SINAMICS G: Speed Control of a G110M/G120 (Startdrive) with S7-1200 (TIA Portal) via PROFINET with Safety Integrated (via Terminal) and HMI

SINAMICS G110M, G120 / SIMATIC S7-1200

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Table of contents

1 Task

The SIMATIC S7-1200 can be operated as a PROFINET controller. A PROFINET-capable SINAMICS G120 drive can be used as PROFINET device and be controlled by the SIMATIC S7-1200. The application description covers the following drive types (with FW ≥V4.6):

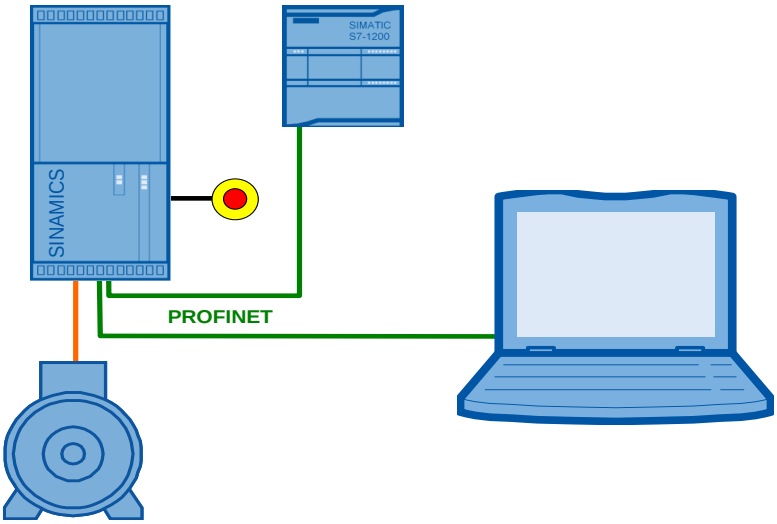
- G110M
- G120 with CU240E-2 PN or CU250S-2 PN
- G120C PN
- G120D with CU240D-2 PN
- G120P with CU230P-2 PN

The abbreviation G120 used in this document refers to the above devices. Using the example of a SINAMICS G120C with PROFINET interface illustrates how to configure the SINAMICS drive, start it up, and access process data and parameters.

Overview of the automation task

The following figure gives an overview of the automation task:

Figure 1-1: Overview



Requirements for the automation task

Table 1-1: Requirements for the automation task

Requirement	Explanation
Access to process data	The SINAMICS G120 shall be switched on and off via the control word, and the speed value is to be specified as quickly as possible.
Access to parameters	Read and write access from the SIMATIC S7-1200 to the parameters in the converter (in this example: ramp-up and ramp-down time) should be possible and performed using as few resources as possible, i.e. small communication load.
Safety function of the SINAMICS G120	The SINAMICS G120 has the option of performing a fail-safe shutdown (STO).

2 Solution

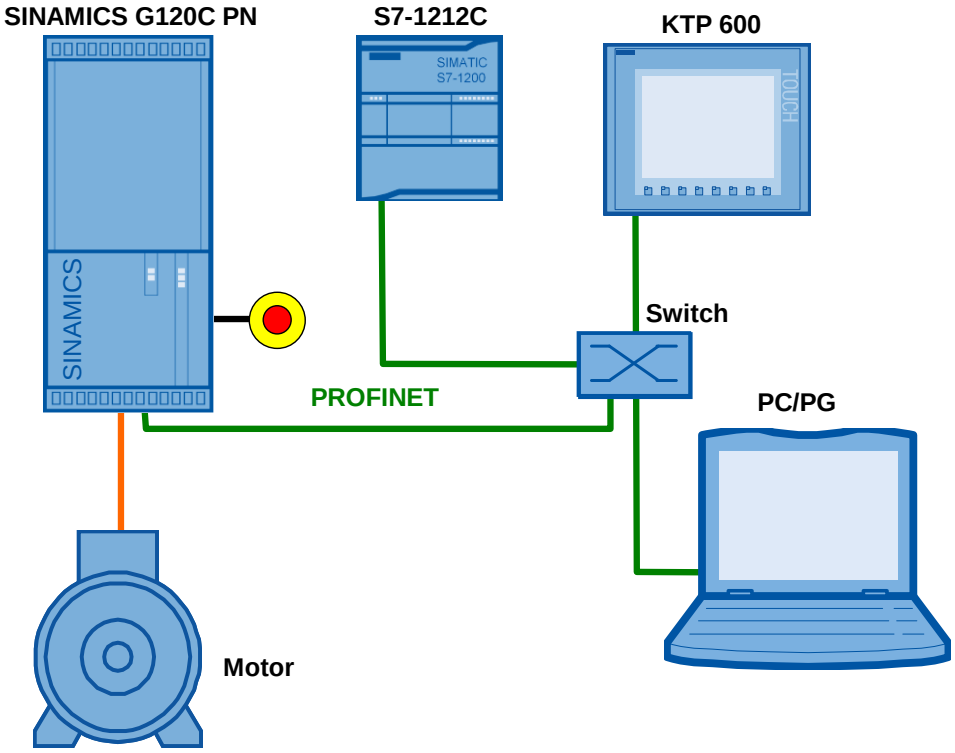
This application description gives an example of a PROFINET connection of a SINAMICS G120C to SIMATIC S7-1212C using SINAMICS Startdrive V13. It uses blocks which can be directly applied to your own application.

2.1 Solution overview

Schematic layout

The following scheme shows the most important components of the solution:

Figure 2-1: Interconnecting the components



The example shows you how ...

- ...the SIMATIC S7-1200 controller is configured.
- ...the communication is programmed in the SIMATIC S7-1200 controller.
- ...the SINAMICS G120 converter is configured using Startdrive.

2.2 Description of the core functionality

2.2.1 Configuring the communication

The SIMATIC controller as well as the SINAMICS converter is configured in TIA Portal V13. Hence, they only require one software.

Note Entering communication parameters twice, as performed so far when using the STARTER commissioning software, is no longer necessary. Also, a GSDML file of the used SINAMICS drive does no longer need to be integrated into the hardware catalog.

The IP addresses and PROFINET device names, as well as the I/O address areas for the data to be exchanged between SIMATIC controller and SINAMICS drive, are automatically created in the TIA Portal during hardware configuration. However, they can be modified at any time. The process data to be exchanged by the SIMATIC controller and the SINAMICS drive is specified by the message frame type to be used (in this example: SIEMENS Telegram 352) which you also configure in the hardware configuration under the Properties of the SINAMICS drive

2.2.2 Data exchange

Data exchange between SINAMICS G120 and SIMATIC S7-1200 occurs in two areas:

- Process data,
  i.e. control word(s) and setpoint(s), or status word(s) and real value(s)
- Parameter area,
  i.e. reading/writing of parameter values

Cyclic process data exchange

Process data is transferred cyclically, which means in each bus cycle. The data is transferred as quickly as possible.

The SIMATIC S7-1200 sends at least the control word and the setpoint value to SINAMICS G120 and in return receives at least the status word and the actual value.

Depending on the message frame type, two further setpoint or real values, or extended control or status words respectively, can be transferred. The available message frame types are available in chapter 7.4.1 of the SINAMICS G120C operating instructions (/6/), for example.

- On the controller side, the process data is supplied as I/O input or output words. The data transfer is supported by STEP 7 instructions (DPRD_DAT, DPWR_DAT).
- In the SINAMICS drive, the configuration specifies which bits of the control word are used and which data is transmitted to the SIMATIC controller.

Acyclic data exchange (parameter access)

To be able to transfer parameters, message frame types were also defined where additionally four words are provided for a parameter transfer ("SIEMENS Telegram 353 and 354" frames). Since these four words, like the process data, are always transmitted cyclically, a permanent communication load is produced even though the parameters themselves are generally only rarely required.

PROFINET also provides the option of using an acyclic data exchange in addition to the cyclic data exchange, which is only inserted on demand. This makes it possible to transfer the parameter area acyclically on demand, without creating a permanent communication load. The acyclic transfer takes clearly longer than the cyclic transfer of the process data.

In this example, the acyclic data exchange is used for parameter access and message frame type "Telegram 352" is used which does not support cyclic parameter transfer.

For acyclic writing and reading of parameters, please proceed as follows:

- In the SIMATIC S7-1200, parameter jobs are sent to the SIMATIC G120 by writing "data set 47", and the response of the SIMATIC G120 is received by reading "data set 47". These functions are supported by the STEP 7 instructions (RDREC, WRREC). A special hardware configuration is not necessary.
  More information on the structure of the data set is available in chapter 3.1.2 of the function manual "Fieldbus systems" (/6/), for example.
- No particular action is required on the SINAMICS G120 side.

Note If you do not select a message frame in the hardware configuration under the Properties of the SINAMICS drive, STEP 7 enters the "Standard telegram 1" frame (PZD-2/2). Use it as well, for example (due to its conciseness), when your application is restricted to acyclic writing and reading of drive parameters and you actually do not wish to exchange process data.

2.3 Hardware and software components used

The application was created with the following components:

Hardware components

Table 2-1: Hardware components

Component	No.	Article number	Note
CPU 1212C AC/DC/RLY	1	6ES7212-1BE31-0XB0	or other S7-1200 CPU (as of FW 2.2)[1]
SINAMICS G120C PN (V4.7)	1	6SL3210-1KE18-8AF1	or other SINAMICS or other SINAMICS G110M, G120, G120C, G120D, G120P or G110M with PN connection according to chapter 1[1]
SIMATIC Panel KTP600	1	6AV6647-0AD11-3AX0	This panel is optional.

[1] When using a device deviating from the given article number, it must be exchanged in the hardware configuration as described in chapter 6.

Component	No.	Article number	Note
Basic color PN			
CSM 1277 COMPACT SWITCH MODULE	1	6GK7277-1AA00-0AA0	or other switch
SINAMICS IOP	1	6SL3255-0AA00-4JA0	optional
Asynchronous motor	1	1LA7083-4AA60-xxxx	
PROFINET connector plug	8	6GK1901-1BB10-2AA0	incl. the connections with KTP600 and the PG/PC
PROFINET line		6XV1840-2AH10	

Standard software components

Table 2-2: Standard software components

Component	Article number	Note
SIMATIC STEP 7 TIA Portal V13 Floating license	STEP 7 BASIC 6ES7822-0AA03-0YA5	The BASIC version is sufficient. However, you can also use the PROFESSIONAL version.
	STEP 7 PROFESSIONAL 6ES7822-1AA03-0YA5	
SINAMICS Startdrive V13 (Option package for SIMATIC STEP 7 V13	6SL3072-4DA02-1XG0	on DVD
	Download free of charge, see /5/.	-

Sample files and projects

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

Table 2-3: Sample files and projects

Component	Note
70155469_SINAMICS_G120C_PN_at_S7-1200_V1d3.zip	STEP 7 project (archived) With SINAMICS FW4.7
70155469_SINAMICS_G120_PN_at_S7-1200_DOCU_V1d4_en.pdf	DOCU

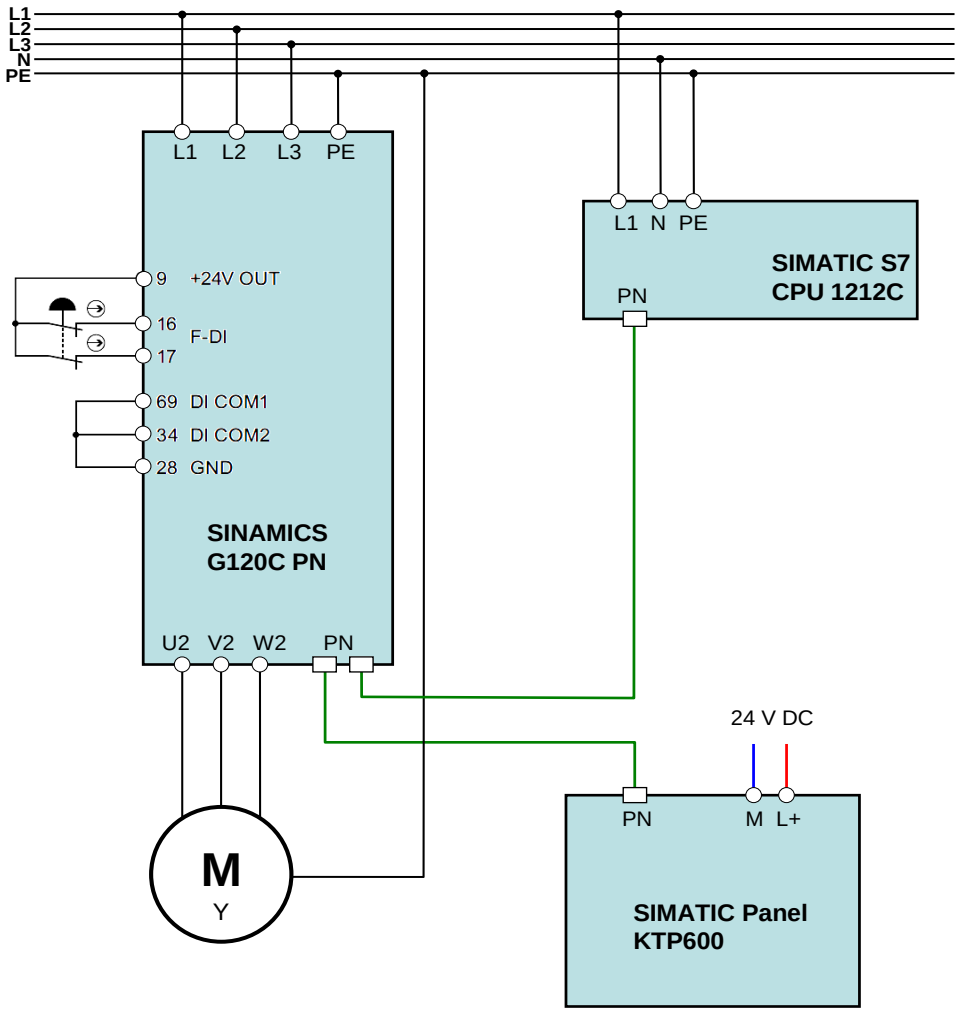
CAUTION **The example project has been designed for usage with the example components listed in Table 2-1. Converter and/or motor may be destroyed if a SINAMICS G120 with a different output or a different motor is connected, without adjusting the respective parameters.**

3 Setting up and commissioning the application

3.1 Wiring

The figure below shows the hardware setup of the application.

Figure 3-1: Wiring



Note Note the setup guideline in the manuals of the respective devices (see /1/, /4/, /6/).

3.2 IP addresses and PN device names

In the example, the following IP addresses and PROFINET device names are used. The user can make changes at any time.

Table 3-1: IP addresses and PN device names

Component	Device name	IP	PN device name
S7-CPU	PLC_1	192.168.0.1	plc_1
G120	G120_1	192.168.0.2	g120_1
KTP600	HMI_1	192.168.0.3	hmi_1
PG/PC	-	192.168.0.200	-

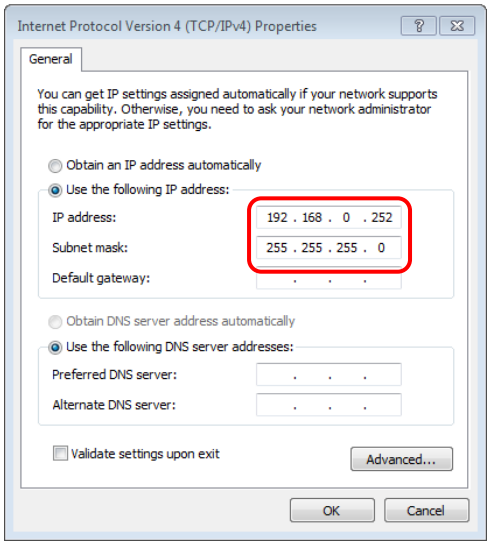
The network mask is always 255.255.255.0 and no router is used.

The PROFINET device names are derived from the device names editable by the user. They are available in the “Properties” of the respective device in “General”. However, in the end a converted name according to IEC 61158-6-10 is loaded in the appropriate device.
If the PROFINET device name is already complying with the norm, it is accepted as converted name. More details on naming can be found, for example, in the information system (online help) of the TIA Portal under “Assigning addresses and names for PROFINET devices”.

3.3 PG/PC settings

To create a connection between the SIMATIC controller and your development system (PG/PC), you need to assign a fixed IP address to the network card used in the PG/PC for the application.

Table 3-2: Instruction – settings on PG/PC

Action	Remarks
Assign a free, fixed IP address 192.168.0.x to the network card used (in this example: x = 252) and assign the subnet mask 255.255.255.0. In Windows 7, for example, you navigate as follows: >Start >Control Panel >Networks and Release Center >Change adapter settings >Right-click to the used network card >Properties >Internet protocol version 4 (TCP/IPv4) >Properties	

3.4 Loading the software

NOTICE	Should you use a different converter or motor than specified in **Table 2-1**, you need to perform your own configuration. In this case, follow the instructions in chapter **6** before loading the software into the device. Otherwise, this may cause damage.

This chapter describes how, in TIA Portal V13, you…

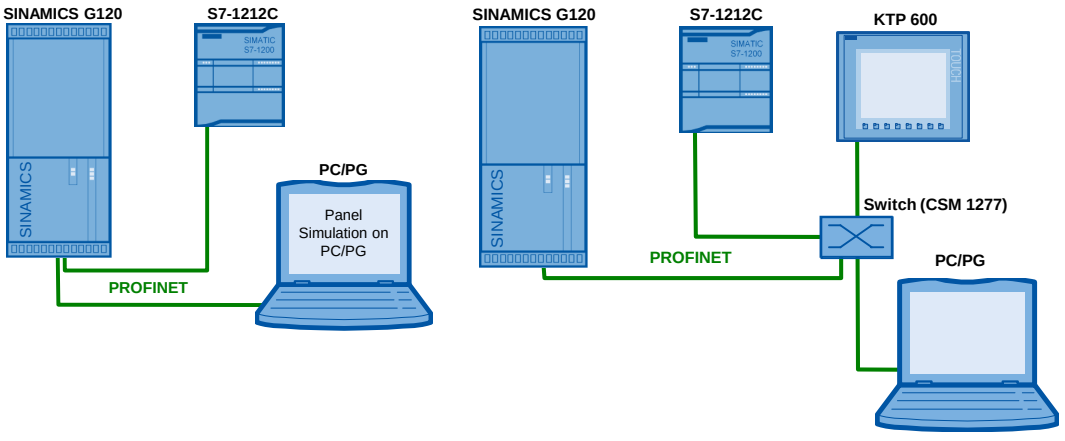
- …load the STEP 7 program into the SIMATIC S7-1200.
- …load the drive configuration into the SINAMICS G120, and
- …load the control panel configuration into the HMI KTP600.

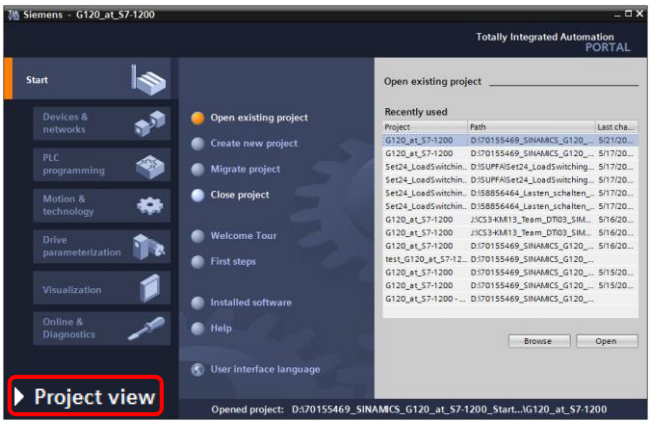
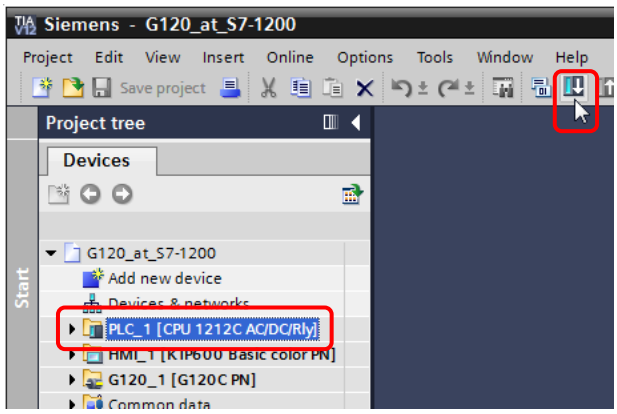
A requirement is that the software has been installed on your PG/PC according to **Table 2-2**.

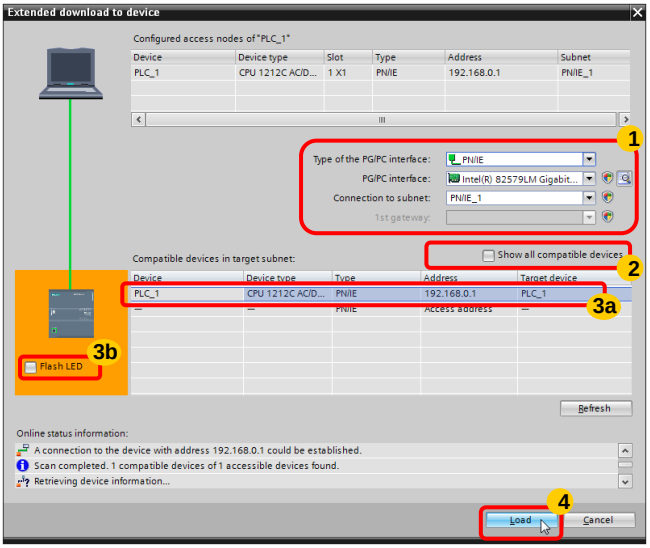
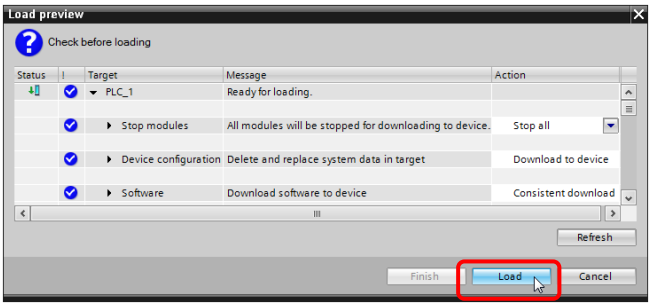
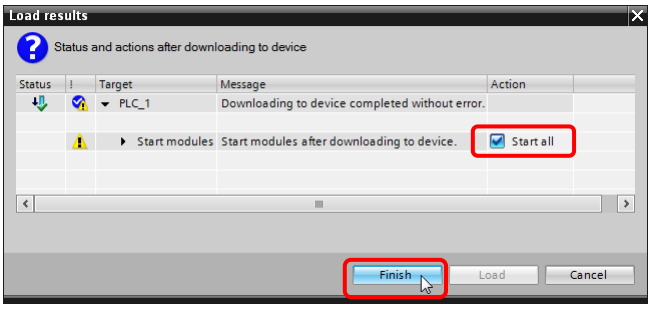
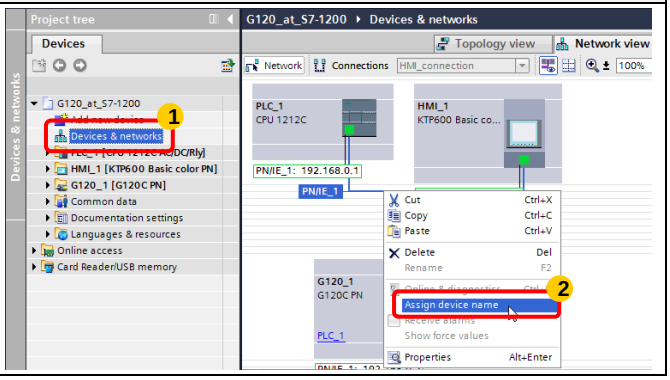
Note

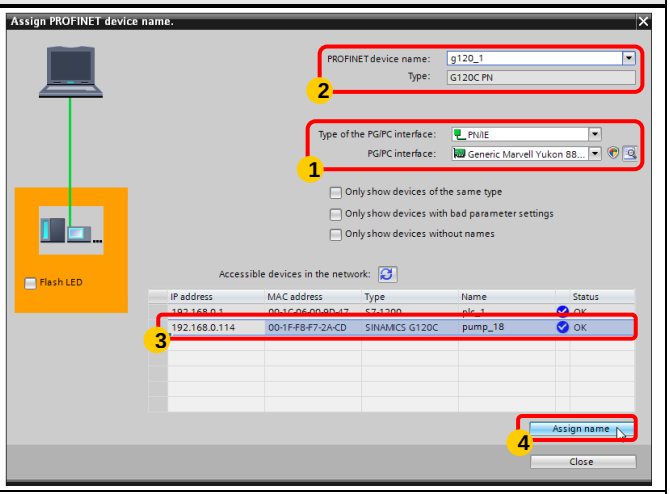
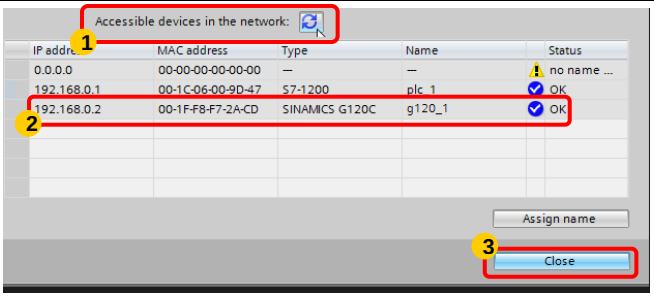
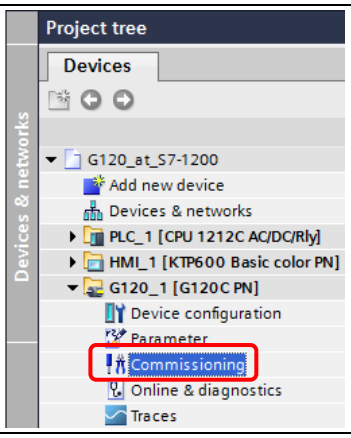
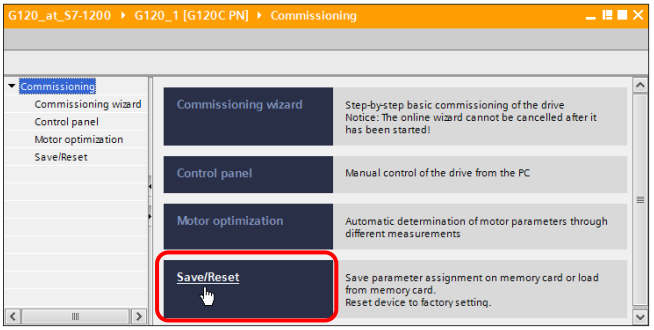
- The procedure described in the step table below represents one configuration option of connecting a SINAMICS G120 to a SIMATIC S7-1200 via PROFINET, and operate it. TIA Portal offers several possible solutions that differ to a greater or lesser degree from the procedure shown here.
- The download to SINAMICS G120 can be performed via Ethernet interface or USB. Below, the use of the Ethernet interface is shown.

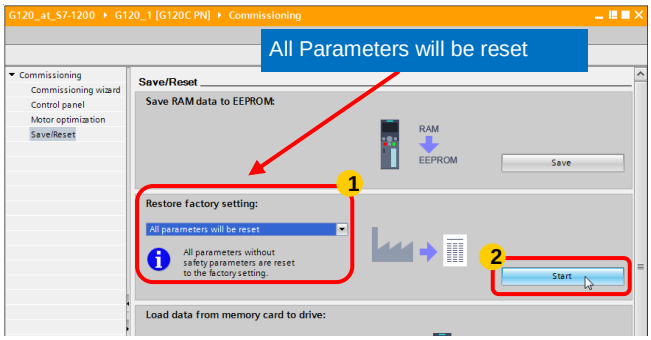
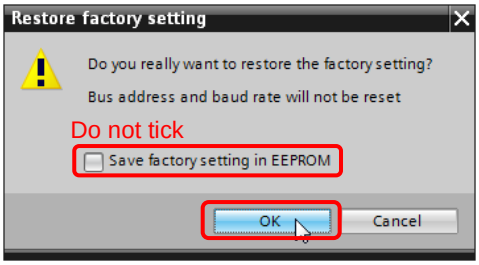
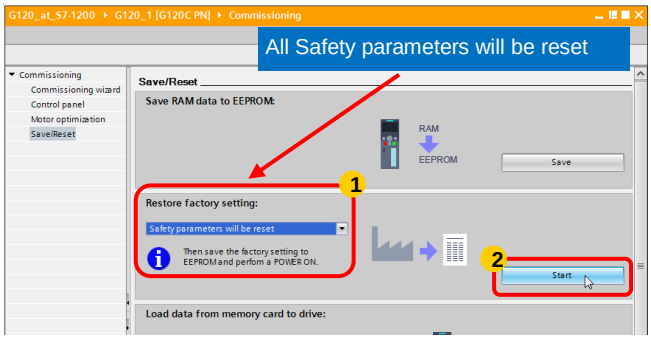
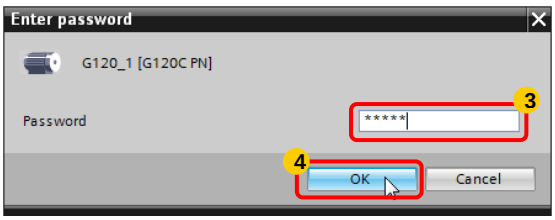
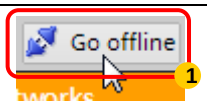
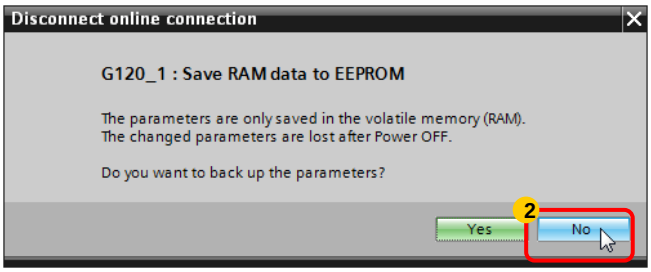
Table 3-3: Loading the software

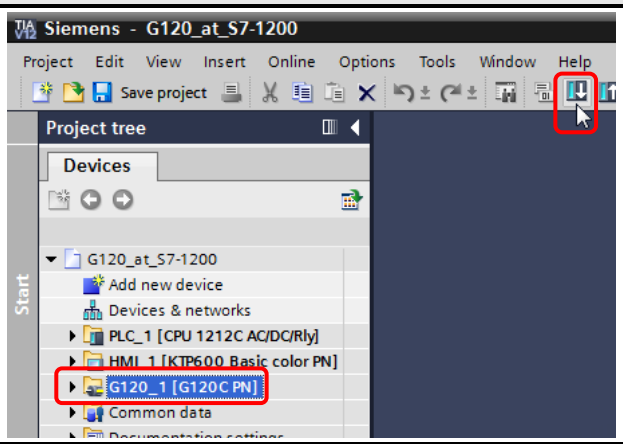
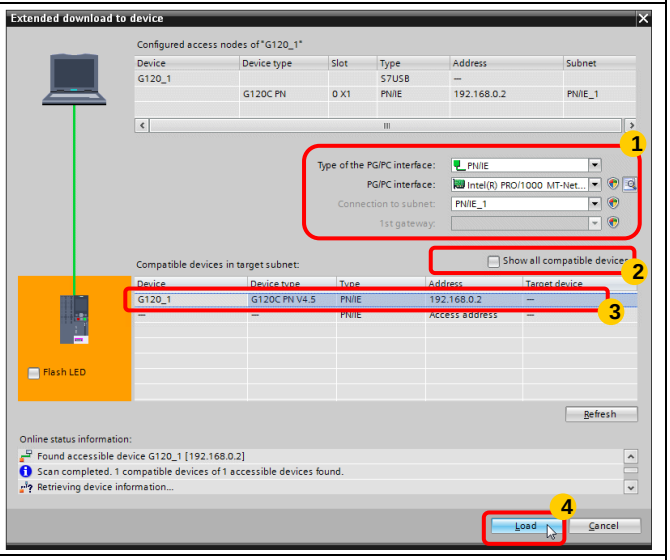
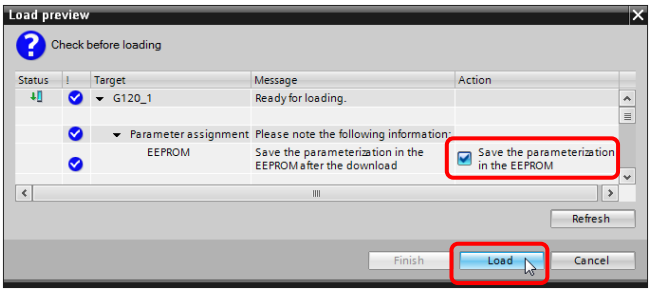
No.	Action	Remarks
1.	Network the example components according to one of the two pictures, for example. 	
2.	Retrieve a project on hand as zip-file named *" 70155469_SINAMICS_**xxxx**_PN_at_S7-1200_V1d3.zip"* on Windows level. In this case, **xxxx** stands for the device family and the possibly configured CU. (e.g. "G120C" for a G120C PN or "G120_CU240EPN" for a G120 with CU240-2 PN) The respective project folder is created and the data extracted into it.	

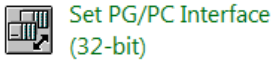
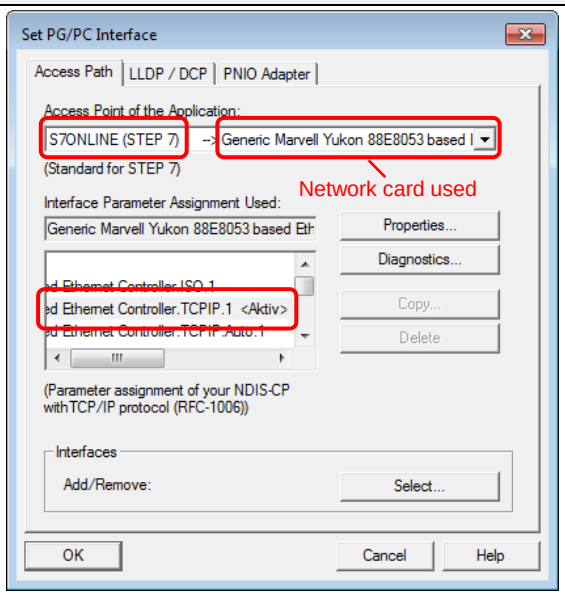
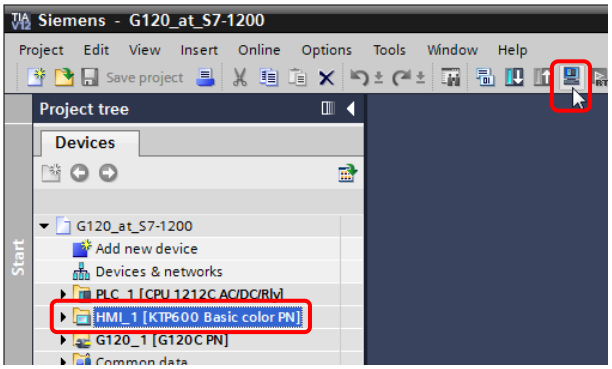
No.	Action	Remarks
3.	Double-click on the ap13-file in the project folder just retrieved in order to open the project in TIA Portal.	
4.	If TIA Portal opens in the Portal view, go to the bottom left to switch to the Project view.	
Loading the STEP 7 program into the SIMATIC controller		
5.	Load the program into the SIMATIC controller.	

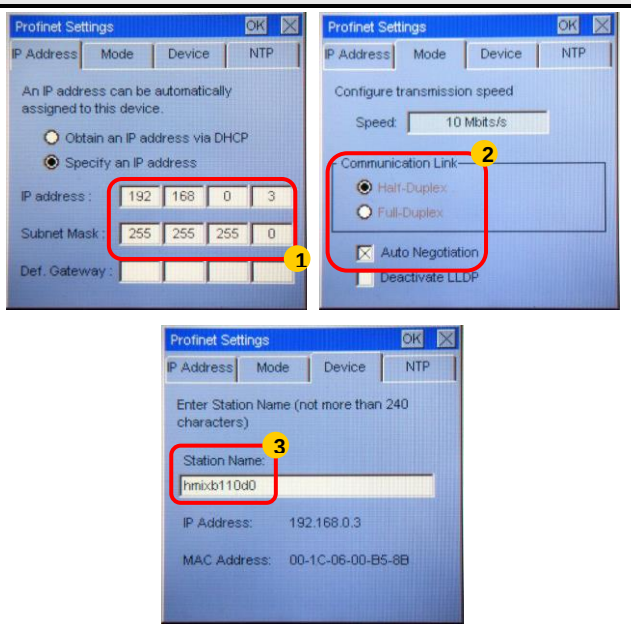
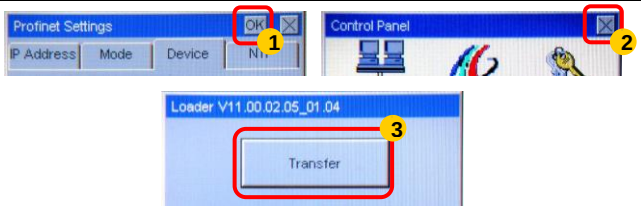
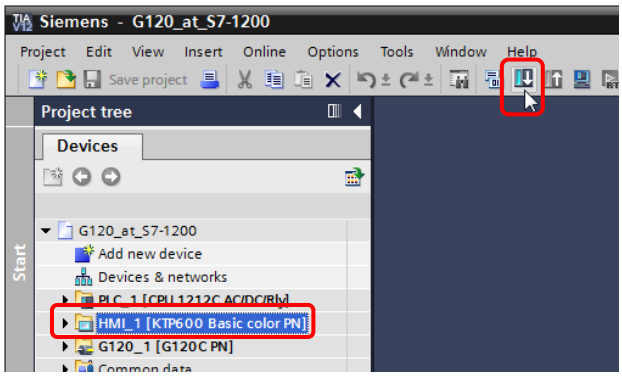
No.	Action	Remarks
6.	If the “Extended download” window appears, proceed as follows: 1. Select the used PG/PC interface to connect with the Ethernet subnet. 2. Checkmark “Show all compatible devices” when receiving a respective online status information in the lower part of the window 3. Select the SIMATIC controller to be used in the target subnet. If necessary, identify it by “Flash LED”. 4. Acknowledge with the “Load” button.	
7.	Start the download process.	
8.	Exit the download with the “Start all” option.	
Downloading the drive configuration into the SINAMICS G120		
9.	1. Go to the network view of the “Devices & Networks” editor. 2. Right-click on the PROFINET IO system PN/IE_1 and select “Assign device name”.	

No.	Action	Remarks
10.	1. Select the appropriate PG/PC interface to connect with the Ethernet subnet. 2. From the upper drop-down list you select the configured PROFINET device name “g120_1” of the drive. 3. In the bottom table you select the IO device to be given this name and which can be accessed online. In this example the SINAMICS G120C with MAC address 00-1F-F8-F7-2A-CD. 4. Then click on the “Assign name” button.	
11.	1. Update the accessible nodes. 2. The SINAMICS G120C now has the PROFINET device name “g120_1” with the IP address 192.168.0.2 assigned to it. 3. Close the window.	
12.	Navigate to the Commissioning option of the drive	
13.	An online connection with the SINAMICS drive is established. Select “Save/Reset”.	

No.	Action	Remarks
14.	1. In “Restore factory setting” you choose the “All parameters will be reset” option. 2. Start the function.	
15.	Acknowledge your function selection. The factory settings need not be saved to EEPROM since the subsequent download of the drive parameters saves these to EEPROM.	
16.	If the used SINAMICS drive has a safety configuration, please also reset it. 1. In “Restore factory setting” you choose the “Safety parameters will be reset” option. 2. Start the function. 3. Enter the previous Safety password. 4. Confirm with OK.	 
17.	1. Disconnect the online connection to SINAMICS drive. 2. Saving the data to EEPROM is not necessary at present.	 

No.	Action	Remarks
18.	Load the drive configuration into the SINAMICS G120.	
19.	If the “Extended download” window appears, proceed as follows: 1. Select the used PG/PC interface to connect with the Ethernet subnet. 2. Checkmark “Show all compatible devices” when receiving a respective online status information in the lower part of the window 3. Select the SIMATIC controller to be used in the target subnet. 4. Acknowledge with the “Load” button.	
20.	Set the checkmark at “Save the parameterization in the EEPROM” and start the download.	
21.	For the SINAMICS G120 you perform a “POWER ON” (switch off the voltage until all LEDs are dark).	-

No.	Action	Remarks
	Simulation of the HMI KTP600 at the PG/PC (not applicable when device exists)	
22.	Set the PG/PC interface on Windows level. Select “S7ONLINE (STEP 7)” as *access point* of the application and our used network card configured for TCP/IP as *Interface Parameter Assignment Used*. Navigate in Windows as follows: Start > Control Panel >Set PG/PC Interface 	
23.	Start the simulation of the HMI control panel.	
	Preparation of the KTP600 (not applicable for simulation at the PG/PC)	
24.	Connect the KTP600 to the supply voltage. 1. Open the Control Panel. 2. Open the PROFINET settings.	 

No.	Action	Remarks
25.	Make the entries according to the screens on the right. 1. Enter the value for the IP address configured in STEP 7. (It is available in the “devices and networks” editor in the device view of the control panel under Properties and “Ethernet addresses”.) 2. Adopt (check) the default settings on the “Mode” tab according to the right-hand screenshot. 3. The PROFINET device names[2] themselves need not be edited. It is automatically entered when loading the HMI project into the HMI control panel.	
26.	1. Exit the PROFINET settings with OK. 2. Exit the Control Panel. 3. Prepare the loading process by clicking the “Transfer” button.	
27.	Unless already performed, connect the KTP600 with an Ethernet patch cable to the PG/PC directly or via a switch and start the data transfer. The operator panel will subsequently start automatically. When working without switch, you can now connect the control panel to the second Ethernet port of the SINAMICS G120.	

[2] The used control panel only supports an S7 connection and no PROFINET connections. The address is not assigned via the station name. However, it can be read and assigned by the PLC in the same way as a PROFINET name.

4 Operating the Application

4.1 Preconditions

To be able to switch on the SINAMICS drive via the HMI or the watch table, the following points must be fulfilled:

- If you have configured the safety function[3] “Safe torque off (STO)” (see chapter 6.2), the yellow “SAFE” LED lights up or blinks at the SINAMICS G120. With permanent light, the SINAMICS drive can be started. With blinking light, the STO safety function is active and the SINAMICS drive does not start up. As a test procedure in this case, apply 24V (terminal 9) to the inputs DI 4 and 5 (terminals 16 and 17) of the G120[4] and connect the reference potential for these inputs (terminals 34 and 69) to earth (terminal 28).
- 24V must not be supplied at terminal 8 (DI 3), since otherwise the command data set is switched over.

Note

When using an IOP for controlling the SINAMICS drive, please ensure that the network icon () is displayed on the top right. If the hand icon () is displayed there, press the Hand/Auto button ().

When using a BOP-2, please check whether the hand icon () is displayed. If yes, press the Hand/Auto button ().

[3] In the STEP 7 example project no safety function has been configured and the respective bullet is not relevant.
[4] You can also connect an emergency-stop control device to the respective terminals.

4.2 Operation via digital inputs

For security reasons, the SINAMICS drives in this application example are exclusively moved via digital inputs, **the HMI is only used for monitoring!**[5].

Table 4-1: Digital inputs

Terminal	Name	Function
I 0.0	On	Switching the SINAMICS drive on/off, (Off2 =1 and Off3 =1 must apply for the operation)
I 0.1	Off 2	0 = Immediately switching off the motor. The SINAMICS drive coasts.
I 0.2	Off 3	0 = Fast stop. The motor is decelerated with ramp-down time Off3 (P1135) until it stops
I 0.3	Ack	A rising edge acknowledges a pending error in the SINAMICS drive
I 0.4	Rev	Reversed direction, the polarity of the setpoint value is negated.
I 0.5	0	The setpoint is set to 0.
I 0.6	n+	The setpoint is increased
I 0.7	n-	The setpoint is decreased

To switch on the SINAMICS drive, please perform the steps below:

Table 4-2: Instruction – Switch on the SINAMICS drive

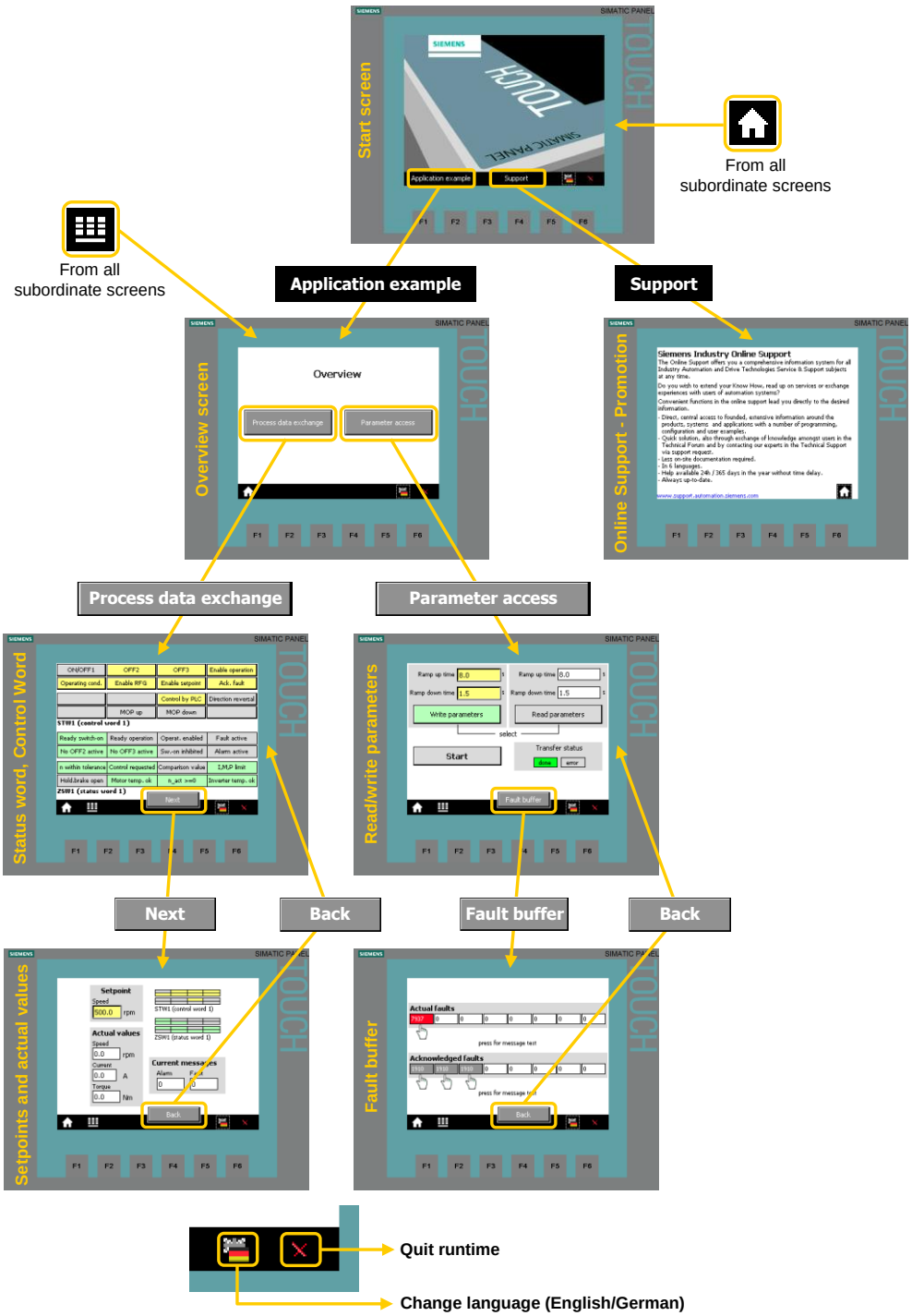
Step	Action	Note / Result
1.	Apply 24V to “Off2” (I 0.1) and “OFF3” (I 0.2).	The further required control bits for the operation are permanently set to 1 by the program.
2.	Enter a pulse (switching on and back off) to “Ack” (I 0.3).	This acknowledges a possibly pending error message.
3.	Enter a pulse (switching on and back off) to “0” (I 0.5).	The setpoint is set to 0.
4.	Apply 24V to “On” (I 0.0).	The SINAMICS drive switches on.
5.	Change the setpoint value with inputs “n+” (I 0.6), “n-” (I 0.7) and “0” (I 0.5).	The speed of the motor changes.
6.	Remove the 24V from “On” (I 0.0).	The SINAMICS drive switches back off and the motor is shut down with the configured ramp-down time.

[5] If you still wish to control the drive from the control device, you need to leave the input parameters “control_word” and “setpoint” of the Process_Data [FB11] when calling it in network 2 of the Main [OB1].

4.3 Monitoring and parameter access via operator panel

4.3.1 Screens and screen navigation

Figure 4-1: Screen navigation

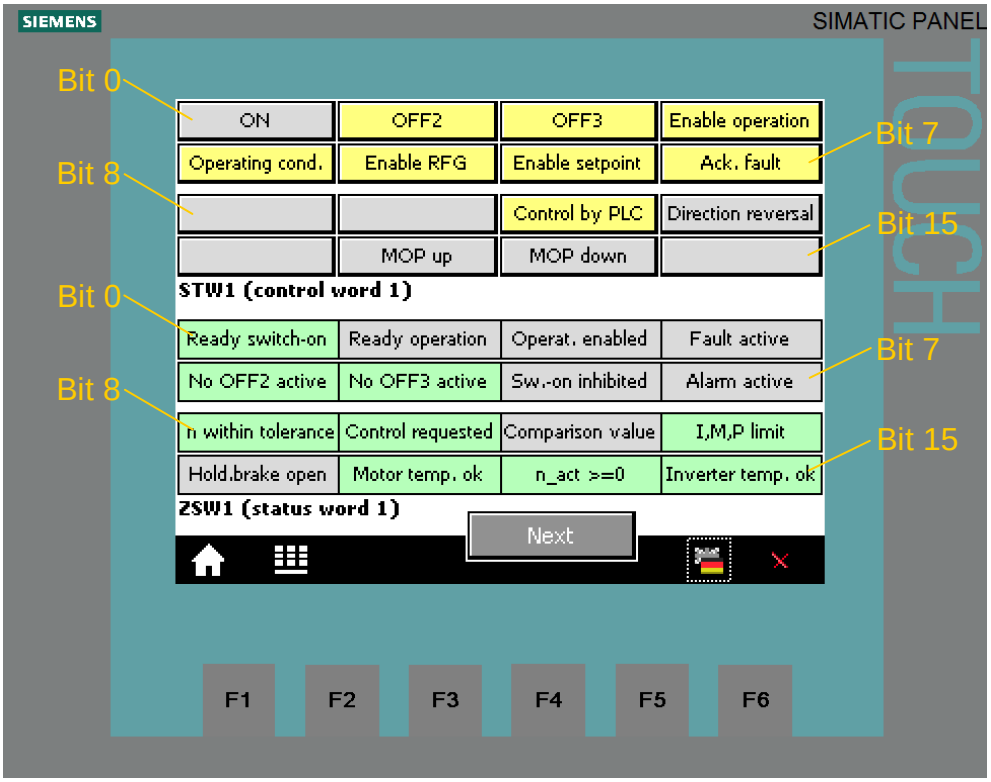


4.3.2 Process data exchange

Both screens for the process data exchange access the instance “idb_Process_Data data” block (DB11).

Control and status word

Figure 4-2: Control and status word



The displayed control or status word is identical with that in the Process_Data tag table (see chapter 4.4).

STW1 (control word 1)

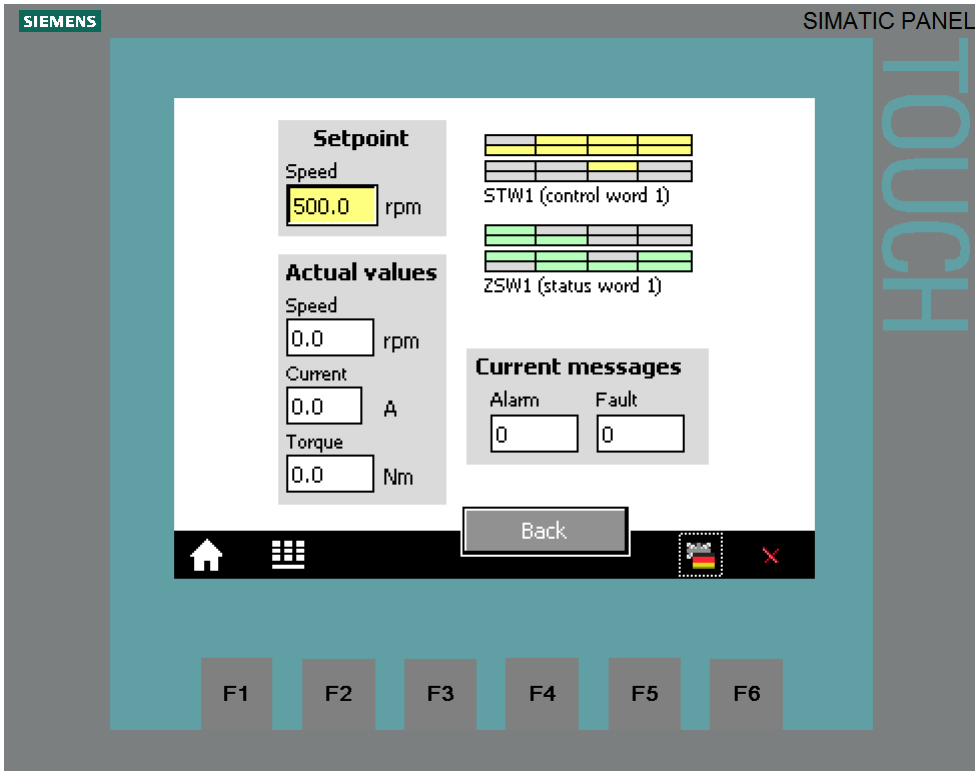
The buttons in the upper part of the screen are inactive (see footnote 5 on page 20). However, the color change indicates the logic states of the individual control bits. Signal state “1” is indicated with yellow color. For running the motor, the bits displayed in Figure 4-2 must be connected with signal state “1” and were therefore given the default value “1” in the program.

ZSW1 (status word 1)

The text fields in the bottom screen section show the state of the individual bits of the status word. Signal state “1” is indicated with green color.
In contrast, “Fault active” and “Alarm active” take on red or pink for state “1”.

Setpoint and actual values

Figure 4-3: Setpoint and actual values



The control tags contained in the above screen are identical with those in the respective Process_Data tag table (see chapter 4.4).

Setpoint speed value
In the yellow field on the top left, the setpoint speed value is displayed which is set via the digital inputs I 0.5, I 0.6 and I 0.7 (see Table 4-1). (For direct setpoint value input at this location see footnote 5 on page 20)

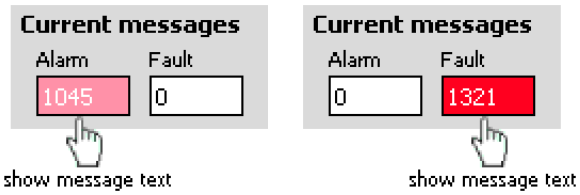
Actual values
The current actual values speed, current and torque are displayed below the speed setpoint value input.

Control and status word
To keep an eye on control word and status word, without switching to the respective screen, they are also given here as a miniature display.

Current messages
Current faults and warnings are displayed with a respective number. A “0” means that no fault or alarm exists. If a message is pending it is displayed according to Figure 4-4.

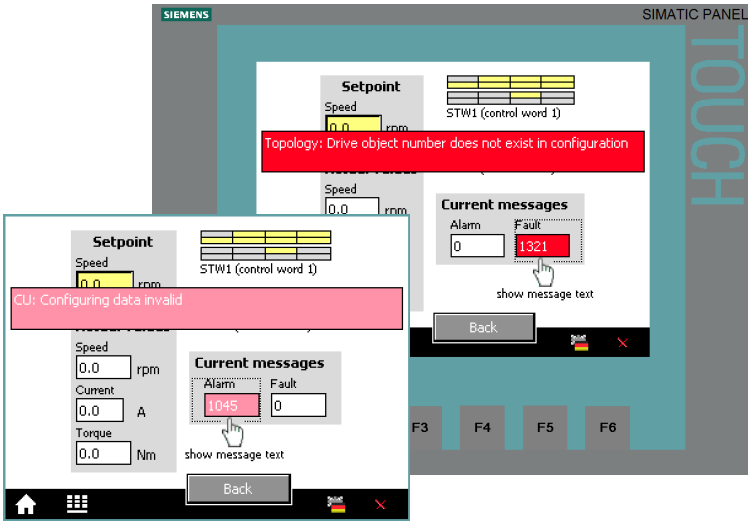
4.3 Monitoring and parameter access via operator panel

Figure 4-4: Current messages as message numbers



Tap or click on the message number to display the respective message text.

Figure 4-5: Current messages in plain text



The message text is displayed for as long as the message number is pressed.

4.3.3 Parameter access

Reading/writing parameters

Figure 4-6: Reading/writing parameters

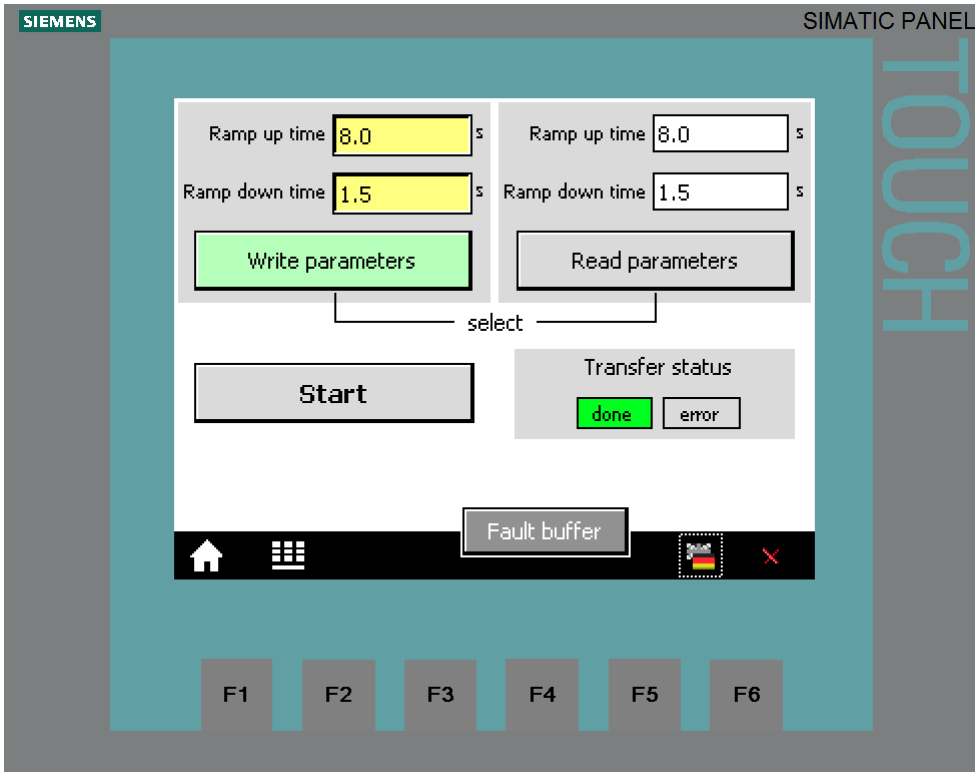
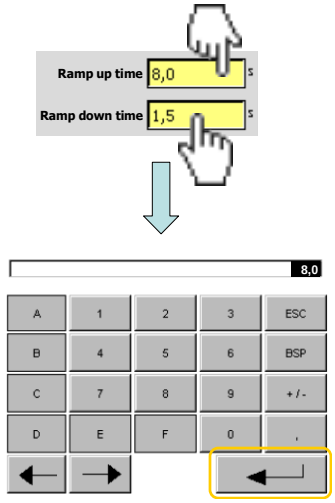


Table 4-3: Instructions – writing/reading parameters

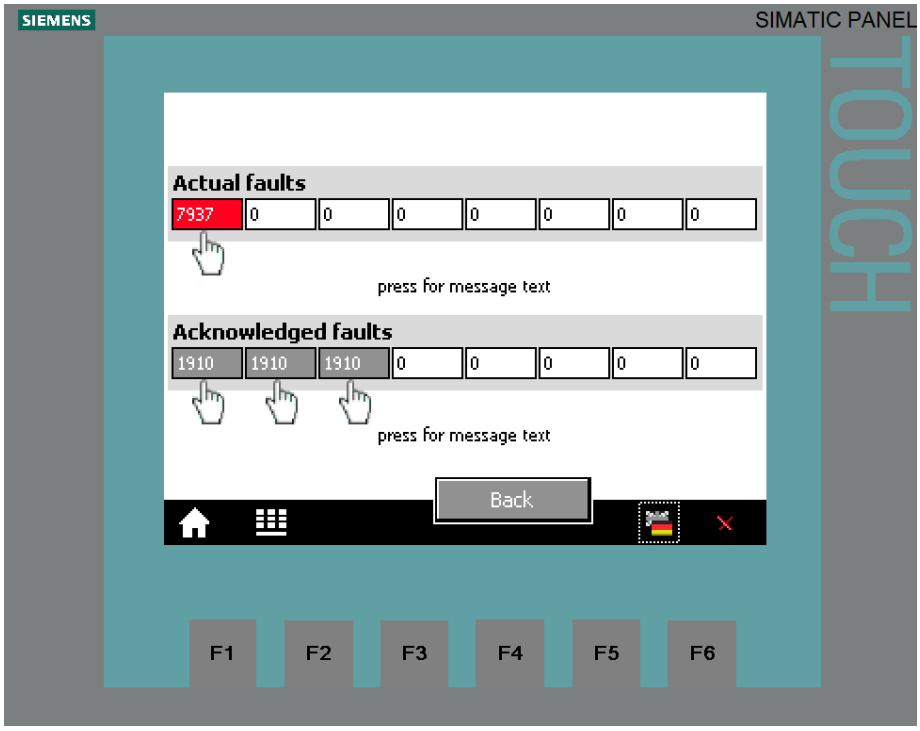
	Action	Remark
1.	Select the access type with the “Read parameters” and “Write parameters” buttons.	The selected access type is displayed via a bright green button.
2.	Read parameters: Proceed with point 3 in the table. Write parameters: When tapping or clicking the yellow input fields for the ramp-up/ramp-down time, a keyboard mask for the value input opens. Finish your input with the Return key.	

	Action	Remark	
3.	Start the write or read job with the “Start Transfer” button. Note: After a write job the new data is adopted as read parameters in the white fields in the left part of the screen. After writing you need not trigger any additional read job for the update.	The job status specifies how the job was completed:	
		busy	Transmission active
		done	Job completed successfully without error
		error	Communication error
		drive error	The job was transferred without errors, however, it could not be realized in SINAMICS (e.g., a negative time was given)
		For fault diagnostics see /1/.	
4.	Terminate the write or read job by clicking “Terminate Transfer”	The job status bits are deleted	

Fault buffer

The screen displays the fault codes of eight current and eight acknowledged faults, which are saved in the converter.

Figure 4-7: Display of fault buffer

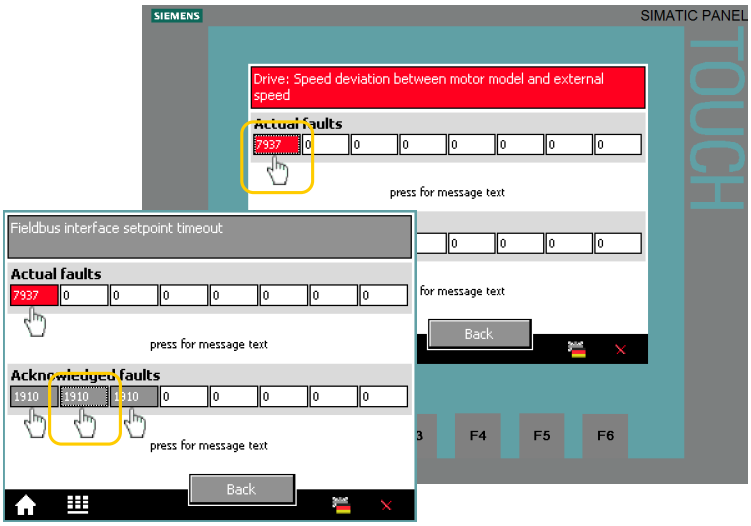


The fault codes in the above screen correspond to control tags V_3_Value_00 (DW18) to V_3_Value_15 (DW48) in the “answer_from_drive” data block (DB103).

Note The fault butters are only updated when you trigger an acyclic transmission. In the example object, you execute the “Read parameters” function before switching to the display of the fault buffer.

Tap or click on the message number to display the respective text.

Figure 4-8: Display of fault buffer message in plain text

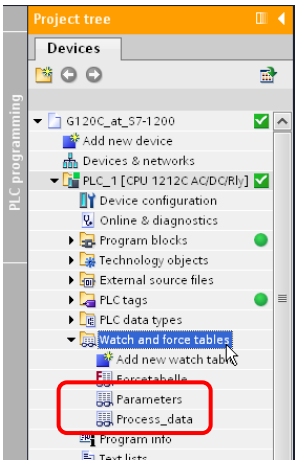


The message text is displayed for as long as the message number is pressed.

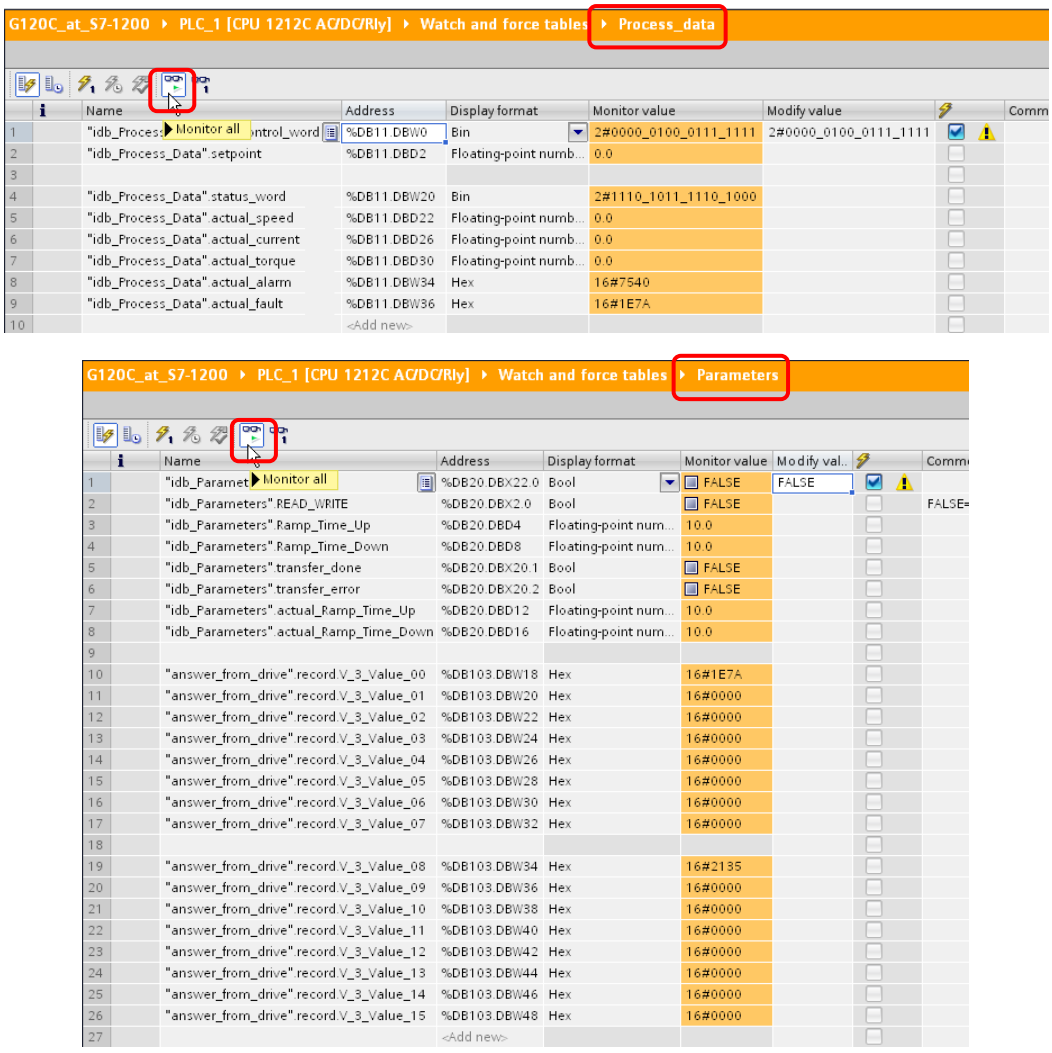
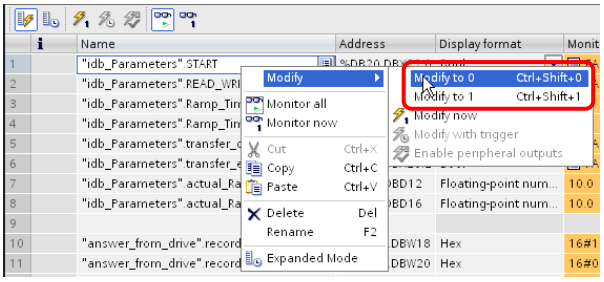
4.4 Operator Control and Monitoring via monitoring table

You can also use the application without HMI. The watch tables “Process_data” and “Parameters” have already been created in the project. The tags you can monitor or control are the same which are also displayed or controlled at the operator panel.

Table 4-4: Operation of the application via watch table

No.	Action	Remarks
1.	In the TIA Portal project you open the desired watch table.	

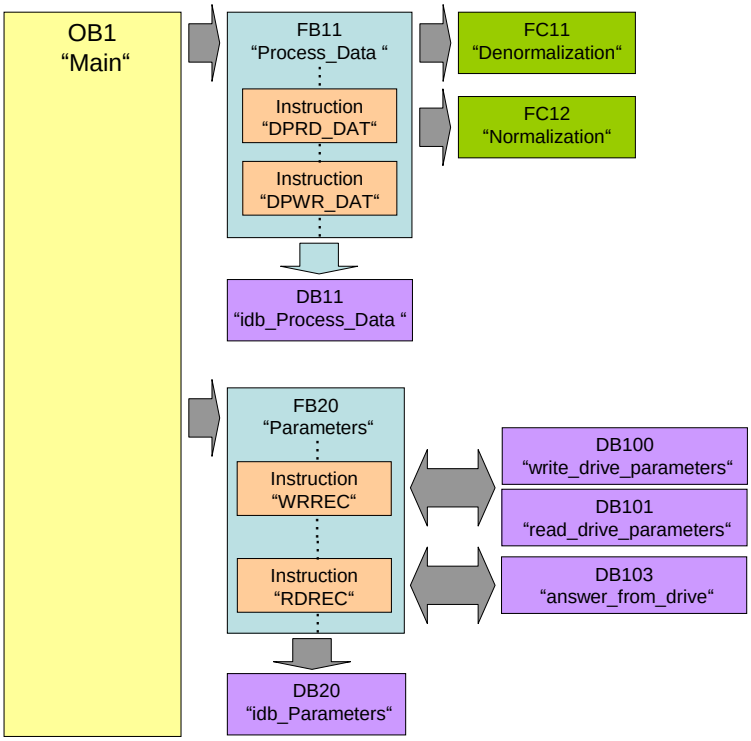
4.4 Operator Control and Monitoring via monitoring table

<table>
<tr><th>No.</th><th>Action</th><th>Remarks</th></tr>
<tr><td>2.</td><td>Go online.
 
</td><td></td></tr>
<tr><td>3.</td><td>For changing a value, you enter it in the “Control value” column in the respective line and tick the checkbox on the right and start the process with  in the header.
For changing a Boolean tag you can also proceed as follows:
Right-click the respective line and go to “Control” (see picture).</td><td> 
</td></tr>
</table>

5 Functional Mechanisms of this Application

Program overview

Figure 5-1: Program overview



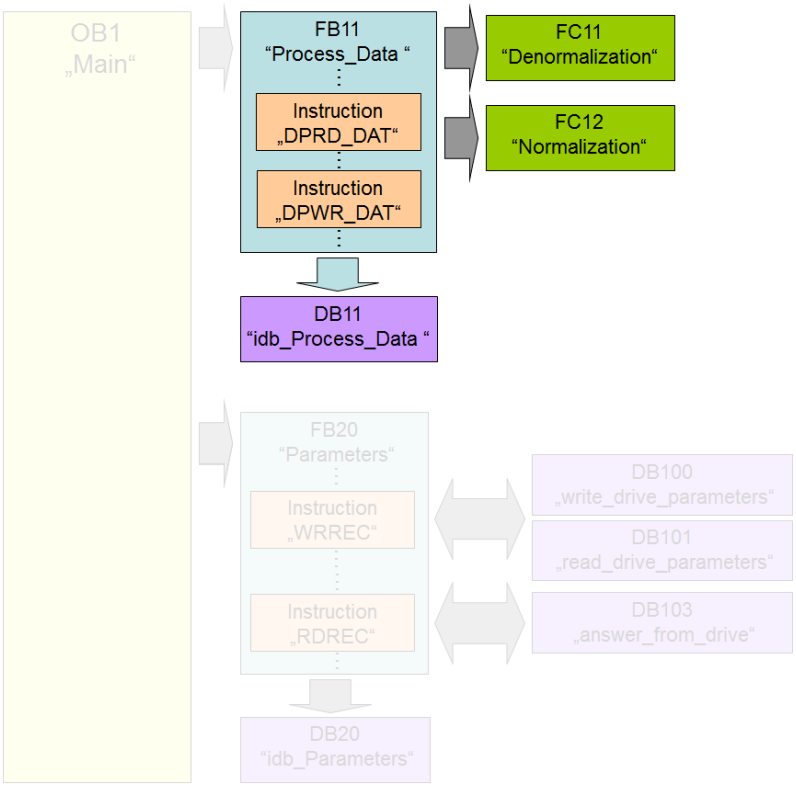
For the cyclic process data exchange and the acyclic parameter access, separate function blocks are used.

Note

In OB1, the FC10 “Simulation” is called up. Here, FC10 simulates a user program, by creating a control word and setpoint using the digital inputs.
Since it is only used here to make the example program runnable, it is not further discussed.

5.1 Functionality of process data exchange

Figure 5-2: Functionality of process data exchange



The process data contains values which are regularly exchanged between SIMATIC controller and SINAMICS converter. These values are at least the control and status word as well as the setpoint speed and actual value. Selecting the message frame type specifies the exact length and structure.
The “Siemens Telegram 352, PZD 6/6” message frame type used in the example exchanges 6 words in both directions.

5.1.1 Accessing process data in the user program of the controller

At the start of the cycle, the operating system of SIMATIC S7-1200 stores the (user) data received by the SINAMICS converter in the I/O input area of the SIMATIC CPU and transmits the data stored in the I/O output area to the SINAMICS converter at the end of the cycle. In the user program, the data can be accessed by copying from or into the I/O area.
The address areas used are defined in the “Devices & Networks” editor. See steps 15 and 16 in Table 6-1.

5.1.2 Standardizing the setpoint and actual values

The setpoint and actual values are transferred as standards.
The standardization and reference values are stored in parameters P2000 to P2006 of the SINAMICS G120.
16384dec = 4000_{hex} = 100% applies here, with 100% referring to the reference value for the transferred variable.

Example:

If P2000 (reference speed or reference frequency) is 1500 rpm and run at a speed of 500 rpm, then 33% or 5461_{dec} must be transferred.

Normalizing and denormalizing is performed in FC11 and FC12 in the application example.

For more information, please refer the function manual “Fieldbus system” (/6/).

5.1.3 Transfer method

To copy the process data into or from the I/O area, the following instructions DPRD_DAT and DPWR_DAT are used:

These instructions ensure that the consistency is maintained across the entire process data, i.e. all elements of the process data of a device are from the same bus cycle or are transferred within a bus cycle. This is necessary, e.g. to enable a distributed synchronization. In the example program, all of the 6 words are copied consistently.

In the “Instructions” task card of the TIA Portal you will find the instructions under

> Expanded instructions
> Distributed I/Os
> Others

5.1.4 Control word (STW1) and status word (ZSW1)

Control and status word are predefined. They are exchanged in all message frame types in the first respective process data word (PDZ01).

Figure 5-3: STW1

Bit	Value	Significance	Comments
0	0	OFF1	Motor brakes with the ramp-down time p1121 at standstill (f < f_{min}) the motor is switched off.
	1	ON	With a positive edge, the inverter goes into the "ready" state, with additionally bit 3 = 1, the inverter switches on the motor.
1	0	OFF2	Switch off motor immediately, motor coasts to a standstill.
	1	No OFF2	---
2	0	Quick stop (OFF3)	Quick stop: Motor brakes with the OFF3 ramp-down time p1135 down to standstill.
	1	No quick stop (OFF3)	---
3	0	Disable operation	Immediately switch-off motor (cancel pulses).
	1	Enable operation	Switch-on motor (pulses can be enabled).
4	0	Lock ramp-function generator	The ramp-function generator output is set to 0 (quickest possible deceleration).
	1	Operating condition	Ramp-function generator can be enabled
5	0	Stop ramp-function generator	The output of the ramp-function generator is "frozen".
	1	Ramp-function generator enable	
6	0	Inhibit setpoint	Motor brakes with the ramp-down time p1121.
	1	Enable setpoint	Motor accelerates with the ramp-up time p1120 to the setpoint.
7	1	Acknowledging faults	Fault is acknowledged with a positive edge. If the ON command is still active, the inverter switches to"closing lockout" state.
8		Not used	
9		Not used	
10	0	PLC has no master control	Process data invalid, "sign of life" expected.
	1	Master control by PLC	Control via fieldbus, process data valid.
11	1	Direction reversal	Setpoint is inverted in the inverter.
12		Not used	
13	1	MOP up	The setpoint stored in the motorized potentiometer is increased.
14	1	MOP down	The setpoint stored in the motorized potentiometer is decreased.
15		Not used	Changes over between settings for different operation interfaces (command data sets).

Note A control word for which all bits are 0 is rejected as invalid by the SINAMICS converter. Therefore, at least bit 10 must always be set.

Figure 5-4: ZSW1

Bit	Value	Significance	Comments
0	1	Ready for switching on	Power supply switched on; electronics initialized; pulses locked.
1	1	Ready for operation	Motor is switched on (ON1 command present), no active fault, motor can start as soon as "enable operation" command is issued. See control word 1, bit 0.
2	1	Operation enabled	Motor follows setpoint. See control word 1, bit 3.
3	1	Fault present	The inverter has a fault.
4	1	OFF2 inactive	Coast to standstill not activated (no OFF2)
5	1	OFF3 inactive	No fast stop active
6	1	Closing lockout active	The motor is only switched on after a further ON1 command
7	1	Alarm active	Motor remains switched on; acknowledgement is not required; see r2110.
8	1	Speed deviation within tolerance range	Setpoint/actual value deviation within tolerance range.
9	1	Control requested	The automation system is requested to assume control.
10	1	Comparison speed reached or exceeded	Speed is greater than or equal to the corresponding maximum speed.
11	0	I, M or P limit reached	Comparison value for current, torque or power has been reached or exceeded.
12	1	Holding brake open	Signal to open and close a motor holding brake.
13	0	Alarm motor overtemperature	--
14	1	Motor rotates forwards	Internal inverter actual value > 0
	0	Motor rotates backwards	Internal inverter actual value < 0
15	1	No alarm, thermal power unit overload	

5.1.5 FB 11 “Process_Data”

This FB shows the access to the process data with the use of the “DPRD_DAT” / “DPWR_DAT” instructions. It is called up cyclically in OB1.

Figure 5-5: FB “Process_Data”

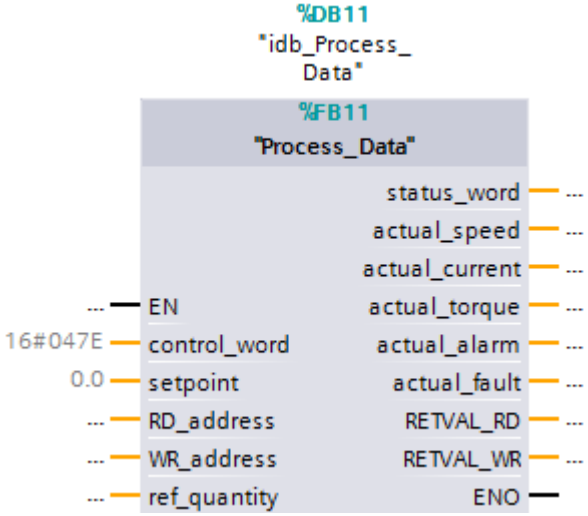


Table 5-1: Interface of the “Process_Data” FB

Parameter	Data type	Start value	Description
Input parameters			
RD_HW-ID	HW_SUBMODULE	-	Decisive hardware identifier for reading data from a DP standard slave /PROFINET IO device. When selecting the frame type in the properties of the drive in the TIA Portal, STEP 7 creates a system constant which corresponds to this identifier. Enter this system constant here. It is symbolically displayed to you in the dropdown list when entering the parameters.
WR_ HW-ID	HW_SUBMODULE	-	Decisive hardware identifier for writing data to a DP standard slave /PROFINET IO device. When selecting the frame type in the properties of the drive in the TIA Portal, STEP 7 creates a system constant which corresponds to this identifier. Enter this system constant here. It is symbolically displayed to you in the dropdown list when entering the parameters.

Parameter	Data type	Start value	Description
control_word	Word	16#047E	Control word of SINAMICS G120 The initial value sets the bits - Bit 01 OFF2 - Bit 02 OFF3 - Bit 03 Operation block - Bit 04 HLG block - Bit 05 HLG stopping - Bit 06 Setpoint value block - Bit 10 PLC control to “1” at a controller restart, so the SINAMICS drive alone can be started with Bit 00 → “1”.
setpoint	Real	0.0	Setpoint speed value [rpm]
ref_speed_ p2000	Real	1500.0	Reference value for the speed according to the converter configuration. Here, the same value must be entered as in parameter P2000 of SINAMICS G120.
ref_current_ p2002	Real	0.0	Reference value for the motor current according to the converter configuration. Here, the same value must be entered as in parameter P2002 of SINAMICS G120.
ref_torque_ p2003	Real	0.0	Reference value for the motor torque according to the converter configuration. Here, the same value must be entered as in parameter P2003 of SINAMICS G120.
Output parameters			
status_word	Word	-	Status word of the SINAMICS G120
actual_speed	Real	-	Actual speed value [rpm]
actual_current	Real	-	Actual current value [A]
actual_torque	Real	-	Actual torque value [Nm]
actual_alarm	Word	-	Number of a pending alarm
actual_fault	Word	-	Number of a pending fault
RETVAL_RD	Word	-	Return value of the DPRD_DAT system instruction called in this FB
RETVAL_WR	Word	-	Return value of the DPWD_DAT system instruction called in this FB

Networks

Table 5-2: Networks of the “Process_Data” FB

Network	Function
1.	The temporary data area #InData is initialized with 0.
2.	The process data is copied from the I/O area into the temporary #InData data area using the “DPRD_Dat” instruction.
3.	Status word, warning and faults are copied from the temporary #InData data area to the respective block outputs, and the current actual values [WORD] are copied into temporary tags [INT] for data type adjustment.
4.	
5.	The current normalized speed value [INT] is denormalized by calling FC11 [REAL, rpm].
6.	The current normalized current value [INT] is denormalized by calling FC11 [REAL, A].
7.	The current torque value [INT] is denormalized by calling FC11 [REAL, Nm].
8.	The setpoint speed value [REAL, rpm] is denormalized by calling FC12 [INT].
9.	Control word and normalized setpoint speed value [INT] are copied to the temporary #OUTData data area. The remaining four words to be transferred are written with 0.
10.	
11.	The process data is copied from the temporary #OutData data area into the I/O area using the “DPWR_DAT” instruction.

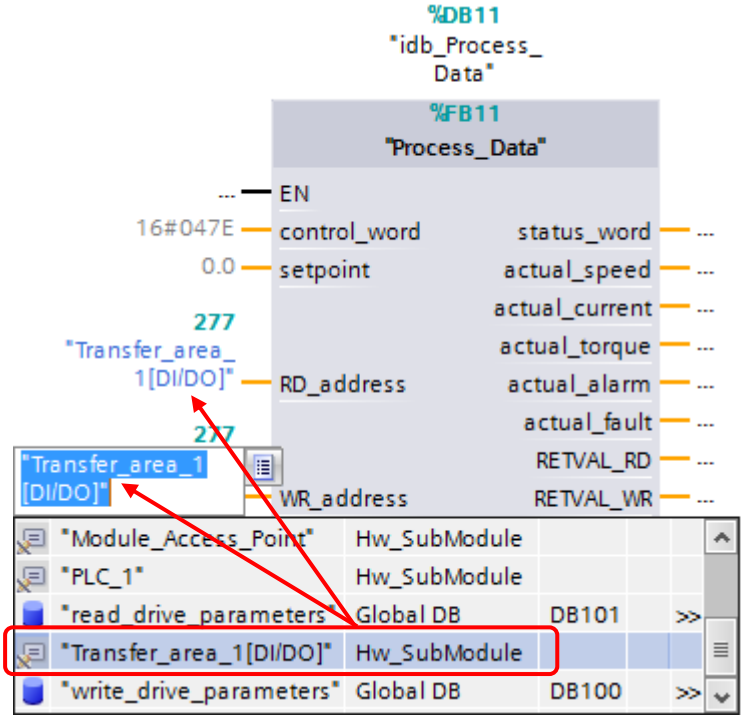
Parameterization

The program supplies and removes the FB largely by directly accessing its instance DB, so that many formal parameters can remain unconnected.

Only the following entries are assigned with actual parameters:

- “RD_HW-ID” of type “HW_SUBMODULE
  The hardware ID required for reading data from the SINAMICS G120 is forwarded to the LADDR input parameter of the “DPRD_DAT” instruction via this parameter. For more detail see chapter 6.3.1.
- “WR_HW-ID” of type “HW_SUBMODULE
  The hardware ID required for writing data to the SINAMICS G120 is forwarded to the LADDR input parameter of the “DPWR_DAT” instruction via this parameter. For more detail see chapter 6.3.1.
- “control_word” of type “WORD”,
  Control word, supplied by the Simulation block [FC10].
- “setpoint” of type “REAL”
  Setpoint speed value, supplied by the Simulation [FC10] block.

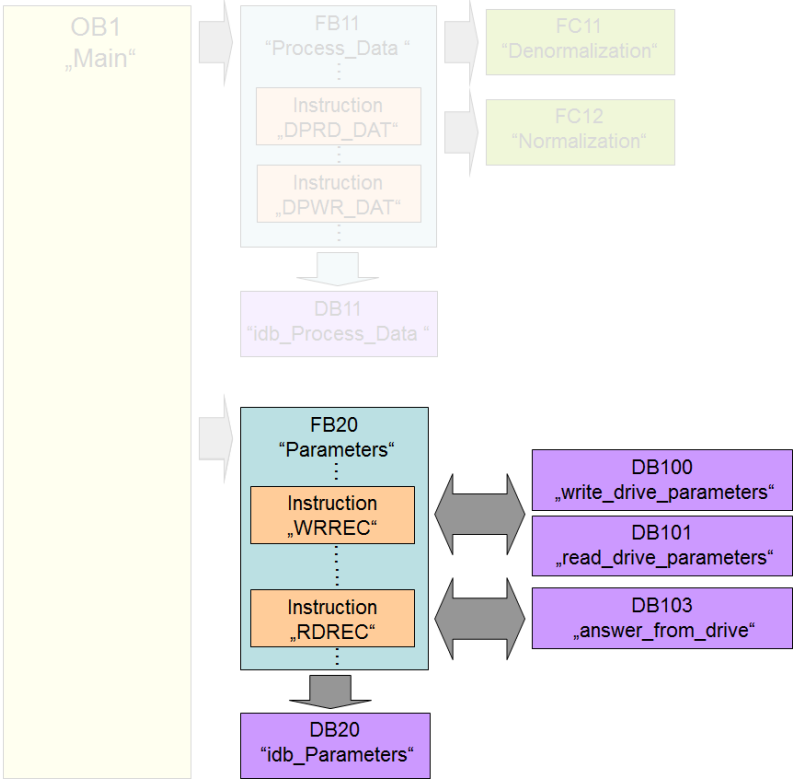
Figure 5-6 Actual parameter for “RD_HW-ID” and “WR_HW-ID”



For a PROFINET connection, RD_HW-ID and WR_HW-ID must be configured with the same hardware ID.

5.2 Parameter access functionality

Figure 5-7: Parameter access functionality



Acyclic parameter access occurs parallel to the cyclic process data exchange. This saves resources, since the data is only established on demand, i.e. when a parameter is to be transferred.

In the SIMATIC controller, the “Write data set” and “Read data set” functions must be used for this. “Data set 47” must always be used.

Writing “data record 47” sends a job to the SINAMICS converter which performs the job and provides a response. Reading “data set 47” makes the response of the SINAMICS converter available in the SIMATIC controller so it can be evaluated.

The instructions “WRREC” and “RDREC” are used in the SIMATIC controller for reading and writing data sets.

5.2.1 Job and response structure

For the structure of the jobs and responses (data record 47) please refer to the function manual “Fieldbus systems (/6/).

Note Since the structure of the data set to be sent or received depends on the number of jobs and their number format, a generally valid structure cannot be used.

5.2.2 The DBs “read/write_drive_parameters” and “answer_from_drive”

The job to access a parameter consists of at least 10 words. Therefore, the job should be assembled in a DB or in the temporary data of a code block. In this example, this is performed using DB 101 “read_drive_parameters” and DB 100 “write_drive_parameters”.
The response by the SINAMICS converter also consists of several words. Therefore, the example uses DB 103 “answer_from_drive”.

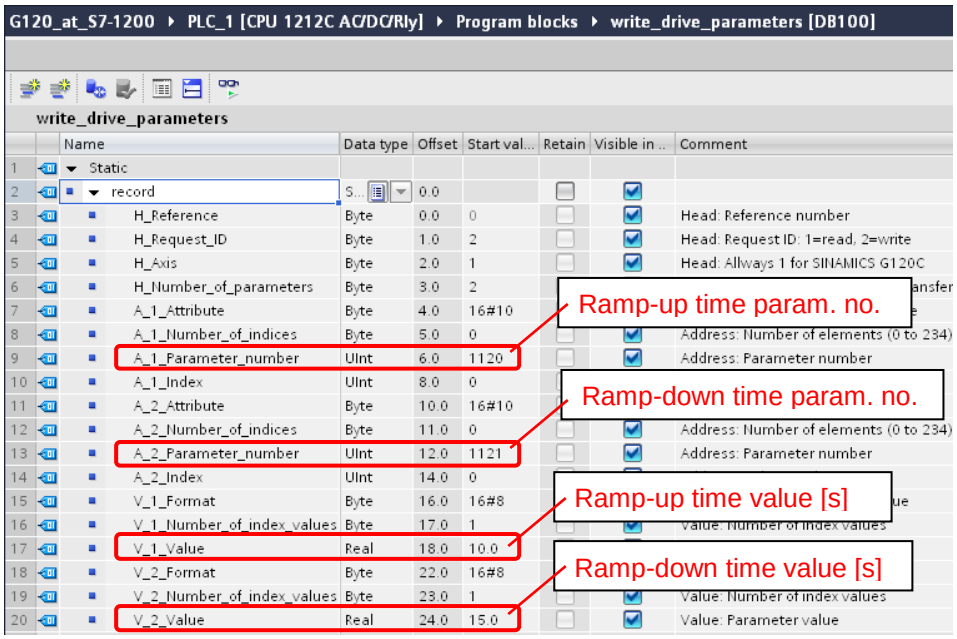
A job may contain the access to several parameters. Since the length of the data to be transferred per job depends on the number and data types of the converter parameters, no generally valid structure can be devised.

Therefore, in this example, only the ramp-up and ramp-down times (P1120 and P1121) and a part of the fault memory (P945.x) is accessed. The job to read the parameters is stored in DB 101 “read_drive_parameters”. The job to write them is stored in DB 100 “write_drive_parameters”.

The response of the SINAMICS converter is copied to DB 103 “answer_from_drive”. The structure contained therein corresponds to the structure for a successful reading of the parameters.

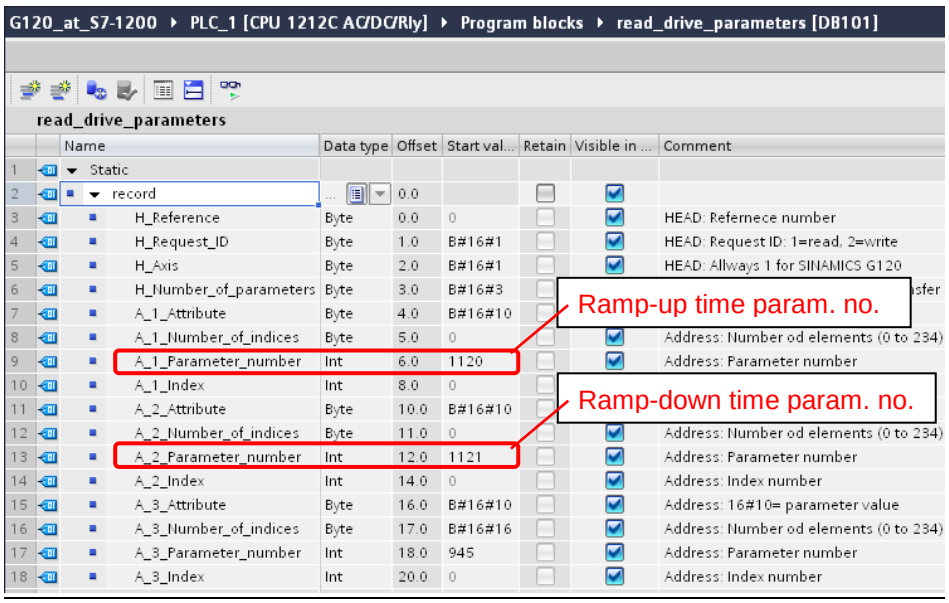
Note Place the entire job into a structure (in this example: “record”). This gives you the option to symbolically address the data set via the structure name (here “record”) with the RDREC/WRREC instructions.

Figure 5-8: DB100 “write_drive_parameters”



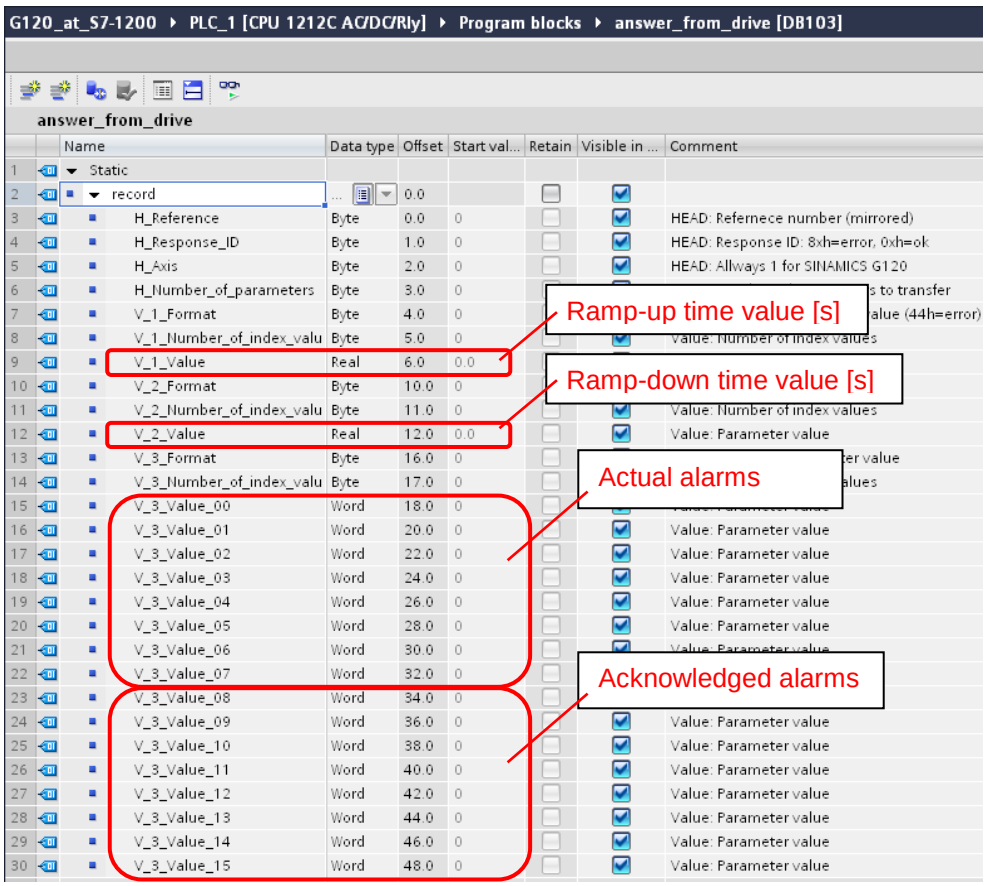
	Name	Data type	Offset	Start val...	Retain	Visible in ...	Comment
1	Static						
2	record	S...	0.0				
3	H_Reference	Byte	0.0	0			Head: Reference number
4	H_Request_ID	Byte	1.0	2			Head: Request ID: 1=read, 2=write
5	H_Axis	Byte	2.0	1			Head: Allways 1 for SINAMICS G120C
6	H_Number_of_parameters	Byte	3.0	2			
7	A_1_Attribute	Byte	4.0	16#10			
8	A_1_Number_of_indices	Byte	5.0	0			Address: Number of elements (0 to 234)
9	A_1_Parameter_number	UInt	6.0	1120			Address: Parameter number
10	A_1_Index	UInt	8.0	0			
11	A_2_Attribute	Byte	10.0	16#10			
12	A_2_Number_of_indices	Byte	11.0	0			Address: Number of elements (0 to 234)
13	A_2_Parameter_number	UInt	12.0	1121			Address: Parameter number
14	A_2_Index	UInt	14.0	0			
15	V_1_Format	Byte	16.0	16#8			
16	V_1_Number_of_index_values	Byte	17.0	1			
17	V_1_Value	Real	18.0	10.0			
18	V_2_Format	Byte	22.0	16#8			
19	V_2_Number_of_index_values	Byte	23.0	1			Value: Number of index values
20	V_2_Value	Real	24.0	15.0			Value: Parameter value

Figure 5-9: DB101 “read_drive_parameters”



	Name	Data type	Offset	Start val...	Retain	Visible in ...	Comment
1	Static						
2	record		0.0				
3	H_Reference	Byte	0.0	0			HEAD: Refernece number
4	H_Request_ID	Byte	1.0	B#16#1			HEAD: Request ID: 1=read, 2=write
5	H_Axis	Byte	2.0	B#16#1			HEAD: Allways 1 for SINAMICS G120
6	H_Number_of_parameters	Byte	3.0	B#16#3			
7	A_1_Attribute	Byte	4.0	B#16#10			
8	A_1_Number_of_indices	Byte	5.0	0			Address: Number od elements (0 to 234)
9	A_1_Parameter_number	Int	6.0	1120			Address: Parameter number
10	A_1_Index	Int	8.0	0			
11	A_2_Attribute	Byte	10.0	B#16#10			
12	A_2_Number_of_indices	Byte	11.0	0			Address: Number od elements (0 to 234)
13	A_2_Parameter_number	Int	12.0	1121			Address: Parameter number
14	A_2_Index	Int	14.0	0			Address: Index number
15	A_3_Attribute	Byte	16.0	B#16#10			Address: 16#10= parameter value
16	A_3_Number_of_indices	Byte	17.0	B#16#16			Address: Number od elements (0 to 234)
17	A_3_Parameter_number	Int	18.0	945			Address: Parameter number
18	A_3_Index	Int	20.0	0			Address: Index number

Figure 5-10 DB103 “answer_from_drive”



	Name	Data type	Offset	Start val...	Retain	Visible in ...	Comment
1	Static						
2	record		0.0				
3	H_Reference	Byte	0.0	0			HEAD: Refernece number (mirrored)
4	H_Response_ID	Byte	1.0	0			HEAD: Response ID: 8xh=error, 0xh=ok
5	H_Axis	Byte	2.0	0			HEAD: Allways 1 for SINAMICS G120
6	H_Number_of_parameters	Byte	3.0	0			s to transfer
7	V_1_Format	Byte	4.0	0			alue (44h=error)
8	V_1_Number_of_index_valu	Byte	5.0	0			Value: Number of index values
9	V_1_Value	Real	6.0	0.0			
10	V_2_Format	Byte	10.0	0			
11	V_2_Number_of_index_valu	Byte	11.0	0			Value: Number of index values
12	V_2_Value	Real	12.0	0.0			Value: Parameter value
13	V_3_Format	Byte	16.0	0			er value
14	V_3_Number_of_index_valu	Byte	17.0	0			alues
15	V_3_Value_00	Word	18.0	0			
16	V_3_Value_01	Word	20.0	0			Value: Parameter value
17	V_3_Value_02	Word	22.0	0			Value: Parameter value
18	V_3_Value_03	Word	24.0	0			Value: Parameter value
19	V_3_Value_04	Word	26.0	0			Value: Parameter value
20	V_3_Value_05	Word	28.0	0			Value: Parameter value
21	V_3_Value_06	Word	30.0	0			
22	V_3_Value_07	Word	32.0	0			
23	V_3_Value_08	Word	34.0	0			
24	V_3_Value_09	Word	36.0	0			Value: Parameter value
25	V_3_Value_10	Word	38.0	0			Value: Parameter value
26	V_3_Value_11	Word	40.0	0			Value: Parameter value
27	V_3_Value_12	Word	42.0	0			Value: Parameter value
28	V_3_Value_13	Word	44.0	0			Value: Parameter value
29	V_3_Value_14	Word	46.0	0			Value: Parameter value
30	V_3_Value_15	Word	48.0	0			Value: Parameter value

5.2.3 FB 20 “Parameters”

In the example, the parameter access occurs in FB “Parameters”. It is called cyclically by OB Main.

Figure 5-11 FB “Parameters”

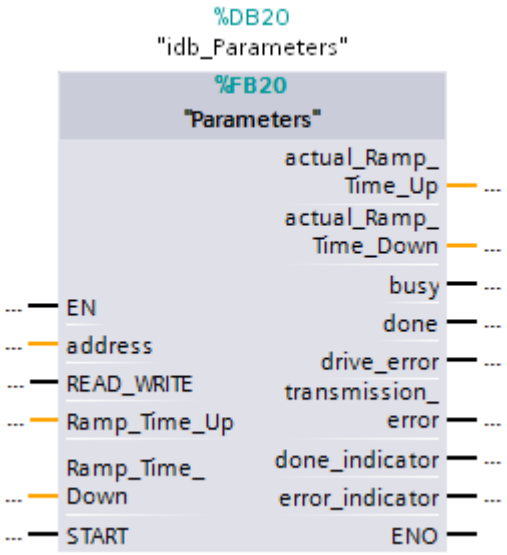


Table 5-3: Interface assignment of FB “Parameter”

Parameter	Data type	Start value	Description
Input parameters			
HW-ID	HW_SUBMODULE	-	Decisive hardware identifier for reading/writing parameters from/to a DP standard slave / PROFINET IO device. When selecting the frame type in the properties of the SINAMICS drive in the TIA Portal, STEP 7 creates a system constant which corresponds to this identifier. Enter this system constant here. It is symbolically displayed to you in the dropdown list when entering the parameters.
START	Bool	False	The transmission is started with a rising edge at START.
READ_WRITE	Bool	False	False: Read ramp-up/ramp-down time True: Write ramp-up/down time
Ramp_Time_Up	Real	10.0	Default ramp-up time [s]
Ramp_Time_Down	Real	10.0	Default ramp-down time [s]

Parameter	Data type	Start value	Description
Output parameters			
actual_ Ramp_Time_Up	Real	-	Ramp-up time [s] read by the SINAMICS drive. In the case of a send/receive error, 999999.9 is entered.
actual_ Ramp_Time_Down	Real	-	Ramp-down time [s] read by the SINAMICS drive. In the case of a send/receive error, 999999.9 is entered.
busy	Bool	-	Job running
done	Bool	-	Job completed without error The bit is pending until START is set to 0 again.
drive_error	Bool	-	The bit is set if an error ID was sent in the drive response. Analyze the DB 103 “answer_from_drive”. The bit is pending until START is set to 0 again.
error	Bool	-	The bit is set if one of the instructions WRREC or RDREC detects an error. Further evaluation through static data in the respective instance DB.[6] The bit is pending until START is set to 0 again.

Structure

FB “Parameter” consists of two parts:

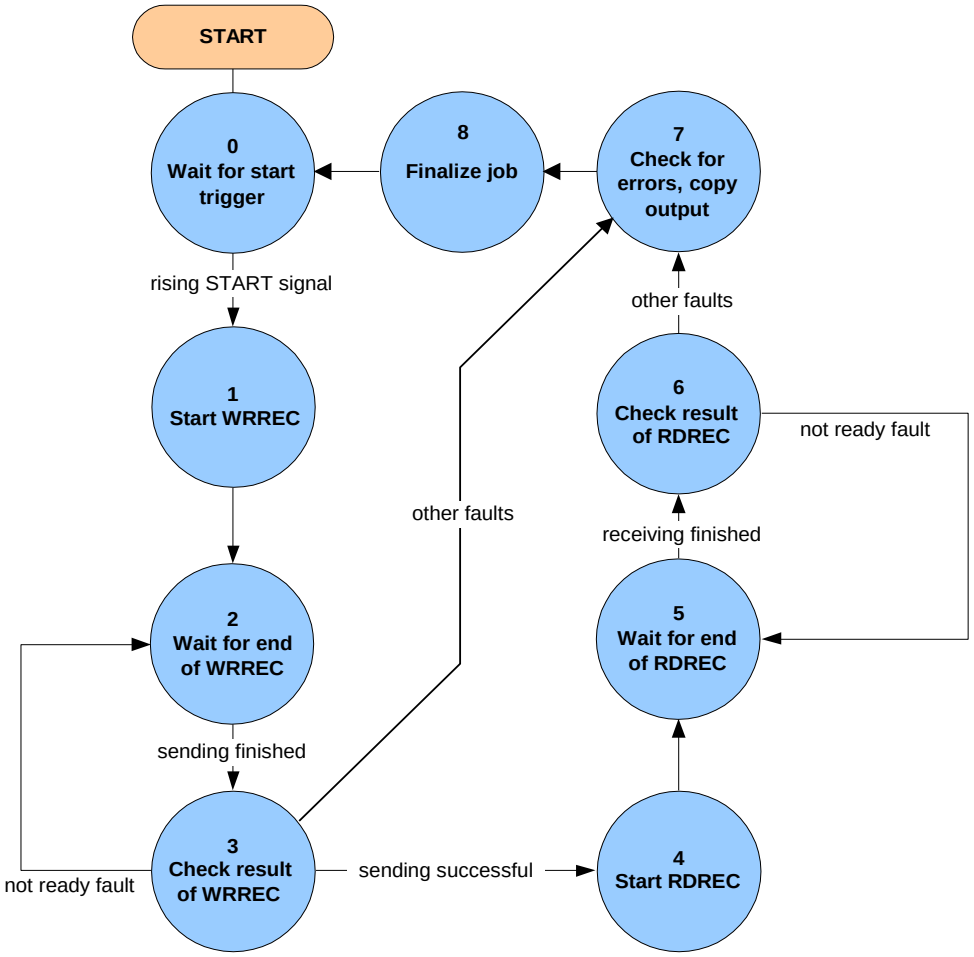
- A step sequence which controls the sequence of the parameter access (networks 1 to 23).
- The calls of the system functions “Write data set” or “Read data set” (networks 24 to 26).

[6] WR_ERROR = true → Error in instruction WRREC → Evaluation through WR_STATUS
RD_ERROR = true → Error in instruction RDREC → Evaluation through RD_STATUS
The tags WR_STATUS and RD_STATUS correspond to the output parameter Status der instructions WRREC und RDREC. For more information, please refer to the STEP 7 online help.

Step sequence

The individual steps of FB “Parameters” are represented in the following graphic. The possible transitions between the individual steps are also displayed there.

Figure 5-12 Step sequence



In the individual states of the step sequence, the following functions are executed:

Table 5-4: Function of the states of FB “Parameters”

State		Function
0	Wait for start trigger	• If START is false, all the transmission-related, block-internal signals and output signals are deleted. • It is waited for a rising edge of the “Start” signal. • If it is detected, “busy” will be set and step 1 activated.
1	Start WRREC	The “REQ” signal of the “WRREC” instruction is set, the parameter values to be written are entered in DB “write_drive_parameters” and step 2 is activated.
2	Wait for end of WRREC	If the “BUSY” signal of the “WRREC” instruction goes to 0 again, step 3 is activated.

3	Check result of WRREC	It is checked whether the data set was written successfully. If yes, the “REQ” signal of the “WRREC” instruction is deleted again and step 4 is activated. If the “WRREC” instruction reports error 16#DF80_B500 (peer not ready), step 3 is activated again so that “WRREC” repeats the job. If a different error has occurred, the “REQ” signal of the “WRREC” instruction is deleted, an internal error bit is set and step 7 is activated.
4	Start RDREC	The “REQ” signal of the “RDREC” instruction is set and step 5 is activated.
5	Wait for end of RDREC	If the “BUSY” signal of the “RDREC” instruction goes to 0 again, step 6 is activated.
6	Check result of RDREC	It is checked whether the data set was read successfully. If yes, the “REQ” signal of the “RDREC” instruction is deleted again and step 7 is activated. If “RDREC” reports error 16#DE80_B500 (peer not ready), step 5 is activated again so that the “RDREC” instruction repeats the job. If a different error has occurred, the “REQ” signal of the “RDREC” instruction is deleted, an internal error bit is set and step 7 is activated.
7	Check for errors, copy outputs	It is checked whether one of the internal error bits is set or whether an error bit has been set in the response of the converter. • In the event of an error - The respective output bit parameter “drive_error” or “transmission error” is set, - the output bit parameter “busy” is deleted, - 999999.9s is output as read time, - step 0 activated. • If no error bit has been set, the read times for the read job are output and step 8 is activated. • If no error bit has been set, the write times for the write job are output and step 8 is activated.
8	Finalize job	The “busy” signal is deleted, the “done” signal is set and step 0 is activated again.

Calling the system functions “WRREC” and “RDREC”

Once the currently required control bits have been set in the step sequence of FB 20 “Parameters”, the “WRREC” instruction “Write data set” and the “RDRE” instruction “Read data set” are called. They can be found in the “instructions” task card of the TIA Portal under…

> Expanded instructions
> Distributed I/Os.

Via the “READ_WRITE” input variable of FB20 it is selected which of the two calls enables the “WRREC” instruction. Both calls only differ in which DB is sent to the SINAMICS drive: the one to write parameters or the one to read parameters.

6 Configuration and Settings

6.1 Creating the project configuration

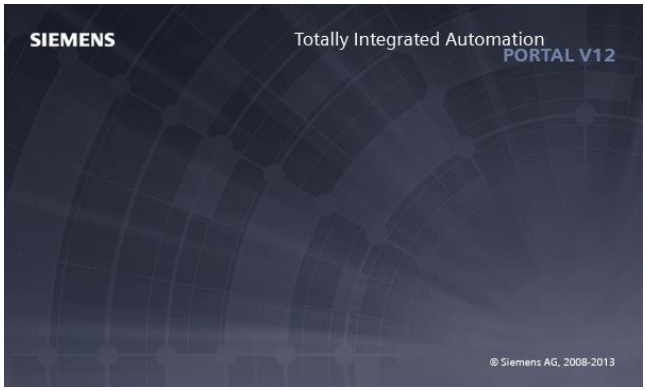
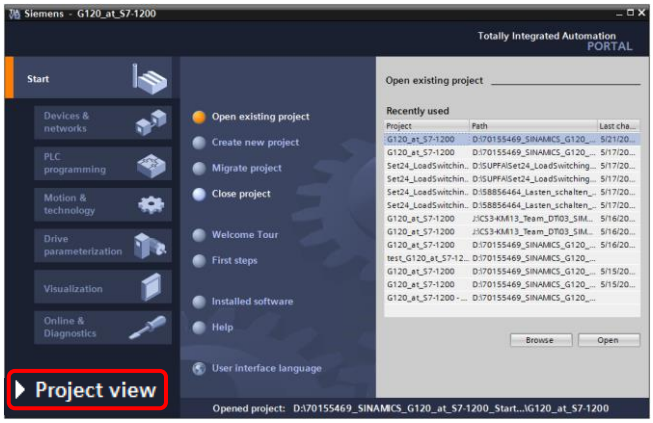
Note

- If you only wish to download and commission the example program, please follow the instructions in chapter 3 "Setting up and commissioning the application"
- The procedure described in the step table below represents one option of configuring a SIMATIC S7-1200 and parameterizing a SINAMICS G120 PN for data exchange between SIMATIC controller and SINAMICS drive. TIA Portal offers several possible solutions that differ to a greater or lesser degree from the procedure shown here.

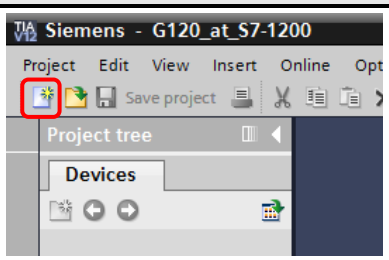
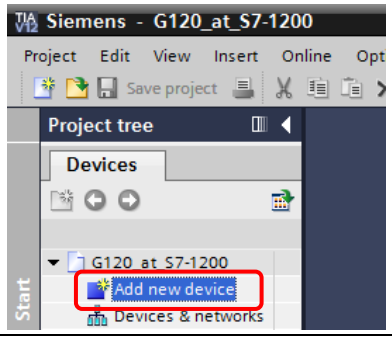
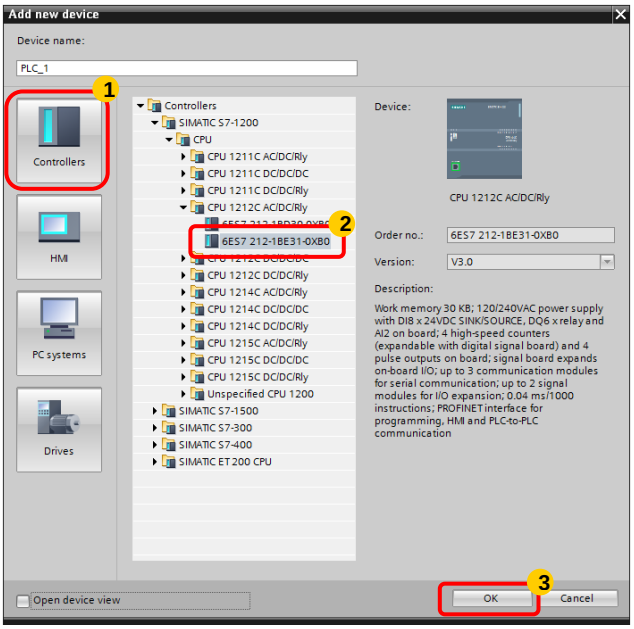
The step tables below describe what to do if you do not want to use the example code, but wish to configure the SIMATIC S7 CPU, SINAMICS G120C and the HMI KTP600. The configuration of the SIMATIC S7-1200 and the configuration of the control panel are not subject of this chapter.

6.1.1 Configuration of the components

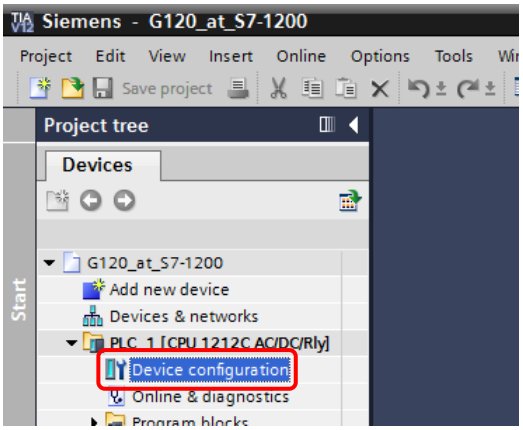
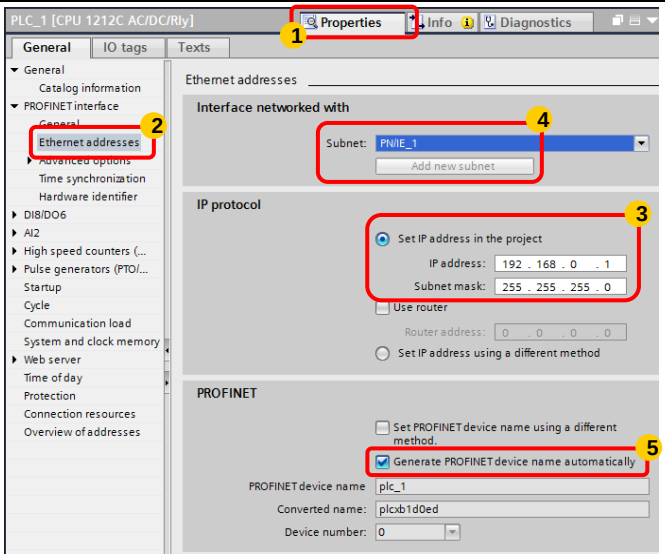
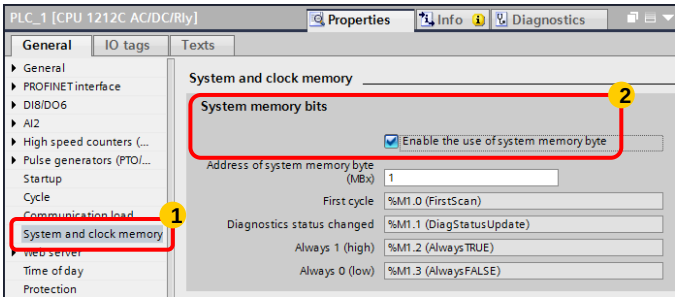
Table 6-1: Creating the project configuration

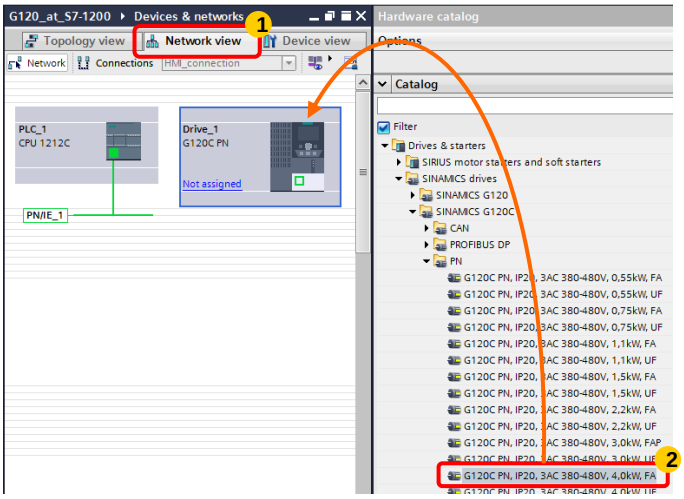
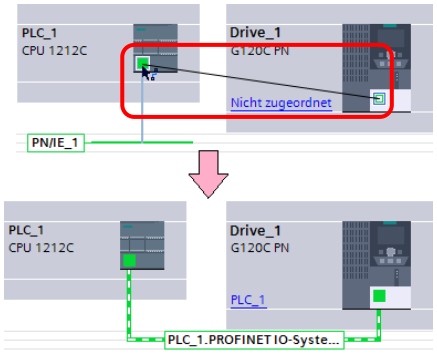
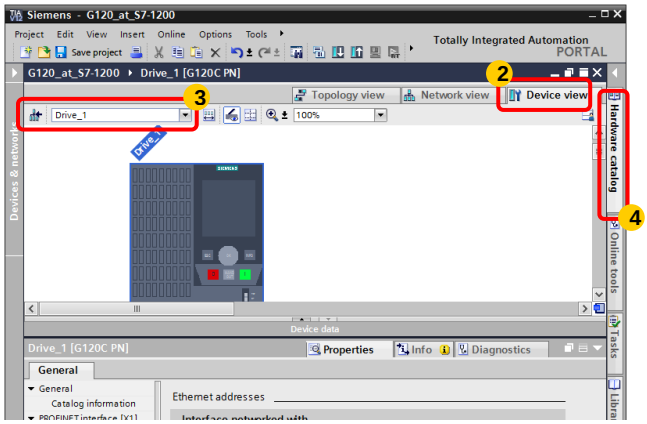
No.	Action	Remarks
	Creating the project	
1.	Open TIA Portal.	
2.	If TIA Portal opens in the Portal view, go to the bottom left to switch to the Project view.	

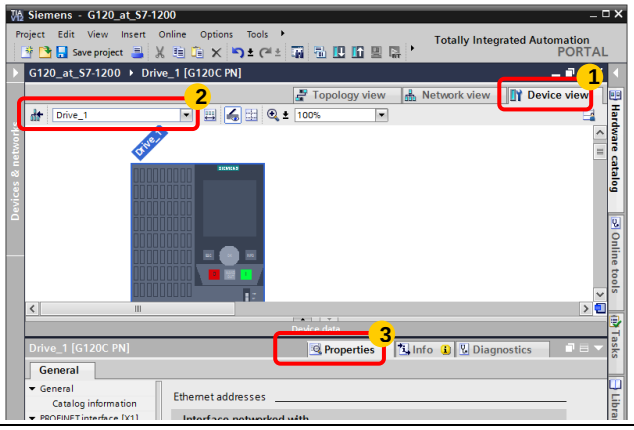
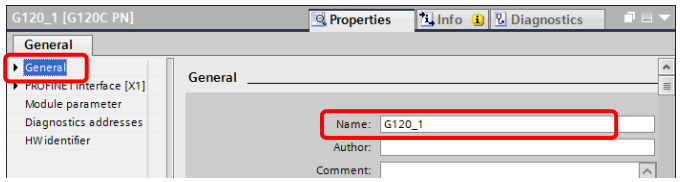
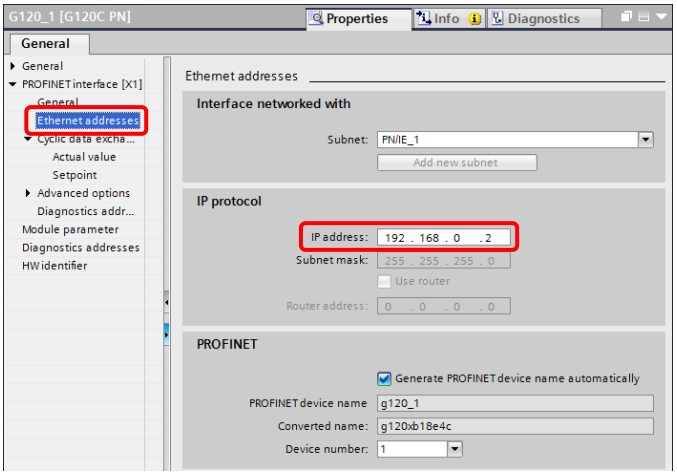
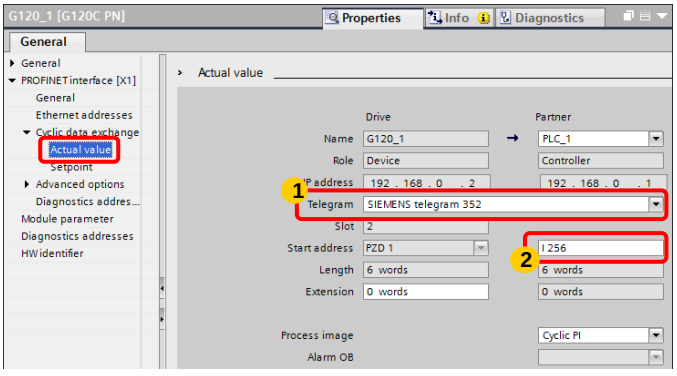
6.1 Creating the project configuration

No.	Action	Remarks
3.	Create a new project and assign a name (e.g.“G120_at_S7-1200”)	
	Inserting the SIMATIC S7-1200	
4.	Double-click on “Add new device”.	
5.	1. Select “Controller”. 2. Select the desired CPU. 3. Then click on “OK”.	

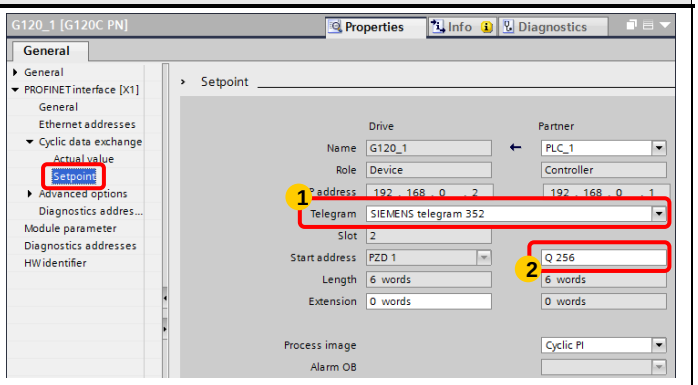
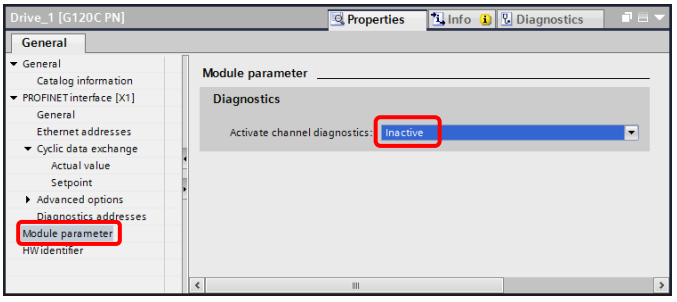
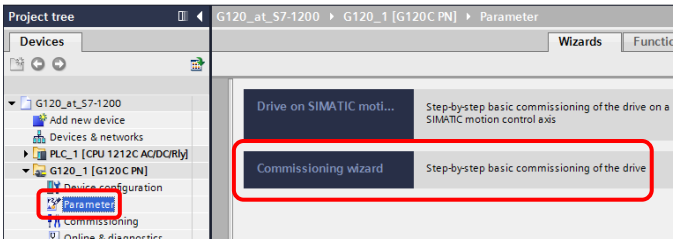
6.1 Creating the project configuration

No.	Action	Remarks
	Configuring the SIMATIC S7-1200	
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. Go to “Ethernet addresses” in the navigation tree. 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.	Enable the use of the system memory bits, since they are used in the control program. 1. In the tree you go to “System and clock memory”. 2. Checkmark “Enable the use of system memory byte” and enter the desired byte address.	 The program in the application example uses MB1 (default setting)

No.	Action	Remarks
	Add and network the SINAMICS G120	
9.	Select the desired SINAMICS drive: 1. In the “Devices & networks” editor, go to the “Network view”. 2. Then drag the required SINAMICS G120 PN from the catalog into 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 >PN	
10.	Graphically connect the Ethernet connections of SIMATIC controller and SINAMICS drive by dragging the mouse.	
	Configuring the SINAMICS G120	
11.	In case you are not using a G120C, you still need to define the power module: 1. In the “Devices & networks” editor, go to the Properties of the SINAMICS drive. 2. Select “Device view” 3. Select the drive 4. Insert the power unit from the catalog.	

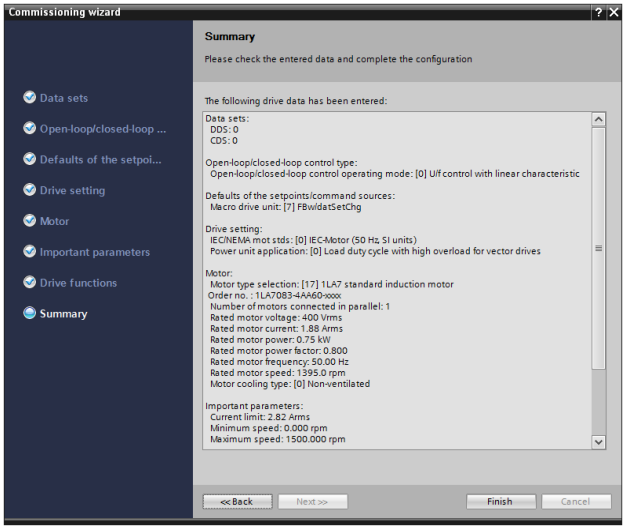
No.	Action	Remarks
12.	In the “Devices & networks” editor, go to the Properties of the SINAMICS drive. 1. Select “Device view” 2. Select the drive 3. Click on “Properties”.	
13.	Now go to >General to change the drive name, when necessary. The PN device name is derived from it as long as its automatic generation is selected (see next step).	
14.	Now go to >PROFINET interface [X1] >Ethernet addresses to change the IP address of the SINAMICS drive, if necessary.	
15.	In >Cyclic data exchange >Actual values you configure the cyclic data reception. 1. Select the message frame type (in the example: SIEMENS telegram 352) 2. Specify the I/O start address of the inputs. (in the example: 256[7])	

[7] Select the I/O addresses which otherwise are not used in the program. As a standard, STEP 7 enters the next so far unused addresses.

No.	Action	Remarks
16.	In >Cyclic data exchange >Setpoint value you configure the cyclic data transfer. 1. The message frame type entered in step 15 is automatically adopted (no action). 2. Specify the I/O start address of the outputs. (in the example: 256[7])	
17.	In >Module parameter you configure the channel diagnostics as Active. When using an S7-1200 CPU with FW ≥4.0, you can also set it to “PROFIdrive standard diagnostics“.[8]	
Parameterizing the SINAMICS G120		
18.	Perform the basic commissioning using the wizard. To do so, select >G120_1 [G120…] >Parameter. …and click on the commissioning wizard.	

[7] Select the I/O addresses which otherwise are not used in the program. As a standard, STEP 7 enters the next so far unused addresses.

[8] Alarms and warnings of the SINAMICS can in TIA Portal (from V13) also be automatically entered into the diagnostics buffer of the S7-1200 CPU, if the S7-1200 CPU has at least FW 4.0.
ERROR or Maint LED of the CPU light up when SINAMICS indicates an alarm or warnings.
When using an S7-1200 CPU with FW < 4.0 and activated “PROFIdrive standard diagnostics”, SINAMICS alarms and warnings are entered in the diagnostics buffer of the S7-1200 CPU and the ERROR or Maint LED lights up; however, these entries are only displayed in the diagnostic buffer as incomprehensible code number.

No.	Action	Remarks
19.	The wizard is self-explanatory. 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:	

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

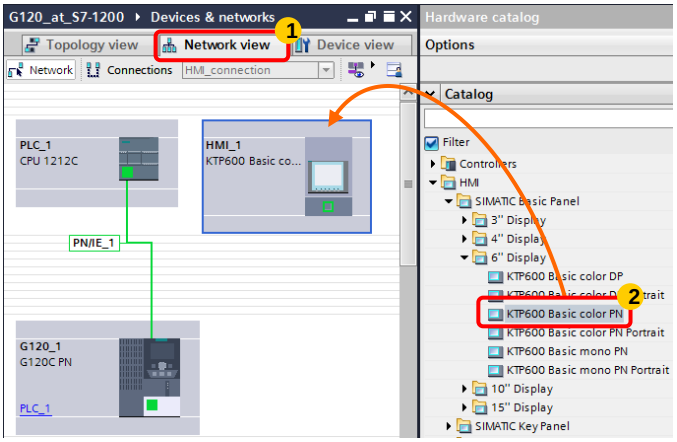
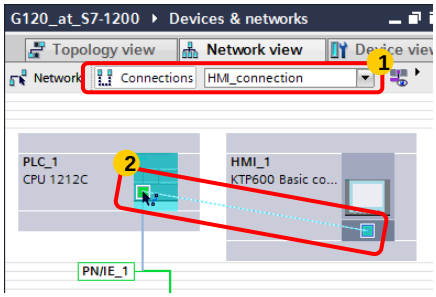
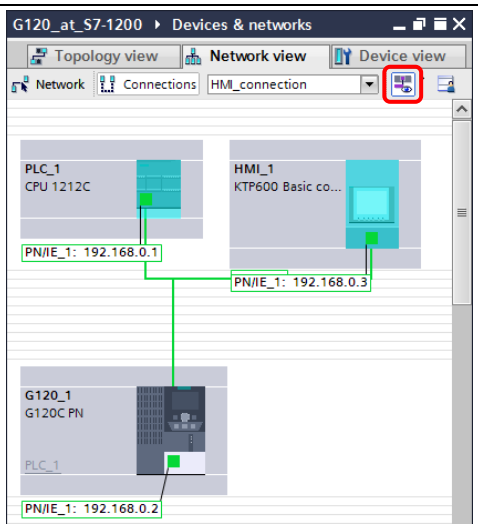
Defaults of the setpoints/command sources:
Macro drive unit: [7] FBw/datSetChg

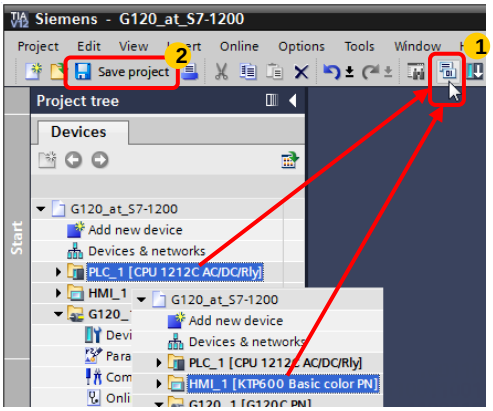
Drive setting:
IEC/NEMA mot stds: [0] IEC-Motor (50 Hz, SI units)
Power unit application: [0] Load duty cycle with high overload for vector drives

Motor:
Motor type selection: [17] 1LA7 standard induction motor
Article No.: 1LA7083-4AA60-xxxx
Number of motors connected in parallel: 1
Rated motor voltage: 400 Vrms
Rated motor current: 1.88 Arms
Rated motor power factor: 0.75 kW
Rated motor power factor: 0.800 s
Rated motor power: 50.00 Hz
Rated motor speed: 1395.0 rpm
Motor cooling type: [0] Non-ventilated

Important parameters:
Current limit: 2.82 Arms
Maximum speed: 0.000 rpm
Maximum speed: 1500.000 rpm
Ramp-function generator ramp-up time: 10.000 s
Ramp-function generator ramp-down time: 10.000 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

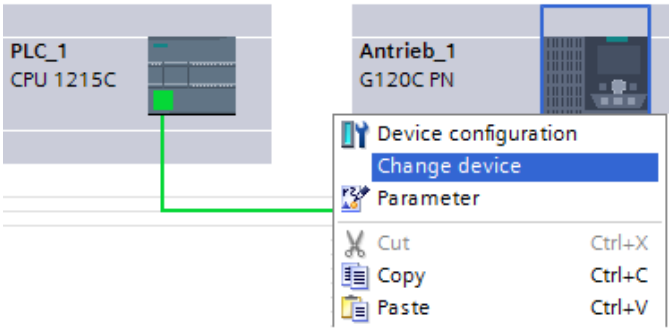
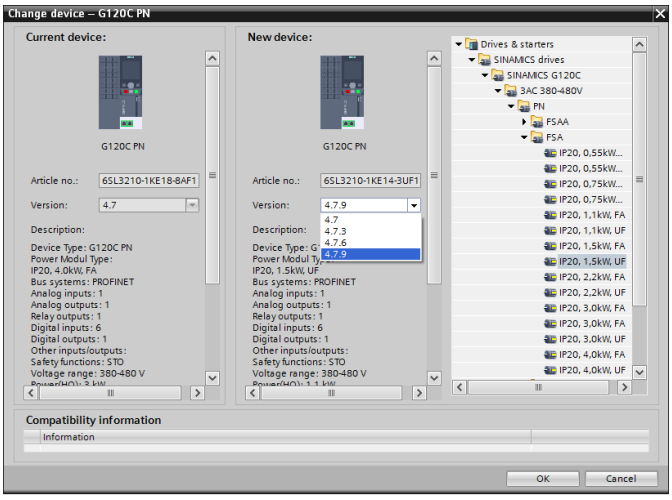
No.	Action	Remarks
	Add and network the KTP600	
20.	Select the desired HMI operator panel: 1. In the “Devices & networks” editor, go to the “Network view”. 2. Then use drag and drop to move the required KTP600 from the catalog to the graphic area. In the catalog, the KTP600 can be found in … >HMI >SIMATIC Basic Panels >6‘‘ Display	
21.	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.	
22.	Show the addresses. The next available IP address 192.168.0.3 is automatically assigned to the KTP600.	

No.	Action	Remarks
23.	The device and network configuration is now completed. 1. Successively compile the configurations of CPU and HMI device for control purposes. The compilation results can be seen in the inspection window. 2. Save the project.	
24.	Now you create the STEP 7 program (programming the OBs, FCs, FBs, DBs) and also configure the control panel (creating pictures, assigning HMI tags etc.). Then load the entire software into SIMATIC controller, SIMATIC drive and panel, according to chapter 3.4.	

6.1.2 Change device of SINAMICS G120

It is possible to change the SINAMICS after the configuration.

Table 6-2: change device of SINAMICS G120

No.	Action	Remarks
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.	

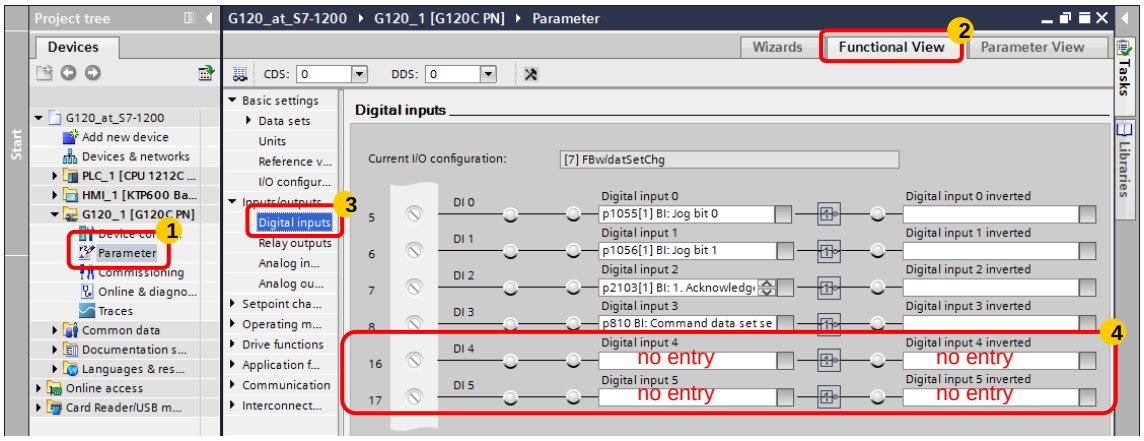
6.2 Safe Torque Off (STO) with Safety Integrated

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

Preconditions

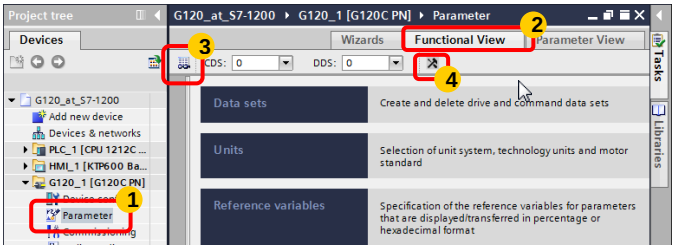
- Make sure that the digital inputs DI 4 and DI 5 (terminals 16 and 17) of the G120 that form the fail-safe input F-DI are not assigned a “standard” function. This is ensured in the sample project and in the factory settings.

Figure 6-1: Digital inputs



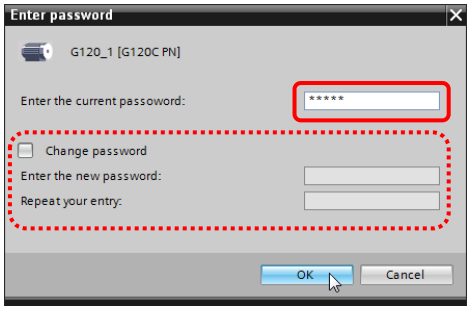
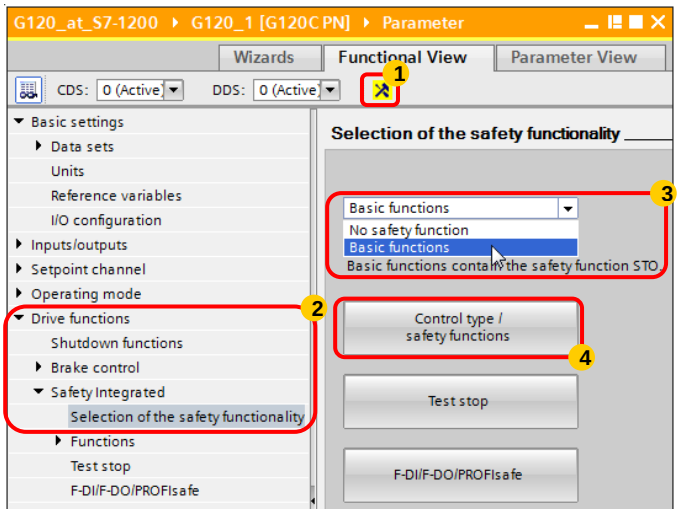
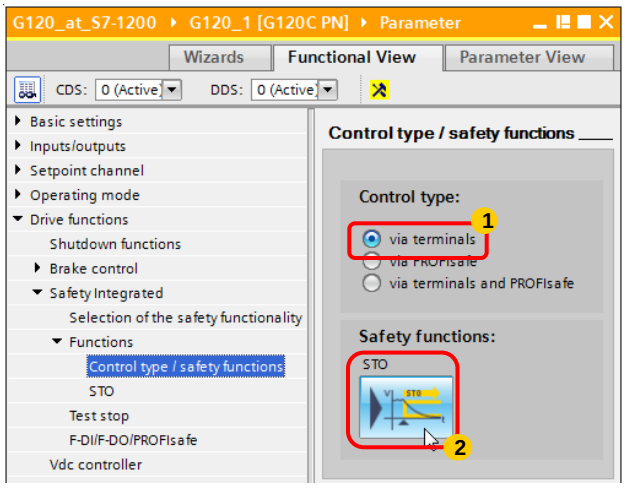
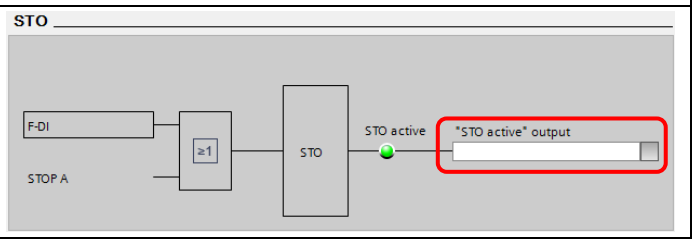
- For test purposes, apply 24V to DI 4 and DI 5 or connect an emergency stop control device. Do not forget to connect the reference potential of inputs DI 4 and DI 5 to ground. Figure 3-1 shows the wiring of the signals.

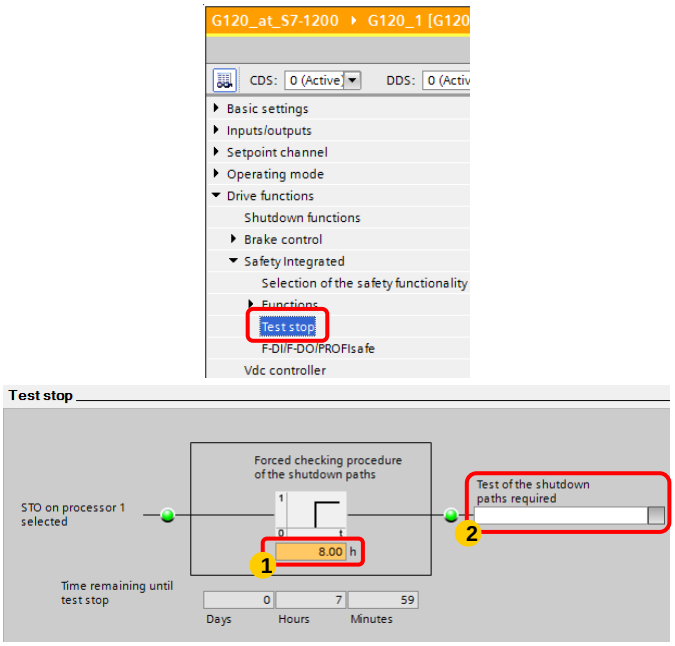
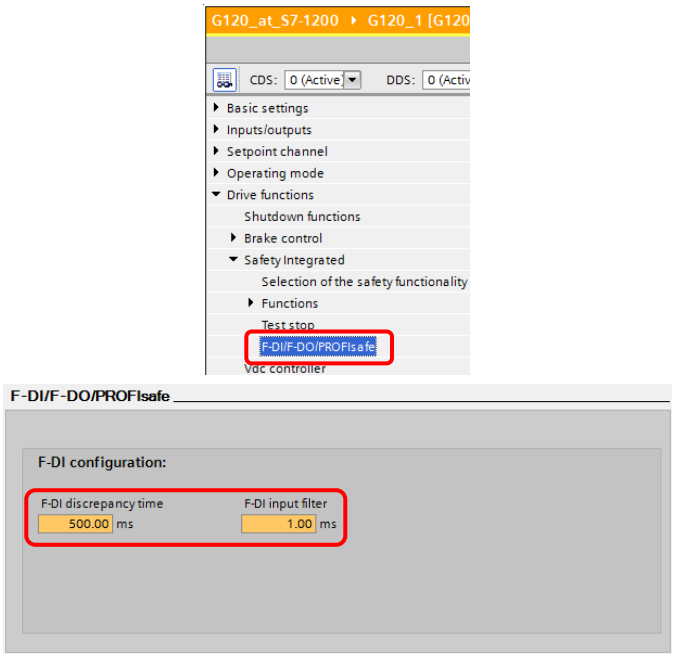
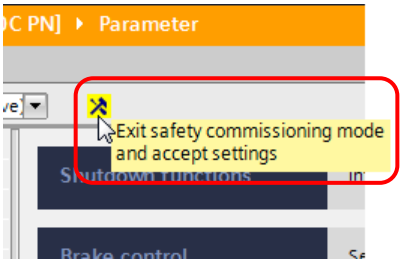
Activating safety functions

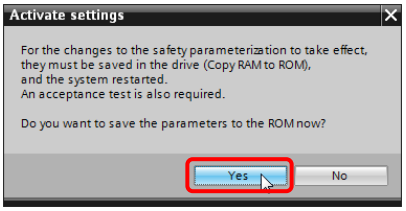
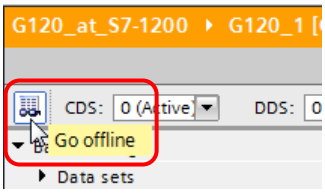
No.	Action	Remarks
1.	1. Navigate to the configuration editor. 2. Select the function view. 3. Go online. 4. Activate the safety commissioning mode.	

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	Remarks
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	Remarks
6.	Test stop On demand you can... 1. change the time for the test stops. 2. interconnect 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 again.	

No.	Action	Remarks
9.	Save the changed safety parameters in ROM.	
10.	Terminate the online connection by pressing the button.	
11.	"POWER ON" the SINAMICS G120. (Keep voltage off until all LEDs are dark.)	

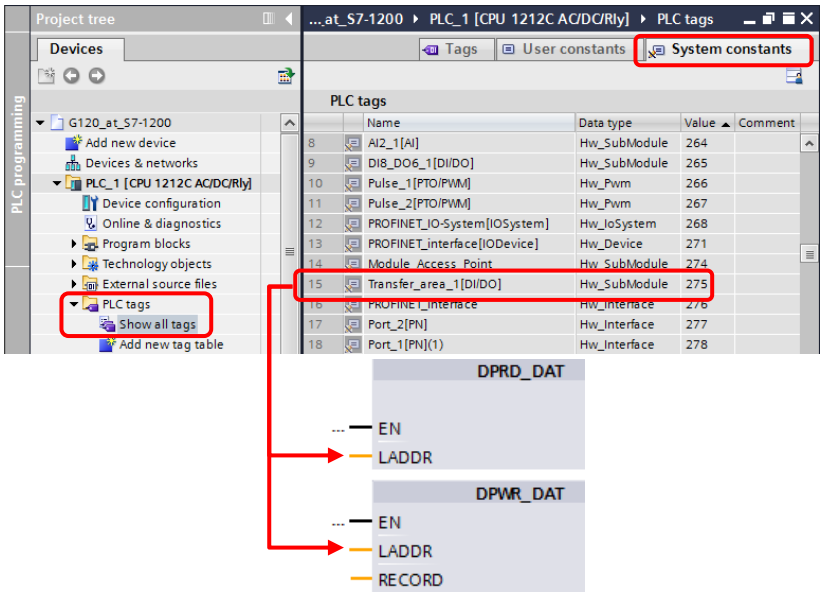
6.3 Comments on programming the SIMATIC S7-1200

This chapter discusses particular points of programming.

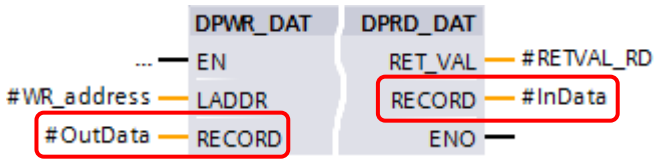
The instructions and their formal parameters discussed below are described in the online help of the TIA Portal and can be easily found in the information system via the search function. The discussion only includes those parameters of the instruction for which the online help only provides insufficient information regarding the SINAMICS G120.

6.3.1 Configuring the DPRD_DAT/DPWR_DAT instruction

Table 6-3: DPRD_DAT/DPWR_DAT – Parameterization of the instruction

Parameter	Explanation
LADDR	LADDR of type “HW_SUBMODULE” refers to an addressable component of the IO device, hence the SINAMICS G120 PN. When, according to step 16 of Table 6-1, selecting the “Telegram 352” frame in the Device view of the SINAMICS drive, STEP 7 creates system constants which correspond to logic IO addresses. In the picture below, the decisive system constant has the value 277 (115_h) or the symbolic name “Transfer_area_1[DI/DO]”[9]. If DPRD_DAT/DPWR_DAT are used for a PROFINET connection, the respective system constant must be created for DPRD_DAT as well as for DPWR_DAT at LADDR. When calling DPRD_DAT/DPWR_DAT you can specify the LADDR parameter as decimal or hexadecimal value or adopt it from the drop-down menu.  (In the application, the system constant is transferred via the tags RD_address and WR_address to the instructions DPRD_DAT and DPWR_DAT. RD_address and WR_address are input parameters of the calling block “Process_Data”, which in the Main [OB1] was supplied with “Transfer_area_1[DI]”.)

[9] The symbolic name of the system constant depends on the selected frame type and the project language. Using the “Standard telegram 1” frame, for example, would give the system constant the name “Setpoint_Actual_value_1[DI/DO]”. The value of the constant in the above picture may deviate from that in the example project.

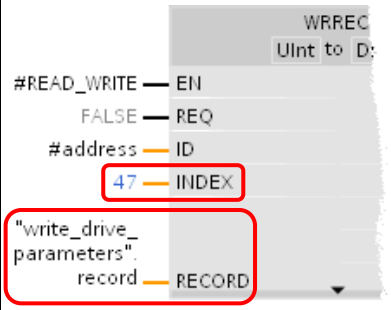
Parameter	Explanation
RECORD	RECORD of type “VARIANT” is a pointer with specified length. It points to a data area in the PLC in which the data read from the SINAMICS drive is stored or from which the data to be written to the SINAMICS drive is fetched. The data area must have the same length as the I/O area addressed by LADDR.  In the application example, RECORD is addressed symbolically[10]. For “InData” a field in the temporary data area of “Process_Data” was used, consisting only of six words (Array [1 .. 6] Of Word), according to the length of the “Telegram 352” frame. Since “InData” is a temporary tag, an absolute access is not possible.

[10] For symbolic addressing, the length to be specified in “RECORD” is specified implicitly by the structure of the actual parameter.

6.3.2 Configuration the RDREC/WRREC instruction

Table 6-4: RDREC/WRREC – Configuration of the instruction

Parameter	Explanation
ID	ID has the same function as the LADDR parameter for DPRD_DAT/DPWR_DAT (see Table 6-3). Even if you only wish to use the acyclic services in your communication with the SINAMICS G120, a cyclic data exchange will be configured by STEP 7. In this case, however, you can select the “Standard Telegram 1” frame (default setting) with the smallest data length.
LEN (for WRREC)	When unfolding the block by clicking on the small triangle, additionally, the input parameter “LEN” appears for specifying the maximal length of the data set to be transferred.  Since in this example the data set length is contained in the “RECORD” parameter, “LEN” needs not be configured. Keep the default value 0.
MLEN (for RDREC)	Maximum length of the data set information to be read in bytes. Since in this example the data set length is contained in the “RECORD” parameter as well, “MLEN” needs not be configured. Keep the default value 0.
INDEX	Here, the data set to be transferred must be specified. Enter the value 47 as the actual parameter for “data set 47”.
RECORD	RECORD of type “VARIANT” is a pointer with specified length. It points to data records “record” in the DBs from chapter 5.2.2. In the application example, RECORD is addressed symbolically (see footnote 10 on page 59).



7 Links & Literature

This list is not complete and only represents a selection of relevant information

Table 7-1: Literature

	Topic	Title / link
/1/	SIMATIC S7-1200 STEP 7 Basic	SIMATIC S7-1200 System Manual 03/2014 http://support.automation.siemens.com/WW/view/en/91696622 Updating the System Manual, Edition 03/2014 http://support.automation.siemens.com/WW/view/en/89851659
/2/		WinCC Basic V13.0 System Manual http://support.automation.siemens.com/WW/view/en/89336297 WinCC Basic V13.0 System Manual http://support.automation.siemens.com/WW/view/en/91379840
/3/		Programming guideline for S7-1200/1500 http://support.automation.siemens.com/WW/view/en/91018783
-		Automating with SIMATIC S7-1200 Author: Hans Berger Publicis Corporate Publishing ISBN: 978-3-89578-384-5
/4/	SIMATIC Basic Panels	Operating instructions http://support.automation.siemens.com/WW/view/en/31032678
/5/	SINAMICS Startdrive	Commissioning tool for SINAMICS drives as option package for SIMATIC STEP 7 V13 http://support.automation.siemens.com/WW/view/en/68034568
/6/	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 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
	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 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
	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 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
	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 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
	SINAMICS G120D	Operating instructions (V4.7):

	Topic	Title / link
	with CU240D-2 Manuals	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 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
	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 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
	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 Function manual Fieldbus systems (V4.7): http://support.automation.siemens.com/WW/view/en/99685159
/7/	This entry	https://support.industry.siemens.com/cs/ww/en/view/70155469http://support.automation.siemens.com/WW/view/en/70155469
/8/	Siemens Industry Online Support	http://support.automation.siemens.com

8 History

Table 8-1: History

Version	Date	Modifications
V1.0	07/2013	First version
V1.2	07/2014	• Updated for TIA Portal V13 • Step 17 in Table 6-1 added for selecting the diagnosis • Revision of FB10 and FB20
V1.3	11/2014	Updated for SINAMICS FW 4.7
V1.4	07/2018	Insert chapter 6.1.2