted data (Transmit Data) +
	2	RD+	Received data (Receive Data) +
	3	TD−	Transmitted data −
	4	RD−	Received data −
	Housing	Shield/FE	Shielding/functional earth

Tab. 8: Network interface of the bus node CPX-FB33/43

Pin allocation of the network interface of the bus node CPX-M-FB34/44

Socket	Pin	Signal	Explanation
RJ45, Push-pull	1	TD+	Transmitted data (Transmit Data) +
	2	TD−	Transmitted data −
	3	RD+	Received data (Receive Data) +
	4	n.c.	not connected
	5	n.c.	not connected
	6	RD−	Received data −
	7	n.c.	not connected
	8	n.c.	not connected
	Housing	Shield/FE	Shielding/functional earth

Tab. 9: Network interface of the bus node CPX-M-FB34/44

Pin allocation of the network interface of the bus node CPX-M-FB35/45

Socket	Pin	Signal	Explanation
SCRJ, Push-pull 1 2 ◯ ◯	1 2	TX RX	Transmitted data Received data

Tab. 10: Network interface of the bus node CPX-M-FB35/45

Overview of connections and plugs

Bus node	Connection technology	Network plugs
CPX-FB33/43	2 x M12, D-coded, female, 4-pin, in accordance with IEC 61076-2	NECU-MS-D12G4-C2-ET
CPX-M-FB34/44	2 x RJ45, push-pull, Cu, AIDA, in accordance with IEC 60603, IEC 61076-3	NECC-M-S-R3G8PP-HX-PN
CPX-M-FB35/45	2 x SCRJ, push-pull, 650 nm, AIDA, in accordance with IEC 61754-24	NOCC-M-S-SCRJG2PP-C5-PN

Tab. 11: Connection technology and network plugs

ⓘ

The cable lengths in the following table have been used in accordance with the specifications for PROFINET networks.

Network plugs	Cable specification
NECU-MS-D12G4-C2-ET	Ethernet cable, shielded, Cat 5/5e, 6 … 8 mm, 0.14 … 0.75 mm^2; max. 100 m PROFINET end-to-end link: 22 AWG
NECC-M-S-R3G8PP-HX-PN	Ethernet cable, shielded, Cat 5/Cat 5e, 5 … 8 mm, 0.13 … 0.36 mm^2 ≙ ca. 26 … 22 AWG; max. 100 m PROFINET end-to-end link: 22 AWG
NOCC-M-S-SCRJG2PP-C5-PN	POF fibre-optic cable, 980/1000 µm, 6.5 … 9.5 mm; max. 50 m PROFINET end-to-end link; ≤ 12.5 dB

Tab. 12: Cable specification for network plugs

Service interface

An operator unit such as CPX-MMI-1 can be connected to the service interface.

Alternatively, the service interface can be connected to a PC with the USB adapter NEFC-M12G5-0.3-U1G5 so that the "Festo Maintenance Tool" software (FMT) can be used.

5 Mounting

The bus node is mounted in an interlinking block of the CPX terminal.

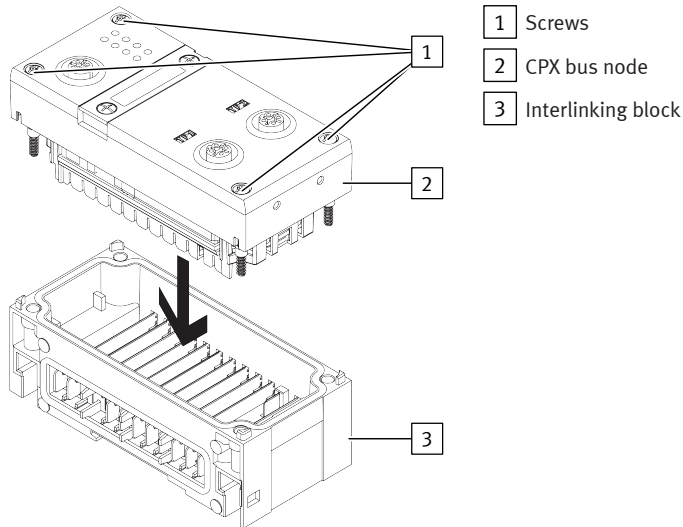| 1 | Screws |
| 2 | CPX bus node |
| 3 | Interlinking block |

Fig. 3: Mounting the bus node in an interlinking
block

– Before working on the product, switch off the power supply and secure it against being switched on
again.
– CPX-M-FB35/45 only permissible on metal interlinking.

Removal

1. Unscrew screws.
2. Carefully lift the bus node.

Mounting

1. Check seal and sealing surfaces and insert the bus node.
2. Screws must be placed so that the pre-grooved threads are used. Tighten the screws by hand
cross-wise.
Tightening torque: 0.9 … 1.1 Nm.

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Use suitable screws for the interlinking block.

• Plastic interlinking block: thread-grooving self-tapping screws.
• Metal interlinking block: screws with metric thread.

6 Installation

6.1 General information about installation

Comply with the handling specifications for electrostatically sensitive devices.

> **i**

Information on mounting the CPX terminal can be found in the CPX system description CPX-SYS-….

6.2 Connecting to the network

Installation guidelines

> **i**

Observe the installation guidelines of the PROFINET user organisation (PNO):

➔ www.profibus.com

> **NOTICE**
>
> **Unauthorised Access to the Device Can Cause Damage or Malfunction.**
> - When connecting the device to a network, protect the network from unauthorised access.
>   Standards for security in information technology can be used for network protection measures, e.g.
>   IEC 62443, ISO/IEC 27001.

> **i**

An access password only protects against unintentional modification.
For additional information ➔ Guidelines and standards for security in information technology, e. g.
IEC 62443, ISO/IEC 27001.

Use of switches and routers

The switch integrated in the bus node enables division of the network into several segments.
The network can be divided into additional segments with the use of additional switches and routers.
This makes it possible to structure the network and expand the network.
Regardless of the network structure, the expansion of a PROFINET segment must not exceed certain
connection lengths:

- Copper connecting cable, Ethernet twisted pair cable, 22 AWG:
  max. 100 m between network participants, PROFINET end-to-end link
- Optical connecting cable, POF fibre-optic cable, max. 12.5 dB signal attenuation over the entire
  connecting section:
  max. 50 m PROFINET end-to-end link.

6.3 Ensuring the degree of protection

- Use connection hardware with the required degree of protection.
- Use cover caps to seal unused connections.

Connection	Connecting hardware	Cover cap
CPX-FB33/43: Network port with M12 plug	Plug: NECU-M-S-D12G4-C2-ET	ISK-M12
CPX-M-FB34/44: Network port with RJ45 plug	Plug: NECC-M-S-R3G8PP-HX-PN	CPX-M-AK-C
CPX-M-FB35/45: Network port with SCRJ plug	Plug: NOCC-M-S-SCRJG2PP-C5-PN	
Service interface	Connecting cable: KV-M12-M12-...	ISK-M12

Tab. 13: Examples of the connection technology and cover caps for degree of protection IP65/IP67

6.4 Power supply

Bus nodes are supplied with power via the interlinking blocks.

If there are problems with the power supply ➔ 9 Diagnostics.

7 Commissioning

7.1 Setting up PROFINET communication

NOTICE

Malfunction due to incorrect switch-on sequence.
- First switch on the operating voltage supply of all network stations and then the operating power supply of the open-loop control.

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CPX- M-FB34: cyclical process data exchange can freeze in exceptional cases in applications with increased electrostatic load.

This results in an entry in the diagnostic memory with error number FN150.
- Restart to ensure normal operation.
- Reduce electrostatic charges in the vicinity of the product or use a CPX Terminal with metal interlinking.

1. Define the operating mode and diagnostic mode with the DIL switches of the bus node.
2. Set up the automation project for the higher-order controller using suitable software.
3. Import the device description file into the software ➔ www.festo.com/sp.
4. Configure the CPX Terminal in the software:
   – System structure
   – Network addressing
   – Address allocation of the modules
5. Transfer the automation project to the higher-order controller.

Behaviour of the display elements of the bus node during commissioning in the CPX Terminal

LED		Status	LED		Status
○	NF	off	☀ (green)	PS	on
○	M/P	off	☀ (green)	PL	on
☀ (green)	TP1	on	○	SF	off
☀ (green)	TP2	on	○	M	off

Tab. 14: Behaviour of the display components after error-free commissioning

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Information on troubleshooting in the event of incorrect behaviour ➜ 9 Diagnostics.

7.2 Setting up MQTT communication

Requirement: the feature must be activated. This can be checked via the web server.

1. Set up the automation project for the higher-order controller using suitable software ➜ 7.1 Setting up PROFINET communication.
2. Import the device description file into the software ➜ 7.1 Setting up PROFINET communication.
3. Select MQTT from the list of submodules.
4. Add MQTT to the bus node as a submodule.

5. Configure MQTT in the software:
   – Broker
     A broker is configured via the IP address, the port and a keepalive time. Up to three brokers can be configured for load balancing. If multiple brokers are configured, a broker is randomly selected for every connection attempt. If a broker is not to be used, the IP address 0.0.0.0 or port 0 must be assigned. MQTT communication requires at least one configured broker.
   – Template selection
     The template selection defines which telegrams are to be sent. The default template selection has the number 0 and contains the Online, Offline, Asset, Diag, Process, Process_Module and Will telegrams.
   – Section from the process image
   – Topic-Prefix
     The Topic-Prefix defines a character string that is inserted before the topic of each MQTT message sent.
   – Client Identifier
     The Client Identifier consists of up to 23 characters. If the Large Client Identifier option is enabled, the Client Identifier can be expanded up to 128 characters. The Large Client Identifier option may only be activated if the broker used supports it.
   – Retain-Flag
     The Retain-Flag option causes the MQTT server to save the last published message for each topic. As a result, other clients receive these messages immediately after subscribing to a topic without having to wait for the next update.
   – Use saved configuration
     This option ignores all configuration settings and instead uses the configuration stored in the device.
6. Transfer the automation project to the higher-order controller ➔ 7.1 Setting up PROFINET communication.
7. Start the web server and check the configuration and status via the MQTT page.

8 Parameterisation

The behaviour of the CPX terminal can be set individually by parameterisation. The following parameterisation variants are distinguished:
– System parameterisation, e.g. deactivating error messages
– Module and channel-specific parameterisation, e.g. module monitoring, settings for errors, adjustment of debouncing times for inputs
– Parameterisation of the diagnostic memory
The following parameterisation options are available:
– Parameterisation of the CPX terminal with PROFINET engineering software
– Parameterisation with the operator unit
– Parameterisation via the Festo Maintenance Tool

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Detailed description of the specific parameters and basic principles for application ➔ CPX system description CPX-SYS-….
Parameter lists of the various CPX modules ➔ Descriptions of the modules.

8.1   Bus node parameters

Bus node parameters	Description/setting options
Standard CPX parameters	
– SCS monitoring – SCO monitoring – Monitoring U_{OUT} – Monitoring U_{VAL} – SCV monitoring – Fail-safe – Force mode – System start with external parameters or default parameters or with saved parameters. – Diagnostic memory	Standard CPX parameters – for further information ➔ CPX system description CPX-SYS-… **Note** The parameters of the diagnostic memory can only be set via the CPX-MMI or CPX-FMT.
Device-specific parameters	
Diagnostic message filter Undervoltage U_{OUT}/U_{VAL} – Only available for bus nodes from Rev 14. – Displayed in the hardware configuration (HW Config) as "Filter Alarm U_{off}/U_{ven}".	– Inactive: Undervoltage is reported via the network – Active: Undervoltage messages are filtered and not reported over the network ➔ the undervoltage is only indicated by the flashing SF LED on the bus node.
Channel alarm filter Undervoltage U_{OUT}/U_{VAL} – Only available for bus nodes from Rev 20. – Displayed in the hardware configuration (HW Config) as "Filter channel alarms U_{off}/U_{ven}".	– Inactive: Undervoltage is reported via the network. – Active: Undervoltage messages are filtered ➔ a maximum of one message per module is sent over the network; the undervoltage is additionally displayed by the flashing SF LED on the bus node.

Bus node parameters	Description/setting options

Filter for combining channel alarms (channel bundling)
– Only available for bus nodes from Rev 20.
	– Inactive:
	  Channel alarms are reported individually via the network.
	– Active:
	  Channel alarms, e.g. as a result of short circuit or undervoltage, are summarised and transmitted as a common message over the network; the error is also displayed by the corresponding flashing LED on the bus node.

Analogue process value representation/byte sequence	Special bus node parameter in Intel/Motorola format - defines the representation of process values of the analogue modules - setting options:
	– Byte Order Intel, LSB-MSB, "Little Endian";
	  Factory setting: process values are displayed in Intel format. The least significant bit is on the right and the most significant bit on the left.
	– Byte order Motorola, MSB-LSB, "Big Endian":
	  process values are displayed in Motorola format. The most significant bit is on the right and the least significant bit on the left.
	This parameter can also be set via the I/O diagnostic interface using function number 4402 in bit 7:
	– Value "0": Intel, LSB-MSB; factory setting
	– Value "1": Motorola, MSB-LSB
	The setting of the byte sequence depends on the control system and the associated user programs: select the byte sequence used in the control system.

Tab. 15: Bus node parameters

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Also consider the set bus node parameters in the user programs, in particular the byte sequence.

If the bus node of an earlier revision is used, the parameters are displayed in the software, but cannot be set.

9 Diagnostics

9.1 Diagnostics options

Depending on the configuration the following options for diagnostics are available in the context of PROFINET:
– LED display
– Status bits
– I/O diagnostics interface
– Diagnostics via CPX-MMI
– Diagnostics via CPX-FMT
– Diagnostics via PROFINET
– Diagnostics via MQTT Topics
– Diagnostics via web server
– Diagnostics via FAS

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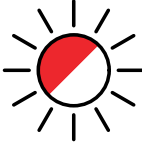
The displayed diagnostic information is dependent on the settings of the on the bus node as well as on the parameterisation of the CPX terminal or the controller.
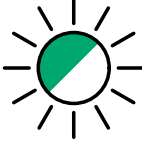
9.2 Diagnostics via LED displays

Various status LEDs are available for diagnostics at the bus node. They show hardware errors, configuration errors and bus errors directly on site, which enables fast error detection.

9.2.1 Network status LEDs
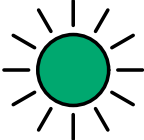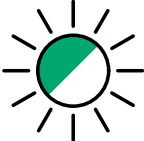
NE – Network Status/Network Error

LED	Sequence	Status	Error handling
LED is off	ON OFF	No error, if the PS LED is green.	–
LED flashes	ON OFF	Network connection not OK - possible causes: – Only before initial start-up: Configuration defective, e.g. MAC-ID not configured. – Device name or device number not correct.	Check: – Configuration – Device name – Device number

NE – Network Status/Network Error

LED	Sequence	Status	Error handling
LED flashes	ON OFF	– IO controller defective. – Network connection interrupted, short-circuited or disturbed.	– IO controller – Network connection

Tab. 16: Network status LED NE
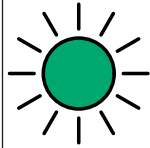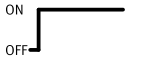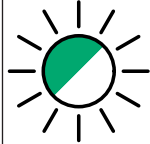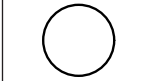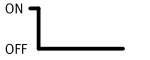
M/P – Maintenance/PROFIenergy

LED	Sequence	Status	Error handling
LED is off	ON OFF	Maintenance action not required, PROFIenergy function not activated.	–
LED is yellow	ON OFF	Maintenance action required.	Check: – Operating voltage – Plug – Fibre optic cable
LED flashes green	ON OFF	PROFIenergy activated.	–

Tab. 17: Network status LED – M/P
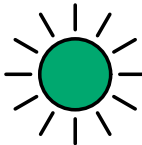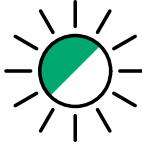
TP1, TP2 – Connection Status

LED	Sequence	Status	Error handling
LED is off	ON / OFF	Physical network connection not detected.	Check network connection/network cable.
LED on	ON / OFF	Network connection is OK.	–
LED flashes	ON / OFF	Both LEDs flashing synchronously: module location, e.g. for troubleshooting or during configuration.	–

Tab. 18: Network status LEDs - TP1 and TP2

9.2.2 CPX terminal status - LEDs
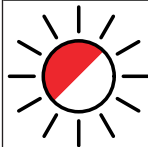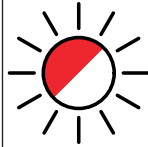
PS – power supply status for electronics/sensors

LED	Sequence	Status	Error handling
LED on	ON / OFF	No error, operating voltage for electronics and sensors is on.	–
LED flashes	ON / OFF	Operating voltage for electronics and sensors outside the tolerance range.	1. Check operating voltage. 2. Rectify short circuit/overload. 3. Depending on the parameterisation: – Factory setting: the sensor supply voltage will be switched on again automatically after the short circuit has been eliminated. – Switch power supply off and on.
LED is off	ON / OFF	Operating voltage for electronics and sensors is not on.	Check the operating voltage connection of the electronics.

Tab. 19: CPX terminal status LED - PS
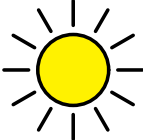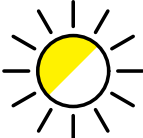
PL – load voltage supply for the outputs/valves

LED	Sequence	Status	Error handling
LED on	ON / OFF (steady on)	No error, load voltage is on.	–
LED flashes	ON / OFF (flashing)	Load voltage outside the tolerance range.	1. Rectify undervoltage. 2. Depending on the parameterisation: – Factory setting: the load voltage supply will be switched on again automatically after the undervoltage has been eliminated. – Switch power supply off and on.

Tab. 20: CPX terminal status LED - PL

SE: System Error

LED	Sequence	Status	Error handling
LED is off	ON / OFF (off)	No error	–
LED flashes 1x	ON / OFF (flashes 1x)	Information or minor error: error class 1	➔ Description of error numbers in the CPX system description CPX-SYS-….

SE: System Error

LED	Sequence	Status	Error handling
LED flashes 2x	ON / OFF	Error: error class 2	➔ Description of error numbers in the CPX system description CPX-SYS-….
LED flashes 3x	ON / OFF	Serious error: error class 3	

Tab. 21: CPX terminal status LED – SE

M – parameterisation modified or forcing active

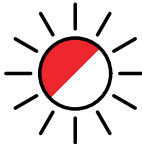| LED	Sequence	Status	Significance/error handling
LED is off	ON / OFF	– Factory setting: system start with default parameterisation and current CPX configuration. – External parameterisation possible.	–
LED on	ON / OFF	– System start with saved parameterisation and saved CPX configuration. – Parameters and CPX configuration are stored permanently; external parameterisation is blocked.	Caution when replacing a CPX terminal with saved parameterisation, LED M on: In case of servicing, such as replacement of the CPX terminal, parameterisation is not established automatically by the PLC or the higher-order system. In this case, before replacing check which settings are required and adjust them if necessary.
LED flashes	ON / OFF	– Force is active.	The Forcen function is enabled; Force mode, function no. 4402 → CPX system description CPX-SYS-...

Tab. 22: CPX terminal status LED – M

ⓘ

The display of the Forcen function has priority over the display of the setting for the system start.

9.3 Diagnostics via status bits

The CPX terminal provides 8 status bits - depending on the hardware configuration of the controller. The status bits are used to display common diagnostic messages. Common diagnostic messages are global error messages. 8 status bits are configured like inputs, the address can be freely selected during configuration. The status bits are transmitted cyclically to the controller with all other inputs. If all status bits return logic 0, an error will not be registered.

Diagnostics via status bits enables fast access to error messages in the PLC user program.

Bit	Diagnostic information with logic 1	Description
0	Error at valve	Module type in which an error has occurred.
1	Error at output	

Bit	Diagnostic information with logic 1	Description
2	Error at input	Module type in which an error has occurred.
3	Error at analogue module/technology module	
4	Undervoltage	Type of error
5	Short circuit/overload	
6	Wire break	
7	Other error	

Tab. 23: Status bits

9.4 Diagnostics via the I/O diagnostics interface (STI)

The CPX terminal provides a bus-independent 16-bit I/O diagnostic interface - provided the controller has the appropriate hardware configuration. This interface enables access to internal data of the CPX terminal, which enables internal parameters and data to be read out at the I/O level.
Additional information ➜ CPX system description CPX-SYS-....

9.5 Diagnostics via CPX-MMI

The operator unit CPX-MMI enables a menu-driven display of diagnostic information. Errors can be read out locally in plain text.
Additional information ➜ Description of the operator unit CPX-MMI-....

9.6 Diagnostics via CPX-FMT

The Festo Maintenance Tool (FMT) offers PC-based diagnostic functions via a graphical representation of the CPX terminal, e.g. status display, parameterisation.
Additional information ➜ Online documentation for the Festo Maintenance Tool CPX-FMT-....

9.7 Diagnostics via PROFINET

PROFINET forms the basis for comprehensive diagnostic functions and information via the automation network, e.g. detailed module-related and channel-related status information and error detection in the online mode of the control software.

Error characteristics
In the case of the following malfunctions the behaviour of the CPX terminal depends on the configured behaviour of the controller and the parameterised fail-safe setting:
– Telegram failure
– Stop the controller
– Network interruption
The fail-safe parameterisation is used to specify the signal status of the outputs in the event of fieldbus communication errors in the network. This signal state is called fail-safe state.

> **i**
>
> Additional information on the fail-safe setting ➜ CPX system description CPX-SYS-....

Diagnostics

Error numbers and types

ℹ️

A list of all CPX-specific error numbers and types ➔ CPX system description CPX-SYS-....

Additional diagnostic information is made available via the error types.

With the exception of the CPX error numbers in the following table, the CPX error numbers in the PROFINET network are sent with offset 1000:

CPX error number + 1000 = PROFINET error number.

Example:

Error in the measuring system: CPX error number 108 + 1000 = PROFINET error number 1108.

CPX error number	PROFINET error number	Error type
2	1	Short circuit
3	6	Wire break
4	2	Undervoltage
5	2	Undervoltage
9	8	Lower critical limit undershot
10	7	Upper critical limit exceeded
11	1	Short circuit at valve
13	6	Wire break at valve
65	64	PROFIsafe addresses/F_Dest_Add different
69	72	Parameterisation error ➔ error in "safe parameterisation"

Tab. 24: PROFINET-specific error numbers and types

9.8 Diagnostics via MQTT telegrams

The bus node sends the telegrams listed in the following chapters to a configured MQTT-Broker. The telegrams consist of MQTT-Topic and MQTT-Payload (user data). The payloads are transferred from the bus node in the JSON format.

9.8.1 Replacement markers

The replacement markers are used to define the message content in the following subsections.

Description	Replacement marker	Data type
Telegram send reason ("Device booted", "Broker connection reestablished", "Configuration changed", "Cyclic")	‹Tx_TELEGRAM_SEND_REASON›	String
Manufacturer name ("Festo")	‹MANUFACTURER›	String
Topic prefix	‹TOPIC_PREFIX›	String

Description	Replacement marker	Data type
Template selection	‹TEMPLATE_SELECTION›	Number
Template version	‹TEMPLATE_VERSION›	String
Profinet device name	‹PN:PDN›	String
PLC name from the firmware	‹CPX:HOSTNAME›	String
Name of the CPX product family	‹CPX:PRODUCT_FAMILY›	String
Gateway of the CPX bus node	‹CPX:FBD:IFx_GW›	String
IP address of the CPX bus node	‹CPX:FBD:IFx_IP›	String
IP address mask of the CPX bus node	‹CPX:FBD:IFx_IPMASK›	String
MAC address of the CPX bus node	‹CPX:FBD:IFx_MAC›	String
Firmware version of the CPX bus node	‹CPX:FBD_FIRMWARE›	String
Order ID of the CPX bus node	‹CPX:FBD_ORDERID›	String
Hardware and software revision of the CPX bus node	‹CPX:FBD_REVISION›	String
Serial number of the CPX bus node	‹CPX:FBD_SERIAL›	String
Current time of the CPX bus node	‹CPX:FBD_TIMESTAMP›	String
Current time quality of the CPX bus node ("No synchronization", "Hard synchronization")	‹CPX:FBD_TIMESTAMP_QUALITY›	String
Input process data	‹CPX:FBD_INPUT_VALUES›	Array of Numbers
Output process data	‹CPX:FBD_OUTPUT_VALUES›	Array of Numbers
Module number of the CPX bus node	‹CPX:FBD_MODULE_NUMBER›	Number
Module number of the relevant module	‹CPX:Mx_MODULE_NUMBER›	Number
Channel number of the relevant channel	‹CPX:Mx:Cx_CHANNEL_NUMBER›	Number
Channel type of the relevant channel ("IN", "OUT")	‹CPX:Mx:Cx_CHANNEL_TYPE›	String
Input process data of the CPX module	‹CPX:Mx_INPUT_VALUES›	Array of Numbers
Output process data of the CPX module	‹CPX:Mx_OUTPUT_VALUES›	Array of Numbers
Module code of the CPX module	‹CPX:Mx_MODULECODE›	String
Serial number of the CPX module	‹CPX:Mx_SERIAL›	String
Detailed description of the CPX module name	‹CPX:Mx_LONGTEXT›	String

Description	Replacement marker	Data type
Brief description of the CPX module name	‹CPX:Mx_SHORTTEXT›	String
Input offset of the CPX module in the input process data container	‹CPX:Mx_INOFFSET›	Number
Occupied input bytes of the CPX module in the input process data container	‹CPX:Mx_INBYTES›	Number
Output offset of the CPX module in the output process data container	‹CPX:Mx_OUTOFFSET›	Number
Occupied output bytes of the CPX module in the output process data container	‹CPX:Mx_OUTBYTES›	Number
Software revision of the CPX module	‹CPX:Mx_SWVER›	String
Hardware revision of the CPX module	‹CPX:Mx_HWVER›	String
Number of parameters of the CPX module	‹CPX:Mx_PARAMCOUNT›	Number
Name of the parameter of the CPX module	‹CPX:Mx:Px_NAME›	String
Value of the parameter of the CPX module	‹CPX:Mx:Px_VALUE›	String
Profinet error number	‹CPX:Dx_DIAG_MESSAGE_ID_PROFINET›	Number
Source of error ("MODULE", "CHANNEL")	‹CPX:Dx_DIAG_MESSAGE_SOURCE›	String
Error degree of severity ("Info", "Warning", "Error")	‹CPX:Dx_DIAG_MESSAGE_TYPE›	String
Error status ("Raised", "Resolved")	‹CPX:Dx_DIAG_MESSAGE_STATUS›	String
CPX error number	‹CPX:Dx_DIAG_MESSAGE_ID_CPX›	Number
Error text	‹CPX:Dx_DIAG_MESSAGE_TEXT›	String

Tab. 25: Replacement markers

9.8.2 Telegrams with template selection 0

9.8.2.1 Online

Is sent when the connection to Broker has been established.

Topic

```
<TOPIC_PREFIX>/ONLINE/<TEMPLATE_VERSION>/<TEMPLATE_SELECTION>
```

Payload

```
{
"ONLINE":{
"Timestamp":"<CPX:FBD_TIMESTAMP>",
"TimestampQuality":"<CPX:FBD_TIMESTAMP_QUALITY>",
"TemplateSelection":<TEMPLATE_SELECTION>,
"TemplateVersion":"<TEMPLATE_VERSION>",
"Publisher":"Online"
}
}
```

9.8.2.2 Asset

Is sent when the connection to Broker has been established and then cyclically every 60 s.

Topic

```
<TOPIC_PREFIX>/ASSET/<TEMPLATE_VERSION>/<TEMPLATE_SELECTION>
```

Payload

```
{
"ASSET":{
"Timestamp":"<CPX:FBD_TIMESTAMP>",
"TimestampQuality":"<CPX:FBD_TIMESTAMP_QUALITY>",
"TemplateSelection":<TEMPLATE_SELECTION>,
"TemplateVersion":"<TEMPLATE_VERSION>",
"TelegramSendReason":"<Tx_TELEGRAM_SEND_REASON>",
"PNDeviceName":"<PN:PDN>",
"HostName":"<CPX:HOSTNAME>",
"InterfaceList":[{
"IPAddress":"<CPX:FBD:IFx_IP>",
"IPMask":"<CPX:FBD:IFx_IPMASK>",
"IPAddressGateway":"<CPX:FBD:IFx_GW>",
"MACAddress":"<CPX:FBD:IFx_MAC>"
}],
"SerialNumber":"<CPX:FBD_SERIAL>",
"OrderNumber":"<CPX:FBD_ORDERID>",
"Firmware":"<CPX:FBD_FIRMWARE>",
"HardwareRevision":"<CPX:FBD_REVISION>",
"Manufacturer":"<MANUFACTURER>",
"DeviceFamily":"<CPX:PRODUCT_FAMILY>",
"BusNodeModuleNumber":<CPX:FBD_MODULE_NUMBER>,
"ModuleList":[{
"ModuleNumber":<CPX:Mx_MODULE_NUMBER>,
"ModuleCode":"<CPX:Mx_MODULECODE>",
"SerialNumber":"<CPX:Mx_SERIAL>",
"Description":"<CPX:Mx_LONGTEXT>",
```

```
"OrderText":"<CPX:Mx_SHORTTEXT>",
"InputOffset":<CPX:Mx_INOFFSET>,
"InputBytes":<CPX:Mx_INBYTES>,
"OutputOffset":<CPX:Mx_OUTOFFSET>,
"OutputBytes":<CPX:Mx_OUTBYTES>,
"SoftwareRevision":"<CPX:Mx_SWVER>",
"HardwareRevision":"<CPX:Mx_HWVER>",
"Parameters":[{
"Name":"<CPX:Mx:Px_NAME>",
"Value":"<CPX:Mx:Px_VALUE>"
}]
}]
}
}
```

9.8.2.3 Offline

Is sent if the connection to Broker is interrupted by the bus node as a result of an MQTT configuration change.

Topic

```
<TOPIC_PREFIX>/OFFLINE/<TEMPLATE_VERSION>/<TEMPLATE_SELECTION>
```

Payload

```
{
"OFFLINE":{
"Timestamp":"<CPX:FBD_TIMESTAMP>",
"TimestampQuality":"<CPX:FBD_TIMESTAMP_QUALITY>",
"TemplateSelection":<TEMPLATE_SELECTION>,
"TemplateVersion":"<TEMPLATE_VERSION>",
"Publisher":"Offline"
}
}
```

9.8.2.4 Process

The process data image of all modules with time stamp and time quality. The telegram is sent cyclically every 5 s.

Topic

```
<TOPIC_PREFIX>/PROCESS/<TEMPLATE_VERSION>/<TEMPLATE_SELECTION>
```

Payload

```
{
"PROCESS":{
"Timestamp":"<CPX:FBD_TIMESPAMP>",
"TimestampQuality":"<CPX:FBD_TIMESTAMP_QUALITY>",
"TemplateSelection":<TEMPLATE_SELECTION>,
"TemplateVersion":"<TEMPLATE_VERSION>",
"InputValues":<CPX:FBD_INPUT_VALUES>,
"OutputValues":<CPX:FBD_OUTPUT_VALUES>
}
}
```

9.8.2.5 Process_Module

The process data image of a module with time stamp and time quality. The telegram is sent cyclically every 5 s for all configured modules.
The configuration takes place via the control software ➔ 7.2 Setting up MQTT communication,
➔ Procedure step 5.
The length of the InputValues and OutputValues fields is determined by the number of input and output bytes of the respective module. The data within the fields must be interpreted according to the module's user manual. The byte order corresponds to the order of the data fetched from the module.

Topic

```
<TOPIC_PREFIX>/PROCESS_MODULE/<TEMPLATE_VERSION>/<TEMPLATE_SELECTION>
```

Payload

```
{
"PROCESS_MODULE":{
"Timestamp":"<CPX:FBD_TIMESTAMP>",
"TimestampQuality":"<CPX:FBD_TIMESTAMP_QUALITY>",
"TemplateSelection":<TEMPLATE_SELECTION>,
"TemplateVersion":"<TEMPLATE_VERSION>",
"ModuleNumber":<CPX:Mx_MODULE_NUMBER>,
"InputValues":<CPX:Mx_INPUT_VALUES>,
"OutputValues":<CPX:Mx_OUTPUT_VALUES>
}
}
```

9.8.2.6 Diagnostics

After the connection to Broker has been established, the telegram is sent for each pending diagnostic message and then for each incoming or outgoing diagnostic message.

Topic

```
<TOPIC_PREFIX>/DIAG/<TEMPLATE_VERSION>/<TEMPLATE_SELECTION>
```

Diagnostics

Payload

```
{
"DIAG":{
"Timestamp":"<CPX:FBD_TIMESTAMP>",
"TimestampQuality":"<CPX:FBD_TIMESTAMP_QUALITY>",
"TemplateSelection":<TEMPLATE_SELECTION>,
"TemplateVersion":"<TEMPLATE_VERSION>",
"ModuleNumber":<CPX:Mx_MODULE_NUMBER>,
"MessageSource":"<CPX:Dx_DIAG_MESSAGE_SOURCE>",
"ChannelNumber":<CPX:Mx:Cx_CHANNEL_NUMBER>,
"ChannelType":"<CPX:Mx:Cx_CHANNEL_TYPE>",
"PNDeviceName":"<PN:PDN>",
"PNErrorCode":<CPX:Dx_DIAG_MESSAGE_ID_PROFINET>,
"MessageType":"<CPX:Dx_DIAG_MESSAGE_TYPE>",
"MessageStatus":"<CPX:Dx_DIAG_MESSAGE_STATUS>",
"MessageId":<CPX:Dx_DIAG_MESSAGE_ID_CPX>,
"MessageText":{
"en-US": "<CPX:Dx_DIAG_MESSAGE_TEXT>"
}
}
}
```

> **i**
>
> The entries for ChannelNumber and ChannelType are omitted in the case of module diagnostics.

9.8.2.7 Want

The telegram is sent by Broker if the connection between the bus node and Broker has been interrupted.

Topic

`<TOPIC_PREFIX>/LASTWILL/<TEMPLATE_VERSION>/<TEMPLATE_SELECTION>`

Payload

```
{
"LASTWILL":{
"TemplateSelection":<TEMPLATE_SELECTION>,
"TemplateVersion":"<TEMPLATE_VERSION>",
"Publisher":"Offline"
}
}
```

9.9 Diagnostics via web server

The built-in web server offers diagnostic functions and diagnostic information via the CPX terminal.

9.10   Diagnostics via FAS

The FAS offers PC-based diagnostic functions via a graphical representation of the CPX terminal, e.g. status indicator, parameterisation.
Further information ➔ Online documentation for FAS

10   Technical data

10.1   General

Characteristics	Bus node
General technical data	➔ CPX system description CPX-SYS-…
Degree of protection by housing, in accordance with IEC 60529, completely mounted, plug inserted or cover cap installed.	IP65/IP67
Protection against electric shock	By PELV circuits. PELV = Protected Extra-Low Voltage

Tab. 26: General characteristics

Characteristics	CPX-FB33	CPX-M-FB34	CPX-M-FB35
Module code in the CPX Terminal			
– Remote I/O	215	216	217
– Remote Controller	164	165	166
Module identification			
– Remote I/O	FB33-RIO PROFINET remote I/O	FB34-RIO PROFINET RJ45 remote I/O	FB35-RIO PROFINET LWL remote I/O
– Remote Controller	FB33-RC PROFINET I/O bus node	FB34-RC PROFINET RJ45 bus node	FB35-RC PROFINET LWL bus node
Power supply			
Operating voltage/load voltage	➔ CPX system description (CPX-SYS-…)		
Internal current consumption of the internal electronics at a nominal operating voltage of 24 V DC, from operating voltage supply for electronics/sensors, $U_{EL/SEN}$	Typ. 85 mA	Typ. 85 mA	Typ. 155 mA

Characteristics	CPX-FB33	CPX-M-FB34	CPX-M-FB35
Separation of the PROFINET interfaces to U$_{EL/SEN}$	Electrically isolated by transformer up to 1500 V	Electrically isolated by transformer up to 1500 V	Electrically isolated by fibre-optic cable
Mains buffering time	10 ms	10 ms	10 ms

Tab. 27: Special characteristics of CPX-(M)-FB33/34/35

Characteristics	CPX-FB43	CPX-M-FB44	CPX-M-FB45
Module code in the CPX Terminal			
– Remote I/O	215	216	217
– Remote Controller	164	165	166
– Sub-module code	32	32	32
Module identification			
– Remote I/O	FB43-RIO PROFINET remote I/O	FB44-RIO PROFINET RJ45 remote I/O	FB45-RIO PROFINET LWL remote I/O
– Remote Controller	FB43-RC PROFINET I/O bus node	FB44-RC PROFINET RJ45 bus node	FB45-RC PROFINET LWL bus node
Power supply			
Operating voltage/load voltage	→ CPX system description (CPX-SYS-…)		
Internal current consumption of the internal electronics at a nominal operating voltage of 24 V DC, from operating voltage supply for electronics/sensors, U$_{EL/SEN}$	Typ. 75 mA	Typ. 75 mA	Typ. 150 mA
Separation of the PROFINET interfaces to U$_{EL/SEN}$	Electrically isolated by transformer up to 1500 V	Electrically isolated by transformer up to 1500 V	Electrically isolated by fibre-optic cable
Mains buffering time	10 ms	10 ms	10 ms
Accuracy in voltage measurement of the operating or load voltage	≤ 5%	≤ 5%	≤ 5%

Tab. 28: Special characteristics of CPX-(M)-FB43/44/45

10.2   Network

Characteristics	Bus node
Network protocol	PROFINET IO (PN IO): – Based on Industrial Ethernet – Based on the standard Ethernet protocol IEEE 802.3
Selection of supported protocol characteristics and protocol functions	– Cyclical data exchange "in real-time", without isochronous mode (Real-Time, RT) or over LAN with isochronous mode (Isochronous Real Time, IRT) – Link Layer Discovery Protocol (LLDP) – Simple Network Management Protocol (SNMP) – Fast Start-up (FSU) – PROFIenergy – PROFIsafe – Shared Device – Media Redundancy Protocol (MRP, MRPD) – S2 system redundancy
Selection of supported CPX properties and CPX functions	– CPX-terminal configuration via CPX-FMT – CPX terminal diagnostics via fieldbus communication and the control system – Web server functionality: Representation of the PROFINET network structure, CPX terminal configuration with diagnostic information, PROFINET I&M data, Ethernet statistics, MQTT configuration
Specification	Selection of directives and standards with reference to PROFINET: – PROFINET installation guidelines: PROFINET Installation Guide, Installation Guideline PROFINET Part 2 … – IEC 61158 – IEC 61784 – IEC 61918 Additional information: ➜ www.profinet.com ➜ www.profibus.com
Transmission technology	Switched Fast Ethernet; 100BaseTX execution in accordance with IEEE 802.3

Tab. 29: General network characteristics

Characteristics	CPX-FB33/43	CPX-M-FB34/44	CPX-M-FB35/45
Transmission rate	100 Mbit/s	100 Mbit/s	100 Mbit/s
Wavelength	–	–	650 nm, suitable for POF fibre-optic cable

Characteristics	CPX-FB33/43	CPX-M-FB34/44	CPX-M-FB35/45
Network connections	2 x M12 bushings, D-coded, 4-pin	2 x RJ45 bushings, push-pull, AIDA-conforming	2 x SCRJ bushings, push-pull, AIDA-conforming
Crossover detection	Auto MDI	Auto MDI	–
Max. addressing volume of outputs/inputs, operating mode-independent	64 bytes I, 64 bytes O	64 bytes I, 64 bytes O	64 bytes I, 64 bytes O

Tab. 30: Special network characteristics CPX-(M)-FB33/34/35/43/44/45