



Integration of MGB2 *Modular* EtherCAT in Beckhoff TwinCAT 3

from V1.0.0

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1. About this document

1.1. Version

Version	Date	Change/addition	Chapter
02-01/24	11/11/2021	Prepared	All
02-01/24	01/22/2024	Revision of chapter 8. <i>Parameterizing the MGB2 Modular EtherCAT via startup configuration on page 14</i>	8

1.2. Scope





This document is used for integration and configuration of the MGB2 Modular EtherCAT with BECKHOFF TwinCAT 3.

1.3. Target group

Design engineers and installation planners for safety systems on machines, as well as setup and servicing staff possessing special expertise in handling safety components as well as expertise in the installation, setup, programming and diagnostics of programmable logic controllers (PLCs) and bus systems.

1.4. Supplementary documents

The overall documentation for this application consists of the following documents:

Document title (document number)	Contents	
Operating instructions (2540772)	Operating instructions for bus module MBM-EC-...MLI-... (EtherCAT)	
Safety information (2525460)	Basic safety information	
Operating instructions for the connected modules and their submodules	Device-specific information for the related module and the installed submodules.	
Possibly enclosed data sheets	Item-specific information about deviations or additions	

1.5. Notice

This application is based on the MGB2 Modular EtherCAT operating instructions and the operating instructions for the BECKHOFF components used. Please refer to the operating instructions for technical details and other information.

2. Components/modules used

2.1. EUCHNER

Description	Order number / item number
Safety system MGB2 Modular with modular bus module MBM (EtherCAT interface), guard locking with guard lock monitoring	169251 / MGB2-L1HEB-EC-U-S4-DA-R-169251
	169252 / MGB2-L1HEB-EC-U-S4-DA-L-169252
	169253 / MGB2-L2HEB-EC-U-S4-DA-R-169253
	169254 / MGB2-L2HEB-EC-U-S4-DA-L-169254
	163293 / MBM-EC-S7-MLI-3B-163293

2.1.1. Items included in the MGB2 Modular set

Description	Order number/item number	MGB2 Modular set			
		169251	169252	169253	169254
Modular bus module MBM	163291 / MBM-EC-S4-MLI-3B-163291	●	●	●	●
	163293 / MBM-EC-S7-MLI-3B-163293	-	-	-	-
Locking module MGB2-L	136776 / MGB2-L1-MLI-U-Y0000-BJ-136776	●	●	-	-
	156392 / MGB2-L2-MLI-U-Y0000-BJ-156392	-	-	●	●
Submodule: emergency stop + two pushbuttons	136687 / MSM-1-P-CA-BPP-A1-136687	●	●	●	●
Submodule: three slide-in labels	137610 / MSM-1-N-AA-QQQ-B1-137610	●	●	●	●
Handle module	136691 / MGB2-H-BA1A3-R-136691	●	-	●	-
	156394 / MGB2-H-BA1A3-L-156394	-	●	-	●
Module connector MLI	157024 / AC-MC-SB-M-A-157024	●	●	●	●
Blanking cover MLI	156718 / AC-MC-00-0-B-156718	●	●	●	●

Key to symbols	●	Included in the MGB2 Modular set
	-	Not included in the MGB2 Modular set

Tip: More information and downloads about the aforementioned EUCHNER products can be found at www.euchner.com. Simply enter the order number in the search box.

2.2. Others

Description	Order number / item number
Basic BECKHOFF CPU module with PROFINET RT controller	CX9020-0115-M930
BECKHOFF TwinSAFE Logic	EL6910
BECKHOFF EtherCAT extension	EK1110
BECKHOFF 2-port EtherCAT P branch with feed-in	EK1322

2.3. Software

Description	Version
TwinCAT 3	3.1.4024.22
TwinCAT 3 Safety Editor	1.3.0

3. Functional description

The MGB2-L1HB-EC-... is a guard locking device in accordance with EN ISO 14119 according to the closed-circuit current principle, the MGB2-L2HB-EC-... is a guard locking device in accordance with EN ISO 14119 according to the open-circuit current principle. In this example, all safety functions are processed via the FSoE protocol. The MGB2 *Modular* is connected to a CX9020-0115-M930 from BECKHOFF via the bus module.

4. Overview of the communication data

4.1. Input

EtherCAT	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1st byte	BM_E_G	-	BM_E_SYS	-	-	BM_E_ML2	BM_E_ML1	BM_D_RUN
2nd byte	Diagnostics byte (pluggable)							

EtherCAT	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1st byte	LM_E_G	LM_E_ER	LM_E_SM1	LM_E_SM0	-	LM_I_UK	LM_I_SK	LM_D_RUN
2nd byte	-	-	-	-	-	LM_I_OL	LM_I_OT	LM_I_OD
3rd byte	Diagnostics byte (pluggable)							

EtherCAT	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1st byte	-	-	SM_E_S1	-	-	SM_I_S3	SM_I_S2	SM_I_S1
2nd byte	Diagnostics byte (pluggable)							

FSoE	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1st byte	-	-	-	-	-	SM_FI_ES	LM_FI_UK	LM_FI_SK
2nd byte	-	-	-	-	-	-	-	-

4.2. Output

EtherCAT	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1st byte	BM_ACK_G	-	-	-	-	-	-	-

EtherCAT	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1st byte	LM_ACK_G	LM_ACK_ER	-	-	-	-	-	LM_O_CL

EtherCAT	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1st byte	-	-	SM_O_H3_B	SM_O_H2_B	SM_O_H1_B	SM_O_H3	SM_O_H2	SM_O_H1

FSoE	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1st byte	-	-	-	-	-	-	-	LM_FO_CL
2nd byte	-	-	-	-	-	-	-	-

Tip: The individual abbreviations are explained in the operating instructions



NOTICE!

While EtherCAT data are always incorporated by bytes, the data for FSoE are always incorporated by individual bits. The *FSoE 2 Bytes module* was therefore used for this application example. It offers a sufficiently large safe memory area for the bits: *LM_FI_SK*, *LM_FI_UK* and *SM_FI_ES*.

5. Installing the ESI file

You will require the corresponding ESI files in XML format to integrate the MGB2 Modular EtherCAT into the TwinCAT 3 hardware configuration:

- › EUCHNER_MBM_ESI.xml (contains all information about the MBM modules and data transfer)

Both ESI files must always be used!

You will find the ESI files in the download area at www.euchner.com. Always use the latest ESI files.

Unzip the content of the ESI file into the following directory:



Name	Änderungsdatum	Typ	Größe
 EUCHNER_MBM_ESI	14.10.2021 10:49	XML-Dokument	570 KB
 EUCHNER_MBM_Modules	14.10.2021 10:49	XML-Dokument	338 KB

Fig. 1: ESI files to be added



Fig. 2: Path of the ESI files for TwinCAT 3

6. TwinSAFE hardware addressing



WARNING

- › Each TwinSAFE address set must occur only once within a network/configuration!
- › Address 0 is not a valid TwinSAFE address!

6.1. BECKHOFF EL6910

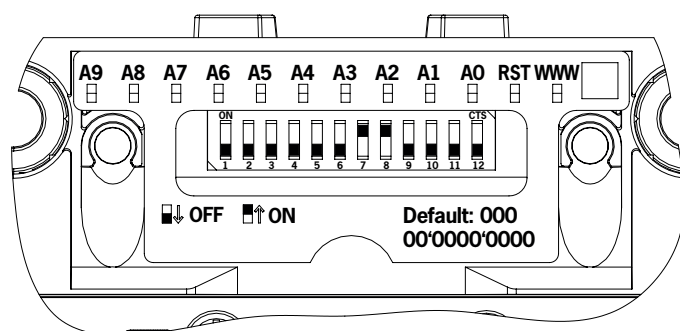
The TwinSAFE address must be set for TwinSAFE logic terminal EL6910. It is set using the DIP switches on the left side of the TwinSAFE terminals.

TwinSAFE device	TwinSAFE address in the example
EL6910	1

6.2. MBM-EC-...MLI-...

The TwinSAFE address must be set for the bus module MBM-EC-...MLI-.... It is set on the bus module MBM using the DIP switches.

TwinSAFE device	TwinSAFE address in the example
MBM-EC-...MLI-...	12



Switch	Description
A0 ... A9	Address switch, bits zero to nine For binary setting of the TwinSAFE address (factory setting: 0000000000)
RST	Factory reset (factory setting: off)
WWW	Activate device web interface with extended diagnostic options (factory setting: off)

The DIP switch setting is as follows for the TwinSAFE address 12 selected in the application:

Switch	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0
DIP switch position MBM	off	off	off	off	off	off	on	on	off	off
Significance	2 ⁹	2 ⁸	2 ⁷	2 ⁶	2 ⁵	2 ⁴	2 ³	2 ²	2 ¹	2 ⁰
Decimal value	512	256	128	64	32	16	8	4	2	1

Table 1: DIP switch settings



ATTENTION!

- › The set TwinSAFE address of the bus module and the address configured in *Alias Device* must match.
- › The TwinSAFE address set using the DIP switches is adopted only after the MBM is restarted.

7. Configuring the MGB2 Modular EtherCAT

7.1. Manually adding the MBM-EC-...MLI-...-

7.1.1. MBM-EC-S4-MLI-3B-163291

The EtherCAT master and terminals EL6910, EK1322 and EK1110 have already been created for this section.

1. Right-click the EtherCAT master to open the context-sensitive menu. Click *Add New Item...*

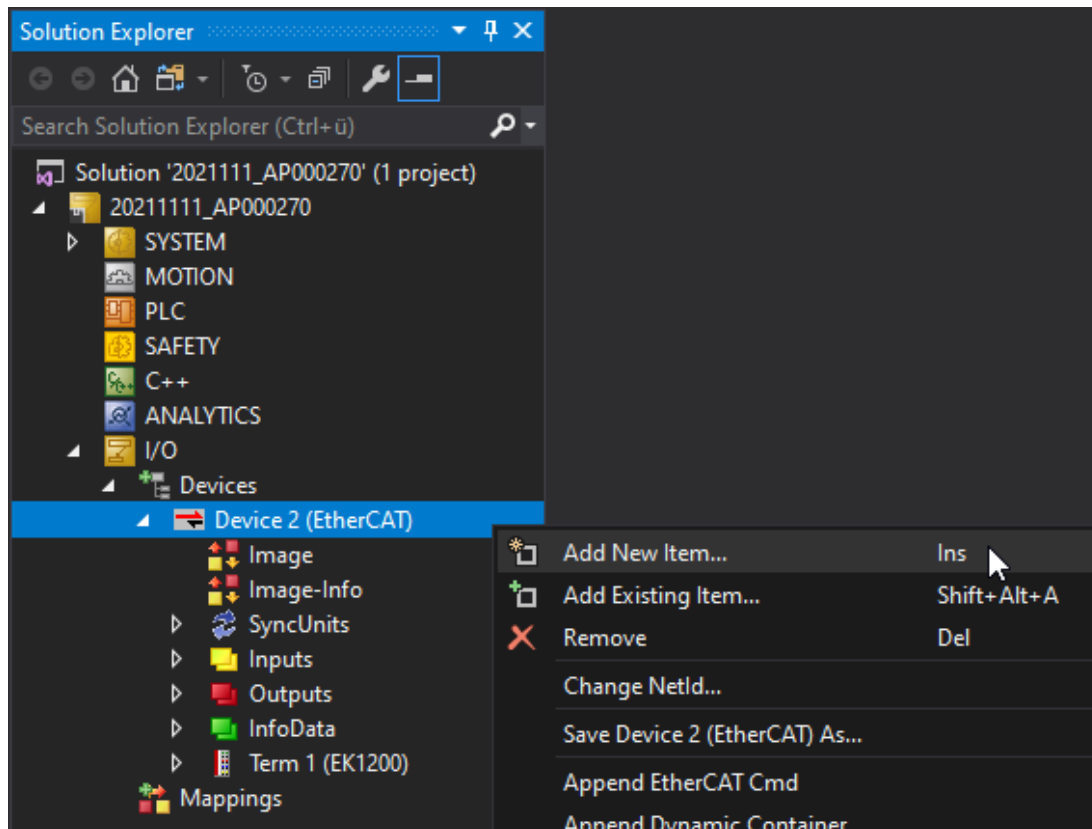


Fig. 3: Adding a new device

2. Select the bus module MBM-EC-S4-MLI-3B-163291 under *EUCHNER GmbH + Co. KG >> Euchner Modular bus module*.

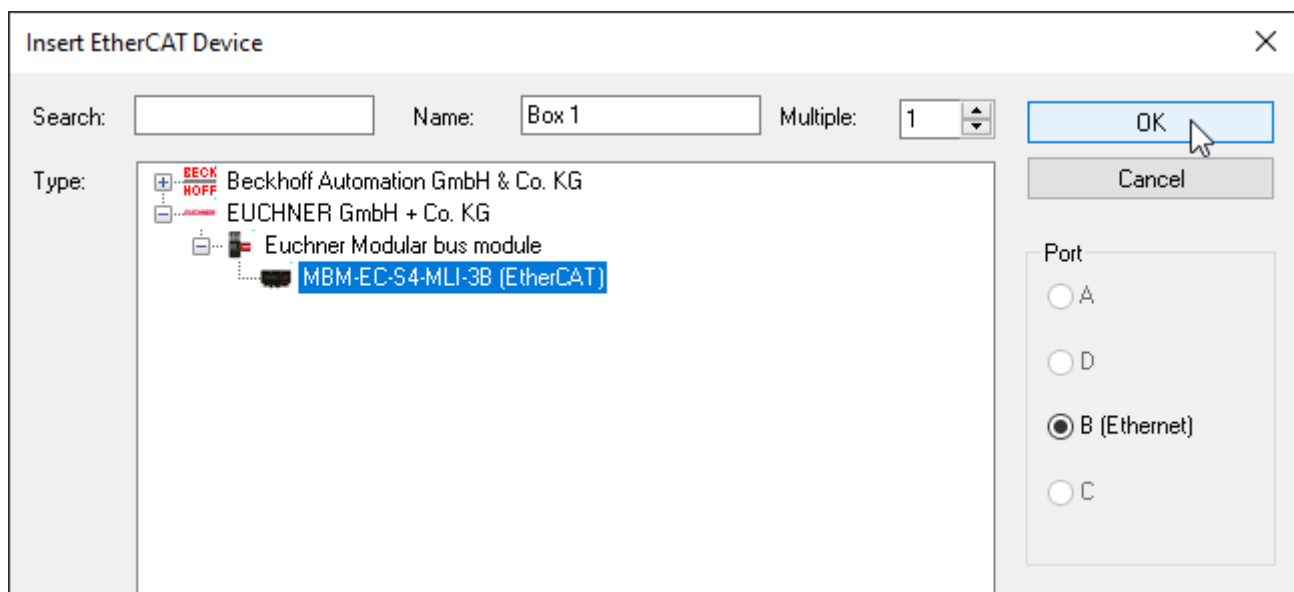


Fig. 4: Selecting the MBM bus module.

7.1.2. MBM-EC-S7-MLI-3B-163293

The EtherCAT master and the terminals EL6910, EK1322 and EK1110 have already been created for this section.

1. Right-click the EtherCAT P terminal to open the context-sensitive menu. Click *Add New Item...* .

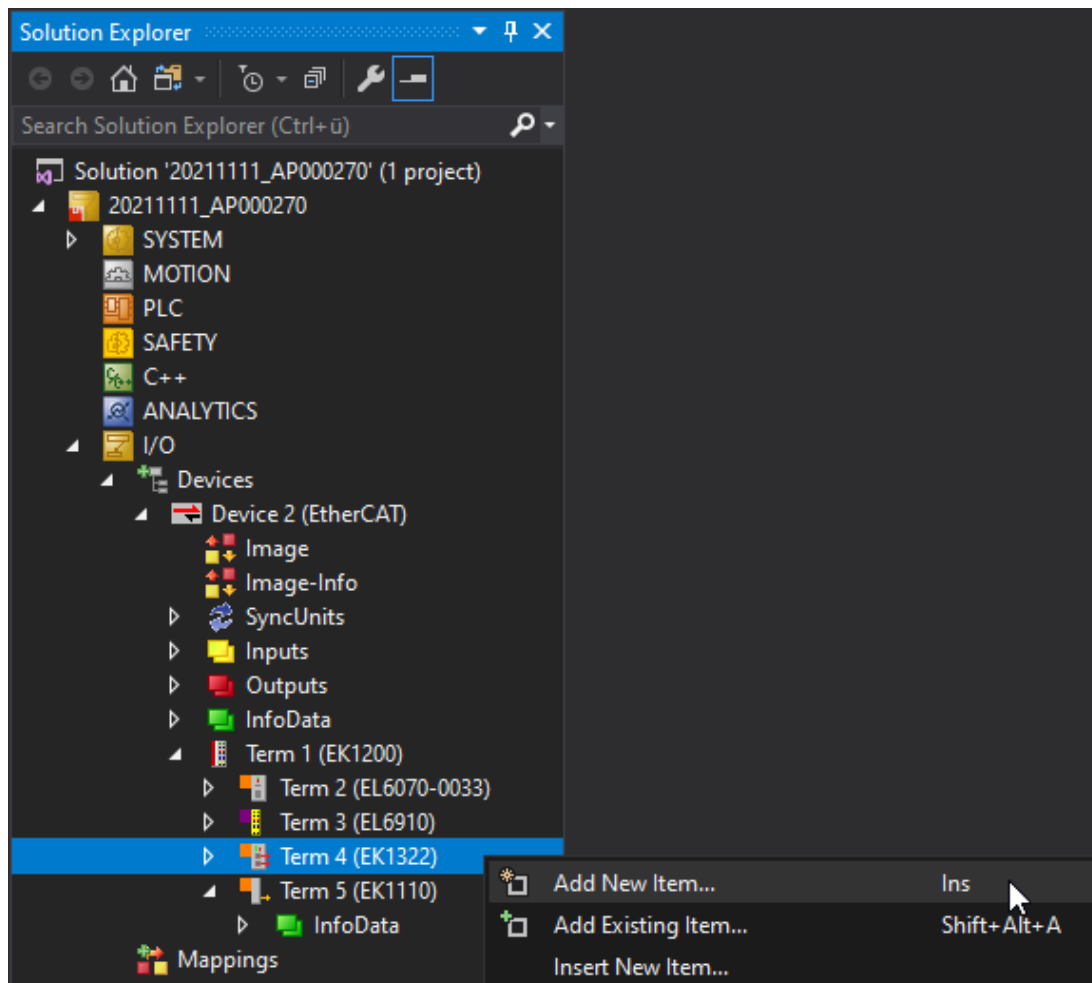


Fig. 5: Adding a new device

- Select the bus module MBM-EC-S7-MLI-3B-163293 under *EUCHNER GmbH + Co. KG >> Euchner Modular bus module*. Please note that an EtherCAT P port must be selected. In our example, the bus module is connected to port D 'X1'.

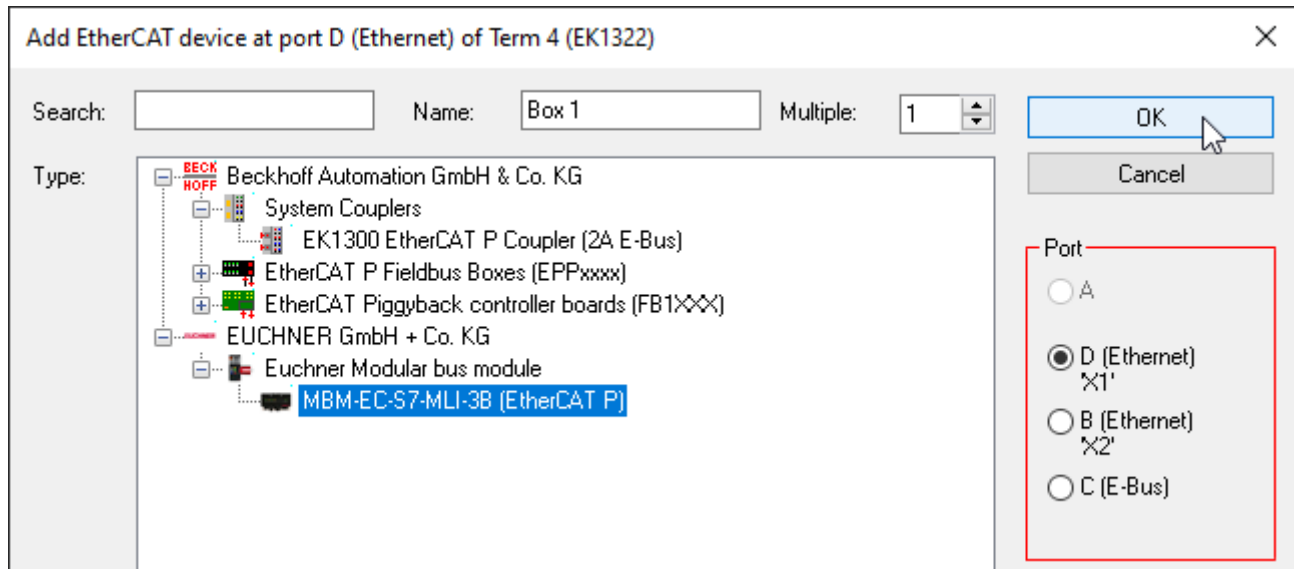


Fig. 6: Selecting the MBM bus module.

7.2. Adding the modules and submodules

Open the bus module in the *IO tree* and go to the *Slots* tab.

- Add the FSoE 2 Bytes module to the *Safety Slot*.

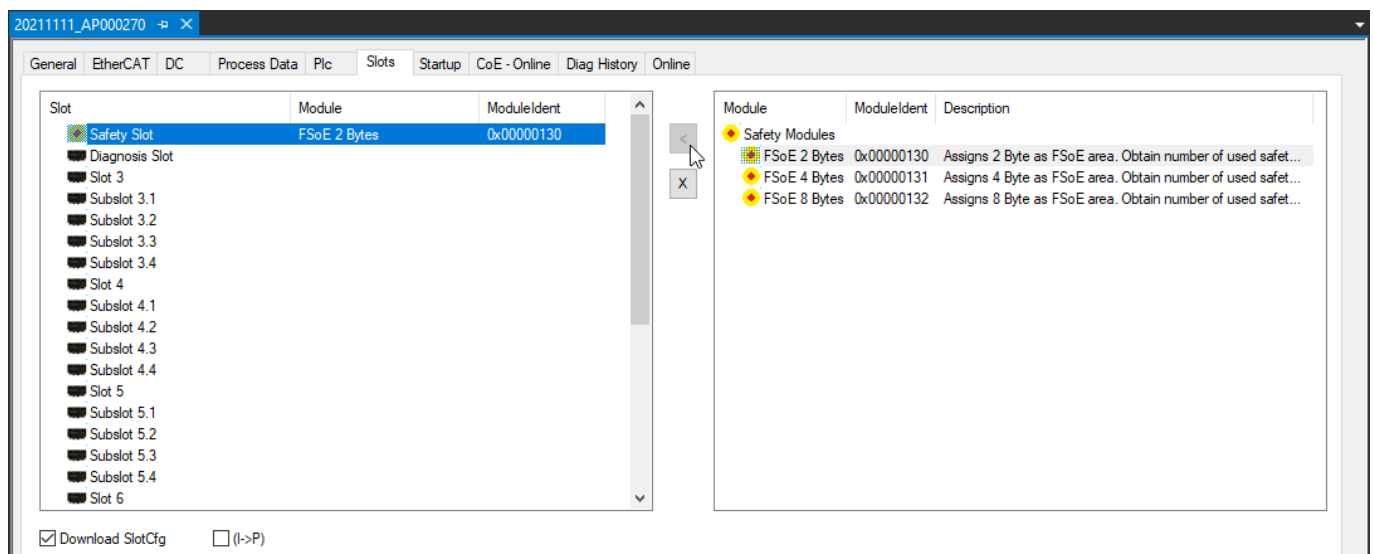


Fig. 7: Adding FSoE module to the slot configuration

2. Add the *MBM DIAGNOSE BASIC* module to the *Diagnosis Slot*.

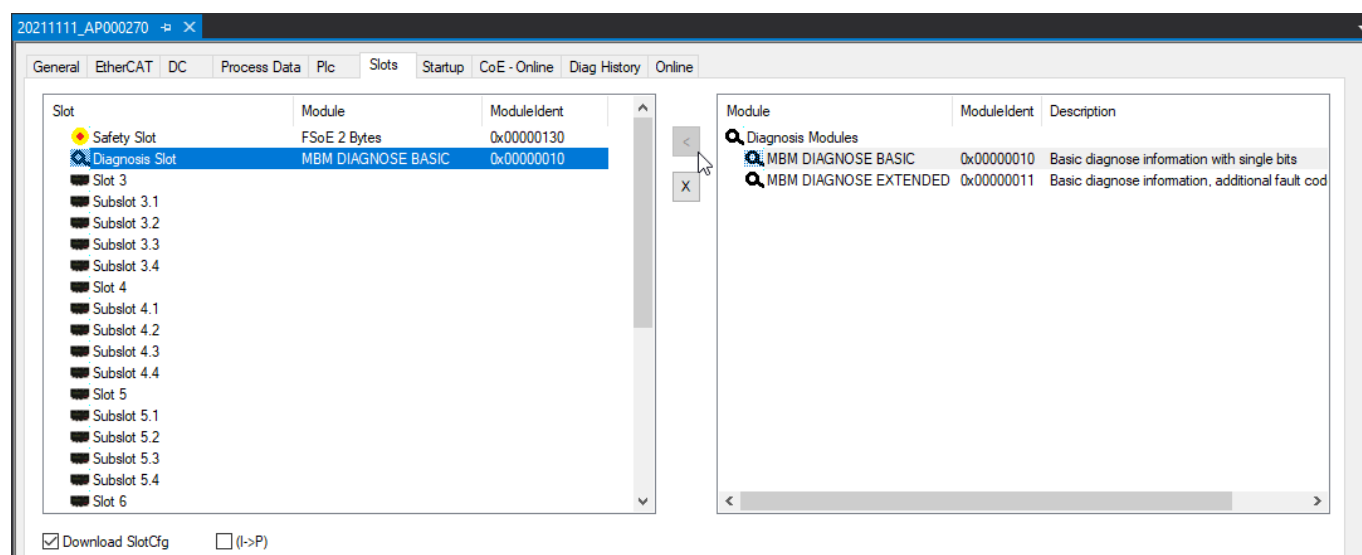


Fig. 8: Adding MBM diagnostic module to the slot configuration

3. Add the *MGB2-L1-MLI-U-Y0000-BJ-136776 Diagnose Basic* locking module to *Slot 3*.

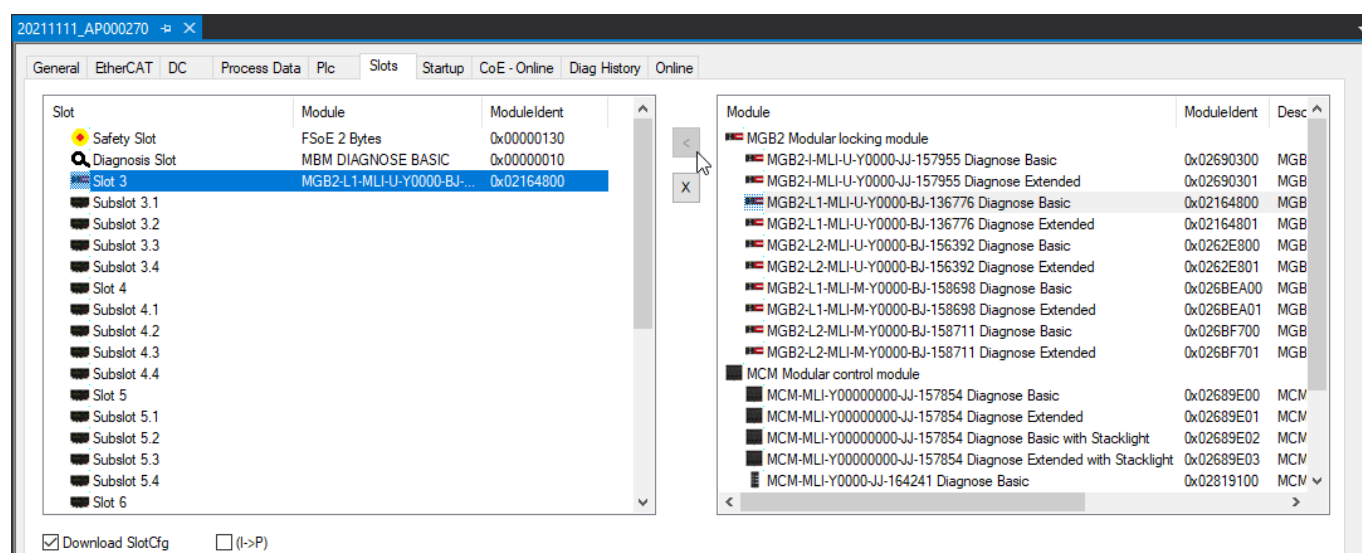


Fig. 9: Adding locking module to the slot configuration

4. Add the *MSM-1-P-CA-BPP-A1-136687 Diagnose Basic* submodule to *Subslot 3.2*.

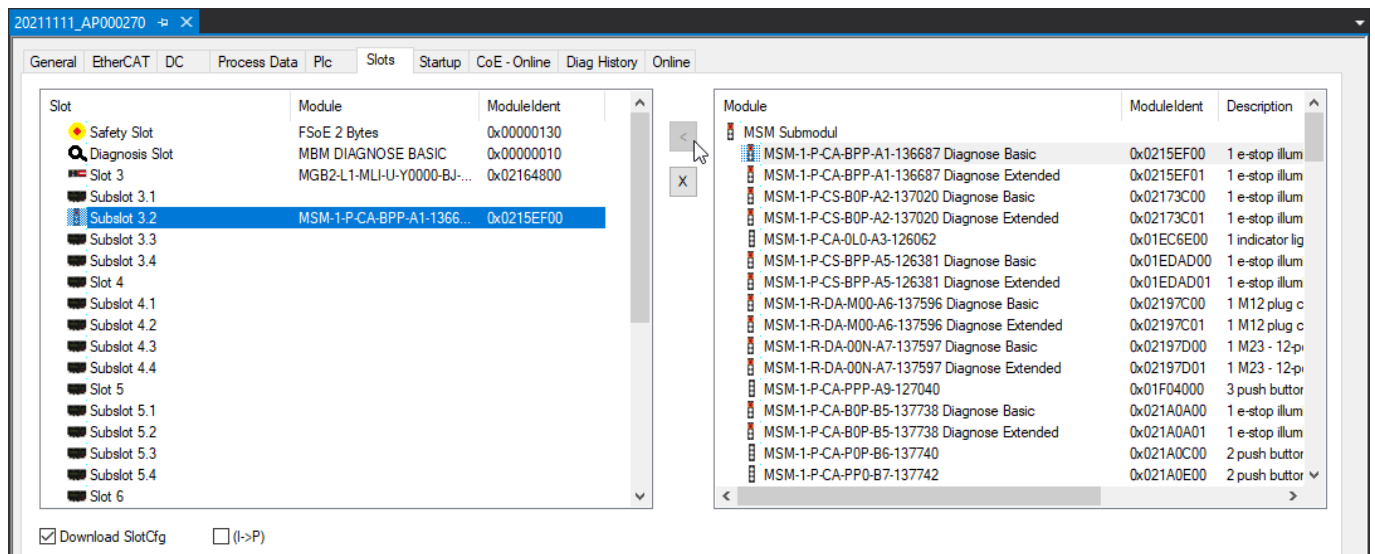


Fig. 10: Adding submodule to the slot configuration

7.2.1. Complete bus structure of MGB2:

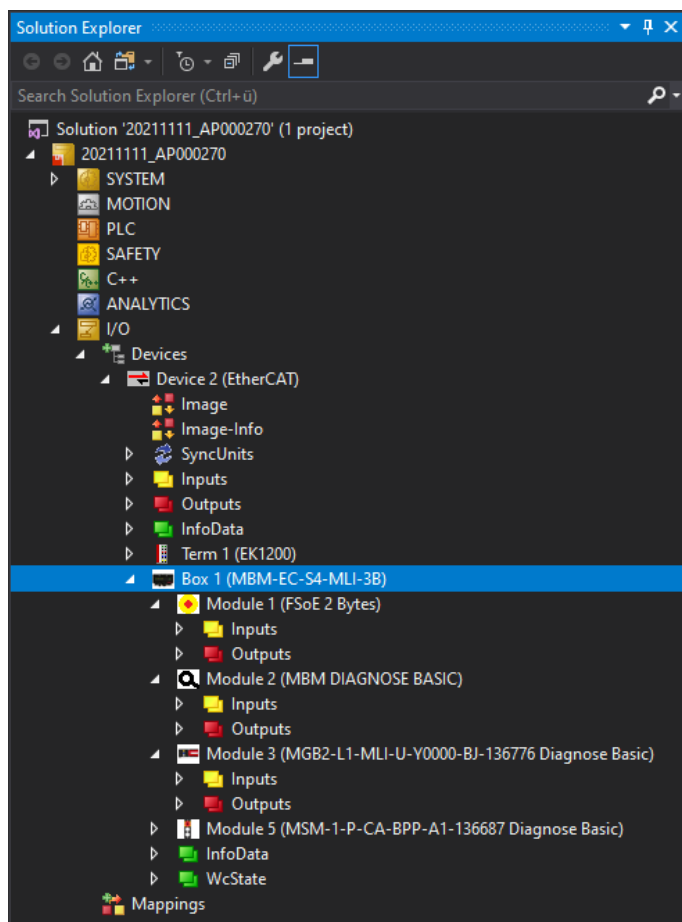


Fig. 11: Completely configured EtherCAT

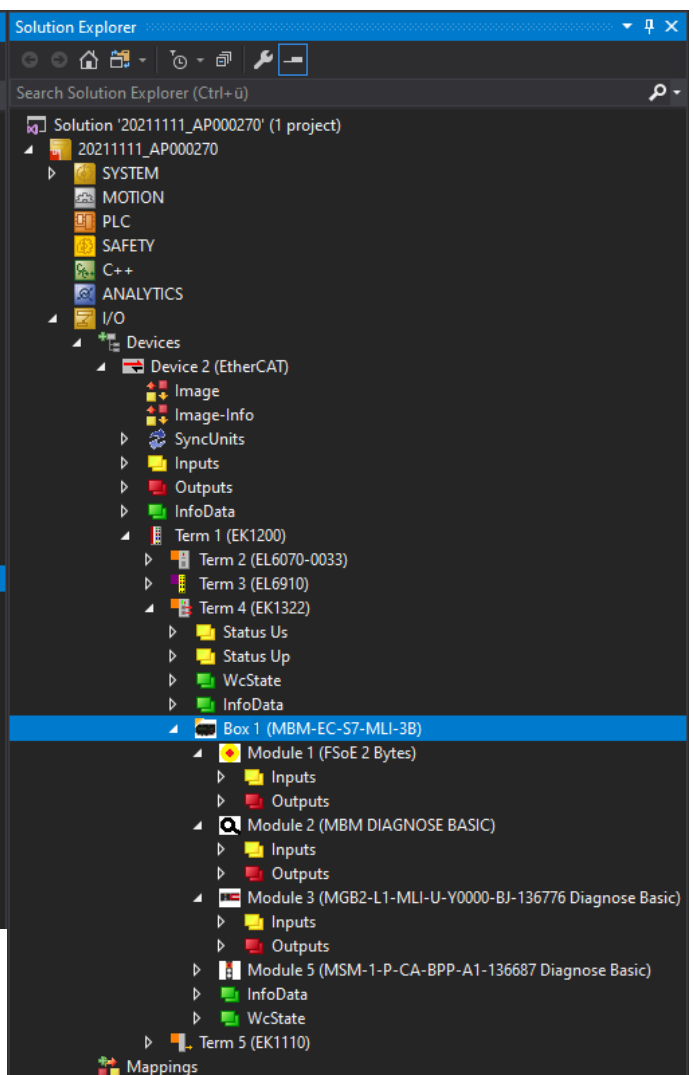


Fig. 12: Completely configured EtherCAT P

8. Parameterizing the MGB2 Modular EtherCAT via startup configuration

The MGB2 Modular EtherCAT can be parametrized to suit requirements. This includes control of the solenoid in the locking module, activation or deactivation of the escape release error and parametrization of any LEDs on the submodule, for example. The escape release error is activated and the LED of the emergency stop on the submodule in slot 2 is parametrized in this application. The modules and submodules are parametrized via the startup configuration.

8.1. Example: activating the escape release error

8.1.1. Locking module L1


	NOTICE! <ul style="list-style-type: none"> ▸ The solenoid is controlled via the SAFE bit and the NON-SAFE bit (default setting). If you do not want to change the slot parametrization of the locking module, you do not have to create any startup values. If you want to activate the escape release error in the slot parametrization, solenoid control must also be parametrized correspondingly. ▸ The decimal values 0, 2, 4 and 6 are not allowed with an L1 locking module and will lead to a parametrization error. 				
Parametrization of locking module L1	Bit 2	Bit 1	Bit 0	Decimal value	Comment
Control guard locking from SAFE area	FALSE	FALSE	TRUE	1	Guard locking is controlled exclusively from the SAFE area
Control guard locking from SAFE and NON-SAFE area	FALSE	TRUE	TRUE	3	Guard locking is controlled from the SAFE and NON-SAFE area
Control guard locking from SAFE area + activate escape release error	TRUE	FALSE	TRUE	5	Guard locking is controlled exclusively from the SAFE area. The locking module enters into an error state when the escape release is actuated.
Control guard locking from SAFE and NON-SAFE area + activate escape release error	TRUE	TRUE	TRUE	7	Guard locking is controlled from the SAFE and NON-SAFE area. The locking module enters into an error state when the escape release is actuated.

Table 2: Parameters of locking module L1

8.1.2. Locking module L2


	NOTICE! <ul style="list-style-type: none"> ▸ The solenoid is controlled via the SAFE bit (default setting). If you do not want to change the slot parametrization of the locking module, you do not have to create any startup values. If you want to activate the escape release error in the slot parametrization, solenoid control must also be parametrized correspondingly. ▸ The decimal value 4 is not allowed with an L2 locking module and will lead to a parametrization error. 				
Parametrization of locking module L2	Bit 2	Bit 1	Bit 0	Decimal value	Comment
Deactivate guard locking	FALSE	FALSE	FALSE	0	Behaves like IO box (applies only to L2)
Control guard locking from SAFE area	FALSE	FALSE	TRUE	1	Guard locking is controlled exclusively from the SAFE area
Control guard locking from NON-SAFE area	FALSE	TRUE	FALSE	2	Guard locking is controlled exclusively from the NON-SAFE area
Control guard locking from SAFE and NON-SAFE area	FALSE	TRUE	TRUE	3	Guard locking is controlled from the SAFE and NON-SAFE area
Control guard locking from SAFE area + activate escape release error	TRUE	FALSE	TRUE	5	Guard locking is controlled exclusively from the SAFE area. The locking module enters into an error state when the escape release is actuated.
Control guard locking from NON-SAFE area + activate escape release error	TRUE	TRUE	FALSE	6	Guard locking is controlled exclusively from the NON-SAFE area. The locking module enters into an error state when the escape release is actuated.
Control guard locking from SAFE and NON-SAFE area + activate escape release error	TRUE	TRUE	TRUE	7	Guard locking is controlled from the SAFE and NON-SAFE area. The locking module enters into an error state when the escape release is actuated.

Table 3: Parameters of locking module L2

8.1.3. Adding Startup value

1. Open the settings of the MBM module and click the *Startup* tab.

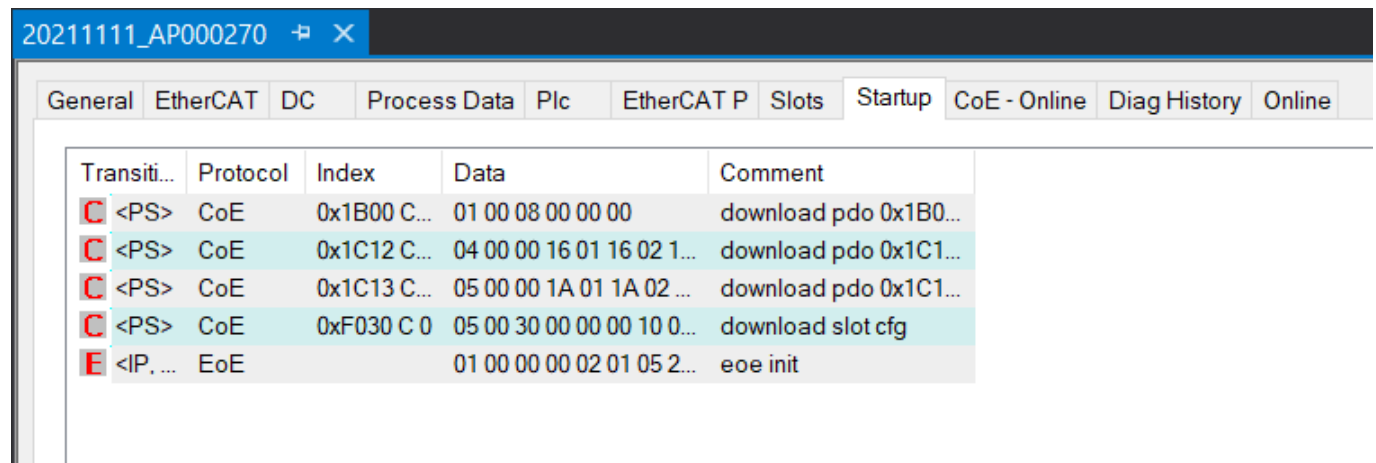


Fig. 13: Startup values

2. Right-click the empty field and select *Add New Item....*

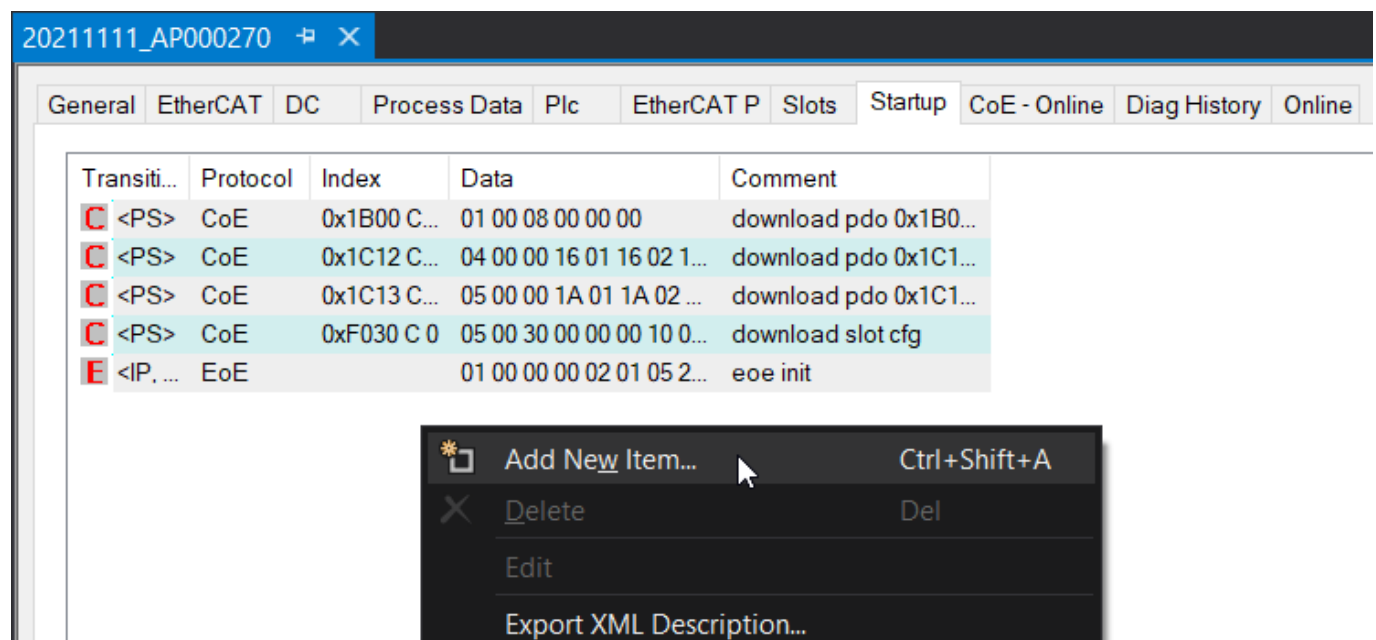


Fig. 14: Adding a new Startup value

3. Select the slot where the locking module is to be found (here: *Slot 3 Configuration*) and then double-click *SubIndex 001*.

Edit CANopen Startup Entry

Transition:
☐ I->P
☒ P->S
☐ S->O
☐ S->P
☐ O->S

Index (hex): 8029
 Sub-Index (dec): 1
☐ Validate ☐ Complete Access

Data (hexbin): 00
 Validate Mask:
 Comment: SubIndex 001

Index	Name	Flags	Value	Unit
8029:0	Slot 3 Configuration		> 4 <	
8029...	SubIndex 001	RW	0x00 (0)	
8029...	SubIndex 002	RW	0x00 (0)	
8029...	SubIndex 003	RW	0x00 (0)	
8029...	SubIndex 004	RW	0x00 (0)	
8039:0	Subslot 3.1 Configuration		> 4 <	
8049:0	Subslot 3.2 Configuration		> 4 <	
8059:0	Subslot 3.3 Configuration		> 4 <	
8069:0	Subslot 3.4 Configuration		> 4 <	

Fig. 15: Selecting the slot



NOTICE!

You can then refer to the settings of the MBM bus module under the *Slots* tab for the corresponding slot configuration.

4. As described above, the escape release error is to be activated in this application. Bit 3 (decimal value 4) must be set to TRUE for this purpose. Solenoid control must additionally be parametrized as described in the notice above. In this application, control of guard locking must be controlled from the SAFE and NON-SAFE area. As shown in *Table 3*, the resulting decimal value is 7.

Set Value Dialog

Dec: 7
 Hex: 0x07
 Float:
 Bool: 0 1
 Binary: 07
 Bit Size: ☐ 1 ☒ 8 ☐ 16 ☐ 32 ☐ 64 ☐ ?

Fig. 16: Activating the escape release error and parameterizing solenoid control (SAFE and NON-SAFE)







20211111_AP000270				
General EtherCAT DC Process Data Plc EtherCAT P Slots Startup CoE - Online Diag History Online				
Transiti...	Protocol	Index	Data	Comment
 <PS>	CoE	0x1B00 C...	01 00 08 00 00 00	download pdo 0x1B0...
 <PS>	CoE	0x1C12 C...	04 00 00 16 01 16 02 1...	download pdo 0x1C1...
 <PS>	CoE	0x1C13 C...	05 00 00 1A 01 1A 02 ...	download pdo 0x1C1...
 <PS>	CoE	0xF030 C 0	05 00 30 00 00 00 10 0...	download slot cfg
 <IP, ...	EoE		01 00 00 00 02 01 05 2...	ee init
 PS	CoE	0x8029:01	0x07 (7)	SubIndex 001

Fig. 17: Created Startup value

8.2. Example: parameterizing the LEDs in the submodule

Submodule parameterization	Value range	Flashing frequency	Default value	Comment
SubIndex 001	1 - 255	0.1 - 25.5 Hz	1 Hz	Flashing frequency H1 = emergency stop LED
SubIndex 002	1 - 255	0.1 - 25.5 Hz	1 Hz	Flashing frequency H2 = pushbutton LED
SubIndex 003	1 - 255	0.1 - 25.5 Hz	1 Hz	Flashing frequency H3 = pushbutton LED

Table 4: Values for parameterizing the submodule

1. Open the settings of the MBM bus module and click the *Startup* tab.

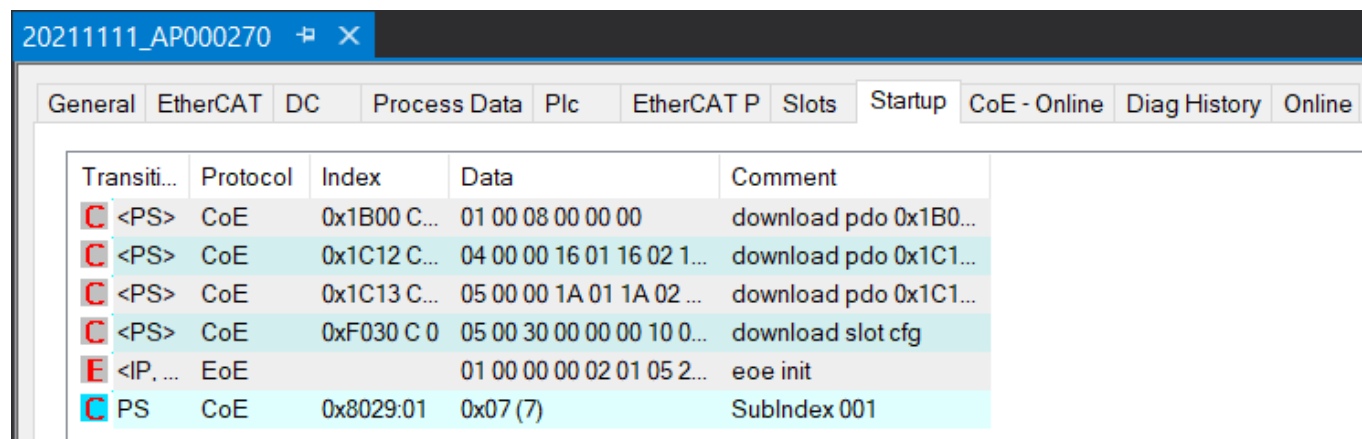


Fig. 18: Startup values

2. Right-click the empty field and select *Add New Item....*

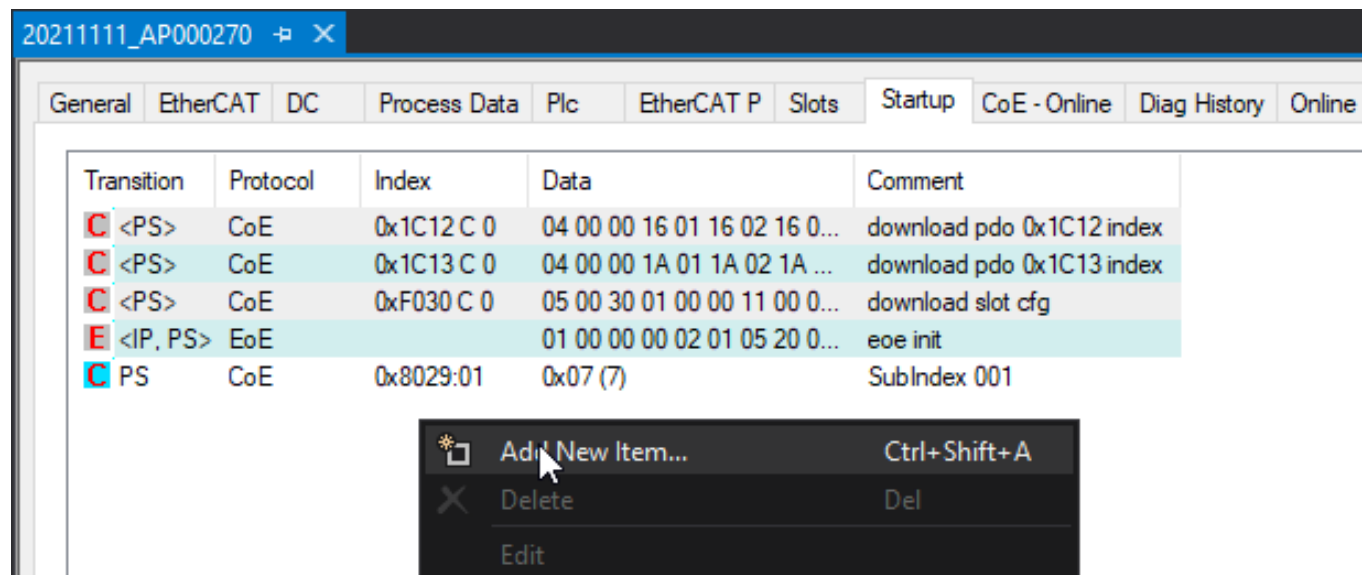


Fig. 19: Adding a new Startup value

- Select *Subslot 3.2 Configuration* and double-click *SubIndex 001* to parameterize the flashing frequency of the LED in the emergency stop.

Edit CANopen Startup Entry

Transition:
☐ I -> P
☒ P -> S ☐ S -> P
☐ S -> O ☐ O -> S

Index (hex): 8049
 Sub-Index (dec): 1
☐ Validate ☐ Complete Access

Data (hexbin): 00
 Validate Mask:
 Comment: SubIndex 001

Index	Name	Flags	Value
1011:0	Restore default parameters	RO	> 1 <
10F1:0	Error Settings		> 2 <
10F3:0	Diagnosis History		> 5 <
10F8	Timestamp Object	RW P	0x0
1C32:0	SM output parameter		> 32 <
1C33:0	SM input parameter		> 32 <
8029:0	Slot 3 Configuration		> 4 <
8039:0	Subslot 3.1 Configuration		> 4 <
8049:0	Subslot 3.2 Configuration		> 4 <
8049:01	SubIndex 001	RW	0x00 (0)
8049:02	SubIndex 002	RW	0x00 (0)
8049:03	SubIndex 003	RW	0x00 (0)
8049:04	SubIndex 004	RW	0x00 (0)

Fig. 20: Selecting the slot

- Enter the required value for the flashing frequency according to *Table 4* (here: dec.: 50 = 5 Hz). If the bit for controlling the LED and the bit for controlling the flashing command are set, the LED will flash at 5 Hz. Refer to chapter 4 or the data sheet of the submodule for the respective bits.

Set Value Dialog

Dec: 50
 Hex: 0x32
 Float:
 Bool: 0 1
 Binary: 32 1
 Bit Size: ☐ 1 ☒ 8 ☐ 16 ☐ 32 ☐ 64 ☐ ?

Fig. 21: Flashing frequency of emergency stop LED 5 Hz

9. Linking the FSoE module of the MGB2 Modular EtherCAT

In order to be able to use the MGB2 in the safety program, the FSoE module from the hardware configuration must be linked with an *Alias Device* in the safety program.

1. Right-click *Alias Devices* in your safety program and select *Add -> New Item...*

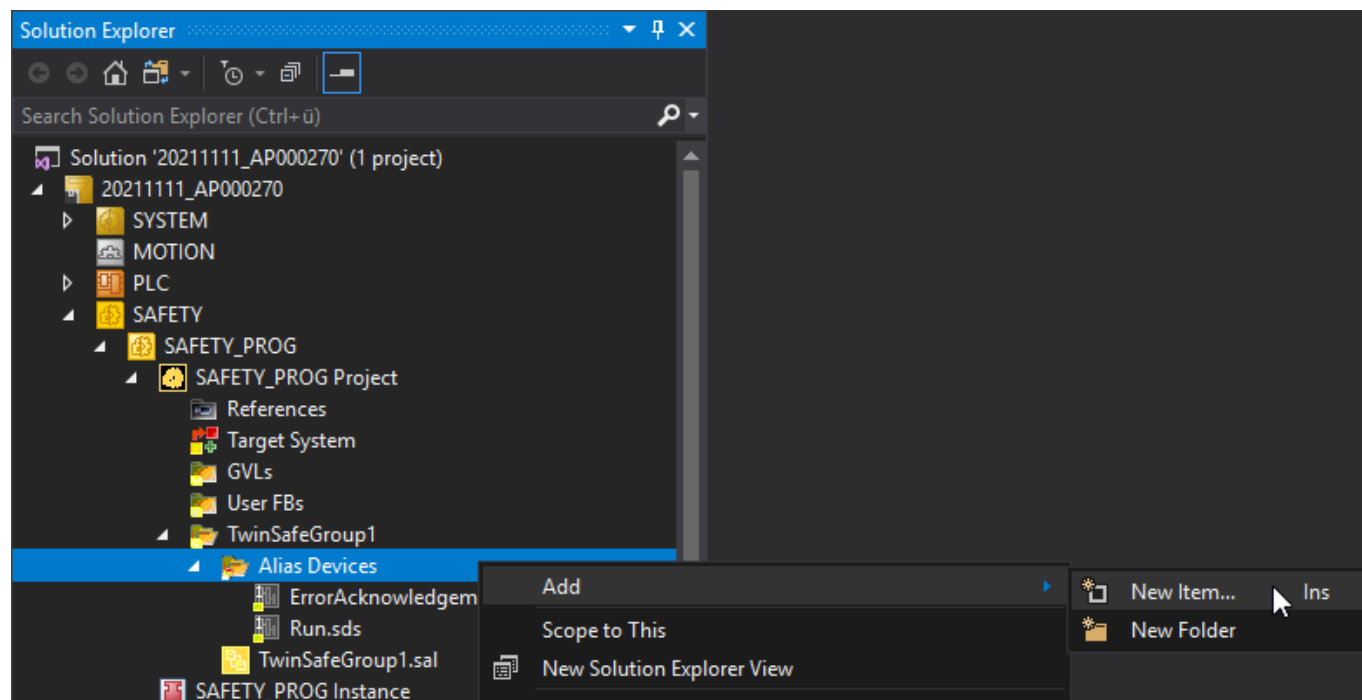


Fig. 22: Adding an *Alias Device*

2. In the *Installed* tree, open the *Safety* structure and *EtherCAT* and then click *EUCHNER GmbH + Co.* Select the *Safety Alias Device* configured in accordance with the hardware (here: 2 Bytes).

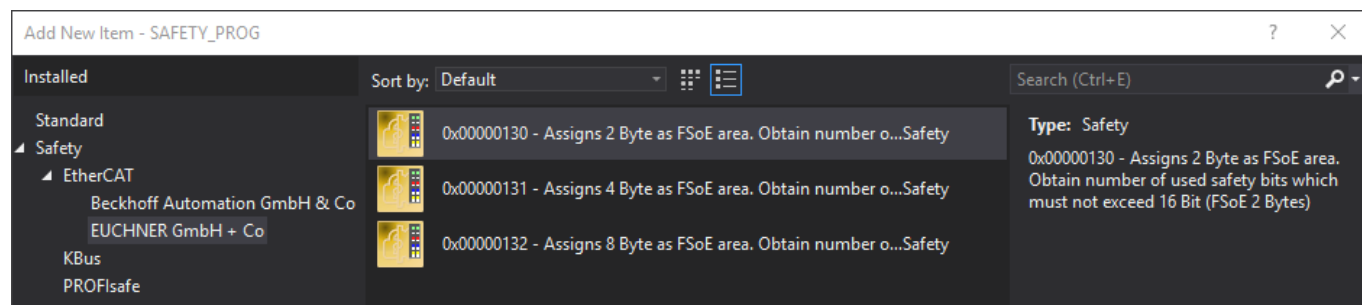


Fig. 23: Selecting the corresponding safety module

- The *Alias Device* must now be linked with the configured hardware module so that the safety data of the MGB2 can be used in the safety project. Double-click to go to the properties of the added *Alias Device* and open the *Linking* tab. Select the physical module.

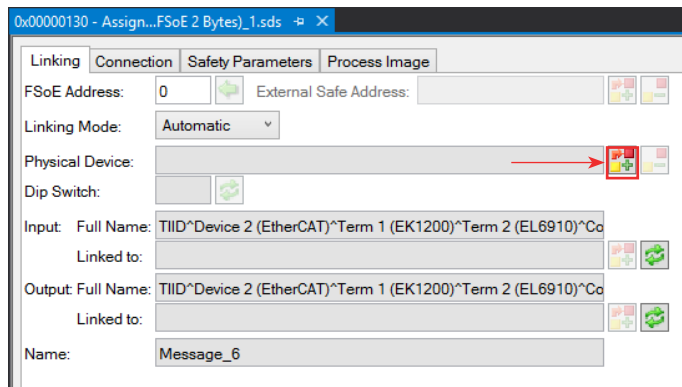


Fig. 24: FSoE module linking

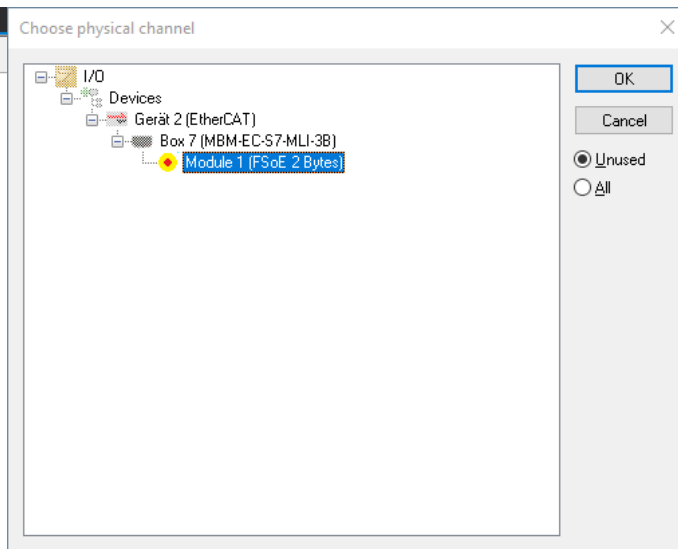


Fig. 25: Selecting FSoE module

- The FSoE address of the physical device (DIP switch) must then be adopted for the *Alias Device* by clicking the green arrow.

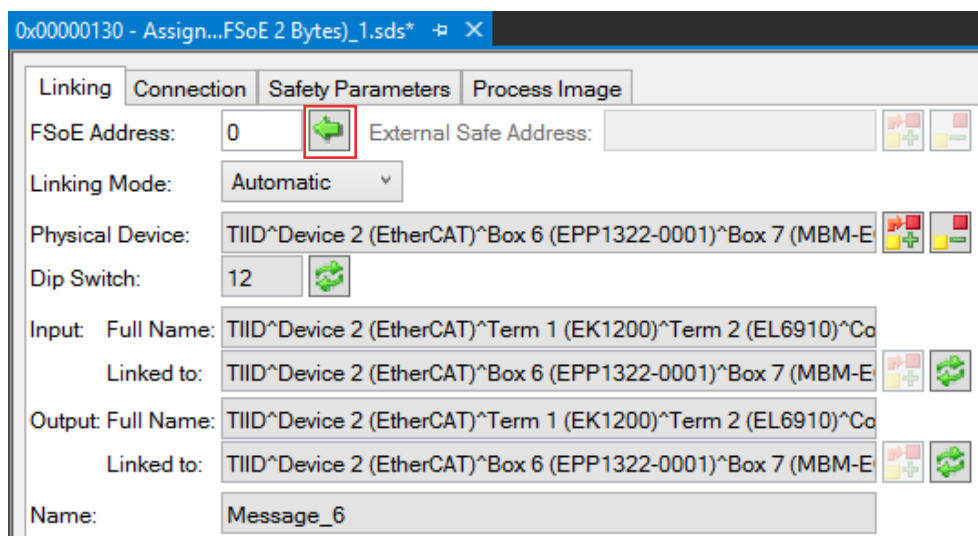


Fig. 26: Adopting FSoE address

The safety program must then be created. This is not part of this application and is the responsibility of the programmer. At least one safe bit of the MGB2 must be used.

10. Important note – please observe carefully!

This document is intended for a design engineer who possesses the requisite knowledge in safety engineering and knows the applicable standards, e.g. through training for qualification as a safety engineer. Only with the appropriate qualification is it possible to integrate the example provided into a complete safety chain.

The example represents only part of a complete safety chain and does not fulfill any safety function on its own. In order to fulfill a safety function, the energy switch-off function for the danger zone and the software must also be considered in the safety evaluation, for example.

The applications provided are only examples for solving certain safety tasks for protecting safety doors. The examples cannot be comprehensive due to the application-dependent and individual protection goals within a machine/installation.

If questions concerning this example remain open, please contact us directly.

According to the Machinery Directive 2006/42/EC, the design engineer of a machine or installation has the obligation to perform a risk assessment and take measures to reduce the risk. While doing this, the engineer must comply with the applicable national and international safety standards. Standards generally represent the current state-of-the-art. Therefore, the design engineer should continuously inform himself about changes in the standards and adapt his considerations to them. Relevant standards for functional safety include EN ISO 13849 and EN 62061. This application must be regarded only as assistance for the considerations about safety measures.

The design engineer of a machine/installation has the obligation to assess the safety engineering himself. The examples must not be used for an assessment, because only a small excerpt of a complete safety function was considered in terms of safety engineering here.

In order to be able to use the safety switch applications correctly on safety doors, it is indispensable to observe the standards EN ISO 13849-1, EN ISO 14119 and all relevant C-standards for the respective machine type. Under no circumstances does this document replace the engineer's own risk assessment, and it cannot serve as the basis for a fault assessment.

In particular in relation to a fault exclusion, it must be noted that a fault can be excluded only by the machine's or installation's design engineer and this action requires justification. A general fault exclusion is not possible. More information about fault exclusion can be found in EN ISO 13849-2.

Changes to products or within assemblies from third-party suppliers used in this example can lead to the function no longer being ensured or the safety assessment having to be adapted. In any event, the information in the operating instructions on the part of EUCHNER, as well as on the part of third-party suppliers, must be used as the basis before this application is integrated into an overall safety function. If contradictions should arise between the operating instructions and this document, please contact us directly.

Use of brand names and company names

All brand names and company names stated are the property of the related manufacturer. They are used only for the clear identification of compatible peripheral devices and operating environments in relation to our products.

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