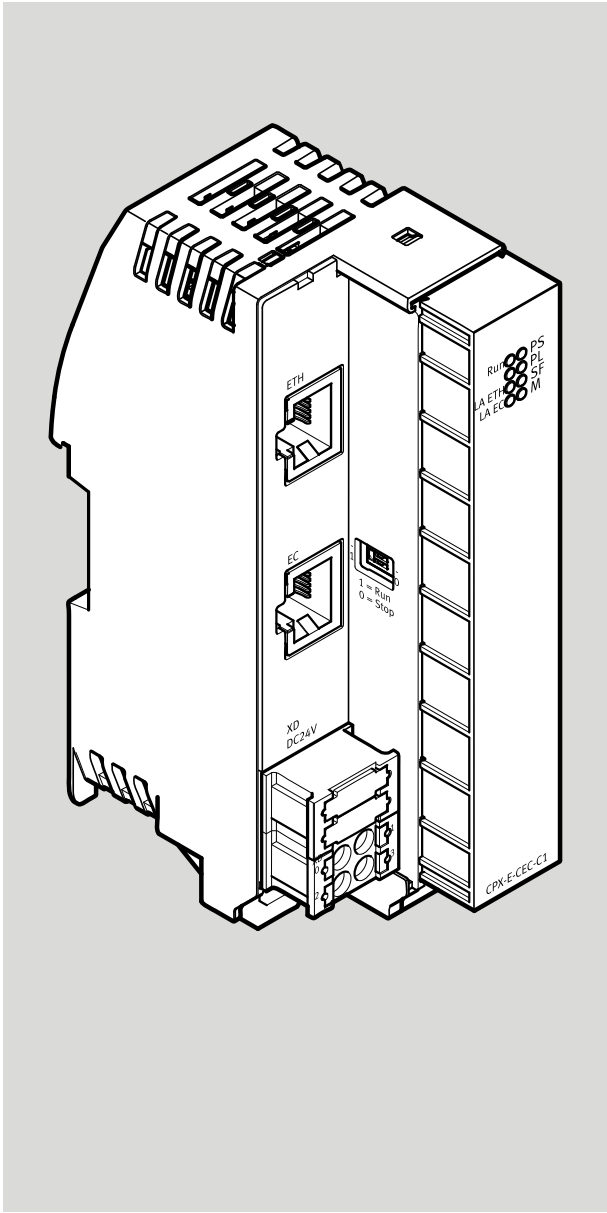


CPX-E-CEC-...
Controller



FESTO

Description | Function,
Parameterisation



8126523
2020-01a
[8126525]

Translation of the original instructions

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Table of contents

1	About this Document.....	4
1.1	Applicable documents.....	4
1.2	Target group.....	4
1.3	Product version.....	4
1.4	Product labelling.....	5
1.5	Specified standards.....	5
1.6	UL/CSA Certification.....	5
2	Function.....	7
2.1	General.....	7
2.1.1	Crossover detection (auto MDI/MDI-X).....	7
2.2	Internal address assignment.....	7
2.3	Product design.....	8
2.4	Display components.....	8
2.5	Control elements.....	9
2.5.1	Run/stop switch.....	9
2.6	Connecting components.....	9
2.6.1	Operating voltage supply.....	9
2.6.2	Network connections.....	10
2.7	Additional functions.....	10
2.7.1	FTP server.....	10
2.7.2	Web server.....	10
2.7.3	Temperature sensor.....	10
2.7.4	Real-time clock.....	10
2.8	Diagnostics options.....	11
2.8.1	LED indicators.....	11
2.8.2	Diagnostics via EtherCAT.....	13
2.8.2.1	Diagnostics history (object 0x10F3).....	14
2.8.2.2	Sample diagnostic message.....	15
2.8.2.3	Specifying the operating mode for diagnostic messages.....	16
2.8.2.4	Emergency message.....	16
2.8.3	Diagnostics via web server.....	19
3	Parameterisation.....	20
4	Technical Data.....	22
4.1	General Technical Data.....	22
4.2	Technical Data UL/CSA Certification.....	23

1 About this Document

This document describes the function and parameterisation of the product stated in the title. Safe use of the product is described in a separate document → 1.1 Applicable documents.

1.1 Applicable documents



All available documents for the product → www.festo.com/pk.

Document	Contents
Description of the automation system CPX-E (CPX-E-SYS)	Detailed description of the automation system CPX-E
Instruction manual for automation system CPX-E (CPX-E-SYS)	Instruction manual and important information on assembly, electrical installation and maintenance tasks for automation system CPX-E
Instructions for controller CPX-E-CEC-... (CPX-E-CEC-...)	Instruction manual and important information on the use and safe usage of the product
Documentation of the components in automation system CPX-E and the connected peripherals	Information on using the components
Online help for CODESYS V3	Detailed information on using the product with CODESYS V3 and the Festo extensions

Tab. 1 Applicable documents

1.2 Target group

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

1.3 Product version

This document refers to the following product versions:

Product	Programming	Version
CPX-E-CEC- C1	With CODESYS V3	Revision 1 and later
CPX-E-CEC- M1	With CODESYS V3 and SoftMotion	Revision 1 and later

Tab. 2 Product version

The product version can be identified from the product labelling or with the help of appropriate software from Festo.

i

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

i

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

1.4 Product labelling

The product labelling is located on the left-hand side of the module. Scanning the printed Data Matrix Code with an appropriate device opens the Festo Support Portal, with the information appropriate for the product. Alternatively, the Product Key (11-digit alphanumeric code on the product labelling) can be entered in the search field of the Support Portal ➔ www.festo.com/sp.

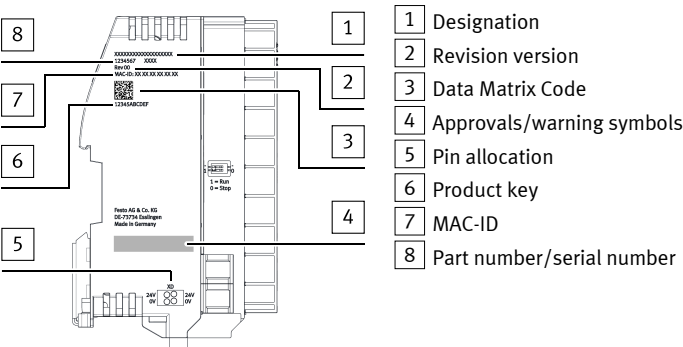


Fig. 1 Product labelling


1.5 Specified standards

Version status	
EN 60529:2013-10	IEC 60204-1:2014-10
EN 61000-6-2:2005-08	NE 21:2012-05
EN 61000-6-4:2007-01	–

Tab. 3 Standards specified in the document


1.6 UL/CSA 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	

Tab. 4 UL/CSA 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.
Observe 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.



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.



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 General

The product is intended for operation as a controller in an automation system CPX-E and can be programmed with CODESYS in accordance with IEC 61131-3. Communication with a PC via a network connection (Ethernet). Standard Ethernet (TCP/IP) and Modbus TCP are also supported.

2.1.1 Crossover detection (auto MDI/MDI-X)

The product supports crossover detection (auto MDI/MDI-X), which means that there is the option of using patch cables or crossover cables.



When using patch cables and crossover cables in the network, crossover detection must be activated in the higher-order controller.

2.2 Internal address assignment

In addition to the controller CPX-E-CEC, a maximum of 10 modules is permitted in one automation system CPX-E. The address space of an automation system CPX-E is limited. The controller provides the automation system CPX-E with a maximum address space of 64 bytes for inputs and 64 bytes for outputs.



The internal addresses for the inputs and outputs of the automation system CPX-E are assigned automatically.

Module	Address assignment
CPX-E-16DI...	2 byte inputs
CPX-E-8DO...	1 byte outputs
CPX-E-4AI-U-I...	8 byte inputs
CPX-E-4AO-U-I...	8 byte outputs
CPX-E-4IOL...	Max. 32 byte inputs and 32 byte outputs
CPX-E-1CI...	12 byte inputs and 2 byte outputs

Tab. 5 Internal address assignment

2.3 Product design

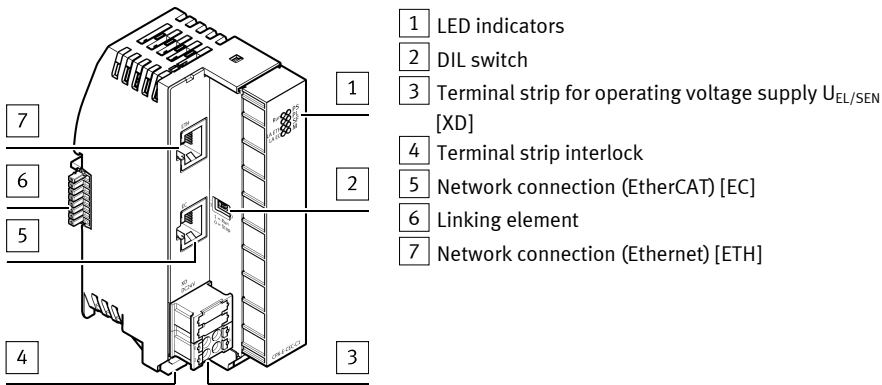


Fig. 2 Product design

2.4 Display components

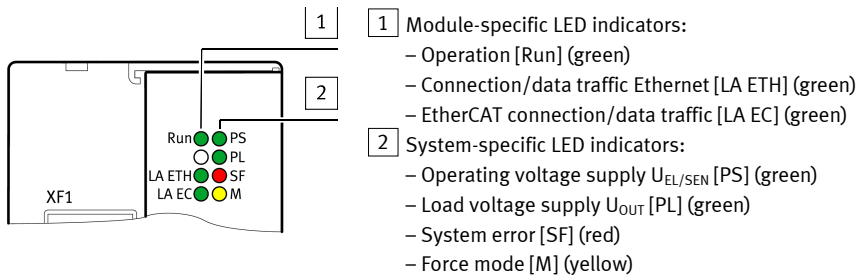


Fig. 3 LED indicators

2.5 Control elements

2.5.1 Run/stop switch

The run/stop switch (DIL switch) is located on the left side of the module.

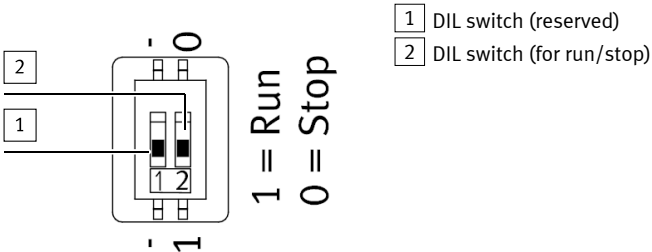


Fig. 4 Run/stop switch

Switch status	Function
Run (standard setting)	A project can be started using CODESYS (run mode active). A CODESYS boot application can be started.
Stop	A project cannot be started using CODESYS. A CODESYS boot application cannot be started.
Run → Stop	A project that is running will be stopped.
Stop → Run	A project that was stopped using the run/stop switch will be continued.

Tab. 6 Run/stop switch

2.6 Connecting components

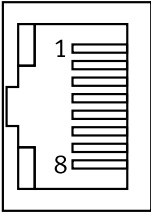
2.6.1 Operating voltage supply

Port [XD] 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) The ports XD.0 and XD.1 and also XD.2 and XD.3 are interconnected in the terminal strip.

Tab. 7 Operating voltage supply

2.6.2 Network connections

Connection [ETH], [EC]	Signal	
	1	TD+ Transmitted data +
	2	TD– Transmitted data –
	3	RD+ Received data +
	4	n.c. –
	5	n.c. –
	6	RD– Received data –
	7	n.c. –
	8	n.c. –
	1) ¹⁾	Shield Functional earth

1) Housing

Tab. 8 Connection [ETH], [EC]

Connection	Function
[ETH]	Ethernet interface for the connection of a programming device, PC or operating unit CDPX
[EC]	EtherCAT master

Tab. 9 Network connections

2.7 Additional functions

2.7.1 FTP server

The controller provides an FTP server.

Data can only be accessed via the directory: /mnt/ftp.

2.7.2 Web server

The integrated web server provides read access to the key parameters and diagnostic functions of the automation system CPX-E → 2.8.3 Diagnostics via web server.

2.7.3 Temperature sensor

The controller has a sensor to measure the internal temperature.

Reading the current temperature:

- via CODESYS using the function block "GetTemperature" → Festo_General_3 library
- via the web server of the controller – menu [System] [Information]
→ 2.8.3 Diagnostics via web server

2.7.4 Real-time clock

The controller has a real-time clock, which can be set or read with the aid of CODESYS function blocks:

- for run-time of CODESYS projects → CODESYS SysTimeRtc library
- in online mode with the aid of the PLC shell → CODESYS V3

2.8 Diagnostics options

The module supports various diagnostics options depending on the configuration and parameterisation of the automation system CPX-E.

Diagnostics option	Description	Detailed information
System-specific LED indicators	The system status and errors are displayed directly on the module via LED indicators.	→ Instruction manual and description of automation system CPX-E
Module-specific LED indicators	Information about CODESYS programs, Ethernet and EtherCAT connections is displayed on the module via the LED indicators.	→ Module-specific LED indicators
Festo software	Malfunctions or errors are displayed directly on a PC, meaning that diagnostics is also possible from a higher automation level.	→ Online help for software
EtherCAT	Diagnostics as part of the EtherCAT function via the network. Detailed module-related and channel-related error detection by means of control software.	→ 2.8.2 Diagnostics via EtherCAT
Web server	Diagnostics via web server	→ 2.8.3 Diagnostics via web server

Tab. 10 Diagnostics options



Further diagnostic options using CODESYS are explained in the online help for the CPX-E-CEC controller.



2.8.1 LED indicators






The module-specific LED indicators are described in this document.

The system-specific LED indicators are described in the documentation for the automation system CPX-E → 1.1 Applicable documents.


Module-specific LED indicators



Operation [Run]		
LED (green)	Meaning	Remedy
 Lit	CODESYS application is running	–
 Off	CODESYS application is not available or has stopped	–

Tab. 11 Operation [Run]

Ethernet interfaces [LA ETH]		
LED (green)	Meaning	Remedy
 Lit	Network connection established Status “Link”	–
 Flashing	Network connection established Status “Activity”	–
 Off	No network connection	Check network connection.

Tab. 12 Ethernet interfaces [LA ETH]

EtherCAT interface [LA EC]		
LED (green)	Meaning	Remedy
 Lit	Network connection established Status “Link”	–

EtherCAT interface [LA EC]		
LED (green)	Meaning	Remedy
 Flashing	Network connection established Status “Activity”	–
 Off	No network connection	Check network connection.

Tab. 13 EtherCAT interface [LA EC]

2.8.2 **Diagnostics via EtherCAT**

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The availability of diagnostic information via the EtherCAT network depends on the settings of the connected EtherCAT devices.

Diagnostics via SDO access

Diagnostic information can be requested from lower-order EtherCAT devices using SDO access.

Diagnostics via diagnostics history

The most recent diagnostic messages from lower-order EtherCAT devices can be displayed via the diagnostics object 0x10F3. An error message referenced with a code is displayed for every event (warning, error, information). A bus module CPX-E-EC, for example, provides 20 diagnostic messages. The diagnostic messages are converted via the ESI file and can then be evaluated by the CODESYS application.

2.8.2.1 Diagnostics history (object 0x10F3)

The diagnostic messages of the lower-order EtherCAT device are stored in the diagnostics history by the object 0x10F3.

Index (hex)	Subindex	Description	Data type	Values	Access ¹⁾
0x10F3	0	Diagnostics history	U8		RO
	1	Maximum messages	U8	20	RO
	2	Newest message	U8		RO
	3	Newest acknowledged message	U8		RW
	4	New message available	BOOL		RO P
	5	Flags	U16	0x0000	RW
	6 ... 70	Subindex 006 ... 070	BYTE [23]		RO

1) RO = read only; RW = read/write; RO P = read only (PDO mappable)

Tab. 14 Structure of diagnostics object 0x10F3

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To simplify diagnostics evaluation, the controller offers the option of having the presence of a new diagnostic message evaluated by the process data. To do this, the object “New message available” can optionally be mapped to the process data. This is done via diagnostics object 0x10F3 (sub-index 4).

2.8.2.2 Sample diagnostic message

Diagnostic message							
02 00 00 E1	02 02	02 37	1F C5 9D 61 31 00 00 00	05 00	02	05 00	80
1	2	3	4	5	6	7	8

Tab. 15 Diagnostic message (sample)

The individual values of the diagnostic message are explained below.

Designation ¹⁾		Value from example (hex)	Explanation
1	Diag Code	02 00 00 E1	CPX error number (2 = short circuit) ²⁾ E1 = CPX-E error number E8 = error code to DS401
2	Flags	02 02	Number of parameters in the diagnostic message (2) and diagnostics type 2 (error message)
3	Text-ID	02 37	Reference to ESI file with the clear text of the diagnostic message (<TextId>#x3702)
4	Time stamp	1F C5 9D 61 31 00 00 00	Local time stamp (time since controller start)
5	Flag parameter 1	05 00	Type of parameter 1 (UNSIGNED8)
6	Parameter 1	02	CPX module number
7	Flag parameter 2	05 00	Type of parameter 2 (UNSIGNED8)
8	Parameter 2	80	Channel 80 _h (channel 128 _d)

1) in accordance with ETG.1020

2) ➔ "Description of automation system CPX-E"

Tab. 16 Values of diagnostic message

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The text IDs 3700_h ... 37FF_h correspond with the CPX error numbers (0 ... 255). Further information is available in the "Description of the automation system CPX-E" ➔ 1.1 Applicable documents.

In addition to the CPX-specific text-IDs, the ESI file also includes EtherCAT-specific text-IDs.

Text-ID (hex)	Clear text (German)	Clear text (English)
3800	Identification check failed for configured module	Identification check failed for configured module
3801	Identification check skipped – PLC has not written to Object 0xF030	Identification check skipped – PLC has not written to Object 0xF030
000F	Calculate bus cycle time failed (local timer too slow)	Calculate bus cycle time failed (local timer too slow)
0011	Sync Manager invalid address	Sync Manager invalid address
0012	Sync Manager invalid size	Sync Manager invalid size
0013	Sync Manager invalid settings	Sync Manager invalid settings

Tab. 17 EtherCAT-specific text-IDs from ESI file

The diagnostic message are written to a buffer (80 bytes).

2.8.2.3 Specifying the operating mode for diagnostic messages

2 operating modes are available for processing diagnostic messages:

- Overwrite mode:
When the number of diagnostic messages reaches 20, old diagnostic messages are overwritten.
- Acknowledge mode:
A diagnostic message must first be acknowledged before it can be overwritten with a new diagnostic message. When the number of unacknowledged diagnostic messages reaches 20, new diagnostic messages will not be saved and will be lost.

The operating mode for diagnostic messages can be read and written using diagnostics object 0x10F3 (Subindex 5, Bit 4).

Operating mode	Value of bit 4
Overwrite mode	0
Acknowledge mode	1

Tab. 18 Specifying the operating mode for diagnostic message

2.8.2.4 Emergency message

The EtherCAT devices send an emergency message when an error occurs. The emergency message can be activated and deactivated using the diagnostics object 0x10F3 (sub-index 5, bit 0).

Emergency message	Value of bit 0
Deactivate	0
Activate	1

Tab. 19 Deactivating/activating emergency message

Structure of emergency message

Byte 0 ... 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Error code ¹⁾	Error register	Status bits	CPX module number	CPX error number	Reserved	Additional error information ²⁾
	Index 1001	Index 1002 (Manufacturer Status Register) ²⁾				

1) in accordance with DS301/DS401

2) device-typical error messages

Tab. 20 Structure of emergency message

Emergency message – error code (byte 1, byte 0)

Byte 1	Byte 0	Explanation
00	00	No error
10	00	General errors
23	20	Short circuit at the outputs
23	30	Load dump (wire break)
31	20	Input voltage too low
33	20	Output voltage too low
50	00	Hardware error (all errors > 128)

Tab. 21 Emergency message – error code (byte 1, byte 0)

Emergency message – error register (byte 2)

Bit	Meaning	Explanation
0	Generic error	Bit is set for each error
1	Current	Short circuit/overload in sensor supply (SCS) Short circuit/overload at outputs (SCO)
2	Voltage	Undervoltage at outputs (U_{OUT}) Load voltage failure at output module or input module
3	–	–
4	Communication error	Node guard, heartbeat, fieldbus-specific only
5 ... 6	–	–
7	Manufacturer specific	Wire break, other error

Tab. 22 Emergency message – error register (byte 2)

Emergency message – status bits (byte 3)

Bit	Meaning	Explanation
0	Error at valve	Module type in which the error has occurred
1	Error at output	
2	Error at input	
3	Error at analogue or function module	
4	Undervoltage	Type of error
5	Short circuit/overload	
6	Wire break	
7	Other error	

Tab. 23 Emergency message – status bits (byte 3)

Emergency message – CPX module number(byte 4)

Bit	Meaning	Explanation
0 ... 7	CPX module number	Number of the module with diagnostic message

Tab. 24 Emergency message – CPX module number(byte 4)

Emergency message – CPX error number (byte 5)

Bit	Meaning	Explanation
0 ... 7	CPX error number	CPX error number ¹⁾

1) → "Description of automation system CPX-E"

Tab. 25 Emergency message – CPX error number (byte 5)

Emergency message – additional error information (byte 7)

Bit	Meaning	Explanation
0 ... 7	Additional error information	For example: <ul style="list-style-type: none">– Node ID with heartbeat error (which participant has caused the timeout?)– Channel number of the first channel with error

Tab. 26 Emergency message – additional error information (byte 7)

2.8.3 Diagnostics via web server



Diagnostics via the web server can affect the real-time response of the CODESYS application.

- 1. Connect PC to controller via the network.
- 2. Adjusts network settings.
- 3. Open the IP address of the controller in a web browser.



IP address of controller: 192.168.0.1 (factory setting)

The IP address of the controller can be read from the controller using suitable software → CODESYS – scan Festo devices or → Festo Field Device Tool (FFT).

CPX-E-CEC-M1 CPX ▾ System ▾ Codesys ▾

FESTO

Terminal

Modules

Slot	Module	Revision	Serial	Diagnosis
0	E-CEC-M1	1	1F110376	OK
1	E-4AI-U-I	2	DD2F3738	OK
2	E-4AO-U-I	1	DD326368	OK
3	E-16DI	1	DD2EA891	OK
4	E-8DO	1	00000000	OK

I/O

Input Image

0 1 2 3 4 5 6 7 8 9

E-4AI-U-I

E-16DI

Output Image

0 1 2 3 4 5 6 7 8

E-4AO-U-I

E-8DO

Fig. 5 Web server

The following pages are available:

CPX

Terminal

- Module configuration of the automation system CPX-E
- Module addressing of the automation system CPX-E

CI (Communication Interface)

- Execute commands from the CPX-E-CEC

System

- Diagnostics information
- Information about the controller and current parameters
- Information about the controller manufacturer

CODESYS

- Information on the CODESYS licence for the controller

3 Parameterisation

The behaviour of the automation system CPX-E can be set using the following parameters:

- System parameters
- Diagnostic memory parameters
- System bus parameters



You can find a detailed description of the individual parameters in the "Description of the automation system CPX-E" and in the descriptions of the corresponding modules ➔ 1.1 Applicable documents.

Parameter	Description/setting options
System parameter (CPX-E)	
Filter alarm U_{off}/U_{ven}	You can find detailed information in the "Description of the automation system CPX-E" → 1.1 Applicable documents. – SCS = Short circuit/overload in sensor supply – SCO = Short circuit/overload at outputs – SCV = Short circuit/overload at the valves
SCS monitoring	
SCO monitoring	
Undervoltage monitoring U_{off}	
Undervoltage monitoring U_{ven}	
SCV monitoring	
Analogue process data format	Intel/Motorola
Diagnostic memory parameters (trace parameters)	
Entries saved retentively with Power On	You can find detailed information in the "Description of the automation system CPX-E" → 1.1 Applicable documents.
Run/stop filter 1	
Run/stop filter 2	
Error end filter	
Error number filter	
Module/channel filter	
Module number	
Channel number	
Error number	
System bus parameters (CPX-E)	
Synchronisation	Synchronisation with cycle time of CODESYS application (MainTask) Detailed information can be found in the "Online help" → 1.1 Applicable documents.

Tab. 27 Parameter



Detailed information on parameterisation can be found in the online help for CODESYS V3.

- Observe the notes on installing CODESYS V3 in the "Instruction manual for the automation system CPX-E" → 1.1 Applicable documents.

4 Technical Data

4.1 General Technical Data

General technical data	
General technical data Automation system CPX-E	Description of automation system CPX-E → 1.1 Applicable documents
Dimensions [mm] (length × width × height) ¹⁾	125.8 × 37.8 × 76.5
Product weight ²⁾ [g]	145
Mounting position	Vertical/horizontal
Ambient temperature [°C] with vertical mounting position	–5 ... +60 ³⁾
Ambient temperature [°C] with horizontal mounting position	–5 ... +50 ³⁾
Storage temperature [°C]	–20 ... +70
Humidity [%] (non-condensing)	0 ... 95
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)	through the use of PELV circuits (protected extra-low voltage)
Electromagnetic compatibility	To EN 61000-6-2/-4 and NE 21
Module code/sub-module code	
CPX-E-CEC-C1	222/106
CPX-E-CEC-M1	222/107
Module identification	
CPX-E-CEC-C1	E-CEC-C1
CPX-E-CEC-M1	E-CEC-M1

1) not including linking element

2) Including linking element

3) for non-conforming technical data see UL operating conditions table UL

Tab. 28 General Technical Data

Power supply		
Operating power supply $U_{EL/SEN}$	[V DC]	24 ± 25%
Intrinsic current consumption at nominal operating voltage 24 V from $U_{EL/SEN}$	[mA]	Typ. 65
Reverse polarity protection 24 V $U_{EL/SEN}$ against 0 V $U_{EL/SEN}$		Yes
Mains buffering time	[ms]	20

Tab. 29 Power Supply

Network-specific data		
Protocol		EtherCAT
Transmission rate	[Mbps]	100
Crossover detection		Auto-MDI/MDI-X
Maximum cable length per segment	[m]	100
Cable specification		
Cable type		Ethernet twisted pair cable, shielded
Transmission class		Category Cat 5 or higher
Cable diameter	[mm]	6 ... 8
Wire cross section	[mm²]	0.140.75; 22 AWG ¹⁾

1) required for maximum connection length between network participants

Tab. 30 Network-specific Data

4.2 Technical Data UL/CSA Certification

Ambient conditions UL/CSA		
Pollution degree		3
Installation site		for indoor use only
Max. installation height	[m]	2000

Tab. 31 Ambient Conditions UL/CSA

Ambient temperature		
Mounting position	Vertical	Horizontal
Operating power supply U _{EL/SEN} via XD		
Ambient temperature, max. current rating of [°C] terminal strip ≤ 4 A	-5 ... +60	-5 ... +50
Ambient temperature, max. current rating of [°C] terminal strip > 4 ... 8 A	-5 ... +50	-5 ... +40
Operating voltage U _{EL/SEN} with feed via both connections [XD] ¹⁾		
Ambient temperature, max. current rating of [°C] terminal strip > 4 ... 8 A	-5 ... +60	-5 ... +50

1) see chapter 'Product design' or 'Connection elements'

Tab. 32 Ambient temperature ranges

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