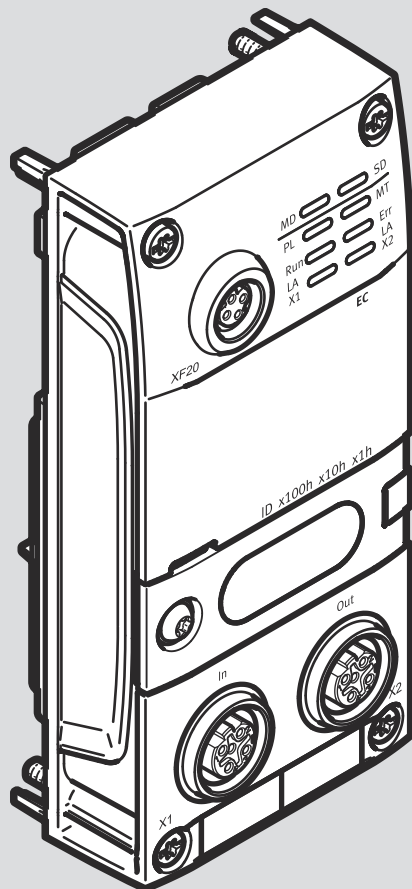


CPX-AP-A-EC-M12

EtherCAT interface

FESTO

Operating instruction



8235741

8235741
2025-05c
[8235743]

Original instructions

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1 About this document

1.1 Applicable documents



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

Document	Content
Operating instructions remote I/O system CPX-AP-A	Instruction manual and important information on the assembly, electrical installation and maintenance tasks and also description of the remote I/O system CPX-AP-A

Tab. 1: Applicable documents

1.2 Product version

This document refers to the following product versions:

Product	Version
CPX-AP-A-EC	From revision 1

Tab. 2: Product version

The product version can be determined from the product labelling.



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

1.3 Product labelling

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

1.4 Specified standards

Version	
IEC 60204-1:2016-10	IEC 61784:2014-08
IEC 60364-4-41:2005-12	IEC 61918:2018-09
IEC 61158:2014-07	ISO/IEC 8802-3:2021-02

Tab. 3: Standards specified in the document

2 Safety

2.1 Safety instructions

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

2.2 Intended use

The EtherCAT interface is intended for use as an interface between a remote I/O system CPX-AP-A and a higher-order controller by integration into a EtherCAT network.

Use the product as follows:

- Use only in an industrial environment. Outside industrial environments, e.g. in commercial and residential/mixed-use areas, it may be necessary to take measures to suppress radio interference.
- Use only in combination with modules and components that are approved for the applicable product variant → www.festo.com/catalogue.

2.3 Training of qualified personnel

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

2.4 Cyber security measures

Accidental or improper execution of functions on the product can lead to failure or malfunction of the product and thus the entire connected system. In addition, unauthorised access to information stored on the product may be possible. The system operator must therefore take appropriate measures to prevent accidental or improper access to the product. Cyber security information → www.festo.com/psirt.

Access with Festo service tools

The following table shows the device functions and the ports used for the specific device function.

Function	Description	Port	Operation
Search	The device can be found on the network using a search protocol.	990 (UDP) 10002 (UDP/MULTI-CAST)	☒
Network	The device supports the display and setting of the network parameters.	990 (UDP) 10002 (UDP/MULTI-CAST)	☐
Firmware	The device supports the download of a new firmware version.	7508 (TCP) 10002 (UDP/MULTI-CAST)	☐
Homepage	The device provides an information page for Internet browsers. In addition, after entering the user and password, it enables changes to parameters in the system, firmware updates, switching services on/off.	80 (TCP)	☒
FAS	The device supports the current version of the "Festo Automation Suite" application as well as the parameterisation and diagnostics of CPX-AP with FAS.	7508 (TCP)	☒
Identification	The device supports the prompt for identification (for example, a flashing LED).	7508 (TCP) 10002 (UDP/MULTI-CAST)	☒
Repair	The device can be repaired after an aborted or faulty firmware update.	10002 (UDP/MULTI-CAST)	☐
Reboot	The device can be restarted.	7508 (TCP) 10002 (UDP/MULTI-CAST)	☐
☐ To avoid potential damage to the system do not perform the function during operation. ☒ The function can be executed during operation.			

Tab. 4: Functions available via the protocols used by Festo service tools

3 Additional information

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

4 Product overview

4.1 Product design

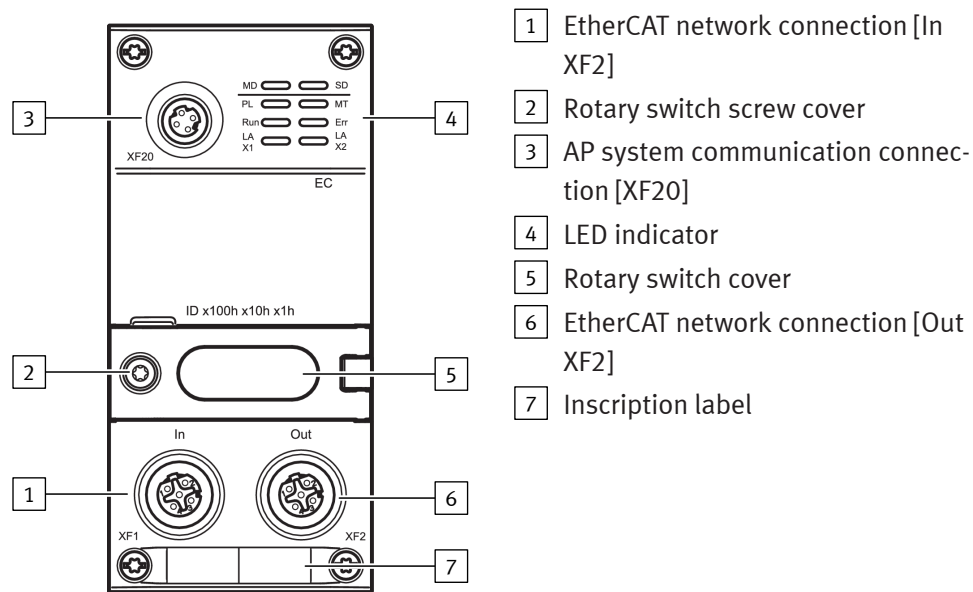


Fig. 1: Product design

4.2 LED indicators

	LED	Meaning
	MD	Module diagnostics [MD] (green, red)
	PL	Load supply [PL] (green, red)
	Run	EtherCAT operating status [RUN] (green)
	LA X1	Network connection [LA X1] (green)
	SD	System diagnostics [SD] (green/red)
	MT	Maintenance [MT] (yellow)
	Err	EtherCAT error [ERR] (red)
	LA X2	Network connection [LA X2] (green)

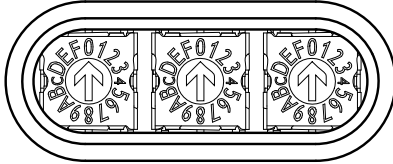
Tab. 5: LED indicators

4.3 Control elements

NOTICE

Damage to internal electronics.
Damage to at-risk components due to electrostatic discharge.

- Ensure your body is electrostatically discharged before activating the rotary switch.

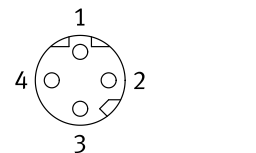
Rotary switches	Function
IDx100hx10hx1h 	The 3 rotary switches are used to set the EtherCAT "Explicit Device ID" of the interface in hexadecimal code. Available settings: – 0 = stored EtherCAT address, no "Explicit Device ID" assigned – 1 ... 4094 (1h ... fffh) = permissible address range – 4095 (0xFFF) = reset to factory settings (including web server password) If set to 0, the address of the interface is automatically assigned by the MainDevice master (autoincrement). Factory setting: 0

Tab. 6: Rotary switches

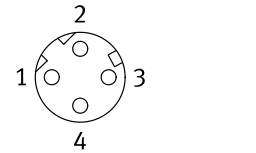


Changes to the rotary switches only take effect following a restart of the interface.

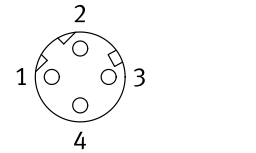
4.4 Connecting elements

Connection for system communication [XF20]			
Socket M8, 4-pin, D-coded		Signal	
	1	RX–	Received data –
	2	TX+	Transmitted data +
	3	RX+	Received data +
	4	TX–	Transmitted data –

Tab. 7: Connection for system communication

Connection for EtherCAT network [IN XF1]			
Socket M12, 4-pin, D-coded		Signal	
	1	TD+	Transmitted data +
	2	RD+	Received data +
	3	TD–	Transmitted data –
	4	RD–	Received data –
	Thread	Shield	Functional earth FE

Tab. 8: Connection for EtherCAT network [IN XF1]

Connection for EtherCAT network [OUT XF2]			
Socket M12, 4-pin, D-coded		Signal	
	1	RD+	Received data +
	2	TD+	Transmitted data +
	3	RD–	Received data –
	4	TD–	Transmitted data –
	Thread	Shield	Functional earth FE

Tab. 9: Connection for EtherCAT network [OUT XF2]

5 Function

The product, installed as a device in a EtherCAT network, establishes the connection between a higher-order controller and the modules in a remote I/O system CPX-AP.

Device description file

A device description file (ESI file) is used for project engineering in the EtherCAT interface of the higher-order controller software. It includes all required information for parameterisation of the remote I/O system CPX-AP-A via controller software.



The device description file is available at the Festo Support Portal
→ www.festo.com/sp.

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.

Web server

The integrated web server provides read and write access to the most important parameters and diagnostics functions of the remote I/O system CPX-AP.

Functions of the web server:

- Parameterisation of the modules in the remote I/O system CPX-AP
- Display of diagnostic messages
- Display of system properties
- Downloading a device description file (ESI file)
- Exporting the changed startup parameters for TwinCAT
- Management of the stored parameters
- Update of the Firmware

The web server can be accessed by entering the IP address in the address bar of a web browser.



Registration data:

- User: admin
 - Password: Product Key → product label on the interface housing
- The login data can be changed after the first login.

Distributed clocks

The product supports the "Distributed Clocks" function for precise synchronisation of stations in an EtherCAT network. Applications that require simultaneously coordinated actions can therefore be implemented.

6 Mounting

- Carry out assembly in accordance with the "Operating Instructions remote I/O system CPX-AP-A" → 1.1 Applicable documents.

7 Installation

- Carry out installation in accordance with the "Operating Instructions remote I/O system CPX-AP-A" → 1.1 Applicable documents.
- EtherCAT Use network cables as described in the cable specification → 12 Technical data.

7.1 Connecting cables**⚠ WARNING****Risk of injury due to electric shock.**

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

1. Switch off the power supply.

2. Use a suitable torque screwdriver with socket to tighten union nuts.
 - For example, use PHOENIX CONTACT SAC BIT M8-D10 with a tightening torque of $0.4 \text{ Nm} \pm 15\%$ for M8. Different from the information for connecting cables.
 - For example, use PHOENIX CONTACT SAC BIT M12-D15 with a tightening torque of $0.6 \text{ Nm} \pm 10\%$ for M12. Different from the information for connecting cables.
3. Close the unused connections with cover caps to ensure IP protection.

8 Commissioning

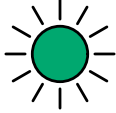
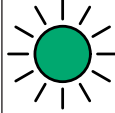
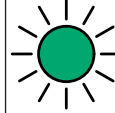
NOTICE

Unauthorised Access to the Device Can Cause Damage or Malfunction.

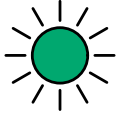
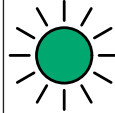
- When connecting the device to a network, protect the network from unauthorised access.
Standards for security in information technology can be used for network protection measures, e.g. IEC 62443, ISO/IEC 27001.

1. Set up an automation project for the higher-order controller using suitable software.
2. Load the device description file into the software → www.festo.com/sp.
3. Configure the remote I/O system CPX-AP in the software:
 - System structure
 - Network addressing
 - Address assignment of the modules → Instructions remote I/O system CPX-AP
4. Upload the automation project to the higher-order controller.

Response of the display components of the module after error-free commissioning

[MD]	[SD]	[PL]	[MT]
			
Green light	Green light	Green light	Off

Tab. 10: Response of the display components after error-free commissioning

[LA X1], [LA X2]	[RUN]	[ERR]
		
Green light	Green light	Off

Tab. 11: Response of the display components after error-free commissioning



Information on troubleshooting in the event of different response:

- 1.1 Applicable documents
- 11 Diagnostics

9 Parameterisation

Various parameters are available for reading out information about the modules in a remote I/O system CPX-AP-A and for configuring the modules for the application. Every configured or connected module also provides some of its parameters as network parameters. They are then displayed in objects 0x2000 ... 0x2FFF.

Parameters

ID	Parameters	Number of instances ¹⁾	Data type	Access ²⁾	Array size
246	Fieldbus serial number	1	UINT32	ro	–
791	Product Key	1	CHAR	ro	12
960	Firmware version	1	CHAR	ro	30
20000	Module code	1	UINT32	ro	–
20022	Configuration for load supply PL voltage monitoring – 0: load voltage monitoring inactive – 1: load voltage monitoring active, with suppression of diagnostics at switch-off (factory setting) – 2: load voltage monitoring active	1	UINT8	rw	–
20085	Measured value of temperature AP-ASIC [°C]	1	INT16	ro	–
20087	Current measured value of logic supply PS [mV]	1	UINT16	ro	–
20088	Current measured value of load supply PL [mV]	1	UINT16	ro	–
20092	Operating time [s]	1	UINT32	ro	–
20093	Hardware version	1	UINT8	ro	–
20196	Diagnostics status – Index 0: diagnostics status of the entire remote I/O system CPX-AP – Index 1: diagnostics status of module 1 (address 1) – Index 2: diagnostics status of module 2 (address 2) – ... Every entry is of the data type UINT8 with the following meaning: – Bit 0: degree of severity information (1) – Bit 1: degree of severity maintenance (1) – Bit 2: degree of severity warning (1) – Bit 3: degree of severity error (1) – Bit 4, 5: reserved – Bit 6: module present (1), module lost (0) – Bit 7: reserved Bit 6 is not valid for index 0.	1	UINT8	ro	Number of modules + 1
1130125	Bootloader version	1	CHAR	ro	30

1) Counting starting at 0.

2) ro = read only; rw = read write

Tab. 12: Parameters

10 EtherCAT®



The following sections contain information for display of the remote I/O system CPX-AP within the EtherCAT object model. Many of the terms shown are the original English terms of the protocol specification and are used for clarity in any language.

10.1 EtherCAT General Objects

EtherCAT general objects

Index	Sub-index	Description	Data type	Access ¹⁾	Value
0x1000	0	Device type	U32	ro	Bit 0 ...15: device profile used Bit 16 ...31: further information on the device profile used
0x1001	0	Error register	U32	ro	Bit 0: generic error Bit 1: current error Bit 2: Voltage error Bit 3: temperature error Bit 4: communication error Bit 5: device-profile-specific error Bit 6: reserved Bit 7: manufacturer-specific error
0x1008	0	Device name	VISIBLE_STRING	ro	Module identification ➔ 12 Technical data
0x1009	0	Hardware version	VISIBLE_STRING	ro	
0x100A	0	Software version	VISIBLE_STRING	ro	
Identity object 0x1018					
0x1018	0	Number of entries	U8	ro	4
	1	Vendor ID	U32	ro	0x0000001D
	2	Product code	U32	ro	Module code ➔ 12 Technical data
	3	Revision number	U32	ro	
	4	Serial number	U32	ro	
Error settings object 0x10F1					
0x10F1	0	Number of entries	U8	ro	2
	1	Local error reaction	U32	rw	0 = PDO status 1 = deactivate SyncManager 2 = device-specific status
	2	Sync error counter limit	U16	rw	
Diagnosis history object 0x10F3					
0x10F3	0	Number of entries	U8	ro	5 ... 255
	1	Maximum messages	U8	rw	250
	2	Newest message	U8	ro	Subindex of latest message (6 ... 255) Factory setting = 0
	3	Newest acknowledged message	U8	rw	Factory setting = 0
	4	New messages available	BOOL	ro p	Overwrite Mode: 0 = latest message read 1 = latest message not read Acknowledge Mode: 0 = no acknowledgeable messages available 1 = acknowledgeable messages available

Index	Sub-index	Description	Data type	Access ¹⁾	Value
0x10F3	5	Flags	U16	rw	Bit 0: send from Emergency messages 0 = do not send messages as Emergency message (factory setting) 1 = send messages as Emergency message
					Bit 1: information messages 0 = store information messages in diagnostics memory (factory setting) 1 = do not store information messages in the diagnostics memory
					Bit 2: warning messages 0 = store warning messages in diagnostics memory (factory setting) 1 = do not store warning messages in the diagnostics memory
					Bit 3: error messages 0 = store error messages in diagnostics memory (factory setting) 1 = do not store error messages in the diagnostics memory
					Bit 4: operating mode 0 = overwrite mode 1 = Acknowledge Mode
					Bit 5: Overwrite/Discard Information Overwrite mode: 1 = overwrite unacknowledged messages Acknowledge Mode: 1 = discard new messages if diagnostics memory full with unacknowledged messages
	6 ... 255	Diagnosis message	OCTET_STRING	ro	Bit 6 ... 15: reserved Diagnostics message 1 ... Diagnostics message 250 Diagnosis message is described in ➔ Diagnosis Message
Timestamp object (0x10F8)					
0x10F8	0	Timestamp object	U64	ro p	Specified in [ns]
Receive PDO Mapping (0x1600 ... 0x17FF)					
0x1600 ... 0x17FF	0	Number of objects in this PDO	U8	rw	0 ... 254
	1	First output object to be mapped	U32	rw	Bit 0 ... 7: length of the object Bit 8 ... 15: subindex of the object Bit 16 ... 31: index of the object
	...	...	...	...	
	n	Last output object to be mapped	U32	rw	

Index	Sub-index	Description	Data type	Access ¹⁾	Value
Transmit PDO Mapping (0x1A00 ... 0x1BFF)					
0x1A00 ... 0x1BFF	0	Number of objects in this PDO	U8	rw	0 ... 254
	1	First input object to be mapped	U32	rw	Bit 0 ... 7: length of the object Bit 8 ... 15: subindex of the object Bit 16 ... 31: index of the object
	...	...	...	...	
	n	Last input object to be mapped	U32	rw	
Sync Manager Communication Type (0x1C00)					
0x1C00	0	Number of used Sync Manager channels	U8	ro	4
	1	Communication type Sync Manager 0	U8	ro	0 = not used 1 = receive mailbox 2 = send mailbox 3 = process data output 4 = process data input
	2	Communication type Sync Manager 1	U8	ro	
	3	Communication type Sync Manager 2	U8	ro	
	4	Communication type Sync Manager 3	U8	ro	
Sync Manager PDO Assignment (0x1C12 ... 0x1C13)					
0x1C12 ... 0x1C13	0	Number of assigned [RT] x PDOs	U8	rw	0 ... 254
	1 ... n	PDO mapping object index of assigned PDO	U16	rw	0x1600: RxPDO 1 0x1601: RxPDO 2 ... 0x17FF: RxPDO 512 or: 0x1A00: TxPDO 1 0x1A01: TxPDO 2 ... 0x1BFF: TxPDO 512
Sync Manager Synchronization (0x1C32 ... 0x1C33)					
0x1C32 ... 0x1C33	0	Number of syn-chronization parameters	U8	ro	0 ... 3
	1	Synchronization type	U16	rw	0: not synchronised 1: synchronized 2: DC Sync0 3: DC Sync1 32: SyncSm0 33: SyncSm1 ... 63: SyncSm31
	2	Cycle time	U32	rw	Specified in [ns]
	3	Shift time	U32	rw	Specified in [ns]

1) ro = read only; rw = read write; ro p = read only (PDO mappable)

Tab. 13: EtherCAT General Objects

Diagnosis Message

Parameter	Data Type	USEw	Description	
Diag Code	UNSIGNED32	M	Diagnosis code to identify the diagnosis message	
			Bit 0-15 = 0x0000-0xDFFF	not used
			Bit 0-15 = 0xE000-0xE7FF	Bit 16-31: Used to map the ICP error codes
			Bit 0-15 = 0xE800	Bit 16-31: Emergency Error Code as defined in DS301 or DS4xxx
			Bit 0-15 = 0xE801-0xEDFF	reserved for future standardization
			Bit 0-15 = 0xEE00-0xEFFF	Bit 16-31: Profile specific
			Bit 0-15 = 0xF000-0xFFFF	not used
Flags	UNSIGNED16	M	Bit 0-3	Diag type: 0: Info message 1: Warning message 2: Error message
			Bit 4	Time Stamp is a local time stamp, the global time stamp can be calculated by reading the actual time stamp (object 0x10F8) and calculating the age of the message
			Bit 5-7	reserved
			Bit 8-15	Number of parameters in this Diagnosis Message
Text ID	UNSIGNED16	M	Text ID as reference to Diagnosis text as defined in the ESI file	
			0	no Text ID
			1-65535	Text ID reference to ESI file Text ID shall be unique in combination with VendorID, Product Code, Revision Number In CPX-AP the unique 16bit number of ICP is used. 
Time Stamp	UNSIGNED64	M	Time Stamp in ns (from the DC unit) Or local time stamp (object 0x10F8) if DCs are not supported or DC are only supported in 32 bit mode	
			0	no time stamp

Parameter	Data Type	USEw	Description	
Time Stamp	UNSIGNED64	M	≪0	time stamp
Flags Parameter 1	UNSIGNED16	0	Describes the type of Parameter 1 If the postfix “:n” is append to the specifier, the parameter value will be added to the message in the specified order (based on the “n”-value). “n” is an unsigned integer.	
			Bit 12-15 = 0	Bit 0-11 = Data type Index of the data type of parameter 1
			Bit 12-15 = 1	Bit 0-11 = size of BYTE-Array in bytes, parameter 1 is a BYTE-Array shall be used for following Data Type: OCTET_STRING (index: 0x00A), specifier %s
			Bit 12-15 = 2	Bit 0-11 = size of ASCII-String (with- outending 0) in bytes, parameter 1 is an ASCII-string shall be used for following Data Type: VISIBLE_STRING (index: 0x009), specifier %s
			Bit 12-15 = 3	Bit 0-11 = size of Uni-Code-String in bytes, parameter 1 is an Uni-Code-string shall be used for following Data Type: UNICODE_STRING (index: 0x00B), specifier %s
			Bit 12-15 = 4	Bit 0-11 = 2 (size of parameter 1 in bytes), parameter 1 number of TextID as referenced in ESI specifier %s
			Bit 12-15 = 5-15	reserved
Parameter 1	depend on Flags Parameter 1	C	value of parameter 1 (Mandatory if Flags Parameter 1 exist)	
Flags Parameter 2	UNSIGNED16	0	see flags parameter 1	

Tab. 14

AP Parameter Access (0x27F0)

Subindex	Datatype	Acces	Description
0	UNSIGNED8	ro	Number of Subindexes (7)
1	UNSIGNED8	rw	Direction 0 = Read 1 = Write Write to this subindex issue data transfer

Subindex	Datatype	Access	Description
2	UNSIGNED16	rw	Module No (Starting at 1)
3	UNSIGNED32	rw	AP Parameter Id
4	UNSIGNED16	rw	AP Parameter Instance
5	UNSIGNED16	ro	Status / Error 0 = Ok 0xFFFF = busy all others = error
6	UNSIGNED16	rw	Length of data
7	ARRAY OF BYTE [512]	rw	Data

Tab. 15: AP Parameter Access (0x27F0)

Stored Parameter NV (0x27F1)

Subindex	Datatype	Access	Description
0	UNSIGNED8	ro	Number of Subindexes (3)
1	UNSIGNED8	rw	Mode 0 = Delete without parameter change 1 = Store / update stored parameter 2 = Delete with restore parameters to default
2	BOOL	ro	Loaded (Successfully Loaded Startup Parameters)
3	UNSIGNED8	ro	Used Memory (Percent) (0 if not used)

Tab. 16: Stored Parameter NV (0x27F1)

Device FSoE SubInstance address (0xF980)

This object is available if at least one safety module is found in the system. It contains the safety device address of the first module only.

Subindex	Data type	Description/value
1	UNSIGNED16	Safety address of first safety module in system

Tab. 17: Device FSoE SubInstance address (0xF980)

10.2 EtherCAT Modular Device Profile

EtherCAT modular device profile

Index	Description	Value
0x2000 ... 0x2FFF	Manufacturer specific area	Network parameters of the respective modules based on the APDD
0x6000 ... 0x6FFF	Input data object area	Input objects (TxPDOs)
0x7000 ... 0x7FFF	Output data object area	Output objects (RxPDOs)
0x9000 ... 0x9FFF	Information data object area	Module information → Information data object area (0x9000 ... 0x9FFF)
0xF000	Modular device profile object	
0xF030 ... 0xF03F	Configured module ident list	
0xF050 ... 0xF05F	Detected module ident list	

Tab. 18: EtherCAT Modular Device Profile

Object Area of the Module Parameter (0x2000-0x2FFF)

ISDU Access (0x2xx1)

The fieldbus parameter of an attached module are mapped into this area and are created based on the APDD. For compatible reasons the order is fixed and well defined. The index distance is 0x10 (0x2xx0).

Only IO Link-Modules.

Subindex	Datatype	Description
0	UNSIGNED8	Number of Subindexes (7)
1	UNSIGNED8	Direction 0 = Read 1 = Write Write to this subindex issue data transfer
2	UNSIGNED8	Channel (Start at 0)
3	UNSIGNED16	ISDU Index from IO-Link device
4	UNSIGNED8	ISDU Subindex from IO-Link device
5	UNSIGNED16	ISDU Error
6	UNSIGNED8	Length of data
7	ARRAY OF BYTE	Data

Tab. 19: ISDU Access (0x2xx1)

Information data object area (0x9000 ... 0x9FFF)

Index	Sub-index	Description	Data type	Access ¹⁾	Value
0x9000 ... 0x9FFF	1	Address of the module	U16	ro	Module address
	2	Type string	VISIBLE_STRING	ro	Module description
	3	Name string	VISIBLE_STRING	ro	Module name
	4	Device type	U32	ro	Type of equipment
	5	Vendor ID	U32	ro	Manufacturer ID
	6	Product code	U32	ro	Product code
	7	Revision number	U32	ro	Revision number
	8	Serial number	U32	ro	Serial number
	9	Module PDO group	U16	ro	
	10	Module ident	U32	ro	Module ID
	11	Slot	U16	ro	Slot number
	12	Slot group	U16	ro	Slot group
	13 ... 29	reserved			
	30	Network segment address	OCTET_STRING[6]	ro	Network address
	31	Network port	U32	ro	Network port
	32	Festo product key	STRING(12)	ro	Festo Product Key
	33	Festo part number	U32	ro	Festo part number

Index	Sub-index	Description	Data type	Access ¹⁾	Value
0x9000	34	Firmware version	STRING(34)	ro	Firmware version
... 0x9FFF	35 ... 255	Vendor/profile specific		ro	Manufacturer/profile-specific information

1) ro = read only; rw = read write; ro p = read only (PDO mappable)

Tab. 20: Information data object area

Module Diagnosis (0xA000-0xA4F0)

Subindex	Datatype	Access	Description
0	UNSIGNED8	ro	Number of Subindexes default 5 IO-Link Modules 9
1	Module Diagnosis State	UNSIGNED32	Bit field for the Diagnosis Categories ➔ Tab. 23 Module Diagnosis State
2	Active Diagnosis Count	UNSIGNED16	Current active count of diagnosis on this module
3	Submodule	UNSIGNED16	Submodule of the latest diagnosis
4	Channel	UNSIGNED16	Channel of the diagnosis
5	Diagnosis Code	UNSIGNED32	

Tab. 21

IO-Link IO-Link has some additional subindexes (per port IO-Link event code)

Subindex	Datatype	Access	Description
6	IO-Link Port 0	ro	IO-Link event code
..			
6+n	IO-Link Port n	ro	IO-Link event code

Tab. 22

Bit	Description
0	Device available (Communication ok)
1	Current
2	Voltage
3	Temperature
4	reserved
5	Movement
6	Configuration / Parameter
7	Monitoring
8	Communication
9	Safety
10	Internal Hardware
11	Software
12	Maintenance
13	Misc
14	reserved
15	reserved
16	External Device

Bit	Description
17	Security
18	Encoder
19-31	reserved

Tab. 23: Module Diagnosis State

Modular device profile object (0xF000)

Index	Sub-index	Description	Data type	Access ¹⁾	Value
0xF000	0	Number of entries	U8	ro	
	1	Index distance	U16	ro	Factory setting: 0x10
	2	Maximum number of modules	U16	ro	Maximum number of modules
	3	General configuration	U32	ro	Factory setting: 0
	4	General information	U32	ro	General information

1) ro = read only; rw = read write; ro p = read only (PDO mappable)

Tab. 24: Modular device profile object

Configured module ident list (0xF030 ... 0xF03F)

Index	Sub-index	Description	Data type	Access ¹⁾	Value
0xF030 ... 0xF03F	1	Module ident of the module configured on position 1	U32	ro	Module ID of the module configured at position 1
	2	Module ident of the module configured on position 2	U32	ro	Module ID of the module configured at position 2
	...	...	...	...	...
	255	Module ident of the module configured on position 255	U32	ro	Module ID of the module configured at position 255

1) ro = read only; rw = read write; ro p = read only (PDO mappable)

Tab. 25: Configured module ident list

Detected module ident list (0xF050 ... 0xF05F)

Index	Sub-index	Description	Data type	Access ¹⁾	Value
0xF050 ... 0xF05F	1	Module ident of the module detected on position 1	U32	ro	Module ID of the module detected at position 1
	2	Module ident of the module detected on position 2	U32	ro	Module ID of the module detected at position 2
	...	...	...	...	...
	255	Module ident of the module detected on position 255	U32	ro	Module ID of the module detected at position 255

1) ro = read only; rw = read write; ro p = read only (PDO mappable)

Tab. 26: Detected module ident list

10.3 Process data

Diagnosis PDO

Bitsize	Datatype	Description
32	DWORD	➔ Category Status
16	UINT	Count of active diagnosis
16	UINT	Module with latest diagnosis
32	UDINT	Last diagnosis code

Tab. 27

Category Status

If bit is set at least one diagnosis of this category is available.

Bit	Description
0	reserved
1	Current
2	Voltage
3	Temperature
4	Pressure
5	Movement
6	Configuration / Parameter
7	Monitoring
8	Communication
9	Safety
10	Internal Hardware
11	Software
12	Maintenance
13	Misc
14	reserved
15	reserved
16	External Device
17	Security
18	Encoder
19-31	reserved

Tab. 28

Power Supply PDO

Bitsize	Datatype	Description
16	UINT	Voltage Sensor/Electric [mV]
16	UINT	Voltage Load [mV]

Tab. 29: Power Supply PDO

Power supply values measured on the EtherCAT node itself.

Condition Counter PDO

Condition Counter PDO provides access to Condition or Life Cycle counter via process data.

A transition from 0 to 1 trigger a read, write or reset. Input Data PDO.

BitSize	Datatype	Description
1	BOOL	Read actual Condition Counter (AP Parameter ID 20095)
1	BOOL	Read actual Life Cycle Counter (AP Parameter ID 20206)
1	BOOL	Read Condition Counter Set Point (AP Parameter ID 20094)
1	BOOL	Read Life Cycle Counter Set Point (AP Parameter ID 20116)
1	BOOL	Write Condition Counter Set Point (AP Parameter ID 20094)

BitSize	Datatype	Description
1	BOOL	Write Life Cycle Counter Set Point (AP Parameter ID 20116)
1	BOOL	Reserved
1	BOOL	Reset Condition Counter
16	UINT	AP Address (starting from 1..Module Count)
8	USINT	Instance (Coil selection = AP Parameter Instance)
32	UDINT	Set Point Value (only used during write)

Tab. 30: Output Data PDO

BitSize	Datatype	Description
1	BOOL	Done
1	BOOL	Error
5	None	Reserved
1	BOOL	Busy (Transaction in progress)
16	UINT	AP Address (starting from 1..Module Count)
8	USINT	Instance (Coil selection = AP Parameter Instance)
32	UDINT	Condition or Life Cycle Counter Value

Tab. 31: Input Data PDO

Busy is set if a valid transaction is processed.

Done is set if a transaction is completed successful.

Error is set if

- more than one command bit is selected
- device is not accessible
- instance is not accessible
- parameter does not exists
- reserved bit is selected

For more information about the error, please consult the log file.

11 Diagnostics

11.1 Diagnostics options

Diagnostics via LED displays

The system and network status and errors are displayed directly on the module via LED indicators → Further information.

Diagnostics via EtherCAT

Diagnostics as part of EtherCAT functions via control software over the network → 11.4 Diagnostics via EtherCAT.

11.2 LED indicators

Module diagnostics [MD]		
LED	Meaning	Remedy
 Off	Logic supply PS not available.	– Check connection of logic supply PS.
 Green light	Module diagnostics not active	–
 Flashing green 0.5 Hz	Module diagnostics active "Information" degree of severity e.g. switching off load supply PL	–
 Flashing red 0.5 Hz	Module diagnostics active "Warning" degree of severity e.g. parameterisation error	– Carry out appropriate remedial measures, e.g. check parameterisation.
 Red light	Module diagnostics active "Error" degree of severity e.g. undervoltage in logic supply PS	– Carry out appropriate remedial measures, e.g. check logic supply PS.
 Fast flashing red 2 Hz	Module ramp-up not yet completed. System communication not yet initialised.	–
 Fast flashing green 2 Hz	Module identification (service function)	–

Tab. 32: Module diagnostics LED [MD]

System diagnostics [SD]		
LED	Meaning	Remedy
 Off	Logic supply PS not available.	Check connection of logic supply PS.
 Green light	System diagnostics not active	–
 Flashing green 0.5 Hz	System diagnostics active "Information" degree of severity e.g. load supply PL to a module not available or firmware update in a module active.	–
 Flashing red 0.5 Hz	System diagnostics active "Warning" degree of severity e.g. parameterisation error in a module.	–
 Red light	System diagnostics active "Error" degree of severity e.g. sensor supply short circuit in a module.	–
 Fast flashing green 2 Hz	Module identification (service function)	–

Tab. 33: LED system diagnostics [SD]

Load supply [PL]		
LED	Meaning	Remedy
 Green light	Load supply PL available.	–
 Flashing green 0.5 Hz	Load supply PL not available.	Check load supply PL.
 Flashing red 0.5 Hz	Load supply PL outside the tolerance range.	Check load supply PL.

Tab. 34: Load supply LED [PL]

Maintenance [MT]		
LED	Meaning	Remedy
 Off	Maintenance not required.	–
 Yellow light	Maintenance required on at least one module in the remote I/O system CPX-AP.	Carry out the necessary remedial measures → Instructions for the applicable module.

Tab. 35: LED maintenance [MT]

EtherCAT operating status [RUN]		
LED	Meaning	Remedy
 Green light	Operational normal operating status	–
 Flashing green	Pre-operational Configuration of EtherCAT network	–
 Flashes green 1x briefly	Safe operational Only the input signals are updated. The outputs retain their current status.	–
 Flickers green	Bootstrap The interface is receiving a firmware update.	–
 Off	Initialisation Normal status after switching on or after a restart	–

Tab. 36: LED EtherCAT operating status [RUN]

EtherCAT error [ERR]		
LED	Meaning	Remedy
 Red light	serious communication error Possible causes: – Application controller not responding – Watchdog timeout by ESC	Contact Festo Service ➔ www.festo.com .
 Flashing red	Configuration error, no network connection Possible causes: – Line interrupted – no connection to the MainDevice – MainDevice is not active	Check network connections. Check the configuration and addressing of the interface.
 Flashes red 1x briefly	EtherCAT state change from Operational to Safe-Operational due to synchronisation error	–
 Flashes red 2x briefly	Application watchdog timeout Watchdog timeout by the Sync Manager	–
 Flickers red	Booting error Error (checksum) in application controller flash memory	–
 Off	no error	–

Tab. 37: EtherCAT error [ERR] LED

Connection status [LA X1], [LA X2]		
LED	Meaning	Remedy
 Off	No network connection.	Check network connection.
 Flickers green	Network connection OK. Data traffic activity.	–
 Green light	Network connection OK. No data traffic.	–

Tab. 38: LED connection status [LA X1], [LA X2]

11.3 Diagnostic messages

The table below contains the diagnostic messages of the interface.

11.4 Diagnostics via EtherCAT



The availability of diagnostics information via the EtherCAT network depends on the parameterisation.

11.4.1 Diagnostics via SDO access

Diagnostic information can be requested from the higher-order controller through SDO access.

11.4.2 Diagnostics via PDO access

Diagnostics via PDO 0x1AF

Bit size	Data type	Description
32	DWORD	Category status bit: – 0 = reserved – 1 = current – 2 = voltage – 3 = temperature – 4 = pressure – 5 = motion – 6 = configuration/parameters – 7 = monitoring – 8 = communications – 9 = safety – 10 = internal hardware – 11 = software – 12 = maintenance – 13 = various – 14, 15 = reserved – 16 = external device – 17 = security – 18 = encoder – 19 ... 31 = reserved If the bit is set, at least one diagnostics of this category is available.
16	UINT	Counter for active diagnostics
16	UINT	Module with the newest diagnostics
32	UDINT	Latest diagnostics code

Tab. 39: PDO structure

11.4.3 Diagnostics via diagnostics history

The diagnostics messages of the EtherCAT Interface are stored in the diagnostics history. The last 250 diagnostic messages of the EtherCAT interface can be displayed via the diagnostics object 0x10F3 (from subindex 6).

An error message referenced with a code is displayed for every event (warning, error, information). The diagnostics messages are translated using the device description file (ESI file) and thus can be read from the controller software.

Operating modes of diagnostics messages

There are two operating modes for handling diagnostics messages. The operating mode can be defined via object 0x10F3 (subindex 5, bit 4):

– Overwrite Mode:

When the number of diagnostics messages reaches 250, old diagnostics messages are overwritten.

– Acknowledge Mode:

A diagnostics message must first be acknowledged before it can be overwritten with a new diagnostics message. When the number of unacknowledged diagnostics messages reaches 250, new diagnostics messages will not be saved and will be lost.

Mapping "New message available" message

For simplification of the diagnostics evaluation, the module offers the option of signalling the existence of a new diagnostics message via the process data. To do this, the "New message available" object can optionally be mapped to the process data.

Deactivate/activate Emergency message

The sending of one Emergency message can be deactivated and activated via object 0x10F3 (subindex 5, bit 0).

Structure of diagnostics messages

Parameters	Data type	Description
Diagnostics code	U32	Bit 0 ... 15
		Bit 16 ... 31
		0x0000 ... 0xDFFF
		not used
		0xE000
		Error number of the diagnostics ID ➔ 11.3 Diagnostic messages e.g.: 0x1 02 01 0017 (33619991) – 02 = main group – 01 = sub-group – 0017 = error number
		0xE001 ... 0xE7FF
		not used
Flags	U16	0xE800
		Emergency Error Code as defined in DS301 or DS4xxx
		0xE801 ... 0xEDFF
		reserved
		0xEE00 ... 0xEFFF
Text ID	U16	profile-specific
		0xF000 ... 0xFFFF
		not used
		Bit 0 ... 3
Flags	U16	Diagnostics status 0 = information message 1 = warning message 2 = error message
		Bit 4
		Local timestamp
		Bit 5 ... 7
Text ID	U16	reserved
		Bit 8 ... 15
Text ID	U16	Number of parameters in this diagnostics message
		0 = no text ID 1 ... 65535 = text ID

Parameters	Data type	Description	
Time stamp	U64	0 = no time stamp	
Flags	U16	Bit 12 ... 15	Bit 0 ... 11
Parameter 1		0	Parameter 1 data type 0x0001 = BOOL 0x0002 = INT8 0x0003 = INT16 0x0004 = INT32 0x0005 = U8 0x0006 = U16 0x0007 = U32
		1	BYTE ARRAY size [byte]
		2	ASCII string size [byte]
		3	UNICODE-STRING size [byte]
		4	Size parameter 1 [byte]
		5 ... 15	reserved
Parameter 1	¹⁾	Value of parameter 1	
Flags	U16	→ flags parameter 1	
Parameter 2			
Parameter 2	²⁾	Value of parameter 2	
...	...	...	

1) depending on flags parameter 1

2) depending on flags parameter 2

Tab. 40: Structure of diagnostics messages

11.4.4 Emergency message

In the event of an error, the remote I/O system CPX-AP sends an Emergency message. This requires the sending of the data Emergency message via object 0x10F3 (subindex 5, bit 0) to be activated.

The Emergency message is structured as follows:

Byte							
0	1	2	3	4	5	6	7
Emergency error code → Tab. 42 Emergency error code		Error register → 0x1001	Error number of the diagnostics ID → 11.3 Diagnostic messages		Module number		Channel number

Tab. 41: Structure of the Emergency message

Emergency error code	Category	
0x2081	1	Current
0x3082	2	Voltage
0x4083	3	Temperature
0xF084	4	Pressure
0xF085	5	Motion
0x6386	6	Configuration/parameterization
0x8087	7	Monitoring
0x8188	8	Communication
0xF089	9	Safety engineering
0x508A	10	Internal hardware
0x608B	11	Software
0xF08C	12	Maintenance
0xFF8D	13	Various
0xFF8E	14	Device-specific
0xFF8F	15	Customer-specific
0x9090	16	External device
0xF091	17	Security (data)
0x7092	18	Encoder

Tab. 42: Emergency error code

12 Technical data

12.1 Technical data, general

General technical data		
Certificates, declaration of conformity		➔ www.festo.com/sp
Mounting position		Any
Dimensions (width × length × height)	[mm]	50.1 × 107.3 × 57.5 (including interlinking module)
Product weight	[g]	113
Ambient temperature	[°C]	−20 ... +50
Storage temperature	[°C]	−20 ... +70
Max. storage time	[years]	2
Humidity (non-condensing)	[%]	5 ... 95
Max. assigned address space (inputs/outputs)	[Byte]	1024/1024
Max. number of AP stations		80
Module code (hex/dec) ¹⁾		0x3086/12422d
Module identification		CPX-AP-A-EC-M12
Protection against electric shock (protection against direct and indirect contact)		By the use of SELV/PELV circuits (Safe extra-low voltage/Protected extra-low voltage)
Electromagnetic compatibility		See declaration of conformity ➔ www.festo.com

1) At the controller level the "Module Ident" designation is specified via CoE in the index from 9000:0A.

Tab. 43: General technical data

12.2 Technical data, electrical

Power supply		
Logic supply PS	[V DC]	24 ± 25 %
Intrinsic current consumption at nominal operating voltage 24 V from PS	[mA]	96
Reverse polarity protection 24 V PS against 0 V PS		Yes
Diagnostics message, over-voltage in logic supply PS	[V DC]	≥ 31
Mains buffering time, logic supply PS	[ms]	10
Load supply PL	[V DC]	24 ± 25 %
Intrinsic current consumption at 24V at nominal voltage 24 V from PL	[mA]	Typically 2.9
Reverse polarity protection 24 V PL against 0 V PL		Yes
Diagnostics message, under-voltage in load supply PL	[V DC]	≤ 17
Diagnostics message, over-voltage in load supply PL	[V DC]	≥ 31
Capacitive load at load supply PL		
24 V PL to 0 V PL	[nF]	Typically 35
24 V PL to FE	[nF]	Typically 35
0 V PL to FE	[nF]	Typically 20

Tab. 44: Power supply

Network-specific data		
Protocol		EtherCAT (based on the Ethernet protocol IEEE 802.3)
Specification		Standards and norms with reference to EtherCAT: IEC 61158 IEC 61784 IEC 61918 ISO/IEC 8802-3
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]	0.14 ... 0.75 AWG 22 (required for maximum connection length between network stations)

Tab. 45: Network-specific data

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