Controlling SINAMICS S210 Safety Integrated Functions using SIMATIC S7-1500TF via PROFIsafe

SINAMICS S210, SIMATIC S7-1500TF

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1 Introduction

1.1 Overview

SIMATIC S7-1500 PLCs support connecting drives operating as speed axis, positioning axis or synchronous axis via PROFINET, PROFIBUS or an analog drive interface. In the TIA Portal, a SINAMICS S210 drive can be controlled in a TIA Portal program and can be operated using motion control instructions.

In addition to the standard drive functions, using an F-PLC, the Safety Integrated Functions of a SINAMICS S210 can be controlled using PROFIsafe.

Two SINAMICS S210 devices are used in this application example.
The drives are commissioned as described in the application example "Configuring technology objects with SIMATIC S7-1500 and SINAMICS S210 in the TIA Portal" (\3\).

In addition, an Emergency Stop is used to select the Safety Integrated Function SS1E and an RFID to select the Safety Integrated Function SLS.

Commissioning Safety Integrated and the necessary steps are described in this document.

The figure below provides an overview of the basic design.

Fig. 1-1 Overview of the components
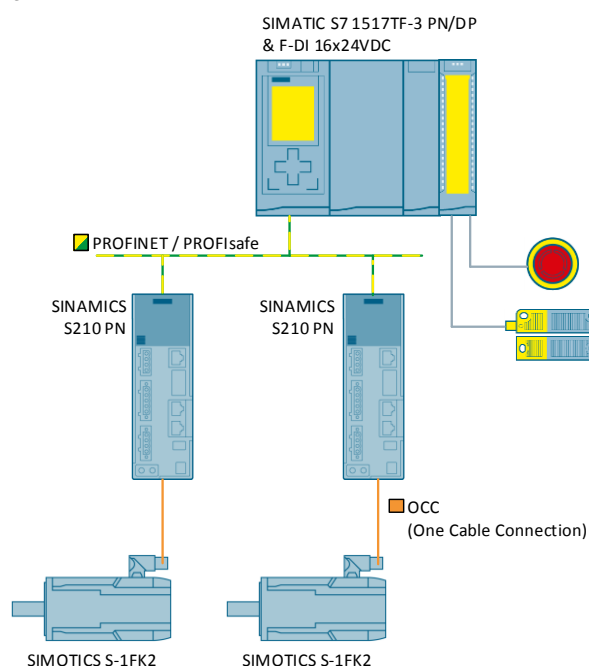
The application example describes the following aspects:

- Adapting the configuration of the TIA Portal
- Configuring Safety Integrated Functions in the drive
- Interaction between Safety Integrated and technology objects

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1.2 Components used

This application example has been created with the following components:

Hardware/software components

Table 1-1: Components used

Component	Number	Article number	Note
SIMATIC S7-1500 PLC 1517TF-3 PN/DP	1	6ES7517-3UP00-0AB0	Firmware V2.5
SIMATIC S7-1500, F-digital input module, F-DI 16x 24VDC	1	6ES7526-1BH00-0AB0	Firmware V1.0
SINAMICS S210 PN 200V	2	6SL3210-5HB10-1UF0	Firmware V5.1 SP1
SINAMICS SD CARD 512 MB, with FW 5.2 SP1 including Extended Safety License	2	6SL3054-4FB10-2BA0-Z F01	Alternative SD card empty 6SL3054-4AG00-2AA0 Extended Safety License 6SL3074-0AA10-0AA0
SIMOTICS S-1FK2 motor	2	1FK2104-4AK10-0MA0	-
STEP 7 Professional V15.1	1	6ES7822-1..05-….	-
STEP 7 Safety Advanced V15.1	1	6ES7833-1FA15-0YH5	-
STEP 7 SIMATIC Startdrive Advanced V15.1	1	6SL3072-4FA02-0XG5	Required for acceptance test

Note	If you still do not have a license – however, you wish to set up and test functions that require a license – then you have the option of activating the Trial License Mode. Details on this are listed in Chapter "6.6.3 Using functions that require a license" in the Operating Instructions Safety Integrated of the SINAMICS S210 (\4\).

Documentation and sample project

Table 1-2: Documentation and sample project

Component	File name
Documentation	109760341_SafetyS210_TO_Axis_DOC_V11_en.pdf
TIA project For the commissioning of the SINAMICS S210 via web server	109760341_SafetyS210_TO_Axis_PROJ_V10.zap15
TIA project For the commissioning of the SINAMICS S210 via Startdrive	109760341_SafetyS210_TO_Axis_PROJ_V11.zap15_1

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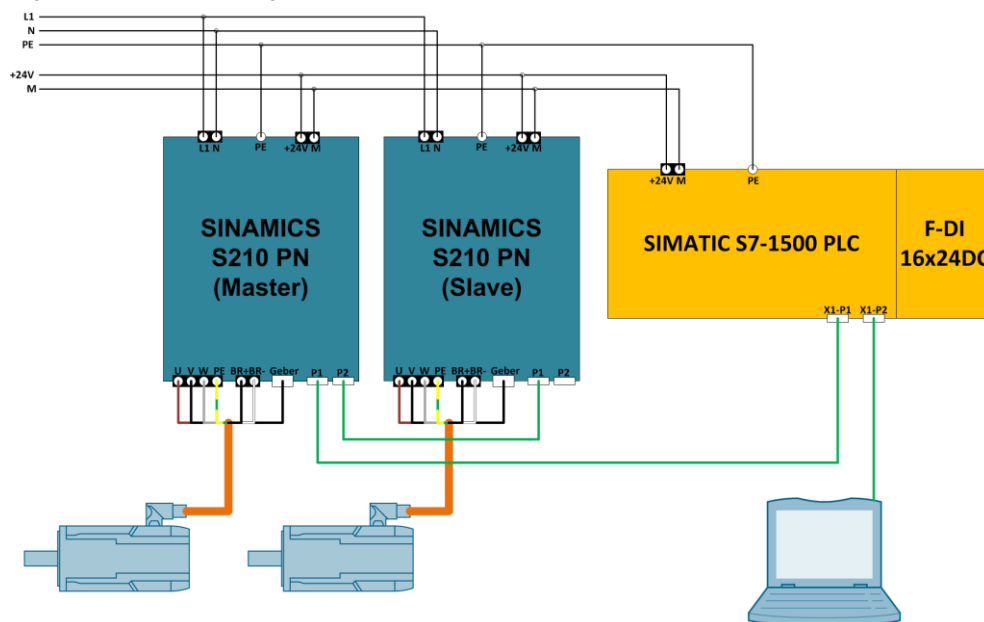Article ID: 109760341, V1.11, 10/20199

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1.3 Installation

The following figure shows the hardware configuration of the application example:

NOTICE	**Incorrect wiring can damage the drive!**
	In this particular example, a 1-phase 230 V power supply is used. Please carefully check the supply voltage; otherwise, the drives could be damaged!

Fig. 1-2: Hardware configuration

Additional connection options for the SINAMICS S210 are listed in detail in the operating instructions of the SINAMICS S210, Chapter, System overview (\4\).

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2 Fundamentals

2.1 Safety Integrated Functions of the SINAMICS S210

SINAMICS S210 makes a distinction between Safety Integrated Basic Functions and Safety Integrated Extended Functions.
The Safety Integrated Basic Functions are part of the standard scope of the drive.
For the Safety Integrated Extended Functions a license is required for each drive.

The following Safety Integrated Functions according to DIN EN 61800-5-2 are integrated in SINAMICS S210 drives:

Table 2-1 Safety Integrated - function overview

	Name	Function	Description
Basic functions	STO	Safe Torque Off	Safely disconnects the torque-generating energy feed to the motor.
			The switching on inhibited function prevents the drive unit from being switched on again. (Category 0 stop function according to EN 60204-1)
	SS1	Safe Stop 1	The drive is quickly and safely stopped along the OFF3 ramp and safely monitored. Transition to STO after a delay time has expired or the shutdown speed has been reached.
			(Category 1 stop function according to EN 60204-1)
	SBC	Safe Brake Control	SBC is only used when there is a motor brake.
			SBC always responds in conjunction with STO.
Extended Functions	SS2	Safe Stop 2	The drive is quickly and safely stopped along the OFF3 ramp and safely monitored.
			After a delay time has expired, a transition is made to SOS; the drive remains in the closed-loop controlled mode. (Category 2 stop function according to EN60204-1)
	SOS	Safe Operating Stop	This function serves to safely monitor the standstill position of a drive; the drive remains in closed-loop control.
			The protected machine areas can be entered without having to shut down the machine as long as SOS is active
	SLS	Safely-Limited Speed	The drive speed is safely monitored. Parameterizable shutdown response when the limit value is violated. In the service mode, this allows machine operators to slowly operate the drive with the protective door open. You can switch between four SLS levels.
			The limit value of the first SLS level can be additionally specified using PROFIsafe telegram 901. This means that the SLS limit value can be dynamically adapted in operation.
	SSM	Safe Speed Monitor	Safely displays when the speed falls below a speed limit ($n < n_x$).
	SDI	Safe Direction	Safety monitors the motion direction (positive and negative directions).
			Parameterizable shutdown response when traversing in a direction that has not been enabled.
	SLA	Safely-Limited Acceleration	Safely-Limited Acceleration monitors the acceleration of the drive.

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	Name	Function	Description
	SBT	Safe Brake Test	Check the holding torque of the motor holding brake.
			A safe brake can be implemented with the SBC and SBT functions.
			The Safe Brake Test (SBT) diagnostic function is suitable for safety functions with a mechanical brake up to category 2 in accordance with ISO 13849-1. This diagnostic function goes beyond the scope of DIN EN 61800-5-2.

Detailed information on the various functions and their scope is provided in the SINAMICS S210 operating instructions (\4\).

2.2 Interaction between Safety Integrated Functions and technology objects

Technology objects (TOs) speed, positioning and synchronous axis support the "Safety Integrated Basic Functions" of the drive. The TO identifies when a Basic Safety Function is initiated, and signals this using an appropriate alarm (technology alarm 550 - alarm response: track setpoints) or alarm (technology alarm 421 - alarm response: withdraw enable).
In the user program - especially for technology alarm 550 - it is not permissible that input "Enable" of the motion control instruction "MC_Power" is set to "FALSE".

After acknowledging and enabling the drive using the actual safety function, at the TO involved, the technology alarm can also be acknowledged using the "MC_Reset" motion control instruction. After this, TO is automatically enabled under the assumption that "MC_Power.Enable" remained = "TRUE".
The TO itself does not support Safety Integrated Extended Functions. In this case, for example when selecting SLS in the user program, the speed must be reduced.

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3 Configuration in the TIA Portal

| Note	This application example is based on the application example "Configuring technology objects with SIMATIC S7-1500 and SINAMICS S210 in the TIA Portal" - in which commissioning the SINAMICS S210 and the S7-1500 are described (\3\).
	Only the steps necessary to commission Safety Integrated are subsequently described.

To control the Safety Integrated Functions via PROFIsafe, the LDrvSafe blocks from the application example "SIMATIC - failsafe library LDrvSafe to control Safety Integrated Functions of the SINAMICS" drive family are used (\5\).

The application example "Controlling the Safety Integrated Functions of the SINAMICS S120 with SIMATIC S7-1500F via PROFIsafe" can be used as example for possible interconnections (\6\).

3.1 F-activation of the F-PLC

Proceed as follows to activate the safety operating mode of the F-PLC:

1. Select "Properties" of the F-PLC under the "General" tab.
2. Select the setpoint "Fail-safe > F-activation"
3. Activate fail safety by clicking on "Enable F-activation".

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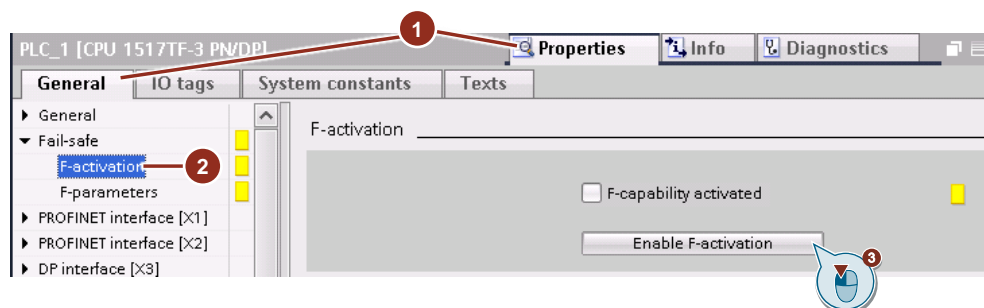
3.2 Defining protection levels

Proceed as follows to assign the necessary protection level and password for the F-PLC:

1. Switch to setpoint "Protection&Security"
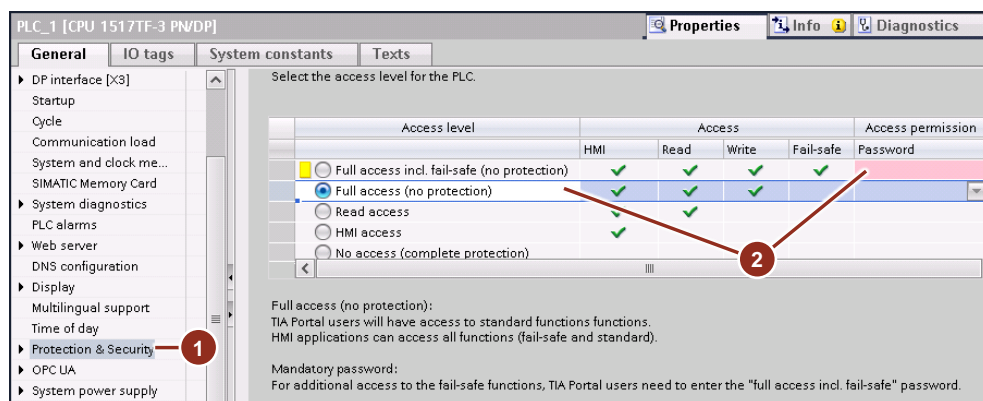2. Select the required access level and assign a password

⚠️ **WARNING**	**In the TIA project sample, access level "Full access including failsafe (no protection)" does not require a password to allow users unrestricted access.**
	However, in a practical environment, access to the failsafe area should be password protected.
	A password must be assigned when selecting an access level that is not equal to "Full access including failsafe (protection)".

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3.3 Inserting the F-DI module

Proceed as follows to configure an F-DI 16x24V DC module:

1. Switch to "Device configuration > Device view"

2. From the hardware catalog, add the F-DI 16x24V DC module

3. Under "Settings > General > Inputs 0 – 15 > F-parameters", set the required PROFIsafe address of the F-DI module; in the application example, an address of 100 is used.

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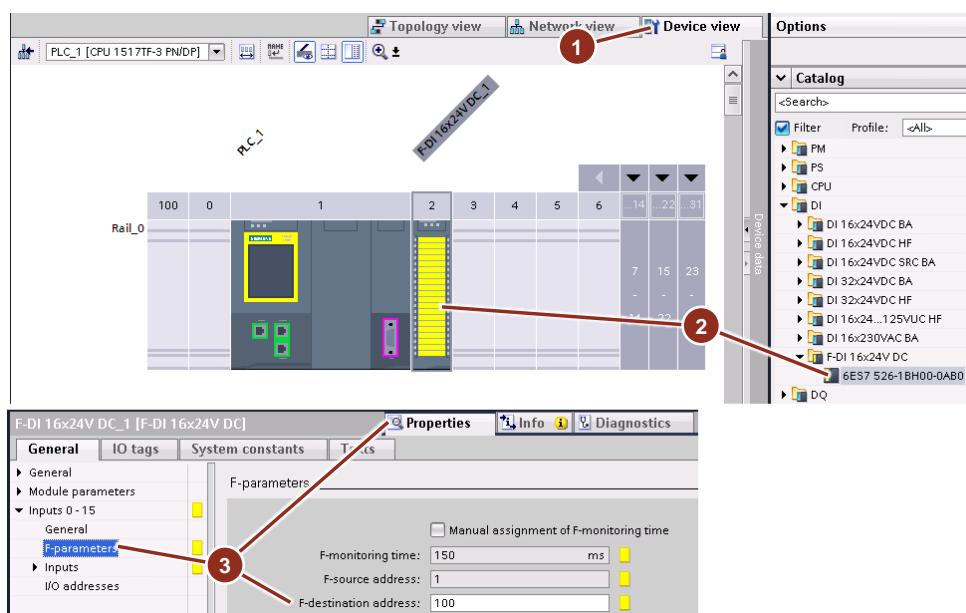
4. Switch to "Properties > General > Inputs 0 – 15 > Inputs > Channel parameters > Channel 1, 9"

5. There, set the discrepancy time to be taken into account, in the example 500ms is used; also make the settings for the other channels of the F-DI module that are used.

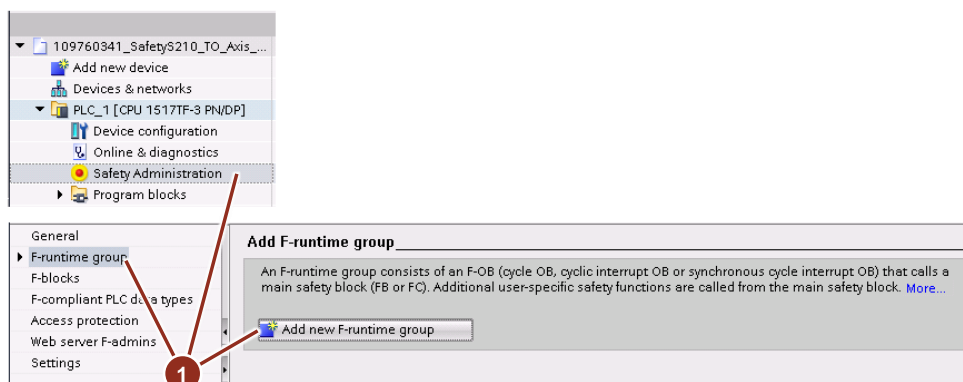| Note	The set discrepancy time may vary depending on the sensors used.
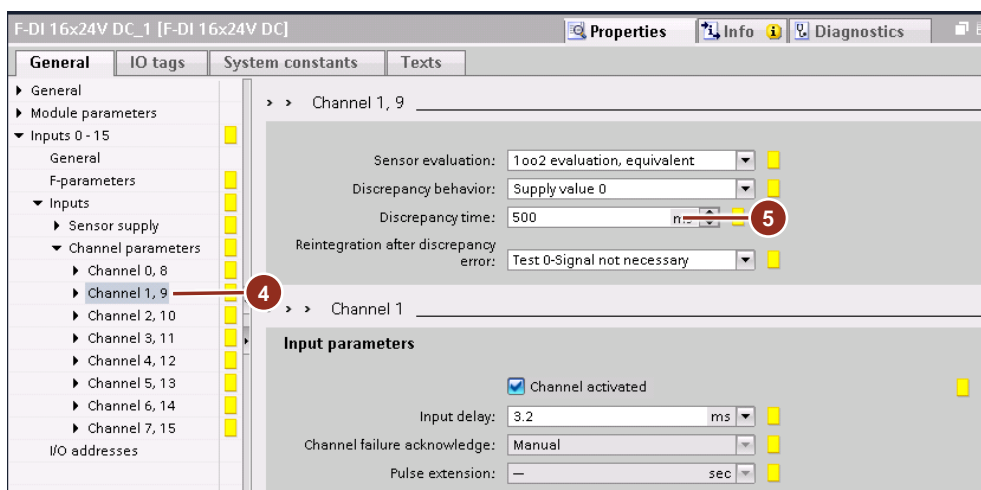
6. Make the appropriate settings for the remaining channels.
   In the application example, inputs 1, 9 (SS1E); 2, 10 (SLS); and 3, 11 (acknowledge) are used.

3.4 Adding an F-runtime group

Add a new F-runtime group as follows:

1. Under "Safety Administration > F-runtime group", press button "Add new F-runtime group".

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3.5 Checking data exchange with the drive setting

Contrary to the application example "Configuring technology objects with SIMATIC S7-1500 and SINAMICS S210 in the TIA Portal", different motors are used in this application.

Therefore, after commissioning SINAMICS S210, observe the modified drive parameters (reference values, encoder data) and adapt these in the configuration of the two technology objects.

In SINAMICS S210, the following parameters supply the required information:

- p2000 reference speed 7400 [rpm]
- p1082 maximum speed 7400 [rpm]
- p2003 reference torque 4.65 [Nm]
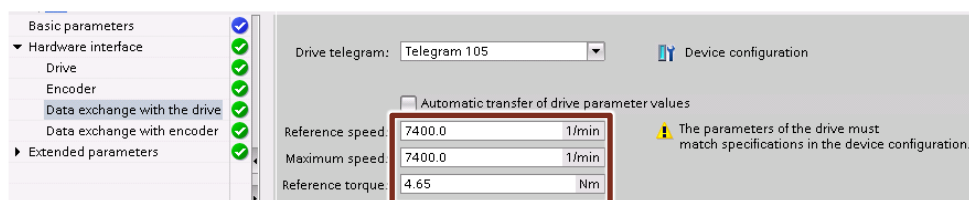
Ensure that the "Automatic transfer of encoder parameter values" is selected so that the motor encoder data are accepted.
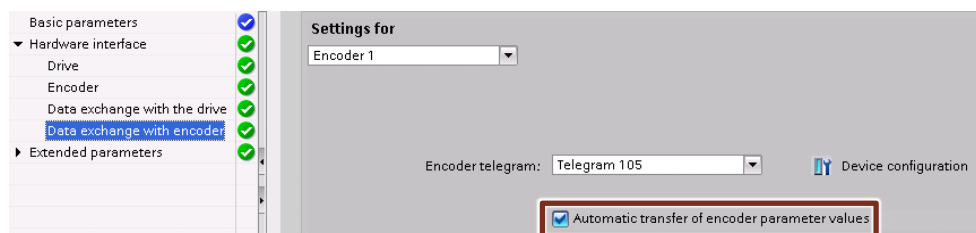

See also Chapter "Configuring the technology objects" in application example "Configuring technology objects with SIMATIC S7-1500 and SINAMICS S210 in the TIA Portal" (\3\).

| Note | When configuring via the TIA Portal from V15.1, the described parameters (reference speed, maximum speed and reference torque) no longer need to be set individually as long as the check mark for automatic detection has been set. |

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3.6 Completing the safety configuration

1. Compile and save your project.
2. Load your project into the controller.
3. In the "Device configuration" switch to "Device view" and with a right-click on the F-DI module, open the selection menu.
4. Select "Assign PROFIsafe address"
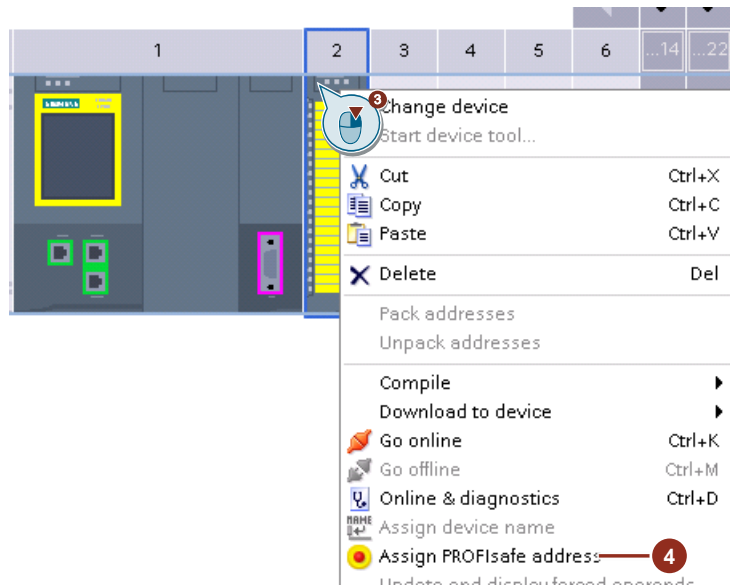
5. Press the "Identification" button, and then select the appropriate hardware from the checkbox.
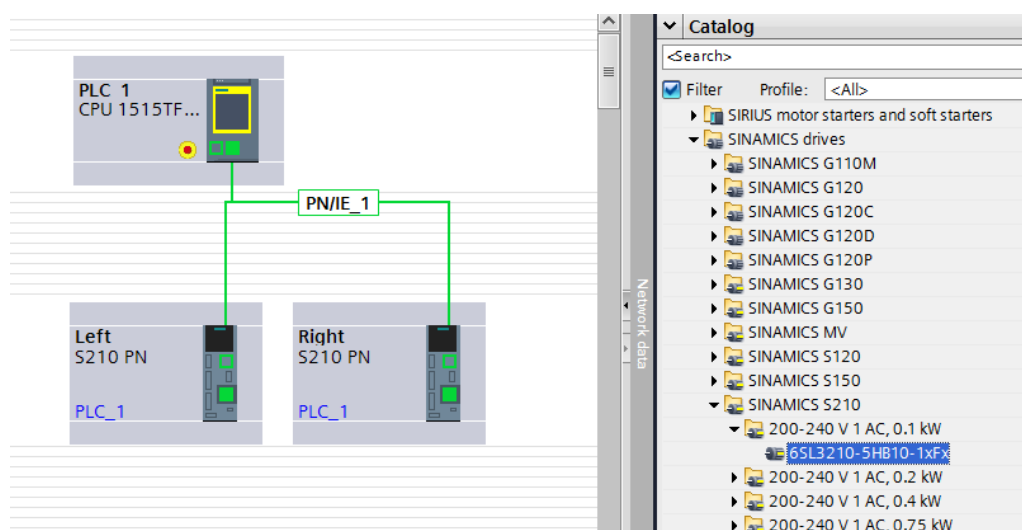6. Transfer the configured PROFIsafe address - in this case 100 - into the module using the "Assign PROFIsafe address" button.
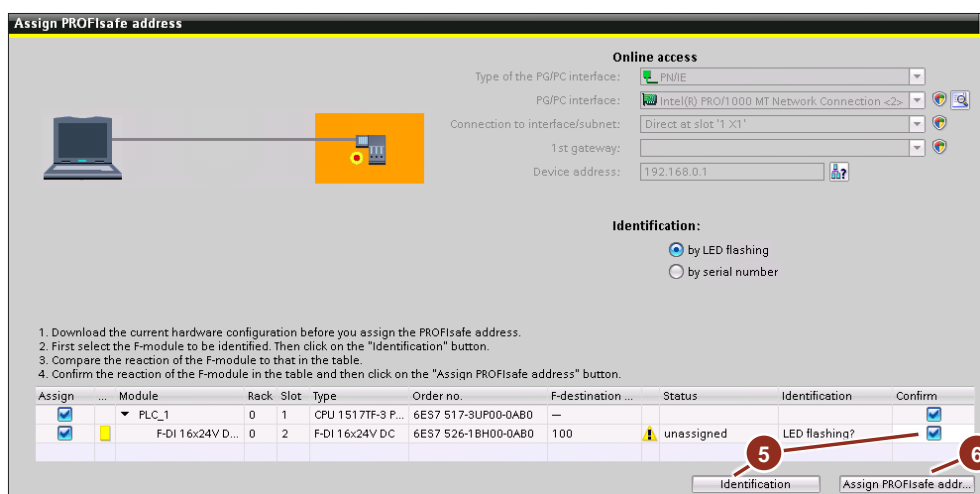
4 Configuration of the S210 in Startdrive

This chapter describes the basic procedure for commissioning the Safety Integrated functions of SINAMICS S210 using the concrete application example.

Detailed commissioning with parameter settings for all functions is not shown in this application example.

More information on the parameter settings of the individual Safety Integrated functions of the SINAMICS S210 can be found in the S210 operating manual (\4\).

Safety commissioning of the SINAMICS S210 can be carried out from Startdrive V15.1 onwards. As of TIA Portal V15.1, the SINAMICS S210 can be configured directly from the hardware catalog.

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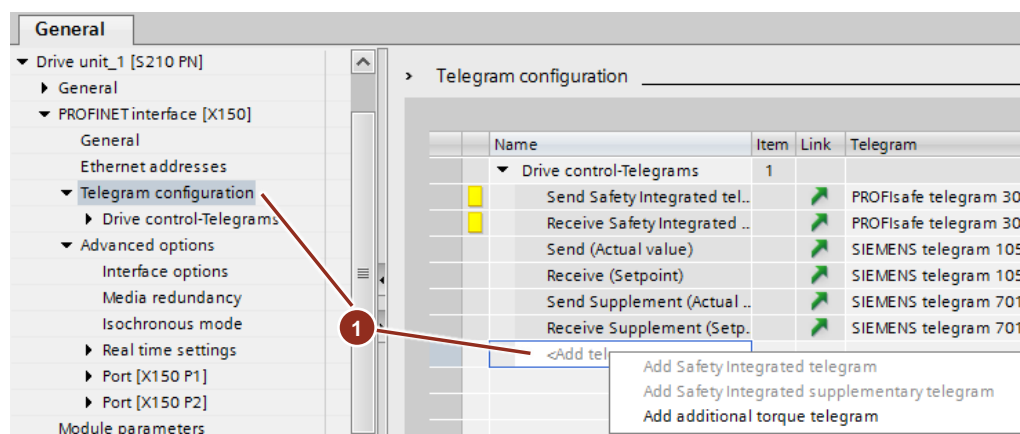Article ID: 109760341,   V1.11,   10/20199

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4.1 Step by Step commissioning

The steps for commissioning the Safety Integrated functions SS1E and SLS used in this application example of the SINAMICS S210 are described below.

Only the steps that deviate from the default settings are described. Different settings can be made using the parameter information from the S210 operating manual (\4\).

1. Start the parameterization by first configuring the telegrams in the settings of the SINAMICS S210. Via "Add telegram", first add the "PROFIsafe telegram 30", then an "Additional telegram Safety Integrated". Select "SIEMENS telegram 701" for the "Safety Integrated additional telegram".
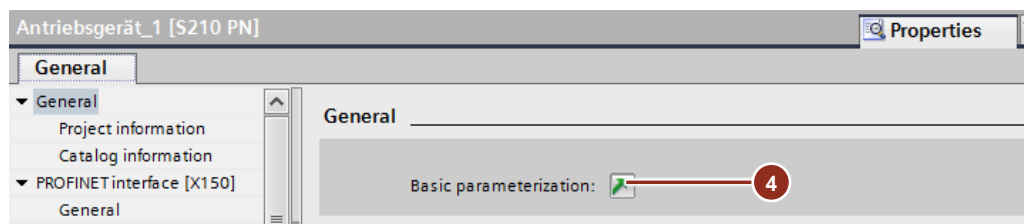
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2. Now select "Drive control telegrams" and set the desired F-target address. The F-target addresses are always identical in send ("Send Safety Integrated telegram") and receive direction ("Receive Safety Integrated telegram").
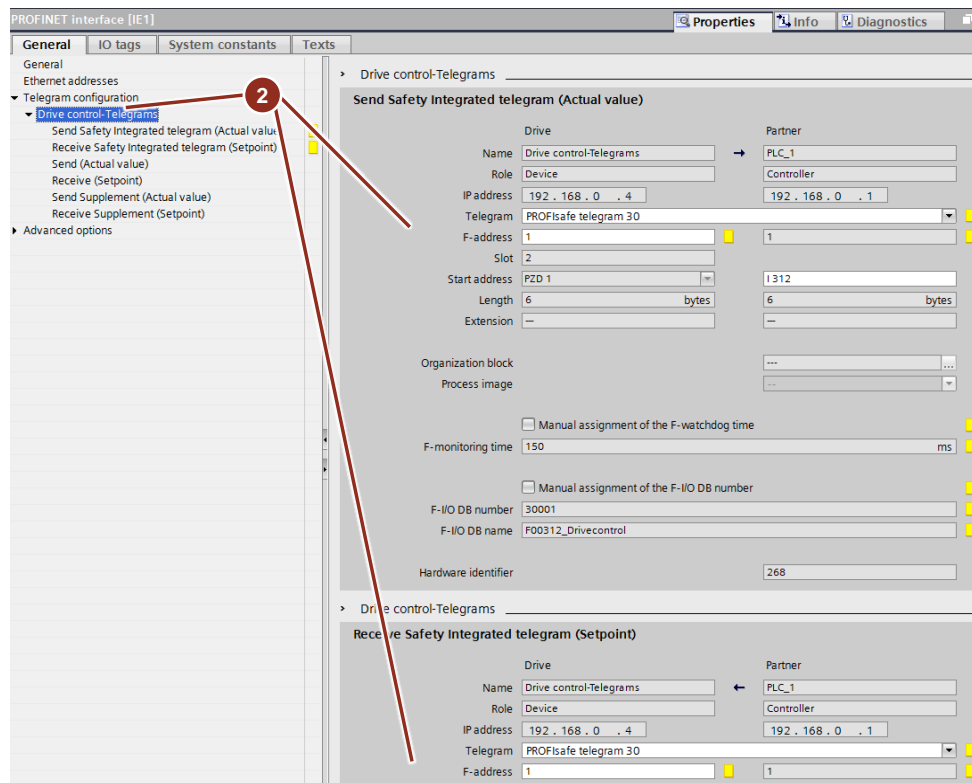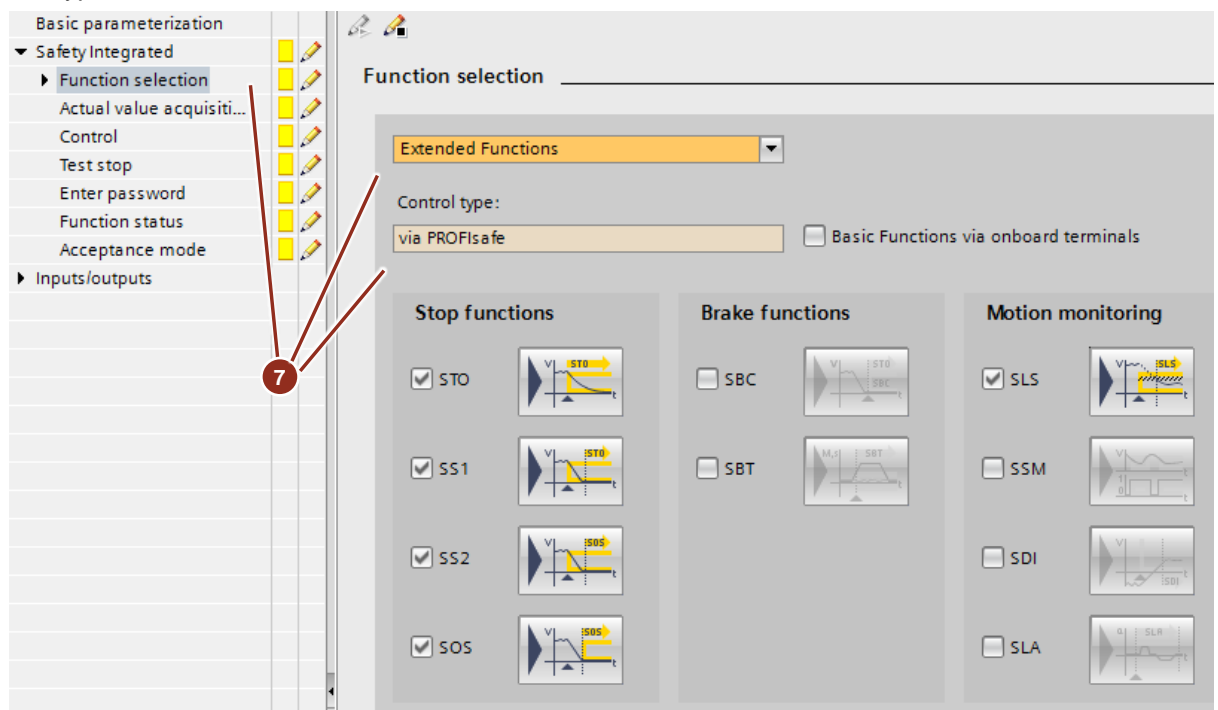

3. After the telegrams have been configured on the S210, the settings are loaded into the drive. Press the "Load to device" button and carry out the download.

4. To parameterize the Safety Integrated functions in the drive, connect online to the drive 🔵 Go online and open the parameters in the properties of the S210 by clicking the "Basic parameterization" button.

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5. Select the "Safety Integrated" group in the navigation bar. The selectable steps of the safety commissioning appear.
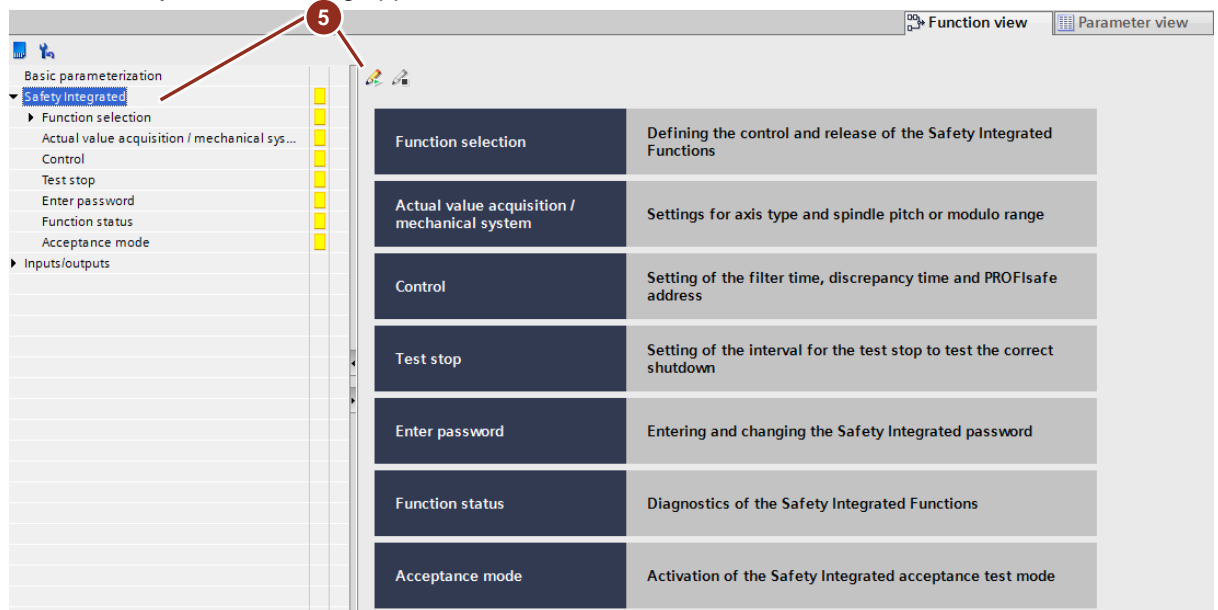
6. you must switch to the Safety Integrated editing mode so that you can now start commissioning with Safety and set the safe parameters.

   Use the direct selection of the editing mode via the "Edit" button.

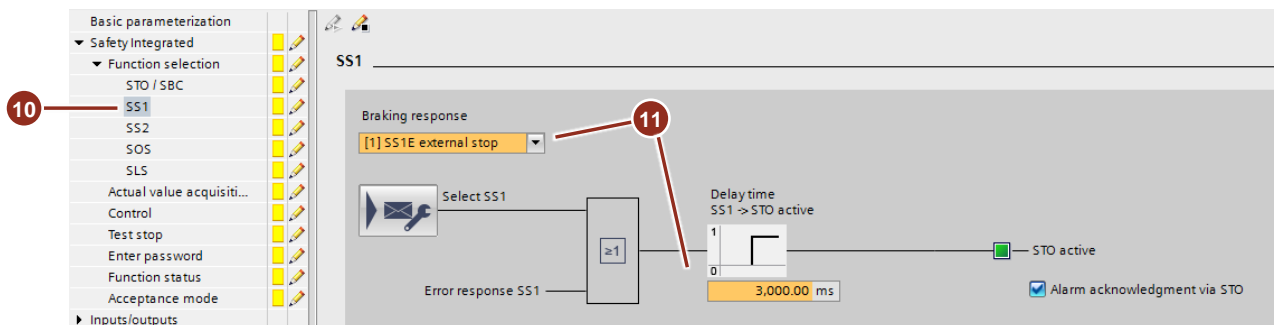7. Now select the item "Function selection" and the "Extended Functions" with control type "via PROFIsafe".

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8. Change to the item "Actual value acquisition/mechanics".
9. To adapt the Safety Integrated unit system, select the "Rotary axis" setting.
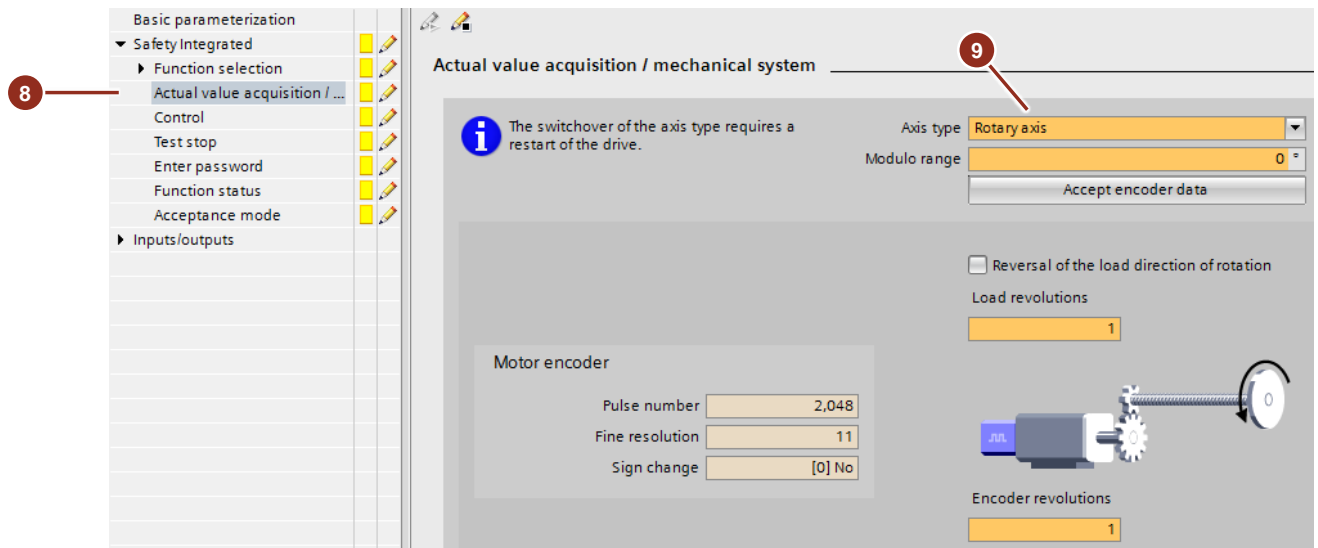

Note After changing the axis type, it is important that the drive is restarted. Before a Power OFF/ON is performed, complete the safety commissioning of the drive.

10. Parameterize the required safety functions one after the other. Start with the stop function "SS1" first.

11. In the concrete application example, the function SS1E is used. The following values are used for "SS1" in the application example:
   - "SS1E external Stop"
   - "SS1 delay time" 3000 [ms]

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12. Switch to the parameters of the "SLS" function.

13. Set the values for the Safety Integrated Function SLS. The following values are used here in the application example:
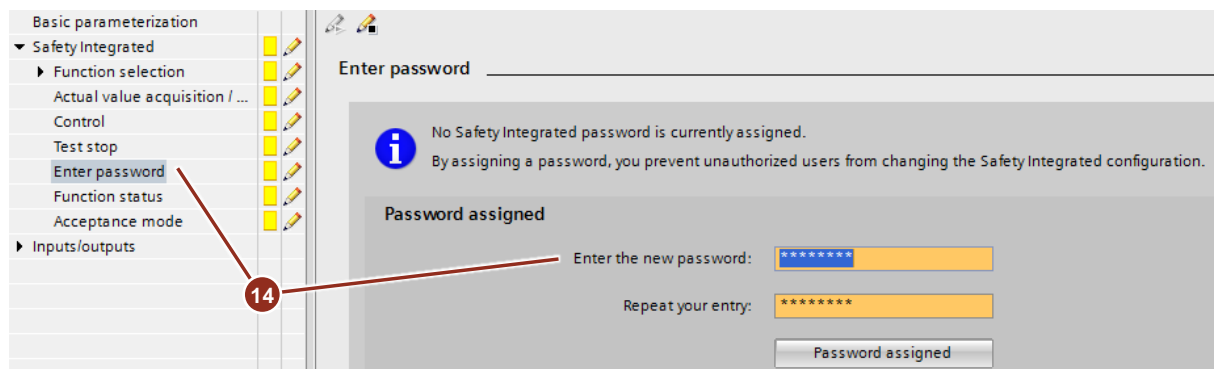
- "SLS- Changeover Delay time " 1000 [ms]
- " Speed limit SLS stage 1" 500 [1/min]
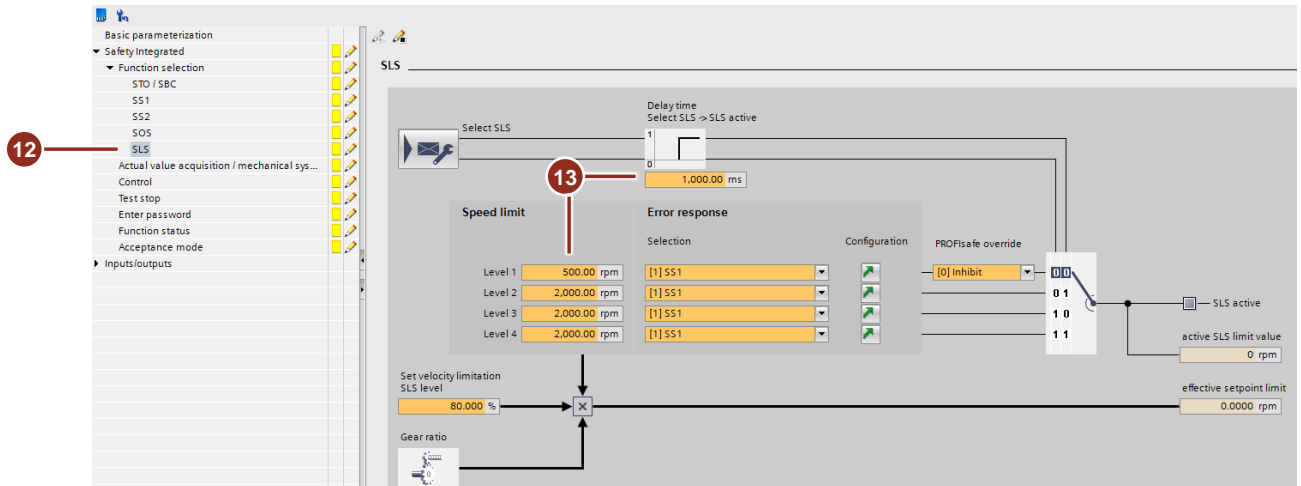
14. Switch to the next item "Password entry". Enter a password to access the Safety Integrated parameters of the S210. By assigning a password, you prevent unauthorized users from changing the Safety Integrated configuration.

Note The password "12345678" was stored in the TIA project "109760341_SafetyS210_TO_Axis_PROJ_V11.zap15_1".

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15. The safety commissioning is now completed, so that your values are also accepted in the inverter and in the project, first end the editing by clicking on the "End editing" button and then on the "Exit editing" button.

16. Then copy the values from RAM to ROM to store all values remanently
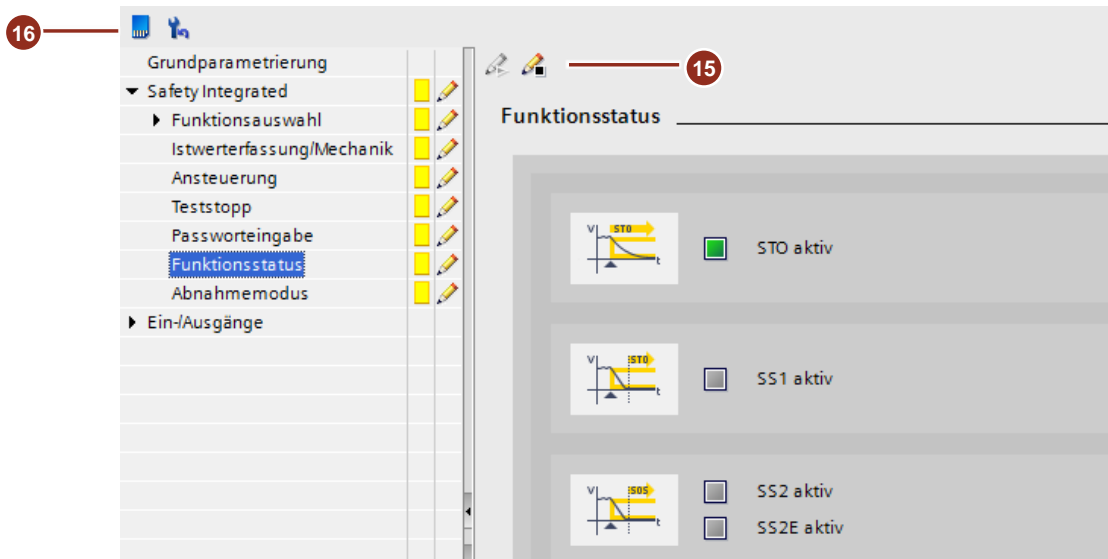
17. Before removing the drive with the "acceptance test", the set safe parameters must be activated via POWER ON (switch off/on).

18. In order to ensure an online/offline adjustment and the consistency of the project, you must upload the drive afterwards. To do this, press the 🔼 " Load from device " button and carry out the upload.

19. Under "Function Status" you can find a general overview of the activity of the safety functions and the remaining time until the next required test stop in the drive.
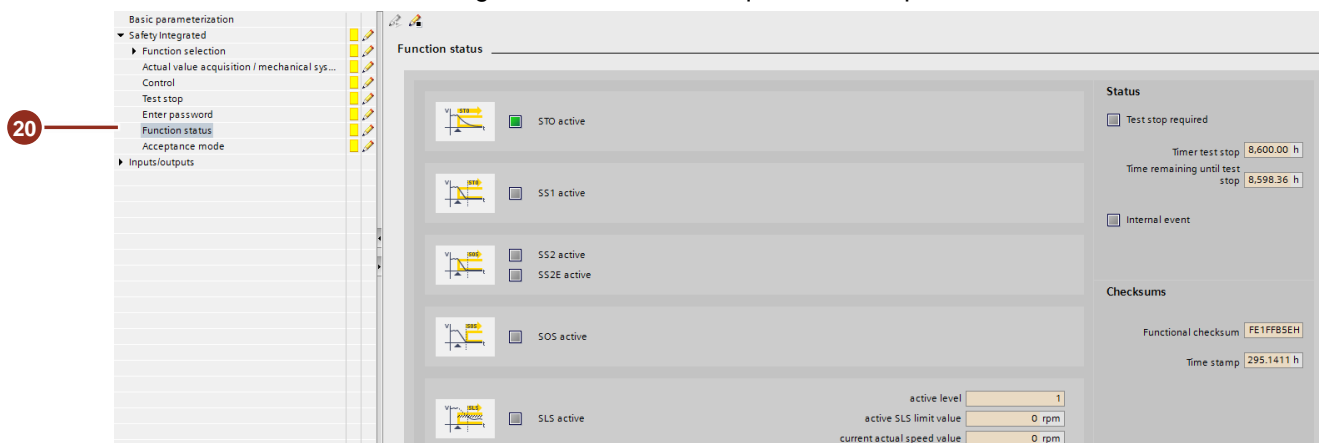
Note	The test stop is performed automatically when the SINAMICS S210 is started up.

20. Perform all steps also for the second SINAMICS S210.

The performance of the acceptance test is described in chapter 6.

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5 Configuring the S210 (web server)

In this chapter, the basic approach to commission the Safety Integrated functions of the SINAMICS S210 are described based on a concrete application example.
A detailed description of the commissioning with parameter settings for all the functions is not provided in this application example.

More information about the parameter settings of the individual Safety Integrated functions of the SINAMICS S210 are provided in the S210 operating instructions (\4\).

5.1 Overview diagram of the web server - Safety Integrated screen forms

A detailed description of the individual Safety Integrated screen forms of the SINAMICS S210 web server is provided in the operating instructions Safety Integrated of SINAMICS S210 (\4\) in Chapter "6.3 Commissioning Safety Integrated".

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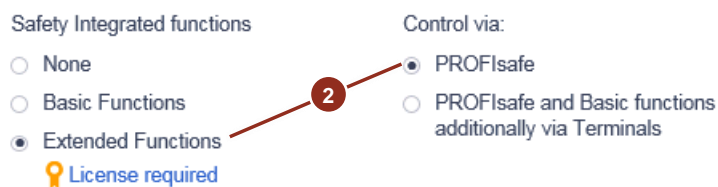
5.2 Step-by-step commissioning

The steps for commissioning the SS1E and SLS Safety Integrated Functions of the SINAMICS S210 used in this application example are subsequently described.

Only those steps are described that deviate from the default settings. Different settings can be made based on the parameter information provided in the S210 operating instructions (\4\).

1. In the navigation menu, select group "Safety Integrated > Commissioning"

2. Select "Extended Functions" with the "PROFIsafe" control mode.

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3. To adapt the Safety Integrated system of units, select setting "Rotary axis".

4. Restart the drive in order to switch over the units.
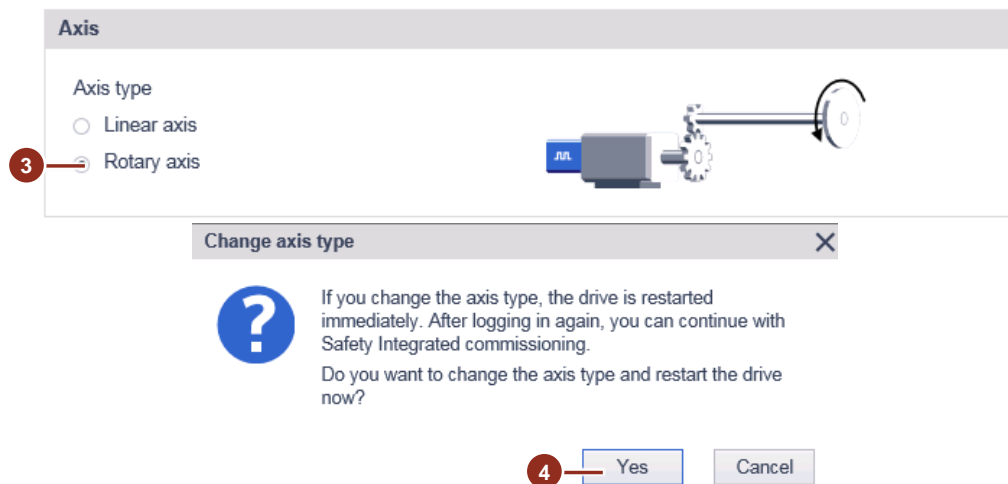
5. Log on again via the web server and click in the footer of the Safety Integrated "Start" screen form to start commissioning the safety functionality.

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6. Now parameterize the required functions one after the other.
   For this application example, set an "SS1 delay time"
   of 3000 [ms]

7. In this specific application example, function SS1E is used.
   In the application example, for "STO/SS1/SBC" the following values are used:

   - "SS1 delay time" 3000 [ms]

   - "SS1E external stop"

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8. Switch to the parameters for the SLS function
9. Here, set the values for the SLS Safety Integrated Function.
    The following values are used in the application example:
    -   "SLS switchover delay time" 1000 [ms]
    -   "Limit value SLS1" 500 [rpm]

10. Switch to the next commissioning section

Parameter name	Value	Unit
SI Motion enable safety functions: Enable transfer SLS limit value via PROFIsafe	Inhibit	
SI Motion SLS switchover/SOS delay time	1000	ms
SI Motion SLS limit values: Limit value SLS1	500	1/min
SI Motion SLS limit values: Limit value SLS2	2000	1/min
SI Motion SLS limit values: Limit value SLS3	2000	1/min
SI Motion SLS limit values: Limit value SLS4	2000	1/min
SI Motion drive-integrated status signals: SLS active	No	

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11. The PROFIsafe telegram is automatically adapted to the selection made in the PLC - PROFIsafe telegram 30.
Set the PROFIsafe address configured in the PLC.
Drive master/left   PROFIsafe address: **2**
Drive slave/right   PROFIsafe address: 3

12. Switch to the next commissioning section

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13. Assign a password to access the Safety Integrated parameterization

14. Complete the Safety Integrated commissioning workflow, save the parameter changes so that they are not lost on power failure and restart the drive.
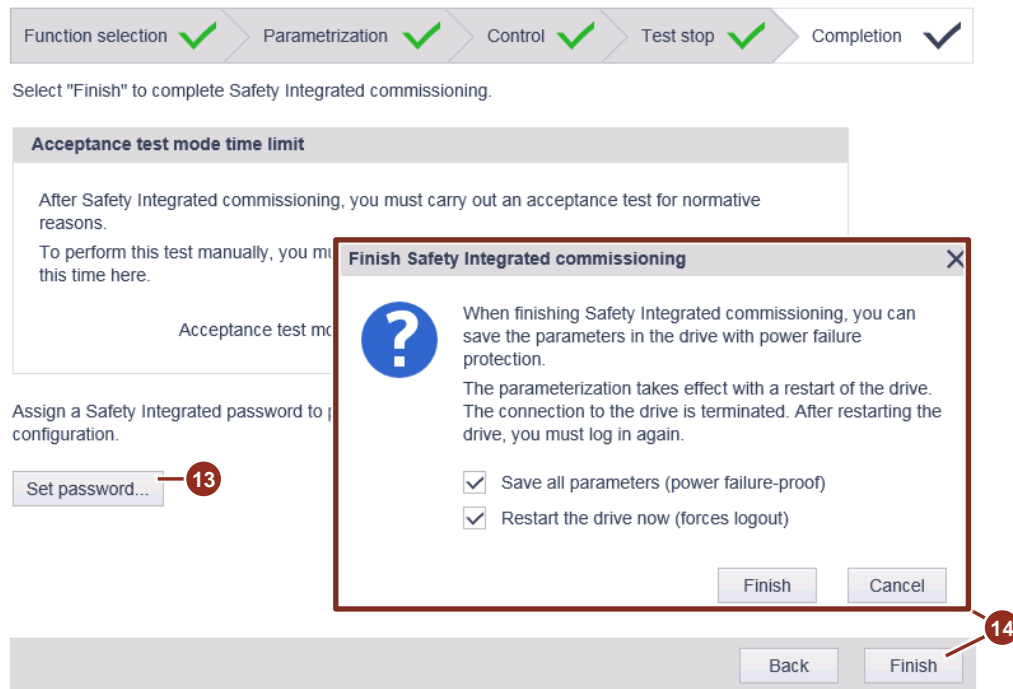
15. Also perform the commissioning steps for the second SINAMICS S210.

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6 Acceptance test

As part of the verification and validation of the machine in accordance with EN ISO 13849-2 and EN 62061, the acceptance test supports you in testing the correct implementation of the safety functions.

The acceptance test proves that the parameterized Safety Integrated functions of SINAMICS have been correctly and completely implemented in accordance with the requirements of the specification of the safety requirements. This uncovers errors from the parameterization. A check is carried out to determine whether the correct Safety Integrated functions of SINAMICS have been selected to suit the machine and its operating modes, thus uncovering systematic errors.

The acceptance test is a guided test for the user with an automatically generated acceptance protocol from which the test results can be seen.

To ensure the consistency of the project, upload the drive before performing the acceptance test. To do this, press the ⬆ "Load device" button and carry out the upload.
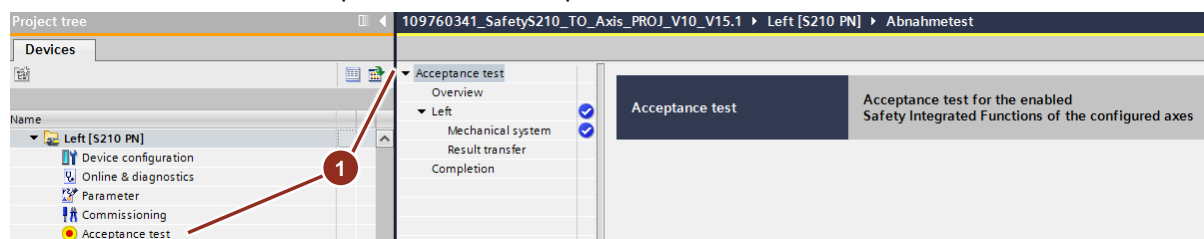
6.1 Step by Step Acceptance test

The necessary steps for the acceptance test of the Safety Integrated functions SS1E and SLS used in this application example of the SINAMICS S210 are described below.

Note	Before you start the acceptance test, make sure that your online and offline project are identical, as the acceptance test reads and documents the parameters from the offline project.

1. You can start the acceptance test from the project tree on the inverter. After you have started it, the acceptance test mask opens.

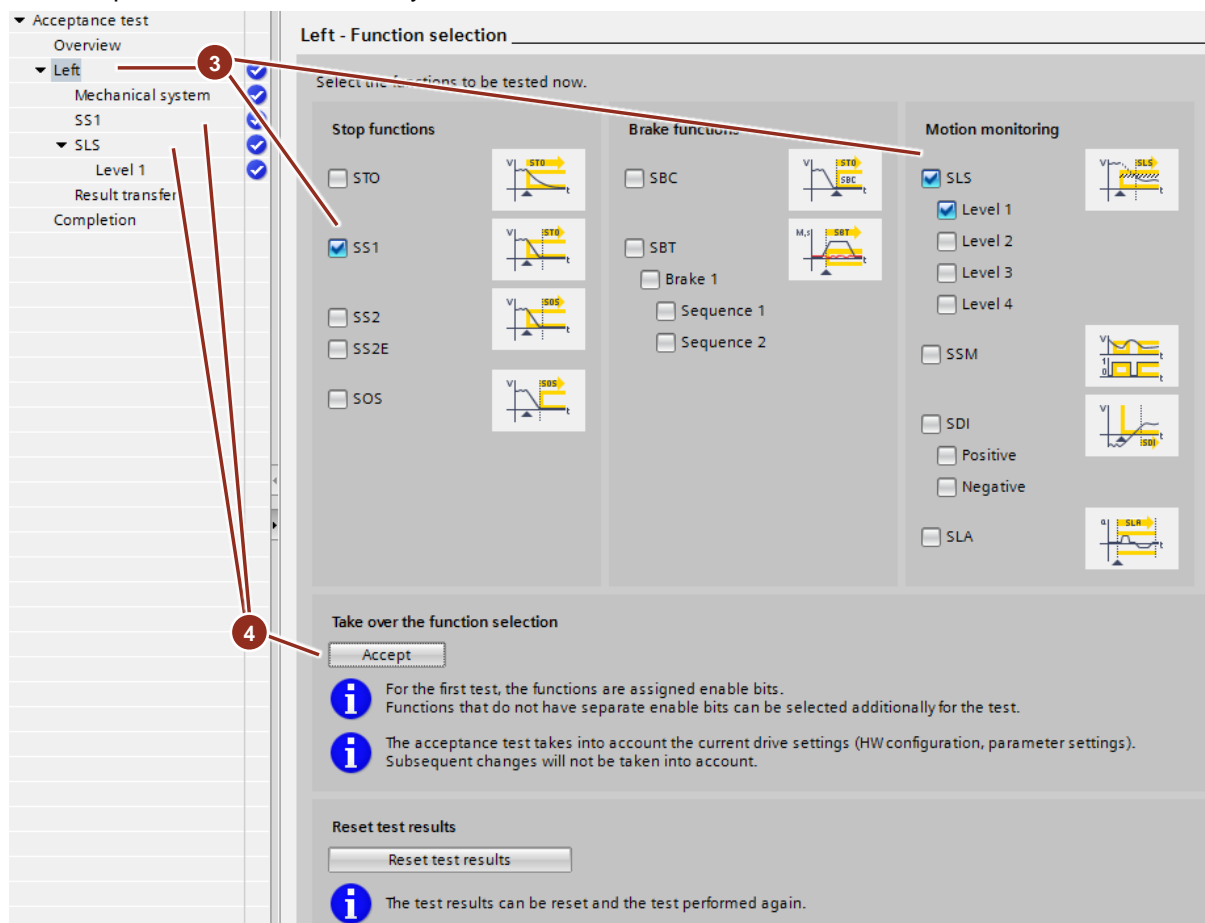Controlling SINAMICS S210 Safety Integrated Functions using
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2. Under the item "Overview" you will see a list of all drives with enabled Safety Integrated functions and their test status after " Refresh" has been pressed.
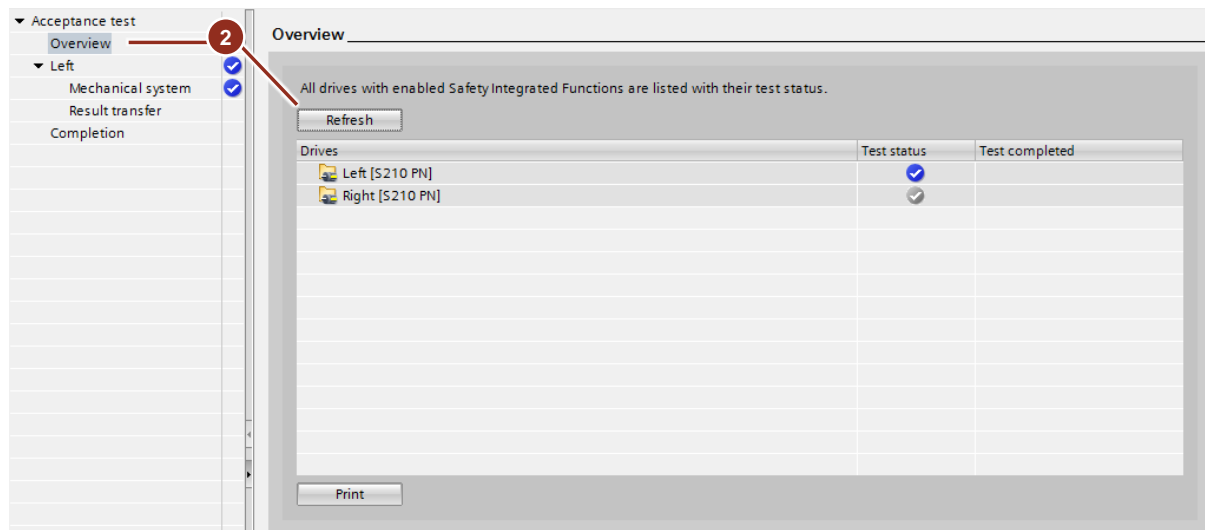
3. Under the name of the inverter (here "Left"), you can also select the functions that are to be tested. The functions "SS1" and "SLS - Level 1" are selected for the application example.

4. After the function selection has been confirmed with "Accept", the selection of the acceptance test is extended by the desired functions.


5. In order to start the acceptance test, connect online to the drive.

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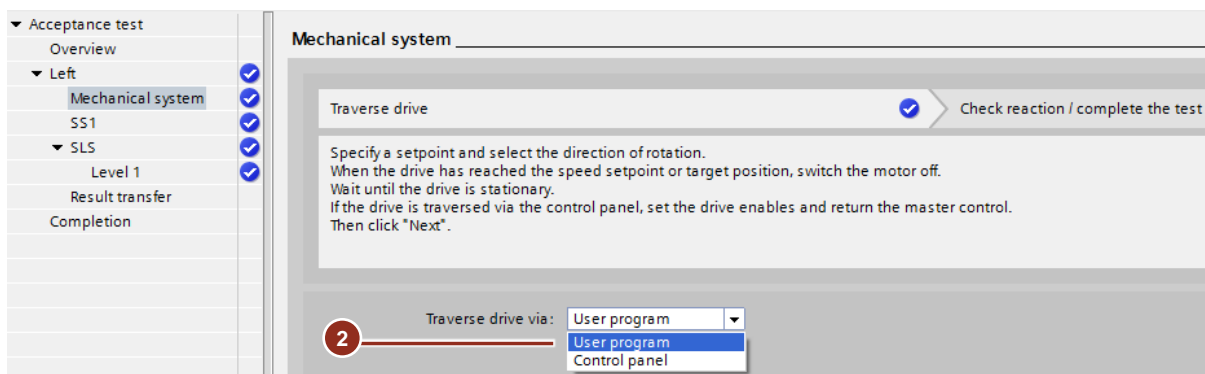Article ID: 109760341,   V1.11,   10/20199

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6.2 Acceptance test "Mechanics"

1. The "Mechanics" test is used to check whether the set standard parameters (speed) correspond to the Safety Integrated parameters and to ensure that the actual operational function of the drive behaves properly. This test can be used to detect errors in the parameterization of the mechanics.
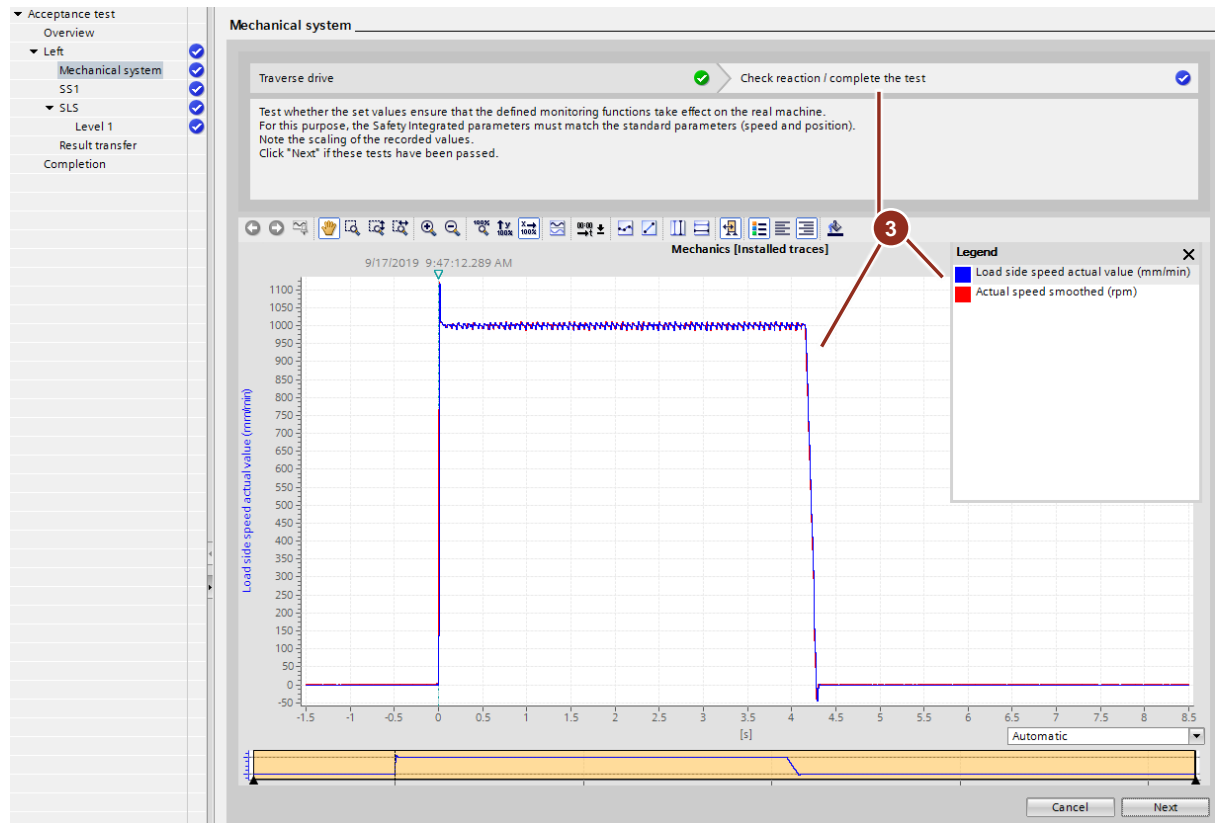
   Start the test via the "Start" button.
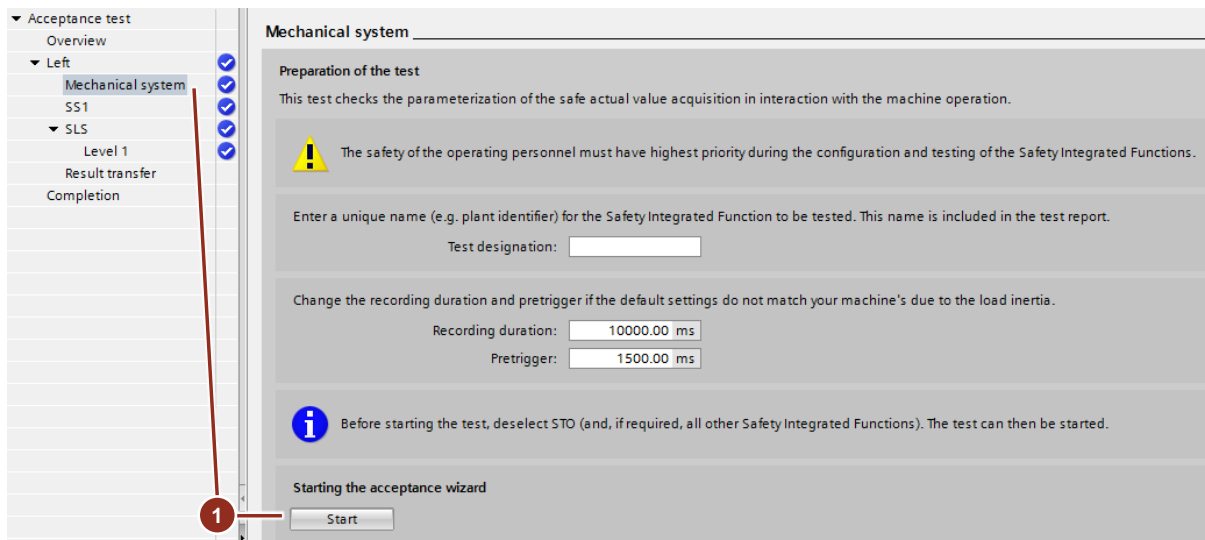
2. After starting the test, the user has the possibility to move the drive via the user program or the control panel. So that you can check your program exactly according to the programmed behavior, it is advisable to select the "user program" at this point.

   Proceed as described in the test description and switch on the drive. Confirm your selection with "Continue".
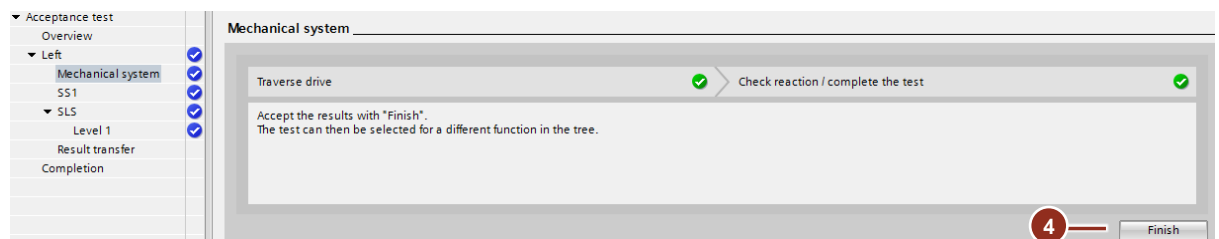
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3. In the next test mask, you can already see the test results of the "Mechanical test". After you have checked the behavior and the characteristic values match, you can confirm this test with "Next".


4. In the last mask of the test, accept the results with "Finish" and complete the test. The test can then be executed for further safety functions.


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6.3 Acceptance test „SS1E"

1. For the acceptance test of the safety function SS1E, SS1 is selected from the function selection. The test serves to guarantee the safe switch-off behavior of the selected safety function.
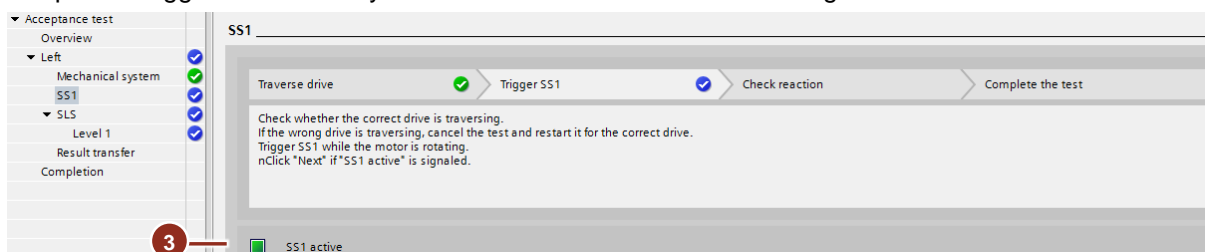
   You start the test via the "Start" button.
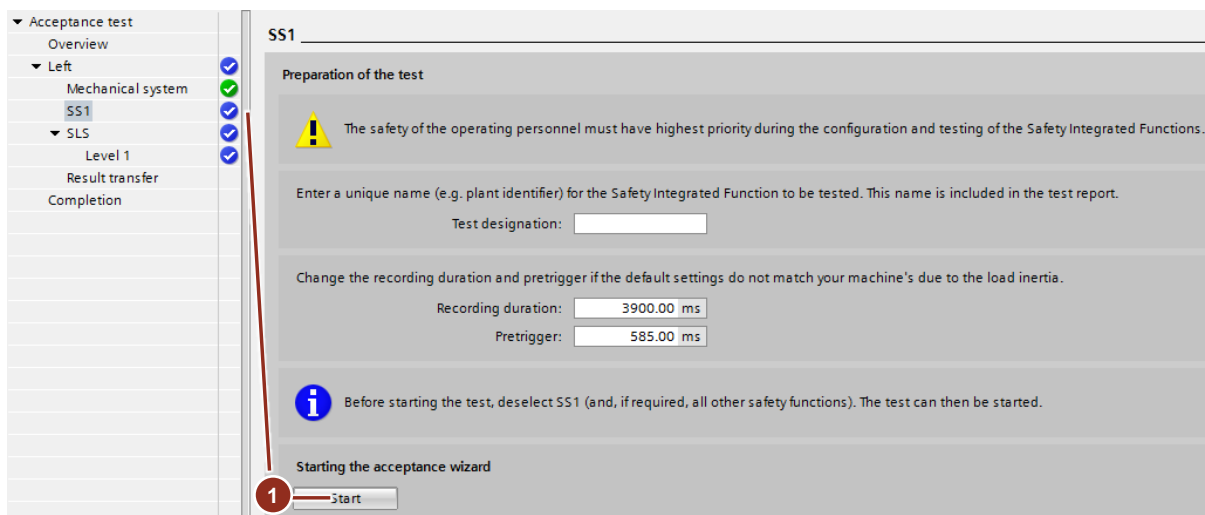
2. After starting the test, the user has the possibility to move the drive via the user program or the control panel. So that you can check your program exactly according to the programmed behavior, it is advisable to select the "user program" at this point.

   Proceed as described in the test description and switch on the drive. Confirm your selection with "Continue".
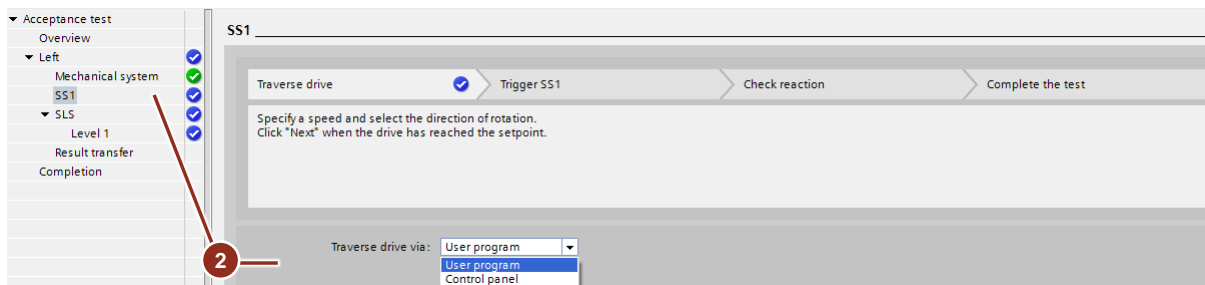
3. In the next step, first check whether the correct drive moves. If this is the case, please trigger SS1 and only switch "Next" when "SS1 active" is signaled.

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4. Wait until the drive has stopped and then press "Next".
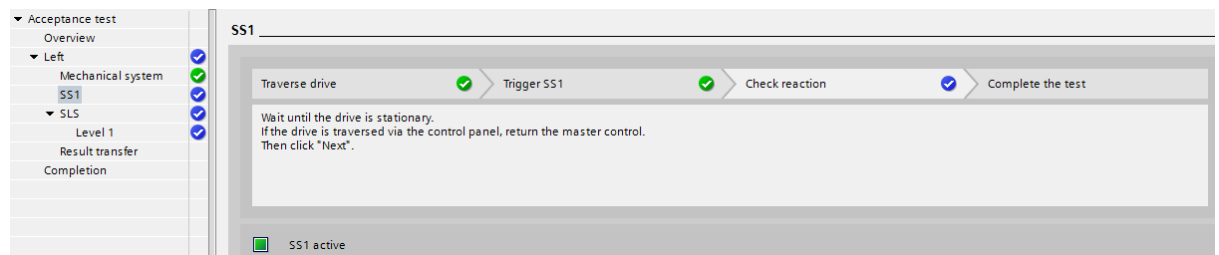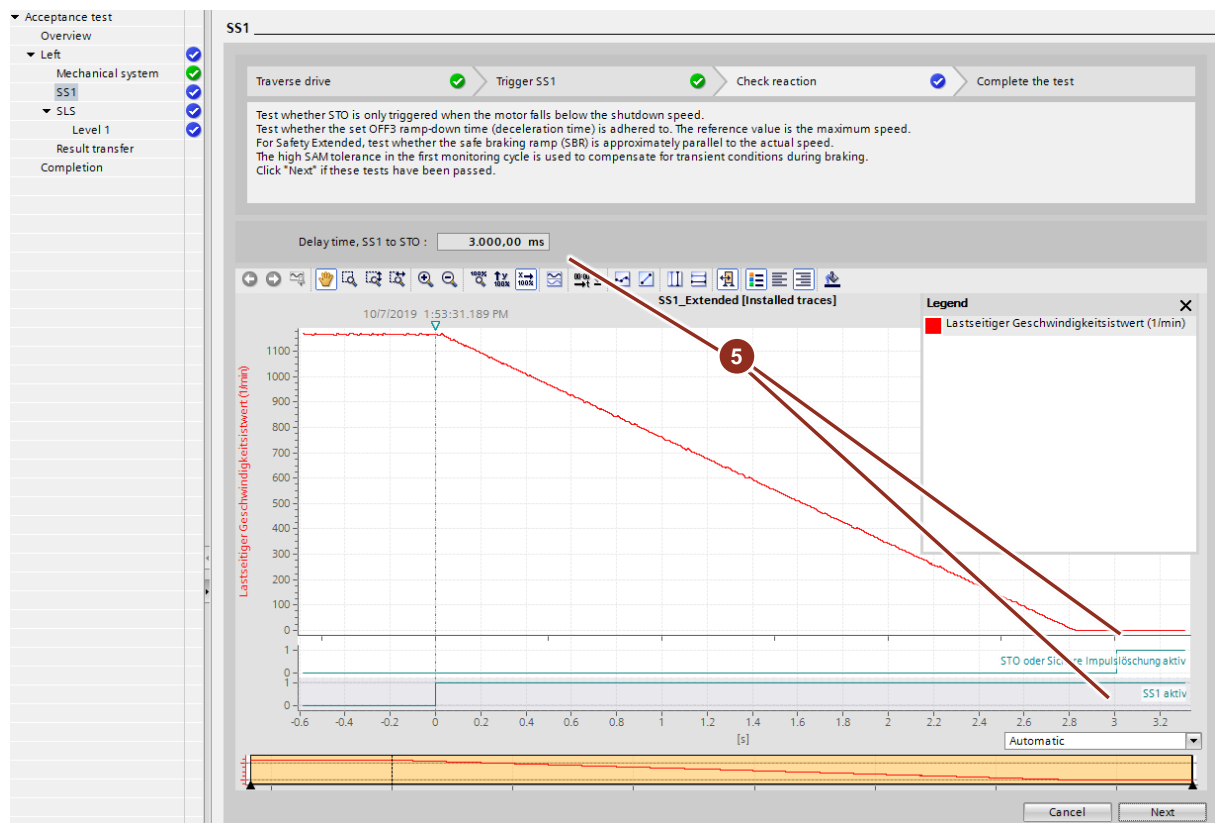

5. Depending on the programmed drive behavior, you can now determine the spin-out of the drive in the recorded trace. With the safety function SS1E, a Safe Stop 1 with external stop is triggered, which means that an STO must be triggered immediately after the delay time of 3s, set in the safety commissioning.

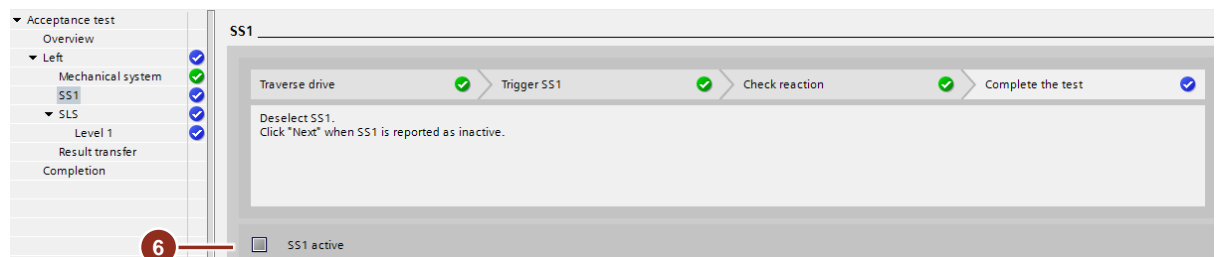After you have checked the behavior and the characteristic values match, you can confirm this test with "Continue".


Note	The output of your velocity curve on the load side can differ greatly from the graph shown here. It depends on the programmed drive behavior.

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6. Then select SS1 again and press "Next".

7. In the last mask of the test, accept the results with "Finish" and complete the test.
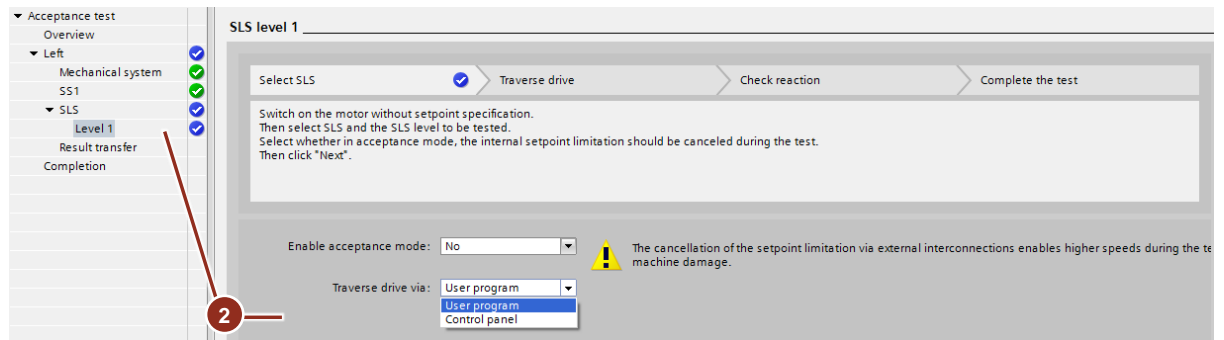The test can then be executed for further safety functions.
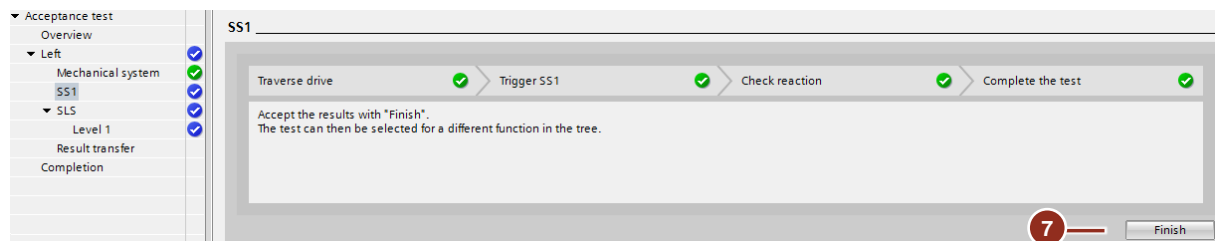
6.4 Acceptance test „SLS"

1. With the SLS "Safely-Limited Speed" safety function, unwanted speeds of the drive in both directions of rotation can be avoided. Exactly these limit values are considered and checked in the acceptance test of the SLS safety function.
Depending on what was selected there, the respective stages are also selected during the acceptance test. In this example, a speed limit SLS stage1 of 500 [1/min] was parameterized.
You start the test via the "Start" button.
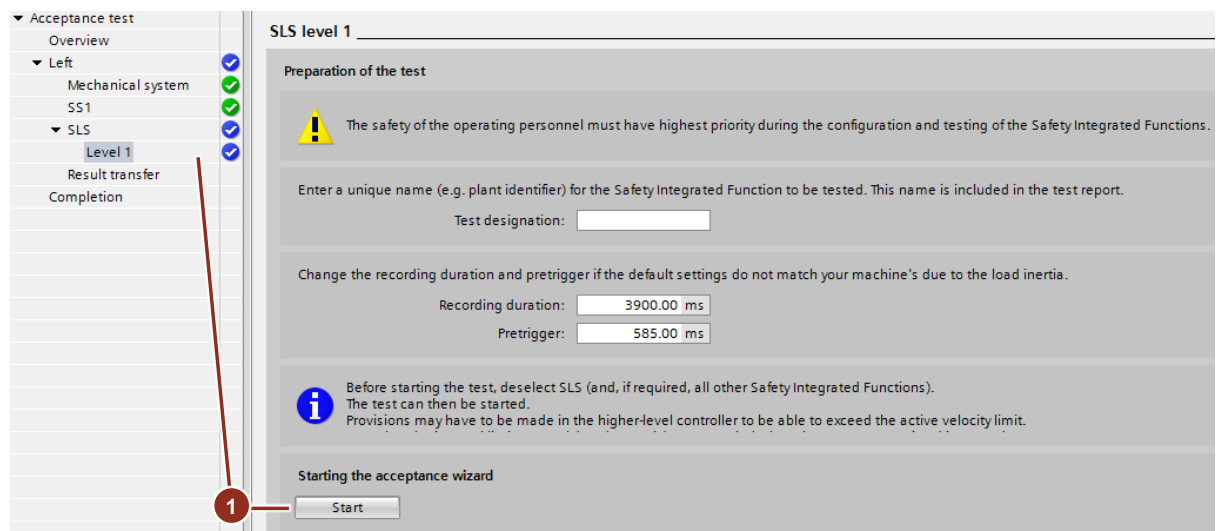
2. After starting the test, the user has the possibility to move the drive via the user program or the control panel. So that you can check your program exactly according to the programmed behavior, it is advisable to select the "user program" at this point.

Proceed as described in the test description, select SLS and switch on the drive without setpoint input. Confirm your selection with "Next".

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3. Proceed as described in the test description. Accelerate the drive beyond the SLS limit. After the SLS limit has been exceeded, the parameterized stop reaction SS1E was triggered.

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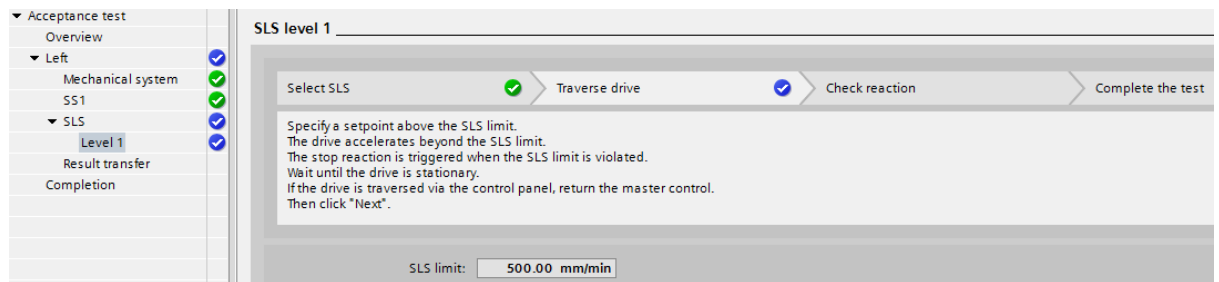
4. In the trace recording it can now be seen that an SS1 was triggered immediately after the speed limit of 500 [1/min] was exceeded.

After you have checked the behavior and the characteristic values match, you can confirm this test with "Next".
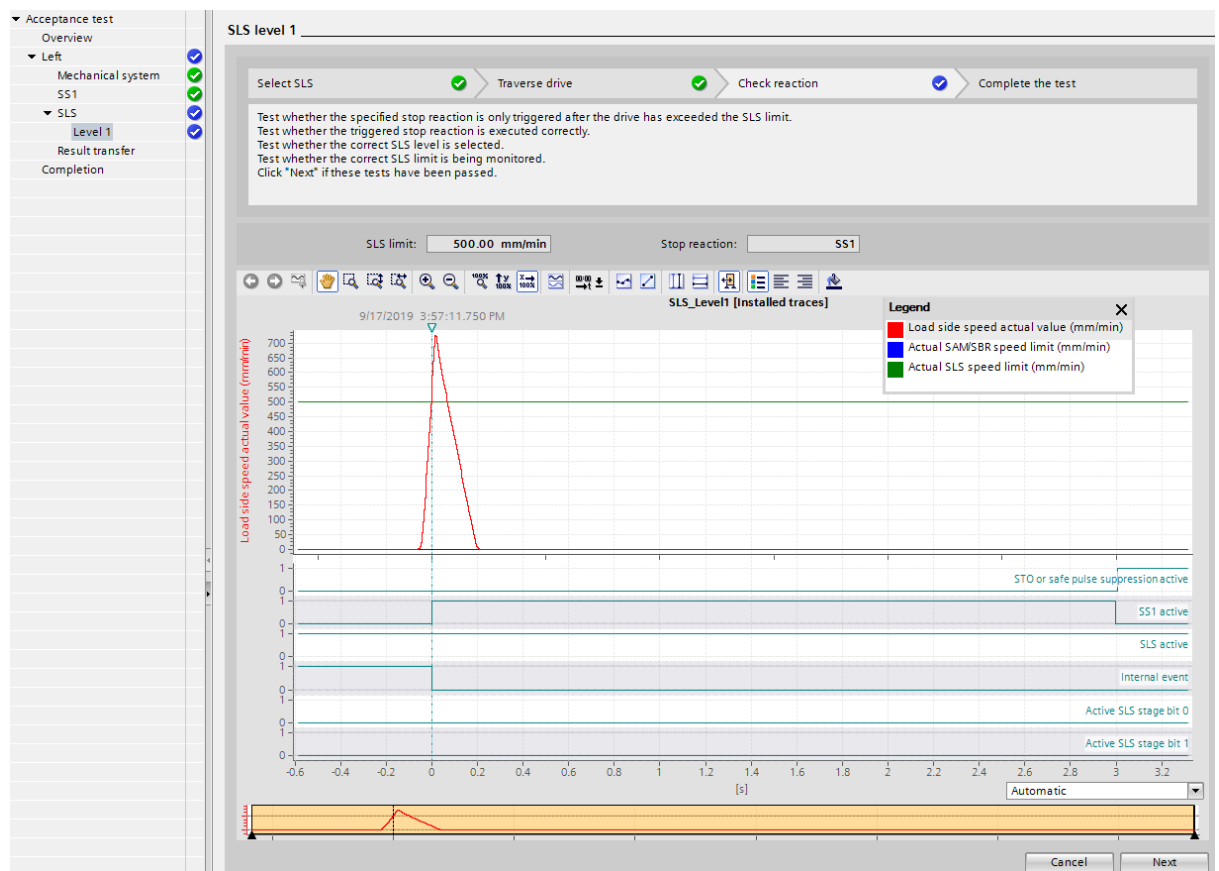
5. In the next step, deselect SLS again and acknowledge the Safety Integrated messages via your user program. Then complete the test.

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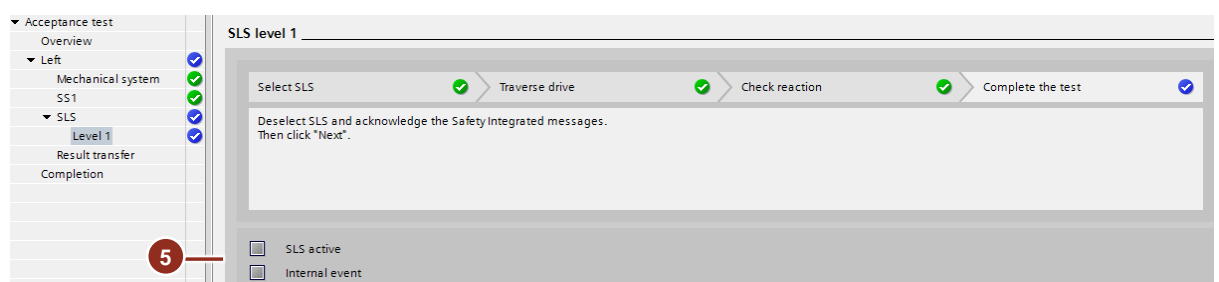
6. In the last mask of the test, accept the results with "Finish" and complete the test. The test can then be executed for further safety functions.
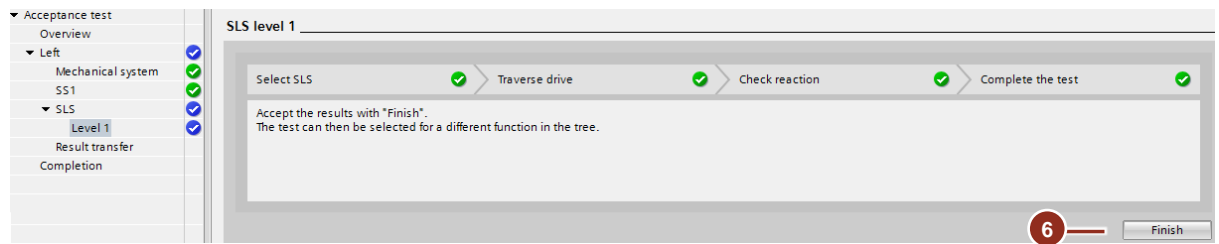
6.5 Result transfer

Using the "Result transfer" function, you can transfer the completed acceptance tests to other drives in the system and thus carry out series acceptance. In order to carry out a series acceptance test, the set parameters (apart from the F target address) for the drives must be the same.
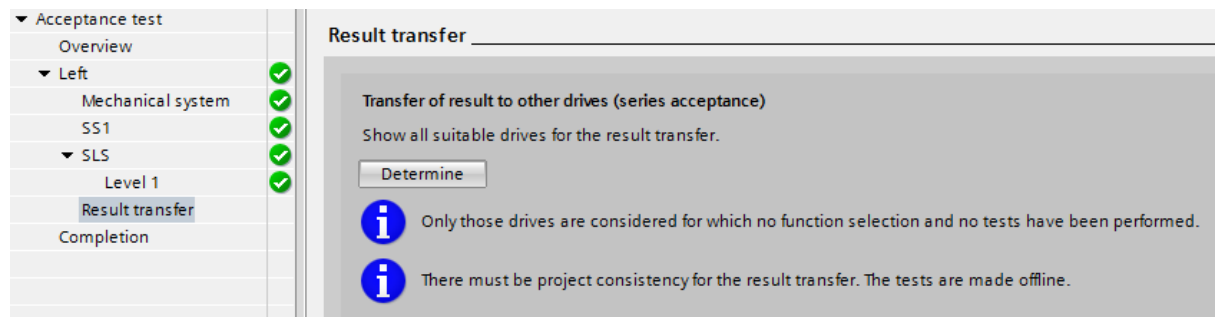
The "Determine" button displays a list of existing drives for which the results can be transferred.
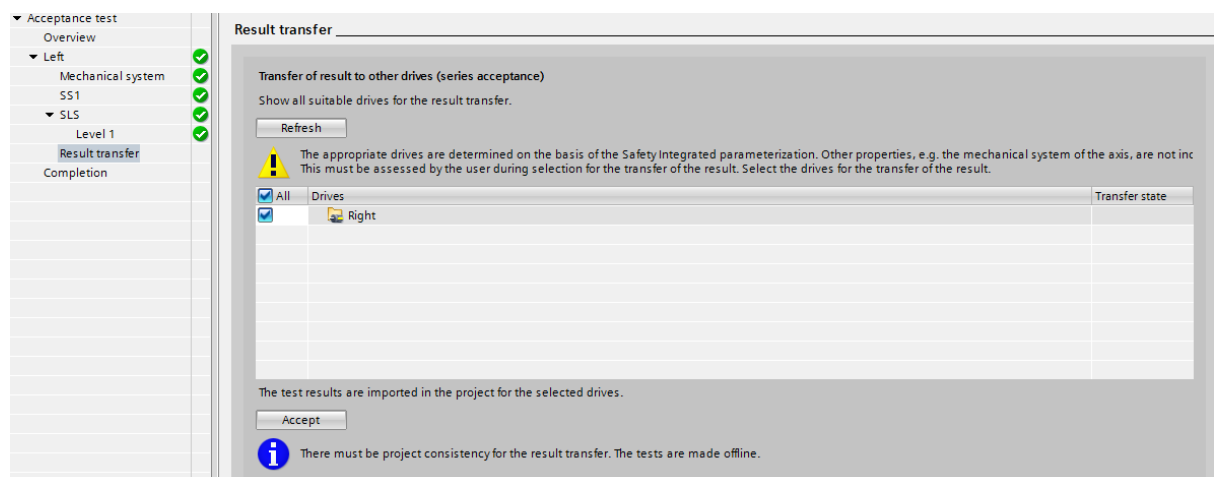
With "Accept" the existing test results are accepted in the selected drives in the project. Make sure that the project is consistent beforehand.

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6.6 Acceptance protocol

In the mask " completion " you can output an acceptance protocol for the acceptance test. This protocol serves as documentation and can be used to validate the drive safety functions. You also have the option of having this document signed by both the commissioning engineer and the machine manufacturer once all the tests have been completed.

In addition, you can include the relationship between the triggering protective device and the drive-integrated safety function in the "Function table", which in turn serves as documentation.

Your test results for the acceptance test are recorded in the acceptance protocol. Use the "Create" button to generate an .xlsx file in which the protocol is stored.

As long as you do not make any changes to the drive and in your TIA project, which will affect the drive application, the acceptance tests you perform will continue to be valid. The acceptance protocol is stored in the TIA project, so you can always refer to and generate the protocol again but pay attention to the time stamp that is output to you in the protocol. The time stamp is set if all test results are marked as passed.

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7 Programming safety functions

7.1 Programming General Safety Functions

To control the safety functions, proceed as follows:

1. Open your F program and insert the block "ACK_GL" from the Task Card "Instructions > Safety Functions" via Drag&Drop.

2. Connect the input "ACK" with the acknowledgement bit, in this example channel (3, 11) of the F-DI module. With a positive edge at this input, each F periphery is reintegrated after a communication failure.
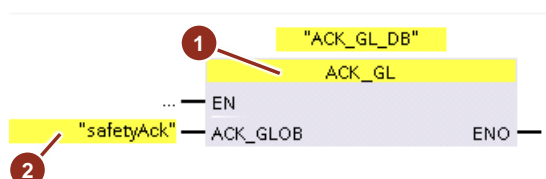
7.2 Controlling and evaluating Safety Integrated functions

The SINAMICS Safety Integrated functions are controlled via PROFIsafe. The "LDrvSafe" library provides fail-safe function blocks (FBs) and PLC data types, depending on the PROFIsafe telegram used (30, 31, 900, 901, 902, 903) for simple control and evaluation of the safety functions, as well as telegrams (700, 701) for the Safety Info and Control Channel.

In the user program, the FBs and PLC data types are used for the configured PROFIsafe telegram 30.

Note	Further information on the function blocks of the "LDrvSafe" library can be found in the application example "SIMATIC - Fail-safe LDrvSafe library for controlling Safety Integrated Functions of the SINAMICS drive family" (\5\).

To control and evaluate the Safety Integrated functions, proceed as follows:

Inserting Library Elements

1. Open the library "LDrvSafe".

2. Insert the following FBs from the library into the folder "Program blocks" by Drag&Drop:
   - "LDrvSafe_SinaSTlg30Control"
   - "LDrvSafe_SinaSTlg30Status"

3. Insert the following PLC data types from the library into the "PLC data types" folder by Drag&Drop:
   - "LDrvSafe_typeSinaSTlg30Control"
   - "LDrvSafe_typeSinaSTlg30Status"

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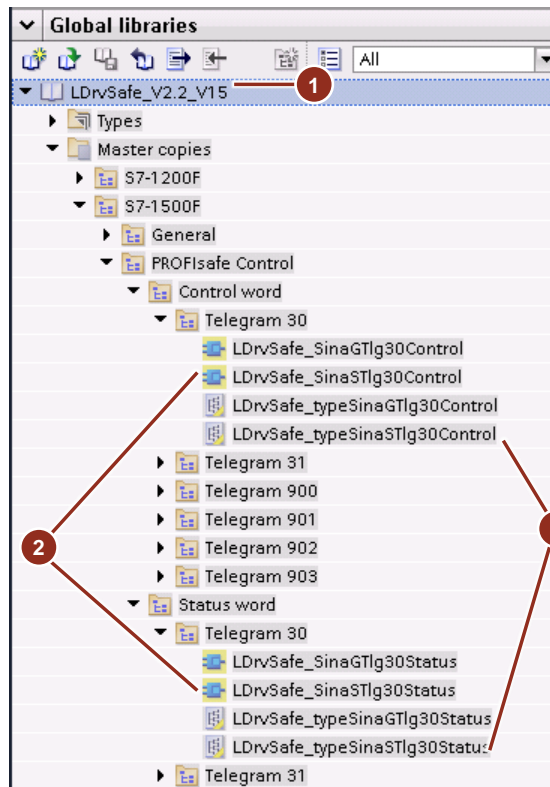
Creating Variables

1. Open the variable table

2. Create 2 variables for each drive with the PLC data types "LDrvSafe_typeSinaSTlg30Control" and "LDrvSafe_typeSinaSTlg30Status" just inserted.

3. Make sure that the start addresses of the variables match the start addresses of the PROFIsafe telegrams 30. The addresses can be found in the "Drive Control Telegrams" view of the respective SINAMIC S210.

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Call up library blocks

1. Insert the FB "LDrvSafe_SinaSTlg30Status" for each drive into your F program. This FB is used for simple evaluation of the Safety Integrated functions of SINAMICS S via PROFIsafe telegram 30.
2. Connect the input "SinaSTlg30Status" with the variable "statusSafetyS210Left" defined in the previous step.
3. Connect the outputs of the FB as required.
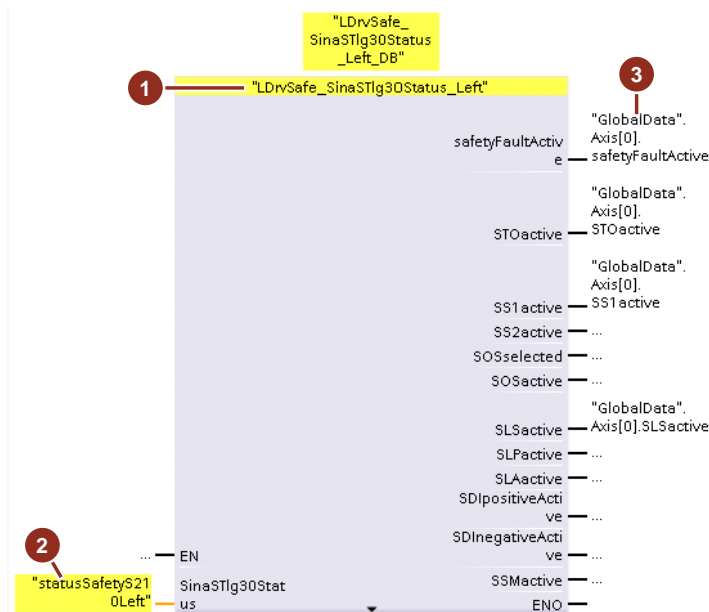
4. Insert the FB "LDrvSafe_SinaSTlg30Control" for each drive into your F program. This function block is used for simple control of the Safety Integrated functions of SINAMICS S via PROFIsafe telegram 30.
5. Connect the block inputs as required. In the example, the inputs SS1 and SLS are connected with safe signals of the F-DI module.
6. Connect the acknowledge bit; in the example, a signal from the F-DI module is also used for this.
7. Connect the output "SinaSTlg30Control" with the defined variable "ctrlSafetyS210Left".
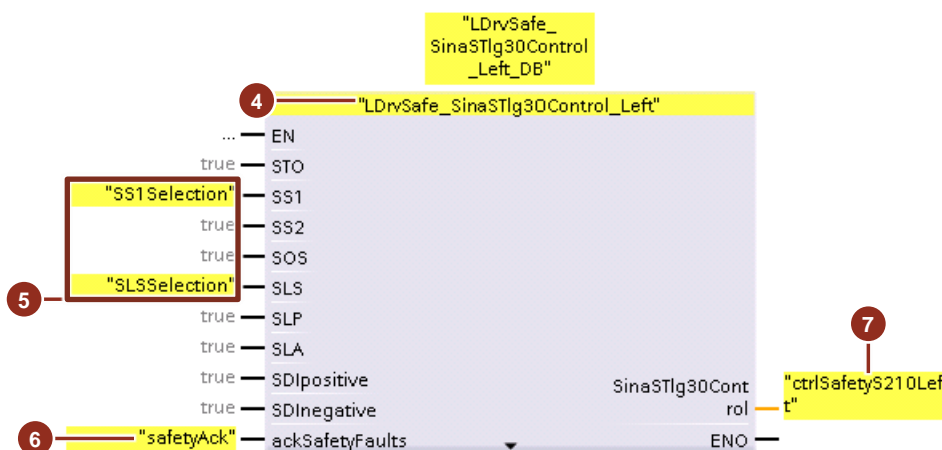
Unused/switched safety functions are deselected via the default assignment with "true".

8. For the "Right" drive, also create the corresponding blocks for control and evaluation.

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7.3   Configuring the Safety Info Channel

The "LDrvSafe" library also provides blocks and PLC data types for the Safety Info Channel and the Safety Control Channel, depending on the selected telegram (700 or 701).

In the user program, the FBs and PLC data types are used for the configured Safety Info Channel telegram 701.

Inserting Library Elements
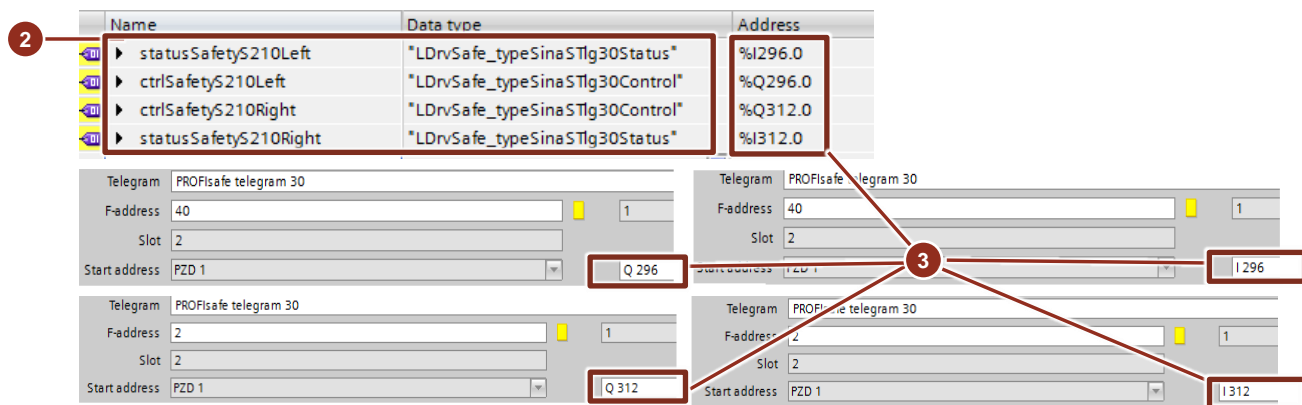
1. Open the library "LDrvSafe".

2. Insert the following FB from the library into the folder "Program blocks" by Drag&Drop:
   - "LDrvSafe_SinaTlg701Status"

3. Insert the following PLC data types from the library into the "PLC data types" folder using Drag&Drop:
   - "LDrvSafe_typeSinaTlg701Status"

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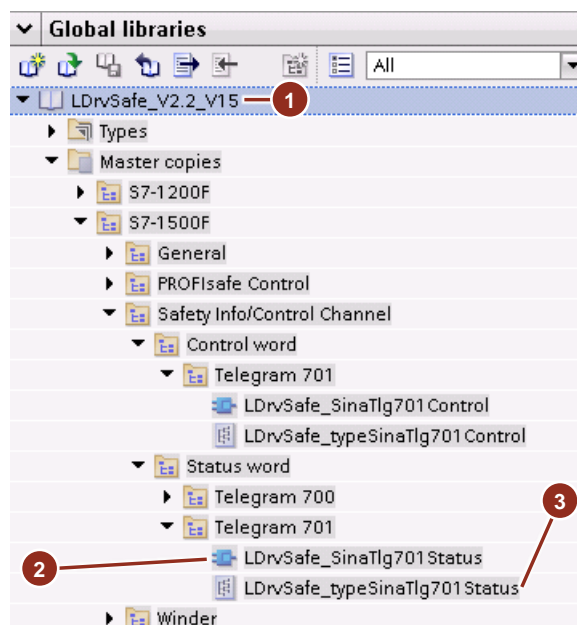
**Call up library blocks**

1. Insert the FB "LDrvSafe_SinaTlg701Status" into your program. This FB is used for simple evaluation of the Safety Info Channel of the SINAMICS S and enables the non-secure transmission of Safety Integrated states next to or without the PROFIsafe telegram.

2. Connect the "enable" input to activate the processing of the block.

3. Assign the corresponding hardware ID of the associated telegram slot of telegram 701 to the input "hardwareID".

4. Connect the outputs of the FB as required.
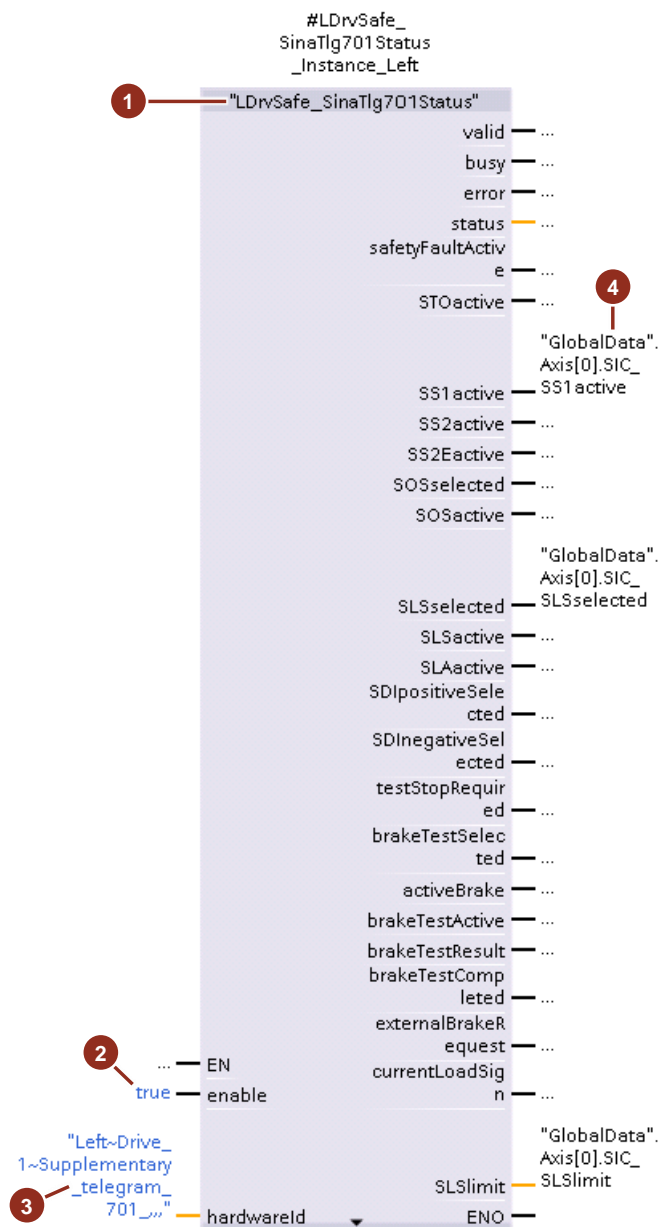
5. Also create the corresponding block for the Safety Info Channel for the "Right" drive.

8 Operating example

In the following operating examples, the interaction between Safety Integrated and the technology object using the blocks provided in the LDrvSafe library is described.

Therefore, disturbance-free operation of a technology object can be implemented, together with the Safety Integrated Extended Functions.

8.1 Scenario 1: Interaction of technology object with SS1E

For some applications, for example when axes are coupled through a material web, when an Emergency Stop is issued, the axes must be stopped together as a group.

Function SS1E can be used for this purpose.

As application scenario, the leading and following drive scenario in Chapter 6.2.1 of the application example "Configuring technology objects with SIMATIC S7-1500 and SINAMICS S210 in the TIA Portal" is used.
For information on controlling the leading and following drives, please refer to the application example (\3\).

Necessary program changes

Make the following steps for this scenario.

1. Open the "MotionControl_Pos" block
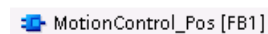
2. Navigate to the "MC_HALT" network and interconnect input "Execute" of the MC_HALT with status bit "SS1active" of the Safety Info Channel of drive "Left".

7. Compile and save your project.
8. Load your project into the controller.

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Resulting drive function

If the leading and following drives are now traversed and an SS1E selected, the leading drive is braked using the MC_HALT block as a result of the "SS1active" status.
The following drive follows the leading drive through the synchronous relationship, therefore allowing the drive group to be stopped in a controlled fashion.

Note	Please note that the SS1 delay time (p9556) must be appropriately parameterized so that the axes come to a standstill within this time, facilitating a controlled stopping process.

8.2 Scenario 2: Interaction of technology object with SLS

When selecting the SLS function, the technology object must reduce the speed, corresponding to the parameterized SLS limit value - in the example 500 [rpm].

As application scenario, the leading and following drive scenario in Chapter 6.2.2 of the application example "Configuring technology objects with SIMATIC S7-1500 and SINAMICS S210 in the TIA Portal" is used.
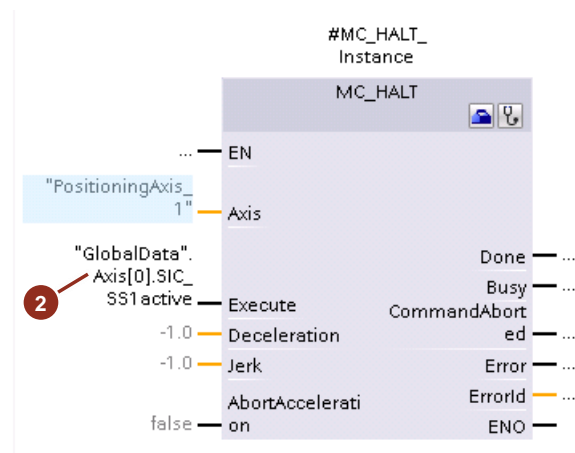For information on controlling the leading and following drives, please refer to the application example (\3\).

Necessary program changes

Make the following steps for this scenario.

1. Insert a new variable to enter the JOG speed setpoint and insert this into the monitoring table.

// MC_MOVEJOG (MASTER)	
"MotionControl_Pos_DB".MC_MOVEJOG_Instance.JogForward	Bool
"MotionControl_Pos_DB".MC_MOVEJOG_Instance.JogBackward	Bool
"GlobalData"."MC_MOVEJOG_Instance.Velocity"	Floating-point number

2. Open the "MotionControl_Pos" block

MotionControl_Pos [FB1]

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3. Navigate to the network with block "MC_MOVEJOG" - and in front of it, insert a new network with blocks "DIV", "MUL" and "SEL".

The value of the active SLS speed limit, transferred via "SLSlimit" of the Safety Info Channel, is converted into unit [°] of the technology object using the division and multiplication block.

Note	The SLS speed limit of the SIC is standardized using p2000. "SLSlimit" = 4000 0000 hex = 1073741824 dec = speed in p2000

The following calculation is applied:
("SLSlimit"/1073741824) * (p2000/60*360°) = technology object speed setpoint

4. Position and interconnect the blocks in the following sequence
    "DIV" → "MUL" → "SEL".

5. Interconnect at block "DIV":
    -   Input "IN1" with "SLSlimit" of the Safety Info Channel
    -   Input "IN2" with 1073741824 dec

6. Interconnect at block "MUL":
    -   Input "IN1" with the value 44400 ((p2000/60*360°)
    -   Input "IN2" with output "Out" of the division block.
    -

Using the selection block, depending on a selected SLS function, the speed setpoint is switched over between the SLS limit and the actual setpoint.

7. Interconnect at block "SEL":
    -   Input "G" with signal "SLSselected" of the Safety Info Channel
    -   Input "IN0" with the newly created variable for the JOG speed setpoint input
    -   Input "IN1" with the output of the multiplication block
    -   Output "OUT" with the "Velocity" input of the MC_JOG
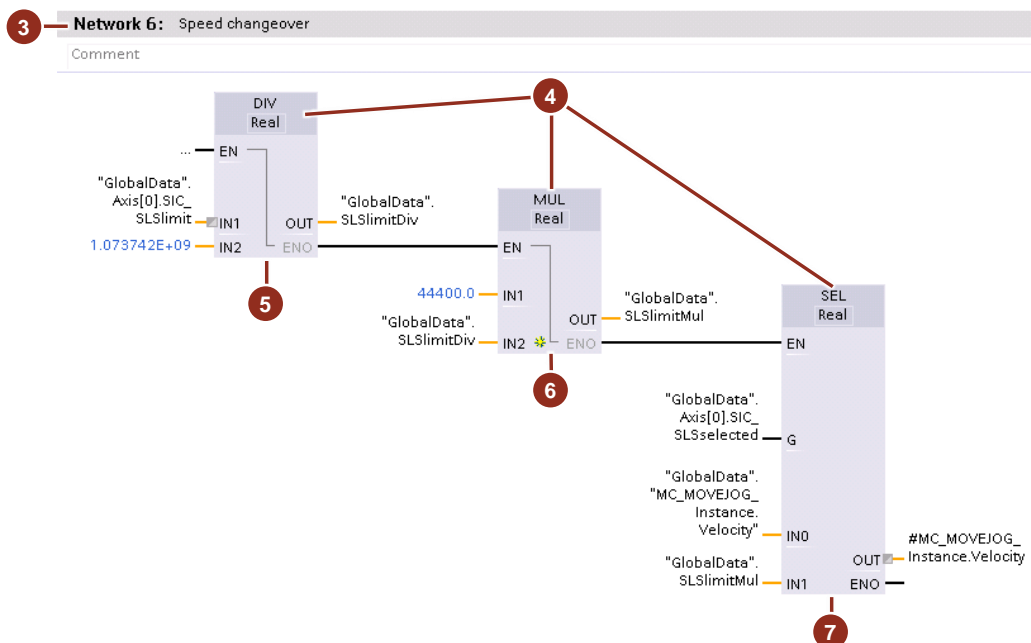
Resulting drive function

If, during an active JOG command, the SLS Safety Integrated Function is selected, then the technology object reduces its speed to the value of the active SLS speed setpoint limit, in the specific application example, to 400 [rpm] or 2400 [°/s] at the technology object.

Note	Bit "SLSselected" is used to switch over the speed of the technology object in order to avoid violating the limit value.
	As a consequence, note that the delay time for the SLS switchover (p9551) must be appropriately selected in SINAMICS S210 so that within this time, the actual speed follows the technology object setpoint and is below the SLS limit value before the SLS function becomes active.

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9 Appendix

9.1 Service and Support

Industry Online Support

Do you have any questions or need assistance?

Siemens Industry Online Support offers round the clock access to our entire service and support know-how and portfolio.

The Industry Online Support is the central address for information about our products, solutions and services.

Product information, manuals, downloads, FAQs and application examples – all information can be obtained with just a few mouse clicks:
https://support.industry.siemens.com/

Technical Support

The Technical Support of Siemens Industry provides you with fast and competent support regarding all technical queries with numerous tailor-made offers
– from basic support up to individual support contracts.

Use the web form to send requests to Technical Support:
https://www.siemens.de/industry/supportrequest

SITRAIN – Training for Industry

With our globally available training courses for our products and solutions, we provide you with practical support through innovative learning methods and with a customer-specific, harmonized concept.

More information is available on the various training courses as well as locations and dates at:
https://www.siemens.de/sitrain

Service portfolio

Our service portfolio includes the following:

- Plant data services
- Spare part services
- Repair services
- On-site and maintenance services
- Retrofit and modernization services
- Service programs and contracts

You can find more detailed information about our service portfolio in the service catalog:
https://support.industry.siemens.com/cs/sc

Industry Online Support App

With the "Siemens Industry Online Support" App, you can obtain optimum support, even when you are on the move. The App is available for Apple iOS, Android and Windows phones:
https://support.industry.siemens.com/cs/ww/en/sc/2067

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9.2 Application support

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9.3 Links and references

Table 9-1

No.	Subject
\1\	Siemens Industry Online Support https://support.industry.siemens.com
\2\	Link to the entry page of the application example https://support.industry.siemens.com/cs/ww/en/view/109760341
\3\	Configuring technology objects with SIMATIC S7-1500 and SINAMICS S210 in the TIA Portal https://support.industry.siemens.com/cs/ww/en/view/109749795
\4\	SINAMICS/SIMOTICS servo drive system SINAMICS S210 operating instructions https://support.industry.siemens.com/cs/ww/en/view/109753800
\5\	SIMATIC – Failsafe LDrvSafe library for controlling Safety Integrated Functions for the SINAMICS drive family https://support.industry.siemens.com/cs/ww/en/view/109485794
\6\	Controlling Safety Integrated Functions of the SINAMICS S120 with SIMATIC S7-1500F via PROFIsafe https://support.industry.siemens.com/cs/ww/en/view/109749224

9.4 Change documentation

Table 9-2

Version	Date	Change
V1.0	09/2018	First edition
V1.1	10/2019	Configuration of the S210 in Startdrive

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