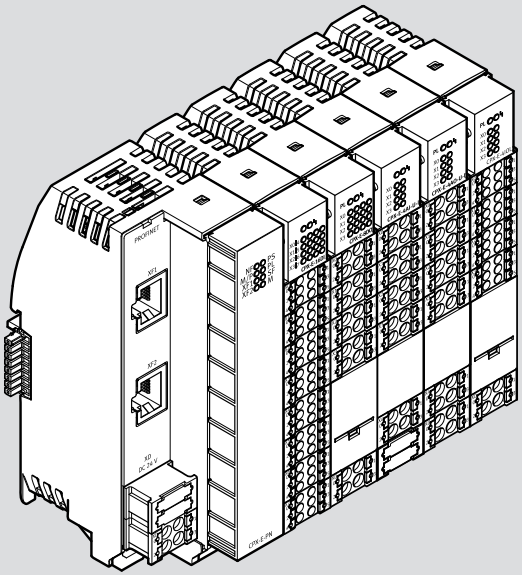
CPX-E
Automation system



FESTO

Manual | Function,
Parameterisation

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Translation of the original instructions

Table of contents

1 About this document

This document describes the function and parameterisation of the product series stated in the title. Use of and further information on handling the products are described in other documents ➔ 1.1 Applicable documents.

1.1 Applicable documents

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

Document	Content
Automation system CPX-E Operating instruction	Instruction manual and important information on assembly, electrical installation and maintenance tasks for an automation system CPX-E
Operating instructions and manuals for the CPX-E modules in the automation system CPX-E	Information on using the CPX-E modules

Tab. 1: Applicable documents

1.2 Additional information

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

Firmware, software or configuration files ➔ www.festo.com/sp.

More information	Content
Device description files	Definition of the modules in an automation system CPX-E for integration into the higher-level controller
Documentation for the higher-order controller and the additional devices in the network	Information on commissioning and parameterisation of the components

Tab. 2: More information

1.3 Target group

This document is intended for qualified personnel. Experience with electrical control systems is required in order to understand this documentation.

1.4 Product version

This document refers to the automation system CPX-E with CPX-E modules.
The product version can be identified from the product labelling or with the help of appropriate software from Festo.

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Software suitable for determining the product version is available from Festo in the Support Portal
➔ www.festo.com/sp.
Information on using the software can be found in the integrated Help function.

1.5 Product labelling

The CPX-E modules are labelled on the left lateral surface. The product labelling is described in the documentation supplied with the product.

1.6 Specified standards

Version		
DIN 46228-1:1992-08		EN 60529:2013-10
DIN 46228-4:1990-09		EN 60715:2001-09
EN 60068-2-27:2010-02		IEC 60204-1:2014-10

Tab. 3: Standards specified in the document

1.7 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 certification information	
Product category code	NRAQ/NRAQ7
File number	E239998
Considered standards	UL 61010-1, 3rd Edition, May 11, 2012, revised April 29, 2016 CAN/CSA-C22.2 No. 61010-1-12, 3rd Edition, Revision dated April 29, 2016 UL 61010-2-201, 1st Edition, Revised February 20, 2017 CSA-C22.2 No. 61010-2-201:14, 1st Edition, Issue date January 01, 2014
UL mark	c UL us LISTED

Tab. 4: 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.
  Note deviations ➔ Technical data.
- 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.

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Unauthorised access to the device can cause damage or malfunctions.
When connecting the device to a network:
Protect the network against unauthorised access.
Measures to protect the network include:
- Firewall
- Intrusion Prevention System (IPS)
- Network segmentation
- Virtual LAN (VLAN)
- Virtual private Network (VPN)
- Security at physical access level (port security)

For additional information ➔ Guidelines and standards for security in information technology, e. g. IEC 62443, ISO/IEC 27001.

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An access password only protects against unintentional modification.

NOTICE

Modules with Ethernet interfaces should only be operated in networks if all connected network components are supplied by PELV circuits or integrated circuits with equivalent protection.

2 Function

2.1 Overview

The automation system CPX-E is a modular system for the connection of electrical peripherals and it is designed for use in a protected environment. An automation system CPX-E can be connected to a higher-order controller via a network using a bus module or controller or operated autonomously. The behaviour of the automation system CPX-E can be adapted for various requirements by parameterisation.
For example, the following can be influenced by accessing the internal parameters:
– Behaviour of the outputs in the event of communication errors (fail-safe settings)
– Behaviour following fault clearance
– Debounce times and signal extension times for digital input signals
– Force settings (force signal status)
– Operating method of the diagnostic memory

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CPX-E modules are supplied with preset parameters. You can find the module-specific parameters in the corresponding module documentation.

2.1.1 Functional example

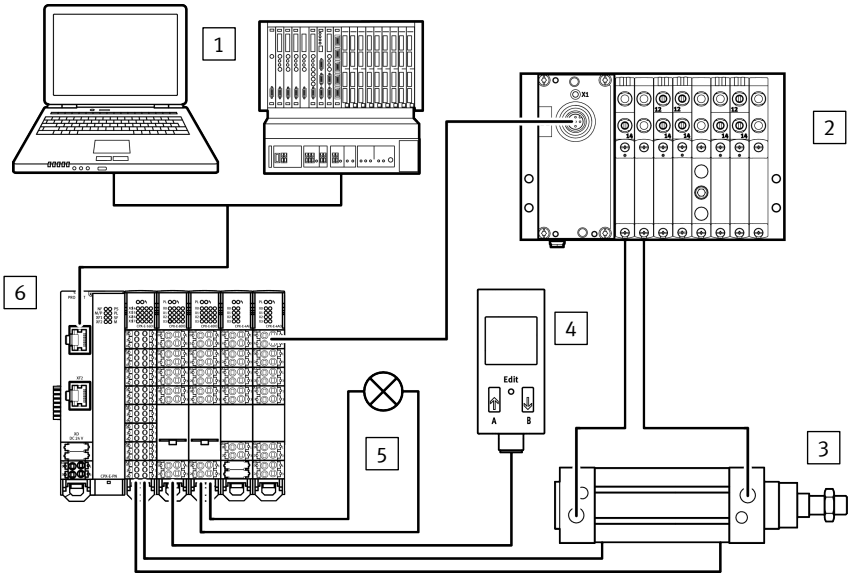

Fig. 1: Functional example

1	Higher-order controller	4	Flow sensor
2	Valve terminal VTUG	5	Indicator light
3	Standards-based cylinder with proximity switches for position sensing	6	Automation system CPX-E with bus module and I/O modules

2.1.2 CPX-E modules

This section presents an overview of the various modules CPX-E that can be used to set up an automation system CPX-E and describes their functions.

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You can find detailed information about the individual modules in the documentation supplied with each product.

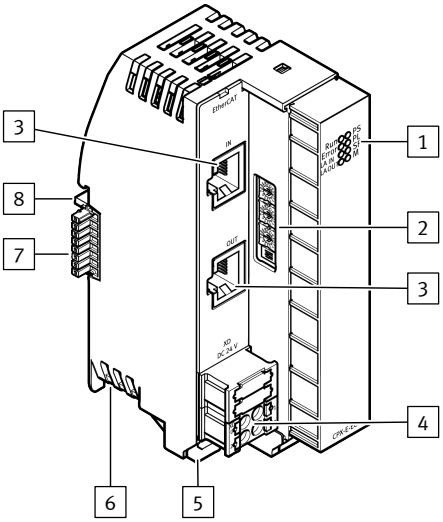
Bus module

A bus module is the interface between an automation system CPX-E and the fieldbus/network, and performs the following functions:

- Connection of the automation system CPX-E to the fieldbus/network
- Data transfer between the automation system CPX-E and the higher-order controller
- Transmission of control signals to the connected modules
- Monitoring the functionality of the connected modules
- Read and write access to system parameters, input and output signals and diagnostic data (dependent on the bus module)
- Controller of the automation system CPX-E

Examples of bus modules:

- CPX-E-PB (PROFIBUS DP)
- CPX-E-PN (PROFINET IO)
- CPX-E-EP (EtherNet/IP, Modbus TCP)
- CPX-E-EC (EtherCAT)



1 LED indicators
2 Rotary and DIL switches
3 Network connection
4 Terminal strip (coded, removable)
5 Terminal strip interlock
6 Module interlock
7 Linkage element
8 Functional earth contact FE

Fig. 2: Bus module product structure (example CPX-E-EC)

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Rotary and DIL switches are not installed on every bus module.

Controller

A controller is used to control an automation system CPX-E:

- as a stand-alone system controller
- for incorporation into higher-order system controllers via integrated communication interfaces (e.g. PROFINET).

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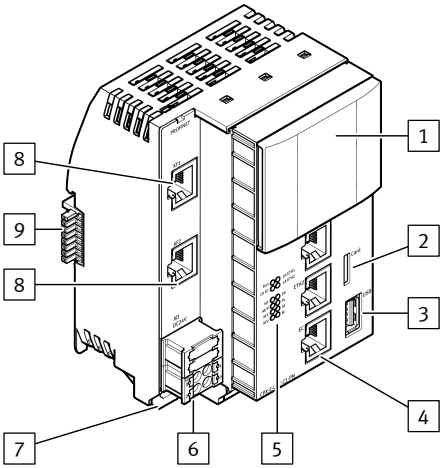
Using a controller provides the option of implementing process visualisation via CODESYS in addition to programming.

Examples of controllers:

- CPX-E-CEC-C1
- CPX-E-CEC-M1
- CPX-E-CEC-C1-EP
- CPX-E-CEC-M1-EP
- CPX-E-CEC-C1-PN
- CPX-E-CEC-M1-PN



1 Cover (removable)
2 Slot for SD memory card
3 USB interface
4 Ethernet interface
5 LED indicators
6 Terminal strip (coded, removable)
7 Terminal strip interlock
8 Network connection
9 Linkage element

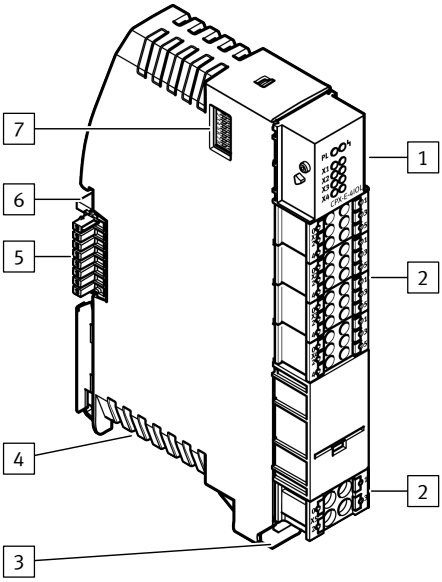
Fig. 3: Controller product structure (example CPX-E-CEC-C1-PN)

Input/output modules

Input or output modules are used to process digital or analogue signals, depending on the module.

Examples of input and output modules:

- Digital input module CPX-E-16DI
- Digital output module CPX-E-8DO
- Analogue input module CPX-E-4AI-U-I
- Analogue output module CPX-E-4AO-U-I
- IO-Link master module CPX-E-4IOL
- Counter module CPX-E-1CI



1 LED indicators
2 Terminal strip (coded, removable)
3 Terminal strip interlock
4 Module interlock
5 Linkage element
6 Functional earth contact FE
7 DIL switches

Fig. 4: Input/output module product structure (example IO-Link master module CPX-E-4IOL)

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DIL switches are not installed on every input/output module.

2.1.3 Automation system CPX-E

2.1.3.1 Rules for set-up

The Automation system CPX-E is basically a bus module or controller and a maximum of 10 additional modules. The bus module or controller is always positioned within an automation system CPX-E as the first module on the left. The other modules can be added in any sequence.

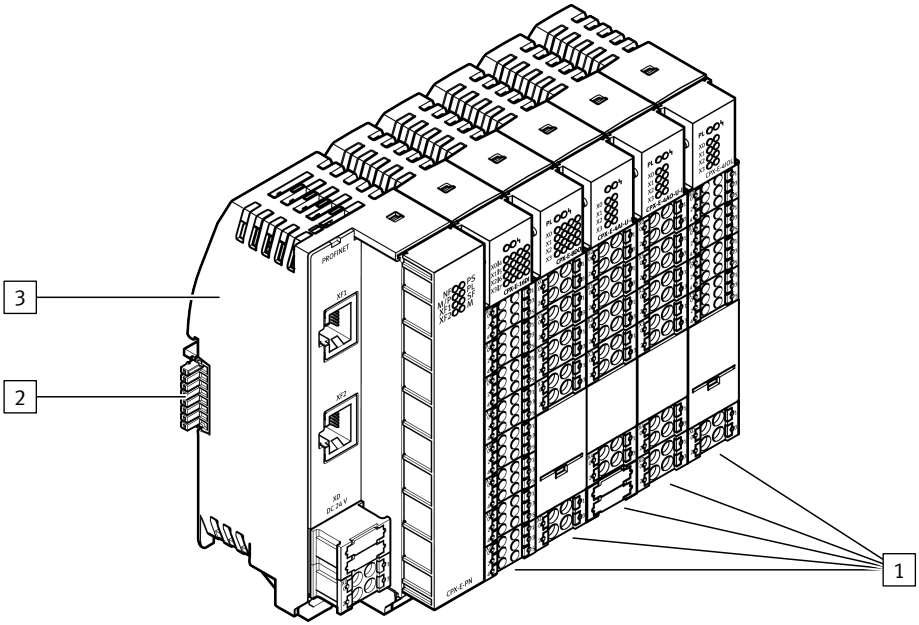

Fig. 5: Structure of the automation system CPX-E (example)

1 Input and output modules

2 Linkage element

3 Bus module, here CPX-E-PN

Input and output modules shown in the picture:
- Digital input module CPX-E-16DI
- Digital output module CPX-E-8DO
- Analogue input module CPX-E-4AI-U-I
- Analogue output module CPX-E-4AO-U-I
- IO-Link master module CPX-E-4IOL

2.1.3.2 H-rail mounting

The modules are mounted on an H-rail 35 mm × 7.5 mm in accordance with EN 60715.

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When selecting screws for H-rail mounting, a distance of 3 mm between the H-rail and the linkage elements must be maintained.
The distance between the retaining screws for mounting the H-rail must not exceed a maximum of 50 mm.

2.1.3.3 Mounting clearances

To ensure sufficient ventilation of the modules, maintain the following minimum clearances when mounting the automation system CPX-E.

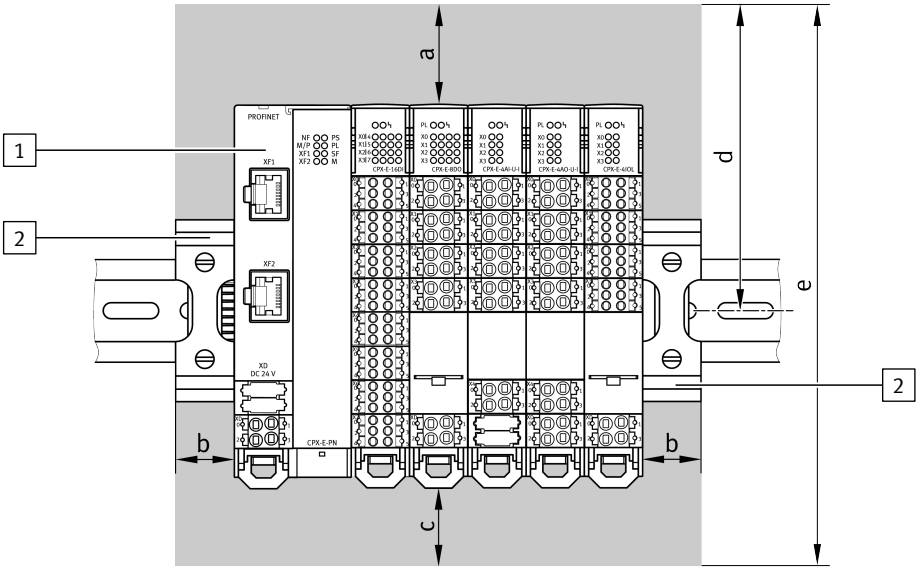


Fig. 6: Mounting clearances

1 Automation system CPX-E

2 End support

Dimension		a	b	c	d	e
Minimum clearance	[mm]	40	20	30	106	195

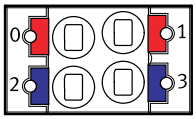
Tab. 5: Minimum clearances

2.1.4 Power supply concept

The Automation system CPX-E uses separate voltages to supply the electronics and sensors ($U_{EL/SEN}$) and to supply outputs (U_{OUT}). The equivalent voltage potentials (+24 V DC and 0 V DC) are connected to each other in the terminal strips.
This enables the applicable voltage to be transferred from one module to the next.

Operating power supply $U_{EL/SEN}$

The operating voltage supply $U_{EL/SEN}$ to supply the electronics and sensors is fed in at the bus module or controller and distributed internally to the entire Automation system CPX-E.

Connection [XD1], [XD2][1)]		Signal
	0	+24 V DC operating voltage supply $U_{EL/SEN}$
	1	
	2	0 V DC operating voltage supply $U_{EL/SEN}$
	3	

1) Connections XDx.0 and XDx.1 and also XDx.2 and XDx.3 are each connected to each other in the terminal strip.

Tab. 6: Connection [XD1], [XD2]

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To comply with the certification requirements of Underwriters Laboratories Inc. (UL) for the USA and Canada, within the scope of UL/CSA, depending on the current consumption, the parallel connection of the operating voltage supply to [XD1] and [XD2] is required ➔ 4.3 Technical data for UL certification.

Load voltage supply U_{OUT}

The load voltage supply U_{OUT} to supply the outputs is fed directly to the module separately for every module with outputs. In the following example with the output module CPX-E-8DO this is the output module CPX-E-4AO-UI and the IO-Link master module CPX-E-4IOL.

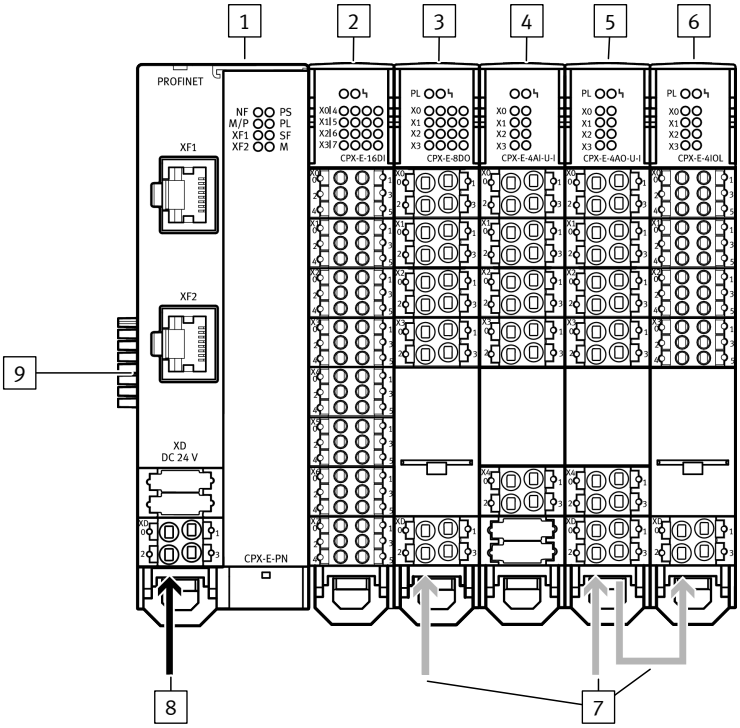

Fig. 7: Power supply concept

1 Bus module CPX-E-PN

2 Input module CPX-E-16DI

3 Output module CPX-E-8DO

4 Input module CPX-E-4AI-U-I

5 Output module CPX-E-4AO-U-I

6 IO-Link master module CPX-E-4IOL

7 Load voltage supply U_{OUT}

8 Operating power supply $U_{EL/SEN}$

9 Linkage element

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The operating voltage supply $U_{EL/SEN}$ and load voltage supply U_{OUT} are routed separately from each other within the automation system CPX-E.
If this separation is not required for the respective use case, both voltages can also be supplied from a common voltage source. In this case, it must be possible to disconnect the load voltage supply separately.

2.2 Influencing signal statuses

Function	Priority[1)]	Brief description	Signals that can be influenced
Forcing[2)]	1	Influences signal statuses independently of actual operating statuses ➔ 2.2.3 Forcing.	Input and output signals
Fail safe	2	Specifies signal statuses that take effect in the event of communication errors in the network ➔ 2.2.4 Signal status in the event of an error (fail safe).	Output signals
Idle mode[3)]	3	Specifies signal statuses that take effect when switching to Idle status ➔ 2.2.5 Signal status in idle state (idle mode).	Output signals

1) If several functions are active at the same time
2) Primarily for test purposes during commissioning
3) Only relevant for certain network protocols

Tab. 7: Functions for influencing signal statuses

2.2.1 Influencing output signals

The basic settings for the specific function are preset using system parameters.
Setting the system parameter appropriately enables the user to specify the desired signal status for every channel separately using channel-specific module parameters.

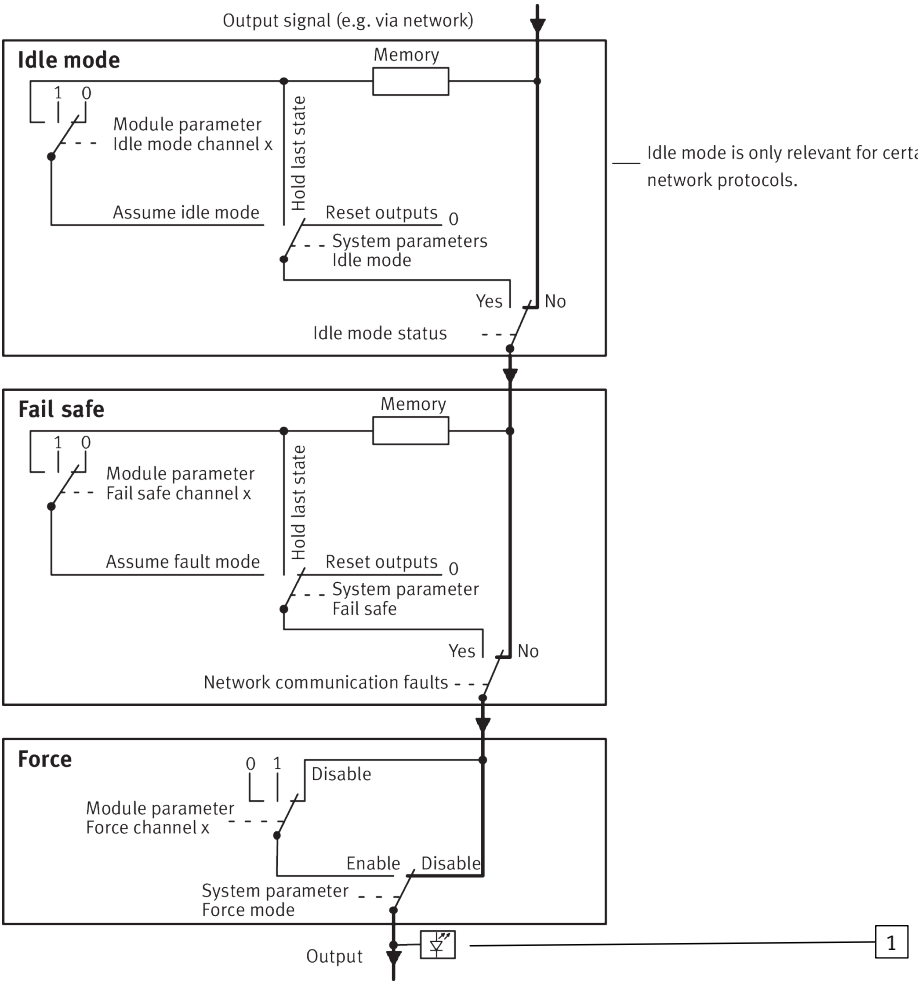

Fig. 8: Influencing output signals

1 Status LED for the specific output

2.2.2 Influencing input signals

Forcing an input does not modify the input signal itself and can also not be observed at the relevant status LED. The logical status of the input only changes internally and may be effective in a program.

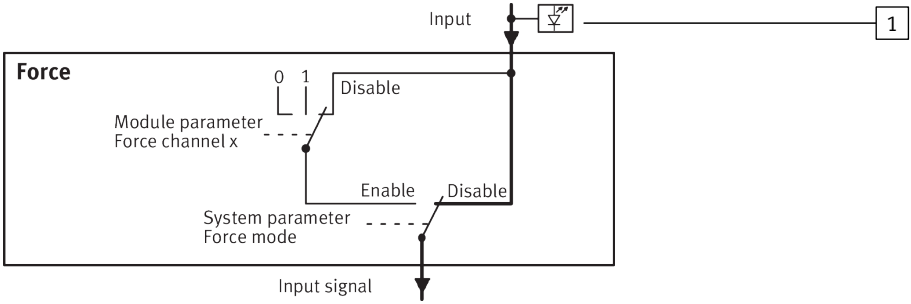

Fig. 9: Influencing input signals

1 Status LED for the specific input

2.2.3 Forcing

2.2.3.1 Basic principles

The Force function enables manipulation of signal states independently of actual operating status. Force enables input and output signals to be overwritten. Input signals that are actually present or changes in status by program will be ignored. The input signals actually pending and the output signals generated by the user program only become valid again when the Force function is deactivated. The Force function is used mainly in the commissioning phase in order to set certain signals to the desired status for test purposes even if the wiring is not complete.

2.2.3.2 Parameterisation

With the automation system CPX-E Force parameterisation can be used for:
- digital inputs and outputs
- Solenoid coils (only in combination with the CPX-E-4IOL module)
- Inputs and outputs of the I/O diagnostic interface and status bits
- analogue inputs and outputs

Force is released or blocked globally for the automation system CPX-E with the "Force mode" system parameter.

System parameters	Settings	Description
Force mode	blocked (default)	Force blocked[1)]
	enabled	Force enabled[1)]

1) The setting is applicable for the complete automation system CPX-E.

Tab. 8: "Force mode" system parameter

The signal status can be specified according to the channel (input/output) for every module.

Module parameters	Settings	Description
Force mode	blocked (default)	Force is blocked for the channel.
	released	Accept the signal status defined by Force state.
Force state		
Digital signal	Reset signal (default)	Reset input/output signal.
	Set signal	Set input/output signal.
Analogue signal	Analogue value (0 = default)	Value of the analogue signal.

Tab. 9: "Force mode" module parameter

2.2.3.3 Mode of operation

Input information actually present will be replaced by the values entered in the Force table in the process image for the inputs.
Information actually present in the process image for the outputs will be replaced by the values entered in the Force table and transmitted to the physical output.

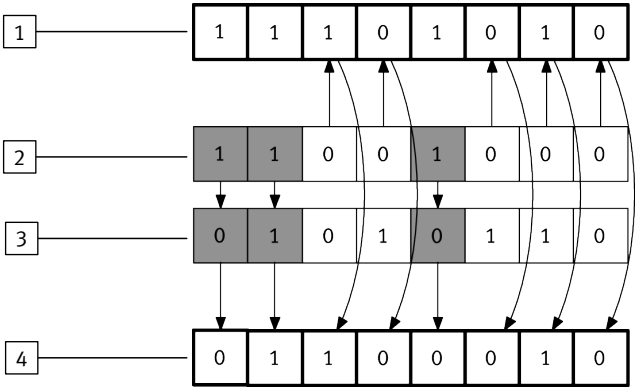

Fig. 10: Force parameterisation – example for binary signals

1 Signal status previously

2 Module parameter (according to channel)
Force mode
0 = Force blocked
1 = Force state

3 Module parameter (according to channel)
Force state
0 = reset signal
1 = set signal

4 Signal status afterwards

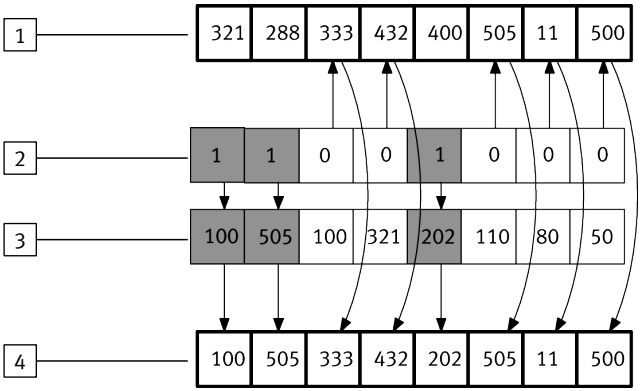

Fig. 11: Force parameterisation – example for analogue signals

1 Analogue signal previously

2 Module parameter (according to channel)
Force mode
0 = Force blocked
1 = Force value

3 Module parameter (according to channel)
Force state

4 Analogue signal afterwards

2.2.4 Signal status in the event of an error (fail safe)

2.2.4.1 Fundamentals

The fail-safe parameterisation is used to help specify the signal status which the outputs are to assume in the event of communication errors in the network (fail-safe status). This should establish a defined machine/system status in the event of communication errors in the network (e.g. failure of the higher-order controller).

2.2.4.2 Parameterisation

With the automation system CPX-E Force fail-safe parameterisation can be used for:
- digital outputs
- analogue outputs
- Solenoid coils (only in combination with the CPX-E-4IOL module or digital outputs)

The “fail safe” system parameter can be used to specify globally the signal status that the outputs are to assume in the event of communication errors in the network, e.g. in the event of:
- Communication failure (network interruption, higher-order controller failure)
- Communication stop

System parameters	Settings	Description
Fail-safe	Reset outputs (default)	Reset all outputs.
	Hold last state	Retain current signal status for all outputs.
	Assume Fault mode value	Adopt the signal status defined for the relevant channel.

Tab. 10: “Fail-safe” system parameter

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“Reset outputs” means the following:
- Monostable valves move to the initial position
- Bistable valves remain in the current position
- Mid-position valves go into mid-position (pressurised, exhausted or blocked, depending on valve type).

If “Assume fault mode value” is activated: the signal statuses defined by module parameter for the relevant channel will take effect ➔ Tab. 11 "Fail safe" module parameter.

Module parameters	Settings	Description
Fault mode	Hold last state	Retain current signal status.
	Fault state (default)	Accept the signal status defined by Force state.
Fault state		
Digital signal	Reset output (default)	Reset output signal.
	Set output	Set output signal.
Analogue signal	Analogue value	Value of the analogue signal

Tab. 11: "Fail safe" module parameter

2.2.4.3 Mode of operation

The ‘Fault mode’ parameter is used to determine whether the current signal status is to be retained or whether the signal status defined by the ‘Fault state’ parameter is to be assumed.

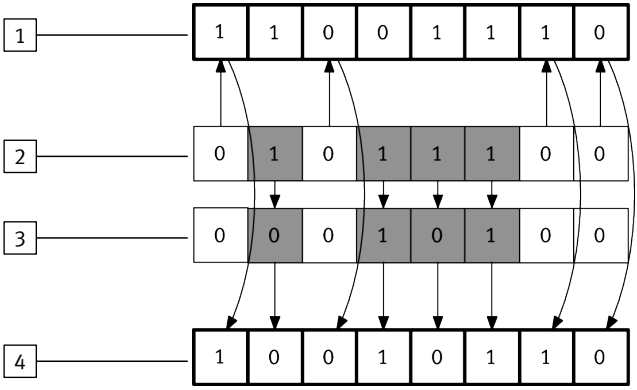

Fig. 12: Fail-safe parameterisation – example for binary signals

1 Signal status before the malfunction

2 Module parameter (according to channel)
Fault mode
0 = hold last state
1 = fault state

3 Module parameter (according to channel)
Fault state
0 = reset output
1 = set output

4 Signal status after the malfunction

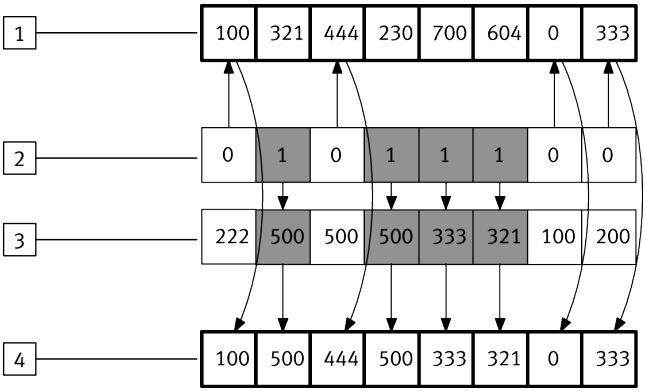

Fig. 13: Fail-safe parameterisation – example for analogue signals

1 Signal status before the malfunction

2 Module parameter (according to channel)
Fault mode
0 = hold last state
1 = fault state

3 Module parameter (according to channel)
Fault state

4 Signal status after the malfunction

2.2.5 Signal status in idle state (idle mode)

2.2.5.1 Basic principles

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This function is only relevant for certain network protocols ➔ Manual for the specific bus module.

The Idle mode parameterisation is used to help specify the signal status which the outputs are to assume when switching to Idle status. This should establish a defined machine/system status.

2.2.5.2 Parameterisation

With the automation system CPX-E Idle mode parameterisation can be used for:
– digital outputs
– analogue outputs
– Solenoid coils (only in combination with the CPX-E-4IOL module or digital outputs)

The ‘Idle mode’ system parameter can be used to globally specify the signal status which the outputs are to assume when switching to Idle status.

System parameters	Settings	Description
System Idle mode	Reset output (default).	Reset all outputs.
	Hold last state	Retain current signal status for all outputs.
	Assume Idle mode value.	Adopt the signal status defined for the relevant channel.

Tab. 12: "Idle mode" system parameter

If 'Assume Idle mode value' is activated: the signal statuses defined by module parameter for the relevant channel will take effect.

Module parameters	Settings	Description
Idle mode	Hold last state	Retain current signal status.
	Idle state (default)	Accept the signal status defined by Idle state.
Idle state		
Digital signal	Reset output.	Reset output signal.
	Set output.	Set output signal.
Analogue signal	Analogue value	Value of the analogue signal

Tab. 13: "Idle mode" module parameter

2.2.5.3 Mode of operation

The mode of operation is identical to fail-safe parameterisation ➔ 2.2.4.3 Mode of operation.

2.3 Diagnostics options

Various options are available for diagnosing errors depending on the parameterisation and network protocol used.

Diagnostics option	Description	Detailed information
LED display components		
System-specific	The system status and errors are displayed directly on the module by LED indicators.	➔ 2.3.1 LED indicators
Module- or network-specific	Module or network status and errors are displayed directly on the module via LED indicators.	➔ Documentation for the specific module

Diagnostics option	Description	Detailed information
Internal system diagnostics		
Status bits	Common diagnostic messages (global error messages) are displayed by 8 internal inputs (8 status bits).	➔ 2.3.2 Status bits
I/O diagnostics interface	Diagnostic information for the automation system CPX-E is made available via the I/O diagnostic interface. The I/O diagnostic interface enables bus-independent read access to diagnostic information, data and parameters via 16 internal inputs and outputs.	➔ 2.3.3 I/O diagnostics interface
Network-specific diagnostic functions	Special diagnostic functions or communication services may be available, such as DPV1 for PROFIBUS, depending on the network.	➔ Documentation for the specific module

Tab. 14: Diagnostics options

2.3.1 LED indicators

Various LED indicators are available on every module for visualisation of status and errors. A distinction is made here between system-specific LED indicators and those specific to the module or network.

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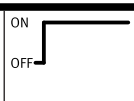
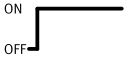
The system-specific LED indicators are described in this document.
The LED indicators specific to the module or network are described in the documentation for the respective module.

Power system [PS] – operating voltage supply $U_{EL/SEN}$			
LED (green)		Meaning	Remedy
on		Power supply present, no error	–
flashes		Power supply present but outside tolerance range	Rectify undervoltage.
		Linkage on the bus module is missing or incomplete	Check linkage.

Power system [PS] – operating voltage supply $U_{EL/SEN}$			
LED (green)		Meaning	Remedy
 flashes		internal fuse of the power supply has tripped	Correct short circuit or overload. Depending on the parameterisation, the power supply is then switched on again automatically (factory setting) or it must be switched off and then on again.
 off		Power supply not present	Check connection of the power supply.

Tab. 15: Power system [PS] – operating voltage supply

Power load [PL] – load voltage supply U_{OUT}			
LED (green)		Meaning	Remedy
 on		Power supply present, no error	–
 flashes		Power supply present but outside tolerance range	Rectify undervoltage.
 off		Power supply not present	Check connection of the power supply.

Tab. 16: Power load [PL] – load voltage supply

System failure [SF] – system error			
LED (red)[1)]		Meaning	Remedy
 flashes		minor error/information (Error class 1)	➔ 2.3.5 Error classes
		Error (Error class 2)	

System failure [SF] – system error			
LED (red)[1]		Meaning	Remedy
 flashes		serious error (Error class 3)	➔ 2.3.5 Error classes
 off		no error	–

1) The LED “System Failure” [SF] indicator flashes depending on the error class.

Tab. 17: System failure [SF] – system error

Modify [M] – parameterisation modified or force active		
LED (yellow)		Meaning
 on		System start set with saved parameterisation and saved configuration; parameters and configuration are saved to non-volatile memory; external parameterisation is blocked.[1] Caution when replacing systems with saved parameterisation. Parameterisation in these systems is not automatically initiated by the higher-order controller on replacement. – Before replacement, note required settings and restore them after replacement, if required.
 flashes		The force function is enabled.[1]
 off		System start set with default parameterisation (factory setting) and current configuration; external parameterisation is possible (presetting).

1) The indication of the force function (LED flashing) has priority over indication of the setting for the system start with the saved parameterisation and saved configuration (LED steady).

Tab. 18: Modify [M] – parameterisation modified or force active

2.3.2 Status bits

Regardless of the bus module used, the automation system CPX-E provides 8 status bits for displaying common diagnostic messages (global error messages).
Status bits are configured like inputs. Which input addresses are to be assigned to status bits depend on the network protocol ➔ Manual for the relevant bus module.

i

The status bits supply coded diagnostic information in form of 0 or 1 signals.
If all status bits send a 0-signal, no error is reported.

- Bits 0 ... 3 specify the module types in which faults have occurred.
- Bits 4 ... 7 specify the type of fault.

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

Tab. 19: Bit allocation of the diagnostic information

2.3.2.1 Examples of typical status information

No error signalled								
	Type of error				Module type			
	Other error	Wire break	Short circuit	Undervoltage	Analogue, function	Input	Output	Valve
Bit	7	6	5	4	3	2	1	0
Status	0	0	0	0	0	0	0	0

Tab. 20: "No error signalled" status information (example)

Short circuit at the output								
	Type of error				Module type			
	Other error	Wire break	Short circuit	Undervoltage	Analogue, function	Input	Output	Valve
Bit	7	6	5	4	3	2	1	0
Status	0	0	1	0	0	0	1	0

Tab. 21: "Short circuit at output" status information (example)

Undervoltage of sensor supply								
	Type of error				Module type			
	Other error	Wire break	Short circuit	Undervoltage	Analogue, function	Input	Output	Valve
Bit	7	6	5	4	3	2	1	0
Status	0	0	0	1	0	1	0	0

Tab. 22: "Undervoltage of sensor supply" status information (example)

i

If different errors occur simultaneously on different module types, errors cannot be assigned. To clearly determine errors, the I/O diagnostic interface can be used ➔ 2.3.3 I/O diagnostics interface.

2.3.3 I/O diagnostics interface

For networks that do not have extensive diagnostic functions, the diagnostic information for the automation system CPX-E is available via the I/O diagnostic interface. The I/O diagnostic interface enables network-independent read access to diagnostic information, data and parameters via internal inputs and outputs (16 I/16 O).

2.3.3.1 Organisation of internal data and parameters

Internal data and parameters of the modules and of the automation system CPX-E are stored in a common memory area. The I/O diagnostic interface can provide read access to individual bytes of this memory area with the aid of the function number.

i

Parameters can be modified with the aid of network-specific functions, depending on the network used ➔ 3 Parameterisation.

2.3.3.2 Mode of operation

Detailed diagnostic information can be accessed via the I/O diagnostic interface.
For example, it is possible to ascertain exactly the module and channel on which an error has occurred.
16 input bits and 16 output bits, through which all diagnostic data can be retrieved, are available for accessing the system diagnostics.

i

The addresses of the input and output bits of the I/O diagnostics interface depend on the network
➔ Manual for the relevant bus module.

2.3.3.3 Output bits

The function number of the desired data is specified in binary coded form using the output bits A0 ... A12 of the I/O diagnostic interface. The function number is accepted if control bit O15 returns a logic 1.

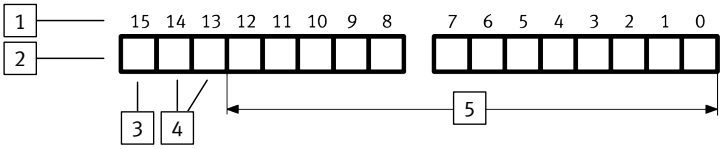


Fig. 14: Output bits

1 Bit number
2 Outputs
3 Control bit
4 Reserved
5 Function number

2.3.3.4 Input bits

The response data are output by the automation system CPX-E via the input bits I0 ... I7 when acknowledgement bit I15 returns a logic 1.

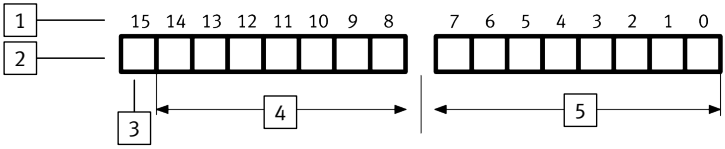


Fig. 15: Input bits

1 Bit number
2 Inputs
3 Acknowledgement bit
4 Reserved
5 Diagnostic data

i

If control bit O15 returns a logic 0, acknowledgement bit I15 will be reset automatically and the status byte will be shown with the diagnostic data bits.

2.3.3.5 Reading out diagnostic data

Flow diagram

The function number is applied if there is a rising edge at control bit O15.

The input bits I0 ... I7 return the diagnostic data when the acknowledgement bit returns a logic 1.

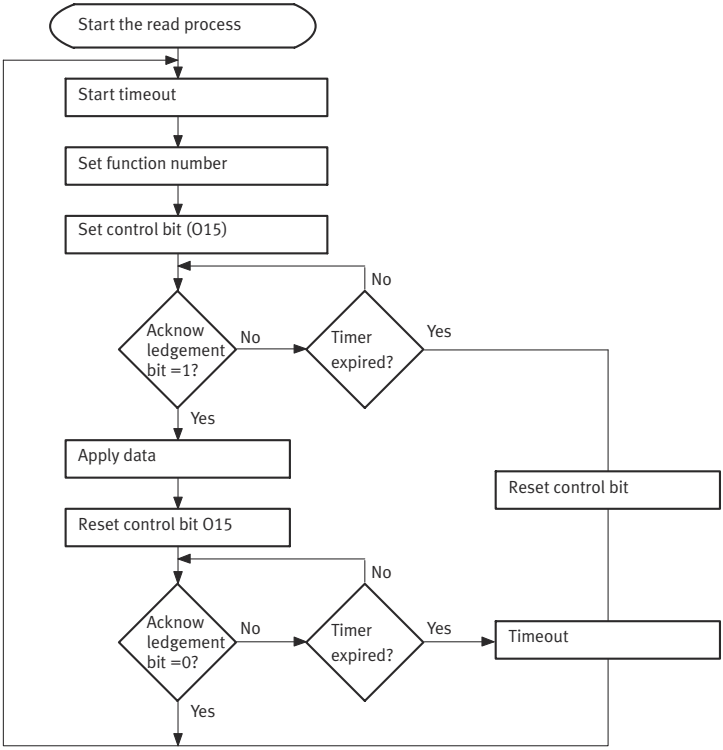


Fig. 16: Reading out the diagnostic data flow diagram

Example 1: check whether diagnostic data is available

Function number 1937 specifies whether there are diagnostic data and contains, where applicable, the number of the first module on which an error has occurred ➔ 3.10.2 Module number and diagnostic status.

– Function number 1937 decimal = 11110010001 binary

Reading out function number 1937

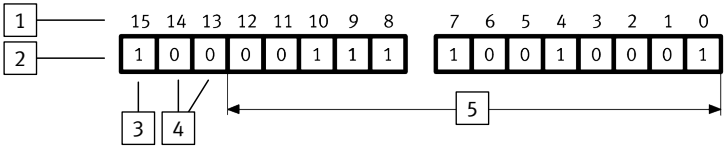


Fig. 17: Reading out function number 1937

1 Bit number of the outputs
2 Signal status of the outputs
3 Control bit
4 Reserved
5 Function number

Diagnostic data are available if bit 6 returns a logic 1. Bits 0 ... 5 then include the module number of the first faulty module ➔ 3.10.2 Module number and diagnostic status.
For example, if there is an error at module 5 (5 decimal = 101 binary), the following input data would be pending:

Response data (example – error at module 5)

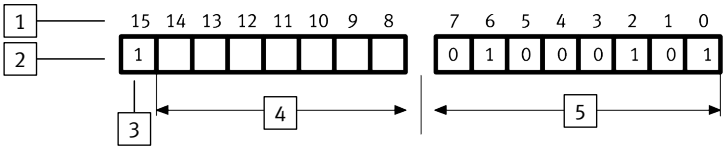


Fig. 18: Response data (example)

1 Bit number of the inputs
2 Signal status of the inputs
3 Acknowledgement bit
4 Reserved
5 Diagnostic data

i

Detailed information on the module diagnostic data ➔ 3.11 Module diagnostic data.

Example 2: read out current error numbers of module 5

The module number of the faulty module can be used to ascertain the function numbers of the relevant module diagnostic data ➔ 3.11 Module diagnostic data.
For example, module diagnostic data can be:
- the number of the faulty channel
- the module error number

For example, the following function number can be used to ascertain the module error number of module 5:
- Function number = 2008 + 4 × 5 + 1 = 2029
- 2029 decimal = 11111101101 binary

Reading out the module error number of module 5

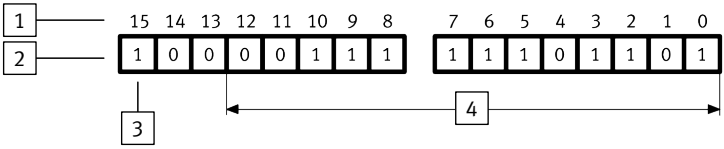


Fig. 19: Reading out the module error number of module 5

1 Bit number
2 Signal status of the outputs
3 Control bit
4 Function number

The response data for the case in which error number 4 (4 decimal = 100 binary) is pending is shown as an example in the following.

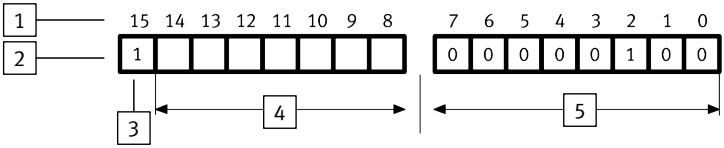


Fig. 20: Response data with error number 4

1 Bit number of the inputs
2 Signal status of the inputs
3 Acknowledgement bit
4 Reserved
5 Diagnostic data

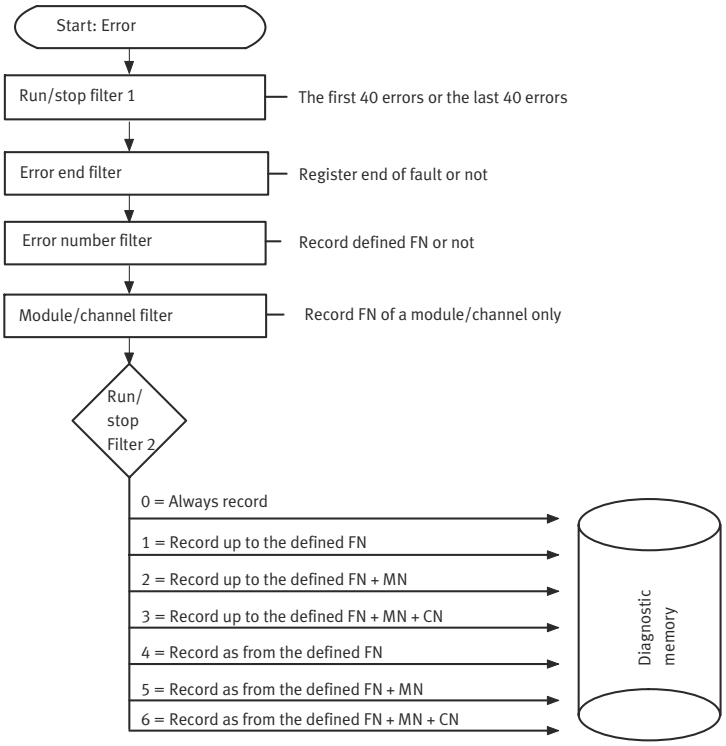
2.3.4 Diagnostic memory

2.3.4.1 Fundamentals

The diagnostic memory is used for logging error statuses. Recording the time when errors occur, and error sequences makes it easier to find the cause of errors which are otherwise difficult to locate. Errors that occur during operation are entered in the diagnostic memory. Depending on parameterisation, the first or the last 40 entries are saved, as well as the time measured from the moment the power supply was switched on.

2.3.4.2 Parameterisation

Various diagnostic memory filters can be parameterised with diagnostic memory parameters ➔ 3.8 Diagnostic memory parameters (trace parameters). These filters can be used to suppress the recording of specific statuses of the automation system, and to control starting and stopping recording.
The following diagram shows the mode of operation of the diagnostic memory filters.



MN = Module number FN = Error number
CN = Channel number
Fig. 21: Mode of operation of the diagnostic memory filters

2.3.4.3 Mode of operation

A maximum of 40 diagnostic messages can be saved in the diagnostic memory. Using appropriate software from Festo or using a controller CPX-E-CEC-... via CODESYS it is possible to parameterise which messages are saved and how these are saved, as well as other functions. This includes how long they are stored for or the diagnostic memory mode ("Entries remanent at Power ON") or the memory procedure ("Run/Stop" setting).
Explanations of the major settings can be found in the following sections.

i

Suitable software for parameterisation is available in the Festo Support Portal ➔ www.festo.com/sp. Information on using the software can be found in the integrated Help function.

Memory duration or diagnostic memory mode

'Trace parameters' > 'Entries remanent at Power ON' or 'Diag.Buffer – Mode':

– 'Active' or 'remanent':
  The diagnostic messages remain saved when the operating voltage $U_{EL/SEN}$ is switched off or after a power failure.
– 'Inactive' or 'not remanent':
  The diagnostic messages are lost after the operating voltage $U_{EL/SEN}$ is switched off or after a power failure.

Memory procedure

'Trace parameters' > 'Run/Stop 1' or 'Diag.Buffer – Mode':

– 'Save first 40 entries' or 'Stop after 40 records...' (stop after 40 entries...):
  The bus module saves the first 40 diagnostic messages. Additional, subsequent messages are not saved.
– 'Stop after 40 records...' or 'Record continually...' (continuous recording...):
  Continuous saving of the diagnostic messages. After the 40th message, the oldest message will be overwritten.

Error end filter

'Trace parameters' > 'Fault end filter' or 'Diag.Buffer – Error end':

– 'Record outgoing faults' or 'Record coming/going' (record incoming/outgoing errors):
  When an error occurs and is eliminated, the error number and the time of the event are recorded.
– 'Do not record outgoing faults' or 'Record coming only' (record incoming errors only):
  The error number and the time of the event are recorded only when an error occurs.
  If the error is eliminated, the time of the event will not be recorded.

2.3.5 Error classes

Potential errors of the automation system CPX-E are classified in 3 error classes (1 ... 3) with different priority depending on the severity of the error. If an error occurs, the system error LED (SF) flashes to indicate the error class.

Error class	Flashing sequence of the system error LED (SF)	Error weighting	Priority
1	1x flashes, pause time	minor	low
2	2x flashes, pause time	medium	medium
3	3x flashes, pause time	high	high

Tab. 23: Error classes

If multiple errors occur simultaneously, the error with the highest priority will have precedence; in other words:
- The system error LED flashes according to the higher priority.
- The number of the error with the higher priority will be entered in the system diagnostic data under function number 1938 (error number).

Within an error class, errors of modules with a lower module number have higher priority. That means that, within an error class, errors on
- module number 0 have the highest priority
- module number 1 have the second highest priority
- ...

2.3.6 Error numbers

Error numbers (error class 2)		
Error number	Meaning	Remedy
0	no error	–
1	General diagnostics (module-specific errors)	➔ Manual for the specific module
2	Short circuit/overload in sensor supply (SCS) or at output (SCO)	Eliminate short circuit/overload ➔ Manual for the specific module.
3	Wire break/idle at current input/output	Check cables and sensors/actuators and replace where required.
4	Failure of load voltage supply U_{OUT} due to short circuit/overload (output side)	Check actuators and their connections.
5	Undervoltage in the operating voltage supply $U_{EL/SEN}$ (on input side)	Rectify undervoltage.
6 ... 8	reserved	–

Error numbers (error class 2)		
Error number	Meaning	Remedy
9	Value falling below nominal range	Check analogue input and parameterised limit value.
10	Value exceeding nominal range	
11	Short circuit at valve	Check valve and pneumatic interface.
12	reserved	–
13	Wire break at valve (open load)	Check valve and pneumatic interface.
14	Limit value of the condition counter exceeded	Set or delete the limit value of the condition counter by parameterising.
15	Module/channel failed	Check module/peripherals and replace if necessary.
16	Saved configuration is different from the actual configuration of the automation system	With the automation system CPX-E: Check configuration and save again if necessary ➔ Tab. 39 System parameter – system start. For the bus module: Modify the System Start parameter to “System start with default parameterisation and current CPX-E configuration”. For the controller: Save the actual configuration as the set-point configuration with the CODESYS software.
17	Saved I/O length of the module is different from the actual configuration of the automation system	➔ Error number 16
18	Number of I/O points exceeded	Check DIL switch position and configuration of the automation system ➔ Manual for the specific bus module or the specific controller.
19	Nominal service life/life cycle exceeded	Replace module or spare part ➔ Manual for the specific module.
20	Error in parameterisation – analogue input	Check the parameterisation and if necessary repeat using the correct parameters.
21	Error in parameterisation – data format	
22	Error in parameterisation – linear scaling	
23	Error in parameterisation – measured value smoothing	

Error numbers (error class 2)		
Error number	Meaning	Remedy
24	Error in parameterisation – lower limit value	Check the parameterisation and if necessary repeat using the correct parameters.
25	Error in parameterisation – upper limit value	
26	Error in actuator supply	Eliminate short circuit/overload and check actuators and actuator supply.
27	missing or incorrect spare part	Replace module or spare part ➔ Manual for the specific module.
28	Alarm value reached	Check operating conditions ➔ Manual for the specific module.
29	Error in parameterisation	Check the parameterisation and if necessary repeat using the correct parameters.
30	Error in internal communication (no new output data)	Replace module if switching on and off does not remedy problem.
31	Bus connection interrupted	Restore bus connection or check configuration.
32	STI read access defective	Repeat STI read access.
33	Read access parameter defective	Repeat read access parameter.
34 ... 36	reserved	–
37	Malfunction in the controller function (e.g. setpoint value cannot be reached)	Check pressure and actuator supply.
38	valve not detected	Check valve (function/installation) and replace if necessary.
39	Service required	➔ Manual for the specific module
40 ... 47	reserved	–
48	Calibration error (factory adjustment missing)	Replace module.
49	Current loop is in the lower drop-out range	Check the installation/parameterisation of the actuator ➔ Manual for the relevant module.
50	Current loop is in the upper drop-out range	
51	Physical limit value for a sensor exceeded: – Process value invalid – Possible hardware damage	Check structure (compliance with module specification), check module for damage and replace if necessary.

Error numbers (error class 2)		
Error number	Meaning	Remedy
52	Short circuit at cold junction compensation	Eliminate short circuit and check connected CJC sensors if necessary.
53	Wire break at cold junction compensation	Check cables and CJC sensors and replace where required.
54	Calibration data is faulty	Replace module.
55	Formation of the process value is invalid due to faulty structure	Check structure (compliance with module specification).
56 ... 63	reserved	–
64	The number of modules in the current automation system configuration does not match the saved configuration	Correct configuration or save new configuration.
65 ... 69	reserved	–
70	Automation system configuration is greater than the number of stations set	Check DIL switch setting (increase number of stations)
71	Bus connection interrupted	Check network cables.
72 ... 79	reserved	–
80	Module-specific malfunction	➔ Manual for the specific module
81 ... 99	reserved	–
100	Error in configuration/parameterisation	Check configuration/parameterisation, correct if necessary or repeat commissioning.
101	Error executing a positioning job	Check the positioning job and correct if necessary.
102	Error executing a positioning record	
103	Error in control or in the parameters of a positioning job	
104	Error in the process control or the system configuration	Check system configuration, positioning job, I/O signals or system status and correct as necessary.
105	Error in the peripherals (power supply, operating pressure, etc.)	Check peripherals, power supply and operating pressure.
106	Error in valve or on axis string	Check valves and cables and replace where required.
107	Error in controller or servo drive	Check the controller or servo drive and replace if necessary.

Error numbers (error class 2)		
Error number	Meaning	Remedy
108	Error in measuring system or on axis string	Check measuring system and cables and replace where required.
109	Error in the motor or power unit	Check motor or power unit and replace if necessary.
110 ... 114	reserved	–
115	Module/channel in a subordinate system has failed	Check the subordinate module (function/installation) and replace if necessary ➔ Manual for the specific module.

Tab. 24: Error numbers (error class 2)

Error numbers (error class 3)		
Errornumber	Meaning	Remedy
128	Hardware defective	Check hardware and replace if necessary.
129	Bus module faulty	Replace bus module.
130	System error on the bus module	Replace module if switching on and off does not remedy problem.
131	Error in internal communication during start-up	Check automation system and replace if necessary.
132	System errors	Replace module if switching on and off does not remedy problem.
133 ... 134	Module faulty	Replace module.
135	Error in internal configuration, module malfunction	Check automation system and replace if necessary.
136	System errors	Replace module if switching on and off does not remedy problem.
137	Error in internal configuration, module malfunction	Check automation system and replace if necessary.
138	Error in internal configuration, e.g.: – Module not correctly mounted, plugged in – Module faulty	Check module mounting/arrangement (no gaps in automation system configuration), check module and replace if necessary.
139	Error when processing cyclical services (e.g. parameters)	Check controller program, check automation system and replace if necessary.
140	Hardware defective	Identify and replace faulty module.

Error numbers (error class 3)		
Errornumber	Meaning	Remedy
141 142	Malfunction in internal communication; automation system was not yet operational	Check application environment, check automation system and replace if necessary.
143	System errors	Replace module if switching on and off does not remedy problem.
144	Module does not have a valid licence	Procure licence or replace module.
145 ... 149	reserved	–
150	System errors	Replace module if switching on and off does not remedy problem.
151 ... 199	reserved	–

Tab. 25: Error numbers (error class 3)

Error numbers (error class 1)		
Errornumber	Meaning	Remedy
200	Error in parameterisation (parameter transfer failed)	Replace module if switching on and off does not remedy problem.
201	Address incorrect	Check DIL switch position and correct if necessary.
202	Initialisation of the protocol chip defective	Replace module if switching on and off does not remedy problem.
203	reserved	–
204	Switch setting invalid	Check DIL switch position and correct if necessary.
205 ... 253	reserved	–
254	Undervoltage of electronics and sensors	Rectify undervoltage.
255	Unknown error	–

Tab. 26: Error numbers (error class 1)

3 Parameterisation

The behaviour of the automation system CPX-E or the behaviour of individual modules and channels can be adapted to the particular application by parameterisation. Parameterisation can be performed with suitable Festo software or by the higher-order controller. The parameters are preset at the factory.

i

The parameterisation options depend on the installed bus module or controller ➔ Manual for the specific bus module/controller.

3.1 Parameterisation using Festo software

i

Suitable software for parameterisation is available in the Festo Support Portal ➔ www.festo.com/sp. Information on using the software can be found in the integrated Help function.

3.2 Parameterisation using the higher-order controller

There are various options for parameterisation of the automation system CPX-E using the higher-order controller.

Parameterisation options	Description/benefits
Interface module or scanner/ master	For example, parameterisation can be ensured in the start-up phase or after network interruptions.
User program in the higher-level controller	The parameters can be modified during run-time.
Network-specific configurators	Parameters can be modified during the commissioning phase or during troubleshooting.

Tab. 27: Parameterisation options

3.3 Types of parameters

The following parameters are defined:

Parameter type	Description	Overview of parameters
System parameters	Influence the behaviour of the complete automation system CPX-E.	➔ Tab. 29 System parameters
Module parameters (module-specific)	Influence the behaviour of a particular module.	➔ Tab. 30 Module parameters
Module parameters (channel-specific)	Influence the behaviour of a particular channel.	
Diagnostic memory parameters	Influence the mode of operation of the internal diagnostic memory.	➔ Tab. 31 Diagnostic memory parameters

Tab. 28: Types of parameters

System parameters	Brief description
Diagnostic monitoring with: – Short circuit/overload – Undervoltage at outputs	Switches monitoring of short circuit/ overload and undervoltage for the entire automation system CPX-E on or off.
Signal status in the event of an error (fail-safe parameters)	Defines the status that digital output signals are to assume in the event of communication errors on the network.
Signal status in idle mode[1)]	Defines the status that digital output signals are to assume when switching to Idle status.
Force signal status (force parameters)	Manipulation of signal statuses separate from actual operating conditions and independent of the higher-order controller.
System start	Specifies the start-up behaviour of the automation system CPX-E.
Analogue process value representation (data format)[2)]	Switches the data format for displaying analogue process values (I/O signals).

1) This function is only relevant for certain network protocols ➔ Manual for the specific bus module.
2) Special parameter, only available on certain bus modules

Tab. 29: System parameters

Module parameters	Brief description
Module-specific	
Diagnostic monitoring with: – Short circuit/overload – Undervoltage – Wire break	Switches monitoring of short circuit/overload and undervoltage on the module on or off.
Behaviour after: – Short circuit/overload – Wire break	Specifies, after a short circuit/overload or wire break, whether the power is to remain switched off or whether it is to be switched on again automatically.
Input debounce time	Serves for trouble-free recognition of digital input signals.
Signal extension time	Serves for recognising short signals.
Data format of analogue values	➔ Manual for the specific analogue module
Channel-specific	
Signal extension	Serves for recognising short signals.
Monitoring wire break	Serves for recognising connection errors.
Fault mode	Defines the status that the relevant channel is to assume in the event of communication errors on the network.
Fault state	
Idle mode[1)]	Defines the status that digital output signals are to assume when the Idle function is accessed.
Idle state[1)]	

Module parameters	Brief description
Force mode	Actual signals are replaced in the process image by the Force settings.
Force state	

1) This function is only relevant for certain network protocols ➔ Manual for the specific bus module.

Tab. 30: Module parameters

Diagnostic memory parameters	Brief description
Entries, saved retentively	Specifies whether the contents of the diagnostic memory are to be retained after the power supply is switched on again or whether they are to be deleted.
Diagnostic memory filters: – Run/stop filter 1 + 2 – Fault end filter – Error number filter – Module/channel filter	The diagnostic memory filters can be used to suppress the recording of certain error messages, and to control both the start and stop of the error recording.

Tab. 31: Diagnostic memory parameters

3.4 Parameters and data of the automation system CPX-E

3.4.1 Overview

Parameter	Description
System parameters	Specify global system functions for the entire automation system, e.g.: – Diagnostic monitoring – System start
Module parameters	Specify module-specific and channel-specific functions for the relevant module, e.g.: – Input debounce time – Signal extension time
Diagnostic memory parameters	Specify the mode of operation of the diagnostic memory

Tab. 32: Overview of parameters

Data	Description
System diagnostic data	Global information about the system status (e.g. error number, common diagnostic message)
Module diagnostic data	Information on locating errors (e.g. error number, number of the first faulty channel etc.)
Diagnostic memory data	Entries in the diagnostic memory (maximum 40)

Data	Description
System data	Information on global system settings
Module data	Serial number, revision code and module code of the modules used

Tab. 33: Overview of data

3.4.2 Function numbers

Function number[1)]	Description	Data/parameters	See section
0	Configuration	System data	➔ 3.12.1
	Force mode	System data	➔ 3.12.2
	System start	System data	➔ 3.12.3
1	Fail safe	System data	➔ 3.12.4
	Idle mode	System data	➔ 3.12.5
2	System monitoring	System data	➔ 3.12.6
16 + 16m + 0	Module code	Module data	➔ 3.13.1
16 + 16m + 13	Revision code	Module data	➔ 3.13.2
784 + 4m + 0 … 3	Serial number	Module data	➔ 3.13.3
1936	Status bits	System diagnostic data	➔ 3.10.1
1937	Module number and diagnostic status	System diagnostic data	➔ 3.10.2
1938	Error number	System diagnostic data	➔ 3.10.3
2008 + 4m + 0	Number of the first faulty channel	Module diagnostic data	➔ 3.11.1
2008 + 4m + 1	Module error number	Module diagnostic data	➔ 3.11.2
2008 + 4m + 2	Info 2 (reserved)	Module diagnostic data	➔ 3.11.3
2008 + 4m + 3	Info 3 (reserved)	Module diagnostic data	➔ 3.11.3
3480	Entries saved retentively with Power ON	Diagnostic memory parameters	➔ 3.8.1
	Run/stop filter 1	Diagnostic memory parameters	➔ 3.8.2

Function number[1)]	Description	Data/parameters	See section
3482	Number of entries in the diagnostic memory	Diagnostic memory data	➔ 3.9.1
3483	Overflow	Diagnostic memory data	➔ 3.9.2
	Status	Diagnostic memory data	➔ 3.9.3
3484	Run/stop filter 2	Diagnostic memory parameters	➔ 3.8.3
	Fault end filter	Diagnostic memory parameters	➔ 3.8.4
	Error number filter	Diagnostic memory parameters	➔ 3.8.5
	Module/channel filter	Diagnostic memory parameters	➔ 3.8.6
3485	Module number	Diagnostic memory parameters	➔ 3.8.7
3486	Channel number	Diagnostic memory parameters	➔ 3.8.8
3487	Error number	Diagnostic memory parameters	➔ 3.8.9
3488 + 10d + 0 ... 9[2)]	Diagnostic memory	Diagnostic memory data	➔ 3.9.4
4401	Monitoring	System parameters	➔ 3.5.1
4402	Fail safe	System parameters	➔ 3.5.2
	Force mode	System parameters	➔ 3.5.3
	Idle mode	System parameters	➔ 3.5.4
	System start	System parameters	➔ 3.5.5
	Analogue process value representation	System parameters	➔ 3.5.6
4828 + 64m + 0	Module monitoring	Module parameters (module-specific)	➔ 3.6.1
4828 + 64m + 1	Behaviour after short circuit/overload	Module parameters (module-specific)	➔ 3.6.2
	Input debounce time	Module parameters (module-specific)	➔ 3.6.3
	Signal extension time	Module parameters (module-specific)	➔ 3.6.4
4828 + 64m + 3	Data format for analogue value of inputs	Module parameters (module-specific)	➔ 3.6.5
	Data format for analogue value of outputs	Module parameters (module-specific)	
4828 + 64m + 6	Signal extension channel x	Module parameters (channel-specific)	➔ 3.7.1

Function number[1)]	Description	Data/parameters	See section
– [3)]	Fail safe channel x	Module parameters (channel-specific)	➔ 3.7.2
	Idle mode channel x	Module parameters (channel-specific)	➔ 3.7.3
	Force channel x	Module parameters (channel-specific)	➔ 3.7.4
– [4)]	Number of input bytes (Rx size)	System data (network-specific)	–
	Number of output bytes (Tx size)	System data (network-specific)	–

1) m = module number (counting from left to right, beginning with 0)
2) d = diagnostic event
3) Access is protocol-specific ➔ Bus module manual
4) Only relevant for certain network protocols ➔ Bus module manual

Tab. 34: Function numbers

3.5 System parameters

3.5.1 Monitoring

Activates or deactivates (suppresses) monitoring of short circuit/overload and undervoltage for the entire automation system.
Values: 1 = active (default); 0 = inactive
If monitoring is active, an error reported by the module will be:
- sent to the higher-level master
- entered, if applicable, in the diagnostic memory (depending on the filter settings)
- entered in the module diagnostic data and, if applicable, in the status bits
- indicated by the red common error LED on the module

System parameter – monitor	Selection via parameter							
	F no.[1)] 4401	Bit						
		7	6	5	4	3	2	1	0
Short circuit/overload in sensor supply (SCS)									0/1
Short circuit/overload at the outputs (SCO)								0/1	
Undervoltage at outputs (U_{OUT})							0/1		

1) Function number

Tab. 35: System parameter – monitor

i

Monitoring can also be set separately for each module using the module parameter ‘Set module monitoring’ ➔ 3.6.1 Module monitoring. The mode of operation of the channel error LED remains unaltered.

3.5.2 Fail safe

The ‘Fail safe’ system parameter specifies which signal status the outputs are to assume in the event of communication errors in the network, e.g. in the event of network interruption, failure of the higher-order controller, communication stop.

System parameter – fail safe	**Selection via parameter**							
	F no.[1)] 4402	Bit						
		7	6	5	4	3	2	1	0
Reset all outputs (default)								0	0
Hold last state (retain signal status)								0	1
Assume Fault mode								1	0

1) Function number

Tab. 36: System parameter – fail safe

i

When switching from ‘Fault mode assume’ to ‘reset all outputs’ or to ‘Hold last state’ the channel-oriented fail-safe settings (module parameter ‘Fault mode’ and ‘Fault state’) are reset automatically for safety reasons to prevent unwanted signal statuses. The fault mode status is set using the channel-specific module parameters ➔ 3.7.2 Fail safe channel x.

3.5.3 Force mode

The ‘Force mode’ system parameter specifies for the entire system whether the Force function is disabled or enabled.

System parameter – force mode	**Selection via parameter**							
	F no.[1)] 4402	Bit						
		7	6	5	4	3	2	1	0
Force mode blocked (default)						0	0		
Force mode enabled (retain signal status)						0	1		

1) Function number

Tab. 37: System parameter – force mode

i

By changing this parameter, the channel-orientated Force settings (module parameters ‘Force mode’ and ‘Force state’) are reset automatically for safety reasons in the following cases in order to avoid undesired signal statuses:

- Change to Festo software:
  When switching from "enabled" to "blocked"
- Change over the network:
  When switching from "blocked" to "enabled"

Force signals have precedence over fail-safe signals.

3.5.4 Idle mode

The ‘Idle mode’ system parameter defines the signal status that outputs should have if the system switches to the Idle status.

System parameter – Idle mode[1]	**Selection via parameter**							
	F no.[2] 4402	Bit						
		7	6	5	4	3	2	1	0
Reset all outputs (default)				0	0				
Hold last state (retain signal status)				0	1				
Assume Idle mode				1	0				

1) This parameter is only relevant with specific network protocols ➔ Manual for the specific bus module.
2) Function number

Tab. 38: System parameter – Idle mode

i

When switching from ‘Idle mode assume’ to ‘Reset all outputs’ or to ‘Hold last state’ the channel-oriented idle mode settings (‘Idle mode’ and ‘Idle state’ module parameters) are automatically reset for safety reasons to prevent undesired signal statuses.

3.5.5 System start

The ‘system start’ system parameter specifies the starting behaviour of the system and saves all current parameter settings and the current configuration.

System parameter – system start	**Selection via parameter**							
	F no.[1] 4402	Bit						
		7	6	5	4	3	2	1	0
System start with default parameterisation (factory setting) and current CPX configuration; external parameterisation is possible (default)			0						
System start with saved parameterisation and saved CPX configuration; parameters and configuration are saved to non-volatile memory; external parameterisation is blocked; the Modify (M) LED on the bus module lights			1						

1) Function number

Tab. 39: System parameter – system start

i

If bit 6 is set to 1, the current parameter settings will be write-protected, and the current configuration will be saved, except for bit 6 itself and the 'Force channel X' module parameters.
Recommendation:
"System start with default parameterisation and current CPX configuration". The desired parameterisation can then be created in the start-up phase or after a network interruption, e.g. by the interface module or the scanner/master (depending on the network used).
If "System start with default parameterisation and current CPX configuration" is active, the factory settings for all module and system parameters will be applied after switching on and off.

3.5.6 Analogue process value representation

The 'analogue process data representation' system parameter switches the data format or byte sequence for displaying analogue process values.

System parameter – analogue process value representation[1]	**Selection via parameter**							
	F no.[2] 4402	Bit						
		7	6	5	4	3	2	1	0
Byte sequence INTEL format (default): Least significant bit left, most significant bit right (LSB-MSB)[3]	0							
Byte sequence MOTOROLA format: Most significant bit left, least significant bit right (MSB-LSB)[3]	1							

1) This parameter is only relevant for specific bus modules ➔ Manual for the specific bus module.
2) Function number
3) LSB = Least Significant Bit; MSB = Most Significant Bit

Tab. 40: System parameter – analogue process value representation

3.6 Module parameters (module-specific)

Module parameters refer to module-specific or channel-specific functions.
64 bytes are available for parameters in each module.

i

You can find detailed information on the module parameters supported by the module along with parameter values and their defaults in the manual for the relevant module.

3.6.1 Module monitoring

Monitoring of the potential errors can be activated or deactivated (suppressed) independently for each module.

Values: 1 = active (default); 0 = inactive

If monitoring is active, an error will be:

– sent to the bus module

– indicated by the common error LED on the module

Module parameter – module monitoring	**Selection via parameter**								
	F no.[1)] 4828 + 64m	Bit							
		7	6	5	4	3	2	1	0
Short circuit/overload in sensor supply (SCS)	+ 0								0/1
Short circuit/overload at the outputs (SCO)	+ 0							0/1	
Undervoltage at outputs (U_{OUT})	+ 0						0/1		
Monitoring of parameterisation errors	+ 0	0/1							

1) Function number; m = module number (counting from left to right, beginning with 0)

Tab. 41: Module parameter – module monitoring

i

Monitoring can also be set for the entire automation system via the ‘Monitoring’ system parameter➔ 3.5.1 Monitoring.

3.6.2 Behaviour after short circuit/overload

The ‘Behaviour after short circuit/overload’ system parameter specifies whether after a short circuit/overload in the sensor supply or the outputs the relevant voltage is to remain switched off or whether it is to be switched on again automatically.
Values: 1 = switch voltage back on; 0 = voltage remains switched off

Module parameter – behaviour after short circuit/overload	**Selection via parameter**								
	F no.[1] 4828 + 64m	Bit							
		7	6	5	4	3	2	1	0
Short circuit/overload in sensor supply (SCS)	+ 1								1
Short circuit/overload at the outputs (SCO)	+ 1							1	
Short circuit/overload at the analogue signal	+ 1					1			

1) Function number; m = module number (counting from left to right, beginning with 0)

Tab. 42: Module parameter – behaviour after short circuit/overload

i

The “Voltage remains switched off” setting requires the power to be switched off and on again or the set/reset of the relevant signals to recover the voltage.

3.6.3 Input debounce time

The ‘input debounce time’ system parameter specifies when a change of edge of the sensor signal on the relevant module is to be accepted as a logical input signal.

Module parameter – input debounce time	**Selection via parameter**								
	F no.[1] 4828 + 64m	Bit							
		7	6	5	4	3	2	1	0
Input debounce time 0.1 ms	+ 1			0	0				
Input debounce time 3 ms (typical default)	+ 1			0	1				
Input debounce time 10 ms	+ 1			1	0				
Input debounce time 20 ms	+ 1			1	1				

1) Function number; m = module number (counting from left to right, beginning with 0)

Tab. 43: Module parameter – input debounce time

i

For more information on this parameter ➔ Manual for the relevant module.

3.6.4 Signal extension time

The module parameter specifies the signal extension time for the relevant module.
Signal statuses accepted as logical input signals usually remain valid at least until the specified signal extension time (minimum signal duration) has expired. Changes of edge within the extension time are ignored.

Module parameter – signal extension time	**Selection via parameter**								
	F no.[1)] 4828 + 64m	Bit							
		7	6	5	4	3	2	1	0
Signal extension time 0.5 ms	+ 1	0	0						
Signal extension time 15 ms (typical default)	+ 1	0	1						
Signal extension time 50 ms	+ 1	1	0						
Signal extension time 100 ms	+ 1	1	1						

1) Function number; m = module number (counting from left to right, beginning with 0)

Tab. 44: Module parameter – signal extension time

i

The signal extension time can be activated channel-by-channel ➔ 3.7.1 Signal extension channel x.
For more information on this parameter ➔ Manual for the relevant module.

3.6.5 Data format for analogue value of inputs/outputs

The ‘data format analogue value of inputs/outputs’ defines the data format for internal processing of the corresponding analogue values (values ➔ Manual for the relevant module).
The choice of data format depends on the network or master and simplifies evaluation of the analogue values.

Module parameter – data format analogue value of inputs/outputs	**Selection via parameter**								
	F no.[1)] 4828 + 64m	Bit							
		7	6	5	4	3	2	1	0
Data format for analogue value of inputs	+ 3							0/1	0/1
Data format for analogue value of outputs	+ 3			0/1	0/1				

1) Function number; m = module number (counting from left to right, beginning with 0)

Tab. 45: Module parameter – data format analogue value of inputs/outputs

3.7 Module parameters (channel-specific)

3.7.1 Signal extension channel x

The module parameter specifies whether the signal extension for the relevant channel is to be enabled or blocked.
Values: 1 = enabled; 0 = blocked
The signal extension time can be specified separately for each module ➔ 3.6.4 Signal extension time.

Module parameter – signal extension channel x	**Selection via parameter**								
	F no.[1)] 4828 + 64m	Bit							
		7	6	5	4	3	2	1	0
Signal extension channel 0	+ 6								1
Signal extension channel 1	+ 6							1	
Signal extension channel 2	+ 6						1		
Signal extension channel 3	+ 6					1			
Signal extension channel 4	+ 6				1				
Signal extension channel 5	+ 6			1					
Signal extension channel 6	+ 6		1						
Signal extension channel 7	+ 6	1							

1) Function number; m = module number (counting from left to right, beginning with 0)

Tab. 46: Module parameter – signal extension channel x

3.7.2 Fail safe channel x

The Fail-safe parameterisation can be used to specify the signal status which the outputs are to assume in the event of communication errors ➔ 2.2.4 Signal status in the event of an error (fail safe)

Module parameter – fail safe channel x		**Selection via parameter**
Fault mode channel x	Hold last state	Access is via protocol-specific functions ➔ Manual for the bus module.
	Fault state (default)	
Fault state channel x	Reset output (default)	
	Set output	

Tab. 47: Module parameter – fail safe channel x

3.7.3 Idle mode channel x

The Idle mode parameterisation can be used to specify the signal status which the outputs are to assume when switching to idle status ➔ 2.2.5 Signal status in idle state (idle mode)

Module parameter – idle mode channel x[1)]		Selection via parameter
Idle mode channel x	Hold last state	Access is via protocol-specific functions ➔ Manual for the bus module.
	Idle state (default)	
Idle state channel x	Reset output (default)	
	Set output	

1) Not supported by all bus modules

Tab. 48: Module parameter – idle mode channel x

3.7.4 Force channel x

The Forcen function permits the manipulation of signal states independently of actual operating conditions ➔ 2.2.3 Forcing

Module parameter – force channel x		Selection via parameter
Force mode inputs channel x	blocked (default)	Access is via protocol-specific functions ➔ Manual for the bus module.
	Force state	
Force state inputs channel x	Set signal	
	Reset signal (default)	
Force mode outputs channel x	blocked (default)	
	Force state	
Force state outputs channel x	Set signal	
	Reset signal (default)	

Tab. 49: Module parameter – force channel x

3.8 Diagnostic memory parameters (trace parameters)

The mode of operation of the diagnostic memory can be adapted to individual requirements using the diagnostic memory parameters. The diagnostic memory parameters retain their last setting after the power supply has been switched off and on again and are saved so as to be protected against mains failure.

i

Additional information on the working method of the diagnostic memory ➔ 2.3.4 Diagnostic memory.

3.8.1 Entries saved retentively with Power ON

Specifies whether the contents of the diagnostic memory are to be retained after the power supply is switched on again or whether they are to be deleted.
Values: 1 = active (default); 0 = inactive
The diagnostic memory will be deleted if the mode is changed.

Diagnostic memory parameter – inputs saved at Power ON	**Selection via parameter**							
	F no.[1] 3480	Bit						
		7	6	5	4	3	2	1	0
Entries saved retentively with renewed switch-on									0/1

1) Function number

Tab. 50: Diagnostic memory parameter – inputs saved at Power ON

3.8.2 Run/stop filter 1

Diagnostic memory filter which is used to specify whether the first 40 errors or the last 40 errors are to be saved.
The diagnostic memory will be deleted if the mode is changed.

Diagnostic memory parameter – run/stop filter 1	**Selection via parameter**							
	F no.[1] 3480	Bit						
		7	6	5	4	3	2	1	0
Save the first 40 entries; stop after 40 entries								0	
Save the last 40 entries; overwrite old entries (default)								1	

1) Function number

Tab. 51: Diagnostic memory parameter – run/stop filter 1

3.8.3 Run/stop filter 2

Diagnostic memory filter which is used to determine when the recording of errors is to be started or stopped.

Diagnostic memory parameter – run/stop filter 2[1]	**Selection via parameter**							
	F no.[2] 3484	Bit						
		7	6	5	4	3	2	1	0
Run/stop filter 2 inactive (default)							0	0	0
record up to the defined FN							0	0	1
record up to the defined FN + MN							0	1	0
record up to the defined FN + MN + KN							0	1	1
record from the defined FN							1	0	0
record from the defined FN + MN							1	0	1
record from the defined FN + MN + KN							1	1	0
reserved							1	1	1

1) MN = module number, CN = channel number, FN = error number

2) Function number

Tab. 52: Diagnostic memory parameter – run/stop filter 2

i

The relevant numbers are defined by the diagnostic memory parameters ‘module number’ (➔ 3.8.7 Module number), ‘channel number’ (➔ 3.8.8 Channel number) and ‘error number’ (➔ 3.8.9 Error number).

3.8.4 Fault end filter

Diagnostic memory filter which is used to specify whether outgoing errors are to be recorded or not.

Diagnostic memory parameter – fault end filter	**Selection via parameter**							
	F no.[1] 3484	Bit						
		7	6	5	4	3	2	1	0
record outgoing errors (end of error); filter inactive (default)						0			
do not record outgoing errors (end of error); filter active						1			

1) Function number

Tab. 53: Diagnostic memory parameter – fault end filter

i

Recording the outgoing errors can determine how long an error has existed. Incoming and outgoing errors each represent one entry. With outgoing errors, the error number “0” is entered. A maximum of 40 entries is saved.

3.8.5 Error number filter

This diagnostic memory filter can be used to suppress recording of a desired error message or to record a desired error message only.

Diagnostic memory parameter – error number filter	**Selection via parameter**							
	F no.[1] 3484	Bit						
		7	6	5	4	3	2	1	0
Error number filter inactive (default)				0	0				
record only defined error number				0	1				
do not record defined error number				1	0				
reserved				1	1				

1) Function number

Tab. 54: Diagnostic memory parameter – error number filter

i

The relevant number is defined by the diagnostic memory parameters ‘error number’ (➔ 3.8.9 Error number).

3.8.6 Module/channel filter

This diagnostic memory filter can be used to suppress the recording of errors of other modules or channels, thereby enabling errors in a particular module or channel to be analysed.

Diagnostic memory parameter – module/ channel filter	**Selection via parameter**							
	F no.[1] 3484	Bit						
		7	6	5	4	3	2	1	0
Module/channel filter inactive (default)		0	0						
record the error number of a given module only		0	1						
record the error number of a given channel only		1	0						
reserved		1	1						

1) Function number

Tab. 55: Diagnostic memory parameter – module/channel filter

i

The relevant numbers are defined by the diagnostic memory parameters ‘module number’ (➔ 3.8.7 Module number) and ‘channel number’ (➔ 3.8.8 Channel number).

3.8.7 Module number

Module number for the diagnostic memory filter.
Only effective if an appropriate diagnostic memory filter is active.

Diagnostic memory parameter – module number	**Selection via parameter**							
	F no.[1)] 3485	Bit						
		7	6	5	4	3	2	1	0
Module number 0 … 47 (0 = default)			0/1	0/1	0/1	0/1	0/1	0/1

1) Function number

Tab. 56: Diagnostic memory parameter – module number

3.8.8 Channel number

Channel number for the diagnostic memory filter.
Only effective if an appropriate diagnostic memory filter is active.

Diagnostic memory parameter – channel number	**Selection via parameter**							
	F no.[1)] 3486	Bit						
		7	6	5	4	3	2	1	0
Channel number 0 … 63 (0 = default)			0/1	0/1	0/1	0/1	0/1	0/1

1) Function number

Tab. 57: Diagnostic memory parameter – channel number

3.8.9 Error number

Error number for the diagnostic memory filter.
Only effective if an appropriate diagnostic memory filter is active.

Diagnostic memory parameter – error number	**Selection via parameter**							
	F no.[1)] 3487	Bit						
		7	6	5	4	3	2	1	0
Error number 0 … 255 (0 = default)	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1

1) Function number

Tab. 58: Error number 0 … 255 (0 = default)

3.9 Diagnostic memory data

3.9.1 Number of entries in the diagnostic memory

Specifies the number of entries in the diagnostic memory. Can be used as a loop counter if the complete diagnostic memory is to be read out by PLC program.

Diagnostic memory data – number of entries in the diagnostic memory	**Selection via parameter**							
	F no.[1] 3482	Bit						
		7	6	5	4	3	2	1	0
Number of entries in the diagnostic memory (0 ... 40)			0/1	0/1	0/1	0/1	0/1	0/1

1) Function number

Tab. 59: Diagnostic memory data – number of entries in the diagnostic memory

3.9.2 Overflow

Indicates whether the diagnostic memory has overflowed. Overflow means that more than 40 errors have occurred.
The overflow is displayed when the first 40 errors are recorded as well as when the last 40 errors are recorded.

Diagnostic memory data – overflow	**Selection via parameter**							
	F no.[1] 3483	Bit						
		7	6	5	4	3	2	1	0
No overflow								0
Overflow								1

1) Function number

Tab. 60: Diagnostic memory data – overflow

3.9.3 Status

Indicates whether error recording is active or inactive. Error recording can be stopped and started with the run/stop filters.

Diagnostic memory data – status	**Selection via parameter**							
	F no.[1] 3483	Bit						
		7	6	5	4	3	2	1	0
Recording active								0	
Recording inactive								1	

1) Function number

Tab. 61: Diagnostic memory data – status

3.9.4 Diagnostic memory

The diagnostic memory contains a maximum of 40 diagnostic entries, with each diagnostic entry consisting of 10 bytes.

The first 5 bytes contain information on the time of the error and the last 5 byes contain information about the error.

Diagnostic memory data – diagnostic memory (10 bytes per entry, 40 entries)			**Selection via parameter**								
Byte	Description	Value	F no.[1)] 3488 + 10d	Bit							
				7	6	5	4	3	2	1	0
1	Days Number of days[2)]	0 … 255	+ 0	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1
2	Hours Number of hours[2)]	0 … 23	+ 1				0/1	0/1	0/1	0/1	0/1
3	Minutes Number of minutes[2)]	0 … 59	+ 2			0/1	0/1	0/1	0/1	0/1	0/1
4	Seconds Number of seconds[2)]	0 … 59	+ 3			0/1	0/1	0/1	0/1	0/1	0/1
5	Milliseconds Number of 10 milliseconds [2)] Bit 7 is additionally set if it is the first entry after a switch-on.	0 … 99 or 128 … 227	+ 4	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1
6	Module code Module code of the module that reported the error	0 … 255	+ 5	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1
7	Module position Module number of the module that signalled the error; 63 = error not module-related	0 … 47; 63	+ 6			0/1	0/1	0/1	0/1	0/1	0/1
8	Number of first faulty output channel (Bits 0 … 5; values 0 … 63)	0 … 255	+ 7	0	0	0/1	0/1	0/1	0/1	0/1	0/1
	Number of first faulty input channel (Bits 0 … 5; values 0 … 63)			1	0	0/1	0/1	0/1	0/1	0/1	0/1
	Module error (Bits 0 … 5; values 0 … 63)			0	1	0/1	0/1	0/1	0/1	0/1	0/1
	reserved			1	1	0/1	0/1	0/1	0/1	0/1	0/1

Diagnostic memory data – diagnostic memory (10 bytes per entry, 40 entries)			**Selection via parameter**							
Byte	Description	Value	F no.[1] 3488 + 10d	Bit						
				7	6	5	4	3	2	1	0
9	Error number (possible error messages ➔ 2.3.5 Error classes)	0 … 255	+ 8	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1
10	Subsequent channels Number of subsequent channels with the same error	0 … 63	+ 9			0/1	0/1	0/1	0/1	0/1	0/1

1) Function number; d = diagnostic event 0 … 39; current diagnostic event = 0

2) Measured from the moment the power supply is switched on

Tab. 62: Diagnostic memory data – diagnostic memory

i

If the error number = 0: the content of this byte is also 0.
If the error number is between 128 … 199 (error class 3): the content of this byte is not relevant (service required).

3.10 System diagnostic data

3.10.1 Status bits

The 8 status bits display common diagnostic messages.
- Bit 0 ... 3: source of error
- Bit 4 ... 7: type of error

Values: 1 = error pending; 0 = no error

System diagnostic data – status bits	Selection via parameter							
	F no.[1] 1936	Bit						
		7	6	5	4	3	2	1	0
Valve									1
Output								1	
Input							1		
Analogue/technology module						1			
Undervoltage					1				
Short circuit/overload				1					
Wire break			1						
Other error		1							

1) Function number

Tab. 63: System diagnostic data – status bits

3.10.2 Module number and diagnostic status

Indicates whether there are diagnostic data and contains, where applicable, the number of the first module on which an error has occurred.

Values: 1 = diagnostic data available; 0 = no diagnostic data

With the aid of the module number of the faulty module, you can ascertain the function number of the relevant diagnostic data.

System diagnostic data – module number and diagnostic status	Selection via parameter							
	F no.[1] 1937	Bit						
		7	6	5	4	3	2	1	0
Module number of the first faulty module (0 ... 47)				1	1	1	1	1	1
Diagnostic status			1						

1) Function number

Tab. 64: System diagnostic data – module number and diagnostic status

3.10.3 Error number

Current error number (possible error messages è ➔ 2.3.6 Error numbers)
Function number 1937 indicates whether diagnostic data are available ➔ 3.10.2 Module number and diagnostic status.

System diagnostic data – error number	Selection via parameter							
	F no.[1] 1938	Bit						
		7	6	5	4	3	2	1	0
Error number (0 ... 255)		0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1

1) Function number

Tab. 65: System diagnostic data – error number

3.11 Module diagnostic data

The module diagnostic data are attributed to the function numbers 2008 ... 2199. A total of 4 items of diagnostic information are available in 4 consecutive bytes for each module.
The function number of the diagnostic data for the faulty module is therefore calculated as follows:
– Function number = 2008 + (4 x module number) + information number

i

You can ascertain the module number of the first faulty module with the aid of the system diagnostic data (function number 1937) ➔ 3.10.2 Module number and diagnostic status.

3.11.1 Number of the first faulty channel

Indicates the number of the first faulty channel.

Module diagnostic data – number of the first faulty channel	Selection via parameter								
	F no.[1] 2008 + 4m	Bit							
		7	6	5	4	3	2	1	0
Channel number (0 ... 63)	+ 0			0/1	0/1	0/1	0/1	0/1	0/1
Number of first faulty output channel	+ 0	0	0						
Number of first faulty input channel	+ 0	1	0						
Module error	+ 0	0	1						
reserved	+ 0	1	1						

1) Function number; m = module number (counting from left to right, beginning with 0)

Tab. 66: Module diagnostic data – number of the first faulty channel

3.11.2 Error number

Error number (possible error messages ➔ 2.3.5 Error classes)

Module diagnostic data – error number	**Selection via parameter**								
	F no.[1] 2008 + 4m	Bit							
		7	6	5	4	3	2	1	0
Error number (0 ... 255)	+ 1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1

1) Function number; m = module number (counting from left to right, beginning with 0)

Tab. 67: Module diagnostic data – error number

3.11.3 Info 2 and 3 (reserved)

Module diagnostic data – info 2 (reserved)	**Selection via parameter**								
	F no.[1] 2008 + 4m	Bit							
		7	6	5	4	3	2	1	0
reserved	+ 2	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1

1) Function number; m = module number (counting from left to right, beginning with 0)

Tab. 68: Module diagnostic data – info 2 (reserved)

Module diagnostic data – info 3 (reserved)	**Selection via parameter**								
	F no.[1] 2008 + 4m	Bit							
		7	6	5	4	3	2	1	0
reserved	+ 3	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1

1) Function number; m = module number (counting from left to right, beginning with 0)

Tab. 69: Module diagnostic data – info 3 (reserved)

3.12 System data

System data provide information about global system settings and the system status.
The system data are not saved to retentive memory and are lost on switching off.

3.12.1 Configuration

Indicates whether the current configuration of the automation system corresponds to the saved configuration.
See also ‘system start’ system parameter ➔ 3.5.5 System start.

System data – configuration	**Selection via parameter**							
	F no.[1)] 0	Bit						
		7	6	5	4	3	2	1	0
Uniform configuration					0				
Non-uniform configuration					1				

1) Function number

Tab. 70: System data – configuration

3.12.2 Force mode

Specifies whether Force is blocked or enabled.
See also system parameter ‘Force mode’ ➔ 3.5.3 Force mode.

System data – force mode	**Selection via parameter**							
	F no.[1)] 0	Bit						
		7	6	5	4	3	2	1	0
Force blocked			0						
Force enabled			1						

1) Function number

Tab. 71: System data – force mode

3.12.3 System start

Specifies how the system start of the automation system is to be carried out.
See also ‘system start’ system parameter ➔ 3.5.5 System start.

System data – system start	**Selection via parameter**							
	F no.[1] 0	Bit						
		7	6	5	4	3	2	1	0
System start with default parameterisation (factory setting) and current configuration		0							
System start with saved parameterisation and saved equipment status		1							

1) Function number

Tab. 72: System data – system start

3.12.4 Fail safe

Indicates whether Fail safe is active or inactive.

System data – fail safe	**Selection via parameter**							
	F no.[1] 1	Bit						
		7	6	5	4	3	2	1	0
Reset all outputs								0	0
Hold last state (retain signal status)								0	1
Assume Fault mode								1	1

1) Function number

Tab. 73: System data – fail safe

3.12.5 Idle mode

Indicates whether Idle mode is active or inactive.

System data – idle mode	**Selection via parameter**							
	F no.[1] 1	Bit						
		7	6	5	4	3	2	1	0
Reset all outputs						0	0		
Hold last state (retain signal status)						0	1		
Assume Idle mode						1	1		

1) Function number

Tab. 74: System data – idle mode

3.12.6 System monitoring

Specifies whether the monitoring of short circuit/overload and undervoltage is active or inactive.
See also ‘monitor’ system parameter ➔ 3.5.1 Monitoring.

System data – system monitor	**Selection via parameter**							
	F no.[1]	Bit						
	2	7	6	5	4	3	2	1	0
Short circuit/overload in sensor supply (SCS)								0/1
Short circuit/overload at the outputs (SCO)							0/1	
Undervoltage at outputs (U_{OUT})						0/1		

1) Function number

Tab. 75: System data – system monitor

3.13 Module data

Module data contain information appropriate to the relevant modules and are thus used to identify modules.

3.13.1 Module code

Indicates the module code of the module.
You can find the module codes in the corresponding module documentation.

Module data – module code	**Selection via parameter**								
	F no.[1)] 16 + 16m	Bit							
		7	6	5	4	3	2	1	0
reserved (0) Module code (1 ... 245) reserved (246 ... 255)	+ 0	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1

1) Function number; m = module number (counting from left to right, beginning with 0)

Tab. 76: Module data – module code

3.13.2 Revision code

Indicates the output status of the module (➔ product labelling).

Module data – revision code	**Selection via parameter**								
	F no.[1)] 16 + 16m	Bit							
		7	6	5	4	3	2	1	0
Revision code (0 ... 255)	+ 13	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1

1) Function number; m = module number (counting from left to right, beginning with 0)

Tab. 77: Module data – revision code

3.13.3 Serial number

Indicates the serial number of the module (in hexadecimal).

Module data – serial number	Selection via parameter								
	F no.[1)] 784 + 4m	Bit							
		7	6	5	4	3	2	1	0
8th digit	+ 0	0/1	0/1	0/1	0/1				
7th digit	+ 0					0/1	0/1	0/1	0/1
6th digit	+ 1	0/1	0/1	0/1	0/1				
5th digit	+ 1					0/1	0/1	0/1	0/1
4th digit	+ 2	0/1	0/1	0/1	0/1				
3th digit	+ 2					0/1	0/1	0/1	0/1
2th digit	+ 3	0/1	0/1	0/1	0/1				
1th digit	+ 3					0/1	0/1	0/1	0/1

1) Function number; m = module number (counting from left to right, beginning with 0)

Tab. 78: Module data – serial number

4 Technical data

4.1 Technical data, general

General technical data		CPX-E
Certificates, declaration of conformity		➔ www.festo.com/sp
Mounting position		Vertical/horizontal
Ambient temperature with vertical mounting position	[°C]	–5 ... +60
Ambient temperature with horizontal mounting position	[°C]	–5 ... +50
Storage temperature	[°C]	–20 ... +70
Humidity (non-condensing)	[%]	0 ... 95
Max. permissible setup altitude above sea level	[m]	2000
Degree of protection in accordance with EN 60529		IP20 The degree of protection is not UL-tested.
Protection against electric shock (Protection against direct and indirect contact in accordance with IEC 60204-1)		By the use of PELV circuits (Protected extra-low voltage)

General technical data	CPX-E
Certification	RCM Mark
Pollution degree	2
Vibration and shock resistance in accordance with EN 60068 ➔ Tab. 80 Type of severity level (SL)	
Vibration (part 2-6)	H-rail SL1
Shock (part 2-27)	H-rail SL1
Continuous shock (part 2-27)	H-rail SL1
Automation system CPX-E	
Address volume of the inputs/outputs [Byte]	64/64 (maximum)
Max. number of modules per Automation system CPX-E, including the bus module or controller	11

Tab. 79: General technical data

Type of severity level (SL)					
Vibration load					
Frequency range [Hz]		Acceleration [m/s²]		Deflection [mm]	
SL1	SL2	SL1	SG2	SL1	SL2
2 … 8	2 … 8	–	–	±3.5	±3.5
8 … 27	8 … 27	10	10	–	–
27 … 58	27 … 60	–	–	±0.15	±0.35
58 … 160	60 … 160	20	50	–	–
160 … 200	160 … 200	10	10	–	–
Shock load					
Acceleration [m/s²]		Duration [ms]		Shocks per direction	
SL1	SL2	SL1	SL2	SL1	SL2
±150	±300	11	11	5	5
Continuous shock load					
Acceleration [m/s²]		Duration [ms]		Shocks per direction	
±150		6		1000	

Tab. 80: Type of severity level (SL)

4.2 Technical data, electrical

Power supply		
Operating power supply $U_{EL/SEN}$		
Nominal operating voltage	[V DC]	24 ± 25%
Trigger level, undervoltage detection	[V DC]	17.5
Max. current rating of terminal strip	[A]	8 [1]
Mains buffering time	[ms]	module-dependent[2]
Load voltage supply U_{OUT}		
Nominal operating voltage	[V DC]	24 ± 25% [3]
Trigger level, undervoltage detection	[V DC]	Module-dependent[2]
Max. current rating of terminal strip	[A]	8

1) Non-conforming operating conditions UL ➔ Documentation of modules
2) ➔ Documentation of the modules
3) The tolerance indication is a deviation with some modules.

Tab. 81: Power supply

Connection data for the terminal strips		**4-pin**	**6-pin**
Conductor cross section			
Solid	[mm²]	0.14 … 1.5	
Flexible	[mm²]	0.14 … 2.5	0.14 … 1.5
Conductor cross section with wire ferrule			
Without plastic sleeve	[mm²]	0.14 … 1.5	
With plastic sleeve	[mm²]	0.14 … 1.5	0.14 … 1.0
Length of the wire ferrule without plastic sleeve[1]			
Conductor cross section 0.14 … 1.0 mm²	[mm]	8 … 10	
Conductor cross section 1.5 mm²	[mm]	8 … 10	10

Connection data for the terminal strips		4-pin	6-pin
Length of the wire ferrule with plastic sleeve[2)]			
Conductor cross section 0.14 … 0.34 mm²	[mm]	8 … 10	
Conductor cross section 0.5 … 1.0 mm²	[mm]	8 … 10	10

1) in accordance with DIN 46228-1
2) in accordance with DIN 46228-4

Tab. 82: Connection data for the terminal strips

4.3 Technical data for UL certification

Electrical data and ambient conditions UL	
Pollution degree	3
Installation site	for indoor use only
Maximum installation height	2000 m
Protection against mechanical influences	Install the product in housing or control cabinet.

Tab. 83: Electrical data and ambient conditions UL

Maximum current rating of operating voltage supply $U_{EL/SEN}$ UL		
Supply via [XD1] connection	[A]	≤ 4
Supply via both [XD1] and [XD2] connections	[A]	> 4 … 8 A

Tab. 84: Maximum current rating UL

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