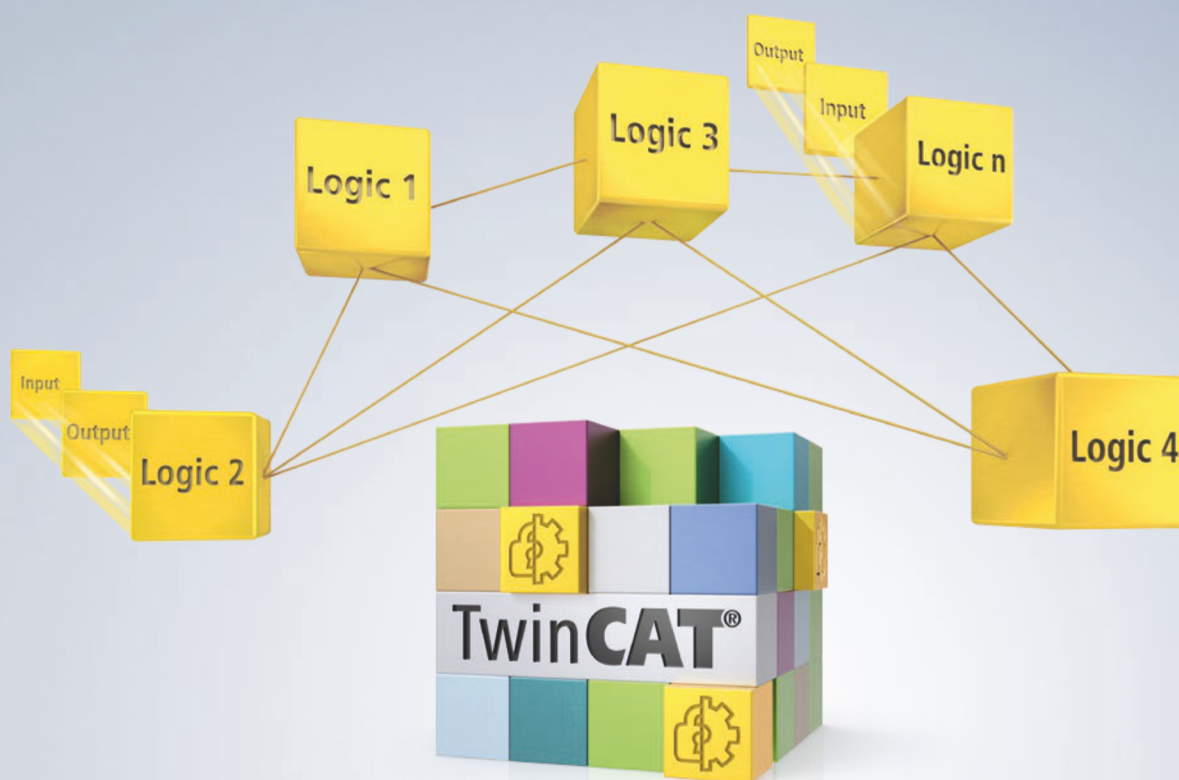


TwinSAFE Tutorial 9 | EN

# SafeMotion Wizard

Realization of a Safe Brake Test (SBT)





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# 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 9 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 extending an existing SafeMotion Wizard project with SBT functionality.

## 1.1 Issue statuses

Version	Comment
1.1.0	<ul style="list-style-type: none"><li>• New cover sheet</li><li>• Formula for torque calculation changed</li></ul>
1.0.0	<ul style="list-style-type: none"><li>• First released version</li></ul>
0.0.1	<ul style="list-style-type: none"><li>• First draft</li></ul>

## 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
- Motor with integrated holding brake

## 1.3 Starting point

At the starting point of the tutorial

- a TwinCAT 3 project with standard PLC exists,
- an EL6910 project exists,
- an AX8000 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
- Motor with integrated holding brake

### 1.4.2 Desired safety functionality

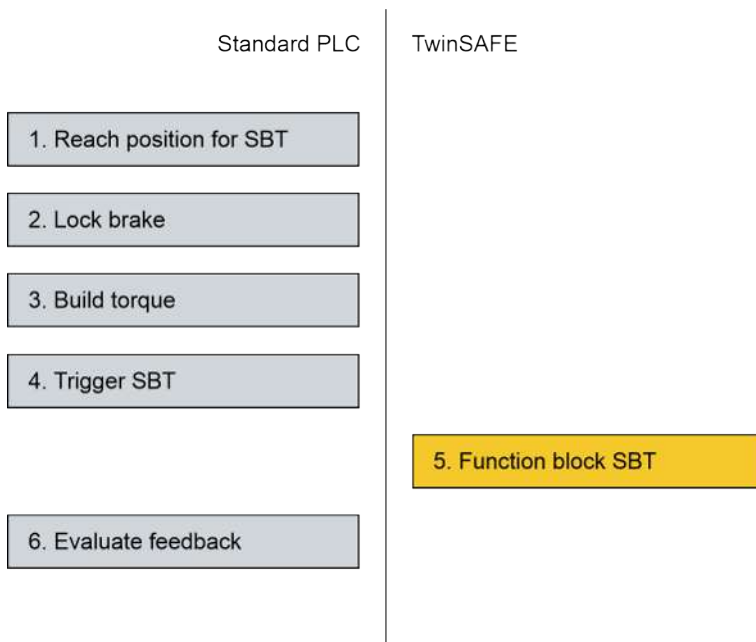
This tutorial describes the realization of the following safety functionality:

- Performing a brake test as requested from the standard PLC and the EL6910.

## 1.5 Approach SBT

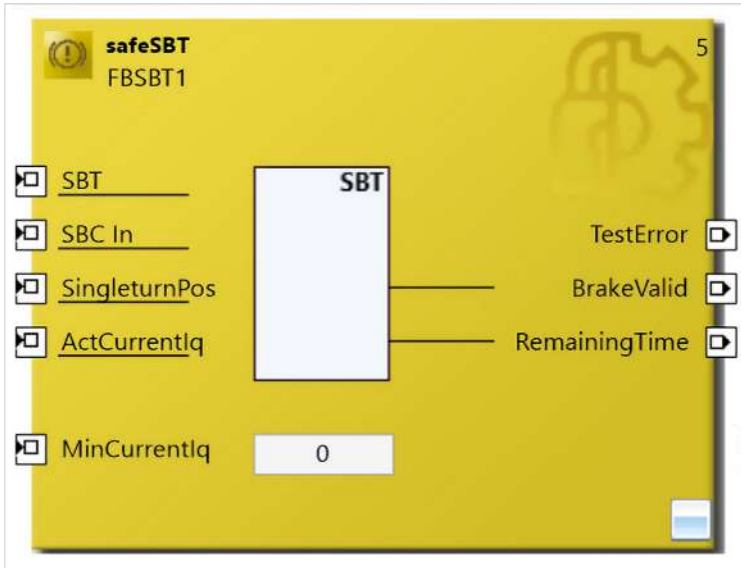
### 1.5.1 Function

The Safe Brake Test is based on a direct interaction between the standard PLC and the safety.



The main part of the brake test consists of PLC code. In the standard PLC, the functional test is executed. On the safety side, the brake test is monitored by a single safety-related function block.

### 1.5.2 Function block



#### Inputs

Input	Function
SBT	Request SBT
SBC	Information whether the brake is closed
SingleturnPos	Safe position information
ActCurrentIq	Torque-forming current
MinCurrentIq	Minimum required torque for SBT

#### Outputs

Input	Function
TestError	Error during SBT
BrakeValid	Test result
RemainingTime	Remaining term until next SBT

### 1.5.3 Function block parameters

In the function block parameters you can make the following SBT settings.

Parameter Setting	
Brake Test Interval	28800
Max Duration	200
Max Position Deviation	0
Min Duration	10

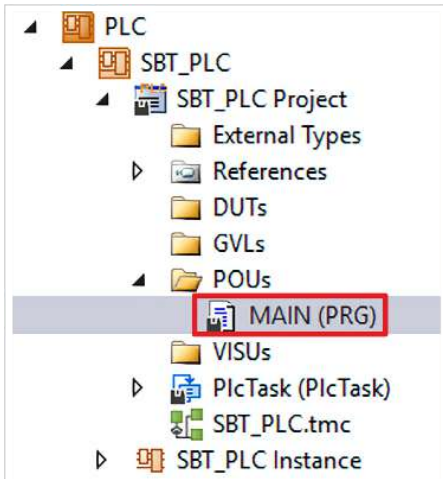
Parameter	Function
Brake Test Interval	Maximum time between 2 runs (for example 1 time per 8 hours)
Max Duration	Maximum time for SBT
Max Position Deviation	Maximum allowed deviation of position information
Min Duration	Minimum time for test torque application

## 2 Demonstration

### 2.1 Configure SBT

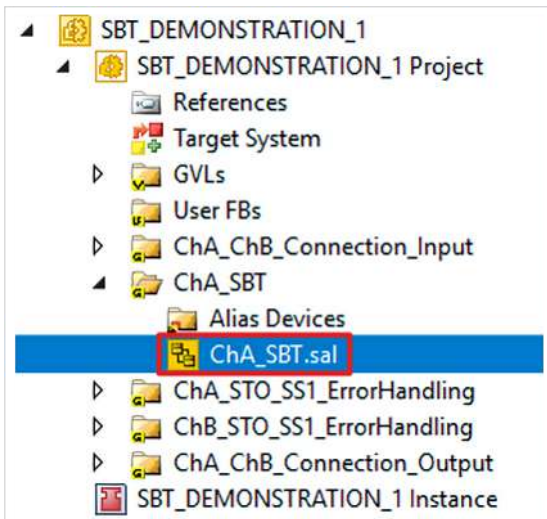
This chapter is about the configuration of the SBT functionality.

#### 2.1.1 Add FBs



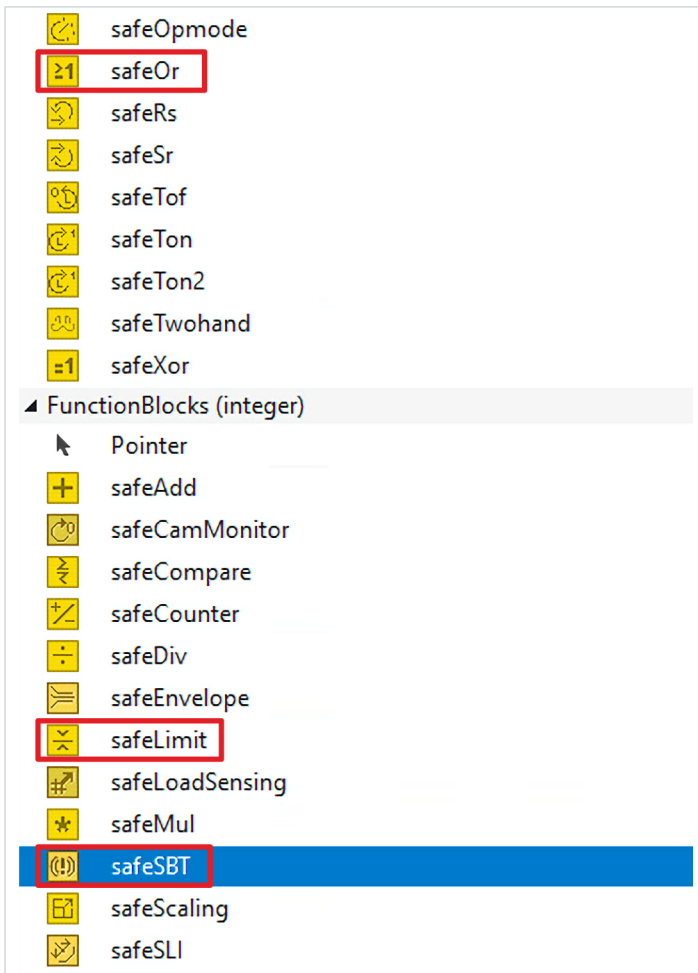
You see your TwinCAT 3 solution with the standard PLC, in which a State Machine is implemented, with which the brake test is controlled.

Proceed as follows to configure SBT in terms of safety:

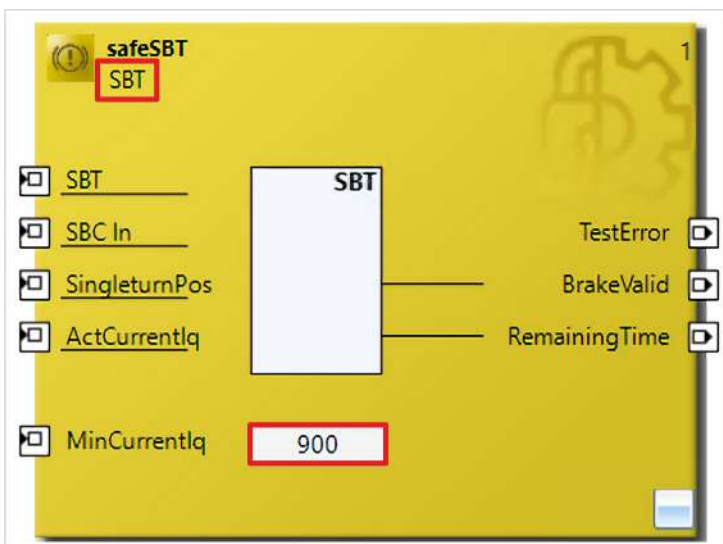


1. Open file "ChA\_SBT.sal"



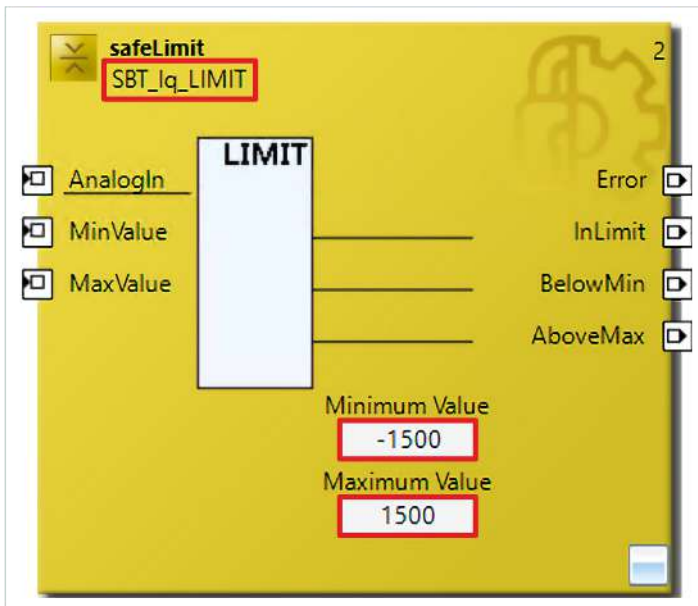


2. Add the block safeSBT to the network from the toolbox
3. Add FB safeLimit
4. Add FB safeOr
5. Add a second FB safeOr



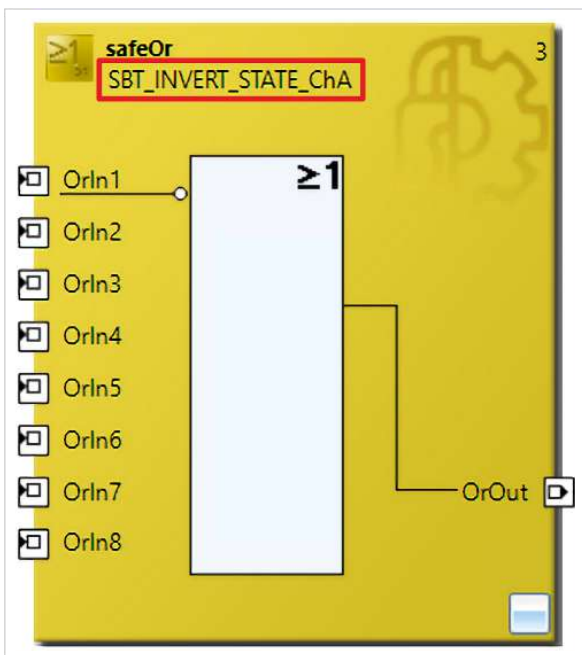
6. Rename safeSBT as shown
7. Adjust the limit torque as shown

The SBT checks if there is more than the limit torque when the brake is applied. The calculation follows in chapter [Further information \[► 24\]](#).



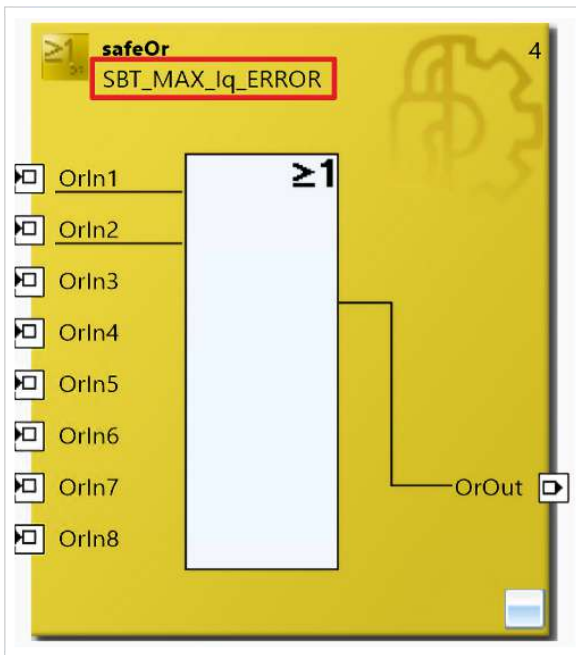
8. Rename safeLimit
9. Adjust the maximum value and the minimum value as shown

The torque is limited by these values.



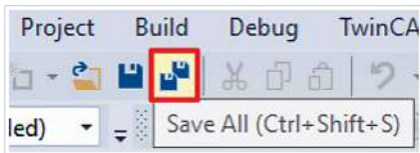
10. Rename the first safeOr

With the first safeOr block the signal is inverted and the SBT status is given to the outside.



11. Rename the second safeOr

With the second safeOr the SBT request is linked to the limit FB.

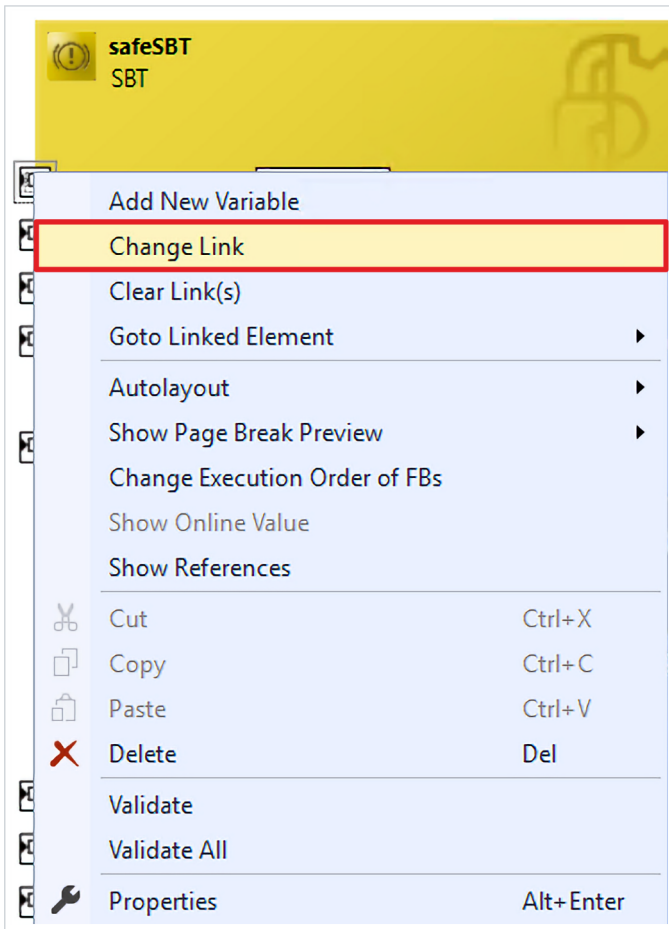


12. Click on "Save all" in the menu bar to save the settings

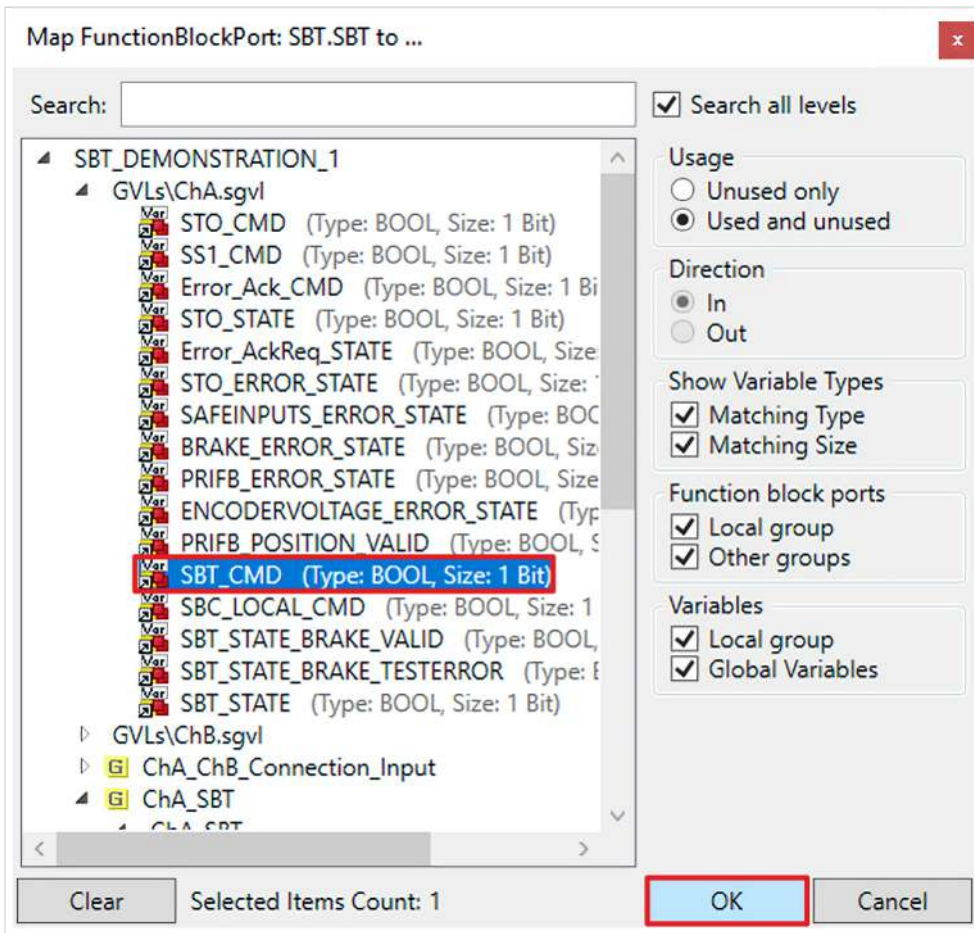
## 2.1.2 Link FB inputs

This chapter describes the linking of the inputs of the SBT functionality.

The procedure is identical for all inputs and is shown here as an example using the screenshots for one input.

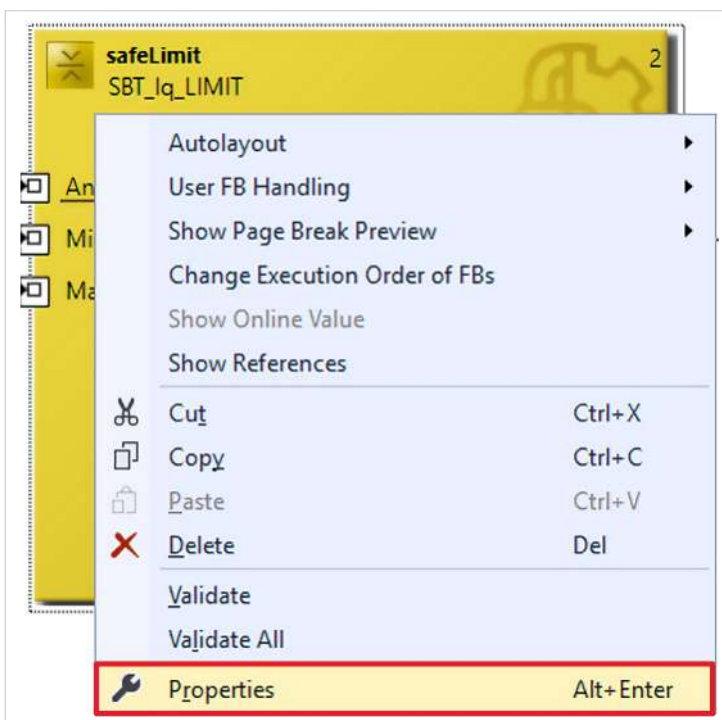


1. Right click on an input
2. Click on "Change Link"

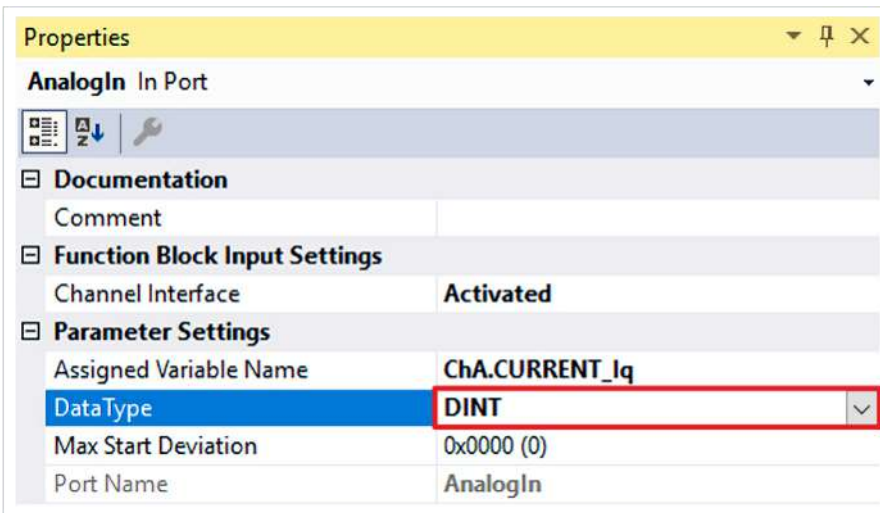


3. Select variable
4. Confirm selection with “OK”
5. Link inputs of FB1 according to steps 1 to 4 as shown in table

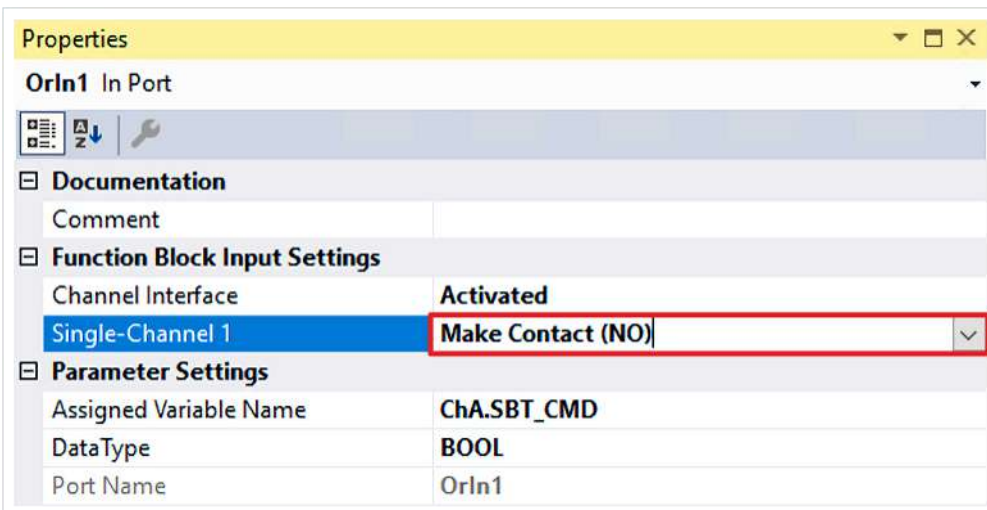
Before you continue with the linking at FB2, first change the data type of the input AnalogIn as follows:



6. Right click on the input AnalogIn
7. Click on “Properties”



8. Select "DINT" for DataType in the properties field
9. Go through steps 1 to 4 for the AnalogIn input of FB2
10. Go through steps 1 to 4 for the OrIn1 input of FB3
11. Click on input OrIn1



12. Select "Make Contact (NO)" in the properties field for single channel 1 to negate the signal

This results in the following links for the individual inputs of the FBs:

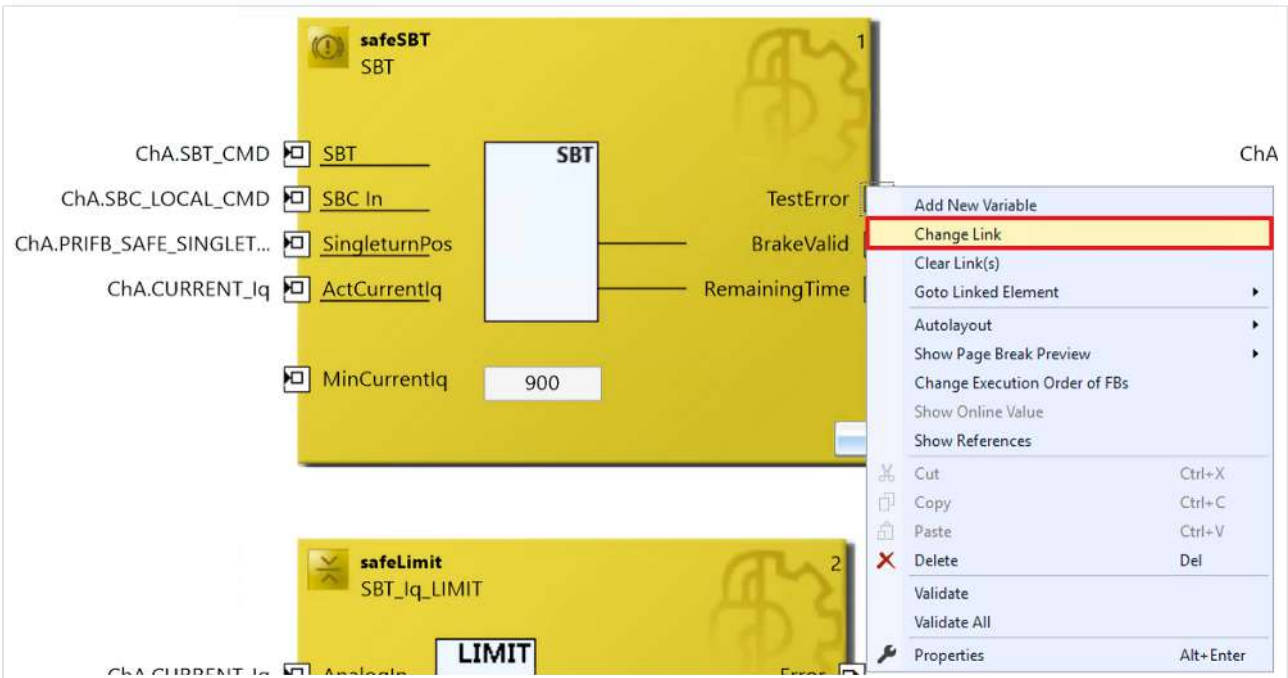
FB	Input	Variable
1	SBT	SBT_CMD
	SBC_In	SBC_LOCAL_CMD
	SingleTurnPos	PRIFB_SAFE_SINGLETURNPOSITION
	ActCurrentIq	CURRENT_Iq
2	AnalogIn	CURRENT_Iq
3	OrIn1	SBT_CMD

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

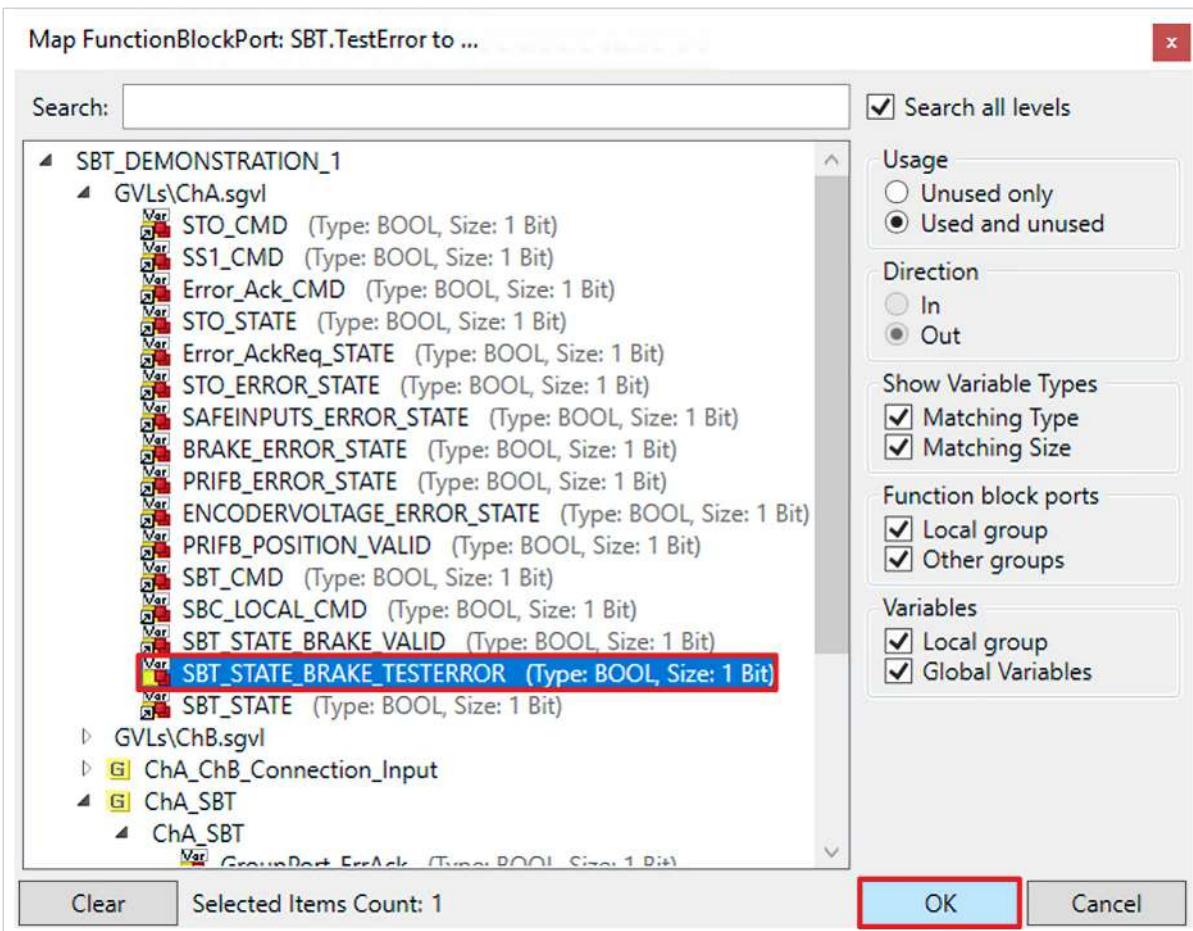
### 2.1.3 Link FB outputs

This chapter describes the linking of the outputs of the SBT functionality.

The procedure is identical for all outputs and is exemplified here with the screenshots for one input.



- 1. Right click on an output
- 2. Click "Change Link"



- 3. Select variable

4. Confirm selection with "OK"

The following links result for the individual outputs of the FBs:

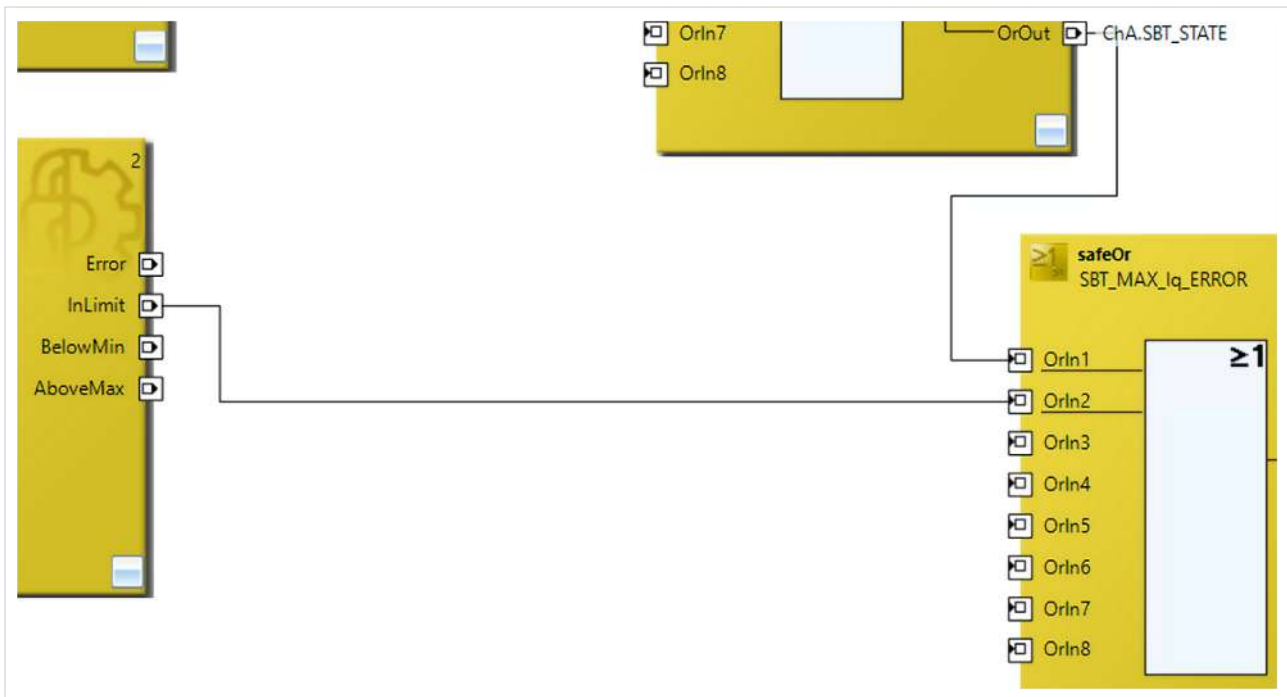
<b>FB</b>	<b>Output</b>	<b>Variable</b>
1	TestError	SBT_STATE_BRAKE_TESTERROR
	BrakeValid	SBT_STATE_BRAKE_VALID
	RemainingTime	SBT_STATE_BRAKE_REMAINING_TIME
3	OrOut	SBT_STATE
4	OrOut	MonIn4

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



### 2.1.4 Connect FBs

Next, connect the FBs as follows:



1. Connect output OrOut of FB3 with input OrIn1 of FB4
2. Connect output InLimit of FB2 with input OrIn2 of FB4
3. Click on "Save all" in the menu bar to save the settings

## 2.1.5 Set deviation

The last step in the SBT configuration is to set the permitted deviation.

1. Click on the safeSBT block for this purpose

The screenshot shows a configuration window titled 'Properties' for the 'FBSBT1 FBSBT' block. The window is divided into several sections: 'Documentation', 'Info Data', 'Misc', 'Parameter Setting', and 'Properties'. The 'Parameter Setting' section is expanded, showing a list of parameters. The 'Max Position Deviation' parameter is highlighted in blue, and its value '3' is enclosed in a red rectangular border. Other parameters include 'Brake Test Interval' (28800), 'Max Duration' (200), and 'Min Duration' (10). The 'Properties' section at the bottom shows 'Function Name' as 'safeSBT' and 'Instance Name' as 'SBT'.

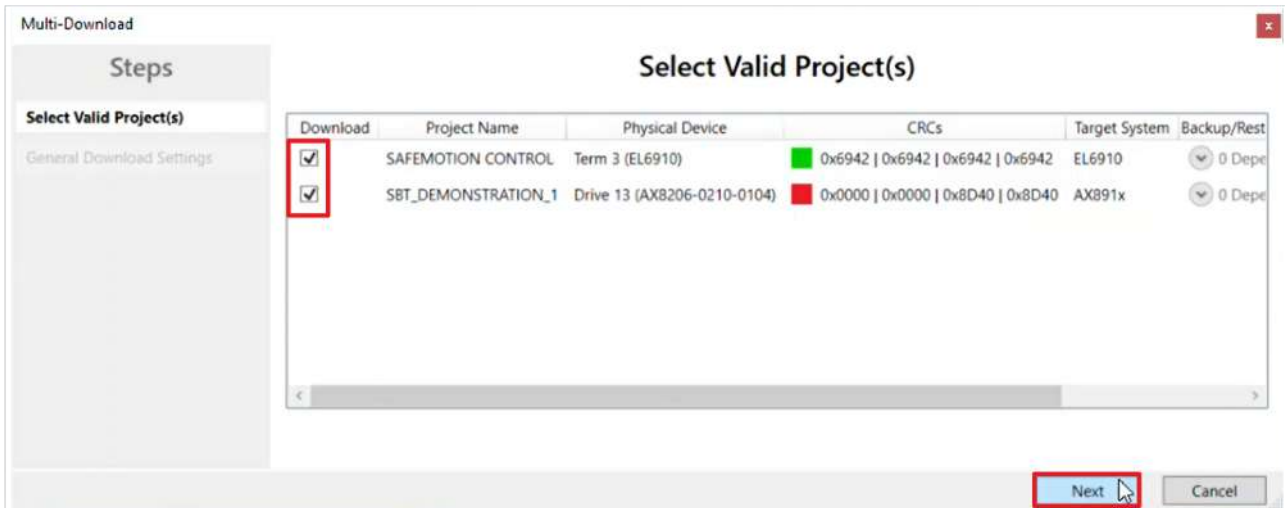
Documentation	
Comment	
Info Data	
Map Diag	False
Map State	False
Misc	
Order Of Execution	1
Parameter Setting	
Brake Test Interval	28800
Max Duration	200
Max Position Deviation	3
Min Duration	10
Properties	
Function Name	safeSBT
Instance Name	SBT

2. Set the “Max Position Deviation” parameter in the properties field as shown in the figure
3. Click on “Save all” in the menu bar to save the settings

## 2.2 Download safety projects

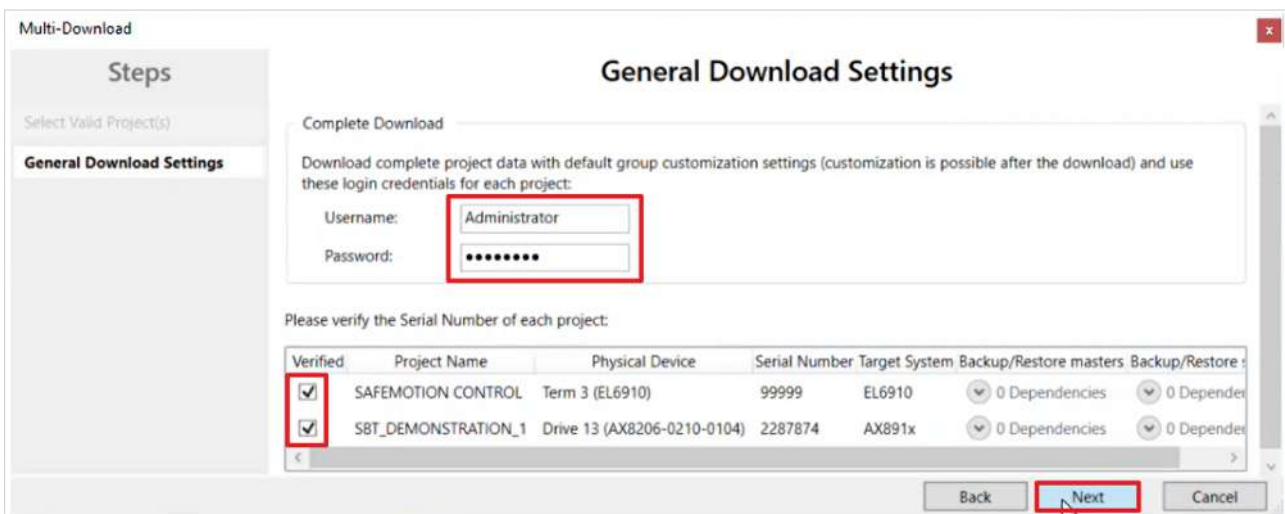


1. Click on “Multi-Download Safety Project(s)”



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 selection with “Next”

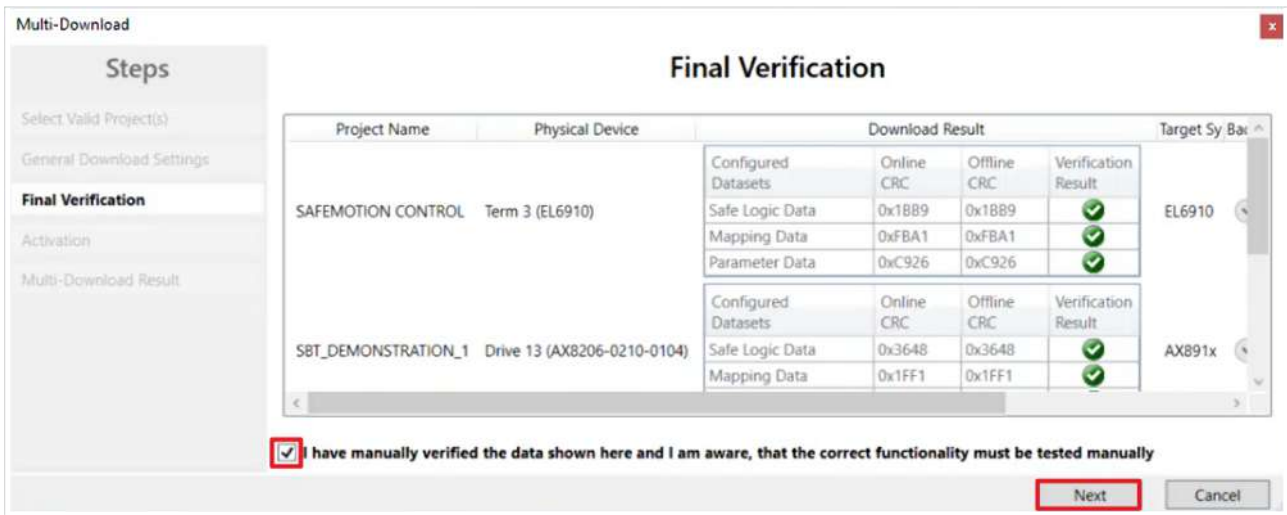


4. Enter the username and password in the “General Download Settings” window

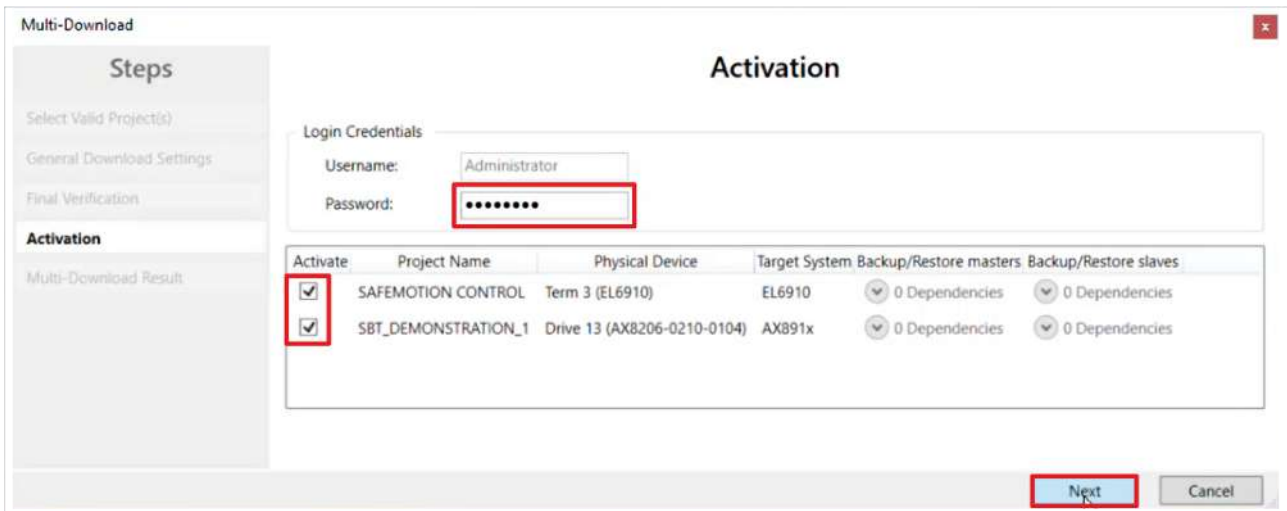
Default username: Administrator

Default password: TwinSAFE

5. Select the safety projects that you want to download
6. Confirm selection with “Next”

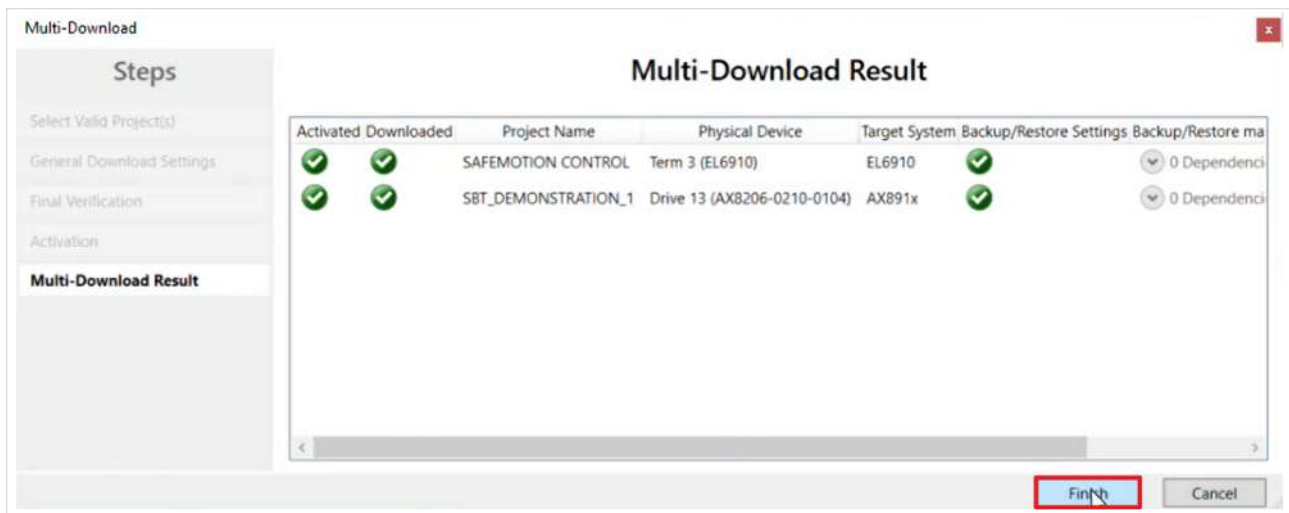


- 7. Check the CRCs in the “Final Verification” window
- 8. If the CRCs match, click on the box to confirm the verification
- 9. Confirm window with “Next”



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

- 10. Enter the default password
- 11. Check if the safety projects are selected
- 12. Confirm selection with “Next”



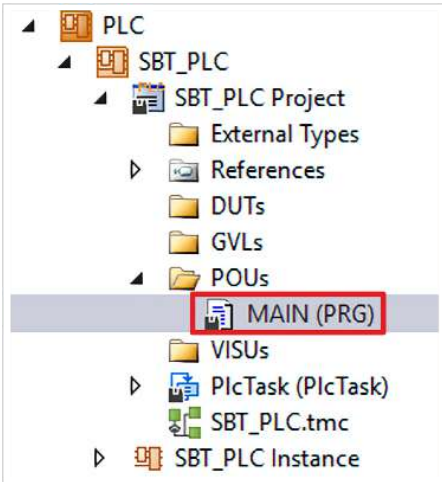
13. Close the window “Multi-Download Result” with “Finish”

14. Click “Save all” in the menu bar to save the settings

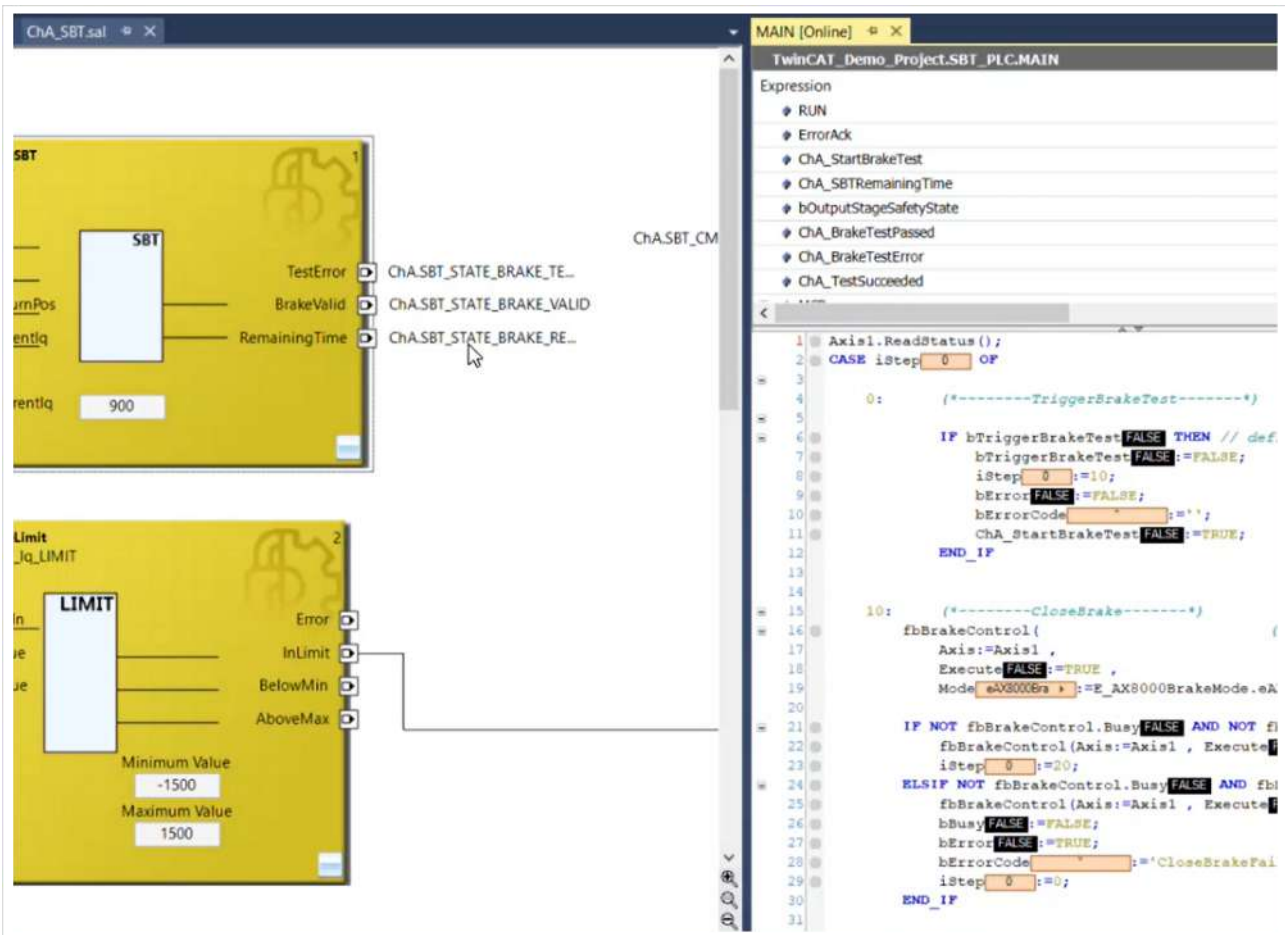
Your safety projects are now downloaded and active.

## 2.3 Control SBT

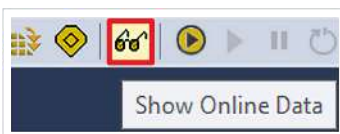
Proceed as follows to control an SBT:



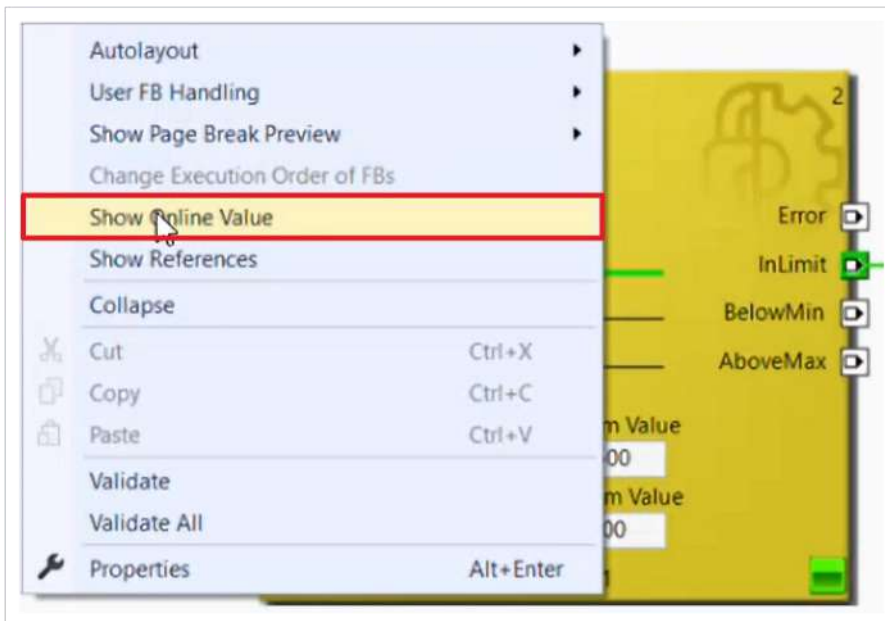
1. Open the file “MAIN (PRG)” in the PLC folder



2. Arrange view “MAIN (Online)” to the right of the network



3. Click on “Show Online Data” in the menu bar to activate the online view



4. Right click in the network
5. Click "Show Online Value"

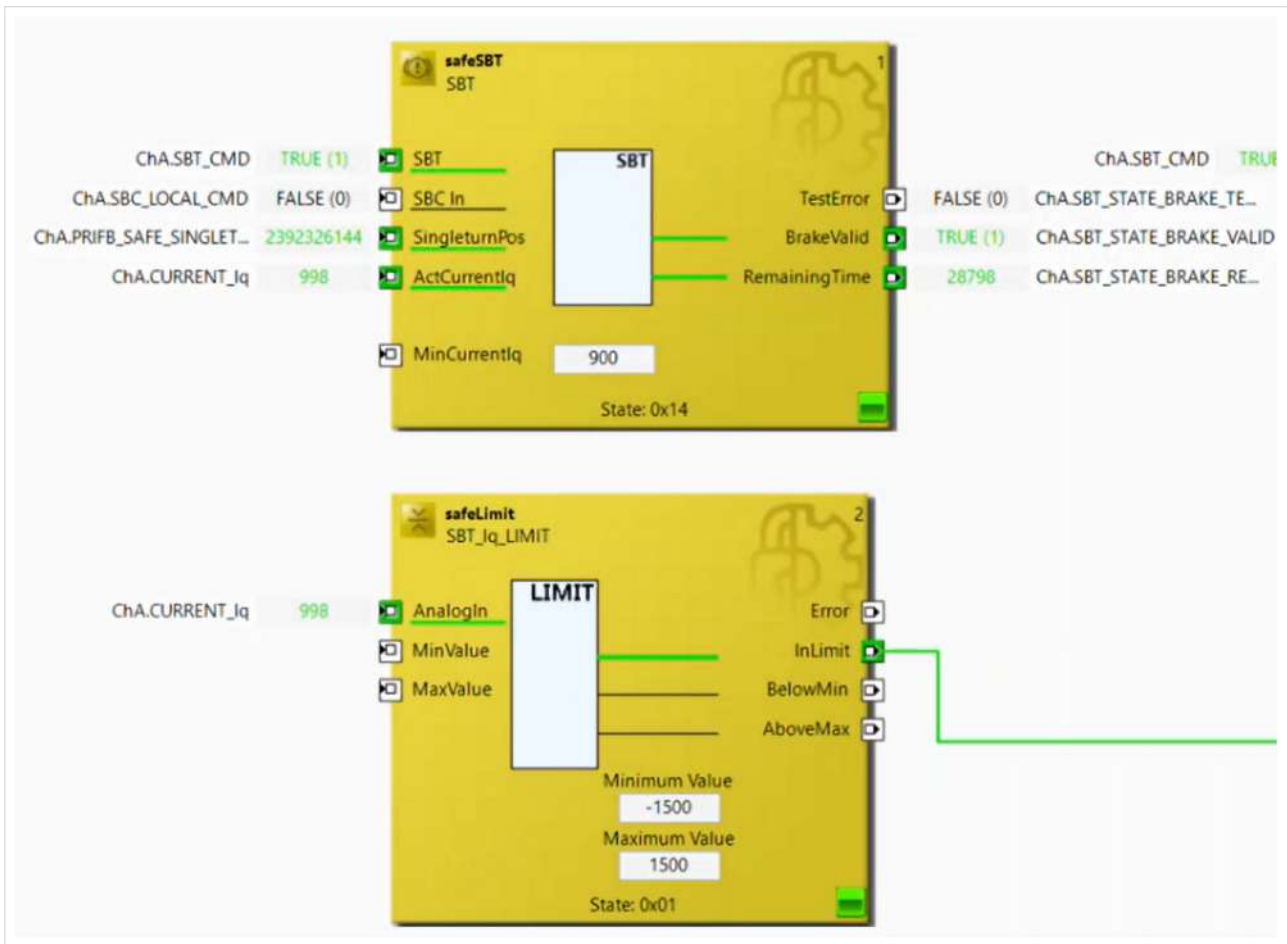
You will now see the analog values of your application.

```

3
4      0:      (*-----TriggerBrakeTest-----*)
5
6      IF bTriggerBrakeTest FALSE THEN // define
7          bTriggerBrakeTest FALSE := FALSE;
8          iStep 30 := 10;
9          bError FALSE := FALSE;
10         bErrorCode := '';
11         ChA_StartBrakeTest TRUE := TRUE;
12     END_IF
13

```

6. Set the value "bTriggerBrakeTest" to TRUE to trigger the brake test



In the online view you can now see that the SBT is activated. In addition, the torque-forming current rises above 900, the corresponding BrakeValid output is set to TRUE and the remaining time counts down the time to the next SBT.

The safeLimit FB shows no error message, which shows a successful SBT.

## 2.4 Further information

### Help with implementation

- Contact Drive Support for help with control from the standard PLC.
- Contact Safety Support for help with using SBT.

### Determining the minimum torque

You must first determine the minimum Torque for SBT in functional control.

You calculate the torque in Safety using the following formula:

$$Torque_{safety} = Torque_{functional} * \sqrt{2}$$





More Information:  
[www.beckhoff.com/twinsafe/](http://www.beckhoff.com/twinsafe/)

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