

Axioline F SBT V3 configuration on an S7-1200 controller with TIA Portal

Quick start guide



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2016-04-20

Designation: UM QS EN AXL F SBT V3 S7-1200 TIA PORTAL

Revision: 00

Order No.: —

This user manual is valid for:

Designation	From HW/FW/FW version	Order No.
AXL F LPSDO8/3 1F	00/100	2702171
AXL F SSDI8/4 1F	01/200	2702263

Please observe the following notes

User group of this manual

The use of products described in this manual is oriented exclusively to qualified application programmers and software engineers, who are familiar with the safety concepts of automation technology and applicable standards.

Explanation of symbols used and signal words



This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety measures that follow this symbol to avoid possible injury or death.

There are three different categories of personal injury that are indicated with a signal word.

DANGER This indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING This indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION This indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.



This symbol together with the signal word **NOTE** and the accompanying text alert the reader to a situation which may cause damage or malfunction to the device, hardware/software, or surrounding property.



This symbol and the accompanying text provide the reader with additional information or refer to detailed sources of information.

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1 Introduction

1.1 Purpose of this user manual

This quick start guide uses an example project to describe how to integrate SafetyBridge Technology V3 modules in a PROFINET system into a SIMATIC S7-1200 controller with TIA Portal.

1.2 Requirements

Knowledge

Knowledge of the following is required:

- The target system (PROFINET)
- The components used in the application
- The Siemens software used
- The Microsoft Windows operating system

Hardware

The following hardware is required in order to start up the example system:

Designation	As of HW/FW	Order No.
AXL F BK PN (PROFINET bus coupler)	01/101	2701815
AXL F LPSDO8/3 1F (logic module)	00/100	2702171
AXL F SSDI8/4 1F (input module)	00/200	2702263

- Siemens controller: SIMATIC S7-1200 as of CPU 1214C
- Programming device/PC
- Other components: emergency-stop button, external reset button, signal lamp, contactor (optional)

Software



The Phoenix Contact software can be found in the download area for the specified product at phoenixcontact.net/products.

The following software is required in order to start up the example system:

Designation	Order No.
SAFECONF V2.92 or later (Phoenix Contact)	2986119
GSDML files for PROFINET bus couplers as of V1.01 (Phoenix Contact)	2701815
Integration package for SafetyBridge Technology V3 (Phoenix Contact)	2702171
SIMATIC STEP 7 Basic TIA V13_SP1 (Siemens)	6ES7822-0AA03-0YA5
or	
SIMATIC STEP 7 Professional TIA V13_SP1 (Siemens)	6ES7822-1AA03-0YA5

- Other software: Microsoft Windows

1.3 Additional documentation

Comprehensive information on PROFINET is available on the Internet at profibus.com.

Please refer to the documentation for the software used, the components used in the application, and the function blocks used.

The documentation for the SafetyBridge Technology V3 modules used and the bus coupler must be strictly observed.

Description	Type	Order No.
User manual: Axioline F module with integrated safety logic and safe digital outputs	UM EN AXL F LPSD08/3 1F	2702171
User manual: Axioline F module with safe digital inputs	UM EN AXL F SSDI8/4 1F	2702263
Data sheet: Axioline F bus coupler for PROFINET	DB EN AXL F BK PN	2701815



The documentation for Phoenix Contact devices can be found in the download area for the specified product at phoenixcontact.net/products.

1.4 Safety hotline

Should you have any technical questions, please contact our 24-hour hotline.

Phone: +49 5281 9462777

E-mail: safety-service@phoenixcontact.com

2 Overview of the integration of the SafetyBridge Technology V3 system

Safety with the SafetyBridge Technology V3 system

Within a SafetyBridge Technology V3 system, safety can only be ensured by using the modules of this system (AXL F LPSDO8/3 1F and 1 to 16 satellites). None of the other components in the overall system are safety-related components. Errors at non-safety-related components or errors during integration of the SafetyBridge Technology V3 system are reliably detected by the SafetyBridge Technology V3 system components. These errors only reduce the system availability but not the system safety.



No safety controllers are required for the implementation of safety functions.

Table 2-1 Integration of a SafetyBridge Technology V3 island

Step	Process	See...
1	Download and installation of the Phoenix Contact software (not safety-related)	
	<ul style="list-style-type: none"> – Download and install SAFECONF configuration software – Download GSDML file for bus coupler – Download and install integration package for SafetyBridge Technology V3 	page 11 page 11 page 11
2	Hardware installation (not safety-related)	
	<ul style="list-style-type: none"> – Set device DIP switches – Mount and wire bus configuration 	page 12 page 13 User documentation for the devices
3	Configure safety logic in SAFECONF (safety-related)	
	<ul style="list-style-type: none"> – Create new project, assign safety island number – Configure the hardware structure – Parameterize I/O channels – Configure safety function – Export configuration and parameter data record 	page 14, page 16 page 16 page 17 page 14 page 21 SAFECONF online help
4	Configuring a TIA project for S7-1200 (not safety-related)	
	<ul style="list-style-type: none"> – Create project and import GSDML file – Insert and network bus coupler in the work area – Insert SafetyBridge Technology V3 modules – Integrate function blocks for SafetyBridge Technology V3 	page 22 page 22, page 23 page 23 page 24

Overview of the integration of the SafetyBridge Technology V3 system

Table 2-1 Integration of a SafetyBridge Technology V3 island

Step	Process	See...
	<ul style="list-style-type: none"> - Import configuration and parameter data record - Create SBT program in TIA Portal 	page 26 page 28 Documentation for the controller and software
5	Startup and overall safety validation (safety-related)	page 35

System overview:

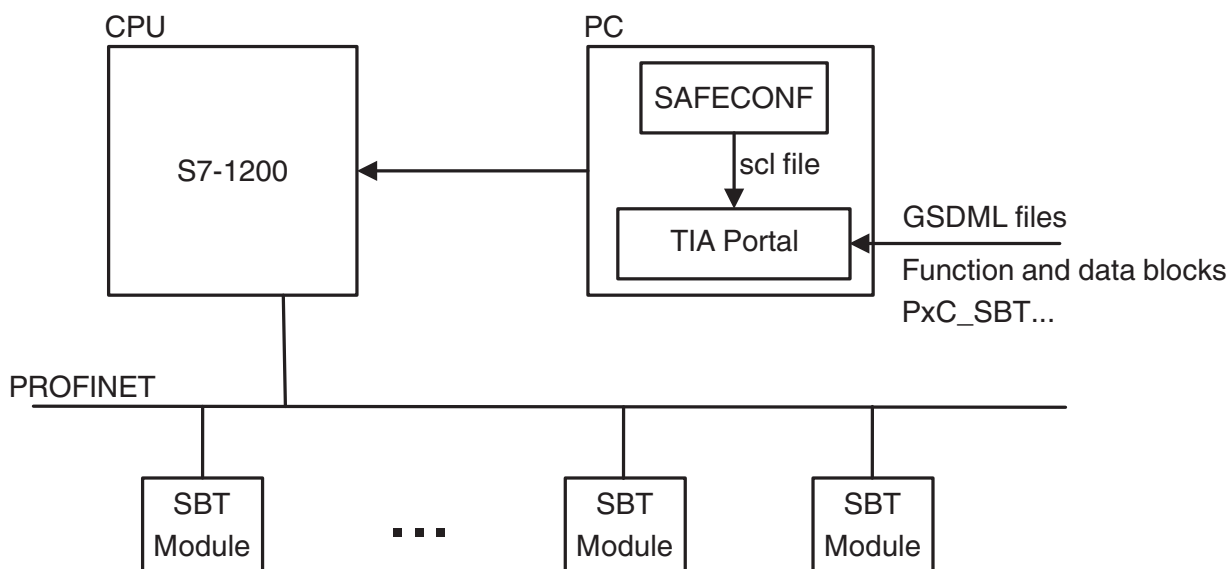


Figure 2-1 System overview of SafetyBridge Technology V3

3 Example project: two-channel emergency stop monitoring

3.1 Download and installation of the Phoenix Contact software



The Phoenix Contact software can be found in the download area for the specified product at phoenixcontact.net/products.

Make sure that you always use the latest version of the GSDML file and the integration package, as well as the correct version of the function blocks for the TIA Portal software version. See "Software" on page 7.

SAFECONF

1. Download the SAFECONF configuration software and install the software (Order No. 2986119).

Device description file

2. Download the GSDML file for the bus coupler (Order No. 2701815).



The GSDML file contains all devices that can be connected to the bus coupler with a device description file.

SBT V3 integration package

3. Download the integration package for SafetyBridge Technology V3 (Order No. 2702171).

Software

	Description	Language	Revision
<input checked="" type="checkbox"/>	[exe, 123 MB] Software SafetyBridge technology integration package for controllers from Phoenix Contact, Rockwell and Siemens (S7-1200 from CPU 1214C, S7-1500, S7-300), Schneider as well as CODESYS-based controllers. SBT_V3_PLC_Integration_Packages_2.0.exe	International	2.0

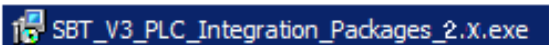
Figure 3-1 Integration package in download area for Order No. 2702171



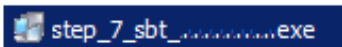
The integration package contains additional file formats so that the SAFECONF configuration can be saved as an scl file for TIA Portal. In addition, the integration package installs an exe file which creates the TIA function blocks for SafetyBridge.

Example project: two-channel emergency stop monitoring

4. Install the integration package as follows:
 - Run setup and select “Siemens” during installation.



- Open “Windows Start menu, All Programs, Phoenix Contact, SBT V3 for SAFECONF 2.92, Siemens, SBT V3 Functionblocks”.
- Install the Siemens function blocks.



Please make a note of where the library files are installed, as you will need this information later when you open the library in TIA Portal.

3.2 Hardware installation

3.2.1 Setting the device DIP switches

To implement the example project, make the following settings at the DIP switches of the SafetyBridge Technology V3 modules before installing the bus configuration.

Table 3-1 Setting the DIP switches

	CM		Island number					Satellite number				
	Operating mode	Reserved	SafetyBridge Technology V3 address: 32 _{dec} (20 _{hex})									
DIP switch	11	10	9	8	7	6	5	4	3	2	1	0
Setting for AXL F LPSD08/3 1F	off	on	0	0	0	0	1	0	0	0	0	0
	1 _{dec}						0 _{dec}					

	CM		Island number					Satellite number				
	Operating mode	Reserved	SafetyBridge Technology V3 address: 33 _{dec} (21 _{hex})									
DIP switch	11	10	9	8	7	6	5	4	3	2	1	0
Setting for AXL F SSDI8/4 1F	off	on	0	0	0	0	1	0	0	0	0	1
	1 _{dec}						1 _{dec}					



You can display the complete DIP switch setting in the SAFECONF configuration software by right-clicking on the module and selecting “Display address switch”. See Figure 3-10 on page 17.

Example project: two-channel emergency stop monitoring

3.2.2 Mounting and wiring the bus configuration



Refer to the user documentation for the devices.
See "Additional documentation" on page 8.

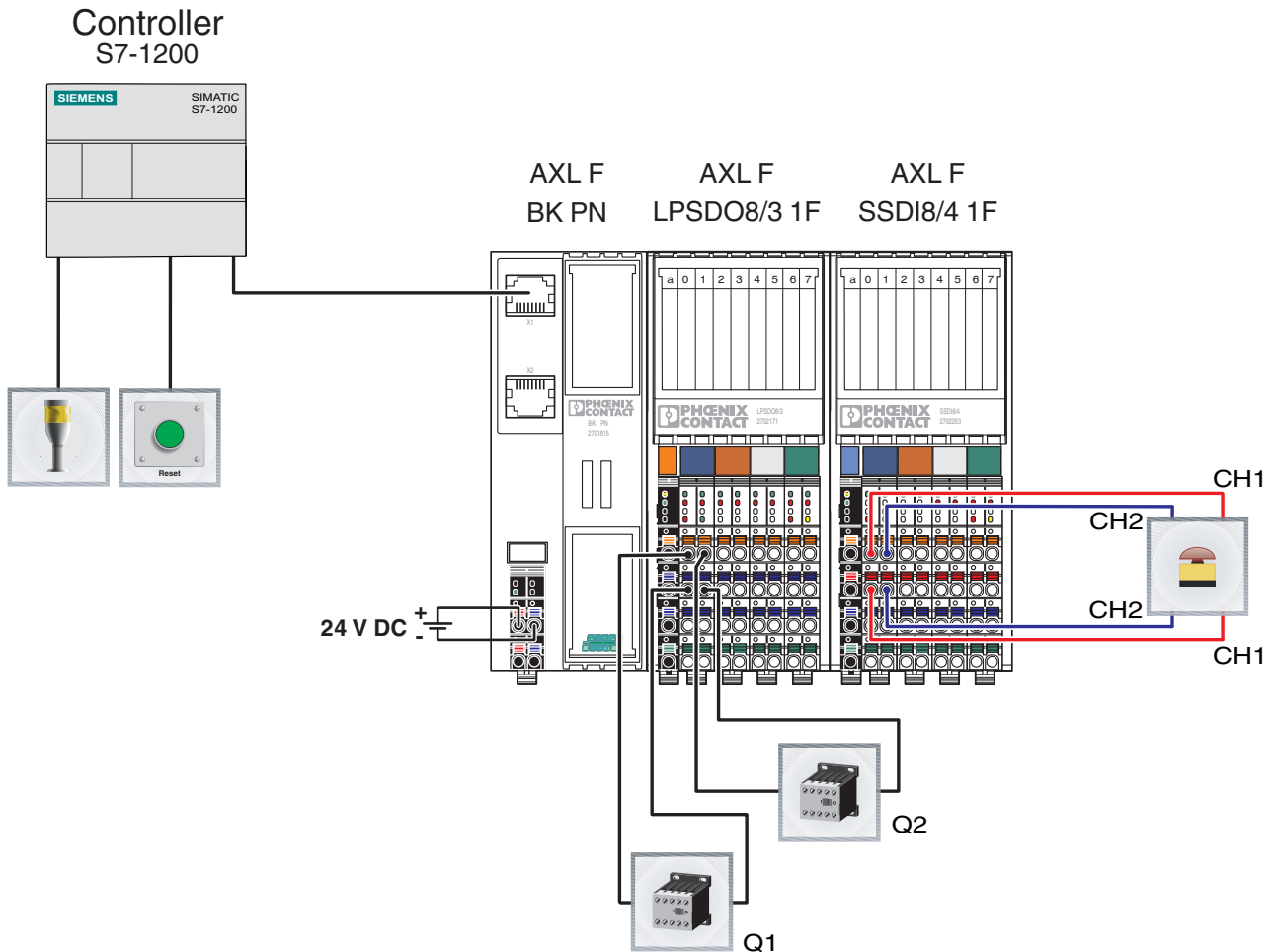


Figure 3-2 Bus configuration for example project

1. After setting the DIP switches on the modules, mount the bus configuration as illustrated.
2. Connect the power supply for the controller and bus coupler and connect the controller and bus coupler via an Ethernet cable.
3. Connect channel 1 of the emergency-stop button to terminal points 00 and 10 and channel 2 to terminal points 01 and 11 of the SSDI8/4 module.
4. Connect the external reset button to the controller.
5. Connect a signal lamp to the controller.
6. Optional: connect contactors to terminal points 00 and 10, as well as to 01 and 11 of the LPSDO8/3 module.

3.3 Configuring the safety logic in SAFECONF



If you have any questions about SAFECONF, please refer to the online help for the software.

3.3.1 Creating a new project

- Open the SAFECONF software.
- Create a new project with the Project Wizard. To do this, select “File, New Project”.
- Specify the name and storage location for the project.



Do not use spaces, dashes or special characters. Note the name and storage location for the project as you will need this information later.

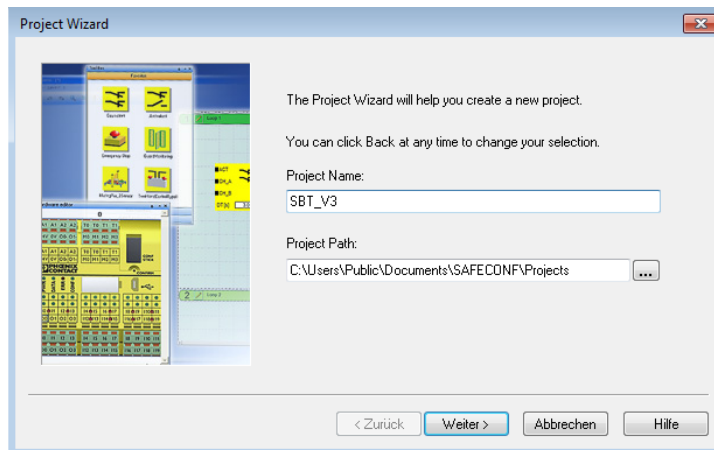


Figure 3-3 Creating the project name and path

Select master device

- Select the AXL F LPSDO8/3 1F master device.

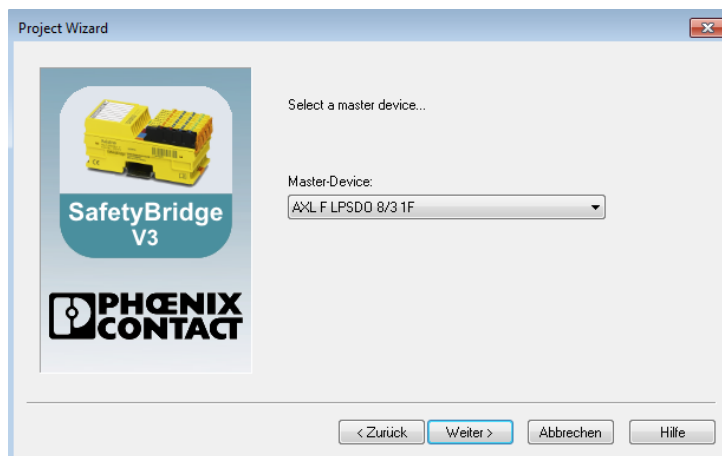


Figure 3-4 Selecting AXL F LPSDO8/3 1F

Example project: two-channel emergency stop monitoring

Select file format

- Select "TIA Portal" as the file format in which the configuration and parameter data record is to be output.

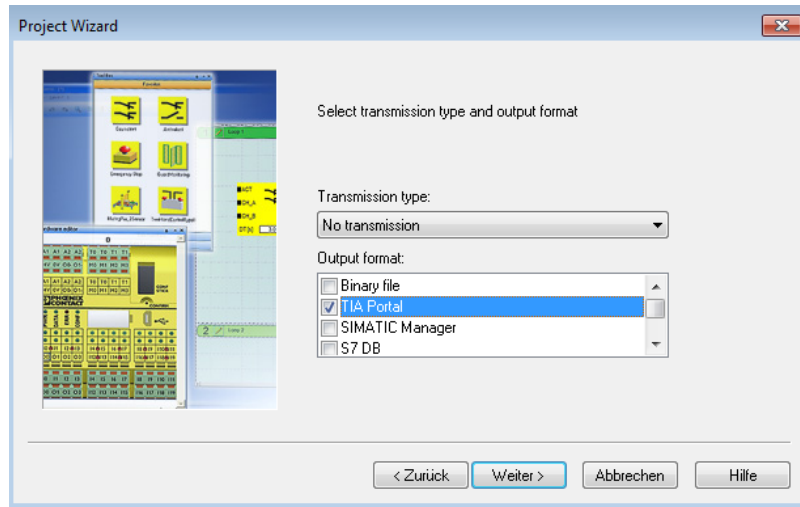


Figure 3-5 Selecting the output format

Enter project description

- Enter a description for the project and the data block (DB).



Use a maximum of four characters for the description and version and a maximum of eight characters for comments.

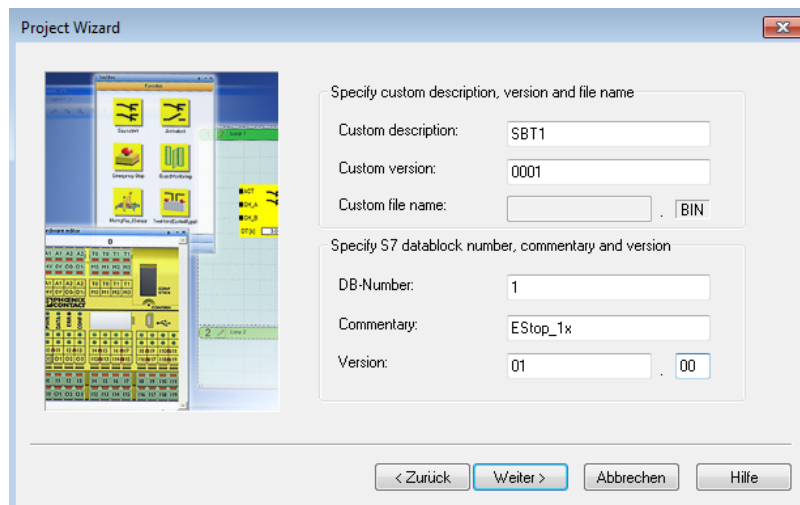


Figure 3-6 Description of the project and the data block

Example project: two-channel emergency stop monitoring

- Click “Finish” to complete the project creation process.

Assign safety island number

When the project is completed, a window opens prompting you to enter the number for the safety island you are configuring.

- Enter an island number (1 in the example).

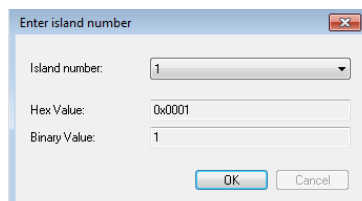


Figure 3-7 Specifying the island number

Specify password

- Specify a password of at least six characters for the project (123456 in the example).



Figure 3-8 Specifying a password

3.3.2 Configuring and parameterizing the hardware structure

- Configure the hardware structure.
To do this, use drag and drop to move the AXL F SSD18/4 1F module from the “Hardware” toolbox to the Hardware Editor.

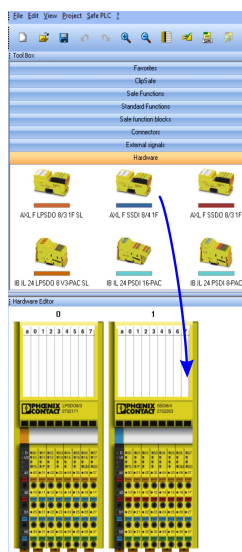


Figure 3-9 Hardware configuration

Example project: two-channel emergency stop monitoring



The corresponding satellite number is displayed via the module.
 You can display the complete DIP switch setting by right-clicking on the module and selecting "Display address switch".

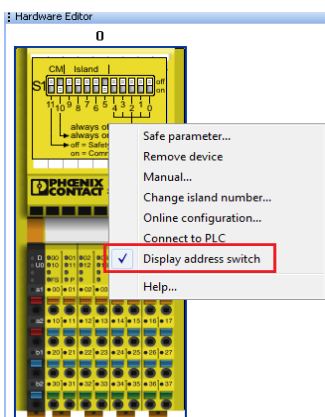


Figure 3-10 Displaying the DIP switch

Parameterize I/O channels

There are two options for parameterizing the input and output channels of the modules:

- 1 In the Hardware Editor, double-click on the module. This opens the window for parameterizing the entire module.
 - 2 In the Hardware Editor, double-click on a terminal point. This opens the window for parameterizing the selected terminal point.
- Parameterize the output channels of the LPSDO8/3 module as illustrated (double-click on the module to parameterize).

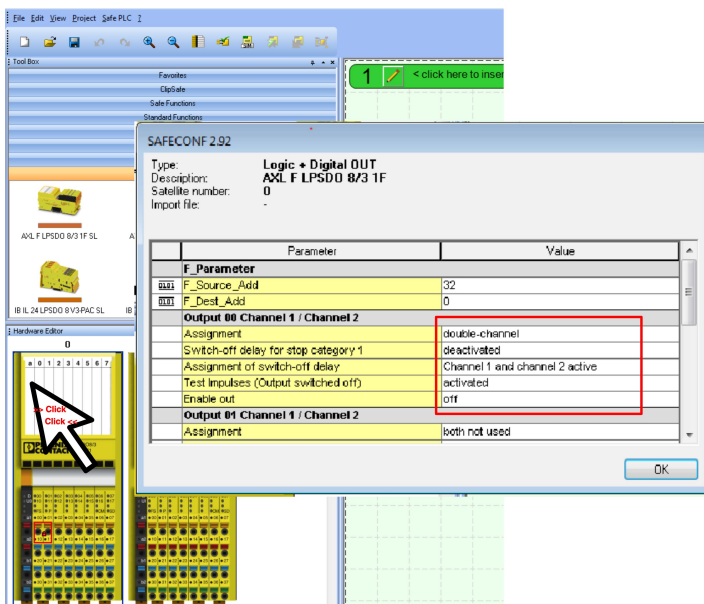


Figure 3-11 Parameterization of the LPSDO8/3

Example project: two-channel emergency stop monitoring

- Parameterize the input channels of the SSDI8/4 module (double-click on the module to parameterize).

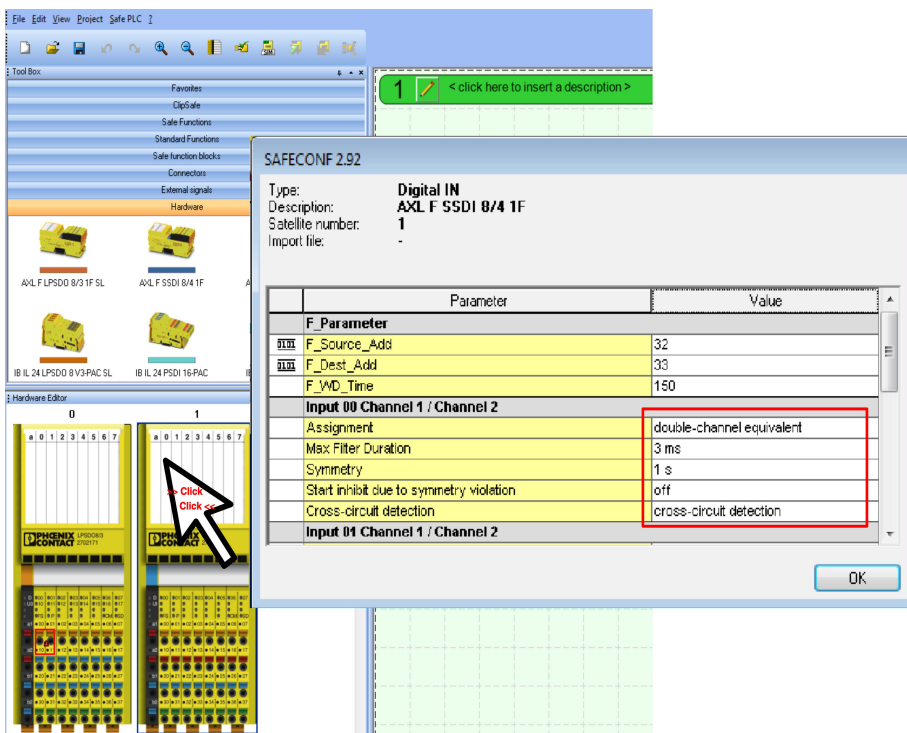


Figure 3-12 Parameterization of the SSDI8/4



Inputs or outputs parameterized for two-channel operation are indicated by a padlock symbol on the module in the Hardware Editor.

However, the input and output signals are only displayed in single-channel form in the connection editor, even if they are parameterized for two-channel operation. See Figure 3-14 on page 19.

Example project: two-channel emergency stop monitoring

3.3.3 Configuring the safety function

Comment function



You can add comments to both function blocks and signals in SAFECONF. Please refer to the online help for the software.

Insert function blocks

- Configure the safety function. To do this, use drag and drop to move the blocks and signals from the corresponding toolboxes to the connection editor.

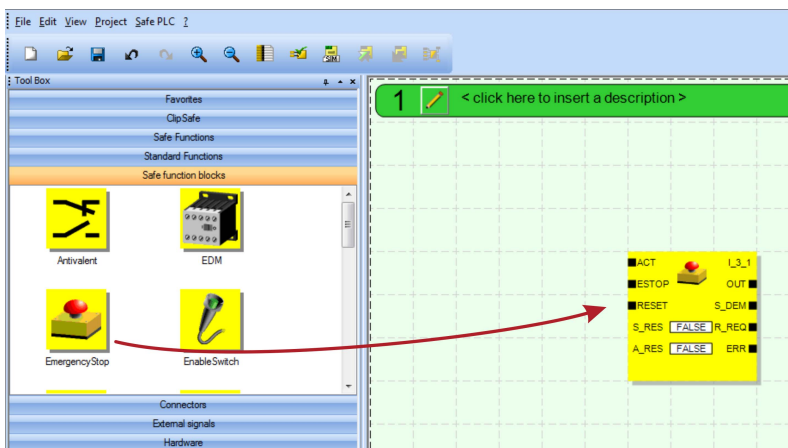


Figure 3-13 Inserting a function block from the “Safe function blocks” toolbox

Insert safe inputs and outputs

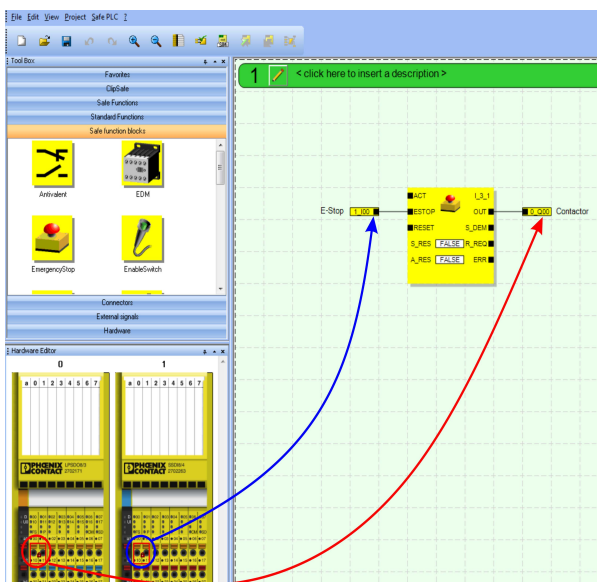


Figure 3-14 Inserting safe inputs and outputs from the Hardware Editor



When you use drag and drop to place the safety module terminal point directly onto a function block input or output, the connecting line is created automatically.

Example project: two-channel emergency stop monitoring

Insert external signals

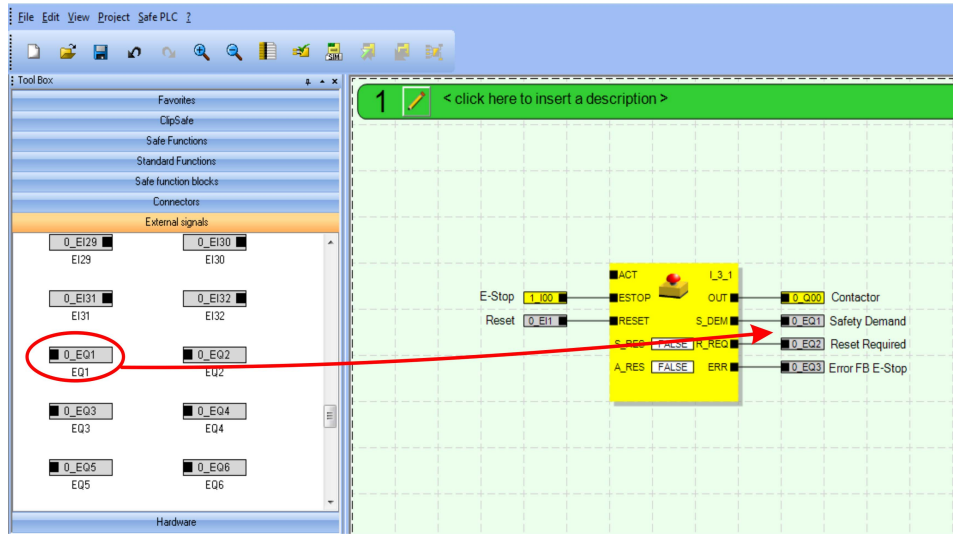
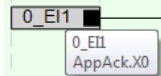


Figure 3-15 Inserting external signals from the “External signals” toolbox



Move your mouse over an external signal to display the corresponding tooltip.



Insert safe functions

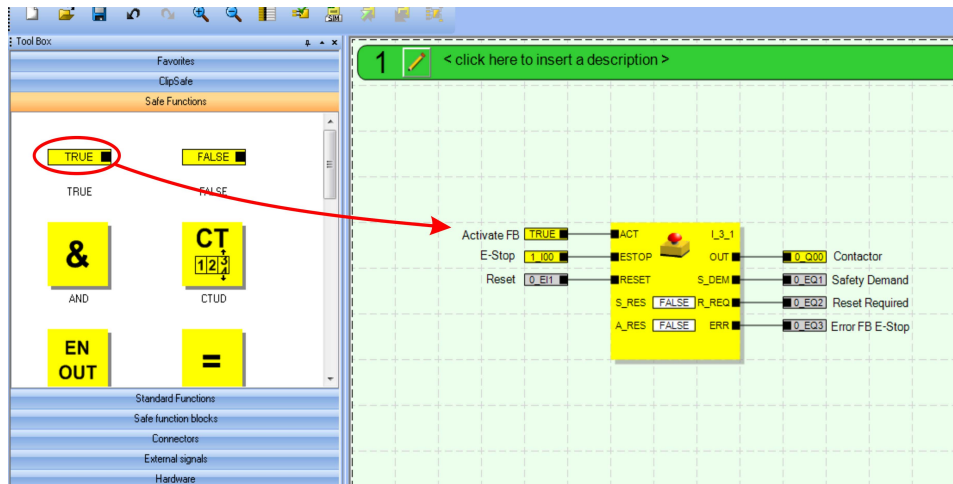


Figure 3-16 Inserting a safe function from the “Safe Functions” toolbox

Example project: two-channel emergency stop monitoring

3.3.4 Exporting the configuration and parameter data record

Check project

- Check the project.
To do this, select the “Project, Check Project” command or confirm by clicking on the corresponding button.



A message window opens displaying the progress of the check. Once the check is complete, the amount of program memory used by the program is displayed.

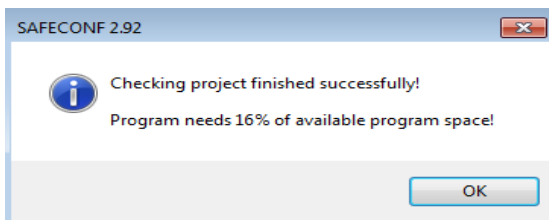


Figure 3-17 Program memory used

scl file for TIA Portal

If the check is completed without errors, the configuration and parameter data record is created as an scl file. This is saved in the path that you have entered for the project (see Figure 3-3 on page 14) in the “FileOutput” folder.

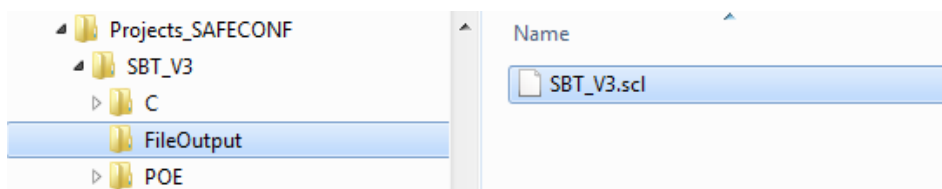


Figure 3-18 scl file in the “FileOutput” folder

3.4 Configuring a TIA project for S7-1200

3.4.1 Creating a project and importing the GSDML file

- Create a new project in the TIA Portal.
- In the TIA Portal, select the appropriate Siemens controller (e.g., SIMATIC S7-1200 CPU 1215C DC/DC/DC).
- Import the GSDML file for the bus coupler.
To do this, select “Options, Install general station description file (GSD)”.

3.4.2 Inserting and networking the bus coupler in the work area

Insert bus coupler

- Select “Network view” in the work area.
- Select the bus coupler and the correct firmware version in the hardware catalog and move the bus coupler to the work area using drag and drop.

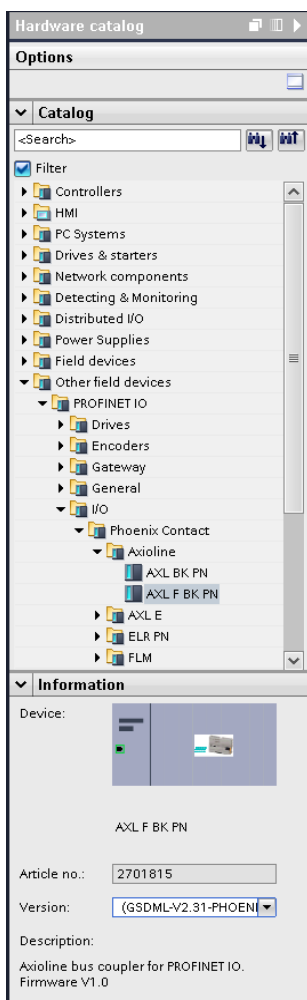


Figure 3-19 Selecting the bus coupler

Example project: two-channel emergency stop monitoring

Network the controller and bus coupler

- Network the Ethernet interfaces of the controller and the bus coupler together (green connecting lines).
- Then click on “Connections”.

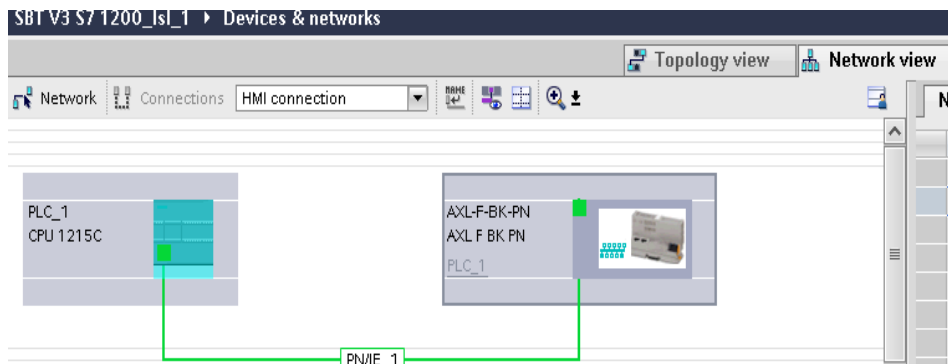


Figure 3-20 Networking the controller and bus coupler

3.4.3 Inserting SafetyBridge Technology V3 modules

Insert SBT modules

- Select the bus coupler in the “Network view” work area and then click on “Device view”.
- Select the following modules in the hardware catalog and move them to the bus coupler device overview using drag and drop:
 - AXL F LPSDO8/3 1F (Order No. 2702171)
 - AXL F SSDI8/4 1F (Order No. 2702263)

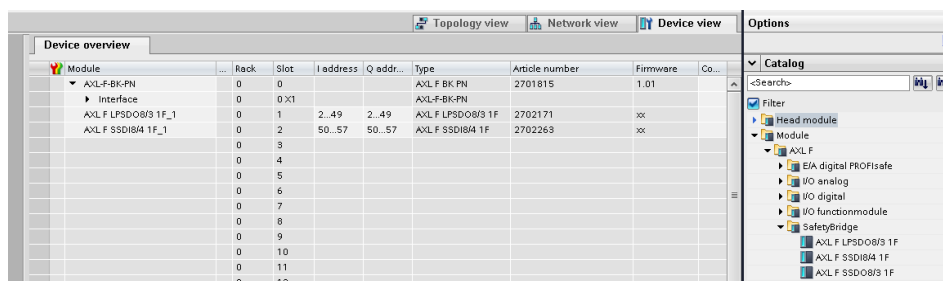


Figure 3-21 Inserting SBT modules in the device overview

Specify PROFINET device name and IP address

- Specify the properties of the bus coupler and controller (e.g., PROFINET device name and IP address).

3.4.4 Integrating function blocks for SafetyBridge Technology V3

Check software version

- In the TIA Portal menu bar, select “Help, Installed software” and check which software version is installed.

Note: Important for next steps

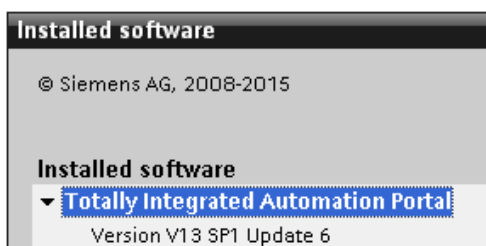


Figure 3-22 Installed TIA Portal software version

Retrieve library from integration package

- Select “Options, Global libraries, Retrieve library”.

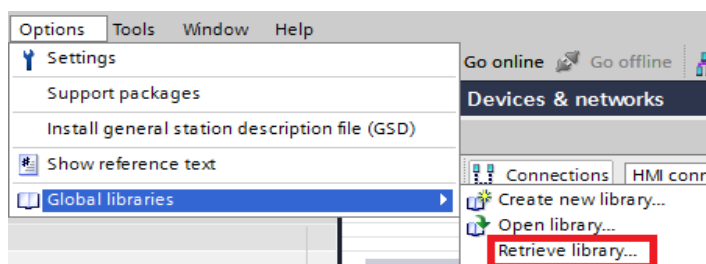


Figure 3-23 Retrieving a library

- Open the directory where the library files from the integration package for SafetyBridge Technology V3 were installed earlier. See page 12 in Section 3.1, “Download and installation of the Phoenix Contact software”.
- Open file “SBT_V3_V3_03_TIA_V13SP1.zal13” and select the destination directory where the file should be extracted.

The “Global libraries” window now contains the open “SBT_V3_V3_03_TIA_V13SP1” library.

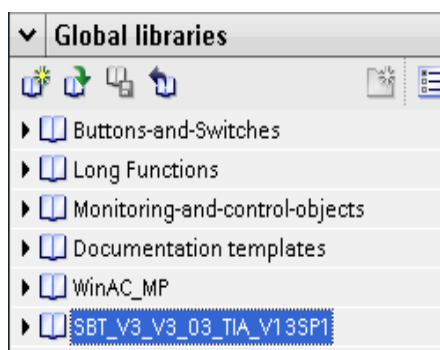


Figure 3-24 Retrieved library

Example project: two-channel emergency stop monitoring

Compare master copies with controller information

- In the library folder, open the “Master copies” folder.
- Compare your Siemens controller information (short designation and firmware version) with the corresponding folder in the master copies.

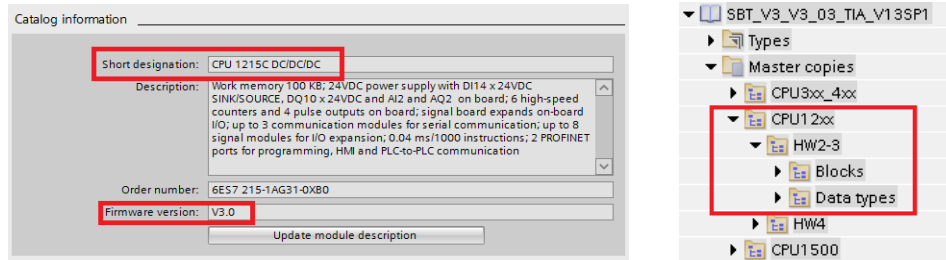


Figure 3-25 Comparing master copies with controller information

Insert “Blocks” in program blocks

- Select the contents of the “Blocks” folder in the master copies and move it to the “Program blocks” folder in the “Project tree” window using drag and drop.

There are now four new function blocks in the “Program blocks” folder: FB65, FB66, FB67, FB68, and two new data blocks: DB70, DB71.

Insert “Data types” in PLC data types

- Select the contents of the “Data types” folder in the master copies and move it to the “PLC data types” folder in the “Project tree” window using drag and drop.

There are now four new data types in the “PLC data types” folder.

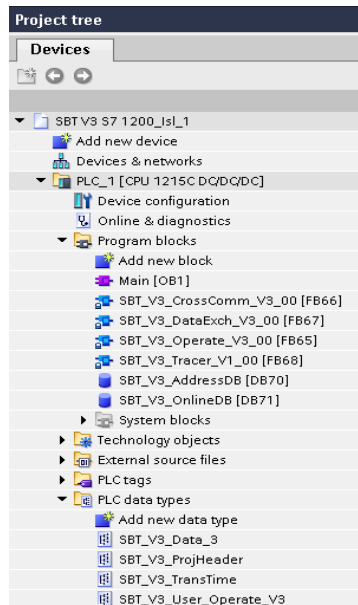


Figure 3-26 Function blocks and data types inserted



A description of the function blocks and data types is provided in Appendix C “Description of the function blocks for SafetyBridge Technology V3”.

Example project: two-channel emergency stop monitoring

3.4.5 Importing the configuration and parameter data record into the project

Import scl file

In “Exporting the configuration and parameter data record” on page 21, the scl file was created and saved in the “FileOutput” folder under the previously specified project path (see Figure 3-18 on page 21).

- Import the file into your project.
To do this, in the “Project tree” window right-click on “External source files” to open the context menu, select the “Add new external file” command, and open the scl file.

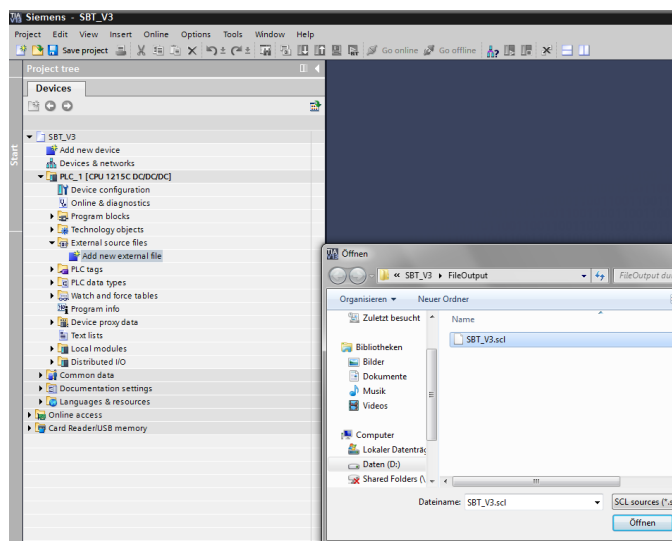


Figure 3-27 Importing the scl file into the TIA project

Compile scl file

The imported file is displayed under “External source files”.

- Compile the file.
To do this, right-click on the file to open the context menu and select the “Generate blocks from source” command.

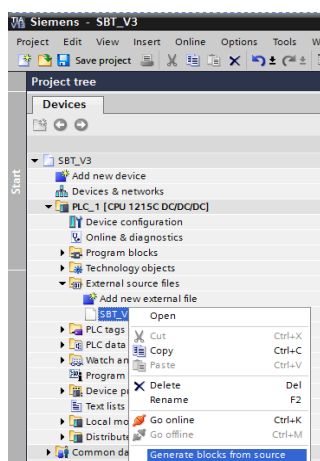


Figure 3-28 Compiling the scl file

Example project: two-channel emergency stop monitoring

Compiling the file creates a data block (DB), which contains the configuration and parameter data record. In the example this is DB1.

Deactivate block attribute selection

- Make sure that **no** attribute is selected in the block properties.

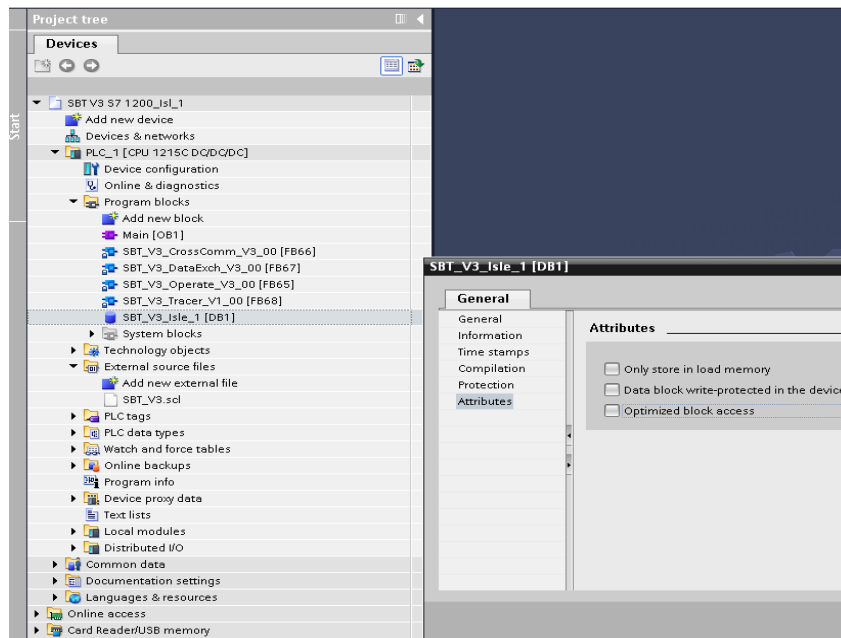


Figure 3-29 Deactivating block attributes



The data block is addressed in the “SBT_V3_Operate_V3_00” function block in parameter “iSafetyLogicDB” (see C 1 on page 43).

Important when making changes in SAFECONF

Procedure when making changes in the SAFECONF project:

Whenever a change is made in the SAFECONF project which affects the checksum (CRC), the scl file must be replaced in TIA Portal. Proceed as follows:

1. Delete the existing file in TIA Portal.
2. Repeat the steps described above:
 - a) Import scl file
 - b) Compile scl file
 - c) Deactivate block attribute selection

Example project: two-channel emergency stop monitoring

3.4.6 Creating the SBT program in TIA Portal

Create data block

- Under “Program blocks” in the “Project tree” window, create a new data block with the name “DB_SBT_V3_Island_1_Operate” and select “SBT_User_Operate” as the type.



This data block helps when connecting the FB65 SafetyBridge function block by providing the required data types.

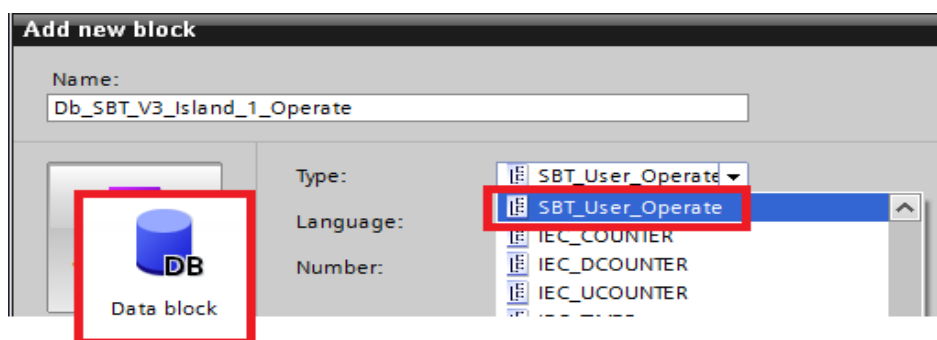


Figure 3-30 Creating a new data block

Create a function

- Create a function with the name “SBT_V3_Island_1” and select the desired programming language (e.g., FBD).

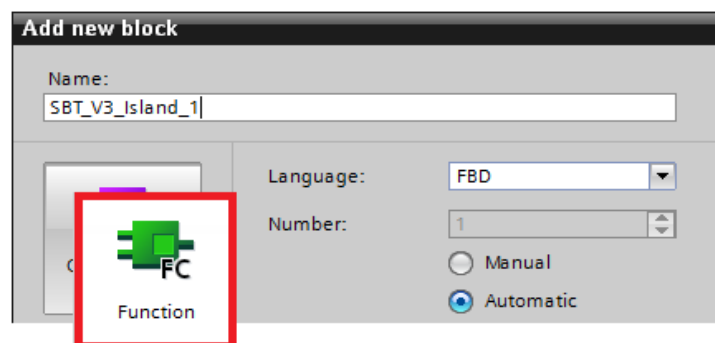


Figure 3-31 Creating a function

- Open programming view for the “SBT_V3_Island_1 [FC1]” function.
- Select the “SBT_V3_Operate_V3_00 [FB65]” function block and call this function block in the programming view of the “SBT_V3_Island_1 [FC1]” function using drag and drop.

Example project: two-channel emergency stop monitoring

The "Call options" window appears.

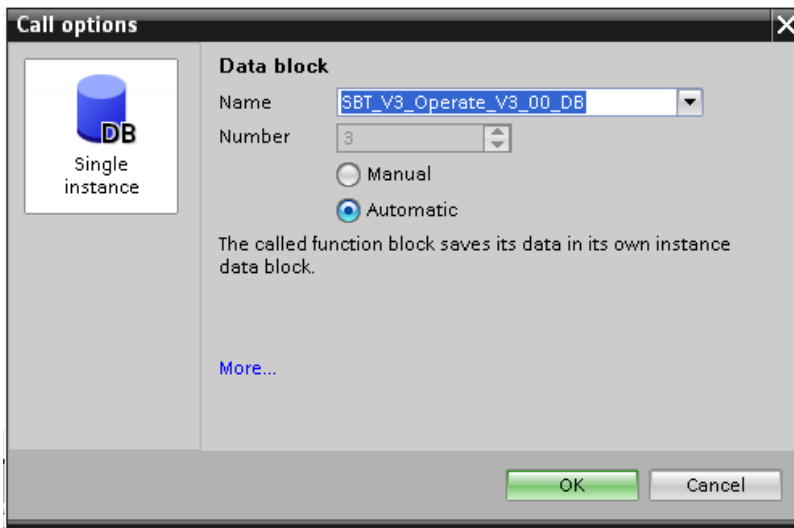


Figure 3-32 Call options for DB

- Confirm with "OK".

The "SBT_V3_Operate_V3_00_DB [DB3]" data block is created automatically.

Connect FB65 function block

- Apply the variable declaration for the "SBT_V3_Operate_V3_00 [FB65]" function block of the "DB_SBT_V3_Island_1_Operate [DB2]" data block. To do this, proceed as described under item 1 and 2 for each input and output parameter of the FB65 function block.



Please note that the procedure is different when connecting the input parameters "xActivate", "xReset", "bBusSystem", "iIslandNo", "iSafetyLogicDB", "iAddressDB", and "iOnlineDB". See "Different procedure for connecting input parameters:" on page 30.

1. Open the selection box for the input or output parameter and select the DB2 data block.

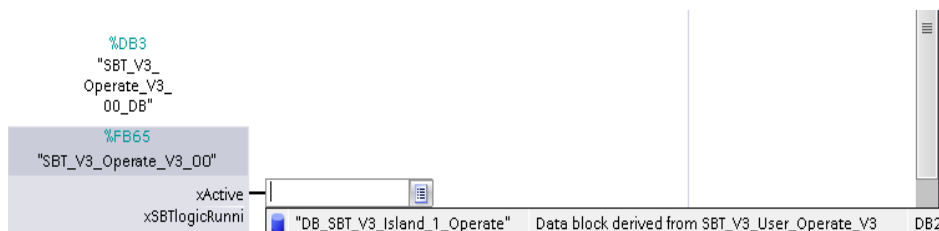


Figure 3-33 Selecting the data block

Example project: two-channel emergency stop monitoring

- From the drop-down menu, assign the element of the same to the input and output parameters.

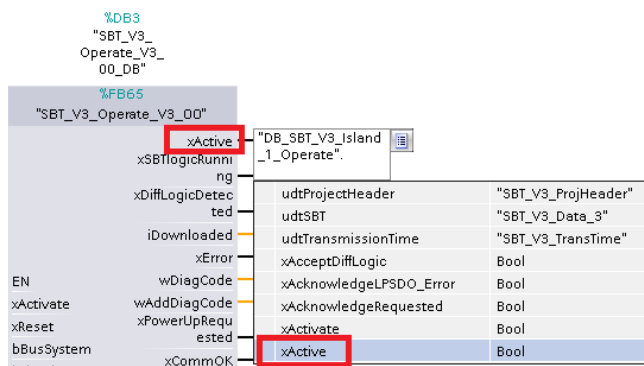


Figure 3-34 Selecting the element

Different procedure for connecting input parameters:

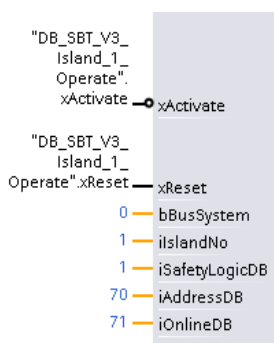


Figure 3-35 Connecting the input parameters “xActivate”, “xReset”, “bBusSystem”, “iIslandNo”, “iSafetyLogicDB”, “iAddressDB”, and “iOnlineDB”

- xActivate:** Invert the previously connected “xActivate” input parameter so that the FB65 function block is activated automatically.
- xReset:** With a rising edge, the function block is reset and re-initialized.
- bBusSystem:** Make sure that the “bBusSystem” input parameter is set to “0”.
- iIslandNo:** Set the “iIslandNo” input parameter to “1” as per the island number selected in SAFECONF. See “Assign safety island number” on page 16.
- iSafetyLogicDB:** Set the “iSafetyLogicDB” input parameter to the DB value generated in TIA Portal to “1” (SAFECONF project).
- iAddressDB:** Set the “iAddressDB” input parameter to number “70” of the “SBT_V3_AddressDB [DB70]” address data block.
- iOnlineDB:** Set the “iOnlineDB” input parameter to number “71” of the “SBT_V3_OnlineDB [DB71]” address data block.

Example project: two-channel emergency stop monitoring

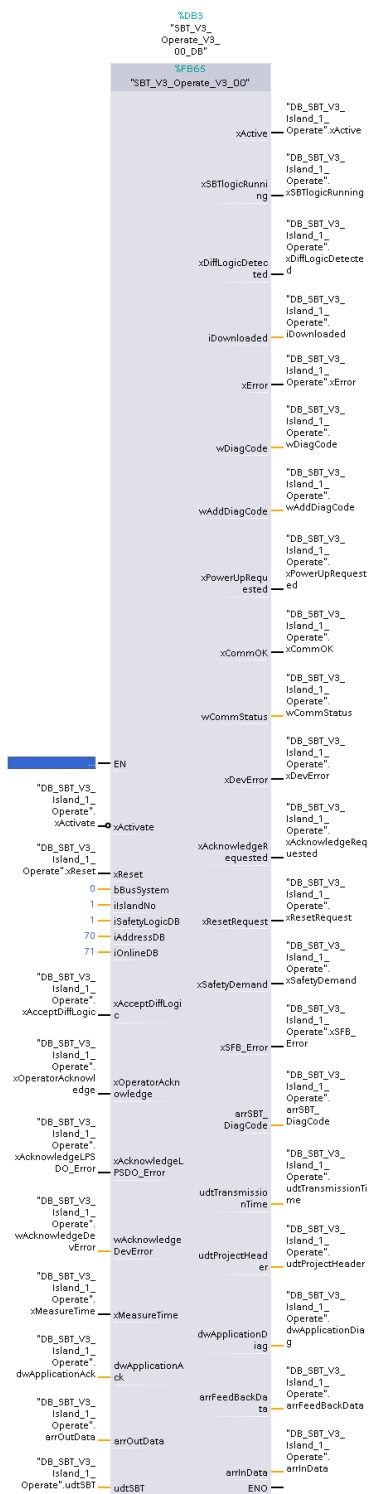


Figure 3-36 FB55 completely wired

Example project: two-channel emergency stop monitoring

Hardware identifier of the SBT modules

- Open device view for the bus coupler and click on the AXL F LPSSD08/3 1F_1 module in the device overview.
- Open the properties window, switch to “Hardware identifier” view, and note down the value (277 in the example).

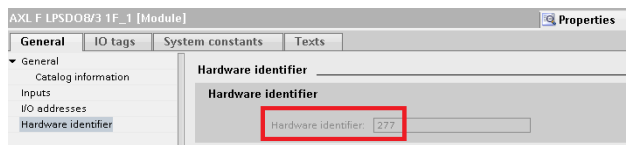


Figure 3-37 Hardware identifier for LPSSD08/3

- Note down the hardware identifier for the AXL F SSDI8/4 1F_1 module (278 in the example) as described above.

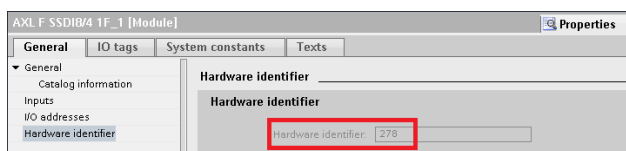


Figure 3-38 Hardware identifier for SSDI8/4



The hardware identifier is required in order to ensure data flow between the SBT modules.

Address the hardware identifier in “SBT_V3_AddressDB [DB70]”

- Open the “SBT_V3_AddressDB [DB70]” data block under “Program blocks”.

Name	Data type	Offset	Start value	Retain	Accessible ...	Visible in ...	Setpoint	Co
1	Static							
2	arr_HW_Identifier	Array [0..16] of Int	0.0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
3	arr_HW_Identifier[0]	Int	0.0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
4	arr_HW_Identifier[1]	Int	2.0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
5	arr_HW_Identifier[2]	Int	4.0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		

Figure 3-39 Addressing hardware identifiers in [DB70]

Address the hardware identifiers of the SBT modules you noted down earlier as follows:

- Enter the hardware identifier of the AXL F LPSSD08/3 1F_1 module (277 in the example) into the “Start value” cell in the “arr_HW_Identifier[0]” row.
- Enter the hardware identifier of the AXL F SSDI8/4 1F_1 module (278 in the example) into the “Start value” cell in the “arr_HW_Identifier[1]” row.

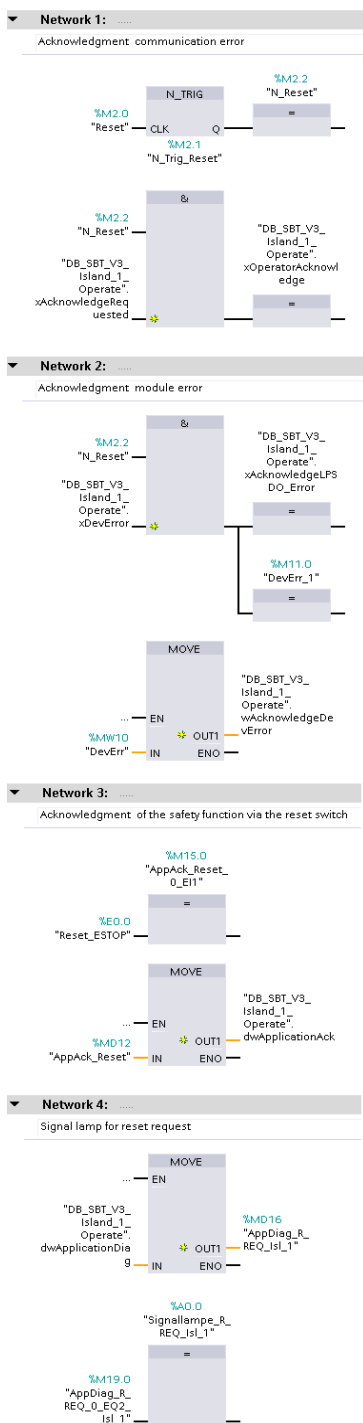


The “arr_HW_Identifier[1...16]” array corresponds to the satellite numbers 1 ... 16, e.g., “arr_HW_Identifier[1]” = satellite 1. “arr_HW_Identifier[0]” always refers to the logic module.

Example project: two-channel emergency stop monitoring

Program the "SBT_V3_Control [FC2]" function

- Create a function with the designation "SBT_V3_Control" and create the following program.



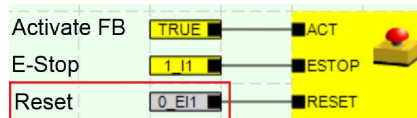
Acknowledgment of communication errors using marker 2.0

Acknowledgment of module errors (LPDO8/3 and SSDI8/4) using marker 2.0

See network 1 at "N_TRIG" block.

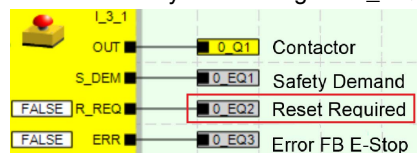
Reset button for acknowledging the safety function

External signal "0_EI1" is controlled via the "Reset_ESTOP" input in SAFECONF.



Signal lamp for reset request

The "AppDiag_R_REQ" output is written from SAFECONF by external signal "0_EQ2".



For assignment of the external signals to a marker double word, see Appendix B on page 40

Figure 3-40 Program for the "SBT_V3_Control" function

Example project: two-channel emergency stop monitoring

Create OB30 organization block

- Create a new OB30 organization block with the designation “Cyclic interrupt”.
- Set the “Cyclic time” parameter (to 20 ms in the example).



This organization block prevents potential communication interruptions by periodically calling the “SBT_V3_Operate” function block at fixed intervals.

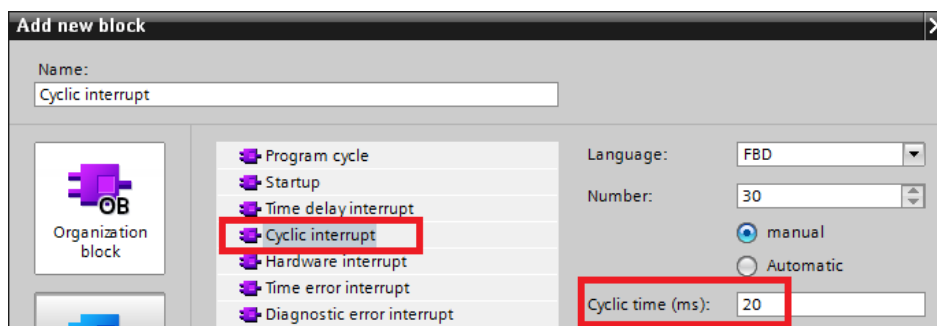


Figure 3-41 Creating OB30 organization block

Call functions FC1 and FC2 in OB30 and OB1

- Call the “SBT_V3_Island_1 [FC1]” functions in the OB30 organization block.

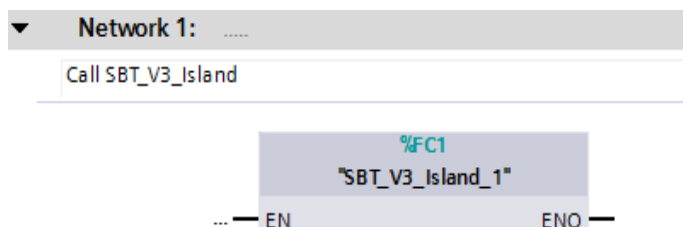


Figure 3-42 Calling FC1 in OB30 organization block

- Call the “SBT_V3_Control [FC2]” functions in the OB1 organization block.

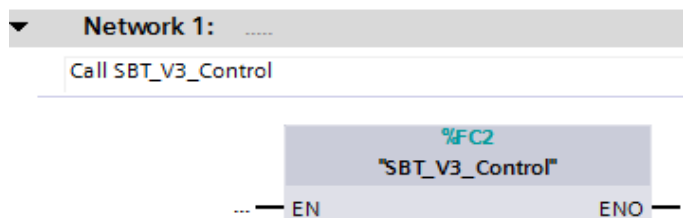


Figure 3-43 Calling FC2 in OB1 organization block

3.5 Startup



A flowchart for starting up and testing the application can be found in Appendix A on page 39.

1. Compile the created project and download it to the controller.

The controller switches to the “Run” state.

The LPSDO8/3 module indicates an error by flashing the FS LED.

Error message: device is not parameterized or parameterization was not applied.

2. Open the programming window for the “SBT_V3_Island_1 [FC1]” function.
3. In the TIA Portal, activate the online values and check the “xDiffLogicDetected” output parameter. If the value is set to “1”, a new SAFECONF project has been detected.
4. Set the “xAcceptDiffLogic” input parameter to “1”.

You can check the download progress at the “iDownloaded” output parameter. Download time: approximately 40 seconds (depending on the project size, CPU, and bus speed).

5. Check whether the “xSBTlogicRunning” output parameter outputs “TRUE” and the “wDiagCode” output parameter outputs the value 16#8000.



If a different code is output by the “wDiagCode” output parameter, see “Function block FB65 diagnostics” on page 47.

Once successfully downloaded, the safe application is ready.

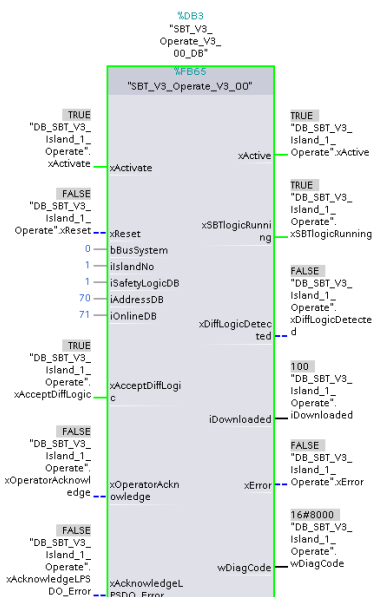


Figure 3-44 Finished project

The diagnostics LEDs of the modules now have the following status:

LEDs off: FS, CM, SD
LEDs on: P, U₀, D

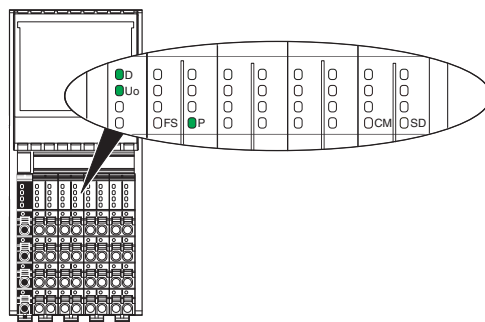


Figure 3-45 Diagnostics LEDs



Perform an overall safety validation after you start up your system.

3.6 Online configuration and establishing a connection

Communication between SAFECONF and the “SBT_V3_Operate” function block is achieved by the “SBT_V3_OnlineDB” data block.

To view the online values in SAFECONF, proceed as follows:

- Open SAFECONF.
- In the Hardware Editor, right-click the LPSDO8/3 module and select “Online configuration...”.

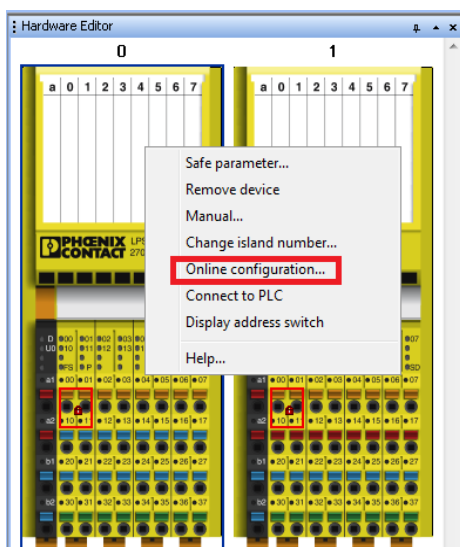


Figure 3-46 Selecting online configuration

- Select the “Siemens S7” interface and then click “Next”.

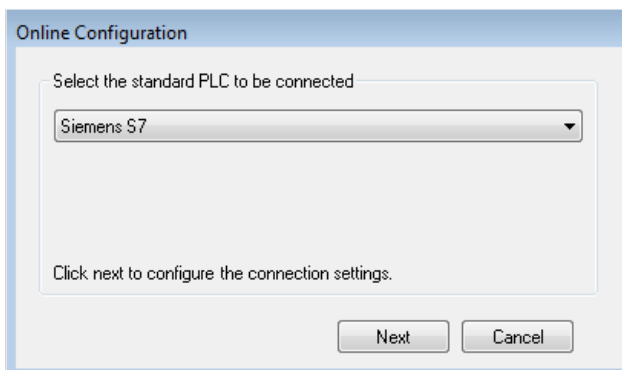


Figure 3-47 Selecting the interface

Example project: two-channel emergency stop monitoring

The “Online Configuration” window opens.

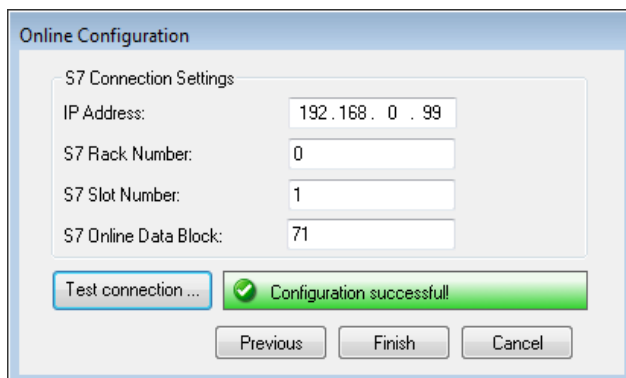


Figure 3-48 “Online Configuration” SAFECONF window

- Switch to the TIA Portal and compare the following parameters with the information in the “Online Configuration” SAFECONF window:
 - IP address
 - Rack number
 - Slot number of the Siemens controller
 - Number of the “SBT_V3_OnlineDB” data block in the project tree

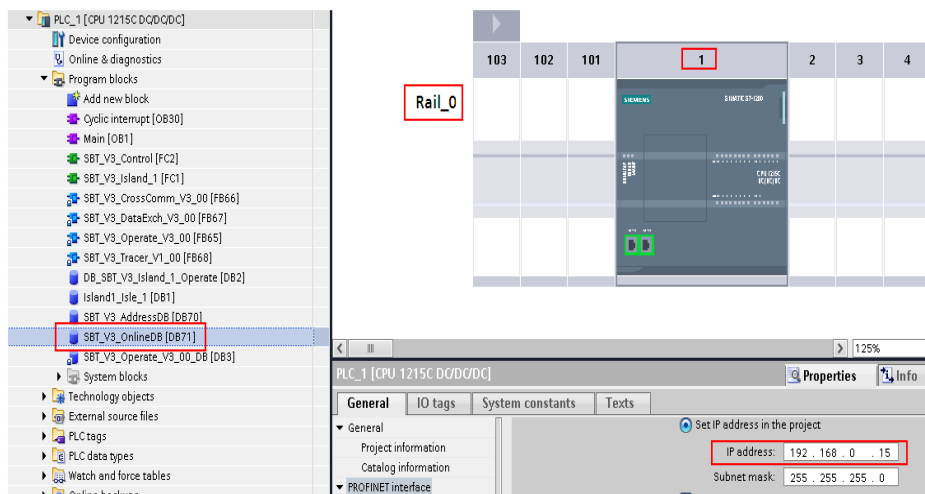


Figure 3-49 Comparison between TIA Portal and SAFECONF



The Siemens controller S7-3xx normally has the rack number 0 and slot number 2.
The S7-12xx and S7-15xx controllers normally have the rack number 0 and slot number 1.

Example project: two-channel emergency stop monitoring

- Enable access via PUT/GET communication in the controller properties under “General, Protection”.

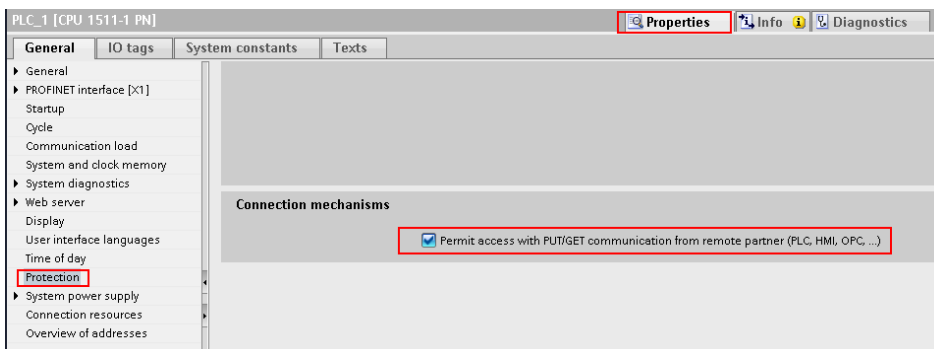


Figure 3-50 Enabling access via PUT/GET communication

- Test the connection via the “Online Configuration” SAFECONF window (see Figure 3-48).
- Once this test has been completed successfully, click “Finish”.
- In the SAFECONF tool bar, click the “Show Online Values” button.

The online values are now displayed in the SAFECONF project.

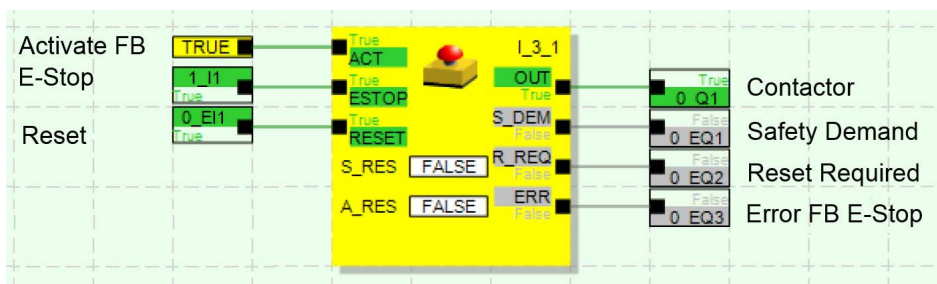


Figure 3-51 Online values in the SAFECONF project

A Flowchart for starting up and testing the application

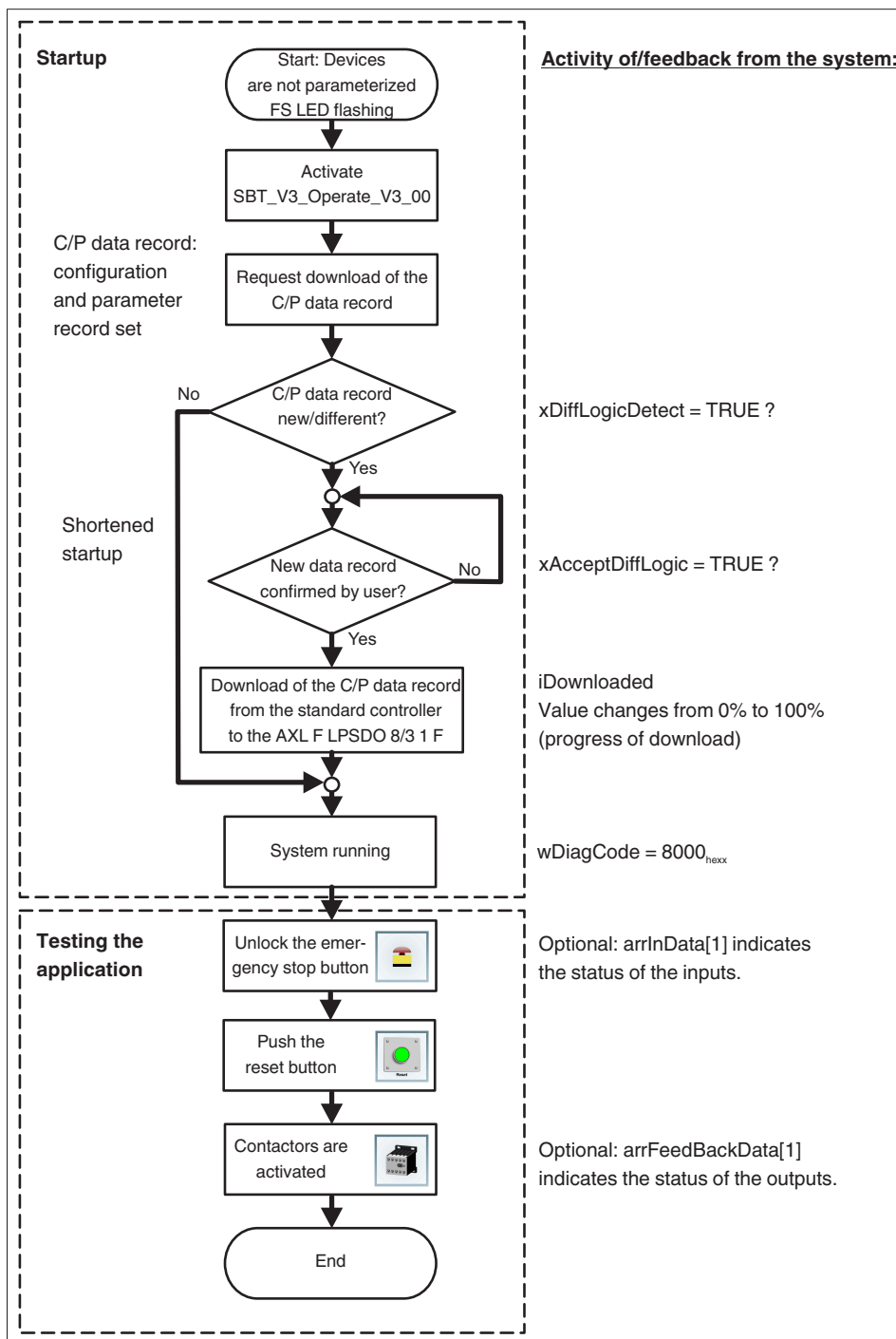


Figure A-1 Flowchart for starting up and testing the application

B Assignment: external SAFECONF signals/TIA Portal marker double word

The external signals of the SAFECONF toolbox correspond for input signals to the “dwApplicationAck” parameter and for output signals to the “dwApplicationDiag” parameter of the “SBT_V3_Operate_V3” function block.

The first external signal is in the least significant bit of the most significant marker byte. An example of the exact assignment for external output signals is shown in Figure B-1.

i The same principle applies when assigning external **input signals**.

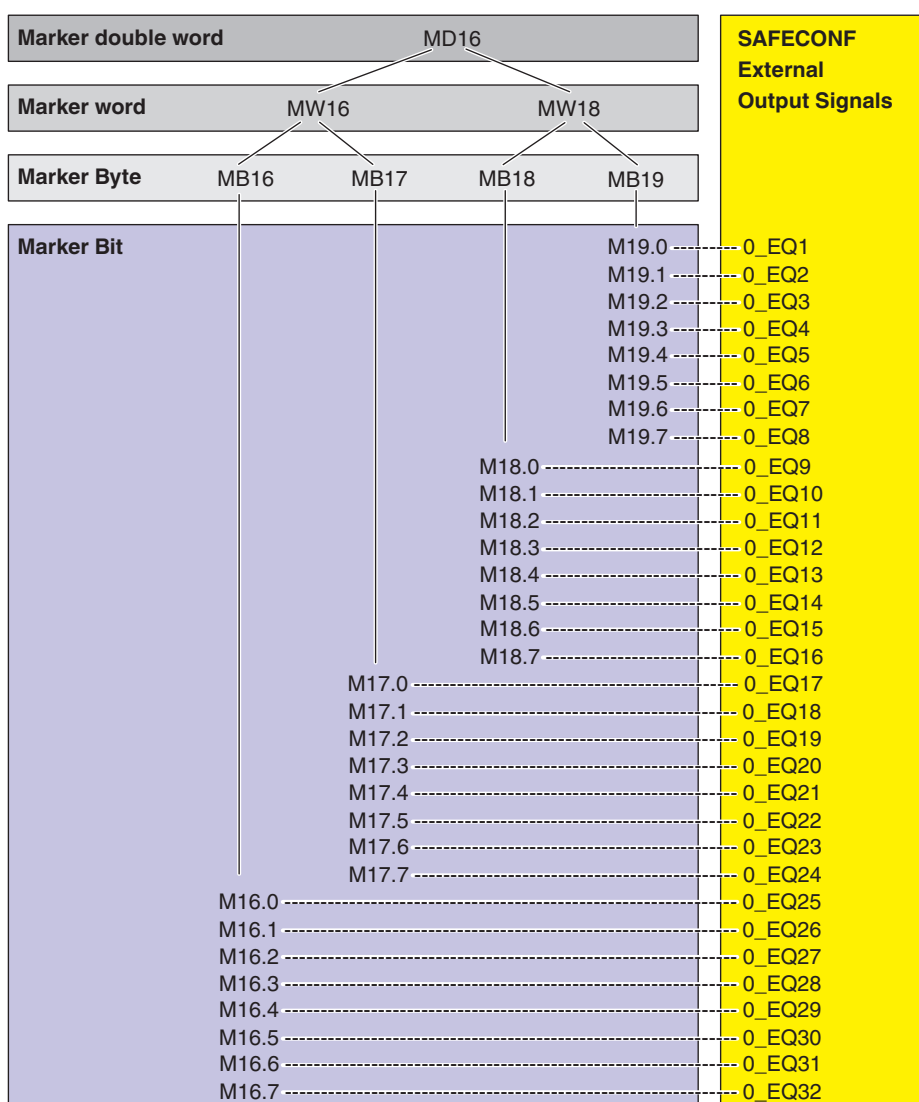


Figure B-1 Assigning external output signals to a marker double word

C Description of the function blocks for SafetyBridge Technology V3

The described function blocks are valid for the following controllers and software versions.

Validity

Table C-1 Validity of the function blocks

PLC	TIA Portal as of V13 SP1		
	PROFINET	PROFIBUS	INTERBUS
S7-3xx	Yes	Yes	Yes
S7-4xx	Yes	Yes	Yes
S7-12xx	Yes	Yes	No
S7-15xx	Yes	Yes	No

Function block overview

Table C-2 Function block overview

Function block	Block No.	Description
SBT_V3_Operate_V3_00	FB65	Block used to operate an SBT island with a maximum of 16 satellites: <ul style="list-style-type: none"> – Download the SAFECNF project – Monitoring of input and output modules – Process data exchange – Transmission of acknowledgment signals – Diagnostics See C 1 on page 43
SBT_V3_CrossComm_V3_00	FB66	Cross communication between two or more SBT islands See C 2 on page 51
SBT_V3_DataExch_V3_00	FB67	Data exchange if two SBT islands are integrated in different controllers See C 3 on page 52
SBT_V3_Tracer_V1_00	FB68	If a communication error has occurred, the block represents the last four telegrams between the logic module and the satellites. See C 4 on page 54

Description of the function blocks for SafetyBridge Technology V3

Data types and data blocks

Table C-3 Data types and data blocks

Designation	Block No.	Description
SBT_V3_AddressDB	DB70	Data block contains input and output addresses of the modules. See C 1.6.1 on page 50.
SBT_V3_OnlineDB	DB71	Data block as an interface for the online-mode function in SAFECONF. See C 1.6.2 on page 50.
SBT_V3_User_Operate_V3	DB165	Contains the data types that are connected to function block FB65 as input and output parameters.
SBT_V3_Data_3		Internal user-defined data type
SBT_V3_TransTime		See C 1.5.1 on page 48
SBT_V3_ProjHeader		See C 1.5.2 on page 49

SBT_V3_Operate_V3_00 function block (FB65)

C 1 SBT_V3_Operate_V3_00 function block (FB65)

The “SBT_V3_Operate_V3_00” function block enables access to process and diagnostic data as well as the start and download behavior.

The figure shows the division of the function block into its individual function areas. The parameters used are described in the following tables:

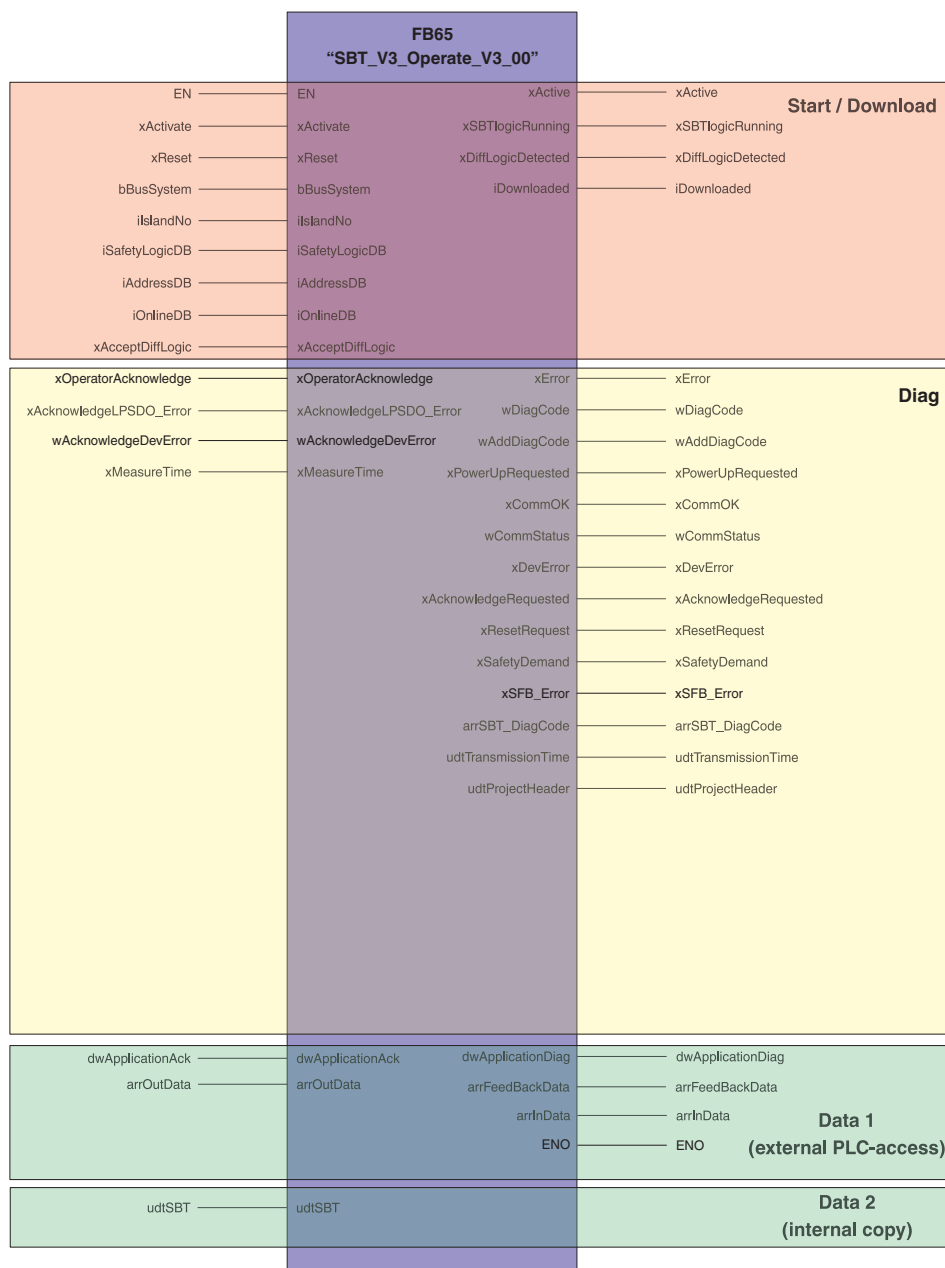


Figure C-1 “SBT_V3_Operate_V3_00” function block (FB65)

SBT_V3_Operate_V3_00 function block (FB65)

C 1.1 Input parameters of FB65

Table C-4 Input parameters for the "SBT_V3_Operate_V3_00" function block

Name	Type	Description
xActivate	BOOL	Activation/deactivation of the function block
xReset	BOOL	With a rising edge, the function block is reset and re-initialized
bBusSystem	BYTE	Selection of the bus system 0 = PROFINET or PROFIBUS (default) 1 = Reserved 2 = INTERBUS
ilIslandNo	INT	SBT island number Valid range: 1 ... 31 (must be the same as the DIP switch position on the LPSDO module and the setting in the SAFECONF project)
iSafetyLogicDB	INT	Number of the generated data block from the SAFECONF source code
iAddressDB	INT	Number of the address data block containing the input and output addresses of the modules
iOnlineDB	INT	Number of the SBT_V3_OnlineDB data block; the data block enables the online-mode function in SAFECONF
xAcceptDiffLogic	BOOL	User confirmation signal that the safety logic differs for the controller and the LPSDO module Rising edge: user has accepted and confirmed the difference (the download then starts)
xOperatorAcknowledge	BOOL	Rising edge: user acknowledgement of a sporadic communication error
xAcknowledgeLPSDO_Error	BOOL	Rising edge: acknowledgement of LPSDO module error
wAcknowledgeDevError	WORD	Each bit is associated with a module If a bit is set, an error is acknowledged at the corresponding module
xMeasureTime	BOOL	True: the transmission time is measured and indicated in the udtTransmissionTime output parameter
dwApplicationAck	DWORD	Freely configurable acknowledgment signals (user data) from the standard controller to the LPSDO module
arrOutData	Array [0...16] of WORD	Array of outputs from all output modules of the SBT island; the index represents the device number; index 0 stands for the LPSDO module Info: depending on the parameterization of the safe outputs, the enable principle applies here. I.e., the safe outputs can be controlled via the standard controller as long as the safety function is not demanded (the safety logic is "enabled"). If there is a demand of the safety function, this overrides the standard controller and switches the safe outputs off.
udtSBT	SBT_V3_Data_3	Structure for data exchange between function blocks

SBT_V3_Operate_V3_00 function block (FB65)

C 1.2 Output parameters of FB65

Table C-5 Output parameters for the "SBT_V3_Operate_V3_00" function block

Name	Type	Description
xActive	BOOL	True: the function block has been initialized successfully and is operating without errors False: error or function block is not initialized
xSBT_LogicRunning	BOOL	Safety logic (SAFECONF logic) running on the LPSDO module
xDiffLogicDetected	BOOL	True: detection of different safety logic for the controller and the LPSDO module
iDownloaded	INT	Percentage of SBT logic that has been downloaded
xError	BOOL	True: the function block has detected an error and is no longer in operation; re-activation is required
wDiagCode	WORD	Diagnostic code for the function block error
wAddDiagCode	WORD	Additional diagnostic code for the function block error
xPowerUpRequested	BOOL	Error state that cannot be acknowledged; restart is required (voltage reset)
xCommOK	BOOL	True: communication status of the SBT island is OK False: loss of communication for one or more modules
wCommStatus	WORD	Communication status of the individual modules; each bit represents the status of a module (example: bit 1 corresponds to module 1)
xDevError	BOOL	Indicates an error in one or more SBT modules
xAcknowledgeRequested	BOOL	Acknowledgment by the user is required
xResetRequest	BOOL	Reset request signal from one or more safety function blocks is "True" in the logic module
xSafetyDemand	BOOL	Safety demand signal from one or more safety function blocks is "True" in the logic module
xSFB_Error	BOOL	Indicates that the error signal is set in a safe function block
dwApplicationDiag	DWORD	Freely configurable feedback signals from the LPSDO module to the standard controller
arrSBT_DiagCode	Array [0...16] of WORD	Array of SBT module diagnostic codes (device-specific; see module user documentation) Also indicates the value of the DIP switches if no diagnostic code is present and the modules are not parameterized
udtTransmissionTime	SBT_V3_TransTime	Structure contains the data transmission time and its maximum value for each module (see Table C-9 on page 48)

SBT_V3_Operate_V3_00 function block (FB65)

Name	Type	Description
udtProjectHeader	SBT_V3_ProjHeader	Structure displays information on the SAFECONF project and the project stored on the LPSDO module (see Table C-10 on page 49)
arrFeedBackData	Array [0...16] of WORD	Feedback data of all outputs of the LPSDO module and the satellites
arrInData	Array [0...16] of WORD	Array of inputs from all input modules (satellites) of the SBT island; the index represents the device number; index 0 stands for the LPSDO module

C 1.3 I/O parameters of FB65

Table C-6 I/O parameters for the "SBT_V3_Operate_V3_00" function block

Name	Type	Description
udtSBT	SBT_V3_Data	Data structure for data exchange between function blocks

C 1.4 Function block FB65 diagnostics

FB65 diagnostics

Table C-7 Diagnostic codes

DiagCode	Meaning
0000 _{hex}	Function block is not active
8000 _{hex}	Function block is active and operating without errors
8001 _{hex}	Initialization
8100 _{hex}	SAFECONF project and BIN file/POU are being read
	AddDiagCode Meaning
	0000 _{hex} Read from source
	0001 _{hex} Copy in function block
8200 _{hex}	Reading "ProjectHeader" of LPSDO module
	AddDiagCode Meaning
	0001 _{hex} Initializing reading of "ProjectHeader"
	0002 _{hex} Reading of "ProjectHeader" is complete
8300 _{hex}	Comparing "Header" of LPSDO module and the loaded program
8400 _{hex}	Downloading SAFECONF program to the LPSDO module
	AddDiagCode Meaning
	0000 _{hex} Removing old "Header" and writing a new one
	0001 _{hex} Downloading logic block
	0002 _{hex} Downloading address block
	0003 _{hex} Downloading new "ProjectHeader"
	0004 _{hex} Download successful; device restarting
8500 _{hex}	Download completed successfully
C001 _{hex}	Initialization error
	AddDiagCode Meaning
	0004 _{hex} Wrong or invalid island number
C002 _{hex}	LPSDO module unavailable <ul style="list-style-type: none"> • Check communication and restart block
C100 _{hex}	Error when reading/copying the SAFECONF project and BIN file/POU
	AddDiagCode Meaning
	0001 _{hex} Error when opening the data
	0002 _{hex} Error when reading the data (e.g., BIN file not found)
	0003 _{hex} Error when closing the data
C850 _{hex}	Error during download
	AddDiagCode Meaning
	0001 _{hex} Download error



Examples of diagnostic codes can be found in Table C-8.

C 1.4.1 Diagnostics examples for FB65 function block

Diagnostics examples

Table C-8 Examples for diagnostic codes

Name	Code	Description
arrSBT_DiagCode[0]	0500 _{hex}	Communication with one or more modules interrupted
	0D00 _{hex}	Acknowledgement of a communication error requested
	8000 _{hex}	SBT island is operating properly
	4xxx _{hex}	Configuration of the DIP switches is displayed
	Other	See diagnostics description in the user manual
arrSBT_DiagCode[1...16]	8000 _{hex}	Module is operating properly
	4xxx _{hex}	Configuration of the DIP switches is displayed
	Other	See diagnostics description in the user manual

C 1.5 Structures of parameters

C 1.5.1 udtTransmissionTime structure

udtTransmissionTime

The “udtTransmissionTime” structure contains the transmission time of modules 1 to 16 (TransTimeDev1 to TransTimeDev16) as well as the maximum transmission time of a module (TransTimeDevMax[1] to TransTimeDevMax[16]).

Table C-9 Structure of “udtTransmissionTime”

Name	Type	Description
arr_TransTime	Array [0...16] of DINT	Array of data transmission times between the LPSDO module and the satellite modules
arr_TransTime_Max	Array [0...16] of DINT	Array of maximum data transmission times between the LPSDO module and the satellite modules



If the data transmission time of a module is greater than the F_WD_Time, a communication error is output at the LPSDO module. In this case, the data transmission time and F_WD_Time should be checked.

Please note that increasing the F_WD_Time has a direct effect on the safety function because it increases response times and therefore delay times and/or safety distances.

SBT_V3_Operate_V3_00 function block (FB65)

C 1.5.2 udtProjectHeader structure

udtProjectHeader

The “udtProjectHeader” structure contains all information on the SAFECONF project and the project stored on the LPSDO module.

Table C-10 Structure of “udtProjectHeader”

Name	Type	Description
ProjectDescription	Array [0...3] of CHAR	Project description of the SAFECONF project imported into the TIA Portal (see “Enter project description” on page 15)
ProjectName	Array [0...11] of CHAR	Project name of the SAFECONF project imported into the TIA Portal (see header in SAFECONF)
ProjVersion	Array [0...3] of CHAR	Project version of the SAFECONF project imported into the TIA Portal (see “Enter project description” on page 15)
ProjCRC	DWORD	Checksum of the SAFECONF project
ProjTimeStamp	DWORD	Time stamp of the SAFECONF project (seconds from 1970-01-01)
SBTdescription	Array [0...3] of CHAR	Project description of the project stored on the LPSDO module
SBTname	Array [0...11] of CHAR	Name of the project stored on the LPSDO module
SBTversion	Array [0...3] of CHAR	Version of the project stored on the LPSDO module
SBT_CRC	DWORD	Checksum of the project stored on the LPSDO module
SBTtimeStamp	DWORD	Time stamp of the project stored on the LPSDO module

C 1.6 Data blocks**C 1.6.1 SBT_V3_AddressDB [DB70] data block****SBT_V3_AddressDB**

The “SBT_V3_AddressDB” data block contains input and output addresses of the modules.

Table C-11 “SBT_V3_AddressDB” data block

Name	Type	Description
arr_HW_Identifier (S7-12xx/S7-15xx)	Array [0...16] of INT	Array of module hardware identifiers; the index represents the device number; index 0 stands for the LPSDO module
InputAddress (S7-3xx/S7-4xx)	Array [0...16] of INT	Array of module input addresses; the index represents the device number; index 0 stands for the LPSDO module
OutputAddress (S7-3xx/S7-4xx)	Array [0...16] of INT	Array of module output addresses; the index represents the device number; index 0 stands for the LPSDO module

C 1.6.2 SBT_V3_OnlineDB [DB71] data block**SBT_V3_OnlineDB**

The “SBT_V3_OnlineDB” data block is used as an interface for the online-mode function in SAFECONF. An instance of the data block is required for each standard controller.

Table C-12 “SBT_V3_OnlineDB” data block

Name	Type	Description
arrSBTONlCntrlBuf	Array [0...175] of DWORD	Array for online mode in SAFECONF
arrSBTONlValBuf	Array [0...175] of DWORD	Array for online mode in SAFECONF

C 2 SBT_V3_CrossComm_V3_00 function block (FB66)

In SafetyBridge Technology V3, islands can communicate with one another. Cross communication takes place via a master/slave model, where one or more islands can act as slaves for other master modules. Each island has the “udtSBT” data structure (see “udtSBT” on page 44). The “SBT_V3_CrossComm_V3_00” function block combines the data structures of the individual islands in an array, thereby enabling cross communication between the islands.



When filling the arrays for the “InputAddress” and “OutputAddress” parameters of the master island, make sure that a 0 is written in the field for the slave island

For example, if a master island has a slave island at position 4:
 InputAddress[4] = 0 and OutputAddress[4] = 0

If cross communication is used, address 0 is reserved and should not be occupied or otherwise used in the program.

The “SBT_V3_CrossComm_V1_00” function block may be called only once for each standard controller.

If another island is in another standard controller, an additional “SBT_V3_DataExch_V3_00” function block is required. See C 3 on page 52.



Figure C-2 “SBT_V3_CrossComm_V3_00” function block (FB66)

C 2.1 Input parameters of FB66

Input parameters

Table C-13 Input parameters for the “SBT_V3_CrossComm_V3_00” function block

Name	Type	Description
iMaxIslandIndex	INT	Maximum index that is used in the “arr_udtSBT” array



To increase performance, the “MaxIslandIndex” parameter limits the cycle for cross communication. If the value is 0, all 31 possible islands are checked by the function block.

C 2.2 I/O parameters of FB66

I/O parameters

Table C-14 I/O parameters for the “SBT_V3_CrossComm_V3_00” function block

Name	Type	Description
arr_udtSBT	Array [0...31] of SBT_V3_Data_3	Array of data structures for data exchange between function blocks

i The “arr_udtSBT” array should contain all “udtSBT” structures of the islands. The index of the “arr_udtSBT” array is independent of the index of the island.

C 3 SBT_V3_DataExch_V3_00 function block (FB67)

If two SBT islands are connected to different controllers but cross communication is required between the two islands, the “SBT_V3_DataExch_V3_00” function block supports data exchange between the master and slave island. The function block uses input and output buffers, which buffer the data that is received from one controller and sent to the other controller. The data transmission method between the two controllers is not specified and can be any of various options, for example Modbus/TCP. However, the data must be transmitted consistently.

i If the master island has more than one slave island, this function block must be called for each slave island.

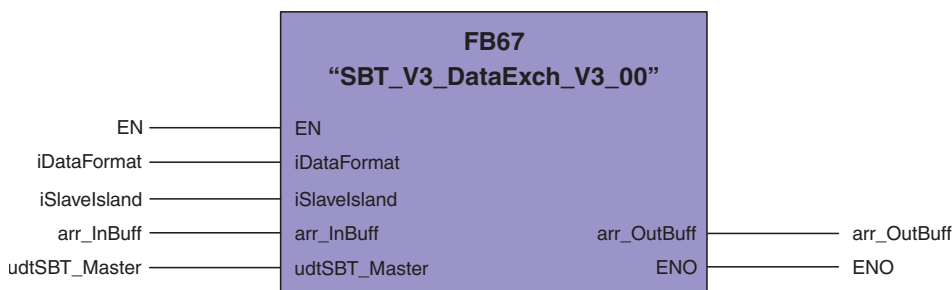


Figure C-3 “SBT_V3_DataExch_V3_00” function block (FB67)

SBT_V3_DataExch_V3_00 function block (FB67)

C 3.1 Input parameters of FB67**Input parameters**

Table C-15 Input parameters for the "SBT_V3_DataExch_V3_00" function block

Name	Type	Description
iDataFormat	INT	Determines the format for the data exchange with the other controller 0: exchange data is not swapped 1: exchange data is swapped
iSlaveland	INT	In the master program: number of the slave island with which the master island is exchanging data In the slave program: 0 because the island itself is a slave
arr_InBuff	Array [0...7] of WORD	Exchange data (input) from the other island

C 3.2 Output parameters of FB67**Output parameters**

Table C-16 Output parameters for the "SBT_V3_DataExch_V3_00" function block

Name	Type	Description
arr_OutBuff	Array [0...7] of WORD	Exchange data (output) sent to the other island

C 3.3 I/O parameters of FB67**I/O parameters**

Table C-17 I/O parameters for the "SBT_V3_DataExch_V3_00" function block

Name	Type	Description
udtSBT	SBT_V3_Data_3	Data structure of the master island In the master Program: the same data structure of the "SBT_V3_Operate_V3_00" function block is connected In the slave program: unassigned structure is connected; not the same data structure of the "SBT_V3_Operate_V3_00" function block Example: If slave data structure = udtSBT[3], then master data structure = udtSBT[4]

C 4 SBT_V3_Tracer_V1_00 function block (FB68)

If a communication error has occurred, the LPSDO module saves the last four telegrams between the module and other devices. The “SBT_V3_Tracer_V1_00” function block reads the telegrams and writes them to the “udtTracer” structure.

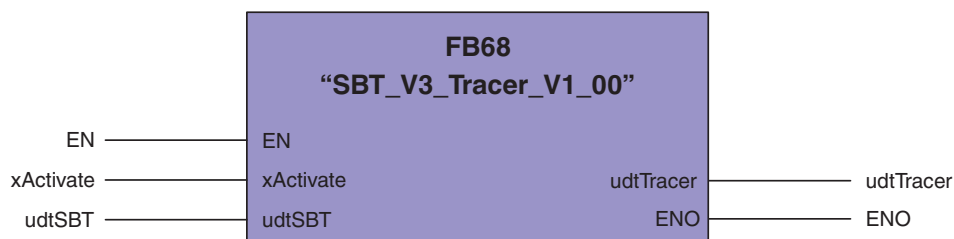


Figure C-4 “SBT_V3_DataExch_V3_00” function block (FB67)

C 4.1 Input parameters of FB68

Input parameters

Table C-18 Input parameters for the “SBT_V3_Tracer_V1_00” function block

Name	Type	Description
xActivate	BOOL	Activation/deactivation of the function block

C 4.2 Output parameters of FB68

Output parameters

Table C-19 Output parameters for the “SBT_V3_Tracer_V1_00” function block

Name	Type	Description
udtTracer	Array [1...16] of BYTE Array [0...3] of BYTE Array [0...7] of BYTE or Array [1...16, 0...3, 0...7] of BYTE	Structure contains the last four telegrams of each module; it is filled when the LPSDO module sets the internal “Trace Trigger” signal to “true”

C 4.3 I/O parameters of FB68

I/O parameters

Table C-20 I/O parameters for the “SBT_V3_Tracer_V1_00” function block

Name	Type	Description
udtSBT	SBT_V3_Data_3	Data exchange structure The following applies when inside an island: Same udtSBT parameter as the “SBT_V3_Operate_V3_00” function block

D Revision history

Revision	Date	Contents
00	2016-03-18	First publication



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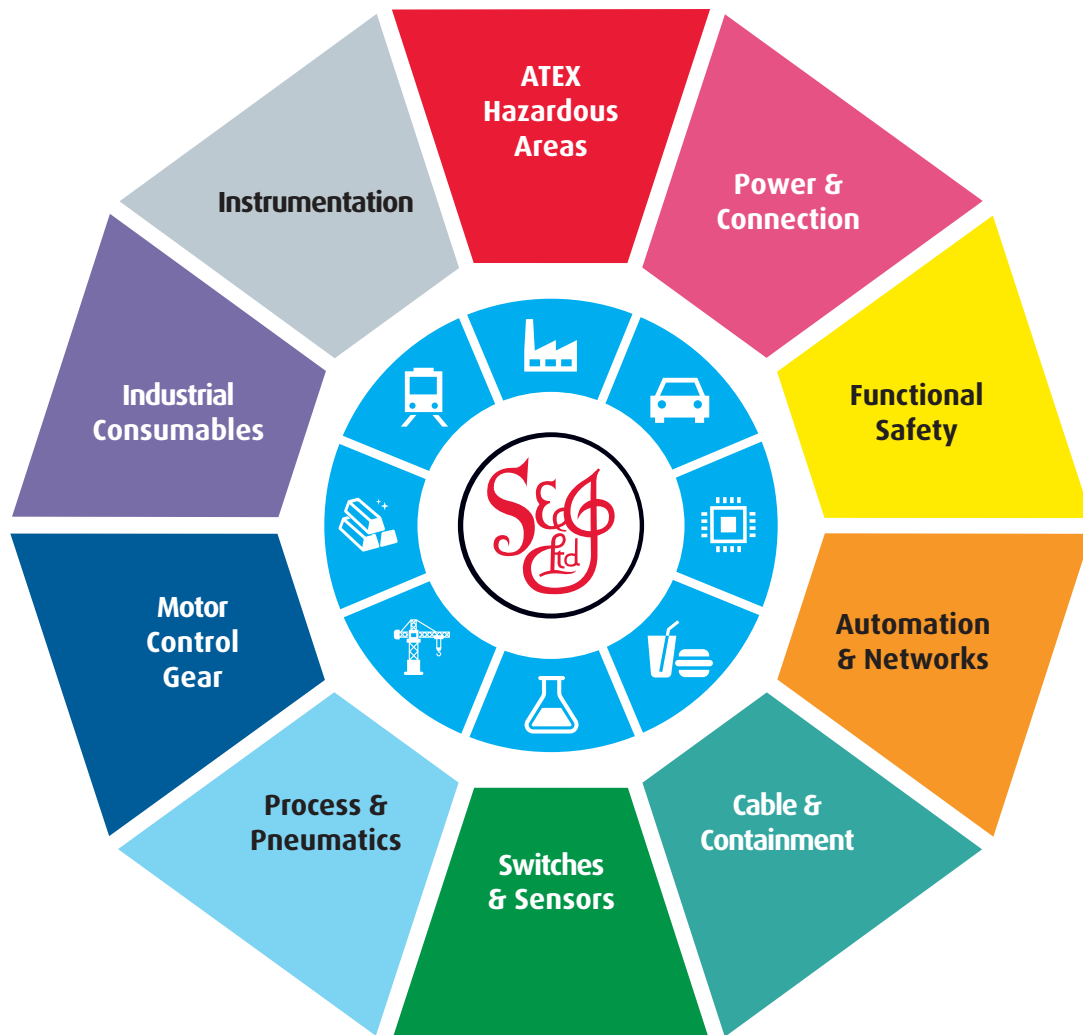
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