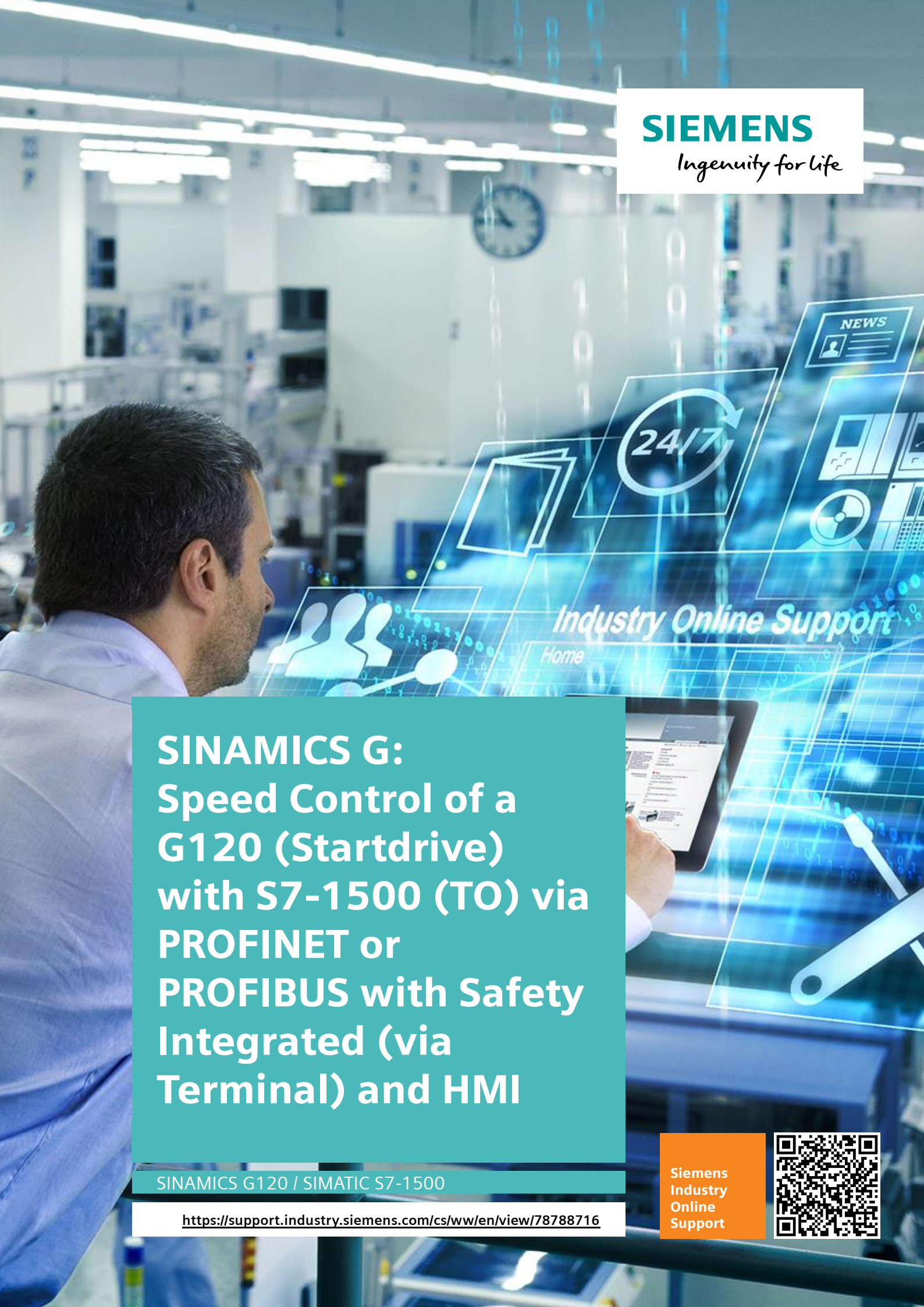

SINAMICS G: Speed Control of a G120 (Startdrive) with S7-1500 (TO) via PROFINET or PROFIBUS with Safety Integrated (via Terminal) and HMI

SINAMICS G120 / SIMATIC S7-1500

https://support.industry.siemens.com/cs/ww/en/view/78788716

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Table of contents

1 Task

1.1 Overview

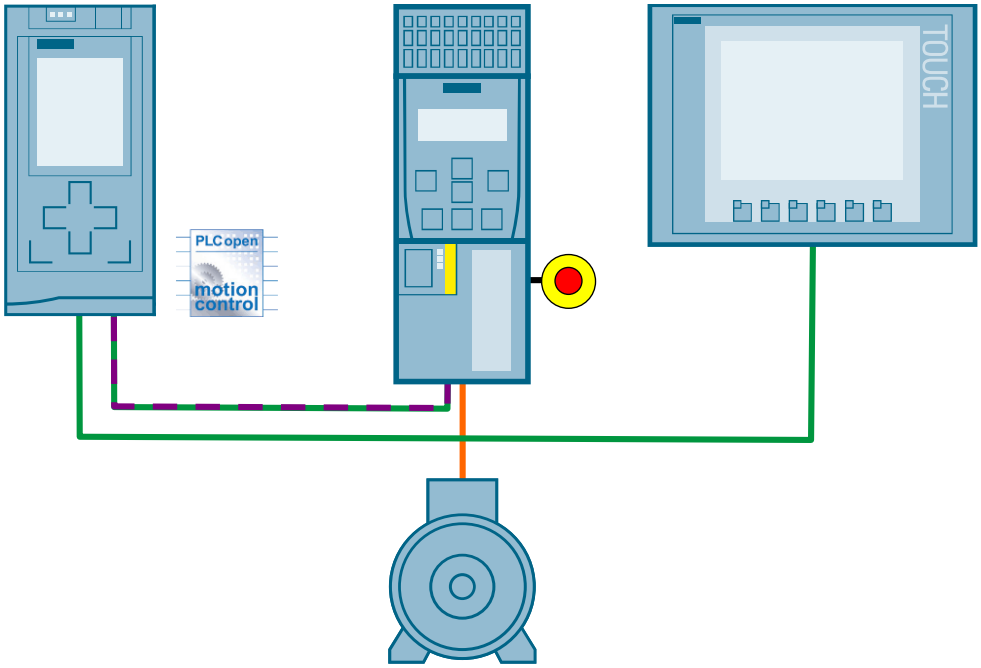
SIMATIC S7-1500 CPUs support the connection of PROFIdrive-capable drives via PROFINET or PROFIBUS as a speed axis or positioning axis. The standardized PLCopen blocks make configuration particularly easy.

This application example shows how to configure and commission the SINAMICS G120 and the SIMATIC S7-1500 using the technological functions of the SIMATIC S7-1500.

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

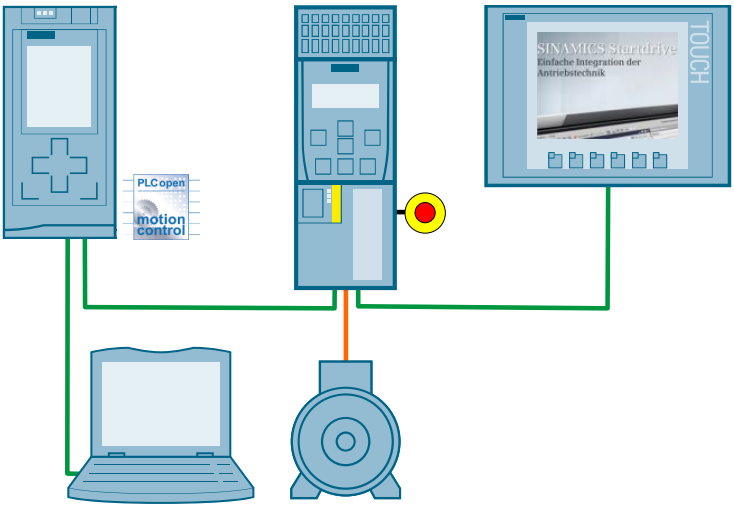
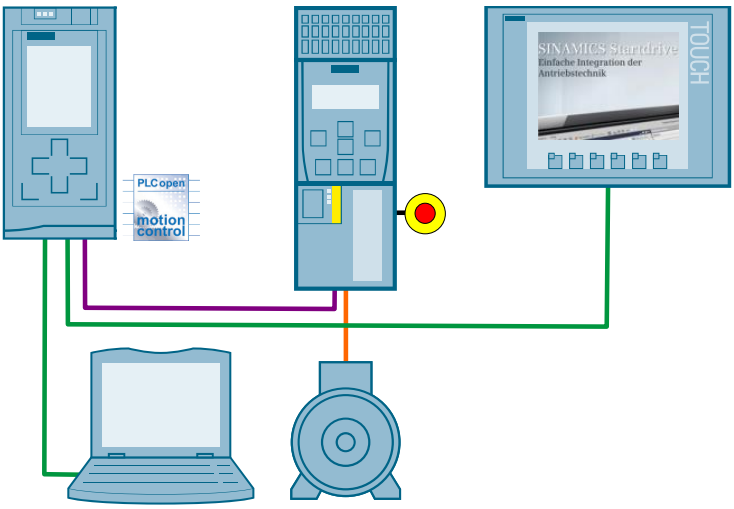


Figure 2-2 Solution with the SINAMICS G120 connected via PROFIBUS



Advantages

Due to the use of the technological functions of the SIMATIC S7-1500, you no longer need to generate the control word and encode the setpoint to send them to the SINAMICS G120.

Instead, you use the SIMATIC S7-1500 motion control instructions (function blocks) conforming to the PLCopen standard to control the SINAMICS G120.

Disadvantages

As a new motion control instruction needs to be sent for each speed change, this method is not fully suited for applications with a constantly changing setpoint (e.g., due to a pressure regulator).

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.

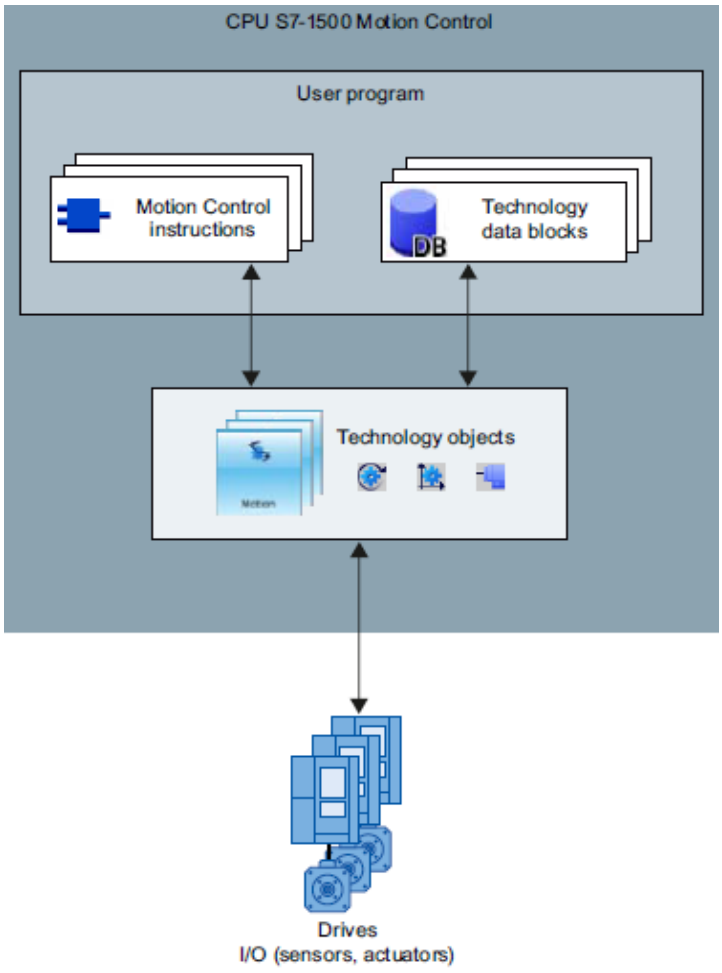
From a programmer's point of view, the Axis technology object represents the SINAMICS drive, i.e. the converter, motor and, where necessary, position encoder. A position encoder is necessary only for positioning applications.

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.
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).
SINAMICS G120	1	**G120:** CU 240E-2 PN 6SL3244-0BB12-1FA0 PowerModule: 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 Power module: 6SL3525-0PE17-5AA1	
		G120P CU230P-2 PN 6SL3243-0BB30-1FA0 Power module: 6SL3224-0BE17-5UA0	
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.
SIMATIC S7 Memory Card 4MB	1	6ES7954-8LC02-0AA0	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).
SINAMICS G120	1	**G120:** CU 240B-2 DP 6SL3244-0BB00-1PA1 CU 240E-2 DP 6SL3244-0BB12-1PA1 PowerModule: 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 Power module: 6SL3525-0PE17-5AA1	
		G120P CU230P-2 DP 6SL3243-0BB30-1PA3 Power module: 6SL3224-0BE17-5UA0	
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.
Startdrive V13	1	6SL3072-4DA02-0XG0	Free download.

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 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.

3.2 Interaction of motion control instructions and technology objects

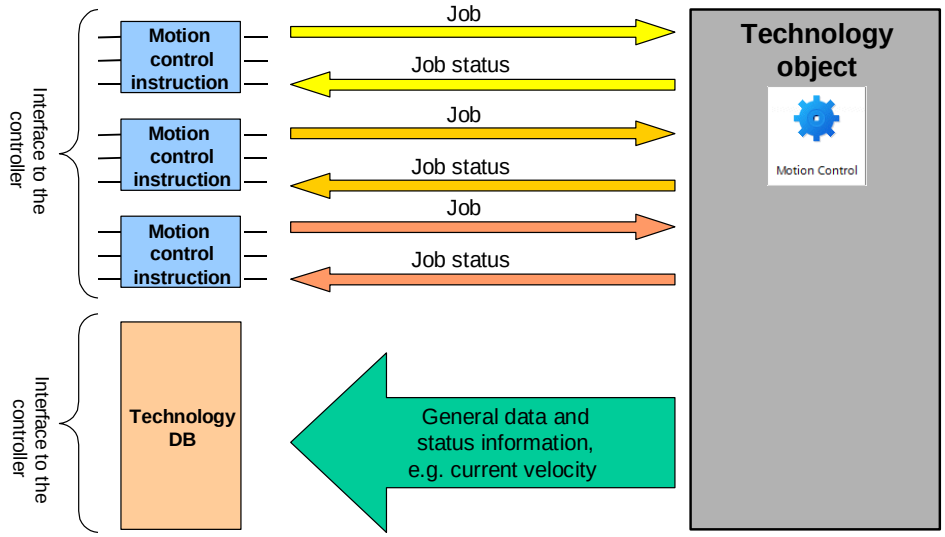
3.2.1 Motion control instructions

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

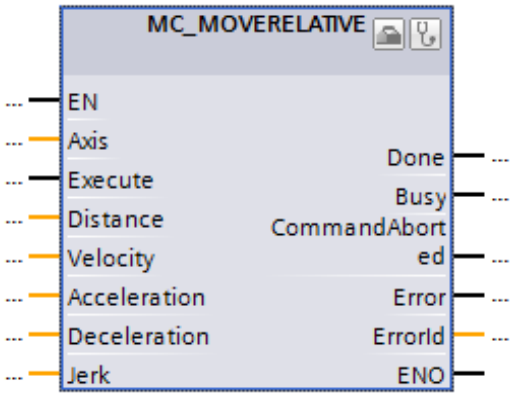
Only an appropriate chronological order of the calls of the motion control instructions in the control program of the SIAMTIC S7-1500 allows you to use the TO in a technologically useful way.
Therefore, it is recommended to use a sequencer in the user program from which the motion control instructions 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!
- A job is terminated when

[2] Positioning axes only

- 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 move at a fixed velocity. (“MC_MoveVelocity”)
  - It accelerates based on the settings and moves at the specified velocity.
  - The **Busy** and **InVelocity** bits are set.
- Now the axis receives the job to stop the motion control job (“MC_Halt”).
  - On “MC_MoveVelocity”, the **Busy** output is now deleted and **CommandAborted** is set.
  - On “MC_Halt”, **Busy** is set.
  - “MC_MoveVelocity” 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_MoveVelocity” was replaced by the halt job via “MC_Halt” and the halt job completed itself when the axis reached a standstill.

Note If you want to change the velocity at which the SINAMICS G120 is running, simply send another job to the axis with the MC_MoveVelocity block.

[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

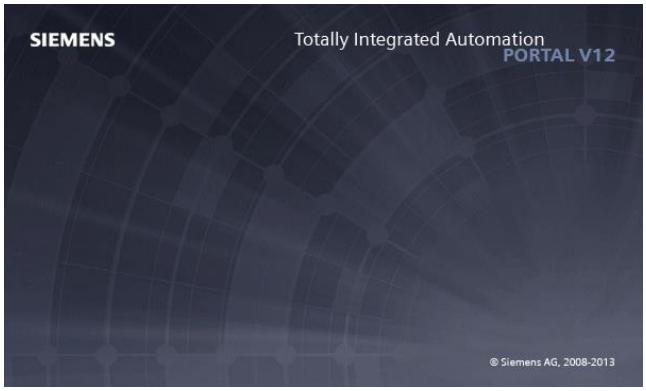
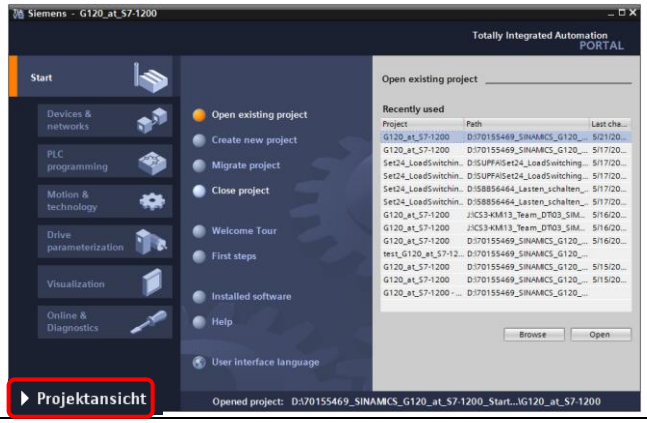
Note

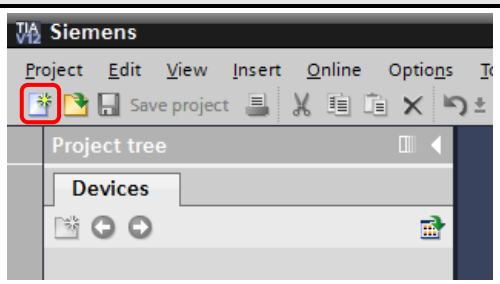
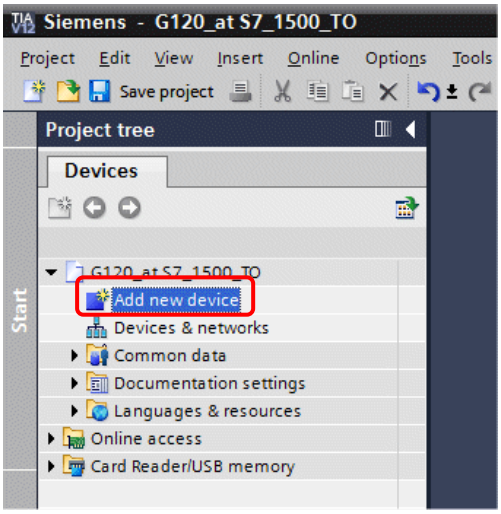
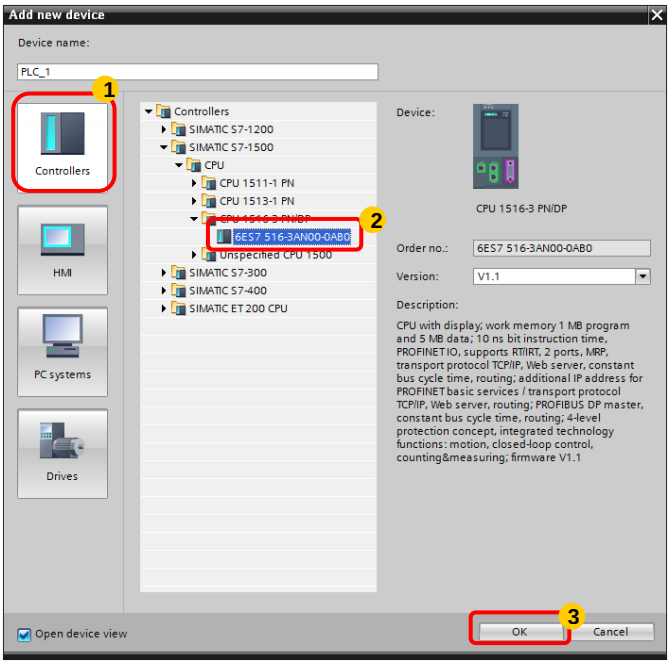
- If you only want to download and start up the sample program, follow the instructions in chapter 5.
- The procedure described in the following table is one option for configuring a SIMATIC S7-1500 and parameterizing a SINAMICS G120C PN for data exchange between a SIMATIC controller and a SINAMICS drive.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

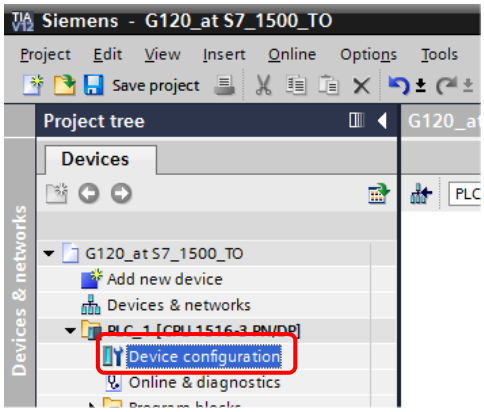
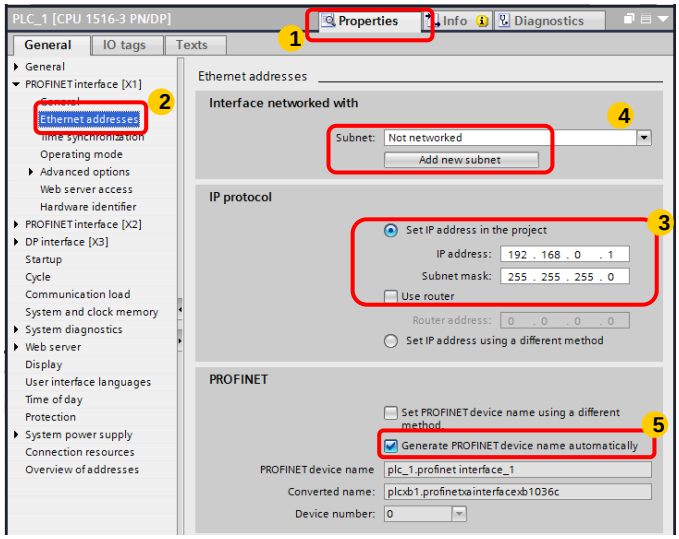
The tables below describe what you have to do if you do not use the sample code and want to configure the SIMATIC S7-1500 CPU, the SINAMICS G120 and the KTP600 HMI yourself.
Programming the SIMATIC S7-1500 and configuring the operator panel are not the subject of this chapter.

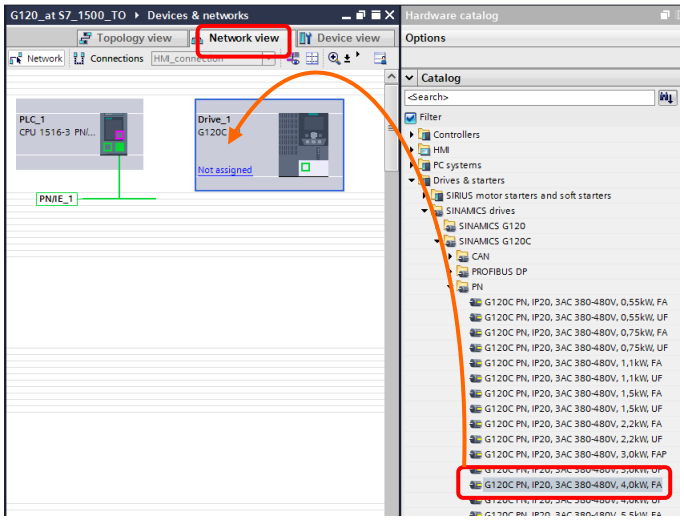
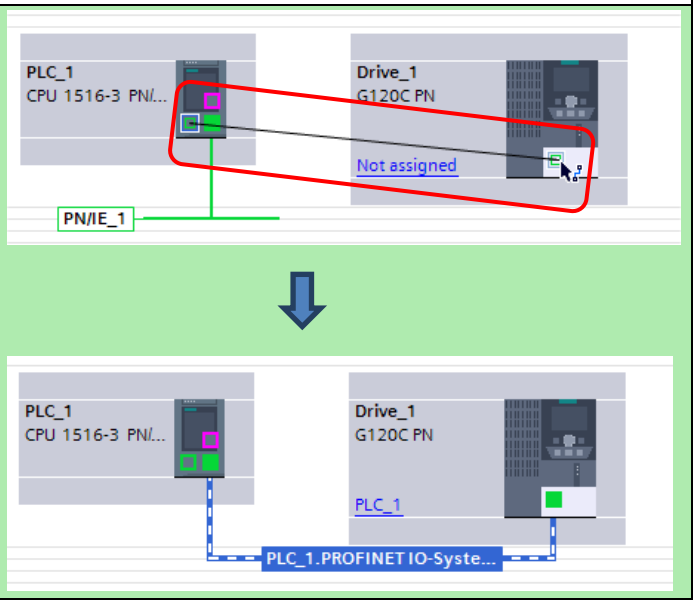
It is assumed that the software, see Table 2-4, is installed on your PG/PC.

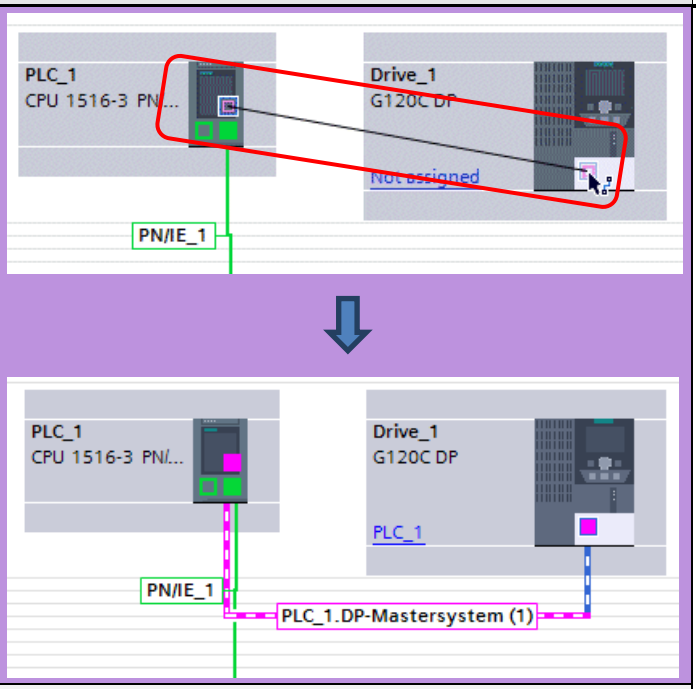
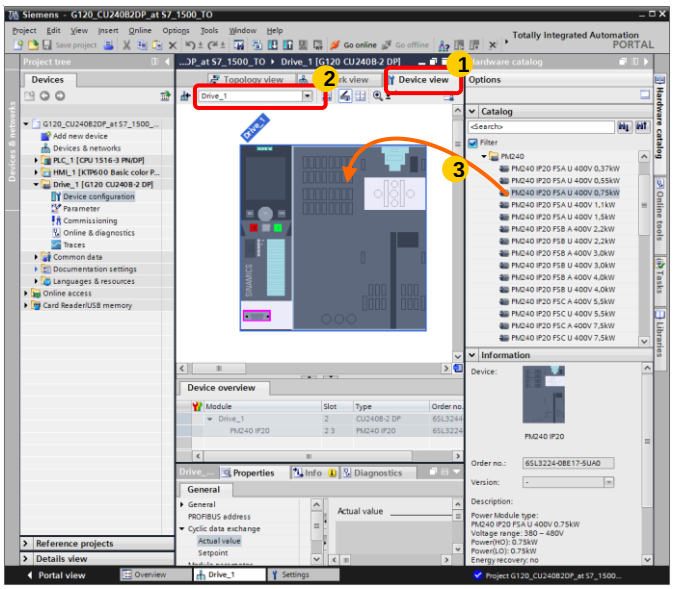
Table 4-1: Creating the project configuration

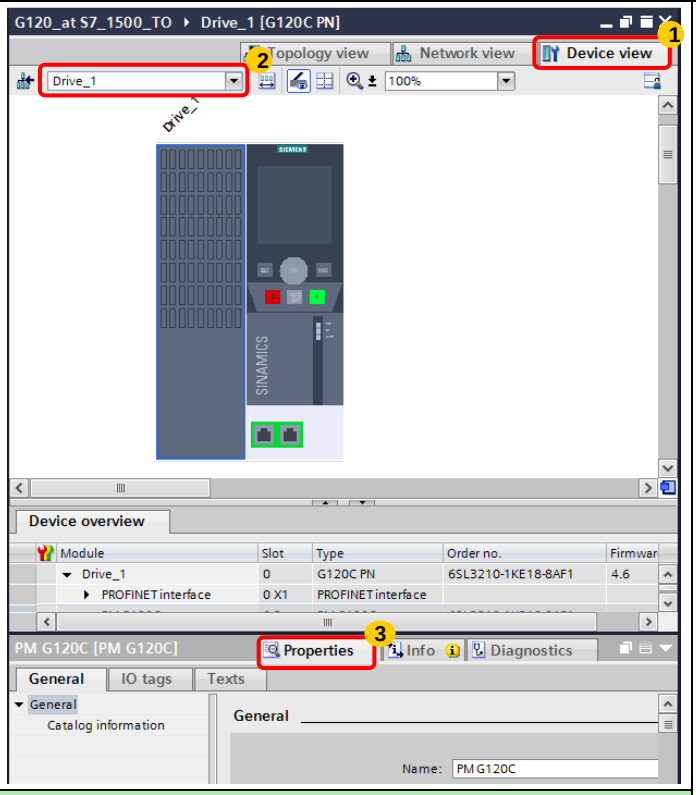
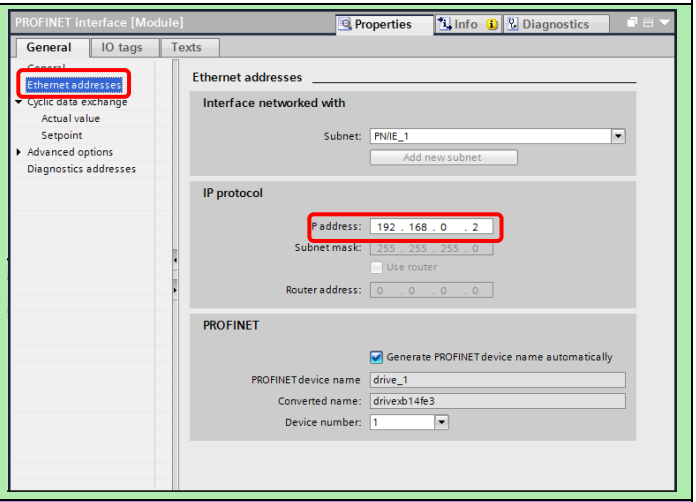
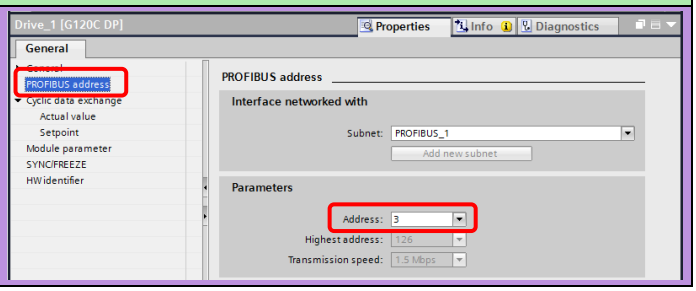
No.	Action	Picture
	Creating the project	
1.	Open TIA Portal.	
2.	If TIA Portal opens in the Portal view, go to the bottom left to switch to the Project view.	

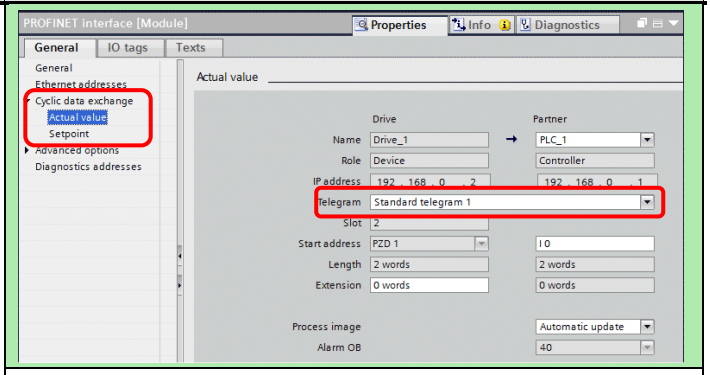
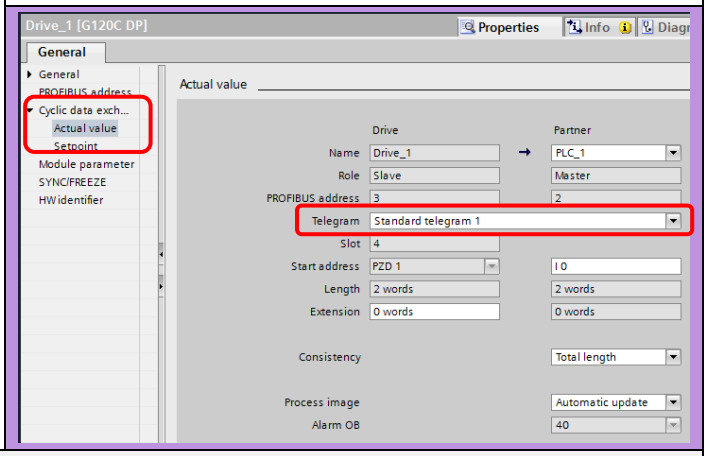
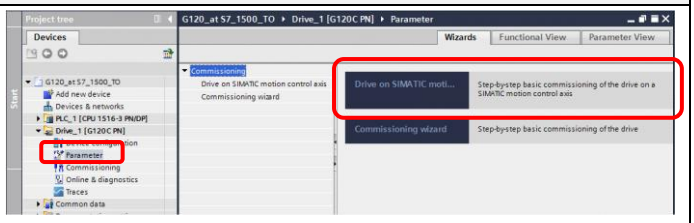
No.	Action	Picture
3.	Create a new project and assign a name (e.g., “G120_at_S7-1500_TO”).	
	Inserting the SIMATIC S7-1500	
4.	Double-click on “Add new device”.	
5.	1. Select “Controller”. 2. Select the desired CPU. 3. Then click on “OK”.	

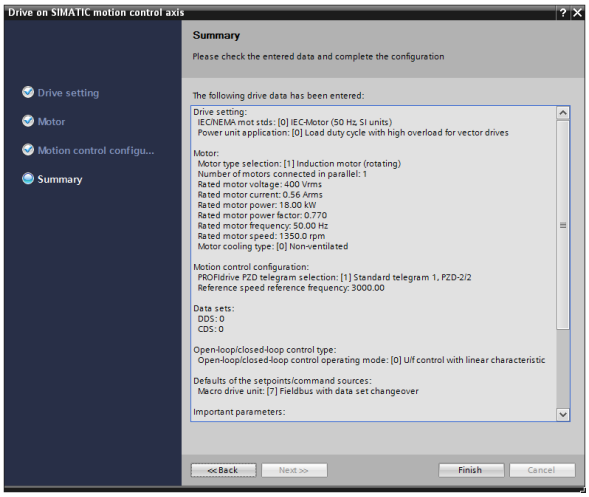
No.	Action	Picture
Configuring the SIMATIC S7-1500		
6.	Go to the Device configuration of the CPU.	
7.	Open the PROFINET interface: 1. In the Device configuration, open the “Properties” of the CPU. 2. In the tree, go to “Ethernet addresses” of the PN_interface [X1]. 3. Select “Set IP address in the project” and enter the desired IP address. 4. Add a new subnet and select it. 5. Select “Generate PROFINET device name automatically”.	

No.	Action	Picture
	Inserting and networking the SINAMICS G120	
8.	Select the desired SINAMICS drive: a. In the “Devices & networks” editor, go to the “Network view”. b. 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.	
9.	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. (PROFIBUS on the next page)	

No.	Action	Picture
	When using a SINAMICS G120 with PROFIBUS: Drag the mouse to connect the two PROFIBUS ports.	
	Configuring the SINAMICS G120	
10.	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. Select “Device view” 2. Select the drive 3. Insert the power module from the catalog.	

No.	Action	Picture
11.	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”.	
12.	When using a SINAMICS G120 with PROFINET: In >PROFINET interface >Ethernet addresses, check the IP address of the SINAMICS drive. (PROFIBUS on the next page)	
	When using a SINAMICS G120 with PROFIBUS: In >PROFIBUS address, check the address of the SINAMICS drive.	

No.	Action	Picture
13.	In >Cyclic data exchange >Actual value, make sure that “Standard telegram 1” is selected.	 or 
Parameterizing the SINAMICS G120		
14.	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
15.	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

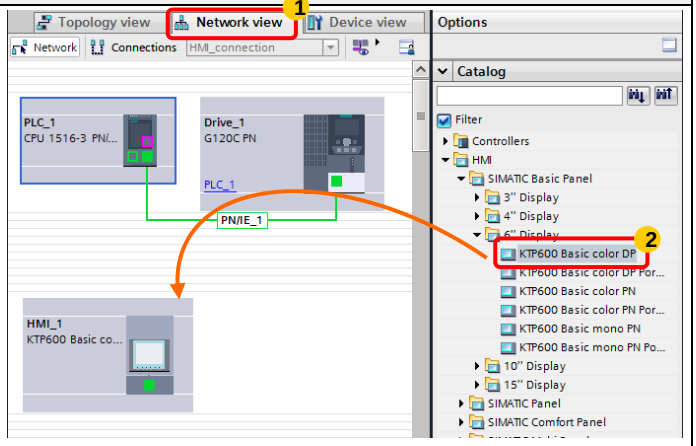
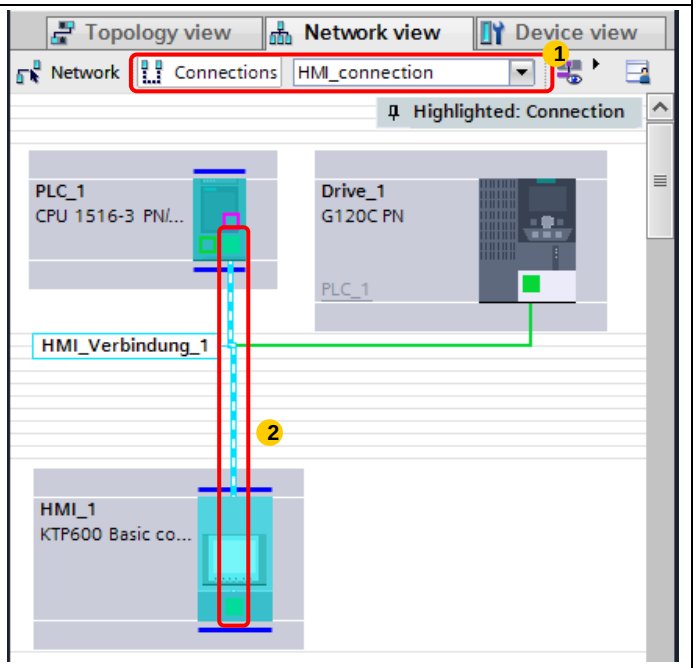
Open-loop/closed-loop control type:
Open-loop/closed-loop control operating mode: [0] U/f control with linear characteristic

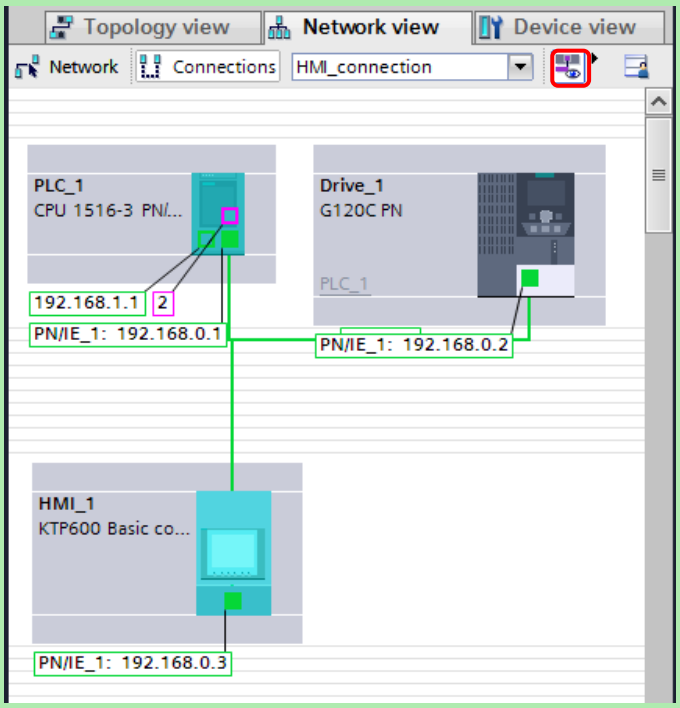
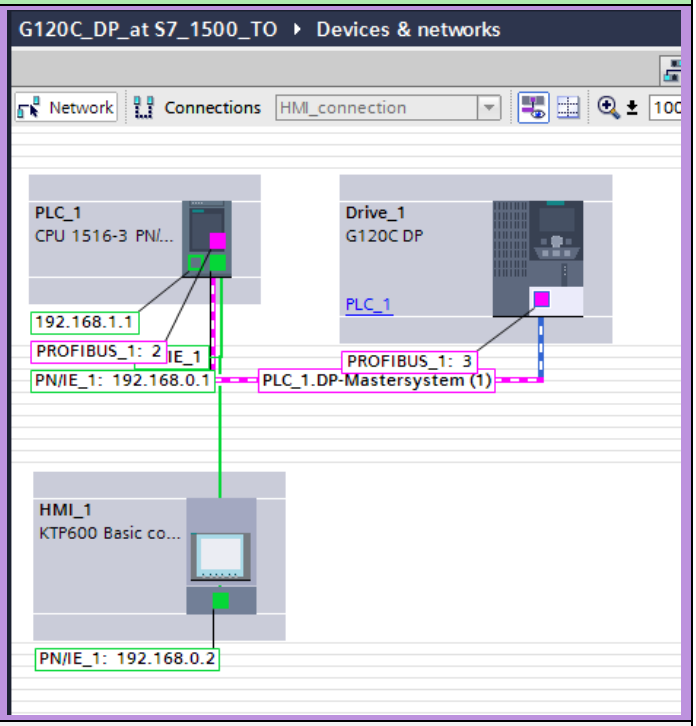
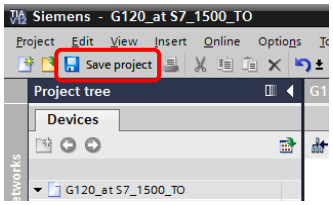
Defaults of the setpoints/command sources:
Macro drive unit: [7] Fieldbus with data set changeover

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 reference an d maximal speed. This values must be uses when parametrating the Technological Object in the PLC.

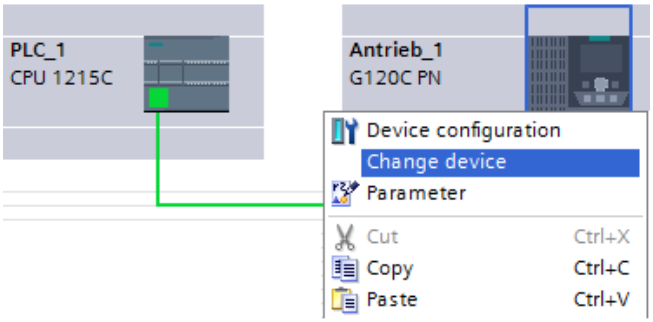
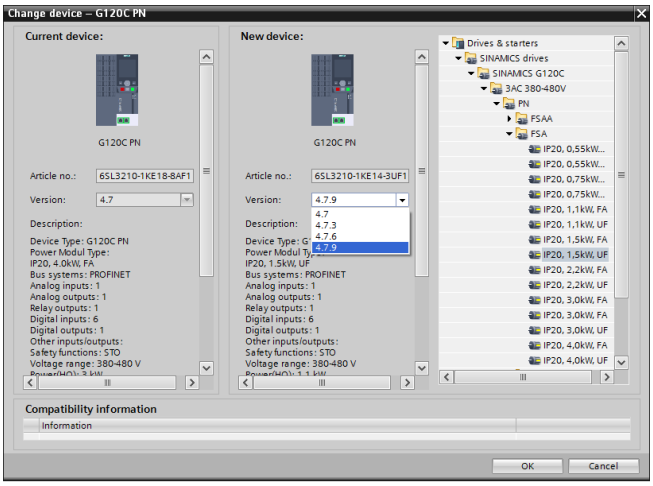
No.	Action	Picture
	Inserting and networking the KTP600	
16.	Select the desired HMI operator panel: 1. In the “Devices & networks” editor, go to the “Network view”. 2. Then use drag and drop to move the required KTP600 from the catalog to the graphic area. In the catalog, the KTP600 can be found in … >HMI >SIMATIC Basic Panel >6" Display	
17.	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
18.	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 configuration	
19.	Save the project	

Change device of SINAMICS G120

It is possible to change the SINAMICS after the configuration.

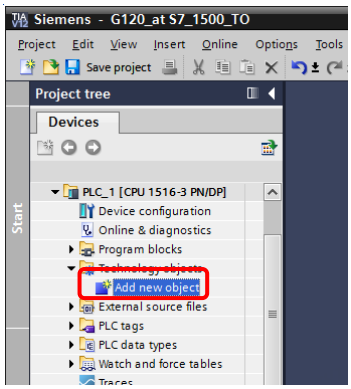
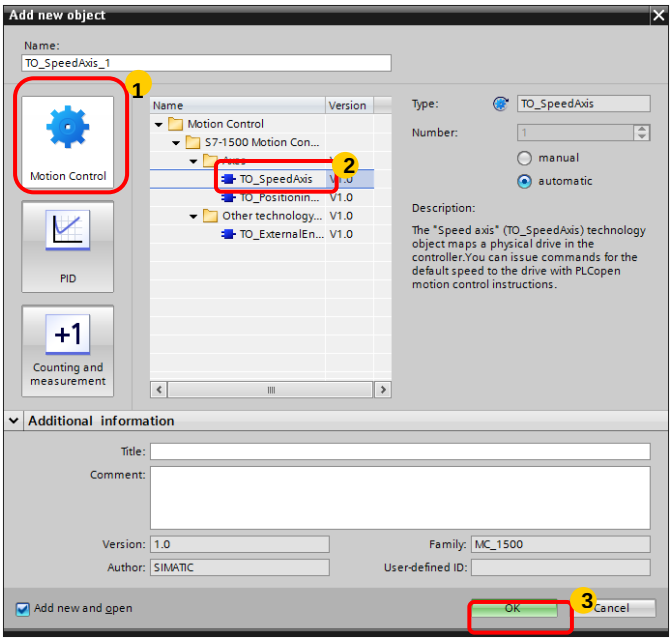
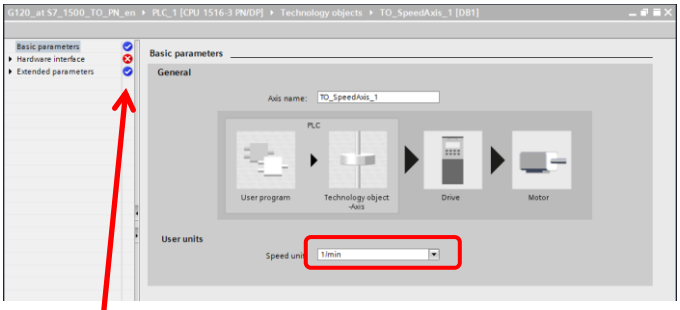
Table 4-2: change device

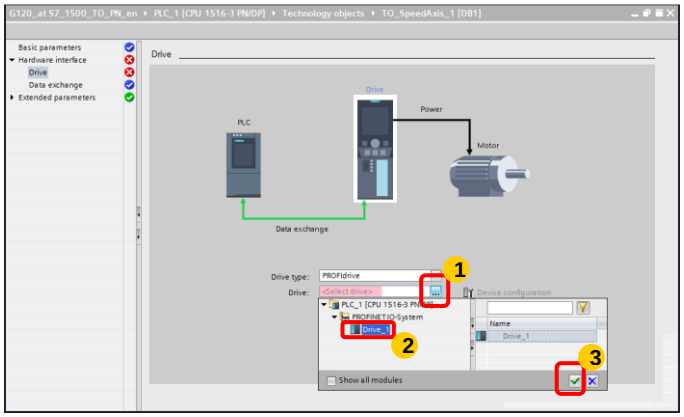
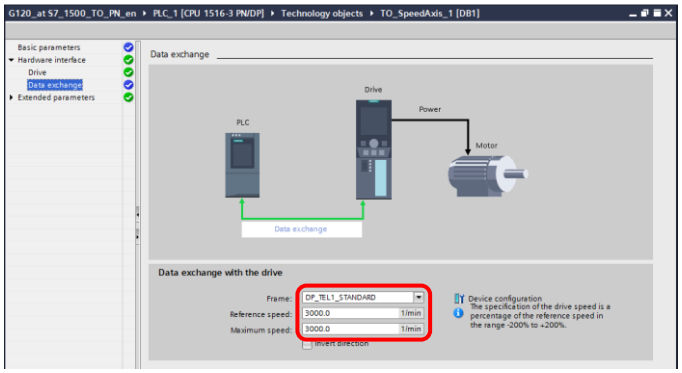
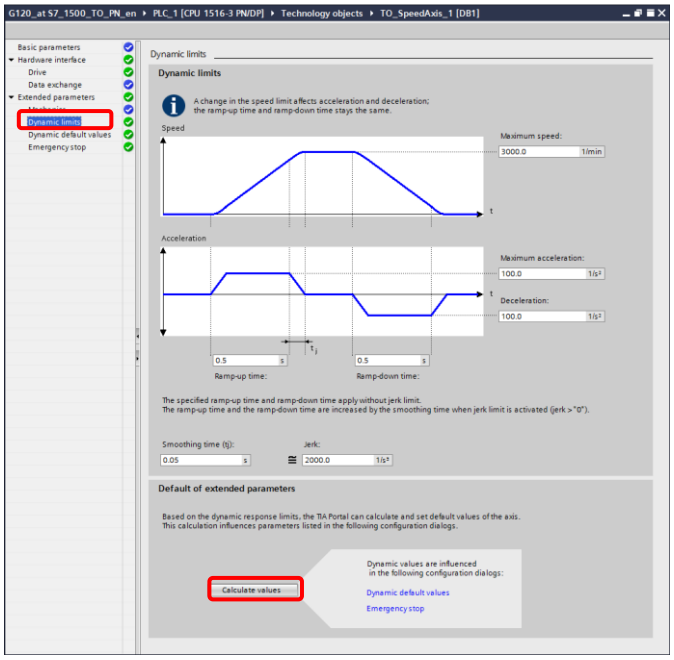
No.	Action	Picture
1.	Select the SINAMICS G120 and open the mask for change.	
2.	It is possible to change the size and the firmware-version of a SINAMICS G120C. The firmware-version is changeable by all SINAMICS G120.	

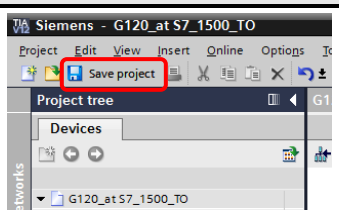
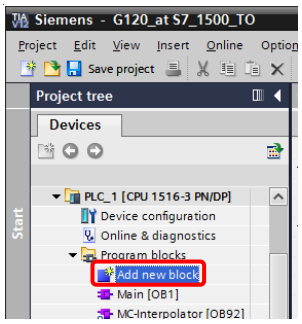
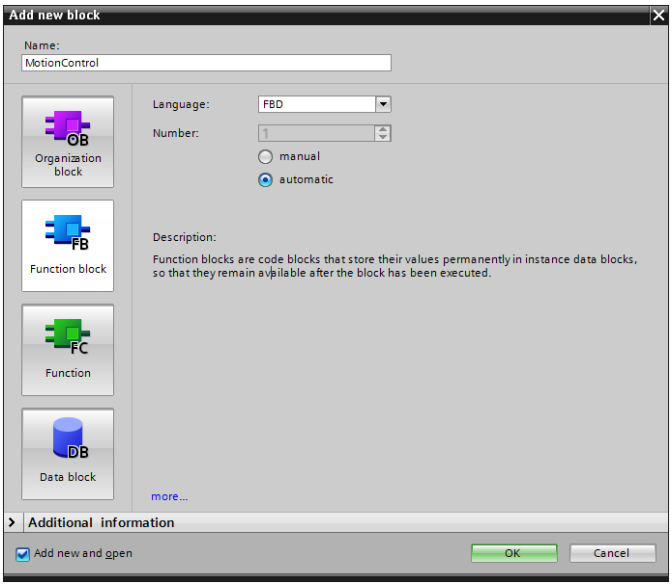
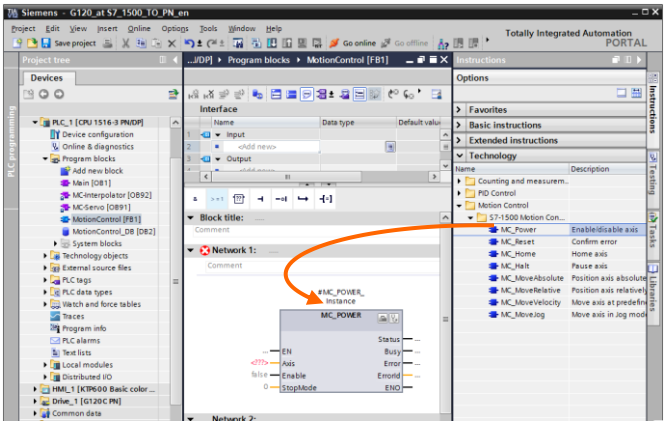
NOTE The procedure to change the SINAMICS G120 is identical by PROFIBUS and PROFINET-devices.

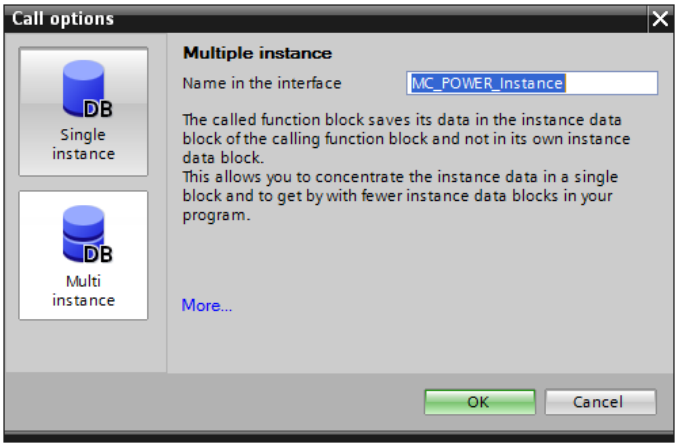
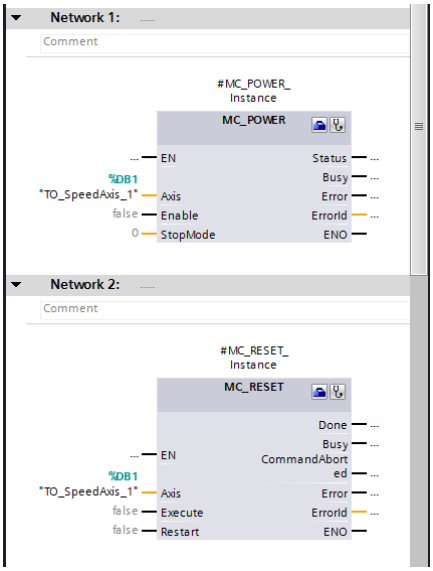
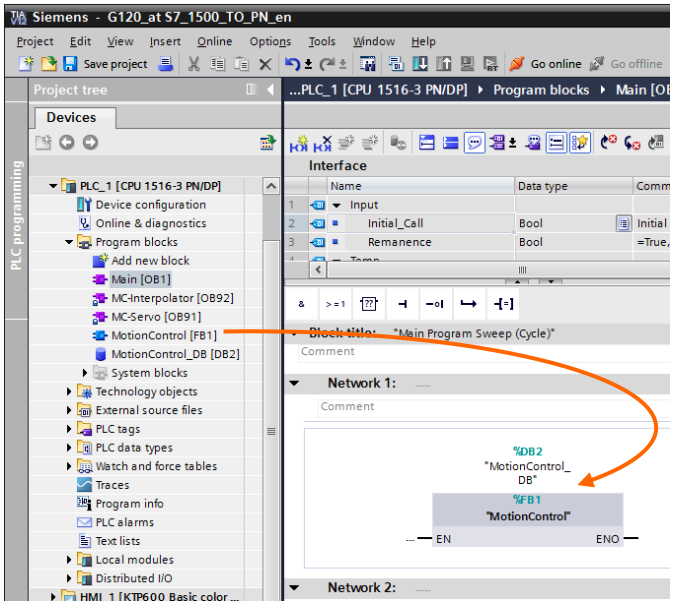
4.2 Creating the Speed axis technology object

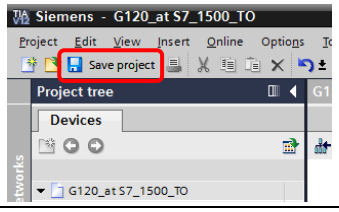
Table 4-3: Creating the project configuration: TO

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_SpeedAxis”. 3. Click on OK to create the object.	
4.	The technology object configuration opens. In Basic parameters, you can define the unit to be used. For this example, you should use “1/min”.	 Note: The “blue” check mark means that default values are sent. The “red” X means that values are missing or invalid. The “green” check mark means that values were entered.

No.	Action	Picture
5.	In “Hardware interface > Drive”, select the SINAMICS drive 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 “Hardware interface > Data exchange”, specify the same telegram and the same standardization as in the parameterization of the SINAMICS G120. a. Make sure that telegram 1 is selected. b. Make sure that the same reference speed is entered as in the SINAMICS Wizard in Table 4-1 Step 15. c. Make sure that the same maximum speed is entered as in the SINAMICS Wizard in Table 4-1 Step 15..	
7.	In “Extended parameters”, you can enter more speed axis data. a. In “Extended parameters>Mechanics”, you can set a gear ratio. b. In “Dynamic limits”, you can specify the maximum dynamic properties of the speed axis. Here you should enter 0.5 s as the (minimum) ramp-up and ramp-down times and have the values recalculated. c. In “Dynamic default values”, you can specify the default values for motion commands. d. In “Emergency stop”, you can enter the deceleration values for the emergency stop.	

No.	Action	Picture
8.	Save the project.	
	Inserting the technology function blocks	
9.	Create a new block in the controller.	
10.	a. Select Function block. b. Assign the block a name, e.g. Motion Control. c. Select a programming language, e.g. FBD. d. Click on “OK”.	
11.	The new FB opens automatically. From “Instructions > Technology > Motion Control > S71500 Motion Control”, insert the following blocks: • MC_Power • MC_Reset • MV_Halt • MC_MoveVelocity • MC_MoveJog	

No.	Action	Picture
	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.	
12.	At the Axis interface of the “MC_...” blocks, always select “TO_SpeedAxis_1”.	 Example of the interconnection of the Axis interface.
13.	Open the “Main [OB1]” block and in this block, call FB “MotionControl”. Confirm the creation of an instance DB.	

No.	Action	Picture
14.	Save the project.	

4.3 Safe Torque Off (STO) with Safety Integrated

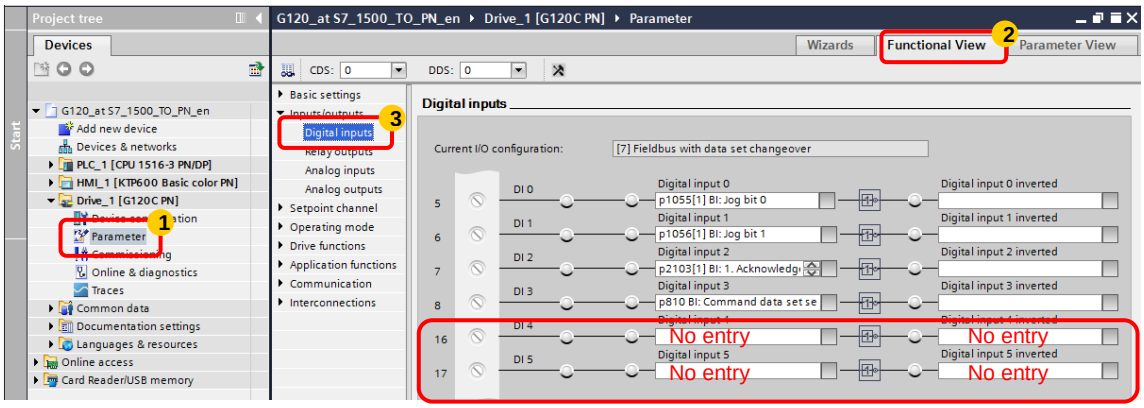
This function is not implemented in the STEP 7 sample project. Furthermore, it is not available for the SINAMICS G120P.

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.

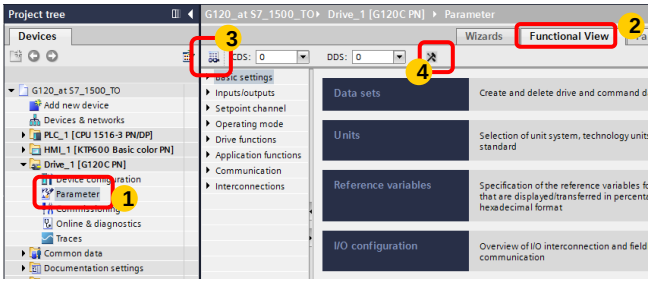
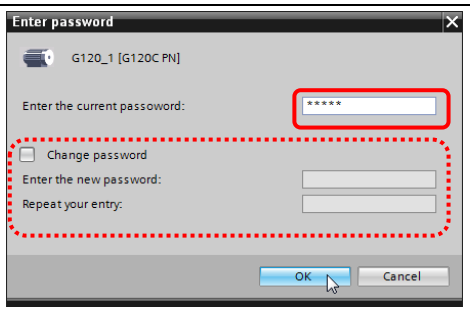
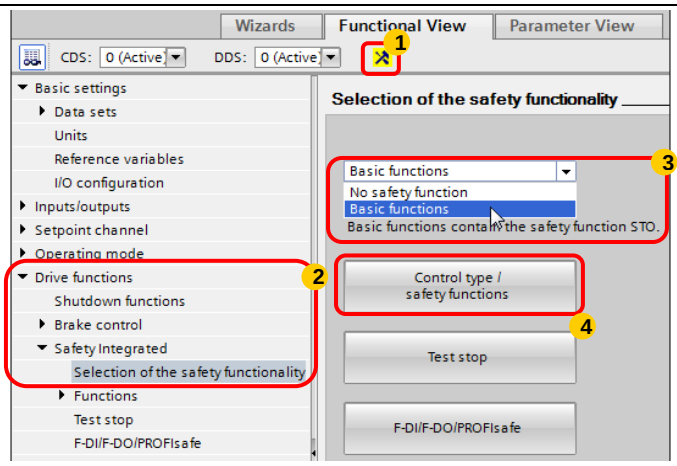
Figure 4-1: Digital inputs

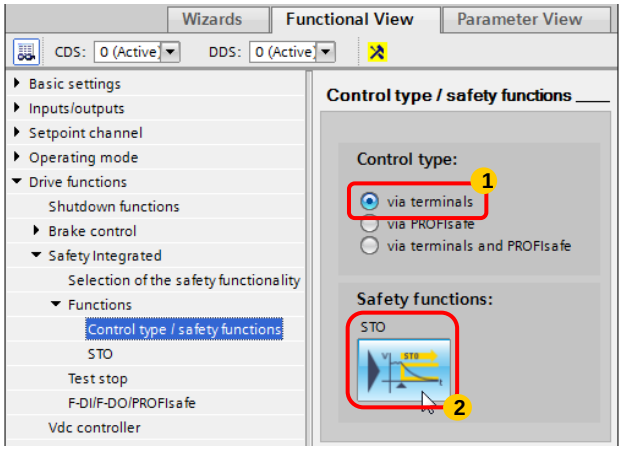
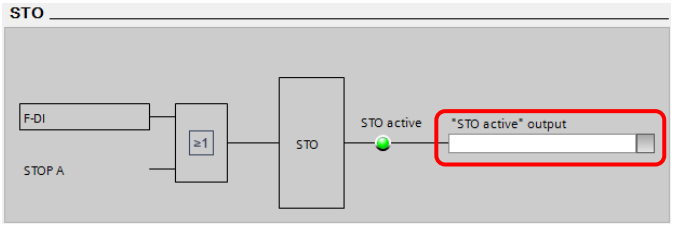
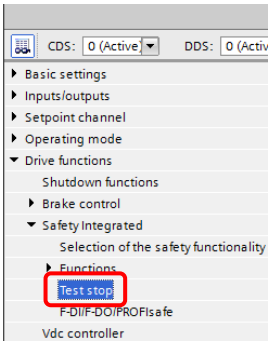
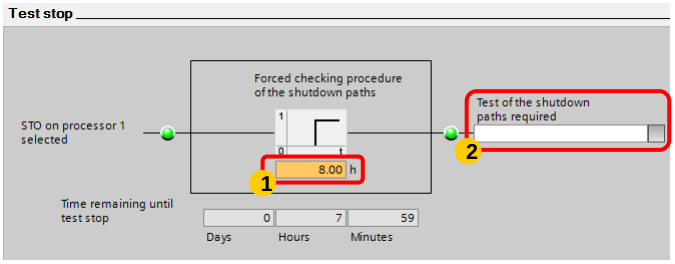
Figure 4-2

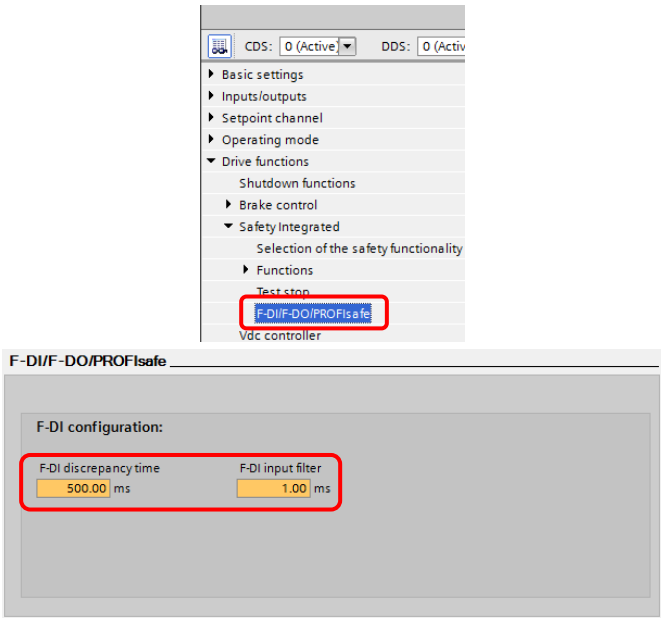
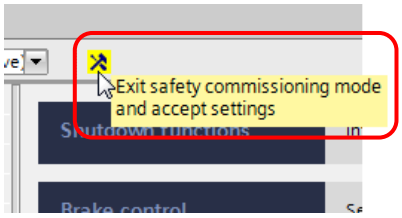
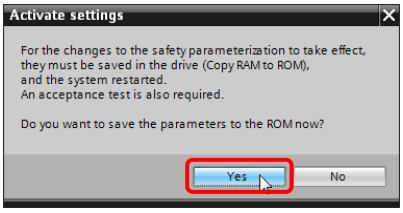
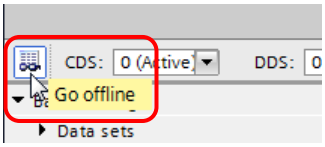


- For test purposes, apply 24V to DI 4 and DI 5 or connect an emergency stop control device. Do not forget to connect the reference potential of inputs DI 4 and DI 5 to ground. The wiring of the signals is shown in chapter **Fehler! Verweisquelle konnte nicht gefunden werden. Fehler! Verweisquelle konnte nicht gefunden werden.**.

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.	
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.	

No.	Action	Picture
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.	
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.	 

No.	Action	Picture
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.	
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.)	

5 Installation and Commissioning

5.1 Connection diagram

Figure 5-1: Wiring for PROFINET

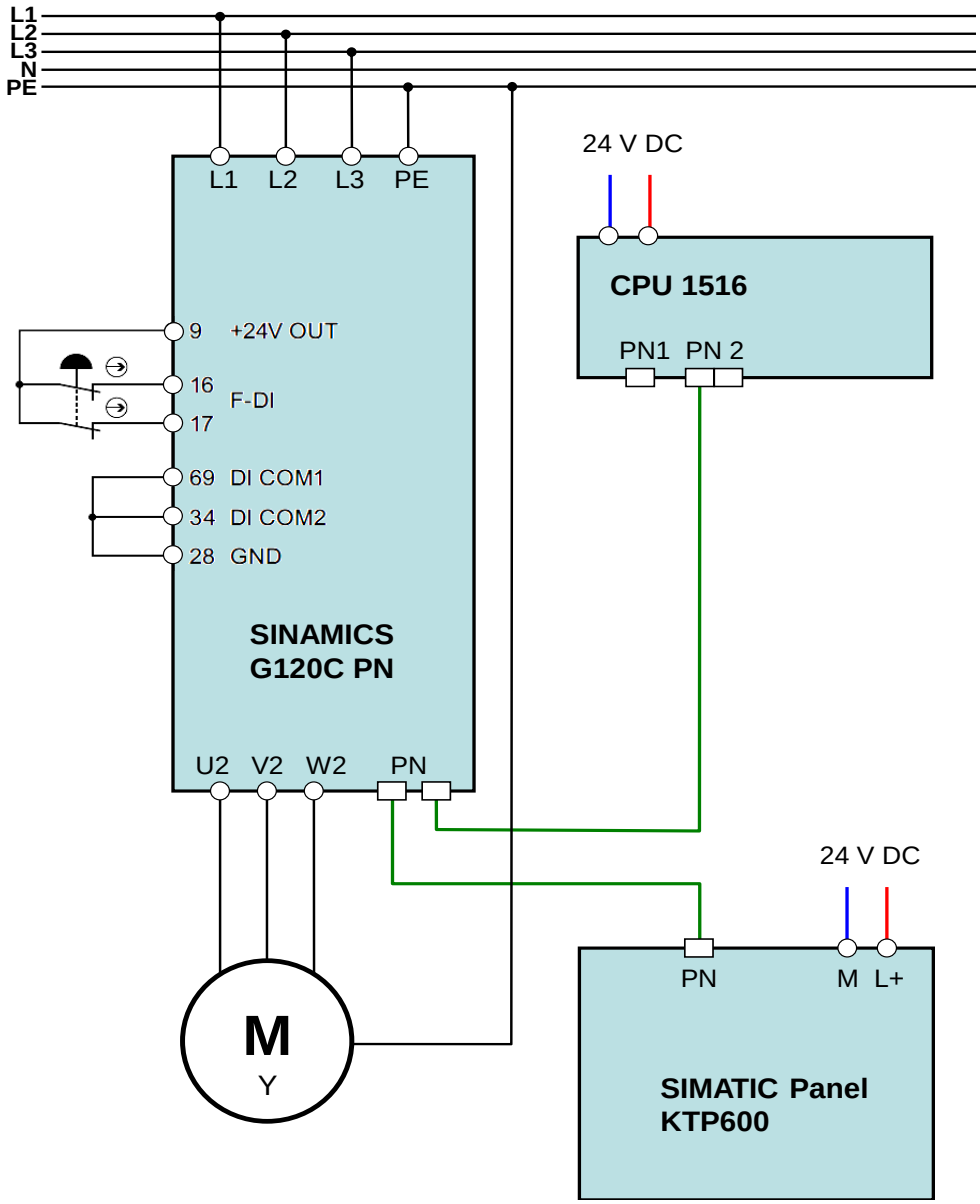
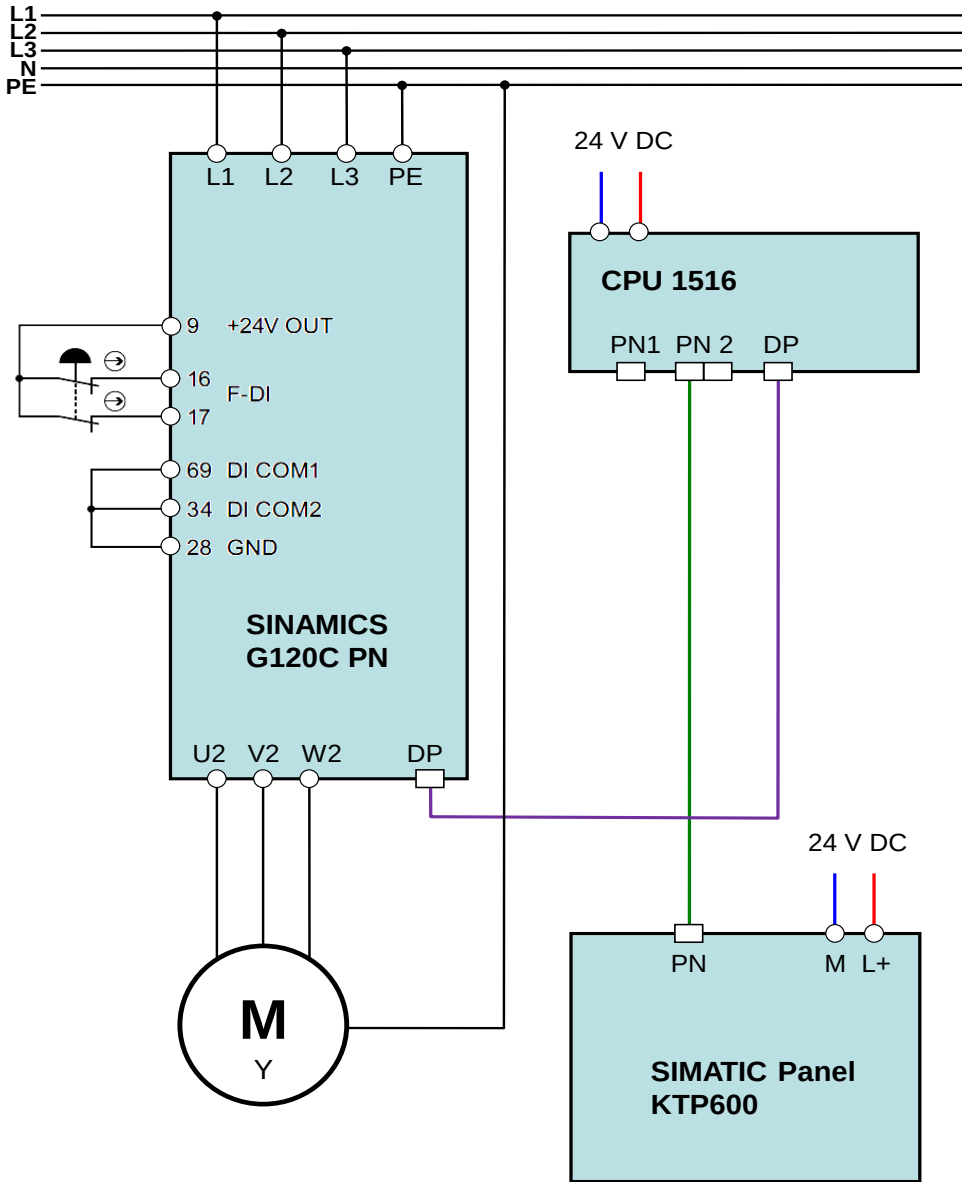
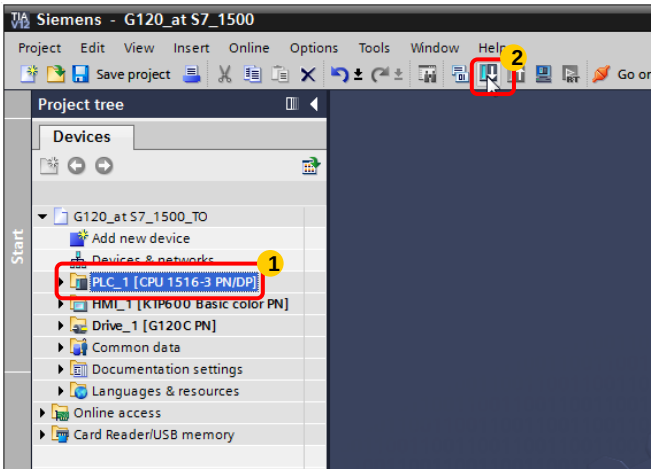
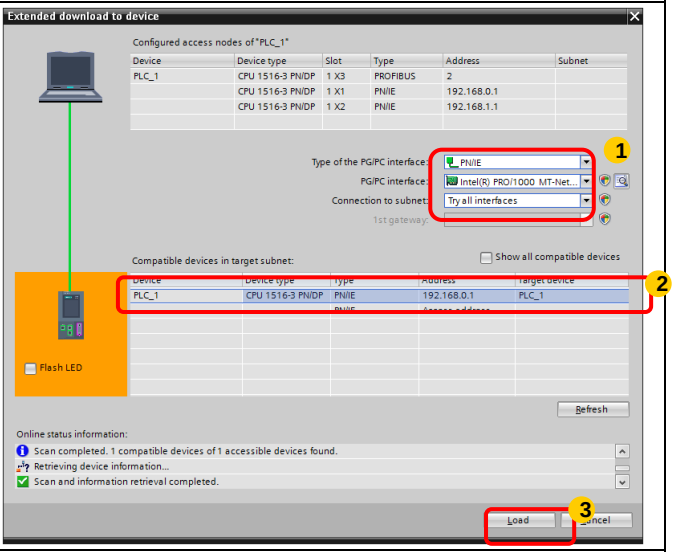
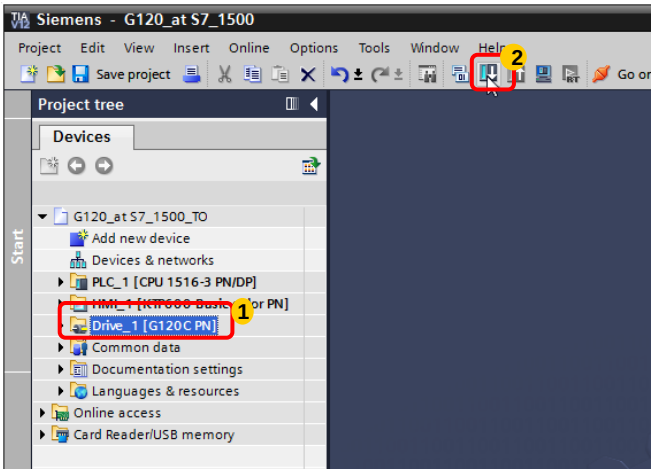


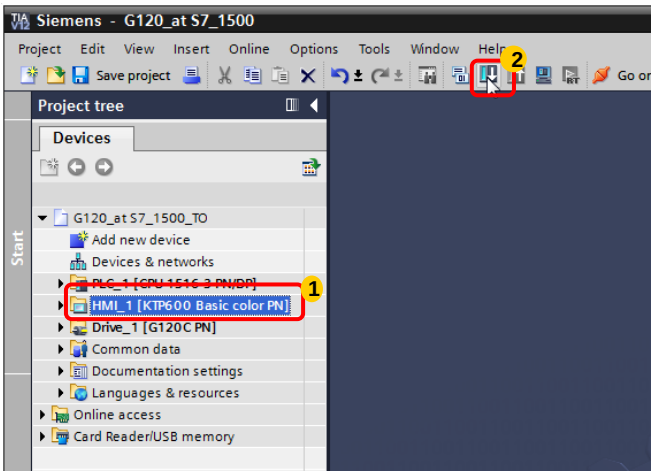
Figure 5-2: Wiring for PROFIBUS



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.	a. Select the S7-1500 CPU and b. then click on “Download to device”.	
3.	If the “Extended download to device” dialog opens, a. select the settings necessary for your online connection, b. select the CPU 1516-3 PN/DP and c. 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.	

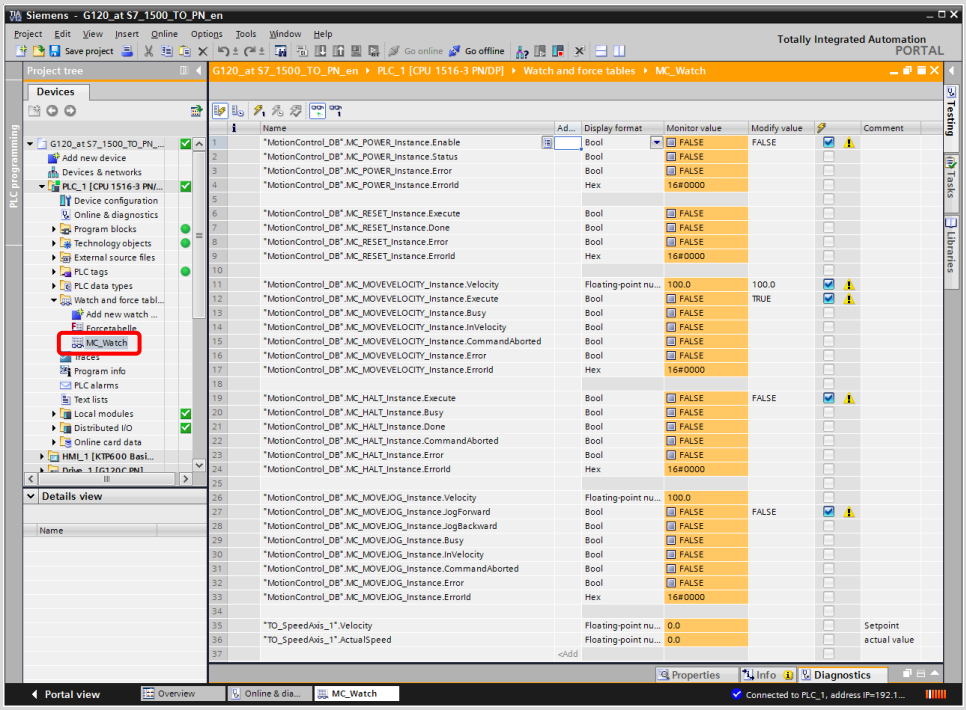
6 Operation of the Application

6.1 “MC Watch” watch table

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 and get to know their reactions.

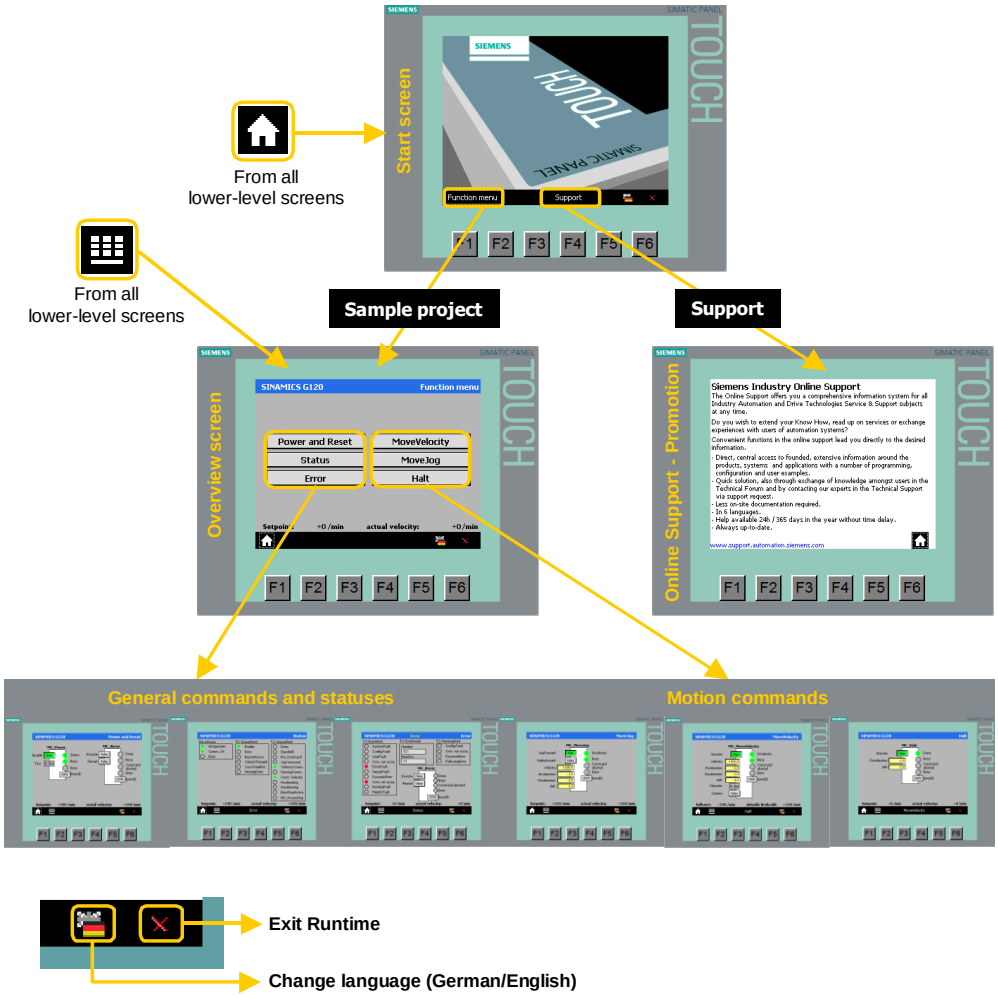
Note If you cannot or do not want to use an operator panel, you can also use the “MC Watch” watch table created in the sample project.



6.2 Operation of the application with a panel

6.2.1 Screens and screen navigation

Figure 6-1



6.2.2 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

The setpoint and the current speed of the drive are displayed directly above the footer.

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

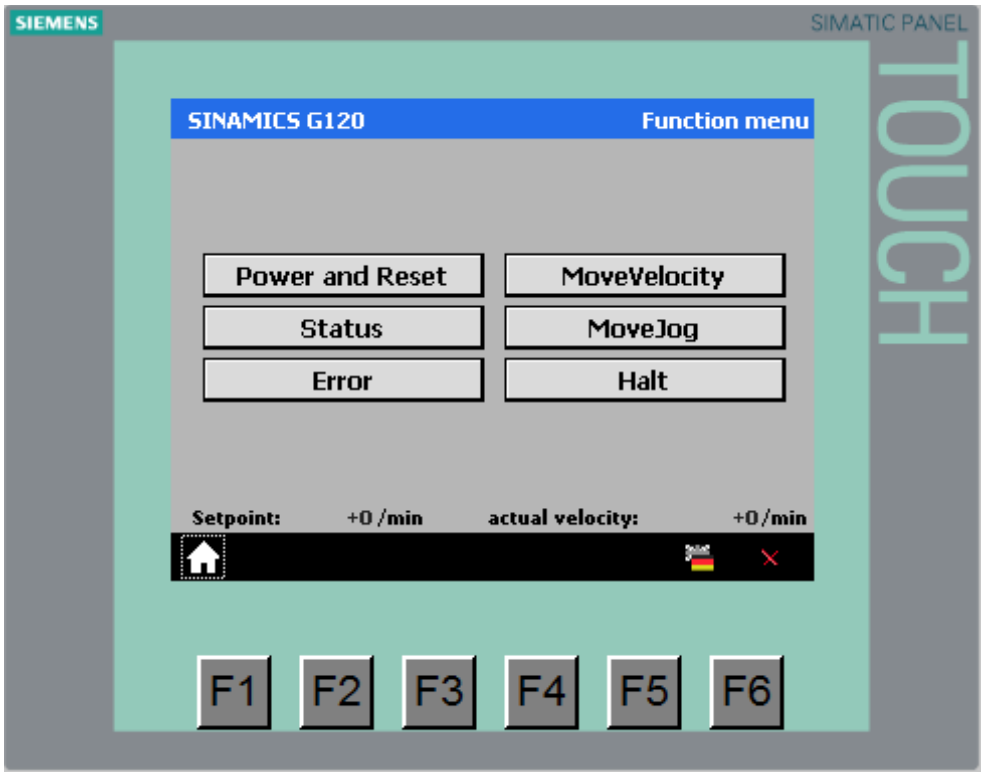
 In all operating screens, “Menu” allows you to return to the Function menu.

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

 “Exit” allows you to exit Runtime.

6.2.3 Function menu

Figure 6-2



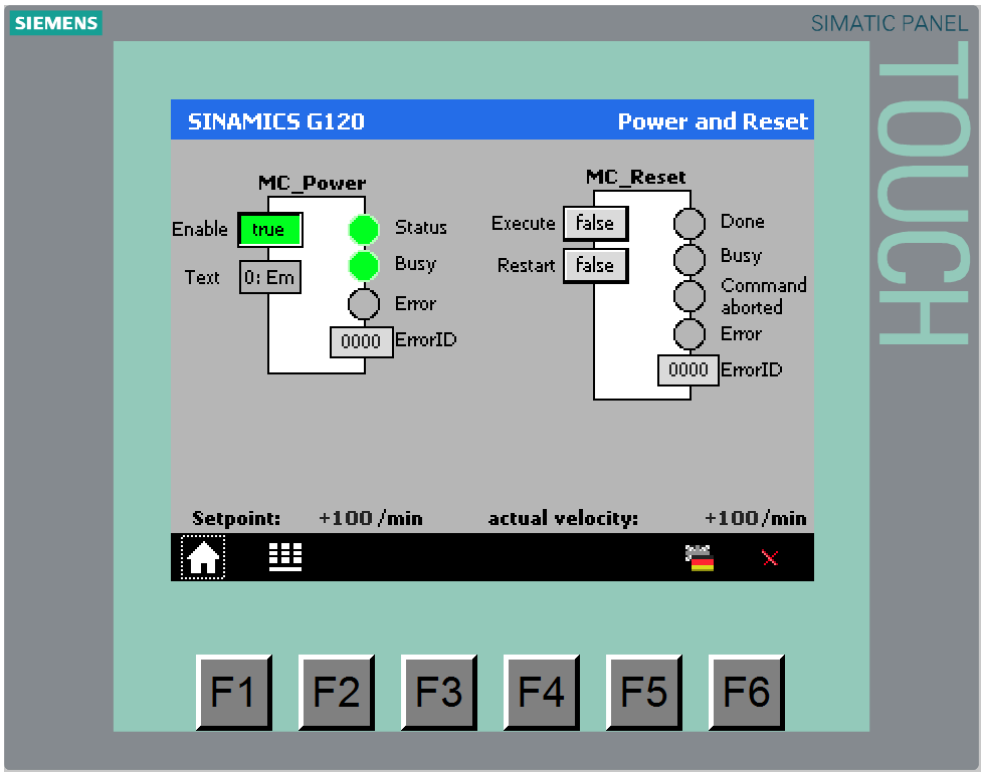
From the Function menu, you can call the individual operating screens:

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.
Status	Visualization of the status bits of the Axis TO.
Error	Visualization of the error bits of the Axis TO.
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.

6.2.4 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 setpoint is 0 until a new setpoint is specified using a motion control command.

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.

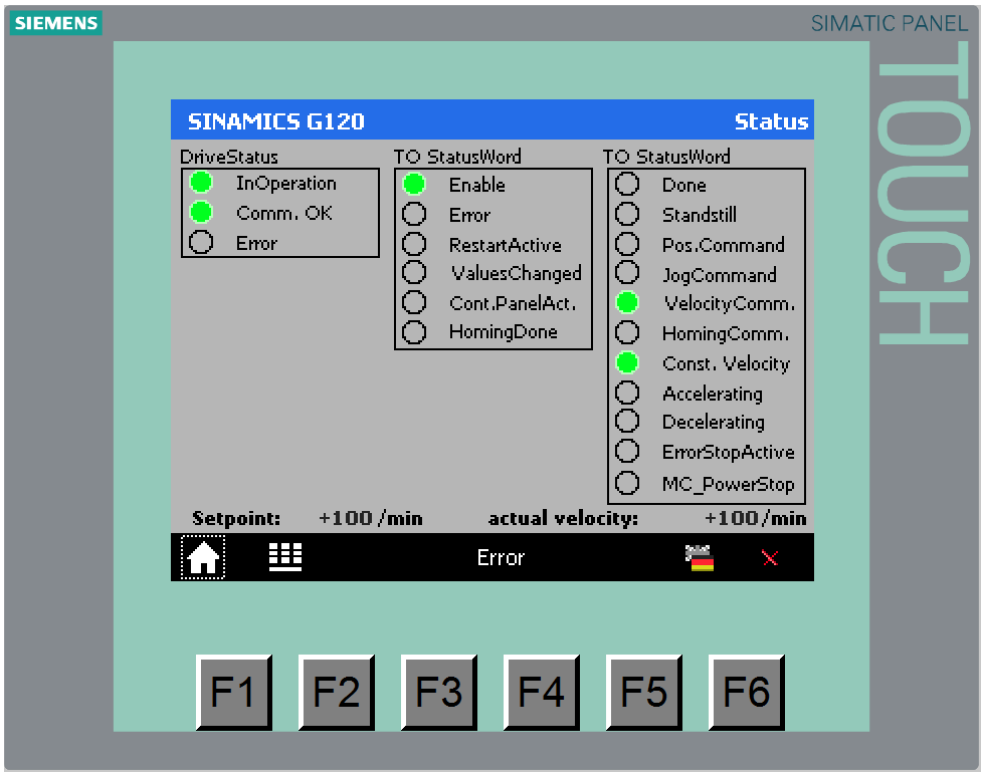
MC_Reset

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.

6.2.5 Status

Figure 6-4

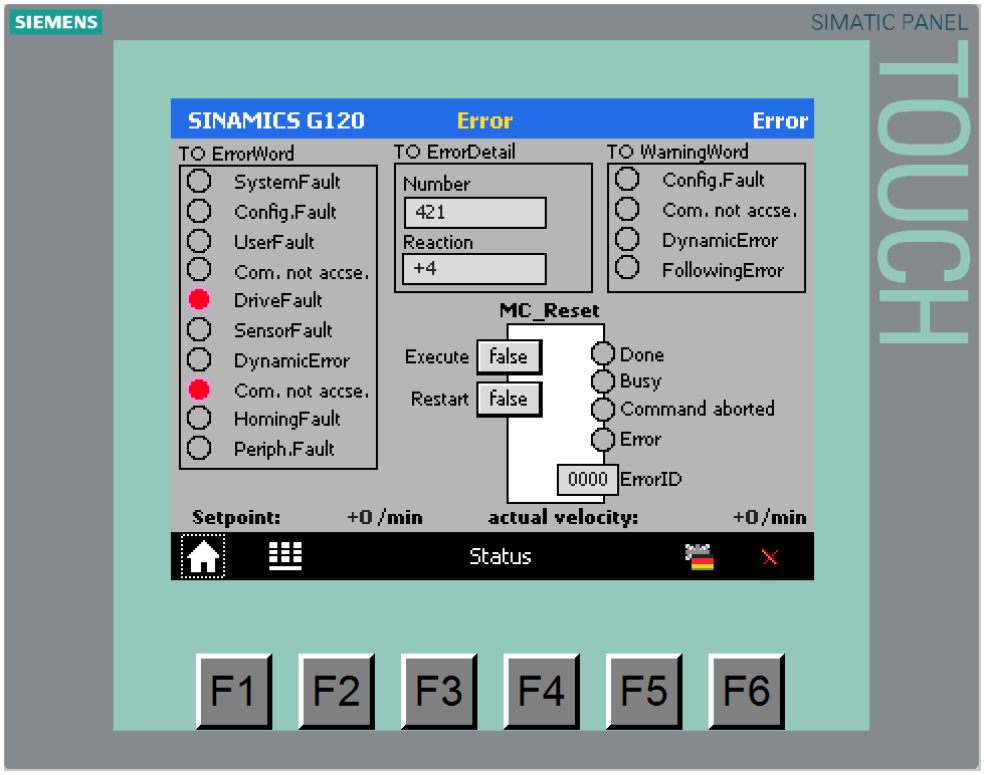


This operating screen displays the status bits of the axis.

The footer of this screen includes a hot key that allows you to go directly to the “Error” operating screen.

6.2.6 Error

Figure 6-5



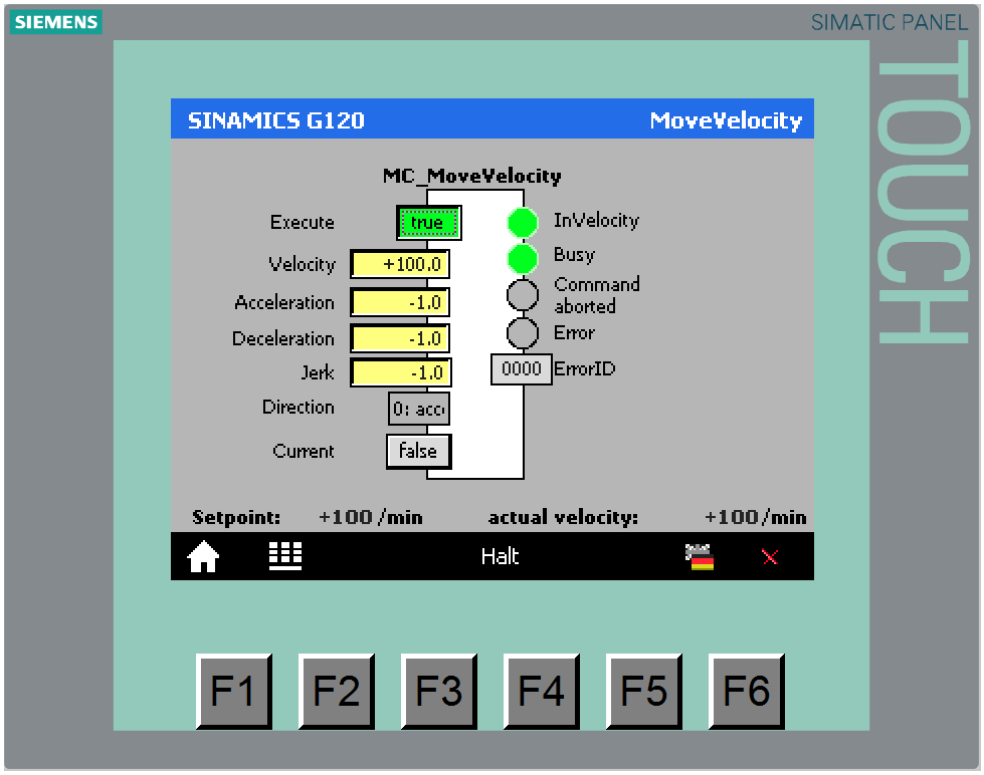
This operating screen displays the error bits of the axis.

MC_Reset allows you to acknowledge pending errors.

The footer of this screen includes a hot key that allows you to go directly to the “Status” operating screen.

6.2.7 MoveVelocity

Figure 6-6



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

Click on the “Direction” input to define in a menu 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.

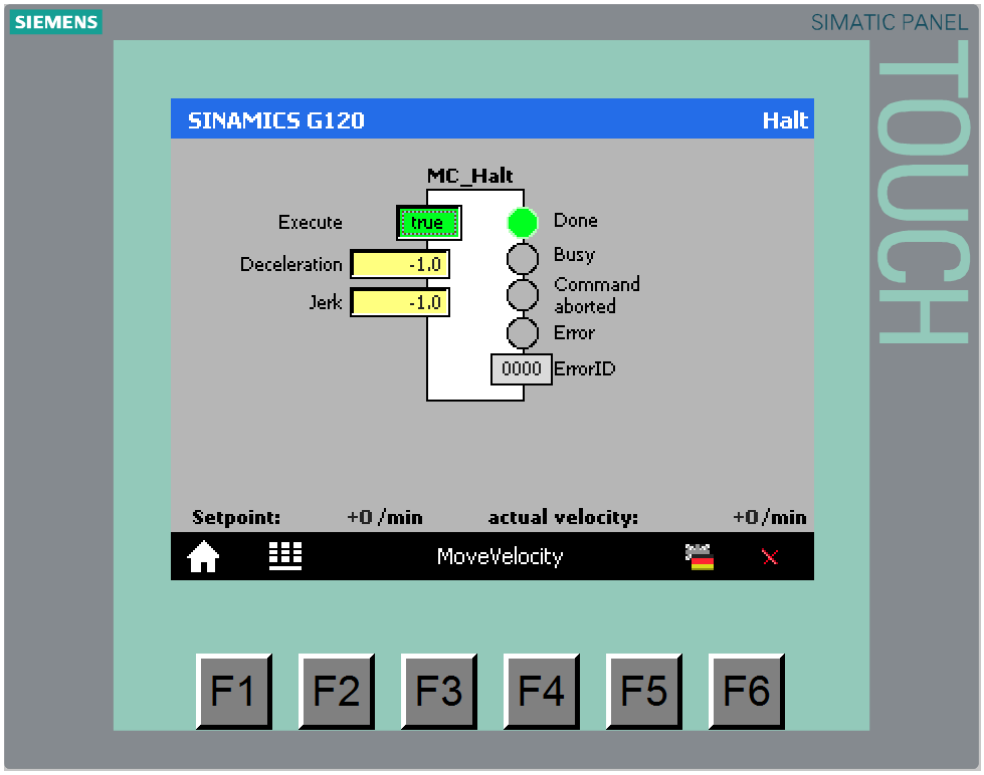
The “Acceleration”, “Deceleration” and “Jerk” inputs allow you to define how the axis is to reach the specified velocity.
If you specify a negative value, for example -1.0, the value defined when parameterizing the axis in TIA Portal (dynamic default value) will be used.

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

The footer of this screen includes a hot key that allows you to go directly to the “Halt” operating screen.

6.2.8 Halt

Figure 6-7



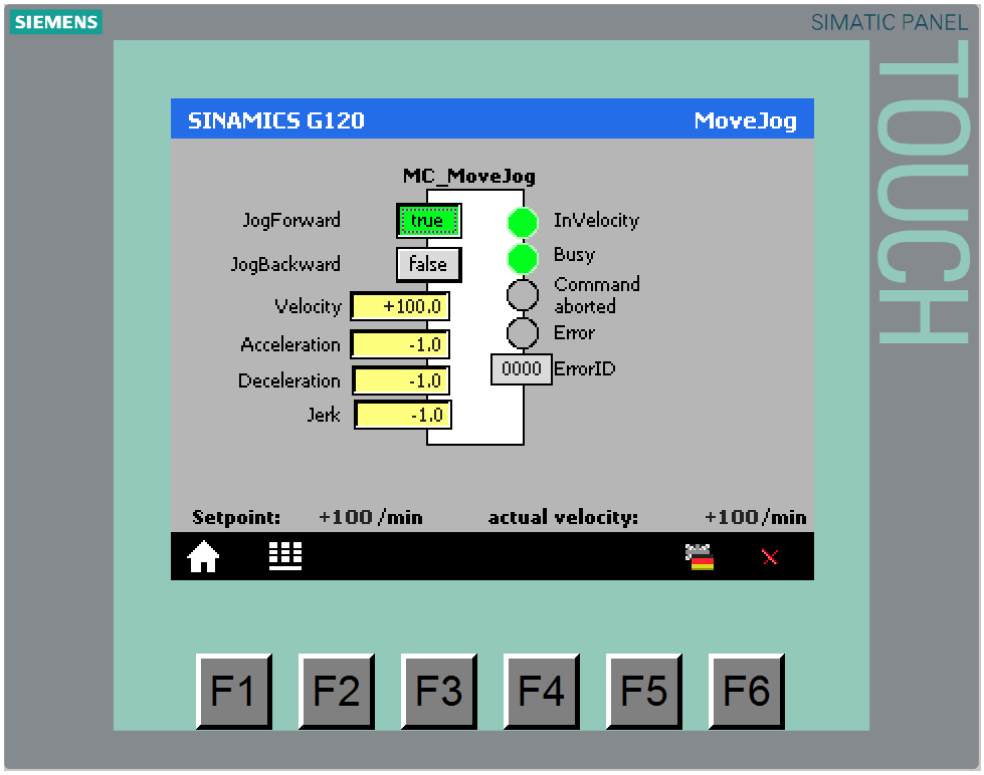
A rising edge at the “Execute” input of “MC_Halt” decelerates the axis to a standstill.

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.

The footer of this screen includes a hot key that allows you to go directly to the “Move_Velocity” operating screen.

6.2.9 MoveJog

Figure 6-8



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.

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 and get to know their reactions.

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

Table 6-2

No.	Action	Remark
1.	Call the “Function menu”.	
2.	Click on “Power and Reset”.	

No.	Action	Remark
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.	Use the hot key to go to “Halt”.	When the drive has stopped, this is indicated by “MC_Halt” with the “Done” output.
12.	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.
13.	Use the hot key to go to “MoveVelocity”.	“CommandAborted” indicates that “MoveVelocity” was aborted.
14.	A rising edge at “Execute” allows you to restart the axis.	
15.	Call the “Function menu”.	
16.	Click on “Status”	This is where you see the status bits of the drive.
17.	Use the hot key to go to “Error”.	This is where you see the error bits of the drive.
18.	Provoke an error by • briefly removing the Ethernet connection cable from 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.
19.	Once communication has been reestablished, you can acknowledge the error with a rising edge at “Execute” of “MC_Reset”.	
20.	If you reduce the acceleration values in the sample project to 1 to 5 m/s², ramp-up and 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 in order 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/78788716http://support.automation.siemens.com/WW/view/en/78788716
\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
	SINAMICS G120P Manuals	Operating instructions (V4.7): http://support.automation.siemens.com/WW/view/en/94020570 List manual (V4.7) (parameters and error list): http://support.automation.siemens.com/WW/view/en/99683691
	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	09/2013	First version
V1.1	11/2014	Updated to TIA Portal V13 and SINAMICS FW4.7
V1.2	07/2018	Included “change SINAMICS G120”