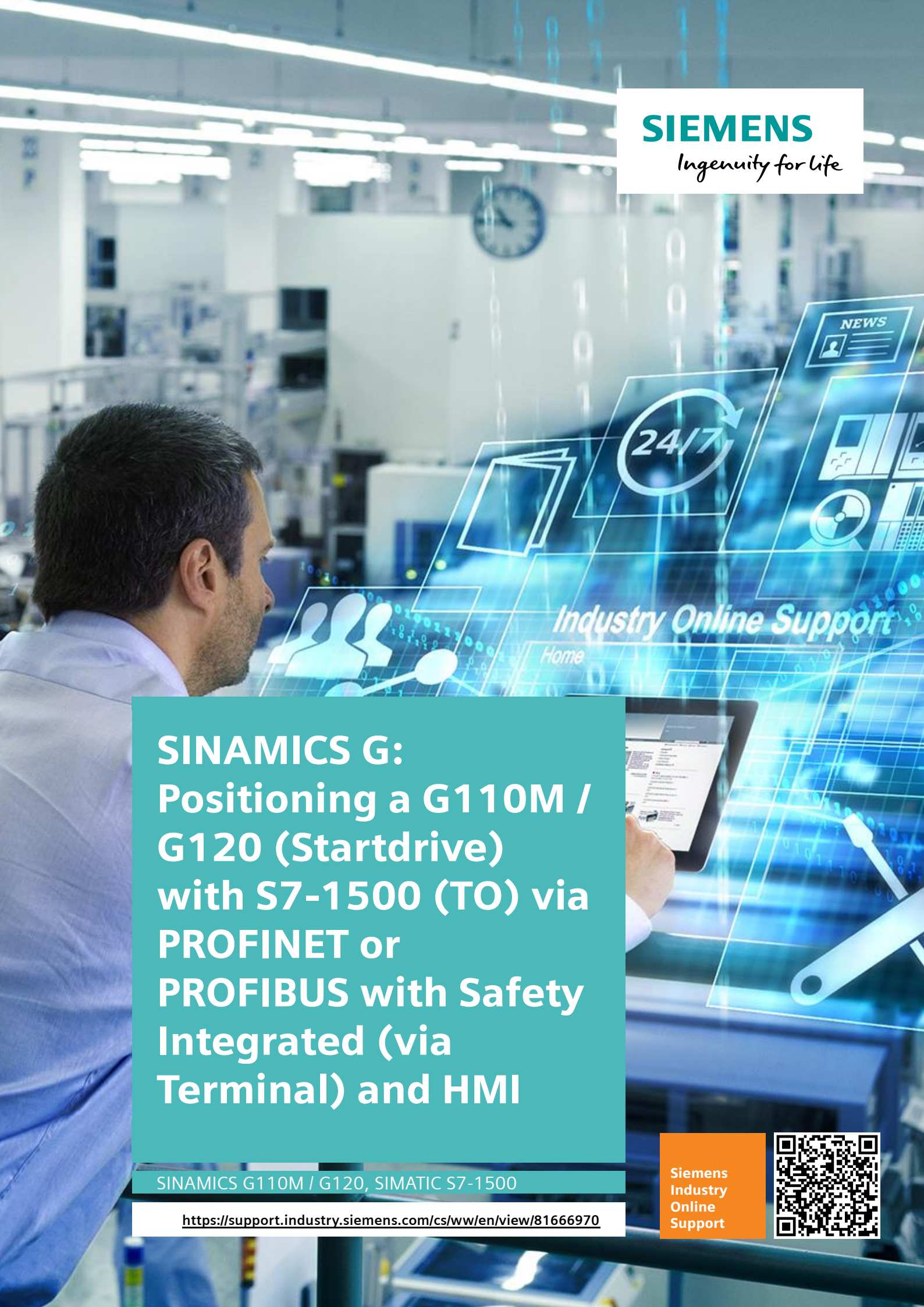

SINAMICS G: Positioning a G110M / G120 (Startdrive) with S7-1500 (TO) via PROFINET or PROFIBUS with Safety Integrated (via Terminal) and HMI

SINAMICS G110M / G120, SIMATIC S7-1500

https://support.industry.siemens.com/cs/ww/en/view/81666970

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Table of contents

1 Introduction

1.1 Overview

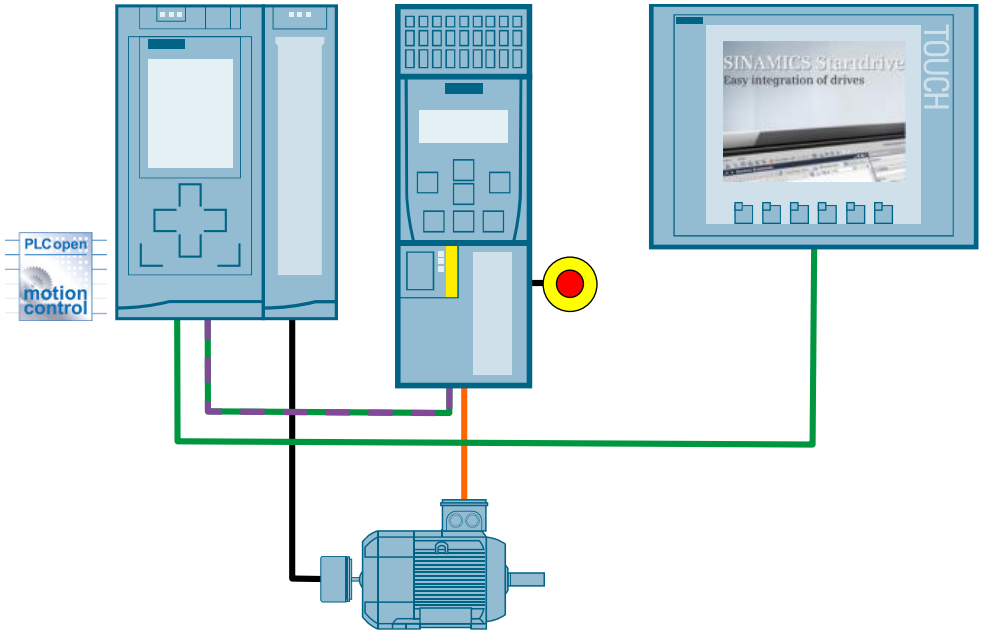
SIMATIC S7-1500 CPUs support the connection of PROFIdrive-capable drives via PROFINET or PROFIBUS as a speed axis or positioning axis. The standardized PLCopen blocks make configuration particularly easy.

This application example shows how to configure and commission the SINAMICS G110M/G120 and the SIMATIC S7-1500 using the technological functions of the SIMATIC S7-1500 in order to implement a positioning axis.

Overview of the automation task

The figure below provides an overview of the automation task:

Figure 1-1



2 Solution

2.1 Overview

Diagrammatic representation

The diagrammatic representation below shows the most important components of the solution:

Figure 2-1 Solution with the SINAMICS G120 connected via PROFINET

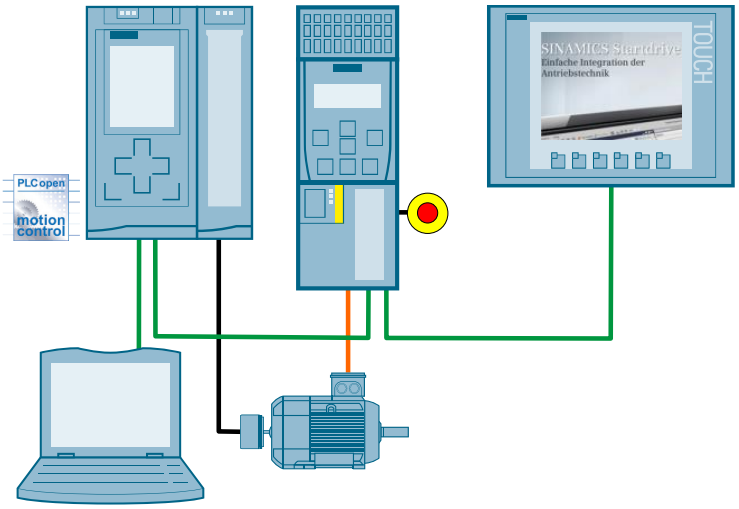
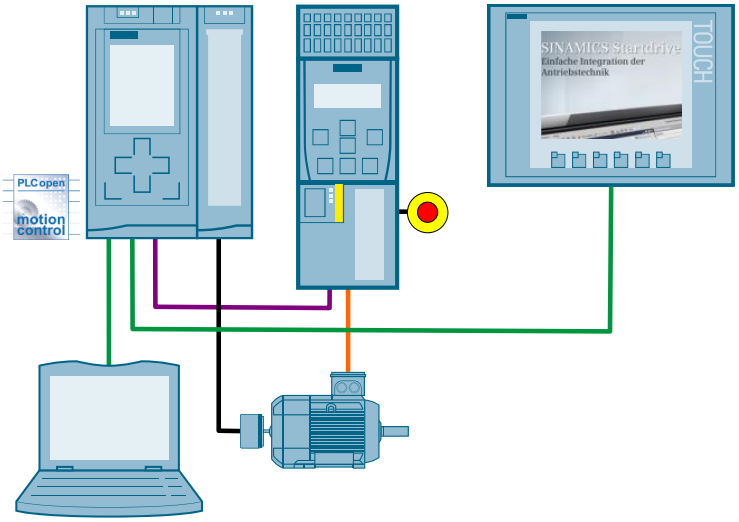


Figure 2-2 Solution with the SINAMICS G120 connected via PROFIBUS



Advantages

Due to the use of the technological functions of the SIMATIC S7-1500, you no longer need to program the technological functions (e.g., positioning) and the connection of the SINAMICS G120.

Instead, you use the SIMATIC S7-1500 motion control instructions (function blocks) conforming to the PLCopen standard to trigger the required movements of the drive.

Disadvantages

The number of technology objects possible in the SIMATIC S7-1500 depends on the CPU type used:
CPU 1511 and CPU 1513 support max. 6 technology objects, CPU 1516 supports max. 20 technology objects.

2.2 PLCopen

PLCopen is a cross-company organization that develops standards intended to increase efficiency in development and reduce maintenance costs for control programs.
The PLCopen organization is independent of vendors or specific products.
For more information on PLCopen, please refer to \7\.

In motion control, PLCopen defines function blocks that execute specific movements or functions.

Figure 2-3

The PLCopen function blocks send jobs to axes, which then execute these jobs. An axis generally consists of a converter, a motor and, where necessary, a position sensor.

2.3 Motion control in the SIMATIC S7-1500

The motion control functions of the SIMATIC S7-1500 CPUs are based on the Axis technology object.

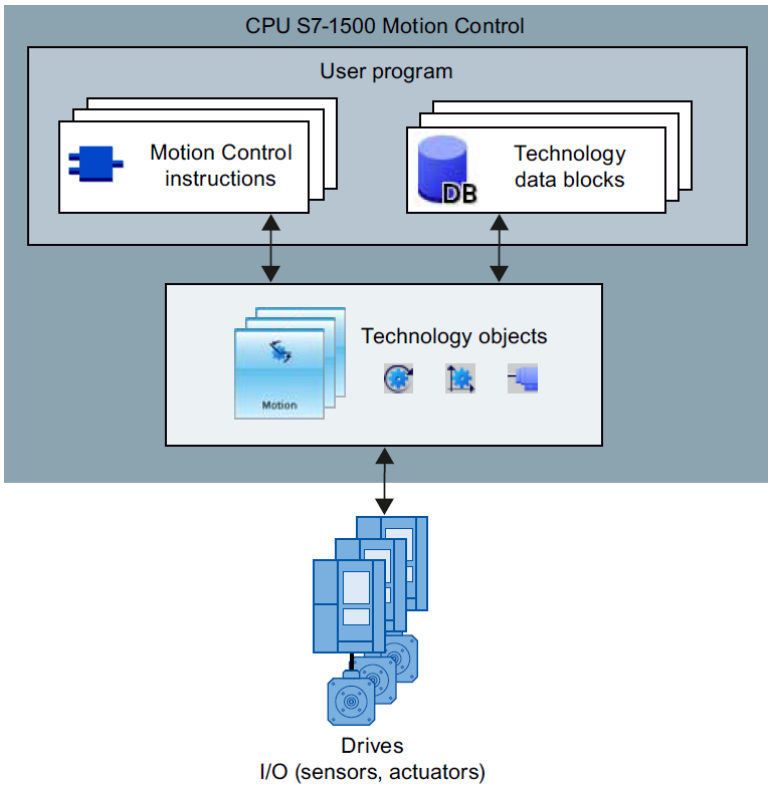
From a programmer's point of view, the Axis technology object represents the SINAMICS drive, i.e. the converter, motor and, where necessary, position encoder. The position encoder is necessary only for positioning axes.

The SIMATIC S7-1500 supports speed axes and positioning axes:

- Speed axes allow you to specify the speed at which the axis is to rotate.
- A positioning axis supports all functions of a speed axis and additionally offers the option of approaching position values.

With the aid of motion control instructions, function blocks according to the PLCopen standard enable the user to move the Axis technology object and therefore the SINAMICS drive. The current axis status can be read out of the technology DB of the Axis technology object at any time.

Figure 2-4



The following motion control instructions are available for an axis:

Table 2-1

Motion control instruction (FB)	Function	Available for	
		Speed axis	Positioning axis
MC_Power	Enables (or disables) the axis	x	x
MC_Reset	Acknowledges technology alarms of the axis	x	x
MC_Home	Homes the position or assigns it a new value	-	x
MC_Halt	Stops the axis (speed: 0)	x	x
MC_MoveJog	Moves the axis with jog signals	x	x
MC_MoveVelocity	Moves the axis at a specified velocity	x	x
MC_MoveRelative	Moves the axis **by** a specified value	-	x
MC_MoveAbsolute	Moves the axis **to** a specified value	-	x

2.4 Hardware and software components

2.4.1 Components used

The application was created with the following components:

Hardware components when using PROFINET

Table 2-2

Component	Qty.	Order no.	Note
CPU 1516-3PN/DP	1	6ES7516-3AN00-0AB0	Alternatively, any other S7-1500 CPU can be used.
TM Count 2x24V	1	6ES7550-1AA00-0AB0	
SIMATIC S7 Memory Card 4MB	1	6ES7954-8LC01-0AA0	Alternatively, any other SIMATIC S7 Memory Card can be used.
SIMATIC Panel, KTP600 Basic color PN	1	6AV6647-0AD11-3AX0	Or other operator panel or simulation/runtime. The panel is optional.
PROFINET connector	6	6GK1901-1BB10-2AA0	To connect the S7 CPU to the panel and the PG/PC.
PROFINET cable		6XV1840-2AH10	Sold by the meter (20 to 2000m).

Component	Qty.	Order no.	Note
SINAMICS G120	1	**G120:** CU 240E-2 PN 6SL3244-0BB12-1FA0 CU 240E-2 PN-F 6SL3244-0BB13-1FA0 Power Module: 6SL3224-0BE17-5UA0	Alternatively, any other SINAMICS G120C PN, G120 or G120D with PROFINET-capable CU can be used.
		G120C PN: 6SL3210-1KE18-8AF1	
		G120D: CU240D-2 PN 6SL3544-0FB20-1FA0 CU240D-2 PN-F 6SL3544-0FB21-1FA0 Power Module: 6SL3525-0PE17-5AA1	
Incremental encoder	1	1XP8001/1024	Or any other encoder with HTL signal.
Motor	1	1LA7063-4AB12	Alternatively, any other motor suitable for the used SINAMICS G120 converter can be used.

Hardware components when using PROFIBUS

Table 2-3

Component	Qty.	Order no.	Note
CPU 1516-3PN/DP	1	6ES7516-3AN00-0AB0	Alternatively, any other S7-1500 CPU can be used.
TM Count 2x24V	1	6ES7550-1AA00-0AB0	
SIMATIC S7 Memory Card 4MB	1	6ES7954-8LC01-0AA0	Alternatively, any other SIMATIC S7 Memory Card can be used.
SIMATIC Panel KTP600 Basic color PN	1	6AV6647-0AD11-3AX0	Or other operator panel or simulation/runtime. The panel is optional.
PROFINET connector	4	6GK1901-1BB10-2AA0	To connect the S7 CPU to the panel and the PG/PC.
PROFINET cable		6XV1840-2AH10	Sold by the meter (20 to 2000m).
PROFIBUS connector	2	6ES7972-0BB60-0XA0	To connect the S7 CPU to the SINAMICS G120.
PROFIBUS cable		6XV1830-0GH10	Sold by the meter (20 to 2000m).

Component	Qty.	Order no.	Note
SINAMICS G120	1	**G120:** CU 240B-2 DP 6SL3244-0BB00-1PA1 CU 240E-2 DP 6SL3244-0BB12-1PA1 CU 240E-2 DP-F 6SL3244-0BB13-1PA1 Power Module: 6SL3224-0BE17-5UA0	Alternatively, any other SINAMICS G120C PN, G120 or G120D with PROFINET-capable CU can be used.
		G120C DP: 6SL3210-1KE14-3UP1	
		G120D: CU240D-2 DP 6SL3544-0FB20-1PA0 CU240D-2 DP-F 6SL3544-0FB21-1PA0 Power Module: 6SL3525-0PE17-5AA1	
Incremental encoder	1	1XP8001/1024	Or any other encoder with HTL signal.
Motor	1	1LA7063-4AB12	Alternatively, any other motor suitable for the used SINAMICS G120 converter can be used.

Software components

Table 2-4

Component	Qty.	Order no.	Note
SIMATIC STEP 7 Professional V13	1	Floating license 6ES7822-1AA03-0YA5	Service Pack and update can be downloaded for free: \3\
Startdrive V13	1	6SL3072-4DA02-0XG0	Free download: \4\

3 Principle of Operation

3.1 Technology objects (TOs) – basics

The motion control functions of the SIMATIC S7-1500 CPUs are based on the Axis technology object.

From a programmer's point of view, the Axis technology object represents the SINAMICS drive, i.e. the converter, motor and, where necessary, position encoder.

The SIMATIC S7-1500 supports speed axes and positioning axes:

- Speed axes allow you to specify the speed at which the axis is to rotate.
- A positioning axis supports all functions of a speed axis and additionally offers the option of approaching position values.

3.2 Interaction of motion control instructions and technology objects

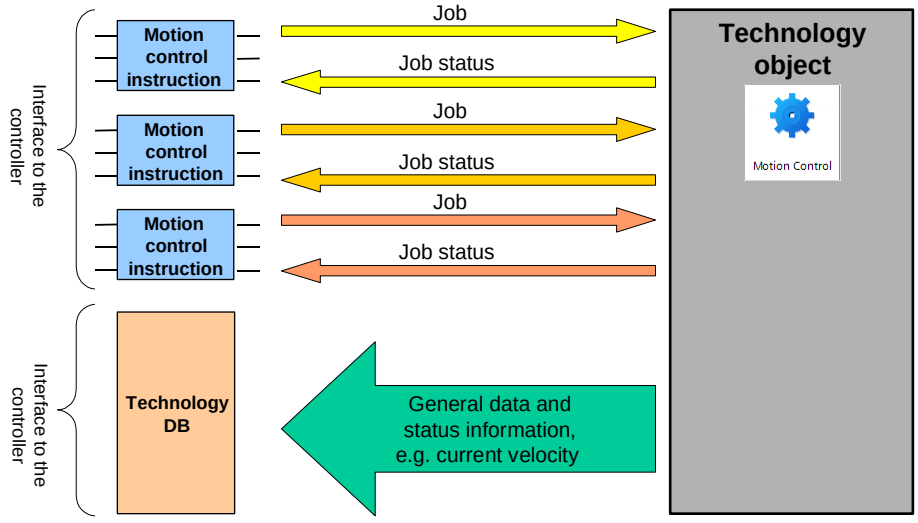
3.2.1 Motion control instructions

A motion control instruction sends a job to the technology object, which then executes the job. Such a command can, for example, be an axis enable, moving at a constant velocity or positioning [1].

A technology object can be accessed by multiple motion control instructions.

Aside from the job status display on the motion control instructions, the Axis technology object also saves general information such as the current velocity and position[2] in a technology DB.

Figure 3-1 Data exchange between a TO and multiple motion control instructions



[1] Only positioning axes

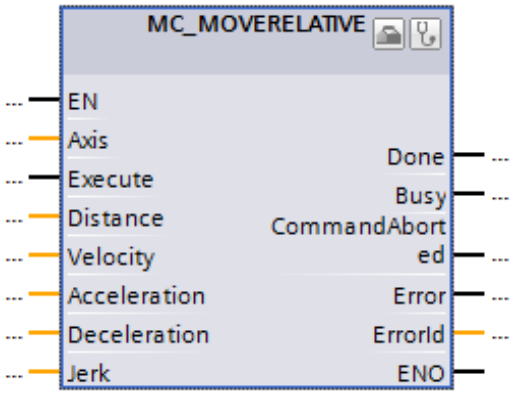
Only an appropriate chronological order of the calls of the motion control instructions in the control program of the SIMATIC S7-1500 allows you to use the TO in a technologically useful way.
Therefore, it is recommended to use a sequencer in the user program from which the motion control instructions according to the PLCopen standard are called.

3.2.2 Technology data blocks

After generating the technology objects, technology data blocks are automatically created. The TO status and more TO-typical information is entered in these blocks; for an axis, this is, for example, the current position[2] and velocity.
The technology data block can be accessed like a normal data block.

3.2.3 Principle of motion control instructions

Figure 3-2



Basically, all motion control instructions work on the following principle:

- The **Axis** input specifies to which TO and therefore to which axis the motion control instruction is to be sent.
- A rising edge at the **Execute** input triggers the job. The job type depends on the motion control instructions used.
- The status outputs of the FB (**Busy**, **Done**, **CommandAborted** and **Error**) display the job status.
  - While a job is active, the **Busy** output parameter displays the value **TRUE**; when the job is complete, **Busy** displays the value FALSE.
  - The other output parameters display the status for at least one cycle. While the **Execute** input parameter is set to **TRUE**, these status messages are displayed on a latching basis.
    - While the **Execute** input is set to **TRUE**, the job status is displayed at the status outputs of the FB (**Busy**, **Done**, **CommandAborted** and **Error**).
    - If the **Execute** input parameter is set to **FALSE** while the job is not yet complete (**Busy = TRUE**), the **Done** output (or **Error** or **CommandAborted**) will be set to **TRUE** for only one cycle once the job is complete!

[2] Only positioning axes

- A job is terminated when
  - it has achieved its objective (e.g., position target or standstill reached or parameter value read) and the **Done** output has been set.[3]
  - it was replaced by another job. If the **Execute** input is still set to **TRUE**, the **CommandAborted** output will be set.
  - an axis error or job error occurs.
    In this case, the **Error** output will be set.
- All other inputs are used to define the motion. They allow the user to specify, for example, the target position, max. velocity, acceleration, etc. The value -1.0 means that the default values specified when creating the Axis technology object are to be used.

3.2.4 Replacement of a job by another job

The replacement of a job is best shown by an example:

- An axis receives the job to start positioning. (“MC_MoveAbsolute”)
  - It accelerates based on the settings and approaches the target position.
  - The **Busy** bit is set.
- Now the axis receives the job to stop the motion control job (“MC_Halt”).
  - On “MC_MoveAbsolute”, the **Busy** output is now deleted and **CommandAborted** is set.
  - On “MC_Halt”, **Busy** is set.
    ⇨ “MC_MoveAbsolute” was replaced by “MC_Halt”.
- The axis decelerates based on the settings and comes to a standstill.
  - On “MC_Halt”, **Busy** is deleted and **Done** is set.

The traversing job via “MC_MoveAbsolute” was replaced by the halt job via “MC_Halt” and the halt job completed itself when the axis reached a standstill.

[3] Some jobs run endlessly and therefore do not stop themselves. These jobs include, for example, the enable or (endless) motion at a constant velocity. Therefore, the appropriate motion control instructions do not have a **Done** output, but instead have a status output, e.g. **Status** or **InVelocity**.

4 Configuration and Project Engineering

4.1 Creating the project configuration

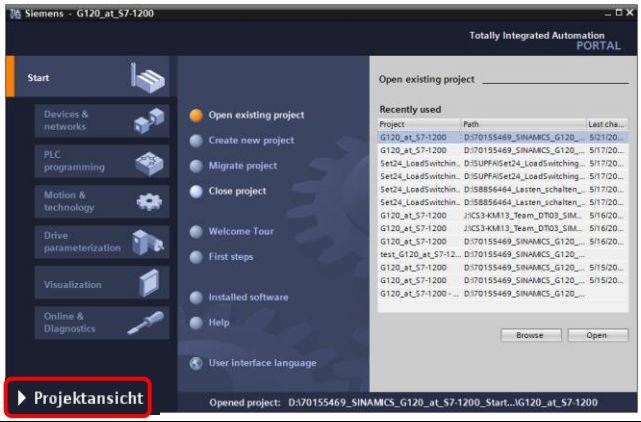
Note

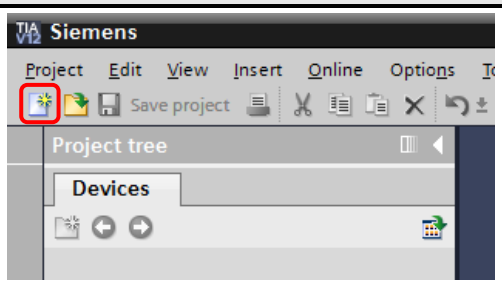
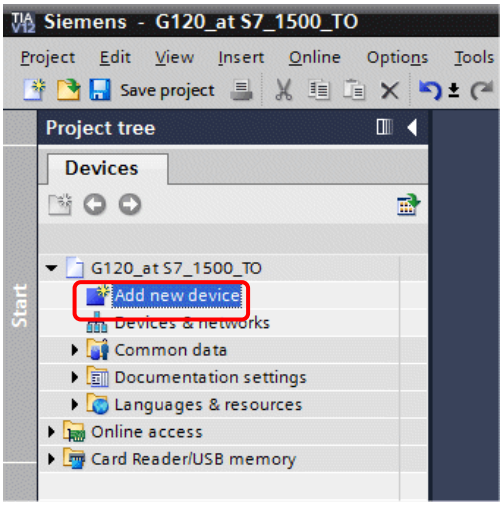
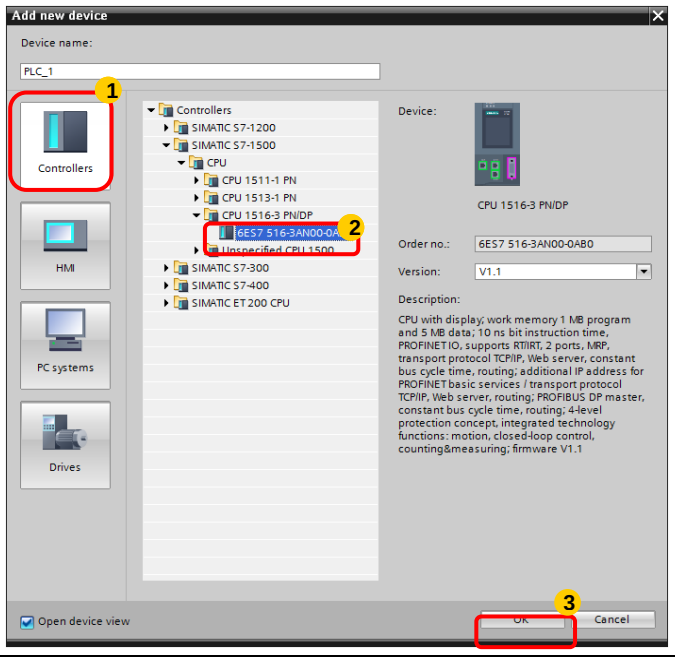
- If you only want to download and start up the sample program, follow the instructions in chapter 5.
- The procedure described in the following table is one option for configuring a SIMATIC S7-1500 and parameterizing a SINAMICS G120C PN for data exchange between a SIMATIC controller and a SINAMICS drive. TIA Portal offers several possible solutions that differ to a greater or lesser degree from the procedure shown here.

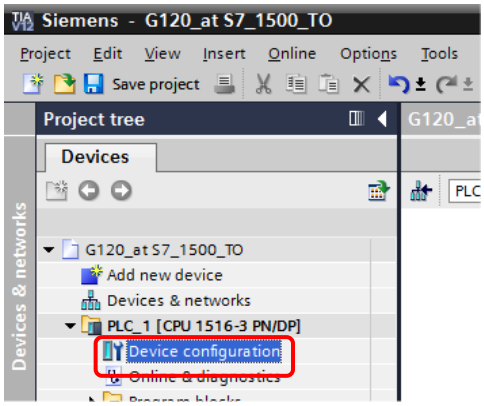
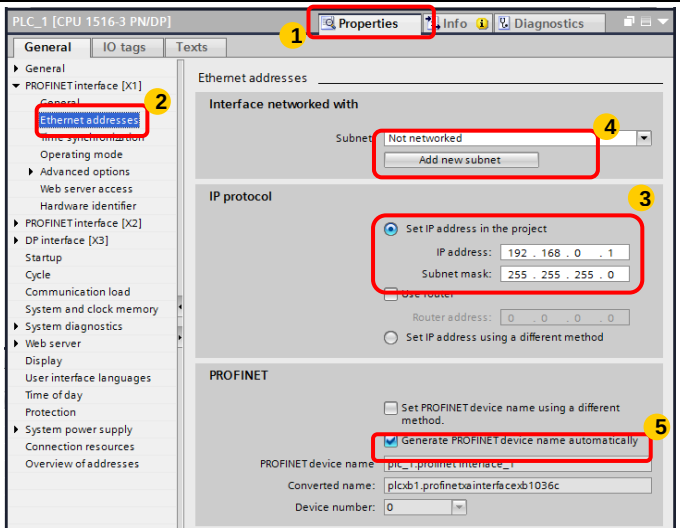
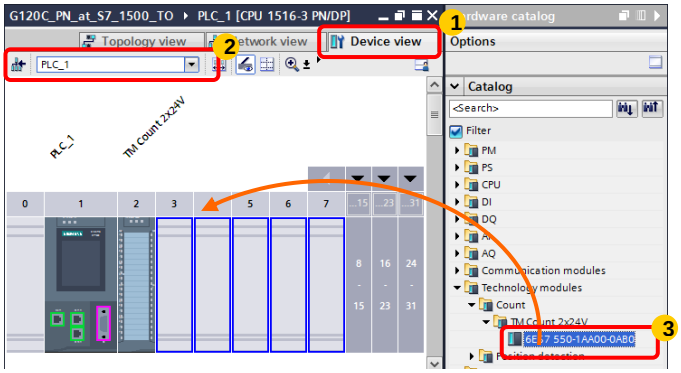
The tables below describe what you have to do if you do not use the sample code and want to configure the SIMATIC S7-1500 CPU, the SINAMICS G120 and the KTP600 HMI yourself.
Programming the SIMATIC S7-1500 and configuring the operator panel are not the subject of this chapter.

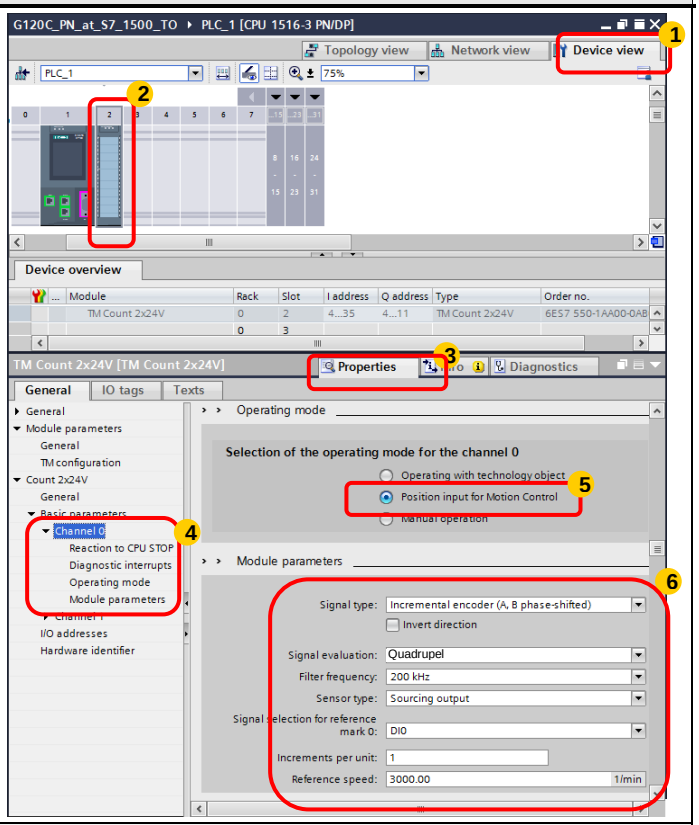
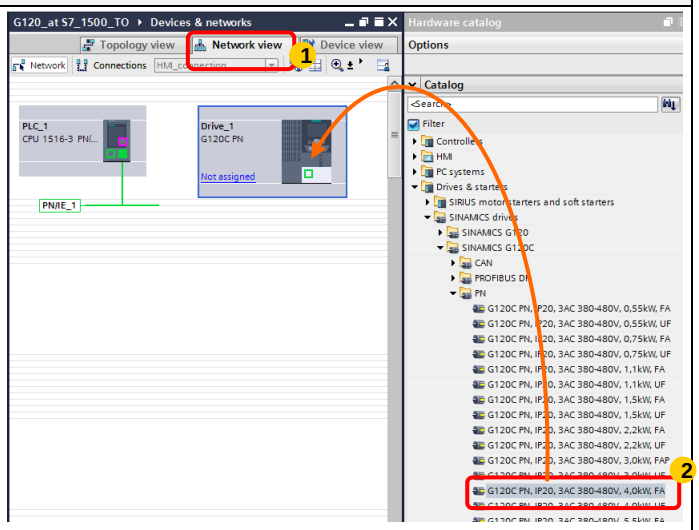
It is assumed that the software, see Table 2-3, is installed on your PG/PC.

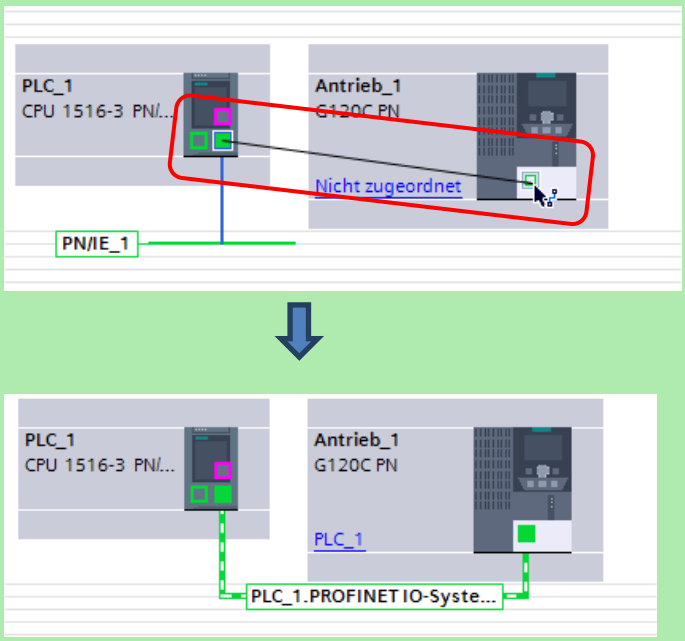
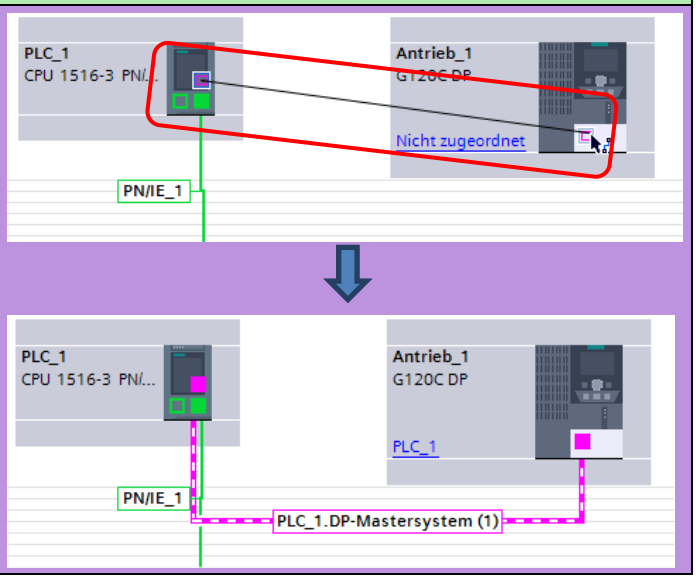
Table 4-1: Creating the project configuration

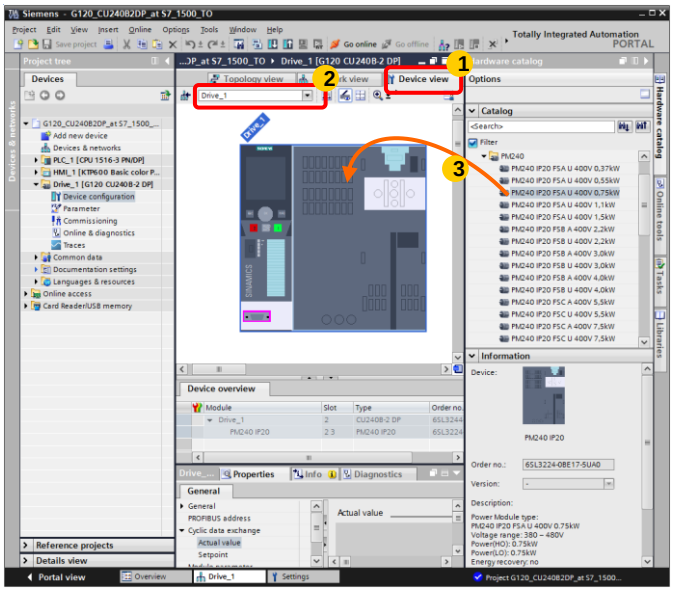
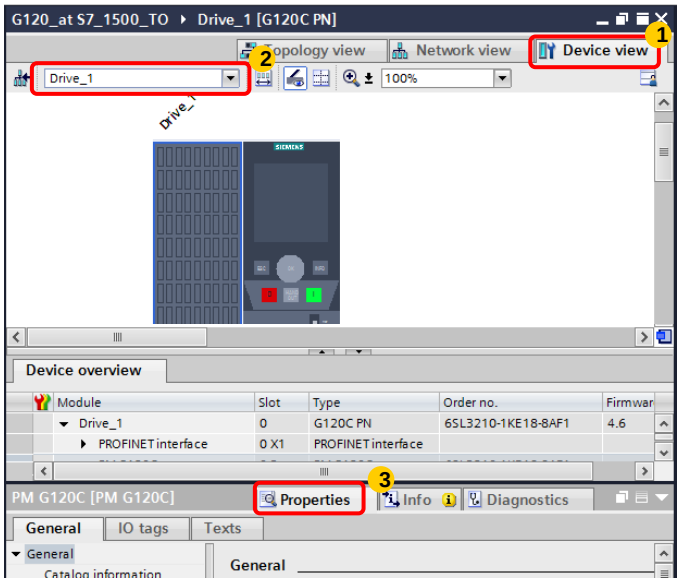
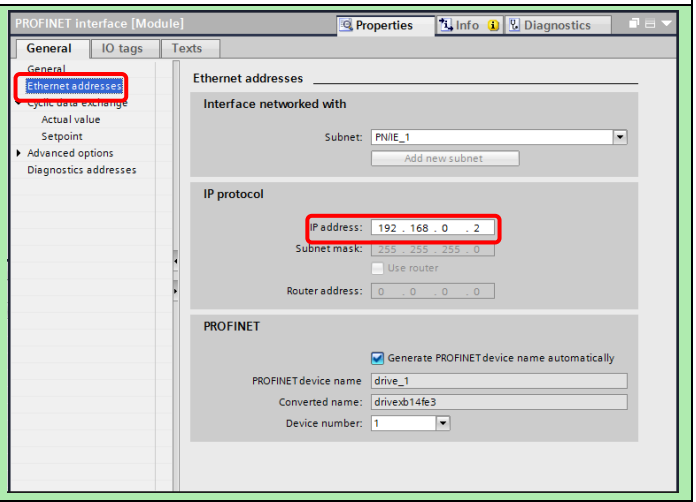
No.	Action	Picture
	Creating the project	
1.	Open TIA Portal.	
2.	If TIA Portal opens in the Portal view, go to the bottom left to switch to the Project view.	

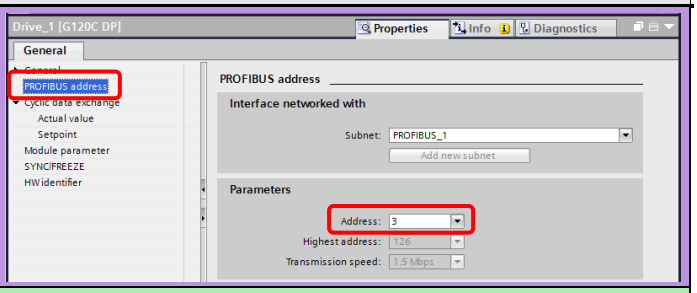
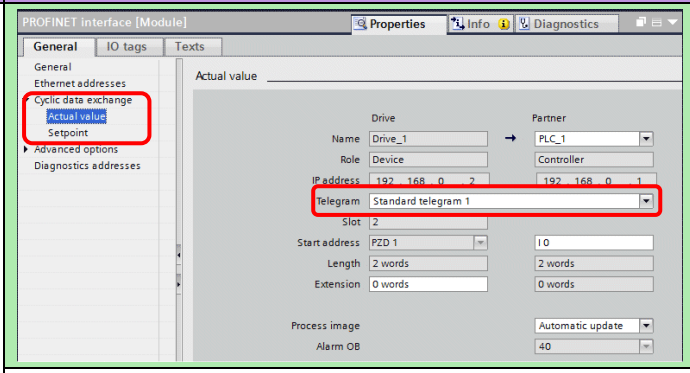
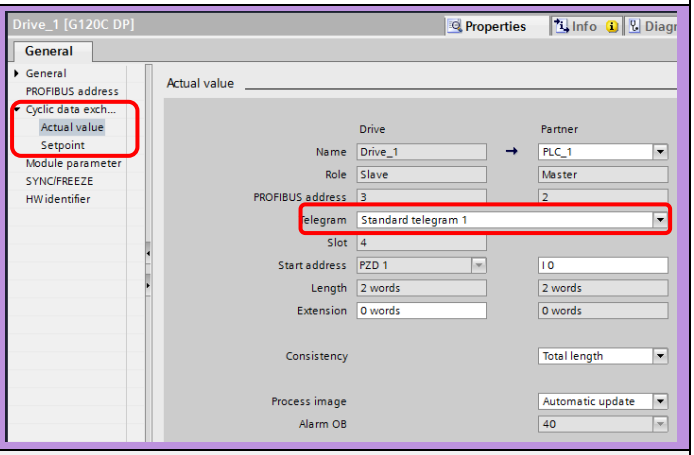
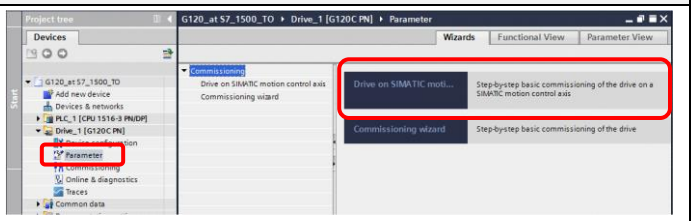
No.	Action	Picture
3.	Create a new project and assign a name (e.g., “G120_at_S7-1500_TO”).	
	Inserting the SIMATIC S7-1500	
4.	Double-click on “Add new device”.	
5.	1. Select “Controller”. 2. Select the desired CPU. 3. Then click on “OK”.	

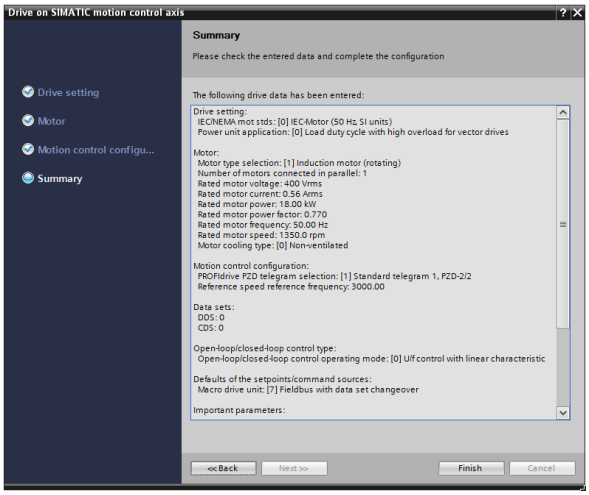
No.	Action	Picture
	Configuring the SIMATIC S7-1500	
6.	Go to the Device configuration of the CPU.	
7.	Configure the PROFINET interface: 1. In the Device configuration, open the “Properties” of the CPU. 2. In the tree, go to “Ethernet addresses” of the PN_interface [X1]. 3. Select “Set IP address in the project” and enter the desired IP address. 4. Add a new subnet and select it. 5. Select “Generate PROFINET device name automatically”.	
8.	Insert a “TM Count 2x24V”. 1. In the “Devices & networks” editor, go to the “Device view”. 2. Select “PLC_1”. 3. Then use drag and drop to move the “TM Count 2x14V” from the catalog to slot 2. In the catalog, the “TM Count 2x24V” can be found in … > TM > Count > TM Count 2x24V	

No.	Action	Picture
9.	Parameterize the “TM Count 2x24V”. 1. In the “Devices & networks” editor, go to the “Device view”. 2. Select the “TM Count 2x14V” in slot 2. 3. Open the “Properties”. 4. Select “Channel 0”. 5. Select “Position input for Motion Control”. 6. Enter the data of your incremental encoder. Please note the selected signal evaluation for the parametrating of the technology object in the PLC.	
Inserting and networking the SINAMICS G120		
10.	Select the desired SINAMICS drive: 1. In the “Devices & networks” editor, go to the “Network view”. 2. Then use drag and drop to move the required SINAMICS G120 from the catalog to the graphic area. In the catalog, the SINAMICS drive can be found in … >Drives & starters >SINAMICS drives >SINAMICS G120(D,P) >Control modules or >Drives & starters >SINAMICS drives >SINAMICS G120C >Profibus DP or PN Alternatively, you can also click on “Add new device” in the tree and add the SINAMICS in the same way as previously the SIMATIC CPU.	 The screenshot shows the selection of a SINAMICS G120 with PROFINET.

No.	Action	Picture
11.	When using a SINAMICS G120 with PROFINET: Drag the mouse to connect the right Ethernet port of the SIMATIC S7 to the one of the SINAMICS G120.	
	When using a SINAMICS G120 with PROFIBUS: Drag the mouse to connect the two PROFIBUS ports.	

No.	Action	Picture
	Configuring the SINAMICS G120	
12.	When using a SINAMICS G 120C, skip this point. When using a SINAMICS G120, G120D or G120P, you have to define the power module: 1. In the “Devices & networks” editor, select the “Device view”. 2. Select the drive. 3. Insert the power module from the catalog.	
13.	In the “Devices & networks” editor, go to the Properties of the SINAMICS drive. 1. Select “Device view”. 2. Select the drive. 3. Click on “Properties”.	
14.	When using a SINAMICS G120 with PROFINET: In >PROFINET interface >Ethernet addresses, check the IP address of the SINAMICS drive.	

No.	Action	Picture
	When using a SINAMICS G120 with PROFIBUS: In >PROFIBUS address, check the address of the SINAMICS drive.	
15.	In >Cyclic data exchange >Actual value, make sure that “Standard telegram 1” is selected.	 or 
Parameterizing the SINAMICS G120		
16.	Perform “basic commissioning of the drive on a SIMATIC motion control axis” with the aid of the wizard. To do so, select >Drive_1 [G120…] >Parameter in the Project tree, … and click on the “Drive on SIMATIC motion control axis” wizard.	

No.	Action	Picture
17.	The wizard is self-explanatory. Enter your motor data here. Make sure that the same telegram as in the previous step is selected at this point. A summary is displayed before you complete the parameterization with “Finish”. This summary can be backed up using copy and paste.	

The parameterization in the application example is shown below:

Drive setting:
IEC/NEMA mot stds: [0] IEC-Motor (50 Hz, SI units)
Power unit application: [0] Load duty cycle with high overload for vector drives

Motor:
Motor type selection: [1] Induction motor (rotating)
Number of motors connected in parallel: 1
Rated motor voltage: 400 Vrms
Rated motor current: 0.56 Arms
Rated motor power: 18.00 kW
Rated motor power factor: 0.770
Rated motor frequency: 50.00 Hz
Rated motor speed: 1350.0 rpm
Motor cooling type: [0] Non-ventilated

Motion control configuration:
PROFIdrive PZD telegram selection: [1] Standard telegram 1, PZD-2/2
Reference speed reference frequency 3000.00

Data sets:
DDS: 0
CDS: 0

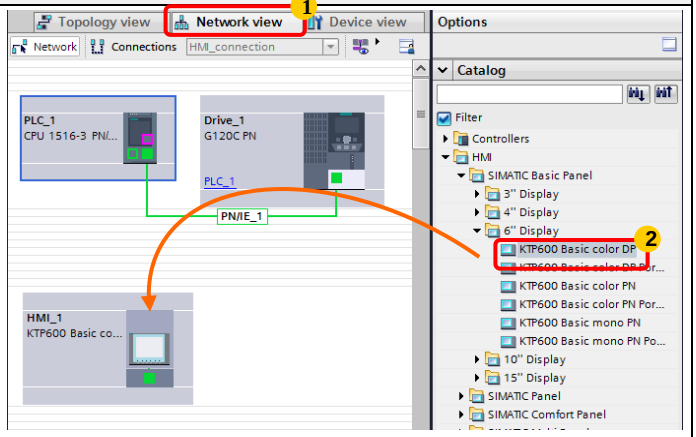
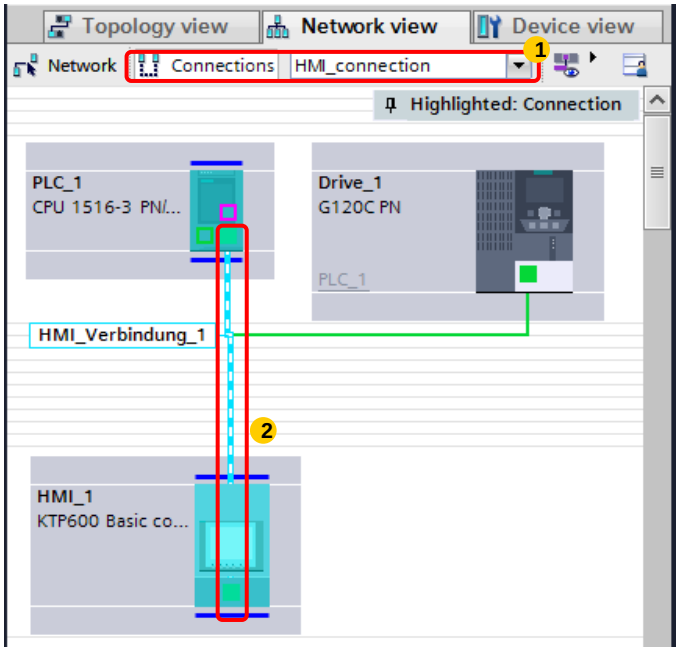
Open-loop/closed-loop control type:
Open-loop/closed-loop control operating mode: [0] U/f control with linear characteristic

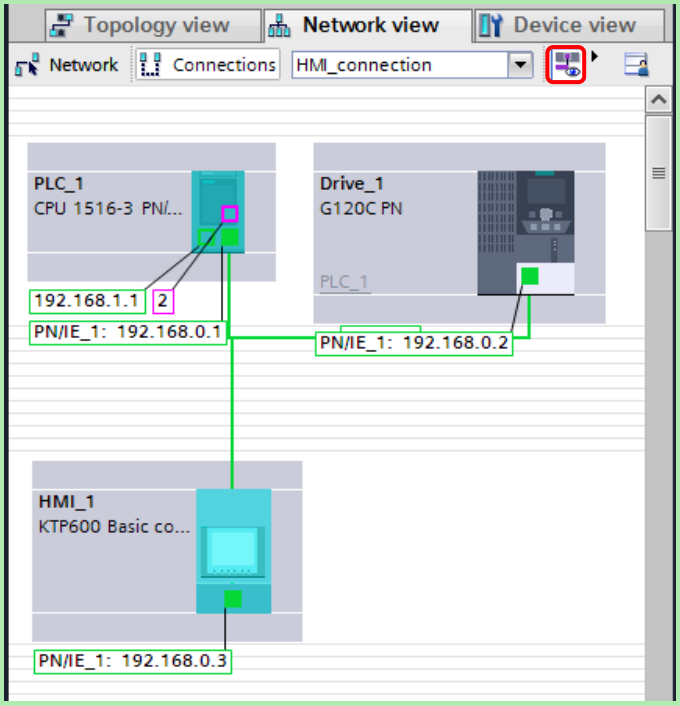
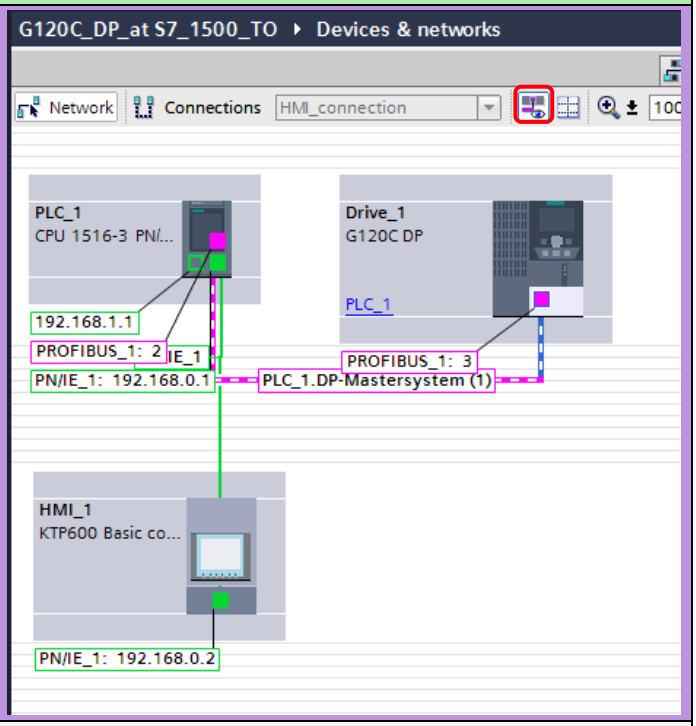
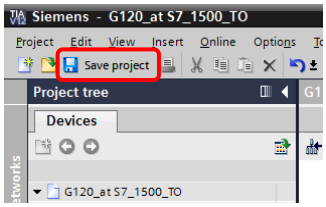
Defaults of the setpoints/command sources:
Macro drive unit: [7] Fieldbus with data set changeover

Important parameters:
Current limit: 0.84 Arms
Minimum speed: 0.000 rpm
Maximum speed 1500.000 rpm
Ramp-function generator ramp-up time: 0.000 s
Ramp-function generator ramp-down time: 0.000 s
OFF3 ramp-down time: 0.000 s

Drive functions:
Motor data identification and rotating measurement: [0] Inhibited
Automatic calculation motor/control parameters: [1] Complete calculation

Please note the values of the reference and maximum speed, You have to use this values in the cvonfiguration of the technology objects in the PLC programming.

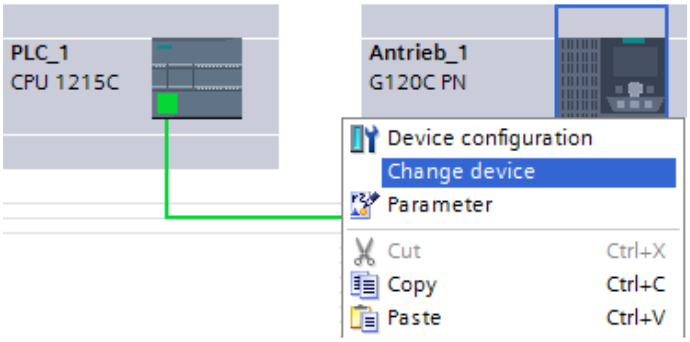
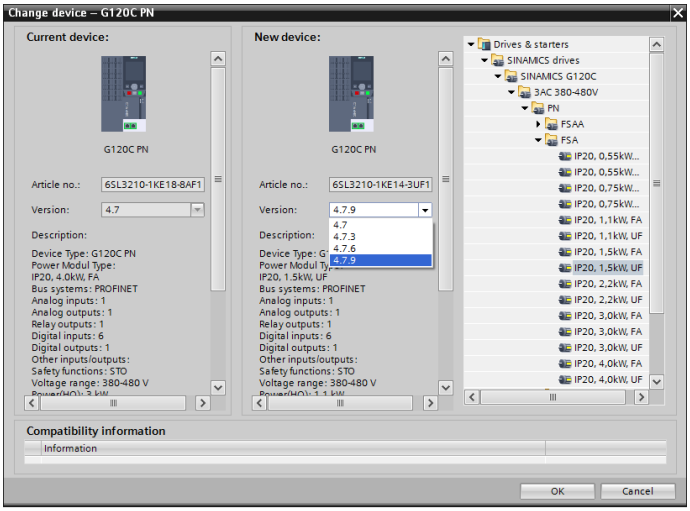
No.	Action	Picture
	Inserting and networking the KTP600	
18.	Select the desired HMI operator panel: 1. In the “Devices & networks” editor, go to the “Network view”. 2. Then use drag and drop to move the required KTP600 from the catalog to the graphic area. In the catalog, the KTP600 can be found in … >HMI >SIMATIC Basic Panel >6" Display	
19.	Connect the HMI operator panel to the SIMATIC controller: 1. Activate connection mode and from the drop-down list, select “HMI connection”. 2. Drag the mouse to create a graphic connection between the Ethernet ports of the KTP600 and the SIMATIC PLC.	 The screenshot shows the SINAMICS G120 with PROFINET.

No.	Action	Picture
20.	When using PROFINET: Show the addresses. The KTP600 is automatically assigned the next available IP address 192.168.0.2.	
	When using PROFIBUS: Show the addresses. The KTP600 is automatically assigned the next available IP address 192.168.0.2.	
	Saving the project	
21.	Save the project	

Change device of SINAMICS G120

It is possible to change the SINAMICS after the configuration.

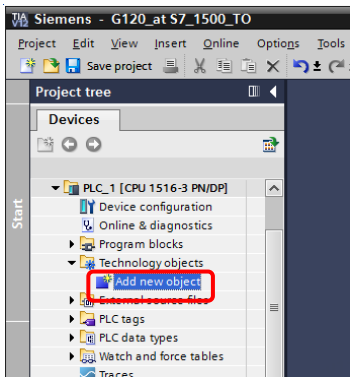
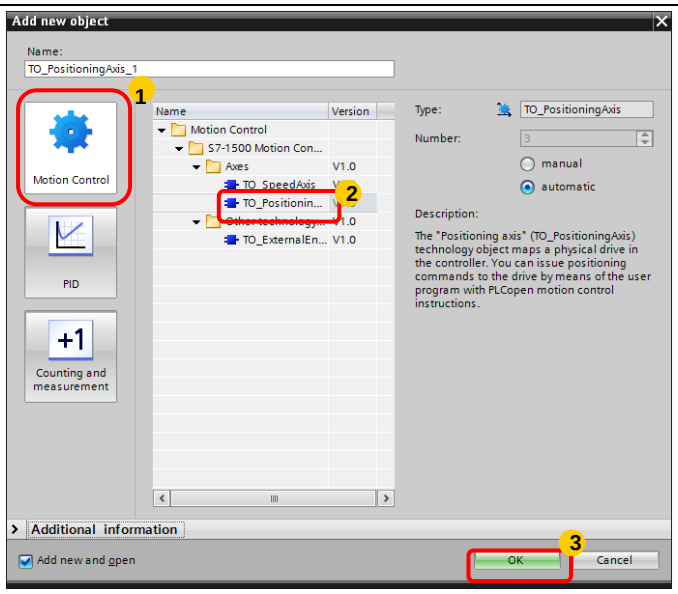
Table 4-2: change device

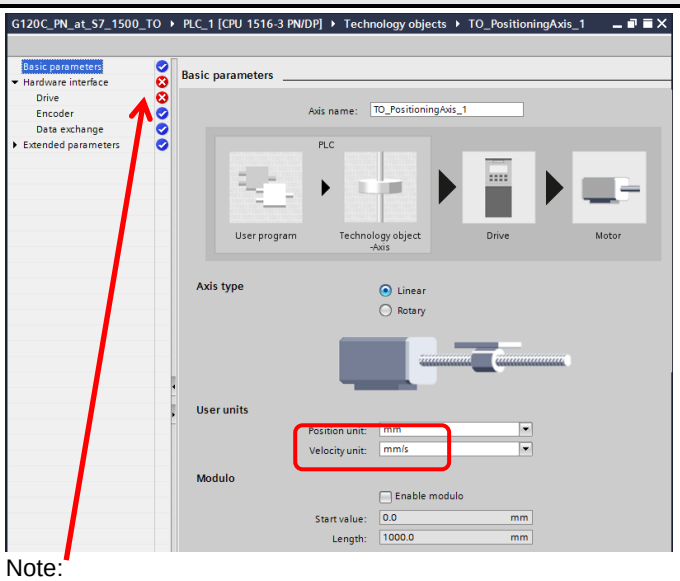
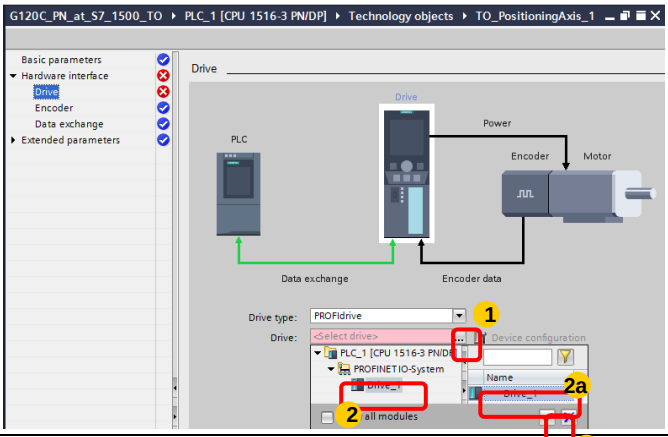
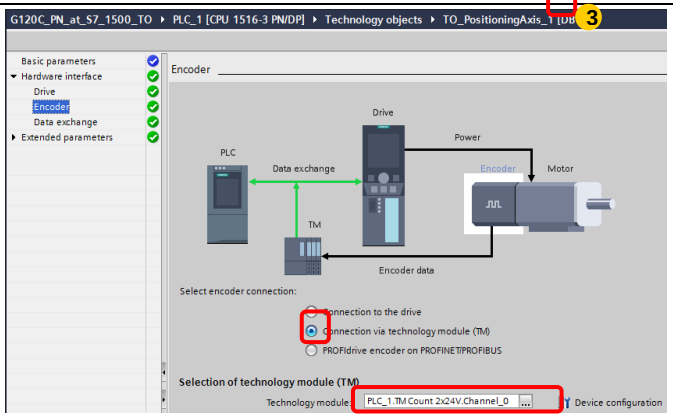
No.	Action	Picture
1.	Select the SINAMICS G120 and open the mask for change.	
2.	It is possible to change the size and the firmware-version of a SINAMICS G120C. The firmware-version is changeable by all SINAMICS G120.	

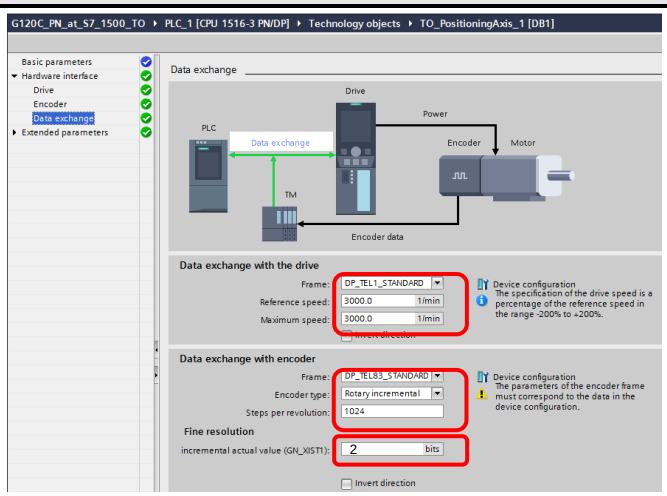
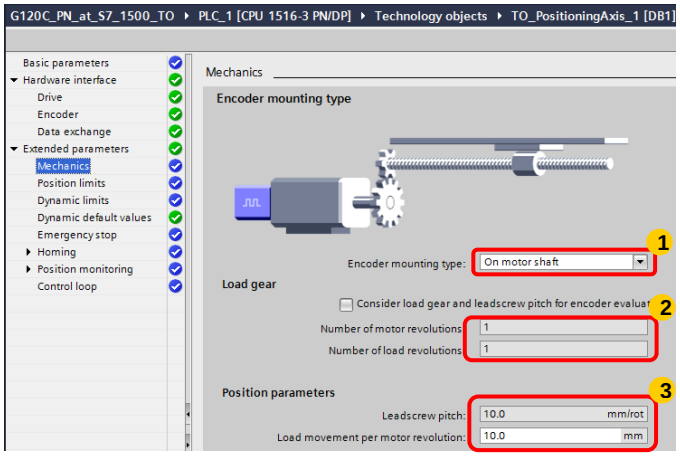
NOTE The procedure to change the SINAMICS G120 is identical by PROFIBUS and PROFINET-devices.

4.2 Creating the Positioning axis technology object

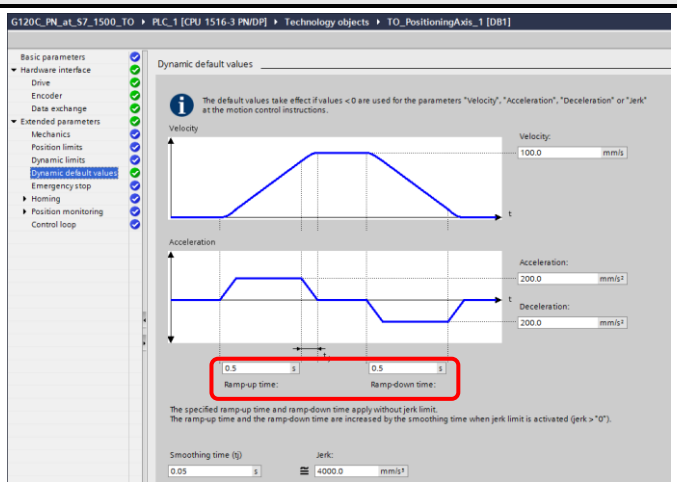
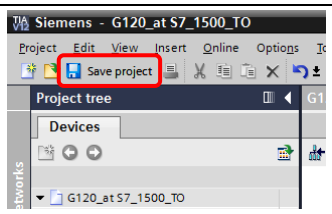
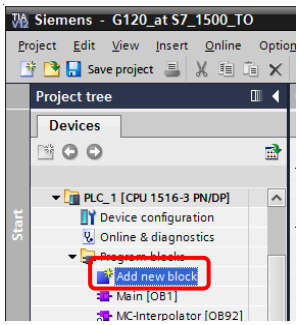
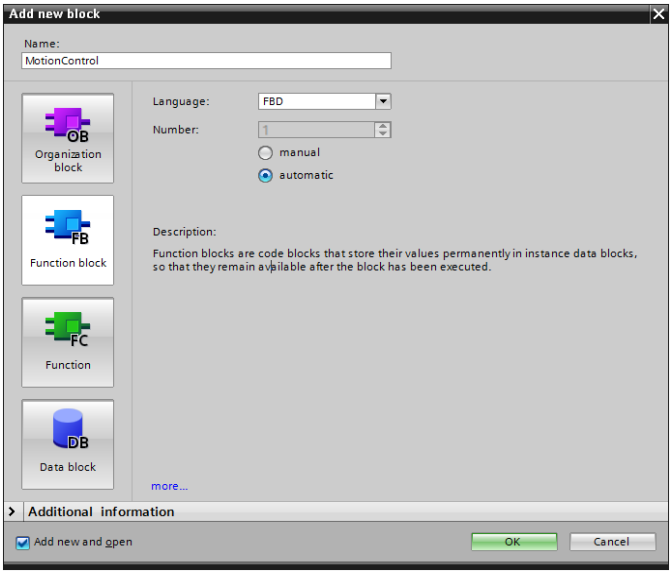
Table 4-3: Creating the project configuration

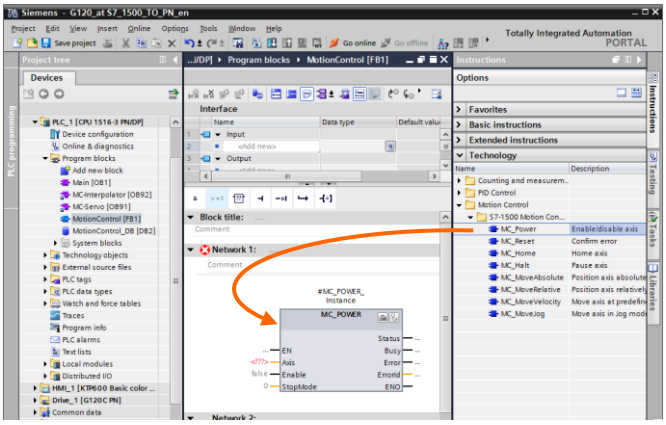
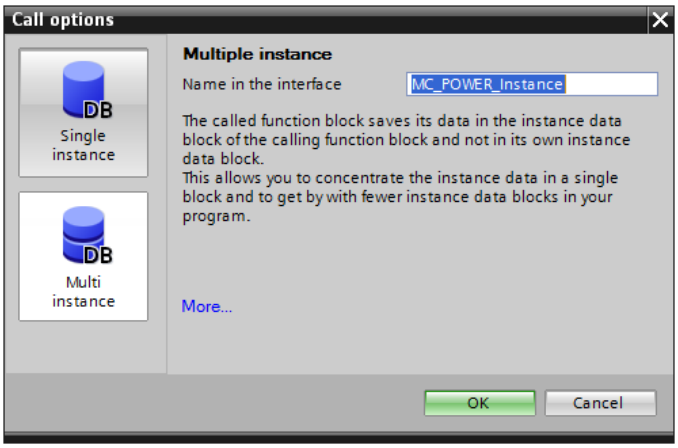
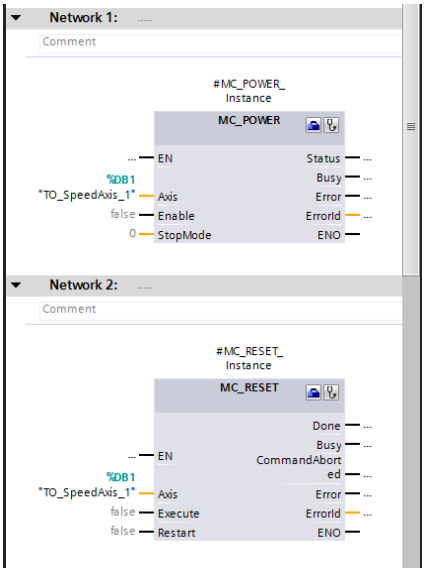
No.	Action	Picture
	Creating the technology object	
1.	Open the project created in 4.1.	
2.	• In the tree, open the controller. • Double-click on “Add new object”.	
3.	First select 1. “Motion Control” and then select 2. the S7-1500 technology object “TO_PositioningAxis”. 3. Click on OK to create the object.	

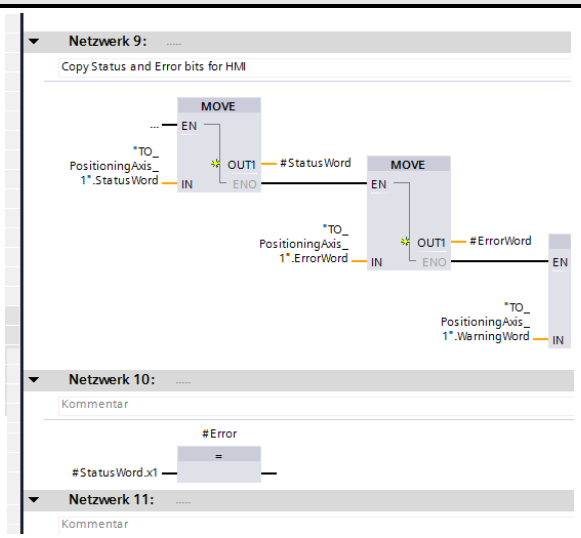
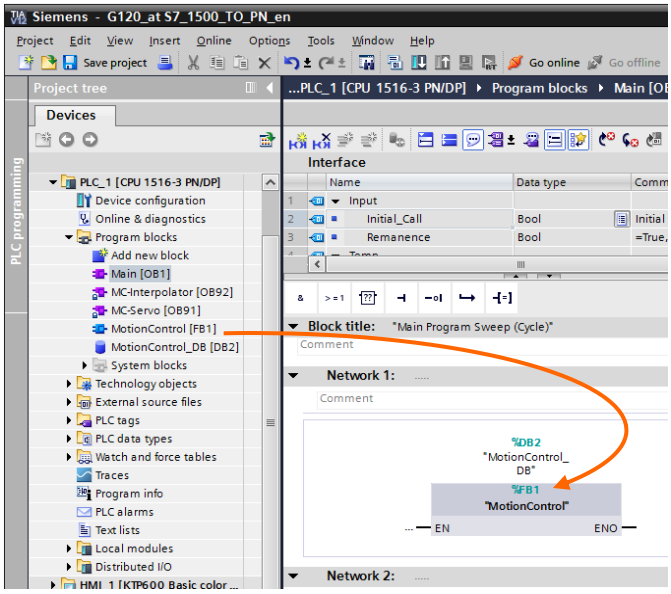
No.	Action	Picture
4.	The technology object configuration opens. In Basic parameters, you can define the unit to be used. For this example, you should use “mm” and “mm/s”.	 Note: The “blue” check mark means that default values are used. The “red” X means that values are missing or invalid. The “green” check mark means that values were entered.
5.	In “Hardware interface > Drive”, select the SINAMICS to be used with the technology object. 1. Click on “…” to open the selection dialog. 2. Select the SINAMICS drive to be used. 3. Confirm the entry.	
6.	In “Encoder”, select “Connection via technology module (TM)” and channel 0 of the TM Count 2x24V.	

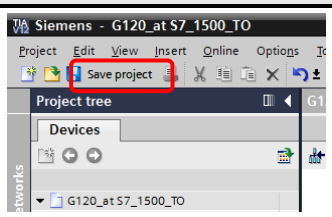
No.	Action	Picture
7.	In “Hardware interface > Data exchange”, specify the same telegram and the same standardization as in the parameterization of the SINAMICS G120 and the TM 2x24V: 1. Drive a. Make sure that telegram 1 is selected. b. Make sure that the reference speed is the same as in Step 17 (e.g.3000 rev/min.) c. Make sure that the maximum speed is the same as in Step 17 (e.g.1500 rev/min) 2. Encoder a. Make sure that telegram 83 is selected b. Make sure that the correct encoder type is set. In the example: Rotary incremental c. Enter the number of steps per revolution. In the example: 1024 d. Set Fine resolution to 2^4.	
8.	In “Extended parameters”, you can enter more axis data. In “Extended parameters > Mechanics”, specify 1. the encoder mounting type and 2. if necessary, gear information and 3. leadscrew information.	

[4] Use 0 for Single, 1 for Double and 2 for Quadrupel signal evaluation in the TM Count. (as used in Table 4-1 step 9)

No.	Action	Picture
9.	In “Extended parameters”, you can enter more axis data. In “Dynamic default values”, specify the default values for the ramp-up and ramp-down time. For the example, extend these times to 0.5 s.	
10.	Save the project	
Inserting the technology function blocks		
11.	Create a new block in the controller.	
12.	1. Select Function block. 2. Assign the block a name, e.g. Motion Control. 3. Select a programming language, e.g. FBD. 4. Click on “OK”.	

No.	Action	Picture
13.	The new FB opens automatically. From “Instructions > Technology > Motion Control > S71500 Motion Control”, insert the following blocks: • MC_Power • MC_Reset • MC_Home • MV_Halt • MC_MoveVelocity • MC_MoveJog • MC_MoveRelative • MC_MoveAbsolute	
	When inserting the blocks, you have to select whether you want to create a separate instance DB for each FB or store the instance data as a multi-instance in the instance DB (to be created) of FB Motion Control. For the example, you should select multi-instance.	
14.	At the Axis interface of the “MC_...” blocks, always select “TO_SpeedAxis_1”.	 Example of the interconnection of the Axis interface.

<table>
<tr><th>No.</th><th>Action</th><th>Picture</th></tr>
<tr><td>15.</td><td>Copy the status words and bits of the axis to the static variables of the FB.</td><td> 
</td></tr>
<tr><td></td><td colspan="2">
<table>
<tr><th>Source</th><th>Static variable</th><th>DataType</th></tr>
<tr><td>"TO_PositioningAxis_1".StatusWord</td><td>#StatusWord</td><td>DWord</td></tr>
<tr><td>"TO_PositioningAxis_1".ErrorWord</td><td>#ErrorWord</td><td>DWord</td></tr>
<tr><td>"TO_PositioningAxis_1".WarningWord</td><td>#WarningWord</td><td>DWord</td></tr>
<tr><td>"TO_PositioningAxis_1".StatusPositioning.TargetPosition</td><td>#TargetPosition</td><td>LReal</td></tr>
<tr><td>"TO_PositioningAxis_1".ErrorDetail.Number</td><td>#ErrorDetail_Number</td><td>UInt</td></tr>
<tr><td>"TO_PositioningAxis_1".ErrorDetail.Reaction</td><td>#ErrorDetail_Reaction</td><td>UInt</td></tr>
<tr><td>#StatusWord.X1</td><td>#Error</td><td>Bool</td></tr>
<tr><td>#StatusWord.X5</td><td>#HomeDone</td><td>Bool</td></tr>
<tr><td>"TO_PositioningAxis_1".StatusDrive.CommunicationOK</td><td>#Drive_CommunicationOK</td><td>Bool</td></tr>
<tr><td>"TO_PositioningAxis_1".StatusDrive.Error</td><td>#Drive_Error</td><td>Bool</td></tr>
<tr><td>"TO_PositioningAxis_1".StatusDrive.InOperation</td><td>#Drive_InOperation</td><td>Bool</td></tr>
</table>
</td></tr>
<tr><td>16.</td><td>Open the “Main [OB1]” block and in this block, call FB “MotionControl”.
Confirm the creation of an instance DB.</td><td> 
</td></tr>
</table>

No.	Action	Picture
17.	Save the project.	

4.3 Safe Torque Off (STO) via Terminals with Safety Integrated

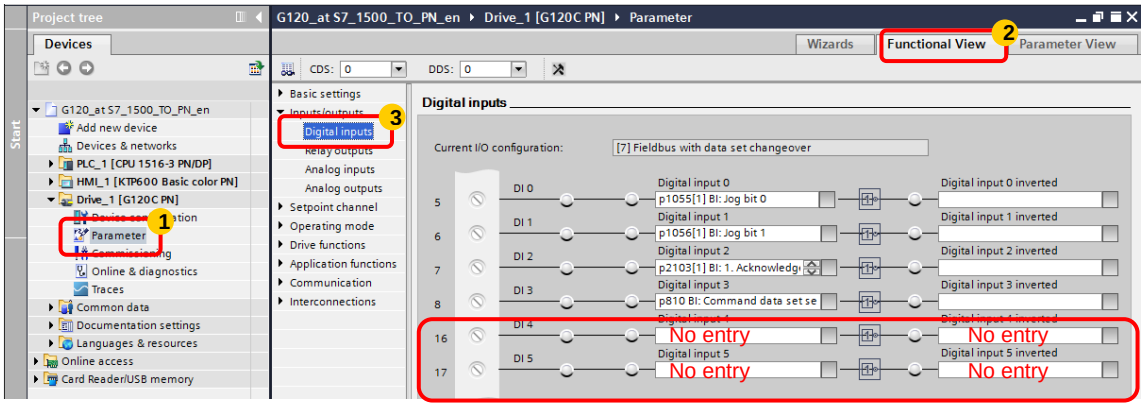
This function is optional and not implemented in the STEP 7 sample projects.

Requirements

- Make sure that the digital inputs DI 4 and DI 5 (terminals 16 and 17) of the G120 that form the fail-safe input F-DI are not assigned a “standard” function. This is ensured in the sample project and in the factory settings.

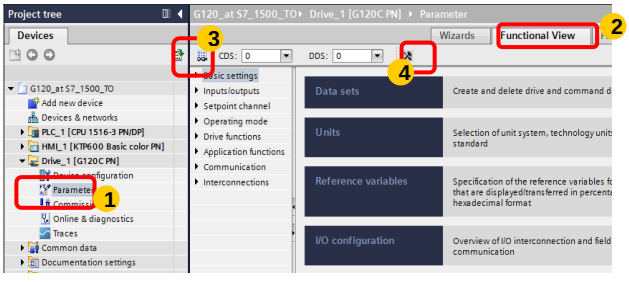
Figure 4-1: Digital inputs

Figure 4-2



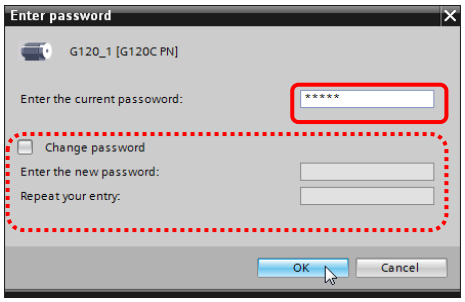
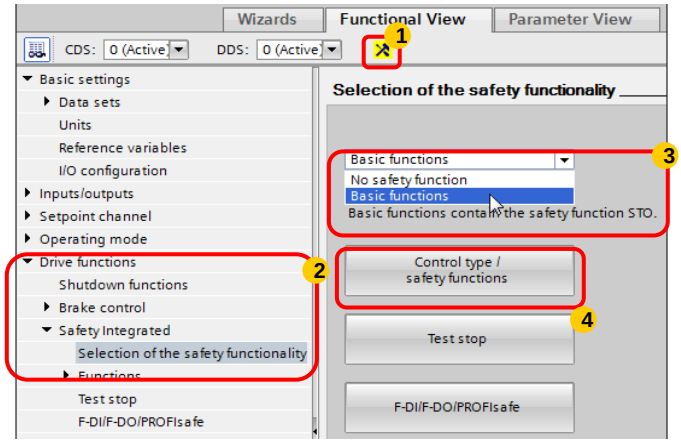
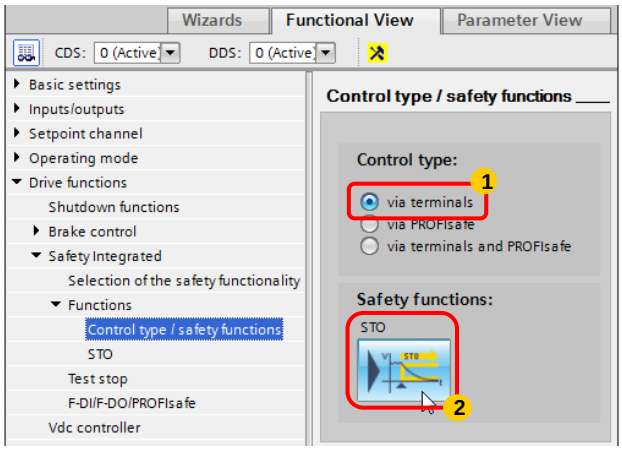
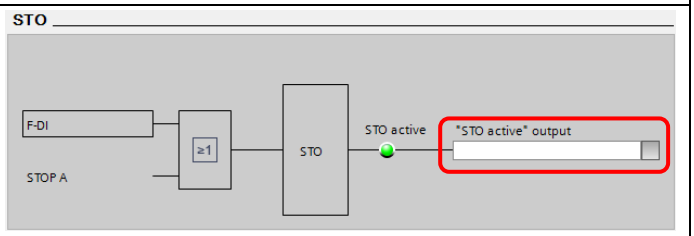
- For test purposes, apply 24V to DI 4 and DI 5 or connect an emergency stop control device. Do not forget to connect the reference potential of inputs DI 4 and DI 5 to ground. The wiring of the signals is shown in chapter 5.1 Connection diagram.

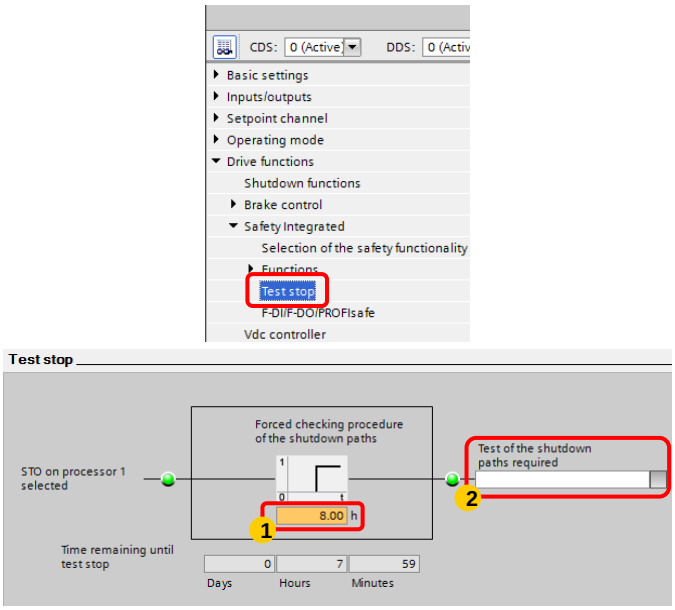
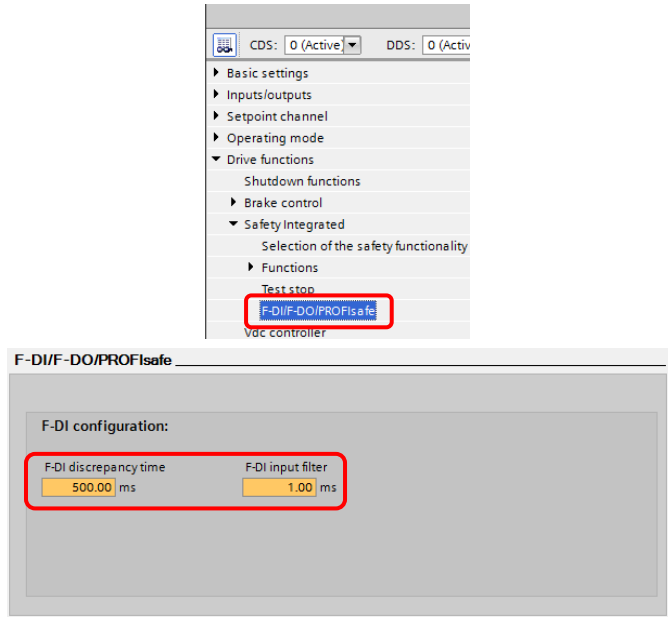
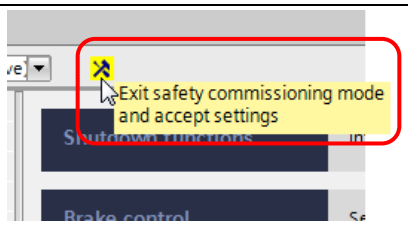
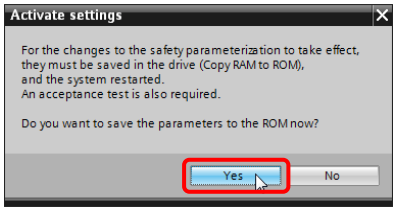
Activating safety functions

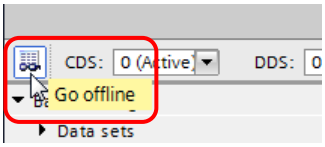
No.	Action	Picture
1.	1. Navigate to the configuration editor. 2. Select the function view. 3. Go online. 4. Activate the safety commissioning mode.	

The safety commissioning mode is displayed as follows:

- The function view is not online.
- The function view is online, safety functions are not activated.
- Safety commissioning is active.

No.	Action	Picture
2.	Enter the current password. Change the default password “0” of a factory new SINAMICS G120. Note: When resetting the safety parameters to factory settings, the assigned password remains.	
3.	Select the safety functionality. 1. Make sure that the safety commissioning is activated. 2. Navigate to the selection of the safety functionality. 3. Select the “Basic functions”. 4. Click on the “Control type / safety functions” button.	
4.	Select control type and safety function. 1. Select the control type “via terminals” (default setting). 2. Click on the “STO” safety function (the only one available).	
5.	Output “STO active” On demand you can interconnect the “STO active” output. However, this is not necessary in this application.	

No.	Action	Picture
6.	Test stop On demand you can interconnect... 1. the time for the test stops. 2. the “Test of the shutdown paths required” output. However, this is not necessary in this application.	
7.	F-DI configuration If necessary, you can change the constants for discrepancy time and input filter for the fail-safe input. However, this is not necessary in this application.	
8.	Exit the safety commissioning mode by pressing the button.	
9.	Save the changed safety parameters in ROM.	

No.	Action	Picture
10.	Terminate the online connection by pressing the button.	
11.	At the SINAMICS G120 you perform a “POWER ON”. (Keep voltage off until all LEDs are dark.)	

4.4 Controlling the safety functions of the SINAMICS G120 via PROFIsafe

This function is optional and not implemented in the STEP 7 sample project.

4.4.1 Requirements

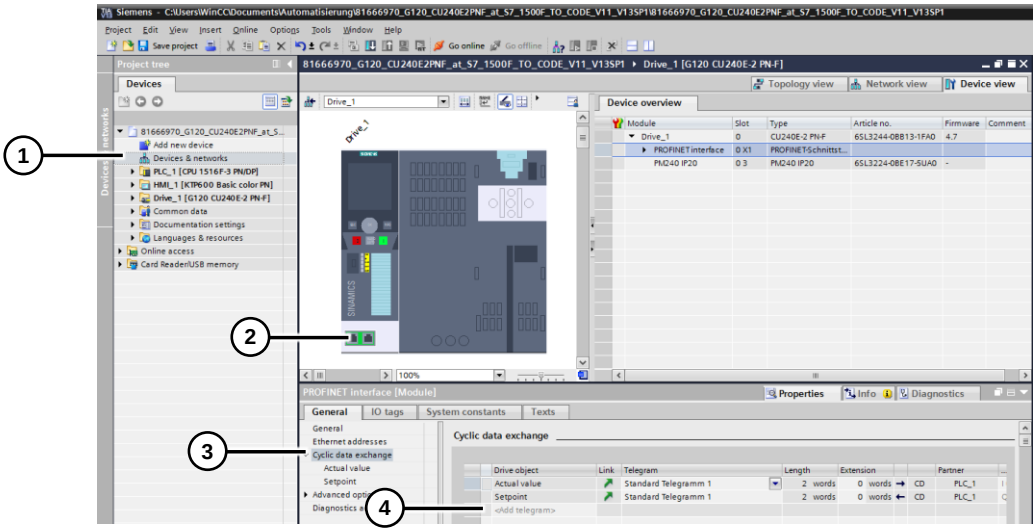
1. To be able to use PROFIsafe, you have to use an F-CPU.
2. You must have configured a SINAMICS that supports PROFIsafe.
3. It is assumed that basic commissioning of the drive has already been performed and only the safety functions need to be activated.
4. You should first read the "Safety Integrated Function Manual for SINAMICS G" (see \5\). This manual describes the parameterization with STARTER; however, the procedure with Startdrive is very similar.
   Through the integration of the SIMATIC and the SINAMICS in TIA Portal, the PROFIsafe address is assigned automatically and it is no longer necessary to enter it manually.

Note If you want to use the sample project, open the PLC station in "Devices & networks", right-click on the CPU, select "Change device" and replace the CPU with an F-CPU.

4.4.2 Creating a PROFIsafe telegram

1. In "Devices & networks", open the SINAMICS station
2. Click on the PROFIBUS or PROFINET interface
3. In the "General" tab, click on "Cyclic data exchange"
4. Click on "Add telegram" and select "Add safety telegram"

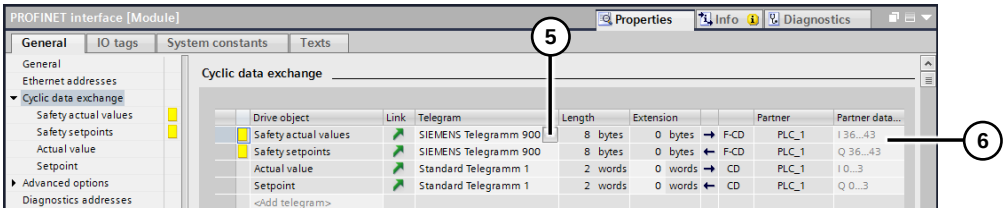
Figure 4-3



A PROFIsafe telegram is automatically inserted in front of telegrams for process data exchange. (as shown in **Fehler! Verweisquelle konnte nicht gefunden werden.**)

5. If you want to use the F-DI inputs of the SINAMICS (only possible with CUs that support the extended safety functions) in the SIMATIC as F-DI, go to PROFIsafe telegram 900.

Figure 4-4



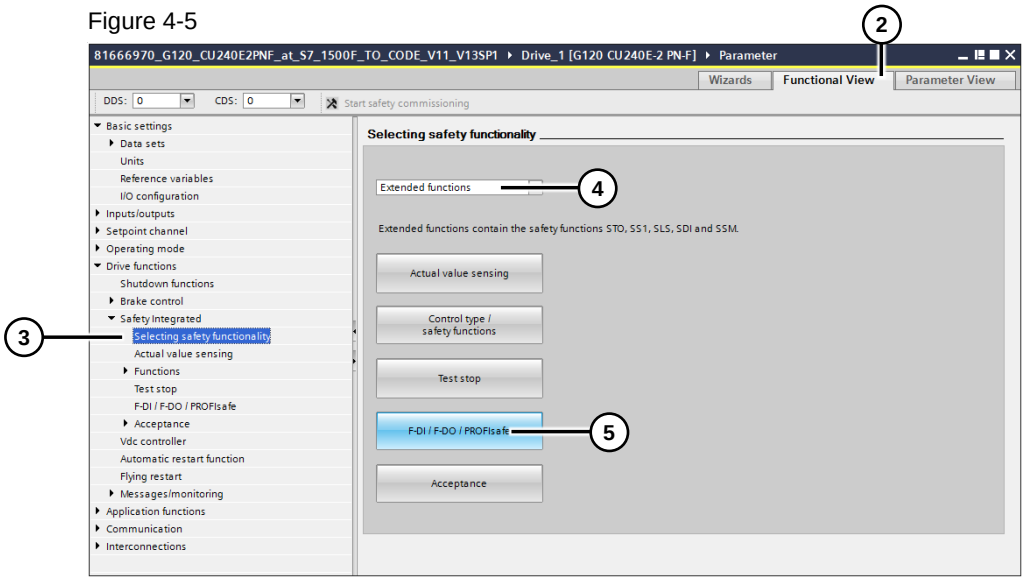
6. Note down the first I/O address assigned to the PROFIsafe telegram. (In the example: Input andr output word 36)
7. Save the project
8. Compile the PLC and load the project to the SIMATIC.

4.4.3 Parameterizing the safety functions in the drive

It is assumed that the drive has already been commissioned and only the safety functions need to be activated.

1. In the project tree, go to the drive and select “Parameter”
2. Go to the “Functional view” tab
3. Select “Drive functions > Safety Integrated > Selecting safety functionality”

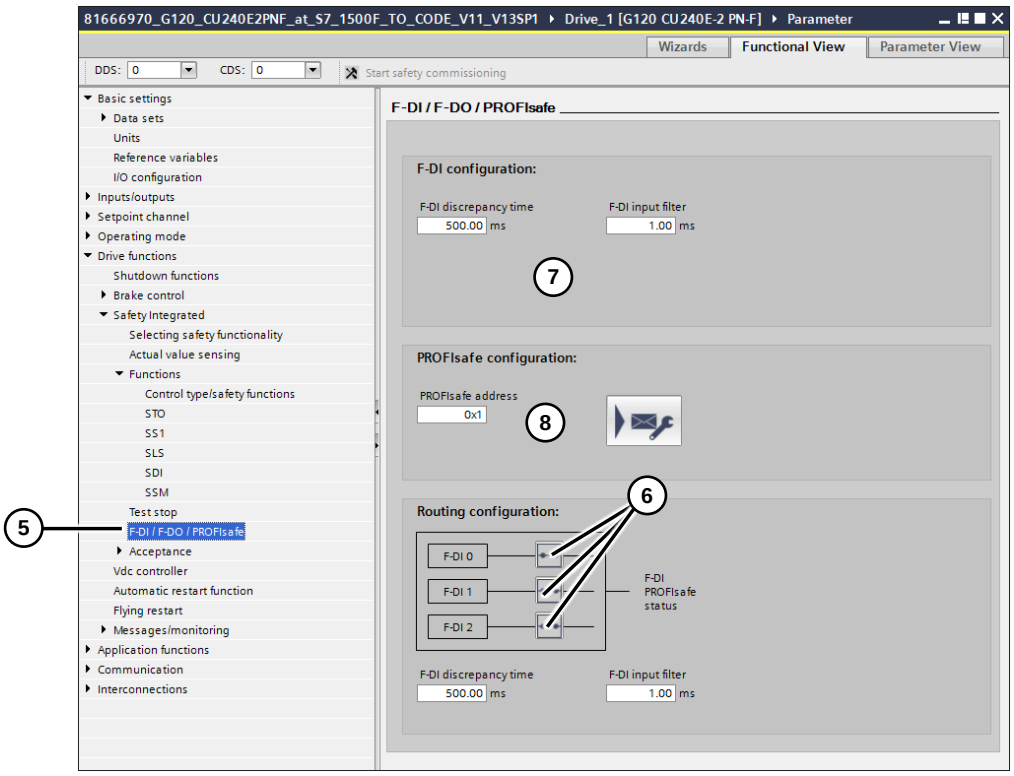
Figure 4-5



4. Select “Basic functions” (STO) or “Extended functions” (STO and other safety functions)
5. Click on F-DI / F-DO / PROFIsafe
6. If you are using PROFIsafe telegram 900, the “Routing configuration” area allows you define which F-DIs of the SINAMICS will be transferred to the F-CPU. For this purpose, create “bridges” for the F-DIs to be transferred. Please also note the restriction regarding F-DIs described in step 14

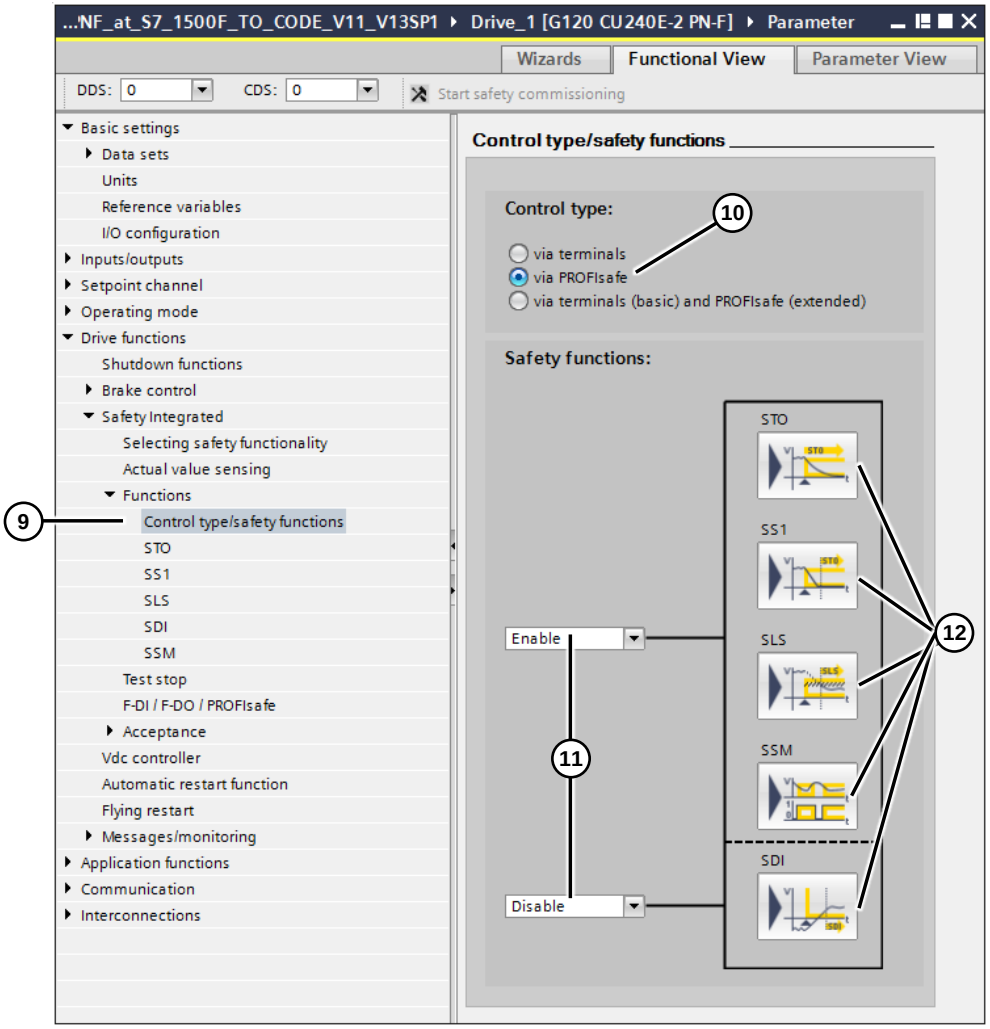
7. If necessary, you can customize the other parameters of the F-DIs of the SINAMICS to your requirements
8. The PROFIsafe settings have already been defined in the telegram selection process and do not have to be changed here

Figure 4-6



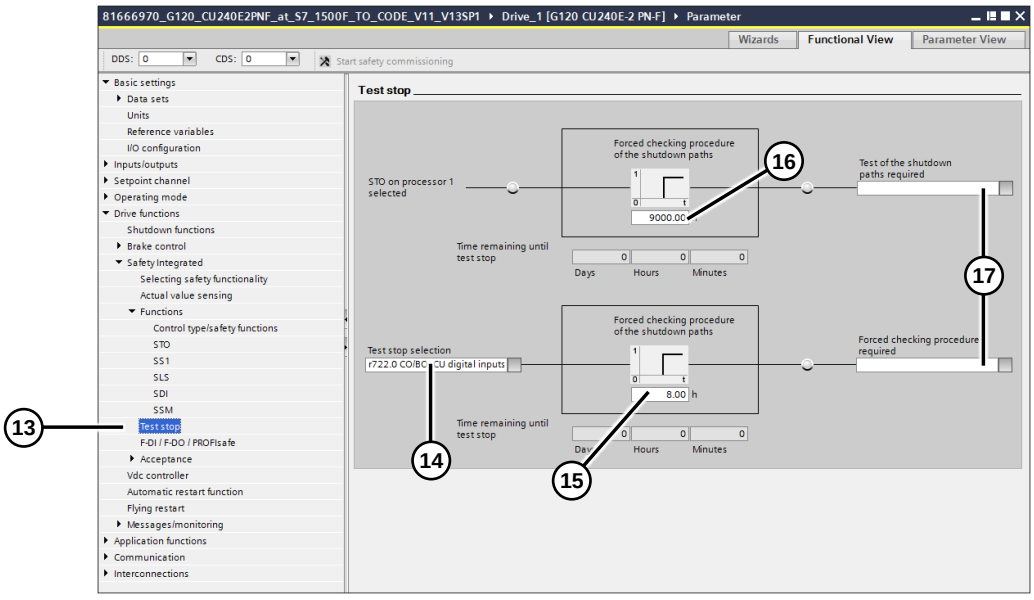
9. Now select “Control type/safety functions”
10. Select “via PROFIsafe”
11. Enable the safety function modules you want to use
12. Parameterize the safety functions according to your requirements

Figure 4-7



13. Select “Test stop”
14. Select a signal for the forced checking procedure of the shutdown paths, for example
    - A digital input of the SINAMICS, e.g. DI0 (r722.x)
      Please note that, for example, F-DI0 can then no longer be used, because DI0 is a channel of F-DI0.
      Furthermore, you should delete the standard assignments of the DIs (DO0, e.g. jog) in “Inputs/outputs > Digital inputs”. To ensure that the DI triggers only one function.
    - One bit in in one of the process data words PZD 3 to 5 (r2093.x to r2095.x)
      Please note that the control word is transferred in PZD1. However, it cannot be used because it is created by the Axis technology object. If necessary, you have to parameterize a telegram extension to transfer another (custom) control word in PZD 3, 4 or 5.
15. Specify a time for the forced checking procedure of the shutdown paths.
16. If you are using the extended safety functions, you can set the time for the forced checking procedure of the shutdown paths for STO to the maximum value: 9000h.
17. You can assign the signal that a forced checking procedure is required to a DO (p730 or p731)
    When using only STO, use the top input field; when using the extended functions, use the bottom input field.

    Figure 4-8

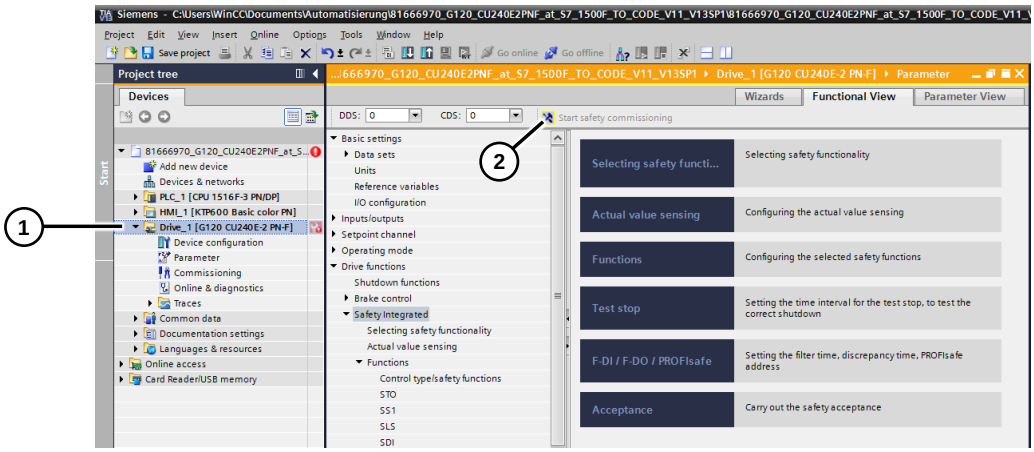


18. Save the project

4.4.4 Activating the safety functions in the drive

1. In the project tree, select the drive and download the parameterization to the SINAMICS.
   After downloading, the SINAMICS has a pending fault because the safety settings are still inconsistent.
2. Go online and click on “Start safety commissioning”.

   Figure 4-9



3. In the dialog that opens, enter a new password.
4. Complete safety commissioning (where you completed (2)) and save the parameters to the ROM.
5. Go offline and disconnect the SINAMICS from the supply[5] until all LEDs are off.
6. Reconnect the SINAMICS to the supply.
   After startup of the SINAMICS, the green RDY LED should be lit and the yellow SAFE LED should flash.
   The flashing yellow SAFE LED signals that the safety functions are active; this is due to the fact that the bits in safety control word 1 have not yet been set.

   Generally, the SINAMICS will also output the warning that the forced checking procedure is required.

[5] If you separately supply the CU with 24V, disconnect this supply as well.

4.4.5 Controlling the safety functions in the safety program of the SIMATIC

Notes

- Please note that the safety functions of the SINAMICS are **de**activated with the TRUE state.
- Shutdown by a safety function will **not** be signaled as an error in the status word and therefore **not** be indicated in the axis status in the SIMATIC.

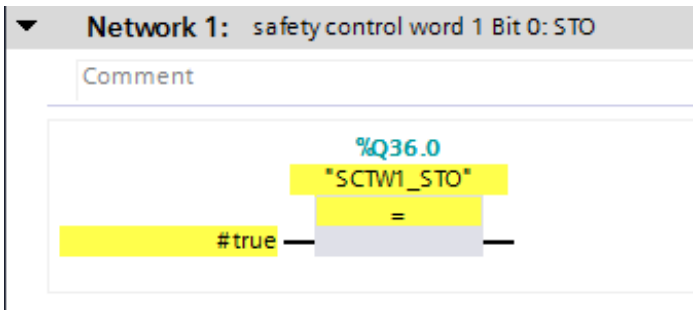
Access via I/O

The bits of the PROFIsafe telegram are accessed in the same way as the F-DIOs of the SIMATIC:
Safety control word 1 is transferred in the first word of the PROFIsafe telegram. Access must be performed to the individual bits, word access is not possible.

In the example, the PROFIsafe telegram starts at address 36.
(For safety control and status words, see chapter 4.4.6)

This is used to select or deselect the STO function in Q 36.0.

Figure 4-10 Example: #true variable output as STO



The activation status of the STO function can be read in I 36.0.

When PROFIsafe telegram 900 is used and the transmission of the signals is activated as described in step 6 in chapter 4.4.3, the states of the F-DI of the SINAMICS can be read in in I 39.0 to I 39.2 in the example.
These bits can be used like F-DIs.

Passivation/depassivation

Passivation/depassivation is performed in the same way as for F-DIOs of the SIMATIC.

Passivation is indicated by the QBAD signal in the associated F-I/O DB. The ACK_REI signal triggers reintegration.
In the example, the F-I/O DB is named “F00036_SINAMICSG_1”.

4.4.6 Safety control and status words

Safety control word 1 and/or safety status word 1 are transferred in PROFIsafe telegram 30.

Safety control word 5 and/or safety status word 5 are additionally transferred in PROFIsafe telegram 900.

Safety Control Words

Figure 4-11 Safety Control Word 1

Byte	Bit	Function	Comment			
0	0	STO	0	Select STO		
			1	Deselect STO		
	1	SS1	0	Select SS1		
			1	Deselect SS1		
	2, 3	*Not relevant*				
	4	SLS	0	Select SLS		
			1	Deselect SLS		
	5, 6	*Not relevant*				
	7	Internal event ack	0	Do not acknowledge faults		
			1 → 0	Acknowledge "Internal event" for a 1 → 0 signal change		
1	*0*	*Not relevant*				
	1	SLS level bit 0	Select SLS level		Bit 10	Bit 9
				Level 1	0	0
	2	SLS level bit 1		Level 2	0	1
				Level 3	1	0
				Level 4	1	1
	3	*Not relevant*				
	4	SDI positive	0	Select SDI with positive direction of rotation		
			1	Deselect SDI with positive direction of rotation		
	5	SDI negative	0	Select SDI with negative direction of rotation		
			1	Deselect SDI with negative direction of rotation		
	6, 7	*Not relevant*				

Figure 4-12 Safety Control Word 5

Byte	Bit	Function	Comment
0 … 1	0 … 15	*Reserved*	Assign the value 0 to the reserved bits.

Safety Status Words

Figure 4-13 Safety Status Word 1

Byte	Bit	Function	Comment			
0	0	Power removed	0	STO is not active		
			1	STO is active		
	1	SS1 active	0	SS1 is not active		
			1	SS1 is active		
	2, 3	*Not relevant*				
	4	SLS active	0	SLS is not active		
			1	SLS is active		
	5, 6	*Not relevant*				
	7	Internal Event	0	Fault-free operation		
			1	The inverter signals an "internal event"		
1	*0*	*Not relevant*				
	1	SLS level bit 0	SLS level is active		Bit 10	Bit 9
				Level 1	0	0
	2	SLS level bit 1		Level 2	0	1
				Level 3	1	0
				Level 4	1	1
	3	*Not relevant*				
	4	SDI positive active	0	SDI positive direction of rotation is not active		
			1	SDI positive direction of rotation is active		
	5	SDI negative active	0	SDI negative direction of rotation is not active		
			1	SDI negative direction of rotation is active		
	6	*Not relevant*				
	7	Status SSM	0	Absolute value of the speed is greater than the SSM limit value		
			1	Absolute value of the speed is less than the SSM limit value		

Figure 4-14 Safety Status Word 5

Byte	Bit	Function	Comment		SINAMICS G120	SINAMICS G120D
0	0 … 7	*Reserved*	-			
1	**8**	**Status of safety inputs**	0	LOW signal (0 V)	At terminals 5 and 6	At pins X7.2 and X7.4
			1	HIGH signal (24 V)		
	9		0	LOW signal (0 V)	At terminals 7 and 8	At pins X8.2 and X8.4
			1	HIGH signal (24 V)		
	10		0	LOW signal (0 V)	At terminals 16 and 17	At pins X9.2 and X9.4
			1	HIGH signal (24 V)		
	11 … 15	*Reserved*	-			

4.4.7 Sample project

The sample project with safety via PROFIsafe, “81666970_G120_CU240E2PNF_at_S7_1500F_TO_CODE_V11_V13SP1”, and the project without safety differ in the following aspects:

- An S7-1516**F**-3 PN/DP and a CU240E-2 PN F are used.
- The user program of the SIMATIC was extended by a simple safety program:
  - The safety program merely controls all safety functions of the SINAMICS with 1 and thus deselects them.
    This allows the user to move the SINAMICS with the active but deselected safety functions in the same way as with non-activated safety functions.
  - When the SINAMICS is passivated, a rising edge at the acknowledgement block (MC_Reset) in the standard program triggers reintegration of the SINAMICS.
- The standard user program was extended by a network to show the passivation of the SINAMICS on the HMI.
- The HMI was extended by a safety screen, see 0.

5 Installation and Commissioning

5.1 Connection diagram

Figure 5-1: Wiring for PROFINET

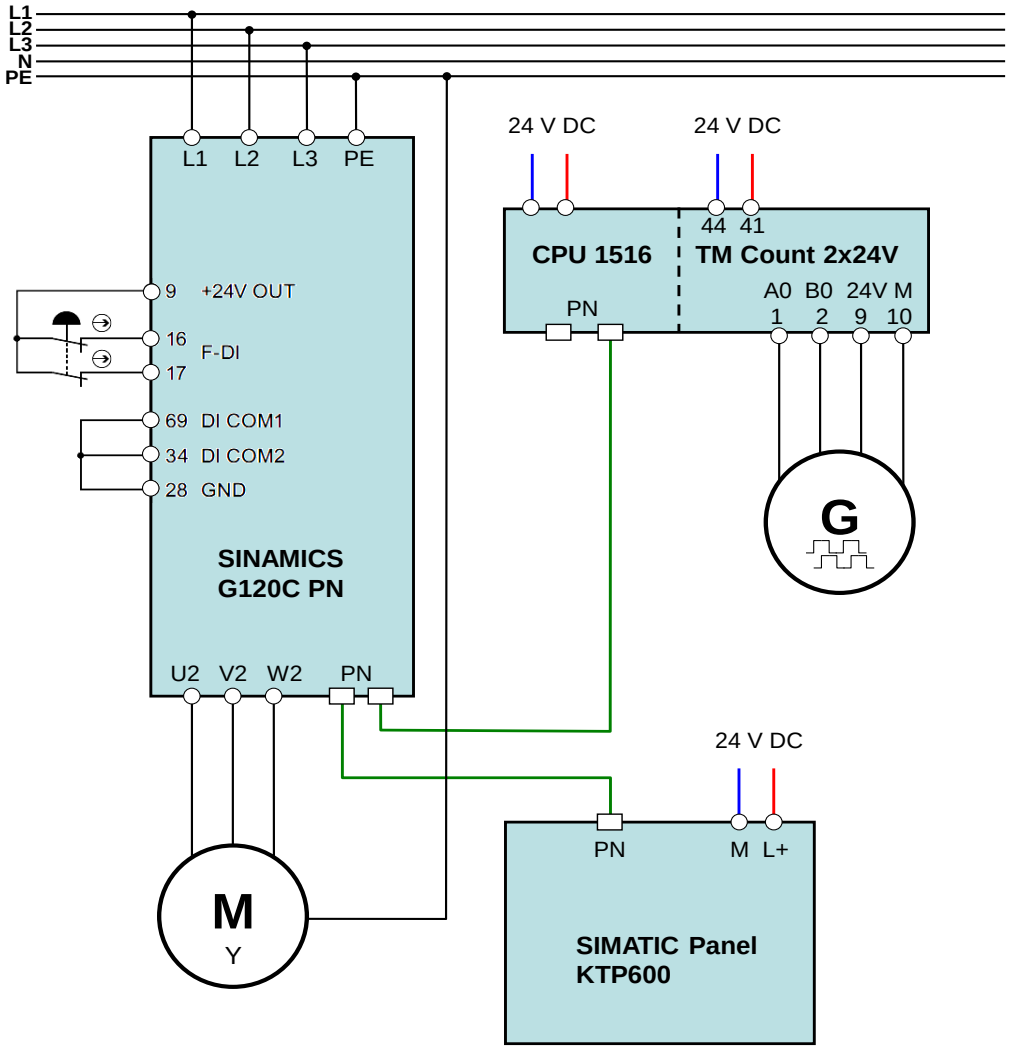
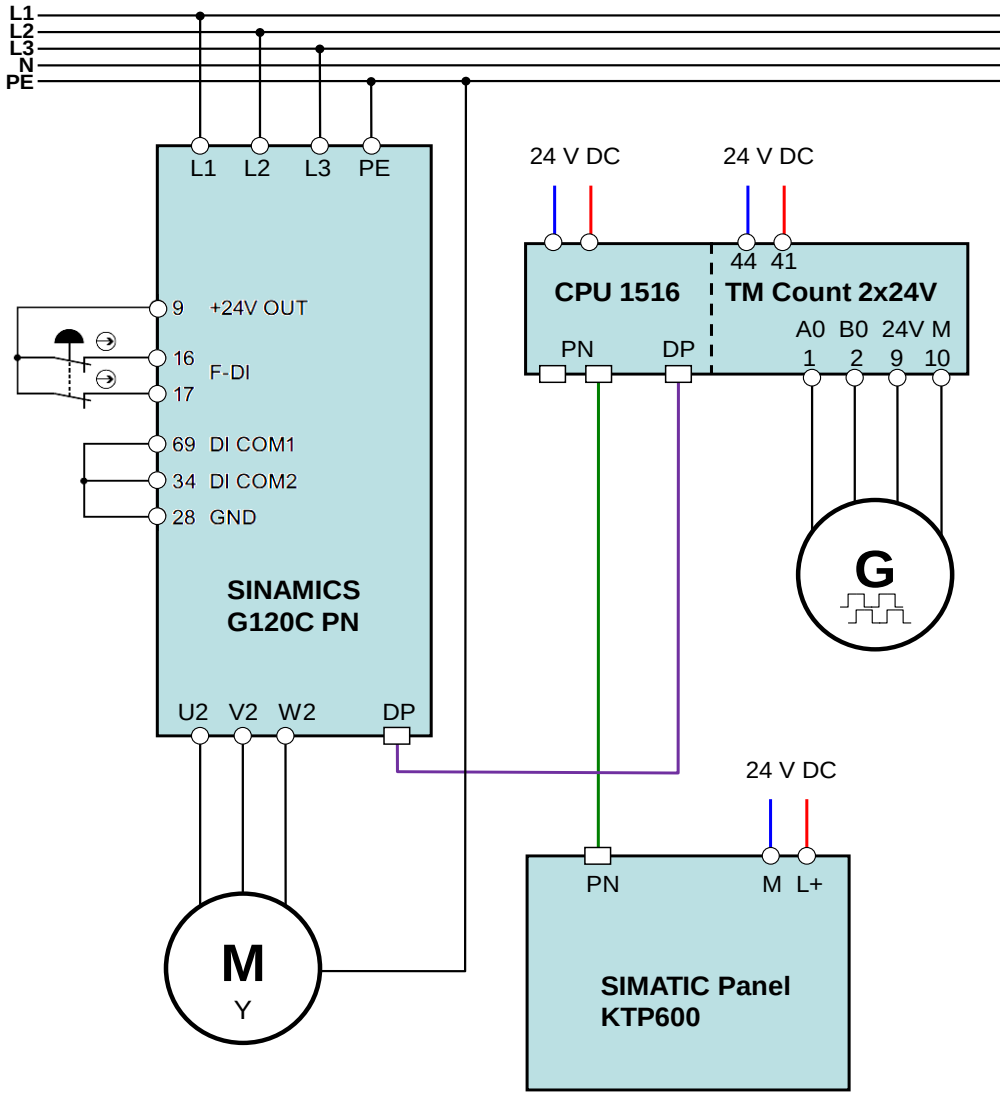
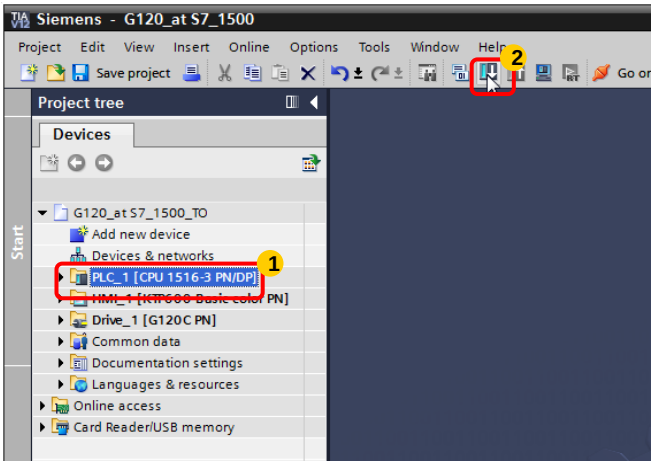
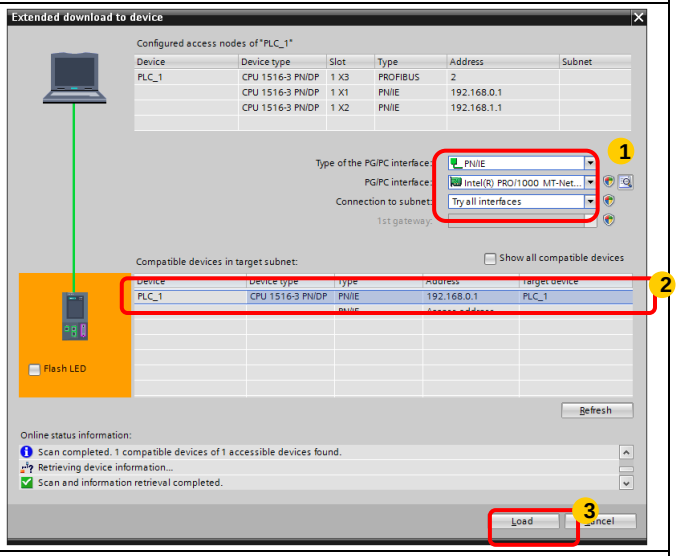
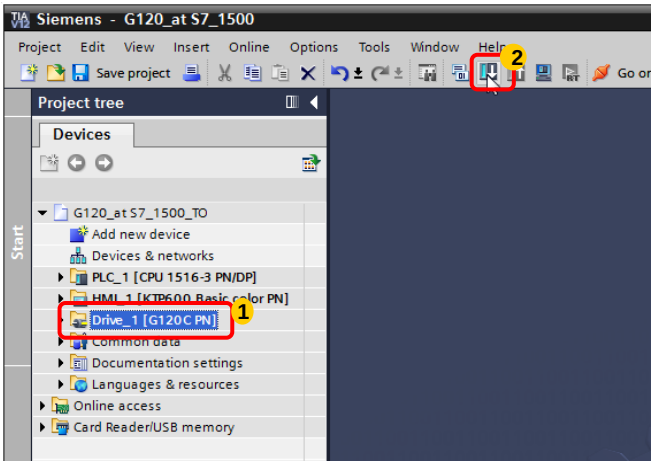


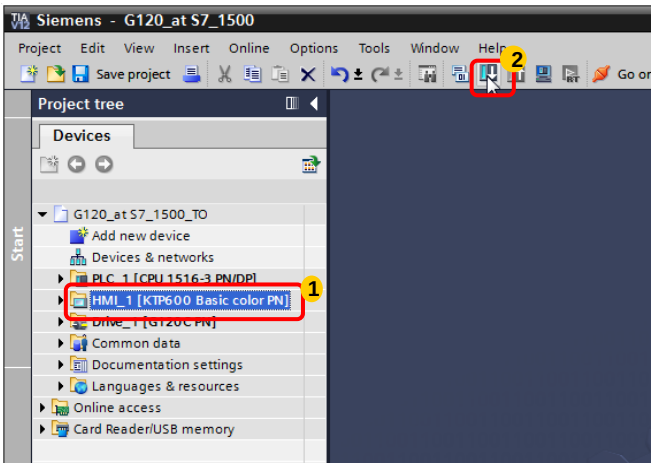
Figure 5-2: Wiring for PROFIBUS



5.2 Downloading the project to the components

Table 5-1

No.	Action	Figure
1.	Open the sample project or the project created in chapter 4.	
2.	1. Select the S7-1500 CPU and 2. then click on “Download to device”.	
3.	If the “Extended download to device” dialog opens, 1. select the settings necessary for your online connection, 2. select the CPU 1516-3 PN/DP and 3. click on “Load”.	
4.	Proceed in the same way to load the SINAMICS G120.	

No.	Action	Figure
5.	“POWER ON” the SINAMICS G120. (Switch off the voltage until all LEDs are off and then switch it back on.)	
6.	Proceed in the same way to load the operator panel.	

5.3 Example with safety via PROFIsafe

The application example with PROFIsafe additionally requires the following actions:

- Wiring
  The forced checking procedure can be triggered using a switch between terminals 9 (24V) and 5 (DI0) or X7.1 (24V) and X7.4 (DI0).
- Download
  After the download of the parameterization and “POWER ON” of the SINAMICS, you have to activate the safety parameterization. Follow the instructions as described in chapter 4.4.4.

6 Operation of the Application

The program of the sample project consists only of calling the blocks for the motion control instructions and copying the status signals for the HMI.

The visualization of the blocks on the operator panel allows you to test the individual functions of the blocks and get to know their reactions.

WARNING

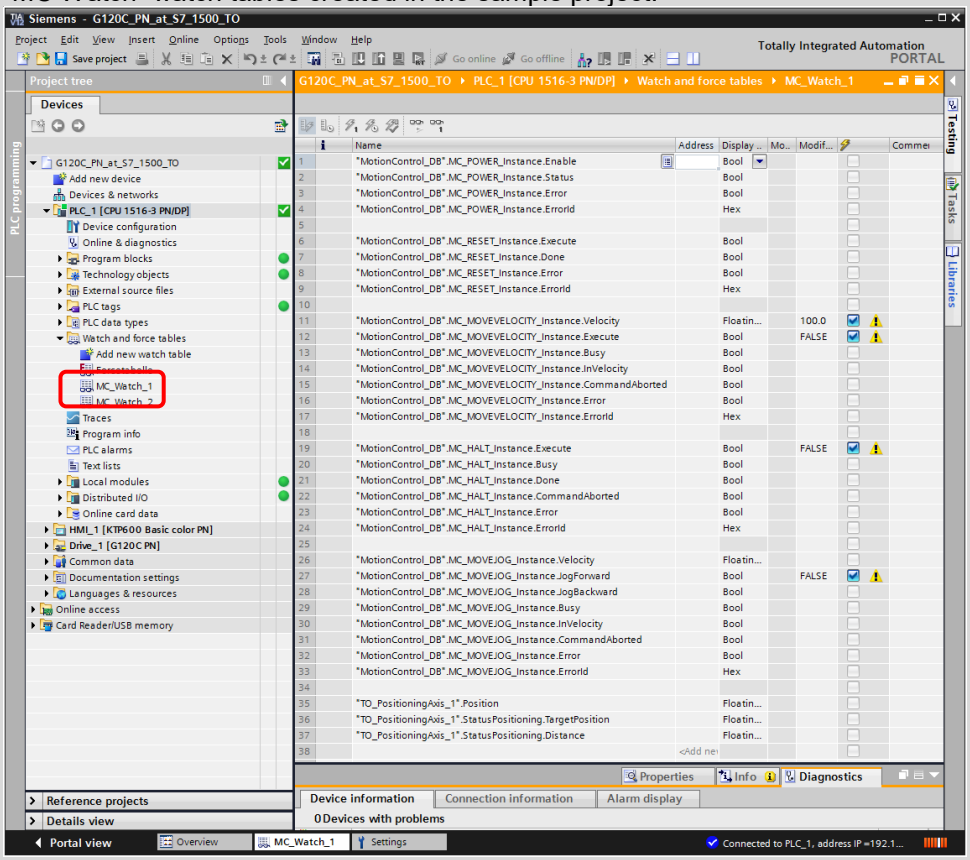
Make sure that the moving drive does not endanger persons or property.

Take appropriate measures to prevent the drive from exceeding technical or mechanical limits.

6.1 “MC Watch” watch tables

NOTE

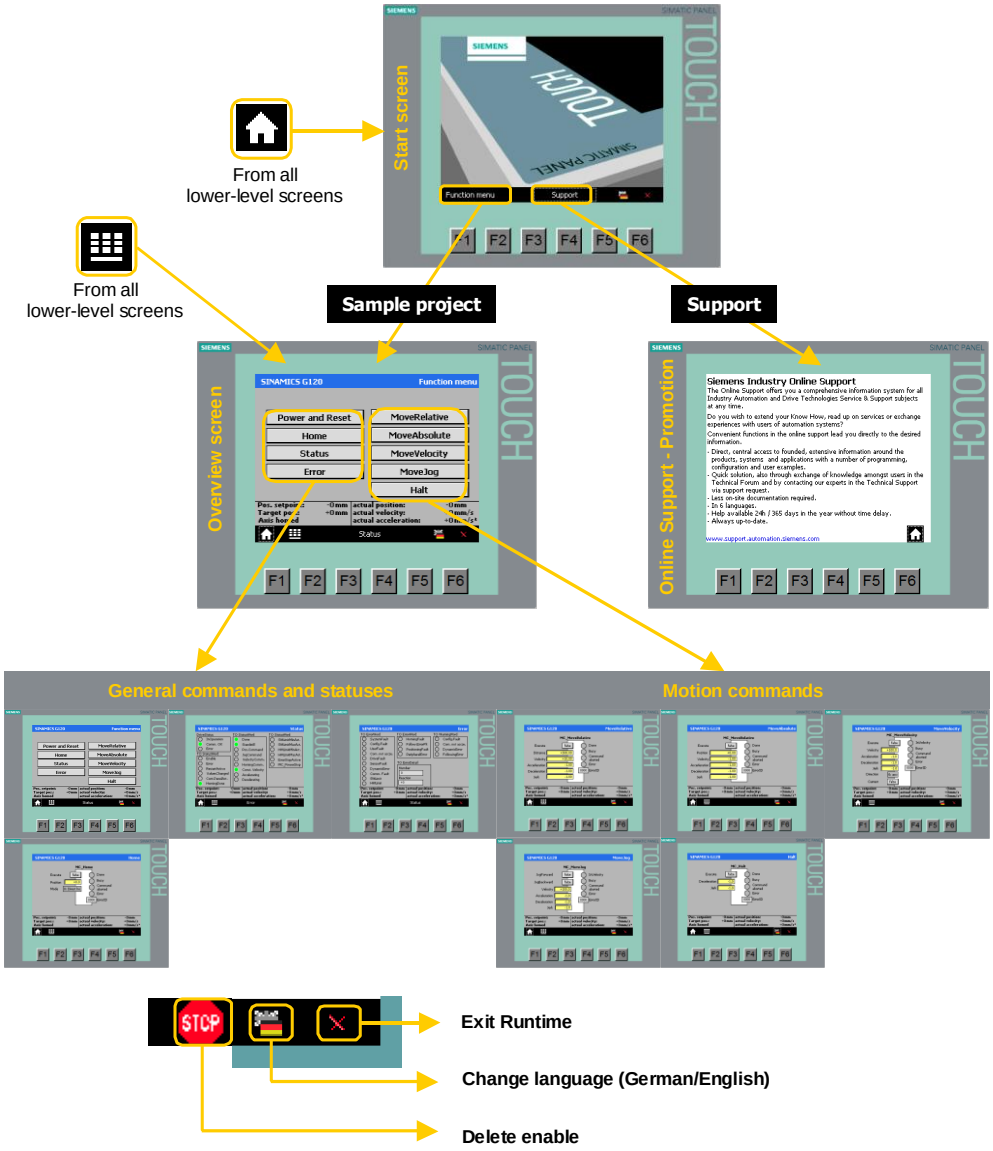
If you cannot or do not want to use an operator panel, you can also use the “MC Watch” watch tables created in the sample project.



6.2 Operation of the application with a panel

Screens and screen navigation

Figure 6-1



General controls

Header

In the header, you can see:

- On the left: The project name
- In the center: The error symbol (if an error has occurred)
- On the right: The name of the current operating screen

Footer

Directly above the footer, you can see

- the position setpoint of the axis
- the target position
- the homing status of the axis
- the current position of the axis
- the current velocity of the axis
- the current acceleration of the axis.

In all operating screens, “Home” allows you to return to the start screen.

In all operating screens, “Menu” allows you to return to the Function menu.

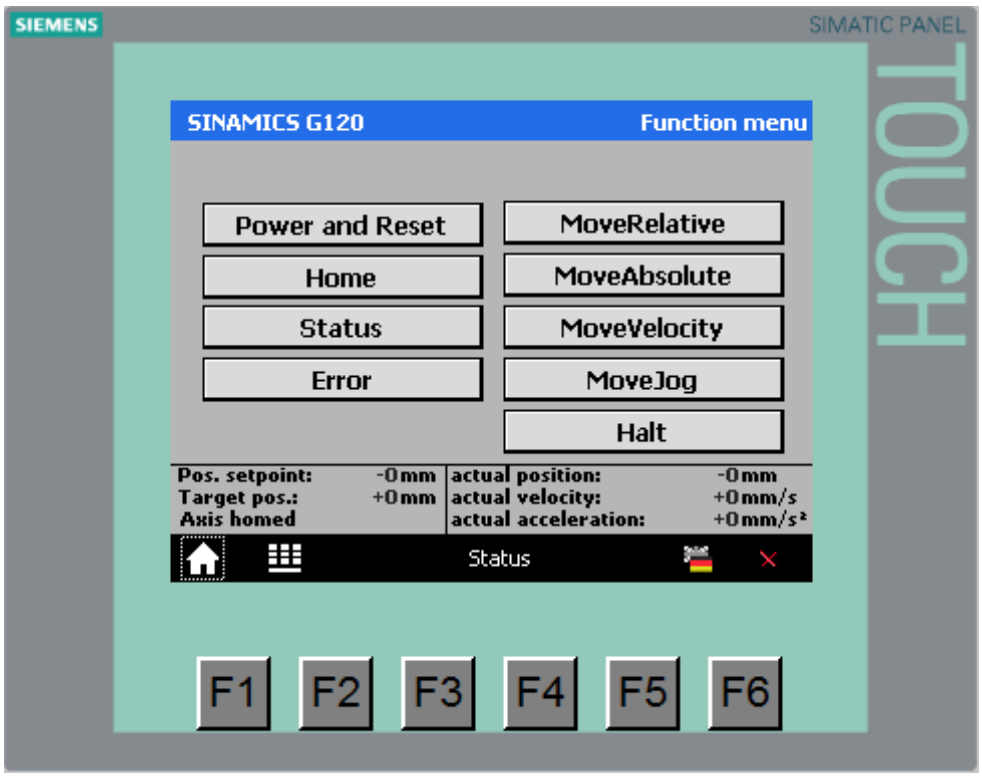
STOP allows you to remove the axis enable at any time.
(Enable of MC Power is set to “false”)

“Language” allows you to change the language between German and English.

“Exit” allows you to exit Runtime.

Function menu

Figure 6-2



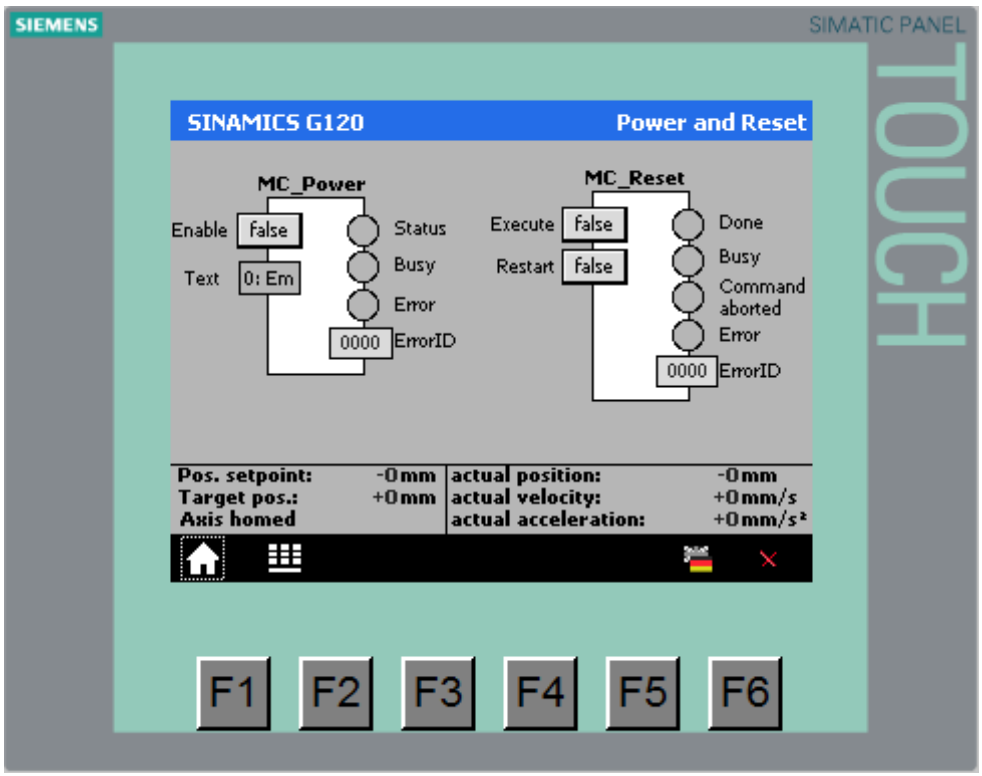
From the Function menu, you can call the individual operating screens:

Table 6-1

Operating screen	Function
Power and Reset	Visualization of MC_Power and MC_Reset. MC_Power is used to enable the axis (On/Off). MC_Reset is used to acknowledge errors of the axis.
Home	Visualization of MC_Home. This FB is used to home the axis, i.e. the position of the axis is set.
Status	Visualization of the status bits of the Axis TO.
Error	Visualization of the error bits of the Axis TO.
MoveRelative	Visualization of MC_MoveRelative. This FB is used to move the axis by the specified distance.
MoveAbsolute	Visualization of MC_MoveAbsolute. This FB is used to move the axis to the specified position.
MoveVelocity	Visualization of MC_MoveVelocity. This FB is used to start an (endless) axis motion at the specified velocity.
MoveJog	Visualization of MC_MoveJog. This FB allows you to “jog” the axis.
Halt	Visualization of MC_MoveHalt. This FB is used to stop the axis.
Safety	Visualization of the bIts des in PROFIsafe Telegram This screen is only available in the example with PROFIsafe.

Power and Reset

Figure 6-3



MC_Power

A rising edge at the “Enable” input of “MC_Power” enables the axis. The SINAMICS G120 switches on, the speed and position setpoints are 0 until a new job is started using a motion control instruction.

The “StopMode” input allows you to define how the axis responds if the enable is removed from it. Click on the gray rectangle to display the select menu.

The “Status”, “Busy”, “Error” and “ErrorID” outputs allow you to read the current status of the block.

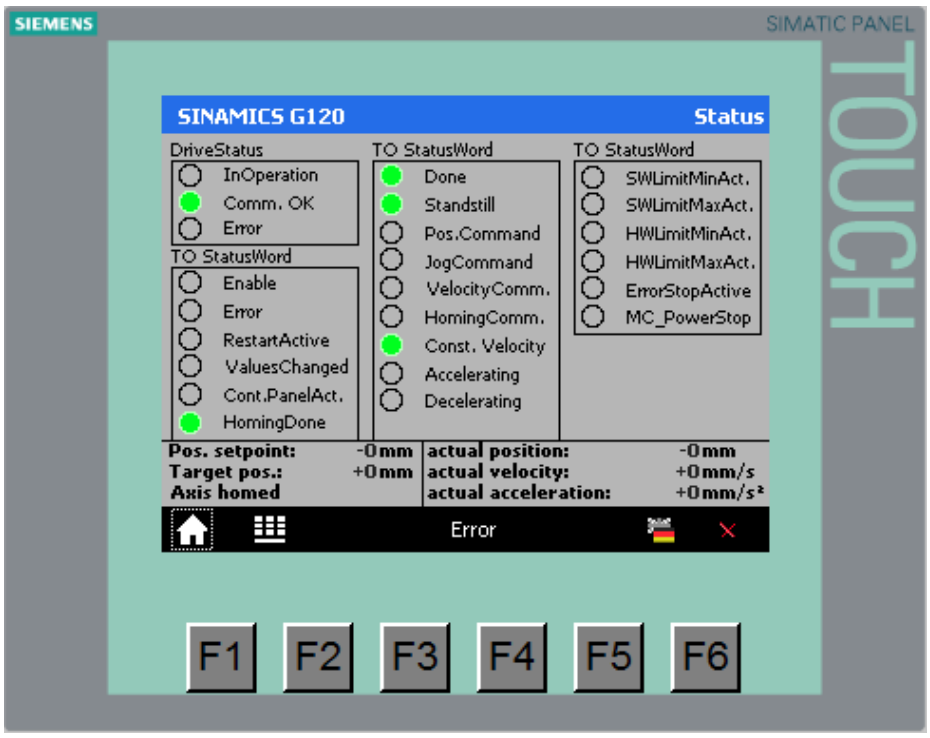
MC_Reset

A rising edge at the “Execute” input of “MC_Reset” acknowledges errors of the axis. (If the cause of the error is no longer relevant.)

The “Done”, “Busy”, “CommandAborted”, “Error” and “ErrorID” outputs allow you to read the current status of the block.

Status

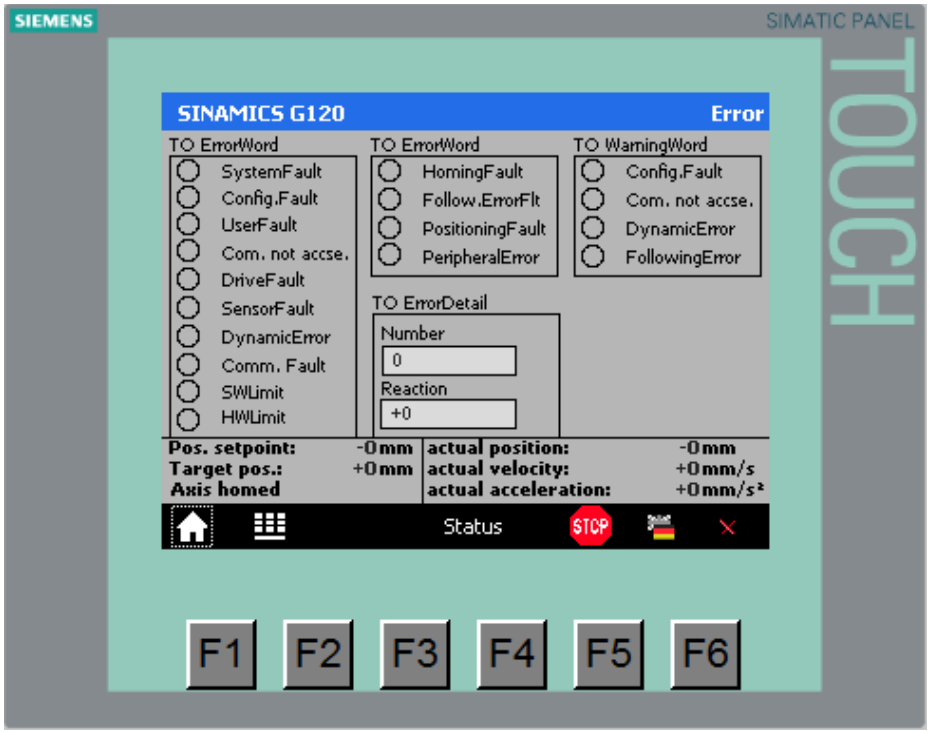
Figure 6-4



This operating screen displays the status bits of the axis.

Error

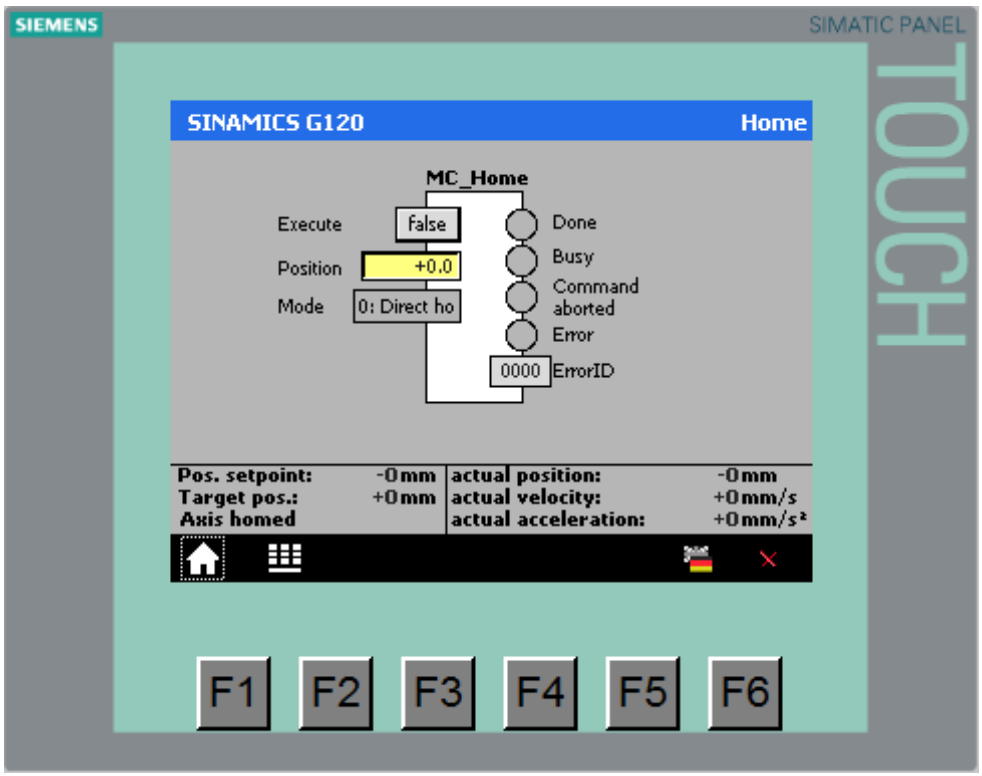
Figure 6-5



This operating screen displays the error bits of the axis.

Home

Figure 6-6



A rising edge at the “Execute” input of “MC_Home” homes the axis or starts homing.

Homing assigns the axis the correct current position. The “Mode” input allows you to define how this is done.

As a home position switch is not connected in the example, only modes 0 and 1 can be used.

CAUTION	**The modes specified in the following table for the MC_Home apply to the technology version 2.0! If you use them with a MC_Home V1.0 the behavior of the axis may be different.** See \6\ (Function manual SIMATIC S7-1500 Motion Control) or https://www.automation.siemens.com/mdm/default.aspx?DocVersionId=69153002379&TopicId=65881045643 for details.

Table 6-2

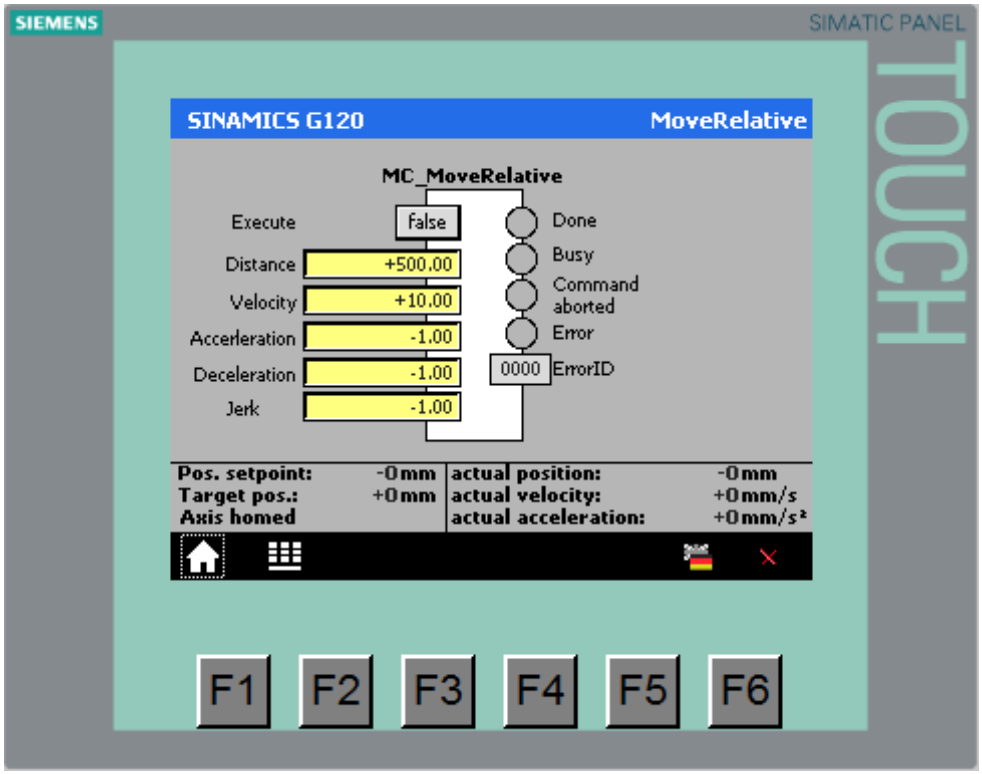
Mode	Action	Example
0 Direct homing (absolute)	The position is set to the value at the “Position” input.	A tape measure is used to measure the position and this value is entered via the HMI and the position is set.
1 Direct homing (relative)	The position is shifted by the value at the “Position” input.	Pieces of a definable length are to be cut from a web. After a cut, the position is shifted by the desired cutting length and the positioning to the cutting position (e.g., 0) is triggered. When the cutting position is reached, the cut is made and the cycle restarts. This avoids overtraveling of the axis position.
2 Passive homing (without resetting)	When the homing mark is detected, the position is set to the value of the “Position” input. The “homed” status bit is not deleted during the job.	If the axis (accidentally) triggers the home position switch while this mode is active, the position will be set. The position of the home position switch was defined during commissioning or maintenance.
3 Active homing	The axis performs a homing movement according to the configuration. When the home position switch is activated, the position is set to the value of the “Position” input.	When the machine has been started, the axis is homed. The position of the home position switch was defined during commissioning or maintenance.
4 Reserved	-	
5 Active homing (“Position” parameter invalid)	Same as 3, but the position value is taken from the configuration data.	
6 Absolute encoder adjustment (relative)	Same as 1, but for absolute value encoders.	
7 Absolute encoder adjustment (absolute)	Same as 0, but for absolute value encoders.	
8 Passive homing	Same as 2, but the “homed” status bit is deleted when the job is started and set again when the position is set.	
9 Canceling passive homing	An active passive homing job is terminated.	

Mode	Action	Example
10 Passive homing (“Position” parameter invalid)	Same as 2, but the position value is taken from the configuration data.	

The “Done”, “Busy”, “CommandAborted”, “Error” and “ErrorID” outputs allow you to read the current status of the block.

MoveRelative

Figure 6-7



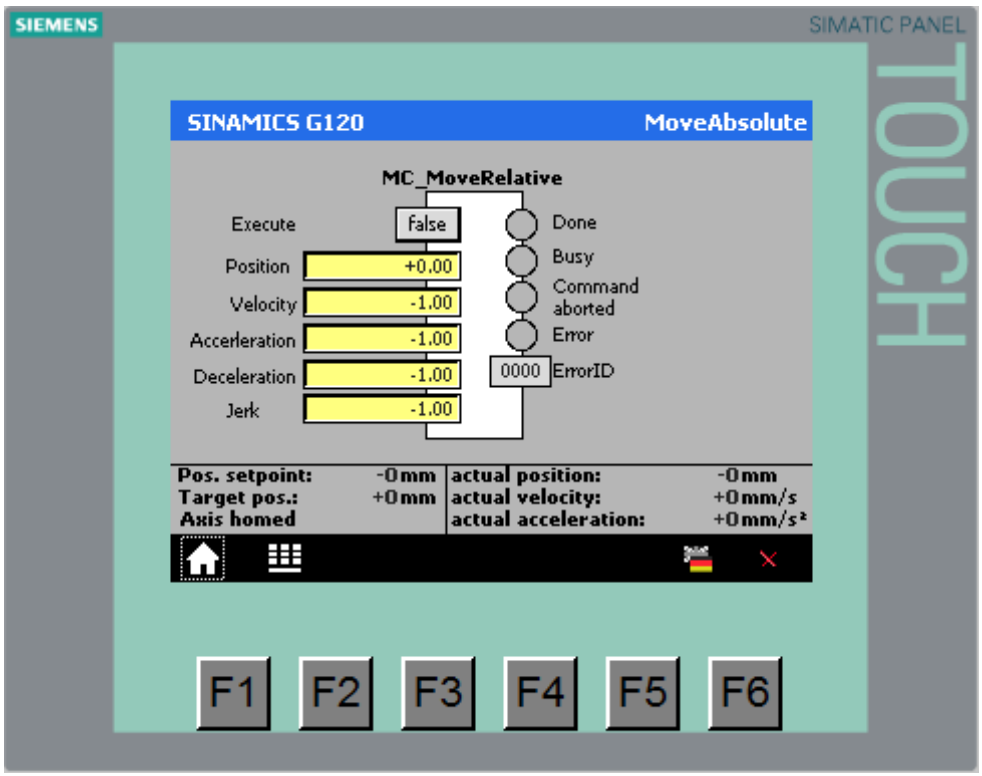
A rising edge at the „Execute“ input of “MC_MoveRelative” starts a positioning operation in which the axis is to travel the distance specified at the “Distance” input.

The “Velocity”, “Acceleration”, “Deceleration” and “Jerk” inputs allow you to define how the axis is to travel the specified distance.
If you specify a negative value, for example -1.0, the value defined when parameterizing the axis in TIA Portal (dynamic default value) will be used.

The “Done”, “Busy”, “CommandAborted”, “Error” and “ErrorID” outputs allow you to read the current status of the block.

MoveAbsolute

Figure 6-8



A rising edge at the “Execute” input of “MC_MoveRelative” starts positioning to the position specified at the “Position” input.

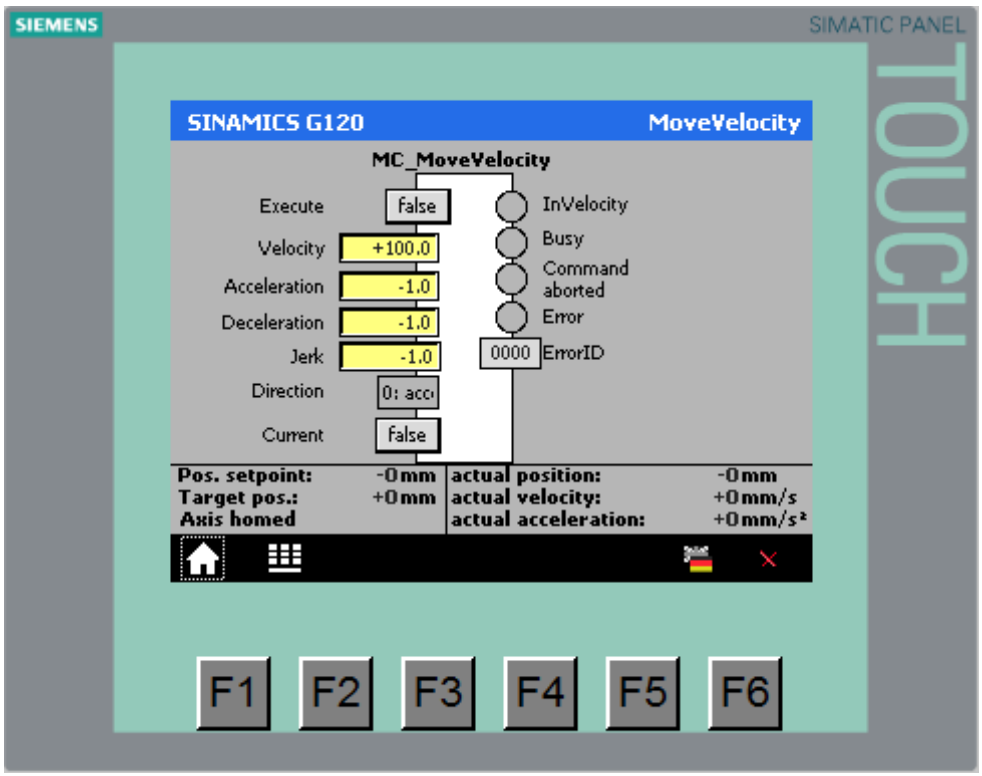
This requires that the axis has been homed; otherwise, an error will be output.

The “Velocity”, “Acceleration”, “Deceleration” and “Jerk” inputs allow you to define how the axis is to reach the specified position.
If you specify a negative value, for example -1.0, the value defined when parameterizing the axis in TIA Portal (dynamic default value) will be used.

The “Done”, “Busy”, “CommandAborted”, “Error” and “ErrorID” outputs allow you to read the current status of the block.

MoveVelocity

Figure 6-9



A rising edge at the “Execute” input of “MC_MoveVelocity” starts the axis motion at the velocity specified at the “Velocity” input or, if it is already in motion, specifies a new setpoint.

In the menu, click on the “Direction” inputs to define how the direction of axis rotation is to be defined.

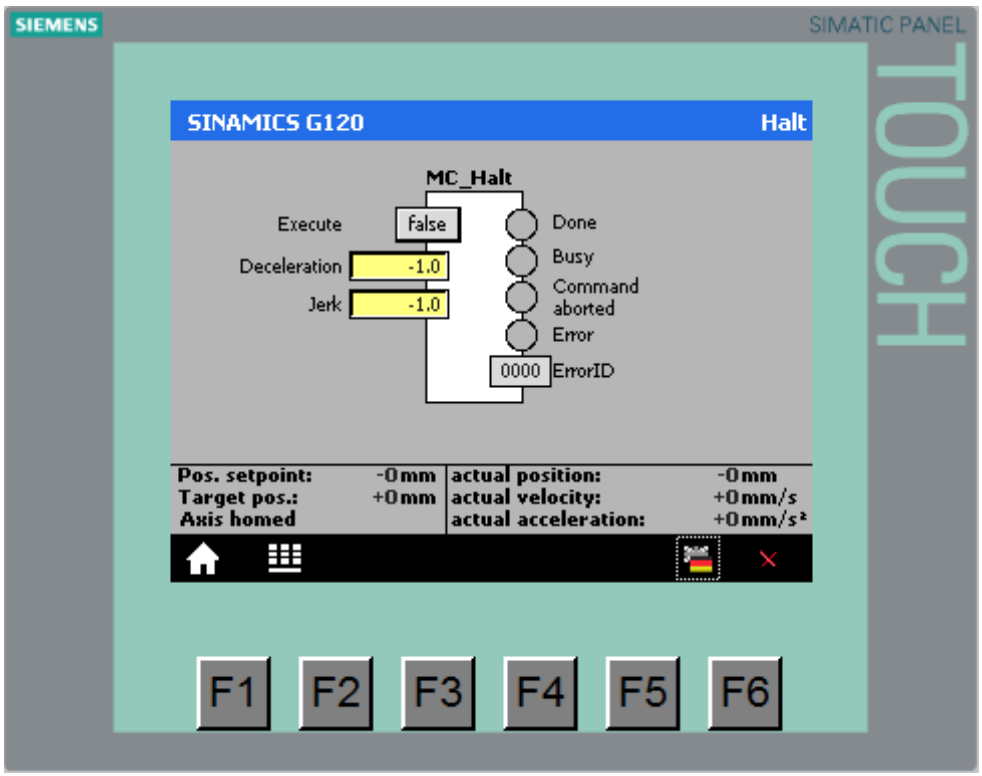
The “Current” input allows you to define if the “Velocity” and “Direction” inputs are evaluated. For speed axes, it is hardly possible to use this function in a useful way. For positioning axes, it allows you, for example, to replace a positioning operation in which the axis is to continue to move at the current velocity.

The “Acceleration”, “Deceleration” and “Jerk” inputs allow you to define how the axis is to reach the specified velocity.
If you specify a negative value, for example -1.0, the value defined when parameterizing the axis in TIA Portal (dynamic default value) will be used.

The “InVelocity”, “Busy”, “CommandAborted”, “Error” and “ErrorID” outputs allow you to read the current status of the block.

Halt

Figure 6-10

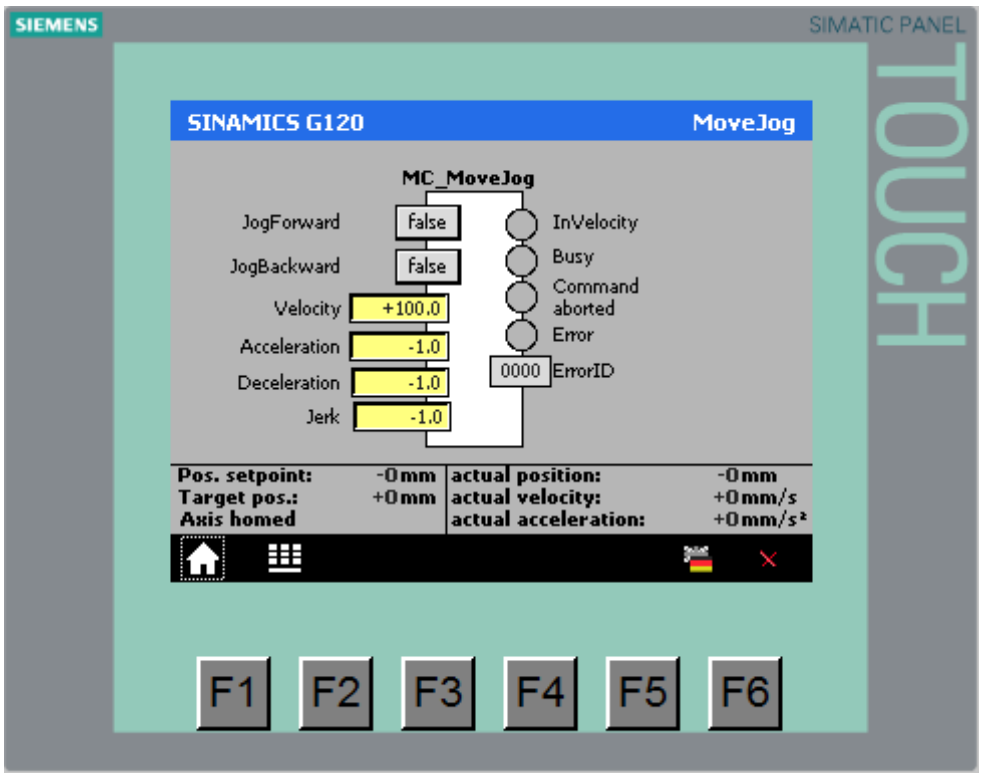


A rising edge at the “Execute” input of “MC_Halt” decelerates the axis to a standstill.

The “Deceleration” and “Jerk” inputs allow you to define how the axis is to come to a standstill.
If you specify a negative value, for example -1.0, the value defined when parameterizing the axis in TIA Portal (dynamic default value) will be used.

MoveJog

Figure 6-11



A rising edge at one of the inputs, “JogForward” and “JogBackward”, of “MC_MoveJog” moves the axis at the velocity specified at the “Velocity” input. The axis stops automatically when the input signal returns to “false”.

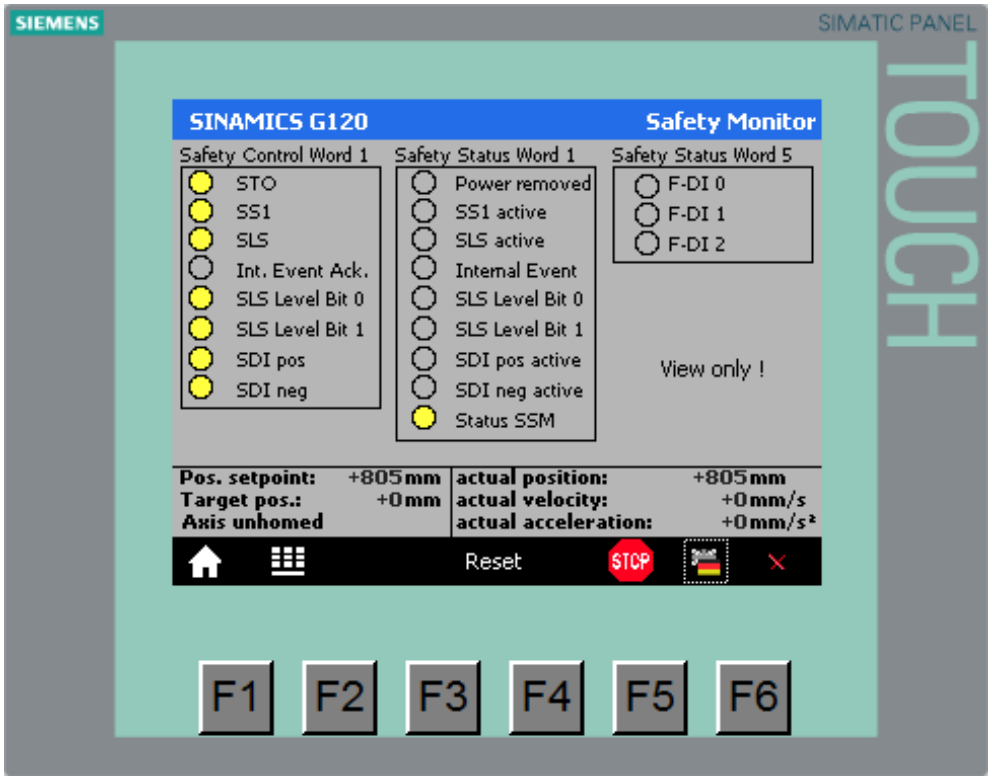
The “Acceleration”, “Deceleration” and “Jerk” inputs allow you to define how the axis is to reach the jog velocity.
If you specify a negative value, for example -1.0, the value defined when parameterizing the axis in TIA Portal (dynamic default value) will be used.

The “InVelocity”, “Busy”, “CommandAborted”, “Error” and “ErrorID” outputs allow you to read the current status of the block.

Safety

The safety screen is only included in the sample project with PROFIsafe. (see 0)

Figure 6-12



The bits of the PROFIsafe telegram, i.e. the status of the safety functions of the SINAMICS, can only be monitored.

Display of the passivation of the SINAMICS

When the SINAMICS is passivated, this is displayed in the header (all screens):

In the sample program with PROFIsafe, a rising edge at the “Execute” input of “MC_Reset” (see 0) also triggers reintegration:

In the sample program, setting this input acknowledges all errors and the axis is ready again (provided that the cause of the error no longer exists).

6.3 Sample scenario for operation

The program of the sample project consists only of the call of the blocks for the motion control instructions.

The visualization of the blocks on the operator panel allows you to test the individual functions of the blocks and get to know their reactions.

The aim of the steps below is to show you some aspects of the motion control instructions.

Table 6-3

No.	Action	Remark
1.	Call the “Function menu”.	
2.	Click on “Power and Reset”.	
3.	Acknowledge pending errors with a rising edge at “Execute” of “MC_Reset”.	
4.	Enable the axis with a rising edge at “Execute” of “MC_Power”.	The drive switches on and keeps the speed 0.0. The “Status” output indicates that the axis is enabled.
5.	Call the “Function menu”.	
6.	Click on “MoveJog”.	
7.	• At “Velocity”, specify a jog velocity. • Move the drive by generating a rising edge at “JogForward” or “JogBackward”. • Remove the signal to stop the axis.	The drive runs at jogging speed. When the setpoint speed is reached, this is displayed at the “InVelocity” output.
8.	Call the “Function menu”.	
9.	Click on “MoveVelocity”.	
10.	• At “Velocity”, specify a velocity. • Move the drive by generating a rising edge at “Execute”. • At “Velocity”, specify a different velocity. • Change to the new velocity by again generating a rising edge at “Execute”.	The drive runs at the specified speed. When the setpoint speed is reached, this is displayed at the “InVelocity” output. The drive decelerates or accelerates to the new speed. When the new setpoint speed is reached, this is displayed at the “InVelocity” output.
11.	Call the “Function menu”.	
12.	Click on “Halt”	
13.	Stop the drive by generating a rising edge at “Execute”. Wait until the drive has stopped.	The drive stops. When the drive has stopped, this is indicated by “MC_Halt” with the “Done” output.
14.	Use the “Function menu” to go to “MoveVelocity”.	“CommandAborted” indicates that “MoveVelocity” was aborted.
15.	A rising edge at “Execute” allows you to restart the axis.	

No.	Action	Remark
16.	Call the “Function menu”.	
17.	Click on “MoveRelative”.	
18.	• At “Distance”, specify the distance the drive is to travel. • Move the drive by generating a rising edge at “Execute”.	When the drive has traveled the distance, this is indicated by “MC_MoveRelative” with the “Done” output.
19.	Call the “Function menu”.	
20.	Click on “Home”.	
21.	Select mode 0 and at “Position”, specify the current position of the drive.	
22.	A rising edge at “Execute” applies the new position.	The new position value is displayed as the current position.
23.	Call the “Function menu”.	
24.	Click on “MoveAbsolute”.	Absolute positioning requires that the axis has been homed with “MC_Home”.
25.	• At “Position”, specify the position the drive is to move to. • Move the drive by generating a rising edge at “Execute”.	When the drive has traveled the distance, this is indicated by “MC_MoveAbsolute” with the “Done” output.
26.	Call the “Function menu”.	
27.	Click on “Status”.	This is where you see the status bits of the drive.
28.	Use the hot key to go to “Error”.	This is where you see the error bits of the drive.
29.	Provoke an error by • briefly removing the Ethernet connection cable to the S7 CPU • briefly disconnecting the SINAMICS G120 from the 400V supply (LEDs must go off).	Disconnect a connection until the S7 CPU displays an error.
30.	Once communication has been reestablished, you can acknowledge the error with a rising edge at “Execute” of “MC_Reset”.	
31.	If you reduce the acceleration values in the sample project to 1 to 5 m/s², ramp-up or ramp-down will last several seconds, enabling you to better monitor the change of the status bits of the blocks and the axis during this time.	Vary the parameters of the blocks to test different situations.

7 References

Table 7-1

	Topic	Title
\1\	Siemens Industry Online Support	http://support.automation.siemens.com
\2\	Download page of the entry	https://support.industry.siemens.com/cs/ww/en/view/81666970https://support.industry.siemens.com/cs/ww/en/view/81666970
\3\	STEP 7 V13 download page	Updates for TIAP V13 http://support.automation.siemens.com/WW/view/en/90466591
\4\	Startdrive V13 download page	http://support.automation.siemens.com/WW/view/en/68034568
\5\	SINAMICS G110M Manuals	Operating instructions (V4.7): http://support.automation.siemens.com/WW/view/en/102316337 List manual (V4.7) (parameters and error list): http://support.automation.siemens.com/WW/view/en/99684082
	SINAMICS G120 with CU240B/E-2 Manuals	Operating instructions (V4.7): http://support.automation.siemens.com/WW/view/en/94020562 List manual (V4.7) (parameters and error list): http://support.automation.siemens.com/WW/view/en/99683523
	SINAMICS G120 with CU250S-2 Manuals	Operating instructions (V4.7): http://support.automation.siemens.com/WW/view/en/94020554 List manual (V4.7) (parameters and error list): http://support.automation.siemens.com/WW/view/en/99683523
	SINAMICS G120C Manuals	Operating instructions (V4.7): http://support.automation.siemens.com/WW/view/en/99710404 List manual (V4.7) (parameters and error list): http://support.automation.siemens.com/WW/view/en/99683780
	SINAMICS G120D with CU240D-2 Manuals	Operating instructions (V4.7): http://support.automation.siemens.com/WW/view/en/99711357 List manual (V4.7) (parameters and error list): http://support.automation.siemens.com/WW/view/en/99684194
	SINAMICS G120D with CU250D-2 Manuals	Operating instructions (V4.7): http://support.automation.siemens.com/WW/view/en/99721485 List manual (V4.7) (parameters and error list): http://support.automation.siemens.com/WW/view/en/99684194
	General SINAMICS G Manuals	Function manual Safety Integrated (V4.7): http://support.automation.siemens.com/WW/view/en/94003326 Function manual Fieldbus systems (V4.7): http://support.automation.siemens.com/WW/view/en/99685159
\6\	SIMATIC S7-1500	SIMATIC S7-1500 Automation System: http://support.automation.siemens.com/WW/view/en/59191792 SIMATIC S7-1500 Motion Control Function Manual: http://support.automation.siemens.com/WW/view/en/99005173 SIMATIC S7-1500 CPU 1516-3 PN/DP Manual: http://support.automation.siemens.com/WW/view/en/59191914
\7\	PLCopen	http://www.plcopen.org

8 History

Table 8-1

Version	Date	Modifications
V1.0	10/2013	First version
V1.1	12/2014	Updated to TIA Portal V13 and SINAMICS FW4.7
V1.1.1	05/2015	Expanded with Safety over PROFIsafe: Chapters 4.4, 5.3 and 0
V1.2	07/2018	Insert “change device for SINAMICS G120”