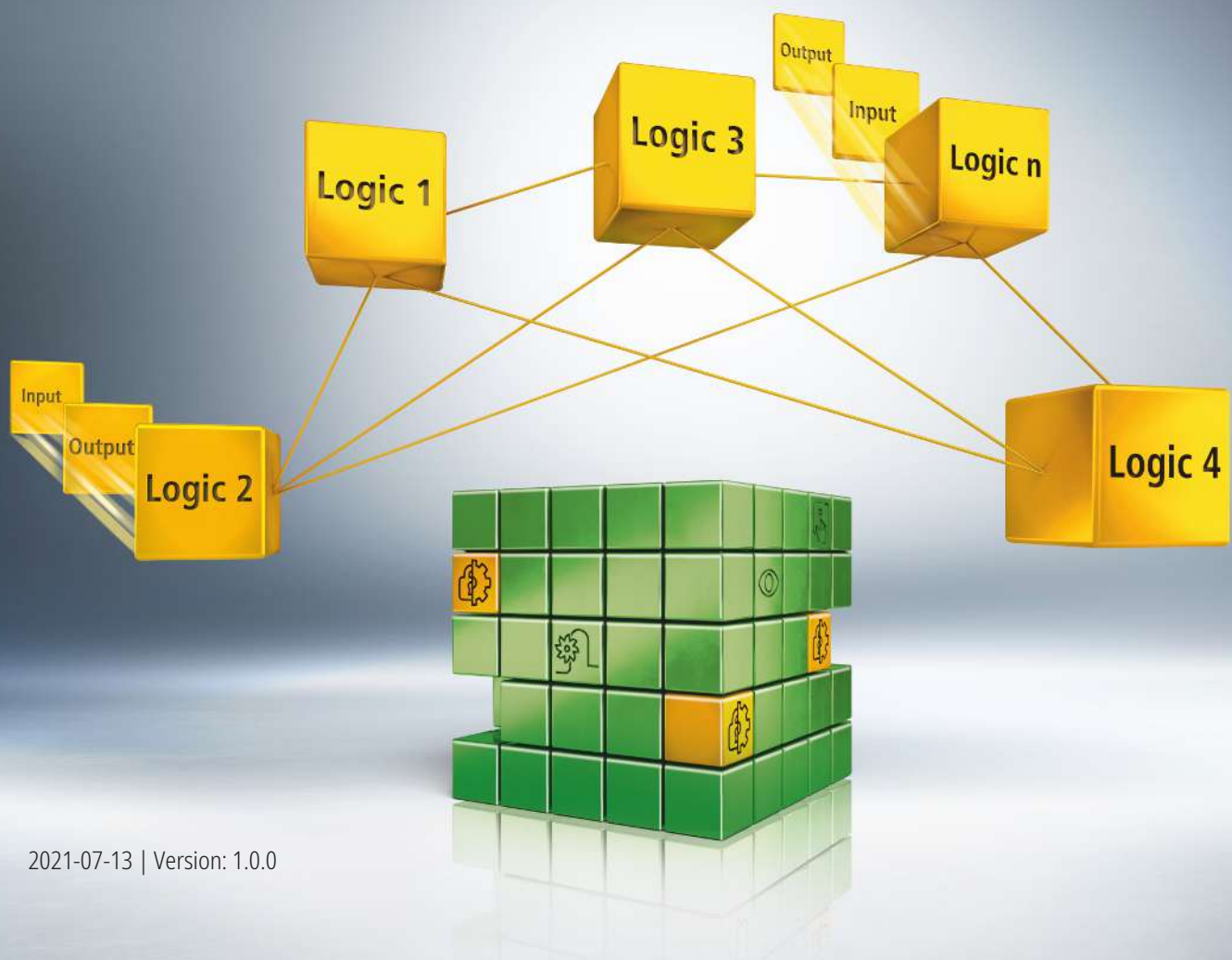


TwinSAFE Tutorial 2 | EN

SafeMotion Wizard

Update of an existing Safe Motion project to a SafeMotion Wizard project



1 Introduction

TwinSAFE includes several innovations that bring more functionality and performance to your safety controller. A major innovation is that the functionality of the safety controller is integrated in each TwinSAFE component. This means that you can, for example, use a TwinSAFE input component both as an input component and the safety control integrated on it to use application-specific pre-processing.

This is tutorial 2 of a tutorial series.

The aim of this tutorial series is to familiarize you with the TwinSAFE innovations using individual examples.

This tutorial is about converting an existing DIY Safe Motion project with user defined SLA functionality to a SafeMotion Wizard project.

1.1 Issue statuses

Version	Comment
1.0.0	• First released version
0.0.1	• First draft

1.2 Requirements

Meet the following requirements for this tutorial:

- TwinCAT 3 version $\geq 3.1.4024.11$
- TwinCAT Safety Editor TE9000 $\geq 1.2.1.1$
- TwinSAFE firmware ≥ 03
- AX8000 firmware ≥ 0104 ; with default module ID active

1.3 Starting point

At the starting point of the tutorial

- a standard PLC solution with an EL6910 project exists,
- a custom DIY Safe Motion project with an AX8000 as Safe Motion component and user defined SLA functionality exists.

1.4 Explanation of the project names

Naming	Term
DIY Safe Motion project	<ul style="list-style-type: none">• custom Safe Motion project• exists already at the starting point of this tutorial• should be converted to SafeMotion Wizard project
SafeMotion Wizard project	<ul style="list-style-type: none">• will be created during this tutorial• will be generated with the SafeMotion Wizard• later replaces the DIY Safe Motion project

1.5 Demo system

1.5.1 Hardware

The demo system of this tutorial consists of the following hardware:

- CX for EtherCAT communication and the standard PLC controller
- EL6910 as master TwinSAFE Logic
- EL1918 with safe inputs for reading light barrier signals
- Light barrier
- AX8000-x2xx

1.5.2 Desired safety functionality

This tutorial describes the realization of the following safety functionalities:

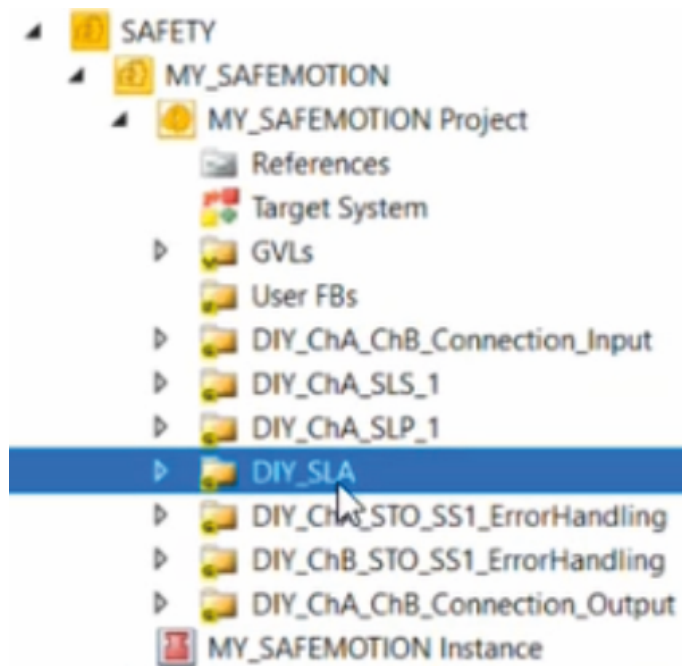
- the original functionality from the DIY Safe Motion project
- additional functions from the SafeMotion Wizard

2 Demonstration

2.1 Assumptions software

- The safety application is modularized.
- The user defined functionality is connected.

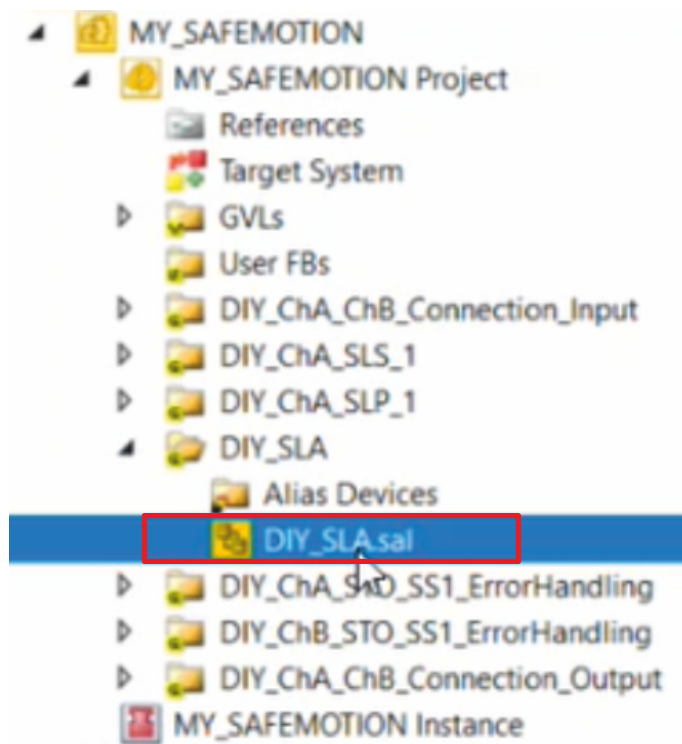
2.2 Create User FB



You see the DIY Safe Motion project with the safety functions SLS and SLP as well as the self-implemented DIY SLA functionality.

In the following, the DIY SLA functionality is to be transferred to the new SafeMotion Wizard project. To do this, first combine the SLA functionality in a User FB.

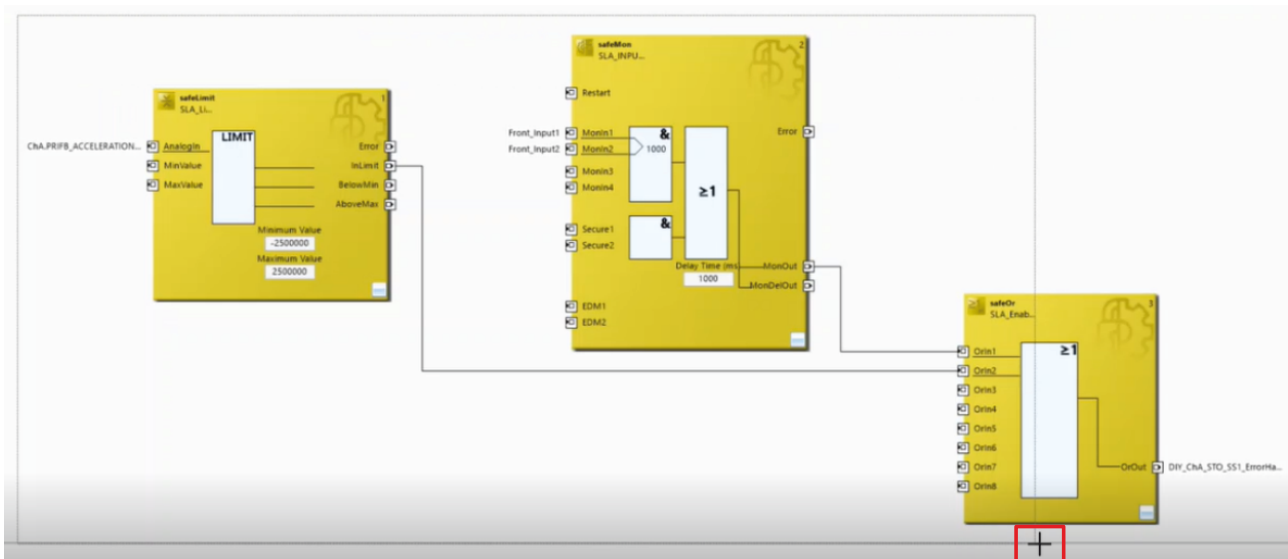
To create a User FB for the SLA functionality, proceed as follows:



1. Open the sal file in the SLA folder.

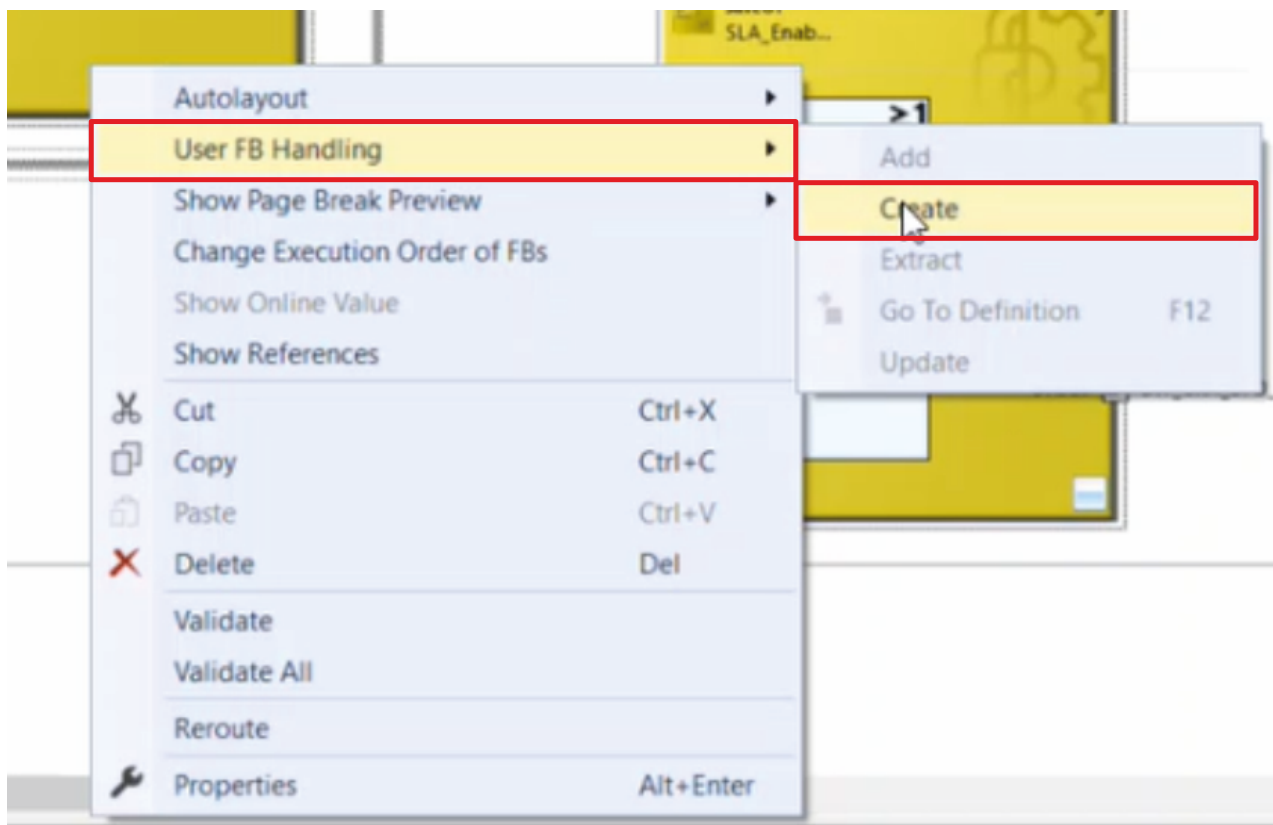


You will see the function blocks (FB) belonging to your SLA functionality.

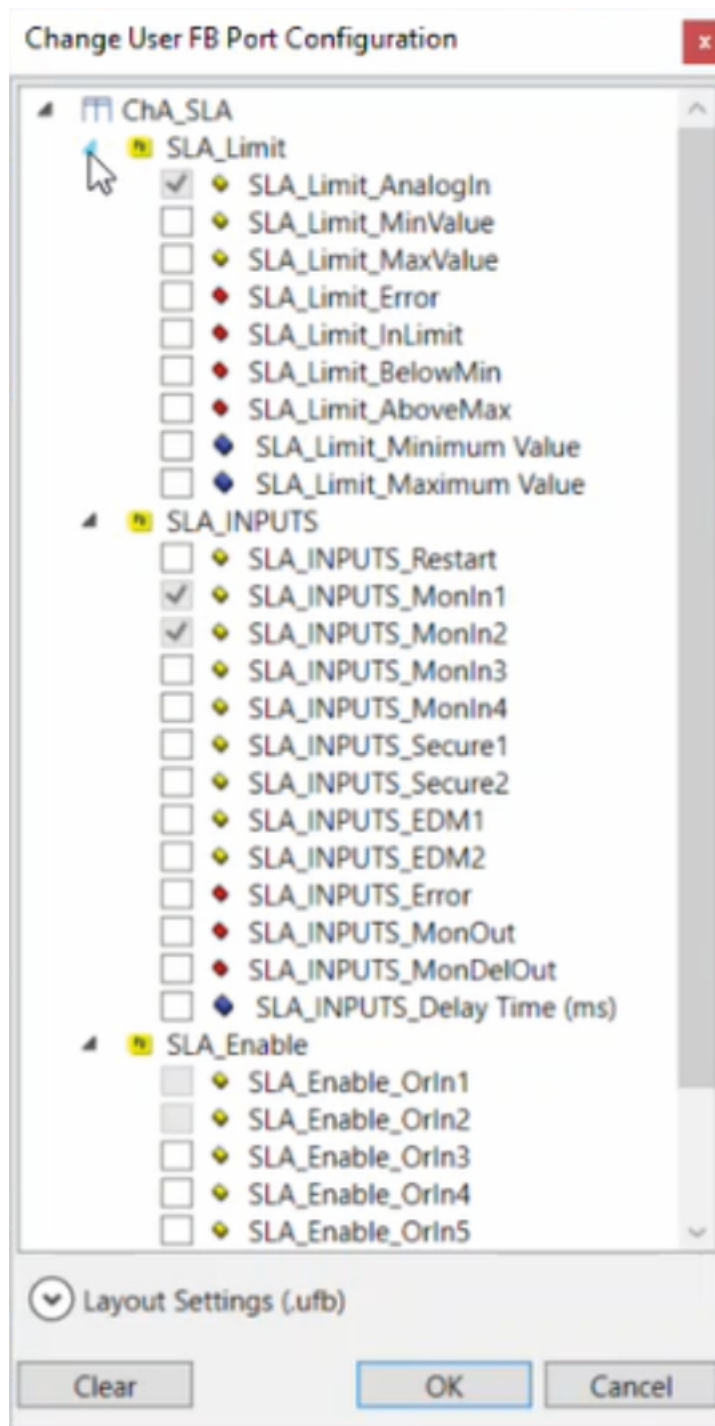


2. Press and hold the left mouse button
3. Drag over all FBs so that all FBs are in the box
4. Release the left mouse button

The FBs are selected.

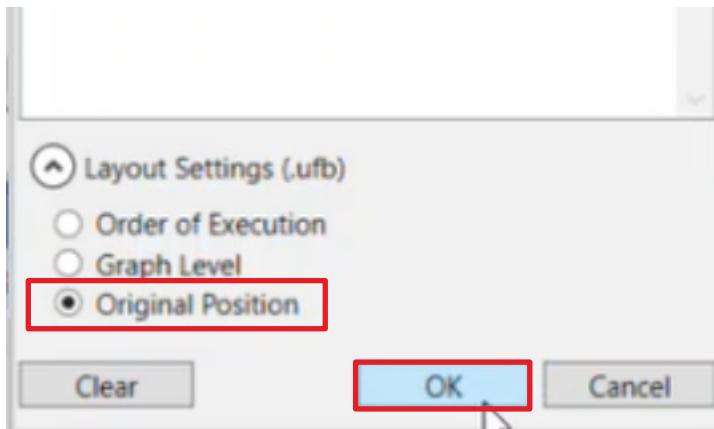


5. Right-click on the selected FBs
6. Click "Create" via the "User FB Handling" field to combine the FBs into one User FB



The "Change User FB Port Configuration" window opens.

Here you have the option of selecting which inputs and outputs are visible to the outside. This selection is not necessary for the use case of this tutorial.



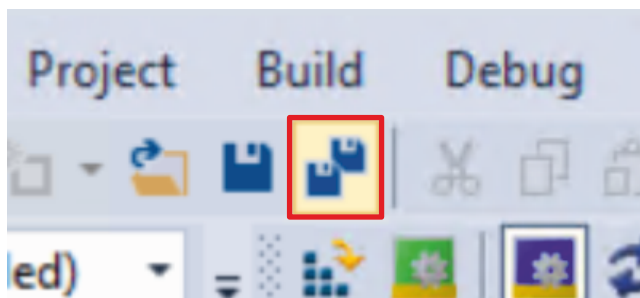
7. Click on the arrow key to open the layout settings
8. Click on "Original Position" in the "Layout Settings (.ufb)" field

The User FB saves the original position of the FBs.

9. Confirm settings with "OK"



You will now see all FBs summarized in your User FB.

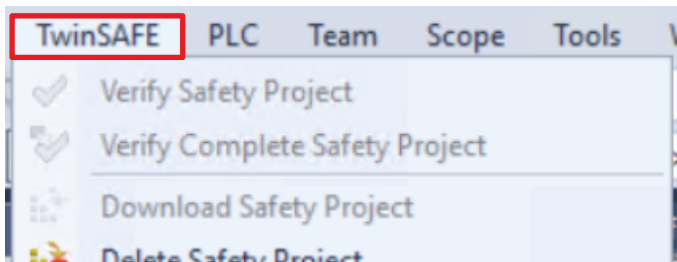


10. Click on "Save all" in the menu bar to save the changes

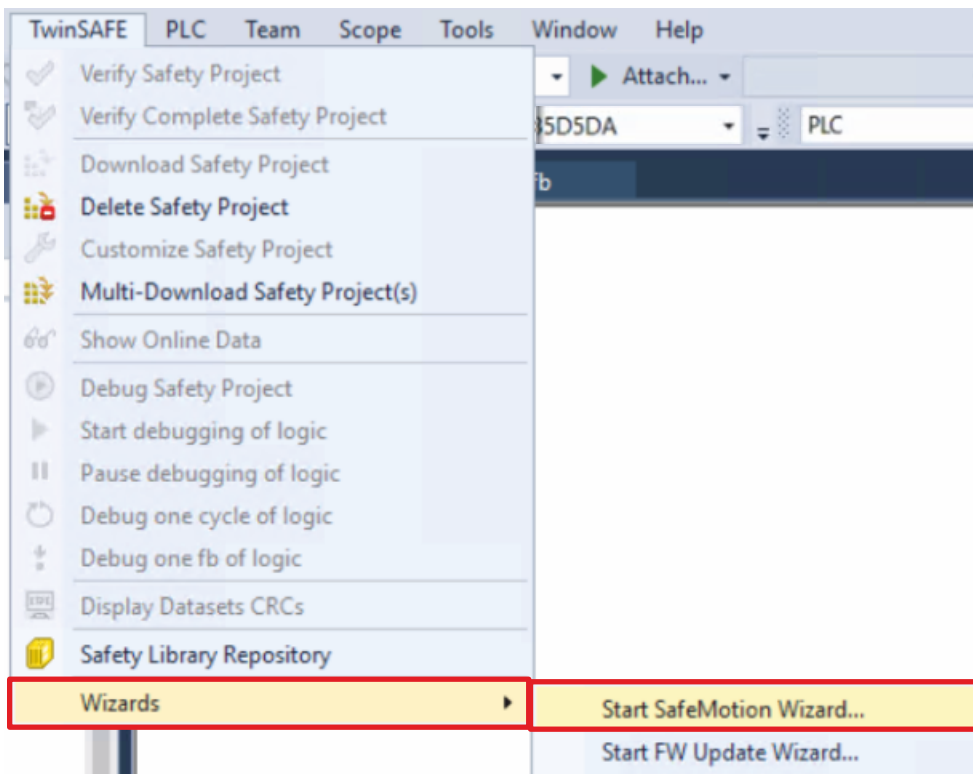
In the following you transfer the created User FB into your new SafeMotion Wizard project.

2.3 Generate SafeMotion Wizard project

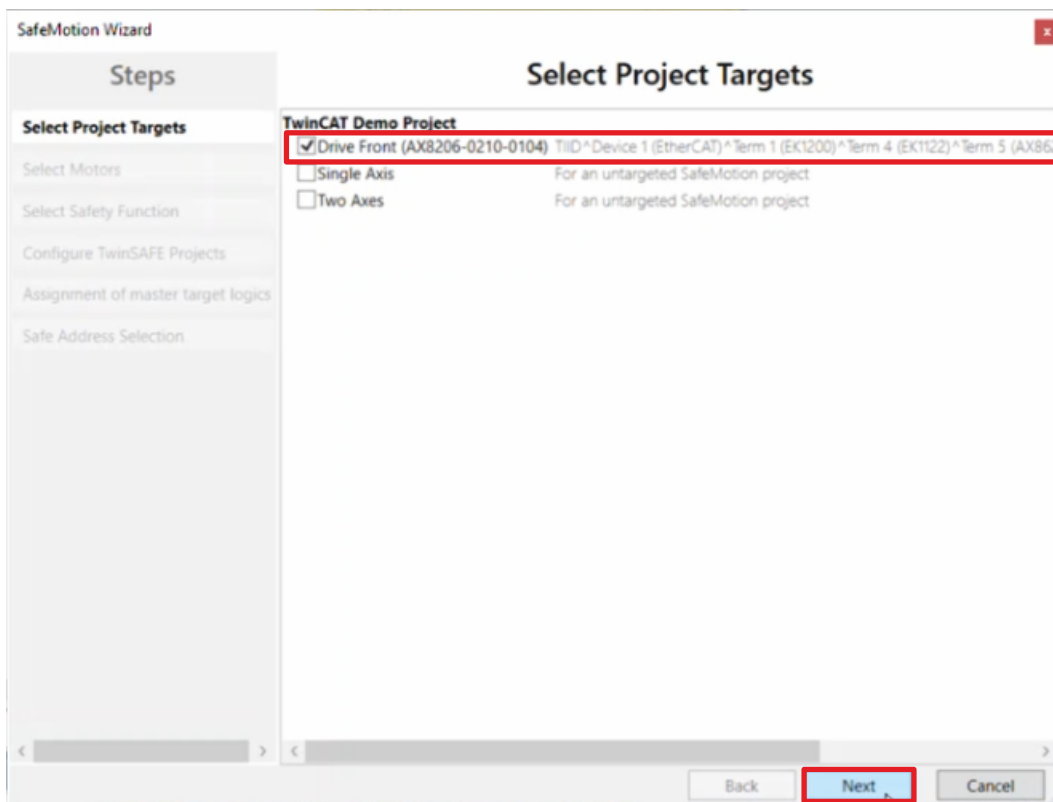
Proceed as follows to create a Safe Motion project with the SafeMotion Wizard:



1. Select the "TwinSAFE" tab

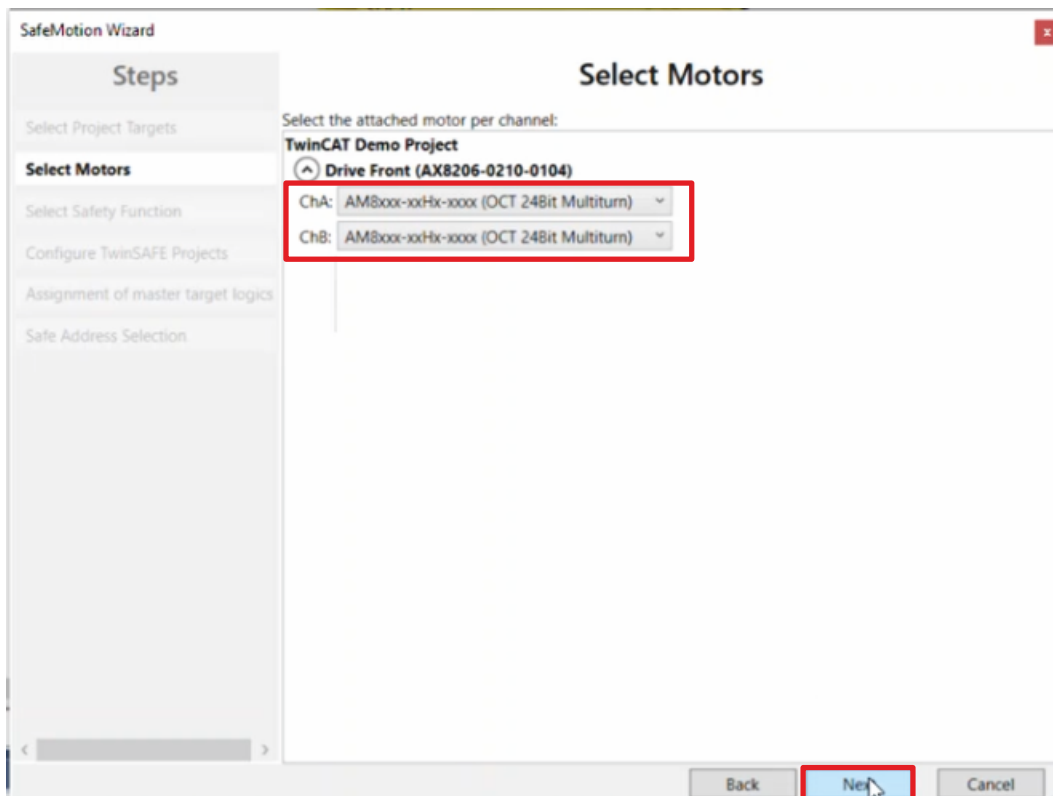


2. Select "Start SafeMotion Wizard..." via the Wizard field



The "Select Project Targets" window opens and shows you an overview of all existing and virtual axes.

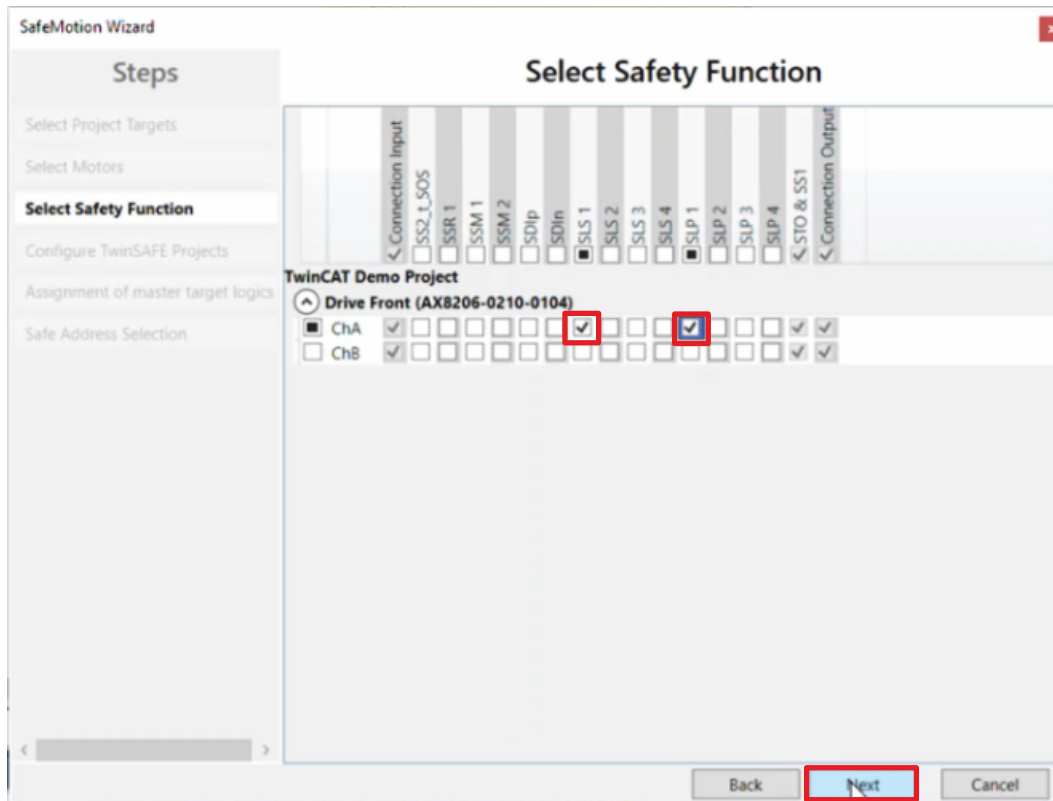
3. Select the Safe Motion component
4. Confirm your selection with "Next"



In the "Select Motors" window, configure the feedback for the individual axes.

5. Select "AM8xxx-xxHx-xxx (OCT 24Bit Multiturn)" for all axes

6. Confirm your selection with "Next"



In the "Select Safety Function" window, select the desired safety functions. In this case, select the safety functions that you have already implemented in the DIY Safe Motion project, but want to use as SafeMotion Wizard variants in your new project.

7. For the ChA channel of your Safe Motion component, select the SLS1 and SLP1 safety functions

With the SLS1 and SLP1 safety functions the selection is complete since the SLA functionality is programmed and therefore not listed. The STO safety function is active as a default setting for all channels.

8. Confirm your selection with "Next"

SafeMotion Wizard

Steps

- Select Project Targets
- Select Motors
- Select Safety Function
- Configure TwinSAFE Projects**
- Assignment of master target logics
- Safe Address Selection

Configure TwinSAFE Projects

The following projects will be created:

TwinCAT Demo Project	
Project Name:	SafeMotionWizard SAFETY ^ TwinCAT Demo Project
Safety Functions:	ChA: 3 selected ChB: 1 selected
Devices:	Drive Front (AX8206-0210-0104)TIID ^ Device 1 (EtherCAT) ^ Term 1 (EK1200) ^ Term 4 (EK11)

Back Next Cancel

The "Configure TwinSAFE Projects" window opens. Here you have the option of renaming your Safe Motion project, which is generated for your Safe Motion component.

You also get an overview of the safety settings that have been made.

9. Rename project as desired
10. Check the settings
11. Confirm your selection with "Next"

SafeMotion Wizard

Steps

- Select Project Targets
- Select Motors
- Select Safety Function
- Configure TwinSAFE Projects
- Assignment of master target logics**
- Safe Address Selection

Assignment of master target logics

The following master logics are available. The individual safe motion devices can be assigned to these logics. New safety projects will be created or already assigned safety projects will be extended. Backup & Restore can be enabled for each safemotion project.

TwinCAT Demo Project	
Master Logic Device:	Term 3 (EL6910) ^ SAFETY ^ TwinCAT Demo Project
Devices:	
Master Project Name:	SAFEMOTION CONTROL ^ SAFETY ^ TwinCAT Demo Project

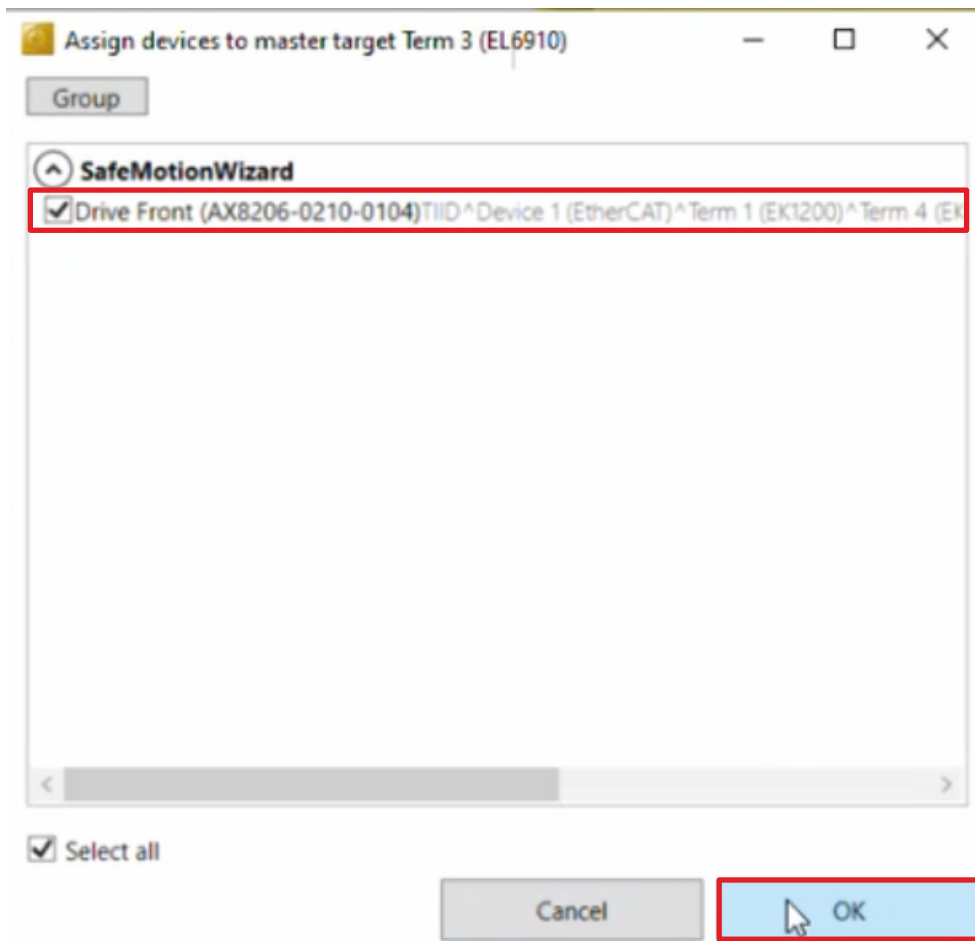
☐ Backup & Restore All

1/1 Devices are not assigned to a master project.

Back Next Cancel

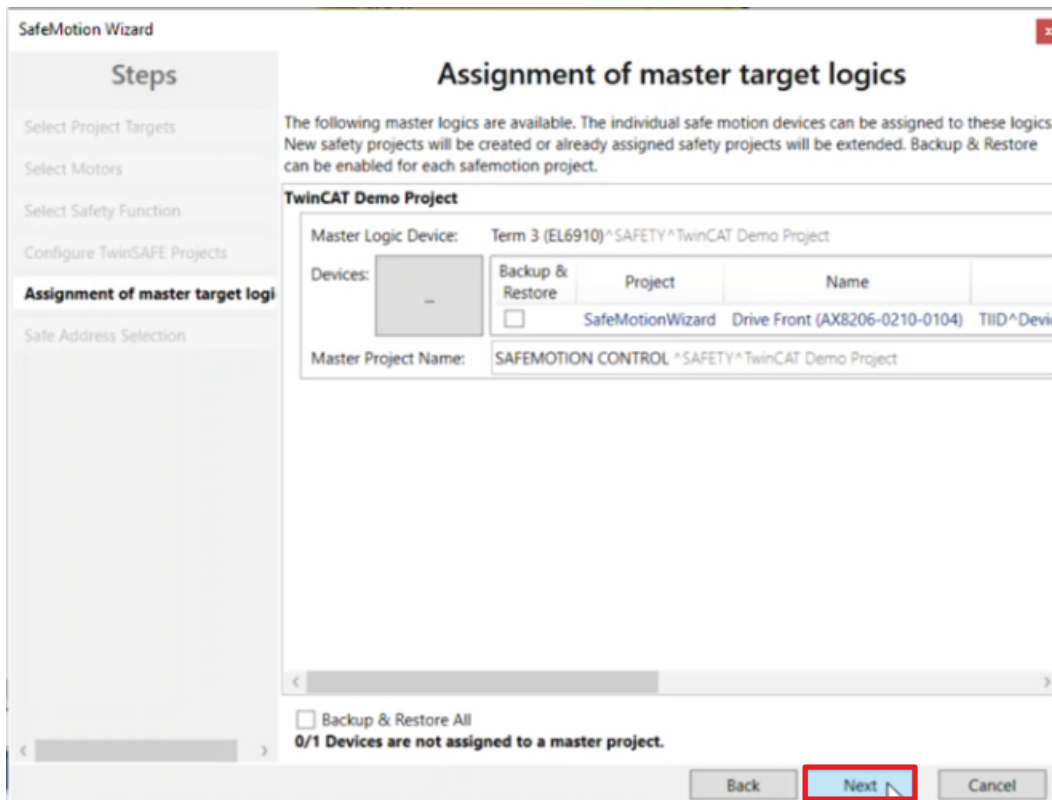
In the next window "Assignment of master target logics" the connection to the EL6910 project is closed, so that your Safe Motion component can communicate with the EL6910 project. The EL6910 project is automatically found and displayed.

12. Click the button " ... "



13. Select your Safe Motion component that you want to connect to the EL6910 project

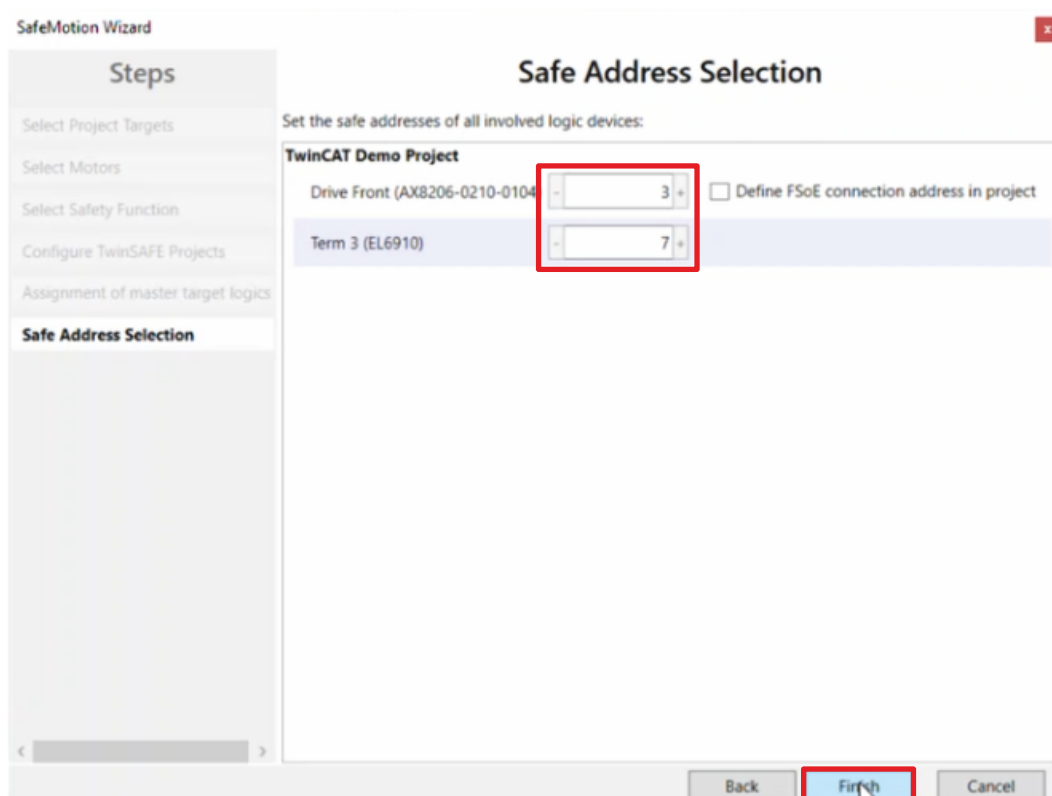
14. Confirm your selection with "OK"



The screenshot shows the 'Assignment of master target logics' window in the SafeMotion Wizard. The left sidebar lists the steps: Select Project Targets, Select Motors, Select Safety Function, Configure TwinSAFE Projects, Assignment of master target logics (highlighted), and Safe Address Selection. The main area contains a text box explaining that master logics are available and individual safe motion devices can be assigned. Below this, a table lists the available master logics. The 'Master Logic Device' is 'Term 3 (EL6910)^SAFETY^TwinCAT Demo Project'. The 'Devices' column shows a list of devices, including 'SafeMotionWizard Drive Front (AX8206-0210-0104) TIID^Device'. The 'Master Project Name' is 'SAFEMOTION CONTROL ^SAFETY^TwinCAT Demo Project'. At the bottom, there is a checkbox for 'Backup & Restore All' and a status message '0/1 Devices are not assigned to a master project.' The 'Next' button is highlighted with a red box.

Devices:	Backup & Restore	Project	Name
...	<input type="checkbox"/>	SafeMotionWizard	Drive Front (AX8206-0210-0104) TIID^Device

15. Confirm the window with "Next"



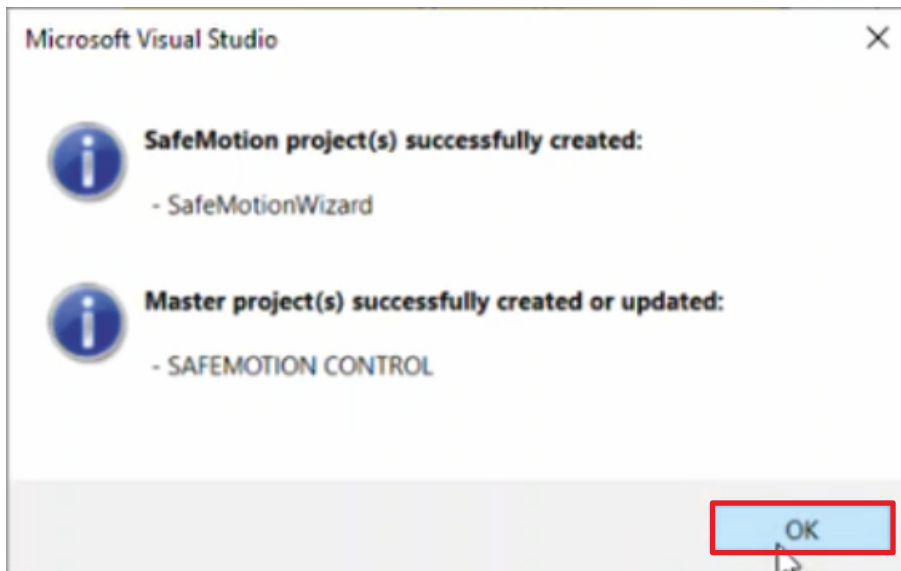
The screenshot shows the 'Safe Address Selection' window in the SafeMotion Wizard. The left sidebar lists the steps: Select Project Targets, Select Motors, Select Safety Function, Configure TwinSAFE Projects, Assignment of master target logics, and Safe Address Selection (highlighted). The main area contains a text box explaining that the safe addresses of all involved logic devices are set. Below this, a table lists the logic devices and their safe addresses. The 'Drive Front (AX8206-0210-0104)' has a safe address of 3. The 'Term 3 (EL6910)' has a safe address of 7. The 'Finish' button is highlighted with a red box.

Logic Device	Safe Address
Drive Front (AX8206-0210-0104)	3
Term 3 (EL6910)	7

The "Safe Address Selection" window opens. Here the safe addresses are read out automatically. For virtual axes or axes that cannot be reached, you have the option of configuring the addresses yourself.

16. Close the window with "Finish"

The SafeMotion Wizard configures the projects.



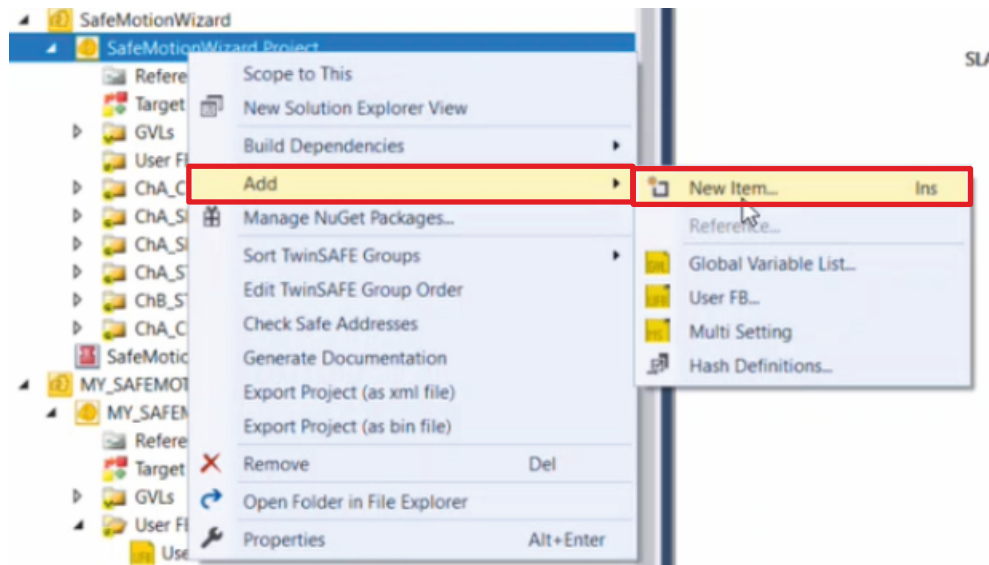
17. Close the window with "OK"

2.4 Create TwinSAFE group SLA

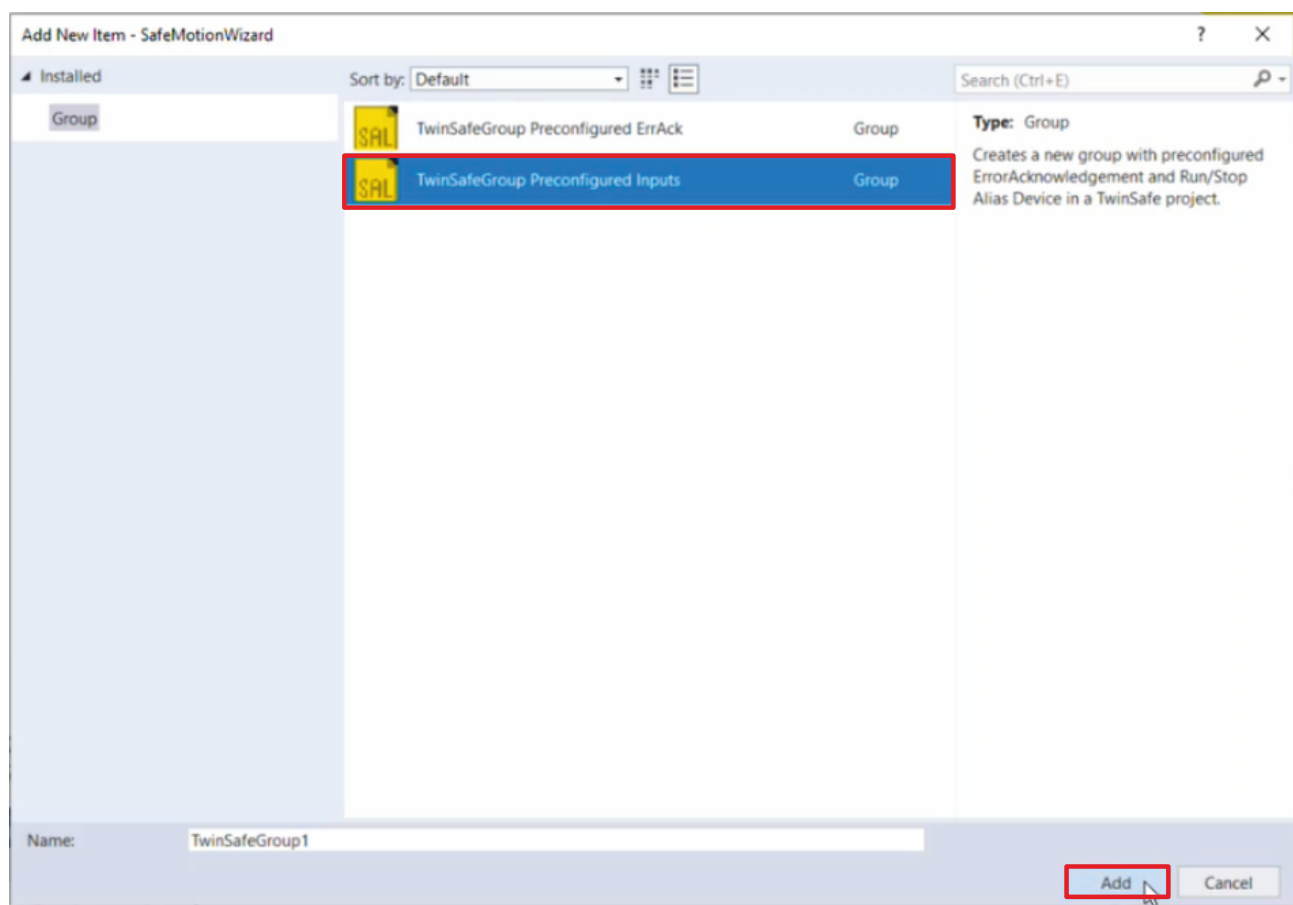
The SafeMotion Wizard project is generated with the selected safety functions.

The next step is to add the SLA functionality to the new project. To do this, proceed as follows:

1. Right-click on the SafeMotion Wizard project



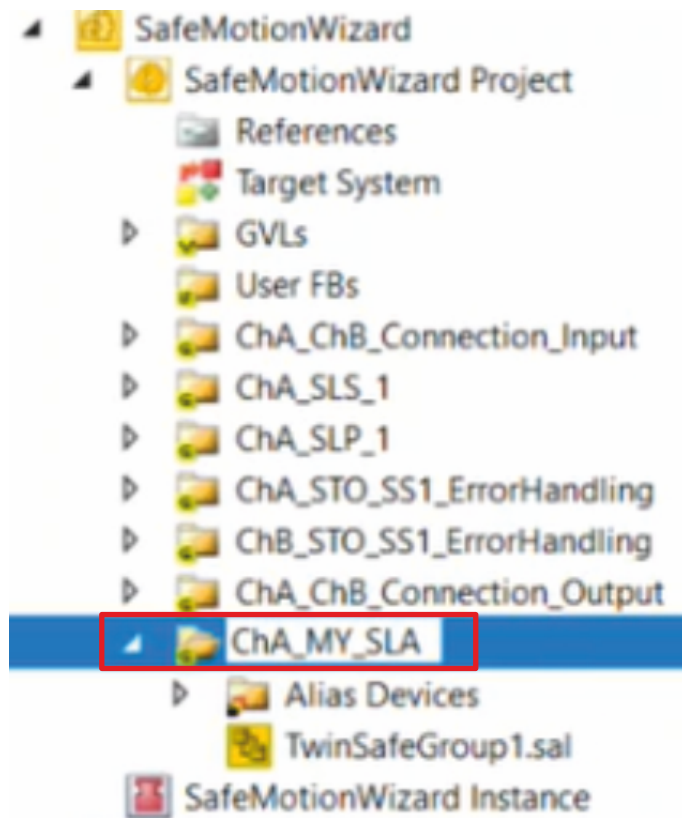
2. Click on "Add New Item" via the "Add" field



3. Select "TwinSafeGroup Preconfigured Inputs" to add a new TwinSAFE group

With the selection "TwinSafeGroup Preconfigured Inputs" the ErrorAck input and the Run input are already linked and a manual alias link is no longer necessary.

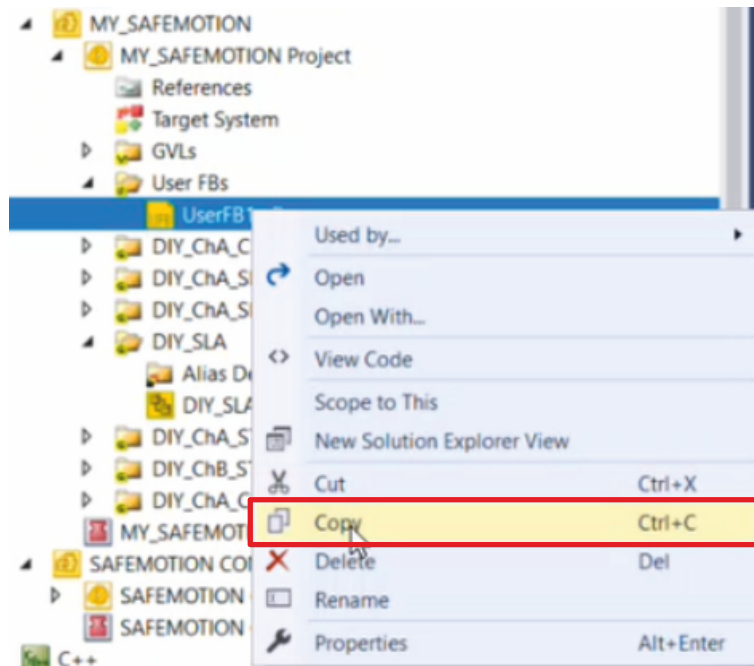
4. Confirm the selection with "Add"



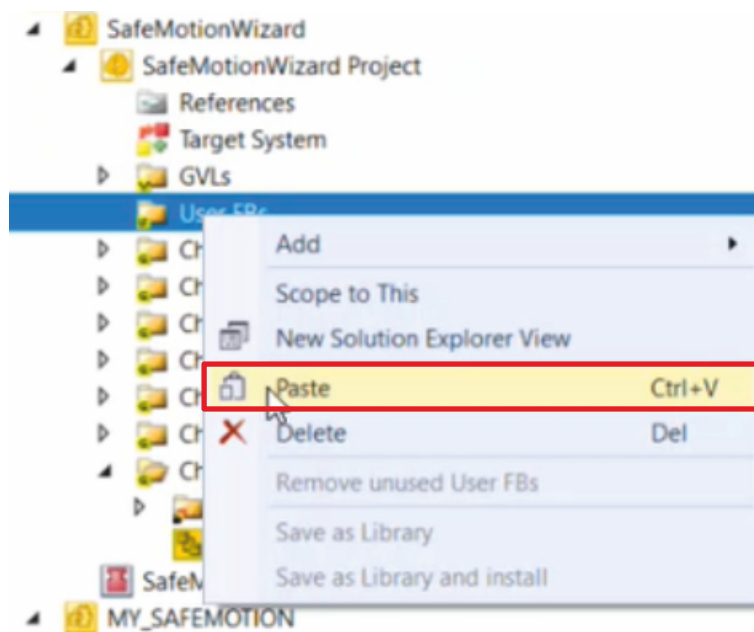
5. Rename the TwinSAFE group to "ChA_MY_SLA"

In the following, you add the created User FB. The procedure can be found in the next chapter.

2.5 Add User FB in your safety project

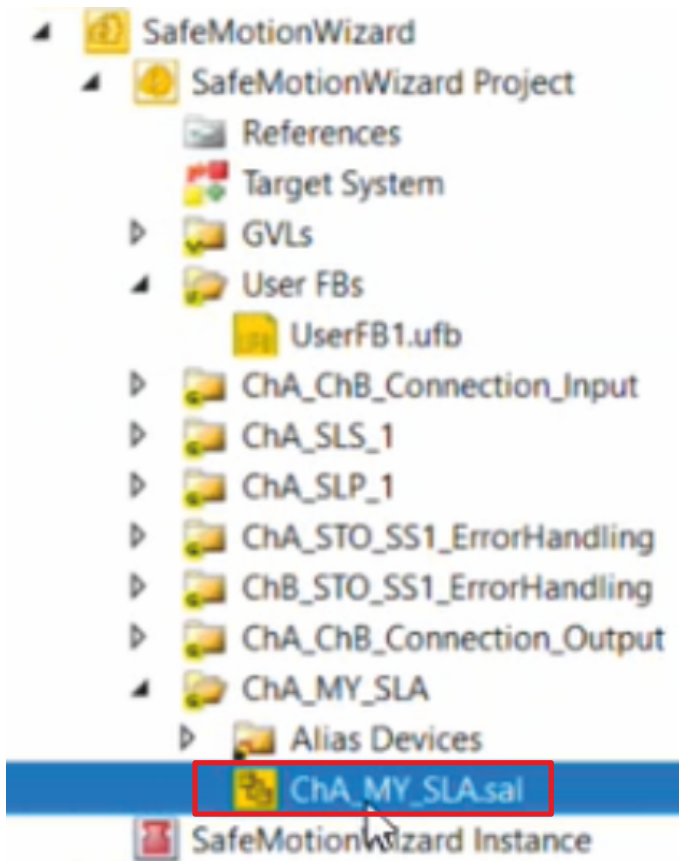


1. Right-click on the created User FB with SLA functionality
2. Click on "Copy"

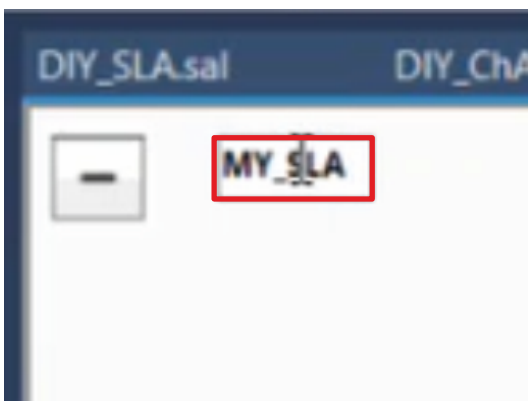


3. Right-click on User FB folder of the new SafeMotion Wizard project
4. Click on "Paste"

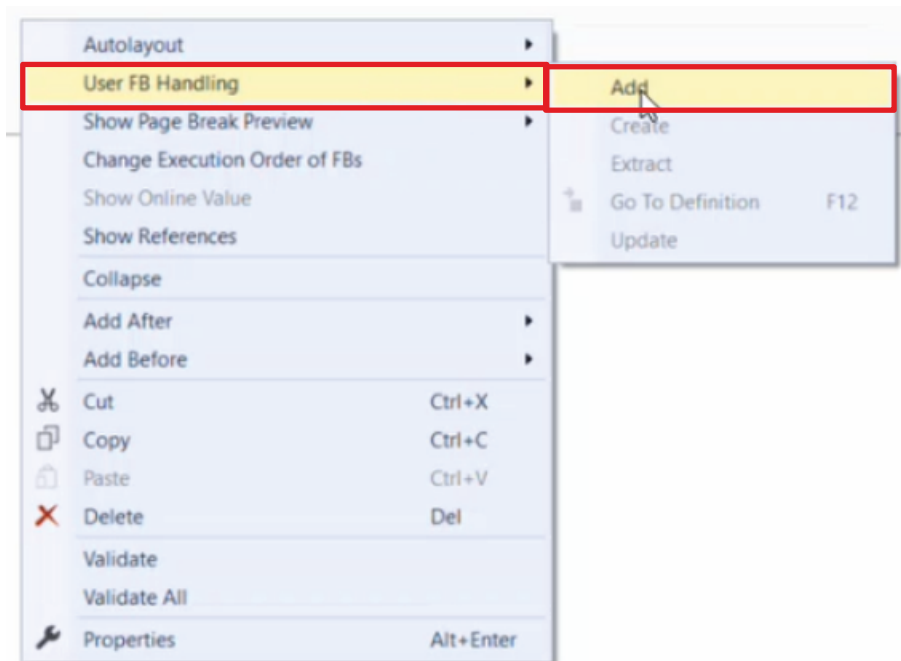
The User FB with SLA functionality is now available within the new SafeMotion Wizard project.



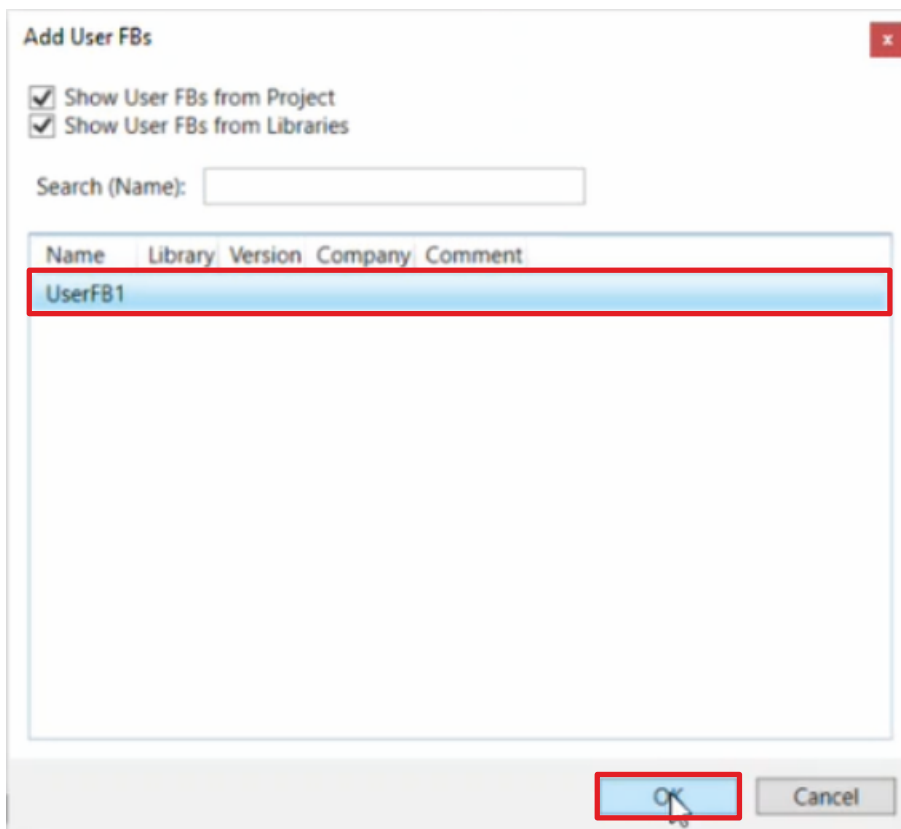
5. Open the new TwinSAFE group SLA



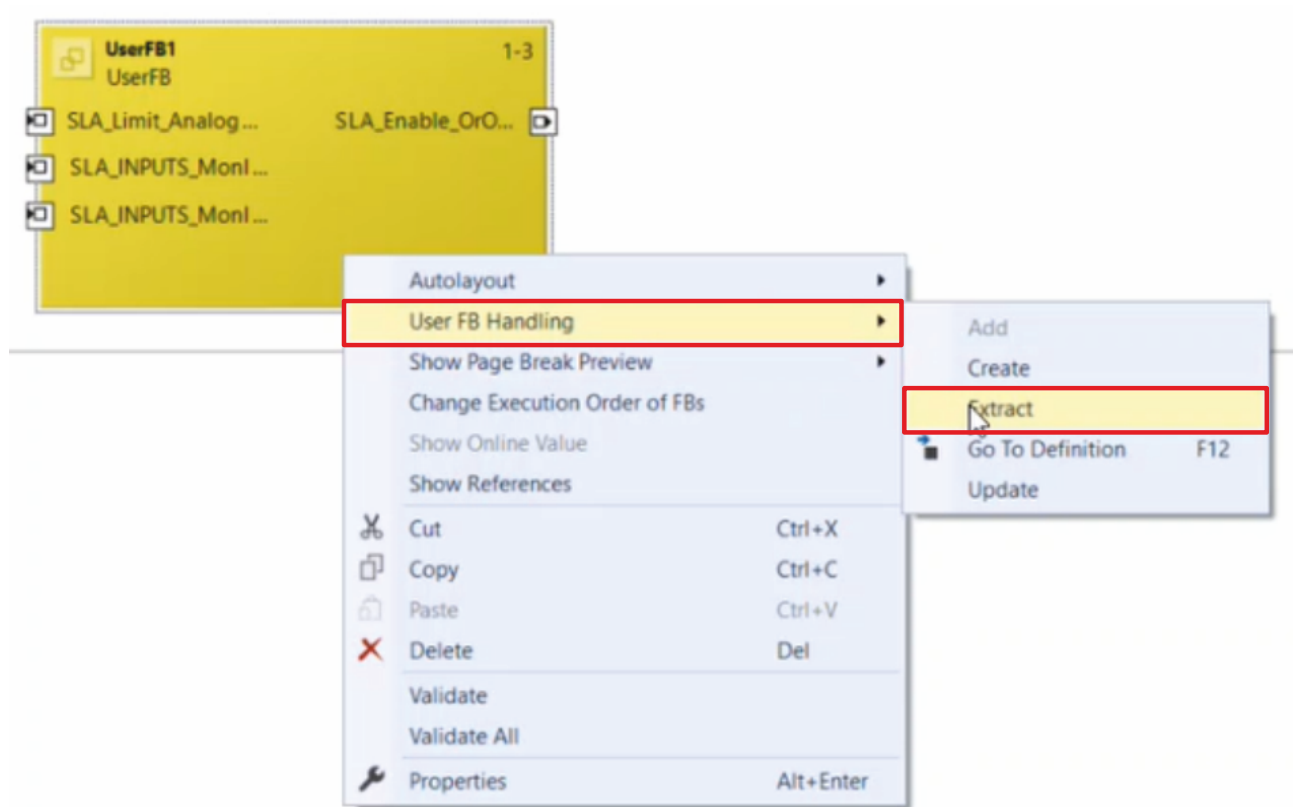
6. Rename the network



7. Right-click in the network
8. Click "Add" via the "User FB Handling" field



9. Select the created User FB in the "Add User FBs" window
10. Confirm selection with "OK"



11. Right-click on the User FB

12. Select "Extract" via the "User FB Handling" field to unpack the User FB

Now you have the same functionality without User FB as in your DIY Safe Motion project.

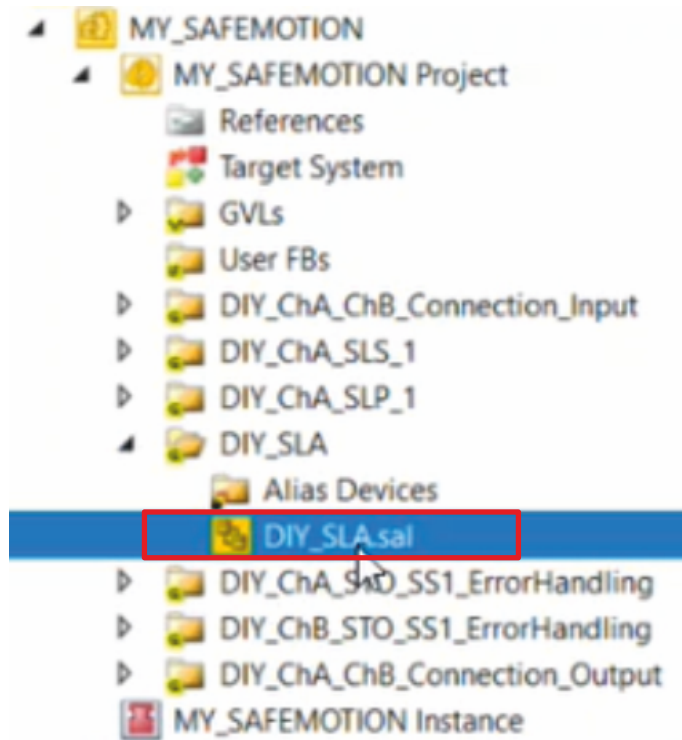
13. Click on "Save all" in the menu bar

In the following chapter you make the links of the unpacked User FB.

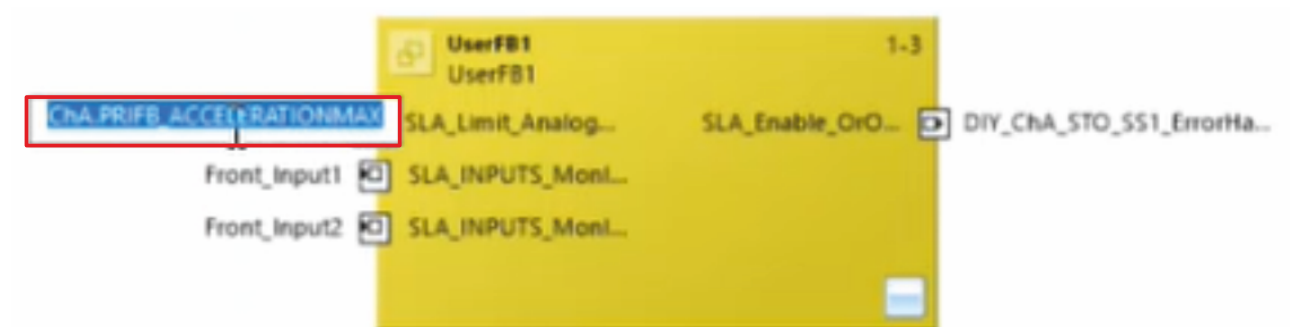
2.6 Link SLA

In this chapter you make the links of the unpacked User FB.

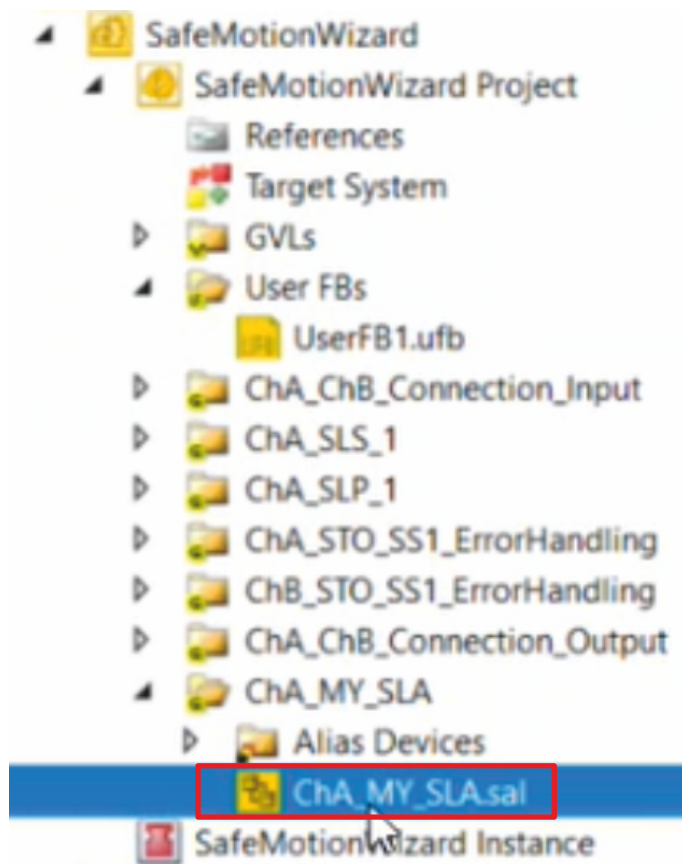
2.6.1 Take over variables



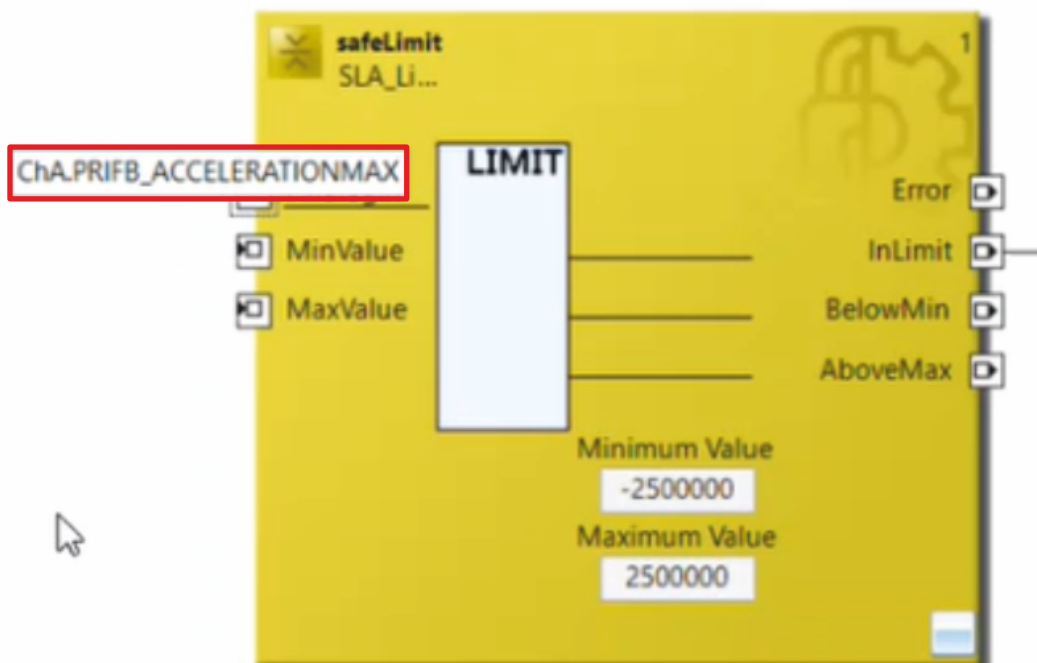
1. Open the file "DIY_SLA.sal"



2. Click on the local variable of the User FB so that the variable is selected
3. Type shortcut Ctrl + C to copy the variable



4. Open the file "ChA_MY_SLA.sal" of the new created SafeMotion Wizard project
5. Click left beside AnalogIn



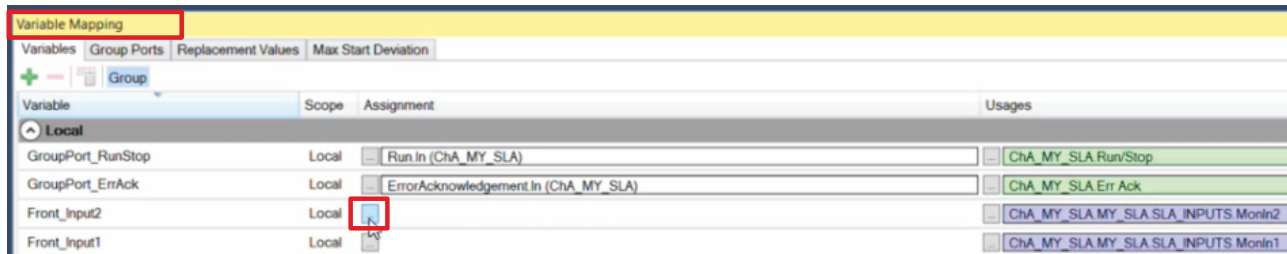
6. Paste the variable with Ctrl + V

2.6.2 Link inputs

Since the inputs Front_Input1 and Front_Input2 are new inputs, error messages appear for this. In the next step you make the link of these new inputs.

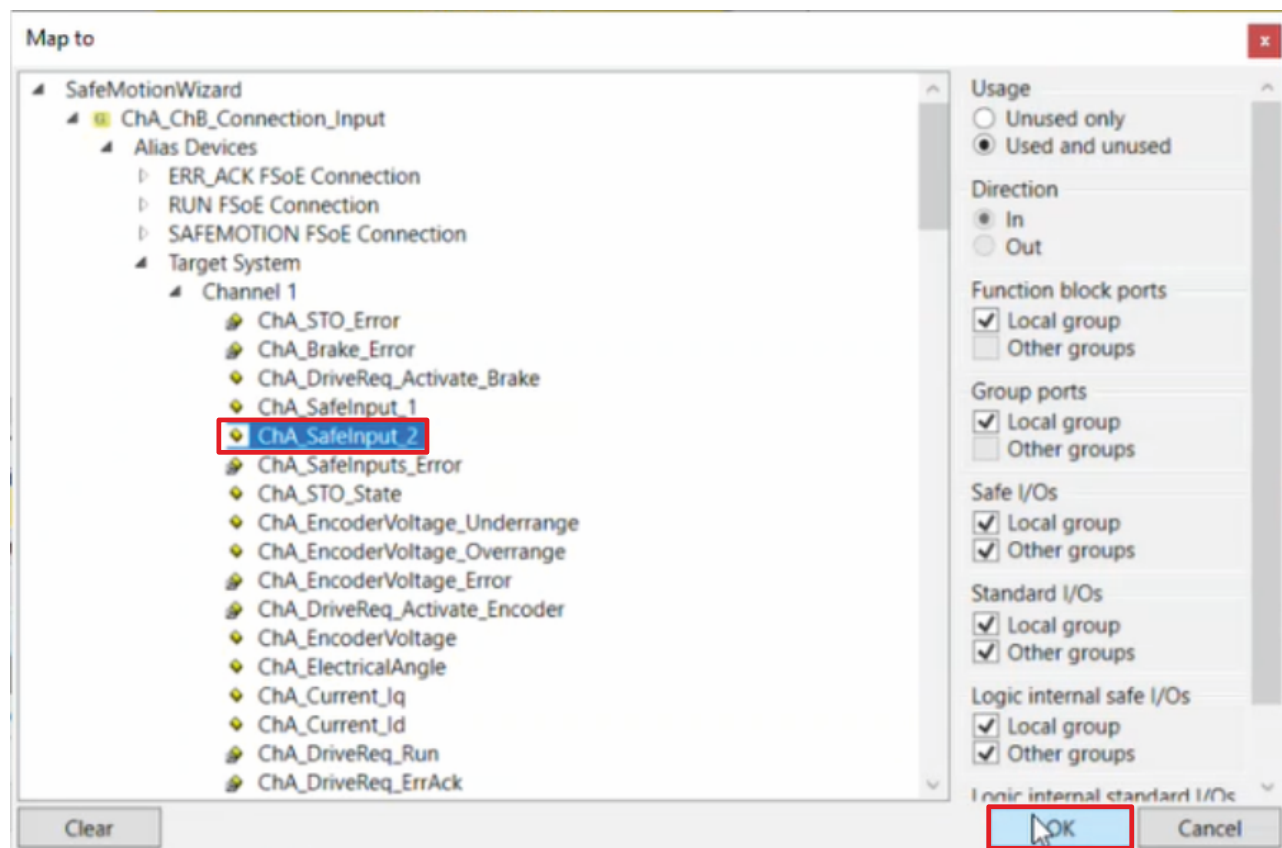
1. Open the tab "Variable Mapping" in the file "ChA_MY_SLA.sal"

In the "Variable Mapping" tab, link the individual signals and parameters. The procedure is identical for all parameters and is shown here as an example using the screenshots for one parameter.



2. Click the "..." button for the desired parameter

Select the target system in the "Map to" window. The target systems are listed in the folder "ChA_ChB_Connection_Input" under "Alias Devices" and "Target System".

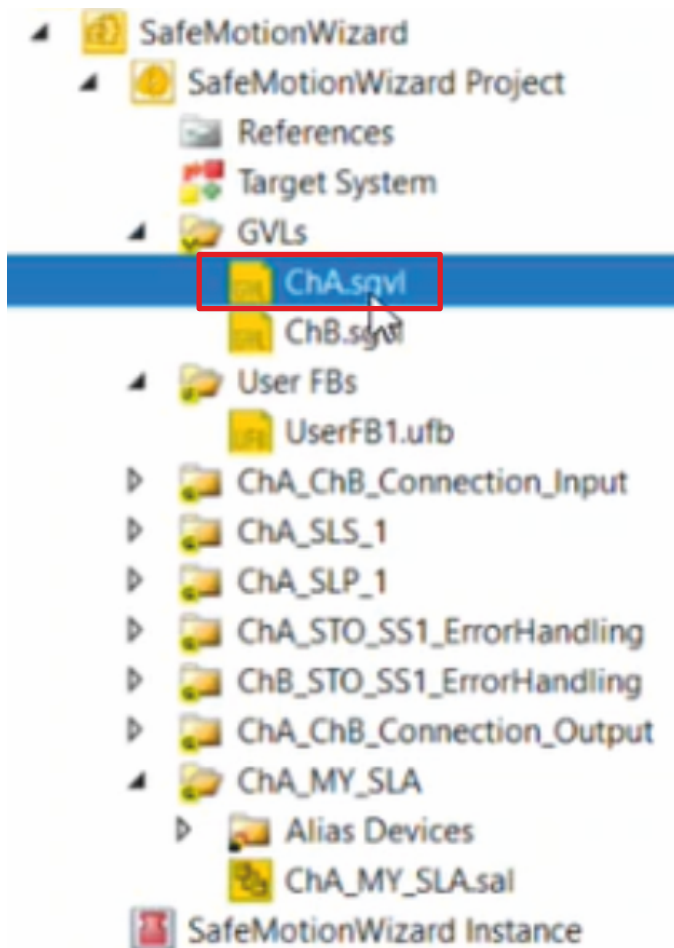


3. Select the signal
4. Confirm selection with "OK"

Go through steps 1-3 for parameters Front_Input1 and Front_Input2. Target systems according to the table.

5. Click "Save all" in the menu bar

Next, link the PRIFB_ACCELERATIONMAX parameter.



6. To do this, open the file "ChA.sgv1" in the GVLs folder to display the variable list for this channel
7. Go through steps 1-3 for the PRIFB_ACCELERATIONMAX parameter. Target system according to the table.

The following links result:

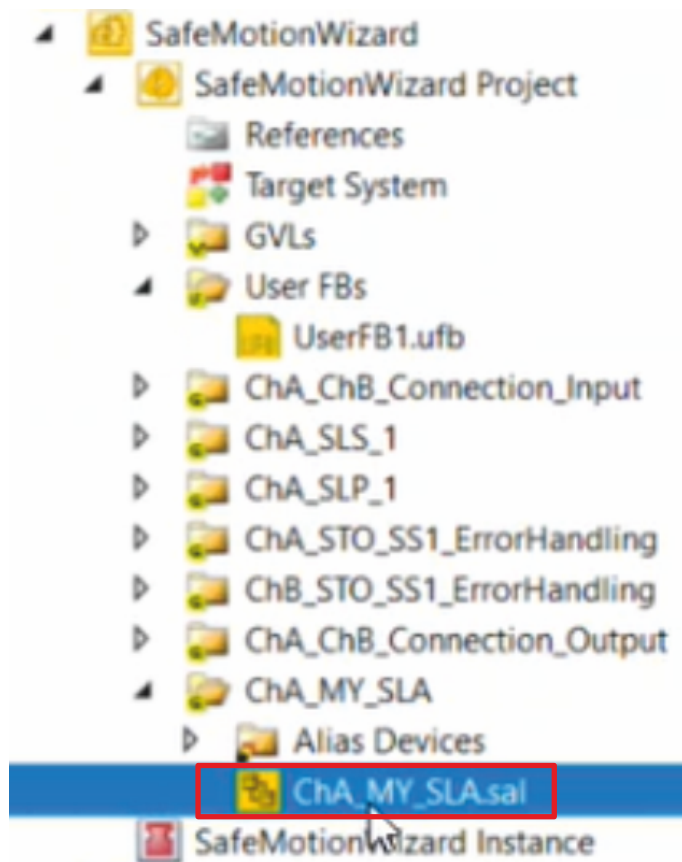
Parameter	Signal
Front_Input2	ChA_SafeInput_2
Front_Input2	ChA_SafeInput_1
PRIFB_ACCELERATIONMAX	ChA_PriFb_Acceleration_Maximum

8. Click on "Save all" in the menu bar to save the settings

Now all inputs and outputs of the SLA functionality are linked.

2.6.3 Link ErrorAck and RunStop

As the last step of the linking the ErrorAck and RunStop inputs of the new TwinSAFE group must be forwarded accordingly. To do this, proceed as follows:



1. Open the "ChA_MY_SLA.sal" file

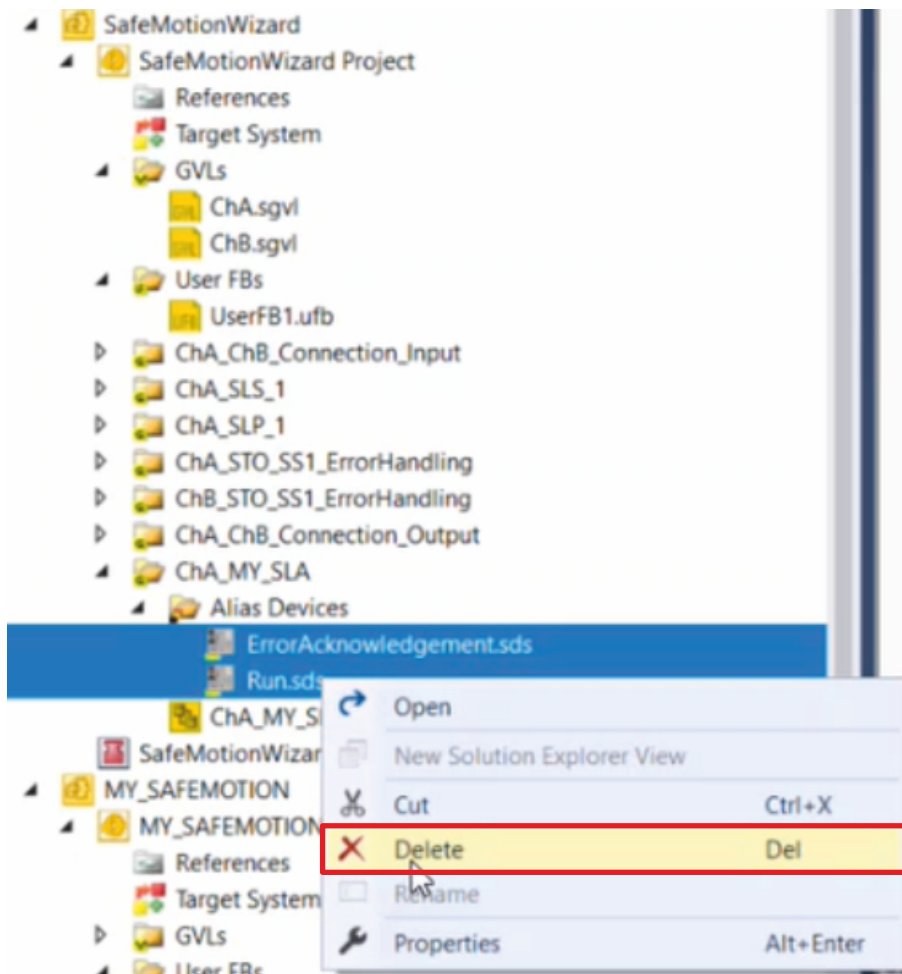
In the "Variable Mapping" tab, link the variables.

2. Go through steps 1-3 of the chapter [Link inputs \[25 \]](#) for the parameters GroupPort_RunStop and GroupPort_ErrAck

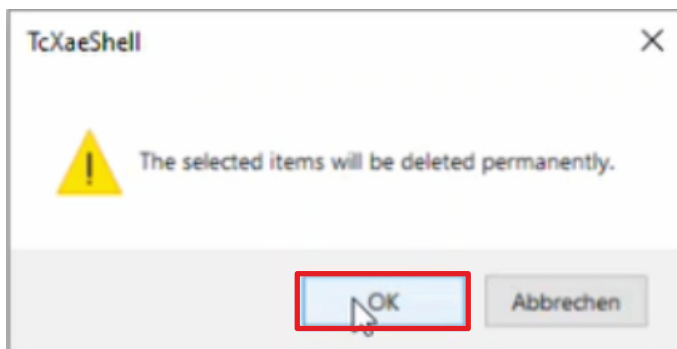
The following links result:

Parameter	Signal
GroupPort_RunStop	ChA_DriveReq_Run
GroupPort_ErrAck	ChA_DriveReq_ErrAck

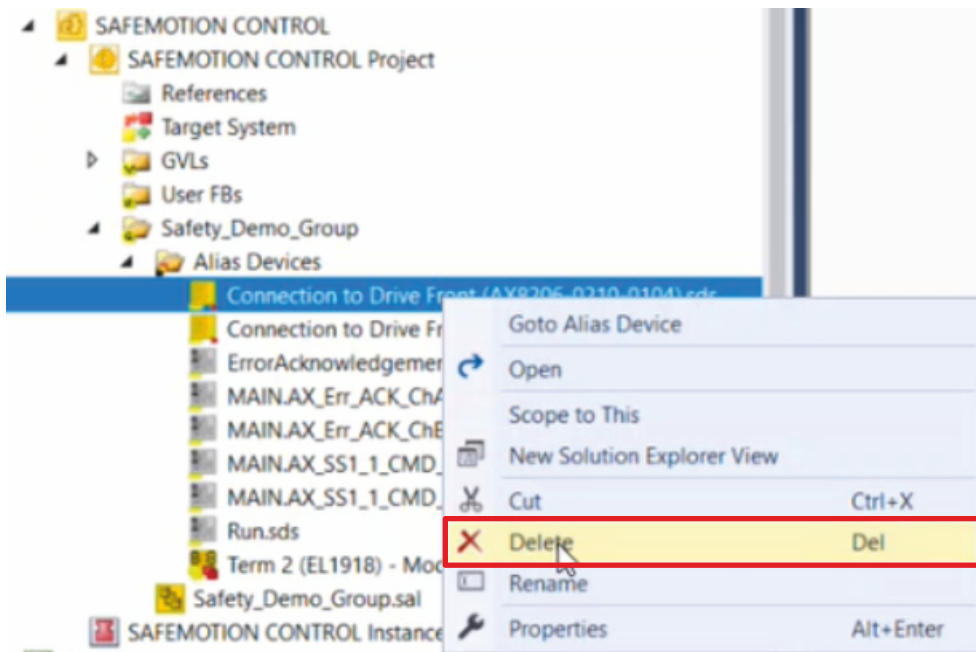
2.6.4 Delete Alias Devices



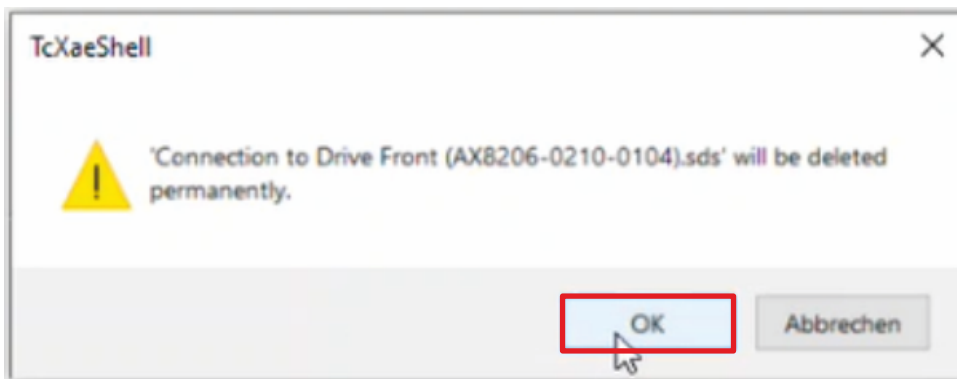
1. Select the Alias Devices in the "Alias Devices" folder of the new TwinSAFE group
2. Right-click to open the context menu
3. Click "Delete"



4. Confirm the window with "OK"
5. Click "Save all" in the menu bar to save the settings



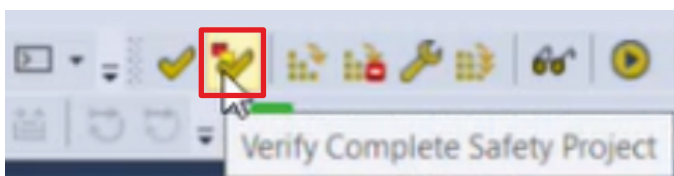
6. In the Safe Motion project, select the Alias Device that is linked to the EL6910
7. Right-click to open the context menu
8. Click on "Delete"



9. Confirm the window with "OK"

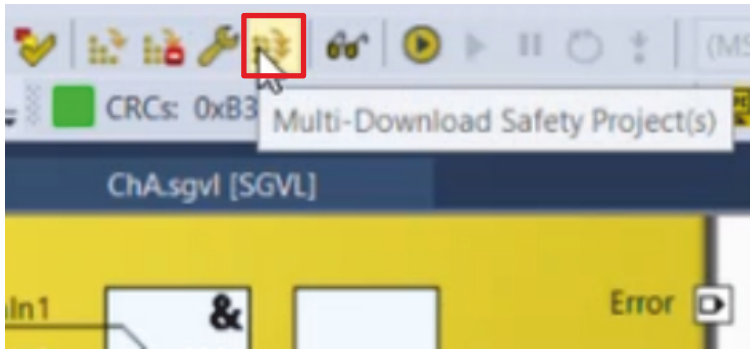
The EL6910 now communicates only with your new SafeMotion Wizard project and no longer with your old DIY Safe Motion project.

The implementation of your new SafeMotion Wizard project is now complete.

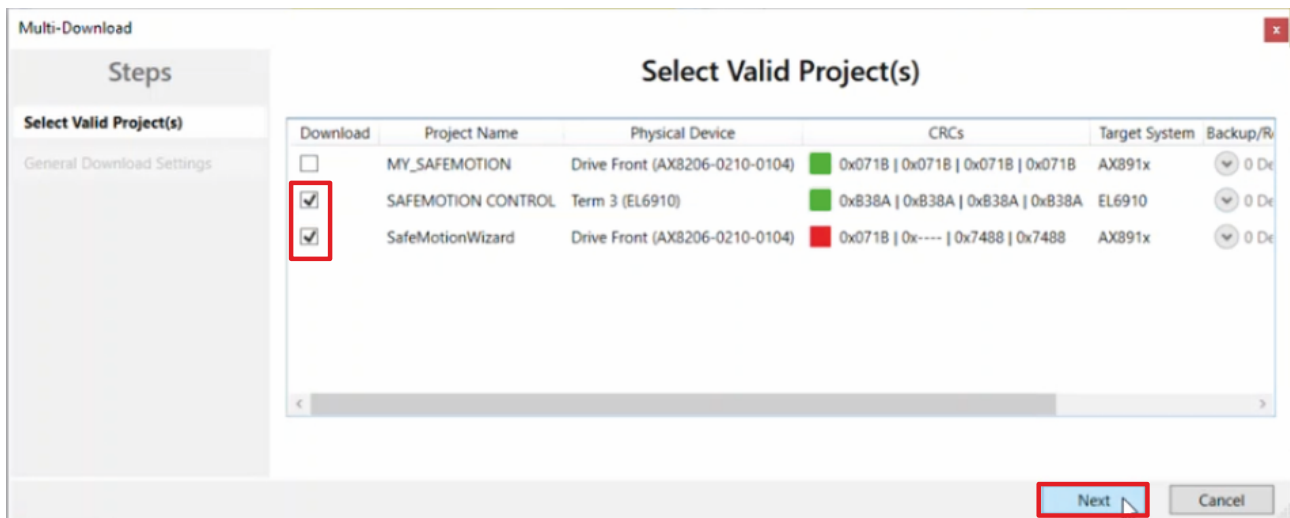


10. Click the function "Verify Complete Safety Project" in the menu bar to verify the SafeMotion Wizard project

2.7 Download safety projects



1. Click on "Multi-Download Safety Project(s)"



The "Select Valid Project(s)" window opens. Here you can see which safety projects you can download.

2. Select the safety projects that you want to download
3. Confirm the selection with "Next"

Multi-Download

Steps

Select Valid Project(s)

General Download Settings

Complete Download

Download complete project data with default group customization settings (customization is possible after the download) and use these login credentials for each project:

Username: Administrator

Password: *****

Please verify the Serial Number of each project:

Verified	Project Name	Physical Device	Serial Number	Target System	Backup/Restore masters	Backup/Restore
<input checked="" type="checkbox"/>	SAFEMOTION CONTROL	Term 3 (EL6910)	99999	EL6910	0 Dependencies	0 Depend
<input checked="" type="checkbox"/>	SafeMotionWizard	Drive Front (AX8206-0210-0104)	2287874	AX891x	0 Dependencies	0 Depend

Back Next Cancel

4. Enter the username and password in the "General Download Settings" window

Default username: Administrator

Default password: TwinSAFE

5. Select the safety projects you want to download

6. Confirm the selection with "Next"

The safety project for your Safe Motion component is now converted into the appropriate form and transferred to your Safe Motion component.

Multi-Download

Steps

Select Valid Project(s)

General Download Settings

Final Verification

Activation

Multi-Download Result

Project Name	Physical Device	Download Result				Target Sy E ^
SAFEMOTION CONTROL	Term 3 (EL6910)	Configured Datasets	Online CRC	Offline CRC	Verification Result	EL6910
		Safe Logic Data	0xEA56	0xEA56	✓	
		Mapping Data	0xE792	0xE792	✓	
		Parameter Data	0xAB29	0xAB29	✓	
SafeMotionWizard	Drive Front (AX8206-0210-0104)	Configured Datasets	Online CRC	Offline CRC	Verification Result	AX891x
		Safe Logic Data	0xCF42	0xCF42	✓	
		Mapping Data	0x9F2F	0x9F2F	✓	

☒ I have manually verified the data shown here and I am aware, that the correct functionality must be tested manually

Next Cancel

7. Check the CRCs in the "Final Verification" window

8. If the CRCs match, click on the box to confirm the verification

9. Confirm the window with "Next"

Multi-Download

Steps

- Select Valid Project(s)
- General Download Settings
- Final Verification
- Activation**
- Multi-Download Result

Activation

Login Credentials

Username: Administrator

Password:

Activate	Project Name	Physical Device	Target System	Backup/Restore masters	Backup/Restore slaves
<input checked="" type="checkbox"/>	SAFEMOTION CONTROL	Term 3 (EL6910)	EL6910	0 Dependencies	0 Dependencies
<input checked="" type="checkbox"/>	SafeMotionWizard	Drive Front (AX8206-0210-0104)	AX891x	0 Dependencies	0 Dependencies

Next Cancel

The "Activation" window opens, in which you activate the safety projects.

10. Enter the default password

11. Check if the right safety projects are selected

12. Confirm the selection with "Next"

Multi-Download

Steps

- Select Valid Project(s)
- General Download Settings
- Final Verification
- Activation
- Multi-Download Result**

Multi-Download Result

Activated	Downloaded	Project Name	Physical Device	Target System	Backup/Restore Settings	Backup/Restore n
✓	✓	SAFEMOTION CONTROL	Term 3 (EL6910)	EL6910	✓	0 Depend
✓	✓	SafeMotionWizard	Drive Front (AX8206-0210-0104)	AX891x	✓	0 Depend

Finish Cancel

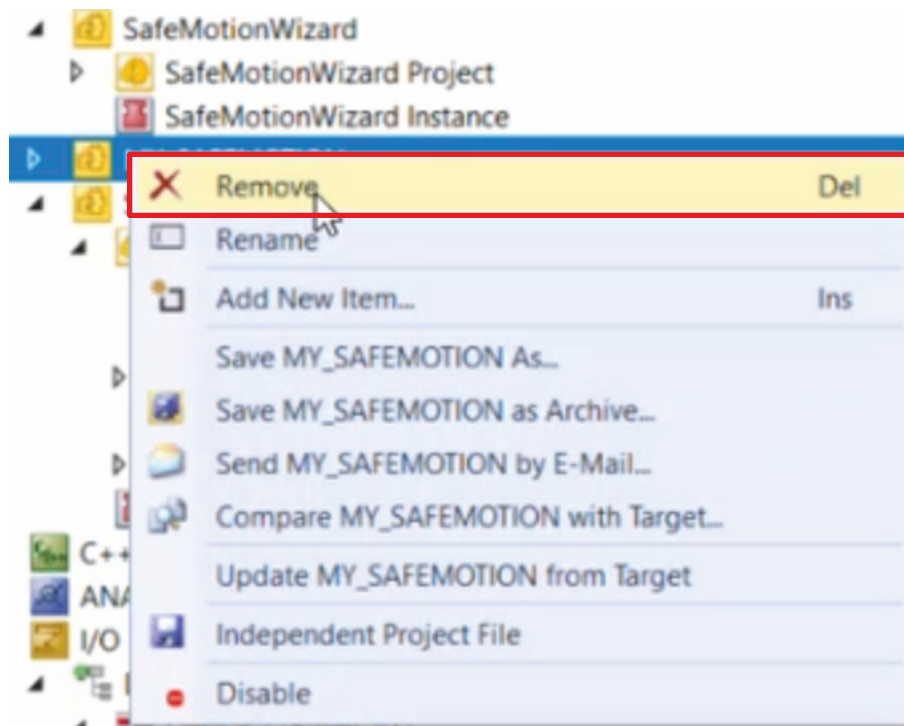
13. Close the window "Multi-Download Result" with "Finish"

The first commissioning of the desired functionality on your Safe Motion component is now complete.

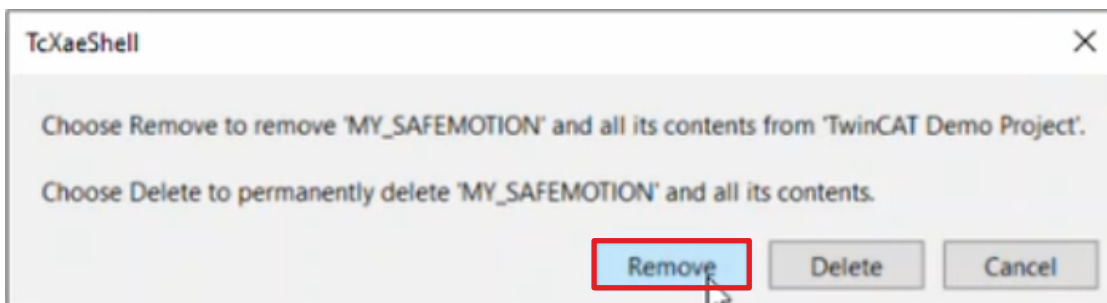
2.8 Remove DIY Safe Motion project

The next step is to remove your DIY Safe Motion project.

To do this, proceed as follows:



1. Right-click on DIY-Safe-Motion project
2. Click "Remove"

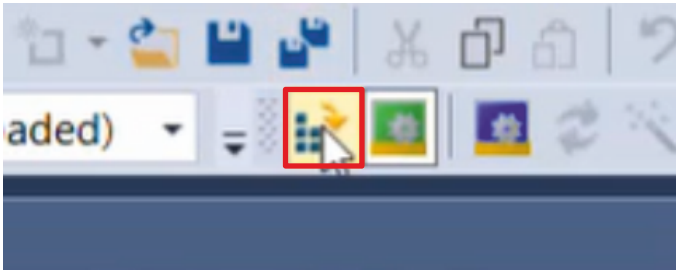


3. Confirm window with "Remove"
4. Click "Save all" in the menu bar to save the removal of the project

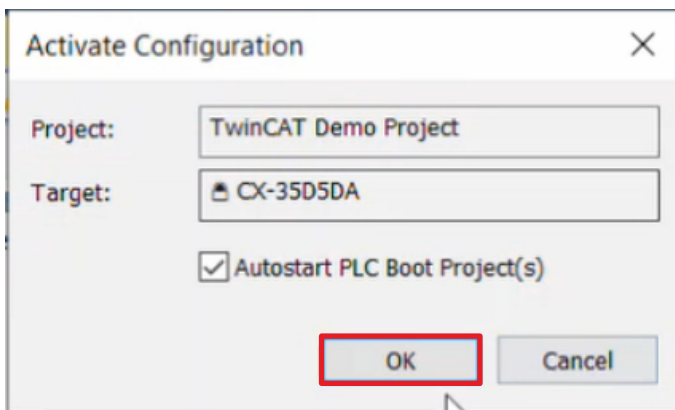
You have now completed the conversion. In the next chapter you will activate the configuration.

2.9 Activate configuration

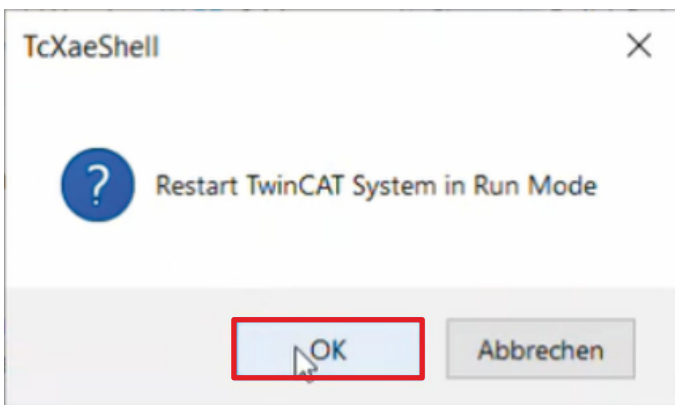
Since the process images of the Safe Motion component and the EL6910 have been changed, it is necessary to reactivate the configuration. To do this, proceed as follows:



1. Click on "Activate Configuration" in the menu bar



2. Confirm the "Activate Configuration" window with "OK"

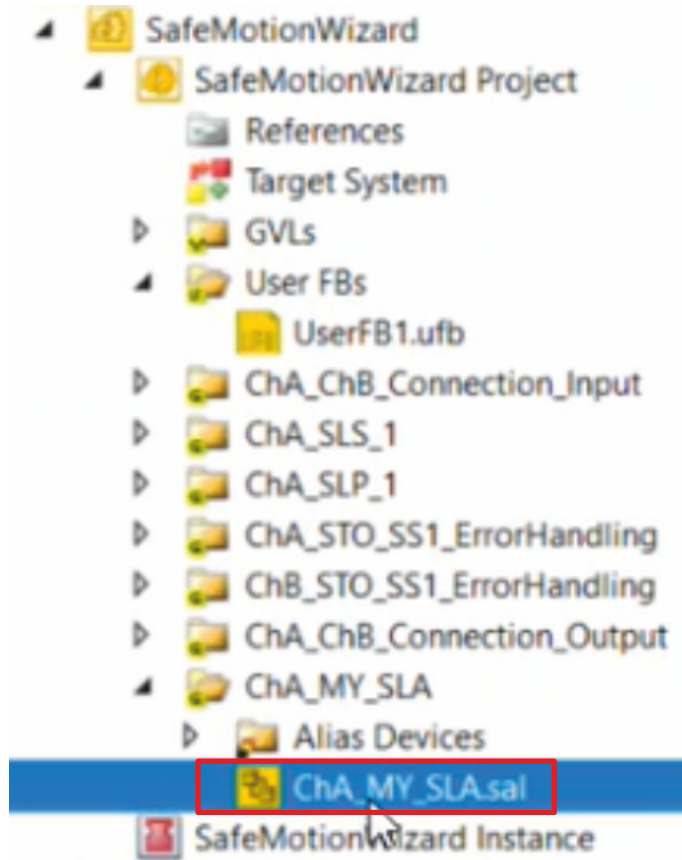


3. Confirm the "Restart TwinCAT System in Run Mode" window with "OK"

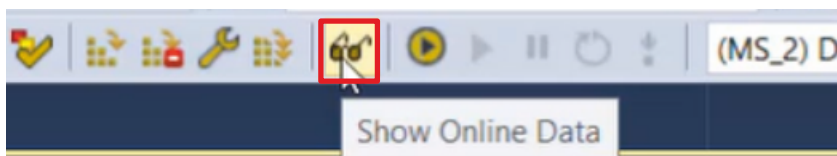
2.10 Check application

In the following, you will check the signals and links of your application.

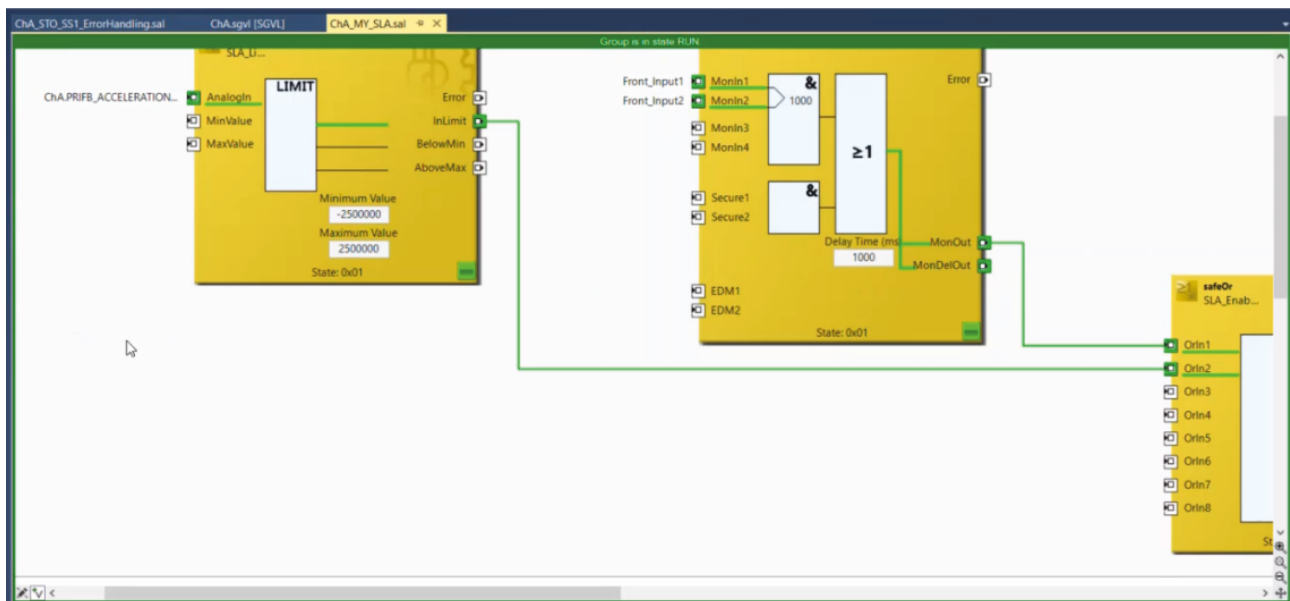
2.10.1 Check signals



1. Open the sal file of your SLA functionality

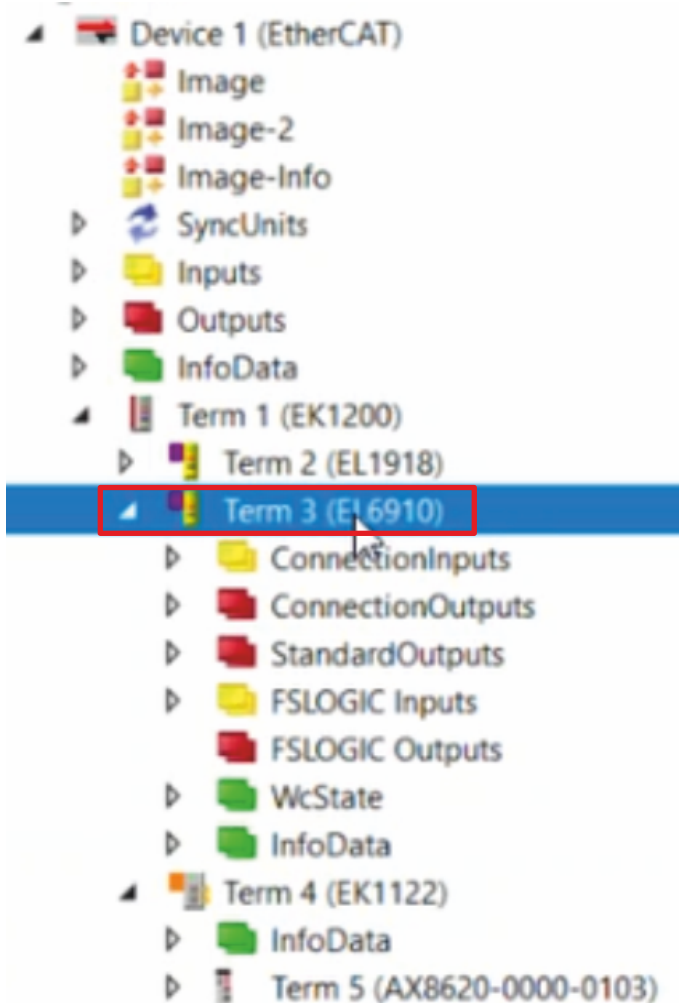


2. Click on "Show Online Data" in the menu bar to activate the online view



Here you can see that all signals arrive correctly.

2.10.2 Check links



1. Open the EL6910 in I/O configuration

Name	Online	Type	Size	>Addr...	In/Out	User ID	Linked to
Message_4 TxPDO X	36 00 BF BF 04 00	Safety.FSOE...	6.0	1571.0	Input	0	MAIN.FROM_EL6910, FSOE
Message_59 TxP... X	36 03 11 B2 BE 03 00 CF 92 03 00	FSOE_11	11.0	1577.0	Input	0	Message_1 . FSoE Slave ...
Safe Logic State	1	USINT	1.0	1588.0	Input	0	
Cycle Counter	77	USINT	1.0	1589.0	Input	0	
WcState	0	BIT	0.1	3058.0	Input	0	
InputToggle	0	BIT	0.1	3060.0	Input	0	
State	8	UINT	2.0	3094.0	Input	0	
AdsAddr	5.53.213.218.2.1:1002	AMSADDR	8.0	3096.0	Input	0	
Message_4 RxPDO X	36 50 14 68 90 04 00	FSOE_7	7.0	1571.0	Output	0	FSOE . FSoE Inputs . Mod...
Message_59 RxP... X	36 81 00 00 0E 81 00 07 8A 03 00	FSOE_11	11.0	1578.0	Output	0	Message_1 . FSoE Slave ...
Standard In Var 1 X	1	BIT	0.1	1589.0	Output	0	MAIN.TS_Run . PicTask O...
Standard In Var 2 X	1	BIT	0.1	1590.0	Output	0	MAIN.TS_Run . PicTask O...

Here you can see that the connection between the EL6910 project and the SafeMotion Wizard project with your Safe Motion component works as configured.

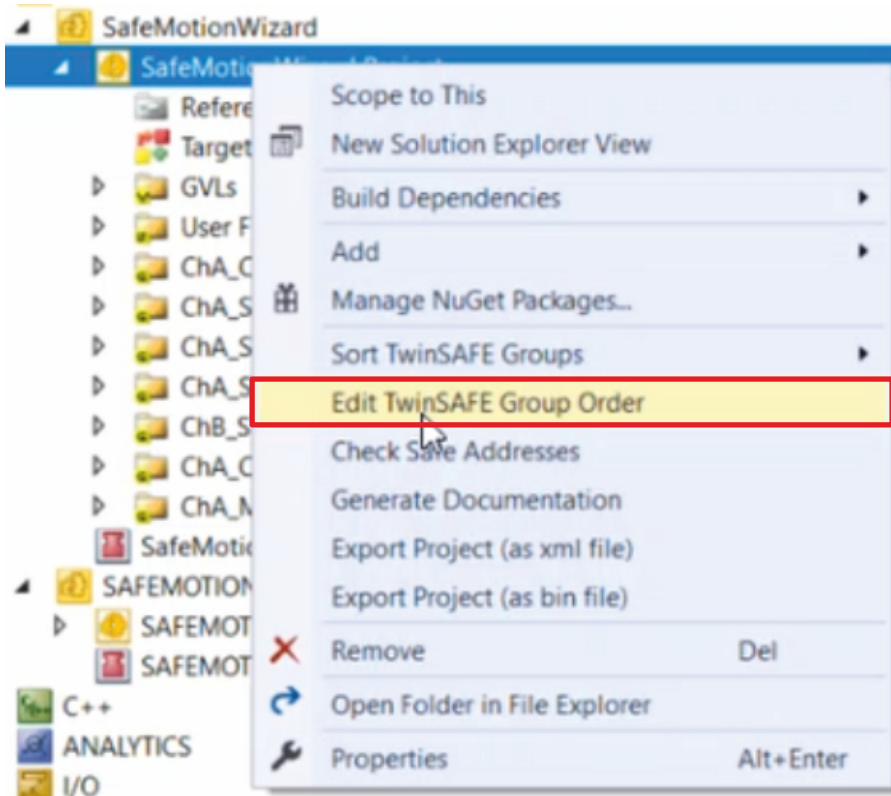
2. Click in the menu bar on "Save all"

2.11 Changing the order of the TwinSAFE groups

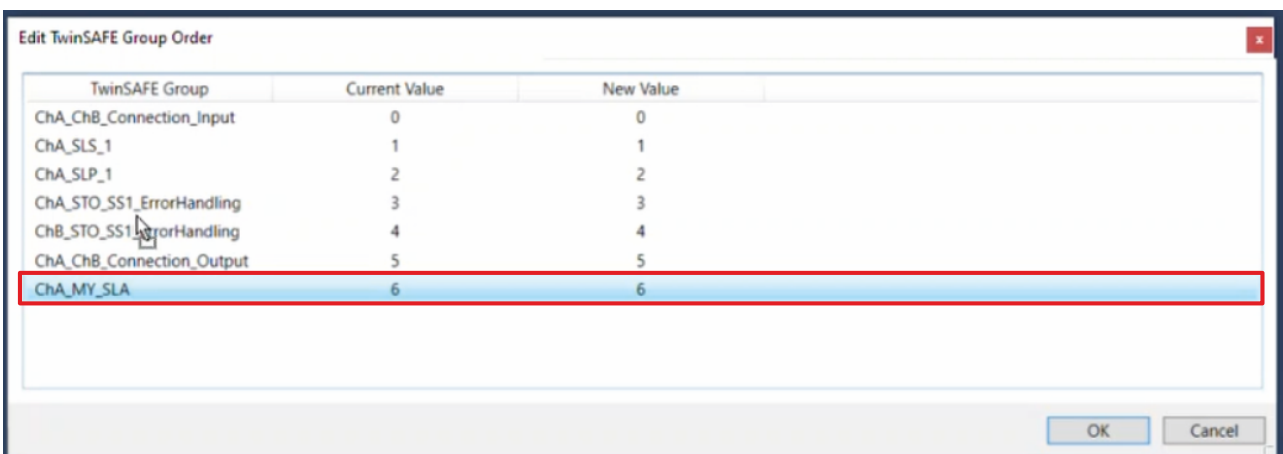
The TwinSAFE groups are displayed in the order in which they are executed. The SafeMotion Wizard generates the TwinSAFE groups accordingly.

Since the SLA functionality was not generated via the SafeMotion Wizard, this function is listed last and not with the other SLS and SLP safety functions.

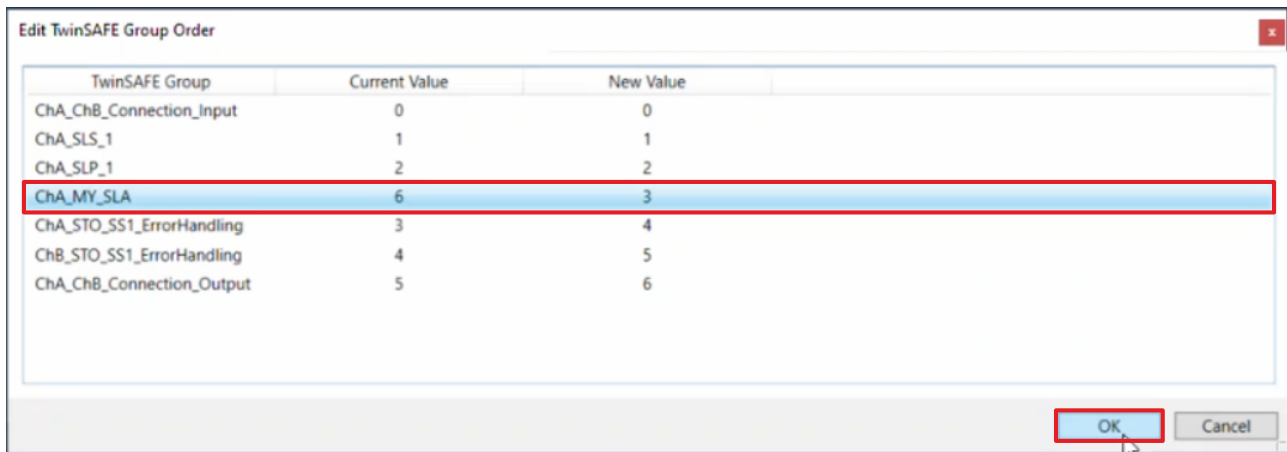
You change the order of the TwinSAFE groups as follows:



1. Right-click on the SafeMotion Wizard project
2. Click on "Edit TwinSAFE Group Order"



In the "Edit TwinSAFE Group Order" window you can see a comparison of the current order values of the TwinSAFE groups with the new order values.



3. Click on the SLA functionality and drag it to the position after SLP with the mouse button held down
4. Confirm the selection with "OK"

The SLA functionality is now executed after the SLP functionality and is arranged accordingly.

Now the SafeMotion Wizard project corresponds to a project completely generated by the SafeMotion Wizard with the functionality within "Connection_Input" and "ErrorHandling".

3 Recommendations in case of deviating procedure

3.1 The custom functionality is distributed

...over several networks

- Generate a User FB from a network.
- Add the remaining functionality via cut & paste.

...over several groups

- Generate a User FB from a network.
- Add the remaining functionality via cut & paste.

3.2 Different Alias Devices are used

...than an AX8000

- Transfer the Alias Devices manually.

3.3 The functionality is realized in a complete TwinSAFE group

- Use the User FB procedure as described in this tutorial.

In the current TwinCAT version TwinSAFE groups cannot be copied completely.

More Information:
www.beckhoff.com/twinsafe/

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