

Terminal CPX

Control block

CPX-CEC-C1-V3/-M1-V3/-S1-V3

FESTO

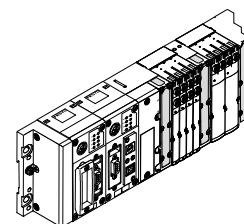
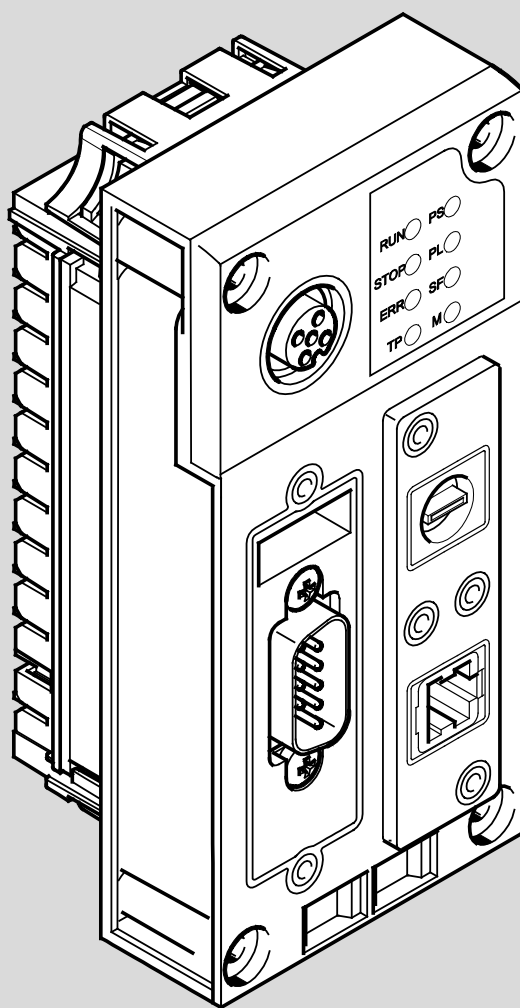
Description

CODESYS-
controller

CPX-CEC-C1-V3

CPX-CEC-M1-V3

CPX-CEC-S1-V3



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- <http://www.gnu.org/copyleft/gpl.html>
- Internal CPX-CEC-...-V3 web server: <http://<IP address of the device>/cgi-bin/system-about>

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1 Important information

1.1 Designated use

The control block CPX-CEC-...-V3 described in this manual is intended exclusively for use in CPX terminals from Festo for installation in a machine or automated system. The control block CPX-CEC-...-V3 performs the function of a CODESYS controller.

In combination with a CPX terminal, the control block is used for:

- Controlling pneumatic and electric actuators (valves, output modules and motor controllers via CANopen)
- Interrogating electric sensor signals through the input modules
- Communication via Ethernet

The CPX terminal must only be used as follows:

- As intended in industrial applications; interference suppression measures may be required outside of industrial environments, e.g. in residential and mixed-use areas
 - In original condition without unauthorised modifications; only the conversions or modifications described in the documentation supplied with the product are permitted
 - In faultless technical condition
 - Only in combination with approved components
- The maximum limits must not be exceeded.
 - Take into consideration the applicable regulations for the destination as well as directives and standards, regulations of the inspection organisations, insurance companies and national regulations.



All notes on designated use, the safety instructions and warnings as well as all further specifications for the control block also apply to the associated software libraries.

1.1.1 Safety instructions

- Before assembly or installation work, switch off the power supply, switch off the compressed air supply, exhaust any pneumatic components.
- Only use PELV circuits to IEC 60204-1/EN 60204-1 for the electrical supply.
- Note the information on installation and power supply as well as on potential equalisation (earthing measures) → CPX system manual P.BE-CPX-SYS-....
- Note the handling specifications for electrostatically sensitive devices.
- Seal unused connections with cover caps to achieve the required degree of protection.
- Use connection technology with the required degree of protection.
- Take into consideration the specifications in the CPX system manual, in the manuals for the relevant valve terminal and in the assembly instructions for individual components.
- Note the information on the correct way to mount the CPX terminal.
- Only fully fitted and wired CPX terminals may be commissioned.
- Only switch on the compressed air and load voltage if the system has been installed, configured and parameterised by technically qualified staff.
- Make sure that nobody enters the positioning range of the actuators.

Switching off the compressed air or load voltage is not a suitable locking mechanism. Unintentional movement of actuators may occur in the event of a malfunction.

1.1.2 Qualification of personnel (target group)

The product must only be commissioned by trained experts in control and automation technology who are familiar with:

- assembly, installation, operation and diagnosis of control systems, networks and fieldbus systems
- the applicable accident prevention and occupational safety regulations
- the documentation for the product.

1.1.3 Service

- Contact your local Festo Service partner if you have any technical problems → www.festo.com.

Including the following information will make it easier to process support queries:

- CPX-CEC-...-V3 project → menu command in CODESYS: [File] [Project Archive] [Save/Send Archive]
- Programming environment version → menu command in CODESYS [Help] [About] [Display Detailed Version Information]
- Controller data → export the device properties with the help of FFT

1.2 Important user information

1.2.1 Danger categories

This manual contains information on the possible dangers that can occur if the product is not used as designated. These danger warnings are marked with a signal word (warning, caution, etc.), placed on a grey background and additionally marked with a pictogram. A distinction is made between the following danger warnings:



Warning

... means that serious injury to people and damage to property can occur if this warning is not observed.



Caution

... means that injury to people and damage to property can occur if this warning is not observed.



Note

... means that damage to property can occur if this warning is not observed.

In addition, the following pictogram marks passages in the text that describe activities involving electrostatic sensitive components:



Note

Electrostatic sensitive components: Inappropriate handling can result in damage to components.

1.3 Marking special information

1.3.1 Pictograms

The following pictograms mark passages in the text that contain special information.



Information: Recommendations, tips and references to other sources of information.



Accessory: Information on necessary or useful accessories for the Festo product.

1.3.2 Text markings

1. Figures denote activities that must be carried out in the order specified.
- Bullets denote activities that may be carried out in any desired order.
 - Hyphens denote general listings.

1.3.3 Further conventions

[File] [New Project...]	Menu items are framed in square brackets. For example, you can create a new project using the [New Project...] command in the [File] menu.
"OK"	Names of windows, dialogs and buttons such as "Message Window", "Dearchive Project", "OK" as well as designations are shown in inverted commas.
CTRL	Names of keys on the PC keyboard are represented in the text with uppercase letters (e.g. CTRL, C, F1).
CTRL+C	For some functions two keys must be pressed simultaneously. For example, press and hold down the CTRL key and also press the C key. This is written in the text as CTRL+C.
	If "click" or "double-click" is mentioned, this always applies to the left-hand mouse button. If the right-hand mouse button is to be used, this will be explicitly mentioned.

1.4 Version information

This manual refers to the following versions:

- Control block CPX-CEC-...-V3 Revision 01 and later
- CODESYS V3 provided by Festo (pbF) programming environment with CPX-CEC package

The manual contains information on the function of the control block as well as its assembly, installation and commissioning.

Further information on the product can be found in the following documents:

Title	Type	Contents
Control block CPX-CEC-...-V3	Brief description	Connection and display components, assembly, installation and technical data.
Festo CameraControl_3 library	Online Help	Configuration, use and error diagnosis in function blocks.
Festo CMAX_3 Library		
Festo CPX_3 library		
Festo CVE_3 library		
Festo EasyIP_3 library		
Festo FHPPMAX_3 library		
Festo General_3 library		
Festo Motion_3 library		
Festo SerialComEx_3 library		
Festo Field Device Tool	Online Help	Servicing and commissioning of Ethernet-based Festo products.

Table: Overview of documents for the product



General basic information on the method of operation, on fitting, installing and commissioning CPX terminals → CPX system manual P.BE-CPX-SYS-...

- Refer also to the user documentation for the components used in the CPX terminal.

2 System overview

2.1 Control block variants

Variant	Features	CODESYS target system ID ¹⁾
CPX-CEC-C1-V3	Control block with CANopen interface to which up to 32 CANopen slaves can be connected	16#103D9C4B
CPX-CEC-M1-V3	Control block with CANopen interface and the CODESYS software package SoftMotion for PLCOpen motion modules and coordinated multi-axis movements	16#103D9C49
CPX-CEC-S1-V3	Control block with RS232 interface (Sub-D, 9-pin) for using third-party devices via the serial interface	16#103D9C4A
1) Device type code for use in the communication settings of CODESYS → Finding devices.		

Table: Control block variants

All variants offer...

- Programming with CODESYS V3 pbF to IEC 61131-3.
- Programming, communication and visualisation via Ethernet.
- Control of the CPX terminal in "Standalone" or "Remote Controller" operating mode.
- Communication via fieldbus in combination with using the respective bus node in the CPX terminal.
- Controller configuration using CODESYS V3 pbF for commissioning, programming and diagnosing the system.
- Connection of an operator unit CPX-MMI for displaying status and diagnostic information and for quick commissioning of the CPX modules in the CPX terminal.
- Process visualisation within CODESYS V3 pbF using an operator unit CDPX and the Software Designer Studio (available separately), use of the OPC server for connecting to an OPC client or use of the web visualisation under CODESYS.



The current version of the CODESYS V3 pbF software package can be found in the Support Portal → www.festo.com/sp.

2.2 Programming software

Use the CODESYS V3 pbF programming software to commission and program the product. CODESYS V3 pbF offers a user-friendly interface with the following functions:

- Configuration and parameterisation of the control block
- Programming in accordance with IEC 61131-3
- Integrated module libraries
- Library Manager for integrating further libraries
- Simulation mode for testing projects on a PC without a PLC
- Integration of a visualisation; configuration using Designer Studio (available separately)
- Documentation using the integrated project documentation function
- Debugging function for testing program sequences, monitoring and changing variables, troubleshooting

2.2.1 Packages

The associated CPX-CEC package is required to use the control block as a target system under CODESYS V3 pbF. This package enables the system functions of the target system to be accessed with the help of libraries and contains corresponding information in the form of online Helps. This enables CODESYS functions to be used for the target system or restrict it.



- Use the CODESYS V3 pbF software and the CPX-CEC package to configure the device (→ www.festo.com/sp).

2.2.2 Libraries

To simplify programming, CODESYS enables the following objects to be organised into libraries on a project-independent basis:

- Function blocks
- Declarations
- Visualisations

Library	Comment
Festo_General_3.library	For controlling and parameterising Festo controllers or control blocks.
Festo_CPX_3.library	For diagnosing CPX devices. For creating specific structs.
Festo_CMAX_3.library	For controlling and parameterising the Festo axis controller CPX-CMAX.
Festo_CVE_3.library	For actuating motor controllers that support the CVE protocol from Festo (e.g. CMMO-ST).
Festo_CameraControl_3.library	For accessing the Compact Vision System SBO...-Q.
Festo_EasyIP_3.library	For easy networking of controllers via EasyIP.
Festo_FHPPMAX_3.library	Festo profile FHPPMAX
Festo_Motion_3.library	For configuring motor controllers from Festo (e.g. CMMP-AS).
Festo_SerialComEx_3.library	For configuring the serial interface RS232.

Table: Libraries for programming the control block

A Library Manager that can be used to integrate and view libraries is available for this.



Detailed descriptions of the libraries and how to program them can be found in the respective online Helps.

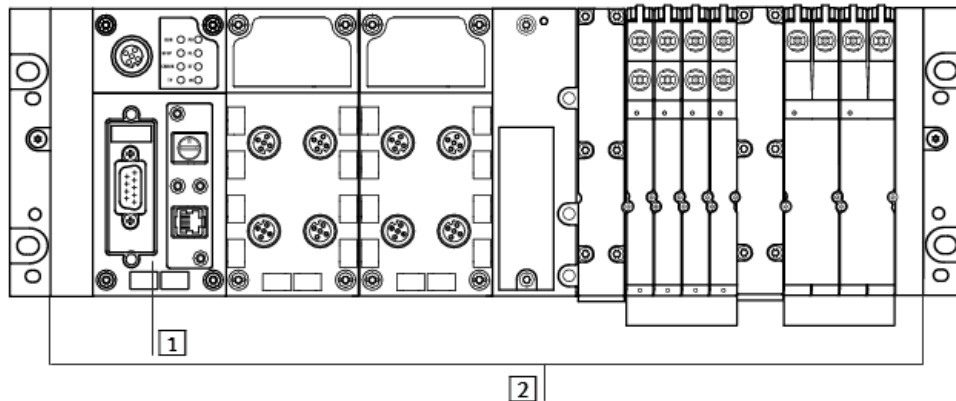
2.3 Operating modes

The control block can be operated in various operating modes depending on the requirement:

- Standalone
- Remote Controller Ethernet
- Remote Controller Fieldbus (bus node required)

The individual operating modes are described briefly below:

2.3.1 Standalone

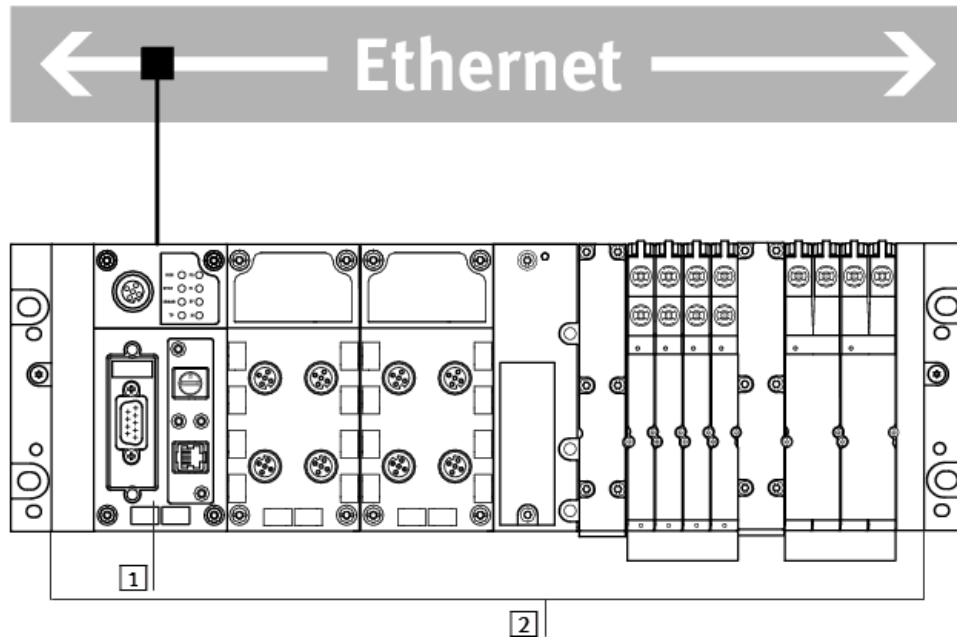


[1] Control block CPX-CEC-...-V3

[2] CPX terminal, controlled by the control block

Figure: Standalone operating mode

2.3.2 Remote Controller Ethernet

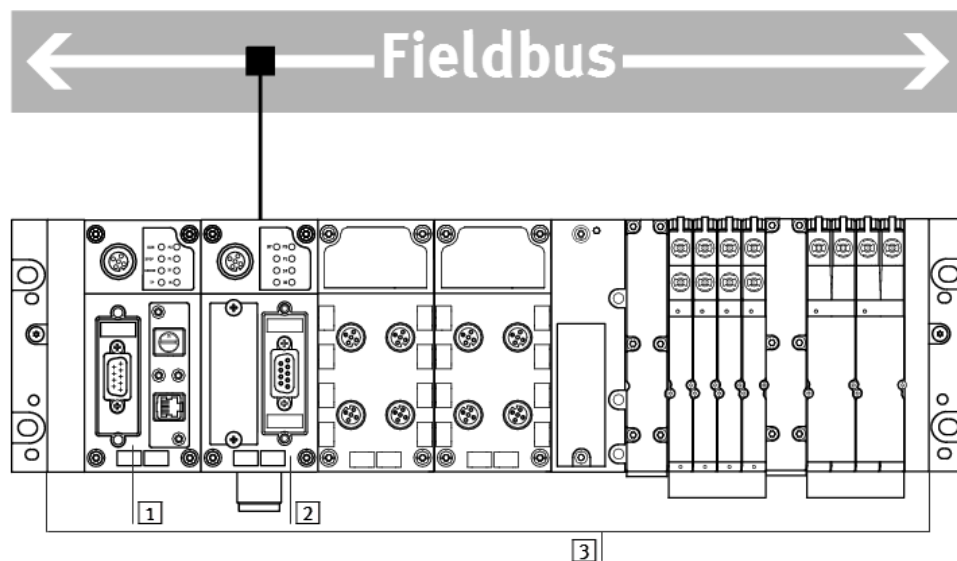


1 Control block CPX-CEC-...-V3, for communication connected to an Ethernet network

2 CPX terminal, controlled by the control block

Figure: Remote Controller Ethernet operating mode

2.3.3 Remote Controller Fieldbus



1 Control block CPX-CEC-...-V3, for communication via the bus node connected to the fieldbus

2 Bus node, in this case CPX-FB13

3 CPX terminal, controlled by the control block

Figure: Remote Controller Fieldbus operating mode (bus node required)

3 Installation



Warning

Uncontrolled movements of the actuators and loose tubing, undefined switching states of the electronic components

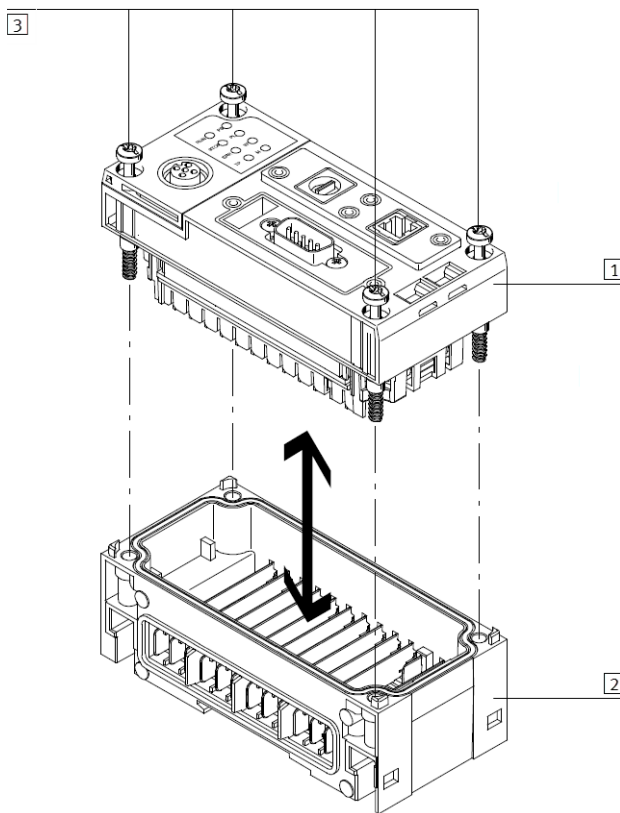
Injury due to moving parts, damage to the machine and system

Before assembly or installation work:

- Switch off the power supply.
- Switch off the compressed air supply.
- Exhaust any pneumatic components.

Information on fitting the CPX terminal → CPX system manual P.BE-CPX-SYS-....

3.1 Fitting and removal



1 Control block CPX-CEC-...-V3

2 Interlinking block

3 Screws

Figure: Fitting/removing the control block (using the example of the CPX-CEC-C1-V3/-M1-V3)



Note

- Do not remove the control block while it is still wired:
Disconnect all cable connections before removing the control block.

3.1.1 Fitting the control block

1. Check the seal and sealing surfaces. Replace damaged parts.
2. Insert control block [1] as far as possible into interlinking module [2] without tilting it.
3. Insert screws [3] into the holes.
4. Tighten the screws in diagonally opposite sequence. Tightening torque: 1 Nm $\pm$ 10%.

3.1.2 Removing the control block

1. Remove screws [3].
2. Pull the control block out of interlinking block [2] without tilting it.

3.2 Connection and display components

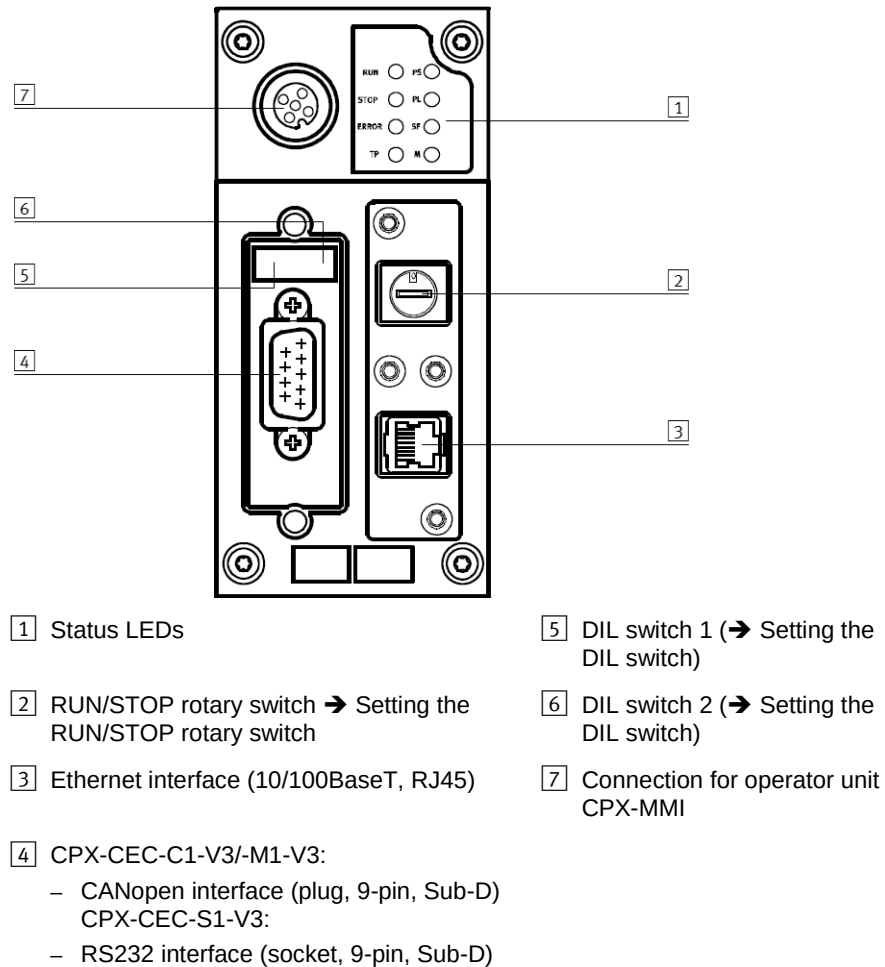


Figure: Connection and display components

3.3 Control elements

3.3.1 Setting the RUN/STOP rotary switch


Note

The RUN/STOP rotary switch is set in the factory to position "1".

- Set the RUN/STOP rotary switch to position "0" (STOP) during installation to prevent the program being started either automatically after the voltage is switched on or inadvertently by a commissioning technician.

The RUN/STOP rotary switch must be accessible to be able to make settings:

- Remove the cover.

The position of the RUN/STOP rotary switch is detected by the control block and is available in CODESYS.

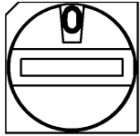
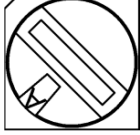
Switch position	Setting	Meaning
	0	STOP Control block stopped. The "STOP" status LED lights up yellow.
	1 ... F	RUN Control block started. The "RUN" status LED lights up green. Factory setting: 1

Table: Switch positions of the RUN/STOP rotary switch

3.3.2 Setting the DIL switch

The DIL switches must be accessible in order to make settings:

- Remove the transparent cover or the plug from the Sub-D interface (→ Ensuring the degree of protection).

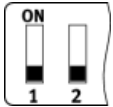
DIL switch 1		Function
	DIL 1.1: OFF DIL 1.2: OFF	Reserved Leave the two switch elements of DIL switch 1 at OFF.

Table: Setting DIL switch 1

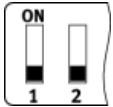
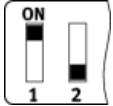
DIL switch 2		Function
	DIL 1.1: OFF DIL 1.2: OFF	CAN bus termination (120 Ω) switched off (factory setting).
	DIL 2.1: ON DIL 2.2: OFF	CAN bus termination (120 Ω) switched on (only with CPX-CEC-C1-V3 and CPX-CEC-M1-V3).
All other switch positions are reserved.		

Table: Setting DIL switch 2

DIL switch 2 is without function on the CPX-CEC-S1-V3.

3.3.3 Power supply



Voltage

Injury due to electric shock, damage to the machine and system.

- Only use PELV (Protective Extra-Low Voltage) circuits to IEC 60204-1/EN 60204-1 for the electrical supply.
- Take into consideration the general requirements of IEC 60204-1/EN 60204-1 for PELV circuits.
- Only use voltage sources that guarantee safe electrical isolation from the mains to IEC 60204-1/EN 60204-1.
- Always connect all circuits for operating and load voltage supply $U_{EL/SEN}$, U_{VAL} and U_{OUT} .

The operating and load voltage supply for the CPX terminal are supplied via an interlinking block or an end plate → CPX system manual P.BE-CPX-SYS-....

3.4 Interfaces

3.4.1 Ethernet interface

The Ethernet interface enables a programming device, PC or operator unit to be connected to the control block.

The Ethernet interface is designed as an RJ45 socket.

Socket	Pin	Signal	Comment
	1	TD+	Transmitted data+
	2	TD–	Transmitted data–
	3	RD+	Received data +
	4	n.c.	not connected
	5	n.c.	not connected
	6	RD–	Received data–
	7	n.c.	not connected
	8	n.c.	not connected
	Housing	–	Screen

Table: Pin allocation of the Ethernet interface



Note

- Seal any unused Ethernet interfaces with a cover AK-RJ45 → Ensuring the degree of protection.

Ethernet cable

Use connecting cables with the following specification:

- Screened flexible Ethernet round cable from category 5
- Max. outside diameter: 5.4 mm
- Core diameter: 0.89 ... 1.0 mm AWG24-26
- Assembly: Via crimp tool to RJ45



Note

If the CPX terminal is fitted onto a moving part of a machine, the Ethernet cable on the moving part must be provided with strain relief.

Network connection



Data transmission faults

Malfunction

Data transmission errors may occur if installation has not been carried out correctly and if high baud rates are used, for example as a result of signal reflections and attenuations.

- Connect screening consistently to all network cables.
- If possible earth screening only once (in a star shape) to avoid earth loops.
- Note the installation guidelines.
- Note the connection and cable specifications:
 - ➔ Ethernet installation guidelines
 - ➔ Documentation for the control system



Note

Unauthorised access to the product can cause damage or malfunctions.

When connecting the product 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)

Further information:

- ➔ Directives and standards on information technology security, e.g. IEC 62443, ISO/IEC 27001.
- An access password only protects against unintentional modification.

You will need a patch or crossover cable to connect your control block to a network or PC. The interface automatically detects which cable is connected and automatically switches the signals.



Note

- Use plug FBS-RJ45-8-GS ➔ Ensuring the degree of protection.
- Note the fitting instructions for the plug.

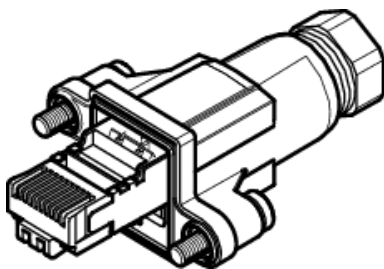
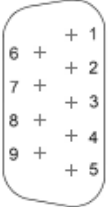


Figure: Ethernet plug FBS-RJ45-8-GS

3.4.2 CANopen interface (only CPX-CEC-C1-V3 and CPX-CEC-M1-V3)

The control block provides a CANopen interface for connecting CAN bus slaves.

The CANopen interface is designed as a 9-pin Sub-D plug.

CAN bus plug	Pin	Signal	Comment
	1	n.c.	not connected
	2	CAN_L	CAN Low
	3	CAN_GND	CAN Ground
	4	n.c.	not connected
	5	CAN_SHLD	Functional earth
	6	CAN_GND ¹⁾	CAN Ground (optional)
	7	CAN_H	CAN High
	8	n.c.	not connected
	9	n.c.	not connected
	Housing (plug)	–	Functional earth

1) Do not use pin 6 (CAN_GND) if a motor controller with an external power supply is connected.

Table: Pin allocation of the CANopen interface (CPX-CEC-C1-V3/-M1-V3)

i The CANopen interface does **not** supply the connected CAN bus slaves with voltage.

→ Note

- Seal any unused connections with a transparent cover → Ensuring the degree of protection.

Connecting CANopen slaves

→ Data transmission faults

Malfunction

Data transmission errors may occur if installation has not been carried out correctly and if high baud rates are used, for example as a result of signal reflections and attenuations.

- Connect screening consistently to all fieldbus cables.
- If possible earth screening only once (in a star shape) to avoid earth loops.
- Set termination at DIL switch 2 (→ DIL switch 2).
- Note the installation guidelines.
- Note the connection and cable specifications.
- Note the maximum cable length.
- Use a twisted, screened 2-wire cable for the CANopen bus.
- Connect the housing of the CAN bus plug to functional earth via pin 5 (CAN_SHLD).

In the case of motor controllers with external power supply:

- Make sure that pin 6 (CAN_GND) is not used.

→ Note

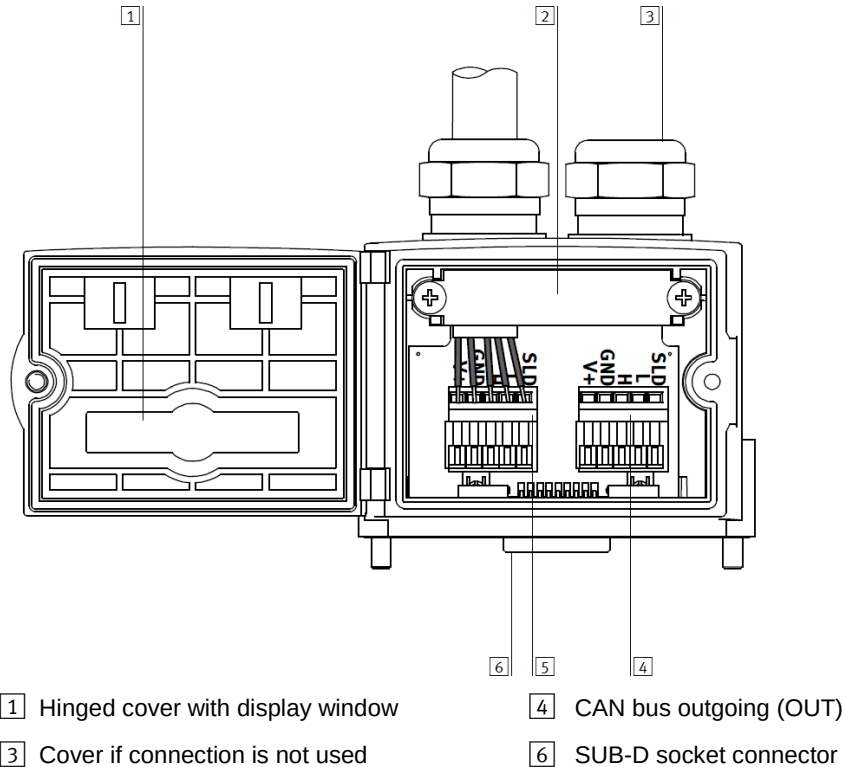
If the CPX terminal is fitted onto the moving part of a machine, the CAN bus cable on the moving part must be provided with strain relief.

Connection using a CAN bus plug from Festo

- Use plug FBS-SUB-9-BU-2x5Pol-B to connect the control block CPX-CEC-C1-V3/-M1-V3 to the CAN bus → www.festo.com/catalogue.

You can disconnect the plug from the node without interrupting the bus cable (T-TAP function).

- Note the fitting instructions for the CAN bus plug.



- | | |
|------------------------------------|--------------------------|
| 1 Hinged cover with display window | 4 CAN bus outgoing (OUT) |
| 3 Cover if connection is not used | 6 SUB-D socket connector |

Figure: CAN bus plug FBS-SUB-9-BU-2x5Pol-B

Connection using another CAN bus plug



Note

- Note the documentation for the product.

3.4.3 RS232 interface (only CPX-CEC-S1-V3)

The RS232 interface enables external devices to be connected to the control block CPX-CEC-S1-V3.

i When using external devices, data communication must be programmed by the user.

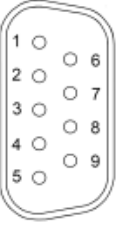
Socket	Pin	Signal	Comment
	1	n. c.	not connected
	2	RxD	Received data
	3	TxD	Transmitted data
	4	n. c.	not connected
	5	GND	Data reference potential
	6	n. c.	not connected
	7	n. c.	not connected
	8	n. c.	not connected
	9	n. c.	not connected
	Housing	–	Screen, functional earth

Table: Pin allocation of the RS232 interface (only CPX-CEC-S1-V3)

➔ Note
Long signal cables reduce interference immunity.

- Make sure that the maximum length of the signal lines (30 m) is not exceeded.

3.4.4 Connection for operator unit CDPX

The operator unit CDPX is a display for executing and monitoring automation tasks at the field level.

- Refer to the accompanying user documentation when installing the device.

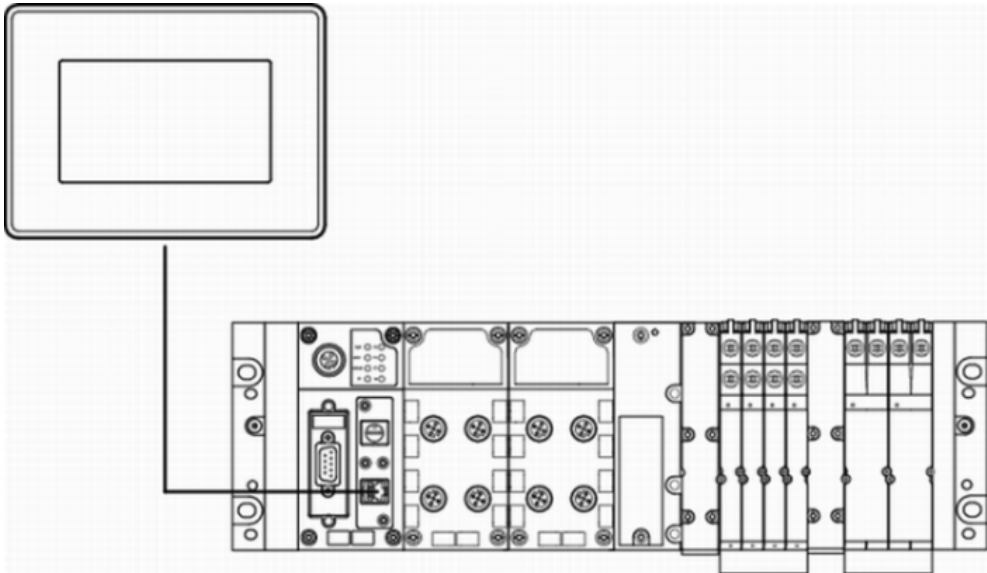


Figure: Control block in the CPX terminal with operator unit CDPX

- Connect the CDPX to the control block via the Ethernet interface.

Further information ➔ documentation for the operator unit CDPX.

3.4.5 Connection for operator unit CPX-MMI

The operator unit CPX-MMI is used for fast preliminary commissioning, diagnosis or parameterisation.



Note

The connection between the operator unit and control block is interrupted when new parameters are being transferred from CODESYS.

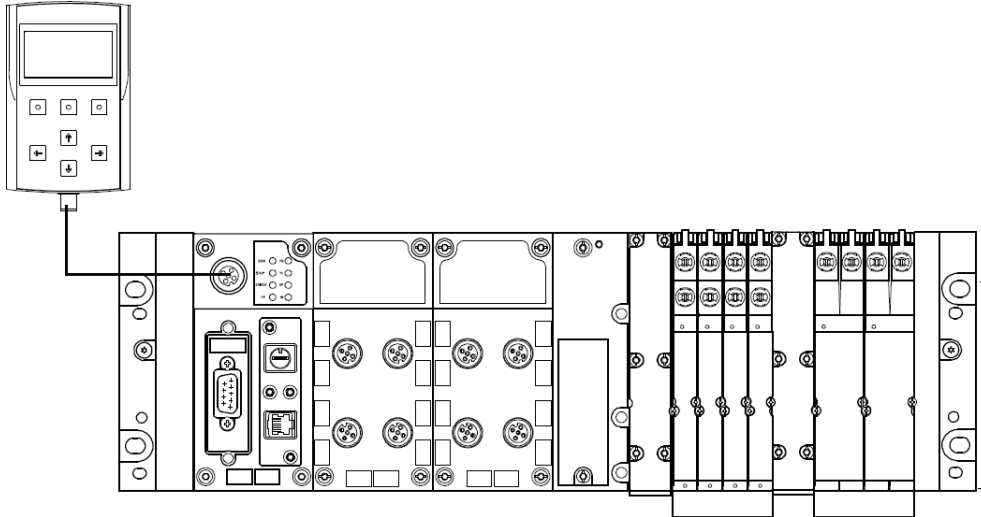


Figure: Control block in the CPX terminal with operator unit CPX-MMI



Only Festo connecting cables must be used to connect the CPX-MMI to the 5-pin M12 socket
 → www.festo.com/catalogue.

Order code	Cable length
KV-M12-M12-3,5	3.5 m
KV-M12-M12-1,5	1.5 m

Table: Connecting cables for the operator unit CPX-MMI



Further information → Parameterisation via the operator unit CPX-MMI.
 General information on the CPX-MMI → manual P.BE-CPX-MMI-1-....

3.5 Ensuring the degree of protection

- Use connection technology with the required degree of protection → www.festo.com/catalogue.
- Seal unused connections, rotary switches and DIL switches with covers.

Connection/Switch	Connection technology	Cover
Ethernet	Plug FBS RJ45-8-GS	Cover AK-RJ45 ¹⁾
Sub-D (CANopen/RS232)	Plug FBS SUB-9-BU-2x5Pol-B	Transparent cover AK-SUB-9/15-B ^{1),2)}
Service interface, M12	Connecting cable and plug of the CPX-MMI	Cover cap ISK-M12 ¹⁾
Rotary switch	–	Cover AK-RJ45 ¹⁾
1) Included in the scope of delivery		
2) Transparent cover for DIL switch also		

Table: Connection technology and covers

4 Commissioning

4.1 General information


Caution

Risk of injury due to uncontrolled movements of the connected actuators.

- Test projects and programs initially without active actuators and without compressed air.


Note

- Only fully fitted and wired CPX terminals may be commissioned.

4.2 Prerequisites

4.2.1 Hardware

- Control block CPX-CEC-...-V3
- PC (Windows 7 or higher) with Ethernet interface
- Components for network connection

Information on the system requirements for the software packages and on installation → relevant documentation.

4.2.2 Software

- CODESYS V3 pbF → www.festo.com/sp
- CPX-CEC package compatible with firmware

Important software documents

Filename	Contents
CODESYS Installation and Start.pdf	Getting started with the CODESYS programming system (English)
CODESYS_OPC_Server_V3_User_Guide.pdf	Documentation for OPC Server V3, installation and use (English)

Table: Selected user documentation



After installing CODESYS you will find the rest of the documentation in the online Help.

4.3 Preparations



Administrator rights are required to install and run the CODESYS programming software on your PC.

1. Install the CODESYS programming software on the PC used to commission, configure and program the control block.
2. Launch CODESYS with administrator rights. Install the CPX-CEC package. To do this, open the Package Manager in CODESYS using the [Package Manager] command in the [Tools] menu.
3. After the package is installed, restart CODESYS to be able to use the modified plug-ins.
4. Connect the PC to the control block directly via the Ethernet interface or indirectly via a switch/hub.



Note

Unauthorised access to the product can cause damage or malfunctions.

When connecting the product 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)

Further information:

➔ Directives and standards on information technology security, e.g. IEC 62443, ISO/IEC 27001.

An access password only protects against unintentional modification.

4.4 Getting started

- Launch CODESYS. [Programs] [Festo Software] [CODESYS V3].

4.4.1 Creating a project

- Create a new project ([File] [New Project...]), enter a name and the storage location and confirm your entries by clicking "OK".

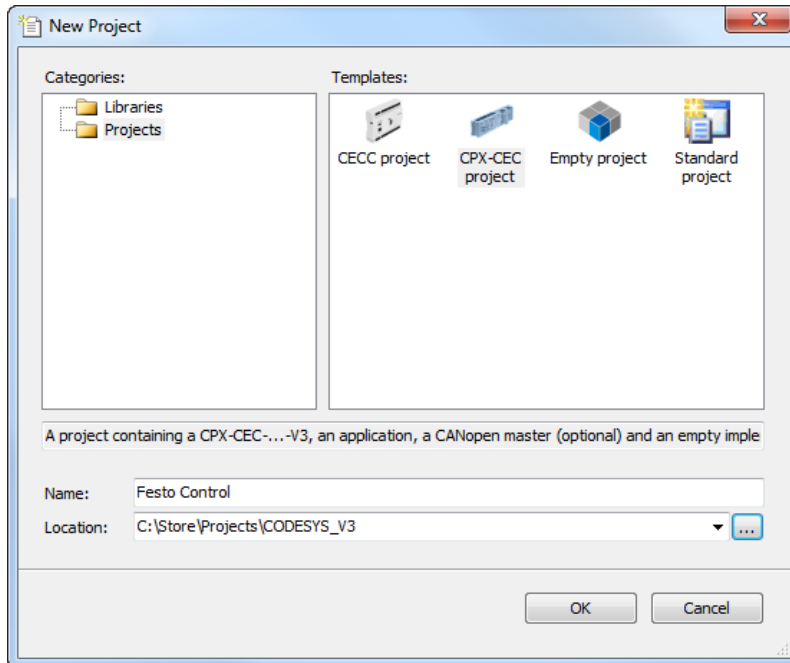


Figure: "New Project" dialog

4.4.2 Selecting a device

1. Select the relevant control block in the "CPX-CEC Project" dialog.
 - Check the "Show all device versions" box for an extended selection of older product variants. The respective version of the relevant device description file is appended to the name of the selected control block.

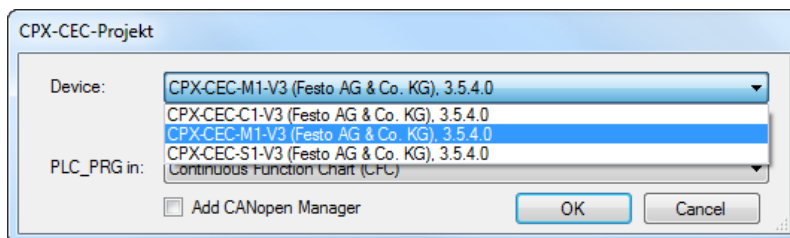


Figure: "New Project" dialog – selecting the control block used

2. Select a programming language, e.g. Continuous Function Chart (CFC).
3. Select the relevant interfaces.

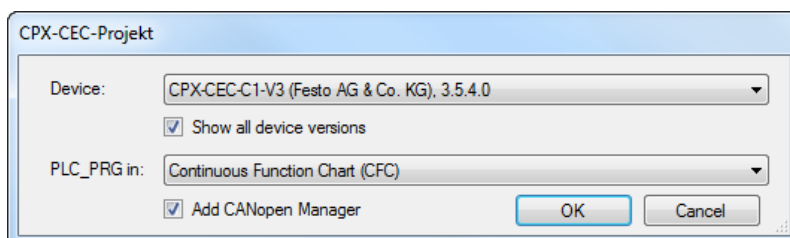
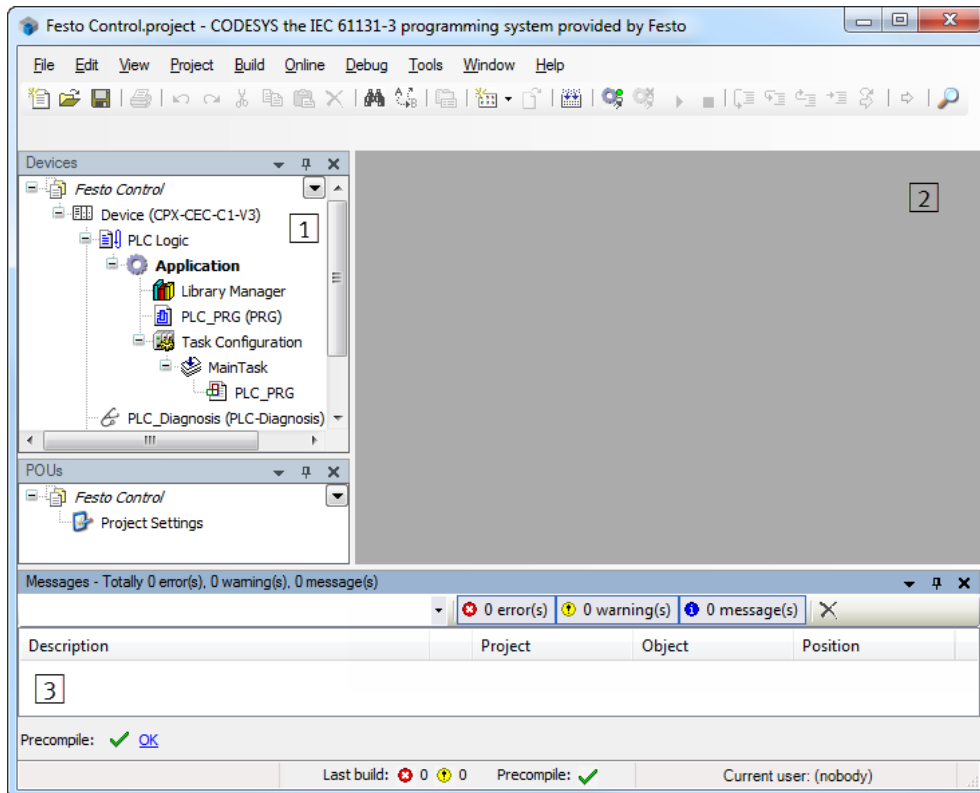


Figure: "New Project" dialog – selecting the interfaces



Options not supported by the respective device are inactive (shown in grey) and cannot be selected.

The CODESYS program window opens with the newly created project.



- 1 Device window with control block CPX-CEC-...-V3, its interfaces and PLC logic
- 2 Editing window with tabs for the objects activated in the device window
- 3 Message window with information about the CPX-CEC-...-V3 as well as error messages and warnings

Figure: CODESYS program window with selected control block

4.4.3 Finding devices

1. Double-click the device to be configured in the CODESYS device window.
The [Device] tab for making settings for the device opens in the editing window. Information and setting options can be found on the sub-tabs.
2. Open the [Communication Settings] tab and click the local gateway (network path).

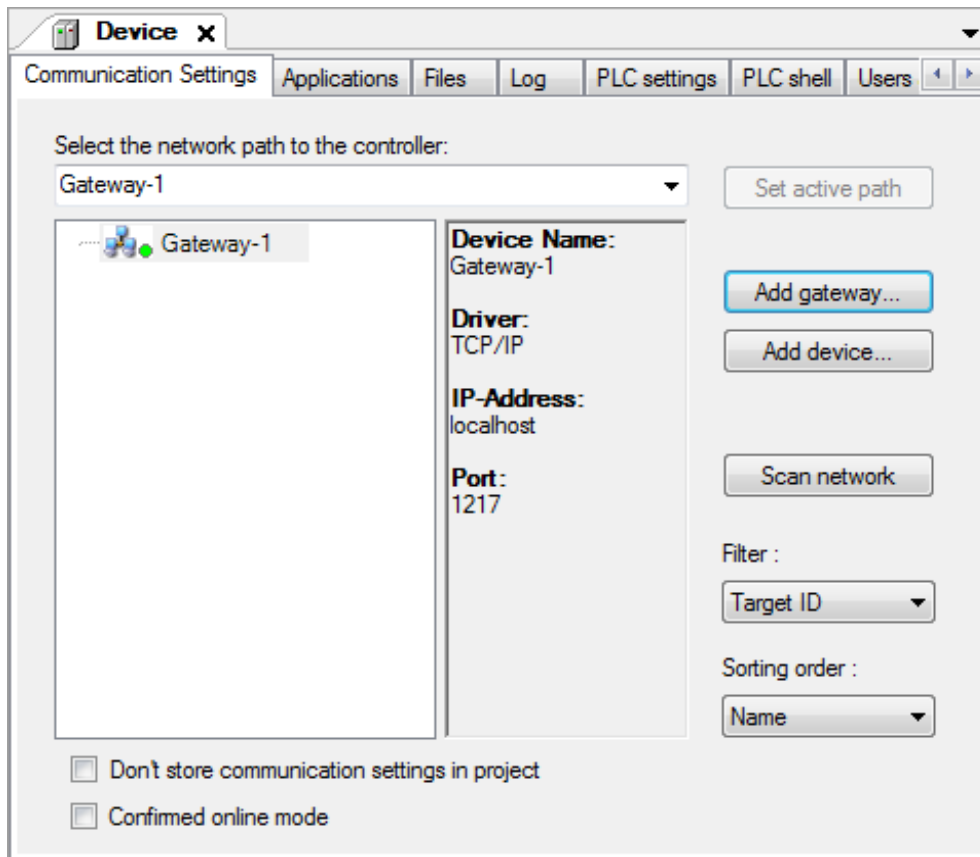


Figure: [Device] tab with [Communication Settings] sub-tab

3. Click the "Scan network" button to add an updated list of devices to the local gateway.

Restricting the search:

- Set the filter to "Target ID".
Only devices that match the control block currently used in the project will then be displayed
→ Selecting a device.
- Change the sorting sequence to alter how the devices are displayed in the updated list.
- Manually select a device if you know the name, node address or IP address of the control block
→ Manually adding a device.
- Change the network properties of the control block → Scan Festo Devices and repeat step 3.
The control block is then added to the local gateway on the basis of the changed properties.



The list only contains devices that match the following criteria:

- The subnet mask settings for the network connection and control block are the same
- The IP address settings for the network connection and control block match

If these criteria are **not** met, the device must be detected using the Festo scan program (→ Scan Festo Devices). The network properties for the control block can be read out in the scan program and changed to suit your company network.

4.4.4 Manually adding a device

You can also manually add a known device as an alternative to automatic selection.

1. Click the local gateway.
2. Click the "Add device..." button.

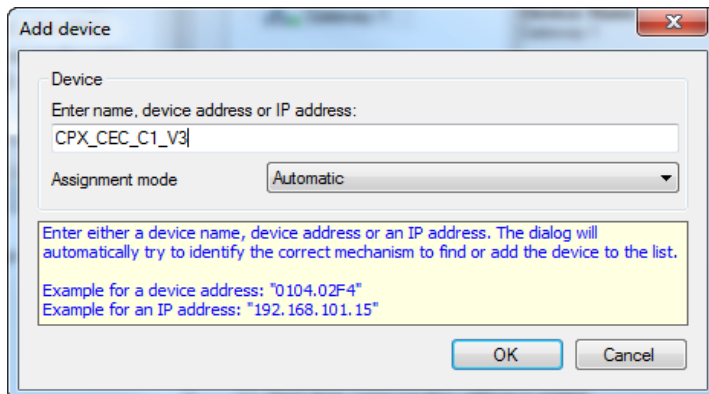


Figure: "Add device" dialog

3. Enter the name, node address or IP address of the device to be connected in the "Add device" dialog.
4. Confirm your entries by clicking "OK".

Following the update, a list of all control blocks in the local gateway that match the filter settings is displayed.

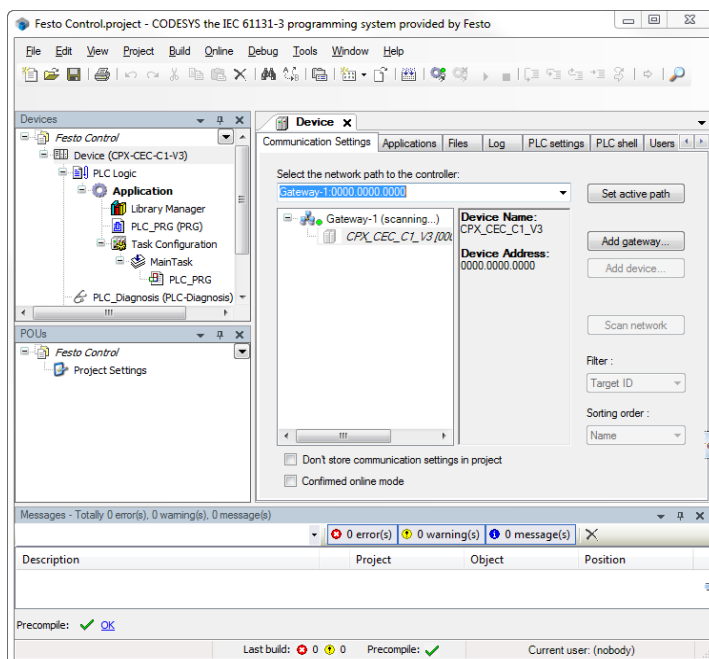


Figure: Local gateway with devices

4.4.5 Activating the communication channel

You need a communication channel to exchange data with the connected control block.

- Start by clicking the control block in the device window and then click the "Set active path" button or
- Double-click the control block.

The currently active path is shown in bold in the list and "(active)" is appended to the name.

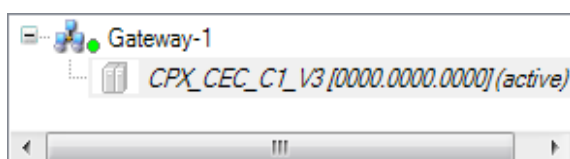


Figure: Control block with activated communication channel

4.5 Scan Festo Devices

This scan program finds all control blocks/controllers connected to the network.



1. Click the icon in the toolbar of the CODESYS program window or click the menu command [Online] [Scan Festo Devices].

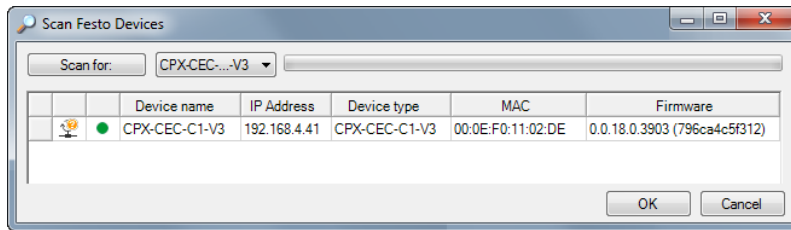


Figure: "Scan Festo Devices" scan program

2. Click the button to select the control block "CPX-CEC-V3".
3. Click the "Scan for" button to start a new scan.

All the devices found are listed in the scan program table.

4.5.1 Changing network properties:

1. Click the found device.
2. Open the "Network properties" dialog
 - menu command [Actions] [Device] [Network Properties] or
 - context menu [Network Properties].

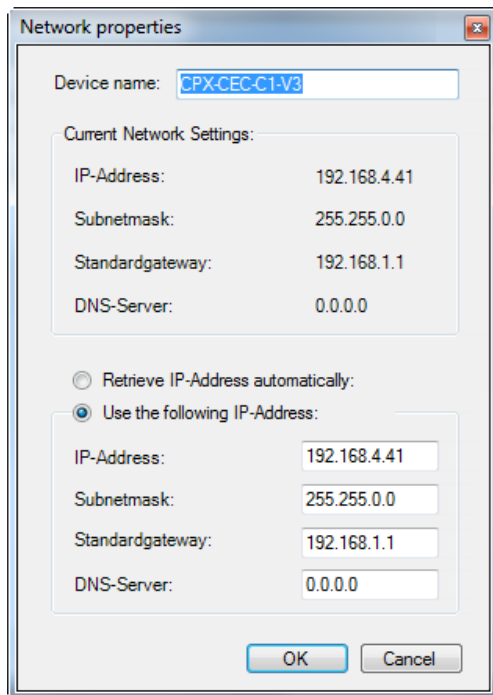


Figure: "Network properties" dialog

3. Change the IP address if it is already assigned in the network.
4. Adapt the settings for the subnet mask, standard gateway and DNS server to your network environment.
5. Apply the changes to the device. To do this, click "OK".
6. Wait until the device has successfully completed switching on ("RUN" or "STOP" status LED lights up).
7. Close the "Scan Festo Devices" scan program.

4.6 Configuring CPX terminal

- Click the "CPX_System" branch in the device window.

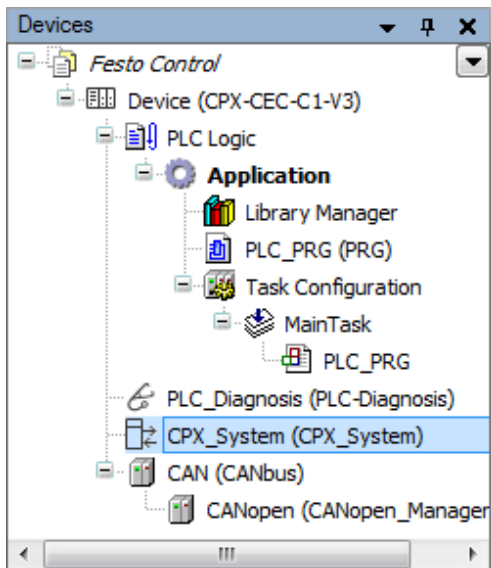


Figure: Configuring the CPX modules

Other options:

- ➔ Configuration by entering the order code
- ➔ Automatically reading in the configuration
- ➔ Manual configuration

4.6.1 Configuration by entering the order code

- Double-click the "CPX_System" branch in the device window.
- Select the "Enter order code" function on the [Module Configuration] tab.
- Enter the one or two-line order code.
- Click "Apply" to transfer the result to the device configuration.

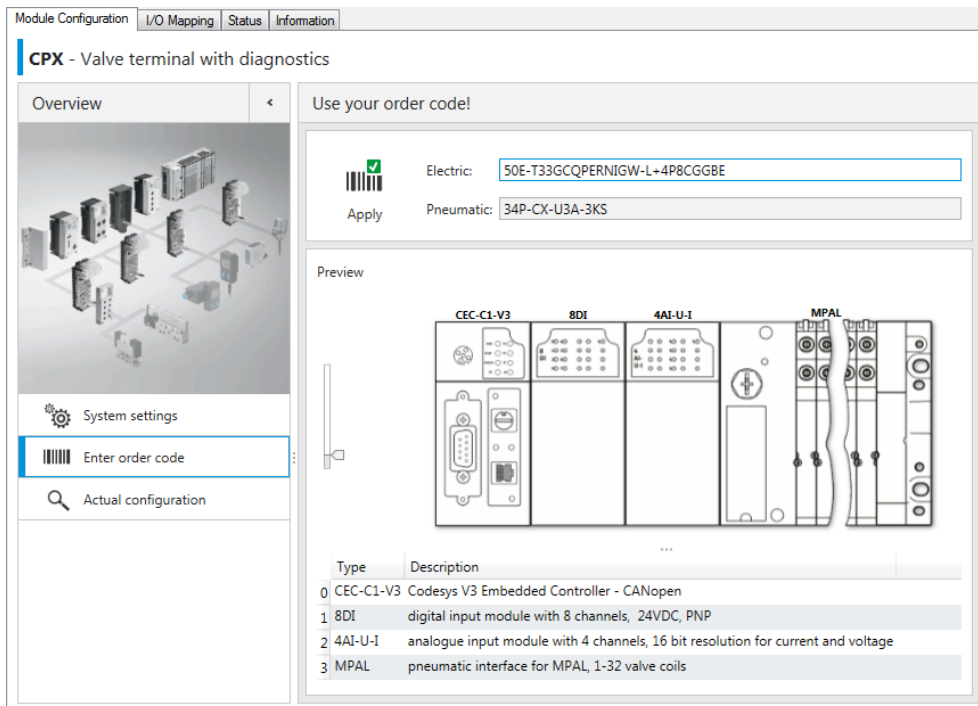


Figure: Configuration by entering the order code

4.6.2 Automatically reading in the configuration

Prerequisite: Communication channel must be set (→ Setting the communication channel)

1. Double-click the "CPX_System" branch in the device window.
2. Select the "Actual configuration" function on the [Module Configuration] tab.
3. Click "Scan".
4. Click "Apply" to transfer the result to the device configuration.

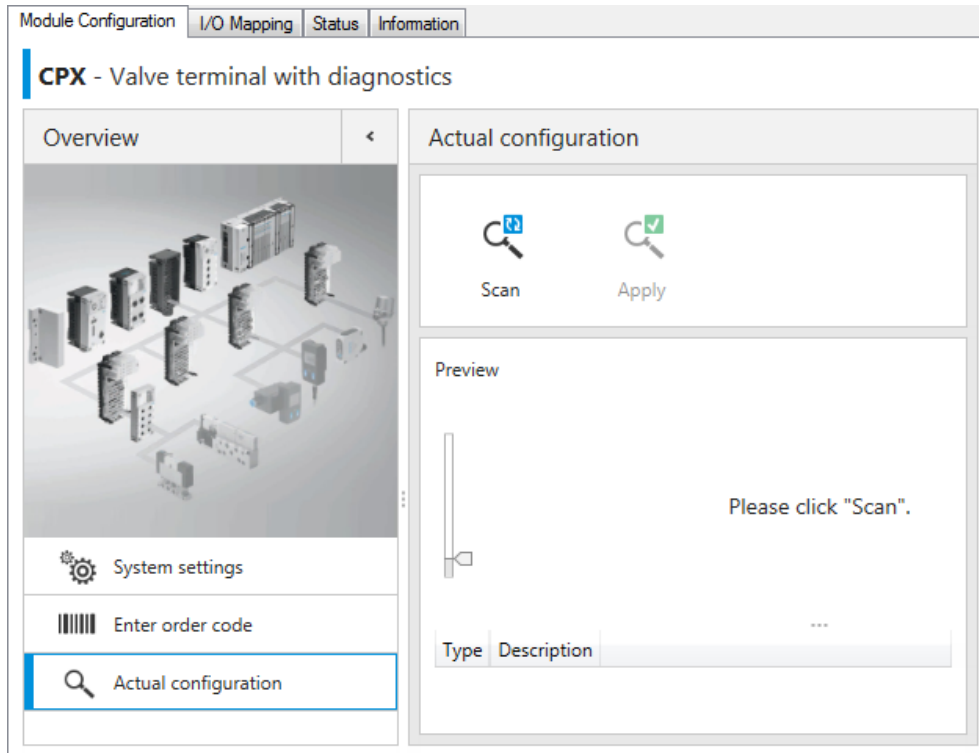


Figure: Automatic scanning function for the actual configuration

4.6.3 Manual configuration

1. Right-click the CPX system in the device window.
2. Select the [Add Device] command in the context menu.

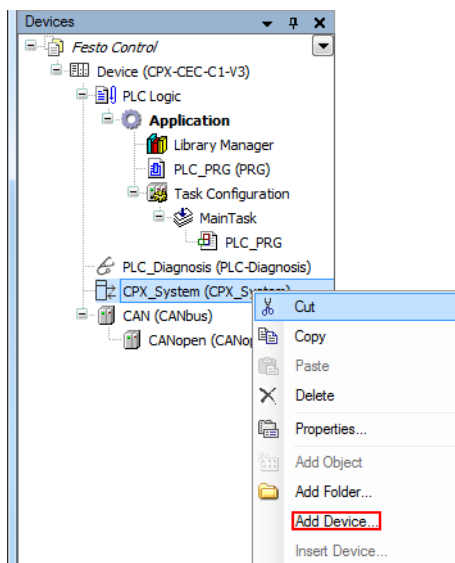


Figure: Adding a device



- Add the CPX modules in accordance with the physical order in the CPX terminal from left to right.

The modules are added at the bottom of the tree structure.

3. Select the appropriate CPX modules from the list.

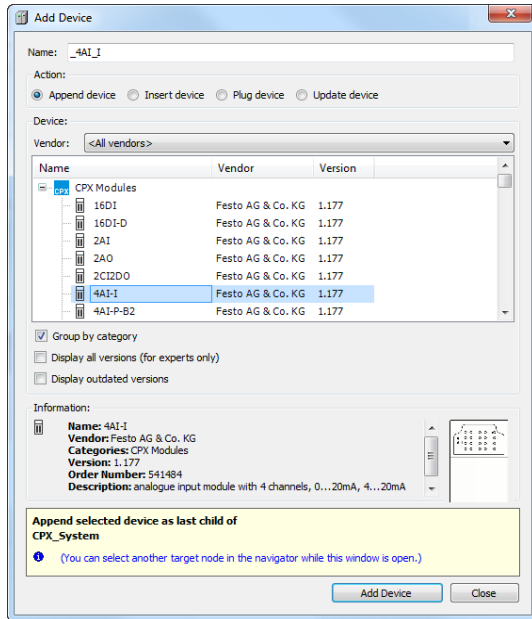


Figure: Adding a CPX module, in this case CPX module 4AI-I

i The inputs and outputs are automatically addressed (preset in the device on delivery). At least 1 byte of inputs or outputs is reserved for each module. The rotary switch of the control block, for example, only occupies 4 bits of inputs, but 1 byte is reserved. Alternatively you can also address the inputs and outputs manually.

4. Save the project and close the dialog by clicking "Close".

Addressing settings

The I/O addresses are automatically assigned by CODESYS.

The I/O addresses are edited directly in the I/O mapping for the respective module.

i When adding a module to an existing project at a later time:

- Specify the address manually.

This will prevent subsequent module addresses from shifting.

→ Note

With manual address assignment, CODESYS does not perform a check for possible overlaps in the I/O range.

- Check the distribution of the address ranges.

Module Configuration		Festo.CPX I/O Mapping		Status	Information		
Channels							
Variable	Mapping	Channel	Address	Type	Default Value	Unit	Description
        		Input 0	%IB4	USINT			
		Bit0	%IX4.0	BOOL	FALSE		
		Bit1	%IX4.1	BOOL	FALSE		
		Bit2	%IX4.2	BOOL	FALSE		
		Bit3	%IX4.3	BOOL	FALSE		
		Bit4	%IX4.4	BOOL	FALSE		
		Bit5	%IX4.5	BOOL	FALSE		
		Bit6	%IX4.6	BOOL	FALSE		
	Bit7	%IX4.7	BOOL	FALSE			
        		Output 0	%QB1	USINT			
		Bit0	%QX1.0	BOOL	FALSE		
		Bit1	%QX1.1	BOOL	FALSE		
		Bit2	%QX1.2	BOOL	FALSE		
		Bit3	%QX1.3	BOOL	FALSE		
		Bit4	%QX1.4	BOOL	FALSE		
		Bit5	%QX1.5	BOOL	FALSE		
		Bit6	%QX1.6	BOOL	FALSE		
	Bit7	%QX1.7	BOOL	FALSE			
		Reset mapping		☐ Always update variables			
 = Create new variable  = Map to existing variable							

Figure: Changing the I/O addresses manually



To be able to reliably trace changes to the I/O information in online mode:

- Check the "Always update variables" box.

4.7 Parameterising the CPX terminal

The CPX terminal is supplied from the factory with preset parameters. If required, you can set the behaviour of the CPX terminal as well as the behaviour of individual modules and channels through parameterisation.

A distinction is made between the following parameters:

- System parameters, e.g. switching off fault messages, setting reaction times, etc.
- Trace parameters
- Module parameters (module and channel-specific), e.g. monitors, settings in the event of faults, settings for forcing.



Detailed information about the module parameters → user documentation for the respective modules.

The following parameterisation options are available:

Parameterisation via	Description	Properties
CODESYS (offline)	Access to all parameters of the CPX terminal → CPX system settings → Parameterising a CPX module	– Convenient parameterisation via PC – Parameter settings are stored in the project, i.e. the parameters are retained after the power is turned off and restored
Operator unit CPX-MMI	Parameterisation is carried out via menu-guided entries with the operator unit → Parameterisation via the operator unit CPX-MMI	– The parameter settings are only saved locally in the CPX terminal and are lost when the power is turned off and restored

Table: Parameterisation options for the CPX terminal

4.7.1 Parameterisation via CODESYS

CPX system settings

- Click the CPX system to be configured in the CODESYS device window.

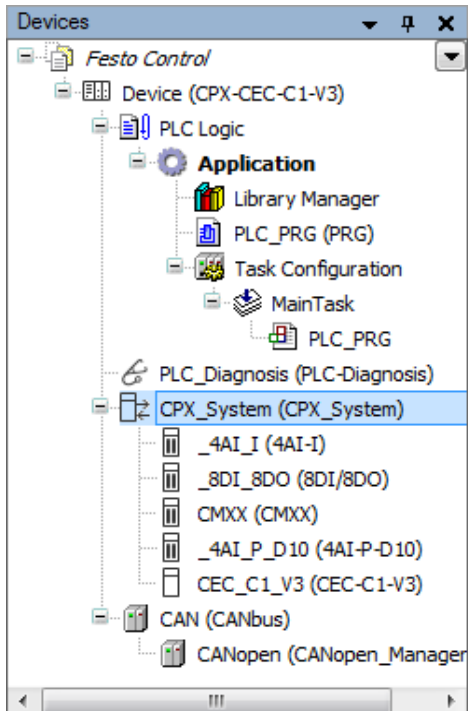


Figure: CPX system in the device window

The [Module Configuration] tab contains information about the settings for the CPX system and the diagnostic memory (trace parameters).

**Note**

Changes only take effect in online mode after the project is downloaded to the control block.

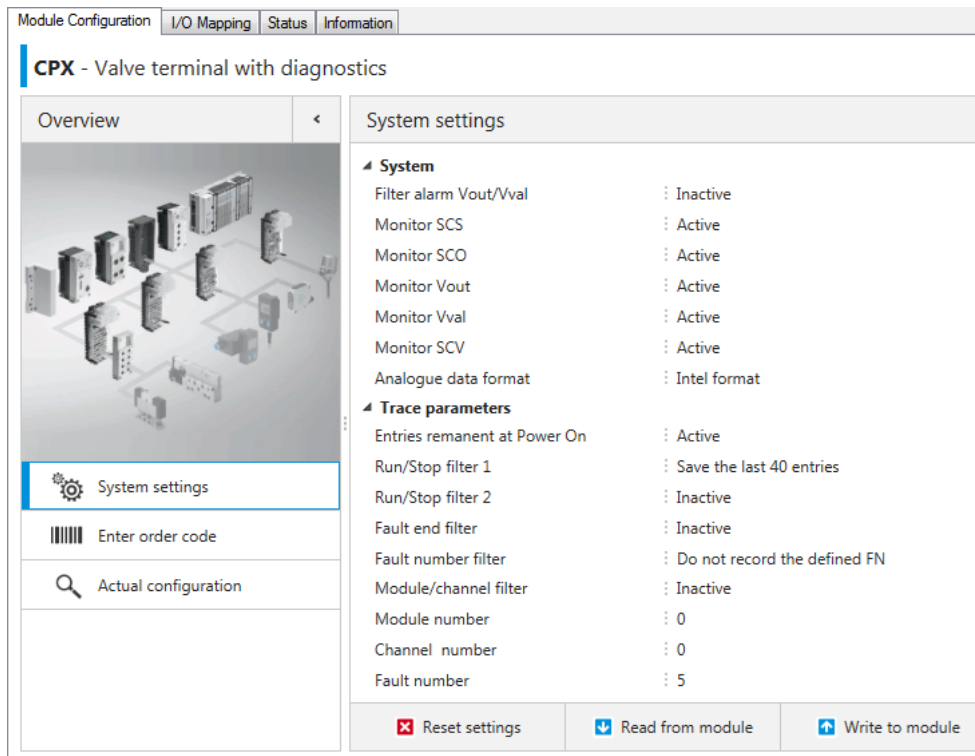


Figure: CPX system settings



The configuration for idle mode can be found in the PLC settings, function "Behaviour for outputs in Stop".

The following options can be set:

- Keep current values
- Set all outputs to default
- Execute program

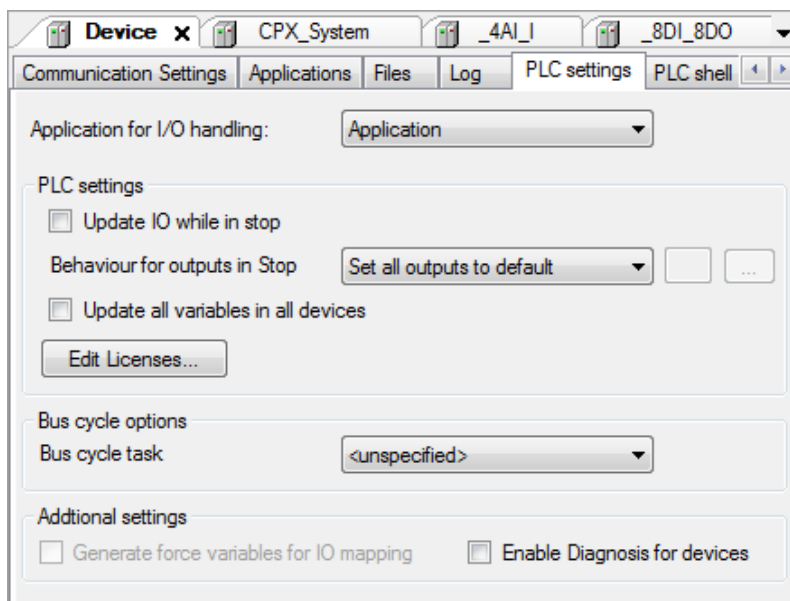


Figure: PLC system settings

The setting of specific values in stop mode can therefore be achieved via the "Execute program" option.

**Note**

General I/O settings in stop mode always also refer to the master interfaces and not just the local inputs and outputs.

Parameterising the CPX module

The parameters of the CPX module are part of the project.

New parameters are only available after the project is downloaded or after the CPX terminal is restarted.

1. Click the CPX module in the CODESYS device window.

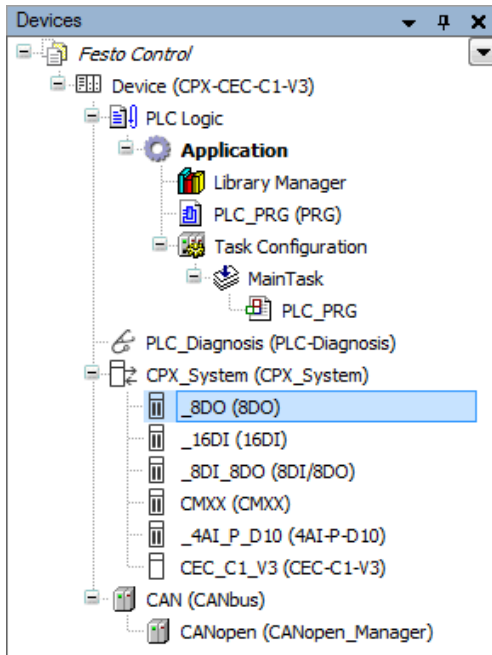


Figure: Selecting a CPX module

2. Double-click the CPX module. This opens the tab for the CPX module in the editing window. The [Module Configuration] sub-tab contains information about the settings for the CPX module.

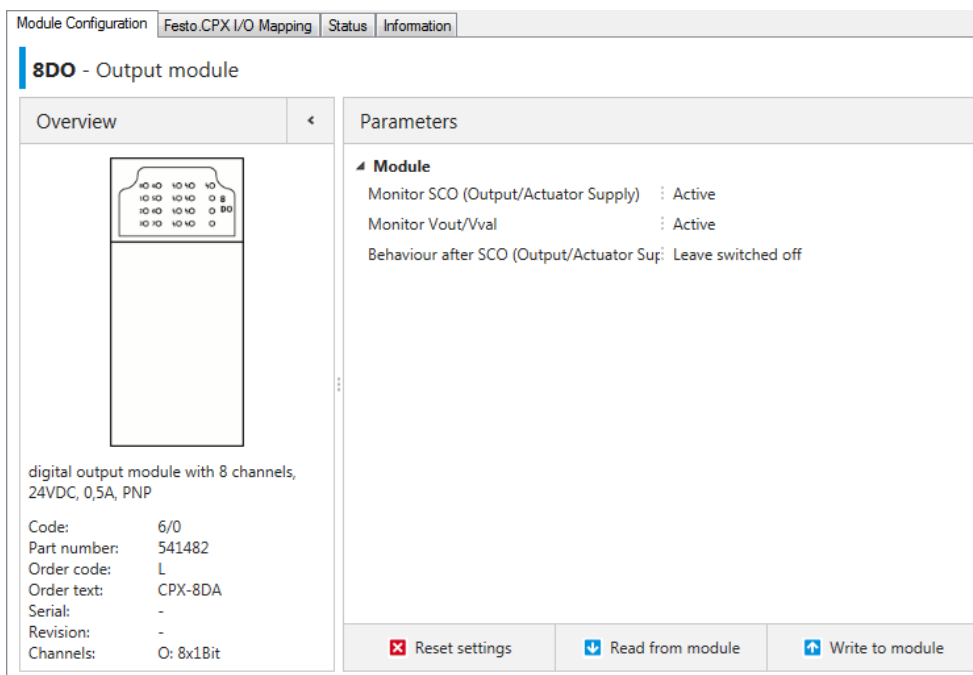


Figure: Editing window with tabs for the CPX module - "Module Configuration" sub-tab



Parameters, serial number and revision are automatically displayed if the CPX module configuration has been automatically read in → Automatically reading in the configuration.

3. Click the "Read from module" button to read in the current values.
4. Change the values of the individual parameters.
5. Transfer the changes using the "Write to module" function or activate online mode.
6. Generate a boot project so that the parameters will be activated in the module after a restart.

The [Festo CPX I/O Mapping] sub-tab contains information about the inputs and outputs of the CPX module.

Variable	Mapping	Channel	Address	Type	Default Value	Unit	Description
		Input 0	%IB10	USINT			
		Bit0	%IX10.0	BOOL	FALSE		
		Bit1	%IX10.1	BOOL	FALSE		
		Bit2	%IX10.2	BOOL	FALSE		
		Bit3	%IX10.3	BOOL	FALSE		
		Bit4	%IX10.4	BOOL	FALSE		
		Bit5	%IX10.5	BOOL	FALSE		
		Bit6	%IX10.6	BOOL	FALSE		
		Bit7	%IX10.7	BOOL	FALSE		
		Output 0	%QB0	USINT			
		Bit0	%QX0.0	BOOL	FALSE		
		Bit1	%QX0.1	BOOL	FALSE		
		Bit2	%QX0.2	BOOL	FALSE		
		Bit3	%QX0.3	BOOL	FALSE		
		Bit4	%QX0.4	BOOL	FALSE		
		Bit5	%QX0.5	BOOL	FALSE		
		Bit6	%QX0.6	BOOL	FALSE		
		Bit7	%QX0.7	BOOL	FALSE		

Reset mapping ☐ Always update variables

= Create new variable = Map to existing variable

Figure: Editing window with tabs for the CPX module - "Festo CPX I/O Mapping" sub-tab



To be able to reliably trace changes to the I/O information in online mode:

- Check the "Always update variables" box.

The CPX module errors can be displayed on the [Status] sub-tab as long as online mode is active.

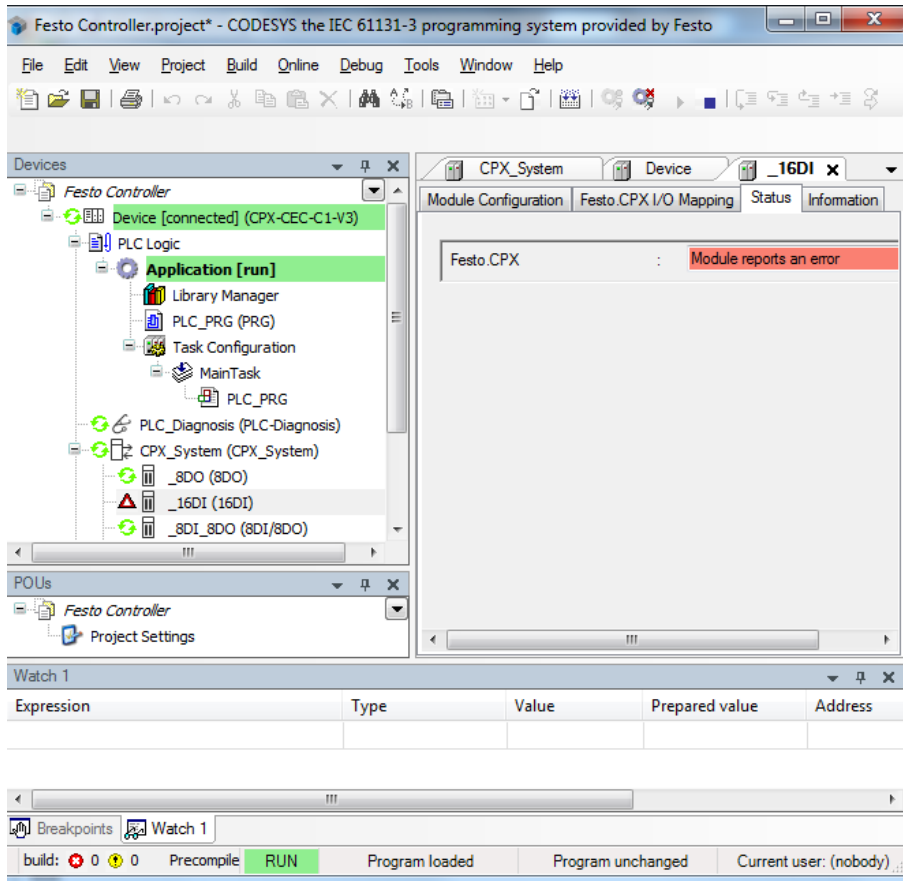


Figure: Status of the CPX module

Information about the CPX module available electronically is displayed on the [Information] sub-tab.

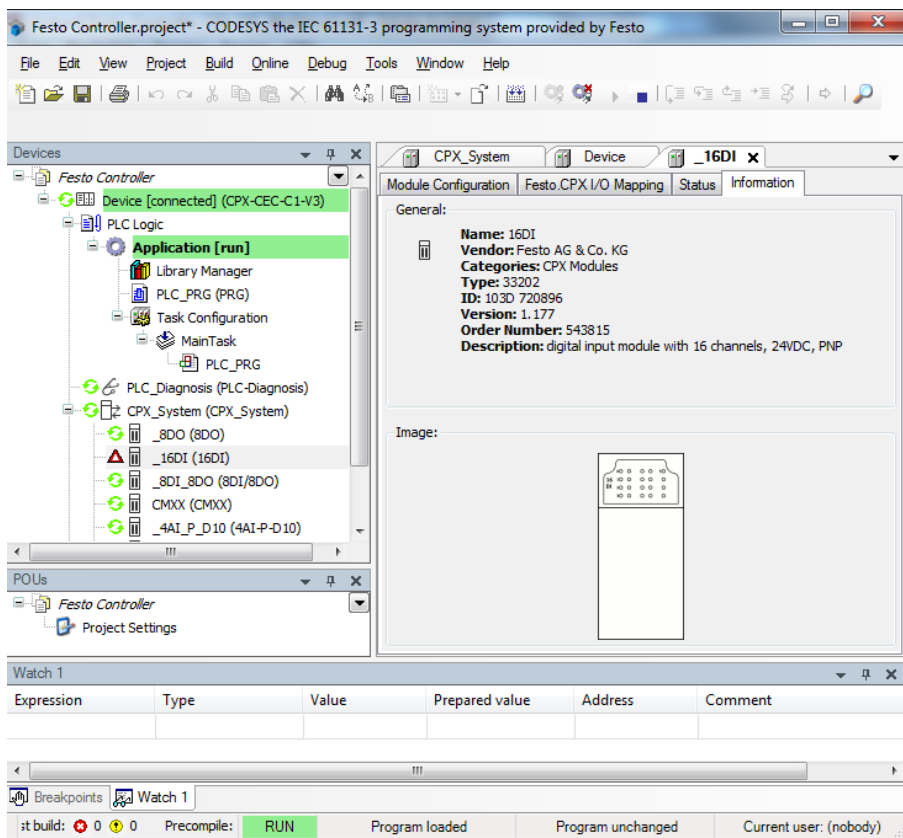


Figure: Information about the CPX module

Parameterising the rotary switch

The rotary switch is permanently assigned to a variable on the [Onboard Bus I/O Mapping] tab. The marking in the configuration area makes this input address available as a global variable (%IB0) so that all the programs in the controller can access this variable.

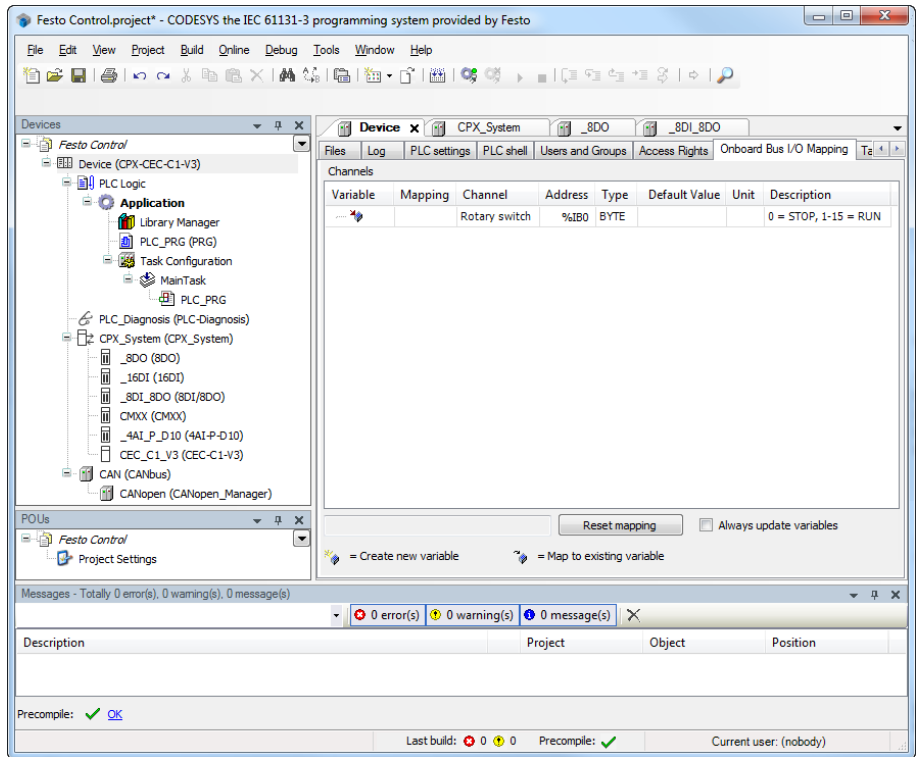


Figure: Rotary switch in the I/O configuration

Switch position	Function
0	Control block is in stop mode. This switch position prevents run mode being activated via CODESYS and therefore the boot project being started.
From x ¹⁾ to 0	A project in run mode will be stopped.
From 0 to x ¹⁾	A project in run mode that was previously stopped by the rotary switch will be switched back to run mode.
1) 0 < x ≤ F	

Table: Rotary switch position

4.7.2 Parameterisation via the operator unit CPX-MMI

The parameters of the CPX terminal can also be read and modified via a connected operator unit CPX-MMI.

Transferring the parameter settings to the CPX modules

**Note**

Parameterisations via CPX-MMI are only saved locally in the CPX terminal and are lost when the power is turned off and restored.
The connection to the CPX-MMI is interrupted while downloading a project if parameters were changed via CODESYS.
Parameters changed by CPX-MMI and Festo_CPX_3.library are overwritten when a project is downloaded.



Further information on parameterisation via CPX-MMI → manual P.BE-CPX-MMI-1-....

4.8 Configuring a CANopen slave



Connecting via CANopen requires an appropriate baud rate.

The [CANbus] tab for setting the baud rate is opened by double-clicking the "CAN" branch in the CODESYS device window.

4.8.1 Adding a CANopen slave

1. Click the "CANopen" branch in the CODESYS device window.

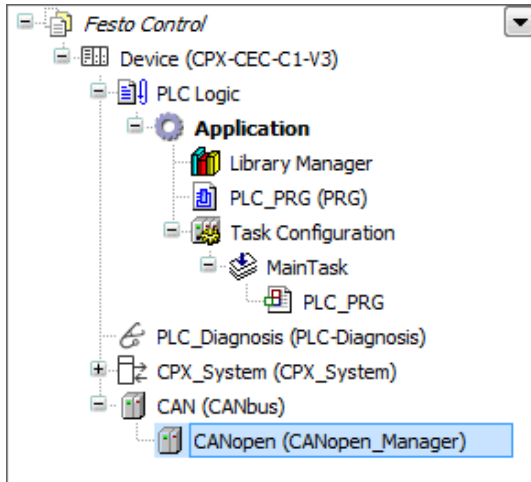


Figure: Device window - "CANopen" branch

2. Open the "Add Device" dialog
 - menu command [Project] [Add Device] or
 - context menu [Add Device].

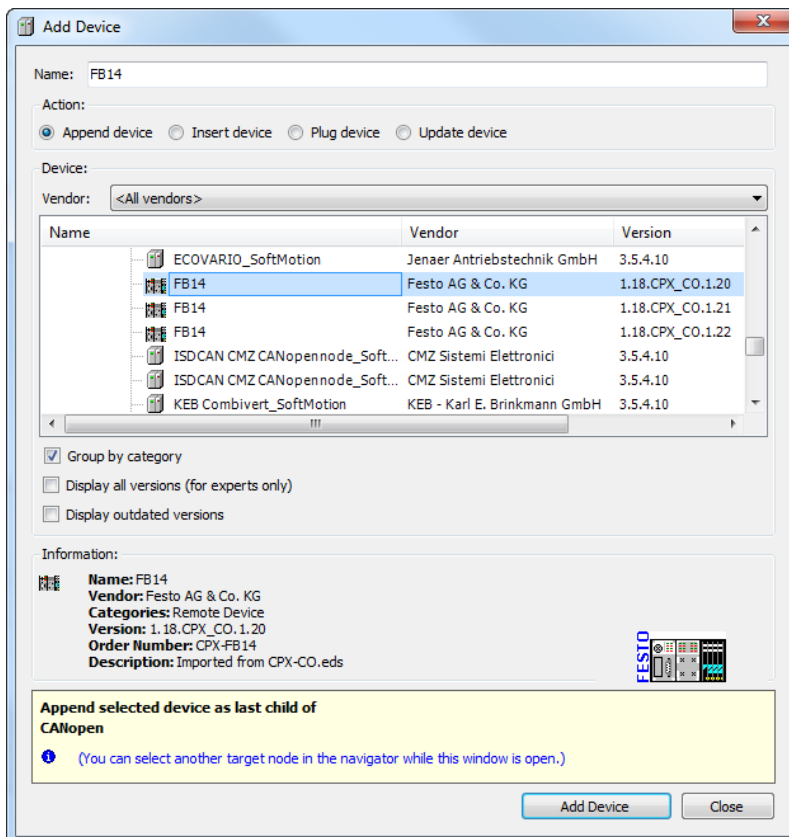


Figure: "Add Device" dialog

3. Click a CANopen slave in the table. Example: FB14
4. Confirm the selection by clicking the "Add Device" button.

5. Repeat steps 3 and 4 to add further devices (max. number of CANopen slaves: 32).
Example: Special case for integrating a valve terminal CPV-CO2 → Integrating CPV terminals.
6. Close the dialog by clicking the "Close" button.
7. Click the added CANopen slave in the device window.

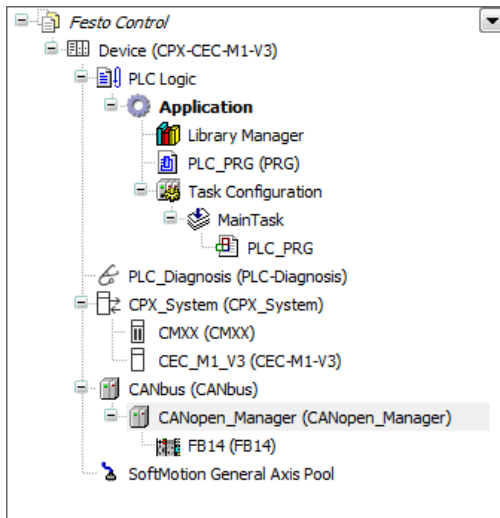


Figure: Device window - CANopen slave (example "FB14")

8. Double-clicking the added device opens the tab for configuring the CANopen slave in the editing window.

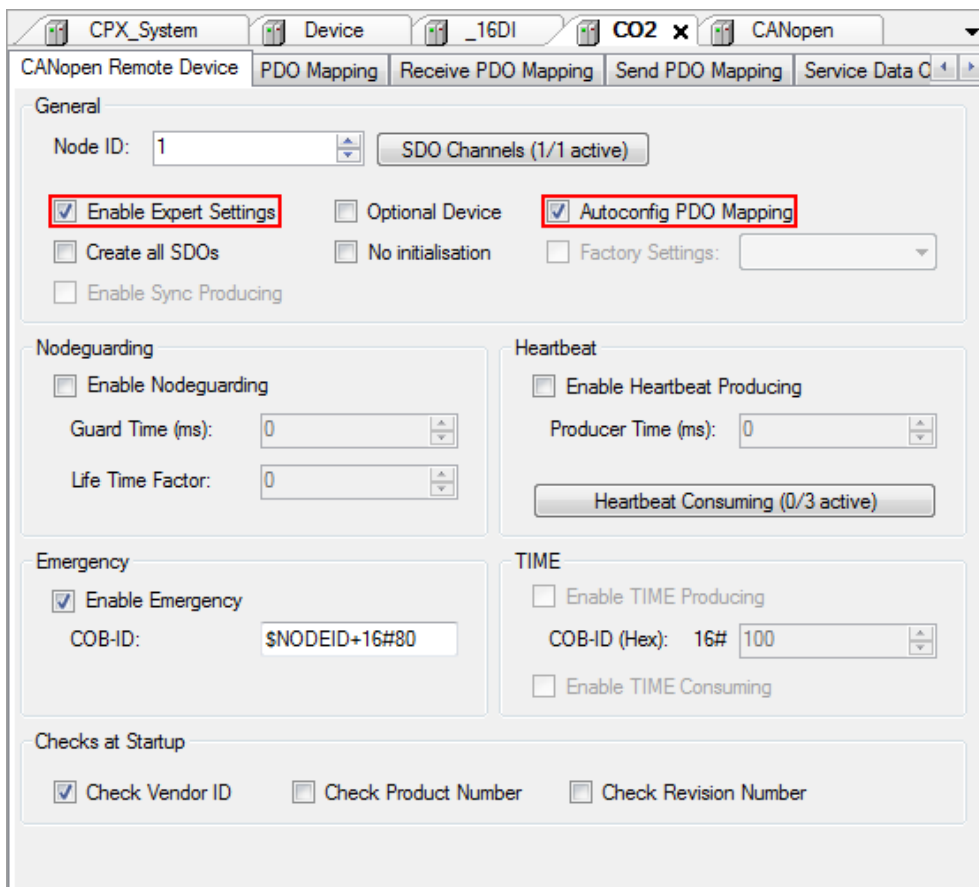


Figure: Editing window with CANopen slave (example "CO2")

9. Check the "Enable Expert Settings" box on the [CANopen Remote Device] tab in the editing window to show all the setting options.



This box is already checked for the control block in CODESYS V3 pbF (default setting).

10. If the CANopen slave supports submodules: check the "Autoconfig PDO Mapping" box on the [CANopen Remote Device] tab in the editing window. This setting executes automatic configuration of the CANopen slave.

The PDO mapping can be found on the sub-tab of the same name.

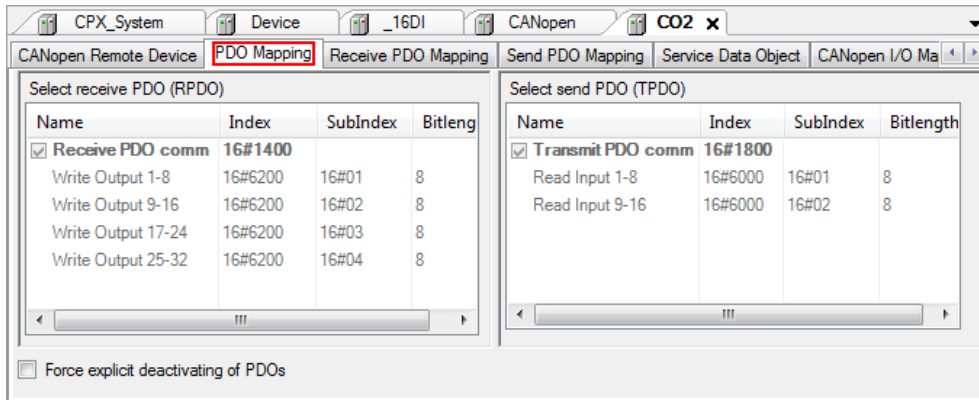


Figure: PDO mapping of the CANopen slave "CO2"

4.8.2 Integrating CPV terminals

CPV terminals are added to CANopen slaves CO2 (CPV-CO2) as submodules (→ Adding a CANopen slave - Step 3).

1. Click the CANopen slave "CO2" in the CODESYS device window.
2. Open the "Add Device" dialog
 - menu command [Project] [Add Device] or
 - context menu [Add Device].
3. Click the CPV terminal you are using or one of the optional modules in the table.

CPV terminal	Explanation
CPV basic unit	Local inputs/outputs (valves)
CPV/CPA valve terminal	Optional extension for a CPV terminal
CP input/output module	
CP input module	Optional extension for a CPV terminal
CP output module	Optional extension for a CPV terminal

4. Confirm the selection by clicking the "Add Device" button.
5. Double-click the added CPV terminal in the device window.

The tab for configuring the CPV terminal appears in the editing window.

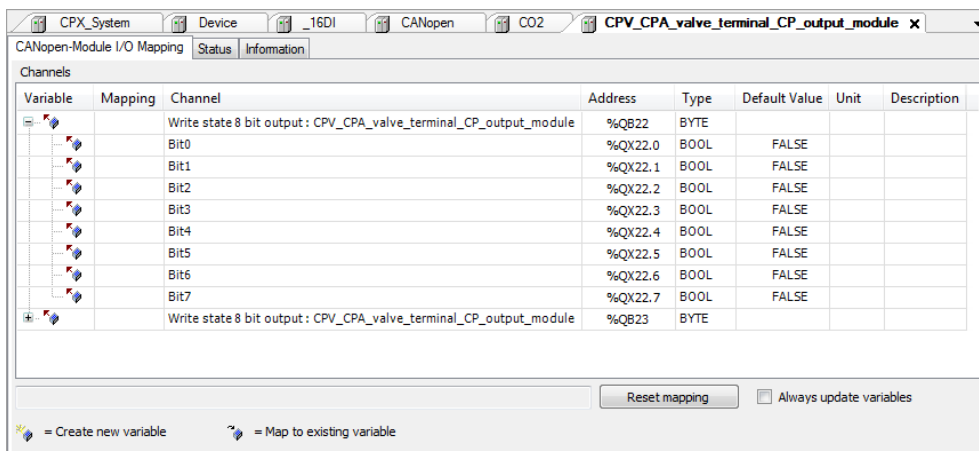


Figure: Editing window with CPV terminal as a CANopen slave

4.9 Configuring SoftMotion (only CPX-CEC-M1-V3)

The SoftMotion software package is available as an extension within CODESYS with the control block CPX-CEC-M1-V3. It allows coordinated multi-axis movements. Specific CPX-CEC-M1-V3 control block features are produced in accordance with the CPX system properties.

4.9.1 Motor controllers supported

CMMS-ST-...	CMMP-AS-...	CMMP-AS-...-M3	CMMP-AS-...-M0
...C8-7-G2	...C20-11A-P3	...C2-3A... ...C5-3A... ...C5-11A-P3... ...C10-11A-P3...	...C2-3A... ...C5-3A... ...C5-11A-P3... ...C10-11A-P3...

4.9.2 Number of axes

The number of axes in SoftMotion is basically unlimited. The possible number of axes varies depending on the complexity of the application. The key parameters for determining the number of axes are the bus cycle time (guide value is 500 µs per servo controller at a transfer rate of 1 MB) and the actual cycle time in the SoftMotion program. We recommend operating up to 8 axes on a control block CPX-CEC-M1-V3.

4.9.3 Cycle time/interpolation time

Different cycle times must be observed depending on the connected motor controller → Figure Configuring the CANopen_Manager.



When using at least one motor controller of the type CMMS-ST, permanently set the sync cycle time to 8 ms.

If only motor controllers of the type CMMP-AS are used, differing settings (e.g. 4 ms) are also possible.

4.9.4 FCT settings for SoftMotion

The following table lists the FCT settings for SoftMotion, differentiated according to all motor controllers supported.

FCT setting	CMMP-AS-...	CMMS-ST-...
Control Interface	CANopen	CANopen
CAN address/node number	Set using FCT or DIL switch	Set using DIL switch
Bit rate	125 kBaud, 250 kBaud, 500 kBaud or 1 MBaud Set using FCT or DIL switch	125 kBaud, 250 kBaud, 500 kBaud or 1 MBaud Set using DIL switch
Protocol/data profile	CiA402	CiA402
Factor group	Not used	Not used
Supply voltage	Internal only	Internal only

4.9.5 Carrying out configuration

1. In the task configuration, open the task responsible for executing the function blocks that generate the movement.

i In the following steps, the task containing the function blocks that generate the movement is called "MotionTask".

2. Make sure that the priority of the "MotionTask" is set to a real-time priority.

i Real-time priorities are in the range from 0 to 15.
Priorities > 15 are non-real-time priorities.

3. Set the MotionTask type to "External" and the external event to "CANopen_SYNC".

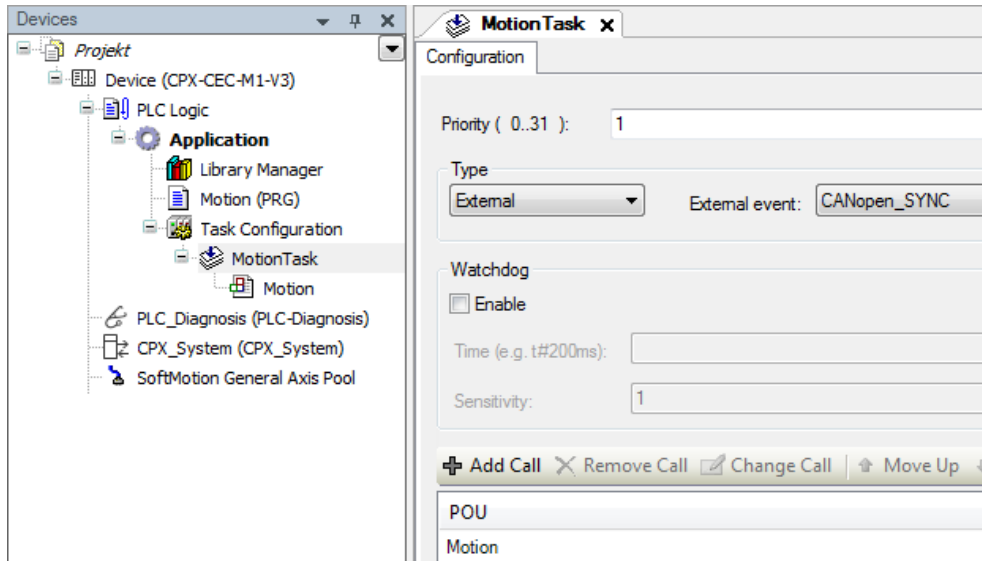


Figure: Configuring a MotionTask

4. Add a CAN bus node to the control block CPX-CEC-M1-V3.
5. Double-click the CAN bus node and set the baud rate.

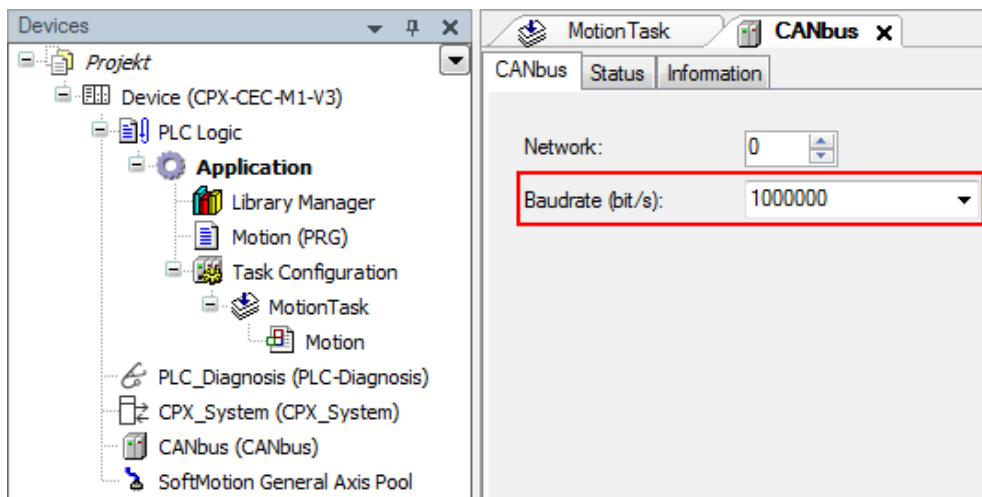


Figure: Configuring the CAN bus

6. Add a CANopen_Manager to the CAN bus node.
7. Double-click the CANopen_Manager.

8. Check the "Enable Sync Producing" box and enter a cycle time in the "Cycle Period (μ s)" field.



This cycle time is used for the "Sync Producing" option and for the MotionTask cycle time
→ Step 3.

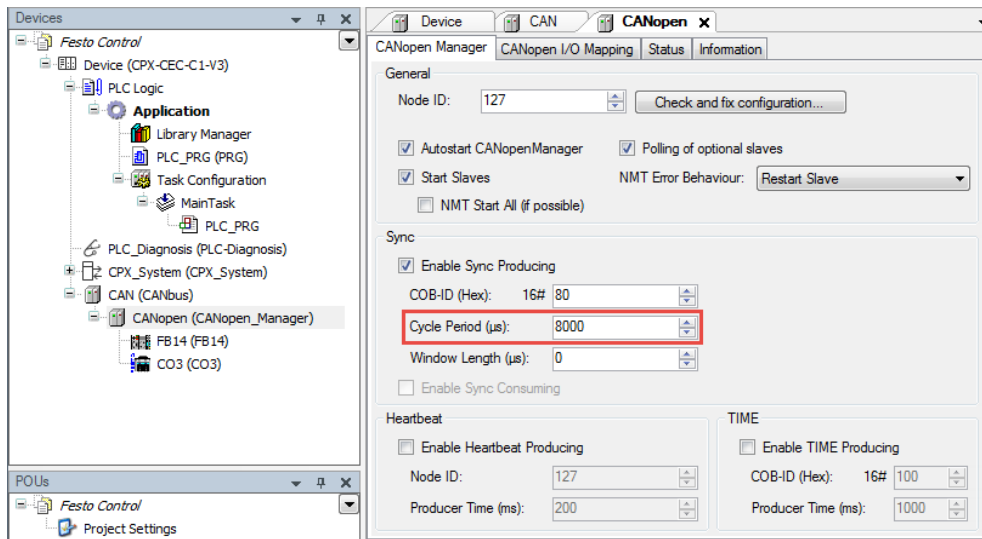


Figure: Configuring the CANopen_Manager

9. Set "MotionTask" as the bus cycle task on the [CANopen I/O Mapping] sub-tab.

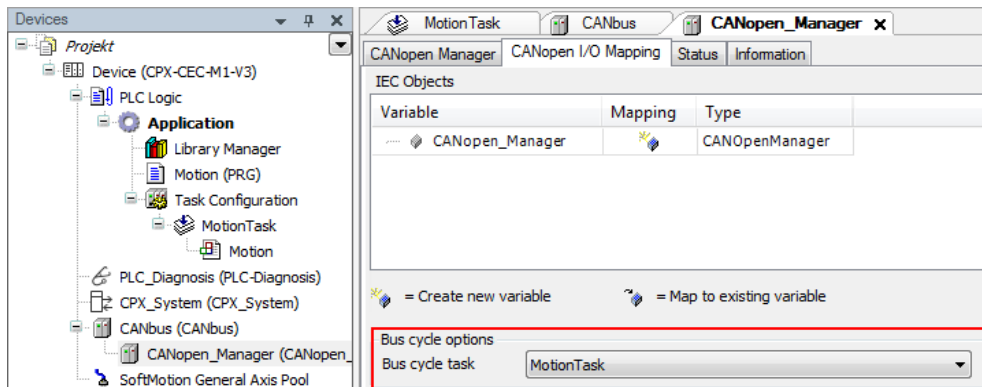


Figure: Configuring a bus cycle task

10. Add SoftMotion drives to the CANopen_Manager (e.g. CMMP_AS_C2_3A_M3_SoftMotion).



Virtual drives can be added to the "SoftMotion General Axis Pool".
In doing so, it is generally a good idea to assign specific names (e.g. DriveX).

11. Set the node IDs of the drives as appropriate to the FCT configuration.

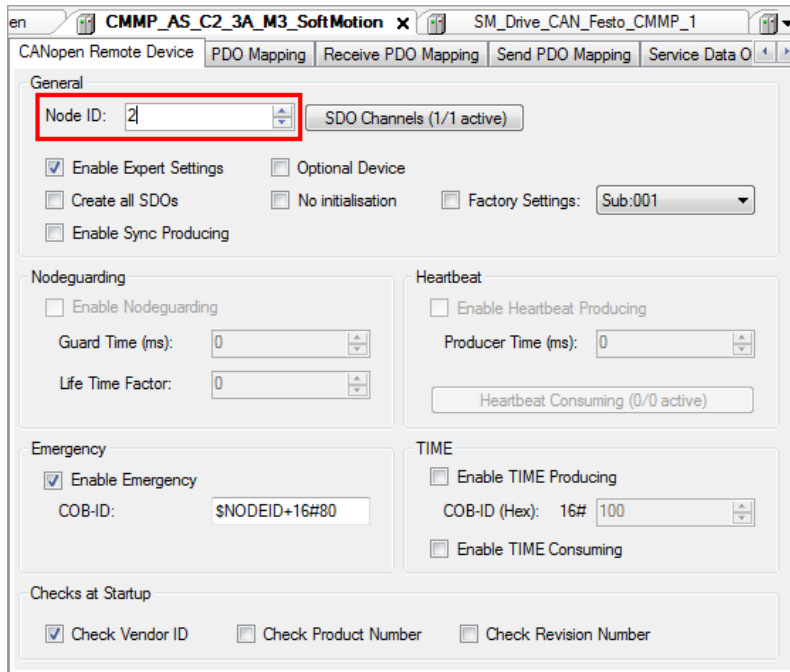


Figure: Configuring a node ID

12. Configure the basic parameters of the individual SoftMotion drives.

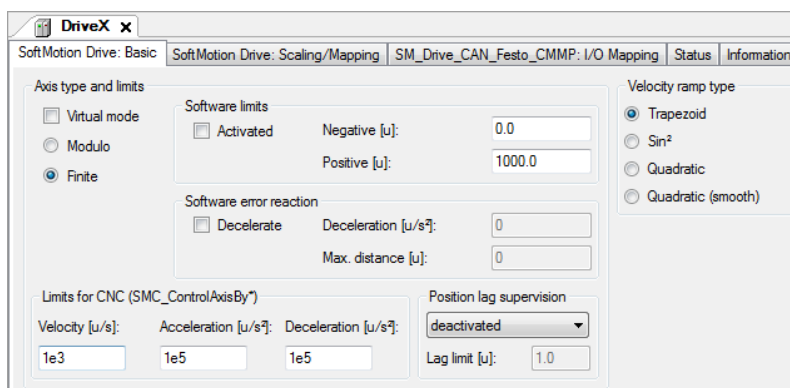


Figure: Configuring basic parameters

13. Configure the scaling factors for the individual SoftMotion drives.

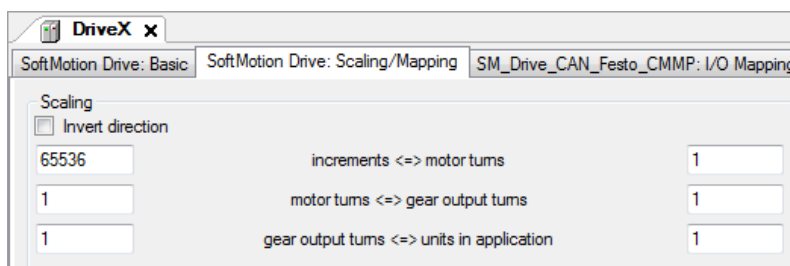


Figure: Configuring the scaling factors



All other information is contained in the CODESYS online Help:

→ [SoftMotion] [SoftMotion Drive Interface / SoftMotion Device Editor] [SoftMotion Device Editor]

4.10 Configuring Modbus TCP

The control block supports Modbus TCP Client as well as Modbus TCP Server.

The control block can be used simultaneously as both a server and a client.

Terms used in CODESYS	Description
Modbus TCP master	Group of Modbus TCP clients
Modbus TCP slave	Modbus TCP client
Modbus TCP slave device	Modbus TCP server

4.10.1 Configuring Ethernet

1. Click the "Device (CPX-CEC-...-V3)" branch in the CODESYS device window.
2. Open the "Add Device" dialog
 - menu command [Project] [Add Device] or
 - context menu [Add Device].

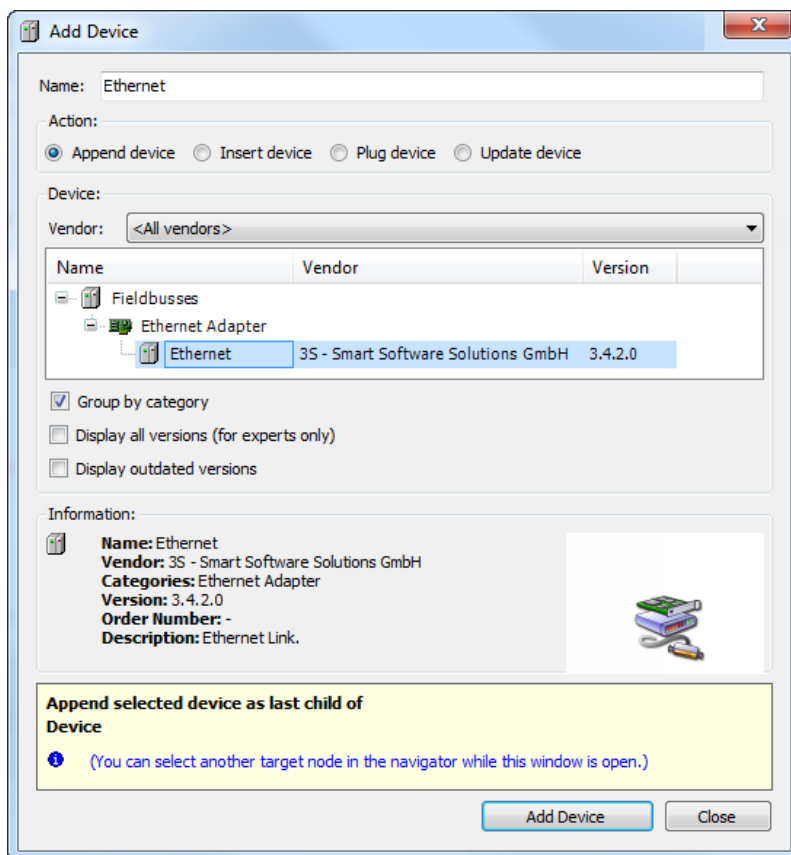


Figure: Add Device - selecting "Ethernet"

3. Select the company "3S - Smart Software Solutions GmbH" in the "Vendor" drop-down list.
4. Select the entry "Ethernet" in the "Device" drop-down list.
5. Click the "Add Device" button.
Leave the "Add Device" dialog open.
6. If you want to configure the control block CPX-CEC-...-V3 as a Modbus TCP client → Configuring the control block as a Modbus TCP client.
7. If you want to configure the control block CPX-CEC-...-V3 as a Modbus TCP server → Configuring the control block as a Modbus TCP server.



Detailed information on Modbus TCP → CODESYS online Help.

4.10.2 Configuring the control block as a Modbus TCP client

1. Click the "Ethernet" branch in the device window.
If there is no "Ethernet" branch added to the control block CPX-CEC-...-V3, add an "Ethernet" branch
→ Configuring Ethernet.
2. Select the module "Modbus TCP Master" in the "Add Device" dialog.
3. Click the "Add Device" button.
Leave the "Add Device" dialog open.

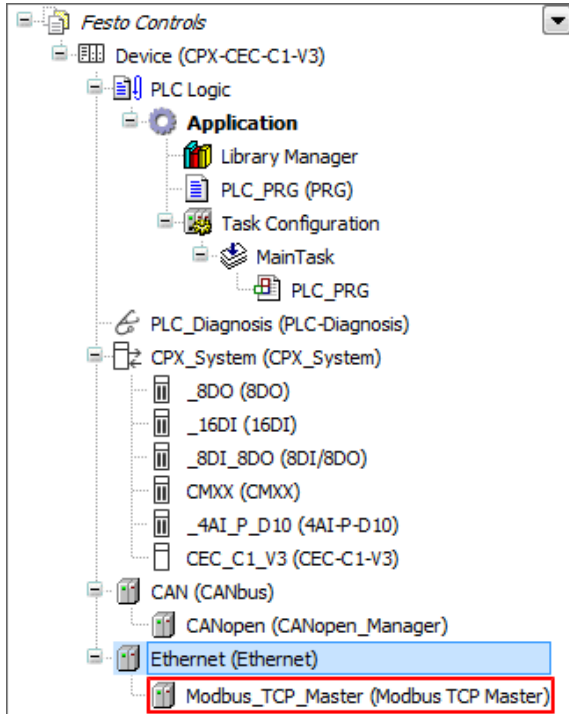


Figure: Device window - selecting "Modbus TCP Master" in the "Ethernet" branch

4. Click the new "Modbus TCP Master" branch.
5. Select the module "Modbus TCP Slave" in the "Add Device" dialog.
6. Click the "Add Device" button.
If you want to add even more devices, leave the "Add Device" dialog open.

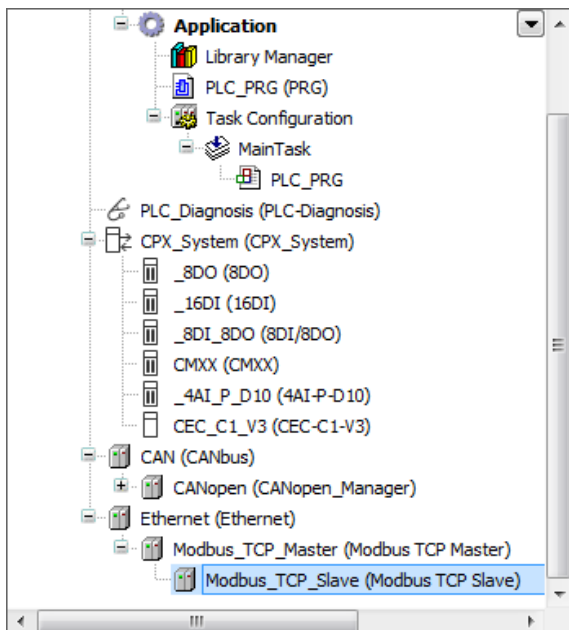


Figure: Device window - selecting "Modbus TCP Slave" in the "Modbus TCP Master" branch

7. Double-click the new "Modbus TCP Slave" branch.

Several tabs for parameterising the selected "Modbus TCP Slave" are displayed in the editing window.

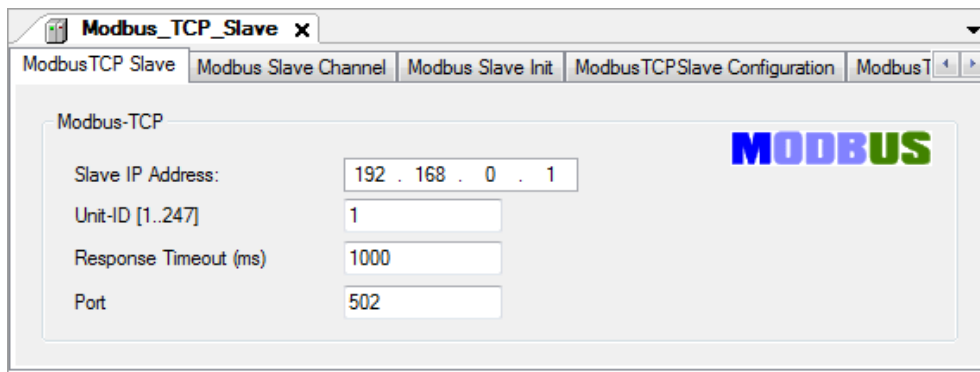


Figure: Editing window with [Modbus TCP Slave] tab (parameters)

8. Enter the IP address of the assigned Modbus TCP server.

9. Enter the unit ID of the Modbus TCP server.

This unit ID must be the same as the unit ID in the assigned Modbus TCP server in order for communication to take place.

10. Enter the port of the Modbus TCP server.

To configure the I/O mapping, appropriate channels must be added.

11. Click the "Modbus Slave Channel" sub-tab.

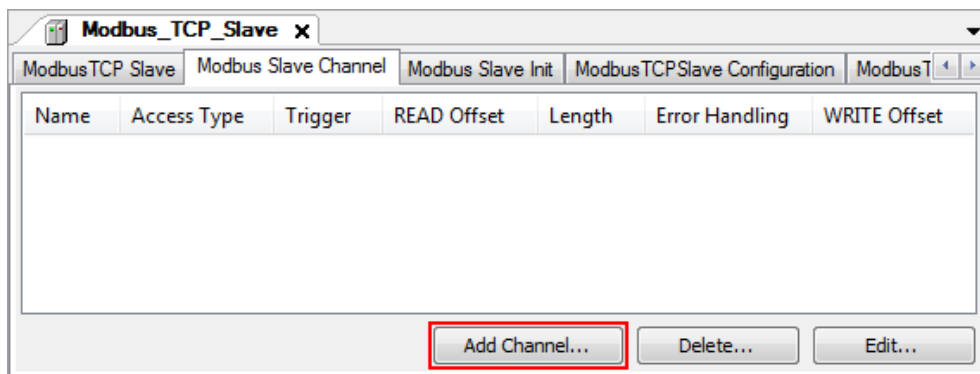


Figure: [Modbus Slave Channel] tab - adding a channel

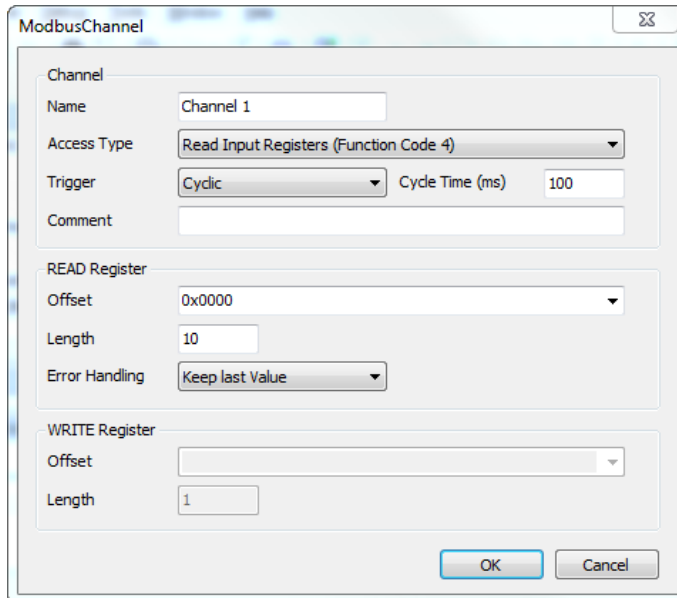
12. Click the "Add Channel..." button and set the desired parameters → CODESYS online Help.



When using the control block as a Modbus TCP client:

- The access type "Read Input Registers" (function code 04) provides access to the address range %QW of a Modbus TCP server
- The access type "Write Multiple Registers" (function code 16) provides access to the address range %IW of a Modbus TCP server

13. Specify in the "Length" field how many words should be read and written.

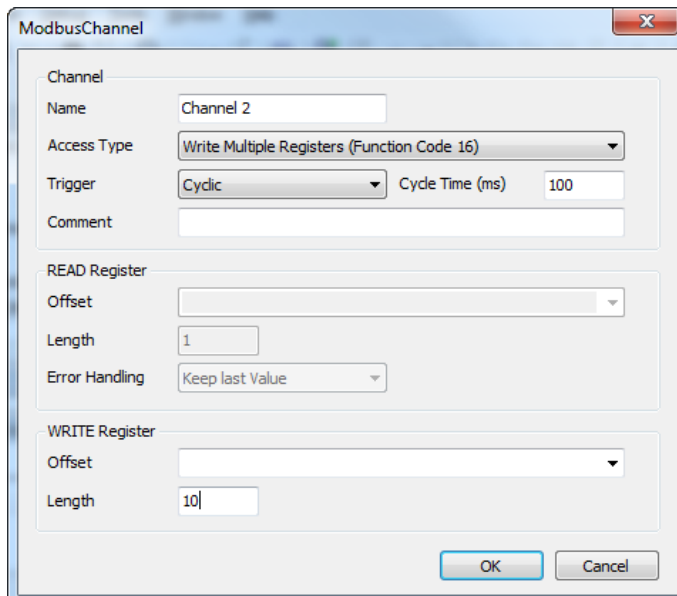


The ModbusChannel dialog box for Channel 1 shows the following settings:

- Channel Name:** Channel 1
- Access Type:** Read Input Registers (Function Code 4)
- Trigger:** Cyclic
- Cycle Time (ms):** 100
- Comment:** (empty)
- READ Register:**
 - Offset:** 0x0000
 - Length:** 10
 - Error Handling:** Keep last Value
- WRITE Register:**
 - Offset:** (empty)
 - Length:** 1

Buttons: OK, Cancel

Figure: Settings on channel 1



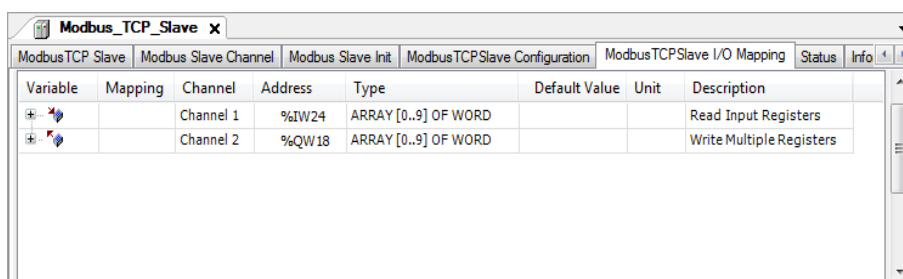
The ModbusChannel dialog box for Channel 2 shows the following settings:

- Channel Name:** Channel 2
- Access Type:** Write Multiple Registers (Function Code 16)
- Trigger:** Cyclic
- Cycle Time (ms):** 100
- Comment:** (empty)
- READ Register:**
 - Offset:** (empty)
 - Length:** 1
 - Error Handling:** Keep last Value
- WRITE Register:**
 - Offset:** (empty)
 - Length:** 10

Buttons: OK, Cancel

Figure: Settings on channel 2

This gives the control block an I/O map of the Modbus TCP server.



Variable	Mapping	Channel	Address	Type	Default Value	Unit	Description
		Channel 1	%IW24	ARRAY [0..9] OF WORD			Read Input Registers
		Channel 2	%QW18	ARRAY [0..9] OF WORD			Write Multiple Registers

Figure: [Modbus TCP Slave I/O Mapping] tab

14. Repeat steps 4 to 13 for each additional Modbus TCP server (Modbus TCP slave) to be grouped with the selected Modbus TCP master.
15. Repeat steps 1 to 14 for each additional Modbus TCP master.

4.10.3 Configuring the control block as a Modbus TCP server

1. Click the "Ethernet" branch in the device window.
If there is no "Ethernet" branch added to the control block CPX-CEC-...-V3, add an "Ethernet" branch
→ Configuring Ethernet.
2. Select the module "Modbus TCP Slave Device" in the "Add Device" dialog.
3. Click the "Add Device" button.
If you want to add more devices, leave the "Add Device" dialog open.

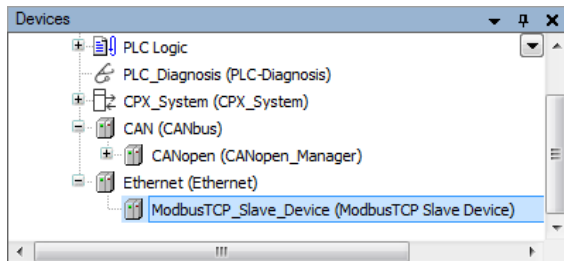


Figure: Device window - selecting "ModbusTCP Slave Device" in the "Ethernet" branch

4. Double-click the "ModbusTCP Slave Device" branch.
Several sub-tabs for parameterising the selected "Modbus TCP Slave Device" are displayed in the editing window.

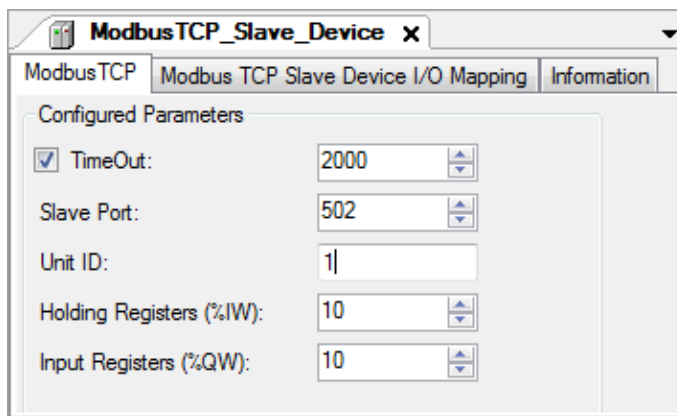


Figure: [Modbus TCP Slave Device] tab - [ModbusTCP Configuration] sub-tab

i If the value of the "Timeout" option is greater than zero and the holding registers are not accessed during this time, the holding register values (%IW) are automatically reset after this time elapses.

5. Enter the unit ID of the Modbus TCP server.
6. Enter the port of the Modbus TCP server.
7. Repeat steps 1 to 6 for each additional Modbus TCP server.

4.11 Online mode



Caution

Risk of injury due to uncontrolled movements of the connected actuators.

- Test projects and programs initially without active actuators and without compressed air.

A configured project including program (CPX-CEC-...-V3 application) is to be transferred to the control block. Online mode must be activated for transfer, i.e. CODESYS must be "logged in" on the control block.

4.11.1 Login



- Log in by carrying out one of the following actions:
 - Click the icon in the toolbar of the CODESYS program window
 - Menu command [Online] [Login]
 - Key combination ALT+F8.

CODESYS logs in to the control block connected via the active path in the gateway.

The first step is a comparison of whether the connected control block is the same as the target system selected in the project. An error message appears if there is a conflict → Control block variants.

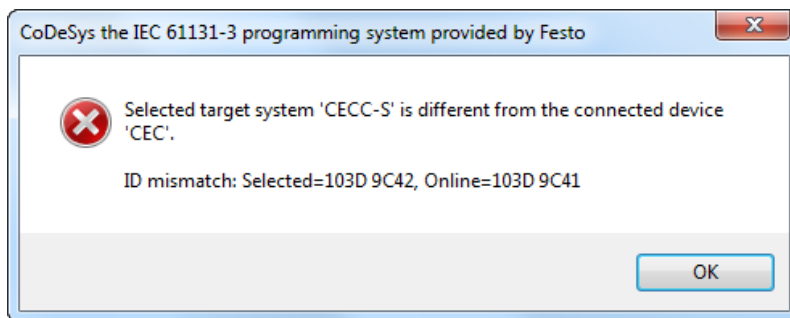


Figure: Warning message about an incorrect target system ID

The next step is a comparison of the project and the application on the control block. The following query appears if the project has been changed.

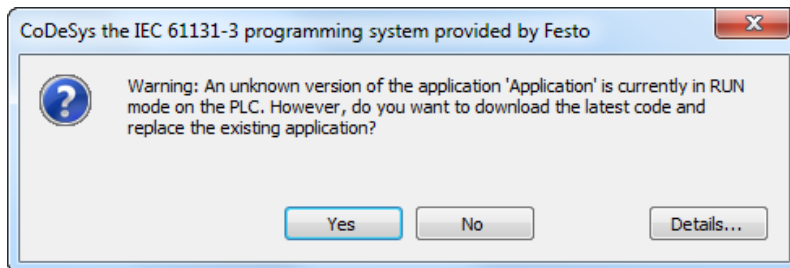


Figure: Query if the versions are different

- Decide how to handle the version differences between the CODESYS project and the application in the control block → CODESYS online Help - "Login".

The connection with the control block is indicated in the CODESYS device window by a green bar:

- Device [connected] (control block)
- Application

The application is not started (not running), the "RUN" status LED lights up yellow.

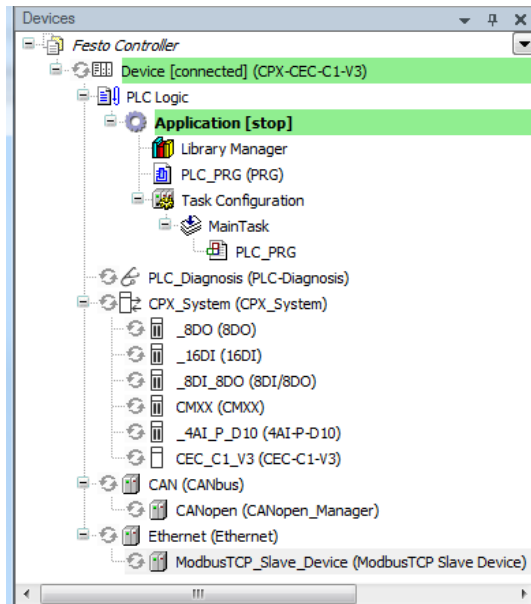


Figure: Device window in online mode

4.11.2 Starting and monitoring the application

The application can be started if error-free data has been transferred.



- Start the application by carrying out one of the following actions:
 - Click the icon in the toolbar of the CODESYS program window
 - Menu command [Debug] [Start]
 - Function key F5.

The entries for the control block and the application are shown against a green background in the device window. The application is running. [run] appears after the application. The circular arrows light up green. The "RUN" status LED lights up green.

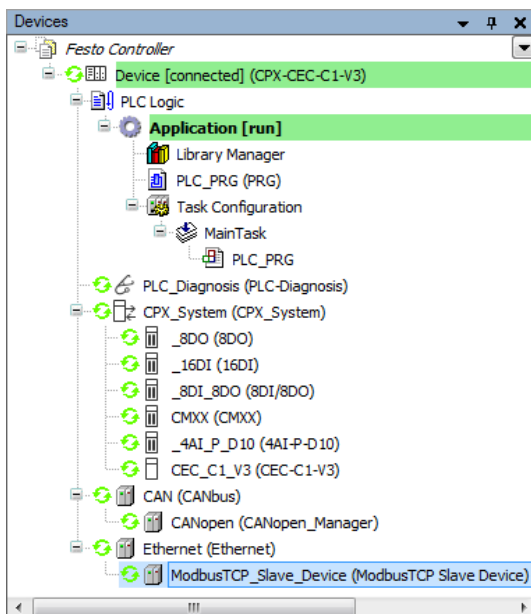


Figure: Device window with control block CPX-CEC-...-V3 in debug mode

4.11.3 Logout



Log out by carrying out one of the following actions:

- Click the icon in the toolbar of the CODESYS program window
- Menu command [Online] [Logout]
- Key combination CTRL+F8.



Further information on monitoring and controlling the application → CODESYS online Help.

4.12 Forcing

Forcing allows you to manipulate input and output signals. Actual input signals or status changes by program are ignored and replaced by the force values.



Warning

High acceleration forces of the connected actuators.

Uncontrolled movements of the actuators can cause collisions resulting in serious injury.

- Be very careful when forcing to avoid uncontrolled movements of the actuators.
- Make sure that nobody enters the positioning range of the actuators.

You have various options for influencing input or output signals, e.g. for test purposes:

- Forcing via the operator unit CPX-MMI
- Forcing via CODESYS



If several functions are active at the same time, the following applies:

- Force signals generally have the highest priority.
- Forcing via the operator unit has higher priority than forcing via CODESYS.

Further information on forcing → CPX system manual P.BE-CPX-SYS-....

4.12.1 Forcing via the operator unit CPX-MMI

Forcing an input does not modify the input signal itself and cannot be observed at the relevant status LED. The logical status of the input changes internally and has an effect on the program.

Forcing an output modifies the actual output signal and can be observed at the relevant status LED. However, the forced output signal is not transferred to the image table of the outputs.



Note

CODESYS always shows the signal status valid in the image table in online mode.

- Note the following when forcing with the operator unit CPX-MMI:
 - Forced input states are transferred to the image table and are therefore detected by the controller. They are visible in the online display.
 - Forced output states are not transferred to the image table and are therefore not detected by the controller. They are therefore not visible in the online display.

4.12.2 Forcing via CODESYS online mode

→ CODESYS online Help: Forcing and writing variables.

4.13 PLC shell

The PLC shell is a text-based controller monitor (terminal). Commands for requesting certain information are entered in the input line and sent to the controller. The returned response strings from the controller are displayed in the CODESYS editing window. This functionality is used for diagnostic, debugging and configuration purposes.

To use the PLC shell:

1. Click the control block (Device) in the CODESYS device window.
2. Double-click the control block. This opens the [Device] tab in the editing window for configuring the control block.
3. Open the [PLC shell] sub-tab.

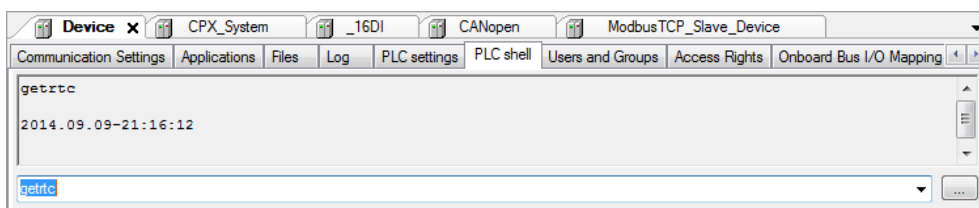


Figure: Editing window with [PLC shell] sub-tab

An online connection between CODESYS and the control block is required for communication using the PLC shell → Online mode.



The target system ID of the control block in the active path must be the same as the device type in the project.

List of standard commands for any target systems → CODESYS online Help.

The following commands are additionally available for the control block CPX-CEC-...-V3.

Command	Comment
?	Shows the list of all commands for the device in the active path.
getrtc	Shows the current real-time clock data.
setrtc YYYY-mm-dd-HH:MM:SS	Sets the current real-time clock data. Example: setrtc 2011-01-25-15:13:26
canlog	Functions for CAN logging. Use the /? option to display the possible parameters. canlog /?
cangetconfig	Shows the current CAN configuration parameters.
cansetconfig	Sets the CAN configuration parameters. Use the /? option to display the possible parameters. cansetconfig /?

Table: PLC shell commands

5 Diagnosis



Warning

When an error occurs, the controller carries on the active program instead of stopping. Uncontrolled actuator movements can cause collisions resulting in serious injury.

- Integrate error handling mechanisms for all error categories in the user program.
- Make sure that nobody enters the positioning range of the drives or other connected actuators.

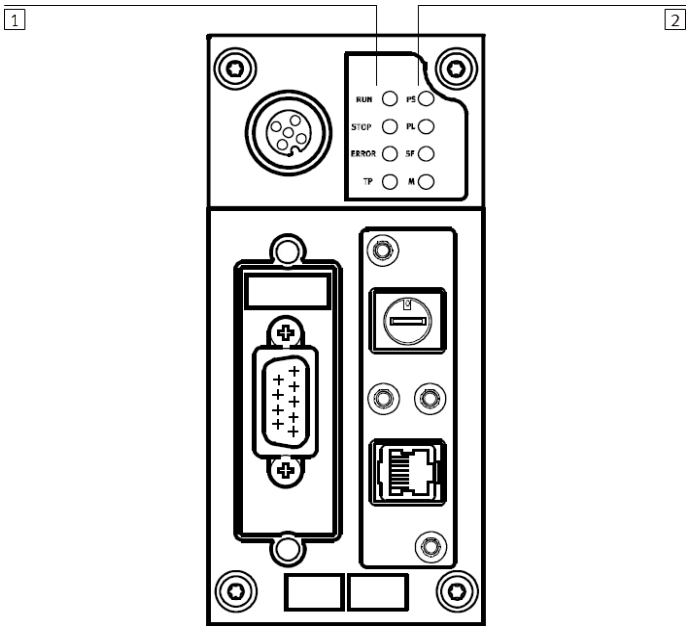
The following tools are available for diagnosis:

Diagnosis via	Advantages
Status LEDs	Fast, local error detection using the indicators on the product → Status LEDs.
CPX-MMI	Fast, local error detection → CPX system manual P.BE-CPX-SYS-... and manual for the operator unit CPX-MMI.
CODESYS	Diagnosis in online mode – In the device window → PLC diagnosis – On the [Log] sub-tab with the "FestoLog" logger → FestoLog – In the "Scan Festo Devices" dialog → Scan Festo Devices
Web server	Shows system diagnosis
SoftMotion	Shows errors when using SoftMotion drives
Libraries	– General device diagnosis with Festo_General_3.library – CPX-specific diagnosis with Festo_CPX_3.library – CANopen diagnosis with CAA_CiA405.library

Table: Diagnostic tools

5.1 Status LEDs

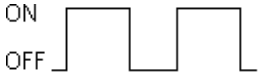
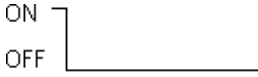
The LEDs of the control block indicate the operating condition of the device.



- 1 RUN PLC status: started (green)¹⁾ 2 PS Electronics supply, sensor supply (green)
- STOP PLC status: stopped (yellow)¹⁾ PL Load supply (green)
- ERROR PLC runtime error (red) SF System fault (red)
- TP Ethernet connection: Link/Traffic (green) M Modify/force active (yellow)

1) The RUN and STOP LEDs indicate the status of the RUN/STOP rotary switch
Figure: Status LEDs on the control block

LED	Sequence		Meaning	Error handling
RUN (PLC status started)	 Lights up green	ON  OFF	PLC program started (RUN/STOP switch set to position "1 ...F")	–
	 Does not light up	ON  OFF	PLC program stopped (RUN/STOP switch set to position "0")	• Set RUN/STOP switch to position "1 ... F"
STOP (PLC status stopped)	 Lights up yellow	ON  OFF	PLC program stopped (RUN/STOP switch set to position "0")	• Set RUN/STOP switch to position "1 ... F"
	 Does not light up	ON  OFF	PLC program started (RUN/STOP switch set to position "1 ...F")	–
ERROR (PLC runtime error)	 Lights up red	ON  OFF	PLC program error Error number: CPX error	• Read out error code via operator unit or CODESYS

LED	Sequence		Meaning	Error handling
	 Does not light up		No error	–
TP (Ethernet connection: Link/Traffic)	 Lights up green		Ethernet connection OK	–
	 Flashes green		Data transfer active (LED flashes at irregular intervals)	–
	 Does not light up		Ethernet connection to parameterisation PC not OK	• Check connection • Check IP address
PS (power system)	 Lights up green		No error. Operating voltage/sensor supply present	–
	 Flashes green, quickly		Operating voltage/sensor supply outside the tolerance range	• Eliminate undervoltage
	 Flashes green, slowly		Internal fuse for the operating voltage/sensor supply has blown	• Eliminate short circuit/overload on module side • Depends on the parameterisation of the module (module parameter): – The sensor supply voltage will be switched on again automatically when the short circuit has been eliminated (default) – Power must be turned off and restored
	 Does not light up		No operating voltage/sensor supply present	• Check the operating voltage connection of the electronics
PL (power load)	 Lights up green		No error. Load voltage present	–
	 Flashes green		Load voltage at the system supply or additional supply outside the tolerance range	• Eliminate undervoltage

LED	Sequence		Meaning	Error handling
SF (system failure)	 Flashes red	ON  OFF 	Minor error (class 1)/information	➔ Error numbers in the CPX system manual P.BE-CPX-SYS-...
		ON  OFF 	Error (class 2)	
		ON  OFF 	Serious error (class 3)	
	 Does not light up	ON  OFF 	No error	–
M (Modify: Modify/force active)	 Flashes yellow	ON  OFF 	Forcing is active The Force function is enabled ➔ CPX system manual, system parameter Force mode; function no. 4402.	–
	 Does not light up	ON  OFF 	Forcing is not active	–

Table: Status LED states

5.2 Online diagnosis with CODESYS

5.2.1 PLC diagnosis

Diagnostic information is recorded and displayed centrally in PLC diagnosis.

1. Double-click the "PLC_Diagnosis" branch in the CODESYS device window.

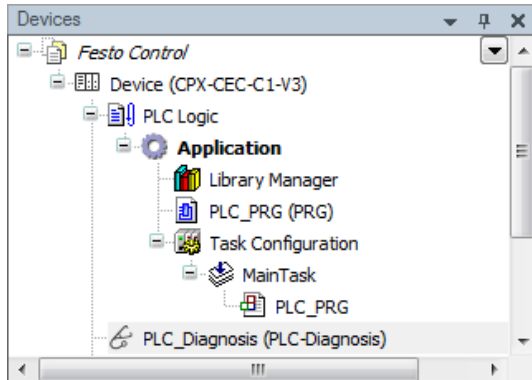


Figure: "PLC_Diagnosis" in the device window

2. Click the [PLC-Diagnosis] sub-tab in the editing window.

You are shown an overview of all the diagnostic messages of the CPX terminal.

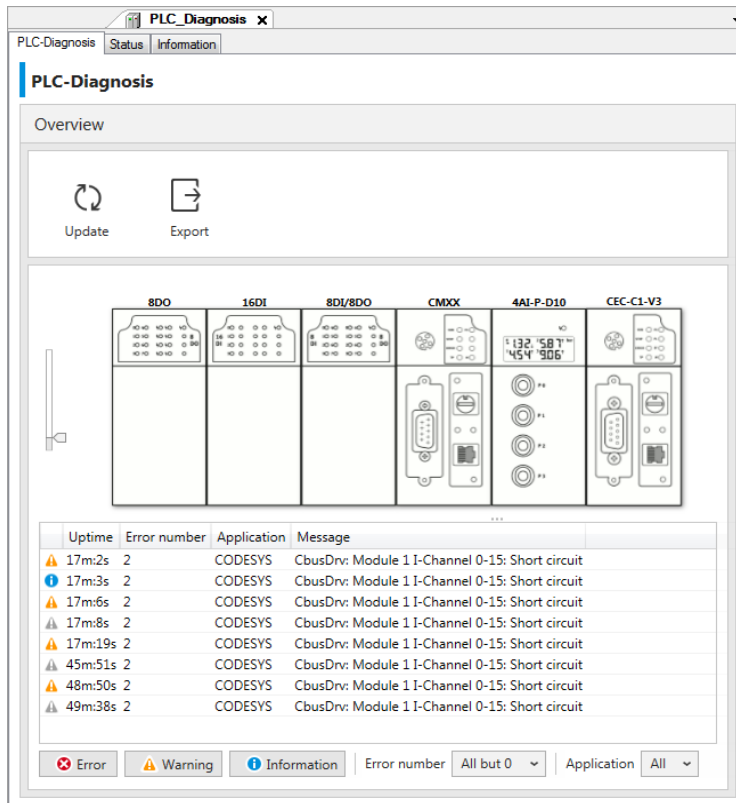


Figure: Editing window with [PLC-Diagnosis] sub-tab

The following functions are available:

- Updating the diagnostic information
- Exporting all messages to a CSV file
- Selecting the diagnostic messages using the following filters:
 - Error
 - Warning
 - Information
 - Error number
 - Application

5.2.2 FestoLog

The "FestoLog" log contains diagnostic information with a timestamp.

1. Double-click the control block in the CODESYS device window.

The [Device] tab opens in the editing window.

2. Open the [Log] sub-tab.
3. Click "FestoLog" in the "Logger" drop-down menu.

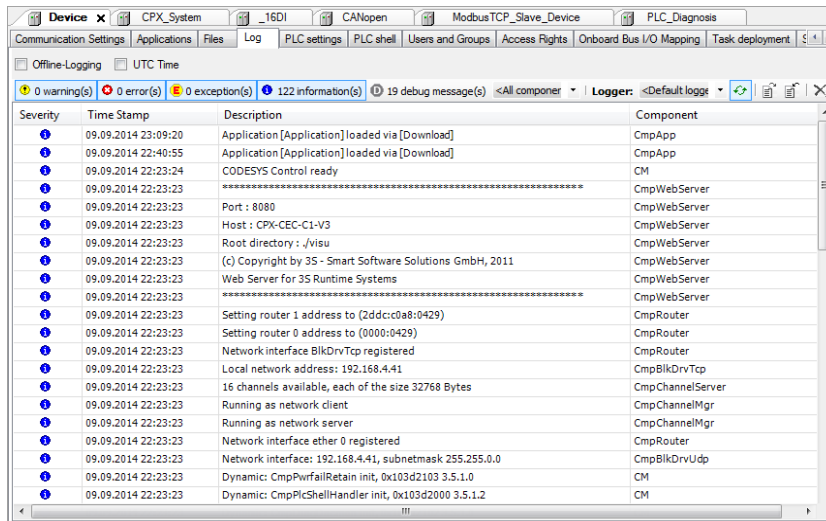


Figure: Editing window with [Log] sub-tab

5.3 Diagnosis using Scan Festo Devices

You activate the diagnostic information in the "Scan Festo Devices" dialog → Scan Festo Devices.

1. Right-click the control block in the table in the dialog.
2. Click the "Diagnosis" command in the context menu.

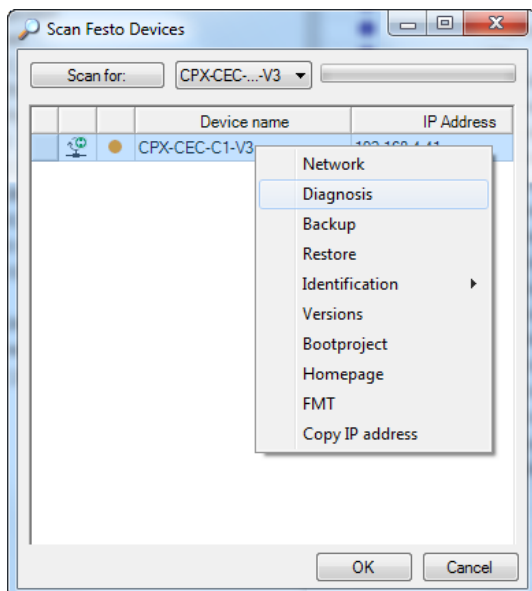


Figure: Activating diagnosis via the "Scan Festo Devices" dialog

5.4 Diagnosis via web server

You activate diagnosis via web server in the "Scan Festo Devices" dialog → Scan Festo Devices

1. Right-click the control block in the table in the dialog.
2. Click the "Homepage" command in the context menu.

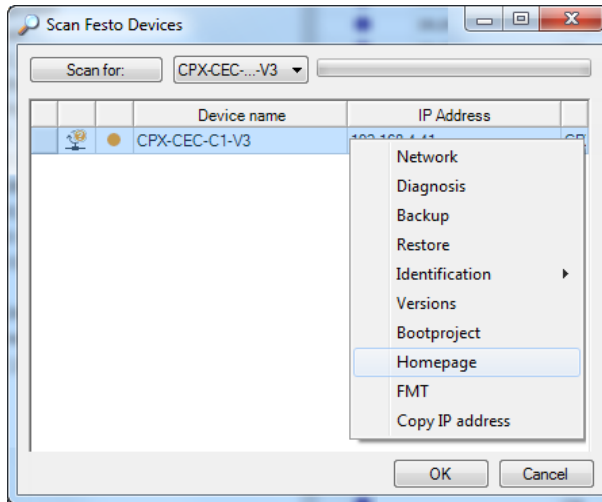


Figure: Calling up the "Homepage" of the CPX-CEC module

3. Click the menu command [System] [Diagnosis] in the browser to show diagnostic information for the CPX modules.

Terminal

Modules

Slot	Module	Revision	Serial	Diagnosis
0	8DO	4	7A057265	OK
1	16DI	1	7B010603	⚠ I-Channel 0: Short circuit (2)
2	8DI/8DO	6	AC809988	OK
3	CMXX	4	AB080376	OK
4	4AI-P-D10	5	98846608	OK
5	CEC-C1-V3	1	1F11020E	OK

I/O

Input Image

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
16DI	8DI/8DO	CMXX														4AI-P-D10										

Output Image

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
8DO	8DI/8DO	CMXX															

Figure: Diagnosis via web server

5.5 Diagnosing SoftMotion (only CPX-CEC-M1-V3)

Errors when using SoftMotion drives are output in the following locations:

- By the function block currently in control at the outputs ErrorID and wErrorID- on the [SoftMotion Drive: Basic] tab:

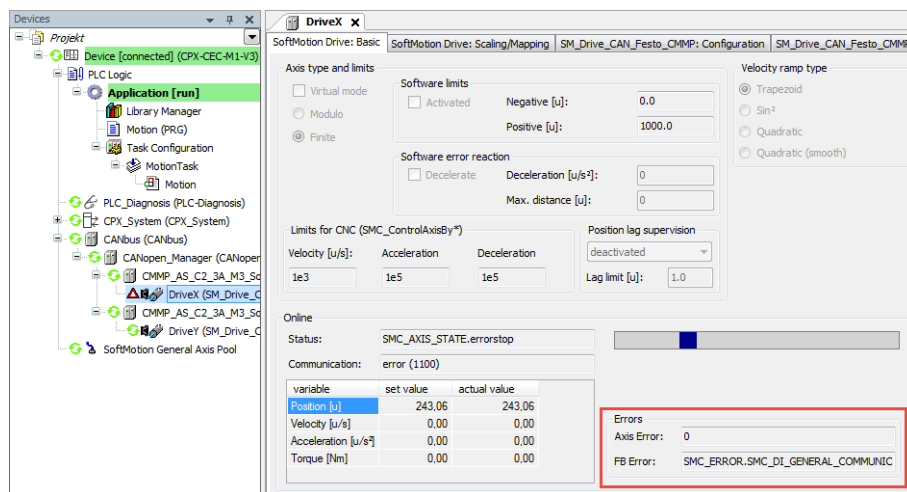


Figure: Error message on the [SoftMotion Drive: Basic] tab

List of possible SoftMotion error numbers → CODESYS online Help: SoftMotion [Programming Interface] [SoftMotion Libraries] [SM3] [Basic] [Data Types] [Error] [SMC_ERROR]

5.6 Libraries for diagnosis

The following libraries are available for diagnosis:

- Festo_General_3: General device diagnosis
- Festo_CPX_3: CPX-specific diagnosis
- CAA_CiA405: CANopen diagnosis

Examples and documentation → online Help for the respective library.

6 Application and programming instructions

6.1 Updating the image table

The runtime system of the control block uses a task-dependent image table (CANopen I/O mapping), which only updates outputs that are assigned to a task. CODESYS automatically detects which outputs a task is using.

Exercise caution when using pointers to outputs because CODESYS cannot automatically detect which output is being accessed. Referencing this output with one of the following calls is enough to guarantee an update on an output:

```
%QB0;  
pByOut := ADR(%QB0)
```



To display an overview of the inputs and outputs that are updated on a task-specific basis:

1. Double-click the control block (Device) in the device window.
2. Select the [Task deployment] tab in the editing window.

To update all inputs and outputs:

- Check the "Always update variables" box → Figure Changing the I/O addresses manually).

6.2 Starting a CANopen station

A start telegram is sent to each CANopen station as standard.

The "NMT Start All" option on the [CANopen_Manager] tab starts all slaves simultaneously.

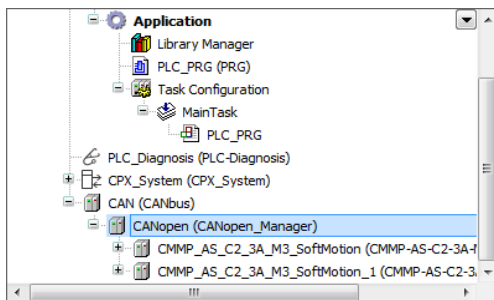


Figure: Selecting CANopen_Manager

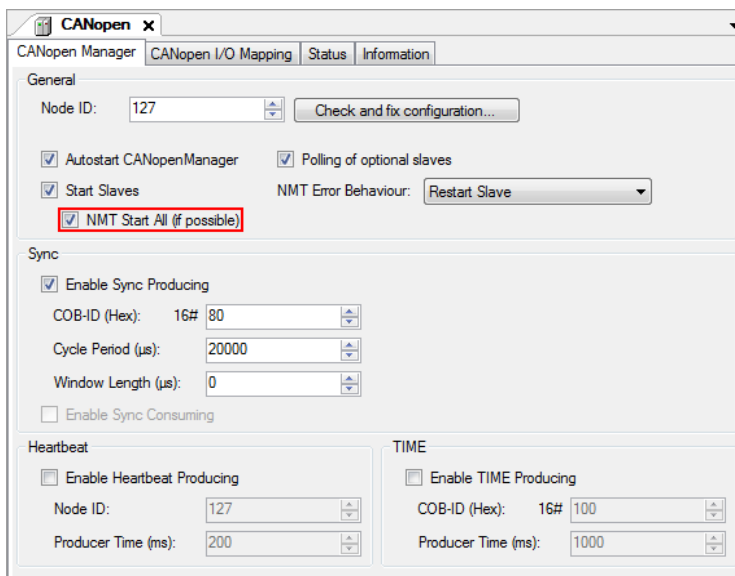


Figure: "NMT Start All" option



Note

The command "NMT Start All" is not executed while optional slaves are not yet ready to start. In this situation, the CANopen Manager starts each slave individually. An "NMT Start All" can only be guaranteed in a project without optional slaves.

6.3 CPX-MMI use and downloading projects



Note

Parameters changed by the CPX-MMI are overwritten by the parameters of the CODESYS project when the project is downloaded or the boot project is started.

6.4 Node guarding

Node guarding telegrams can be interrupted in stop mode when using the CAN interface.

1. Open the [PLC settings] tab in the CPX-CEC-...-V3.
2. Check the "Update IO while in stop" box.

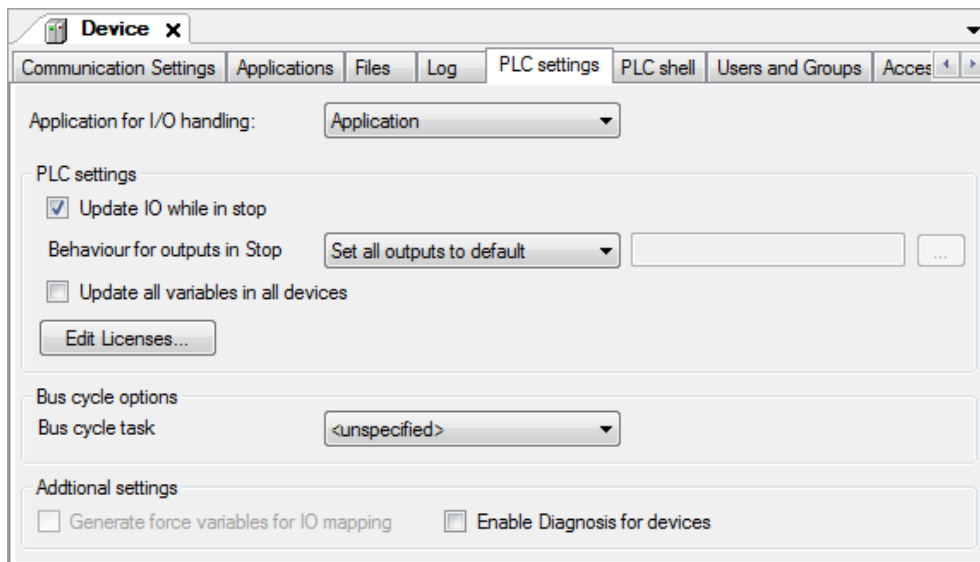


Figure: PLC settings for CPX-CEC

6.5 Version conflict

The following message is displayed if the device version used in CODESYS and the version of the runtime system on the connected device are not the same:

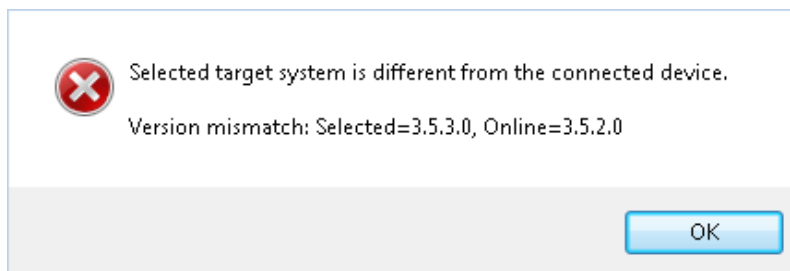


Figure: Version conflict error message



The first two digits of the device version and the runtime system version must be the same. The third digit of the runtime system must be greater than or equal to the third digit of the device version
 → "Device" tab, "Information" sub-tab.

Possible remedies:

- Update the firmware of the control block using the FFT.
- Use an appropriate package (newer/older version) → www.festo.com/sp.
- Contact your local Festo Service partner if you have any questions → www.festo.com.

7 Technical appendix

7.1 Technical data

Feature	CPX-CEC-C1-V3	CPX-CEC-M1-V3	CPX-CEC-S1-V3
General technical data for the CPX terminal	CPX system manual P.BE-CPX-SYS-... ➔ www.festo.com/sp		
Total number of axes	32	32	–
Hardware			
– Processor	800 MHz		
– RAM	256 MB		
– Flash	32 MB		
Configuration support	CODESYS V3 pbF		
Parameterisation	CODESYS V3 pbF		
Programming software	CODESYS V3 pbF		
Programming language	SFC, STL, CFC, FCH, LDR, ST To IEC 61131-3		
Program memory	16 MB user program		
Processing time	Approx. 200 µs/1 k instructions		
Device-specific diagnosis	Channel and module-oriented diagnostics – Module undervoltage/short circuit – Diagnostic memory		
Additional functions	– Motion functions for electric drives – Diagnostic functions	– SoftMotion functions for electric drives – Diagnostic functions	– RS232 communication function – Diagnostic functions
Ethernet			
– Protocols	EasyIP, Modbus TCP, TCP/IP		
– Baud rate	10/100 Mbit/s to IEEE 802.3 (10BaseT) or IEEE 802.3u (100BaseTx)		
LED display			
– bus-specific	TP: Ethernet connection: Link/Traffic		
– product-specific	RUN: PLC status "started" STOP: PLC status "stopped" ERR: PLC runtime error PS: Electronics supply, sensor supply PL: Load supply SF: System failure M: Modify/force active		
Further interface	CAN bus		RS232
– Connection technology	Plug, Sub-D, 9-pin		Plug, Sub-D, 9-pin
– Transfer rate	125, 250, 500, 800, 1000 kbps (can be set via software)		9600, 19200, 38400, 57600, 115200, 230400 bps (can be set via software)
– Max. line length	30 m		

Feature	CPX-CEC-C1-V3	CPX-CEC-M1-V3	CPX-CEC-S1-V3
– Electrical isolation			
– Signal lines of the interface to the circuit of the CPX-CEC-...-V3	Electrically isolated, via optocoupler (up to 500 V)		
– Internal power supply of the interface for operating voltage supply UEL/SEN	Electrically isolated, by means of transformer (up to 500 V)		
Degree of protection provided by housing in acc. with IEC 60529, completely fitted, plug connector inserted or provided with protective cap	IP65/IP67		
Nominal operating voltage	24 V DC		
Load voltage			
– Without pneumatic components	18 V DC ... 30 V DC		
– With Midi/Maxi pneumatic components	21.6 V DC ... 26.4 V DC		
– With CPA pneumatic components	20.4 V DC ... 26.4 V DC		
– With MPA pneumatic components	18 V DC ... 30 V DC		
Intrinsic current consumption – At nominal operating voltage	Typically 85 mA		
Power failure bridging	10 ms		
Storage temperature	-20 ... 70 °C		
Ambient temperature	-5 ... 50 °C		
Relative air humidity	95%, non-condensing		
Product weight	135 g		
Dimensions W x L x H	50 mm x 107 mm x 55 mm		

Table: Technical data

7.2 Memory

Memory	CPX-CEC-...-V3
Flash memory	32 MB
– Available for CODESYS (boot project, project archive, web visualisation, application data)	16 MB
RAM	256 MB
– Available for CODESYS (projects, variables, constants)	192 MB
Flag memory	8 kB
Input	8 kB
Output	8 kB
Remanent memory	28 kB

Table: Overview of memories

7.2.1 Remanent variables

The control block provides max. 28 kB for storing remanent variables. They are automatically shared based on the variable declaration within the application.

The following sample combinations for distributing the remanent memory are possible:

RETAIN variable	PERSISTENT RETAIN variable
28 kB	0 bytes (only if there is no PERSISTENT variable list)
0 bytes	28 kB
1,024 bytes	28 - 1 kB = 27 kB
x bytes	28,672 - x bytes

Table: Division of the remanent memory



Note

- Make sure during programming that the total size of all the remanent data does not exceed the maximum available range of 28 kB.

This will avoid errors when transferring an application to the control block.

8 Glossary

0

16#01: Hexadecimal numbers are indicated in CODESYS by a preceding "16#".

B

Bus node: Provides the connection to specific field buses. Transmits control signals to the connected modules and monitors their ability to function.

C

CANopen: CAN-based fieldbus protocol standardised as a European standard.

CNC: Computer numerical control is an electronic method for closed-loop and open-loop control of machine tools (CNC machines) or the devices (controllers, computers) used for them.

CODESYS V3 pbF: CODESYS V3 provided by Festo allows the configuration, commissioning and programming of different Festo components and devices. Abbreviation used sometimes in this document: CODESYS.

CODESYS target system ID → Target system ID.

CPX modules: General term for the various modules that can be incorporated into a CPX terminal.

CPX terminal: Complete system consisting of CPX modules with or without pneumatic components.

D

DIL switch: Dual-in-line switches consist of several switch elements with which settings can be made.

E

EasyIP: UDP-based protocol for rapid exchange of operands between controllers.

EDS file: Electronic data sheet; this file describes the functions and features of a CANopen device in standardised form (e.g. number of I/Os, number of diagnostic bytes).

F

Function block; in this document, "function block" is used as a general term for function module, function and program.

FFT: Festo Field Device Tool.

FHPP: Festo Handling and Positioning Profile; standardised fieldbus data profile for positioning controllers from Festo.

I

I/Os: Inputs and outputs.

I/O mapping: Image table

I/O modules: General term for the CPX modules that provide inputs and outputs.

IP: Internet Protocol: protocol for addressing and delivering data.

L

Logic 0: 0 V applied at the input, or output supplying 0 V.

Logic 1: 24 V applied at the input, or output supplying 24 V.

M

Modbus TCP: Communication standard via TCP/IP (port 502) in automation technology.

N

Node ID: Serves to clearly identify a bus slave on the CANopen fieldbus.

O

OLE: Object Linking and Embedding.

OPC: OLE for Process Control; standardised software interface that provides access to process data.

Operator unit CPX-MMI: Handheld programmer for commissioning and service purposes.

P

Package: All the configuration and expansion files that are required to make a specific controller (target system) usable for the CODESYS programming software are combined in a package.

Pneumatic interface: Interface between the modular electrical peripherals and the pneumatic components.

S

SoftMotion: Motion functionality integrated in the CODESYS programming and runtime system.

Single-/multi-axis motions with PLCopen motion modules are offered in a modular system as a motion control model.

PLC/IPC: Programmable logic controller/industrial PC.

T

Target system ID: Unique code for the product variant (in this case control block).

TCP: Transmission Control Protocol; protocol for data transport and backup.

TCP/IP: Combination of the protocols TCP and IP, the most-widely used protocol in communication via Ethernet.

U

UDP: User Datagram Protocol; a minimal, connection-free network protocol that has a lower protocol overhead compared to TCP. This protocol has the advantage of a faster exchange of data. Correct transmission must be monitored (e.g. by a user program) due to the absence of feedback.

