



PNOZ m EF EtherCAT FSoE with TwinCAT 3 and Codesys 3.5

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Product

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Name: PNOZ m EF EtherCAT FSoE
Manufacturer: Pilz GmbH & Co. KG, Safe Automation

Document

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February 2024

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Abbreviations

Abbreviation / term	Description	Source
AN	A pplication N ote	 AN content (1002400)">www.pilz.com > AN content (1002400)
PNOZ	Pilz E-STOP positive-guided (DE: P ilz N OT-AUS- Z wangsgeführt)	 PNOZ">www.pilz.com > PNOZ
PSS	Programmable control system (DE: P rogrammierbares S teuerungssystem)	 PSS">www.pilz.com > PSS
PSS u2	PSS universal, 2 nd generation	 PSS u2">www.pilz.com > PSS u2
POU	P rogram O rganisation U nit	
NC	N ormally C losed	
NO	N ormally O pen	
FSoE	FailSafe over EtherCAT	
CoE	C AN application protocol o ver E therCAT	
MDevice	MainDevice	
SubDevice	SubordinaryDevice	
FSoE MInstance	FSoE MainInstance	
FSoE SubInstance	FSoE SubordinaryInstance	

Definition of Symbols

- Information that is particularly important is identified as follows:



CAUTION!

This refers to a hazard that can lead to a less serious or minor injury plus material damage, and also provides information on preventive measures that can be taken.



NOTICE

This describes a situation in which the product or devices could be damaged and also provides information on preventive measures that can be taken. It also highlights areas within the text that are of particular importance.



INFORMATION

This gives advice on applications and provides information on special features.

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1 Useful documentation

Reading the documentation listed below is necessary for understanding this Application Note. The availability of the software used, and its safe handling are also presupposed for the user.

1.1 Documentation from Pilz GmbH & Co. KG

No.	Description	Item No. /Download
1	Pilz international homepage, download section	www.pilz.com
2	Operating Manual PNOZmulti 2 Communication Interfaces 1002971-EN-XX	 OpMan 1002971">www.pilz.com > OpMan 1002971
3	Operating Manual Operat. Manual PNOZ m EF EtherCAT FSoE 1006493-EN-XX	 OpMan 1006493">www.pilz.com > OpMan 1006493
4	Technical Catalogue Techn. Catalogue PNOZmulti Classic/Mini 1001153-EN-XX	 TeCat 1001153">www.pilz.com > TeCat 1001153
5	Operating Manual Operat. Manual PNOZ m B1 1003790-EN-XX	 OpMan 1003790">www.pilz.com > OpMan 1003790
6	Technical Catalogue Techn. Catalogue PNOZmulti 2 1006421-EN-XX	 TeCat 1006421">www.pilz.com > TeCat 1006421
7	System Description PNOZmulti System Expansion 1002217-EN-XX	 SyDes 1002217">www.pilz.com > SyDes 1002217

1.2 Documentation from other sources of information

No.	Description	Item No. / Download
1	Beckhoff Information System	Beckhoff Information System (EN)
2	CODESYS Online Help	CODESYS Online Help (EN)

2 Used hardware and software

2.1 Pilz products

No.	Descriptions	Order number	Version	Number
1	PNOZ m B1	772101	--	1
2	PNOZ m EF 8DI4DO	772142	--	1
3	PNOZ m EF EtherCAT FSoE	772123	--	1
4	PNOZ m B1 Set4 Spring Terminals	751016	--	1
5	PNOZ m EF 8DI4DO Set spring terminals	751004	--	1
6	USB-Memory 512MB	779213	--	1
7	PNOZmulti Configurator	--	V11.3	--

2.2 Third-party products

No.	Descriptions	Order number	Version	Number
1	Beckhoff CX5020 mit TwinCAT 3	--	--	--
2	Beckhoff TwinCAT 3	--	v3.1.4024.32	--
3	CODESYS	--	v3.5 SP17 Patch1	--

2.3 Structure of the application (schematic)

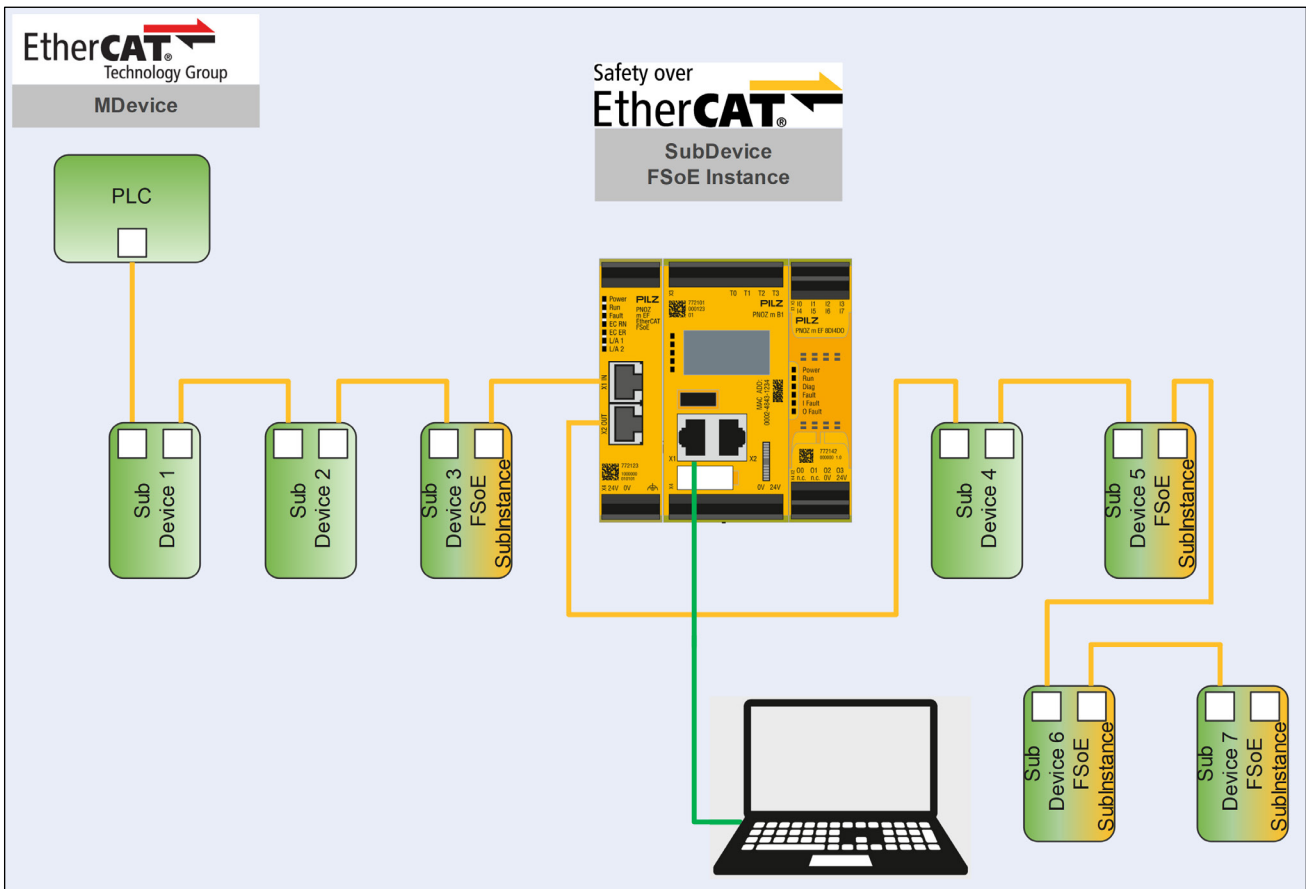


Figure 1: Application – Structure of the hardware (schematic)

3 Preface

This Application Note describe the essential commissioning of the Module PNOZ m EF EtherCAT FSoE with a Beckhoff TwinCAT 3 and Codesys PLC.
The basic procedure for successful basic configuration is shown here step-by-step, mostly in pictures.
The PNOZ m EF EtherCAT FSoE module can be operated as FSoE MainInstance and FSoE SubInstance, even simultaneously. In this application note, the module is used only as an FSoE MInstance.



NOTICE

- ▶ The Module “PNOZ m EF EtherCAT FSoE” can only be connected to a PNOZ m B1.
- ▶ A detailed explanation of safety functions used in the failsafe application and its evaluation regarding functional safety are not a part of this document.
- ▶ This document is not intended as a technical documentation for general use of the third part software TwinCAT3 from Beckhoff and CodeSys from 3S.



INFORMATION

The ETG (EtherCAT Technology Group) has replaced the terms master and slave. This change has already been taken into account in the application note; the screenshots of the tools used still contain the previous terms.

Old terminology	New name	New terminology
Master device	MainDevice	MDevice
Slave device	SubordinaryDevice	SubDevice
Master instance	FSoE MainInstance	FSoE MInstance
Slave instance	FSoE SubordinaryInstance	FSoE SubInstance

Figure 2: Adjustment terminology

4 Hardware configuration

4.1 Used hardware

4.1.1 Pilz devices

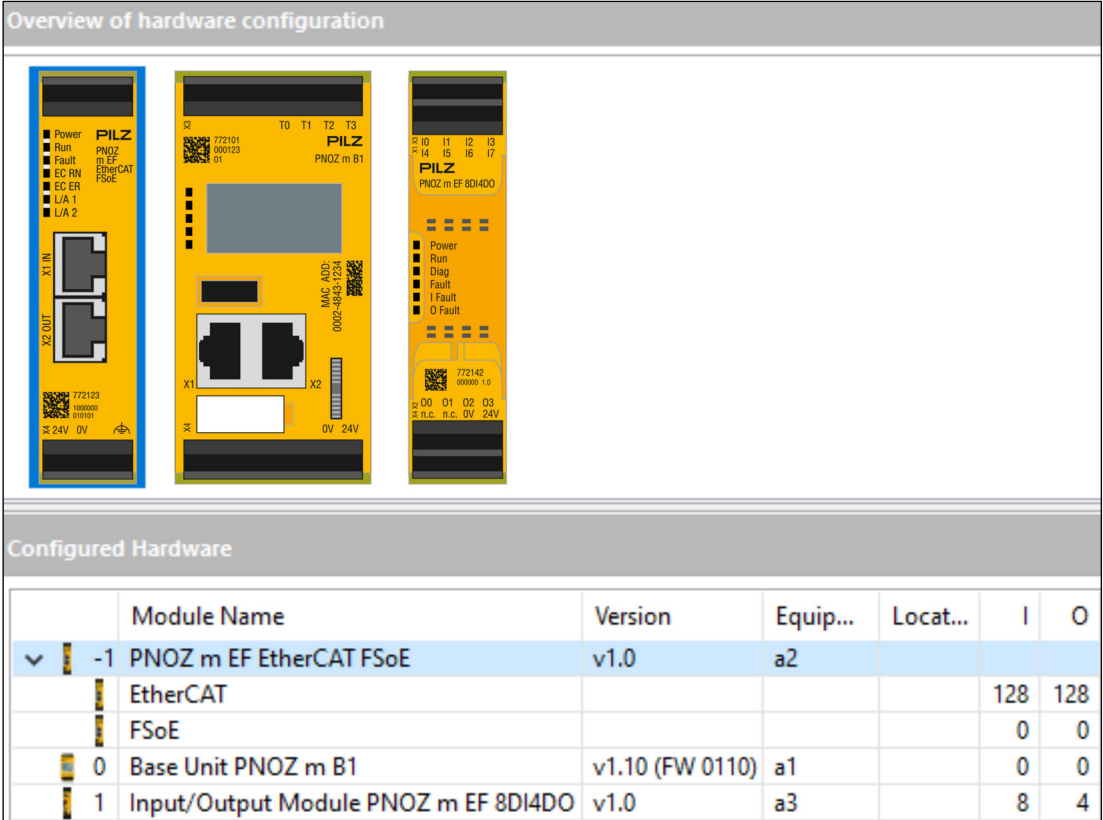


Figure 3: Used Hardware – Pilz devices

4.1.2 Third-party devices

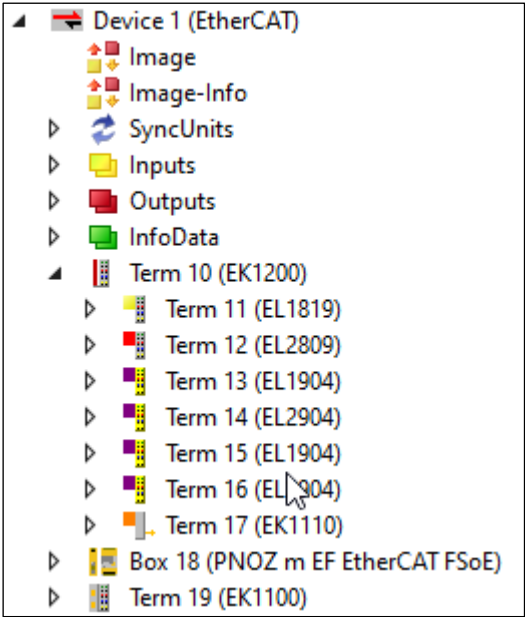


Figure 4: Used Hardware – Third-party devices

5 Properties of the Module PNOZ m EF EtherCAT FSoE

5.1 MDevice / SubDevice

The Modul PNOZ m EF EtherCAT FSoE is part of a EtherCAT-Network and operates as an SubDevice, simultaneously as an FSoE MInstance and FSoE SubInstance.

In a EtherCAT-Network the data will be received and transmitted to the Module PNOZ m EF EtherCAT FSoE (SubDevice).

For more information, please have a look to Manuals.



NOTICE

- ▶ Because the PNOZ m EF EtherCAT FSoE module does not have any MDevice functionality, it is necessary to integrate an MDevice into the network.
- ▶ The EtherCAT MDevices in this Application Note are:
 - a Beckhoff TwinCAT PLC and
 - a CodeSys PLC.

5.2 FSoE MInstance / FSoE SubInstance

The PNOZ m EF EtherCAT FSoE module can be configured as an FSoE MInstance and FSoE SubInstance.

- ▶ As an FSoE MInstance, up to 60 connections can be configured, a maximum of 512 bits of fail-safe input and 512 bits of fail-safe output data can be transferred.
- ▶ As an FSoE SubInstance, up to 4 connections can be configured.



NOTICE

- ▶ System boundaries of the Module PNOZ m EF EtherCAT FSoE

Number of Connections	min. per Connection	max. per Connection	max. per FSoE MInstance
60 FSoE MInstance to FSoE SubInstance	8 Bit Fail-Safe Inputs	16 Byte Fail-Safe Inputs	512 Bit Fail-Safe Inputs
4 as an FSoE SubInstance	and 8 Bit Fail-Safe Outputs	and 16 Bytes Fail-Safe Outputs	and 512 Bit Fail-Safe Outputs

Figure 5: PNOZ m EF EtherCAT FSoE – Overview system boundaries

5.3 Network Topology

The MDevice, the SubDevices, the FSoE MInstance and the FSoE SubInstances are all together in one network and are connected to each other.

From the MDevice point of view, the FSoE MInstance is an SubDevice.

The structure is shown schematically in [Figure 1: Application – Structure of the hardware \(schematic\) \[6\]](#).

6 Create a FSoE-Connection



INFORMATION

It is recommended to start with the FSoE configuration in PNOZmulti so that the slot assignment can be adopted when configuring or searching the EtherCAT network.



INFORMATION

In this application note, a TwinCAT 3 PLC is used as the MDevice. Alternatively, the procedure with CodeSys 3.5 is also described.

It is also possible to use other MDevices that can handle ESI files with FSoE elements.

6.1 PNOZmulti Configurator

6.1.1 Hardware Configuration



NOTICE

- ▶ It is only possible to use one communication module to the left side of the base unit. If the PNOZ m EF EtherCAT FSoE module is plugged in, no other communication module can be plugged in. Exception: PNOZ m EF SafetyNET.
 - ▶ Via the integrated ETH interface of the PNOZ m B1, Modbus TCP and TCP/IP can additionally be used.
 - ▶ The module provides the standard EtherCAT functionality similar to the PNOZ m ES EtherCAT
- For more details, see the document Communication interfaces [Chapter 1.1 \[5\]](#).

- ▶ Create a new PNOZmulti project
- ▶ Select PNOZ m B1, PNOZ m EF EtherCAT FSoE and an extension module on the right side. In this example we choose a PNOZ m EF 8DI4DO.

	Module Name	Version	Equipment Identifier	Location Description	I	O
-1	PNOZ m EF EtherCAT FSoE	v1.0	a2			
	EtherCAT				128	128
	FSoE				0	0
0	Base Unit PNOZ m B1	v1.10 (FW 0110)	a1		0	0
1	Input/Output Module PNOZ m EF 8DI4DO	v1.0	a3		8	4

Figure 6: PNOZmulti Configurator – Hardware Configuration

6.1.2 Import ESI file

- ▶ For all FSoE SubInstances that are used, an ESI file must be installed.
- ▶ Open the FSoE-Configuration with a right mouse click to the Module PNOZ m EF EtherCAT FSoE.

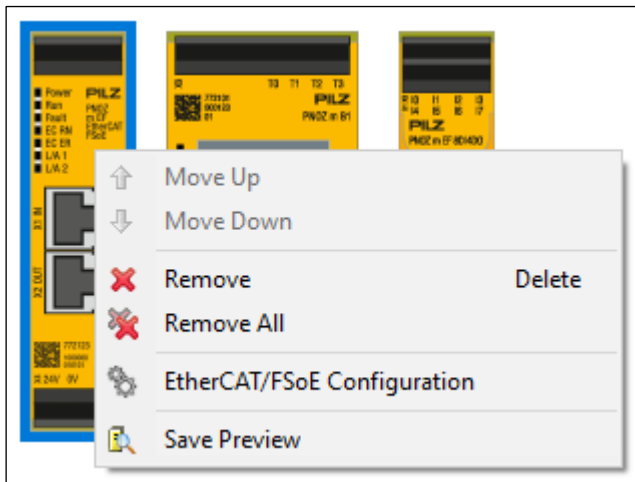


Figure 7: PNOZmulti Configurator – open FSoE Configuration

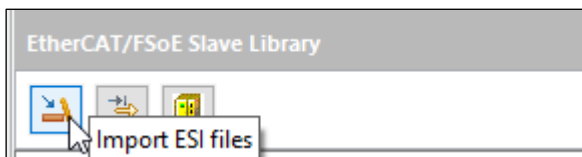


Figure 8: PNOZmulti Configurator – Import ESI file

- ▶ After the successful import of the ESI file, the device (if FSoE data containing the BOOL data type is available) is shown in the library:

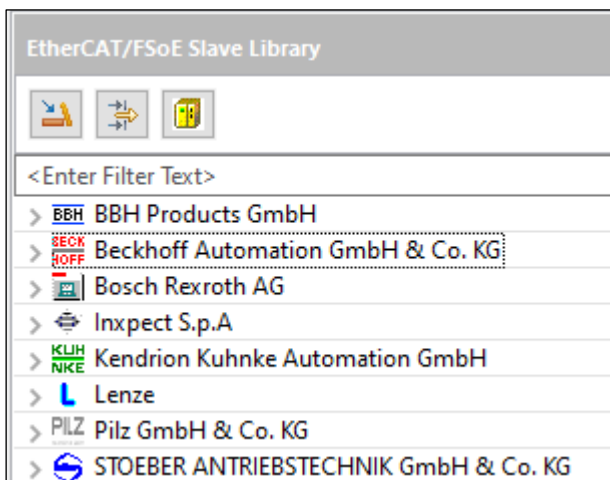


Figure 9: PNOZmulti Configurator – EtherCAT/FSoE SubInstance-Library

- ▶ The imported ESI files are stored in the folder
 » C:\ProgramData\Pilz\PNOZmulti Configurator_v11.3.0\AppData\Esi Library
 and can also be deleted there if required.

6.1.3 FSoE Configuration

6.1.3.1 FSoE SubInstance Configuration

- ▶ In the FSoE configuration, all FSoE Instances are selected to which a connection needs to be established.
- ▶ The FSoE SubInstances that are available after the ESI import are displayed on the right in the library.
- ▶ Devices can be added from the library using drag and drop.

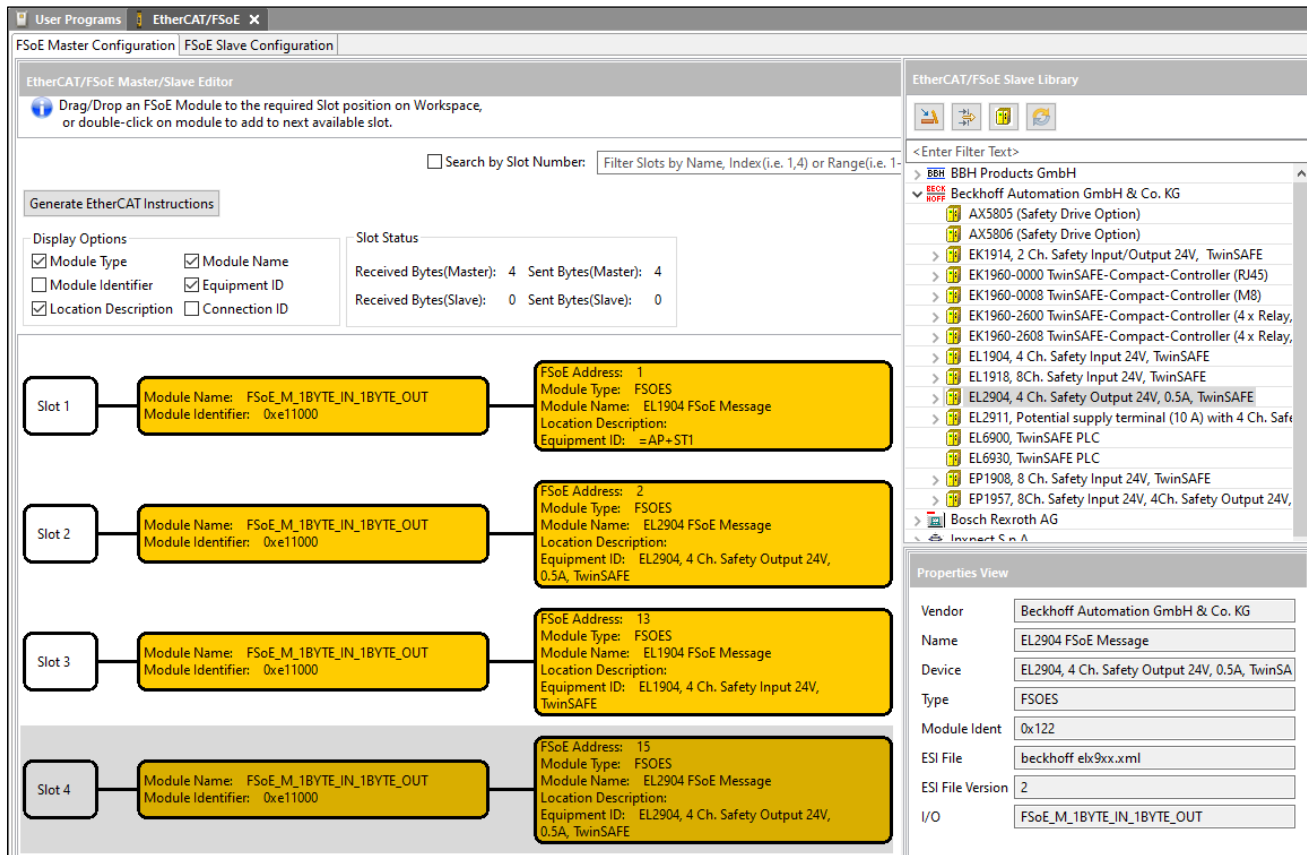


Figure 10: PNOZmulti Configurator – Add FSoE Connections



NOTICE

- ▶ The module PNOZ m EF EtherCAT FSoE only supports the data type BOOL. It only supports ESI files that contain the data type BOOL. If the ESI file does not contain a BOOL data type, it is still imported, but is grayed out and a message is displayed.
- ▶ If the ESI file contains at least one variable with the BOOL data type and a non-supported data type, this is also marked with a warning.

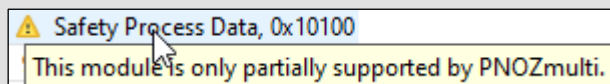


Figure 11: PNOZmulti Configurator – Module only partially supported

- ▶ The PNOZ m EF EtherCAT FSoE module supports FSoE SubInstances with a data size of at least 1 byte and up to 16 bytes, see system boundaries in the [Chapter 5.2 \[9\]](#).
- ▶ FSoE SubInstances that have multiple FSoE connections are supported.

6.1.3.2 Setting the safety parameters of the FSoE SubInstance connections

After all connections have been configured, the safety parameters must be set. These are parameters that the FSoE SubInstances manufacturer has defined in its ESI file for the respective device.

- ▶ The definition of the safety parameters can be found in the documentation of the respective FSoE SubInstance manufacturer.
- ▶ The FSoE address must be entered here and must match with the address set on the FSoE SubInstance.
- ▶ The FSoE address may only exist once in the EtherCAT network.
- ▶ The PNOZmulti Configurator creates the Connection ID automatically and checks whether it is used once.
- ▶ The Watchdog timeout must also be set for each connection. The default value is 100ms.

Safety Parameters			
Safety Parameters			
Equipment ID:	EL2904, 4 Ch. Safety Output 24V, 0.5A, TwinSAFE	Location Description:	
		Format ☐ Hex ☒ Dec ☐ Bin	
FSoE Address:	15	Watchdog Timeout[ms]:	100
		Connection ID:	4
Index	Name	Value	Unit
▼ #x8000:0	FSOE Settings		
#x8000:1	Standard outputs active	false	
#x8000:2	Current measurement active	false	
#x8000:3	Testing of outputs active	true	
#x8000:4	Error acknowledge active	false	
#x0000:0		0	
#x10E0:1	Store Code	0	
#x10E0:2	Project CRC	0	

Figure 12: PNOZmulti Configurator – Safety Parameter



NOTICE

The watchdog timeout can be set separately for each connection. The watchdog timeout can be calculated. The calculation of the watchdog timeout and the detailed reaction times are described in the document System configuration, see [Chapter 1.1 \[5\]](#)



CAUTION!

The EtherCAT cycle time (set in the MDevice) has a direct effect on the watchdog timeout and therefore on the response times! See also [Chapter 6.4 \[29\]](#)
Please read the documentation of the module PNOZ m EF EtherCAT FSoE.

- ▶ In the Safety parameters, the Equipment ID and the location description of the FSoE connection can also be adjusted; both will then appear in the Error Stack in the case of an error.

Figure 13: PNOZmulti Configurator – Equipment ID

- ▶ By default, the Equipment ID from the ESI file are displayed.
- ▶ The Equipment ID are displayed in the user program as described in the following chapter.

6.1.4 User Program (Main Program and Modul Program)

- ▶ In the tab 'Assignment list', the Equipment Identifier (EID) of the individual FSoE connections can now be adjusted.

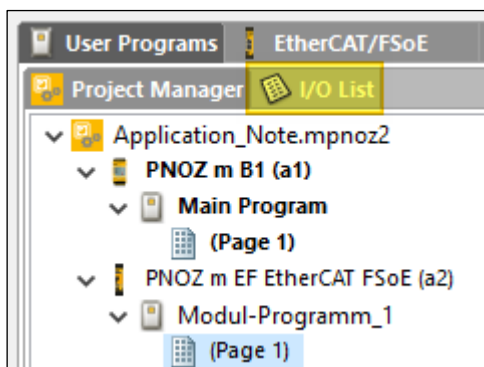


Figure 14: PNOZmulti Configurator – I/O List » Adjust Equipment ID (1)

- ▶ For all variables shown, the Equipment Identifier (EID) can be adjusted.

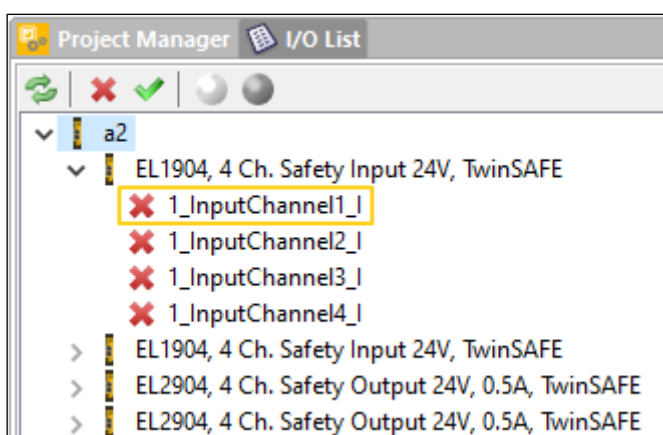


Figure 15: PNOZmulti Configurator – I/O List » Adjust Equipment ID (2)

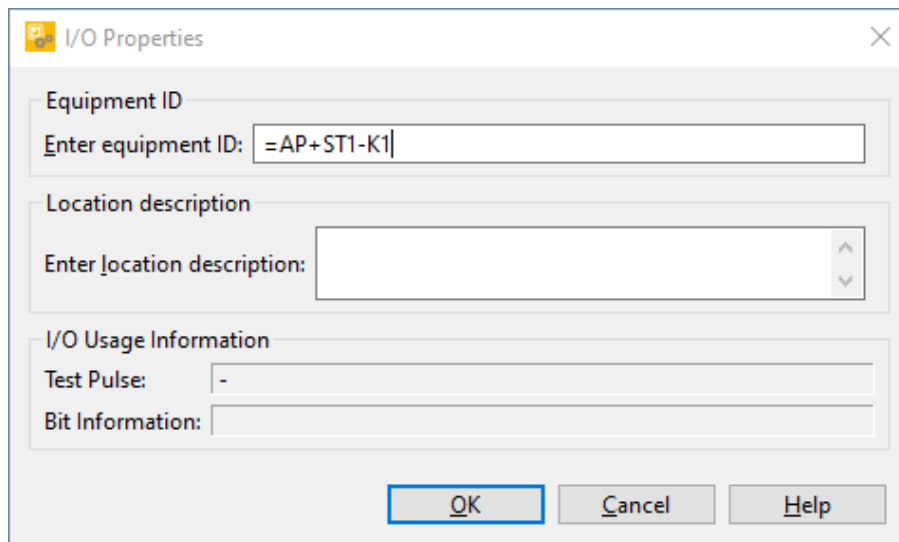


Figure 16: PNOZmulti Configurator – I/O List » Adjust Equipment ID (3)

- ▶ The PNOZ m EF EtherCAT FSoE module has its own module program. The inputs and outputs of the FSoE connections are available in the module program, but they cannot be addressed directly in the main program.
- ▶ All Boolean variables are available in the user program.
- ▶ Each variable begins with the FSoE address; after the "_" the actual variable name begins.

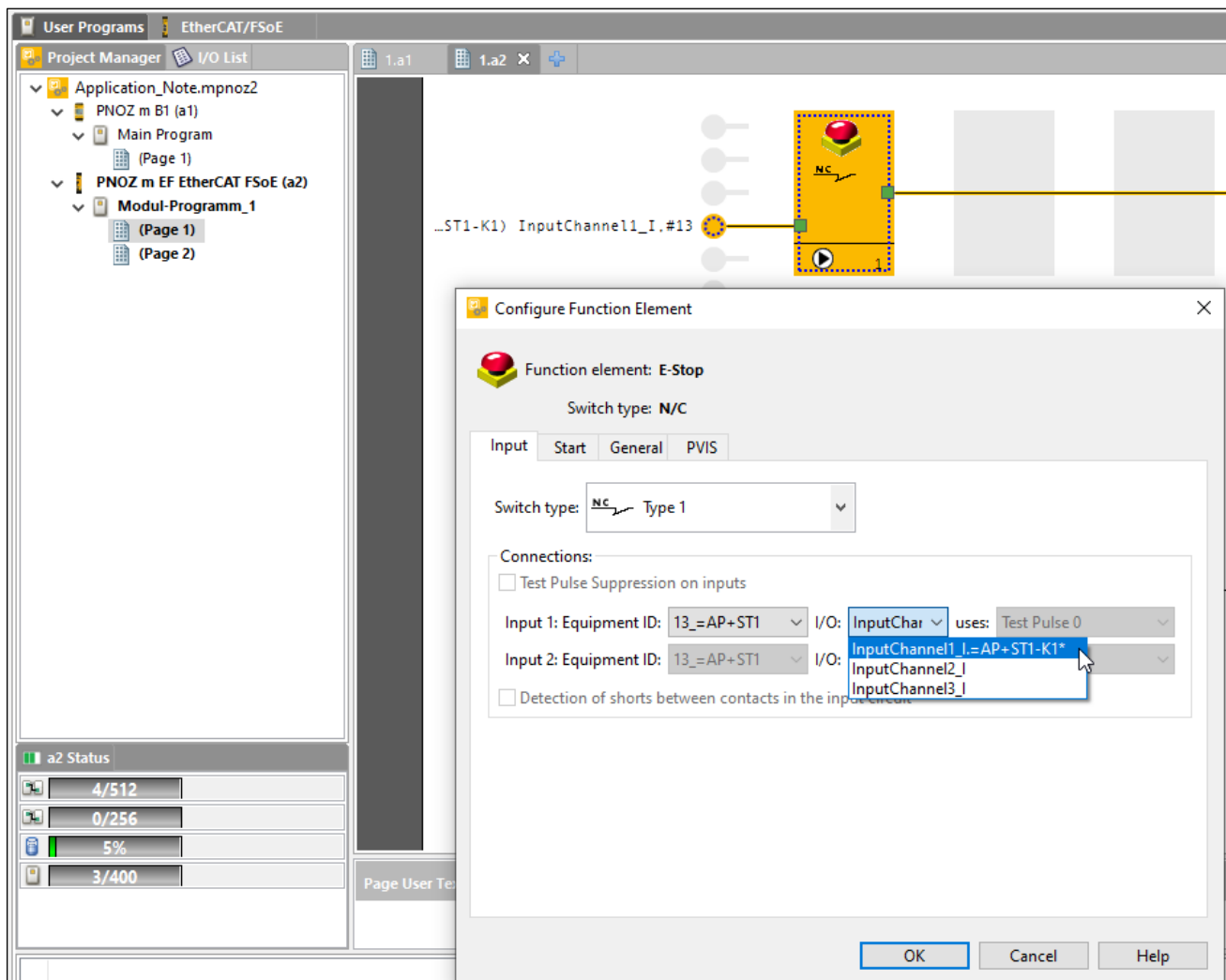


Figure 17: PNOZmulti Configurator – Add E-Stop Element

- ▶ 128 program connectors are available for data exchange between the module program and the main program of the PNOZ m B1.
- ▶ To monitor the FSoE connection, an FSoE connection status element is available in the user program for each FSoE connection.

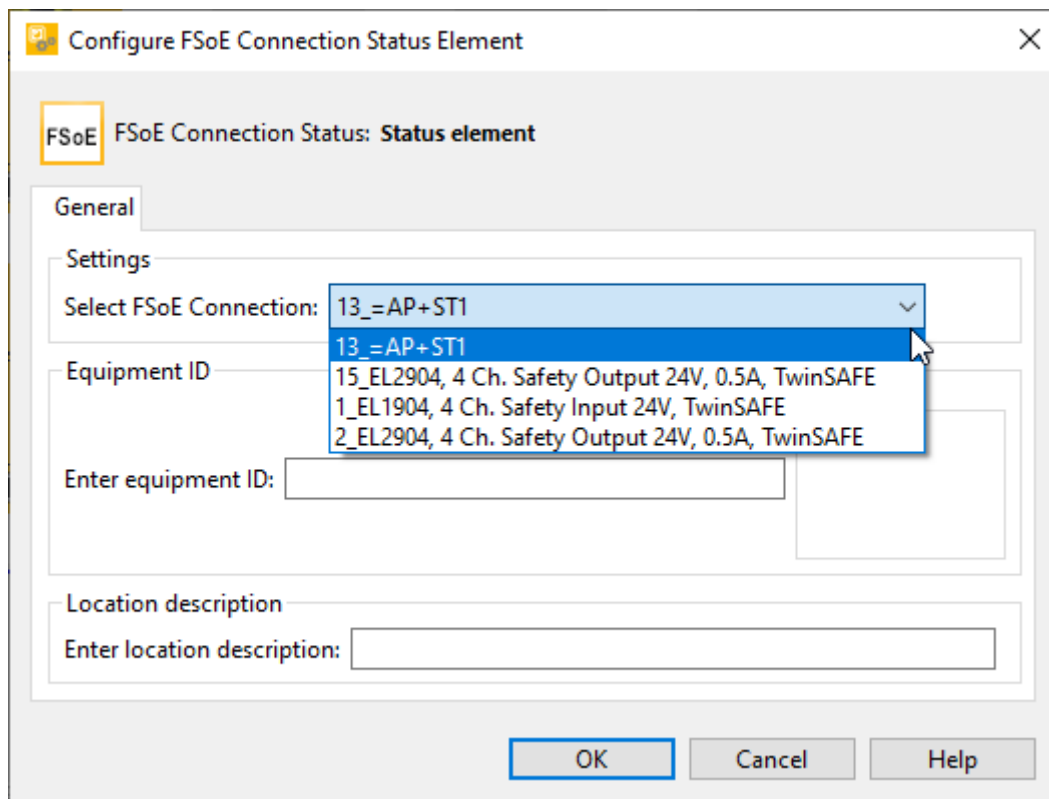


Figure 18: PNOZmulti Configurator – Add FSoE Connection Sstatus Element



CAUTION!

If an FSoE connection is interrupted, the FSoE MainInstance automatically tries to re-establish the connection. If the application requires a manual restart with a user acknowledgement, this can be programmed in the PNOZmulti Configurator using the FSoE connection status element.

- ▶ Also available (as with other communication modules) are 128 virtual inputs and outputs (standard) in the user program.

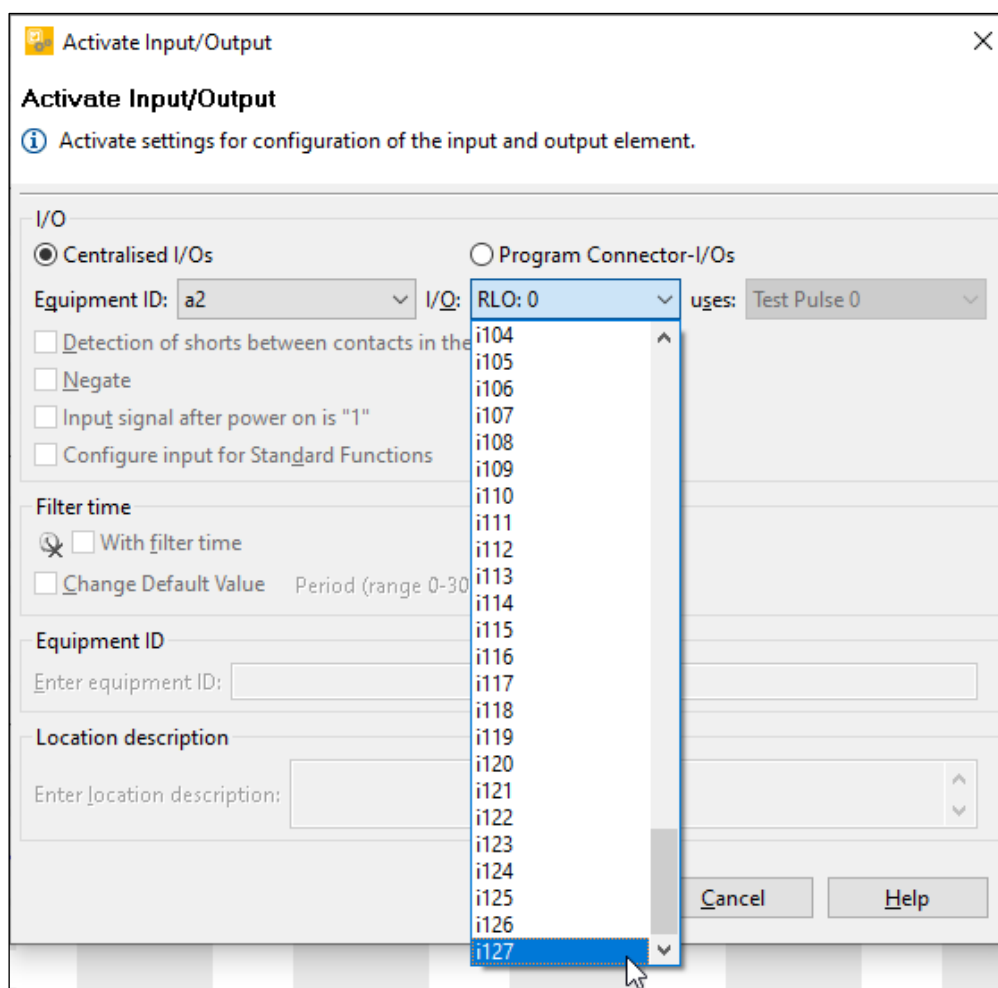


Figure 19: PNOZmulti Configurator – virtual In-Outputs

6.1.5 Download the User program

After the user program and the FSoE configuration have been created, the program can be downloaded.

The FSoE configuration is also downloaded to the base unit when the program is downloaded.



NOTICE

- ▶ After the download, the EtherCAT/FSoE configuration is adopted and the PNOZ m EF EtherCAT module executes a reset. As a result, this and the following SubDevices shortly lose the connection to the MDevice.

6.2 TwinCAT

6.2.1 Import ESI file

- ▶ For all FSoE SubInstances that are to be used, an ESI file must be installed.
- ▶ Furthermore, the PNOZ m EF EtherCAT FSoE module requires an ESI file. This can be downloaded from www.pilz.com.
- ▶ All ESI files must be copied to the TwinCAT directory, the default path is:
`C:\TwinCAT\3.1\Config\Io\EtherCAT`
- ▶ After inserting an ESI file, TwinCAT must be restarted or updated via the menu under: **TwinCAT – EtherCAT Devices – Reload Device Descriptions**

6.2.2 EtherCAT Configuration

- ▶ All connected EtherCAT Devices in the network must be configured in the MDevice.
- ▶ The device scan performs the task automatically, it is also possible to create all the devices manually.

6.2.3 Slot Configuration

After all EtherCAT devices have been configured, the identical configuration as in the PNOZmulti Configurator on the EtherCAT/FSoE tab must now be created on the Slots tab. Please note that the modules must be configured in the same order with the identical length.



INFORMATION

Using a device scan, the slots are automatically entered in TwinCAT. If an EtherCAT or FSoE connection cannot be established, you must check at this point whether the configuration in the PNOZmulti Configurator and TwinCAT is identical.

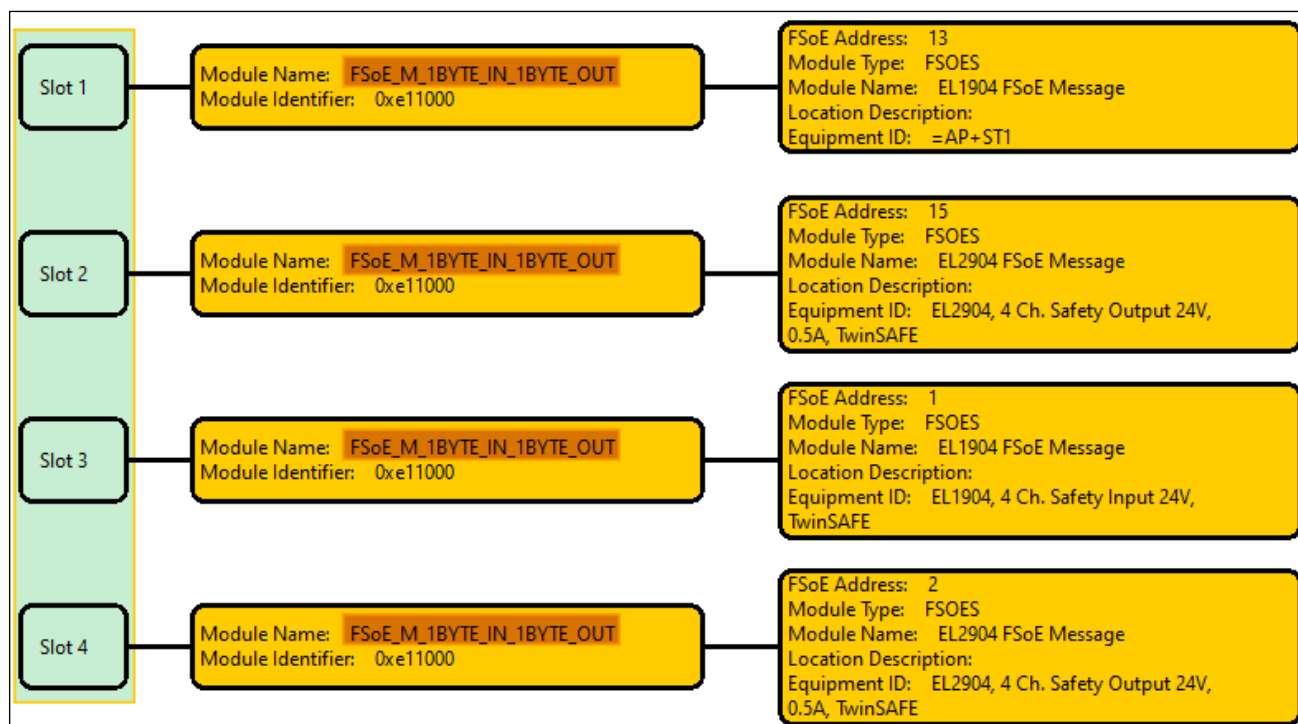


Figure 20: PNOZmulti Configurator – Slot Configuration

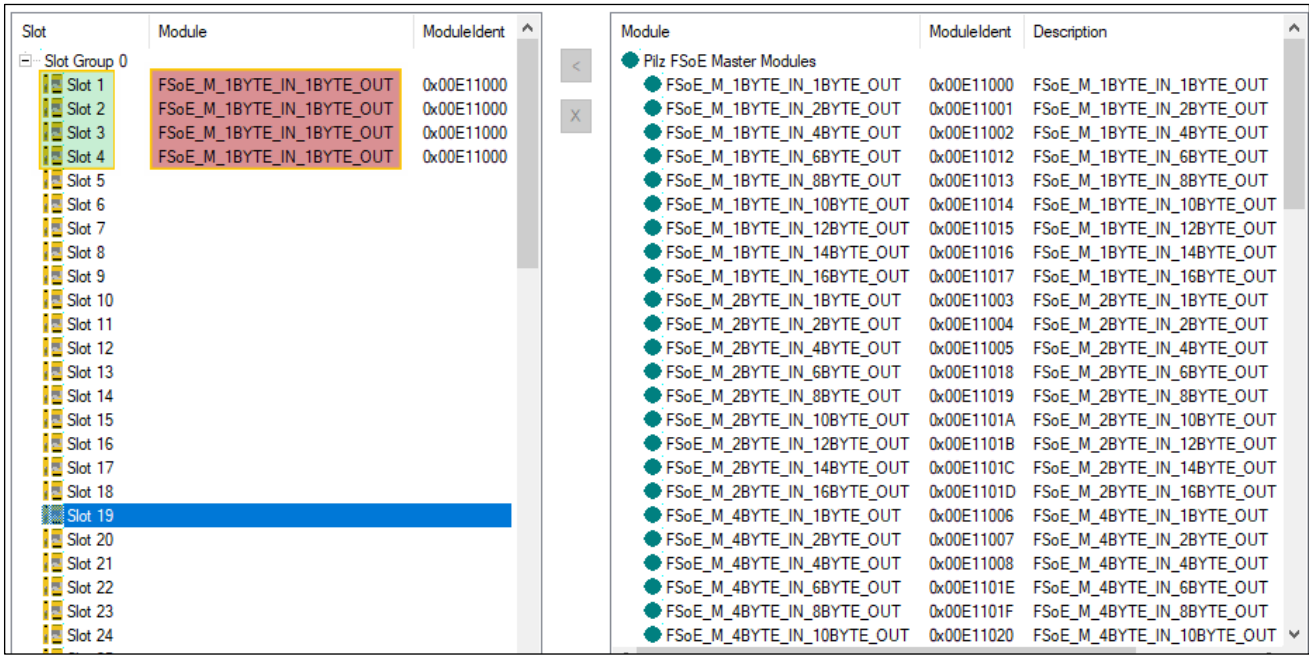


Figure 21: TwinCAT – Slot Configuration

6.2.4 Mapping the FSoE data

In order for the FSoE MInstance to receive the data from the FSoE SubInstances, a mapping must be created for them in TwinCAT. The PNOZmulti Configurator offers support for this, the instructions can be generated in the EtherCAT/FSoE tab.

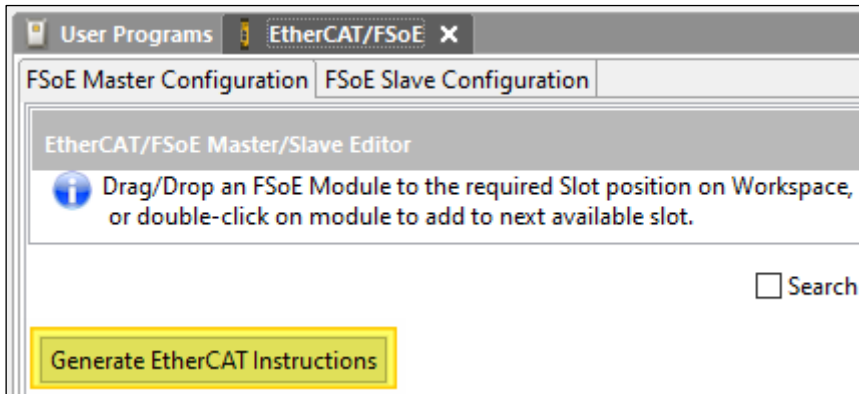


Figure 22: PNOZmulti Configurator – Generate EtherCAT Instructions

- ▶ The slot configuration is documented in the upper section and the necessary mapping is shown below.

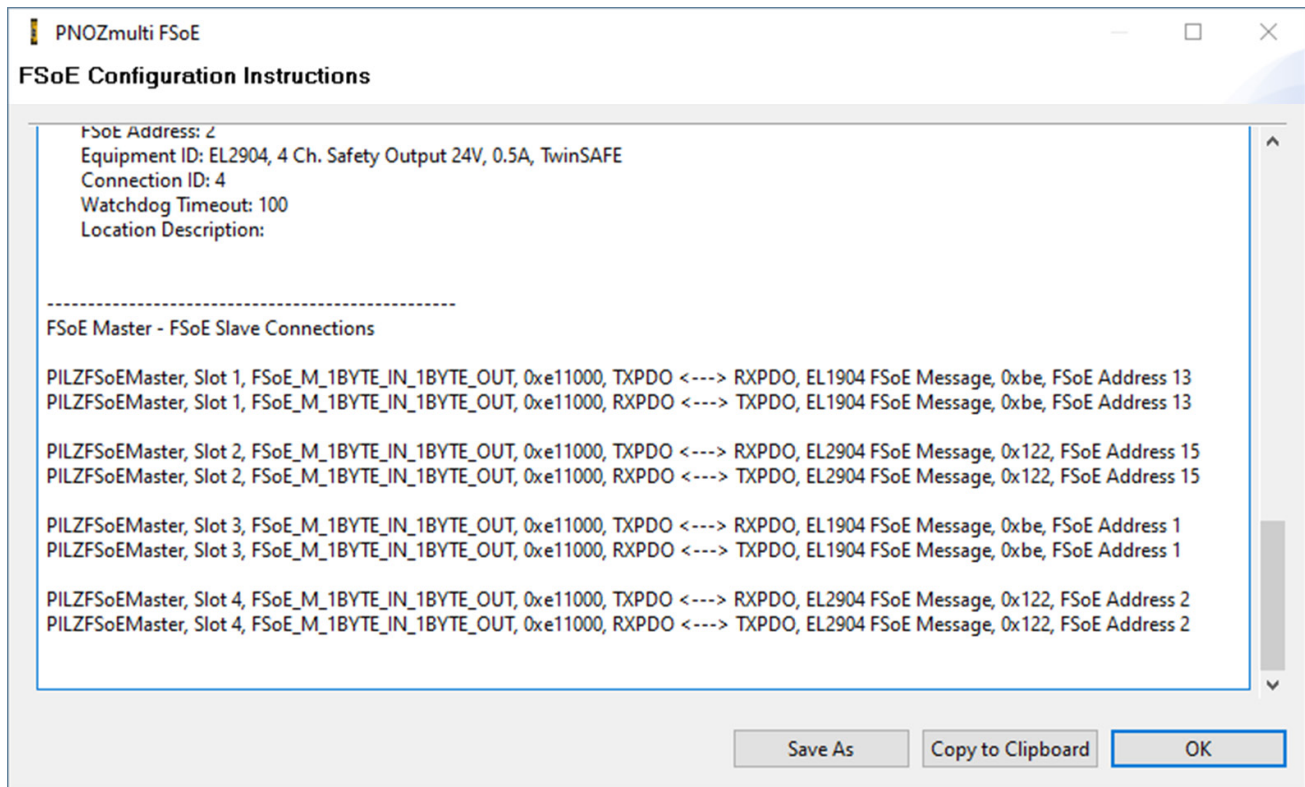


Figure 23: PNOZmulti Configurator –EtherCAT Instructions

- ▶ The mapping takes place in the MDevice, the general procedure is explained in the following screenshots.



INFORMATION

The complete "FSoE" structure must be mapped and not just individual bits from it.

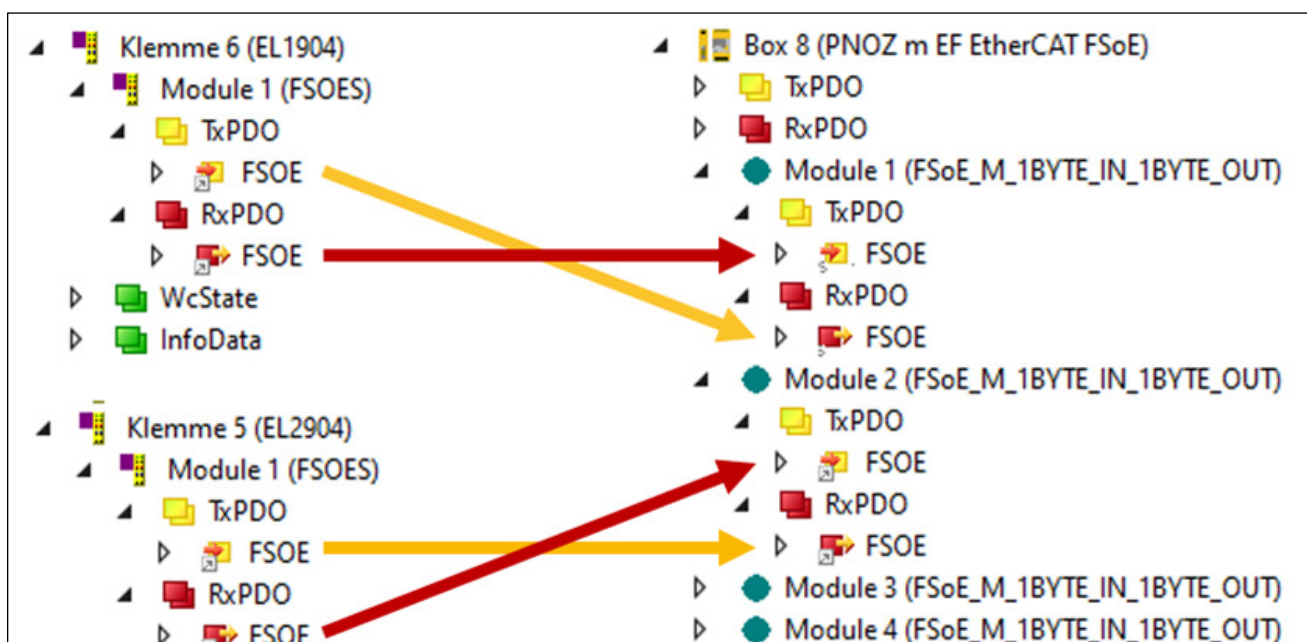


Figure 24: Overview – Mapping the FSoE data

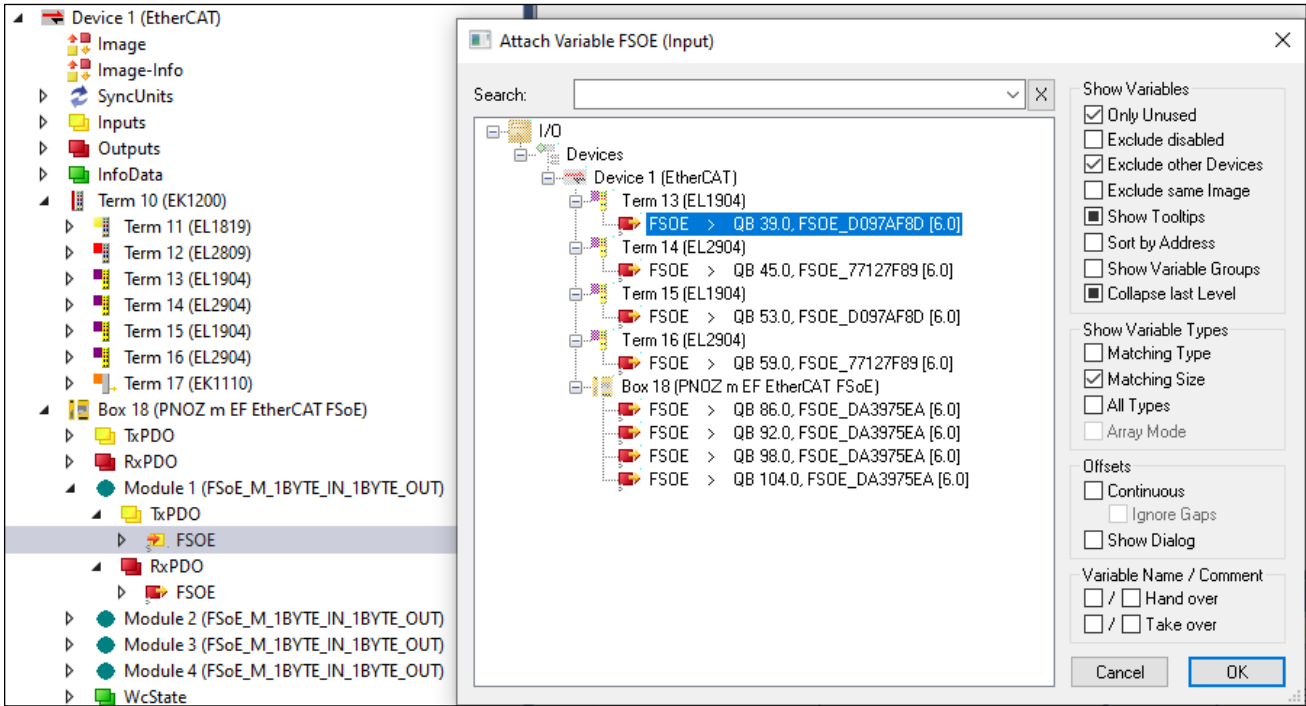


Figure 25: TwinCAT – Mapping the FSoE data

6.2.5 Status of the EtherCAT Devices

After the download, check whether all EtherCAT devices are in "Operational" mode.

General Adapter EtherCAT Online CoE - Online					
No	Addr	Name	State	CRC	
1	1001	Term 11 (EL1819)	OP	0, 0	
2	1002	Term 12 (EL2809)	OP	0, 0	
3	1003	Term 13 (EL1904)	OP	0, 0	
4	1004	Term 14 (EL2904)	OP	0, 0	
5	1005	Term 15 (EL1904)	OP	0, 0	
6	1006	Term 16 (EL2904)	OP	0, 0	
7	1007	Term 17 (EK1110)	OP	0, 0	
8	1008	Box 18 (PNOZ m EF EtherCAT FSoE)	OP	0, 0	

Figure 26: TwinCAT – Online

6.3 PMCprimo C with CodeSys V3.5

6.3.1 Import ESI file

- ▶ An ESI file must be installed for the PNOZ m EF EtherCAT FSoE module and for all FSoE SubInstances that are to be used.
- ▶ The PNOZ m EF EtherCAT FSoE module also requires an ESI file.
This can be downloaded from www.pilz.com.
- ▶ The ESI file can be installed in the device repository.

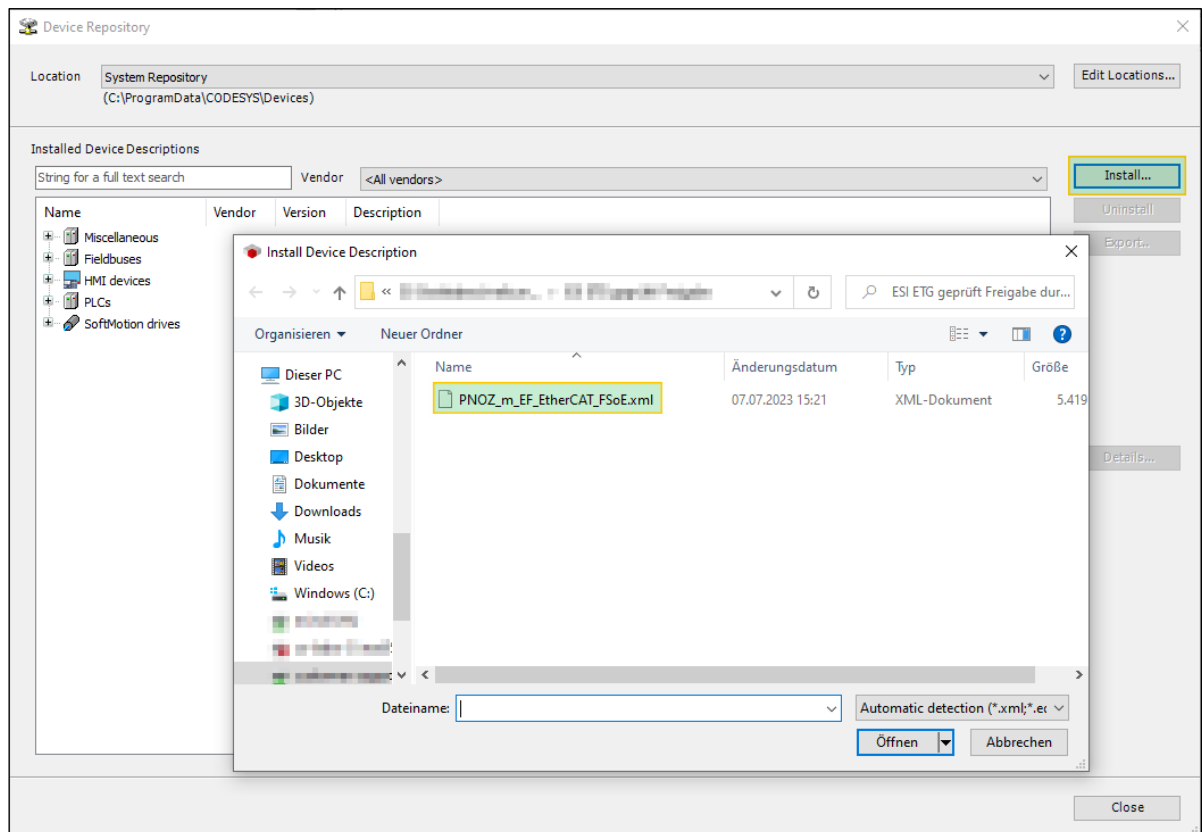


Figure 27: Codesys – Install ESI file

6.3.2 EtherCAT Configuration

- ▶ All EtherCAT devices in the network must be added to the MDevice.
- ▶ The device scan performs the task automatically, it is also possible to create all the devices manually.

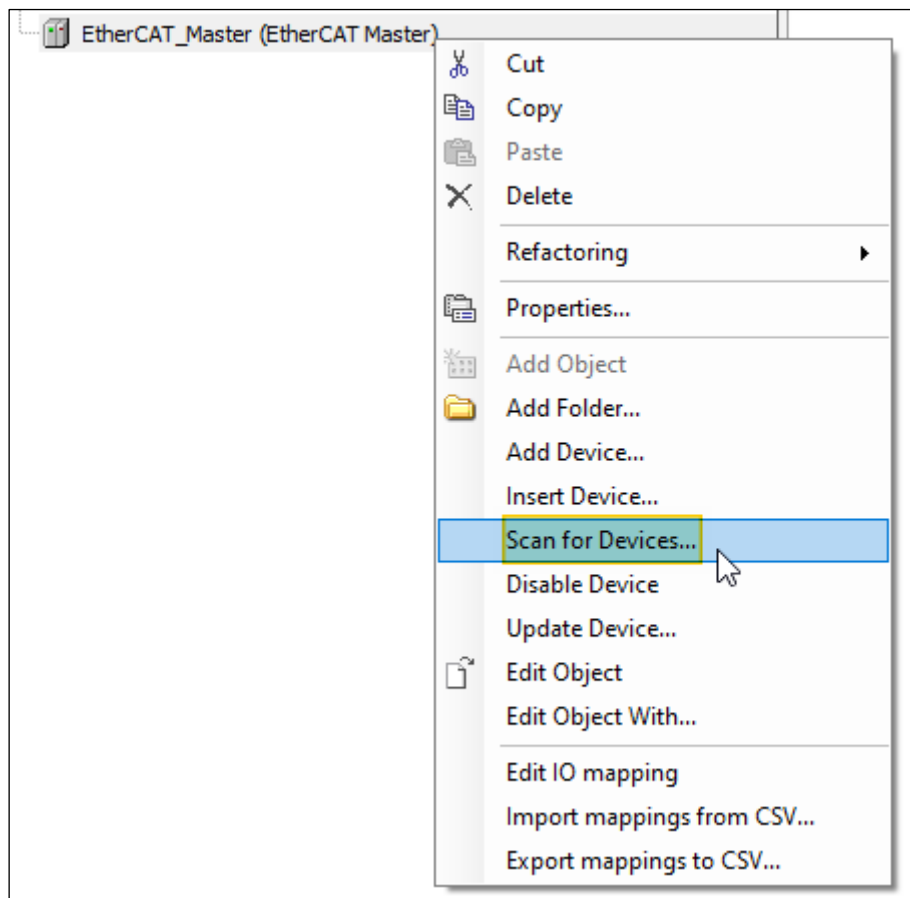


Figure 28: Codesys – Scan for Devices

- ▶ All connected EtherCAT devices were found and added to the project.

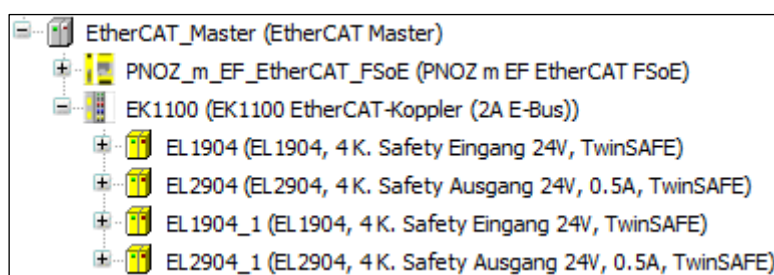


Figure 29: Codesys – EtherCAT Devices

6.3.3 Slot Configuration

After all EtherCAT devices have been configured, the identical configuration as in the PNOZmulti Configurator on the EtherCAT/FSoE tab must now be created on the Slots tab.

Please note that the modules must be configured in the same order with the identical length.



INFORMATION

Using a device scan, the slots are automatically entered in TwinCAT. If an EtherCAT or FSoE connection cannot be established, you must check at this point whether the configuration in the PNOZmulti Configurator and TwinCAT is identical.

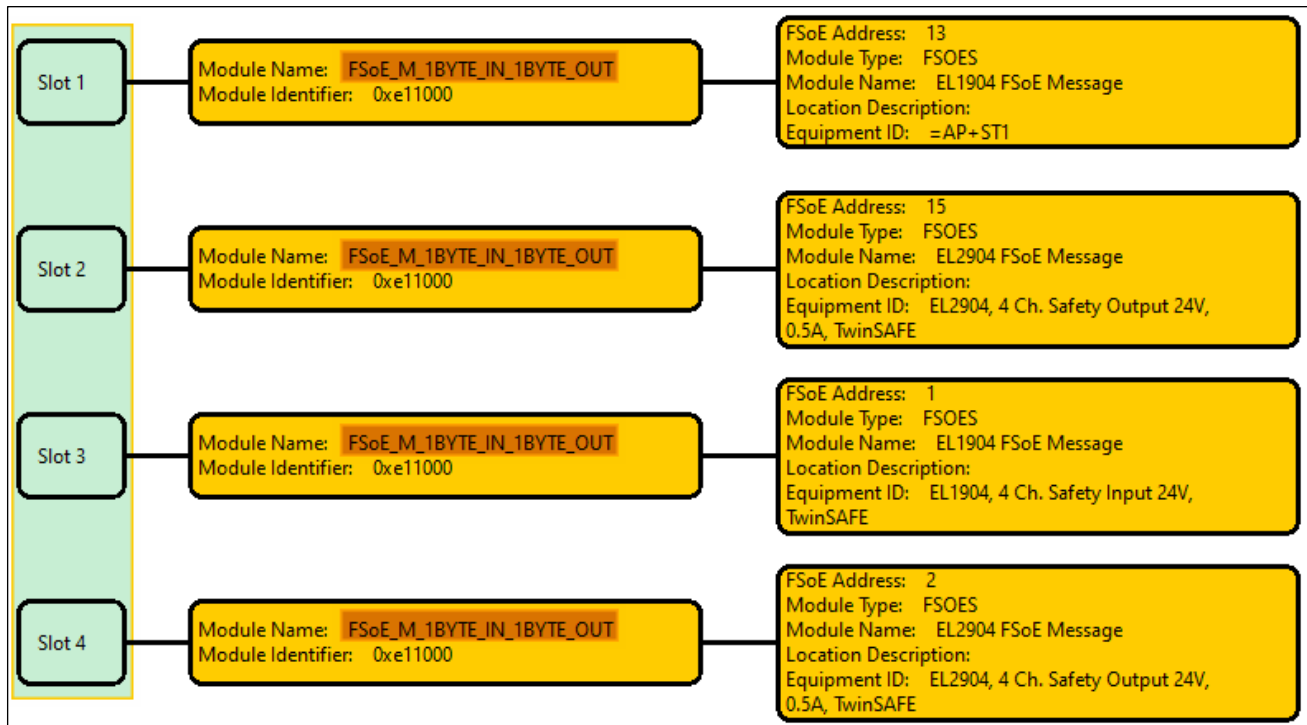


Figure 30: PNOZmulti Configurator – Slot Configuration

- ▶ The configured connections of the PNOZ m EF EtherCAT FSoE module were also read during the device scan.

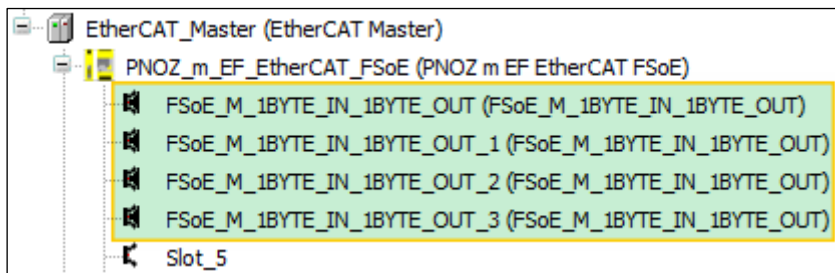


Figure 31: CODESYS – PNOZ m EF EtherCAT FSoE » Device Slots

- ▶ The connections can also be created manually if required.

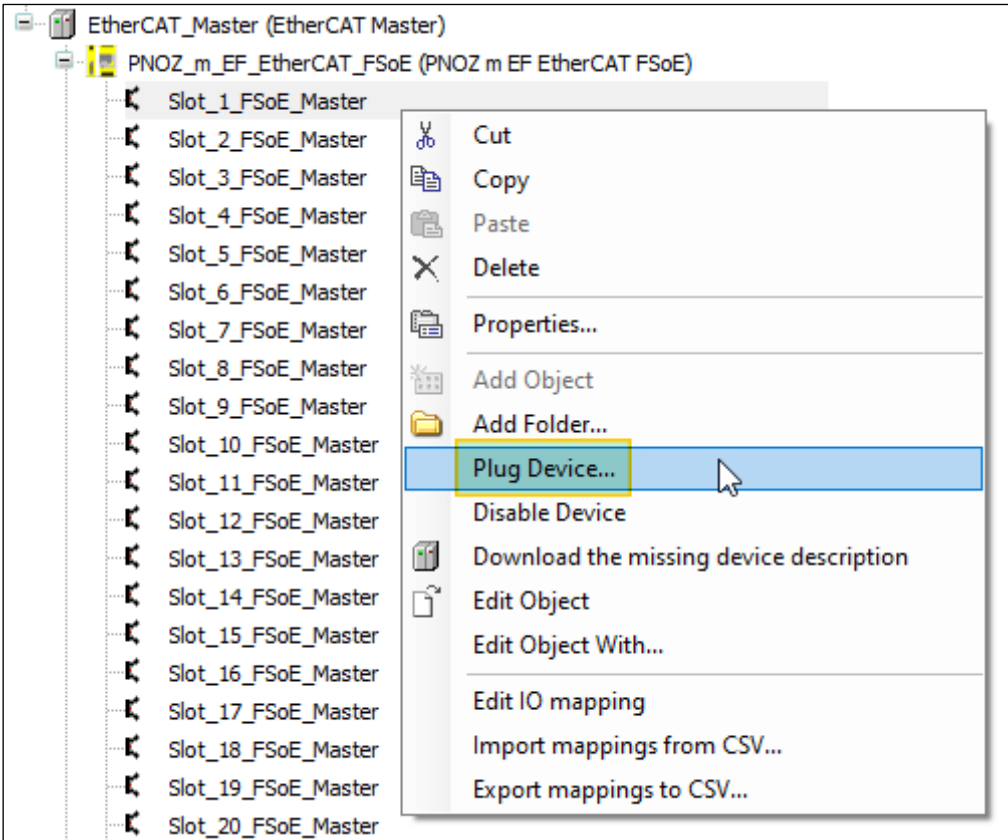


Figure 32: CODESYS – PNOZ m EF EtherCAT FSoE » Plug Device (1)

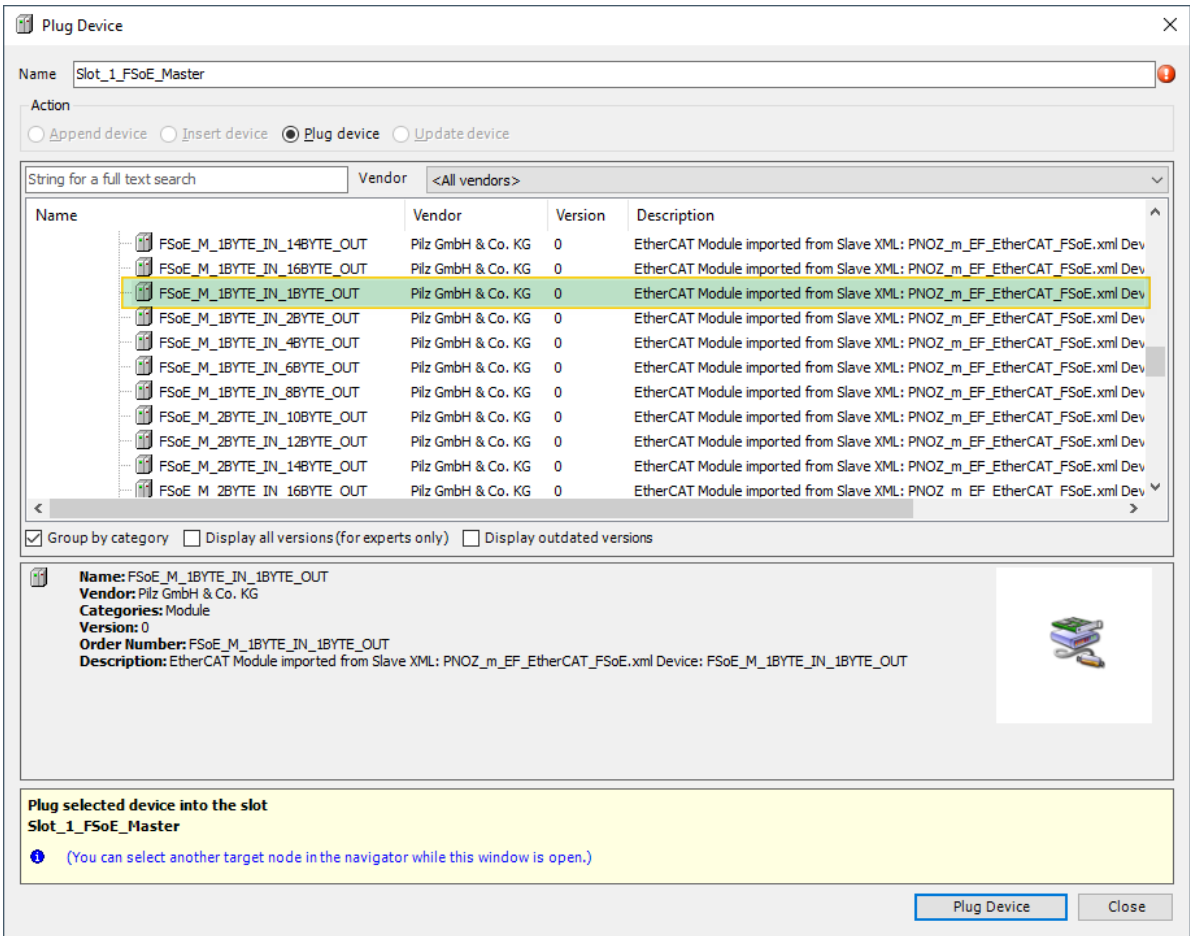


Figure 33: CODESYS – PNOZ m EF EtherCAT FSoE » Plug Device (2)

6.3.4 Copying the FSoE data

In order for the FSoE MainInstance to receive the data of the FSoE SubInstances, the process data of the FSoE SubInstances must be copied to the FSoE MDevice.

With Codesys, this is done via the user program.

- ▶ Because no I/O addresses are visible on the configured modules on the slots, these must be made visible via a workaround.
- ▶ As shown in Figure 33, export the I/O image for all slots used.

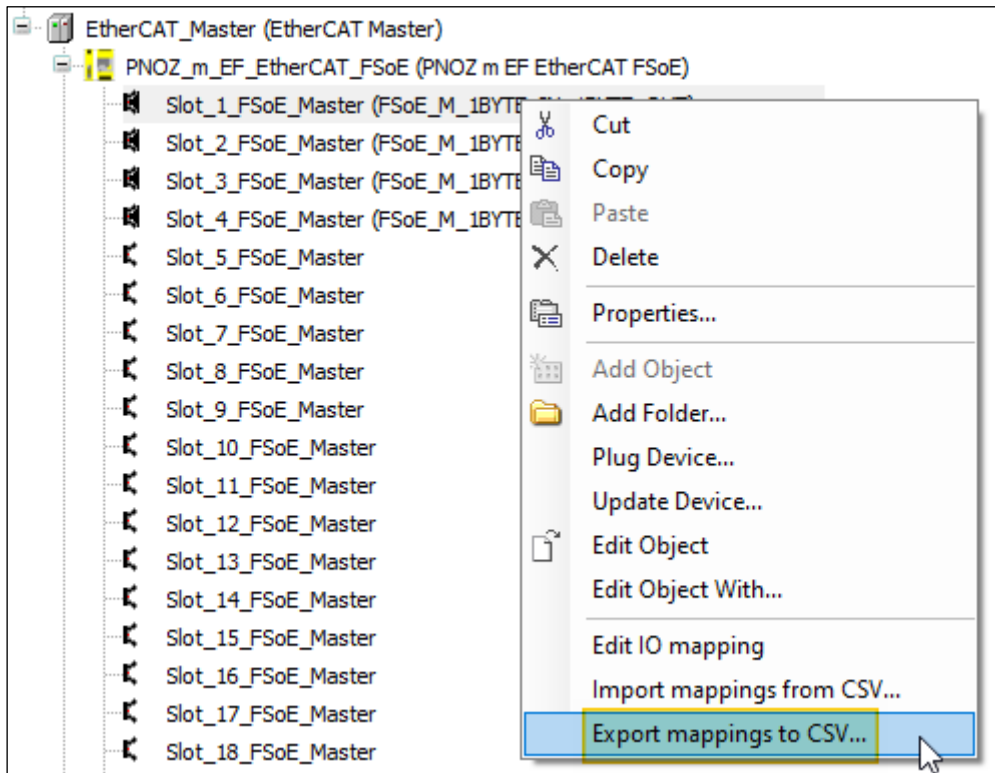


Figure 34: CODESYS – PNOZ m EF EtherCAT FSoE – Export mappings to CSV

- ▶ The exported CSV file can now be opened with any text editor.
- ▶ The required start addresses can be found in the lines after the CMD (Command), here %QB44 and %IB56.

```
//CoDeSys Mapping Export V1.2
//Mapped variable; //Parameter name @ counter in device; //Unit; //Description
//Important: change only first, third or fourth column in Excel or add
;FSoE_FSoE Slave CMD; FSoE_FSoE Slave CMD;%QB20; Slot_1_FSoE_Master
;Bit0;;; %QX20.0; Slot_1_FSoE_Master
;Bit1;;; %QX20.1; Slot_1_FSoE_Master
;Bit2;;; %QX20.2; Slot_1_FSoE_Master
;Bit3;;; %QX20.3; Slot_1_FSoE_Master
;Bit4;;; %QX20.4; Slot_1_FSoE_Master
;Bit5;;; %QX20.5; Slot_1_FSoE_Master
;Bit6;;; %QX20.6; Slot_1_FSoE_Master
;Bit7;;; %QX20.7; Slot_1_FSoE_Master
;FSoE_SafeInput0; FSoE_SafeInput0;%QB21; Slot_1_FSoE_Master
```

Figure 35: Mappings in CSV – first Slot (1)

- ▶ The next I/O address can be found further down.

```
;FSoE_FSoE Master CMD;;FSoE_FSoE Master CMD;%IB32;Slot_1_FSoE_Master
;Bit0@4;;;%IX32.0;Slot_1_FSoE_Master
;Bit1@4;;;%IX32.1;Slot_1_FSoE_Master
;Bit2@4;;;%IX32.2;Slot_1_FSoE_Master
;Bit3@4;;;%IX32.3;Slot_1_FSoE_Master
;Bit4@4;;;%IX32.4;Slot_1_FSoE_Master
;Bit5@4;;;%IX32.5;Slot_1_FSoE_Master
;Bit6@4;;;%IX32.6;Slot_1_FSoE_Master
;Bit7@4;;;%IX32.7;Slot_1_FSoE_Master
```

Figure 36: Mappings in CSV – first Slot (2)

- ▶ This must be done for all slots.
- ▶ Afterwards, the I/O addresses of the FSoE SubInstances are displayed, here is an example for a Beckhoff EL1904 module on the first slot.
- ▶ Only the addresses of the "FSoE Master CMD" variables need to be noted here.

Module I/O Mapping

Find

Filter

Show all

+

Add

Information

Variable	Mapping	Channel	Address	Type	Unit	Description
		FSoE Master CMD	%QB44	USINT		Command
		FSoE Master CRC_0	%QW23	UINT		FSoE Master CRC_0
		FSoE Master ConnID	%QW24	UINT		FSoE Master ConnID
		FSoE Slave CMD	%IB56	USINT		Command
		InputChannel1	%IX57.0	BIT		Subindex 001
		InputChannel2	%IX57.1	BIT		Subindex 002
		InputChannel3	%IX57.2	BIT		Subindex 003
		InputChannel4	%IX57.3	BIT		Subindex 004
		FSoE Slave CRC_0	%IW29	UINT		CRC0
		FSoE Slave ConnID	%IW30	UINT		FSoE Slave ConnID

Figure 37: Process Image EL1904 – first Slot

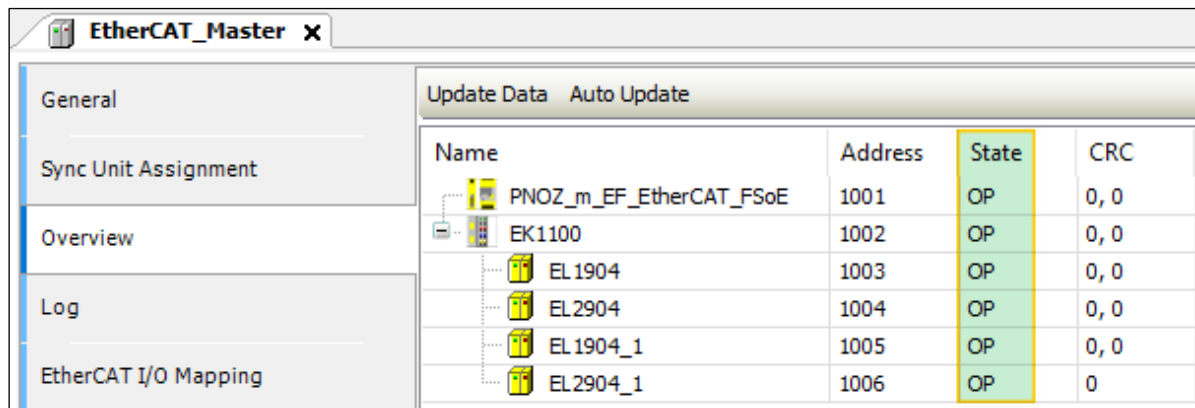
- Example for copying the FSoE Process Data data with the I/O addresses read out above:

<pre> TYPE FSoE : STRUCT Cmd : USINT; IO : BYTE; Crc : UINT; ConnID : UINT; END_STRUCT END_TYPE </pre>	<pre> PROGRAM FSoE_Mapping VAR Multi_Slot1_in AT %IB32 : FSoE; Multi_Slot1_out AT %QB20 : FSoE; EL1904_in AT %IB56 : FSoE; EL1904_out AT %QB44 : FSoE; Multi_Slot2_in AT %IB38 : FSoE; Multi_Slot2_out AT %QB26 : FSoE; EL2904_in AT %IB62 : FSoE; EL2904_out AT %QB50 : FSoE; Multi_Slot3_in AT %IB44 : FSoE; Multi_Slot3_out AT %QB32 : FSoE; EL1904_l_in AT %IB68 : FSoE; EL1904_l_out AT %QB58 : FSoE; Multi_Slot4_in AT %IB50 : FSoE; Multi_Slot4_out AT %QB38 : FSoE; EL2904_l_in AT %IB74 : FSoE; EL2904_l_out AT %QB64 : FSoE; END_VAR </pre>
	<pre> (* ***** *) (* F S o E M a p p i n g *) (* ***** *) (* Multi Slot 1 (1B out, 1B in) <==> EL 1904 *) (* Multi Slot 1 := EL 1904 *) Multi_Slot1_out := EL1904_in; (* EL 1904 := Multi Slot 1 *) EL1904_out := Multi_Slot1_in; (* Multi Slot 2 (1B out, 1B in) <==> EL 2904 *) (* Multi Slot 2 := EL 2904 *) Multi_Slot2_out := EL2904_in; (* EL 2904 := Multi Slot 2 *) EL2904_out := Multi_Slot2_in; Multi_Slot3_out := EL1904_l_in; EL1904_l_out := Multi_Slot3_in; Multi_Slot4_out := EL2904_l_in; EL2904_l_out := Multi_Slot4_in; </pre>

Figure 38: Codesys – coping the FSoE Process Image

6.3.5 Status of the EtherCAT Devices

After the download, check whether all EtherCAT devices are in "Operational".



The screenshot shows the 'EtherCAT_Master' window. On the left is a sidebar with tabs: 'General', 'Sync Unit Assignment', 'Overview', 'Log', and 'EtherCAT I/O Mapping'. The 'Overview' tab is selected. The main area has a header with 'Update Data' and 'Auto Update' buttons. Below is a table of devices:

Name	Address	State	CRC
PNOZ_m_EF_EtherCAT_FSoE	1001	OP	0, 0
EK1100	1002	OP	0, 0
EL1904	1003	OP	0, 0
EL2904	1004	OP	0, 0
EL1904_1	1005	OP	0, 0
EL2904_1	1006	OP	0

Figure 39: Codesys – Online

6.4 EtherCAT Cycle Time



CAUTION!

If the EtherCAT cycle time on the EtherCAT MDevice is changed, this affects the FSoE response time!
Please read the documentation for the PNOZ m EF EtherCAT FSoE module.

6.5 Diagnosis

6.5.1 Diagnosis in PNOZmulti Configurator

- ▶ The status for each FSoE connection can be displayed in the PNOZmulti Configurator using the dynamic program display.

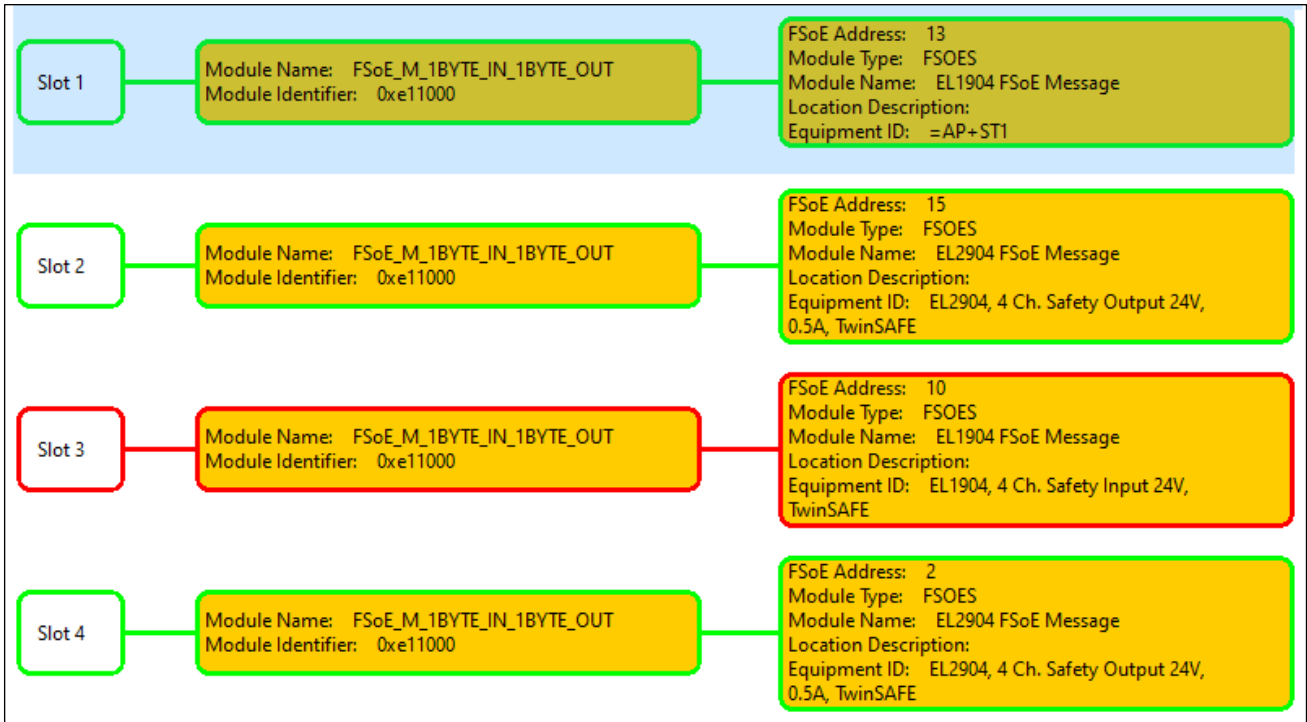


Figure 40: PNOZmulti Configurator – dynamic program display

- ▶ If an FSoE connection cannot be established, this is also displayed in the PNOZmulti error stack; the other FSoE connections run independently of this.

No.	Class	Message
49	6A	The SRA parameters of FSoE connection Connection 3 are invalid.
2B	6A	Problem in the FSoE connection Connection 3.
49	6A	The SRA parameters of FSoE connection Connection 3 are invalid.
13	02	The system has adopted the project with the overall check sum BC 28/ 00 00. (FS program's check sum safe: A0 60).

Figure 41: PNOZmulti Configurator – Error stack

6.5.2 Diagnosis in CoE

In the tab 'CoE-Online', the connection status is displayed in the objects 'A0xx' for each configured FSoE connection.

If the connection has been successfully established, the connection state is set to "Data".

The screenshot shows the 'CoE - Online' tab in the TwinCAT software. At the top, there are tabs for 'General', 'EtherCAT', 'Process Data', 'Plc', 'Slots', 'Startup', 'CoE - Online', and 'Online'. Below the tabs, there are buttons for 'Update List', 'Advanced...', and 'Add to Startup...'. To the right of these buttons are checkboxes for 'Auto Update', 'Single Update' (checked), and 'Show Offline Data'. Below these is a text input field for 'Module OD (AoE Port)' with the value '0'. A table below displays the connection data.

Index	Name	Flags	Value
+ 7000:0	FSoE Slave Frame Elements	RO	> 3 <
+ 7001:0	FSoE Slave Frame Data	RO	> 1 <
+ 7010:0	FSoE Slave Frame Elements	RO	> 3 <
+ 7011:0	FSoE Slave Frame Data	RO	> 1 <
+ 7020:0	FSoE Slave Frame Elements	RO	> 3 <
+ 7021:0	FSoE Slave Frame Data	RO	> 2 <
+ 9001:0	FSoE Comm- Parameter	RO	> 8 <
+ 9011:0	FSoE Comm- Parameter	RO	> 8 <
+ 9021:0	FSoE Comm- Parameter	RO	> 8 <
- A000:0	Connection Diagnosis		> 2 <
A000:01	Connection State	RO	Data (104)
A000:02	Connection Diagnosis	RO	0x0000 (0)
- A010:0	Connection Diagnosis		> 2 <
A010:01	Connection State	RO	Data (104)
A010:02	Connection Diagnosis	RO	0x0000 (0)
- A020:0	Connection Diagnosis		> 2 <
A020:01	Connection State	RO	Reset (100)
A020:02	Connection Diagnosis	RO	0x0045 (69)
+ F000:0	Modular Device Profile	RO	> 2 <
+ F010:0	Module List	RO	> 64 <
+ F030:0	Configured Module Ident List	RW	> 3 <
+ F050:0	Detected Module Ident List	RO	> 64 <
+ F980:0	Device FSoE Slave Address		> 4 <

Figure 42: TwinCAT – CoE Online

6.5.3 AL Statuscode

To see the status of the FSoE connections, the variable "FSoE Master CMD" can also be viewed for each TxPDO and RxPDO.

The possible values and their meaning are shown in the following table.

Command (hex)	Command (dez)	Description
0x36	54	ProcessData
0x2A	42	Reset
0x4E	78	Session
0x64	100	Connection
0x52	82	Parameter
0x08	8	FailSafeData

Figure 43: Overview – AL Status code

Example: A test pulse is configured on a safe input of a Beckhoff EL1904, 24V is connected to the input instead. The module detects this, the FSoE connection is then interrupted and changes to the "FailSafeData" state.

Variable	M.	Channel	Address	Type	Current Value	..	Description
		FSoE Master CMD	%QB44	USINT	54		Command
		FSoE Master CRC_0	%QW23	UINT	9401		FSoE Master CRC_0
		FSoE Master ConnID	%QW24	UINT	1		FSoE Master ConnID
		FSoE Slave CMD	%IB56	USINT	8		Command
		InputChannel1	%IX57.0	BIT	FALSE		Subindex 001
		InputChannel2	%IX57.1	BIT	FALSE		Subindex 002
		InputChannel3	%IX57.2	BIT	FALSE		Subindex 003
		InputChannel4	%IX57.3	BIT	FALSE		Subindex 004
		FSoE Slave CRC_0	%IW29	UINT	37451		CRC0
		FSoE Slave ConnID	%IW30	UINT	1		FSoE Slave ConnID

Figure 44: Codesys – Error in FSoE Connection

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