SINAMICS G120 with CU240S PN (FW3.2)

Control via PROFINET

Application • July 2010

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G120_STD_APP2_en.doc

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1 Automation function

1.1 Description of the functionality

The SINAMICS G120 drive inverter is a modular inverter system with degree of protection IP20. It comprises the two function units Control Unit (CU) and Power Module (PM).

When using the Control Unit CU240S PN, you have the possibility to use the PROFINET IO interface. This interface can be used for data exchange between inverter and control and to run the drive with the control.

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2 Functionality of the function example

2.1.1 Task description

The SINAMICS G120 is to be controlled from an S7-300 CPU via Profinet.

2.1.2 Solution

In this function example, the control of a SINAMICS G120 (control word and frequency setpoint) will be demonstrated using an S7-300 CPU and a specific program example.

This program example comprises an S7 program to control the SINAMICS G120 and the appropriate configuration in the SINAMICS G120.

2.2 Structure of the function example

- In Chapter 3 the required hard and software components for the function-examples are shown.
- The download and test of the program examples supplied are described in Chapters 4 to 5.
- Chapter 6 informs about the key performance date.
- In Chapter 7 more detailed information are delivered. These Steps are not necessary for the commissioning of the function-example and you don't have to do these because they are already included in the S7-Program and accordingly the SINAMICS G120 Project. The given information should help you with the creation of your own projects.

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3 Components that are required

An overview of the hardware and software components required for the function example is provided in the Chapter.

3.1 Hardware components

Component	Type	Order No./ordering data	Qty	Manufacturer
S7 control				
Power supply	PS307 5A	6ES7307-1EA00-0AA0	1	SIEMENS
S7-CPU	CPU 315-2 PN / DP	6ES7315-2EH13-0AB0	1	
Memory Card	MMC 512 KB	6ES7953-8LJ11-0AA0	1	
DI / DO simulation module	SM374	6ES7374-2XH01-0AA0	1	
Profile rail	Profile rail	6ES7390-1AE80-0AA0	1	
PROFINET RJ45 connector *	PROFINET connector	6GK1901-1BB10-2AA0	4	
PROFINET cable	PROFINET cable	6XV1840-2AH10	5m	
Drive				
SINAMICS G120 Control Unit	CU240S PN F (FW3.2)	6SL3244-0BA21-1FA0	1	SIEMENS
SINAMICS G120 Power Module	PM240	6SL3224-0BE21-5UA0	1	
Basic Operator Panel	BOP	6SL3255-0AA00-4BA1	1	
Motor	Three-phase induction motor	1LA7060-4AB10	1	

Note

The functionality was tested with the specified hardware components. Similar components that are different from those listed above can be used. Please note that in such a case it may be necessary to change the code example (e.g. setting other addresses).

3.2 Software components

Component	Version	Order No. / ordering data	Qty	Manufacturer
SIMATIC STEP 7	V5.4 + SP5 + HF1	6ES7810-4CC08-0YA5	1	SIEMENS
STARTER	V4.1 + SP5 + HF1	http://support.automation.siemens.com/WW/view/en/26233208	1	
GSDML-File CU240S PN	V3.2	http://support.automation.siemens.com/WW/view/en/26641490	1	

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4 Configuration and wiring

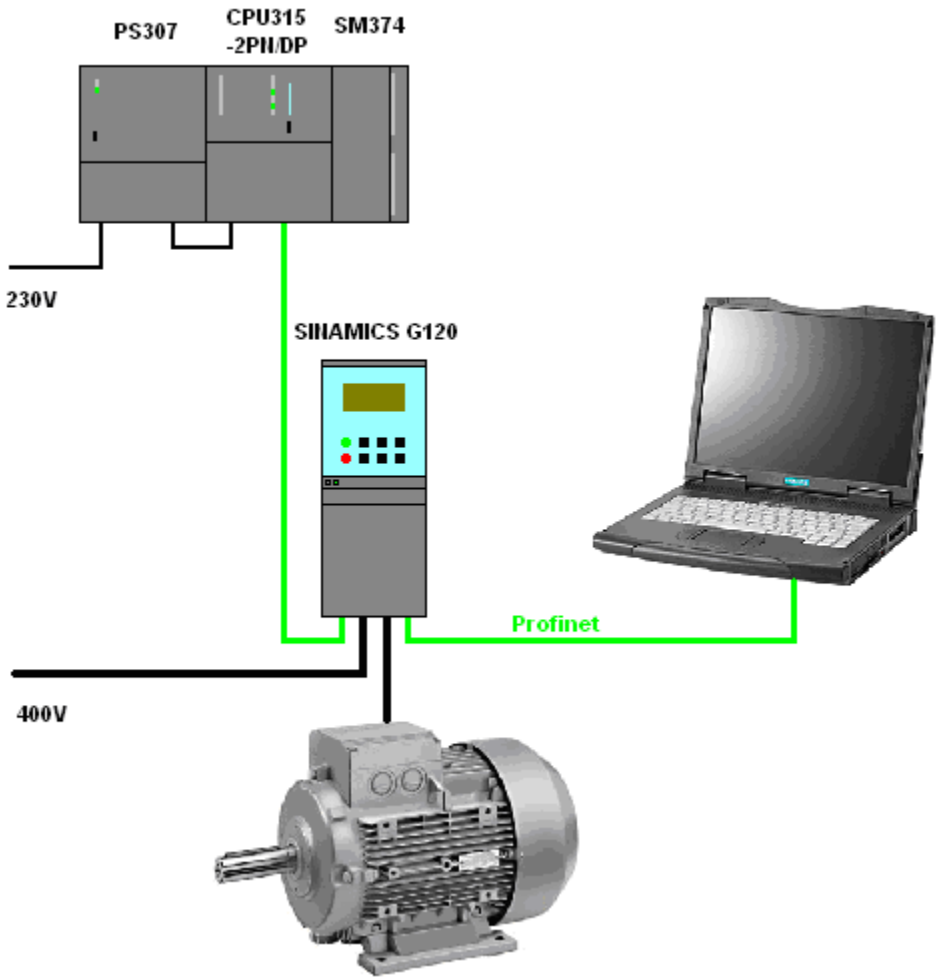
The hardware configuration and connecting-up the function example are described in this Chapter.

Please carefully observe the following safety information & instructions when using the SINAMICS G120:

Warning

The SINAMICS G120 has hazardous voltages and controls rotating mechanical parts that can also be potentially hazardous. If the warning information is not observed or the information & instructions from the instructions belonging to SINAMICS G120 are not complied with this could result in death, severe bodily injury or significant material damage.

4.1 Overview of the hardware configuration



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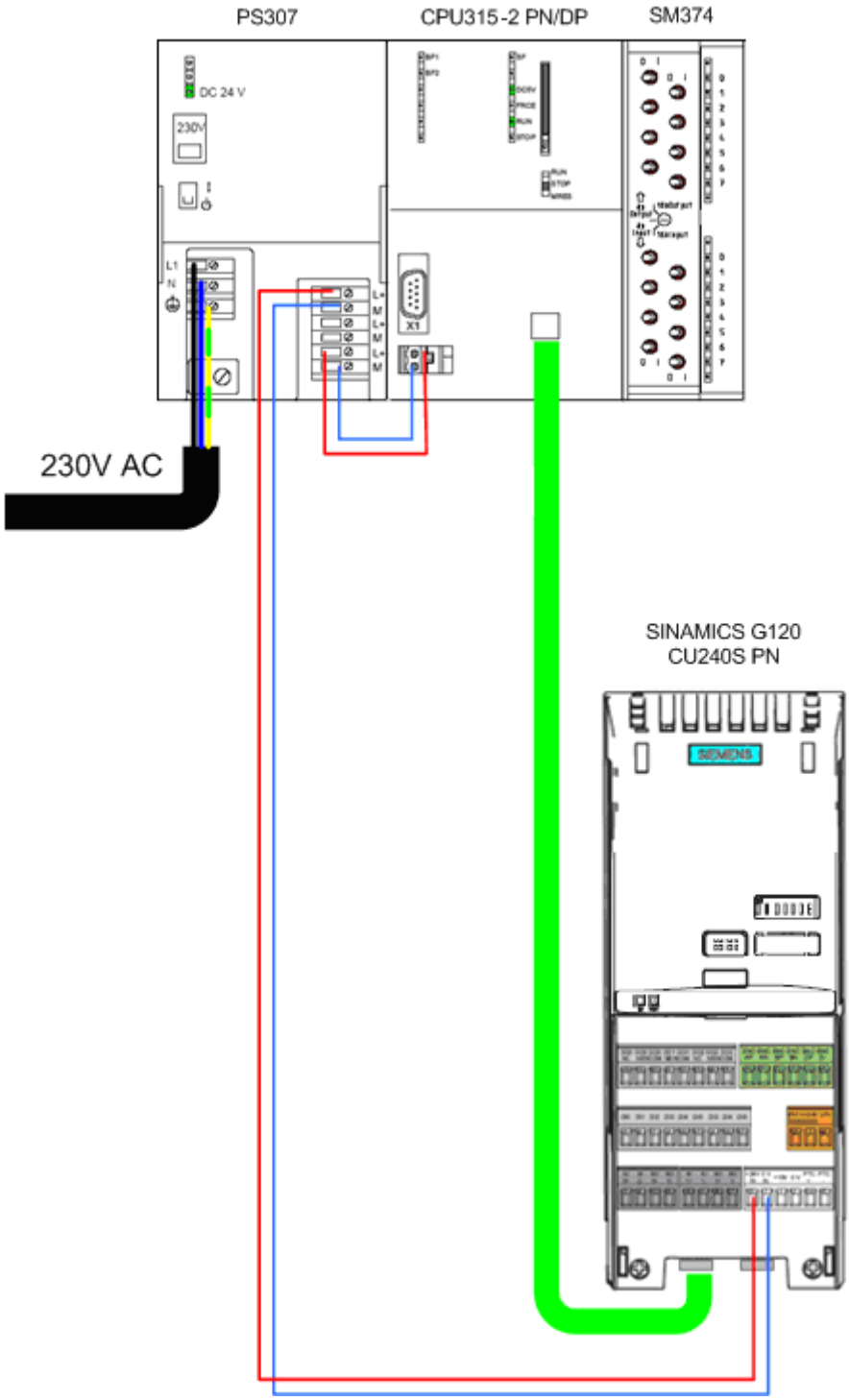
4.2 Connecting-up the hardware components

4.2.1 S7-300 control and CU240S PN



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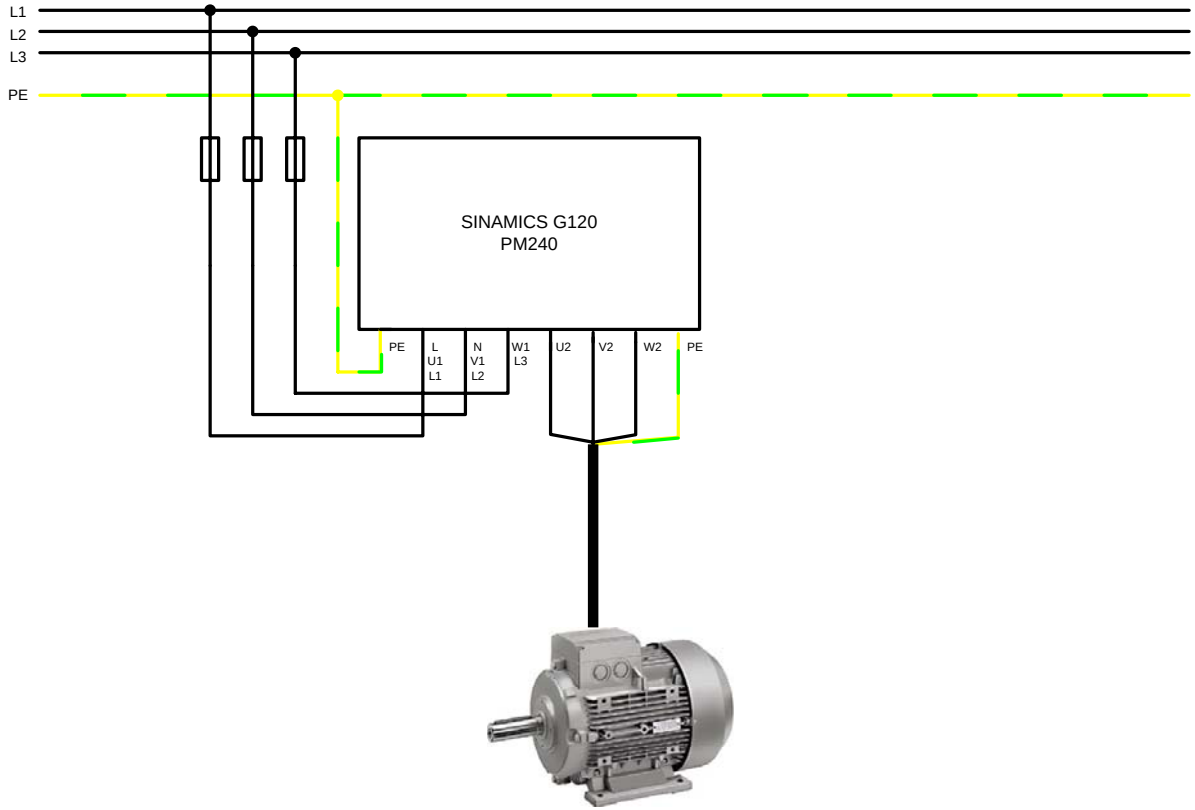
4.2.2 PM240 and motor



For more detailed information regarding the installation please refer to the ***SINAMICS G120 Hardware Installation Manual Power Module PM240.*** Download from: **http://support.automation.siemens.com/WW/view/en/22339653/133300**

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4.3 Fault 395 (acceptance test / acknowledgement present)

Fault F395 is output when powering-up for the first time and after replacing the Control Unit (CU) or the Power Module (PM).

This fault does not represent an incorrect drive inverter function. The reason for this fault message is to monitor the individual drive inverter components (CU and PM) to prevent them from being replaced by unauthorized personnel.

Acknowledging fault F395

Just like any other fault, it can be acknowledged using an appropriately parameterized input, via the field bus or using the STARTER parameterizing software.

4.4 Important hardware component settings

Most of the module/board settings are made in the HW Config in the software. Hardware settings are only required for the following modules/boards.

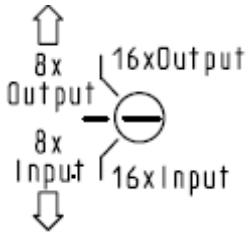
The modules/boards must be set with the control system in a no-voltage state.

4.4.1 SM374 simulation module

This module can be operated as 16 x DO (output via LED), 16 x DI (input via switch) or as combined 8 x DI / 8 x DO. The last combination is used in this function description.

The function of the module is selected using a rotary switch behind the front cover between the series of switches.

As shown in the following diagram set the function switches to the setting ***8 x Output 8 x Input***.



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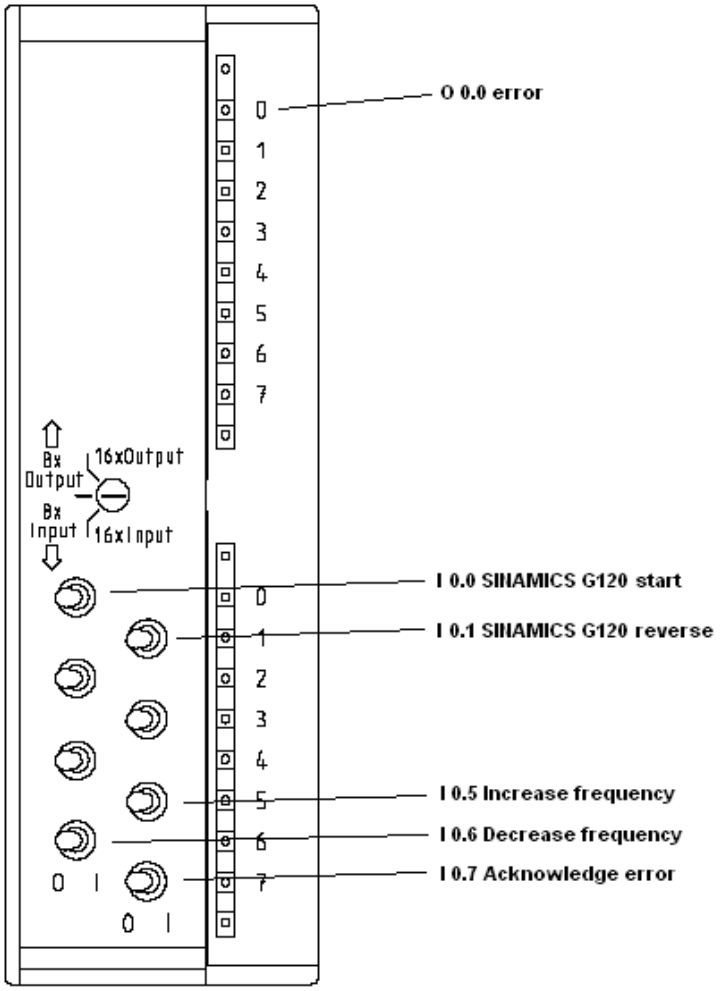
4.5 Overview of inputs and outputs

4.5.1 Simulation module SM374



Address	Function	Symbolic address	Default	Explanation
O 0.0	Indicator lamp error	error	0	faults are signaled via this output
I 0.0	SINAMICS G120 start	Start_G120	0	The motor connected to SINAMICS G120 is started by activating the input
I 0.1	SINAMICS G120 reverse	Reverse_G120	0	After the input is activated, a negative frequency setpoint is entered (direction of rotation reversal)
I 0.5	Increase frequency	Increase_frequency	0	The motor frequency can be increased using this input
I 0.6	Decrease frequency	Decrease_frequency	0	The motor frequency can be reduced using this input
I 0.7	Acknowledge error	ACK_error	0	Fault messages that are present can be acknowledged using this input.

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4.5.2 SINAMICS G120

The SINAMICS G120 is controlled and the feedback signals read-in via the I/O addresses listed below.

Address	Function
S7 program -> SINAMICS G120	
PQW256	Control word 1
PQW258	Frequency setpoint
PQW260	Torque setpoint
PQW262	Control word 2
PQW264	-- Reserve --
PQW266	-- Reserve --
SINAMICS G120 -> S7 program	
PIW256	Status word 1
PIW258	Frequency actual value
PIW260	Current actual value
PIW262	Status word 2
PIW264	Last fault number
PIW266	Last alarm number

For more detailed information about the configuration of the individual signals, please refer to ***SINAMICS G120 Operating Instructions Control Unit CU240S***, Chapter ***Commissioning***.

Download from:
http://support.automation.siemens.com/WW/view/en/22339653/133300

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5 Download

5.1 S7 program

To download the S7 program, you will require a connection between the MPI interface of your PG/PC and the MPI interface of the S7 CPU.

- Start the ***SIMATIC Manager***.
- De-archive the function example supplied.
- Open the ***G120_STD_APP2*** project.
- Select the ***MPI*** interface parameterization using ***Options > Select PG/PC interface…*** .
- Open ***HW-Config*** and download this into the control. After the download re-close ***HW-Config***.
- In SIMATIC Manager, select the block folder via ***CPU315-2 PN/DP*** > ***S7 Program*** > ***Blocks***.
- Download all of the S7 program blocks into the CPU

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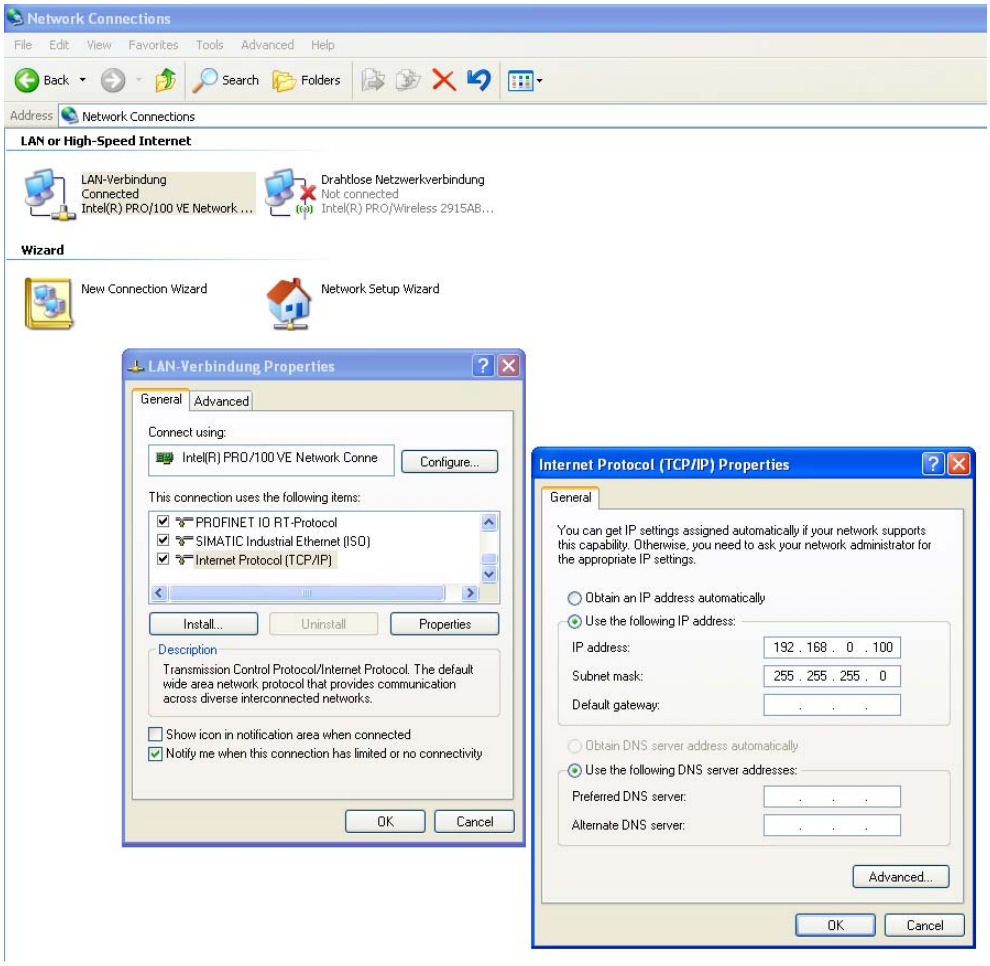
5.2 Setting the SINAMICS G120 IP adresse and device name

Different than for Profibus, for PROFINET, the node addresses are not set in the hardware, but in the software. To do this, a connection is required between the PG/PC and the PROFINET interface of the SINAMICS G120 via TCP/IP.

- To do this, connect the PROFINET cable from the SINAMICS G120, interface X01 P2 to the Ethernet interface (port) of your PG/PC (refer to Chapter 4.1).
- Set the IP address and the subnet mask of the Ethernet card of your PG/PC as follows.



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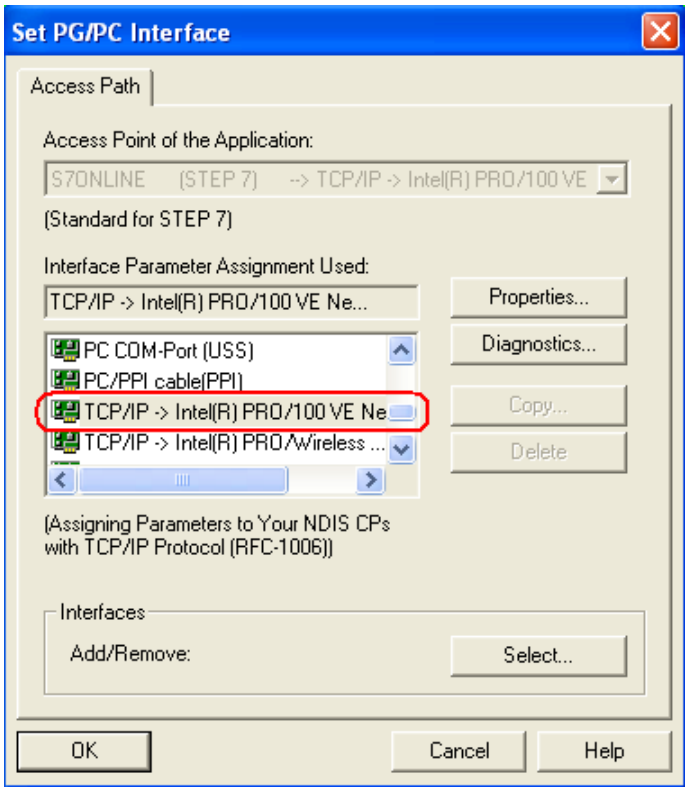
- Using ***Options > Set PG/PC Interface…*** select the TCP/IP interface parameterization. You can carry out all additional steps via this interface during the course of the function example.



- Then, using ***PLC > Edit Ethernet Node…***, open the dialog box ***Edit Ethernet Node***.

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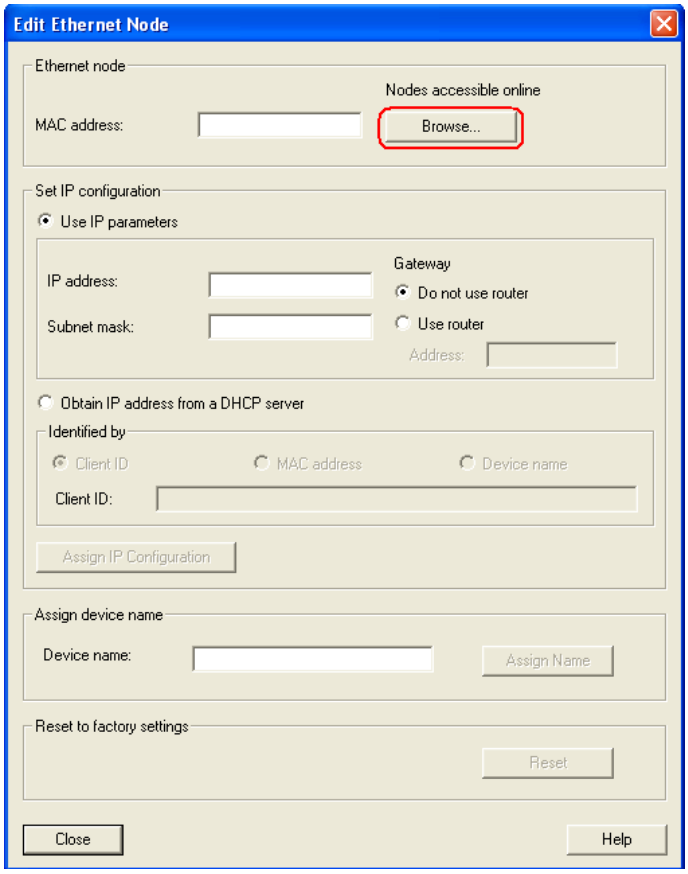
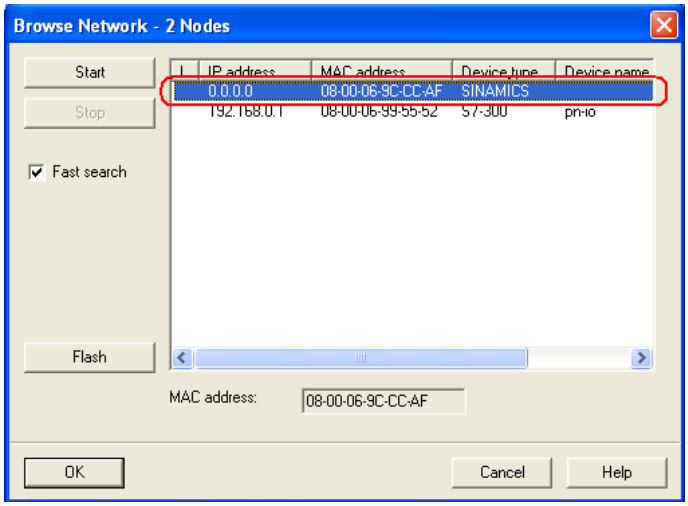
- Press the ***Browse…*** button



- In the dialog box that then opens, select the node with the SINAMICS device type and then press the ***OK*** button.



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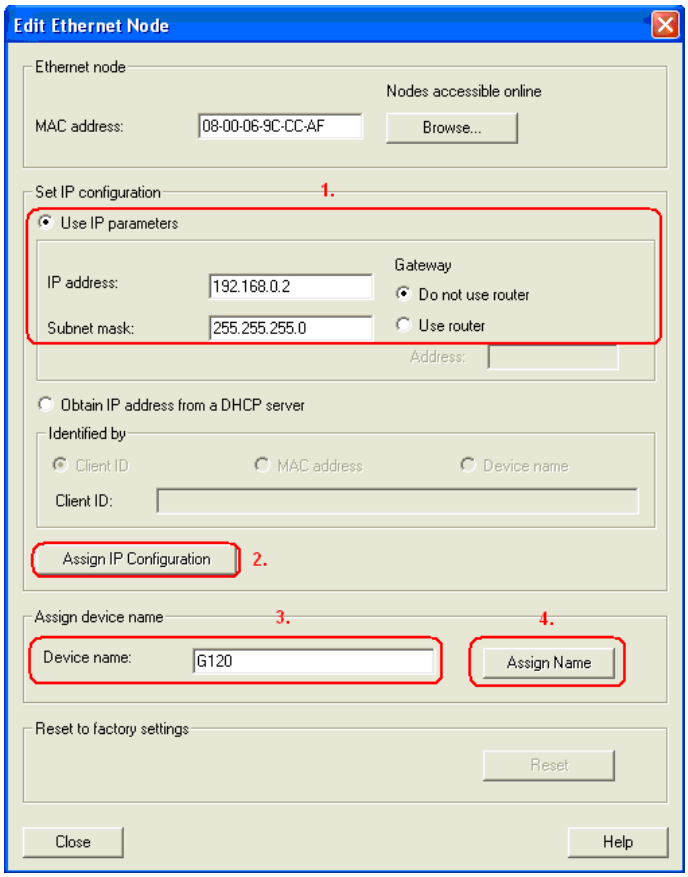
- **(1.)** Now, enter under ***IP-adresse: 192.168.0.2*** and under ***Subnetmask: 255.255.255.0***. **(2.)** Then press the ***Assign IP Configuration*** button.



- **(3.)** After completing the IP configuration assignment, enter the device name - assigned in HW Config - under ***Device name:*** (in this particular function example, ***G120***). **(4.)** This is then assigned to the SINAMICS G120 by pressing the ***Assign Name*** button.
- Close the mask by pressing the ***Close*** button.

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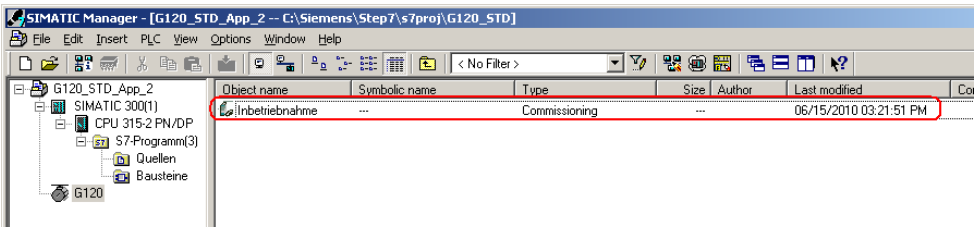
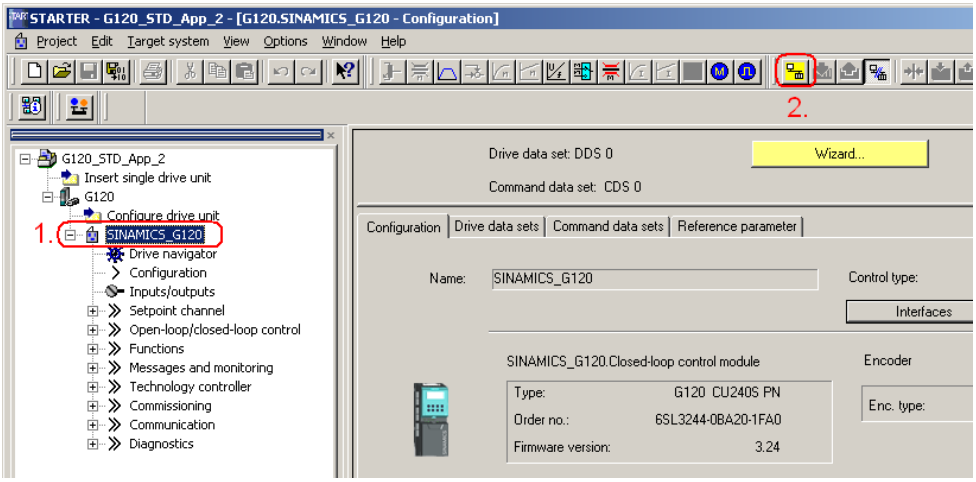
5.3 SINAMICS G120 configuration

When this has been completed, download the SINAMICS G120 configuration using the STARTER parameterizing tool.

- Starting from the main path of the SIMATIC Manager, start the STARTER parameterizing software by selecting the ***SINAMICS_G120*** icon and double click on the ***Inbetriebnahme*** icon.



- Then, in the Project Navigator of the STARTER parameterizing software select the object "***G120***" **(1.)** and press the button **(2.)** to establish the online connection to the drive inverter.



- After you have established the online connection, press the button to download the SINAMICS G120 drive parameters.
- Follow the instructions on the screen and acknowledge the prompt "***After loading, copy RAM to ROM***".

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5.4 Exiting the STARTER parameterizing software

- If you don't wish to set any additional parameters, then you can now exit the STARTER commissioning tool.
- In the tree select SINAMICS G120 and transfer all of the parameter changes into the ROM memory of the SINAMICS G120 by pressing the button
- Then transfer all of the parameters into your offline a project by pressing the button.
- Disconnect the PG / PC from SINAMICS G120 by pressing the button.
- Now you can close STARTER using ***Project > Close*** or by pressing the button.

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6 Key performance data of the SIMATIC CPU

Load memory and working memory

	Total
Load memory	Approx. 6 k
Working memory	Approx. 2 k

Cycle time

Total cycle time (typical)	Approx. 1ms

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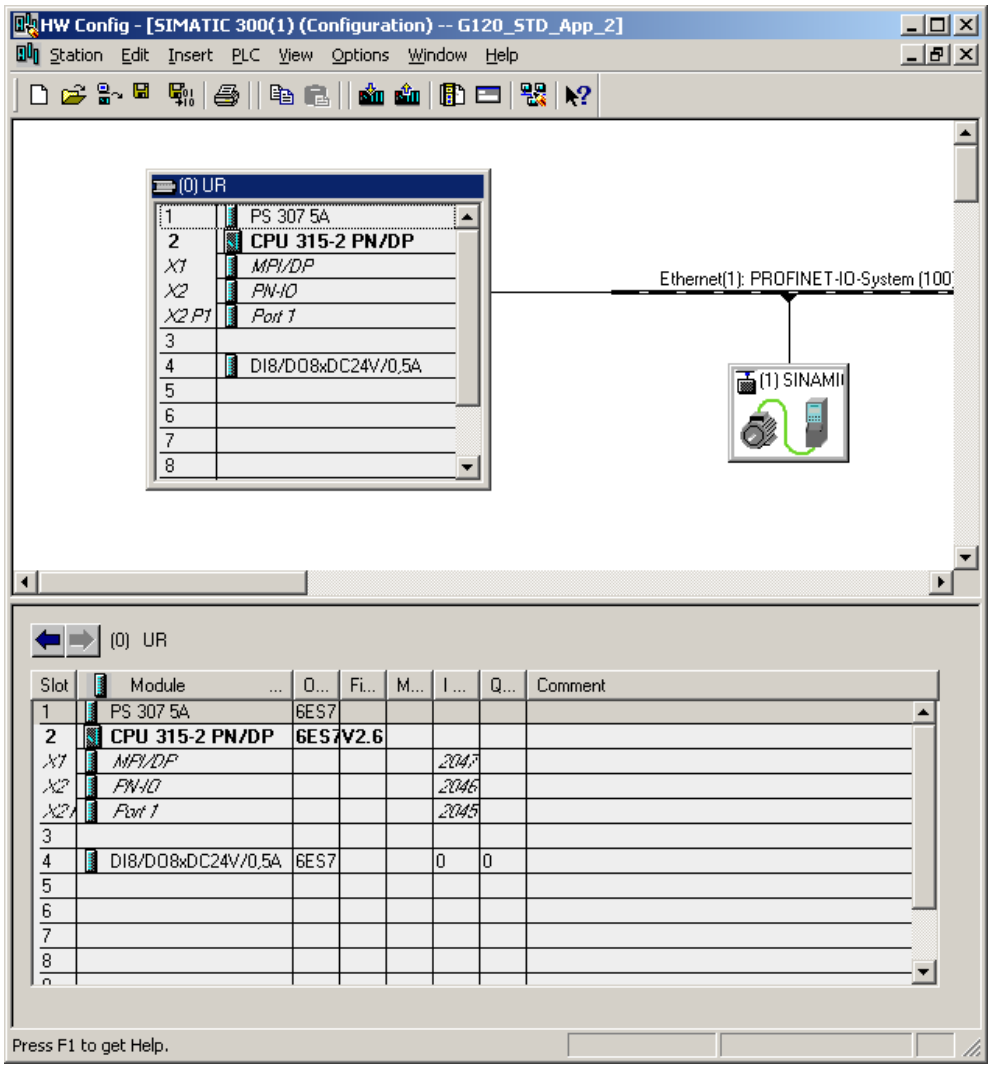
7 Background information

The individual functions of the example code are explained in the following Chapters so that you will then be in a position to implement your own project.

For this function example, the settings described <u>no</u> longer have to be made.

7.1 Settings in the hardware configuration



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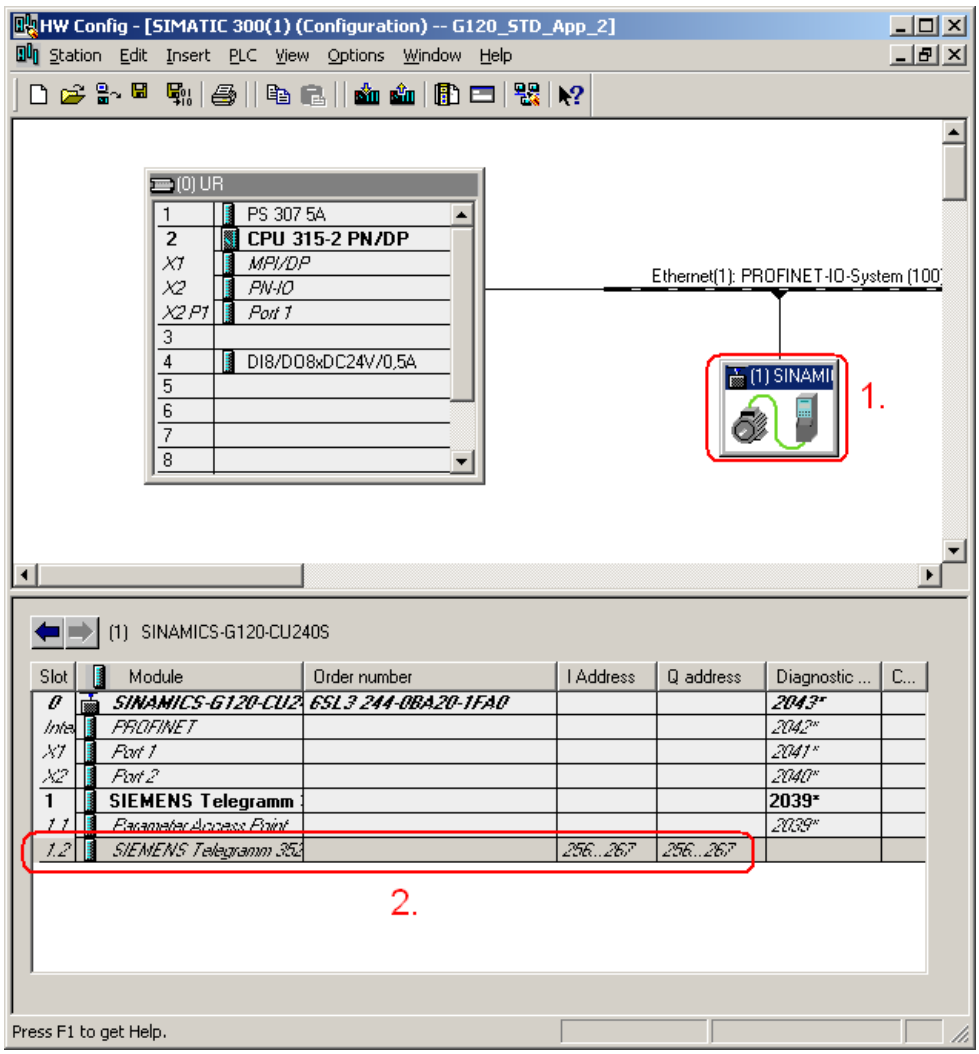
7.1.1 Properties of the SINAMICS G120

The window of the SINAMICS G120 PROFINET properties **(2.)** is displayed by clicking once on the SINAMICS G120 icon **(1.)**.



The PROFINET telegram **(2.)** between the CPU and the SINAMICS G120 is the ***Standard Telegram***, in this particular example, ***Standard Telegram 352*** for the communications of the SINAMICS G120 (control signals, status signals, frequency setpoint, frequency actual value etc.)

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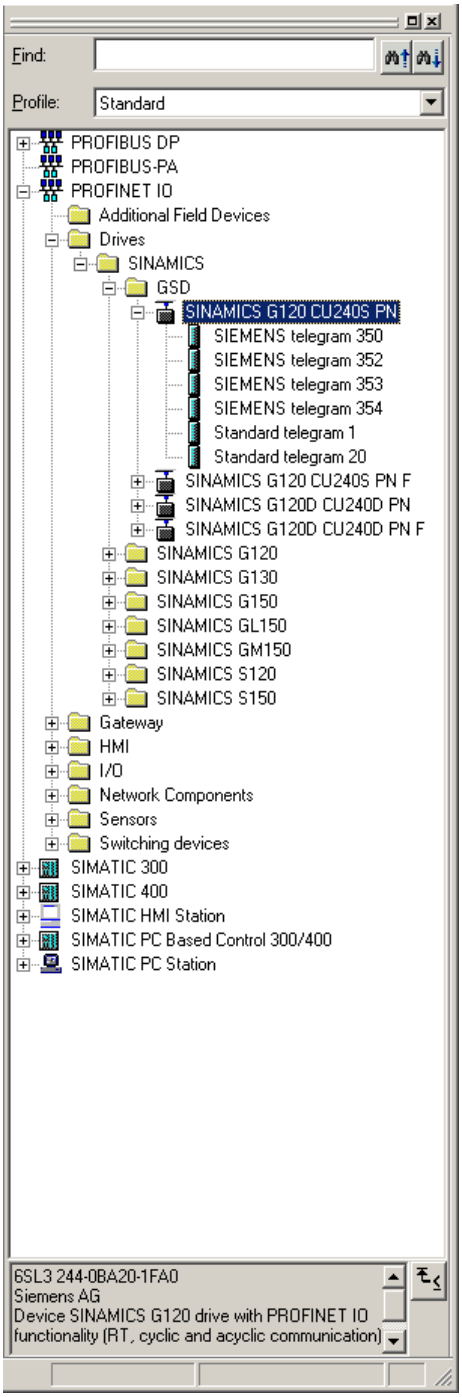
The telegram is selected in the Catalog after pressing the button.



You can download the GSDML files for the SINAMICS G120 under the following link: **http://support.automation.siemens.com/WW/view/en/26641490**

GSD files are required to operate a node (e.g. the SINAMICS G120) on PROFINET – and to register (log-on) the device to the engineering tool.

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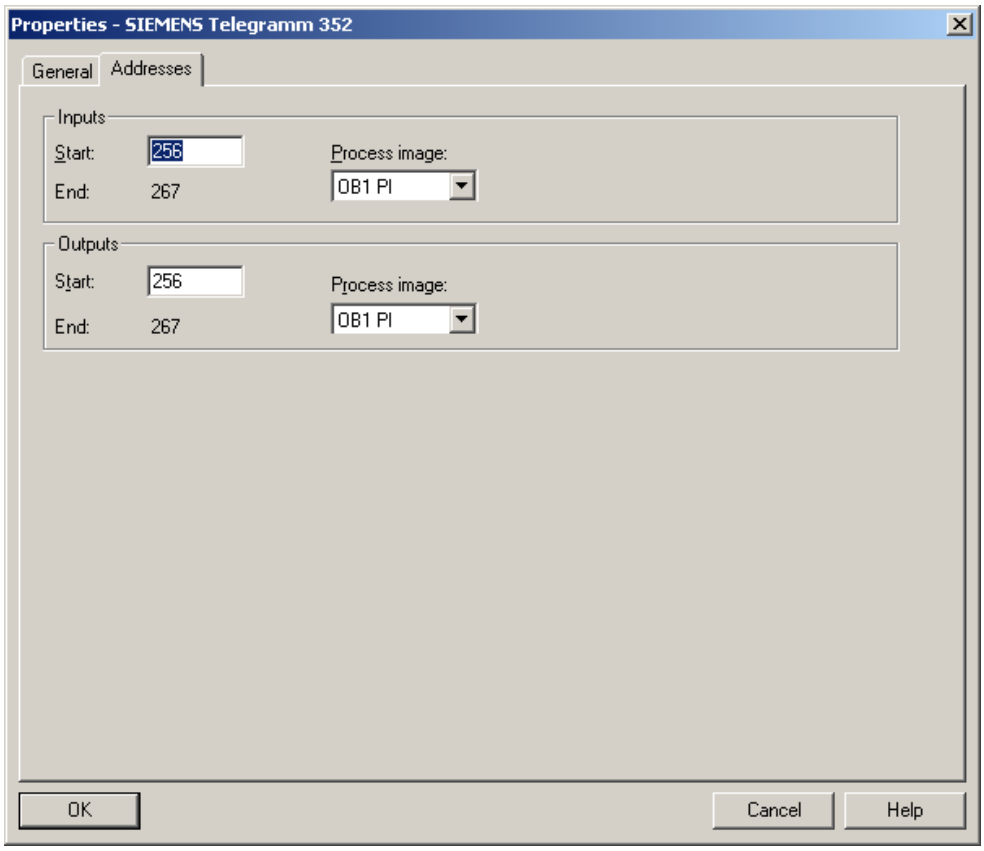
7.1.1.1 Standard Telegram



Various pre-assigned telegrams are available for this communication; these can be selected from the hardware catalog (refer to 6.1.3).

The **Standard Telegram 352** is used in this function example. It contains a length of 6 words sending (output) and receiving (input) – beginning from starting address **256**.

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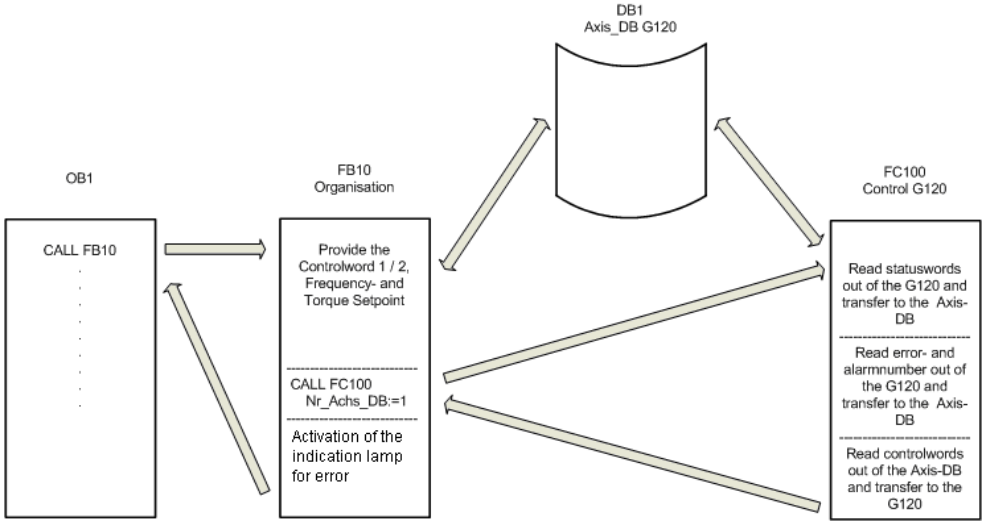
7.2 Functions of the Step 7 program

7.2.1 Program overview



The Step 7 program essentially comprises blocks FB10, FC100 and DB1 that are called in the cyclic program (OB1).

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7.2.2 DB1, Axis_DB

The Axis_DB represents the interface between the S7 program and the SINAMICS G120 via FC100.

Axis_DB is generated from ***UDT 1 (Axis_DB_G120)***

Principal structure of Axis_DB:

Address	Symbolic name	Type	Function
Internal data			
DBW0	Basic_Data.Moduleadress	INT	I/O start address of the SINAMICS G120 (refer to HW Config)
DBB3	Basic_Data.Drivetyp	Byte	Drive type, must be 2
S7 -> SINAMICS G120			
DBW4	Control_signals.STW2	Bool	Control word 2 (for details, refer to the S7 program)
DBW6	Control_signals.STW1	Bool	Control word 1 (for details, refer to the S7 program)
DBW8	Control_signals.Frequency_set	INT	Frequency setpoint in x.x %
DBW10	Control_signals.Torque_set	INT	Torque setpoint in x.x %
SINAMICS G120 -> S7			
DBW14	Status_signals.ZSW2	Bool	Status word 2 (for details, refer to the S7 program)
DBW16	Status_signals.ZSW1	Bool	Status word 1 (for details, refer to the S7 program)
DBW18	Status_signals.Actual_frequency	INT	Frequency actual value in x.x %
DBW20	Status_signals.Actual_current	INT	Current actual value (Value from SINAMICS G120)
DBW22	Status_signals.Actual_current_A	INT	Current actual value in x.xx A
Error messages			
DBW24	Faults.Drive_error_number	INT	Actual error number of the SINAMICS G120
DBW26	Faults.Drive_alarm_number	INT	Actual alarm number of the SINAMICS G120

In this function example the individual data of the DB1 are supplied in FB10.

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7.2.3 FB10, Organization

This block is called-up in absolute terms in OB1 and in turn calls up FC100.

Principle of the FB10

Network	Function
1	Calls the FB11 to generate the frequency setpoint
2	Controls the SINAMICS G120 via the axis-DB, DB1.
	Calls the SINAMICS G120 control block FC100.
	Provides the feedback signals – incl. error and alarm number
	This network can be used as template for additional SINAMICS G120 control functions.
3	Controls the signal lamp for fault.

7.2.4 FC100, Control of SINAMICS G120

SINAMICS G120 is controlled using the FC100 via PROFINET.

Only signals from the Axis_DB are used to control the block - but no fixed addresses - this is the reason that instances can be used.

This block can be used in the same way for both a standard and a Safety SINAMICS G120.

Formal operands of the FC100

Formal operands	Type	Description
Nr_Axis_DB	IN	Number of the Axis-DB generated using UDT1
Internal_Error	OUT	Displays an internal error 0 = no error 1 = incorrect Axis-DB type (wrong UDT)

Principle structure of the FC100

Network	Function
1	Opens the Axis_DB specified using the formal operands ***Nr_Axis_DB***.
	Generates the internal error message.
2	Reads-in the SINAMICS G120 status words, processes these and saves them in the Axis_DB.
3	Resets internal error messages.
4	Converts frequency and torque setpoint from the Axis_DB (entered in x.x %) into the SINAMICS G120 format (hex).
5	Enters SINAMICS G120 error and alarm number into the Axis_DB.
6	Sends control words from the Axis_DB to the SINAMICS G120

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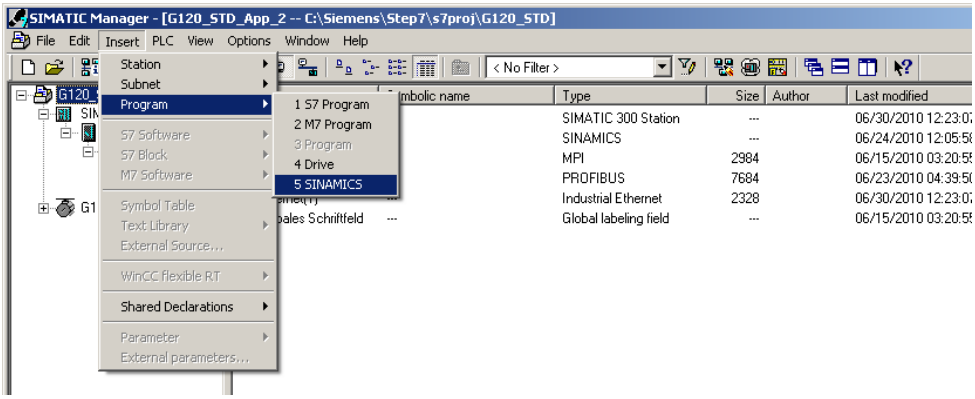
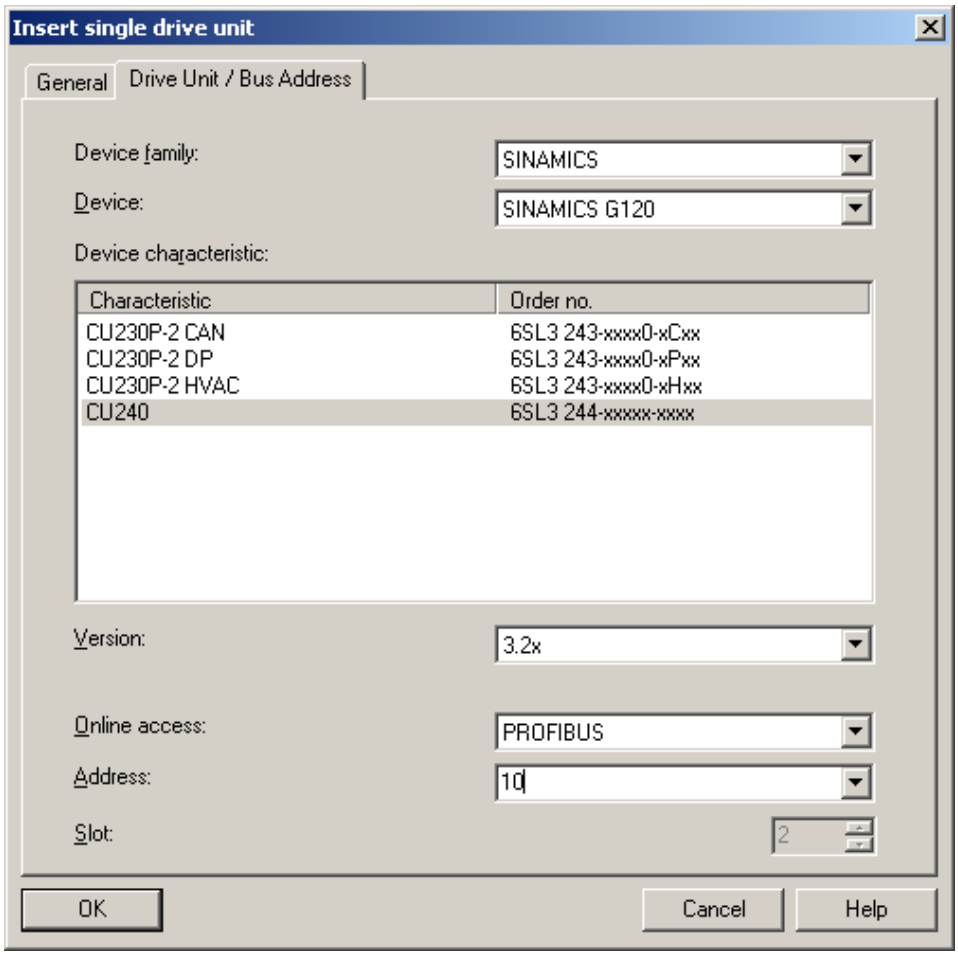
7.3 SINAMICS G120 parameterization

7.3.1 SIMATIC Manager - inserting SINAMICS G120 ,

- In SIMATIC Manager select the tree ***G120_STD_App2*** and using ***Insert > Program > SINAMICS*** select a ***SINAMICS G120*** type object.



- Make the following settings and press the ***OK*** button.



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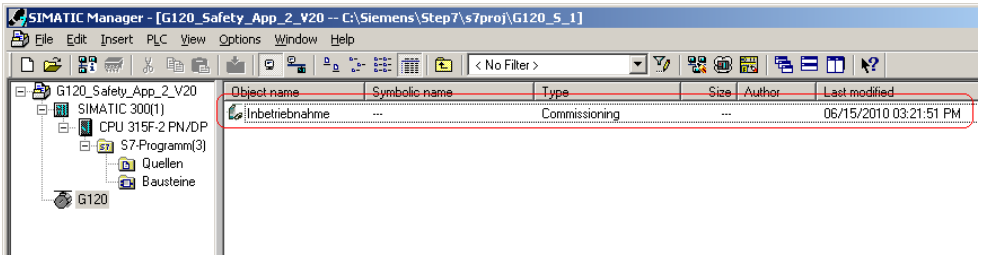
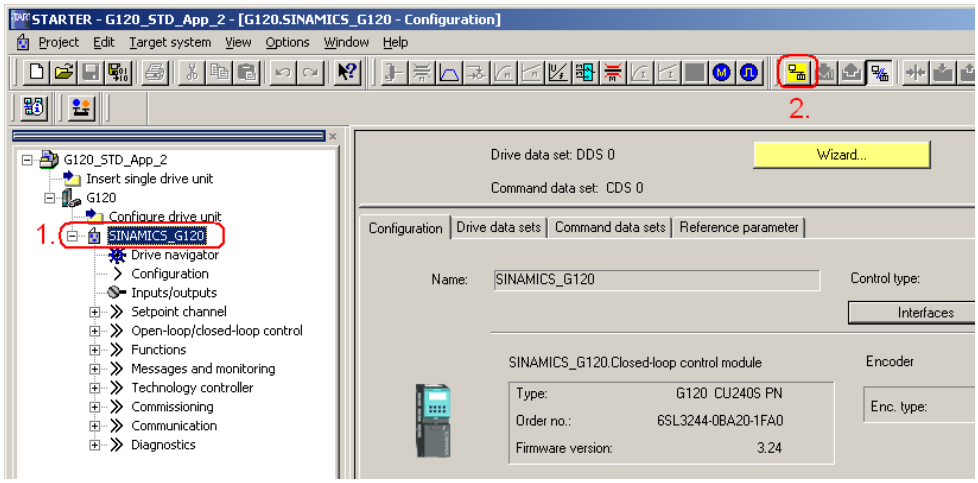
7.3.2 Calling the STARTER parameterization tool

- Starting from the main path of the SIMATIC Manager, start the STARTER parameterization software by selecting ***SINAMICS_G120*** and double click on ***Inbetriebnahme***.



- Then, in the Project Navigator of the STARTER parameterization software select the object ***G120*** **(1.)** and press button **(2.)** to establish an online connection to the drive inverter.



7.3.3 STARTER - carrying out quick commissioning

- The screen form with the actual configuration is opened by double clicking on ***Configuration*** in the Project Navigator.
- The quick commissioning Wizard is started after pressing the Wizard... button.
- Enter the appropriate values into the ***Control structure*** to ***Encoder*** screen forms. You can call-up corresponding help texts in the individual screen forms by pressing on the ***Help*** button.
- In the screen form ***Drive functions***, select for ***Motor identification***, the function ***Ident. of al param. in standstill incl. the saturation curve (3)***.
- Enter the corresponding parameters into the ***Important parameters*** screen form.
- In the screen form ***Calculation of the motor data***, select ***Restore factory setting and calculate motor data***.
- In the screen form ***Summary*** do <u>not</u> activate the function ***RAM -> ROM***, but instead press the ***Finish*** button.

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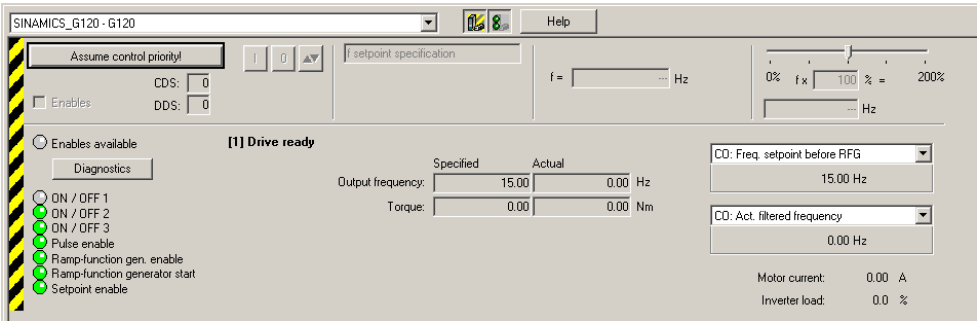
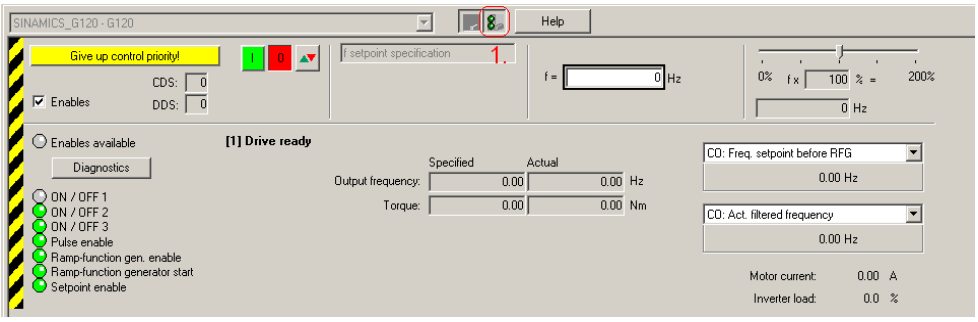
7.3.4 STARTER - carrying out a motor identification routine

- After completing the quick commissioning, alarm ***A0541*** (Motor data-identification active) is displayed. Please carefully note that when starting the motor identification routine current flows in the motor. For hanging (suspended) axes the load must always be supported.
- To start the motor data identification routine, in the Project Navigator select the menu item ***Commissioning*** and activate by double clicking on ***Control panel***.



- Press ***Assume control priority*** and carefully note the security/safety information and instructions. Then activate ***Enables***.



- **1.)** If the Control panel isn't completely displayed on your PG/PC, then press the button.
- The motor data identification routine is started by pressing the button. Do not exit the STARTER software and go to another task as otherwise the motor data identification routine will be interrupted for safety reasons.
- Please wait until the button changes back to the button.
- Return the control priority to the S7 control by pressing the Give up control priority! button.

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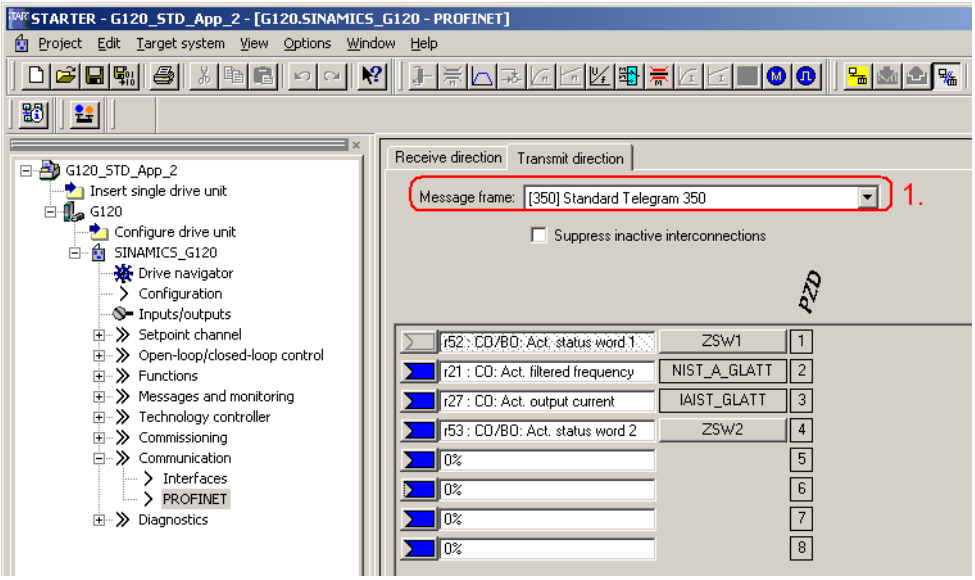
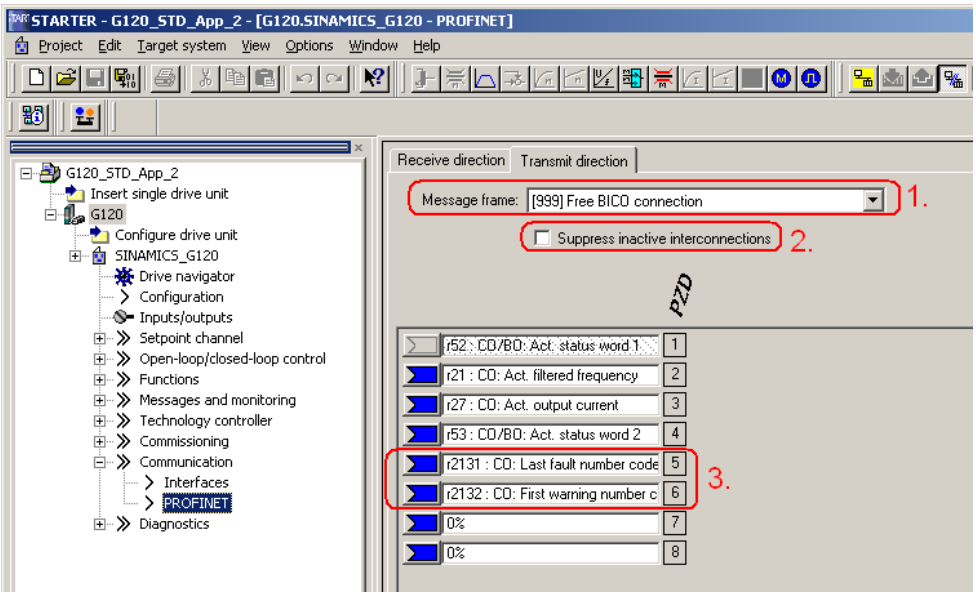
7.3.5 STARTER - setting the Profinet communications

- Communications between the CPU and the SINAMICS G120 must then be parameterized. To do this, open the screen for the communication settings using ***Communication*** -> ***Profinet***. Select the tab ***Transmit direction***.
- To start, select the ***Standard-Telegram 350 (350)*** from ***Message frame***: **(1.)**. This pre-assigns the telegram.



- Then replace telegram 350 by telegram type ***Free BICO connection (999)*** **(1.)**. Deactivate any possibly active ***Suppress inactive interconnections*** function **(2.)** and establish the following interconnections **(3.)**:
  - PZD 5 = r2131 (Last fault number code)
  - PZD 6 = r2132 (First warning number code)



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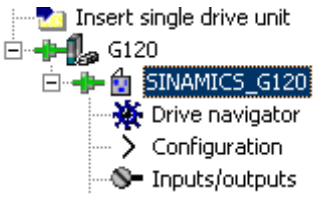
- Finally, you only have to save the SINAMICS G120 configured software in the ROM memory of the drive inverter. To do this in the Project Navigator select the menu item **SINAMICS_*G120***



- In the function bar press the button.
- Please wait until the download operation has been completed.

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8 Appendix

8.1 Internet link data

Subject area	Title
Link to safety items	http://support.automation.siemens.com/WW/view/en/20810941
SINAMICS G120 Documentation	http://support.automation.siemens.com/WW/view/en/22339653/133300
Siemens customer support homepage	Customer Support
SINAMICS G120 Homepage	http://www.automation.siemens.com/mcms/standard-drives/en/low-voltage-inverter/sinamics-g120/Pages/sinamics-g120.aspx

8.2 History

Version	Datum	Change
V1.0	July 2010	First edition

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