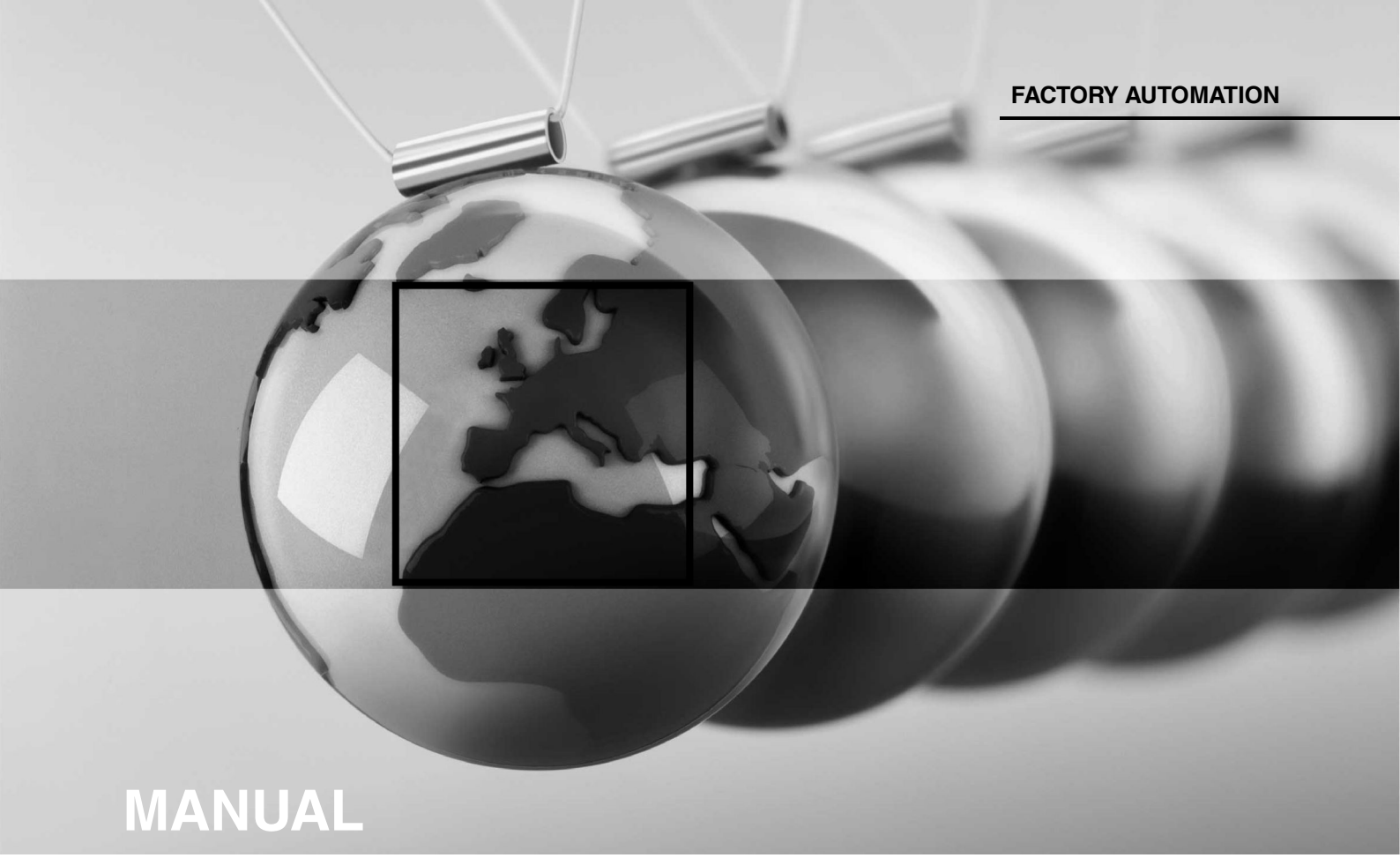
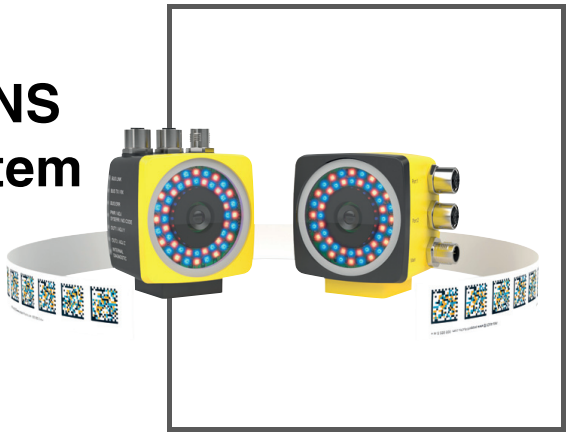


MANUAL

Configuration Instructions for PXV100A / PGV100A

Parameterization with SIEMENS SIMATIC S7-1500 control system



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With regard to the supply of products, the current issue of the following document is applicable: The General Terms of Delivery for Products and Services of the Electrical Industry, published by the Central Association of the Electrical Industry (Zentralverband Elektrotechnik und Elektroindustrie (ZVEI) e.V.) in its most recent version as well as the supplementary clause: "Expanded reservation of proprietorship"

1 Introduction

This guide leads you through the steps necessary to configure the sensors PXV100A* and PGV100A* using the Siemens SIMATIC S7-1500 control system.

1.1 Scope

These Configuration Instructions only apply for the following devices with **PROFINET IO** interface and **PROFIsafe** profile in conjunction with a SIEMENS SIMATIC S7 control panel from the 1500 series:

- PXV100A*-B28
- PGV100A*-B28

The devices are marked with affixed nameplates and are an integral part of a plant.

In addition to the Configuration Instructions, the following documents apply. Observe the instructions contained therein:

- SIEMENS manual: SIMATIC Safety – Configuring and Programming
- Plant-specific operator's documentation
- PXV100A*/ PGV100A* – Original Instructions
- PXV100A*/ PGV100A* - EU Declaration of Conformity
- Interface-specific manuals

Note!

Terms and conditions of use for the software examples

Pepperl+Fuchs GmbH assumes no liability and no warranty for error-free operation of the safety program. Use is at the user's own risk.

Note on Figures in the Documentation

The figures in this documentation are provided for basic understanding and may deviate from the actual design.

1.2 Registered trademarks

PROFINET®, PROFIBUS®, PROFIsafe: Brands of the PROFIBUS Nutzerorganisation e.V. (PNO)

SIMATIC, TIA Portal: Brands of SIEMENS AG

1.3 Display conventions

Note!

The figures in this documentation are provided for basic understanding and may deviate from the actual design.

1.4 Symbols used

This document contains information that you must observe to prevent interference.

Warnings

Caution!

This symbol indicates a possible fault.

Non-observance could interrupt the device and any connected systems and plants, or result in their complete failure.

Information messages

Note!

This symbol brings important information to your attention.

Action

This symbol indicates a paragraph with instructions. You are prompted to perform an action or a sequence of actions.

1.5 List of Abbreviations

CRC	Cyclic Redundancy Check
F-CPU	Fail-safe CPU
F-device	Safety device
F-host	Safety device
F-parameters	Safety-specific parameters
F-Par_CRC	The F-Par_CRC is a signature across all F-parameters that is used to ensure the correct delivery of the F-parameters.
F-I/O	The F-I/O ensures safe processing of field information.
F-system	Error-free system: Functional safety is implemented through targeted safety functions in the software. For example, the plant is brought into or maintains a safe state in the event of a dangerous event.
TIA portal	Network and device editor (Totally Integrated Automation Portal)

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2 System Description

2.1 Structure of the configuration software

Portal view

The portal view provides a task-oriented view of the installed tools. The portals for the various tasks (1) are located on the left side of the window. The actions for the selected window range are adjacent window range (2). The objects processed with the selected action are displayed in the central part of the window range (3). If necessary, switch to the project view to edit the selected object. From the portal view, navigate to the project view via the *"Project view"* (4) link on the bottom left of the screen.

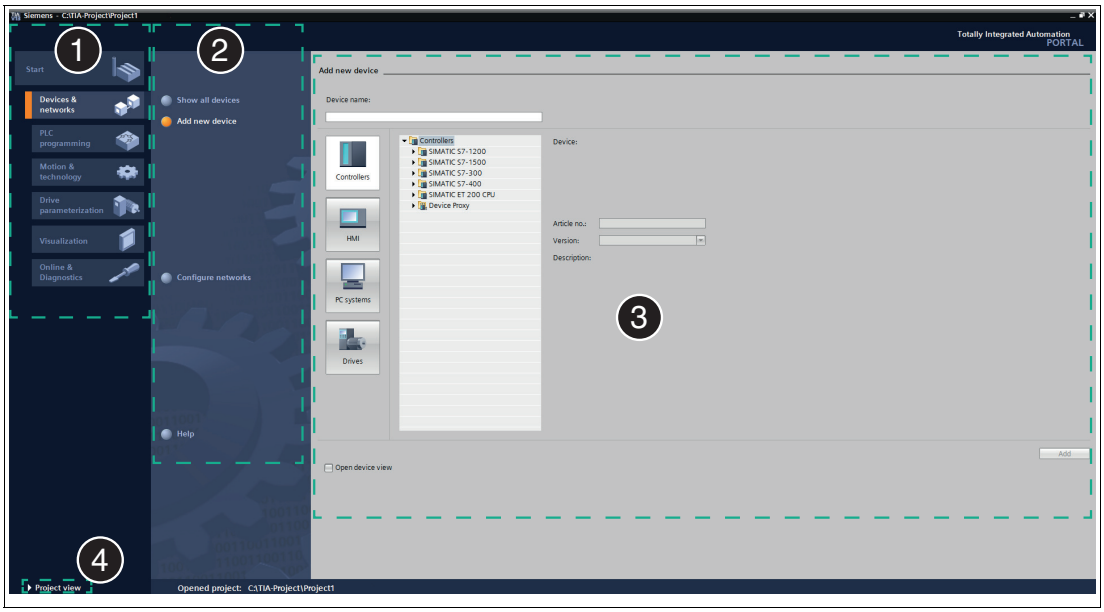

Figure 2.1 Layout of the portal view

Project view

The project view provides an object-oriented view with several windows whose contents change depending on the executed action. The **working area** (2) with the device to be configured is in the central window range in the device configuration. You use the work window to configure the hardware of the automation system, create the user program, or configure the process images. The rack with the modules that have already been positioned is displayed in the **device view** (1). Another window – the **inspection window** (4) – displays the properties of the object selected in the work window. The **task window (Task Card)** (3) provides support with the available modules via the hardware catalog. Certain content of an object selected in the overview window or in project navigation is displayed in the **detailed view** (5).

The figures below show the project view windows in a sample project. Different window contents are displayed depending on the type of editor used.

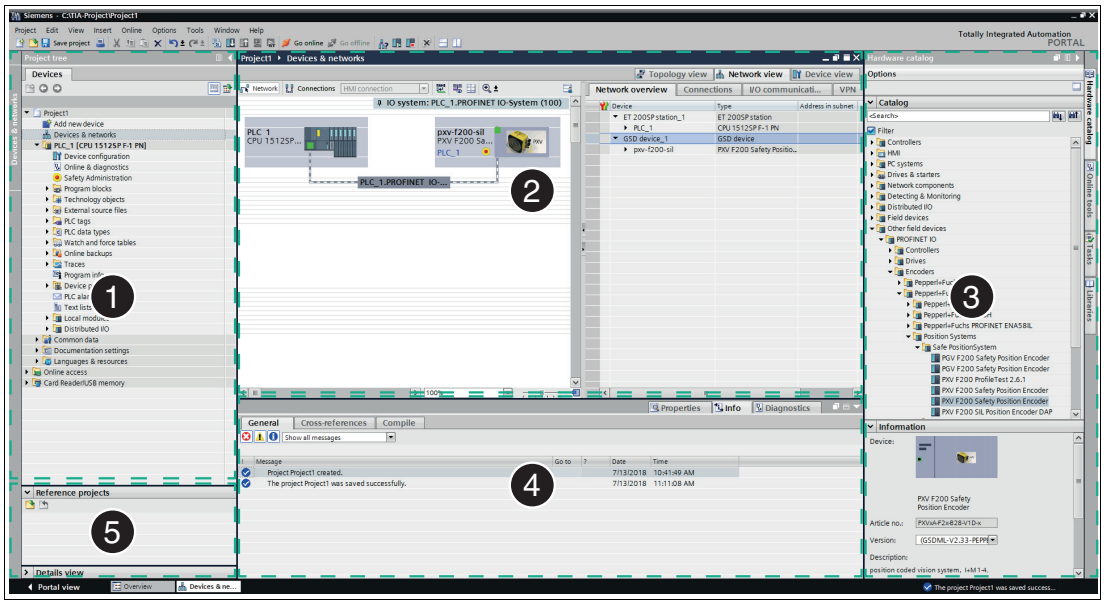

Figure 2.2 Layout of the project view

2.2 Safety Function and Safe State

Safety Function

The PXV100A* series device determines **safe X position values** for linear, guided applications.

The PGV100A* series device determines **safe X position values** for automated guided vehicles (AGV).

The position values for all device variants are determined using the stationary Data Matrix code tape attached to the plant.

Note!

Note the Type of Code Tape!

The positioning system only works if the reader is used together with the 2-colored Data Matrix code tape of the following type: PXV*-AA25-*.

The use of other code tapes is not permitted!

The safety-related customer application checks the plausibility of the received values against expected values.

The plant designer assigns appropriate values when setting up the plant. After attaching the Data Matrix code tape, the plant designer determines the corresponding expected values at the positions relevant for the application. The values determined in this way are incorporated into the safety-related application and then their plausibility can be assessed during the operation of the plant using the data from the sensor. Depending on the result, the application responds to ensure the safe operation of the plant.

For the safety function, the reader provides the following safety-related data:

	PXV100A*	PGV100A*
Safe X position data	x	x
Safe status	x	x

The reader provides you with the following non-safety-related data:

	PXV100A*	PGV100A*
X position data	x	x
Y deviation	-	x
Z distance	-	x
Angular deviation	-	x
Speed	x	x
Status	x	x
Warning	x	x

The valid bit in safe status reflects the state of the safe position data. For processing of the position data in the application, the state of the valid bit must be evaluated in terms of safety. Depending on the state of the valid bit, the plant control software performs further processing. The corresponding actions are triggered, to continue to ensure the safe state of the plant. The response to the respective state is determined by the application and can only be displayed here by way of example.

Valid bit = "logic 1": a valid position value is delivered in the safe X position data. This can be used for further processing in the safety-related plant control software, where it is checked against the expected values of the application for plausibility. The application responds, depending on the result.

Valid bit = "logic 0": The device is unable to determine a position at this time. The content of the safe X position data is "0." This state can be triggered by the following scenarios:

- Data Matrix code tape is missing
- Data Matrix code tape is not readable
- Reader is outside the sensing range
- Lens is dirty
- Reader is in the initialization phase

It is the task of the plant control software of the respective customer to evaluate and check the plausibility of this state in each case. The result of this evaluation and the application determine the steps necessary to ensure the safety of the plant.

When planning and setting up the plant control software, the evaluation of the valid bit must be considered and incorporated in terms of safety.

The described state is not to be confused with the safe state of the positioning device.

Additional requirements, which are described below, apply to the safe state of the positioning device.

Safe State

The safe state of the reader means that it interrupts the PROFIsafe communication in defined fault cases. If the reader switches to the safe state, PROFIsafe data is no longer transferred to the control panel.

Fault cases that result in the safe state.

If the PROFIsafe connection from the reader to the control panel is interrupted, this generates a communication error according to the PROFIsafe standard, which the plant designer must deal with appropriately. After the reader is restarted, it goes back to the initialization phase (INIT). If another error triggers the safe state again within 90 s, the startup lock is activated. See the section "System startup lock in the case of a fault."

In this case, contact Pepperl+Fuchs support.

Reaction time

The reaction time for the safety function is 165 ms.

The reaction time does not include the PROFIsafe watchdog time.

System Startup Lock in the Case of a Fault

The positioning system has an internal error counter for the safe state. This is increased when the safe state occurs. If the safe state is triggered twice within 90 seconds, a startup lock is activated in the system. As a result, the safety-relevant part is no longer started, and PROFIsafe communication can therefore no longer be established.

The user can identify this state by means of the disabled illumination unit. The non-safe PROFINET communication part remains available. The camera is thus disabled. The positioning system must be restarted (power reset) to exit this state. The counter is cleared 90 seconds after the positioning system is started, provided that no safety-critical errors occur during this period, or upon the successful establishment of PROFIsafe communication.

The following errors result in the safe state:

- Internal safety system errors
- Device-specific errors (0x48) and suberrors (see original instructions)
- Abortion or termination of the PROFIsafe connection

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3 Modules

The following modules enable reader data to be retrieved using PROFINET.

You receive modules that contain non-secure data for positioning, and one module that contains secure data according to PROFIsafe.

3.1 PXV100A*

Overview of modules

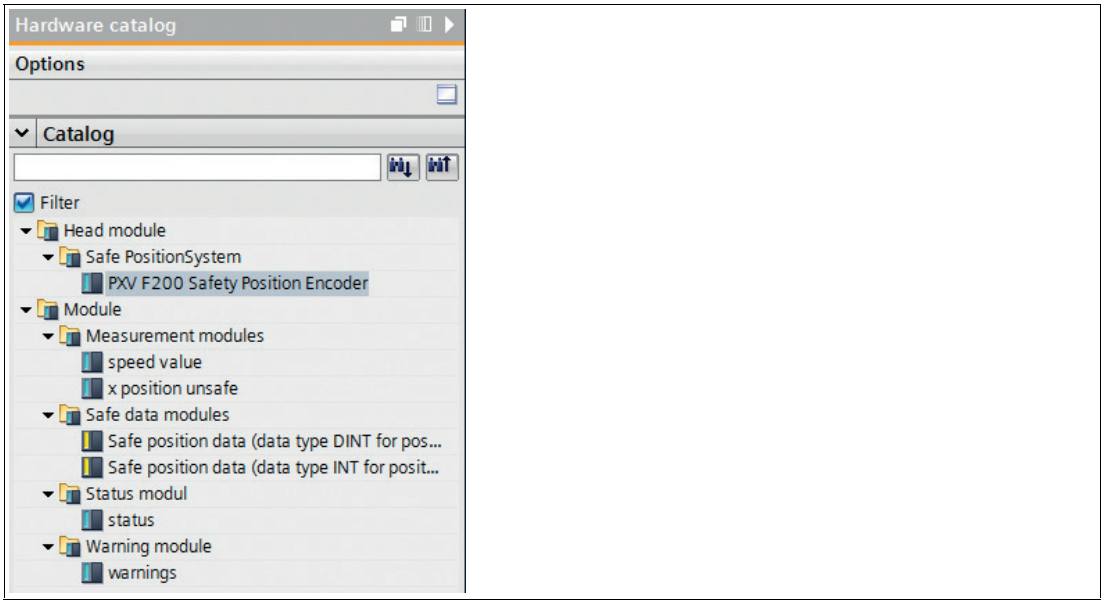

Figure 3.1 PXV100A*

3.1.1 Safety-related data

The following modules enable safe reader data to be retrieved using PROFIsafe. The modules are compatible with PROFIsafe V2.4 and each consist of 6 bytes.

Safety Module – Data Format 32 Bit DINT

This data is safe status data and safe X position data. STEP 7 Safety Advanced supports the DINT data format.

Size	Type	Content	Data Type
6 bytes	Input Data	8 bit safe status data	Bit
		8 bit safe status data negated	Bit
		32 bit safe X position data	DINT
		Resolution: 10 mm	

Input Data

Bits / Bytes	7	6	5	4	3	2	1	0	Function
1	0	0	0	OVD	OT	INIT	0	VAL	Safe status
2	/VAL	1	/INIT	/OT	/OVD	1	1	1	Safe status negated
3	XS31	XS30	XS29	XS28	XS27	XS26	XS25	XS24	Safe X position data
4	XS23	XS22	XS21	XS20	XS19	XS18	XS17	XS16	Safe X position data
5	XS15	XS14	XS13	XS12	XS11	XS10	XS9	XS8	Safe X position data
6	XS7	XS6	XS5	XS4	XS3	XS2	XS1	XS0	Safe X position data

Table 3.1 Input data telegrams for the safety module (data format 32 bit DINT)

Bit	Value	Description
VAL	1	Safe X position data is valid
	0	Invalid; safe X position data = 0x00000000
INIT	0	Initialization inactive
	1	Initialization active
OT	0	No excess temperature detected on the HiCore module. The temperature is not safety-related.
	1	Excess temperature detected on the HiCore module. The temperature is not safety-related.
OVD	0	No overvoltage detected on +UB
	1	Overvoltage > 32 VDC detected on +UB

Table 3.2 Description of the individual bits in the safety module (data format 32 bit DINT)

Safety Module – Data Format 2 x 16 Bit INT

This data is safe status data and safe X position data. STEP 7 Distributed Safety supports the data format INT.

Size	Type	Content	Data Type
6 bytes	Input Data	8 bit safe status data	Bit
		8 bit safe status data negated	Bit
		16 bit safe X position data (MSB)	INT
		16 bit safe X position data (LSB)	INT
		Resolution: 10 mm	

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Input Data

Bits / Bytes	7	6	5	4	3	2	1	0	Function
1	0	0	0	OVD	OT	INIT	0	VAL	Safe status
2	/VAL	1	/INIT	/OT	/OVD	1	1	1	Safe status negated
3	XS31	XS30	XS29	XS28	XS27	XS26	XS25	XS24	Safe X position data
4	XS23	XS22	XS21	XS20	XS19	XS18	XS17	XS16	Safe X position data
5	XS15	XS14	XS13	XS12	XS11	XS10	XS9	XS8	Safe X position data
6	XS7	XS6	XS5	XS4	XS3	XS2	XS1	XS0	Safe X position data

Table 3.3 Input data telegrams for the safety module (data format 2 x 16 bit INT)

Bit	Value	Description
VAL	1	Safe X position data is valid
	0	Invalid; safe X position data = 0x00000000
INIT	0	Initialization inactive
	1	Initialization active
OT	0	No excess temperature detected on the HiCore module. The temperature is not safety-related.
	1	Excess temperature detected on the HiCore module. The temperature is not safety-related.
OVD	0	No overvoltage detected on +UB
	1	Overvoltage > 32 VDC detected on +UB

Table 3.4 Description of the individual bits in the safety module (data format 2 x 16 bit INT)

Functional Description of the Valid Bit

The valid bit reflects the state of the safe X position data. Only when the state of the valid bit = "logic 1" may the safe X position data be used for the plausibility check and further processing in the control program.

If the state of the valid bit = "logic 0", the reader cannot determine safe X position values at this time. The plant control software has the task of carrying out further processing and triggering the appropriate actions to ensure the safe state of the plant.

3.1.2 Non-safety-related data

The reader makes the following non-safety-related data available for the positioning:

Module 1

Bit no.	Content
0 ... 31	X position data[1]

1.see "X position data"

Module 2

Bit no.	Content
0 ... 15	Speed[1]

1.see "Speed Data"

Module 3

Bit no.	Content
0 ... 15	Status[1]

1.see "Status"

Module 4

Bit no.	Content
0 ... 15	Warning[1]

1.see "Warning"

Position Data X

This data is non-safe position data for positioning in the X direction.

Size	Type	Content
4 byte	Input Data	32 bit X position data MSB[1] first Resolution: 0.1 mm

1.MSB = **m**ost **s**ignificant **b**yte

Input Data

Bit Bytes	7	6	5	4	3	2	1	0	Function
1	XS31	XS30	XS29	XS28	XS27	XS26	XS25	XS24	X position data
2	XS23	XS22	XS21	XS20	XS19	XS18	XS17	XS16	X position data
3	XS15	XS14	XS13	XS12	XS11	XS10	XS9	XS8	X position data
4	XS7	XS6	XS5	XS4	XS3	XS2	XS1	XS0	X position data

Table 3.5 Input data telegrams for X position data

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Error Codes (in Position Data X)

Code	Fault Type	Priority
1	Reader tilted 180°	2
2	No clear position can be determined (difference between codes is too great, code distance incorrect, etc.)	3
1000	Internal error	1

Table 3.6 Possible error codes

Speed Data

Size	Type	Content
1 word consistent	Input Data	16 bit speed data Resolution: 0.1 m/s

Input Data

Bits Bytes	7	6	5	4	3	2	1	0	Function
1	SP15	SP14	SP13	SP12	SP11	SP10	SP9	SP8	Speed
2	SP7	SP6	SP5	SP4	SP3	SP2	SP1	SP0	Speed

Table 3.7 Input data telegrams for speed

Status

Size	Type	Content
1 word	Input Data	16 bit status

Input Data

Bits Bytes	7	6	5	4	3	2	1	0	Function
1	0	0	0	0	0	0	0	0	Reserved
2	0	0	0	0	RES	WRN	NP	ERR	Reserved

Table 3.8 Input data telegrams for status

RES Reserved

WRN Warnings present. See information on warning.

NP No position information/OUT
(XP=0; SP=0)

ERR Error message present
see Error Codes.

Warning

Size	Type	Content
1 word consistent	Input Data	Last warnings Last warning no.

Input Data

Bits / Bytes	7	6	5	4	3	2	1	0	Function
1	WRN16	WRN15	WRN14	WRN13	WRN12	WRN11	WRN10	WRN09	Warning, see Warning Data Set
2	WRN08	WRN07	WRN06	WRN05	WRN04	WRN03	WRN02	WRN01	Warning, see Warning Data Set

Table 3.9 Input data telegrams for warning

Warning Data Set

Number	Warning
WRN01	Code with non-PXV content found
WRN02	Reader too close to code tape
WRN03	Reader too far from code tape
WRN04	Y position too large; the sensor is just before OUT
WRN05	Y position too small; the sensor is just before OUT
WRN06	The reader is rotated or tilted in relation to the code tape
WRN07	Low level of code contrast
WRN08	Repair tape detected
WRN09	Temperature too high
WRN10 ... WRN16	Reserved

Table 3.10 Existing warning data sets

If no warnings are present, all bits in the warning data set are set to 0.

3.2 PGV100A*

Overview of modules

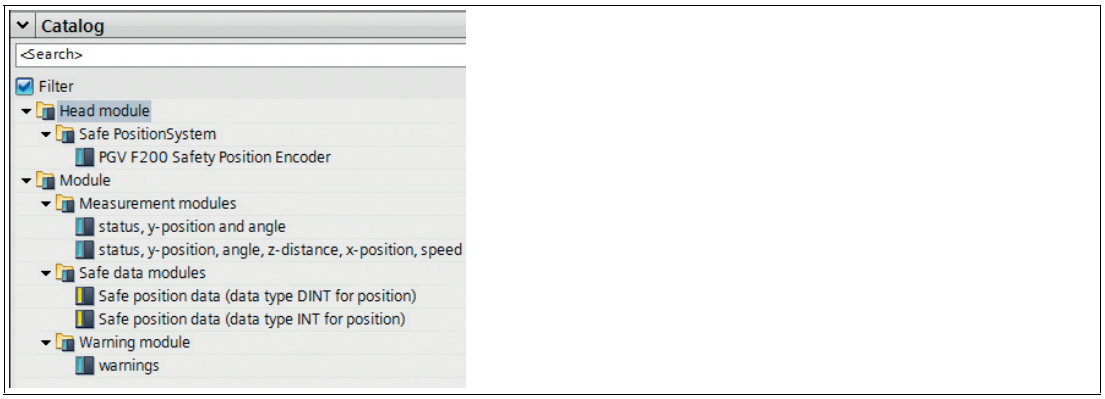

Figure 3.2 PGV100A*

3.2.1 Safety-related data

The following modules enable safe reader data to be retrieved using PROFIsafe. The modules are compatible with PROFIsafe V2.4 and each consist of 6 bytes.

Safety Module – Data Format 32 Bit DINT

This data is safe status data and safe X position data. STEP 7 Safety Advanced supports the DINT data format.

Size	Type	Content	Data Type
6 bytes	Input Data	8 bit safe status data	Bit
		8 bit safe status data negated	Bit
		32 bit safe X position data	DINT
		Resolution: 10 mm	

Input Data

Bits / Bytes	7	6	5	4	3	2	1	0	Function
1	0	0	0	OVD	OT	INIT	0	VAL	Safe status
2	/VAL	1	/INIT	/OT	/OVD	1	1	1	Safe status negated
3	XS31	XS30	XS29	XS28	XS27	XS26	XS25	XS24	Safe X position data
4	XS23	XS22	XS21	XS20	XS19	XS18	XS17	XS16	Safe X position data
5	XS15	XS14	XS13	XS12	XS11	XS10	XS9	XS8	Safe X position data
6	XS7	XS6	XS5	XS4	XS3	XS2	XS1	XS0	Safe X position data

Table 3.11 Input data telegrams for the safety module (data format 32 bit DINT)

Bit	Value	Description
VAL	1	Safe X position data is valid
	0	Invalid; safe X position data = 0x00000000
INIT	0	Initialization inactive
	1	Initialization active
OT	0	No excess temperature detected on the HiCore module. The temperature is not safety-related.
	1	Excess temperature detected on the HiCore module. The temperature is not safety-related.
OVD	0	No overvoltage detected on +UB
	1	Overvoltage > 32 VDC detected on +UB

Table 3.12 Description of the individual bits in the safety module (data format 32 bit DINT)

Safety Module – Data Format 2 x 16 Bit INT

This data is safe status data and safe X position data. STEP 7 Distributed Safety supports the data format INT.

Size	Type	Content	Data Type
6 bytes	Input Data	8 bit safe status data	Bit
		8 bit safe status data negated	Bit
		16 bit safe X position data (MSB)	INT
		16 bit safe X position data (LSB)	INT
		Resolution: 10 mm	

Input Data

Bits / Bytes	7	6	5	4	3	2	1	0	Function
1	0	0	0	OVD	OT	INIT	0	VAL	Safe status
2	/VAL	1	/INIT	/OT	/OVD	1	1	1	Safe status negated
3	XS31	XS30	XS29	XS28	XS27	XS26	XS25	XS24	Safe X position data
4	XS23	XS22	XS21	XS20	XS19	XS18	XS17	XS16	Safe X position data
5	XS15	XS14	XS13	XS12	XS11	XS10	XS9	XS8	Safe X position data
6	XS7	XS6	XS5	XS4	XS3	XS2	XS1	XS0	Safe X position data

Table 3.13 Input data telegrams for the safety module (data format 2 x 16 bit INT)

Bit	Value	Description
VAL	1	Safe X position data is valid
	0	Invalid; safe X position data = 0x00000000
INIT	0	Initialization inactive
	1	Initialization active
OT	0	No excess temperature detected on the HiCore module. The temperature is not safety-related.
	1	Excess temperature detected on the HiCore module. The temperature is not safety-related.
OVD	0	No overvoltage detected on +UB
	1	Overvoltage > 32 VDC detected on +UB

Table 3.14 Description of the individual bits in the safety module (data format 2 x 16 bit INT)

Functional Description of the Valid Bit

The valid bit reflects the state of the safe X position data. Only when the state of the valid bit = "logic 1" may the safe X position data be used for the plausibility check and further processing in the control program.

If the state of the valid bit = "logic 0", the reader cannot determine safe X position values at this time. The plant control software has the task of carrying out further processing and triggering the appropriate actions to ensure the safe state of the plant.

3.2.2 Non-safety-related data

For the navigation of automated guided vehicles, the reader makes the following non-safety-related data available:

Module 1

Bit no.	Content
0 ... 15	Status[1]
16 ... 47	Position Data Y[2]
48 ... 63	Angle Data[3]

1.see "Status"

2.see "Position Data Y"

3.see "Angle Data"

Module 2

Bit no.	Content
0 ... 15	Status[1]
16 ... 47	Position Data Y[2]
48 ... 63	Angle Data[3]
64 ... 95	Position Data X[4]
96 ... 111	Speed[5]
112 ... 127	Position Data Z[6]

1.see "Status"

2.see "Position Data Y"

3.see "Angle Data"

4.see "Position Data X"

5.see "Speed Data"

6.see "Position Data Z"

Position Data X

This data is non-safe position data for positioning in the X direction.

Size	Type	Content
4 byte	Input Data	32 bit X position data MSB[1] first Resolution: 0.1 mm

1.MSB = **m**ost **s**ignificant **b**yte

Input Data

Bit / Bytes	7	6	5	4	3	2	1	0	Function
1	XS31	XS30	XS29	XS28	XS27	XS26	XS25	XS24	X position data
2	XS23	XS22	XS21	XS20	XS19	XS18	XS17	XS16	X position data
3	XS15	XS14	XS13	XS12	XS11	XS10	XS9	XS8	X position data
4	XS7	XS6	XS5	XS4	XS3	XS2	XS1	XS0	X position data

Table 3.15 Input data telegrams for X position data

Error Codes (in Position Data X)

Code	Fault Type	Priority
1	Reader tilted 180°	2
2	No clear position can be determined (difference between codes is too great, code distance incorrect, etc.)	3
1000	Internal error	1

Table 3.16 Possible error codes

Position Data Y

Size	Type	Content
4 byte consistent	Input Data	32 bit Y data MSB first Resolution: 0.1 mm

Input Data

Bits / Bytes	7	6	5	4	3	2	1	0	Function
1	YS31	YS30	YP29	YP28	YP27	YP26	YP25	YP24	Y position data
2	YP23	YP22	YP21	YP20	YP19	YP18	YP17	YP16	Y position data
3	YP15	YP14	YP13	YP12	YP11	YP10	YP9	YP8	Y position data
4	YP7	YP6	YP5	YP4	YP3	YP2	YP1	YP0	Y position data

Table 3.17 Input data telegrams for Y position data

Angle Data

Size	Type	Content
2 byte consistent	Input Data	16 bit angle data Resolution: 0.1°

Input Data

Bit / Bytes	7	6	5	4	3	2	1	0	Function
1	ANG15	ANG14	ANG13	ANG12	ANG11	ANG10	ANG9	ANG8	Angle Data
2	ANG7	ANG6	ANG5	ANG4	ANG3	ANG2	ANG1	ANG0	Angle Data

Table 3.18 Input data telegrams for angle data

Speed Data

Size	Type	Content
1 word consistent	Input Data	16 bit speed data Resolution: 0.1 m/s

Input Data

Bits Bytes	7	6	5	4	3	2	1	0	Function
1	SP15	SP14	SP13	SP12	SP11	SP10	SP9	SP8	Speed
2	SP7	SP6	SP5	SP4	SP3	SP2	SP1	SP0	Speed

Table 3.19 Input data telegrams for speed

Status

Size	Type	Content
1 word	Input Data	16 bit status

Input Data

Bits Bytes	7	6	5	4	3	2	1	0	Function
1	0	0	0	0	0	0	0	0	Reserved
2	0	0	0	0	RES	WRN	NP	ERR	Reserved

Table 3.20 Input data telegrams for status

RES Reserved

WRN Warnings present. See information on warning.

NP No position information/OUT
(XP = 0, YP = 0, ZP = 0, ANGL = 0, SP = 0)

ERR Error message present
see Error Codes.

Warning

Size	Type	Content
1 word consistent	Input Data	Last warnings Last warning no.

Input Data

Bits Bytes	7	6	5	4	3	2	1	0	Function
1	WRN16	WRN15	WRN14	WRN13	WRN12	WRN11	WRN10	WRN09	Warning, see Warning Data Set
2	WRN08	WRN07	WRN06	WRN05	WRN04	WRN03	WRN02	WRN01	Warning, see Warning Data Set

Table 3.21 Input data telegrams for warning

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Warning Data Set

Number	Warning
WRN01	Code with non-PXV content found
WRN02	Reader too close to code tape
WRN03	Reader too far from code tape
WRN04	Y position too large; the sensor is just before OUT
WRN05	Y position too small; the sensor is just before OUT
WRN06	The reader is rotated or tilted in relation to the code tape
WRN07	Low level of code contrast
WRN08	Repair tape detected
WRN09	Temperature too high
WRN10 ... WRN16	Reserved

Table 3.22 Existing warning data sets

If no warnings are present, all bits in the warning data set are set to 0.

Position Data Z

Size	Type	Content
1 word consistent	Input Data	16 bit Z data MSB first Resolution: 1 mm

Input Data

Bit no.	Content Word 1 Z data
0	ZP01
1	ZP02
2	ZP03
3	ZP04
4	ZP05
5	ZP06
6	ZP07
7	ZP08
8	ZP09
9	ZP10
10	ZP11
11	ZP12
12	ZP13
13	ZP14
14	ZP15
15	ZP16

Table 3.23 Input data telegrams for Z position data

4 Safety application

This chapter describes the procedure for creating a safety application for example for PXV100A* using the SIEMENS configuration software **TIA Portal V13** and the optional package **S7 Safety Advanced V13**.

Access protection

Access to the F-system "S7 Safety Advanced V13" is secured by two password prompts, the password for the F-CPU and the password for the safety program. For the password for the safety program, a differentiation is made between an offline and an online password:

- The offline password forms part of the safety program in the offline project on the programming unit.
- The online password is part of the safety program in the F-CPU.

This procedure describes how to create passwords.

4.1 Prerequisites

Warning!

Risk of injury due to incorrect configuration of the safety program

An error during the configuration of the safety program can override the fail-safe function, causing a danger to people and machinery.

- Ensure that the device is programmed exclusively by qualified personnel.
- Create the safety program only in combination with the relevant software or hardware system documentation supplied by SIEMENS.
- SIEMENS provides comprehensive documentation on the subject of configuring and programming a safe control panel in its "SIMATIC Safety – Configuring and Programming" manual. This documentation is part of the S7 Safety Advanced V13 add-on package.

System requirements

Note!

Various configuration tools are available for configuration of your device. This manual describes the configuration of a Siemens control panel using the TIA Portal V13 as an example. If you are using a programmable logic controller (PLC) from a different manufacturer, the process will be similar to the one described here.

S7 Safety Advanced V13:

- Software components: TIA Portal V13
- Hardware components of the SIMATIC 1500 series: F-CPU unit "CPU15 12F-1 PN" (6ES7 512-1SK01-0AB0)

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4.2 Integrating hardware

In this chapter you will create a new project and add a fail-safe CPU (F-CPU).

Creating a project

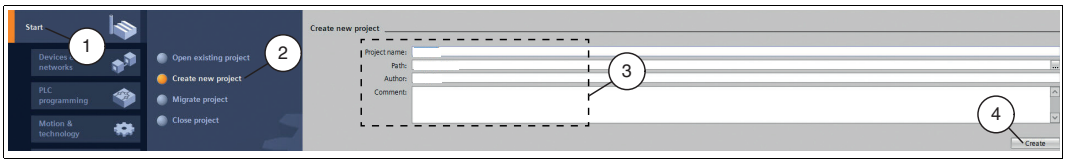

Figure 4.1 Creating a new project

1. Start the **"TIA Portal V13"** and create a new project with the associated path and name (3). To do so, select the *"Start"* (1) > *"Create new project"* (2) button in the portal view.
2. Use the *"Create"* button (4) to confirm your entry.

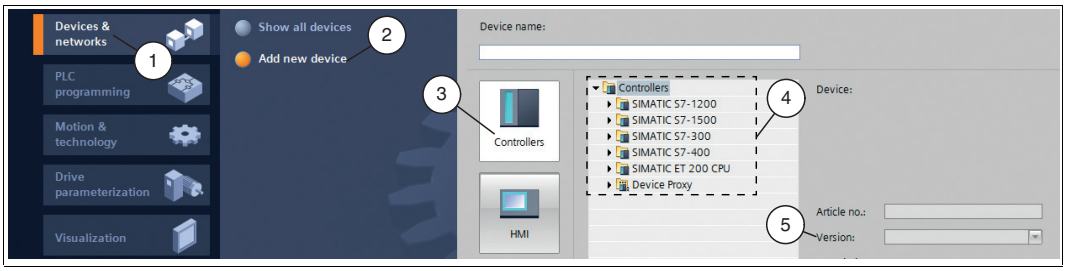

Figure 4.2 Adding a new device

3. In the portal view, select the *"Device & networks"* (1) > *Add new device"* (2) button.
4. Click on the *"Controller"* button (3), and then select your control panel from the hardware catalog. Also, ensure that you select the right *version* (5).
5. Double-click on the *"Add"* button to accept the device in the project.

   ↳ The project view automatically opens. In the work area, the device view with profile rail and CPU is selected. The hardware catalog is opened on the right-hand side.

4.3 Configuring the hardware

This chapter describes the configuration of your device and the control panel. Once the configuration is successfully completed, you can create your safety program.

To ensure proper operation of the device, perform the following steps for the configuration:

- Install the GSDML file
- Integrate a device into the project
- Integrate modules into the project
- Define the properties of the control panel
- Define device properties

A more detailed description of the individual steps is provided in the following subchapters.

4.3.1 Installing the GSDML file

Warning!

Risk of injury due to incorrect GSDML file

Using an incorrect GSDML file can override the fail-safe function, causing a danger to people and machinery.

Ensure that you use the correct GSDML file.

You require a **GSDML file** for the operation of the device. The GSDML file can be downloaded from our website: www.pepperl-fuchs.com. Simply enter the product name or item number in the Product/Keyword field and click the "Search" icon. Select your product from the list of search results. Click on the information you require in the product information list, e.g., Software. A list of all available downloads is displayed.

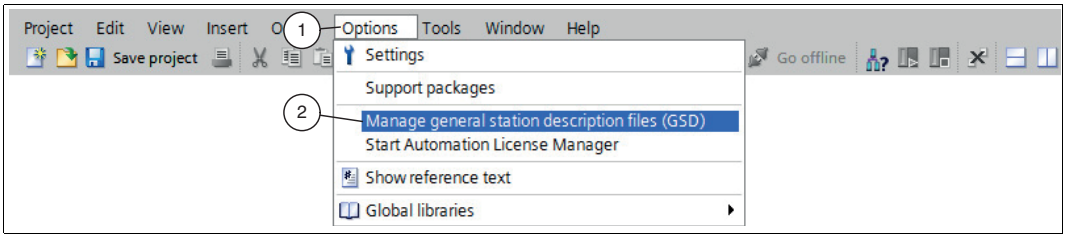

Figure 4.3 GSDML File

1. In the menu bar under *"Options"* (1), select the *"Manage general station description files (GSD)"* (2) command.

   ↳ The *"Manage general station description files"* window opens.

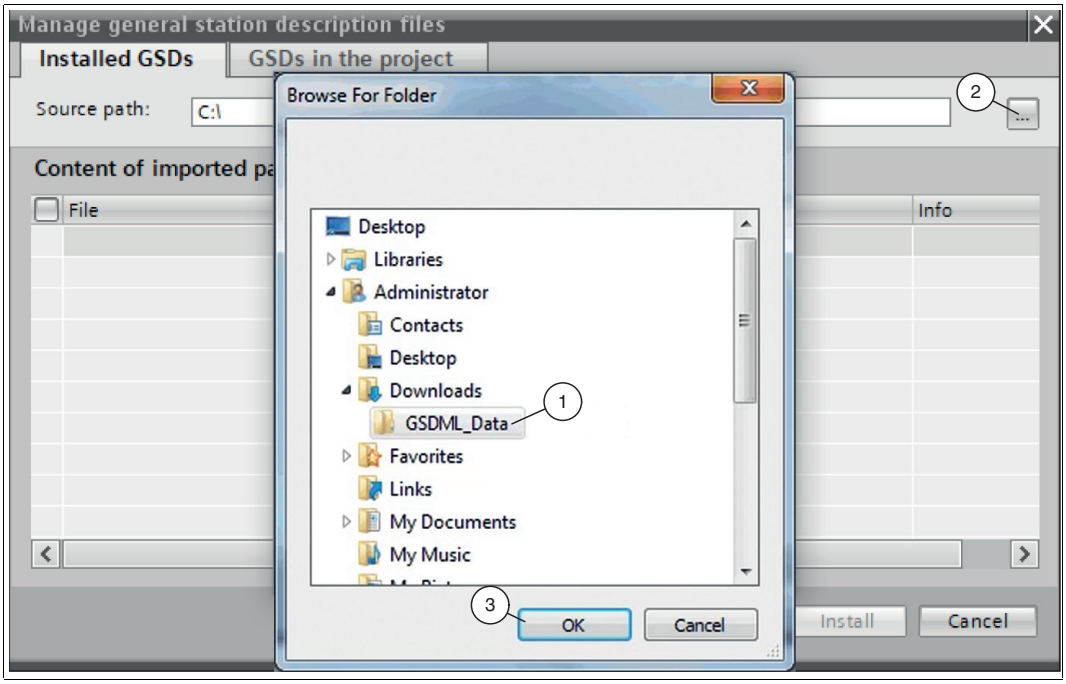

Figure 4.4 Searching for the GSDML file

2. Click the *"Button with the three dots"* (2), which allows you to search for your GSDML file on the storage medium.

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3. Select the folder containing the GSDML file (1) and click *"OK"* (3) to confirm your selection.
4. Select the GSDML file to install by checking the box to the left of the filename.
5. Click the *"Install"* button. The installation process may take a few minutes.

   ↳ Once the file is installed successfully, the system issues a notification that installation was successful. Close this window. The device data is added to the hardware catalog. The project view opens in the work area without a selection being made.

4.3.2 Integrating a device into the project

1. In project navigation on the left-hand side, double-click with the left mouse button to select the *"Device and networks"* entry. The network view is displayed in the work area.
2. Open the hardware catalog. Browse through the tree structure until you see your device.

Note!

The figures serve to provide basic understanding and may deviate from the actual design.

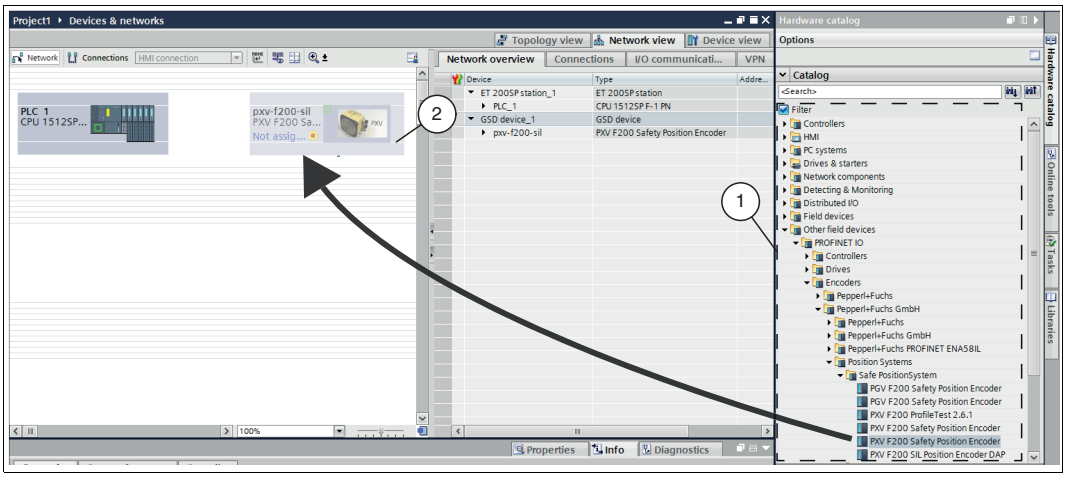


Figure 4.5 Integrating a GSDML file

3. Select your device (1) from the hardware catalog and drag this module into the network view (2).

   ↳ Your device is displayed in the network view window (2).

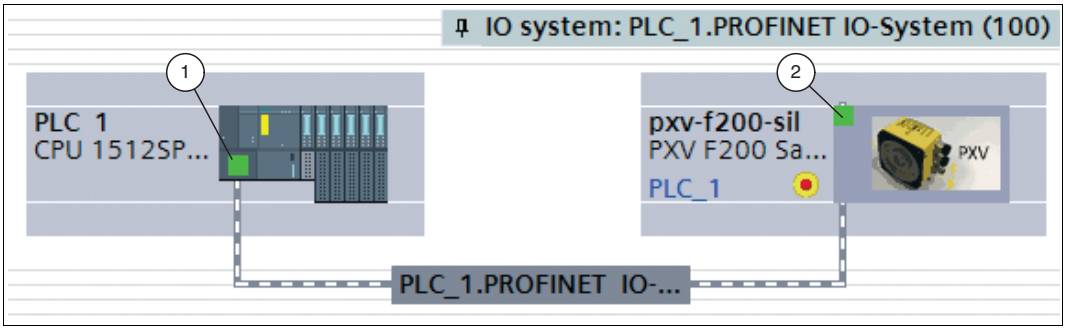


Figure 4.6 Connecting the device with the control panel

4. To connect the device with the control panel, move the mouse to the PROFINET interface that is highlighted in green in the control panel (1). Click and hold the left mouse button and drag the line shown to the PROFINET interface on the device (2). Once there, release the left mouse button again.

   ↳ The device is now connected to the control panel. A PROFINET subsystem is created.

4.3.3 Integrating modules into the project

From the hardware catalog, you can integrate modules into the device configuration.

To insert a module in the device configuration, proceed as follows:

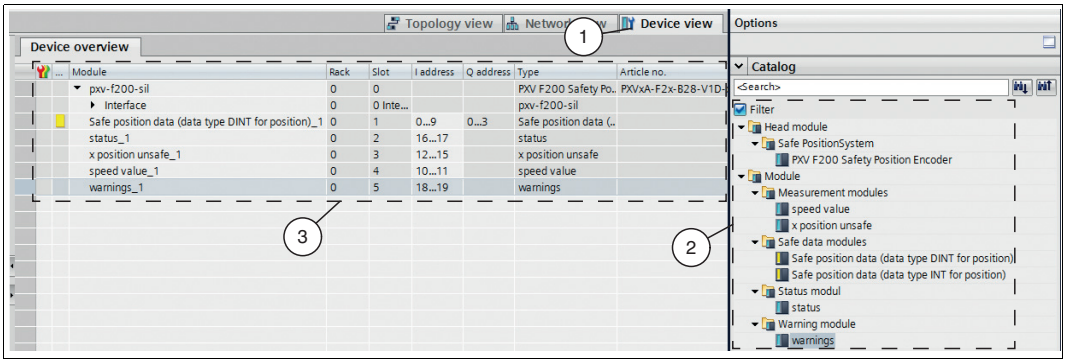


Figure 4.7 Integrating modules

1. In the *"Device and networks"* window, switch to the *"Device view"* (1) tab.
2. Open the hardware catalog. Select your module (2) from the hardware catalog and drag this module into the network view (3).

   ↳ The modules are automatically assigned an address range.

4.3.4 Defining the properties of the control panel

The following settings can only be made in **offline mode**. You can use the menu bar above the two functions *"Go online"* and *"Go offline"* to control the connection to the CPU and to switch to offline mode.

1. In the *"Device and networks"* window, switch to the *"Device view"* (2) tab.
2. In the selection window (1), select your control panel. In this example, it is control panel "PLC_1" (3).

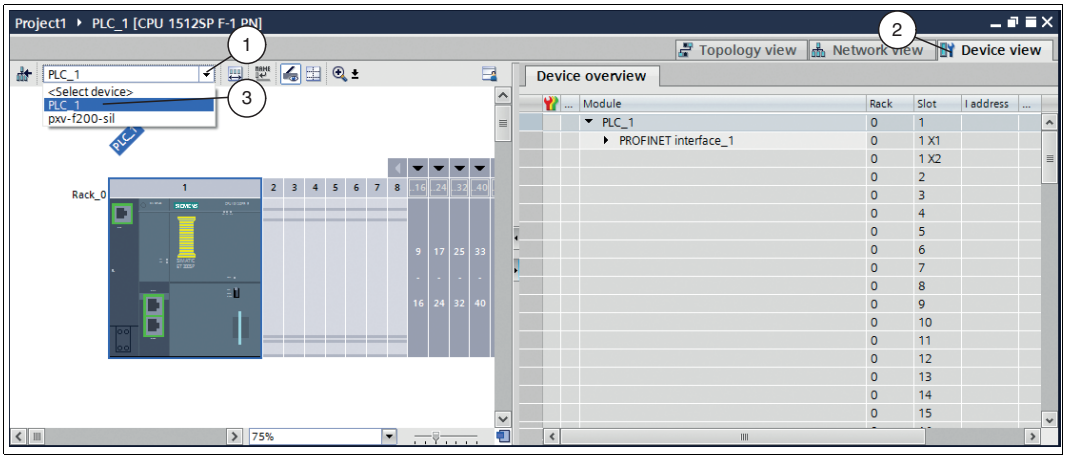


Figure 4.8 Selecting the control panel

↳ The control properties appear in the inspection window.

3. In the inspection window under the *"Properties"* (1) tab, select *"General"* (4) > *"Ethernet addresses"* (3).

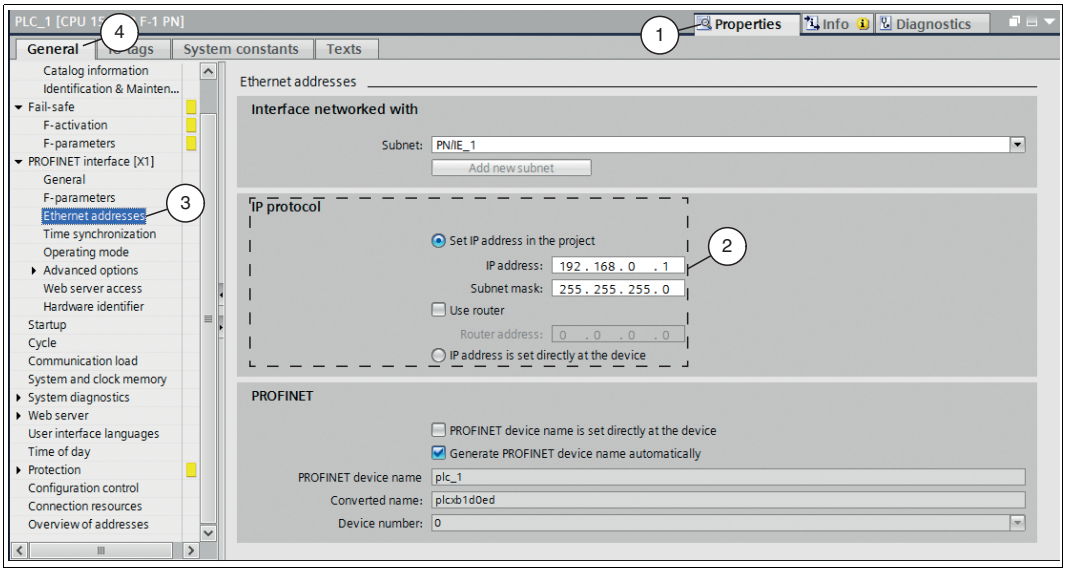


Figure 4.9 Ethernet address of the control panel

↳ The input screen *"Ethernet addresses"* opens. In the input screen, you can see the IP address and the subnet mask under *"IP protocol"* (2). The IP address is automatically included with the download of the project by the PG/PC.

4. To set up access permission for the F-CPU, select *"General"* (4) > *"Protection"* (3) under the *"Properties"* (1) tab in the inspection window.

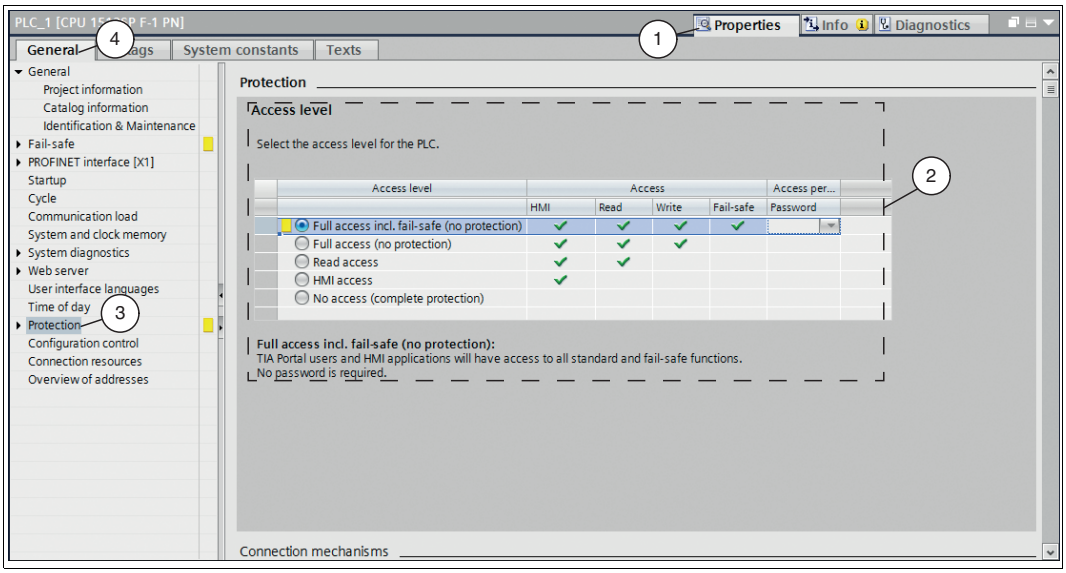


Figure 4.10 Control panel protection

↳ The *"Protection"* (2) input screen opens. Here you can set the access permission for the F-CPU.
The description for the access permission is displayed directly below the table in the inspection window when you select the required access permission.

5. In the *"Protection"* (2) input screen, select at least access level "Full access (no protection)." Assign a password in the setting "Full access incl. fail-safe (no protection)."
6. In the inspection window under the *"Properties"* (1) tab, select *"General"* (4) > *"Fail safe"* (3).

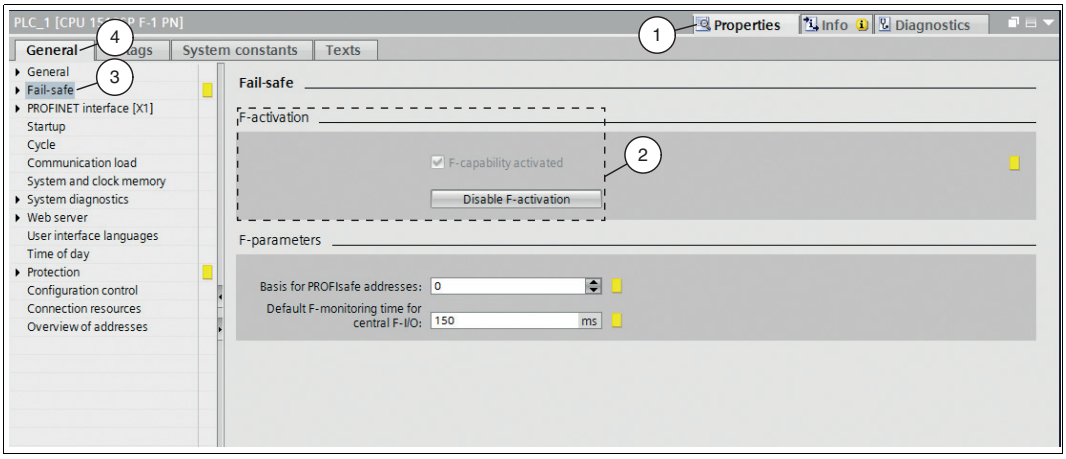


Figure 4.11 Intrinsic safety

↳ The *"fail safe"* input screen opens.

7. Ensure that in the *"F-activation"* (2) input screen, a checkmark is set for *"F-capability activated."* If this box is not checked, activate the *"F-activation"* function by selecting the *"Activate F-activation"* button.

↳ The blocks for the safety program are generated automatically.

4.3.5 Defining the device name

For the device to be addressed as a participant on the PROFINET device, this device requires a unique PROFINET device name. The device name is defined as follows:

1. In the *"Device and networks"* window, switch to the *"Device view"* (2) tab.
2. Select your device from the selection window (1). In this example, the device is "pxv-F200-sil" (3).

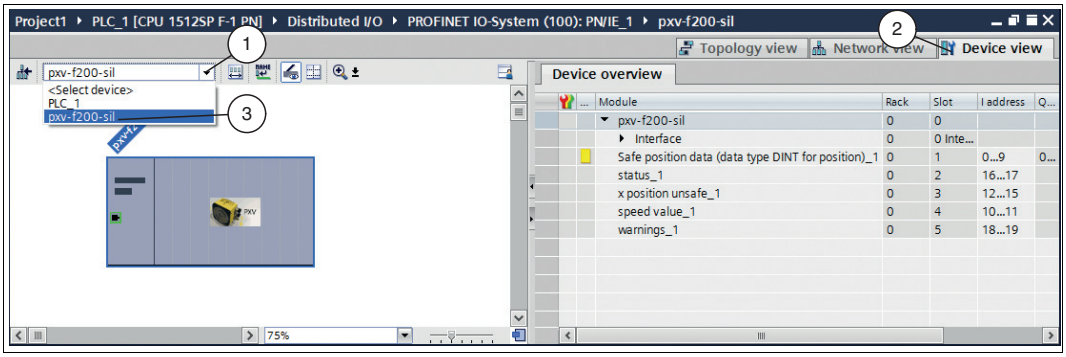


Figure 4.12 Select the device

↳ The device properties appear in the inspection window.

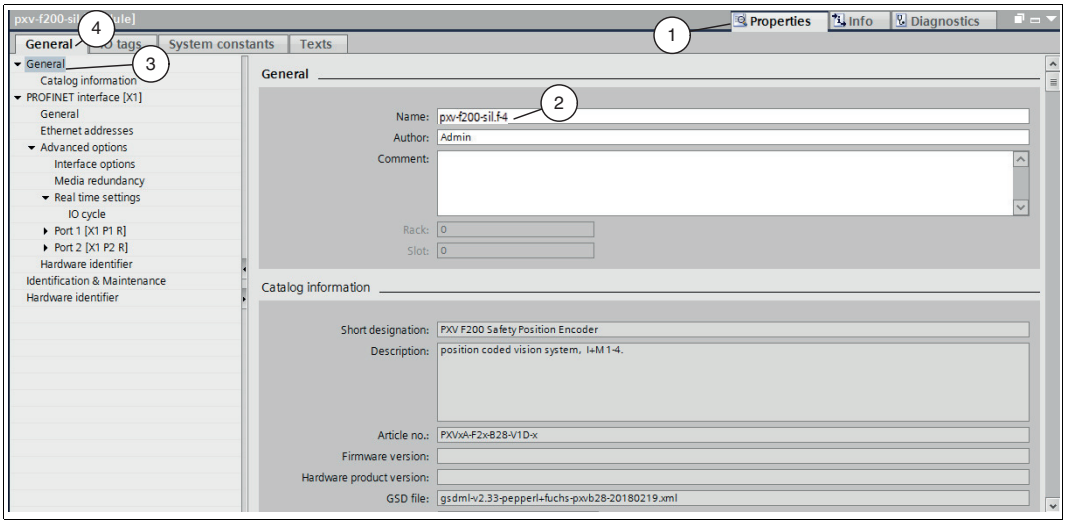


Figure 4.13 Device properties inspection window

3. Under the *"Properties"* (1) tab, select *"General"* (4). Select the *"General"* (3) menu.

   ↳ The *"General"* input screen opens.

4. Enter the name of your device in the *"Name"* (2) input field.

Note!

The default device name is **pxv-f200-sil**. The default PROFIsafe target address is **"3"**. The PROFIsafe target address (matching "F_Dest_Add" in the project) of the device is set via the device name. To do this, use a suffix that contains the address of the device.

Example: pxv-f200-sil.f-4 -> xxx.f-4 -> The address **"4"** is adopted.

The device name can be changed directly in the TIA portal or using the "PRONETA" software available free of charge from Siemens. After changing, the device must be restarted once.

5. Switch to the *"Device view"* (1) tab.

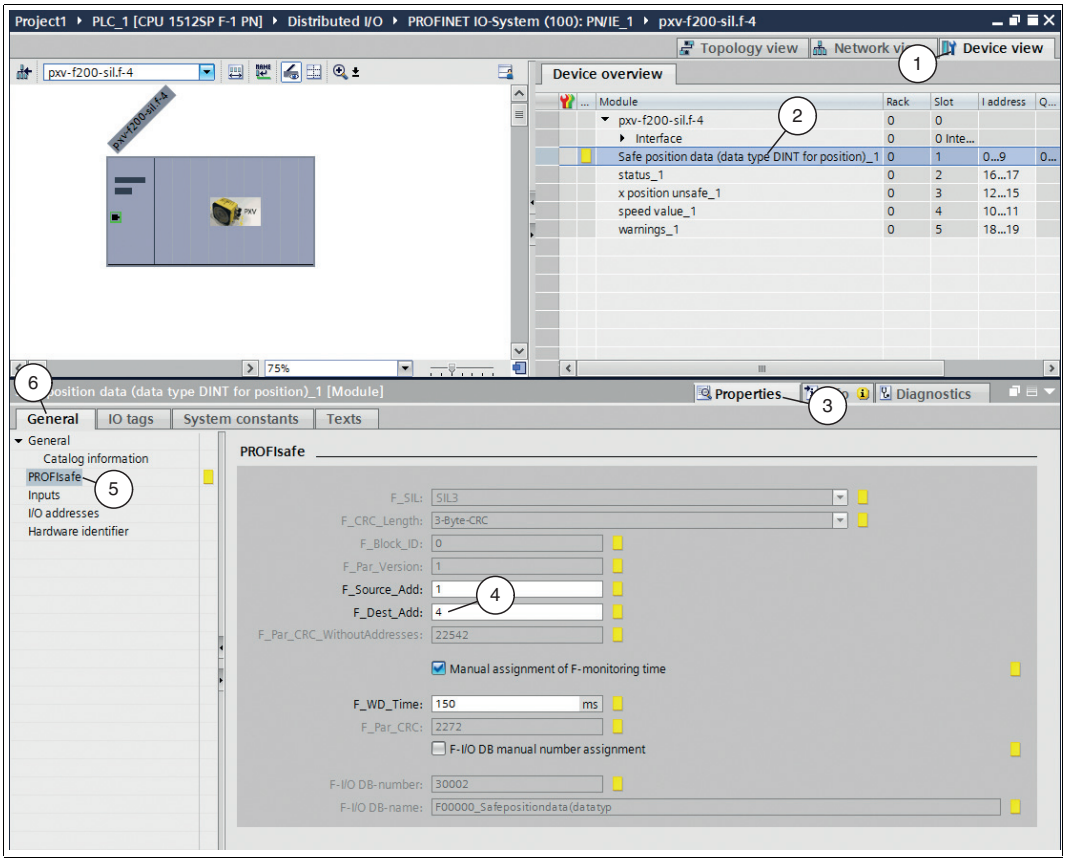


Figure 4.14 PROFIsafe address

6. In the "Device overview" window, select the *"Safe position data (data type DINT for position)_1"* (2) module, by clicking it once with the left mouse button.

   ↳ The *"Safe position data (data type DINT for position)_1"* dialog box opens.

7. In the inspection window under the *"Properties"* (3) tab, select *"General"* (6). Select the *"PROFIsafe"* (5) menu.

   ↳ The *"PROFIsafe"* input mask opens.

8. In the input field *"F_Dest_Add"* (4), enter the device address. In this example "**4**", and confirm your entry by *pressing "Enter."*

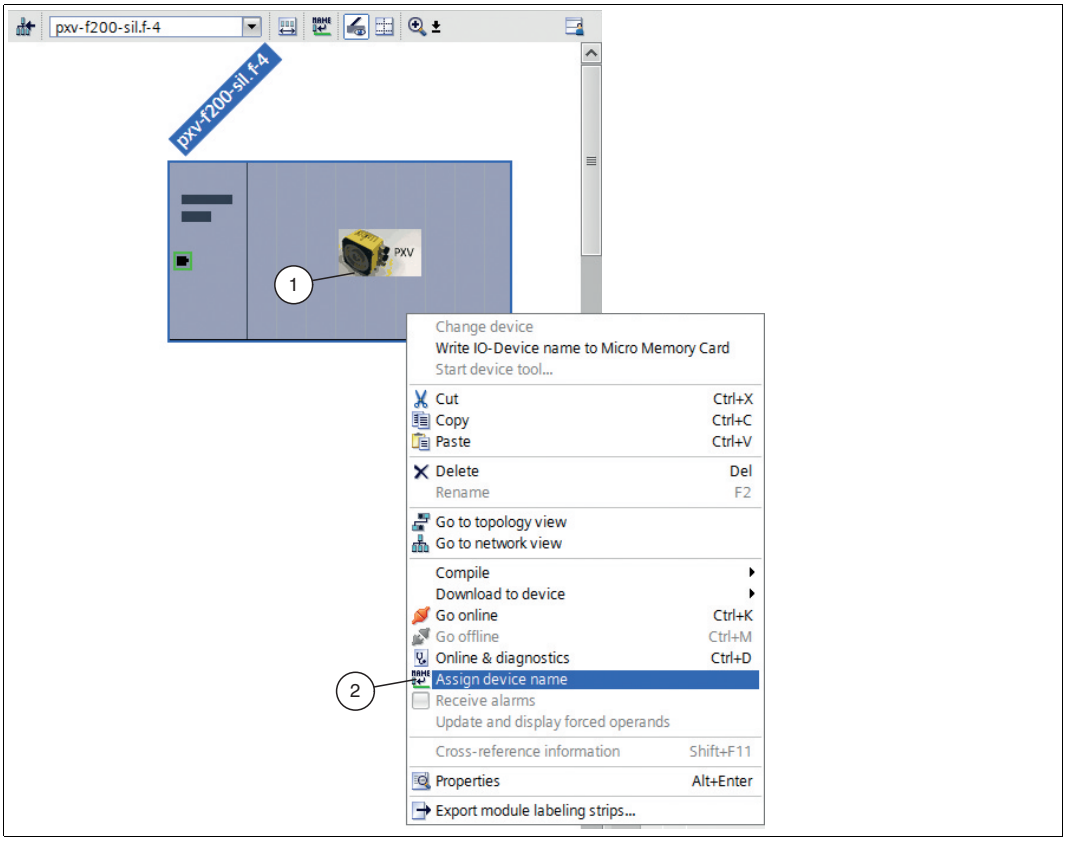


Figure 4.15 Assigning the device name

9. To assign the modified device name, right-click on the **device** (1) in the device view. Select the *"Assign device name"* (2) submenu.

   ↳ The *"Assign PROFINET device name"* dialog box opens.

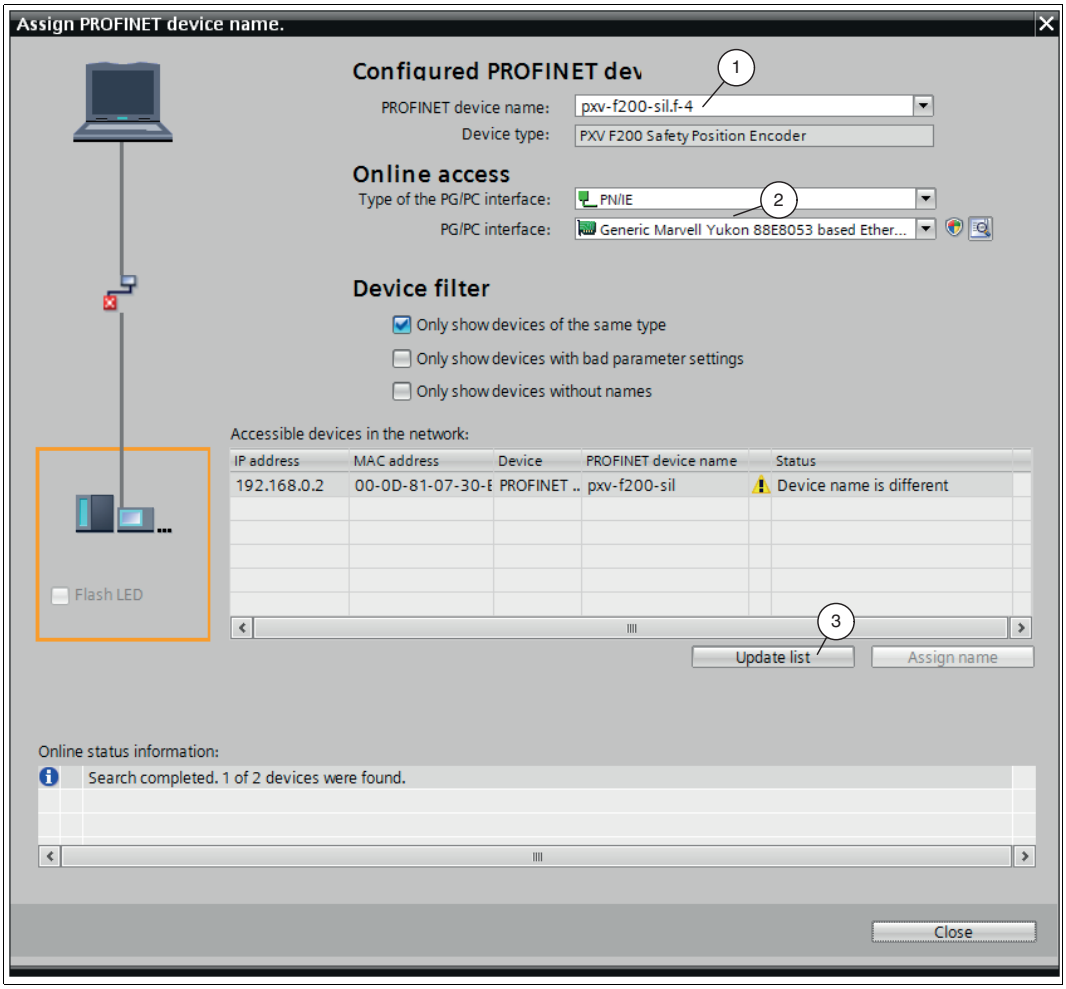


Figure 4.16 "Assign device name" dialog box

10. Check or select the *"PROFINET device name"* (1).
11. Establish the connection to the Ethernet network via the two drop-down lists under *"Online access"* (2).
12. Confirm your entry by clicking on *"Update list"* (3).

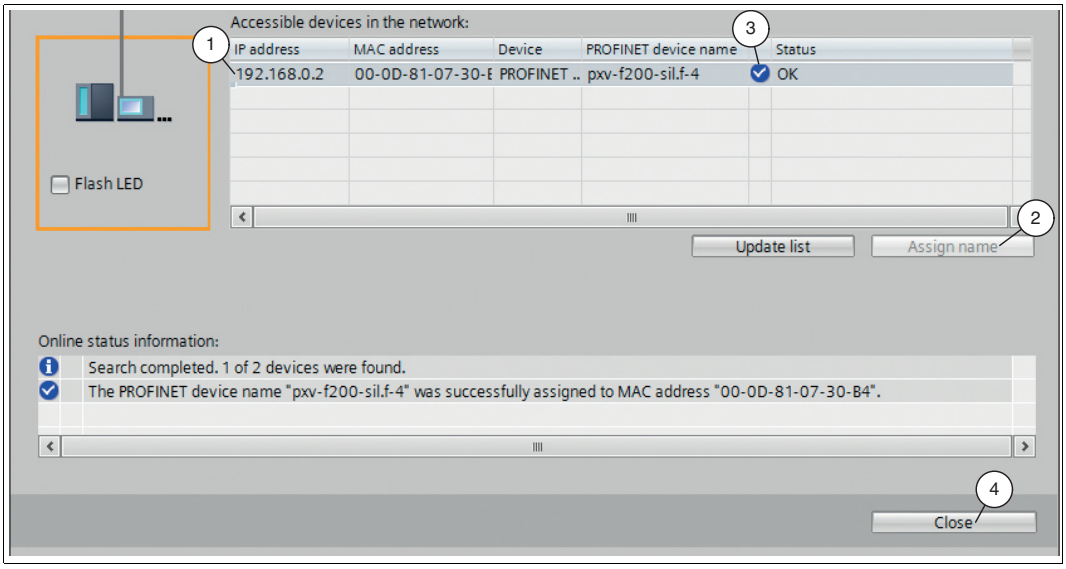


Figure 4.17 Confirming the device name

13. Select the device with the assigned device name (1) from the network list. Confirm your selection by clicking *"Assign name"* (2).

    ↳ As soon as the device name is assigned, a blue checkmark (3) appears in the "Status" column next to the assigned device name in the network list.

14. Close the window by clicking on the *"Close"* (4) button.

4.4 Translating project data

To load the project data to the F-CPU, the data must be translated first. During translation, project data is converted so that it can be read from the F-CPU.

1. In project navigation, use the left mouse button to select your project *"PLC_1 [CPU 1512SP F-1 PN]."*
2. In the menu bar under *"Edit"* (1), select the *"Compile"* (2) command.

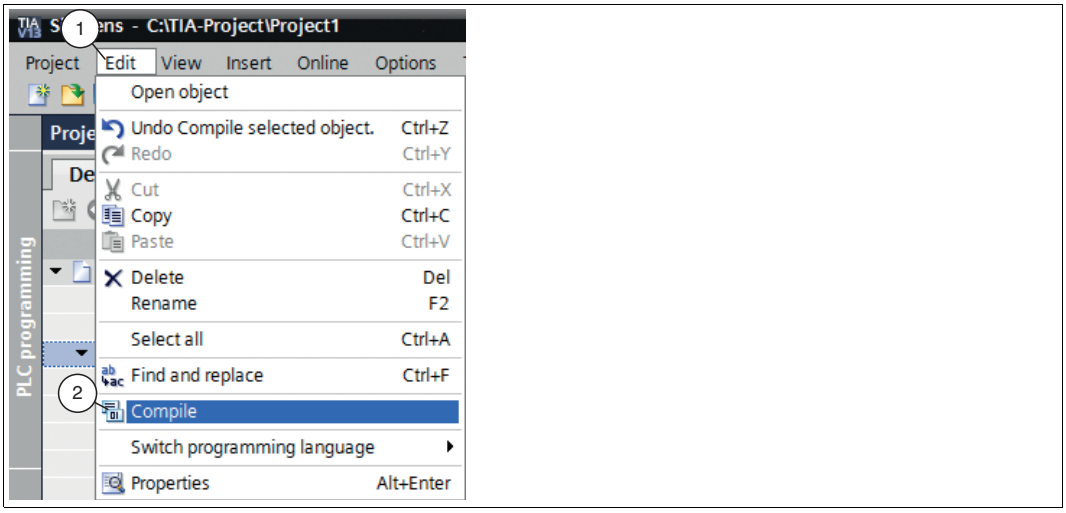


Figure 4.18 Translate project data

↳ The translation process starts.

Note!

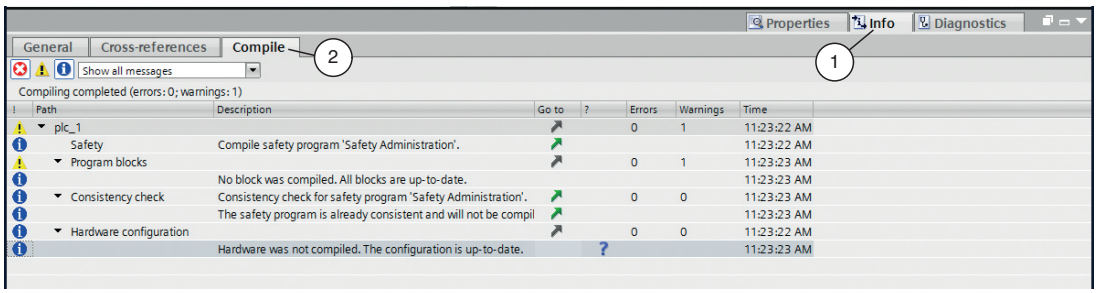


Figure 4.19 Translation process

The translation process can be controlled in the inspection window by selecting *"Info"* in the *"Compile"* tab.

To load a functional program to the control panel, the translation must run without errors.

4.5 Downloading project data

After translating the project data, you can load the project to the F-CPU.

1. In project navigation, use the left mouse button to select your project *"PLC_1 [CPU 1512SP F-1 PN]."*
2. In the menu bar under *"Online"* (1), select the *"Download to device"* (2) command.

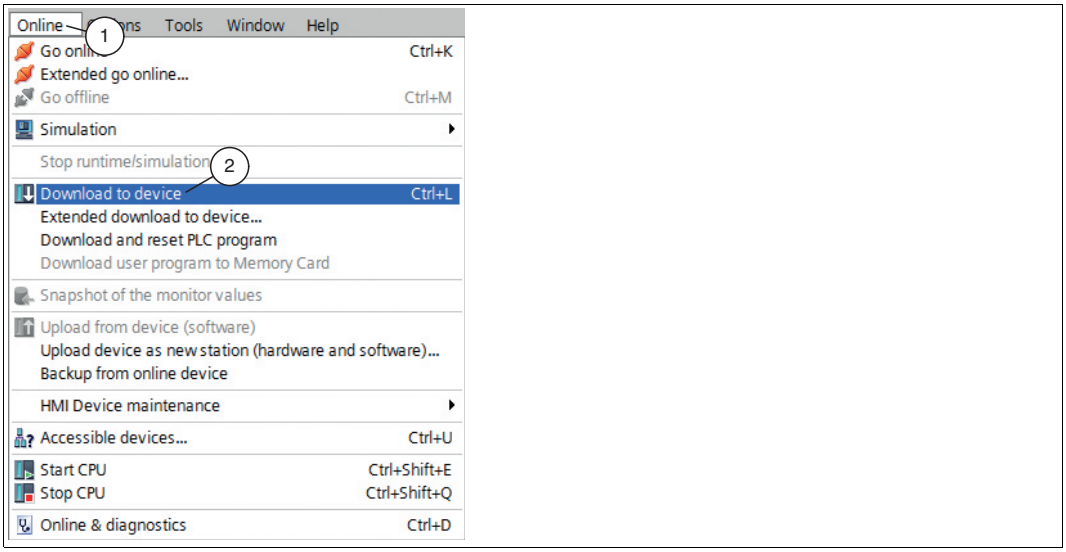


Figure 4.20 Downloading project data

↳ The *"Load preview"* window opens.

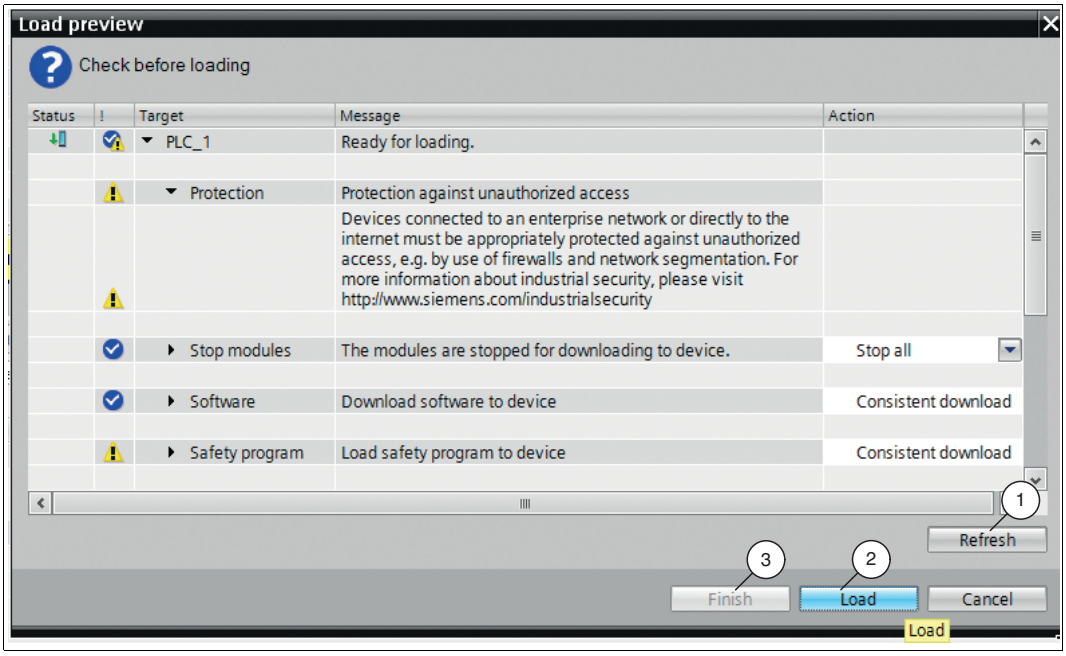


Figure 4.21 Load preview

3. Check the messages in the dialog box. If all the conditions are met, proceed to the next step. If this is not the case, correct the errors and repeat the loading procedure with the *"Refresh"* (1) button.
4. Press the *"Load"*(2) button.

↳ The load process is started.

5. Once the project is loaded to the F-CPU, click on the *"Finish"* (3) button in the *"Load preview"* window.

5 Programming

This chapter describes how to create a fail-safe block. Data types **INT** and **DINT** are available for this purpose. The following is an example of how to create a fail-safe block using the DINT data type.

Introduction

From TIA Portal V13, fail-safe S7-1500F CPUs are supported. In these control panels, both standard and fail-safe programming is possible in one device. The SIMATIC STEP 7 Safety (TIA Portal) add-on package is used for programming the fail-safe user program.

Note!

Fail-safe does not mean that the program is free of errors. The programmer is responsible for the accuracy of the programming logic. Fail-safe means that correct execution of the fail-safe user program in the control panel is ensured.

5.1 Setting F-parameters

For secure transmission of individually set F-parameters, a "CRC" is required that is calculated automatically by the TIA Portal V13. This check sum corresponds to the F-parameter **F_Par_CRC** that is displayed in the device view in the "Inspector window" under *Properties* > *General* > *PROFIsafe* during configuration of the positioning system.

Non-adjustable F-parameters

The following F-parameters are managed either by the positioning system or from the control panel and can therefore not be changed manually:

- F_CRC_Length: 3 byte CRC
- F_Block_ID: 0
- F_Par_Version: 1

Configurable F-parameters

The following settings are possible for the PROFIsafe information in the control panel.

- F_Dest_Add: Address of the reader,
  value range: 1 ... 1022
- F_WD_Time: Monitoring time
  40 ... 2000 ms (standard)
- F_Source-Add: Address of the control panel,
  value range: 1 ... 65534

Setting F-parameters

1. In the working window, select the *"Device view"* tab.

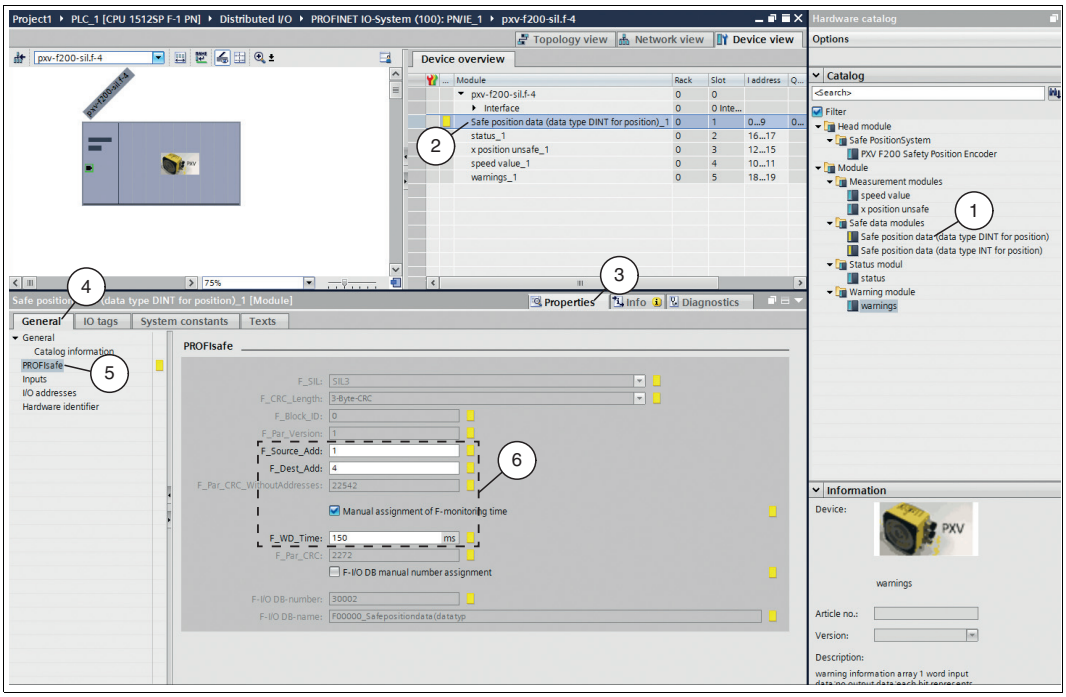


Figure 5.1 Configurable F-parameters

Note!

The *"Safe position data (data type DINT for position)"* module is displayed in the device view by default. If you want to use the safety module with the data type "Int", you must first remove the active module in the device view and the new module from the hardware catalog by double-clicking on it.

2. Double-click to select the *"Safe position data (data type DINT for position)"* (1) module from the hardware catalog.

   ↳ The selected module is displayed in the device overview *"Safe position data (data type DINT for position)"* (2).

3. In the inspection window under the *"Properties"* (3) tab, select *"General"* (4). Select the *"PROFIsafe"* (5) menu.

   ↳ The *"PROFIsafe"* input mask opens. You can set the F-parameters (6) according to your application.

Note!

The PROFIsafe address of the device is modified to include a name extension. To this end, a suffix ".f-x" is added to the end of the actual device name (here "pxv-f200-sil"), where x stands for the relevant address. Accordingly, if 4 is to be set as the address for the device, the full designation is "pxv-f200-sil.f-4." It is important to note that this address must correspond to the value stored in the control panel.

5.2 Programming F-blocks

You can create a safety program in the programming editor. You can program fail-safe function blocks (FB) and functions (FC) in the function plan programming language (FUP) or contact plan (KOP) and create fail-safe data blocks (DB).
The fail-safe system performs a dual execution through coded processing. The fail-safe system automatically performs security checks and adds additional fail-safe logic for error detection and error response during the compilation of the safety program. This ensures the detection of errors and failures and the appropriate execution of responses, with which the fail-safe system maintains a safe state or is put into a safe state.

To ensure proper operation of the device, perform the following steps during configuration:

- Create variables
- Create instruction for user acknowledgment
- Create instruction for transferring data
- Translate project data
- Load project data to the F-CPU
- Create observation table
- Test the safety program

A more detailed description of the individual steps is provided in the following subchapters.

5.2.1 Creating variables

This section describes how to create variables for your safety program. Variables are reserved memory ranges for values in the control panel.

Terms from the variable table:

- **Name** (e.g., X position safe): The name of a variable is valid for a control panel and may only occur once within the entire program and this control panel.
- **Data type** (e.g., Bool): The value representation and the permitted value range are determined by the data type. For example, the selection of the data type "Bool" can specify that a variable can only adopt the binary values "0" and "1."
- **Address** (e.g., M0.0): The address of a variable is absolute and defines the memory range from which the variable reads or writes a value. Examples of possible memory ranges are inputs, outputs, and markers. The variables may not overlap in a memory range. The address of a variable must be unique.

Creating PLC variables

1. Create a new variable table. To do so, in project navigation double-click with the left mouse button to select the *"PLC_1 [CPU 1512SP F-1 PN] > PLC tags>* ***Show all tags***" (1) entry.

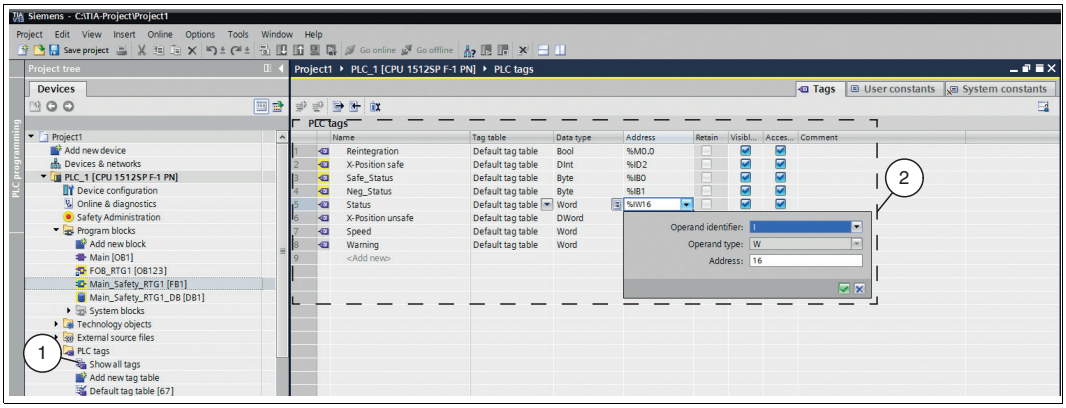


Figure 5.2 PLC variable table

2. Assign symbolic names for the variables as shown in the figure above (2). Adjust the data types and addresses depending on your application.

Note!

Assigning addresses

The addresses in this example are project-dependent and can differ from your address assignment. The memory range is automatically assigned by the control panel when integrating the modules. This memory range determines the address assignment in the variable table.

Creating a static variable

1. Create a new static variable. To do so, in project navigation double-click with the left mouse button to select the *"PLC_1 [CPU 1512SP F-1 PN] > Program block >* ***Main_Safety_RTG1 [FB1]***" (1) entry.

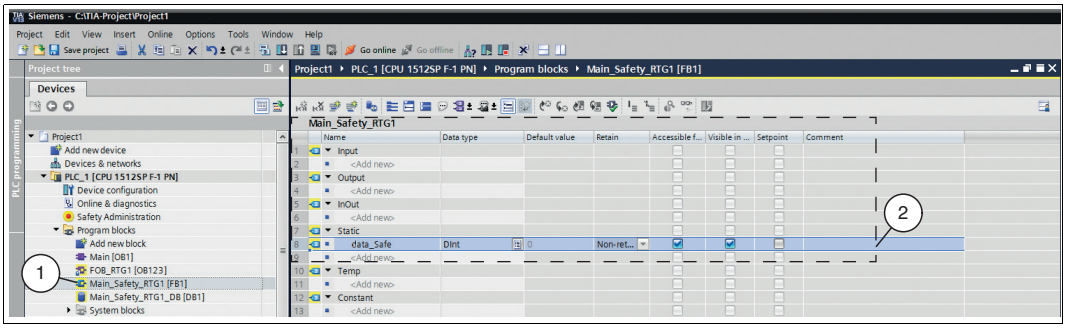


Figure 5.3 Static variables

2. Assign symbolic names for the variables and adjust the data type as shown in the figure above (2).

Note!

In order to avoid confusion with the PLC variables, it is helpful to write the static variables in lower case.

5.2.2 User acknowledgment

The following describes the adaptation of the *"Main_safety_RTG1 [FB1]"* block for the use of a user acknowledgment. To perform a user acknowledgment during startup of the F-CPU or after rectifying errors, set the *"ACK_REI"* variable of the F-I/O DB to *"High."* The F-I/O DB, which is automatically generated for the device, is called *"F00000_Safe Position data"* in the project and can be accessed via project navigation under the following path in the tree structure: *PLC_1 [CPU 1512SP F-1 PN] > Program blocks > System blocks > STEP7 Safety > F-IO data blocks*.

Since we have selected the "FUP" programming language for the project as a whole, you must also assign the programming language *"FBD"* to the *"Main_safety_RTG1 (FB1)"*block. To do so, proceed as follows:

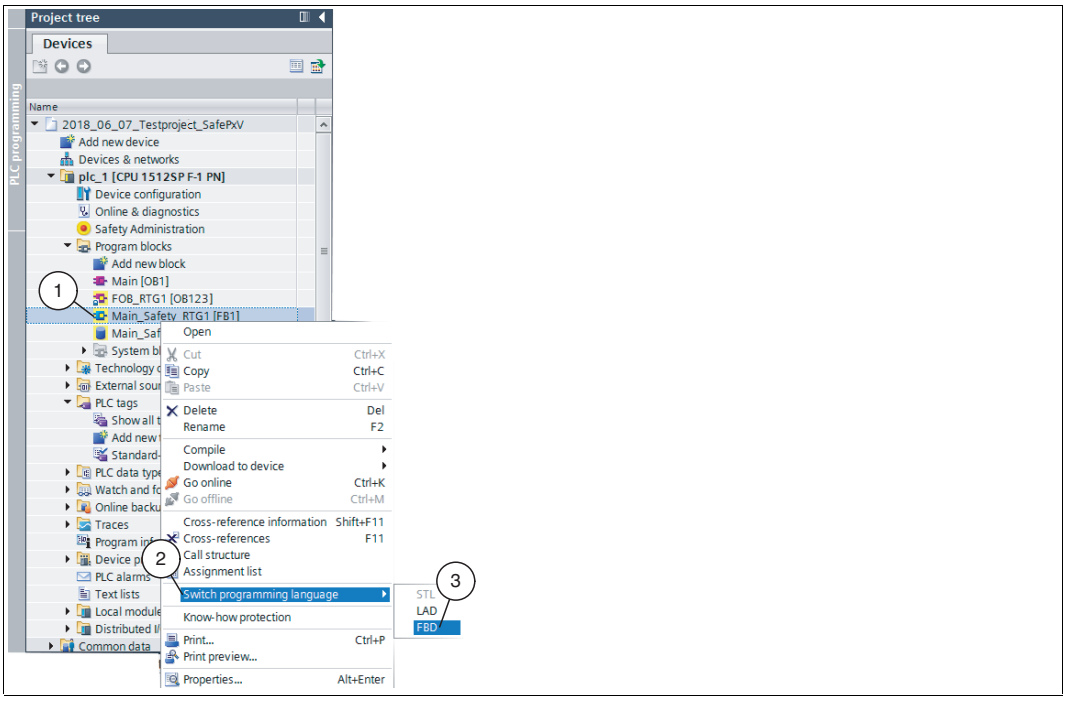


Figure 5.4 Programming language "FBD"

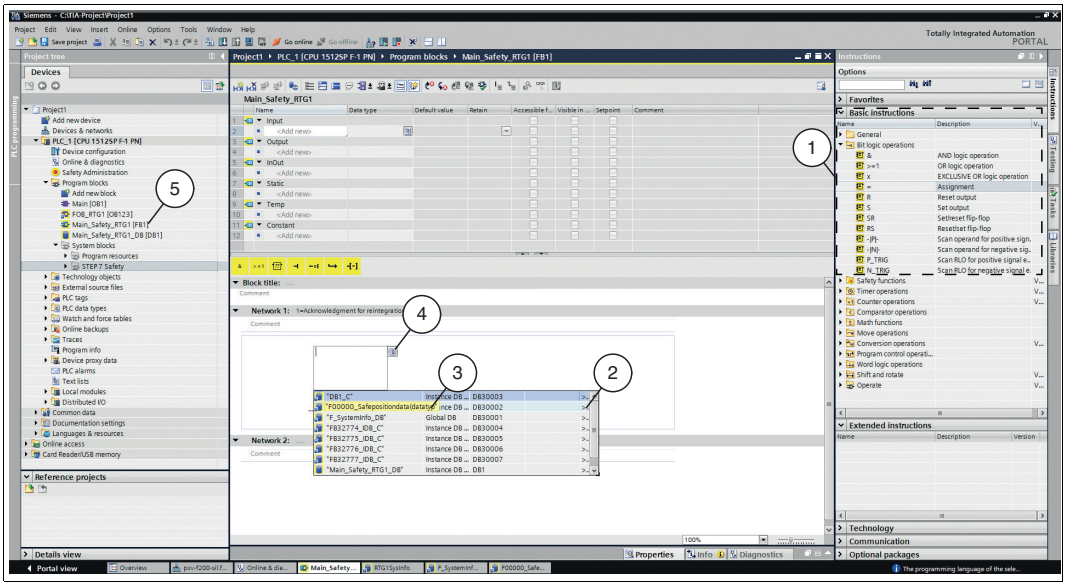
1. In project navigation, right-click to select the *"PLC_1 [CPU 1512SP F-1 PN] > Program blocks > Main_safety_RTG1 (FB1)"* (1) entry.

   ↳ The context menu opens.

2. In the context menu, select *"Switch programming language"* (2) > *"FBD"* (3).

   ↳ The *"Main_safety_RTG1 (FB1)"* block is assigned the *"FBD"* programming language.

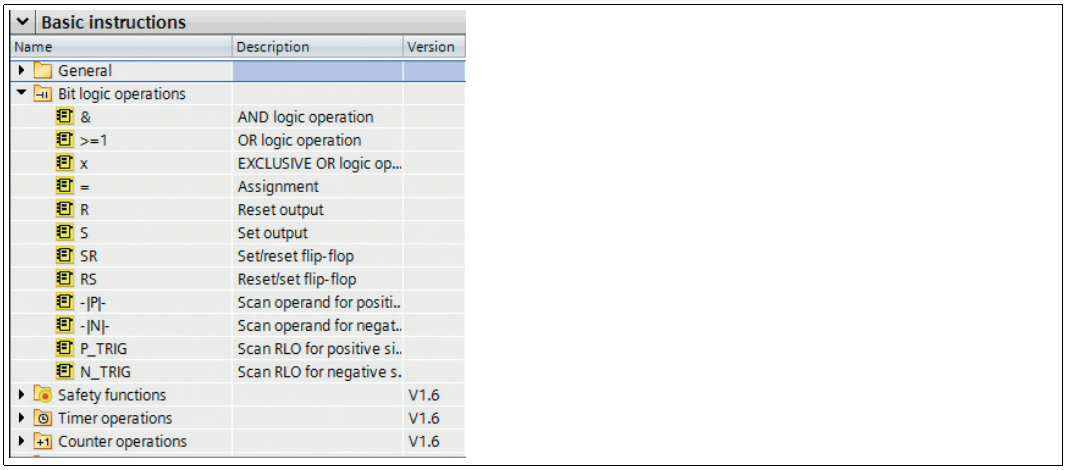
3. In project navigation, double-click to select the *"Main_safety_RTG1 (FB1)"* (5) block.



↳ In the work area, the program editor opens with the *"Main_safety_RTG1 (FB1)"* block. The right window range displays the list of all *"Basic instructions"* (1) that you need for programming.

Note!

Note that changes to the block that are used in the safety program result in a password prompt. Your password created in *"Safety Administration"* must be entered.



Basic instructions

Name	Description	Version
General		
Bit logic operations		
&	AND logic operation	
>=1	OR logic operation	
x	EXCLUSIVE OR logic op...	
=	Assignment	
R	Reset output	
S	Set output	
SR	Set/reset flip-flop	
RS	Reset/set flip-flop	
-|P|-	Scan operand for positi..	
-|N|-	Scan operand for negat..	
P_TRIG	Scan RLO for positive si..	
N_TRIG	Scan RLO for negative s..	
Safety functions		V1.6
Timer operations		V1.6
Counter operations		V1.6

Figure 5.5 Detailed view of "Basic instructions"

4. From the list of *"Basic instructions"*, add the instruction *"Assignment"* from the *"Bit logic operations"* subfolder.

Note!

If you move the mouse pointer to the command (no click), this will automatically display a help text.

5. Click with the left mouse button in the selection field (4) and add the *"F00000_Safe Position data"* (3) data block with data type *"ACK_REI."*

Note!

You are taken to selection list *"ACK_REI"* by selecting *"F0 0000_Safe Position data"* by clicking on the arrow icon pointing to the right (2).

6. Click with the left mouse button in the selection box at the instruction input and select the previously set variable *"Reintegration."*

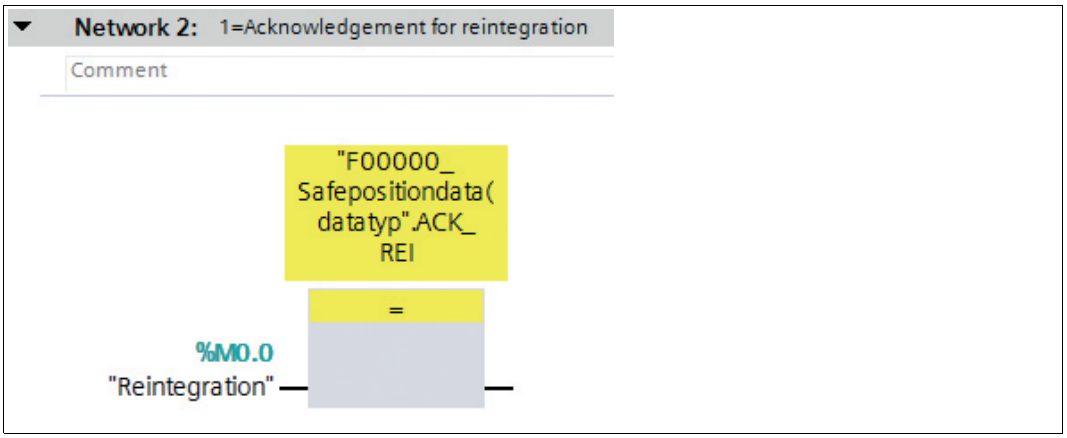


Figure 5.6 User acknowledgment

↳ Programming of the user acknowledgment is now complete.

5.2.3 Instruction for transferring data

With the instruction to **MOVE** (copy value), a single data item is copied from the specified source address with the "IN" parameter to the specified target address with the "OUT" parameter.

Creating a MOVE instruction

In "Network 2", the *"Basic instructions"* on the right-hand side of the screen are used to create the **"MOVE instruction"** as follows:

1. Use drag-and-drop to add the *"MOVE"* (2) instruction from the *"Move operations"* (1) sub-folder of the *"Basic instructions"* to your work area.

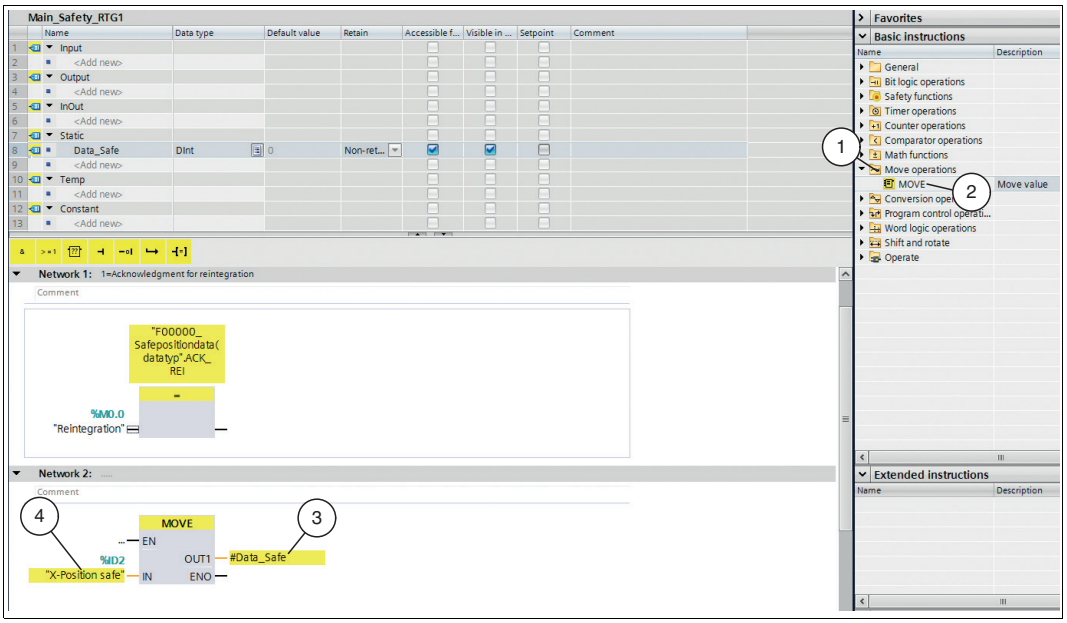


Figure 5.7 MOVE instruction

2. Ensure that the inputs and outputs of the instruction are as shown in the image above.
3. Insert PLC variable *"X-PositionSafe"* (4) at the **"IN"** input.
4. Add static variable *"Data_Safe"* (3) at the **"OUT"** output.

↳ Programming of the **MOVE instruction** is now complete.

Note!

The process for creating the safety program with the "INT" data type largely corresponds to the preceding description. The difference is the number of "Move instructions." If you use the "INT" data type, you must create two "MOVE instructions" (low integer and high integer).

5.2.4 Translating project data

To load the project data to the F-CPU, the data must be translated first. During translation, project data is converted so that it can be read from the F-CPU.

1. In project navigation, use the left mouse button to select your project *"PLC_1 [CPU 1512SP F-1 PN]."*
2. In the menu bar under *"Edit"* (1), select the *"Compile"* (2) command.

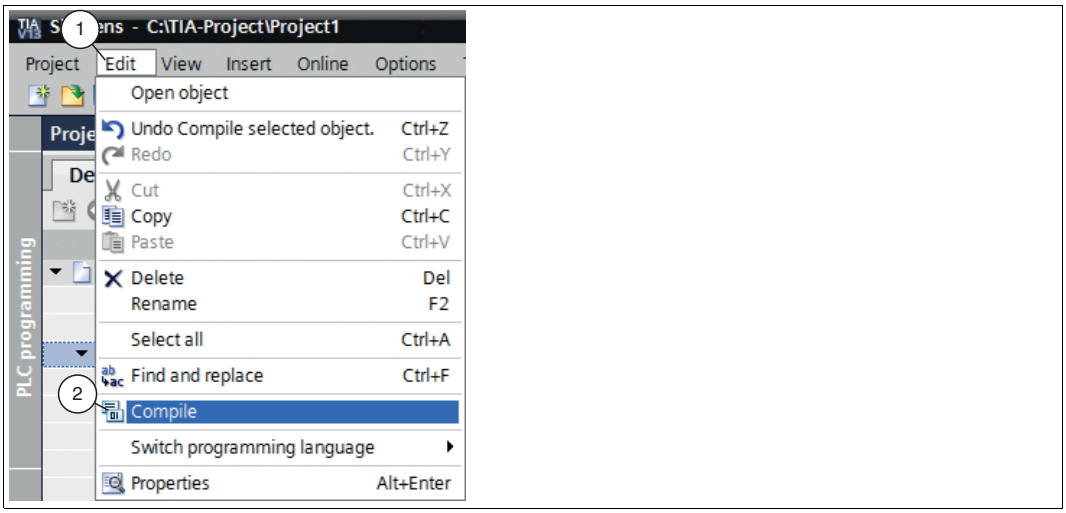


Figure 5.8 Translate project data

↳ The translation process starts.

Note!

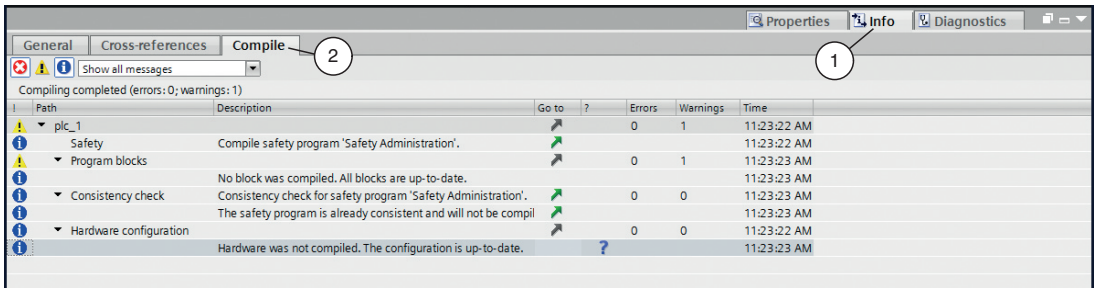


Figure 5.9 Translation process

The translation process can be controlled in the inspection window by selecting *"Info"* in the *"Compile"* tab.

To load a functional program to the control panel, the translation must run without errors.

5.2.5 Downloading project data

After translating the project data, you can load the project to the F-CPU.

1. In project navigation, use the left mouse button to select your project *"PLC_1 [CPU 1512SP F-1 PN]."*
2. In the menu bar under *"Online"* (1), select the *"Download to device"* (2) command.

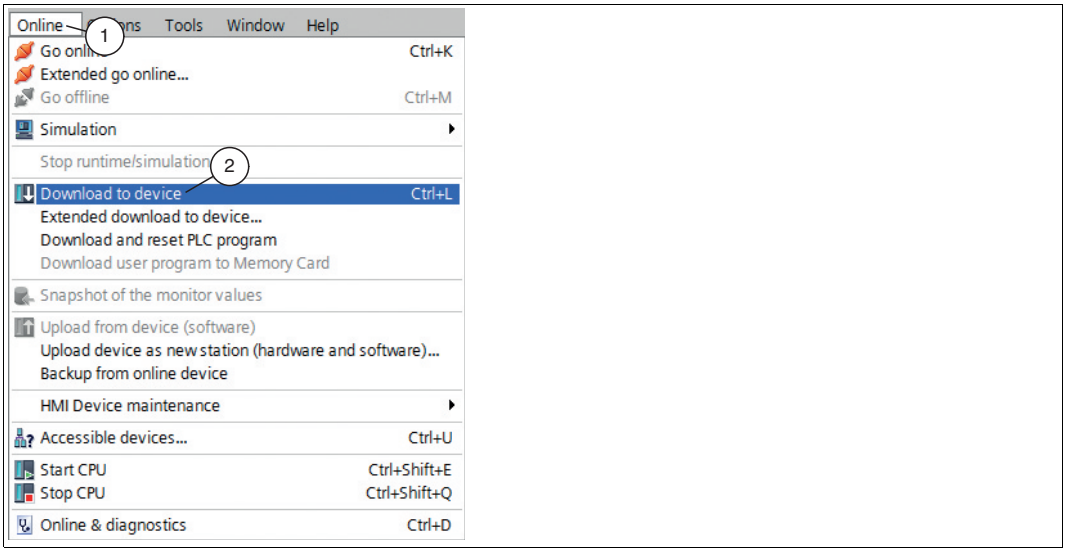


Figure 5.10 Downloading project data

↳ The *"Load preview"* window opens.

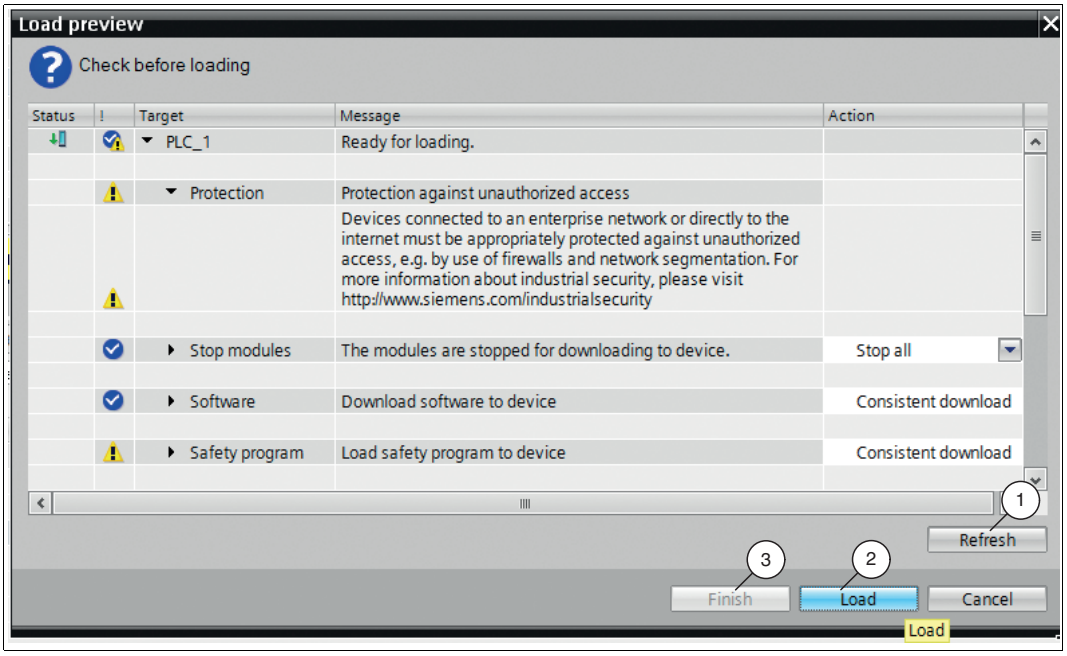


Figure 5.11 Load preview

3. Check the messages in the dialog box. If all the conditions are met, proceed to the next step. If this is not the case, correct the errors and repeat the loading procedure with the *"Refresh"* (1) button.
4. Press the *"Load"*(2) button.

↳ The load process is started.

5. Once the project is loaded to the F-CPU, click on the *"Finish"* (3) button in the *"Load preview"* window.

5.2.6 Testing the safety program

Warning!

Commissioning the fail-safe system

Commissioning prior to a successful validation of the safety-related functions is not permitted. If no adequate precautions are taken before the plant is commissioned, this can result in death, serious injury, and damage to machinery and equipment.

A fail-safe system may only be started up for use of the standard functions once you have successfully tested the safety-related functions.

After creating a safety program, you must perform a full function test according to your automation task.

Note!

It is possible that an error may occur when starting the device. This leads to passivation of the device. The error is triggered in the project via the *"Reintegration (M0.0)"* marker. As a result, the safe position values of the X position will no longer be displayed. To display the safe position values again, you must reintegrate the passivated device.

Reintegration

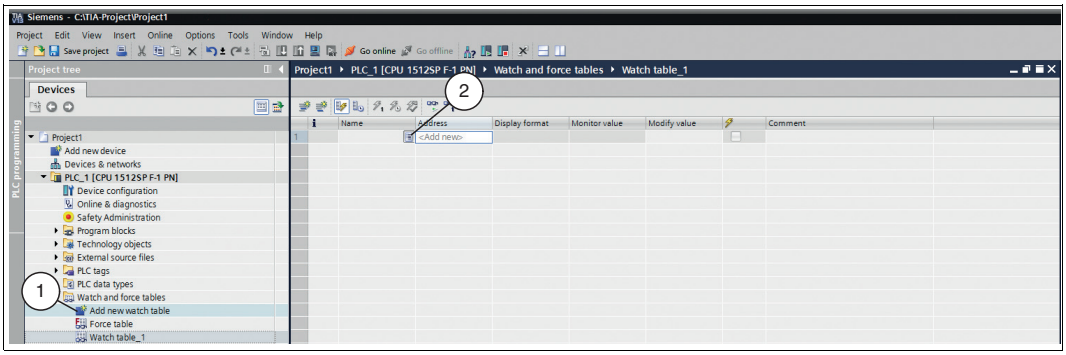


Figure 5.12 Creating an observation table

1. Create a new observation table. To do so, select the *"PLC_1 [CPU 1512SP F-1 PN] > Watch and force tables > Add new watch table"* (1) entry in project navigation.

   ↳ A new observation table opens in the work area.

2. Enter the variables to be monitored in the "Name" (2) column.

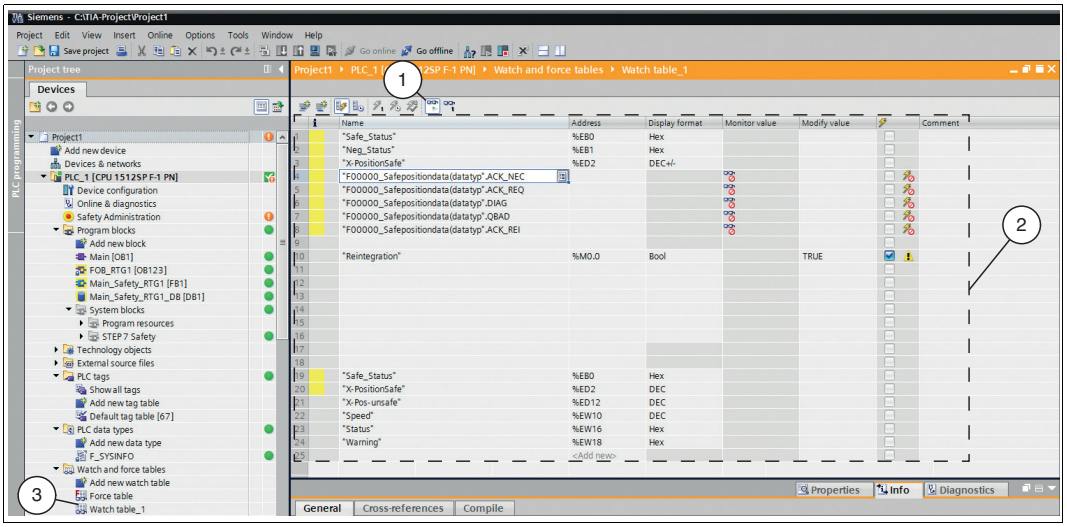


Figure 5.13 Monitoring variables

3. In the menu bar, select the *"Glasses icon"* or the *"Online > Monitor all"* menu.

Note!

Ensure that the editor for "Watch table_1" is the activated application in the work area.

↳ A connection to the F-CPU is established.

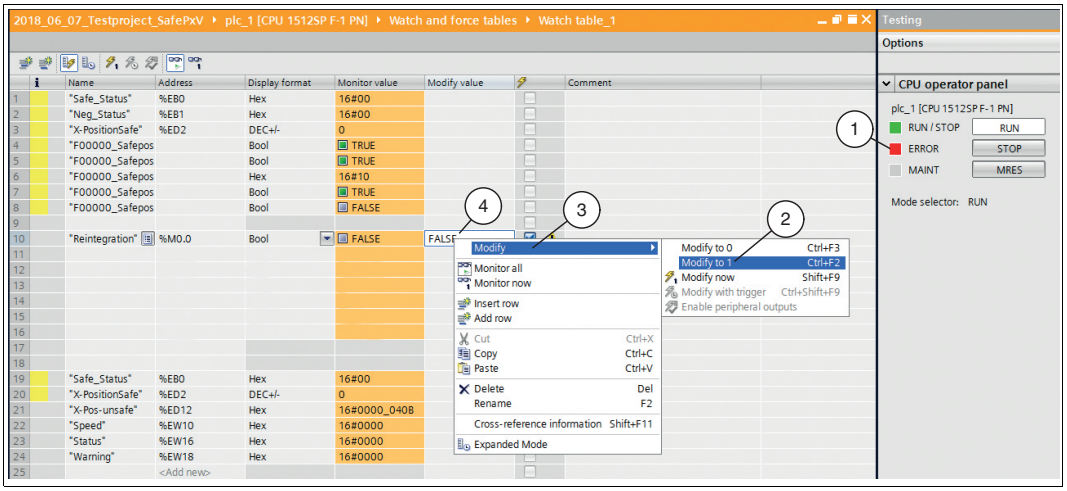


Figure 5.14 Reintegration

Note!

In the right window range, the red *"ERROR"* (1) status indicator flashes if there is a "safety error." In this example, the device is passivated and must be reintegrated.

4. In the observation window, set the *"Reintegration"* variable to **"TRUE."** To do so, right-click in the field (4) in the "Reintegration" line and "Modify value" column.
5. In the context menu, select *"Modify"* (3) > *"Modify to 1"* (2).

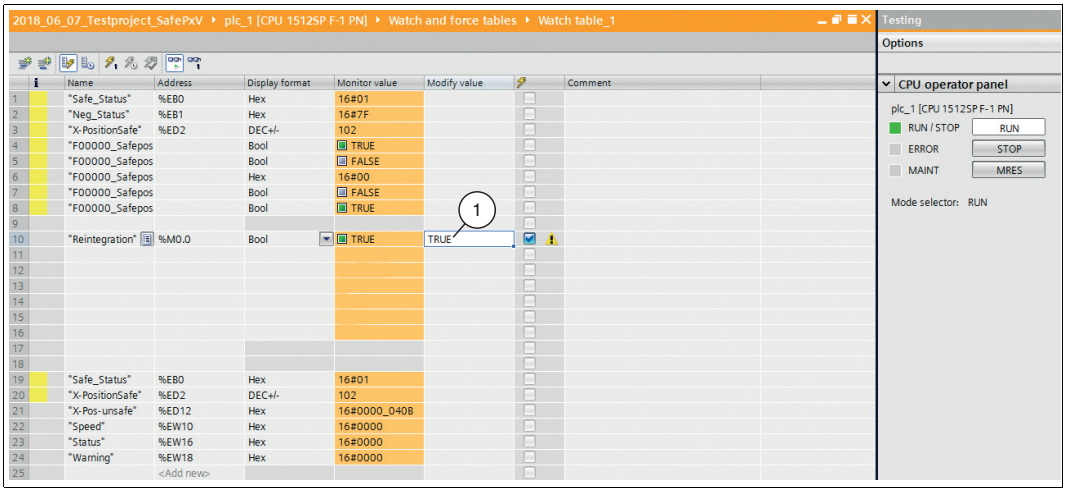


Figure 5.15 Reintegration

↳ The control value changes from "**FALSE**" to "**TRUE**" (4). The device is reintegrated and the safe input values are displayed in the observation table. The red *"ERROR"* status indicator goes out.

6 Access to safety-related communication

The safety-related communication takes place via the process image inputs/outputs (PAE/PAA) as in standard automation systems. Direct I/O access is not permitted.

The process image of the inputs is updated at the beginning of the F-runtime group, before the F-program block is executed. The process image of the outputs is updated at the end of the F-runtime group, after the F-program block is executed. Actual communication between the F-CPU (process image) and the F-I/O for the purpose of updating the process image takes place in the background using a special safety protocol in accordance with PROFIsafe.

The F-I/O communication is evaluated via the variables previously created by the user.

6.1 Passivation and reintegration

If a safety-oriented data channel outputs substitute values, it is passivated. The safety function requires that a fail-safe module automatically outputs substitute values instead of the process values, if any of the following occurs:

- When starting the F-system
- In the event of a communication error between the F-CPU and F-I/O using the PROFIsafe safety protocol
- F-I/O and channel errors (e.g., wire break, short circuit, and discrepancy errors)
- Activating a passivation of the F-I/O in the F-I/O DB with PASS_ON = 1.

Reintegration

After troubleshooting that leads to passivation, you can switch the substitute value to process values. The switch can take place automatically or after a user acknowledgment in the safety program.

6.2 F-I/O DB

An F-I/O DB is created for each F-I/O (in safety operation) when the F-I/O is configured. The F-I/O DB contains variables that you can evaluate and can or must describe in the safety program. Changes to the start values of the variables directly in the F-I/O DB are not permitted, because the F-I/O DB expertise is protected. When an F-I/O is deleted, the associated F-I/O DB is also deleted.

Access to an F-I/O DB

In some cases, you may need to access the variables of the F-I/O DB:

- For reintegrating the F-I/O after communication errors, F-I/O errors, and channel errors
- When evaluating, whether substitute or process values should be output
- If you want to passivate the F-I/O depending on certain statuses of your safety program
- If you want to disable the F-I/O (e.g., for configuration control)

6.2.1 Variables of the F-I/O DB

The following table shows the variables of the F-I/O DB:

	Variable	Data Type	Function	Start Value
Variables that can/must be described	PASS_ON	BOOL	1 = activate passivation	0
	ACK_NEC	BOOL	1 = acknowledgment for reintegration (required in the event of F-I/O errors or channel errors)	1
	ACK_REI	BOOL	1 = acknowledgment for reintegration (after communication errors or after the startup phase)	0
	IPAR_EN	BOOL	Variable for re-parameterization	0
Variables that can be evaluated	PASS_OUT	BOOL	Passivation output	1
	QBAD	BOOL	1 = substitute values are output	1
	ACK_REQ	BOOL	1 = acknowledgment requirement for reintegration	0
	IPAR_OK	BOOL	Variable for re-parameterization	0
	DIAG	BYTE	Non-fail-safe service information, only possible in the standard program	0

PASS_ON

The "PASS ON" variable allows you to enable passivation of an F-I/O, for example, depending on particular states in your safety program. Passivation does not occur directly in the F-I/O, instead, the state of these variables is registered by the safety control and the passivation is first activated through the data of the safety program. Cyclical data will continue to be output from the F-I/O!

As long as PASS_ON = 1, passivation of the associated F-I/O occurs.

ACK_NEC

The "ACK_NEC" variable enables you to decide between automatic reintegration and manual reintegration after an F-I/O error.

For the positioning system, however, no process is defined, for which reintegration is permitted after an F-I/O error. For security reasons, this error must be eliminated and then the supply voltage switched OFF/ON.

Once the F-I/O error has been eliminated, the reintegration of the affected F-I/O occurs depending on ACK_NEC:

- With ACK_NEC = 0, you can parameterize an automatic reintegration.
- With ACK_NEC = 1, you can parameterize reintegration by user acknowledgment.

Note!

The initial value for ACK_NEC is 1 following the creation of the F-I/O DB. If you do not require automatic reintegration, you must not describe ACK_NEC.

ACK_REI

If the fail-safe system detects a communication error or an F-I/O error for an F-I/O, the relevant F-I/O is passivated. Reintegration of the F-I/O/channels of the F-I/O after eliminating the error requires a user acknowledgment with a positive edge at the ACK_REI variable of the F-I/O DB, which in our case is connected to the marker **M.0.0**, symbol name **"F00000_Safe position data(data type".ACK_REI)**.

A user acknowledgment is required:

- After every communication error
- After the startup phase

An acknowledgment is only possible if the variable is ACK_REQ = 1. There must be a user acknowledgment via the ACK_REI variable for each F-I/O in the safety program. This specification has already been taken into account for the positioning system.

IPAR_EN

If you must set/reset this variable when re-parameterizing fail-safe DP standard slaves/standard I/O devices, refer to the PROFIsafe specification V1.20 or higher or the documentation for the fail-safe DP standard slave/IO standard device.

Note that IPAR_EN = 1 does not trigger passivation of the relevant F-I/O.

If passivation is to occur with IPAR_EN = 1, you must also set the variable PASS_ON = 1.

PASS_OUT/QBAD

The variables PASS_OUT = 1 and QBAD = 1 indicate that passivation of the measuring system has occurred.

The F-system sets PASS_OUT and QBAD = 1, as long as the measurement system outputs substitute values (0) instead of the cyclic values.

If a passivation is performed via the PASS_ON = 1 variable, however, only QBAD = 1 is set. PASS_OUT does not change its value during passivation via PASS_ON = 1. PASS_OUT can therefore be used for group passivation of additional F-I/Os.

ACK_REQ

If the fail-safe system for an F-I/O detects a communication error or channel error, the relevant F-I/O or individual channels of the F-I/O are passivated. ACK_REQ = 1 indicates that user acknowledgment is required for reintegration of the relevant F-I/O or channels of the F-I/O.

The F-system sets ACK_REQ = 1 as soon as the fault is resolved and a user acknowledgment is possible. After successful acknowledgment, ACK_REQ is reset to 0 by the F-system.

IPAR_OK

The IPAR_OK variable corresponds to the iPar_OK_S in the PROFIsafe bus profile; PROFIsafe Specification V1.20 and higher.

DIAG

Using the DIAG variable provides non-fail-safe information (1 byte) about faults that can be used for service purposes. Access to this variable in the safety program is not permitted.

6.2.2 Access to the variables of the F-I/O DB

Name and number of the F-I/O DB

When programing an F-I/O, an F-I/O-DB is generated automatically for each F-I/O and this is automatically assigned a name. To this end, a suffix ".f-x" is added to the end of the actual device name (here "pxv-f200-sil"), where x stands for the relevant address. Accordingly, if 4 is to be set as the address for the device, the full designation is "pxv-f200-sil.f-4." It is important to note that this address must correspond to the value stored in the control panel.

Rule for access to the variables of the F-I/O DB

The variables of the F-I/O DB of an F-I/O can only be accessed from the F-runtime group, from which access to the channel of this F-I/O occurs (if access is available).

"Fully Qualified DB Access" rule for access to the variables of the F-I/O DB

The variables of the F-I/O DB can be accessed via "fully qualified DB access." To do so, specify the name and the variable of the F-I/O DB.

6.3 Passivation and reintegration of F-I/O

After startup of the F-system

During startup, passivation of the entire F-I/O occurs, since communication between the F-CPU and the F-I/O via the PROFIsafe protocol must first be established. "Channel value = substitute value (0)" and the variables QBAD and PASS_OUT = 1 apply for all channels.

The reintegration of the F-I/O is performed regardless of the setting at the ACK_NEC variable or the "Channel error acknowledgment" configuration, at the earliest after the second cycle of the F-runtime group after startup of the F-system. Depending on the type of F-I/O used, the cycle time of the F-runtime group, and the PROFIBUS DP/PROFINET IO, the reintegration can first take place after a few cycles of the F-runtime group.
Establishing communication between F-CPU and F-I/O takes longer than the F-monitoring time set in the properties of the F-I/O, meaning automatic reintegration does not take place.

After communication errors

When a communication error between the F-CPU and F-I/O is detected, passivation of all channels of the affected F-I/O occurs. "Channel value = substitute value (0)" and the variables QBAD and PASS_OUT = 1 apply for all channels.

The reintegration of the affected F-I/O takes place only when the following occurs:

- The communication error no longer exists and the F-system has set the variable ACK_REQ = 1
- A user acknowledgment with a positive edge is carried out at the ACK_REI variable of the F-I/O DB

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