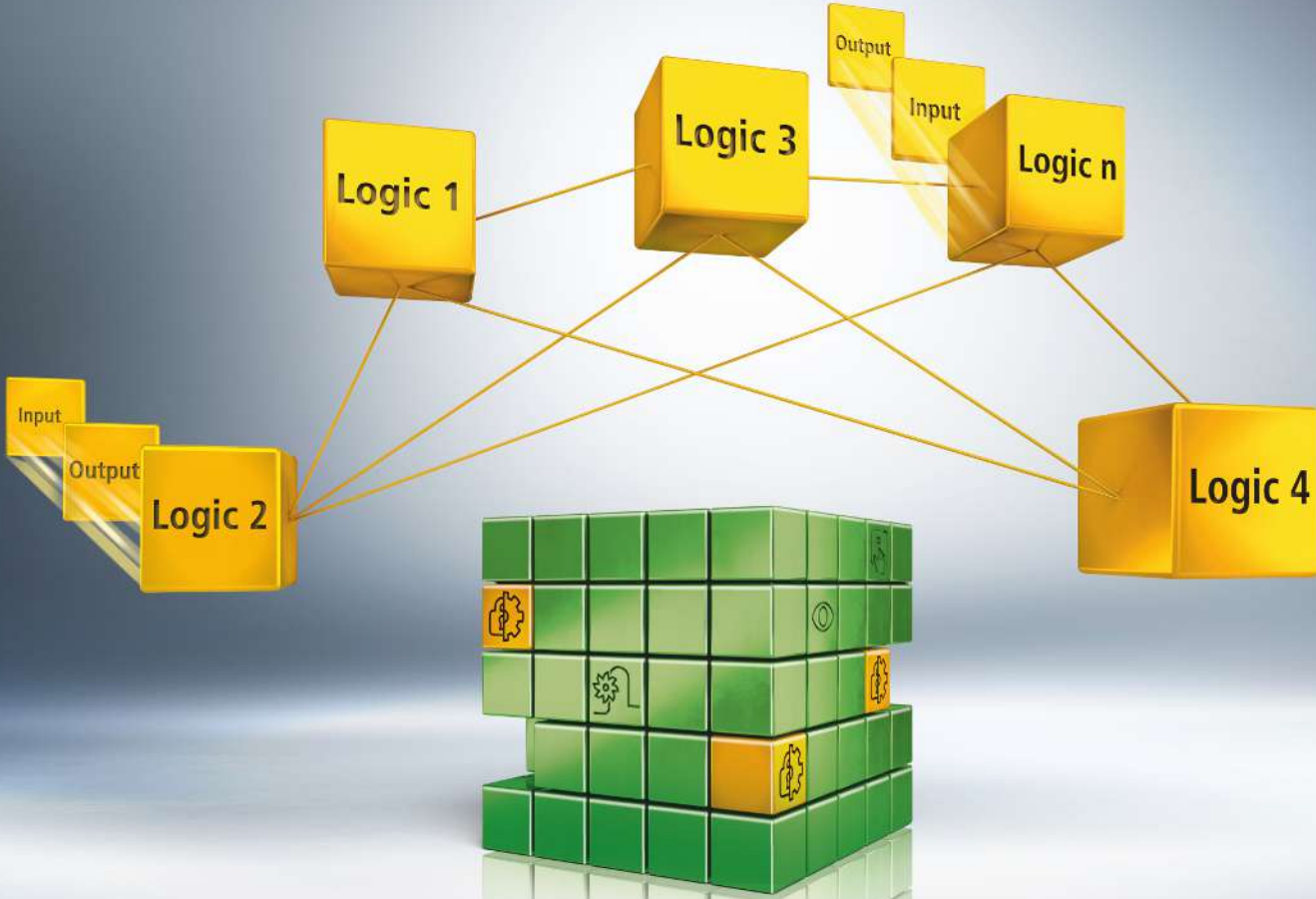


TwinSAFE Tutorial 3 | EN

SafeMotion Wizard

Safe Motion project with Safe Limited Position



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 3 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 the implementation and commissioning of a Safe Motion project with the Safe Limited Position (SLP) safety function.

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 \geq 03
- AX8000 firmware \geq 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.

1.4 Demo system

1.4.1 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

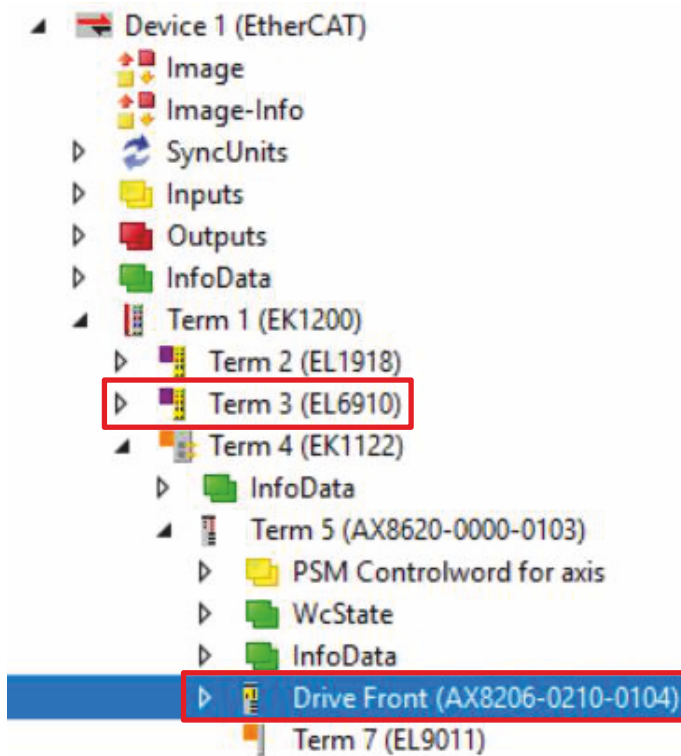
1.4.2 Desired safety functionality

This tutorial describes the realization of the following safety functionalities:

- EL6910 triggers SLP on the Safe Motion component.
- A position violation triggers STO.

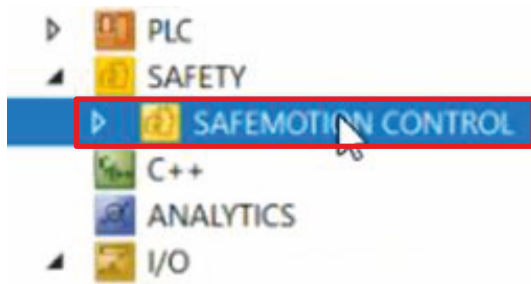
2 Demonstration

2.1 Download Safe Motion project

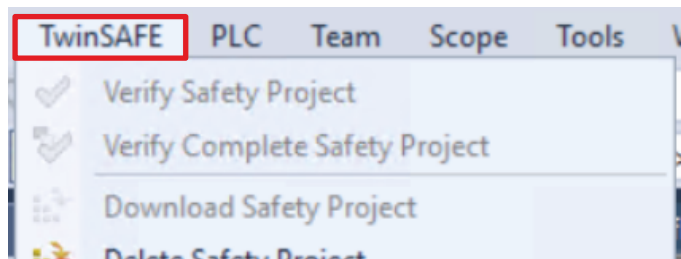


Starting point of the tutorial is an existing TwinCAT3 project with an existing I/O configuration and the corresponding Safe Motion entries.

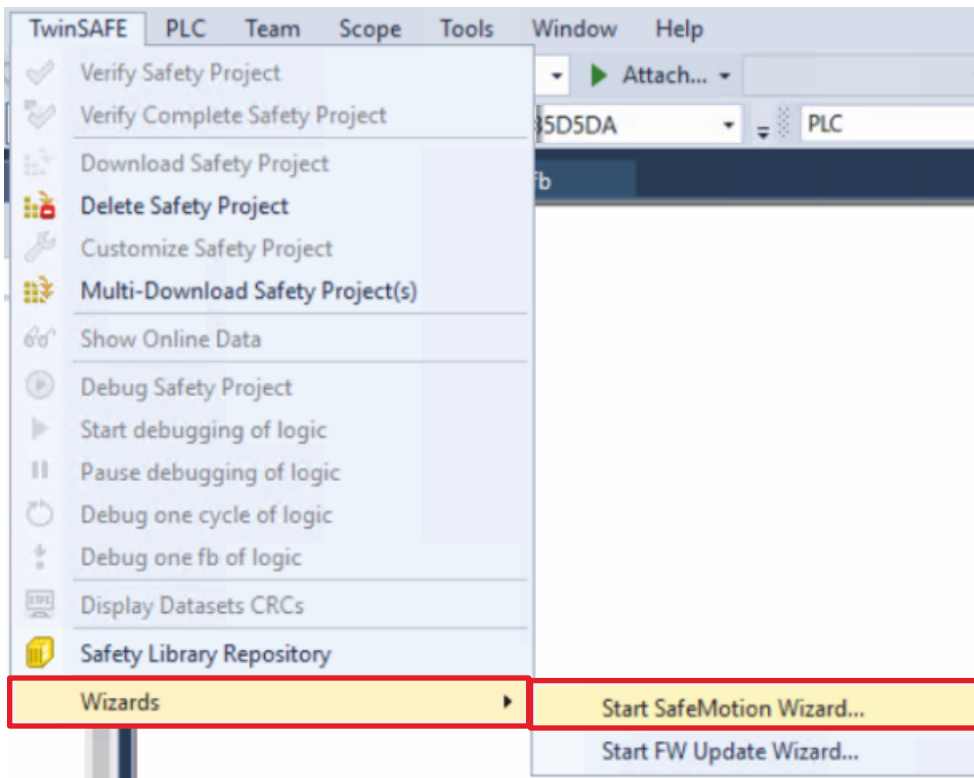
Proceed as follows to create a Safe Motion project with the SafeMotion Wizard:



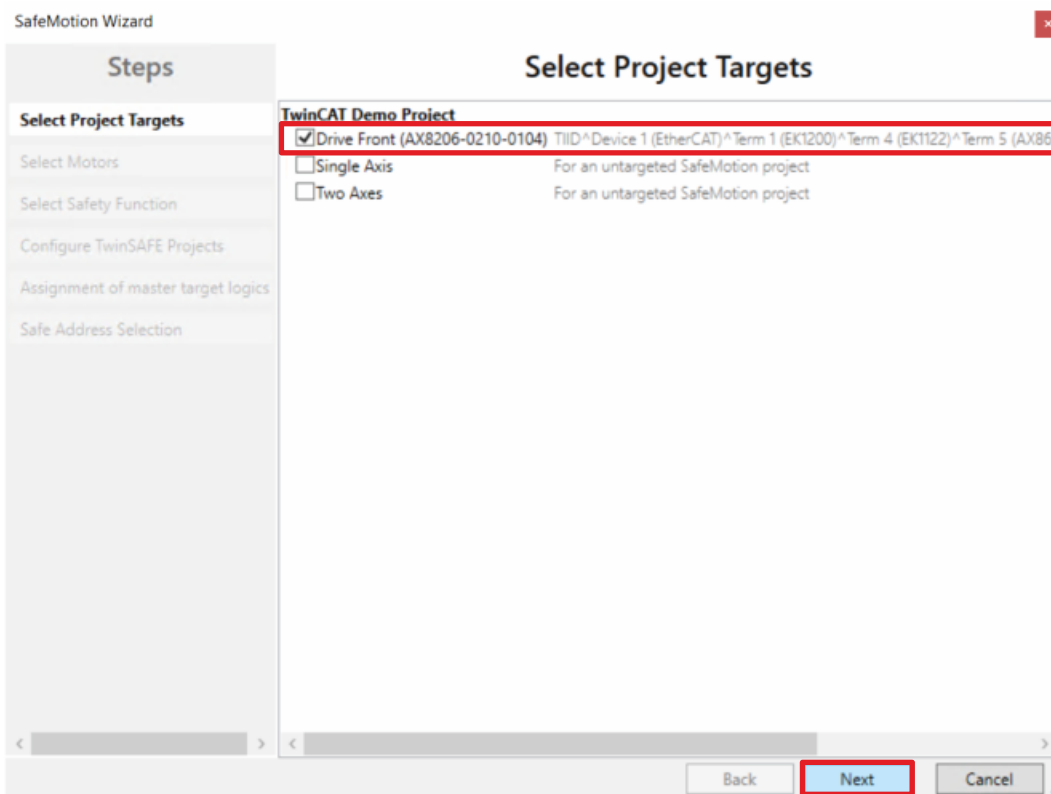
1. Select safety project



2. Select the "TwinSAFE" tab

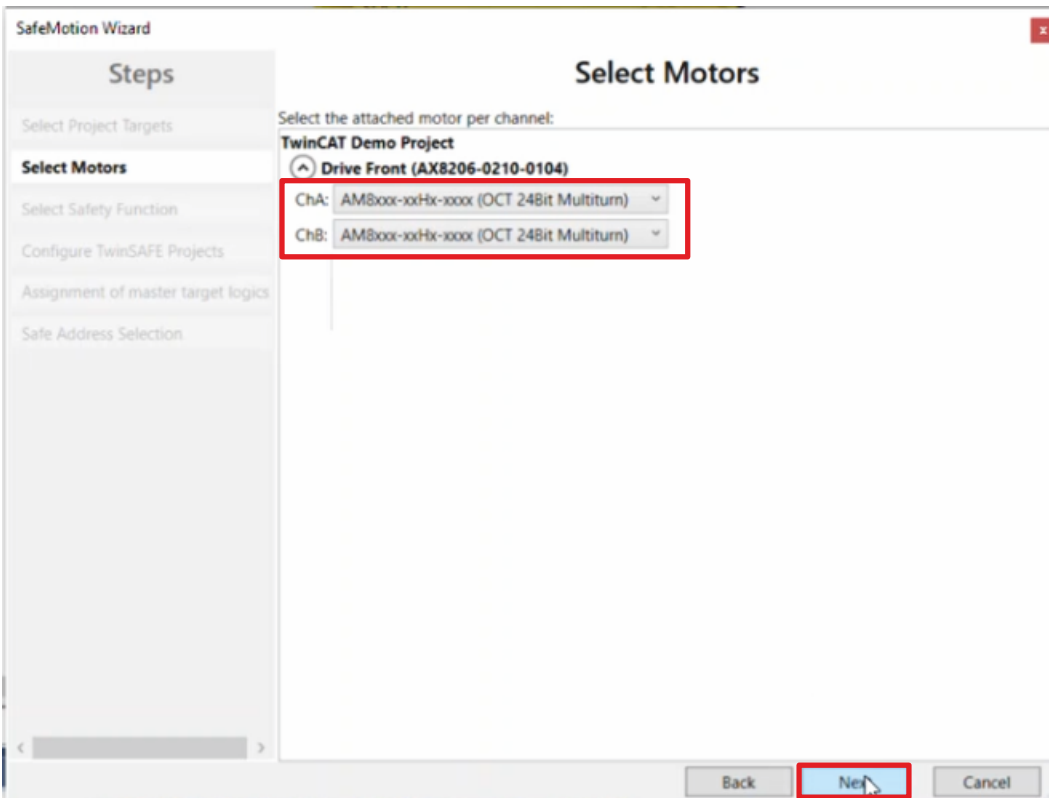


3. Select "Start SafeMotion Wizard..." via the Wizard field



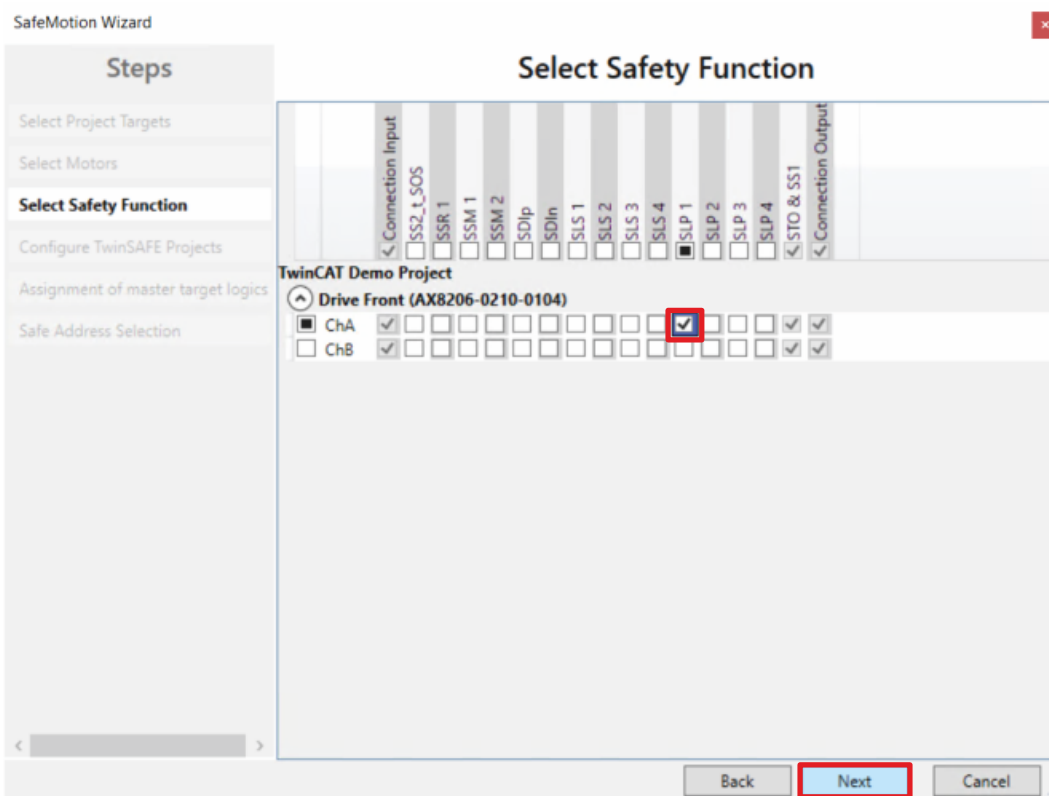
The "Select Project Targets" window opens and shows you an overview of all existing and virtual axes.

4. Select the axes of your Safe Motion component
5. Confirm the selection with "Next"



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

- 6. Select "AM8xxx-xxHx-xxx (OCT 24Bit Multiturn)" for all axes
- 7. Confirm the selection with "Next"

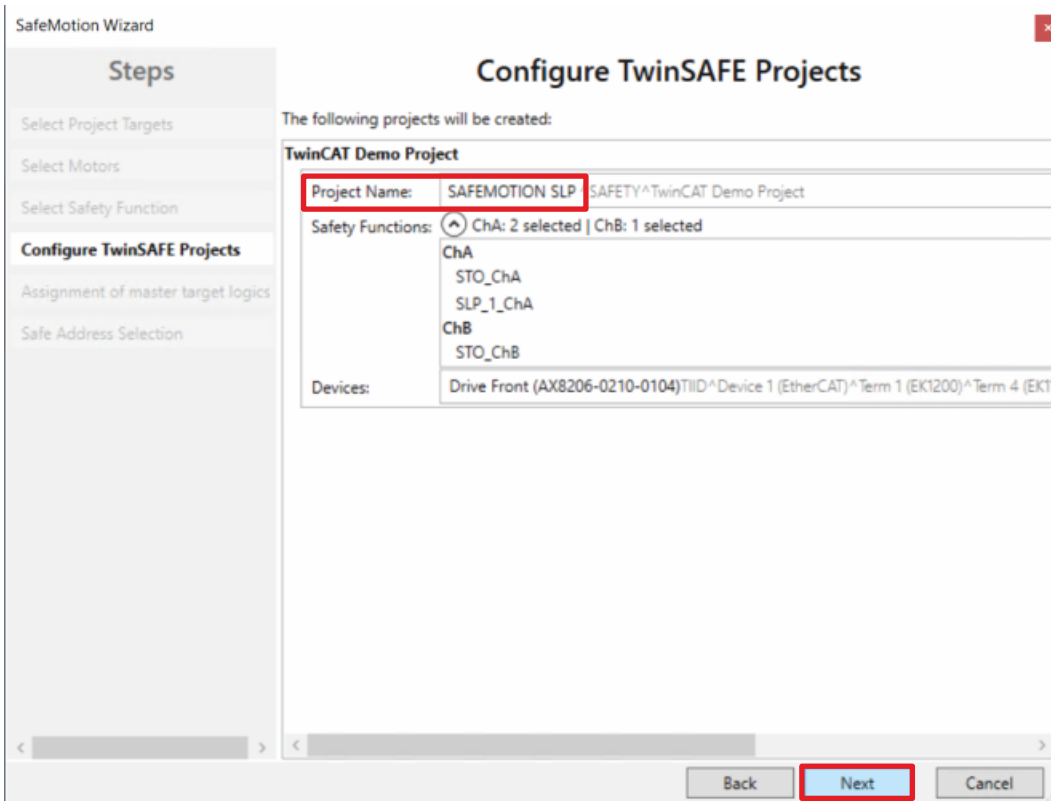


In the "Select Safety Function" window, select the desired safety functions.

- 8. For the ChA channel of your Safe Motion component, select the SLP safety function

The STO safety function is active as a default setting for all channels.

9. Confirm the selection with "Next"



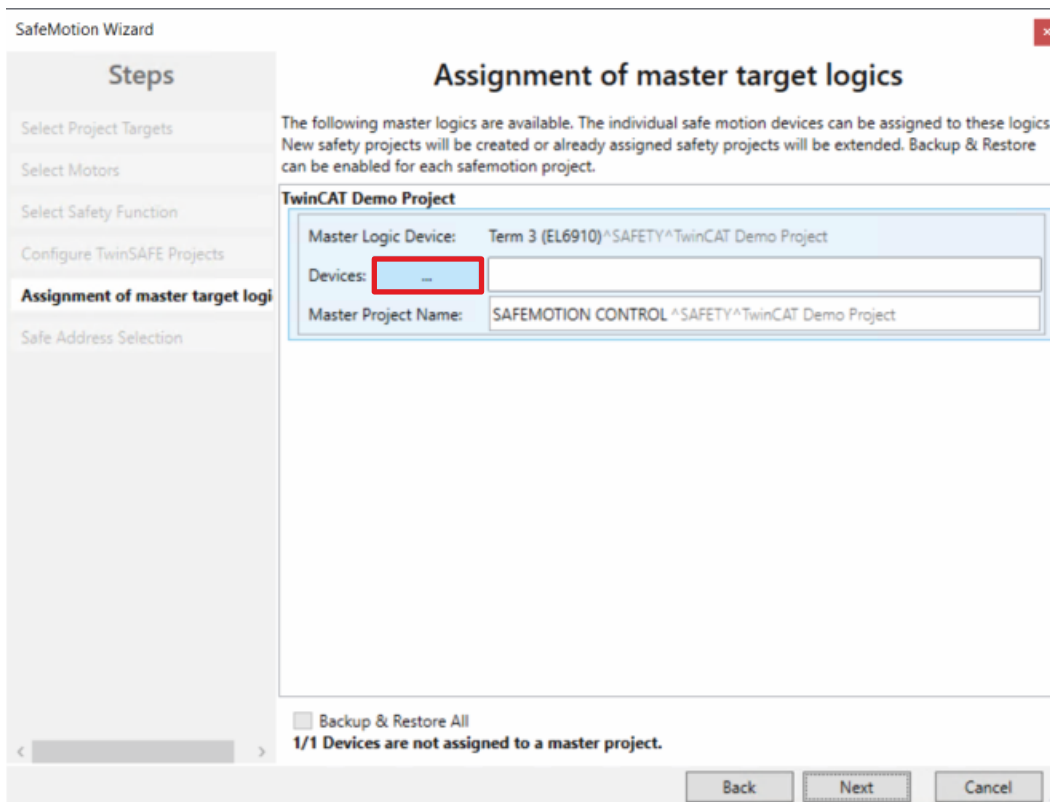
The "Configure TwinSAFE Projects" window opens. Here you have the option of renaming your Safe Motion project, which is generated for your Safe Motion component.

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

10. Rename project as desired

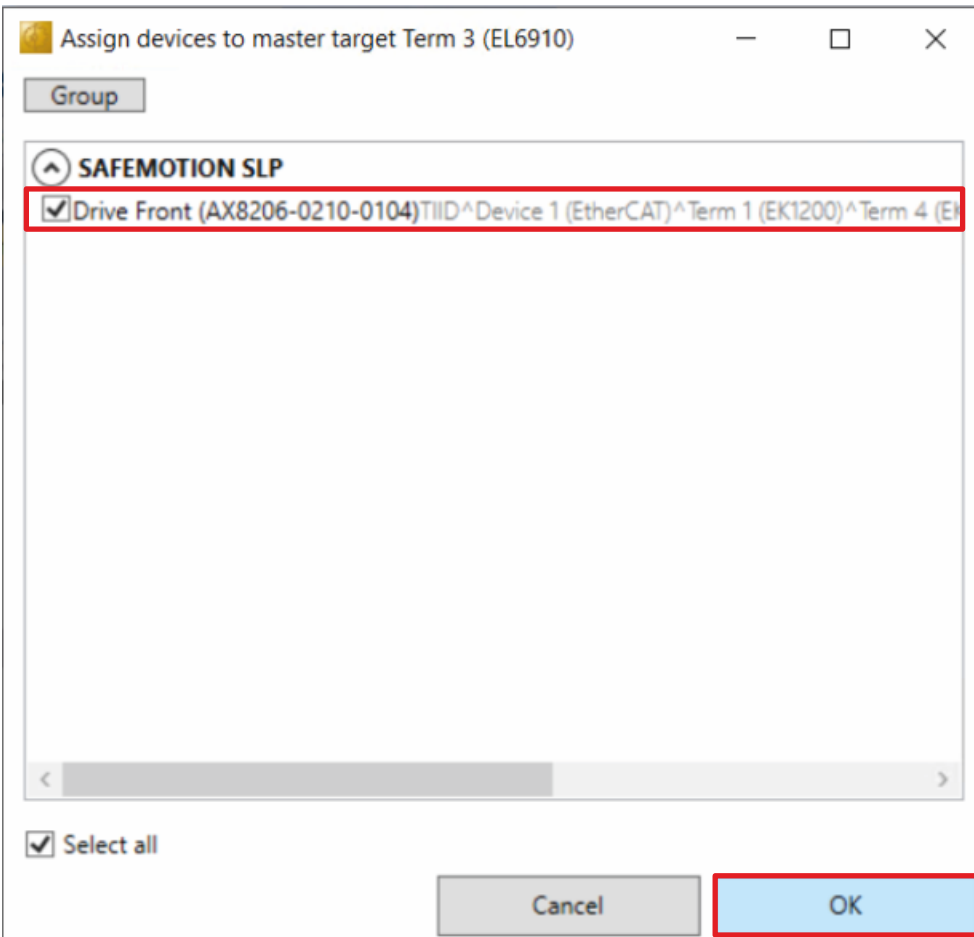
11. Check the settings

12. Confirm the selection with "Next"



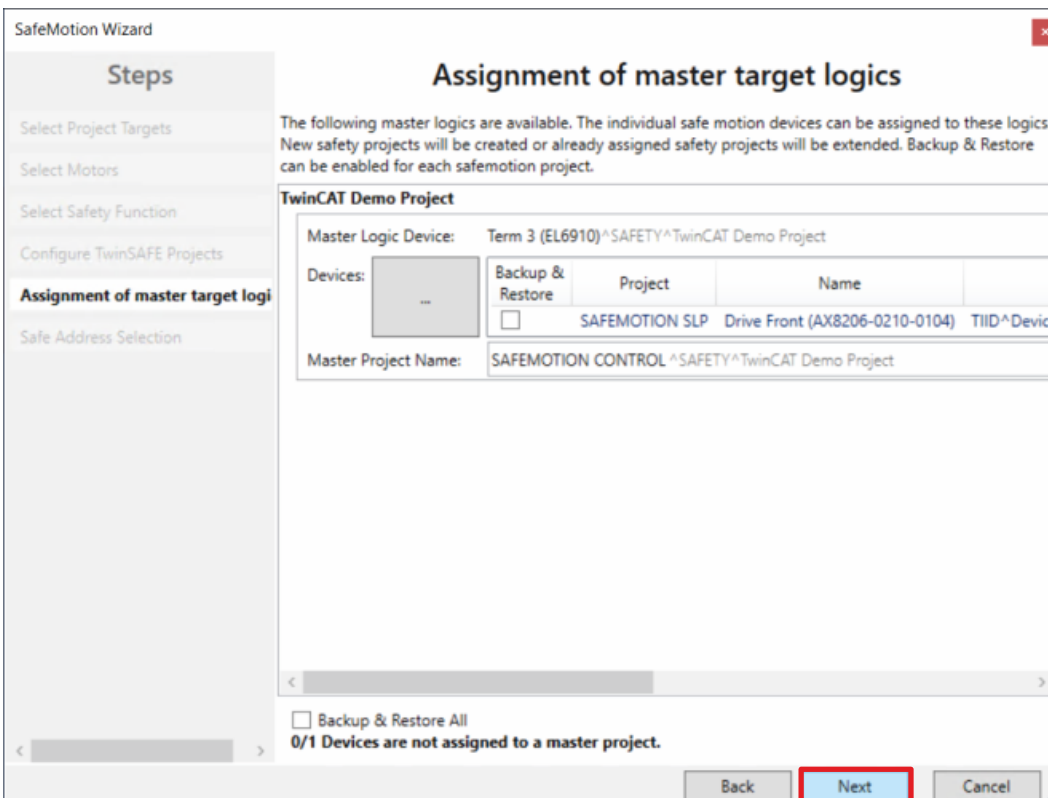
In the next window "Assignment of master target logics" the connection to the EL6910 project is closed, so that your Safe Motion component can communicate with the EL6910 project. The EL6910 project is automatically found and displayed.

13. Click the button " ... "

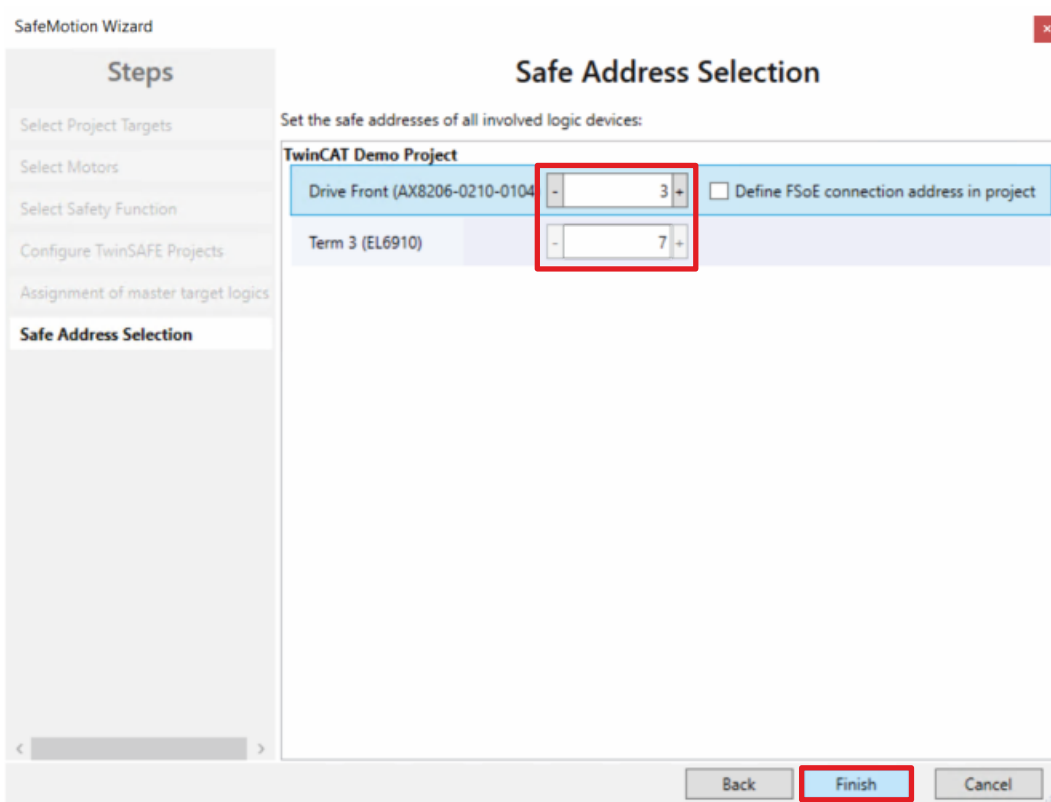


14. Select the Safe Motion component that you want to connect to the EL6910 project

15. Confirm your selection with "OK"



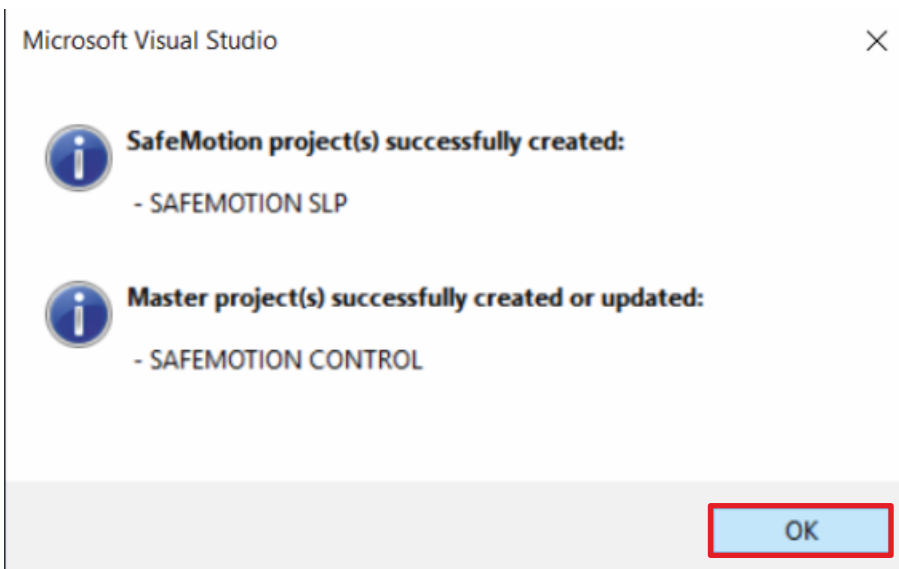
16. Confirm the window with "Next"



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.

17. Close window with "Finish"

The SafeMotion Wizard configures the projects.



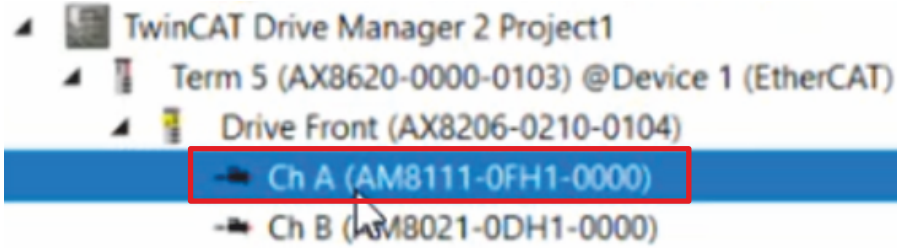
18. Close the window with "OK"

2.2 Configure SLP module

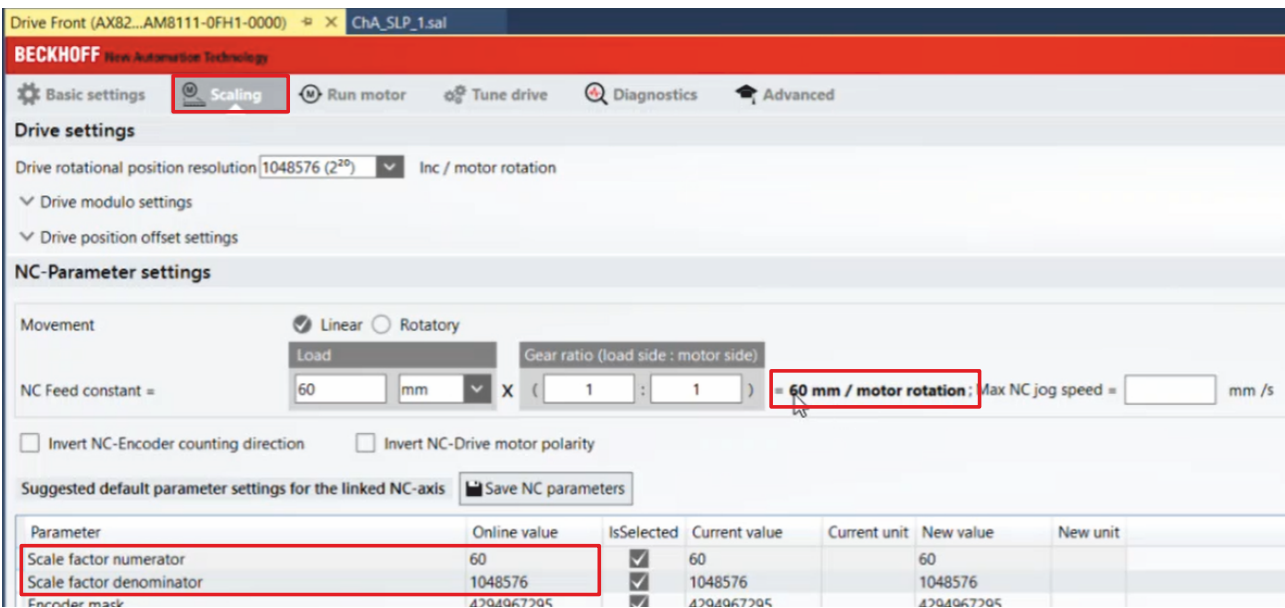
In the following, you configure the Scaled View so that you can view the values of your SLP functionality.

Define the scaling values "Scale factor numerator" as numerator and "Scale factor denominator" as denominator as well as the unit so that the scaling works.

The definition takes place in the FB properties. Proceed as follows:



1. Open the Drive Manager for channel ChA

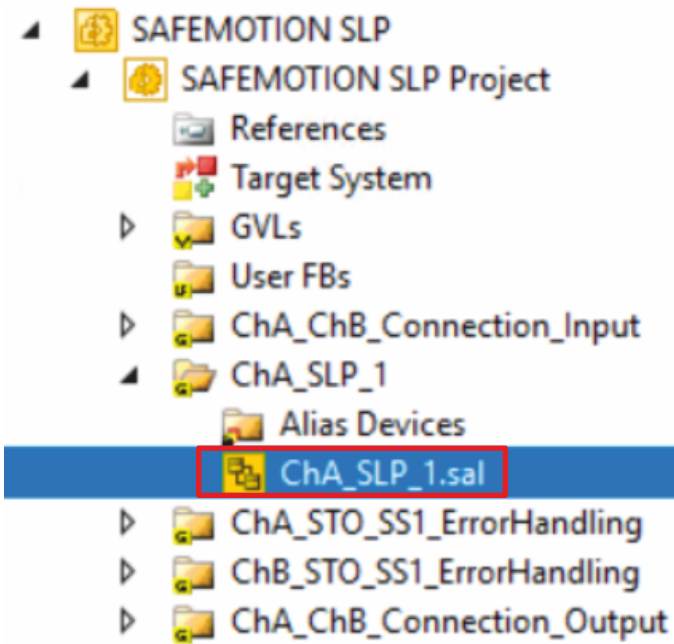


2. Open the "Scaling" tab

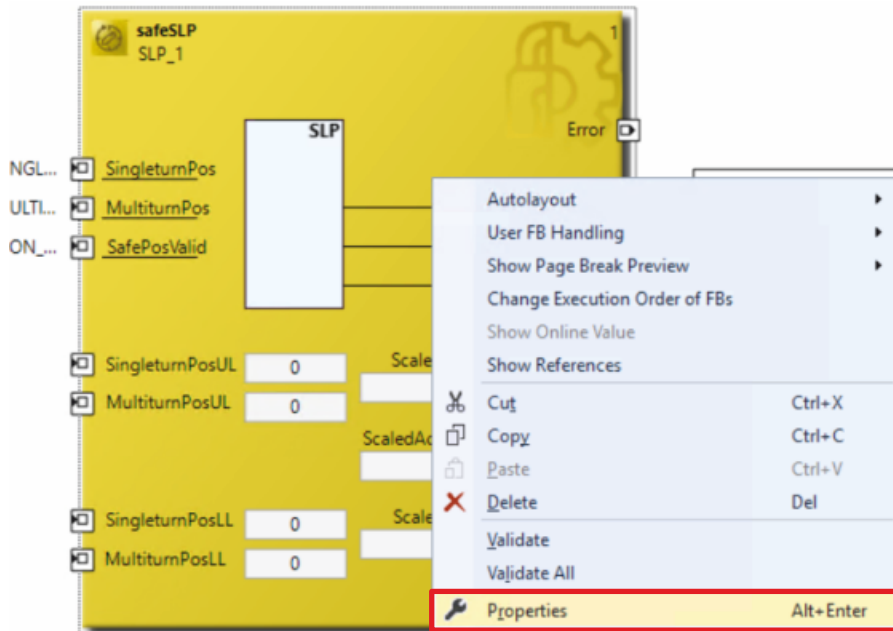
The "Scaling" tab contains the relevant scaling information. The relevant information for the use case of this tutorial are:

Information	Value
NC Feed constant	60 mm / motor rotation
Scale factor numerator	60
Scale factor denominator	1048576

3. Remember information about "NC Feed constant", "Scale factor numerator" and "Scale factor denominator"

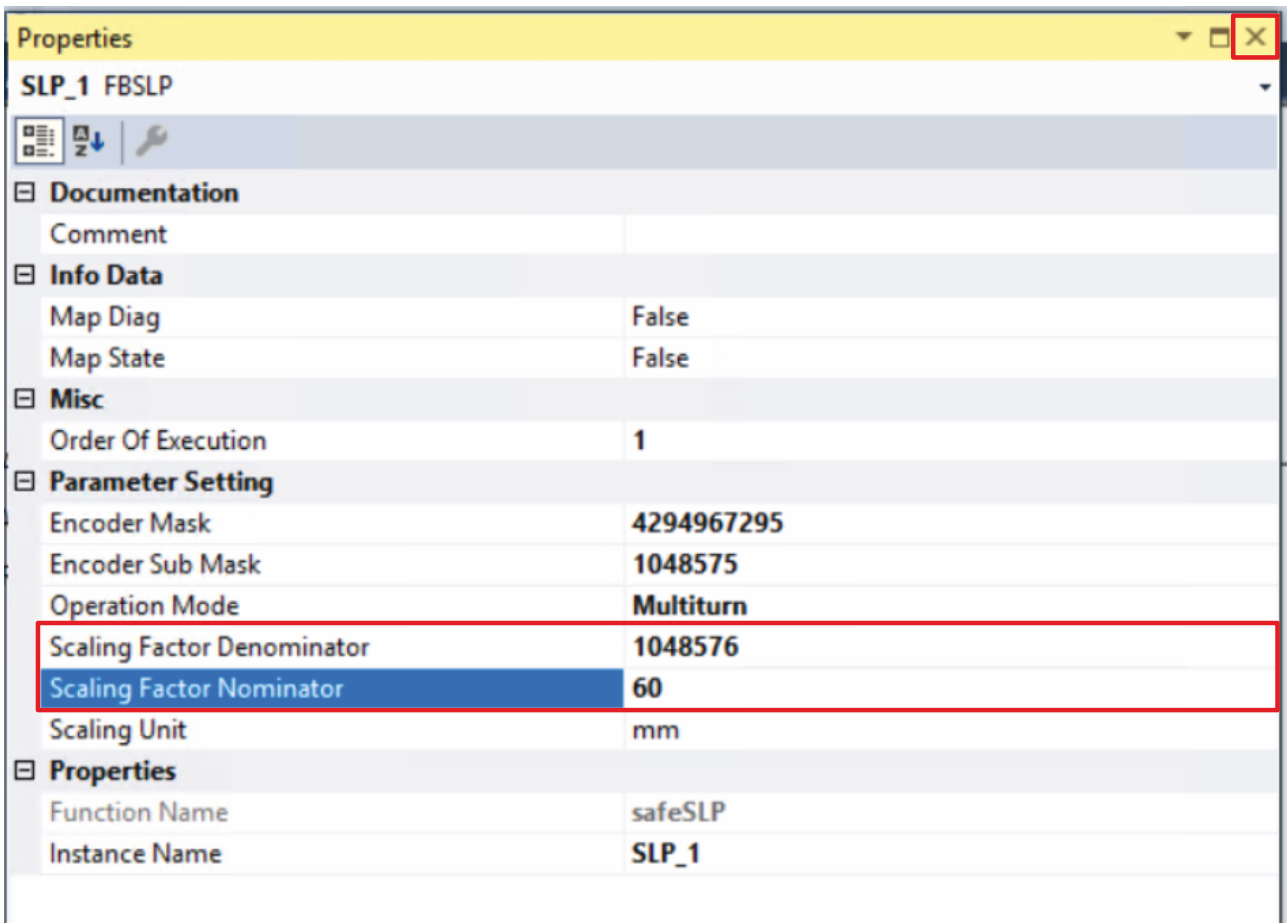


4. Open file "ChA_SLP.sal"



5. Right-click on FB

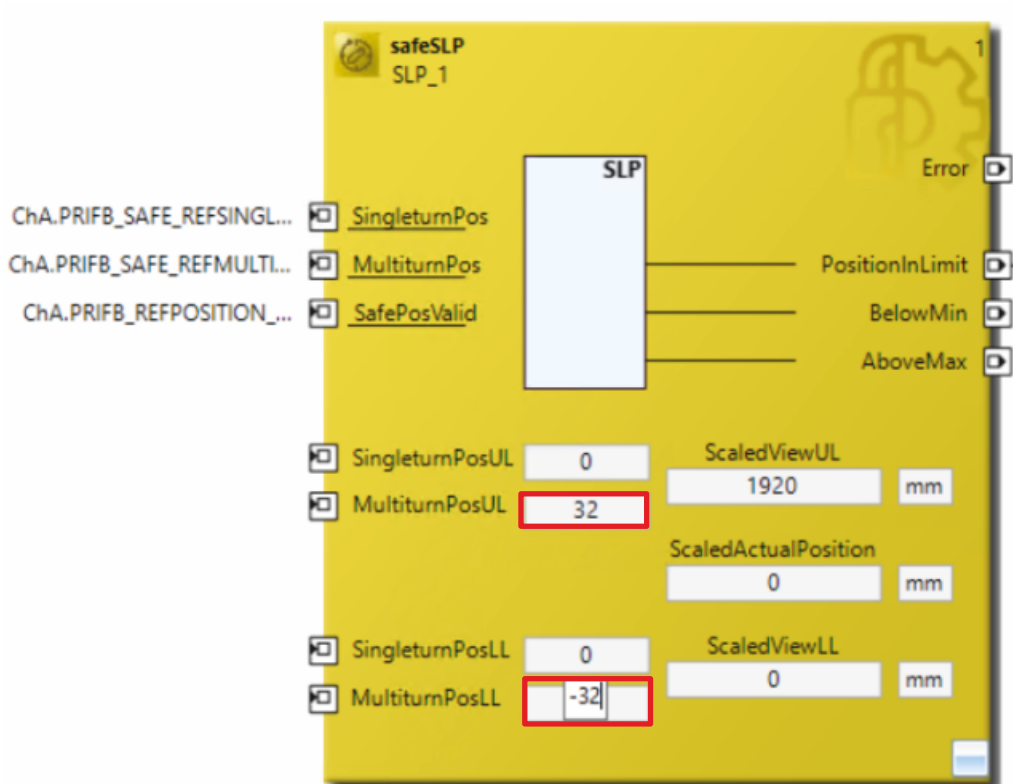
6. Click on "Properties"



7. Enter the values from the Drive Manager for "Scale factor numerator" and "Scale factor denominator" in the corresponding lines

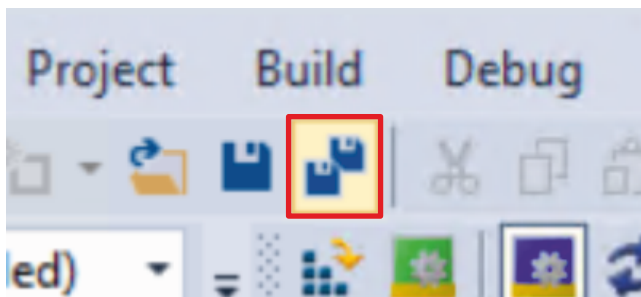
You need the value "NC Feed constant" in chapter [Define zero point and traverses \[► 18\]](#).

After you have transferred the values for "Scale factor numerator" and "Scale factor denominator", configure the number of motor rotations in the SLP module as follows:



8. Enter values from the table into the fields of the FB

Parameter	Value
MultiturnPosUL	32
MultiturnPosLL	-32

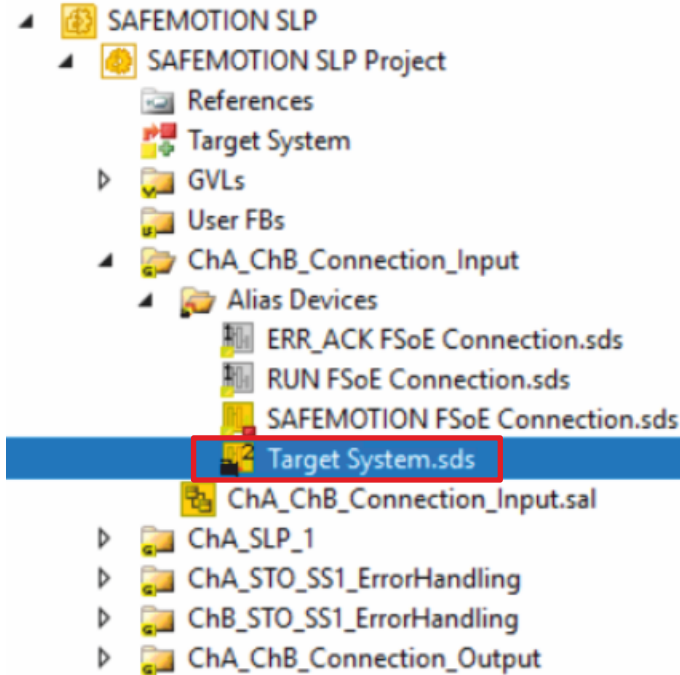


9. Click on "Save all" in the menu bar to save the settings

Displaying the values enables you to monitor your application in a safety-relevant manner.

2.3 Configure safety parameters

Since the motor is to move around the safety-relevant zero point, the reference position must be determined. Proceed as follows to do this:



1. Open the "Target_Systems.sds" file in the "ChA_ChB_Connection_Input" folder

Linking	Connection	Safety Parameters	Process Image	Internal Safety Parameters	Internal Process Image
Index	Name			Value	
> C110:0	Ch A FSOUT BRAKE Settings Common			>4<	
> C121:0	Ch A FSIN Settings Channel			>5<	
> C130:0	Ch A FSDRIVE Settings			>3<	
> C140:0	Ch A SAFEDRIVEFEEDBACK Primary Feedback Settings			>25<	
> C141:0	Ch A SAFEDRIVEFEEDBACK Secondary Feedback Settings			>25<	
▲ C142:0	Ch A SAFEDRIVEFEEDBACK Primary Feedback Referencing Settings			>24<	
C142:01	Operation Mode			Referencing disabled (0)	
C142:11	Reference SafePosition Singleturn			0x00000000 (0)	
C142:12	Reference SafePosition Multiturn			0x00000000 (0)	
C142:13	Speed at Reference Position			0x00000000 (0)	
C142:14	Maximum Singleturn Referenced SafePosition			0x00000000 (0)	
C142:15	Maximum Multiturn Referenced SafePosition			0x00000000 (0)	
C142:16	Minimum Singleturn Referenced SafePosition			0x00000000 (0)	
C142:17	Minimum Multiturn Referenced SafePosition			0x00000000 (0)	
C142:18	Deviation Startup Position			0x00000000 (0)	

2. Open "Internal Safety Parameter" tab

Below the parameter "Ch A SAFEDRIVEFEEDBACK Primary Feedback Referencing Settings" you can see the settings for referencing.

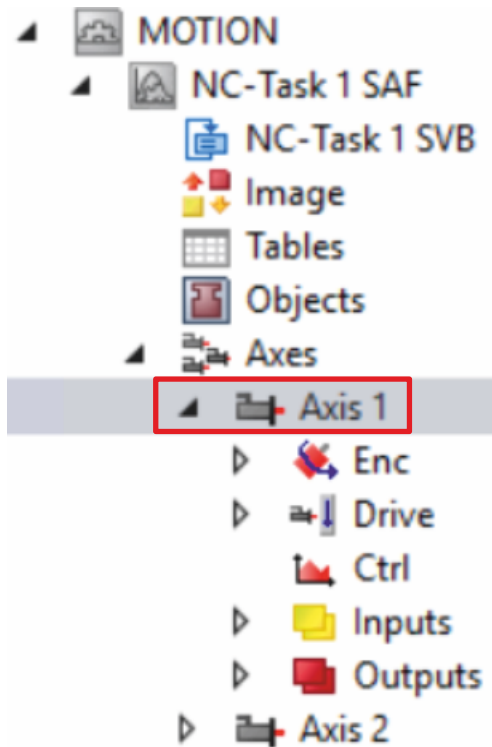
For this application settings are required for the following parameters:

- Operation Mode
- Reference SafePosition Multiturn
- Maximum Multiturn Referenced SafePosition
- Minimum Multiturn Referenced SafePosition

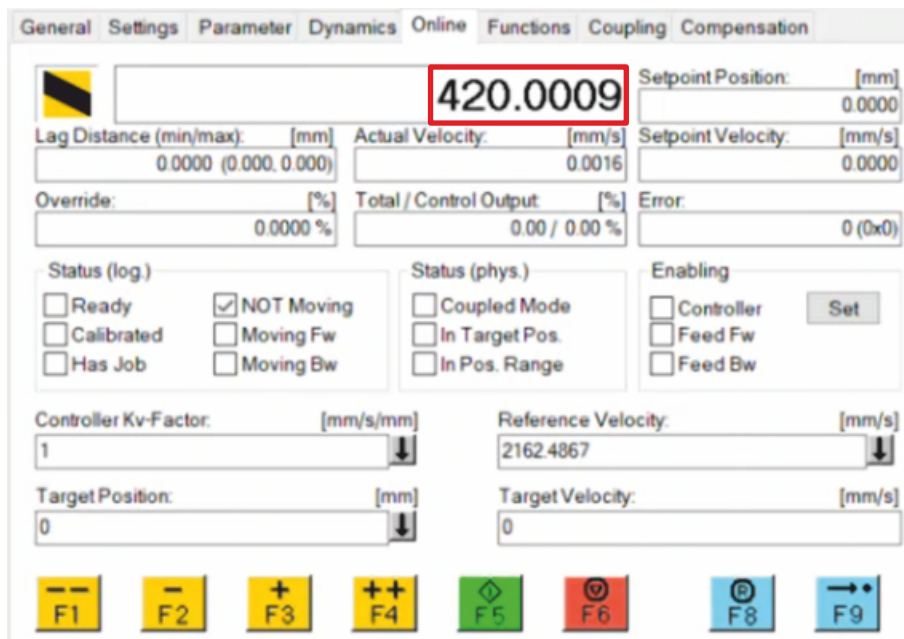
2.3.1 Determine reference position

For the "Maximum Multiturn Referenced SafePosition" and "Minimum Multiturn Referenced SafePosition" parameters, you need the reference position.

To get to the reference position, proceed as follows:



1. Open axis 1 in your NC configuration



You can see from the configuration that the position is approximately 420 mm. This value is to be configured as the zero point.

In the next chapter, you will make the settings for the safety parameters.

2.3.2 Define zero point and traverses



Number of rotations

Since 60 mm per motor rotation is specified in the Drive Manager, you must make the following calculation:

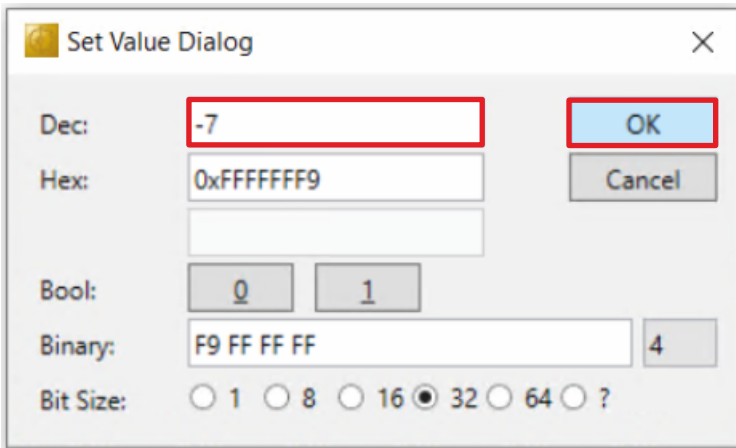
$$Reference\ SafePosition\ Multiturn = \frac{420}{60} = 7$$

Index	Name	Value
> C110:0	Ch A FSOUT BRAKE Settings Common	>4<
> C121:0	Ch A FSIN Settings Channel	>5<
> C130:0	Ch A FSDRIVE Settings	>3<
> C140:0	Ch A SAFEDRIVEFEEDBACK Primary Feedback Settings	>25<
> C141:0	Ch A SAFEDRIVEFEEDBACK Secondary Feedback Settings	>25<
▲ C142:0	Ch A SAFEDRIVEFEEDBACK Primary Feedback Referencing Settings	>24<
C142:01	Operation Mode	Referencing disabled (0)
C142:11	Reference SafePosition Singleturn	0x00000000 (0)
C142:12	Reference SafePosition Multiturn	0x00000000 (0)
C142:13	Speed at Reference Position	0x00000000 (0)
C142:14	Maximum Singleturn Referenced SafePosition	0x00000000 (0)
C142:15	Maximum Multiturn Referenced SafePosition	0x00000000 (0)
C142:16	Minimum Singleturn Referenced SafePosition	0x00000000 (0)
C142:17	Minimum Multiturn Referenced SafePosition	0x00000000 (0)
C142:18	Deviation Startup Position	0x00000000 (0)

1. Open the "Internal Safety Parameter" of the "Target_Systems.sds" file

In the following you must make the parameter settings. The procedure is identical for all parameters and is shown here as an example using the screenshots for one parameter.

2. Double-click on the desired parameter



3. Enter the corresponding value in the "Dec" field
4. Confirm the window with "OK"

Enter the following values for the parameters:

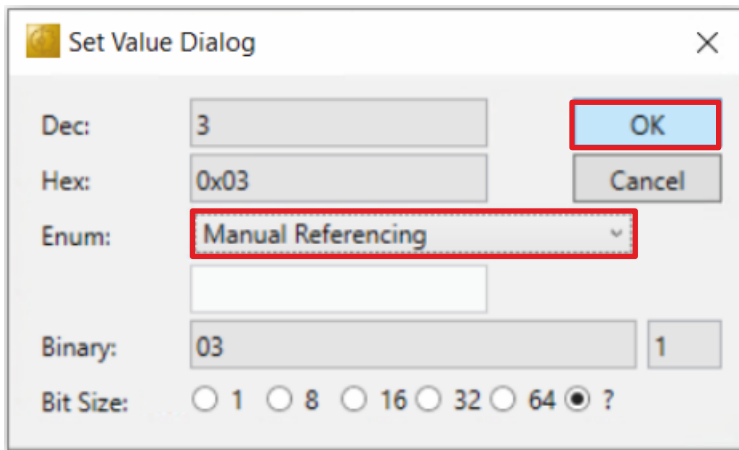
Parameter	Value	Explanation
Reference SafePosition Multiturn	-7	Reference position
Maximum Multiturn Referenced SafePosition	1000	Maximum traverse
Minimum Multiturn Referenced SafePosition	-1000	Minimum traverse

2.3.3 Activate referencing

The last setting is to activate the referencing.

Index	Name	Value
> C110:0	Ch A FSOUT BRAKE Settings Common	>4<
> C121:0	Ch A FSIN Settings Channel	>5<
> C130:0	Ch A FSDRIVE Settings	>3<
> C140:0	Ch A SAFEDRIVEFEEDBACK Primary Feedback Settings	>25<
> C141:0	Ch A SAFEDRIVEFEEDBACK Secondary Feedback Settings	>25<
▲ C142:0	Ch A SAFEDRIVEFEEDBACK Primary Feedback Referencing Settings	>24<
C142:01	Operation Mode	Referencing disabled (0)
C142:11	Reference SafePosition Singleturn	0x00000000 (0)
C142:12	Reference SafePosition Multiturn	0xFFFFFFFF (-7)
C142:13	Speed at Reference Position	0x00000000 (0)
C142:14	Maximum Singleturn Referenced SafePosition	0x00000000 (0)
C142:15	Maximum Multiturn Referenced SafePosition	0x000003E8 (1000)
C142:16	Minimum Singleturn Referenced SafePosition	0x00000000 (0)
C142:17	Minimum Multiturn Referenced SafePosition	0xFFFFFC18 (-1000)
C142:18	Deviation Startup Position	0x00000000 (0)

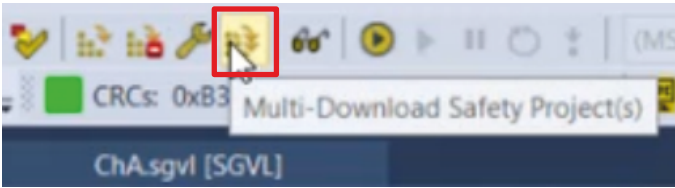
1. Double-click on the "Operation Mode" parameter



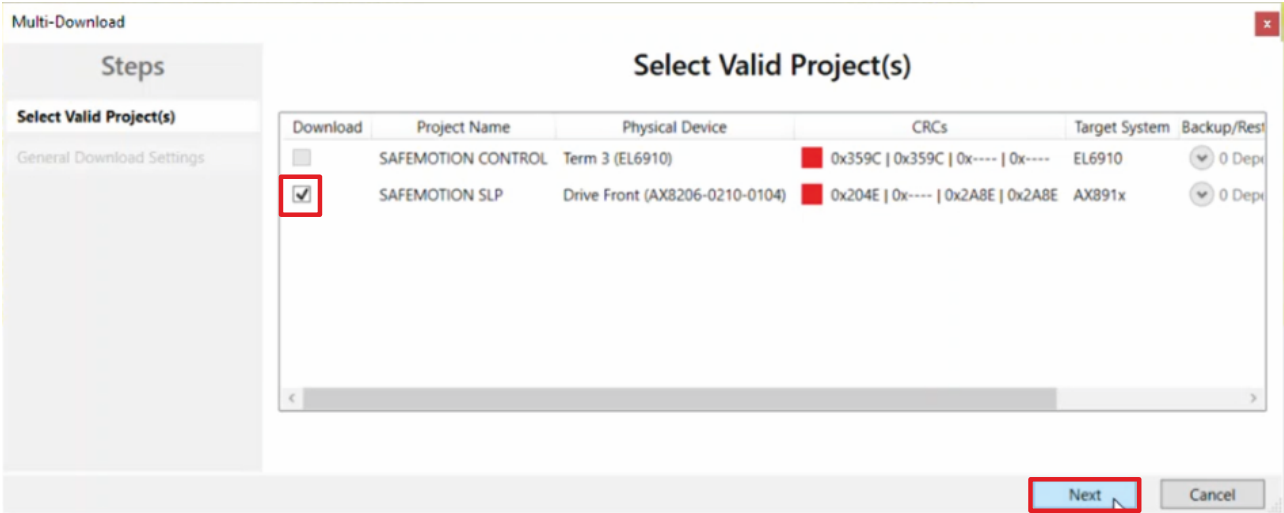
2. Select "Manual Referencing" in the drop-down menu
3. Confirm the selection with "OK"
4. Click "Save all" in the menu bar to save the settings

The configuration is complete.

2.4 Download safety project of the Safe Motion component

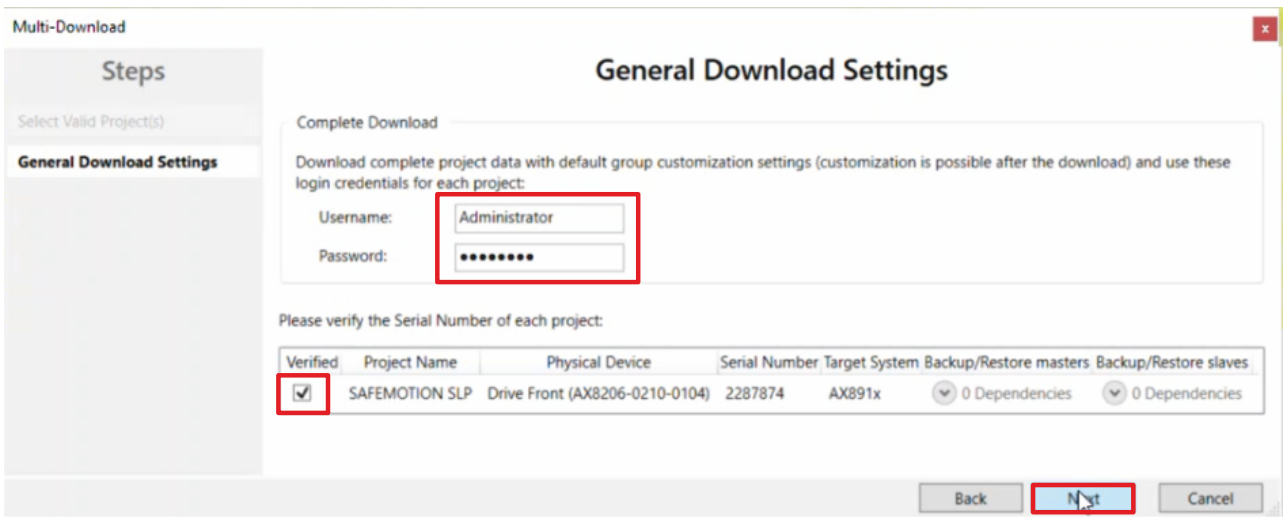


1. Click on "Multi-Download Safety Project(s)"



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

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



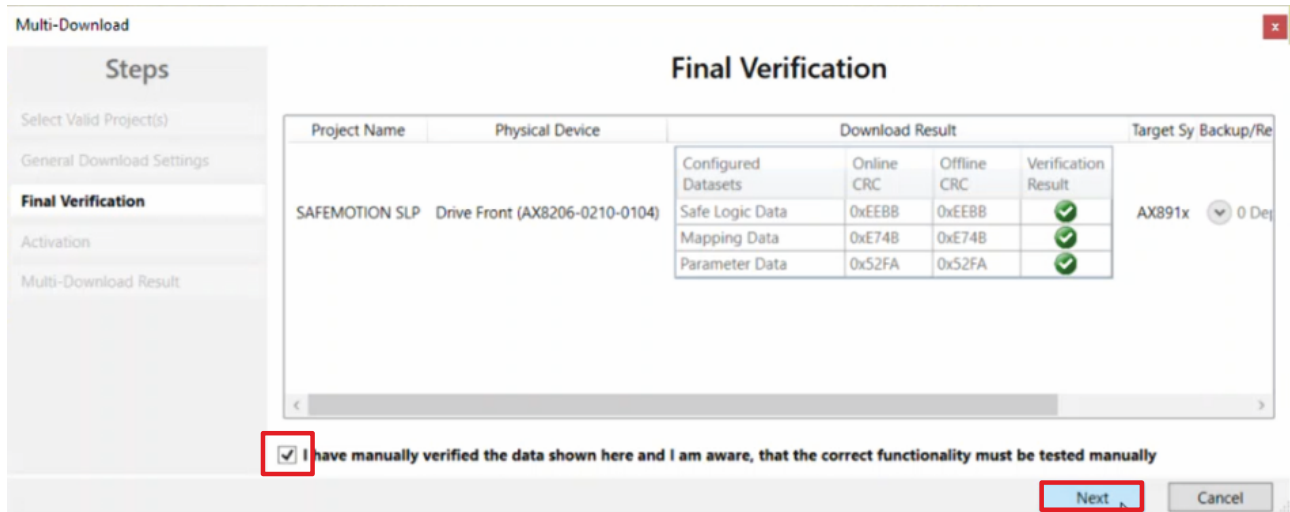
4. Enter the username and password in the "General Download Settings" window

Default username: Administrator

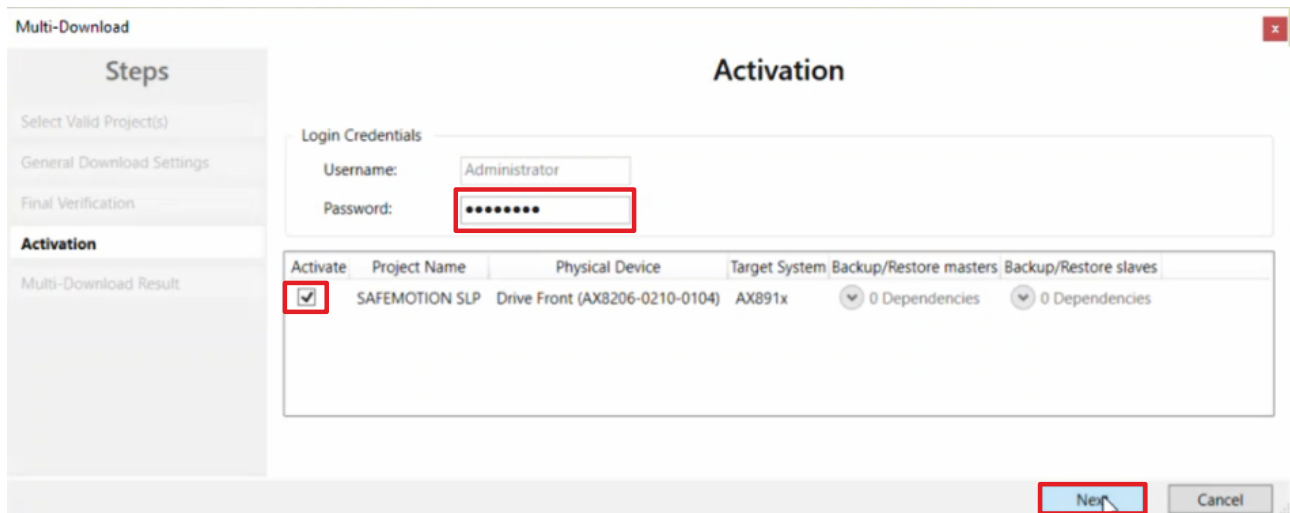
Default password: TwinSAFE

5. Select the safety project that 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.

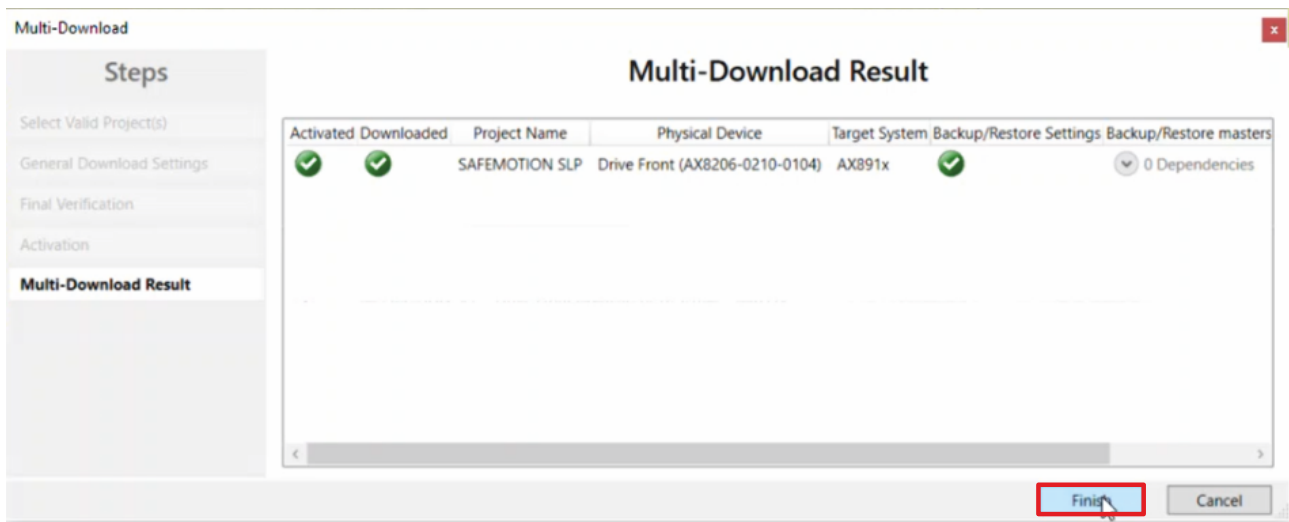


7. Check the CRCs in the "Final Verification" window
8. If the CRCs match, click on the box to confirm the verification
9. Confirm the window with "Next"



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

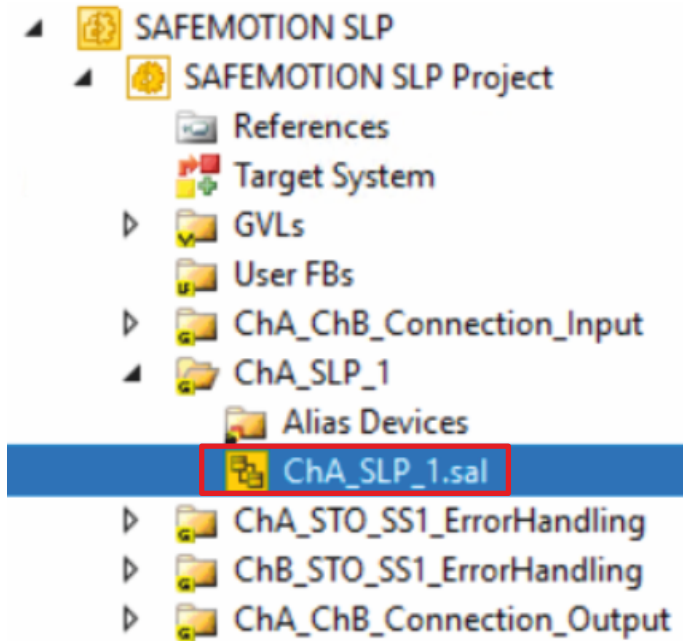
10. Enter the default password
11. Check if the safety project is selected
12. Confirm the selection with "Next"



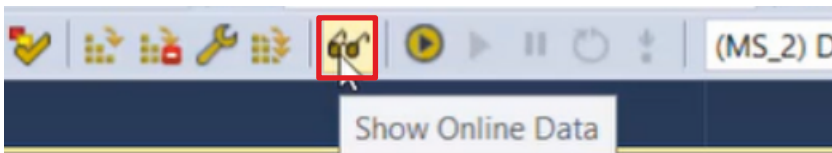
13. Close the window "Multi-Download Result" with "Finish"

Your safety project is now downloaded and active.

2.5 Check current position



1. Open the file "ChA_SLP_1.sal"

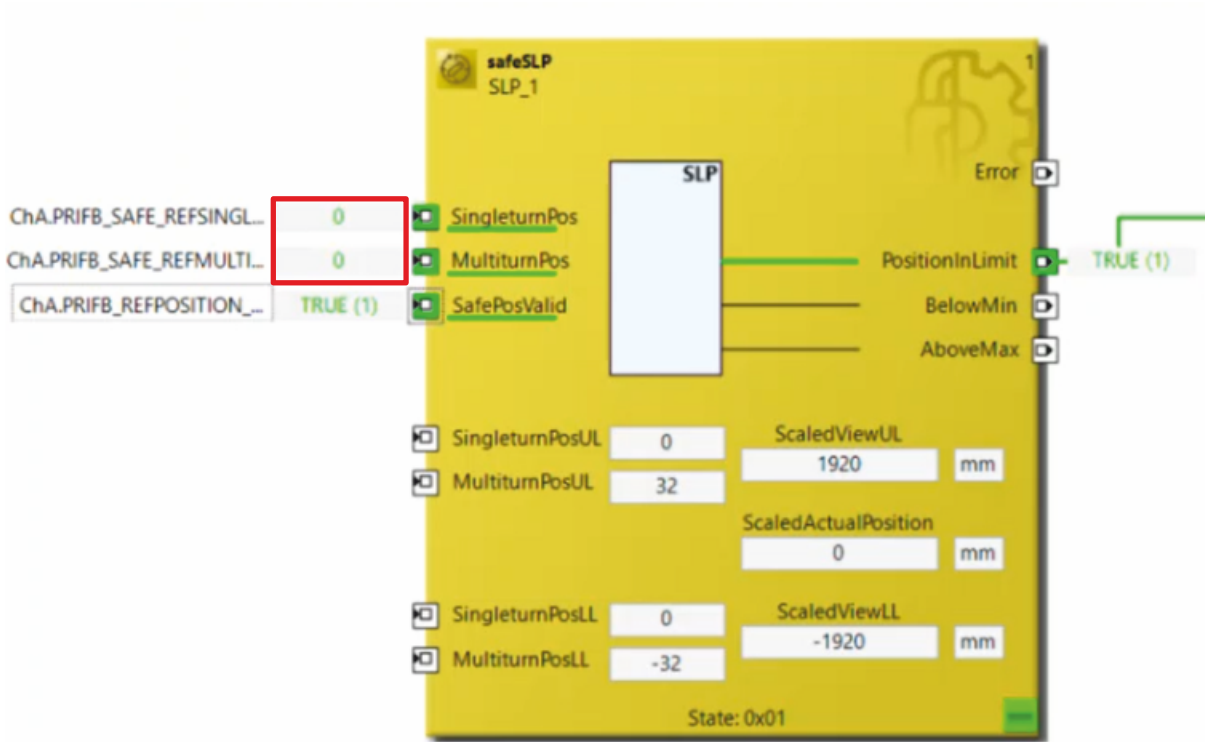


2. Click on "Show Online Data" in the menu bar to activate the online view



3. Right-click on a variable

4. Click on "Show Online Value"



You will see that the current multiturn and singleturn position is set to 0 and the positions are therefore correctly configured.

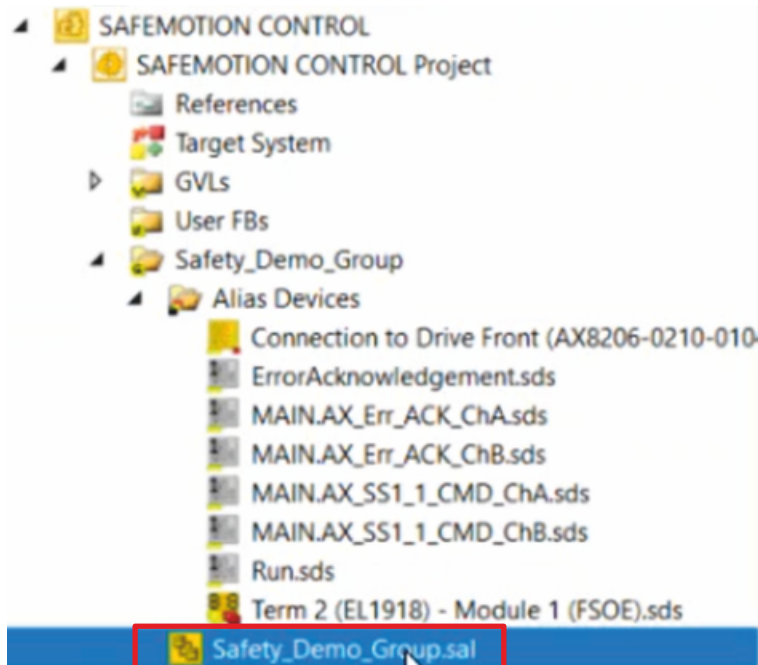
Your safety function is now completely configured. In the next chapter you will link the Safe Motion project to the EL6910 project.

2.6 Link projects

This chapter describes the step-by-step procedure for connecting the Safe Motion project to the EL6910 project via the parameters.

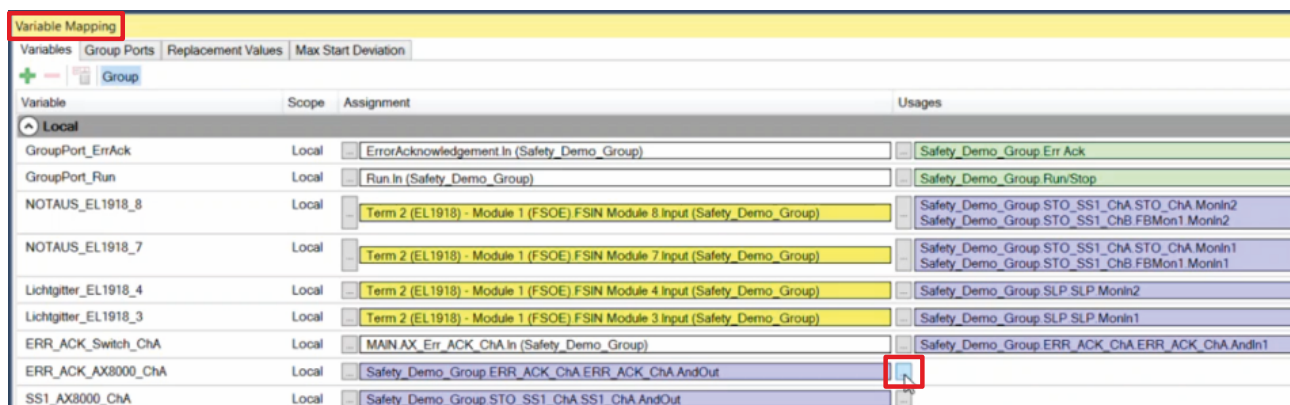
The SafeMotion Wizard has already created the connections via the Alias Devices.

Proceed as follows:

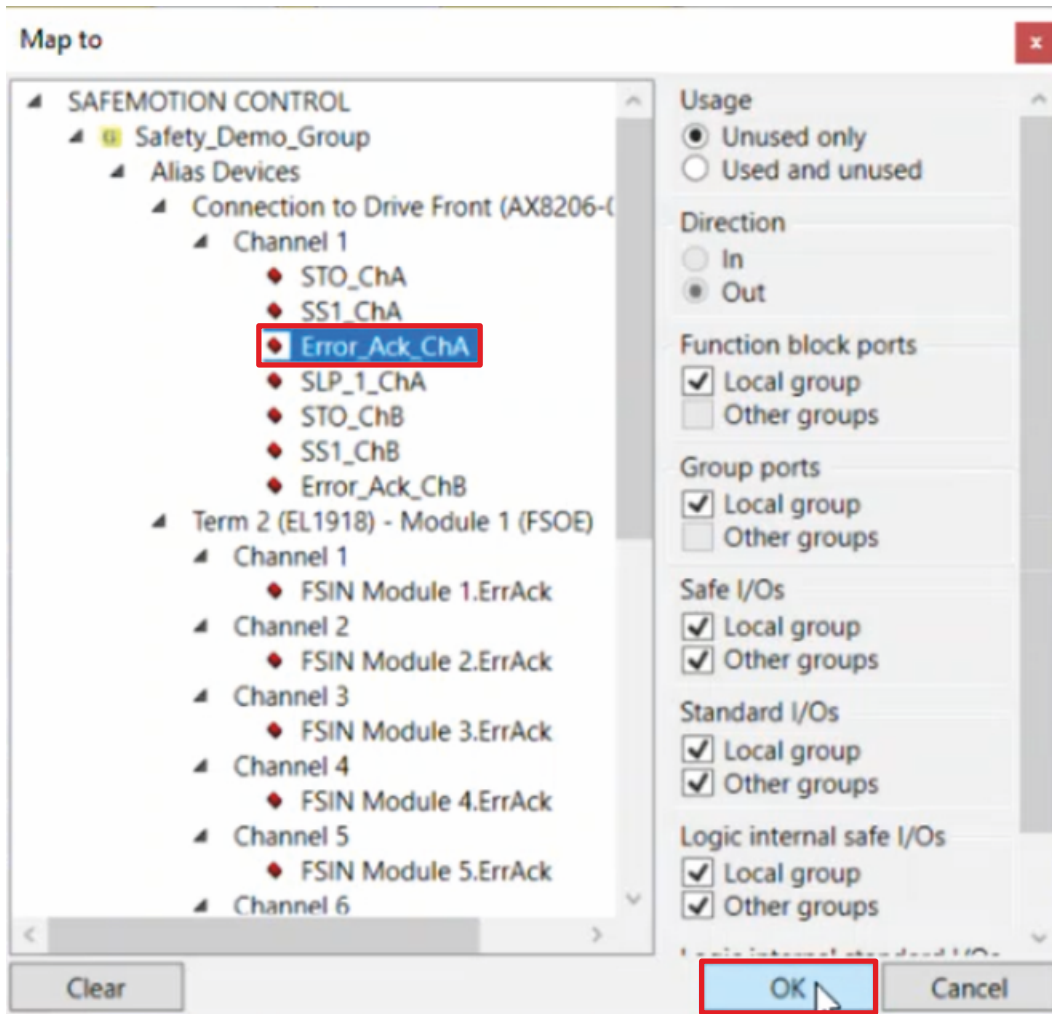


1. Open the sal file in your EL6910 project

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



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



3. Select the signal for the parameter
4. Confirm the window with "OK"

The following links result for the parameters:

Note When aliasing the STO parameters, make sure that the existing link is retained.

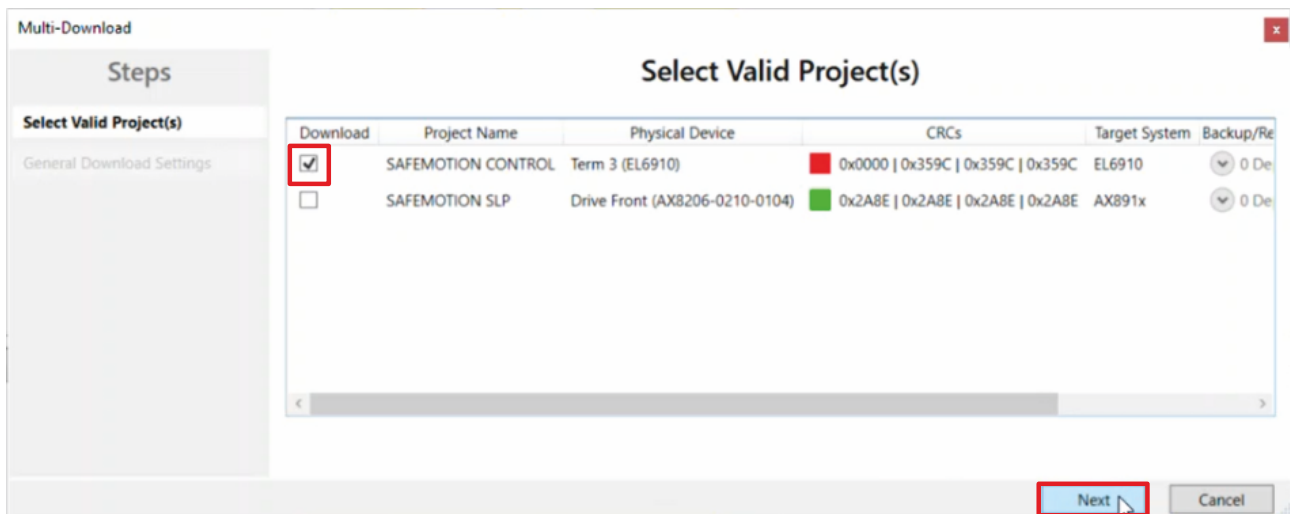
Parameter	Signal
ERR_ACK_AX8000_ChA	Error_Ack_ChA
SS1_AX8000_ChA	SS1_ChA
SS1_AX8000_ChB	SS1_ChB
ERR_ACK_AX8000_ChB	Error_Ack_ChB
SLP_AX8000_ChA	SLP_1_ChA
SLP_AX8000_ChB	SLP_1_ChB
STO_ChA	STO_ChA
STO_ChB	STO_ChB

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

The Safe Motion project and the EL6910 project are now linked.

2.7 Download Safety projects

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

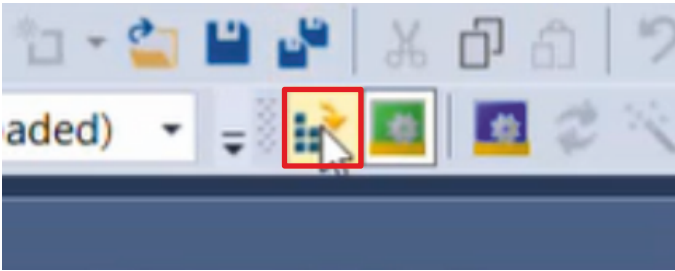


2. Remove the check mark from the safety project of the safe motion component so that only the EL6910 safety project is downloaded
3. Go through steps 4 - 13 of chapter [Download safety project of the Safe Motion component](#) [▶ 20]
4. Confirm the selection with "Next"
5. Click "Save all" in the menu bar to save the settings

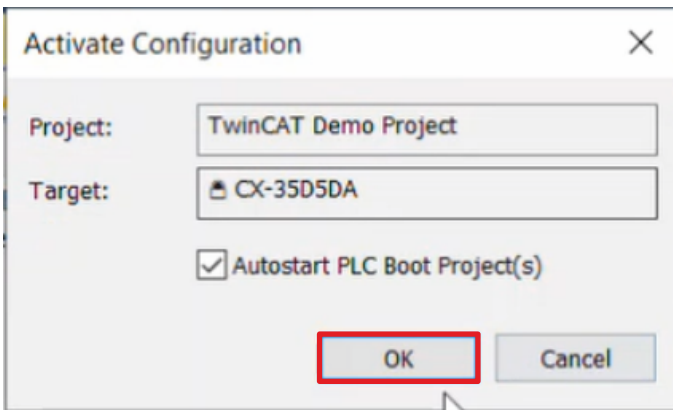
The commissioning of the desired functionality on your Safe Motion component is now complete.

2.8 Activate configuration

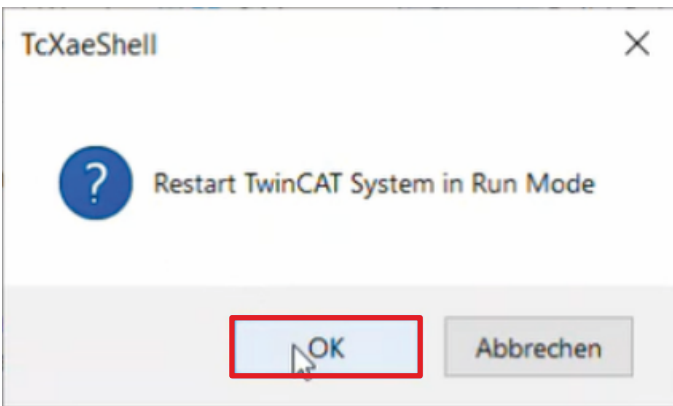
After downloading the EL6910 project, it is necessary to re-enable the configuration, as the EL6910 image has been modified. Proceed as follows:



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



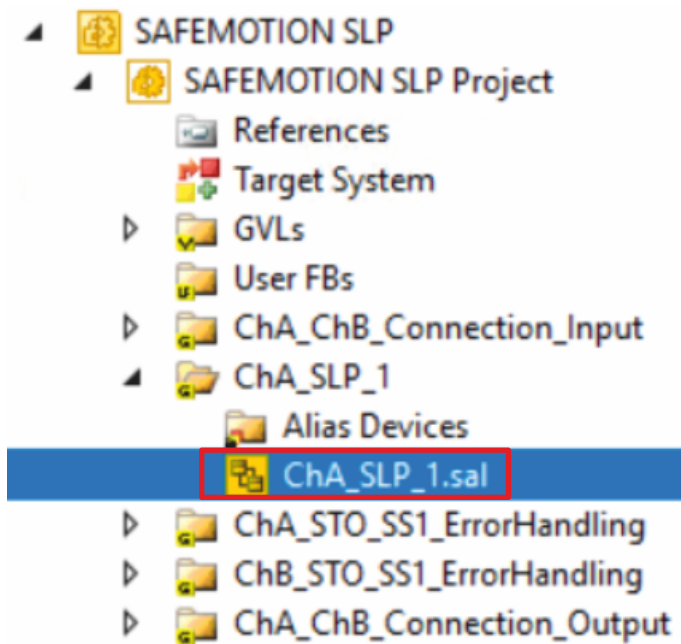
2. Confirm the "Activate Configuration" window with "OK"



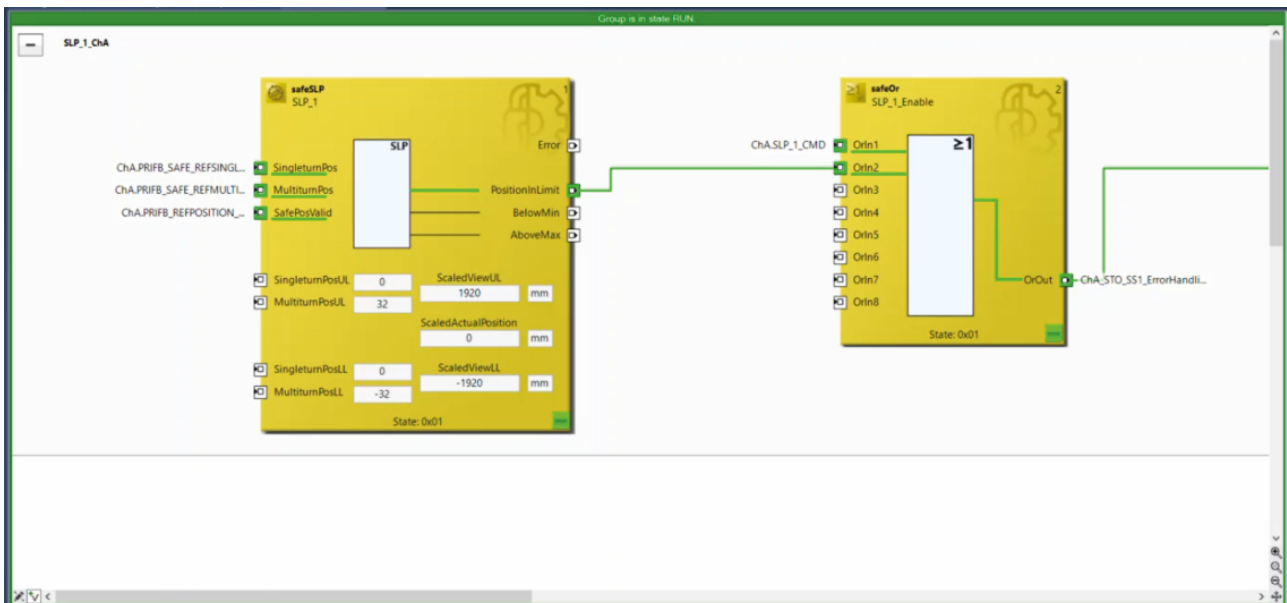
3. Confirm the "Restart TwinCAT System in Run Mode" window with "OK"

2.9 Check applikation

2.9.1 Check signals

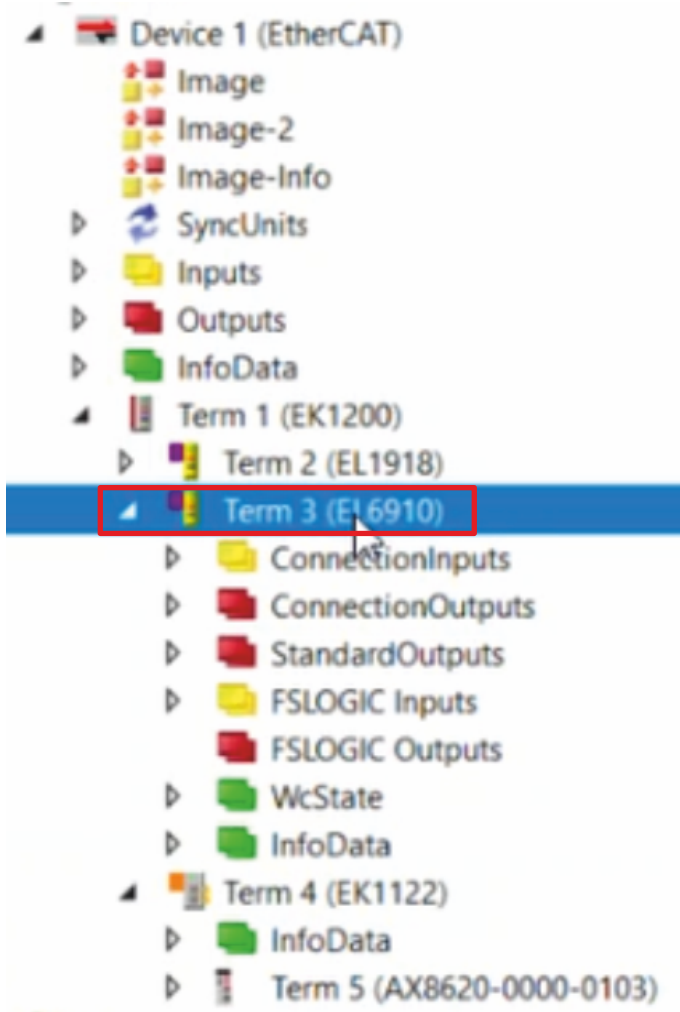


1. Open the file "ChA_ChB_ErrorHandling.sal"
2. Click on "Show Online Data" in the menu bar to activate the online view



Here you can see that all signals arrive correctly.

2.9.2 Check links



1. Open the EL6910 in the I/O configuration

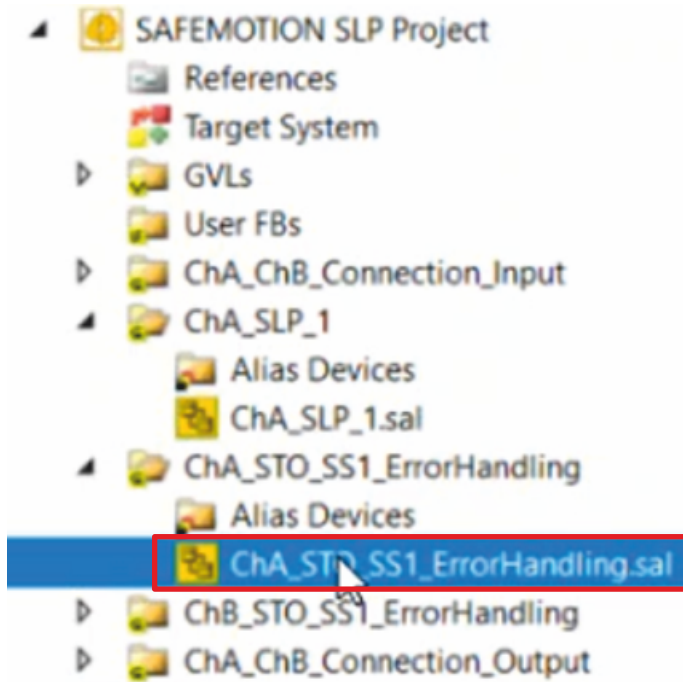
Name	Online	Type	Size	>Addr...	In/Out	User ID	Linked to
Message_4 TxPDO	X 36 00 A3 3F 04 00	Safety.FSOE...	6.0	1571.0	Input	0	MAIN.FROM_EL6910, FSOE
Message_65 TxP...	X 36 03 10 01 24 03 00 52 19 01 00	FSOE_11	11.0	1577.0	Input	0	Message_1 . FSoE Slave ...
Safe Logic State	1	USINT	1.0	1588.0	Input	0	
Cycle Counter	20	USINT	1.0	1589.0	Input	0	
WcState	0	BIT	0.1	3058.0	Input	0	
InputToggle	1	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 CB E2 04 00	FSOE_7	7.0	1571.0	Output	0	FSoE . FSoE Inputs . Mod...
Message_65 RxP...	X 36 81 00 15 74 81 00 42 C0 01 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 . PlcTask O...
Standard In Var 2	X 0	BIT	0.1	1589.1	Output	0	MAIN.TS_ErrAck . PlcTask ...
Standard In Var 15	X 0	BIT	0.1	1589.2	Output	0	MAIN.AX_SS1_1_CMD_Ch...
Standard In Var 16	X 0	BIT	0.1	1589.3	Output	0	MAIN.AX_Err_ACK_ChA ...
Standard In Var 17	X 0	BIT	0.1	1589.4	Output	0	MAIN.AX_SS1_1_CMD_Ch...

Here you can see that the connection between the EL6910 project and the Safe Motion project is working as configured.

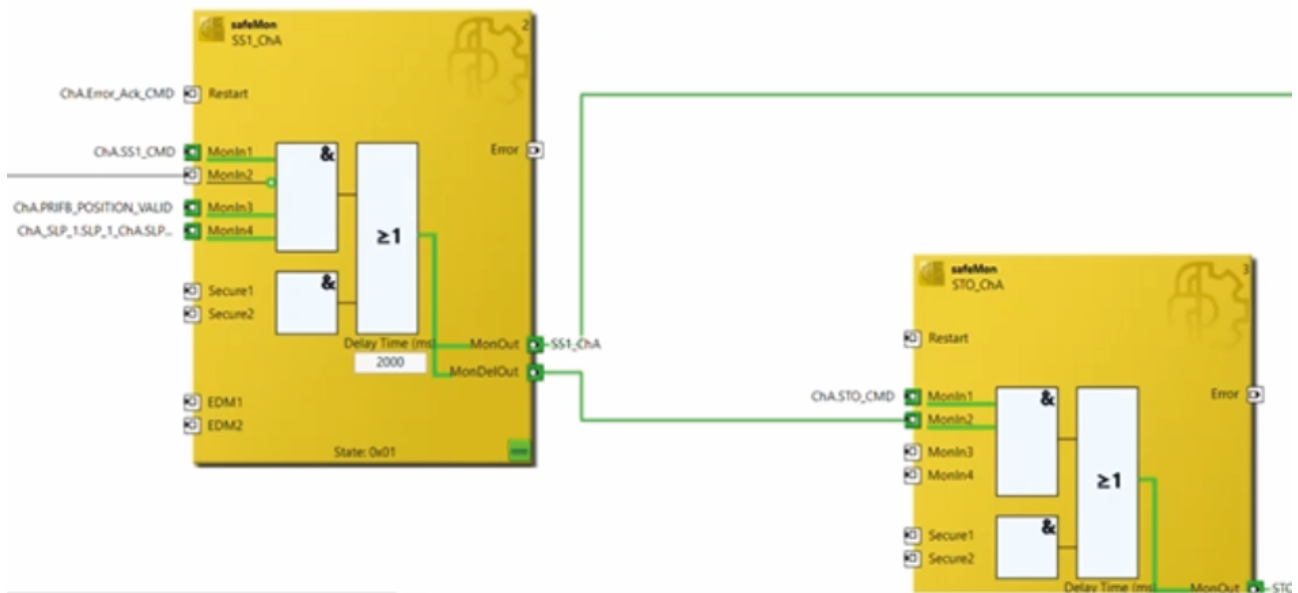
2. Click "Save all" in the menu bar

2.9.3 Check ErrorHandling

Next, check the ErrorHandling as follows:

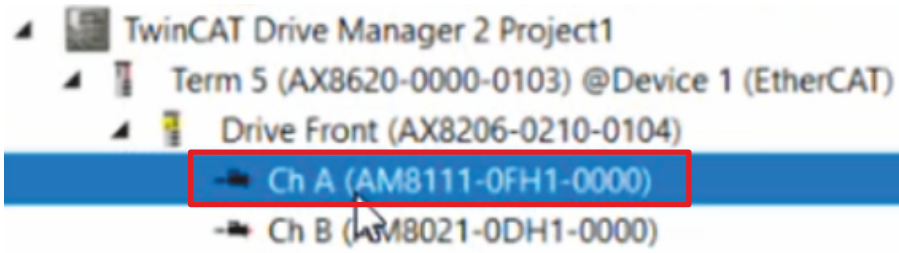


1. Open the file "ChA_STO_SS1_ErrorHandling.sal" in the Safe Motion project
2. If the online view is no longer activated, click on "Show Online Data" in the menu bar

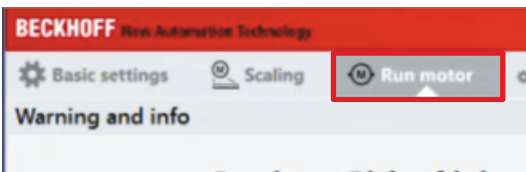


Here you can see that all signals are available.

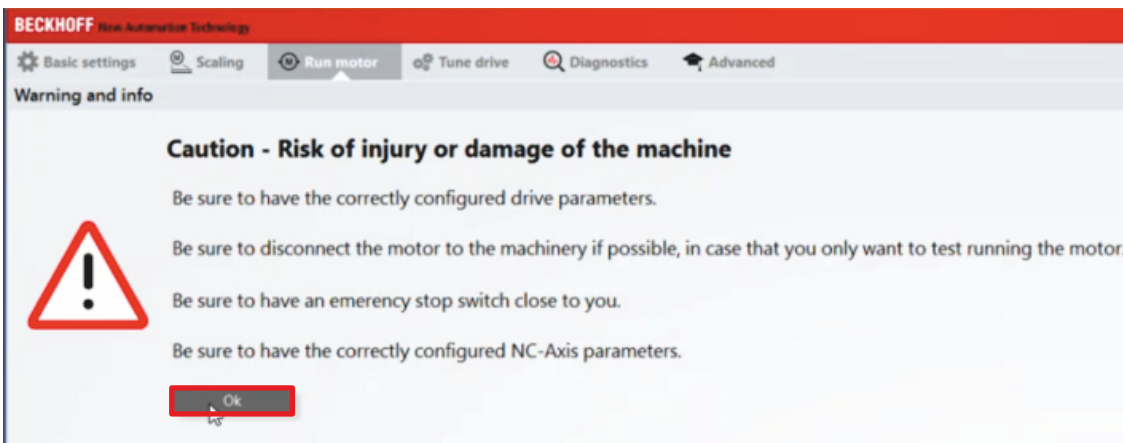
2.10 Let motor traverse



1. Open the ChA channel in the Drive Manager

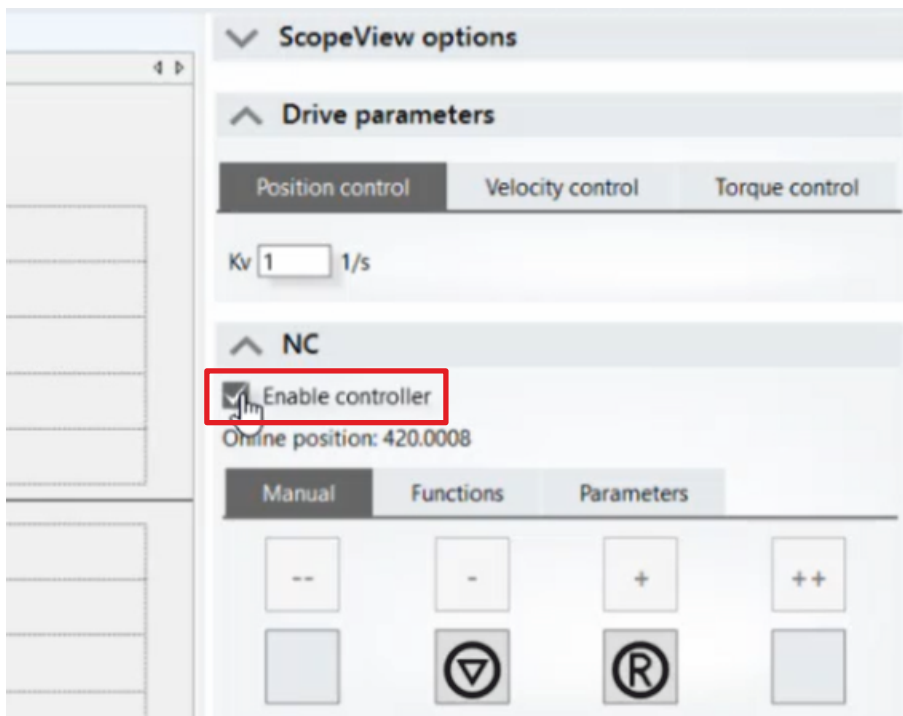


2. Open the tab "Run Motor"

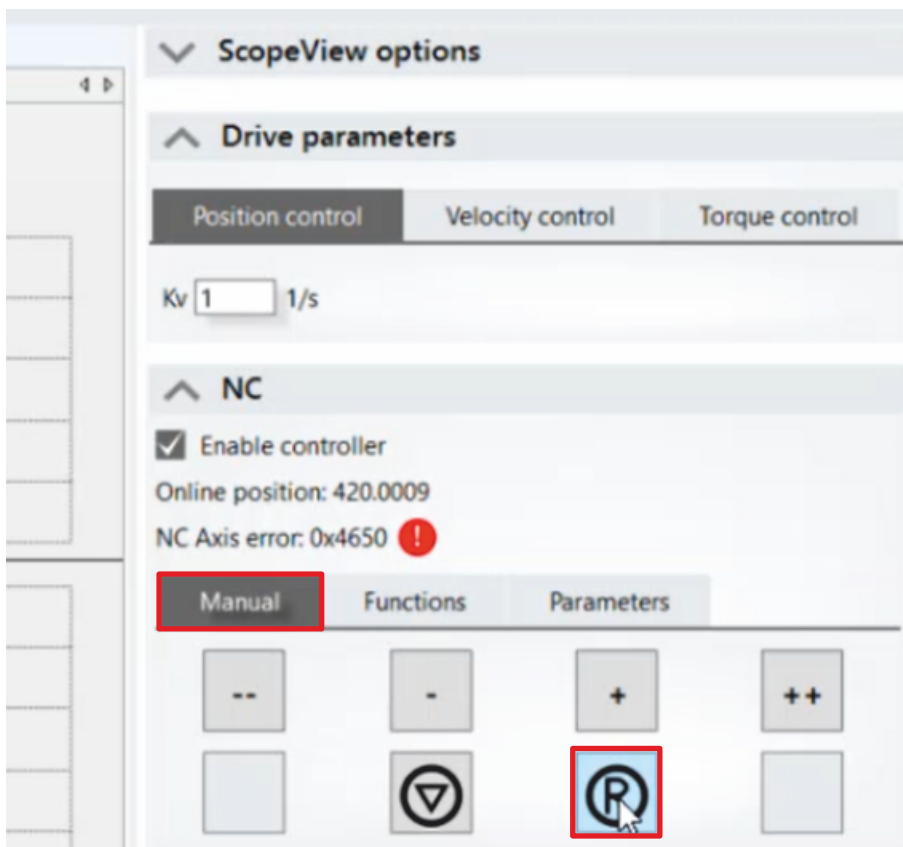


A warning message appears. Since this application is a demo system, there is no danger here.

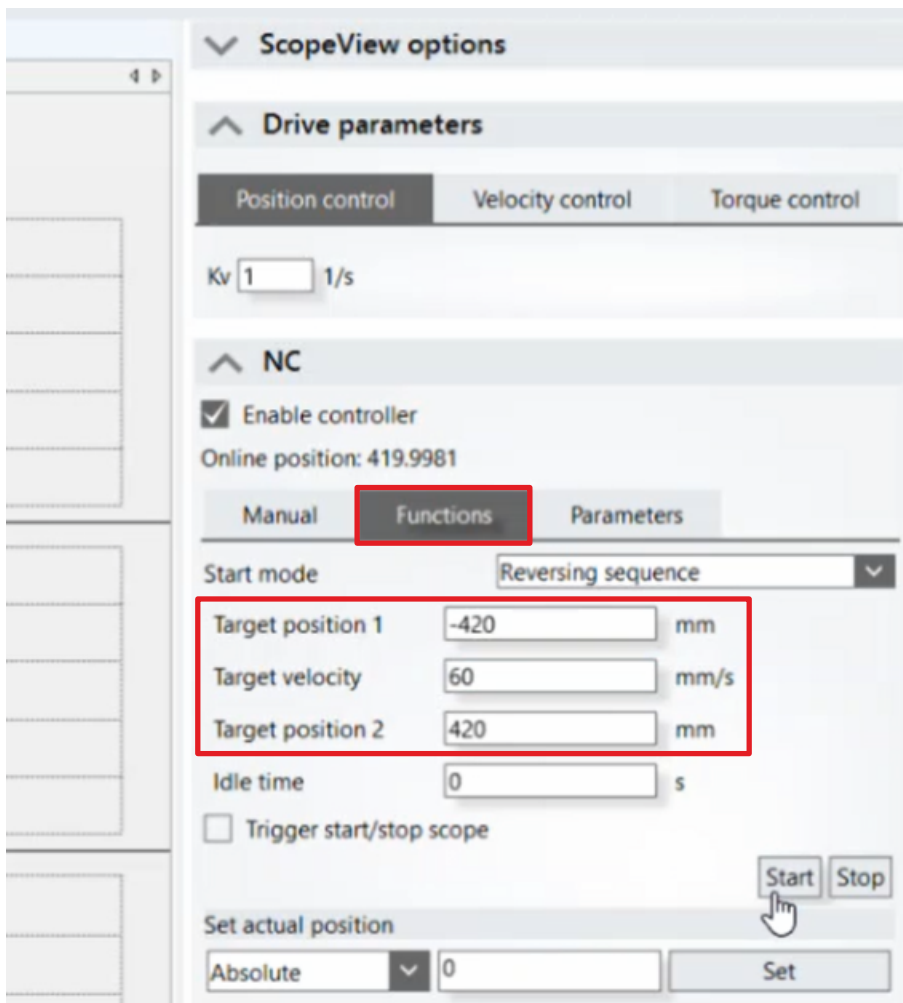
3. Close the warning with "OK"



4. Click the box "Enable controller" in the field "NC"



5. Click on the "R" symbol in the "Manual" tab to reset the error

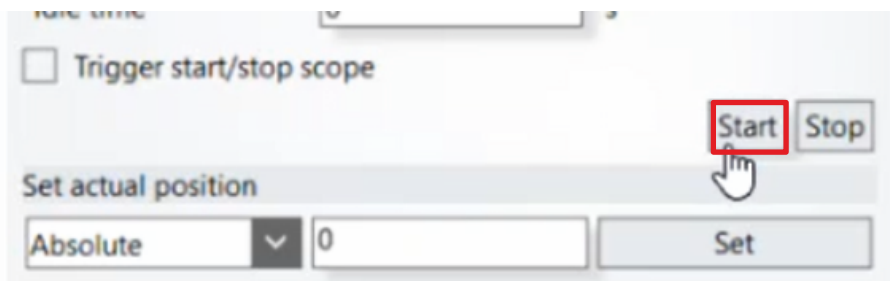


6. Open the "Functions" tab

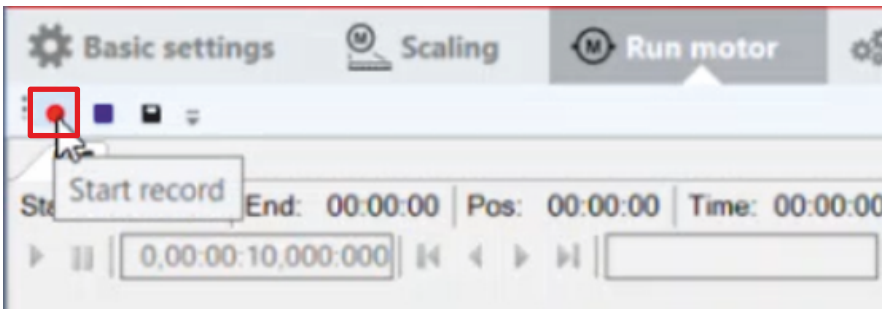
In the "Functions" tab, now configure the movement.

7. Enter the following values:

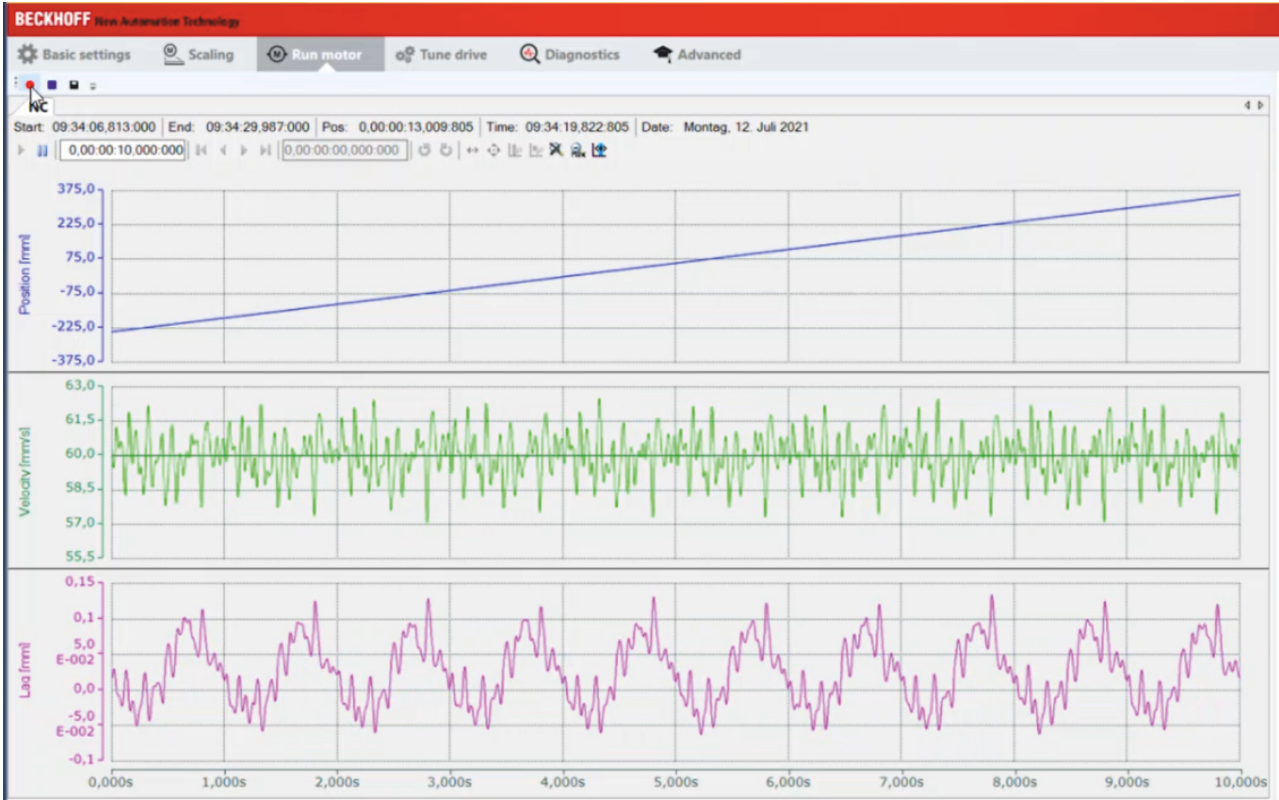
Setting	Value
Target position 1	-420 mm
Target velocity	60 mm/s
Target position 2	420 mm



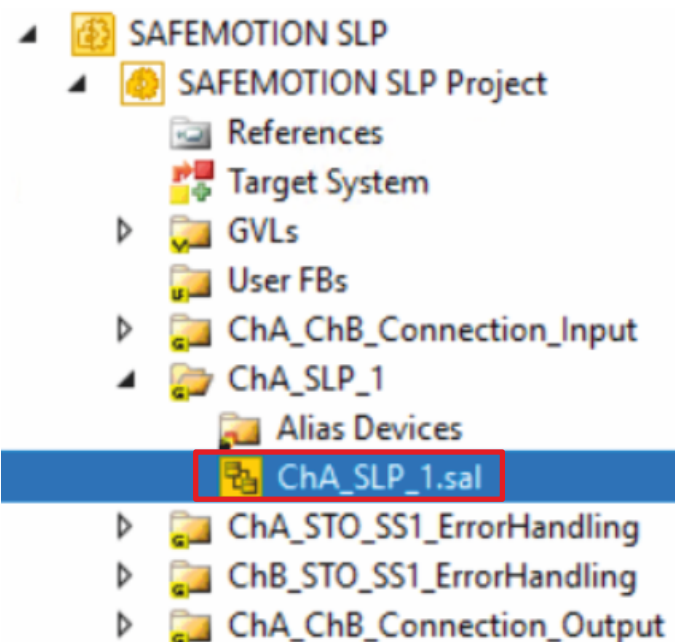
8. Click on "Start"



9. Click on the "Start record" field to start the Drive Manager Scope

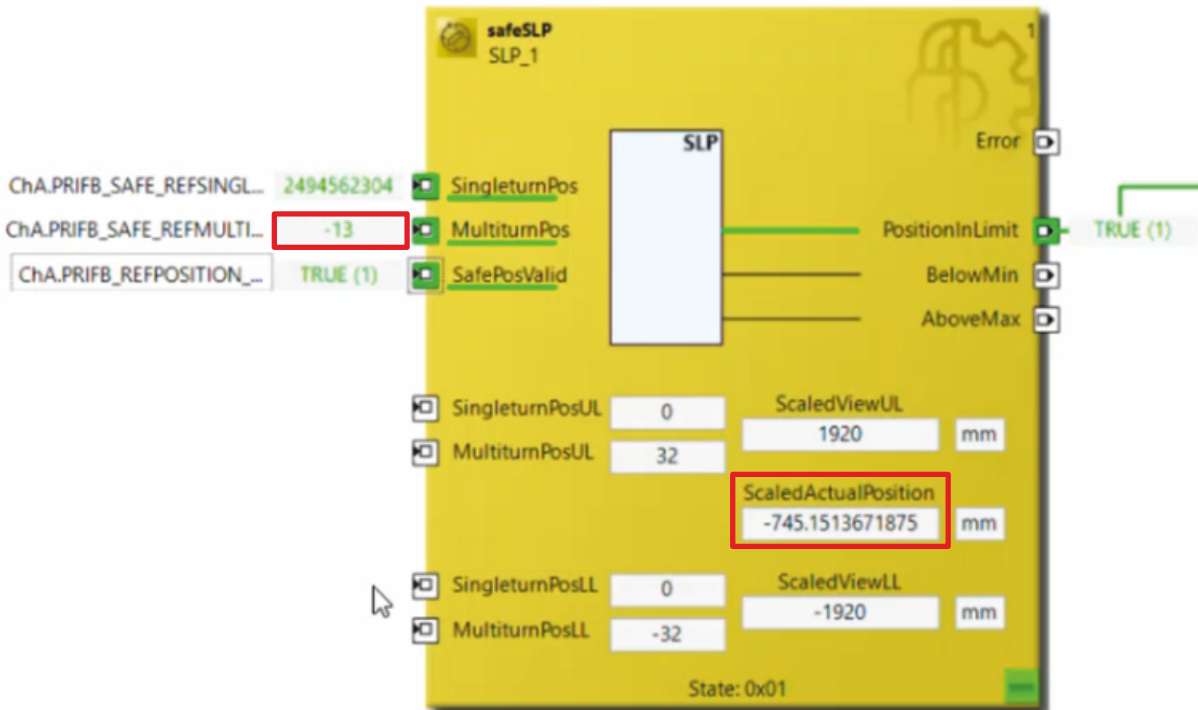


You will now see how the motor traverses.



10. Open the file "ChA_SLP_1.sal"

- 11. Right-click on a variable in the online view
- 12. Click on "Show Online Data"

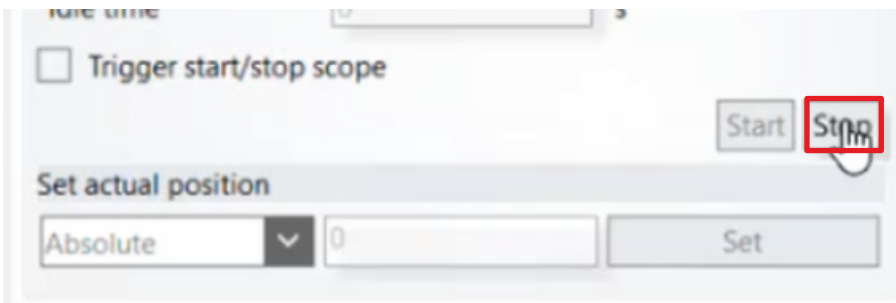


In the "ScaledActualPosition" field, you can see how the motor moves back and forth between -840 and 0 from a safety point of view.

At the variable REFMULTITURN you see the motor revolutions.

To stop the motor again, proceed as follows:

- 13. Open the tab "Run Motor" in the Drive Manager in channel ChA



- 14. Click on "Stop" in the "Functions" tab

Now you can continue with the further commissioning.

More Information:
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