MANUAL

Configuration Instructions for PXV100A / PGV100A

Parameterization with SIEMENS SIMATIC S7-1500 control system





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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

C)
Γ]

Note!

This symbol brings important information to your attention.



1.5

Action

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

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.

M Siemens - C:(TIA-Project)Project1		_#×
	1	Totally Integrated Automation
(1) (2)		
	Add new device	
Devices &	Device name:	
networks		
PLC Add new device		
programming 💜 📗	Im Controllers Im SIMATIC 57-120P	Device:
Motion &	► SIMATIC 57-1500	
technology	Controllers	
Drive 📥	SIMATIC ET 200 CPU	
parameterization	Device Proxy	
		Article no.:
Visualization	HMI	Version:
Online &		Description:
Diagnostics Configure networks		
	PC systems	
		2
		•
	Drives	
1011001		
O Help		
		Add
	Upen device view	
10011	0 ,	
0110		
Project view Opened project: CATIA-Project	\Project1	

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.

M Siemens - C:ITIA-Project\Project1		- # X
Project Edit View Insert Online Options Tools Windo	v Help	
📑 📴 📑 Save project 🚢 🐰 🖄 🗔 🗙 🍏 🛨 🖓 🗄 🔣	🖬 🗑 🐺 🂋 Goonline 🖉 Goonline 🕴 Goonline 🕴 Goonline 🕴	AL
Project tree	Project > Devices & networks	
Devices	Topology view & Network view D Daving view Ortiges	- m.
Devices The	g topology view in network view in perfective view options	-E
. 300	Retwork Overview Connections I/O communicat VPN	-151
2	IO system: PLC_1.PROFINET IO-System (100) Y Device Type Address in subnet Y Catalog	
Project1	✓ ET 2005P station_1 ET 2005P station	at 👔
Add new device	PLC_1 CPU15125PF-1 PN	8
bevices a networks	CPU 15125P Store PXV F200 Sa Store www. Scale Controllers	2 2
N Oncine configuration	PIC 1 • Pix+f200-sil PXV F200 Safety Positio.	
Nonine & diagnostics	► D PC systems	
Safety Administration	Drives & starters	ő
Program blocks	PLC_1.PROFINET IO	
Technology objects	→ 🛅 Detecting & Monitoring	ē
External source files	Kim Distributed I/O	8
PLC tags	Equip Field devices	
PLC data types		
Watch and force tables	▼ Important IO	
Online backups	La Controllers	- 19 <u>-</u>
Traces	P to Unives	6
Program info	The second	
Bevice p		
PLC alar	A Report 5	- F
Text lists	i generalis, et al	i ii
 Local module. Distributed IIO 	In Popperi-Fuch: PROFINET ENASBIL	
Common data	▼ Position Systems	
Documentation rettion	Safe PositionSystem	
Languages & resources	MGV F200 Safety Position Encoder	
Griline access	PGV F200 Safety Position Encoder	
Gard Reader/USB memory	V EVV F200 ProfileTest 2.6.1	
	x = 2 PXV F200 Safety Position Encoder	
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	PXV F200 SIL POSITION Encoder DAP	× .
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	Show all messages	
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 Reference projects 	PXV F200 Safety	
	Position Encoder	
	Article no.: PXXxAF2x8284/1D-x	
5	Warrise (CSDBIL-U) 22.0509	
	VEDAUE (GJUNE VZJSY PEPT)	
	Description:	
Details view	position coded vision system, HM1-4.	~
Portal view 🖾 Overview 📥 Devices & ne.	✓ The project Project Was saved success	

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.

0 ∏

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	Х
Safe status	x	x

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

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

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



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	Туре	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	7	6	5	4	3	2	1	0	Function
Bytes									
1	0	0	0	OVD	ОТ	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
ОТ	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	Туре	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	ОТ	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				
ОТ	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	Туре	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 3.5Input 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 3.6Possible error codes

Speed Data

Size	Туре
0.20	

1 word consistent Input Data

Content

16 bit speed data Resolution: 0.1 m/s

Input Data

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

Table 3.7Input data telegrams for speed

Status

Size	Туре	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 3.8Input 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	Туре
1 word consistent	Input Data

Last warnings Last warning no.

Content



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 3.10Existing 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



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	Туре	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	7	6	5	4	3	2	1	0	Function
Bytes									
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
ОТ	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	Туре	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	ОТ	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
ОТ	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	Туре	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	7	6	5	4	3	2	1	0	Function
Bytes									
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	Туре
4 byte consistent	Input Data

32 bit Y data MSB first Resolution: 0.1 mm

Content

Input Data

ł	Bits	7	6	5	4	4 3	2	1	0	Function
E	Bytes									
-	1	YS31	YS30	YP29	YP28	YP27	YP26	YP25	YP24	Y position data
2	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	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	Туре	Conte
2 byte consistent	Input Data	16 bit a

ent

angle data Resolution: 0.1°

Input Data

Bit	7	6	5	4	3	2	1	0	Function
Bytes									
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

SizeType1 word consistentInput Data

Content

16 bit speed data Resolution: 0.1 m/s

Input Data

Bits	7	6	5	4	3	2	1	0	Function
Bytes									
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	Туре	Content
1 word	Input Data	16 bit status

Input Data

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

Table 3.20Input data telegrams for status

RES Reserved

WRN Warnings present. See information on warning.

- ERR Error message present see Error Codes.

Warning

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

Input Data

Bits	7	6	5	4	3	2	1	0	Function
Bytes									
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 Inpu	it data tele	arams for v	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 2.00 Evicting warning de	

Table 3.22Existing warning data sets

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

Position Data Z

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

Input Data

Content
Word 1
Z data
ZP01
ZP02
ZP03
ZP04
ZP05
ZP06
ZP07
ZP08
ZP09
ZP10
ZP11
ZP12
ZP13
ZP14
ZP15
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

\triangle

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 addon 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)



4.2 Integrating hardware

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



Creating a project

Start			Create new project		
Devices a networks PLC programming Motion &	*	Open existing project Create new project Migrate project Close project	Project name:	3	(4) ×
technology					Create

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.

Devices & networks	Show all devices Device name: Device name:
PLC programming	3 Device:
Motion & technology	Controllers → [m] SIMATIC 57-1500 → [m] SIMATIC 57-300 → [m] SIMATIC 57-400
Drive parameterization	> □ SIMATIC ET 200 CPU > □ SIMATIC ET 200 CPU > □ Device Proxy
Visualization 📁	HMI 5 Version:

Figure 4.2 Adding

- 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.

 \mapsto 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.

Project Edit View Insert O	Options Tools Window Help Y Settings	🖉 Go offline 🛔 🖪 🖛 🗶 🖃 🛄
(2)-	Support packages Manage general station description files (GSD) Start Automation License Manager Show reference text G Global libraries	

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.

- 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.

 \rightarrow 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.

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!

4.3.2

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).

 \rightarrow 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).
 - \mapsto The modules are automatically assigned an address range.

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.
- 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

 \mapsto The control properties appear in the inspection window.

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

4.3.4





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PLC_1 [CPU 15 4 F-1 PN]	1 Roperties	ostics 🗖 🗖 🗖 🤝
General General Syste	iem constants Texts	
Catalog information Addition	Ethernet addresses	
▼ Fail-safe	Interface networked with	
F-activation		
F-parameters	Subnet: PN/IE_1	-
 PROFINET interface [X1] 	Add pewsubpet	
General	Add new subject	
F-parameters 3 Ethernet addresses		
Time synchronization	Set IP address in the project	
Operating mode		
 Advanced options 	I IP address: 192.168.0 .1	
Web server access	Subnet mask: 255.255.0	
Hardware identifier	Use router	
Startup	Bautor addresses	
Cycle		
Communication load		
System and clock memory		
 System diagnostics 	PROFINET	
 Web server 		
User interface languages	PROFINET device name is set directly at the device	
Time of day	Generate PROFINET device name automatically	
Protection	PROFINET device name Infr. 1	
Configuration control		
Connection resources	Converted name: [pickbildued	
Overview of addresses	Device number: 0	
< III >		

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.

PLC_1 [CPU 1500SP F-1 PN]					🗟 Propert	ties 🗓 In	fo 追 🖫 Diagnostic	
General 4 ags System General Project information Catalog information Identification & Maintenance Fail-safe PROFINET interface [X1] Catalog	Constants Texts Protection Faccess level Select the access level for the PLC.			<u>1</u>			 (2)	
Gurla	Access level		Ac	cess		Access per		
Cycle Communication load		HMI	Read	Write	Fail-safe	Password		
System and clock memory	Full access incl. fail-safe (no protection)	 Image: A second s	 V 	 V 	 Image: A second s			
 System diagnostics 	Full access (no protection)	~	~	~				
Web server	Read access	× .	~				1	
User interface languages Time of day	HMI access No access (complete protection)	1						
Protection Configuration control Connection resources Overview of addresses	Full access incl. fail-safe (no protection): TA Portal users and HMI applications will have acce No password is required.	ess to all st	andard and	fail-safe fu	nctions.		 	
	Connection mechanisms							~

Figure 4.10 Control panel protection

 \rightarrow 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).



General 4 ags System constants Texts General 3 Fail-safe Fail-safe Fail-safe PROFINET interface [X1] Fail-safe Cycle Fail-safe Communication load F-capability activated System and clock memory F-capability activated Veb server User interface languages Time of day F-parameters Protection General Configuration control Configuration control Connection resources Default F-monitoring time for control H-100: Connection resources Time of addresses:	PLC_1 [CPU 15 P F-1 PN]			Properties	🗓 Info 🔋 🗓 Diagnostics	
General 3 Fail-safe PROFINET interface [X1] Startup Cycle Communication load System and clock memory System diagnostics Web server User interface languages Time of day Protection Configuration control Connection resources Overview of addresses Default F-monitoring time for Overview of addresses	General 4 ags System	constants Texts		\cup		
	General 4 ags System General 3 Fail-safe PROFINET interface [X1] Startup Cycle Communication load System and clock memory System diagnostics Web server User interface languages Time of day Protection Configuration control Connection resources Overview of addresses	renstants Texts Fail-safe F-activation F-parameters Basis for PROFIsafe addresses: Default F-monitoring time for central F-IIO:	F-capability activated Disable F-activation 0 150			•

Figure 4.11 Intrinsic safety

 \mapsto 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.
- Select your device from the selection window (1). In this example, the device is "pxv-F200-sil" (3).



Figure 4.12 Select the device

 \rightarrow The device properties appear in the inspection window.



pxv-f200-silule]		Properties Unfo Uniagnostics	
General tags System cons	stants Texts		
• General (3)			~
Catalog information	General		
 PROFINET interface [X1] 			
General	Name:	pw:/200silf4	
Ethernet addresses	Author	Admin	-
 Advanced options 	Aution:	/winin	-
Interface options	Comment:		^
Media redundancy			
 Real time settings 			
IO cycle			<u> </u>
 Port 1 [X1 P1 R] 	Rack:	0	
 Port 2 [X1 P2 R] 	Slot:	0	
Hardware identifier			
Identification & Maintenance	Catalog information		
Hardware identifier	,		_
	Short designation:	PXV F200 Safety Position Encoder	
	Description:	position coded vision system, I+M 1-4.	
	Article no.:	PXVxA-F2x-B28-V1D-x	
	Firmware version:		
	Hardware product version:		
	CCD file:	and mill v2.32 papped (fuche pwih29.20190210 vml	51
	GSD file:		- *

Figure 4.13 Device properties inspection window

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

 \mapsto The "General" input screen opens.

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

Note!

о П

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.

Project1 + PLC_1 [CPU 1512SP F-1 PN] + Distributed I/O + PR	OFINET IO-System (100): PN/IE_1 → pxv-f200-sil.f-4 📃 🖬 🖬	×
	F Topology view 🛔 Network vir 🕅 Device view	N
🔐 pxv-f200-sil.f-4 🔽 🖽 🖭 🔍 ±	Device overview	
	Module Rack Slot Laddress	0
60 ⁵³¹¹	■ model (2) 0 0	Q
all'	Interface O O Intern	
.8.	Safe position data (data type DINT for position) 1 0 1 09	0
	status_1 0 2 1617	
	x position unsafe_1 0 3 1215	
	speed value_1 0 4 1011	
	warnings_1 0 5 1819	
6		,
osition data (data type DINT for position)_1 [Module]	🖳 Properties 🔤 👔 🗓 Diagnostics	•
General IO tags System constants Texts	$\overline{0}$	
▼ General		
Catalog information PROFIsafe		-
PROFIsafe		
Inputs (5)		
I/O addresses		
Hardware identifier		
F_Block_ID:	0	
F_Par_Version:		
F Source Add:		
E Doct Adds		
F_Par_CRC_withoutAddresses:		
	Manual assignment of E-monitoring time	
•		
F WD Time:	150 ms	
E Des CDC		
F_Pal_CRC:		
	E F-I/O DB manual number assignment	
E I/O DB number	20002	
F-I/O DB-number:		
F-I/O DB-name:	F00000_Safepositiondata(datatyp	

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.

 \mapsto 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.



Assign PROFINET device name.			\sim	×
	Configured PROFIN	NET dev		
	PROFINET device name:	pxv-f200-sil.f-4	•	
	Device type:	PXV F200 Safety Po	sition Encoder	
	Online access Type of the PG/PC interface:	PN/IE	2	
	PG/PC interface:	Generic Marvell	Yukon 88E8053 based Ether 💌 🛡 🖳	
Ę.	Device filter			
- T	🛃 Only show devices of	f the same type		
	Only show devices w	ith bad parameter se	ttings	
	Only show devices w	ithout names		
Accessible	levices in the network:			
IP address	MAC address Device	PROFINET device n	ame Status	
192.168.0	2 00-0D-81-07-30-E PROFINE	T pxv-f200-sil	🔥 Device name is different	
Flash LED				
<			(3)	>
			Update list Assign name	2
Online status information:				
Search completed. 1 of 2 device	s were found.			
<				>
			Close	
				ð

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).



		Accessible devi	ices in the network:			3			
	(-	1) IP address	MAC address	Device	PROFINET device name	ne	Status		
	_	192.168.0.2	00-0D-81-07-30	-E PROFINET .	. pxv-f200-sil.f-4	0	OK		
🗆 Ela	shiED								
0110	511 22 5								
		<			III				
						Upda	te list	Assign r	ame
Online	tatus information								
Online s	tatus informatior	n:							
Online s	tatus informatior	n: d. 1 of 2 devices we	ere found.						
Online s	tatus informatior Search completed The PROFINET de	n: d. 1 of 2 devices w vice name "pxv-f2	ere found. 00-sil.f-4" was succe	essfully assigr	ed to MAC address "	00-0D	-81-07-30-B	4".	
Online s	tatus informatior Search completed The PROFINET de	n: d. 1 of 2 devices we vice name "pxv-f2	ere found. 00-sil.f-4* was succe	essfully assigr	ed to MAC address *	00-0D	-81-07-30-B	4".	
Online s € S ♥ T	tatus informatior Search completed The PROFINET de	n: d. 1 of 2 devices we vice name "pxv-f2	ere found. 00-sil.f-4" was succe	essfully assigr	ed to MAC address *	00-0D	-81-07-30-B	4".	
Online s	tatus informatior Search completec The PROFINET de	n: d. 1 of 2 devices we vice name "pxv-f2	ere found. 00-sil.f-4" was succe	essfully assigr	ed to MAC address *	00-0D	-81-07-30-B	4*.	
Online s	tatus informatior Search completed The PROFINET de	n: d. 1 of 2 devices w vice name "pxv-f2	ere found. 00-sil.f-4* was succe	essfully assign	ned to MAC address *	00-0D	-81-07-30-B	4*.	(4)
Online s	tatus informatior Search completed The PROFINET de	n: d. 1 of 2 devices w vice name "pxv-f2	ere found. 00-sil.f-4* was succe	essfully assign	ned to MAC address *	00-0D	-81-07-30-B	4*.	4
Online s	tatus informatior Search completed The PROFINET de	n: d. 1 of 2 devices w vice name "pxv-f2	ere found. 00-sil.f-4" was succe	essfully assign	ed to MAC address *	00-0D	-81-07-30-B	4*. Clos	4 e

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).

 \mapsto 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.

VA S	(1)	ens	- C:\TI	A-Pr	oject\P	roject1	
Proje	ect	Edi	t Vie	w	Insert	Online	Options
2			Open o	bjec	t		
P	roje	5	Undo C	omp	ile sele	cted objec	t. Ctrl+Z
	De	G	Redo				Ctrl+Y
H	De	Ж	Cut				Ctrl+X
Ľ	э́ (Ē	Сору				Ctrl+C
6u			Paste				Ctrl+V
		×	Delete				Del
			Renam	e			F2
prog	-		Selecta	all			Ctrl+A
FC	\bigcirc	ab 4ac	Find ar	nd re	place		Ctrl+F
	-	5	Compil	le			
			Switch	prog	rammir	ng languag	e 🕨
		Q	Propert	ies			Alt+Enter

Figure 4.18 Translate project data

 \hookrightarrow The translation process starts.

Note!

						🖳 Propertie	s 🗓 Info	B Diagnostics	
General Cross-references	Compile					,	\sim		
😧 🛕 🚺 Show all messages	• 2					(1		
Compiling completed (errors: 0; warn	ings: 1)						-		
! Path	Description	Go to	?	Errors	Warnings	Time			
1 v plc_1		~		0	1	11:23:22 AM			
Safety	Compile safety program 'Safety Administration'.	~				11:23:22 AM			
 Program blocks 		~		0	1	11:23:23 AM			
0	No block was compiled. All blocks are up-to-date.					11:23:23 AM			
Consistency check	Consistency check for safety program 'Safety Administration'.	~		0	0	11:23:23 AM			
0	The safety program is already consistent and will not be compi					11:23:23 AM			
 Hardware configuration 		~		0	0	11:23:22 AM			
0	Hardware was not compiled. The configuration is up-to-date.		?			11:23:23 AM			
 Hardware configuration 	The safety program is already consistent and will not be compi Hardware was not compiled. The configuration is up-to-date.	;	?	0	0	11:23:23 AM 11:23:22 AM 11:23:23 AM			

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.

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Downloading project data

4.5

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.

Online ns Tools Window He	lp
💋 Go onl	Ctrl+K
💋 Extended go online	
Go offline	Ctrl+M
Simulation	•
Stop runtime/simulation 2	
Download to device	Ctrl+L
Extended download to device	
Download and reset PLC program	
Download user program to Memory Car	d
Snapshot of the monitor values	
Upload from device (software) Upload device as new station (hardware Backup from online device	and software)
HMI Device maintenance	٢
Accessible devices	Ctrl+U
Start CPU	Ctrl+Shift+E
F Stop CPU	Ctrl+Shift+Q
🖫 Online & diagnostics	Ctrl+D



Downloading project data

→ The <i>"Loa</i> a	' preview"	window	opens.
---------------------	------------	--------	--------

- 1	_				
	<u>.</u>	PLC_1	Ready for loading.		
4	1	 Protection 	Protection against unauthorized access		
4	Ł		Devices connected to an enterprise network or directly to the internet must be appropriately protected against unauthorized access, e.g. by use of firewalls and network segmentation. For more information about industrial security, please visit http://www.siemens.com/industrialsecurity		
•	9	 Stop modules 	The modules are stopped for downloading to device.	Stop all	•
C	9	 Software 	Download software to device	Consistent download	ł
4	1	 Safety program 	Load safety program to device	Consistent download	ł
٤			1111		-

Figure 4.21 Load preview

- 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.



 \mapsto 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.

Project1 > PLC_1 [CPU 1512SP F	F-1 PN] + Distributed I/O + PROFI	NET IO-System (100): I	PN/IE_1 → pxv-f200-sil.f-4		_ • •	X Hardware catalog	
			🖉 Topology vie	w 🔥 Network view	V Device view	v Options	
pxv-f200-sil.f-4	🌐 🖻 🚄 🖽 🍳 ±	🔤 🛛 Devic	e overview				
alta		<u>^</u> <u>*</u>	Module	Rack	Slot Laddress	Q Catalog	167
1100		=	 pxv-f200-sil.f-4 	0	0	<search></search>	inf
Pr			 Safe position data (data type DII 	NT for position) 1 0	1 09	0 Bilter	
		\bigcirc	status_1	0	2 1617	Safe PositionSystem	
	No. 10	. 2	x position unsafe_1	0	3 1215	PXV F200 Safety Position Encod	er
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						x position unsafe)
						Safe position data (data type DI	NT for position)
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\sim		~		(3)		Status modul	
< <u> </u>	> 75%	9 •				Warning module	
Safe position (data type DIN	I for position)_1 [Module]		Second Se	🗓 Info 🔒 🔛 Diag	gnostics	warnings	
General' IO tags System	m constants Texts						
Catalog information	PROFIsafe						
PROFIsafe 5							
Inputs UO addresses	F_SIL: SI			v			
Hardware identifier	F_CRC_Length: 3-	lyte-CRC		–			
	E Source Add: 1						
	E Dest Add: 4		- <mark>-</mark> (6)				
	F_Par_CRC_WithoutAddresses: 2	542				v Information	
			r			Davisa	
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	F_Par_CRC: 2						
		F-I/O DB manual number a	ssignment			warnings	
	F-I/O DB-number: 3						
	F-I/O DB-name: FO	0000_Safepositiondata(dat	atyp			Article no.:	
						Version:	
						Description:	
						warning information array 1 word input	
						data no outout data each hit represents	

Figure 5.1 Configurable F-parameters

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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.

 \rightarrow 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.

 \rightarrow 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.

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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.

Ma Siemens - C:\TIA-Project\Project1											
Project Edit View Insert Online Options Tools	Window	Help									
📑 🎦 📑 Save project 🚔 💥 💷 🖹 🗙 🏷 ± (= ±	8 10 16	밀딚	🖉 Go online 🖉 Go of	fline 🛵 🖪 🖪 🗶 🚍							
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E a Parisan		PLC ta	gs					be at the			
Project i	Â.	-	Baistanatian	Tag table	Data type	Address	Retain	VISIDI AC	ces Commen		
Add new device	1	4	Reintegration	Default tag table	BOOI	%00.0					
	2	-	X-Position safe	Default tag table	Dint	96ID2				.()	
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 Device configuration Device configuration 	9	4	iveg_status	Default tag table	Byte	961B1				\sim	
So Contine & diagnostics	P	-	Status	Default tag table	word	15/W16			Z	Y	
	10	-	A-Position unsale	Default tag table	Dword		Operand iden	tifier:			
Add naw block	10	-	Speed	Default tag table	Word		Onorand	tunos IV			
Add new block	= 8	-01	warning	Default tag table	word		Operand	type: w			
	9		<add new=""></add>				Ado	ress: 16			
Main Safaty BTG1 [EB1]						_					
Main Safety PTG1 DP (DP1)										× ×	
Sustam blocks		-									
Technology objects											
Recented by objects											
Showall tags											
Add new tag table											
Default tag table [67]											
		_									

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

 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"

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

 \mapsto The context menu opens.

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

 \rightarrow 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.

Siemens - C:\TIA-Project\Project1			
sject Edit View Insert Online Options Tools	Window Help		Totally Integrated Automatic
Project tree	Project1 → PIC 1 (CPU 1512SP E-1 PN) → Program blocks → Main Safety BTG1 (EB1)	_ 0 = X	Instructions
Perdens			Outing
Devices			opuons
	비표 (N 번 지도) # 프로그램 이 제1 전 1 전 10 년 10 년 10 년 10 년 10 년 10 년 10	-4	nd un
	Main_Safety_RTG1		> Favorites
• 🗋 Project1	Name Dats type Default value Retain Accessible f Visible in Setpo	int Comment	Basic instructions
Add new device	1 💶 = Input		Name Description
📥 Devices & networks	2 Add news	\frown	> General
PLC_1 [CPU 1512SP F-1 PN]	3 🖸 🕶 Output	(1)	▼ Sit logic operations
Device configuration	4 Add new>		AND locir operation
Online & diagnostics	5 💶 👻 InOut		P >=1 OB look operation
Safety Administration	6 • <add new=""></add>		EVCLUSIVE OR Logic operation
- Rogram blocks	7 💶 💌 Static		
Add new block	8 < Add new>		R n Development
# Main (081)	9 💶 🔻 Temp		ET C Cotoutout
TOB RTG1 [08123]	10 CAD Add news		Construction of the second
Main Safety RTG1 [FB1]	11 di Y Constant		Setteset rip-riop
Main Safety RTG1 DB [DB1]	12 • <4dd pews		KS Reset/Set Tip-Tiop
 Fiel System blocks 			Scan operand for positive sign
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By External source mes	Comment		 Timer operations
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 up watch and force tables 	Comment		Math functions
Online backups	\sim		Move operations
Traces			Conversion operations
Program info		~	Program control operati
 Device proxy data 			Word logic operations
PLC alarms)	Shift and rotate
Text lists		- /	Operate
Local modules	TOPI C" Instance DR DR20002		-
 Distributed NO 	SERVICE Safety indiate (data and a particular and a parti		
Common data			< II
Documentation settings	Contraction Contra		Y Extended instructions
Languages & resources	PB32774_DB_C Instance DB., DB30004 >=		Name Description Veri
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Card Reader) 58 memory	Comment 1832/76_DB_C Instance DB DB30006 >-		
- /	FB32777_DB_C* Instance DB DB30007 >-		
Defense and tasks	"Main_Safety_RTG1_D8" Instance D8 DB1 >		
nererence projects			
			1
			Prechnology
		100%	> Communication
Details view		Properties Junfo () Diagnostics	Optional packages
Details net		Stropendes Same S Diagnosues	. opaana pacaages

 \rightarrow 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
Fil 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.

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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).

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





→ 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) subfolder 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.





 \mapsto Programming of the **MOVE instruction** is now complete.

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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

 \mapsto The translation process starts.

0 ∏

Note!

						Rropertie	s 🗓 Info	Diagnostics	
General Cross-references	Compile					,	\sim		
😧 🚹 🚺 Show all messages	- 2					(1)		
Compiling completed (errors: 0; warni	ngs: 1)						<u> </u>		
! Path	Description	Go to	?	Errors	Warnings	Time			
🕂 ▼ plc_1		7		0	1	11:23:22 AM			
Safety	Compile safety program 'Safety Administration'.	~				11:23:22 AM			
 Program blocks 		~		0	1	11:23:23 AM			
1	No block was compiled. All blocks are up-to-date.					11:23:23 AM			
Consistency check	Consistency check for safety program 'Safety Administration'.	~		0	0	11:23:23 AM			
0	The safety program is already consistent and will not be compi					11:23:23 AM			
Hardware configuration		~		0	0	11:23:22 AM			
0	Hardware was not compiled. The configuration is up-to-date.		?			11:23:23 AM			



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.

Onlinens Tools Window H	lelp
💋 Go onl	Ctrl+K
💋 Extended go online	
Go offline	Ctrl+M
🖳 Simulation	•
Stop runtime/simulation 2	
Download to device	Ctrl+L
Extended download to device	
Download and reset PLC program	
Download user program to Memory Ca	rd
Snapshot of the monitor values	
Upload from device (software) Upload device as new station (hardwar Backup from online device	e and software)
HMI Device maintenance	•
Accessible devices	Ctrl+U
Start CPU	Ctrl+Shift+E
F Stop CPU	Ctrl+Shift+Q
😨 Online & diagnostics	Ctrl+D



→ The <i>"Loa</i> a	' preview"	window	opens
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Image: Plc_1 Ready for loading. Image: Protection Protection against unauthorized access Devices connected to an enterprise network or directly to the internet must be appropriately protected against unauthorized access, e.g. by use of firewalls and network segmentation. For more information about industrial security, please visit http://www.siemens.com/industrialsecurity Image: Plc_1 Ready for loading. Image: Plc_2 Protection Image: Plc_3 Protection against unauthorized access Image: Plc_4 Protection Image: Plc_4 Protection Image: Plc_5 Protection against unauthorized access Image: Plc_4 Plc_6 Image: Plc_6 Plc_6 <					·		-	
Protection Protection against unauthorized access Devices connected to an enterprise network or directly to the internet must be appropriately protected against unauthorized access, e.g. by use of firewalls and network segmentation. For more information about industrial security, please visit http://www.siemens.com/industrialsecurity Stop modules The modules are stopped for downloading to device. Stop all				Ready for loading.	PLC_1	▼ P	N	1
Devices connected to an enterprise network or directly to the internet must be appropriately protected against unauthorized access, e.g. by use of firewalls and network segmentation. For more information about industrial security, please visit http://www.siemens.com/industrialsecurity Stop modules The modules are stopped for downloading to device. Stop all			ccess	Protection against unauthorize	 Protection 	•		
Stop modules The modules are stopped for downloading to device. Stop all			se network or directly to the otected against unauthorized d network segmentation. For security, please visit lsecurity	Devices connected to an enter internet must be appropriately access, e.g. by use of firewalls more information about indust http://www.siemens.com/indus			4	
	•	Stop all	nloading to device.	The modules are stopped for d	 Stop modules 	•	0	
Software Download software to device Consistent downle	bad	Consistent downloa		Download software to device	 Software 	•	0	
Safety program Load safety program to device Consistent downle	bad	Consistent downloa		Load safety program to device	 Safety program 	•	▲	
	(٤

Figure 5.11 Load preview

- 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.



- \mapsto 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

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Davisas							_			
Devices										
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6		i	Name	Address	Display format	Monitor value	Modify value	9	Comment	
🗧 💌 🛄 Project1		1		<add new=""></add>						
Add new device										
Devices & networks										
PLC_1 [CPU 1512SP F-1 PN]										
Device configuration										
Online & diagnostics										
 Safety Administration 										
Program blocks										
Technology objects										
External source files										
PLC tags										
PLC data types										
Watch and force tables										
Add new watch table										
Force table										
SS Watch table_1										

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.

 \mapsto A new observation table opens in the work area.

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



roject tree	П 4	Projec	t1 > PLC 1 (12SP E-1 PNI > Watch and	force tables > W	atch table 1					
Devices		riojec	(1)	force tubics v v	atten tuble_1					
t o o										-
300										
		1 1	Name	Address	Display format	Monitor value	Modify value	2	Comment •	
Project1		-f	"Safe_Status"	%EBO	Hex				1	
Y Add new device		2	"Neg_Status"	%EB1	Hex					
Devices & networks		3	"X-PositionSafe"	%ED2	DEC+/-	-			1	
PLC_1 [CPU 1512SP F-1 PN]	M	14	"F00000_Safepositiondata(datatyp".ACK_NEC			õ		20		
Device configuration		5	"F00000_Safepositiondata(datatyp".ACK_REQ			0		1		
Online & diagnostics		6	"F00000_Safepositiondata(datatyp".DIAG			0		- 70		-
Safety Administration	•	7	"F00000_Safepositiondata(datatyp".QBAD			0		- %		1
 Program blocks 	•	8	"F00000_Safepositiondata(datatyp".ACK_REI			0		- %		1
Add new block	=	9								ト
🖀 Main [OB1]		10	"Reintegration"	%M0.0	Bool		TRUE	🗹 🔔		
FOB_RTG1 [OB123]		11							'/	
🔹 Main_Safety_RTG1 [FB1]	•	12							V	
Main_Safety_RTG1_DB [DB1]	•	13							r	
 System blocks 	•	14							1	
Program resources		15								
STEP 7 Safety		,16								
Technology objects		17								
External source files		18								
PLC tags		19	"Safe_Status"	%EBO	Hex					
Show all tags		20	"X-PositionSafe"	%ED2	DEC					
Add new tag table		21	"X-Pos-unsafe"	%ED12	DEC					
Sefault tag table [67]		22	"Speed"	%EW10	DEC					
PLC data types		23	"Status"	%EW16	Hex				1	
Add new data type		24	"Warning"	%EW18	Hex				1	
E SYSINFO		25		<add news<="" td=""><td></td><td></td><td></td><td></td><td>1</td><td></td></add>					1	
Watch and force tables		-								
Add new watch table						-				-
2 Fill France table							Properties	🔄 Info	B Diagnostics	



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.

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i	Name	Address	Display format	Monitor value	Modify value	Comment			✓ CPU operat	or panel
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	"X-PositionSafe"	%ED2	DEC+/-	0				(1	RUN / STOP	RUN
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	"F00000_Safepos		Bool	TRUE						
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					V cut		Ctrl+Y			
					Copy		Ctrl+C			
					Ta Paste		Ctrl+V			
	"Safe_Status"	%EBO	Hex	16#00	M Delete					
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	"X-Pos-unsafe"	%ED12	Hex	16#0000_040B	Kename		F2			
	"Speed"	%EW10	Hex	16#0000	Cross-ret	ference information	5hift+F11			
	"Status"	%EW16	Hex	16#0000	Lo Expande	d Mode				
1	"Warning"	%EW18	Hex	16#0000						
5		<add new=""></add>								

 \rightarrow 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).



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i	Name	Address	Display format	Monitor value	Modify value	9	Comment	✓ CPU operate	or panel
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	"F00000_Safepo:	s	Bool	FALSE					5101
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	"Safe_Status"	%EBO	Hex	16#01					
	"X-PositionSafe"	%ED2	DEC+/-	102					
	"X-Pos-unsafe"	%ED12	Hex	16#0000_040B					
	"Speed"	%EW10	Hex	16#0000					
	"Status"	%EW16	Hex	16#0000					
	"Warning"	%EW18	Hex	16#0000					
		<add new=""></add>							

Figure 5.15 Reintegration

 \rightarrow 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.



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

6

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		
ust	PASS_ON	BOOL	1 = activate passivation	0		
can/m bed	ACK_NEC	BOOL	1 = acknowledgment for reintegration (required in the event of F-I/O errors or channel errors)	1		
s that o	ACK_REI	BOOL	1 = acknowledgment for reintegration (after communication errors or after the startup phase)	0		
Variable	IPAR_EN	BOOL	Variable for re-parameterization	0		
ç	PASS_OUT	BOOL	Passivation output	1		
it ca	QBAD	BOOL	OL 1 = substitute values are output			
es tha valuat	ACK_REQ	BOOL	1 = acknowledgment requirement for reintegration	0		
iabl oe e	IPAR_OK	BOOL	Variable for re-parameterization	0		
Var b	DIAG BYTE Non-fail-safe service information, only possible in the standard program					

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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