Application Note

FESTO

Programming CPX-F8DE-P and the CPX-FVDA-P2 in TIA Portal V14 SP1

The application note contains an explanation how to program CPX-F8DE-P **bit oriented** and the CPX-FVDA-P2 in TIA Portal V14 SP1 V14 SP1

CPX-F8DE-P
CPX-FVDA-P2

Note:

The program code is just an example. It is no must to use the program sequences 1 to 1

Title ..... Programming CPX-F8DE-P and the CPX-FVDA-P2 in TIA Portal V14 SP1
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Author ..... Festo

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Table of contents

1 Components/Software/Basics

Type/Name	Version Software/Firmware	IP address	Subnet mask
CPU 1516F-3 PN/DP	V 2.1	192.168.0.1	255.255.255.0
CPX-FB34 valve terminal system	REV 24	192.168.0.2	255.255.255.0
Laptop	--	192.168.0.100	255.255.255.0
TIA Portal V14	V14 SP1	--	--
SIMATIC STEP7 Safety	V14 SP1	--	--

Table 1.1: 1 Components/Software used

1.1 Recommended manuals / GSDML

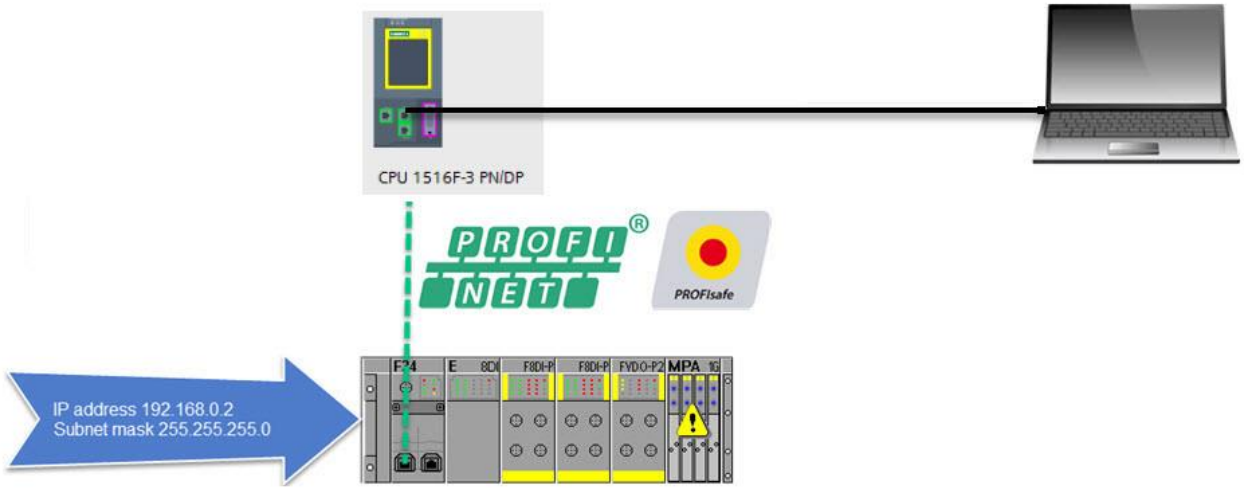
CPX-F8DE-P manual:
https://www.festo.com/net/SupportPortal/Files/377575/CPX-F8DE-P_2015-05_8035497g1.pdf

CPX-F8DE-P short description:
https://www.festo.com/net/SupportPortal/Files/377582/CPX-F8DE-P_2015-05_8035522g1.pdf

CPX-FVDA-P2 manual:
https://www.festo.com/net/SupportPortal/Files/326376/CPX-FVDA-P2_2012-09_8022607g1.pdf

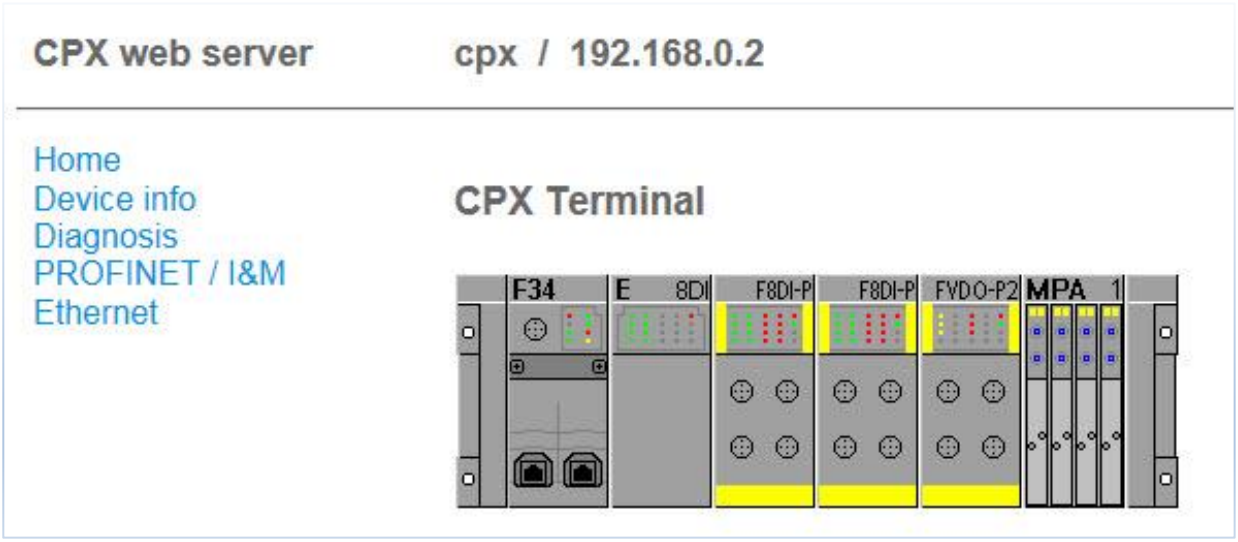
CPX GSDML:
https://www.festo.com/net/de_de/SupportPortal/default.aspx?q=CPX+GSDML&tab=4

1.2 Network Topology

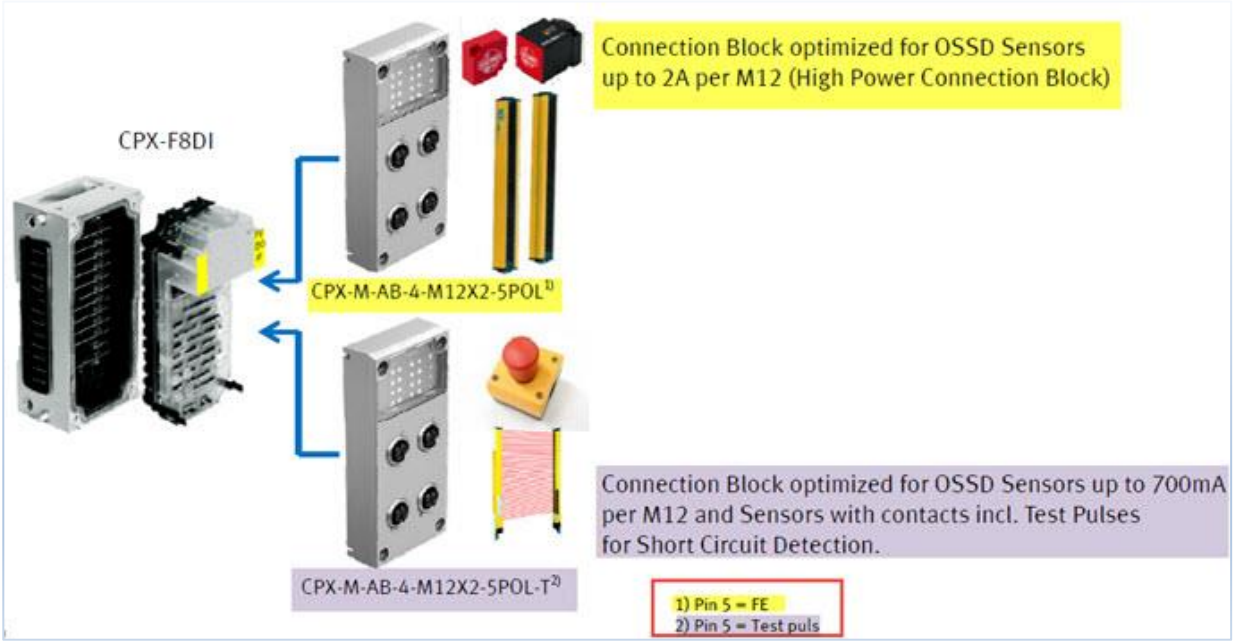


1.3 CPX system

The CPX extension is following:



The valve terminal includes two CPX-F8DE-P with different M12 connection blocks. The reason is:

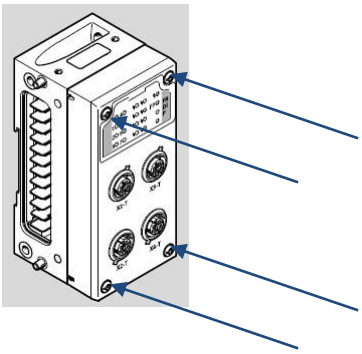


1.4 CPX-F8DE-P and CPX-FVDA-P2 Safety address settings

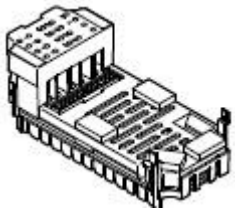
In PROFIsafe sender and receiver must have a unique identification called “F-address”. At the CPX safety modules you can set the PROFIsafe address via DIL switches. Therefore you have to do following:

1. Power off the CPX system

2. Remove the 4 Screws of the connection block



3. Take out the electronic module



4. Change the DIL settings to define the F-address on the module backside

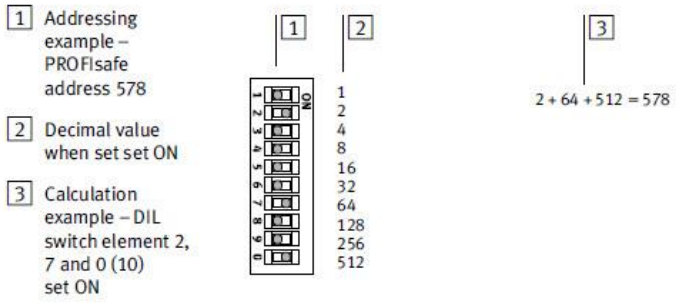


Fig. 2/2: 10-bit DIL switch for setting the PROFIsafe address – binary coded

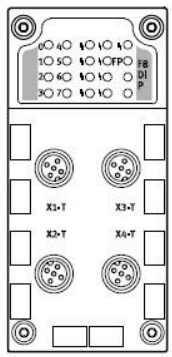
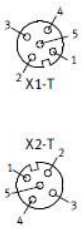
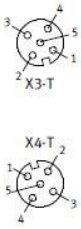
2 Safety Application

2.1 Emergency Stop

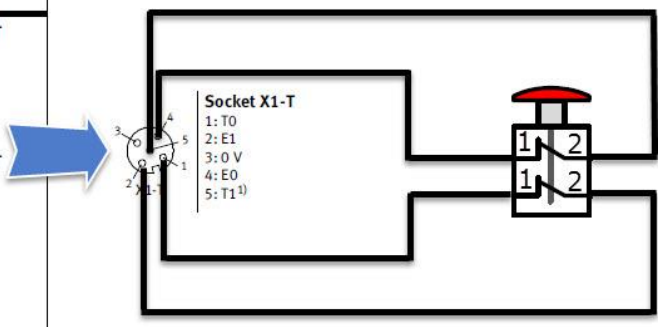
An emergency stop contains very often two Normally Closed switches. It is used to shut off a device/machine in an emergency situation.

The circuit with a CPX-F8DE-P module on **X1-T** and the connection block **CPX-M-AB-4-M12X2-5POL-T** looks like:

CPX-F8DE-P with connection block CPX-M-AB-4-M12X2-5POL-T

Connection block	Pin allocation X1-T, X2-T		Pin allocation X3-T, X4-T	
		**Socket X1-T** 1: T0 2: E1 3: 0 V 4: E0 5: T1 [1]		**Socket X3-T** 1: T4 2: E5 3: 0 V 4: E4 5: T5 [1]
		Socket X2-T 1: T2 2: E3 3: 0 V 4: E2 5: T3 [1]		**Socket X4-T** 1: T6 2: E7 3: 0 V 4: E6 5: T7 [1]

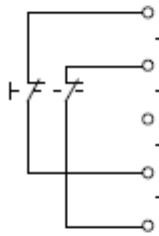
[1] For this connection technology, never connect Function Earth (FE) to Pin 5.
The metal thread on the connection block can be used as the function earth for connected sensors.



The recommended CPX-F8DE-P function mode is 6:

Function mode 6 – 1oo2 T (equivalent, with clock signal monitoring)

Signal evaluation of a two-channel switch/sensor (internal equivalent) per channel pair with individually switched power supply.

Circuit diagram	Channel pair ports			
	T0	T2	T4	T6
	E1	E3	E5	E7
	0 V			
	E0	E2	E4	E6
	T1	T3	T5	T7

Tab. 1/21: Function mode 6 – 1oo2T

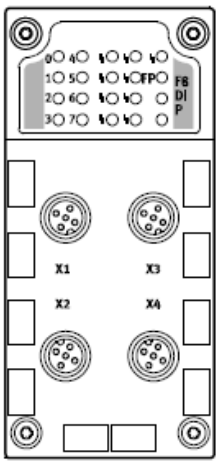
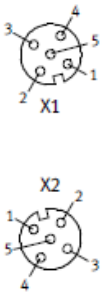
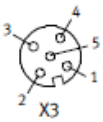
This function mode detects short circuits and cross-circuiting in the sensor wiring.
This function mode is especially well suited to applications that expect fast reactions (e.g. emergency stop, certified switches/sensors).

2.2 Euchner Door switch CES-AP-01-CH-SB

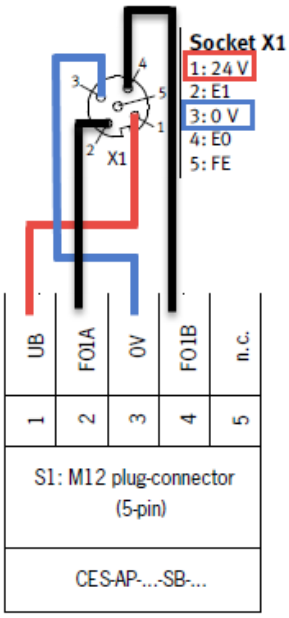
This safety switch is an interlocking device without guard locking. A stop command is triggered if the safety guard is opened during dangerous machine function. The safety outputs (OA and OB) can be connected to the safe inputs of a control system. Important is that the inputs must be suitable for pulsed safety signals (OSSD [Output Signal switch device] signals)

The circuit with a CPX-F8DE-P module on **X1** and the connection block **CPX-M-AB-4-M12X2-5POL** looks like:

CPX-F8DE-P with connection block CPX-M-AB-4-M12X2-5POL

Connection block	Pin allocation X1, X2		Pin allocation X3, X4	
		**Socket X1** 1: 24 V 2: E1 3: 0 V 4: E0 5: FE **Socket X2** 1: 24 V 2: E3 3: 0 V 4: E2 5: FE		**Socket X3** 1: 24 V 2: E5 3: 0 V 4: E4 5: FE **Socket X4** 1: 24 V 2: E7 3: 0 V 4: E6 5: FE

FE = functional earth
n.c. = free (not connected)



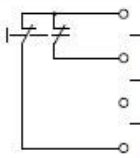
The recommended CPX-F8DE-P function mode is 5:

Function mode 5 – 1oo2 (equivalent)

Signal evaluation of a sensor (typically OSSD) that switches both signals of a channel pair simultaneously.

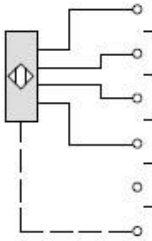
The sensor can monitor for short circuits and for cross-circuiting.

A two-channel sensor (internally equivalent) per channel pair with standard unswitched sensor power supply. T0, T2, T4, T6 run in this function mode on static 24 V DC.

Circuit diagram	Channel pair ports			
	T0/24 V	T2/24 V	T4/24 V	T6/24 V
	E1	E3	E5	E7
	0 V			
	E0	E2	E4	E6
	T1/FE	T3/FE	T5/FE	T7/FE

Tab. 1/19: Function mode 5 – 1oo2 (example A)

OSSD sensor Euchner

Circuit diagram	Channel pair ports			
	24 V	24 V	24 V	24 V
	E1	E3	E5	E7
	0 V			
	E0	E2	E4	E6
	T1/FE	T3/FE	T5/FE	T7/FE
	FE contact of sensor via the M12 connector screw connection on the module			

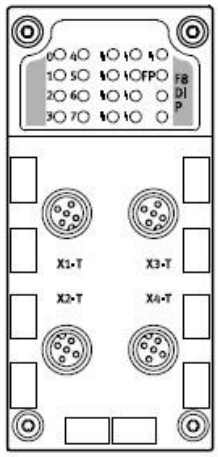
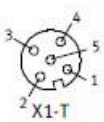
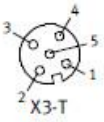
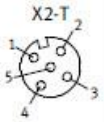
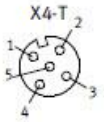
Tab. 1/20: Function mode 5 – 1oo2 (example B)

2.3 Two-Hand control after EN574 type IIIC

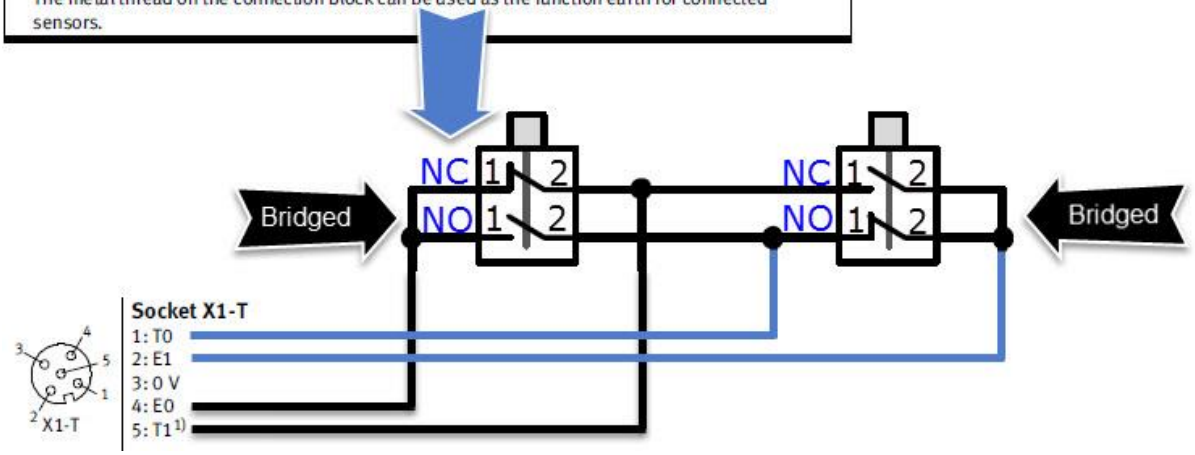
EN574 type IIIC means that both antivalent switches have to be pressed synchronous within 500ms

The circuit with a CPX-F8DE-P module on **X1-T** and the connection block **CPX-M-AB-4-M12X2-5POL-T** looks like:

CPX-F8DE-P with connection block CPX-M-AB-4-M12X2-5POL-T

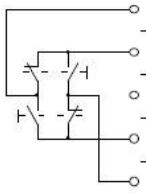
Connection block	Pin allocation X1-T, X2-T		Pin allocation X3-T, X4-T	
	 X1-T	**Socket X1-T** 1: T0 2: E1 3: 0 V 4: E0 5: T1 [1]	 X3-T	**Socket X3-T** 1: T4 2: E5 3: 0 V 4: E4 5: T5 [1]
	 X2-T	**Socket X2-T** 1: T2 2: E3 3: 0 V 4: E2 5: T3 [1]	 X4-T	**Socket X4-T** 1: T6 2: E7 3: 0 V 4: E6 5: T7 [1]

[1] For this connection technology, never connect Function Earth (FE) to Pin 5.
The metal thread on the connection block can be used as the function earth for connected sensors.

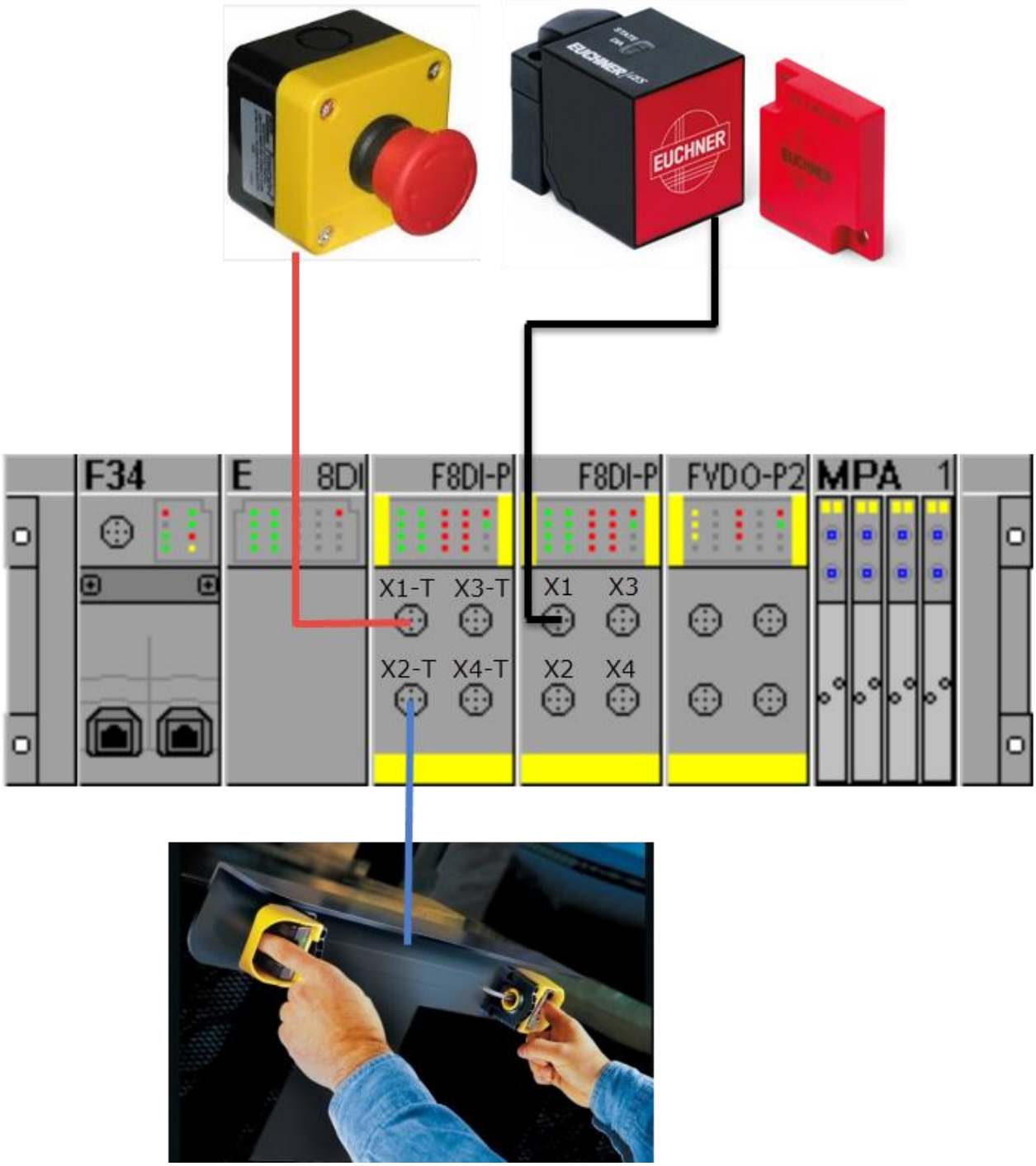


The recommended CPX-F8DE-P function mode is 7:

Function mode 7 – 1oo2 D (two-hand control device EN 574 type IIIc)

Circuit diagram	Channel pair ports				Comments
	T0	T2	T4	T6	Signal evaluation of 2 independent dual-channel switches/sensors (internally antivalent, NO/ NC) per channel pair, with monitoring of the signal change over time. At E1, E3, E5 and E7, the clock signals are wired as a mirror image of E0, E2, E4, E6. – If both pushbuttons are actuated within 500 ms, a logic 1 is set in the input image of the channel pair. – Before each actuation, a zero crossover is required (both normally closed contacts NC closed). • Use only antivalent switches in which the one contact opens before the other contact closes. • Make sure that the NO or NC switches of the sensors are connected with the matching clock signal connections of the channel pair (➔ Circuit diagram). Safety evaluation only with the following connection blocks: – CPX-M-AB-4-M12X2-5POL-T – CPX-AB-8-KL-4POL.
	E1	E3	E5	E7	
	0 V				
	E0	E2	E4	E6	
	T1	T3	T5	T7	

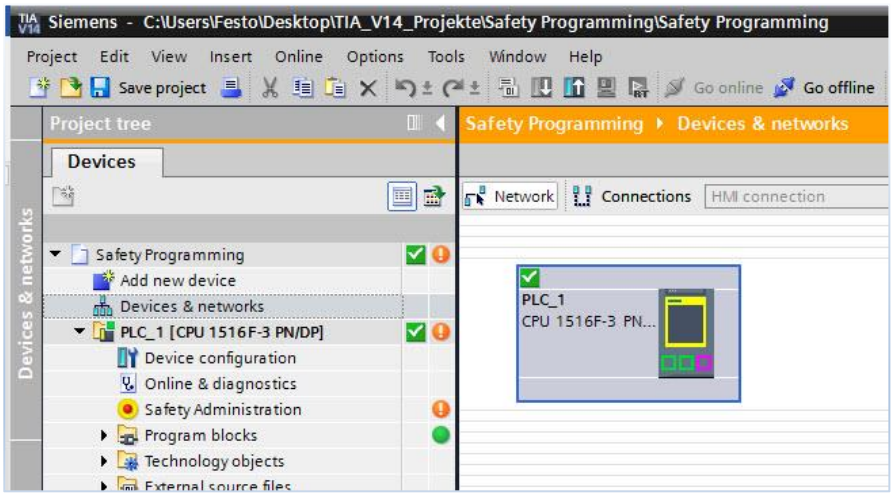
2.4 Example architecture with CPX-F8DE-P



3 Programming in TIA Portal V14 SP1

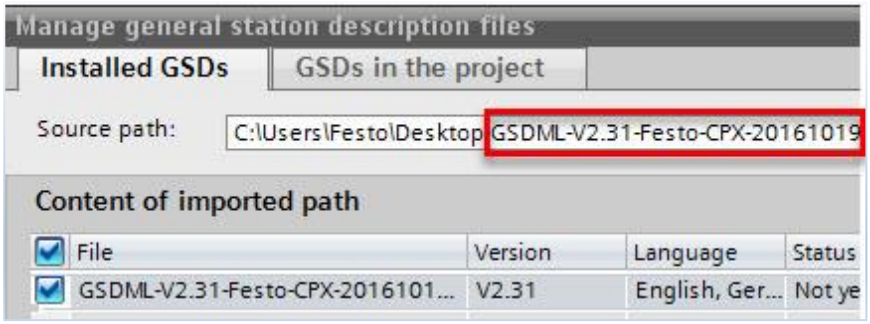
3.1 Key requirements

A) You have created a new TIA Portal project with no network error:



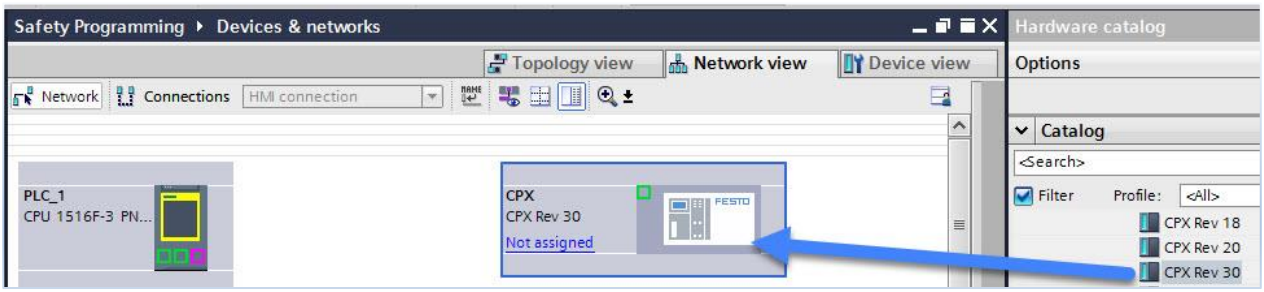
Note
Go Online to check the status of your PLC

B) You have downloaded and installed the latest CPX GSDML

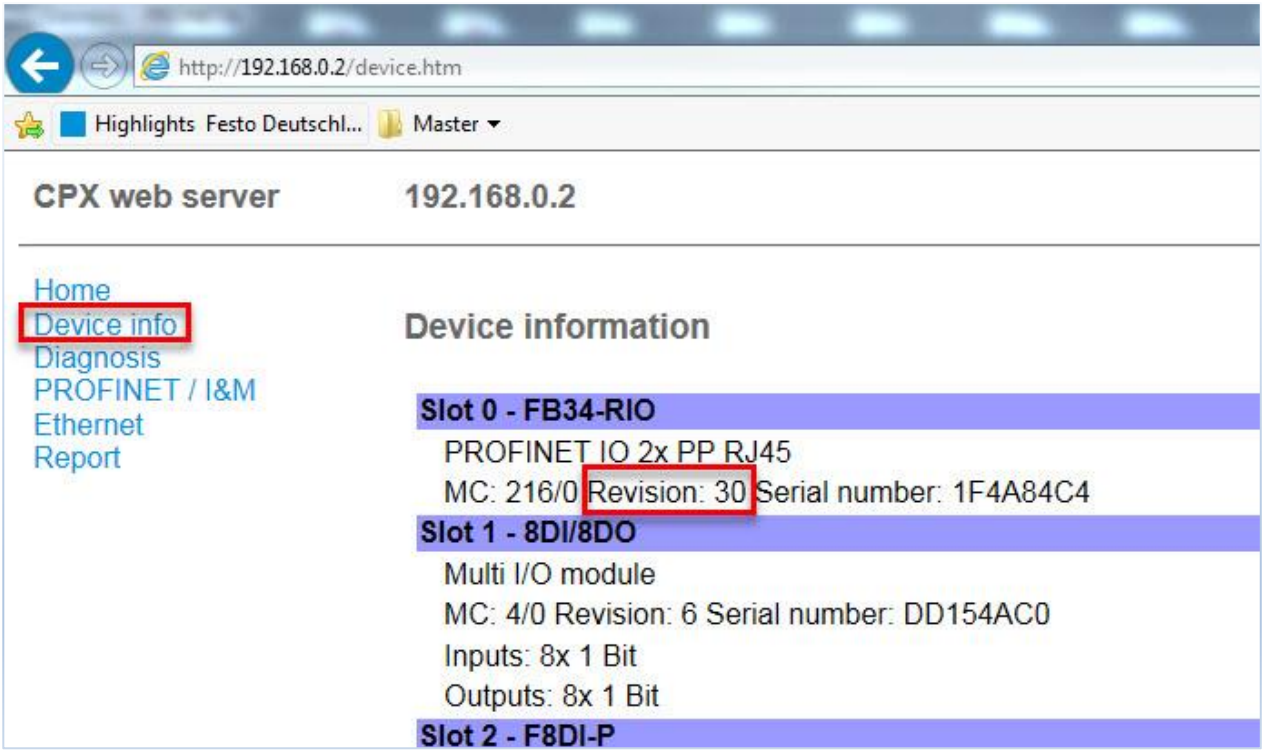


3.2 Establish a Profinet network with the CPX

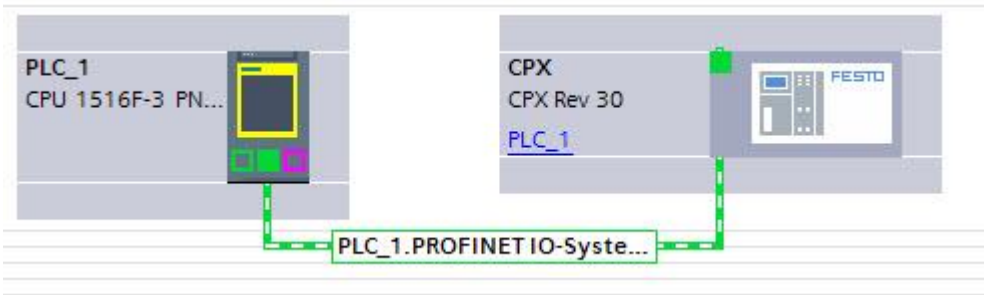
A) Drag and drop the CPX entry to the network:



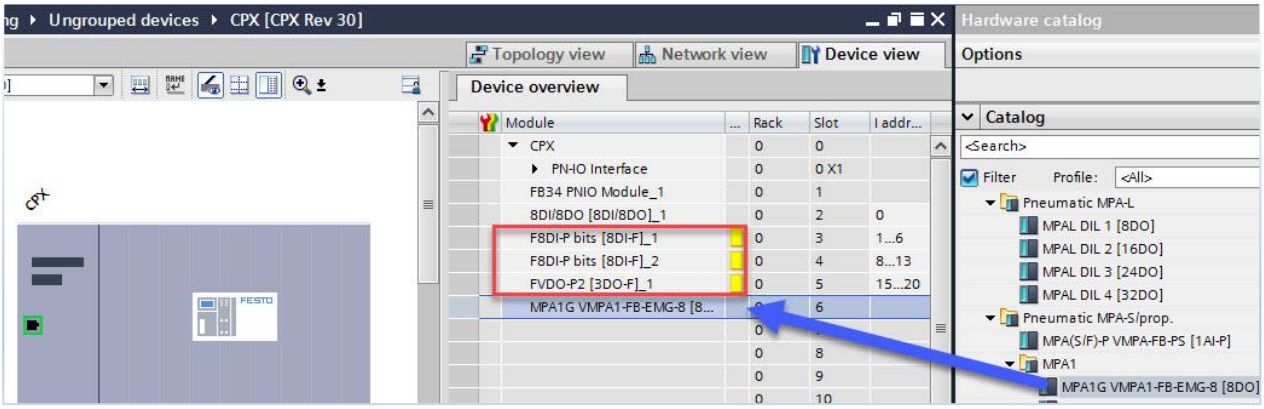
Note
To take the right CPX entry (REV18, REV20 or REV30)
Check e.g. via the webserver which Revision your node really has:



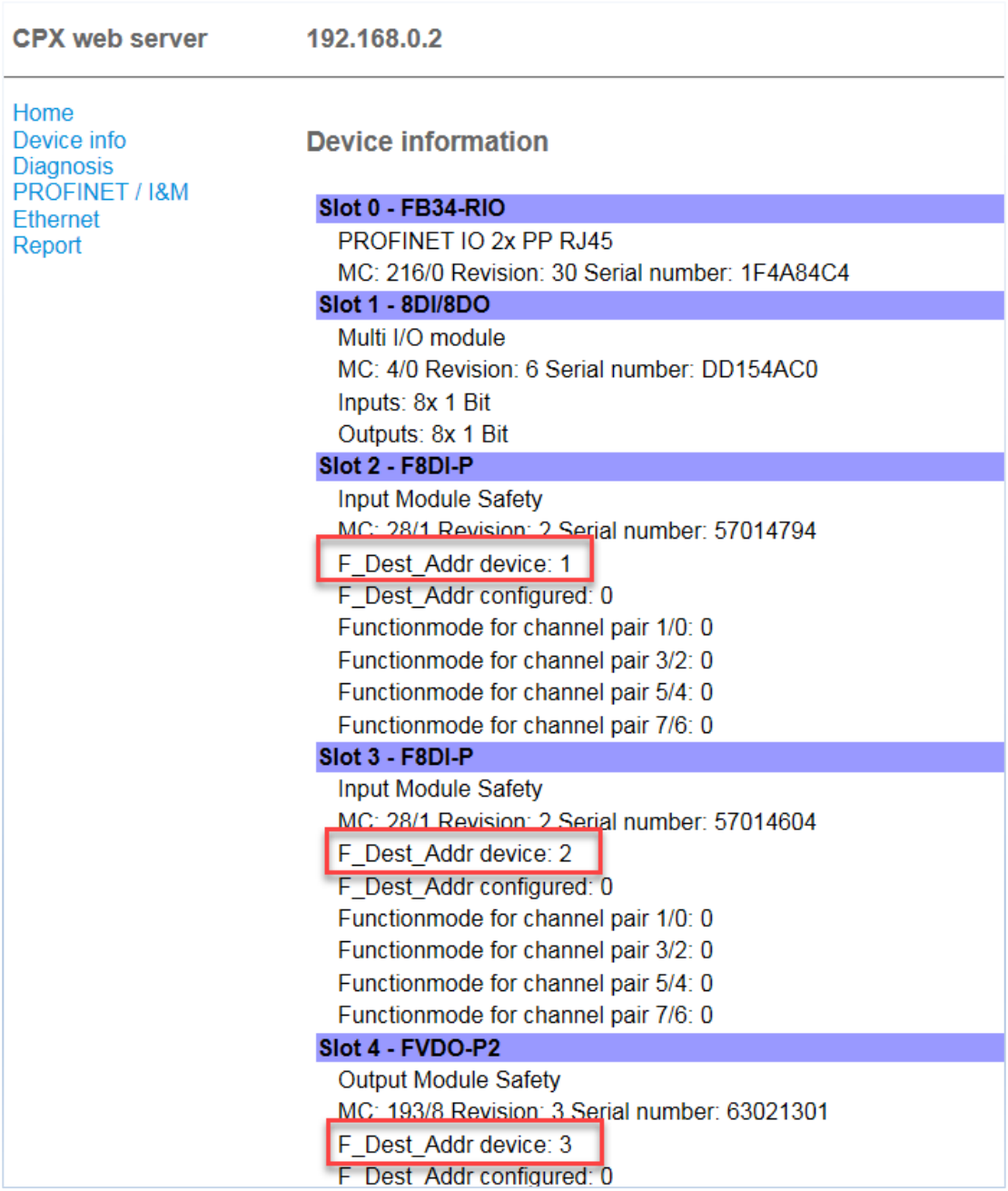
B) Establish the Profinet connection to the PLC :



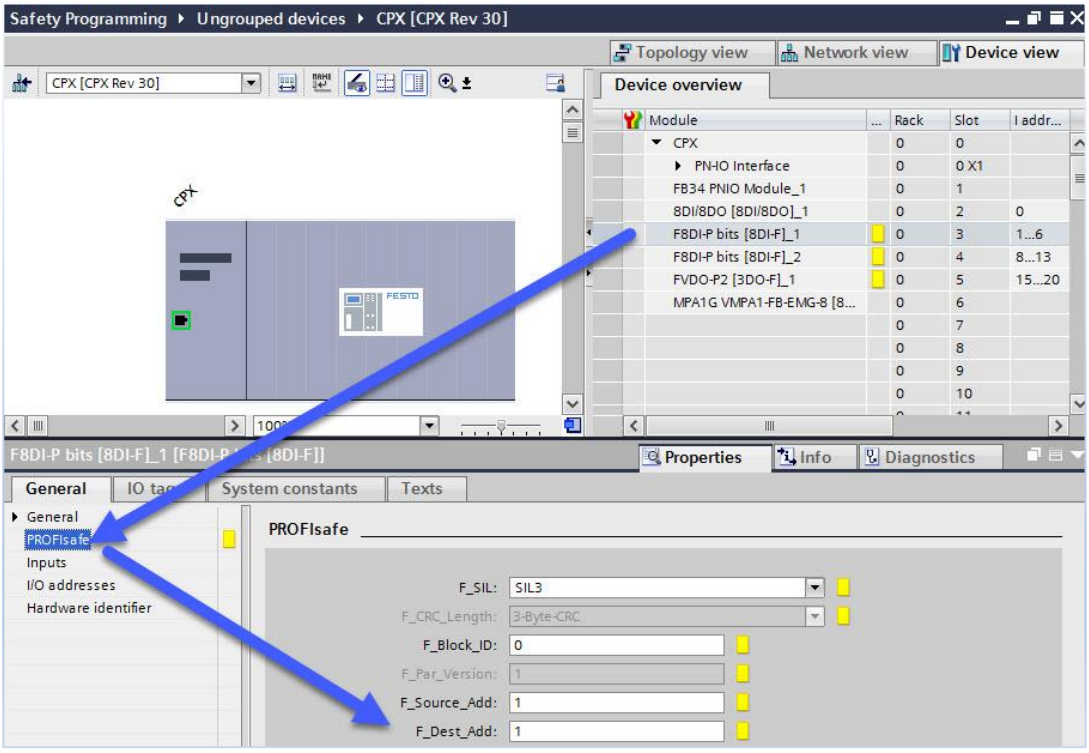
C) Define the CPX modules from the left to the right side :



As reference see the CPX webserver again. It shows you too which Profisafe DIL address is set actually:



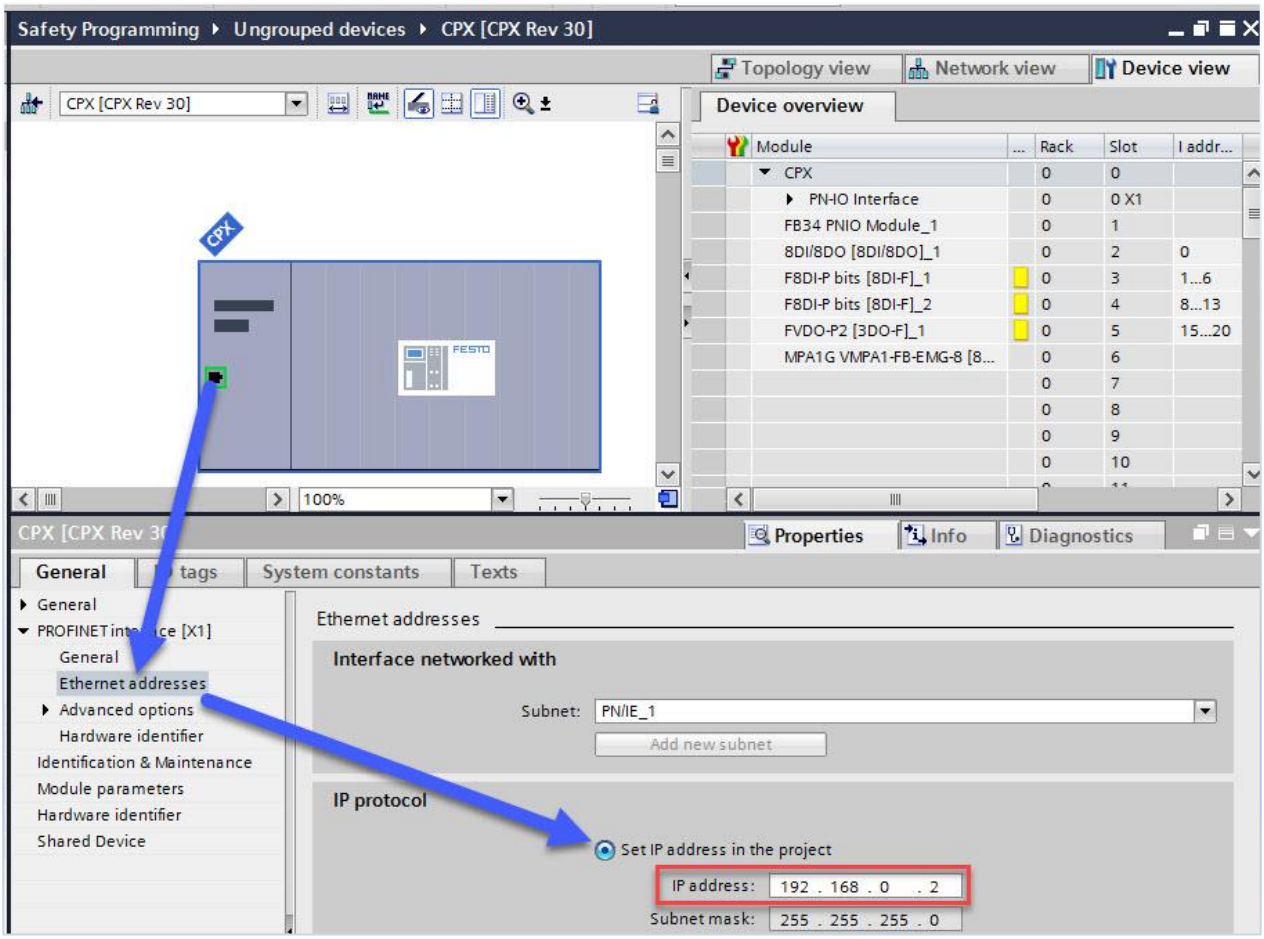
D) Define the PROFIsafe address parameter of each CPX safety module:



Note

How to set the PROFIsafe on the HW side you see in chapter 1.4

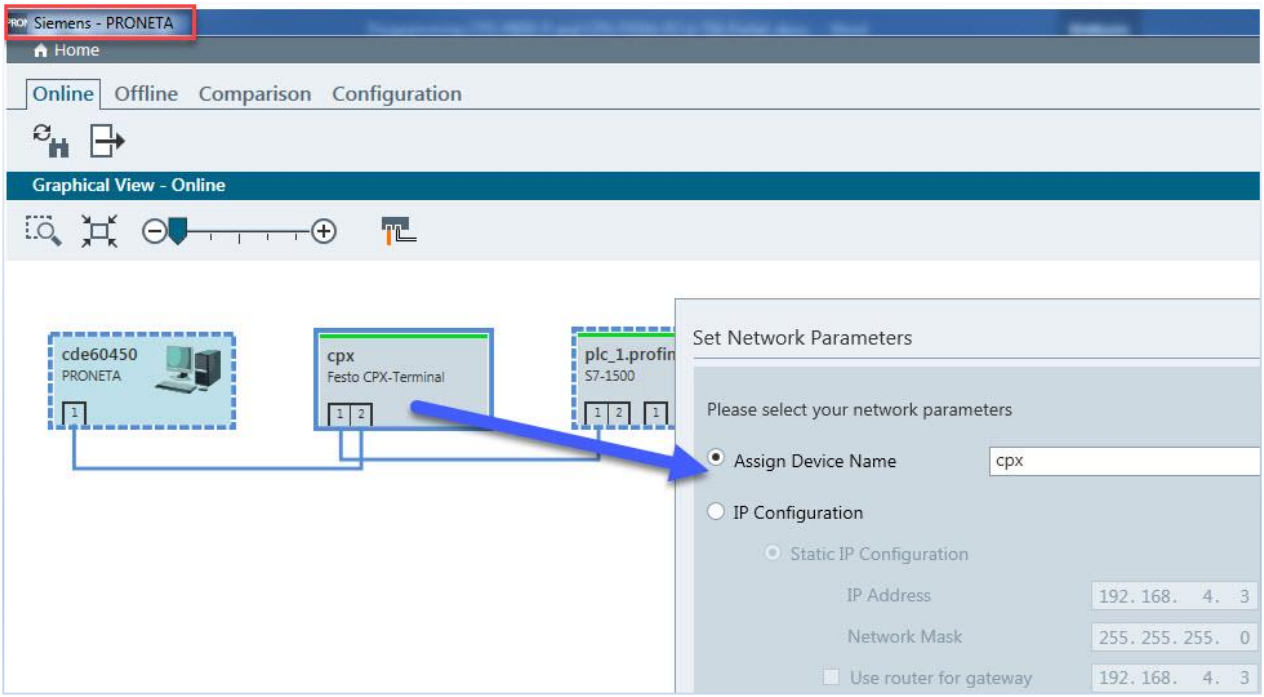
E) Define CPX IP address and Profinet name:



Note

The Profinet IP address and name have to be equal in the Offline project compared to Online settings, otherwise communication problems appear. Via the Online access it is possible to change name and IP address of a device

Or use the Siemens freeware Software Proneta to change name and IP address:



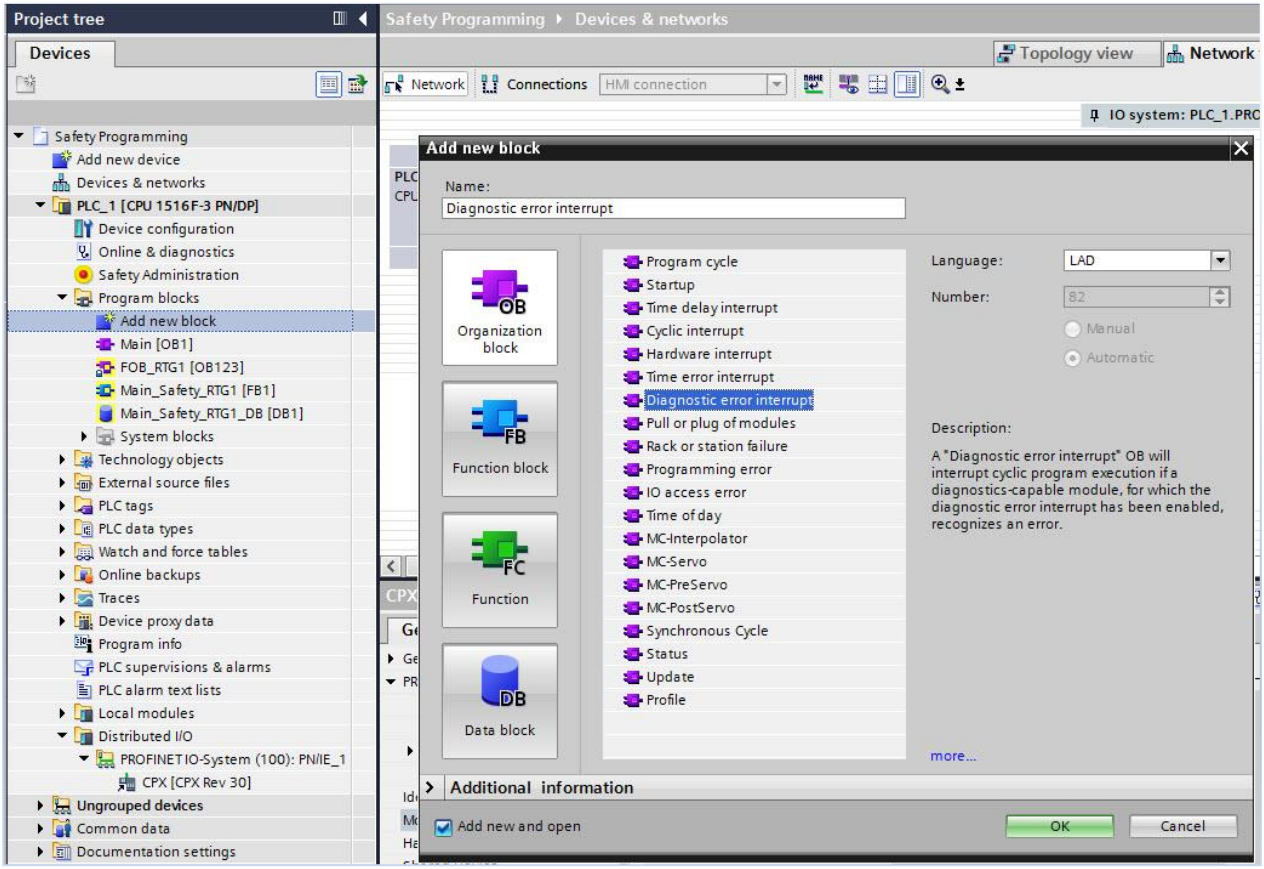
You find this Software in the Siemens Support Portal

F) Download everything to the PLC

3.3 Start safety programming

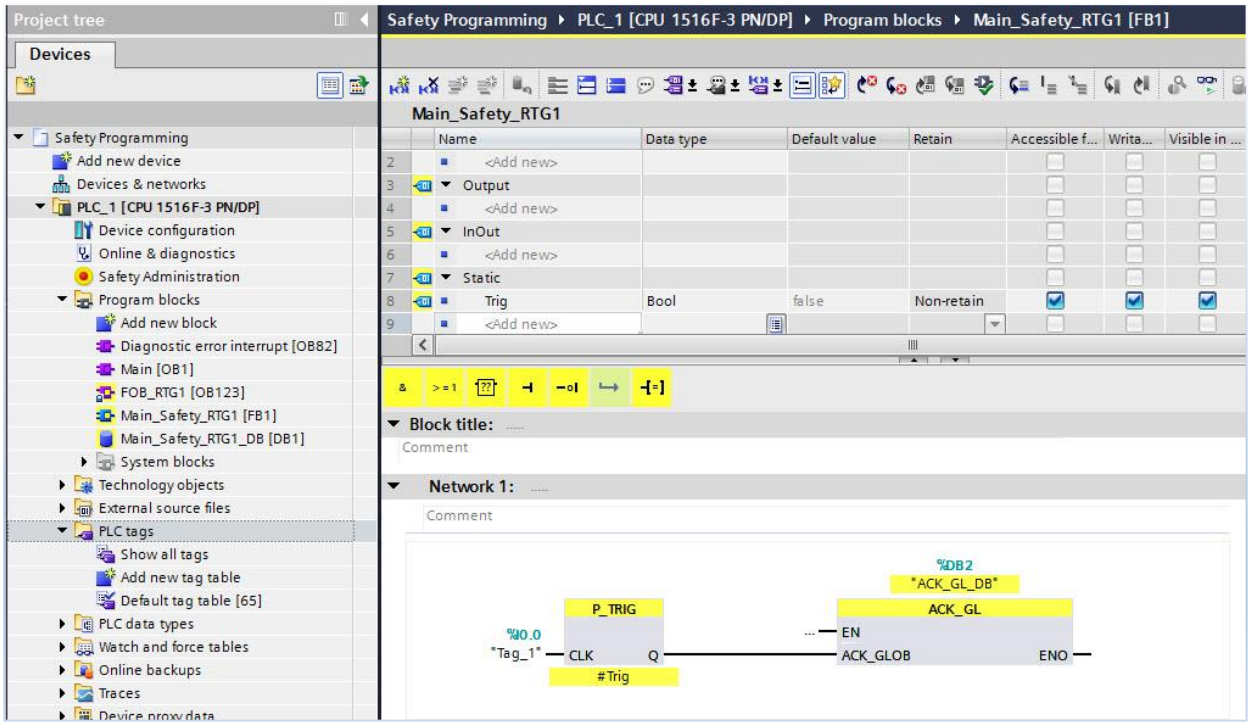
A) Insert OB82:

Note
At old CPU types like S7-300 or ET200 S it is a must



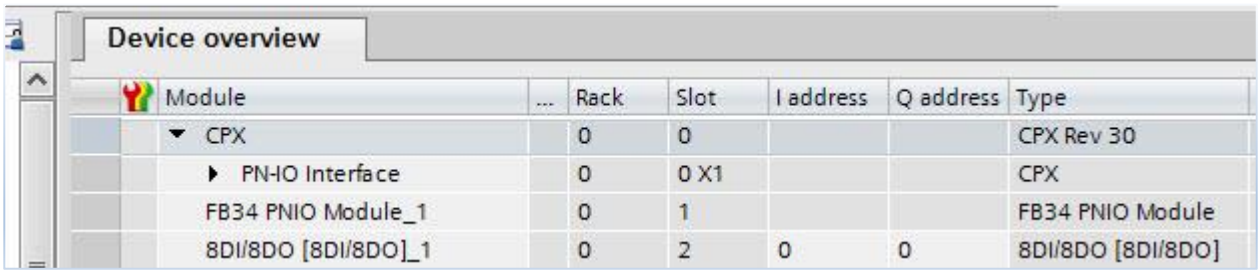
Note
Without OB82 a Safety programming mistake can create an error and the Main program stops working. A restart of the whole system is necessary!

B) Open the Main safety program and insert the Global Acknowledgment function block:



Note

1. If you take as safety input for the HW signal then in error case it freezes and works not anymore! Use e.g. a normal input of a DI module. In this case the signal 0 of CPX-8DE is taken (address %I0.0).



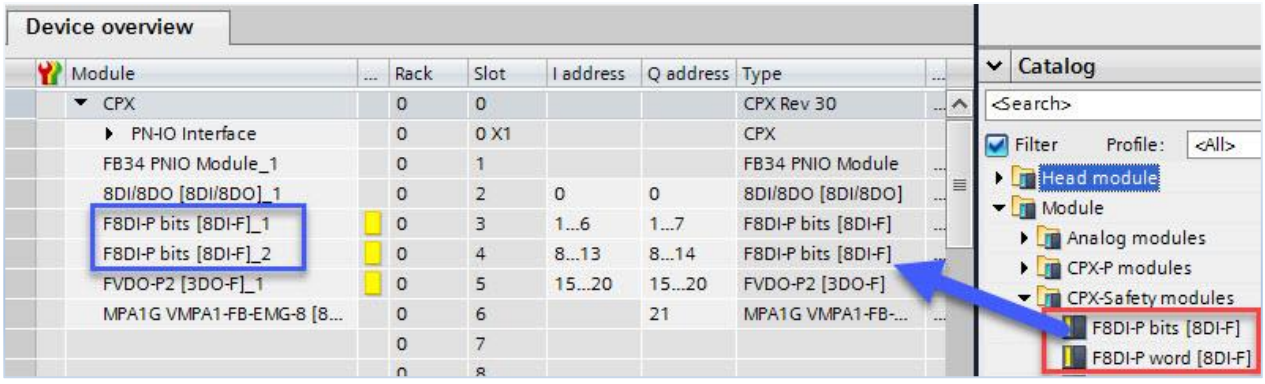
Note

2. If you use the instruction ACK_GL, you do not have to provide a user acknowledgment for each F-I/O of the F-runtime group via the ACK_REI tag of the F-I/O DB.

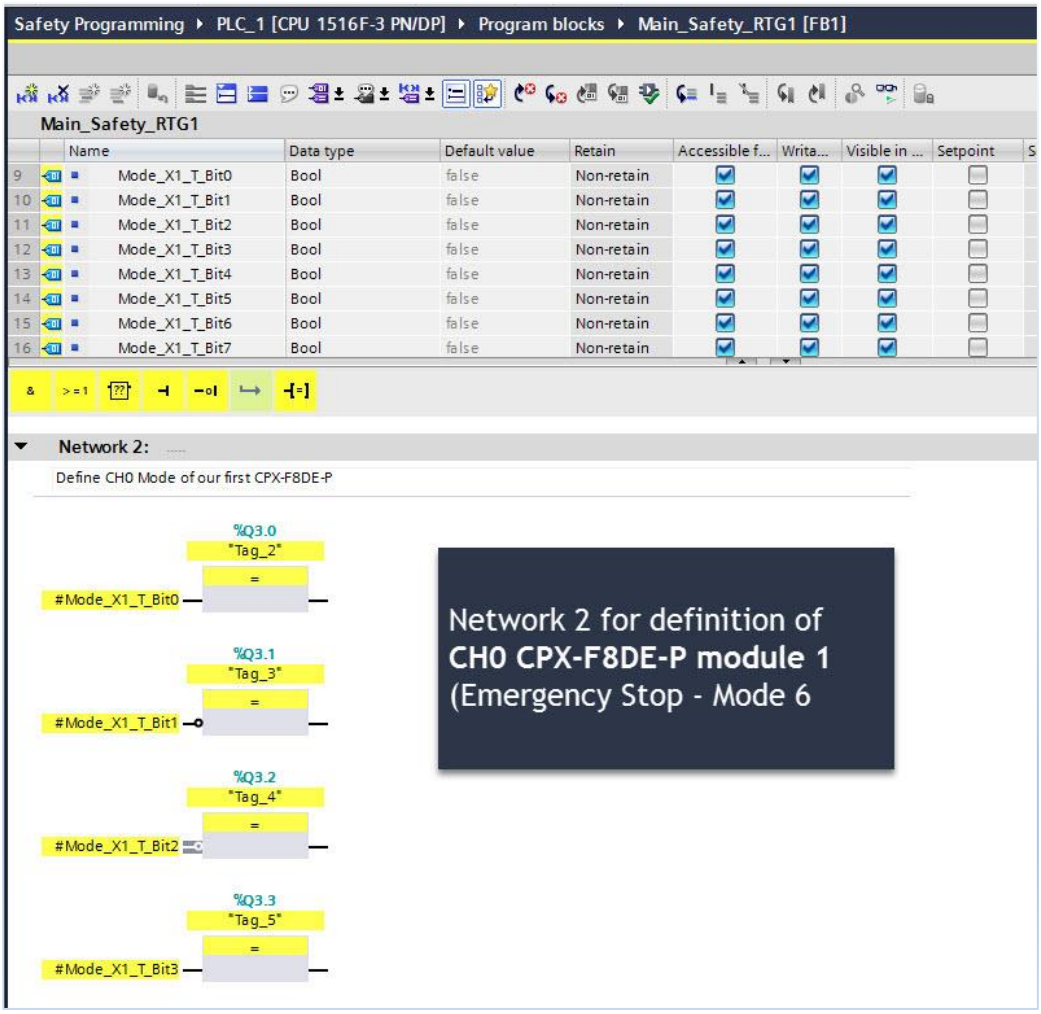
C) Insert the Bit commands for CPX-F8DE-P modes at F-module 1 and 2:

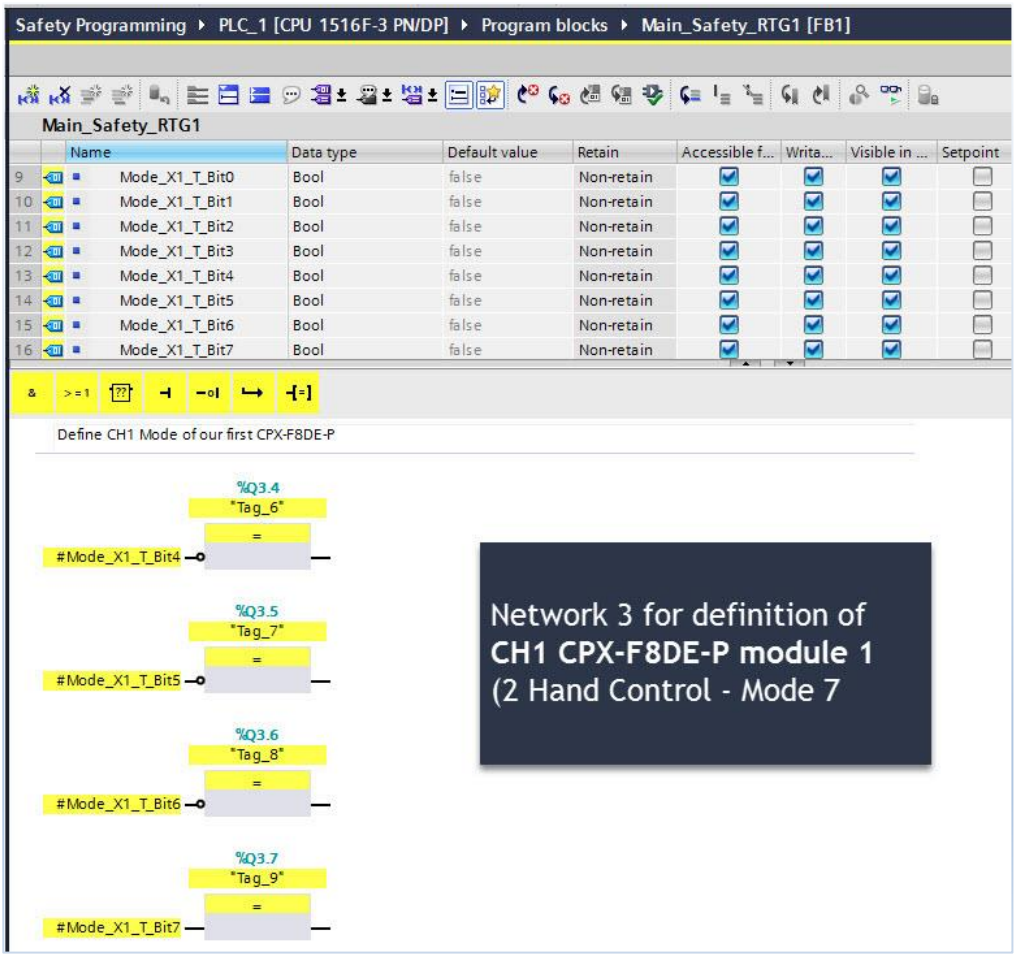
Background info:

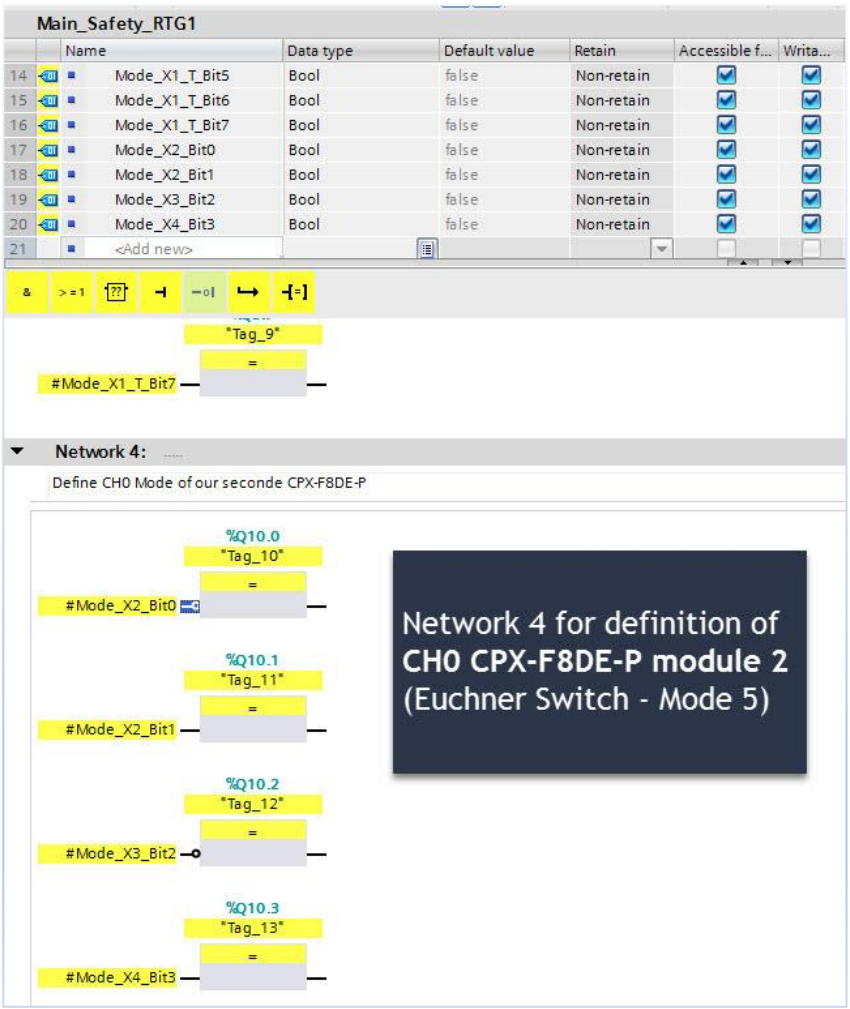
If you are using the CPX GSDML **bit entry** then you can't use the Move command function.



In such case it is a must to set the mode bit by bit!

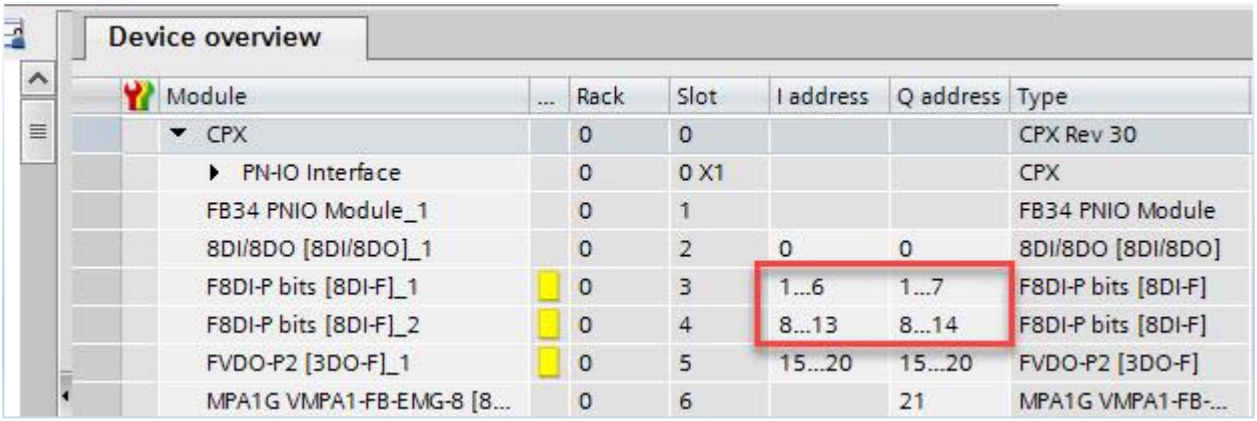



Safety Programming ▸ PLC_1 [CPU 1516F-3 PN/DP] ▸ Program blocks ▸ Main_Safety_RTG1 [FB1]
Main_Safety_RTG1
Name | Data type | Default value | Retain | Accessible f... | Writa... | Visible in ... | Setpoint
9 Mode_X1_T_Bit0 Bool false Non-retain
10 Mode_X1_T_Bit1 Bool false Non-retain
11 Mode_X1_T_Bit2 Bool false Non-retain
12 Mode_X1_T_Bit3 Bool false Non-retain
13 Mode_X1_T_Bit4 Bool false Non-retain
14 Mode_X1_T_Bit5 Bool false Non-retain
15 Mode_X1_T_Bit6 Bool false Non-retain
16 Mode_X1_T_Bit7 Bool false Non-retain
Define CH1 Mode of our first CPX-F8DE-P
%Q3.4 "Tag_6" #Mode_X1_T_Bit4
%Q3.5 "Tag_7" #Mode_X1_T_Bit5
%Q3.6 "Tag_8" #Mode_X1_T_Bit6
%Q3.7 "Tag_9" #Mode_X1_T_Bit7
Network 3 for definition of CH1 CPX-F8DE-P module 1 (2 Hand Control - Mode 7


Main_Safety_RTG1
Name | Data type | Default value | Retain | Accessible f... | Writa...
14 Mode_X1_T_Bit5 Bool false Non-retain
15 Mode_X1_T_Bit6 Bool false Non-retain
16 Mode_X1_T_Bit7 Bool false Non-retain
17 Mode_X2_Bit0 Bool false Non-retain
18 Mode_X2_Bit1 Bool false Non-retain
19 Mode_X3_Bit2 Bool false Non-retain
20 Mode_X4_Bit3 Bool false Non-retain
21 <Add new>
"Tag_9" #Mode_X1_T_Bit7
Network 4:
Define CH0 Mode of our seconde CPX-F8DE-P
%Q10.0 "Tag_10" #Mode_X2_Bit0
%Q10.1 "Tag_11" #Mode_X2_Bit1
%Q10.2 "Tag_12" #Mode_X3_Bit2
%Q10.3 "Tag_13" #Mode_X4_Bit3
Network 4 for definition of CH0 CPX-F8DE-P module 2 (Euchner Switch - Mode 5)

Note

1. As reference for the function mode see chapter 2
2. The Output variable depends on the HW config.



Device overview

Module	...	Rack	Slot	I address	Q address	Type
CPX		0	0			CPX Rev 30
PN-IO Interface		0	0 X1			CPX
FB34 PNIO Module_1		0	1			FB34 PNIO Module
8DI/8DO [8DI/8DO]_1		0	2	0	0	8DI/8DO [8DI/8DO]
F8DI-P bits [8DI-F]_1		0	3	1...6	1...7	F8DI-P bits [8DI-F]
F8DI-P bits [8DI-F]_2		0	4	8...13	8...14	F8DI-P bits [8DI-F]
FVDO-P2 [3DO-F]_1		0	5	15...20	15...20	FVDO-P2 [3DO-F]
MPA1G VMPA1-FB-EMG-8 [8...		0	6		21	MPA1G VMPA1-FB-...

Note

For the function mode the start byte (QB3 and QB10) are important. It includes CH1/0 of the CPX-F8DE-P

Bit samples for the output data

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	0	0	0	1/0	1/0
	Operating mode: 1 = channel-based passivation 0 = module-based passivation							
	1 = Acknowledgment of a channel error							
1 CH3/2	8	4	2	1	8	4	2	1
	Function mode for channel pair 7/6				Function mode for channel pair 5/4			
2 CH1/0	8	4	2	1	8	4	2	1
	Function mode for channel pair 3/2				Function mode for channel pair 1/0			

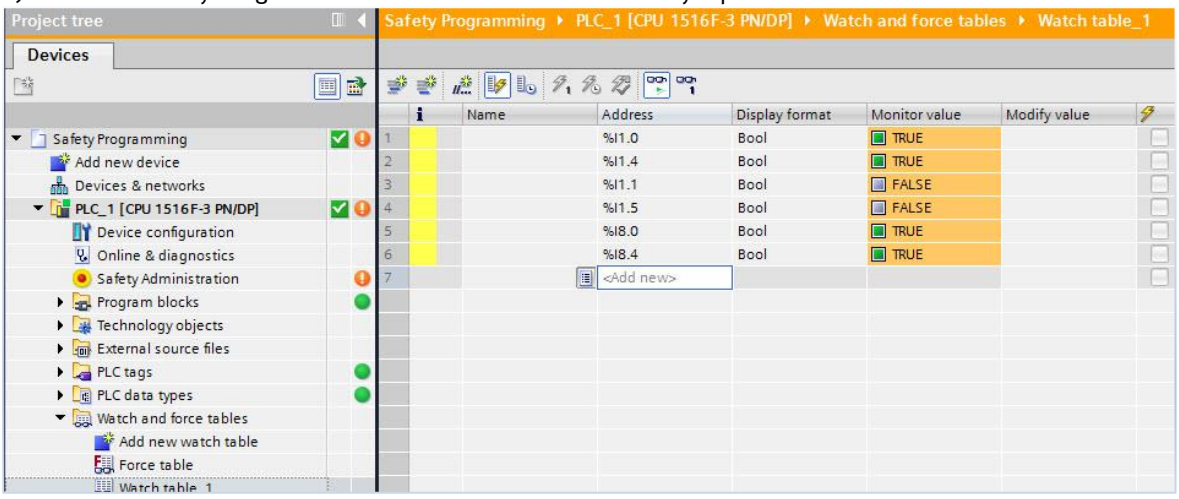
Tab. 1/7: Bit pattern for output data (F usage data, bytes 0, 1 and 2)

Note

3. The mode and Bit relation you find in following table

Value	Binary
Zero	0000
One	0001
Two	0010
Three	0011
Four	0100
Five	0101
Six	0110
Seven	0111
Eight	1000
Nine	1001
Ten	1010
Eleven	1011
Twelve	1100
Fhirteen	1101
Fourteen	1110
Fivteen	1111

D) Download everything and check the behaviour of the safety input variables via watch table:



Note

1. The reasons for the safety input addresses are

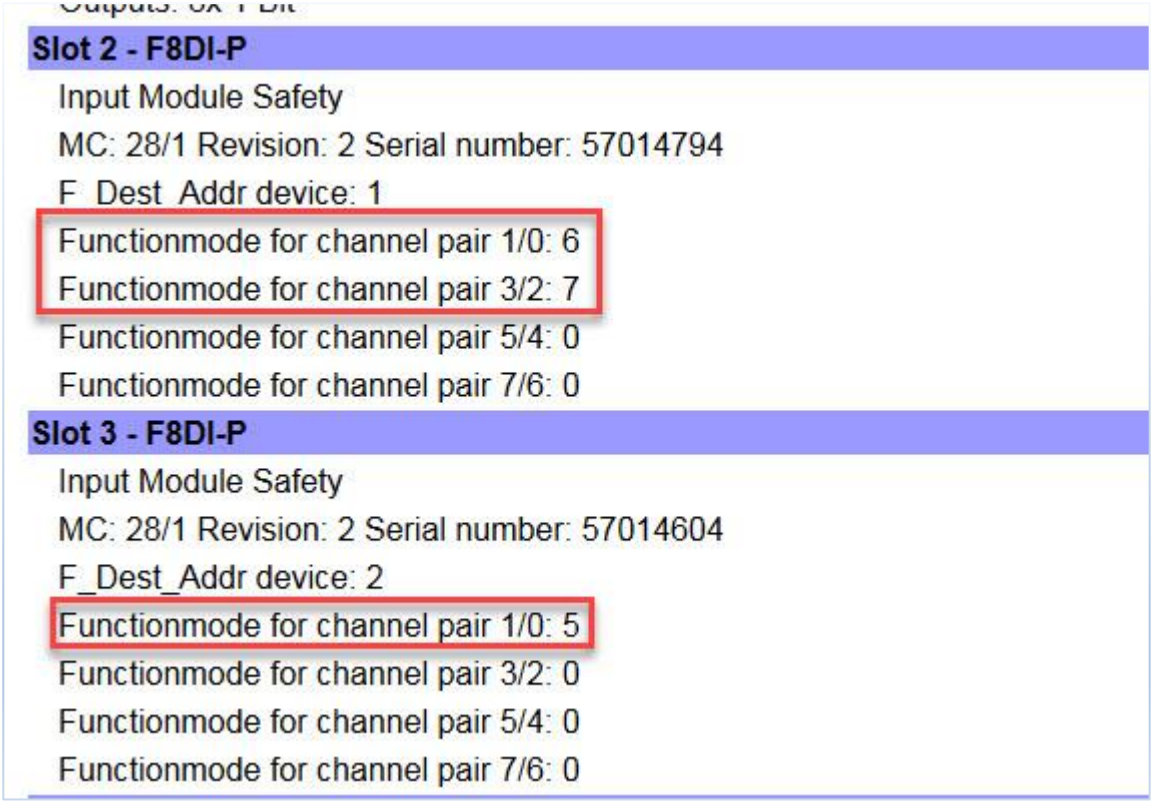
Bit pattern of input data: byte 0 and byte 1

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	E7	E5	E3	E1	E6	E4	E2	E0
	Input image							
1	Q7	Q5	Q3	Q1	Q6	Q4	Q2	Q0
	Qualification bits Qx = 1: Signal Ex is valid Qx = 0: Signal Ex is invalid, incorrect input function in accordance with function mode/ channel error/module fault							

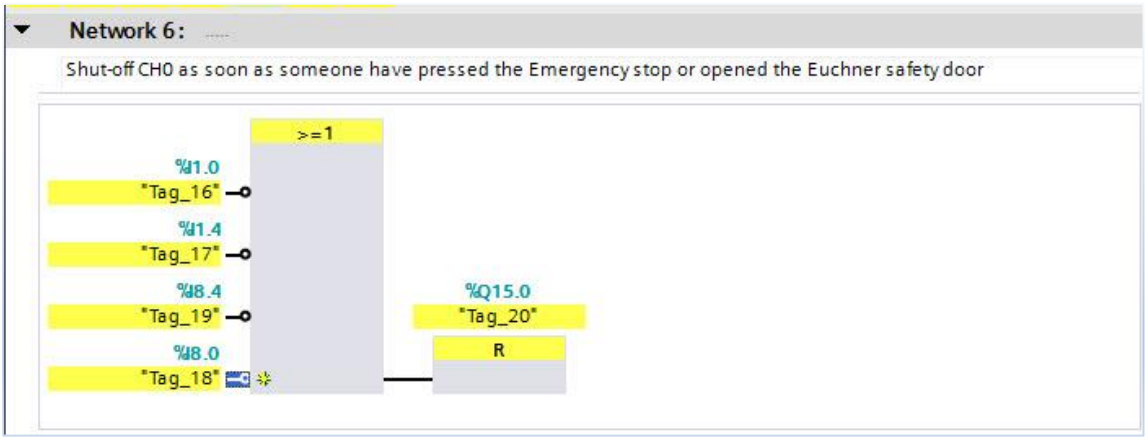
Tab. 1/8: Bit pattern of input data (F-usage data, byte 0 and byte 1)

Note

2. In the webserver you can check the assigned mode too!

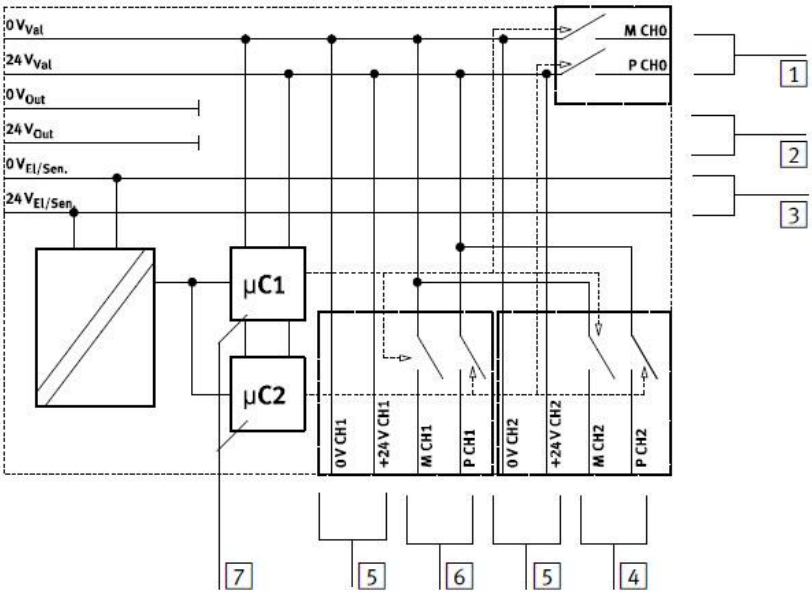


E) Write a small sample project to energize CH0 in network 5 of the CPX-FVDA-P2:



Note

1. The internal circuit of the CPX-FVDA-P2 is looking like this:



1. CH0: output supplied through 24 V_{VAL} and 0 V_{VAL} for right-side-mounted pneumatics modules
2. Load voltage 24 V_{OUT} and 0 V_{OUT} is no longer available on the right side
3. Operating voltage for electronics and sensors (24 $V_{EL/SEN}$ and 0 $V_{EL/SEN}$) for right-side-mounted pneumatics modules
4. CH2: output supplied through 24 V_{VAL} and 0 V_{VAL}; available through the connection technology of the module CPX-FVDA-P2
5. Unswitched voltage U_{VAL} for supply of intelligent load systems (auxiliary supply)
6. CH1: output supplied through 24 V_{VAL} and 0 V_{VAL}; available through the connection technology of the module CPX-FVDA-P2
7. Processors for control and monitoring of the P- and M-switches

Note

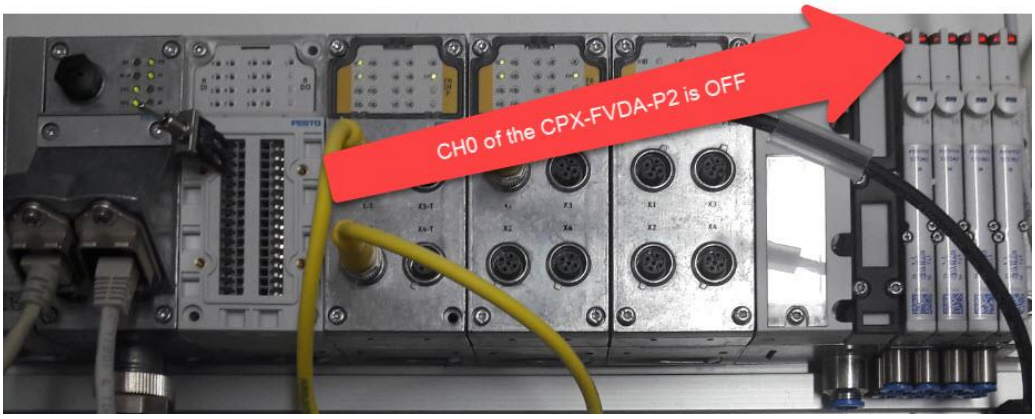
2. If you activate the Bit0 then you power on CH0 too and the supply in CPX backplane for the valves is forwarded safety

Bit pattern of the output data: byte 0 and byte 1

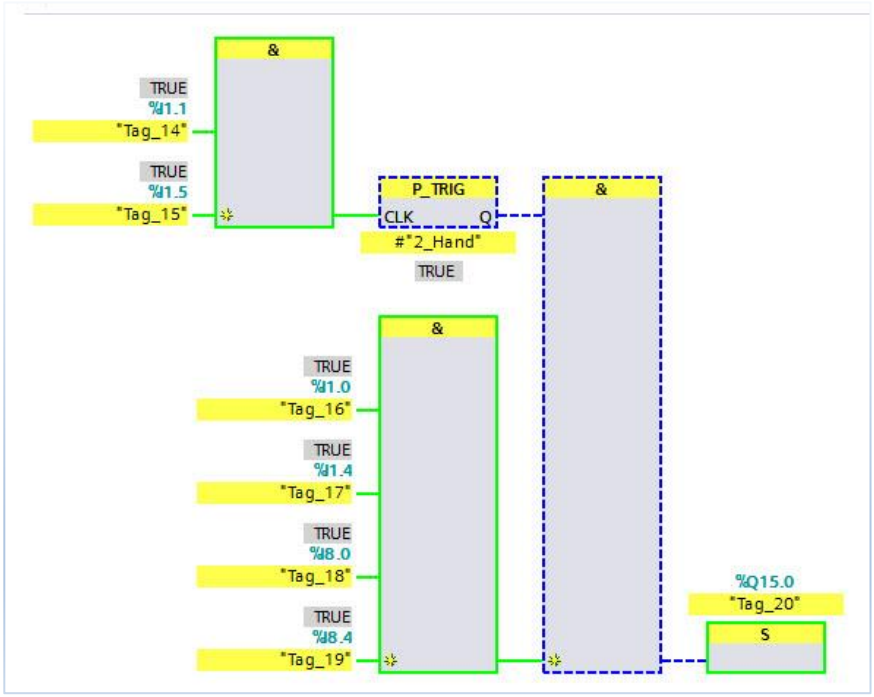
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	Reserved	Test pulse activated		Reserved		Nominal status		
		CH2	CH1			CH2	CH1	CH0
	0	0 = activate 1 = deactivate		0		0 = off 1 = on		
Byte 1	Channel-wise passiva-tion	Reserved		Data direction	Reserv ed	Acknowledgment		
						CH2	CH1	CH0
	0 = off 1 = On	0		0 = Device to host (fixed value)	0	– Change Low → High = user acknowledgment or – Permanent 1 = auto-acknow-ledgment		

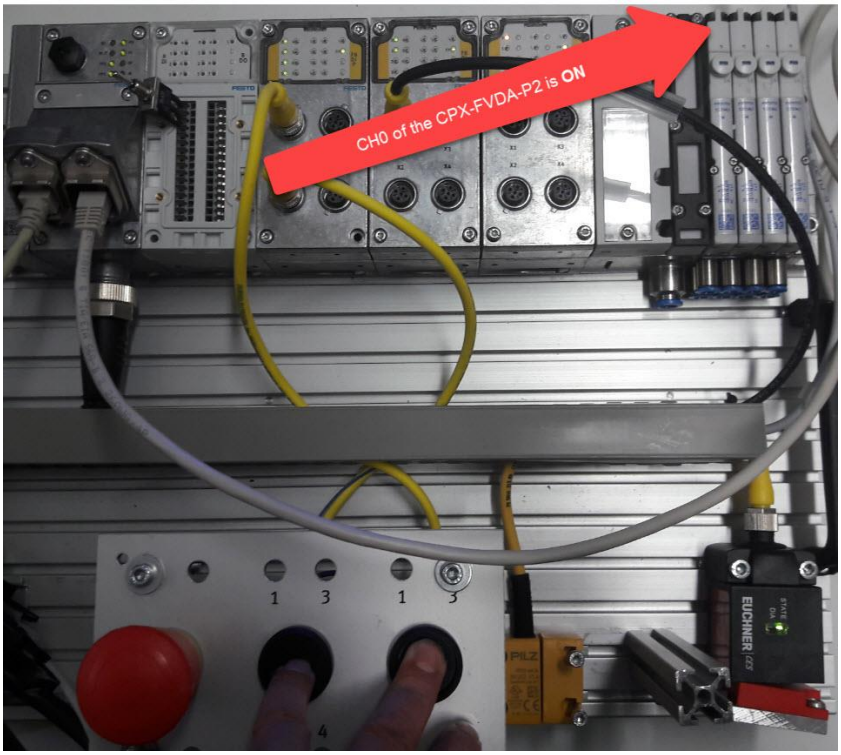
Tab. 1/7: Bit pattern of the output data (F-user data, byte 0 and byte 1)

D) Download everything and press the 2-Hand control:



After pressing the 2-Hand Control the safety logic is active and the valves have no error anymore:





4 Further function mode examples

4.1 SICK Light curtain type “deTec 4 Core”

The deTec4 Core safety light curtain is an electro-sensitive protective device (ESPE) consisting of a sender and receiver.

A series of parallel infrared light beams form a protective field between sender and receiver that protects the hazardous area (hazardous point, access, and hazardous area protection). When one or more beams are completely interrupted, the safety light curtain reports the interruption in the light path to the secure output signal switching devices (OSSDs) by a signal change. The machine or its control must evaluate the signals reliably (e.g., by means of a safety controller or a safety relay) and bring an end to the dangerous state.

Sender and receiver automatically synchronize themselves optically. An electrical connection between both components is not required.

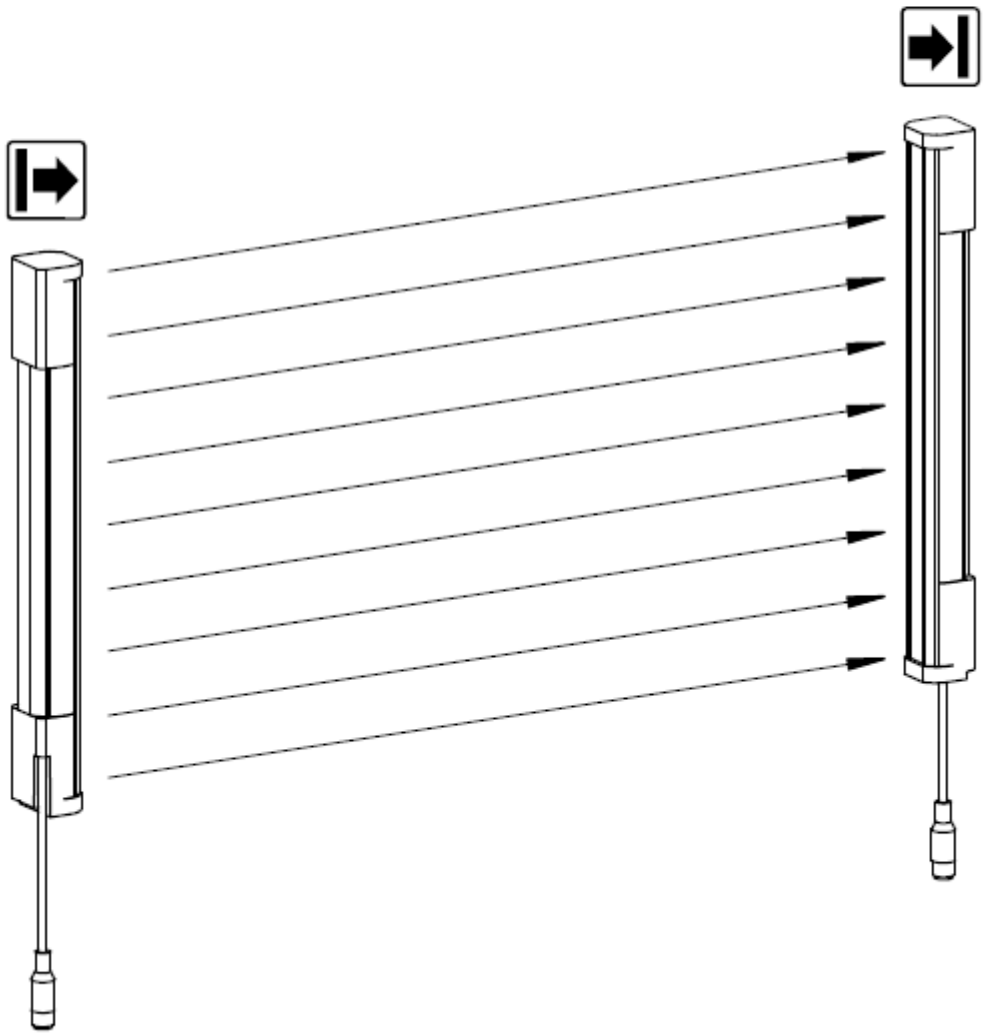


Figure 1: Sender and receiver

The Sender and receiver have following pin allocation:

System connection (M12, 5-pin)

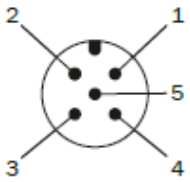


Figure 27: System connection (M12, 5-pin)

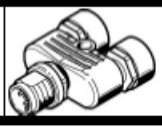
Pin	Wire color	Sender	Receiver
1	Brown	+24 V DC (power supply input)	+24 V DC (power supply input)
2	White	Reserved	OSSD1 (output signal switching device 1)
3	Blue	0 V DC (power supply input)	0 V DC (power supply input)
4	Black	Reserved	OSSD2 (output signal switching device 2)
5	Gray	Not yet assigned	Not yet assigned

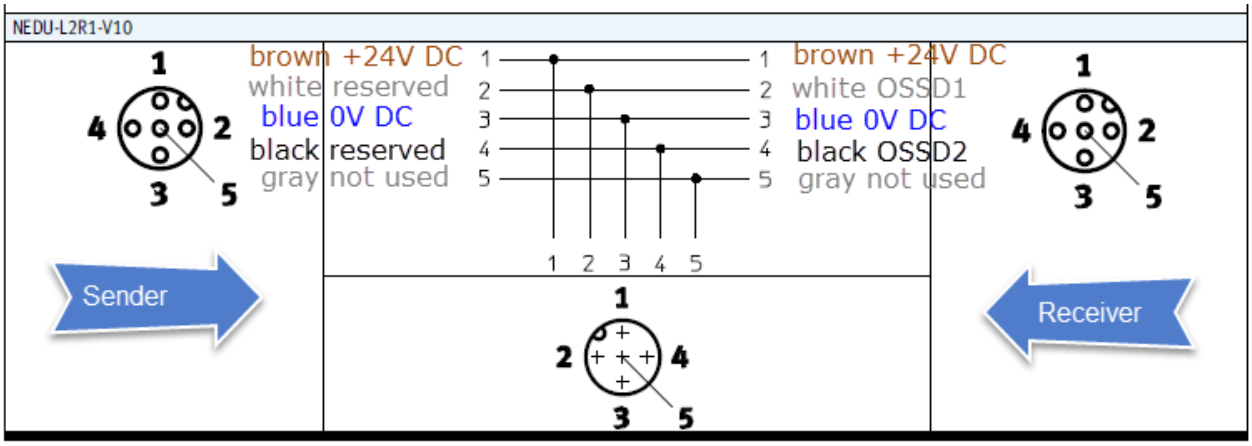
Table 2: System connection pin assignment (M12, 5-pin)

Via the Festo NEDU connector you can combine the Sender and Receiver:

1.3 Sensors

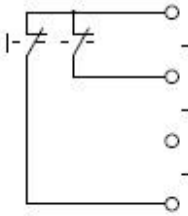
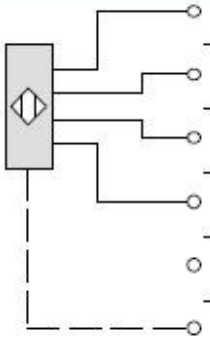
1.3.1 Plug connectors

Part no.	Order code	Name	Picture	Quantity	Price	Total	Case layer	ID
2839867	NEDU-L2R1-V10-M12G5-M12G5	Push-in T connector		1	15,15 EUR	15,15 EUR	1	5



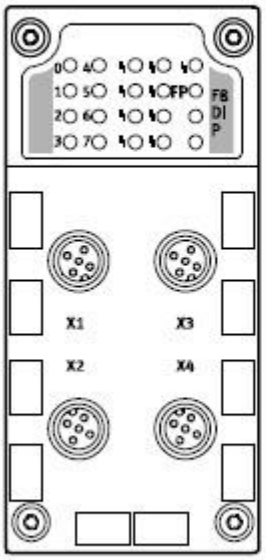
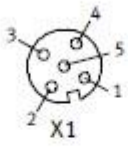
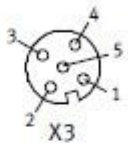
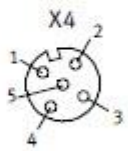
In this case the right function mode could be 5:

Function mode 5 – 1oo2 (equivalent)

Circuit diagrams	Channel pair ports				Comments
A 	T0/ 24 V	T2/ 24 V	T4/ 24 V	T6/ 24 V	Signal evaluation of a sensor (typically OSSD), which switches both signals of the channel pair simultaneously. Short-circuit and cross-circuit monitoring can take place through the sensor. **Example A** A dual-channel switch/sensor (internally equivalent) per channel pair with uniformly unclocked sensor supply.
	E1	E3	E5	E7	
	0 V				
	E0	E2	E4	E6	
	T1/ FE	T3/ FE	T5/ FE	T7/ FE	
B 	24 V	24 V	24 V	24 V	In this function mode, T0, T2, T4 and T6 are at static 24 V DC. **Example B** OSSD sensor
	E1	E3	E5	E7	
	0 V				
	E0	E2	E4	E6	
	T1	T3	T5	T7	
	FE connection of the sensor via the M12 plug connector fitting of the module				

The connection block have to be the cage clamp variant or

CPX-F8DE-P with connection block CPX-M-AB-4-M12X2-5POL

Connection block	Pin allocation X1, X2		Pin allocation X3, X4	
		**Socket X1** 1: 24 V 2: E1 OSSD1 3: 0 V 4: E0 OSSD2 5: FE		**Socket X3** 1: 24 V 2: E5 3: 0 V 4: E4 5: FE
		**Socket X2** 1: 24 V 2: E3 3: 0 V 4: E2 5: FE		**Socket X4** 1: 24 V 2: E7 3: 0 V 4: E6 5: FE
FE = functional earth n.c. = free (not connected)				

Keine Indexeinträge gefunden.