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Controlling a SINAMICS G120 via PROFIsafe with a SIMATIC S7-1200 F-CPU

SINAMICS G120, SIMATIC S7-1200 F-CPU

<https://support.industry.siemens.com/cs/ww/en/view/109746271>

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1 Task

Introduction

The SIMATIC S7-1200 F-CPU can be operated as PROFINET controller. As such, it can control a PROFINET-capable drive SINAMICS G120 as PROFINET device. The data exchanged also includes safety-related data.

This application example covers the following drive types:

- G120 with CU240E-2 PN-F or CU250S-2 PN
- G120D with CU240D-2 PN-F or CU250D-2 PN-F

The abbreviation G120 is used in the following to represent all the above-listed devices.

This application example shows you the following:

- Configuring and parameterizing the SIMATIC S7-1200 F-CPU via the TIA Portal
- Configuring and parameterizing the SINAMICS G120 via Startdrive
- Access to process data and parameters
- Implementing safety-related communication between SIMATIC S7-1200 F-CPU and SINAMICS G120 via PROFIsafe
- Controlling SINAMICS G120 safety functions

Requirements

Table 1-1 Requirements relating to the automation task

Requirement	Explanation
Accessing process data	The SINAMICS G120 should be switched on and switched off and the speed setpoint entered from an HMI device.
SINAMICS G120 safety functions	Safety-related shutdown (STO or SS1) and speed monitoring (SLS) is to be implemented in the SINAMICS G120.

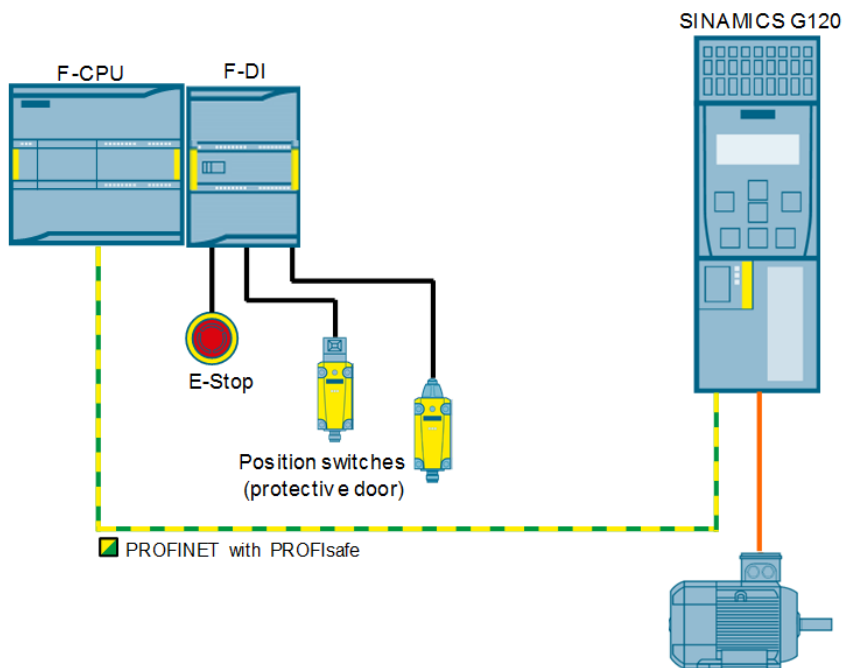
2 Solution

The solution shown here contains code blocks, that you can directly use in your own applications.

2.1 Overview of the total solution

The most important components of the solution are schematically shown in the following diagram:

Fig. 2-1 The most important hardware components that are used



Know-how that is required

This application assumes the following know-how:

- Basic knowledge regarding the TIA Portal.
- Basic knowledge regarding SINAMICS Startdrive

2.2 Hardware and software components

2.2.1 Validity

This application is applicable for the subsequently listed conditions:

- TIA Portal from V14 SP1
- STEP 7 Safety Basic from V14 SP1
- SIMATIC S7-1200 F-CPU from FW 4.2
- SINAMICS Startdrive from V14 SP1
- SINAMICS G120 from FW 4.7
- Standard induction motor

2.2.2 Components used

The most important components to implement the application example are listed below.

Hardware components

Table 2-1 Hardware components that are used

Component	Number	Article number	Note
CPU 1214FC DC/DC/DC	1	6ES7214-1AF40-0XB0	Alternatively, any other SIMATIC S7-1200 F-CPU can be used. In this case, the hardware configuration must be adapted.
SM 1226 F-DI8/16x24V DC	1	6ES7226-6BA32-0XB0	
SINAMICS G120	1	<u>G120:</u> CU 240E-2 PN-F 6SL3244-0BB13-1FA0 <u>Power Module:</u> 6SL3210-1SB11-0AA0	Alternatively, the components from Chapter 1 can be used.
Motor	1	1LA7060-4AB10	Alternatively, other induction motors can also be used. In this case, the motor data must be adapted.

Software components

Table 2-2 Software components that are used

Component	Number	Article number	Note
SIMATIC STEP 7 Professional V14 SP1	1	Floating license 6ES7822-1AA04-0YA5	You can download the Service Pack and the update at no charge: https://support.industry.siemens.com/cs/ww/de/view/109745984
Startdrive V14 SP1	1	6SL3072-4EA02-0XA0	Can be downloaded at no charge: https://support.industry.siemens.com/cs/ww/de/view/68034568

Files and project example

The following list includes all files and projects that are used in this example:

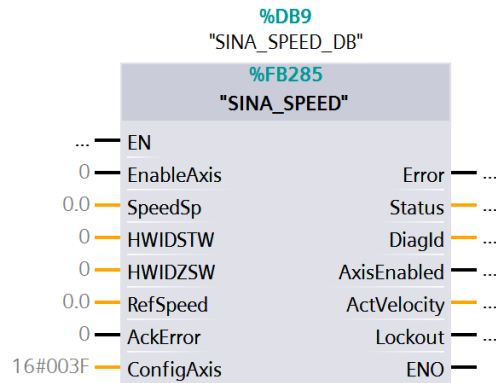
Table 2-3 Files and project example

File	Note
109746271_1200F_G120_PROFIsafe_V1_0_EN_DOC.pdf	This document
109746271_1200F_G120_PROFIsafe_V1_0_TIA.zip	TIA Portal project

3 Fundamentals

3.1 Function block "SINA_SPEED" (FB285)

Fig. 3-1 FB "SINA_SPEED" (FB285)



NOTICE The function block cyclically supplies the SINAMICS drive with data from the standard telegram 1. This must be selected when configuring the telegram.

Note The block interface is restricted to just a few inputs and outputs. All telegram signals are reachable in the setpoint direction at any time via input "ConfigAxis". The inputs are preassigned standard default values when inserting the block.

Function block "SINA_SPEED" (FB285) has the following functions:

- The axis is ready to be switched on if there is no error ("Error"= "0") and no switching-on inhibit ("Lockout" = "0").
- The speed setpoint is directly entered at block input "SpeedSp" in the REAL format.
- The setpoint must be scaled, and this is done using input "RefSpeed" (in the SINAMICS drive, this corresponds to parameter p2000).
- The speed actual value is output at "ActVelocity" in the REAL format.

3.2 Safety functions integrated in the SINAMICS G120

Presently, the following encoderless safety functions acc. to DIN EN 61800-5-2 are integrated in the SINAMICS G120 drives:

Table 3-1 Safety functions integrated in SINAMICS G120

Name	Function	Description
STO	Safe Torque Off	Safely disconnects the torque-generating energy feed to the motor. The switching-on inhibit prevents the drive from being switched on again. (stop function, Category 0 according to EN 60204-1)
SBC (only for CU250S-2)	Safe Brake Control	SBC is only used if there is a motor brake. SBC always responds in conjunction with STO - or when internal safety monitoring functions respond, with safe pulse cancellation.
SS1	Safe Stop 1	The drive is quickly shut down along the OFF3 ramp, safely monitored. Transition to STO after a delay time expires, or reaching the shutdown speed. (stop function, Category 1 according to EN 60204-1)
SLS	Safely Limited Speed	Safe monitoring of the drive speed Parameterizable shutdown response when a limit value is violated.
SSM	Safe Speed Monitor	Safety-related display when a speed limit is fallen below ($n < n_x$)
SDI	Safe Direction	Safe monitoring of the direction of motion (positive and negative direction). Parameterizable shutdown response when traversing in a direction that has not been enabled.

These safety functions can be controlled as follows:

- Via PROFIsafe (via PROFINET or PROFIBUS)
- Via onboard terminals

In this example, the safety functions are controlled via PROFINET with PROFIsafe from a SIMATIC F-CPU.

The implementation of safety concepts is significantly simplified by using safety technology integrated in the drive itself. Further, it is simpler to verify and prove the safety category required for a machine. The Safety Evaluation tool also provides support here.

The safety functions used in this application are subsequently described. You can obtain more detailed information about additional safety functions at

www.siemens.com/safety-drives.

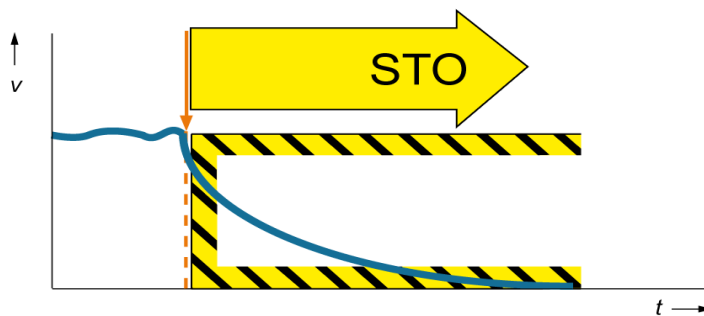
3.2.1 Safe Torque Off (STO)

Safe Torque Off = torque is safely shut down

This is a safety function that prevents unexpected starting according to EN 60204-1 Section 5.4.

The STO function is the most common and most basic safety function integrated in a drive. This function ensures that a motor can no longer develop a torque, therefore preventing undesirable starting.

Fig. 3-2 Safe Torque Off (STO)



Effect

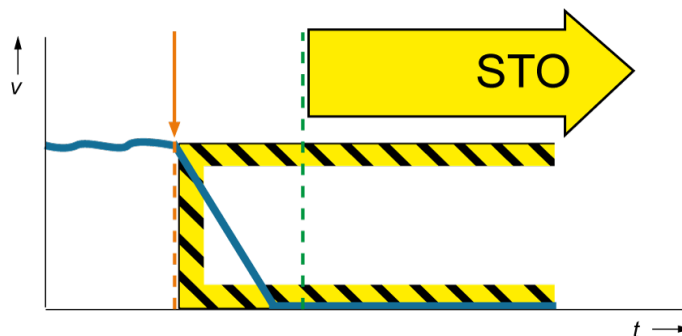
Drive pulses are safely deleted using the Safe Torque Off function. The drive is therefore in a safety-related no-torque state, and can no longer provide torque-generating energy. This state is internally monitored in the drive.

3.2.2 Safe Stop 1 (SS1)

Using the Safe Stop 1 function, safe shutdown can be implemented according to Stop Category 1 in compliance with EN 60204-1.

Function SS1 quickly and safely stops a motor - and once the motor has come to a standstill, activates STO to bring the motor into a safety-related, torque-free condition.

Fig. 3-3 Safe Stop 1 (SS1)



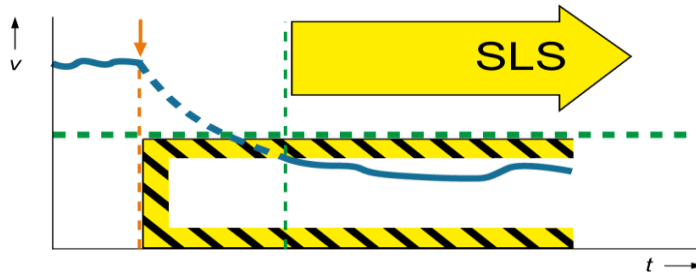
Effect

After selecting function SS1, the drive independently brakes along a fast stop ramp, and after a set, safety-related delay time has expired, or a parameterizable speed has been fallen below, automatically activates the Safe Torque Off safety function.

3.2.3 Safely Limited Speed (SLS)

The SLS function monitors that the drive does not exceed a specific speed/velocity limit.

Fig. 3-4 Safely Limited Speed (SLS)

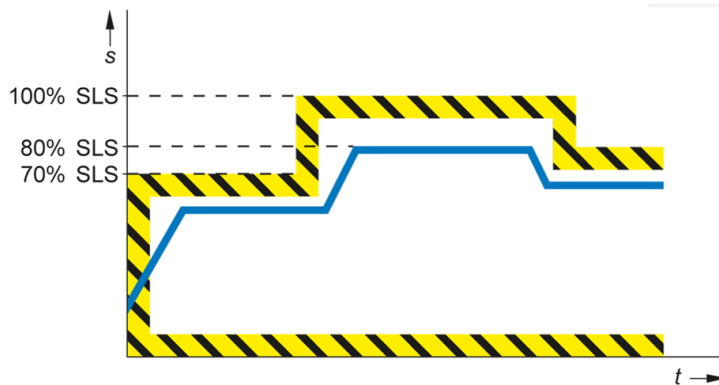


Effect

The drive monitors the speed in a safety-related fashion, and activates a fault response defined when configuring the system if a set velocity/speed limit was exceeded. The speed monitoring of the SLS function can be broken down to a maximum of 4 SLS levels.

Expanded functionality: Selecting SLS levels

Fig. 3-5 Selecting SLS levels



3.2.4 Fail-safe communications via PROFIsafe

Every drive with configured PROFIsafe telegram represents an F device with PROFIsafe communication to the F host.

A dedicated PROFIsafe telegram is selected for each drive (in this particular example, telegram 30). This telegram includes 6 bytes of input data and 6 bytes of output data. The first two bytes (PZD1) include the safety user (net) data. The remaining bytes are required for the safety-related PROFIsafe communication.

Note PROFIsafe telegram 900 is an alternative to PROFIsafe telegram 30. Depending on the safety functions being used, users must select the corresponding PROFIsafe telegram.

The following control signals are sent to the drive from the F-CPU:

Fig. 3-6 From the F-CPU to the drive

PROFIsafe control word (S_STW1 in telegram 30)															
Byte 0								Byte 1							
0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7
STO	SS1	-	-	SLS	-	-	Internal Event Ack	-	Select SLS bit 0	Select SLS bit 1	-	SDI positive	SDI negative	-	-

The drive returns the status of the safety functions to the F-CPU.

Fig. 3-7 From the drive to the F-CPU

PROFIsafe status word (S_ZSW1 in telegram 30)															
Byte 0								Byte 1							
0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7
STO active	SS1 active	-	-	SLS active	-	-	Internal Event	-	Active SLS level bit 0	Active SLS level bit 1	-	SDI positive active	SDI negative active	-	SSM

Note Safety functions integrated in the drive that are not used must be deselected in the F-CPU safety program using a high signal.

3.3 "LDrvSafe" library

Description

The library includes fail-safe S7 blocks to implement various applications in conjunction with SIMATIC S7-300F/S7-1200/S7-1500F and SINAMICS via PROFIsafe. It provides fail-safe blocks to simply control safety functions of the drive via PROFIsafe.

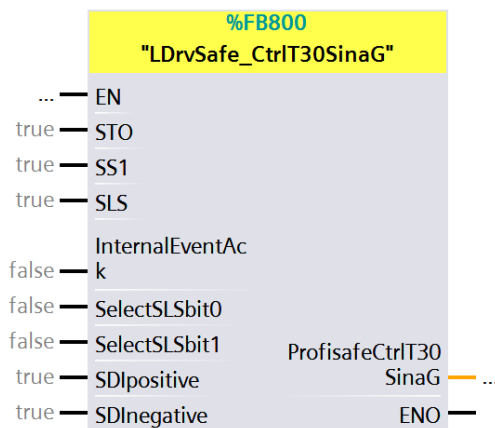
You can find the library at the following link:

<https://support.industry.siemens.com/cs/ww/de/view/109485794>

"LDrvSafe_CtrlT30SinaG" block

This function block is used to simply control the safety functions of the SINAMICS G120 via PROFIsafe telegram 30.

Fig. 3-8 FB "LDrvSafe_CtrlT30SinaG"



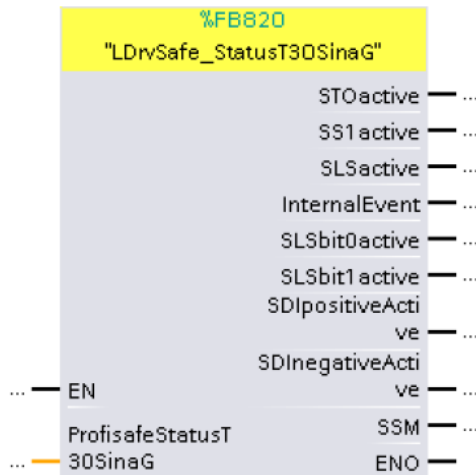
The safety functions of the SINAMICS are shown at the input of the block.

- Input "InternalEventAck" is available to acknowledge SINAMICS safety messages. These messages are acknowledged using a positive signal edge.
- The user must interconnect the block output (in this case, "ProfisafeCtrlT30SinaG") with a variable with the data type of the selected PROFIsafe telegram. This is then used to directly control the drive.

Block "LDrvSafe_StatusT30SinaG"

This function block is used to simply evaluate the safety functions of the SINAMICS G via PROFIsafe telegram 30.

Fig. 3-9 FB "LDrvSafe_StatusT30SinaG"



- The status of the safety functions of the SINAMICS are shown at the output of the block.
- The user must interconnect the input of block (in this case "ProfisafeStatusT30SinaG") with a variable having a data type of the selected PROFIsafe telegram. It is directly interconnected with the information of the PROFIsafe telegram.

4 Engineering and configuring

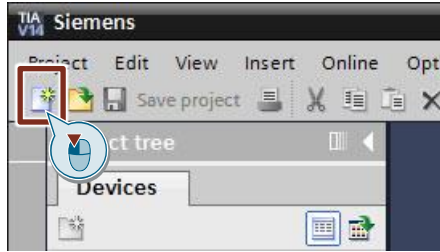
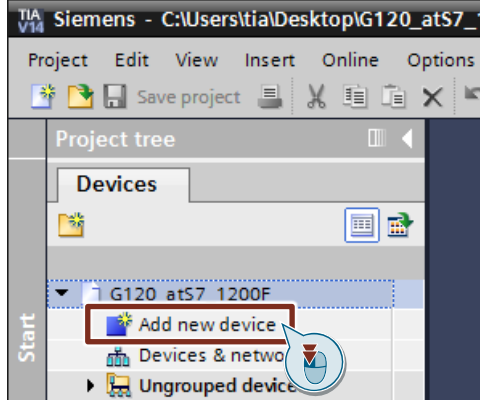
4.1 Generating a project configuration

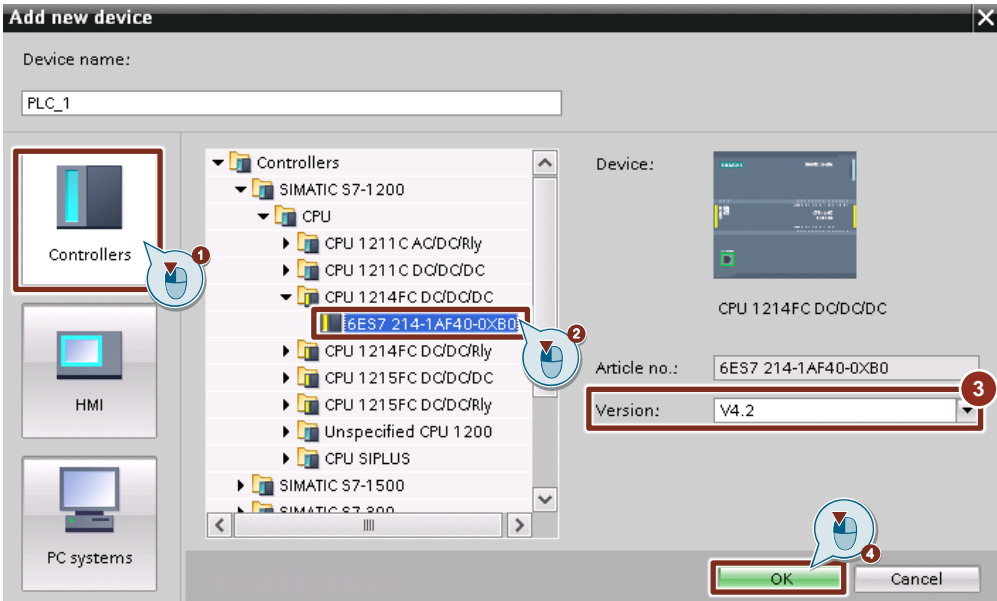
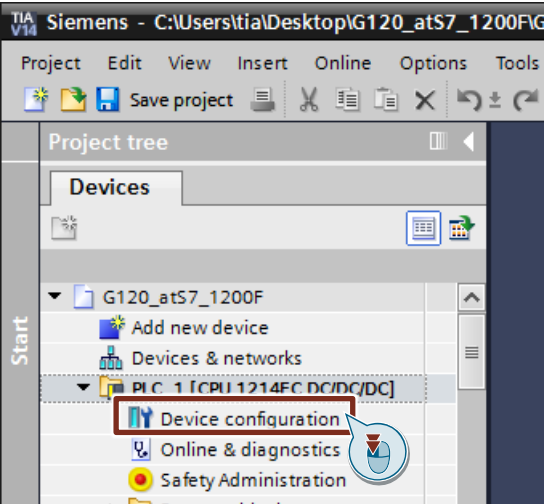
Note If you only wish to load the program example and commission, then follow the instructions provided in Chapter 5.

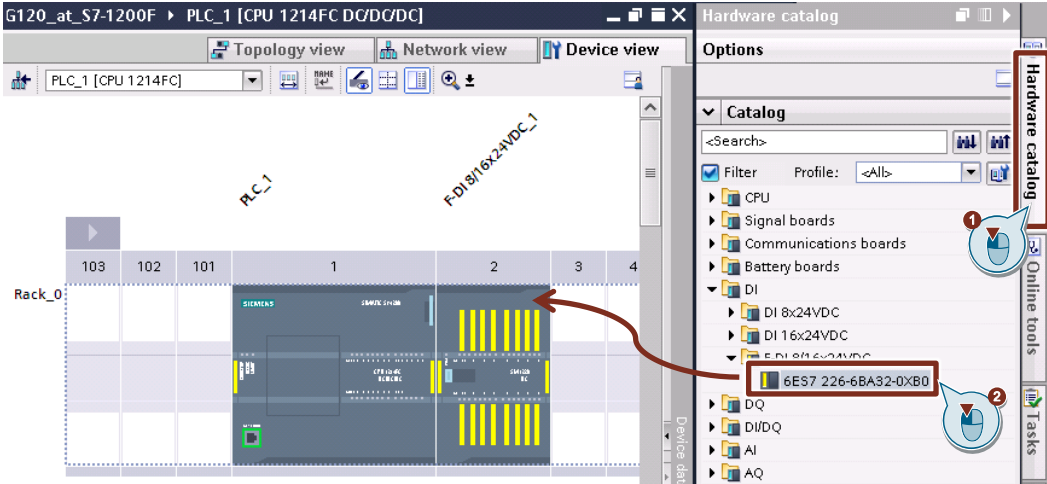
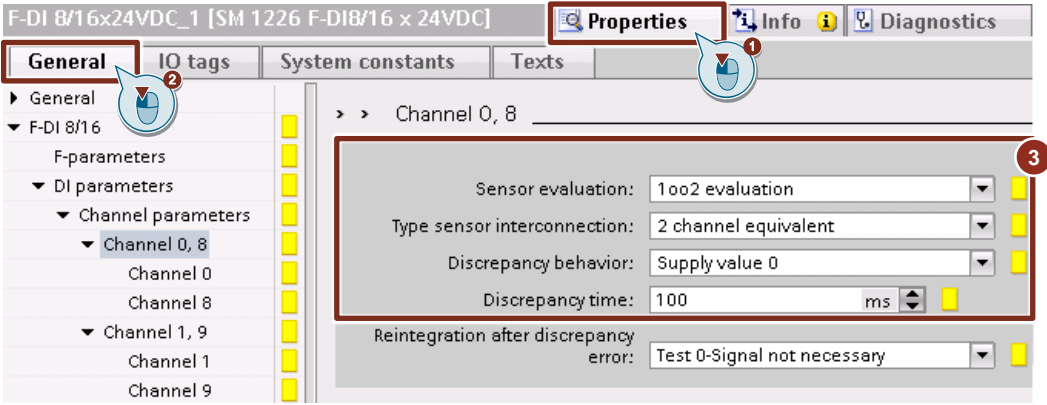
If you wish to configure the SIMATIC S7-1200 F-CPU and the SINAMICS G120 yourself, and you do not wish to use the code example, then the subsequent tables describe the necessary steps to do this.

This chapter does not describe the complete programming of the SIMATIC S7-1200 and the configuring of the HMI device.

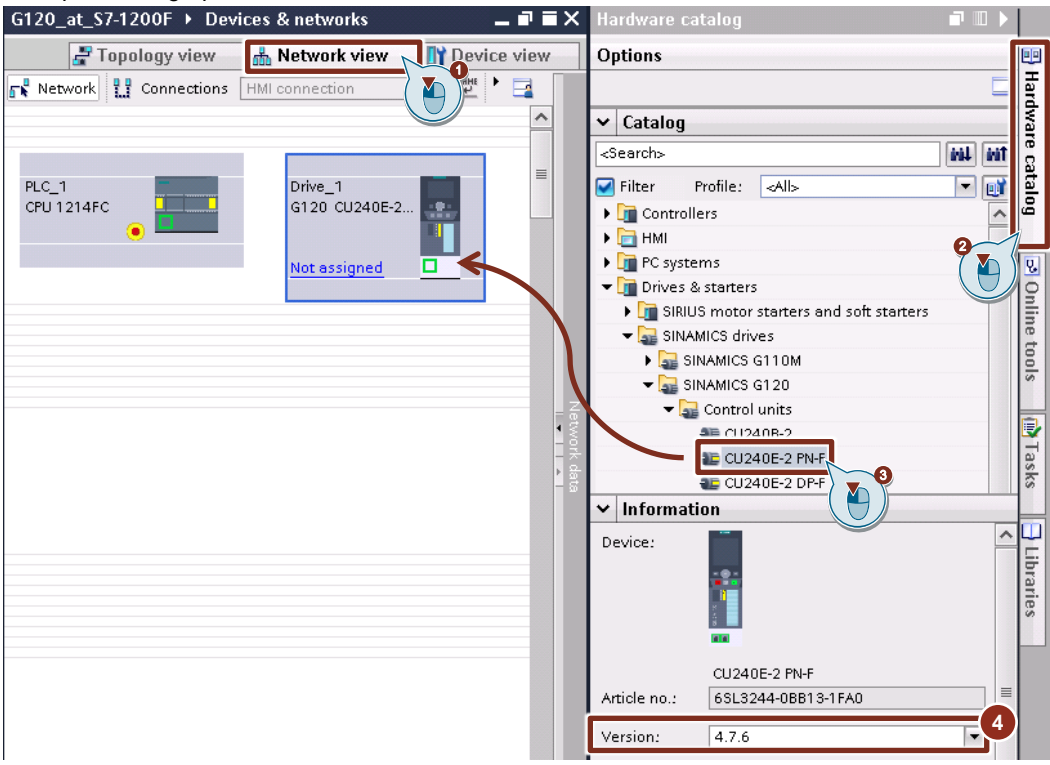
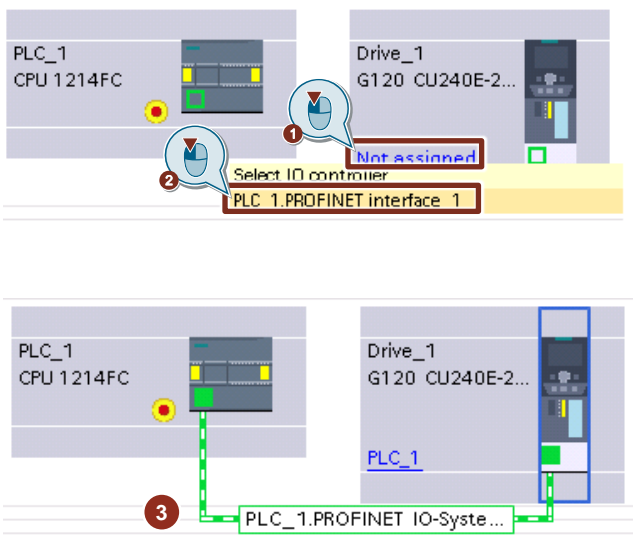
Table 4-1 Creating a project configuration

No.	Action	Screen
Creating a new project		
1	<ul style="list-style-type: none"> Open the TIA Portal. Create a new project and assign it a name (e.g. "G120_at_S7-1200F"). 	
Inserting the SIMATIC F-CPU S7-1200		
2	Click on "Add new device".	

No.	Action	Screen
3	<ul style="list-style-type: none"> Under "Controller (1) > SIMATIC S7-1200 > CPU", select the required CPU, e.g. "CPU 1214FC DC/DC/DC". (2) Then check the firmware version (3) and acknowledge with "OK". (4) 	
Configuring the SIMATIC S7-1200 F-CPU		
4	<p>In the project tree, click on "Device configuration" to configure the hardware.</p>	

No.	Action	Screen
5	<p>In the hardware catalog (1), on the right-hand side of the screen, select the fail-safe input module "F-DI 8/16x24VDC" (2) and insert this by dragging & dropping.</p>	
6	<p>Then, under "Properties (1) > General (2)" parameterize the fail-safe input module depending on the sensors being used, e.g.:</p> <p><u>Channel 0, 8 (Emergency Stop command device) and Channel 2, 10 (position switch) (3)</u></p> <ul style="list-style-type: none"> • Sensor evaluation: "1oo2 (2v2) evaluation" • Sensor type: "2 channel equivalent" • Discrepancy behavior: "Provide 0 value" • Discrepancy time: 100ms 	

Inserting SINAMICS G120

7	<ul style="list-style-type: none"> Click on the "Network view" tab (1) and in the hardware catalog, select the required Control Unit (2) under "Drives & Starter > SINAMICS drives > SINAMICS G120 > Control modules" - for example "CU240E-2 PN-F" (3). Check the firmware version (4) and then drag the Control Unit, selected from the catalog, and drop into the graphic area.
	
8	<p>In order to establish a PROFINET (PN) connection between SIMATIC S7-1200 F-CPU and G120, now click on hyperlink "Not assigned" (1) and select the SIMATIC S7-1200 F-CPU "PLC_1.PROFINET Interface_1" (2).</p> <p>The PN connection is then displayed as shown here. (3)</p>
	

SINAMICS G120 configuration

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- Change to "Device view" (1) - and there select drive device (2).
- Then select the appropriate power unit in the hardware catalog (3), e.g. "PM340 IP20 FSA A 240V 0.12kW" (4) then drag this and drop it next to the control module (5).
- To make the Control Unit settings, then click on the control module (5).

10

- Under "Properties (1) > General (2) > PROFINET interface [X150]" open the telegram configuration. (3)
- Using "Add telegram (4) > Add safety telegram (5)", insert PROFI-safe telegram 30.

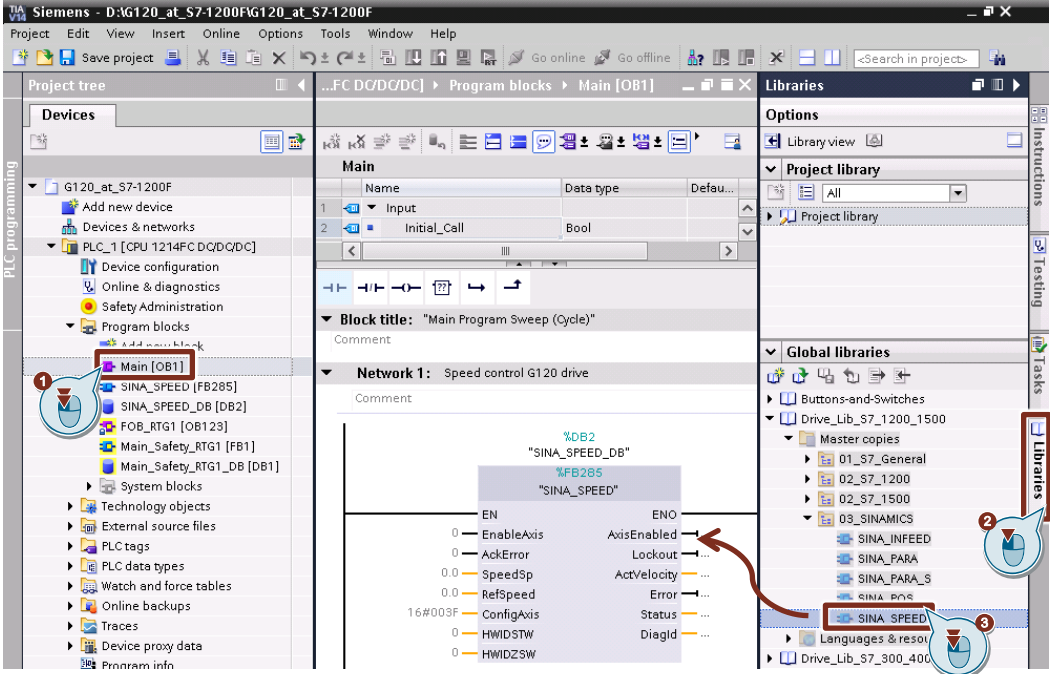
Name	Item	Link	Telegram	Partner	Partner data area
Drive_1	1				
Send Safety telegram (Ac...		➔	PROFIsafe telegram 30	PLC_1	I 2...7
Receive Safety telegram ...		➔	PROFIsafe telegram 30	PLC_1	Q 2...7
Send (Actual value)		➔	Standard telegram 1	PLC_1	I 256...259
Receive (Setpoint)		➔	Standard telegram 1	PLC_1	Q 256...259

Note

IP address and PROFINET device names are automatically assigned when inserting the modules (S7-1200 and Control Unit). You can change these module settings at any time under "Settings > General > PROFINET interface > Ethernet addresses".

4.2 User program of the SIMATIC S7-1200 F-CPU

Table 4-2 User program SIMATIC S7-1200 F-CPU

No.	Action	Screen
Standard user program to switch on and enter a speed setpoint for the G120		
1	<ul style="list-style-type: none"> • Open block "Main" (OB1) (1). • From "Libraries (2) > Drive_Lib_S7_1200_1500 > Master copies > 03_SINAMICS" insert block "SINA_SPEED" (3) by dragging & dropping. 	

No.	Action	Screen
2	<ul style="list-style-type: none"> Interconnect the following block inputs, for example with variables from global data blocks, bit memories etc. in order to switch on and operate the G120: <ul style="list-style-type: none"> "EnableAxis" (1) to switch on the drive "AckError" (2) to acknowledge errors "SpeedSp" (3) to enter a speed setpoint Enter a fixed reference speed at input "RefSpeed" (4). This speed must match parameter p2000 of the SINAMICS. The hardware ID at the block input must be interconnected in order to control the correct drive. To do this, symbolically assign inputs "HWIDSTW" (5) and "HWIDZSW" (6) the hardware ID of PROFINET ("Drive_1~PROFINET_interface~Standard_telegram_1"). 	

Safety user program

3 To more easily control the safety functions of the SINAMICS, user library ["LDrvSafe" library](#) is used.

- Open the library and copy the blocks
 - "LDrvSafe_CtrlT30SinaG" and
 - "LDrvSafe_StatusT30SinaG"
 to the "Program blocks" folder (1).
- Further, copy data types
 - "LDrvSafe_typeCtrlT30SinaG" and
 - "LDrvSafe_typeStatusT30SinaG"
 to folder "PLC data types" (2).

The screenshot shows the SIMATIC Manager interface. On the left, the project tree for 'G120_atS7_1200F' is visible, with 'Program blocks' and 'PLC data types' folders highlighted. On the right, the 'Global libraries' pane shows the 'LDrvSafeV11_TIA' library. Red arrows and boxes indicate the transfer of 'LDrvSafe_CtrlT30SinaG' and 'LDrvSafe_StatusT30SinaG' blocks to the 'Program blocks' folder (1), and 'LDrvSafe_typeCtrlT30SinaG' and 'LDrvSafe_typeStatusT30SinaG' data types to the 'PLC data types' folder (2).

4 Then open the variable table and create two arbitrary variables (1) with the data types just inserted (2), e.g.:

Name	Data type	Address
PROFIsafeCtrlDrive	"LDrvSafe_typeCtrlT30SinaG"	%Q2.0
PROFIsafeStatDrive	"LDrvSafe_typeStatusT30SinaG"	%I2.0

The start address (3) must be the same as the start address of the PROFIsafe telegram in the HWCN (4) (hardware configuration); in this example, "2.0":

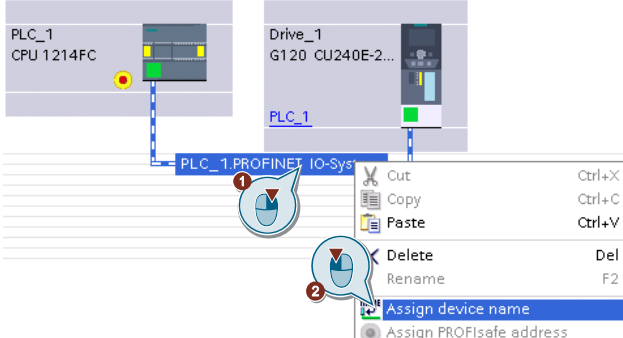
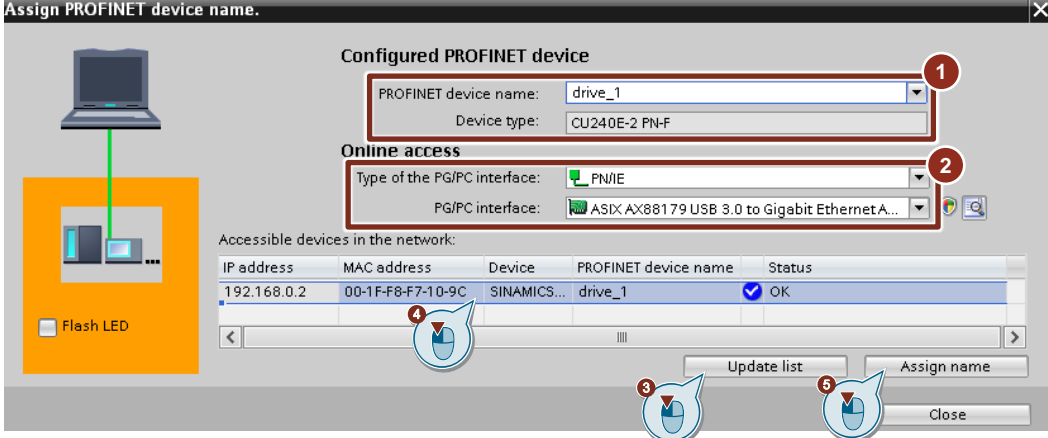
Name	Item	Link	Telegram	Partner data area
Drive_1				
Safety actual value	1	➔	PROFIsafe telegram 30	I 2...7
Safety setpoint		➔	PROFIsafe telegram 30	Q 2...7
Actual value		➔	Standard telegram 1	I 256...259
Setpoint		➔	Standard telegram 1	Q 256...259

<p>5</p>	<ul style="list-style-type: none"> Now open function block "Main_Safety_RTG1", and insert block "ACK_GL" by dragging & dropping. The block can be found under the "Instructions" tab in the "Safety functions" folder. Interconnect input "ACK_GLOB" (1) with a variable or an input, e.g. "I0.1". With a positive edge at this input, each F I/O will be reintegrated after communication failure. 	
<p>6</p>	<ul style="list-style-type: none"> Also insert block "ESTOP1" by dragging & dropping. Interconnect input "E_STOP" with the Emergency Stop command device, e.g. I8.0 (1). To reset the Emergency Stop command, input "ACK" must be interconnected, e.g. with I0.1 (2). 	
<p>7</p>	<ul style="list-style-type: none"> Then insert block "SFDOOR" by dragging & dropping. Interconnect inputs "IN1" and "IN2" with the protective door position switch, in this case I8.2 (1). Then link the value status of position switch (I10.2) with inputs "QBAD_IN1" and "QBAD_IN2" (2). To acknowledge, interconnect input "ACK", e.g. with I0.1 (3). 	

<p>8</p> <p>To control safety functions STO and SLS of the SINAMICS G120, call block "LDrvSafe_CtrlT30SinaG".</p> <ul style="list-style-type: none"> • Interconnect input "STO" with the output of the "ESTOP1" block: "STO" = "instEstop.Q" (1) • Interconnect input "SLS" with the output of the "SFDOOR" block: "SLS" = "instSfdoor.Q" (2) • To acknowledge safety errors of the G120, link input "InternalEventAck", e.g. with I0.1 (3) • Output "ProfisafeCtrlT30SinaG" must be interconnect with the previously created variable "PROFIsafeCtrlDrive" (4). 		<p>Network 4: Control Safety functions of G120</p> <p>Comment</p>
<p>9</p> <p>To evaluate the status of the active safety functions, interconnect input "ProfisafeStatus_T30SinaG" with the previously created variable "PROFIsafeStatDrive" (1).</p> <p>You can now further evaluate and interconnect the outputs in your user program.</p>		<p>Network 5: Get status of G120 Safety functions</p> <p>Comment</p>
<p>10</p> <p>Save your project.</p>		<p> Save project</p>
<p>11</p> <p>Then download the SIMATIC S7-1200 F-CPU.</p>		<p></p>

4.3 Node initialization for PROFINET communication

Table 4-3 Node initialization PROFINET

No.	Action	Screen
1	<p>In order that PN communication can be established, each IO device must be assigned a PN device name.</p> <p>To do this, right click on the PN line (1) and then select "Assign device name"(2).</p>	
2	<p>Assigning the PN device name is carried out for the SINAMICS G120:</p> <ul style="list-style-type: none"> • Select the PN device name of the SINAMICS, in this case "drive_1". (1) • Set the PG/PC interface, via which you are connected to SINAMICS. (2) • Click on "Update list". (3) • Select SINAMICS. (4) • Click on "Assign name". (5) 	

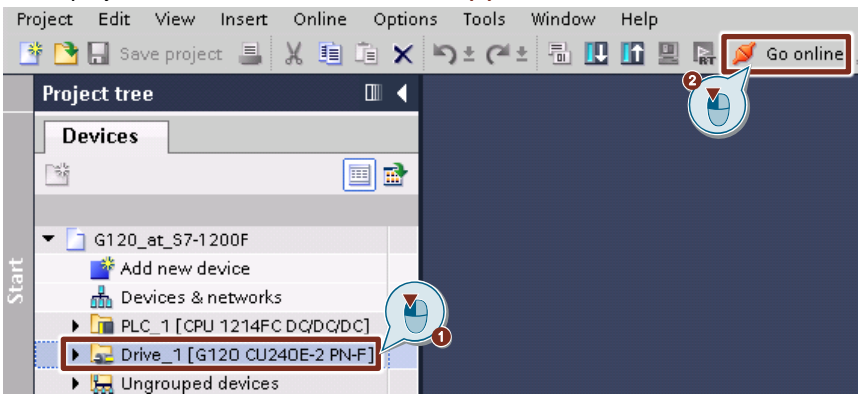
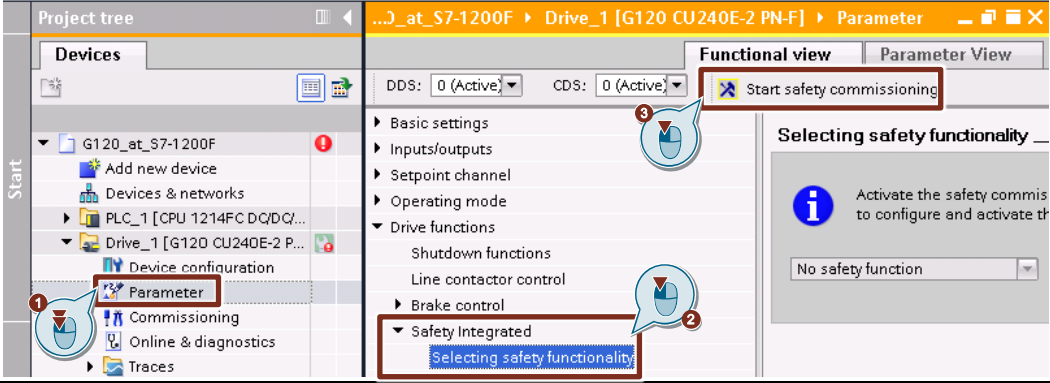
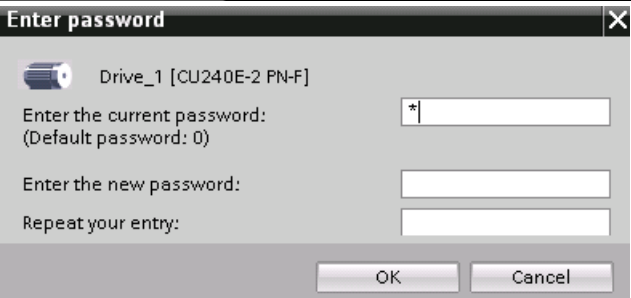
4.4 Commissioning SINAMICS G120

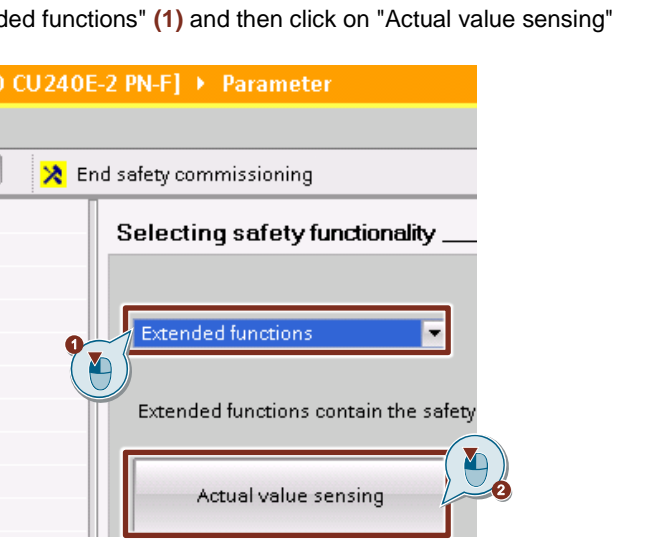
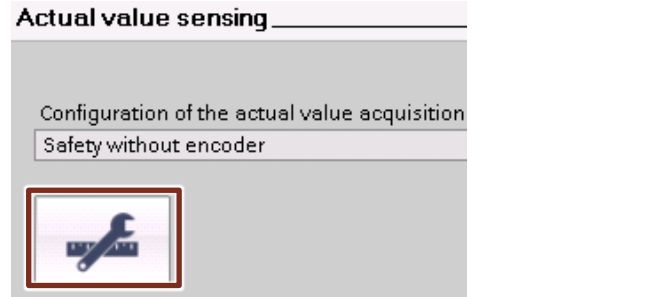
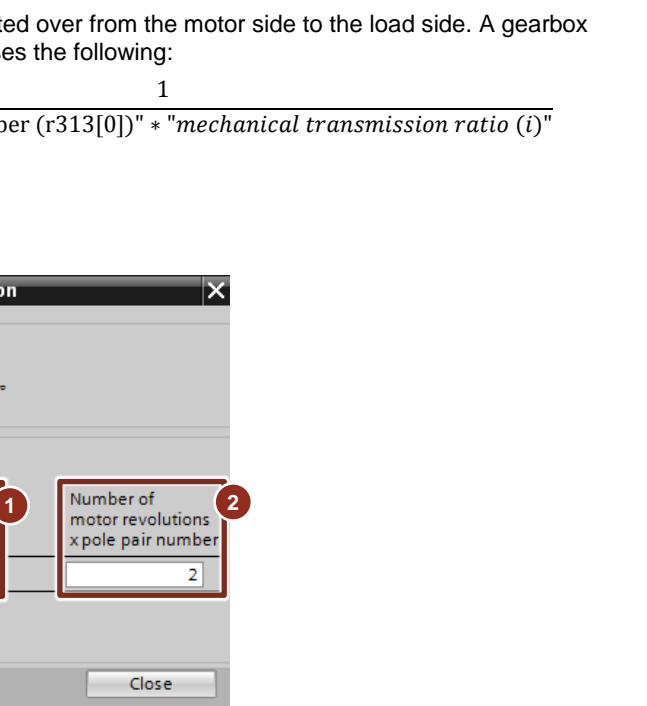
Table 4-4 Commissioning the SINAMICS G120

No.	Action	Screen
1	<ul style="list-style-type: none"> Carry out the basic commissioning of the G120. To do this, click on "Commissioning" (1) and start the "Commissioning Wizard" (2). 	
2	<ul style="list-style-type: none"> For all menu items, press "Next" without making any changes - with the exception of "Motor" (1). Here, select "Select from order number list" (2), "1LA7 induction motor" (3) and "Order number 1LA7060-4AB10-xxxx" (4). Then click on "Next" (5), and continue to run through the Wizard. 	
3	Save your project.	Save project
4	Then download the G120.	

4.5 Parameterizing safety functions in the drive

Table 4-5 Parameterizing safety functions in the drive

No.	Action	Screen
1	<p>In the project tree, click on the drive device (1) and establish an online connection (2).</p>	
2	<ul style="list-style-type: none"> Then select entry "Parameter" (1) in the project tree. To parameterize the safety functions, click in the secondary navigation under "Functional view > Drive functions" on entry "Safety Integrated > Selecting safety functionality" (2) - and start safety commissioning (3). 	
3	<p>The system now prompts you to enter the password for parameterizing the safety functions. Here, enter the safety password (factory setting "0") - and acknowledge with "OK".</p>	

No.	Action	Screen
4	<p>In the drop-down menu, select "Extended functions" (1) and then click on "Actual value sensing" (2).</p>	
5	<p>Click on the tool symbol to transfer the motor pole pair number into the safety settings.</p>	
6	<p>The safely calculated speed is converted over from the motor side to the load side. A gearbox ratio must be specified, which comprises the following:</p> $\frac{p9521[0] (1)}{p9522[0] (2)} = \frac{1}{\text{"Motor pole pair number (r313[0])" * "mechanical transmission ratio (i)"}}$ <p>In this specific example, the ratio is:</p> $\frac{p9521[0] (1)}{p9522[0] (2)} = \frac{1}{2 * 1} = \frac{1}{2}$	

No.	Action	Screen
7	<ul style="list-style-type: none"> Then, in the navigation, set entry "Control type/safety functions" (1). Set the radio button for "via PROFIsafe" (2) and enable the safety functions (3). 	<p>The screenshot displays the 'Control type/safety functions' configuration screen. At the top, there are fields for 'DDS: 0' and 'CDS: 0', and a 'Start safety commissioning' button. The left sidebar contains a navigation tree with 'Control type/safety functions' highlighted (1). The main content area is divided into 'Control type:' and 'Safety functions:'. Under 'Control type:', three radio buttons are shown: 'via terminals', 'via PROFIsafe' (which is selected and highlighted with a red box and callout 2), and 'via terminals (basic) and PROFIsafe (extended)'. Under 'Safety functions:', there are four sub-sections: STO, SS1, SLS, and SSM, each with a corresponding graphical icon. At the bottom of the 'Safety functions' section, there is an 'Enable' dropdown menu (3).</p>

No.	Action	Screen
8	<ul style="list-style-type: none"> In the navigation bar, select safety function "SLS" (1). As soon as the SLS safety function is selected with level 1, the G120 brakes the motor along the OFF3 ramp (the OFF3 ramp is defined using p1082 and p1135) down to setpoint speed n_{set}. Depending on the application, this braking operation can be monitored in a fail-safe fashion (Safe Brake Ramp). In this particular example, the ramp is not monitored; therefore, the setting "with delay time" (2) is selected. Setpoint speed n_{set} is limited by the ramp-function generator to the following value: $n_{setpoint} (p1051[0], 1052[0]) = \text{"Setpoint speed limiting (p9533)" (4)} * n_{SLS} (p9531[0])" (5)$ In this example, setpoint n_{set} is limited to $n_{setpoint} = 80\% * 300rpm = 240rpm$. In order that the motor can be braked to below the SLS limit speed n_{SLS}, before SLS becomes active, set the time delay between selecting and actually activating the SLS safety function (3). Here, a time delay of 500ms is selected. Adapt the SLS limit speed (5) and the stop response (6) when this speed is exceeded. In this example, "STOP A" (corresponds to safety function STO) is initiated when the SLS limit speed of 300rpm is exceeded. 	

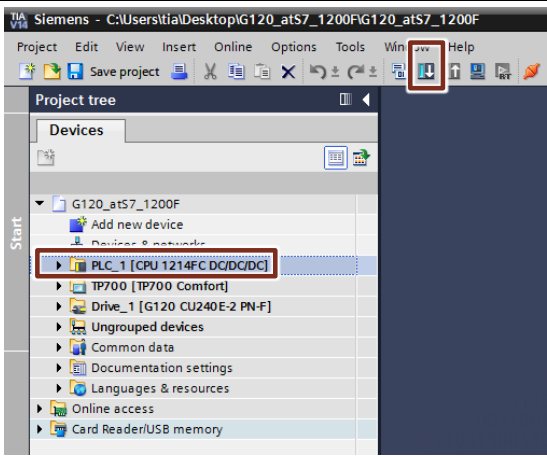
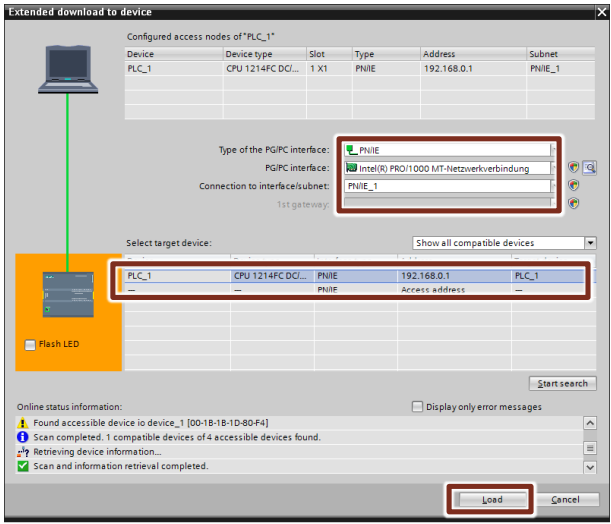


No.	Action	Screen
9	<ul style="list-style-type: none"> Select "Test stop" (1) in the navigation bar. To maintain the guaranteed failure probability of the SINAMICS safety functionality, the test stop must be executed at least once every year (8760 hours). As the extended safety functions are used, the timer for the basic and extended functions must be adapted (p9659 (2) = p9559 (3) = 8760). The test stop of the extended safety functions is executed using a standard signal, e.g. via fieldbus, BiCo or digital input. In this particular example, digital input 4 of the Control Unit is used (p9705 = r722.4) (4). 	
10	<p>This completes the parameterization of the STO and SLS safety functions via PROFIsafe. Click on "End safety commissioning".</p>	
11	<p>Then back up the parameterization in the non-volatile memory. To do this, confirm the message box with "Yes".</p>	
12	<p>In order that the safety settings become active, disconnect the online connection and then switch off the drive device and switch on again.</p>	
13	<p>Then upload the G120, so that the online and offline project are consistent.</p>	
14	<p>Save your project.</p>	

5 Commissioning

Download the project to the components

The following table lists the actions to download the project.

Table 5-1 Download the project to the components

No.	Action	Screen
1	Open the project example, or the project created in Chapter 4.	
2	Select the F-CPU and then click on "Load to device".	
3	If the "Extended download to device" dialog opens, then <ul style="list-style-type: none"> select the settings necessary for your online connection, select the CPU 1214, and click on "Load". 	
4	Load the SINAMICS G120 in the same way.	
5	Load the operator panel (TP700) in the same way.	

6 Using the application example

The project example program only comprises the call of the blocks for the motion control instructions - and copying the status signals for the HMI.

You can test the individual block functions, and understand their responses by visualizing the blocks on the operator panel.



WARNING

Carefully ensure that the moving drive cannot endanger persons or machine parts.

Take suitable measures so that the drive cannot traverse outside limits that are either technically or mechanically specified.

6.1 Protective door and Emergency Stop

An Emergency Stop with acknowledgment and a protective door with acknowledgment are configured in the project example. For the protective door, there is also the requirement that this must be opened before the system starts and then reclosed. It can then be acknowledged.

The drive can be started if the Emergency Stop is released, the protective door closed and both elements are acknowledged.

If Emergency Stop is actuated, STO is initiated and the motor is switched into a torque-free condition.

If the protective door is opened in operation, the speed is limited by the internal interconnection of the drive, and is safely monitored against the set limit value.

The speed limiting is not a safety function! The SLS functionality monitors the speed against a certain limit value, and when exceeded, initiates a safe stop response.

If the protective door is closed, the speed limiting and monitoring can be canceled by acknowledging.

6.2 "MCWatch" monitoring table

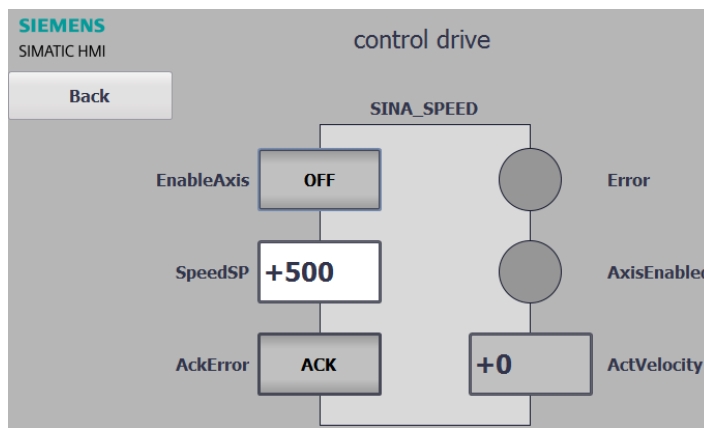
If you are not using an operator panel, then you can also use the "MCWatch" monitoring table, created in the project example, to control the drive - or you simulate the HMI.

6.3 Using the application example with the panel

6.3.1 Controlling the drive via "SINA_SPEED"

- A setpoint speed can be entered via "SpeedSP". If "EnableAxis" is activated, the drive is switched on and operates with the specified speed.
- Signals "Error", "AxisEnabled" and "Act Velocity" indicate the status information of the drive.

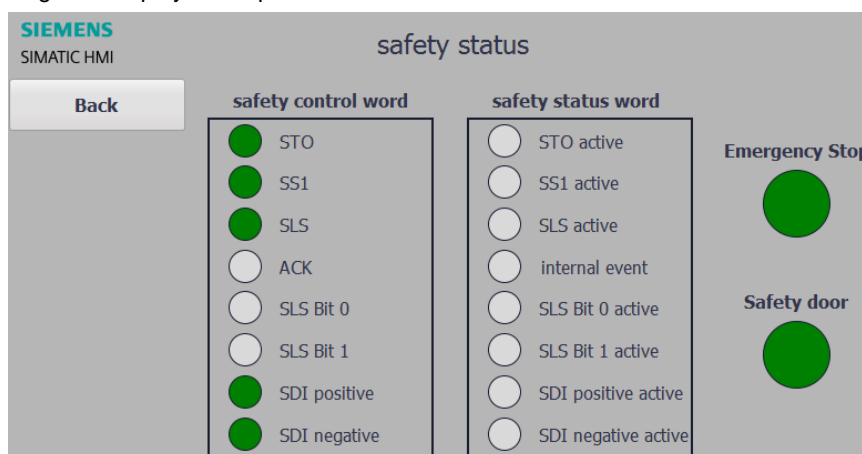
Figure 6-1 Display at the panel



6.3.2 Safety information

The "Safety" screen form is only used for information purposes. The safety control word and status word are shown, as well as the status of the Emergency Stop and protective door.

Fig. 6-2 Display at the panel



7 Links and references

Table 7-1 Links and references

No.	Topic
\1\	Siemens Industry Online Support http://support.automation.siemens.com
\2\	Link to the article page of the application example https://support.industry.siemens.com/cs/ww/en/view/109746271
\3\	STEP 7 V14 SP1 https://support.industry.siemens.com/cs/ww/en/view/109745984
\4\	Startdrive V14 SP1 download page https://support.industry.siemens.com/cs/ww/en/view/68034568
\5\	General SINAMICS G manuals Safety Integrated Function Manual (V4.7SP6): http://support.automation.siemens.com/WW/view/en/109744795 Fieldbus Systems Function Manual (V4.7SP6): http://support.automation.siemens.com/WW/view/en/109483004
\6\	SINA_SPEED Documentation for the SINAMICS DriveLib communication blocks for controlling the TIA Portal https://support.industry.siemens.com/cs/ww/en/view/109475044
\7\	Safety Evaluation Tool www.siemens.com/safety-evaluation-tool
\8\	LDrvSafe https://support.industry.siemens.com/cs/ww/en/view/109485794

8 Change documentation

Table 8-1: Change documentation

Version	Date	Modifications
V1.0	07/2017	First Edition