

# SINAMICS G120D with CU240D PN (FW3.2)

Control via PROFINET

Application • July 2010

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# Table of Contents

<b>Warranty and Liability .....</b>	<b>3</b>
<b>1 Automation function.....</b>	<b>5</b>
1.1 Description of the functionality .....	5
<b>2 Functionality of the function example.....</b>	<b>6</b>
2.1.1 Task description .....	6
2.1.2 Solution .....	6
2.2 Structure of the function example .....	6
<b>3 Components that are required .....</b>	<b>7</b>
3.1 Hardware components .....	7
3.2 Software components.....	7
<b>4 Configuration and wiring .....</b>	<b>8</b>
4.1 Overview of the hardware configuration.....	8
4.2 Connecting-up the hardware components .....	9
4.2.1 S7-300 control and CU240D PN-F .....	9
4.2.2 PM250D and motor .....	10
4.3 Fault 395 (acceptance test / acknowledgement present) .....	11
4.4 Important hardware component settings.....	11
4.4.1 SM374 simulation module .....	11
4.5 Overview of inputs and outputs.....	12
4.5.1 Simulation module SM374 .....	12
4.5.2 SINAMICS G120D.....	13
<b>5 Download.....</b>	<b>14</b>
5.1 S7 program.....	14
5.2 Setting the SINAMICS G120D IP address and device name .....	15
5.3 SINAMICS G120D configuration.....	19
5.4 Exiting the STARTER parameterizing software .....	20
<b>6 Key performance data of the SIMATIC CPU.....</b>	<b>21</b>
<b>7 Background information .....</b>	<b>22</b>
7.1 Settings in the hardware configuration.....	22
7.1.1 Properties of the SINAMICS G120D .....	23
7.2 Functions of the Step 7 program.....	26
7.2.1 Program overview .....	26
7.2.2 DB1, axis_DB .....	27
7.2.3 FB10, Organization .....	28
7.2.4 FC100, Control of SINAMICS G120D .....	28
7.3 SINAMICS G120D parameterization.....	29
7.3.1 SIMATIC Manager - inserting SINAMICS G120D ,.....	29
7.3.2 Calling the STARTER parameterization tool.....	30
7.3.3 STARTER - carrying out quick commissioning .....	30
7.3.4 STARTER - carrying out a motor identification routine .....	31
7.3.5 STARTER - setting the PROFINET communications .....	32
<b>8 Appendix .....</b>	<b>34</b>
8.1 Internet link data.....	34
8.2 History .....	34

# 1 Automation function

## 1.1 Description of the functionality

The SINAMICS G120D drive inverter is a modular inverter system with degree of protection IP65. It comprises the two function units Control Unit (CU) and Power Module (PM).

When using the Control Unit CU240D 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.

## 2 Functionality of the function example

### 2.1.1 Task description

The SINAMICS G120D is to be controlled from an S7-300 CPU via Profinet.

### 2.1.2 Solution

In this function example, the control of a SINAMICS G120D (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 G120D and the appropriate configuration in the SINAMICS G120D.

Further, the digital inputs of the SINAMICS G120D are cyclically read-in to the PLC. For instance, this function can be used in conveyor systems to read-in sensor signals into the PLC.

## 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.

## 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
<b>S7 control</b>				
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	6XV1870-8AH50	5m	
<b>Drive</b>				
SINAMICS G120D Control Unit	CU240D PN (FW3.2)	6SL3544-0FA20-1FA0	1	SIEMENS
SINAMICS G120D Power Module	PM250D 1,5kW	6SL3525-0PE21-5AA0	1	
Three-phase induction motor	Motor	1LA7080-4AA10	1	
Motor cable 1,5m	Motor cable	6ES7194-1LA01-0AA0	1	
Power cable 1,5m	Power cable	3RK1911-0DB13	1	
7/8" connector for 24V power supply	7/8" connector	6GK1905-0FB00	0,2	

\* Two PROFINET cables (M12 ↔ RJ45) are required for this function example. You can easily fabricate these yourself by halving the PROFINET cable 6XV1870-8AH50 and then attaching the two RJ45 connectors 6GK1901-1BB10-2AA0.

#### 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	<a href="http://support.automation.siemens.com/WW/view/en/26233208">http://support.automation.siemens.com/WW/view/en/26233208</a>	1	
GSDML-File CU240D PN	V3.2	<a href="http://support.automation.siemens.com/WW/view/en/26641490">http://support.automation.siemens.com/WW/view/en/26641490</a>	1	

## 4 Configuration and wiring

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

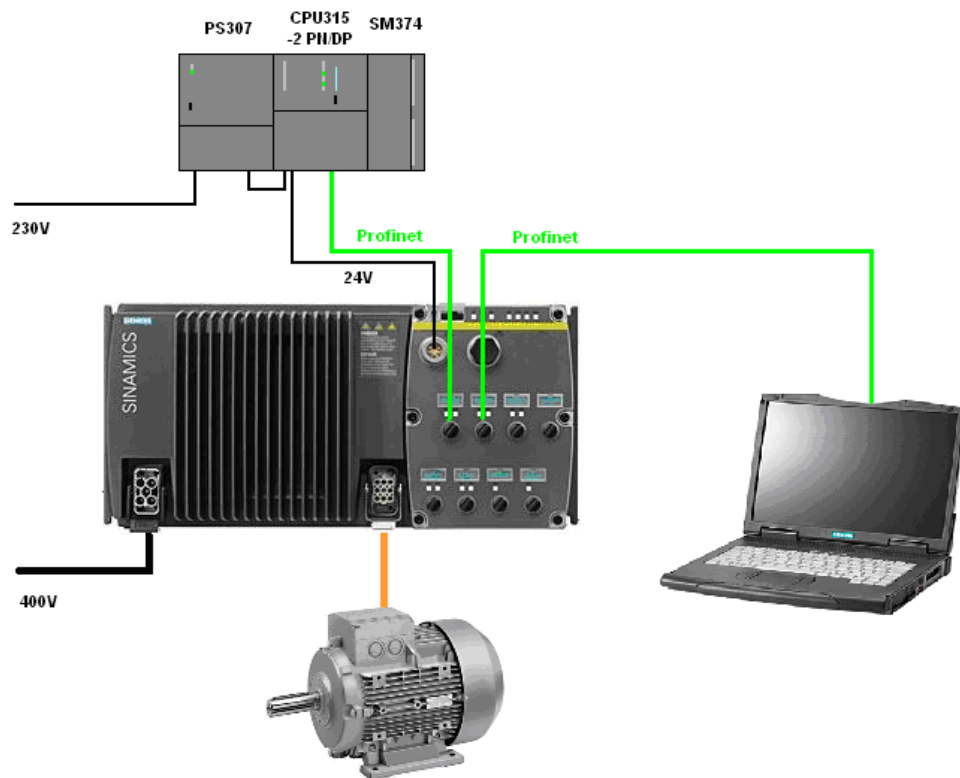
Please carefully observe the following safety information & instructions when using the SINAMICS G120D:



**Warning**

The SINAMICS G120D 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 G120D are not complied with this could result in death, severe bodily injury or significant material damage.

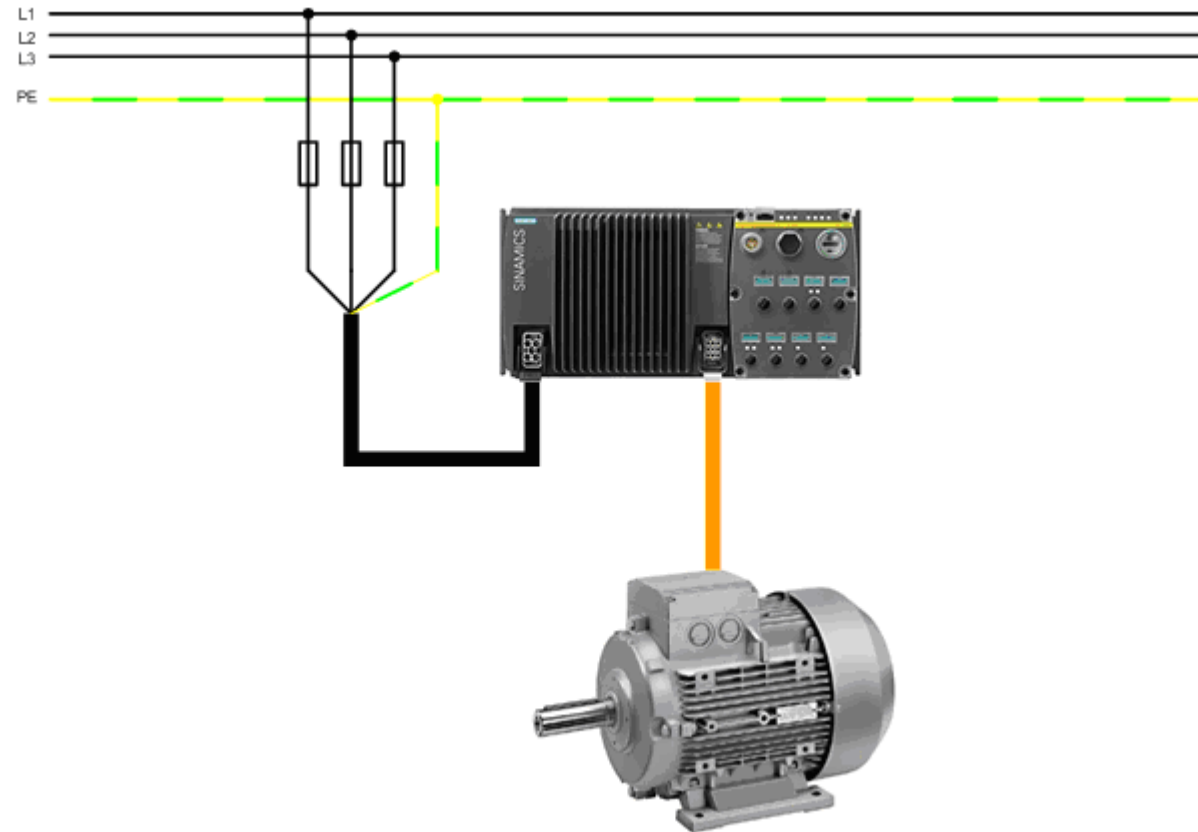
### 4.1 Overview of the hardware configuration







### 4.2.2 PM250D and motor



For more detailed information regarding the installation please refer to the **SINAMICS G120D Getting Started**. Download from: <http://support.automation.siemens.com/WW/view/en/25021636/133300>

### 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.

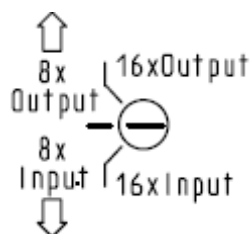
The modules/boards must be set with the control system in a no-voltage state.

#### 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.

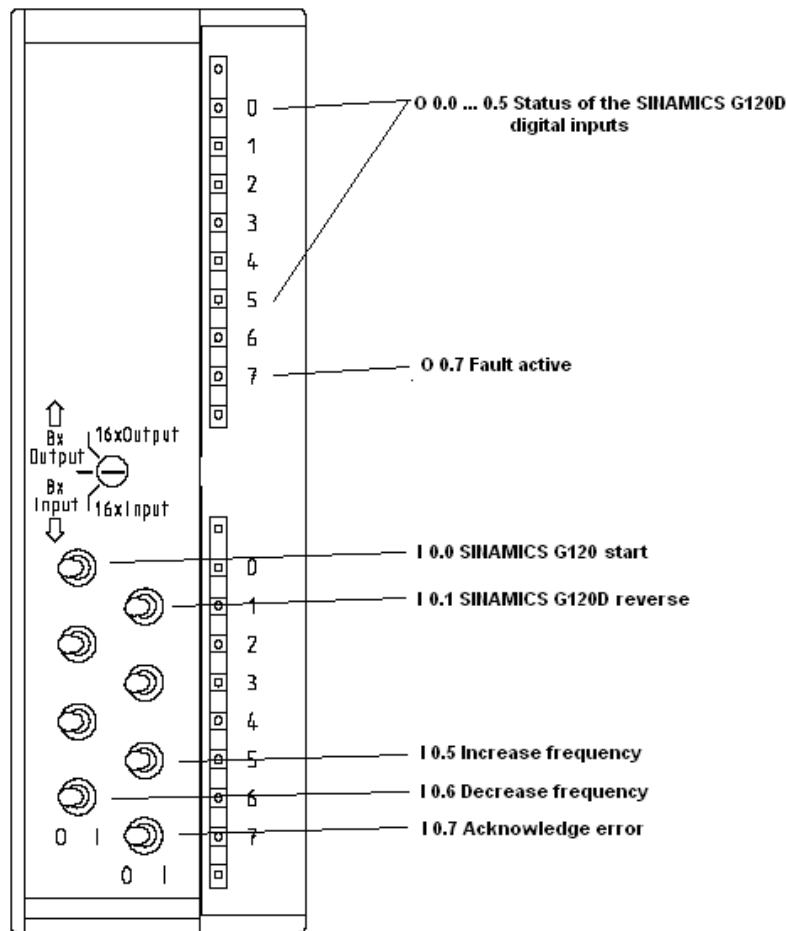
The function of the module is selected using a rotary switch behind the front cover between the series of switches.

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



## 4.5 Overview of inputs and outputs

### 4.5.1 Simulation module SM374



Address	Function	Symbolic address	Default	Explanation
O 0.0 ... O 0.5	Status G120D digital inputs DI0 ... DI5	Status_G120D_DI_0 ... Status_G120D_DI_5	0	The status of the G120D digital inputs DI0 to DI5 are output to the PLC via these outputs.
O 0.7	Indicator lamp Safety functions active or error	Safe_stop_or_error	0	Fault active is signaled via this output
I 0.0	SINAMICS G120D start	Start_G120D	0	The motor connected to SINAMICS G120D is started by activating the input
I 0.1	SINAMICS G120D reverse	Reverse_G120D	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.

#### 4.5.2 SINAMICS G120D

The SINAMICS G120D is controlled and the feedback signals read-in via the I/O addresses listed below.

Address	Function
<b>S7 program -&gt; SINAMICS G120D</b>	
PQW256	Control word 1
PQW258	Frequency setpoint
PQW260	Torque setpoint
PQW262	Control word 2
PQW264	-- Reserve --
PQW266	-- Reserve --
<b>SINAMICS G120D -&gt; S7 program</b>	
PIW256	Status word 1
PIW258	Frequency actual value
PIW260	Status of the SINAMICS G120D binary inputs
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 G120D CU240D Operating Instructions*** Chapter ***Commissioning, Commissioning with PROFINET***.

Download from:

<http://support.automation.siemens.com/WW/view/en/25021636/133300>

## 5 Download

### 5.1 S7 program

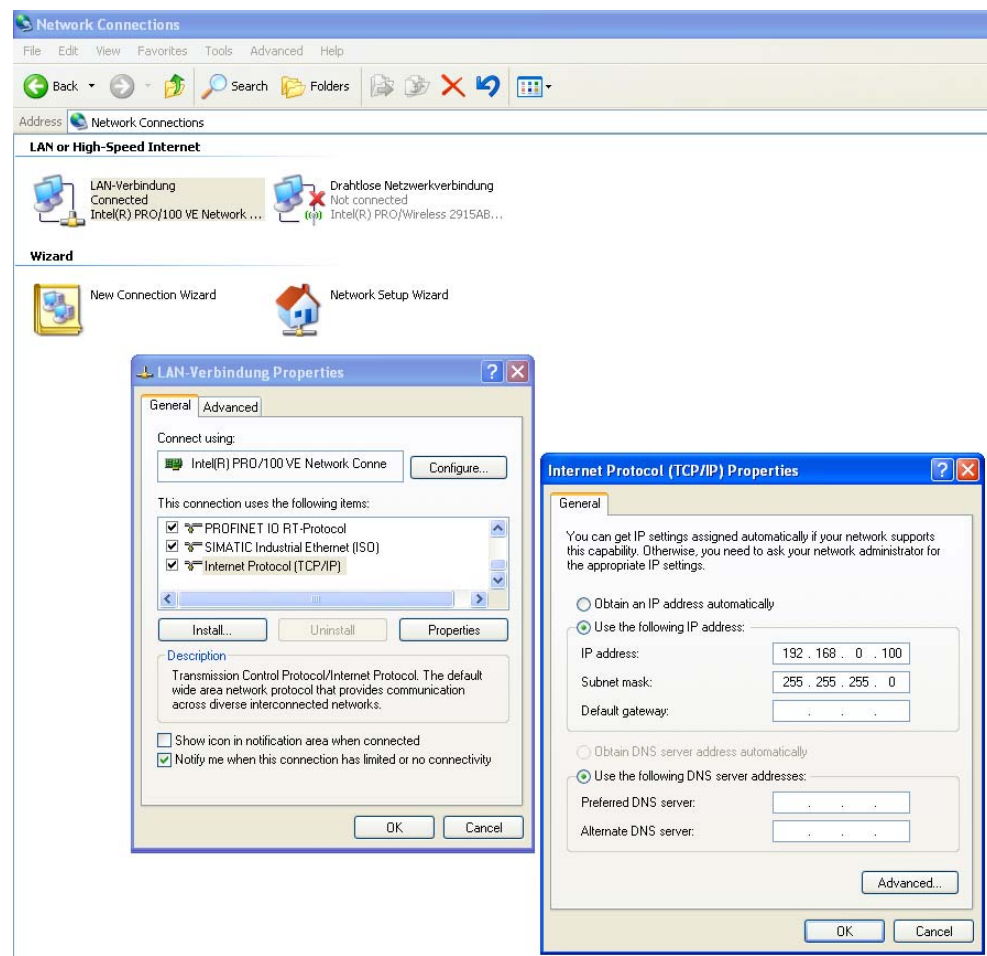
To download the S7 program, you will require a connection between the MPI interface of your PG/PC and the MPI interface of the S7 CPU.

- Start the **SIMATIC Manager**.
- De-archive the function example supplied.
- Open the **G120D\_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

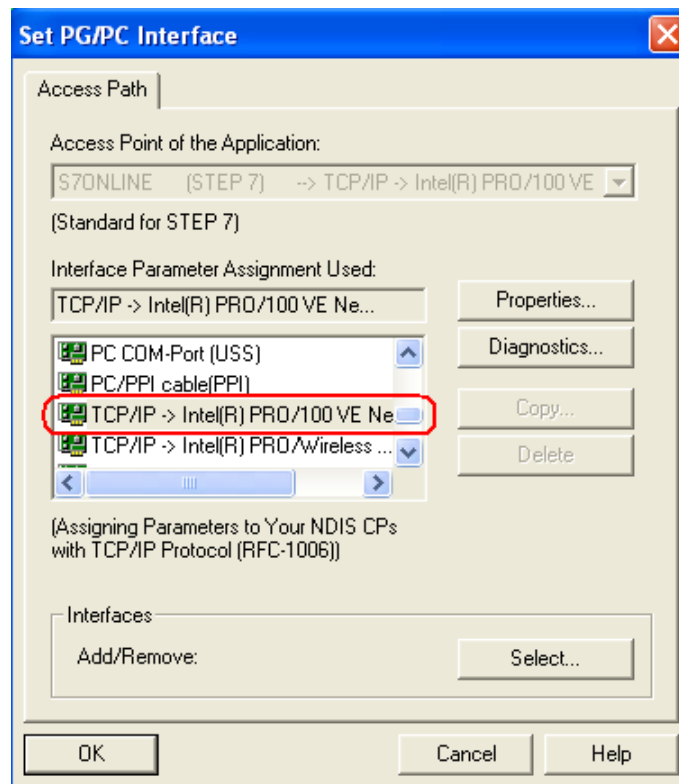
## 5.2 Setting the SINAMICS G120D IP address and device name

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 G120D via TCP/IP.

- To do this, connect the PROFINET cable from the SINAMICS G120D, interface X03 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.



- 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**.



- Press the **Browse...** button

**Edit Ethernet Node**

Ethernet node

MAC address:  **Browse...**

Nodes accessible online

Set IP configuration:

Use IP parameters

IP address:  Subnet mask:

Gateway

Do not use router

Use router

Address:

Obtain IP address from a DHCP server

Identified by:

Client ID  MAC address  Device name

Client ID:

Assign IP Configuration

Assign device name

Device name:  Assign Name

Reset to factory settings

Reset

Close Help

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

**Browse Network - 2 Nodes**

Start Stop

Fast search

IP address	MAC address	Device type	Device name
0.0.0.0	08-00-06-9C-CC-AF	SINAMICS	
192.168.0.1	08-00-06-99-55-52	S7-300	prio

Flash

MAC address:

OK Cancel Help

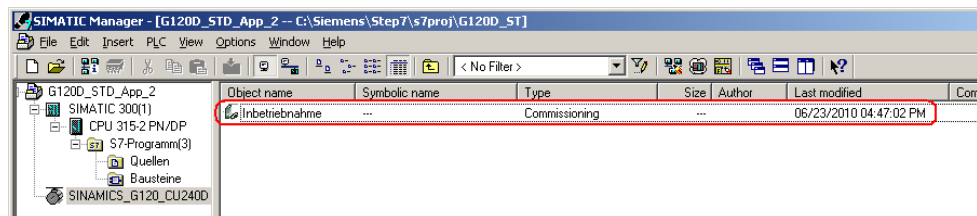
- **(1.)** Now, enter under **IP-adresse: 192.168.0.2** and under **Subnetmask: 255.255.255.0**. **(2.)** Then press the **Assign IP Configuration** button.


- **(3.)** After completing the IP configuration assignment, enter the device name - assigned in HW Config - under **Device name:** (in this particular function example, **g120d**). **(4.)** This is then assigned to the SINAMICS G120D by pressing the **Assign Name** button.
- Close the mask by pressing the **Close** button.

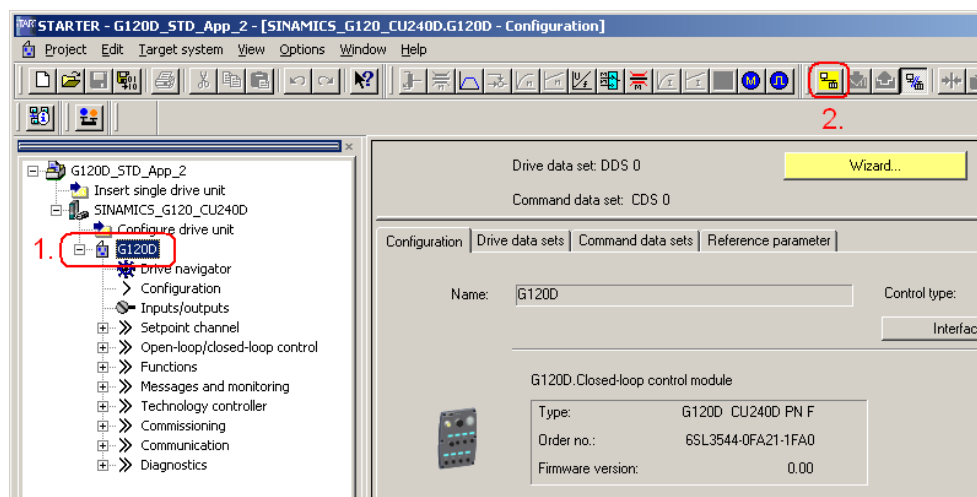
## 5.3 SINAMICS G120D configuration


When this has been completed, download the SINAMICS G120D configuration using the STARTER parameterizing tool.

- Starting from the main path of the SIMATIC Manager, start the STARTER parameterizing software by selecting the **SINAMICS\_G120D** icon and double click on the **Inbetriebnahme** icon.







- Then, in the Project Navigator of the STARTER parameterizing software select the object "**G120D**" (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 G120D drive parameters.
- Follow the instructions on the screen and acknowledge the prompt "**After loading, copy RAM to ROM**".

## 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 G120D and transfer all of the parameter changes into the ROM memory of the SINAMICS G120D 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 G120D by pressing the  button.
- Now you can close STARTER using **Project > Close** or by pressing the  button.

## 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
----------------------------	-------------

## 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 no longer have to be made.

### 7.1 Settings in the hardware configuration

The screenshot displays the HW Config software interface for a SIMATIC 300(1) configuration. The main window shows a hardware rack configuration for a rack labeled (0) UR. The rack contains the following modules:

- Slot 1: PS 307 5A
- Slot 2: CPU 315-2 PN/DP
- Slot X1: MPI/DP
- Slot X2: PN-IO
- Slot X2 P1: Port 1
- Slot 3: (Empty)
- Slot 4: DI8/DO8xDC24V/0.5A
- Slot 5: (Empty)
- Slot 6: (Empty)
- Slot 7: (Empty)
- Slot 8: (Empty)

The rack is connected to an Ethernet network labeled Ethernet(1): PROFINET-ID-System (100). A G120D motor is connected to this network.

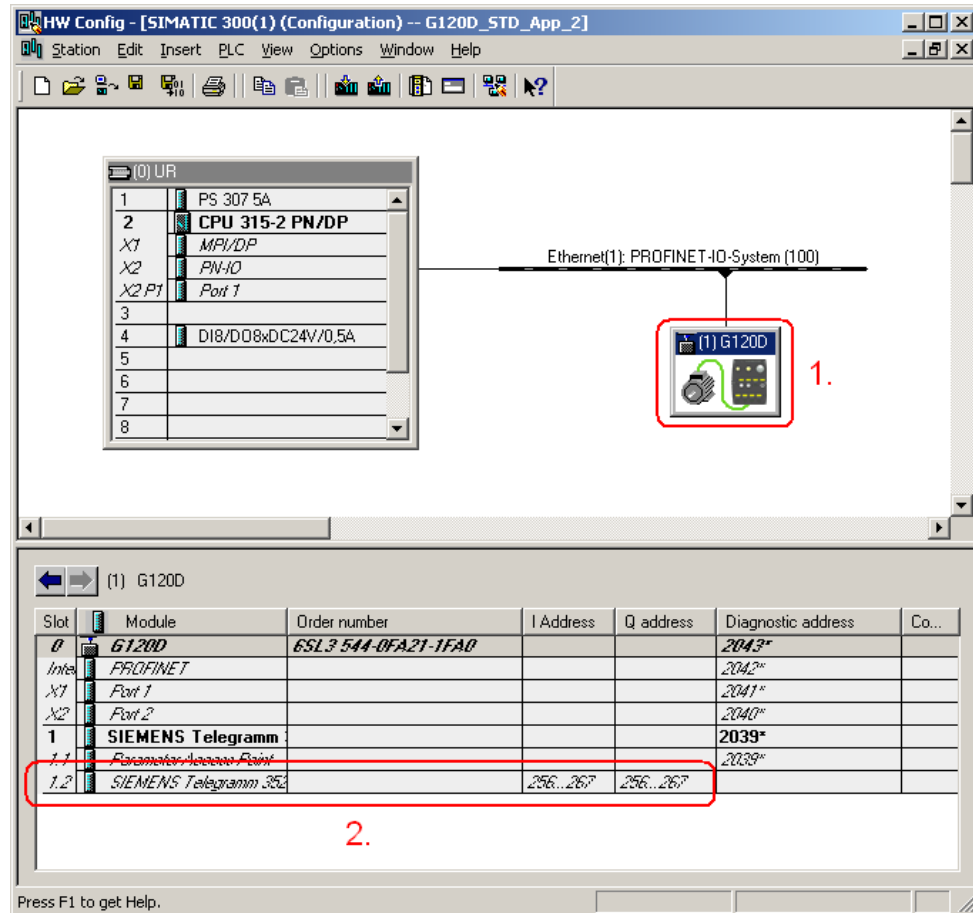
Below the rack configuration, a detailed table shows the hardware components:

Slot	Module	Order number	Fl...	M...	I...	Q...	Comment
1	PS 307 5A	6ES7 307-1EA00-0AA0					
2	CPU 315-2 PN/DP	6ES7 315-2EH13-0AB0	V2.6				
X1	MPI/DP				2047		
X2	PN-IO				2046		
X2 P1	Port 1				2045		
3							
4	DI8/DO8xDC24V/0.5A	6ES7 323-1BH01-0AA0			0	0	
5							
6							
7							
8							

Press F1 to get Help.

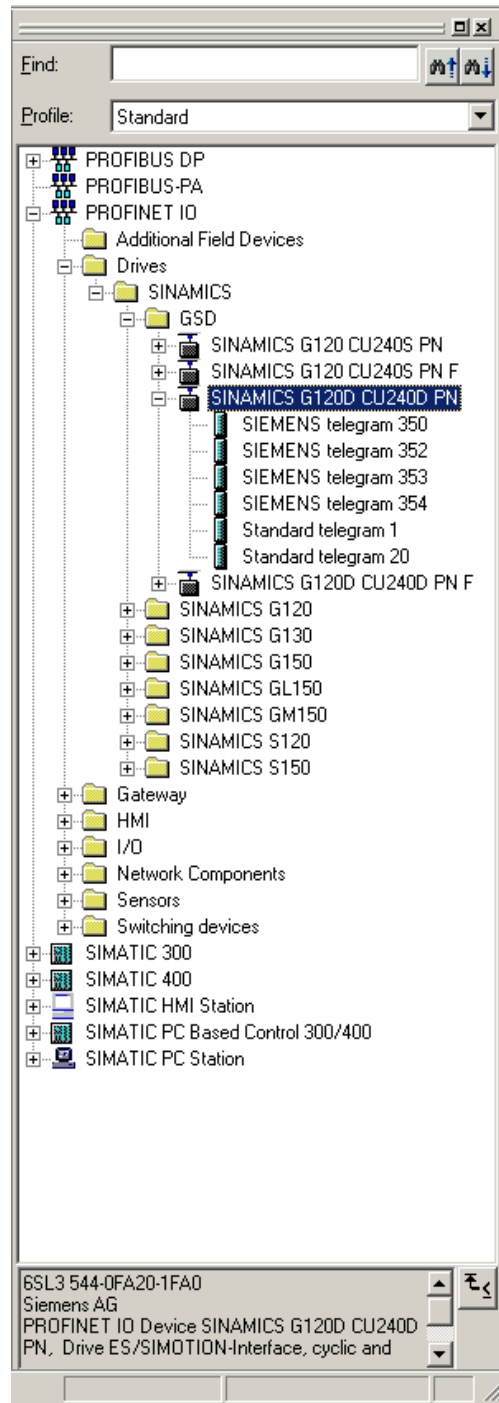
### 7.1.1 Properties of the SINAMICS G120D

The window of the SINAMICS G120D PROFINET properties (2.) is displayed by clicking once on the SINAMICS G120D icon (1.).



The PROFINET telegram (2.) between the CPU and the SINAMICS G120D 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.)

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

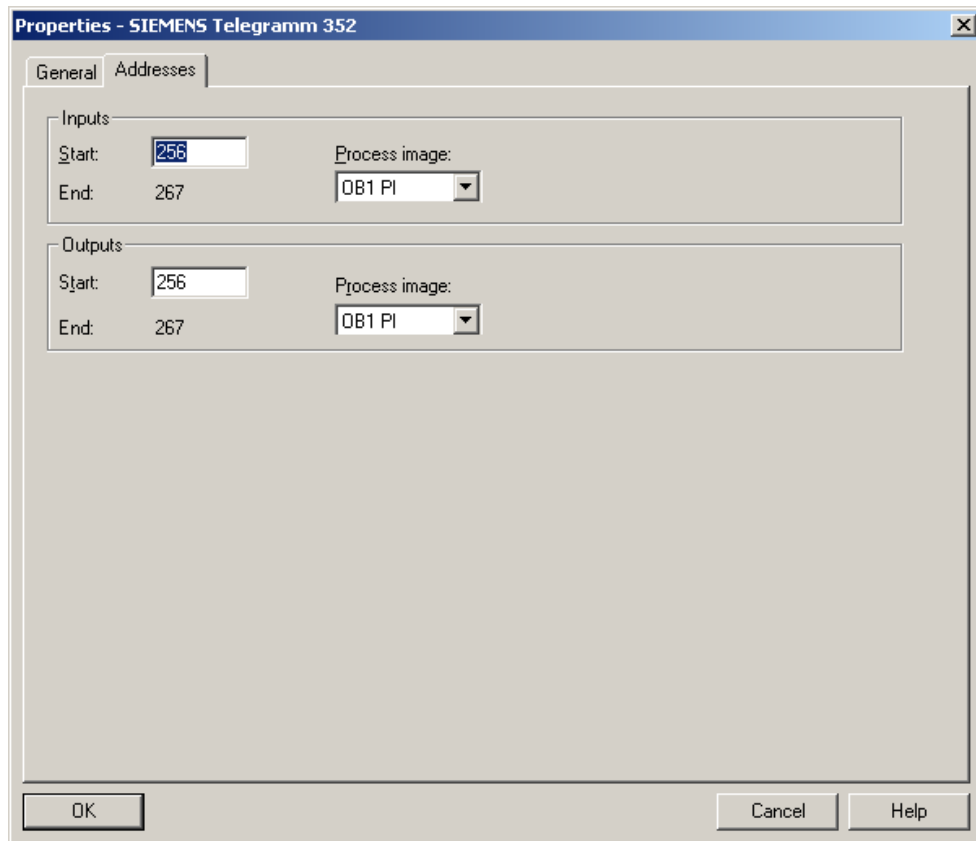


You can download the GSDML files for the SINAMICS G120D under the following link: <http://support.automation.siemens.com/WW/view/en/26641490>

GSD files are required to operate a node (e.g. the SINAMICS G120D) on PROFINET – and to register (log-on) the device to the engineering tool.



## 7.1.1.1 Standard Telegram

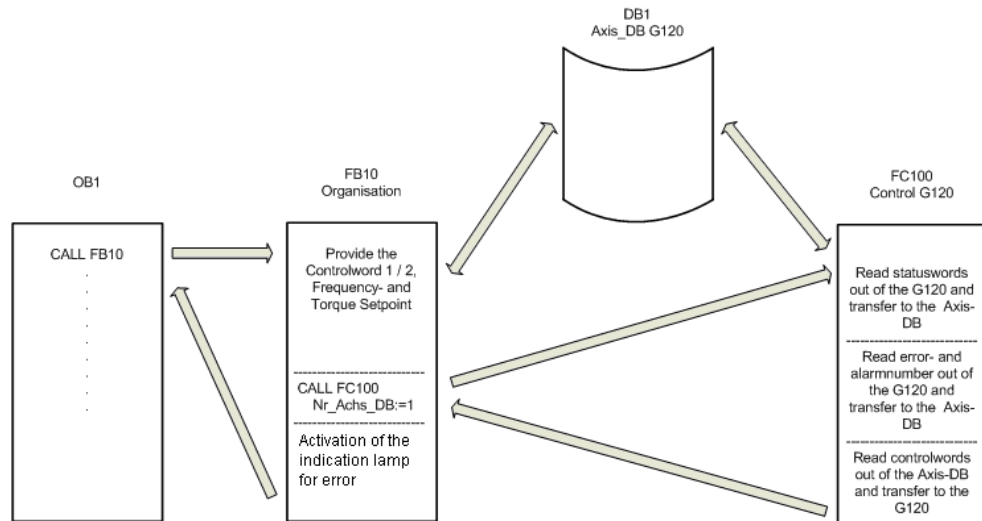


Various pre-assigned telegrams are available for this communication; these can be selected from the hardware catalog (refer to 6.1.3).

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**.

## 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).

## 7.2.2 DB1, axis\_DB

The axis\_DB represents the interface between the S7 program and the SINAMICS G120D via FC100.

Axis\_DB is generated from **UDT 2 (Axis\_DB\_G120D)**

Structure of axis\_DB:

Address	Symbolic name	Type	Function
<b>Internal data</b>			
DBW 0	Basic_Data.Moduleaddress	INT	I/O start address of the SINAMICS G120D (refer to HW Config)
DBB 3	Basic_Data.Drivetyp	Byte	Drive type, must be 3
<b>S7 -&gt; SINAMICS G120D</b>			
DBW 4	Control_signals.STW2	Bool	Control word 2 (for details, refer to the S7 program)
DBW 6	Control_signals.STW1	Bool	Control word 1 (for details, refer to the S7 program)
DBW 8	Control_signals.Frequency_set	INT	Frequency setpoint in x.x %
DBW 10	Control_signals.Torque_set	INT	Torque setpoint in x.x %
DBW 12	Reserve	Word	Reserve
<b>SINAMICS G120D -&gt; S7</b>			
DBW 14	Status_signals.ZSW2	Bool	Status word 2 (for details, refer to the S7 program)
DBW 16	Status_signals.ZSW1	Bool	Status word 1 (for details, refer to the S7 program)
DBW 18	Status_signals.Actual_frequency	INT	Frequency actual value in x.x %
DBW 20	Status_signals.binary_inputs	Bool	Status of the SINAMICS G120D binary inputs
DBW 22	Reserve	Word	Reserve
<b>Error messages</b>			
DBW 24	Faults.Drive_error_number	INT	Actual error number of the SINAMICS G120D
DBW 26	Faults.Drive_alarm_number	INT	Actual alarm number of the SINAMICS G120D

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

### 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 G120D via the axis-DB, DB1.
	Calls the SINAMICS G120D control block FC100.
	Provides the feedback signals – incl. error and alarm number
	This network can be used as template for additional SINAMICS G120D control functions.
3	Controls the signal lamp for fault.

### 7.2.4 FC100, Control of SINAMICS G120D

SINAMICS G120D 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 G120D.

Formal operands of the FC100

Formal operands	Type	Description
Nr_Axis_DB	IN	Number of the Axis-DB generated using UDT2
Internal_Error	OUT	Displays an internal error 0 = no error 1 = incorrect Axis-DB type (wrong UDT)

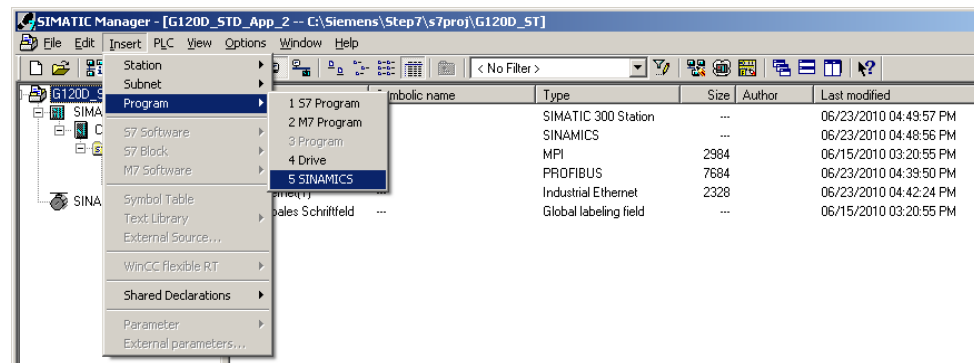
Principle structure of the FC100

Network	Function
1	Opens the Axis_DB specified using the formal operands <b>Nr_Axis_DB</b> .
	Generates the internal error message.
2	Reads-in the SINAMICS G120D 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 G120D format (hex).
5	Enters SINAMICS G120D error and alarm number into the Axis_DB.
6	Sends control words from the Axis_DB to the SINAMICS G120D

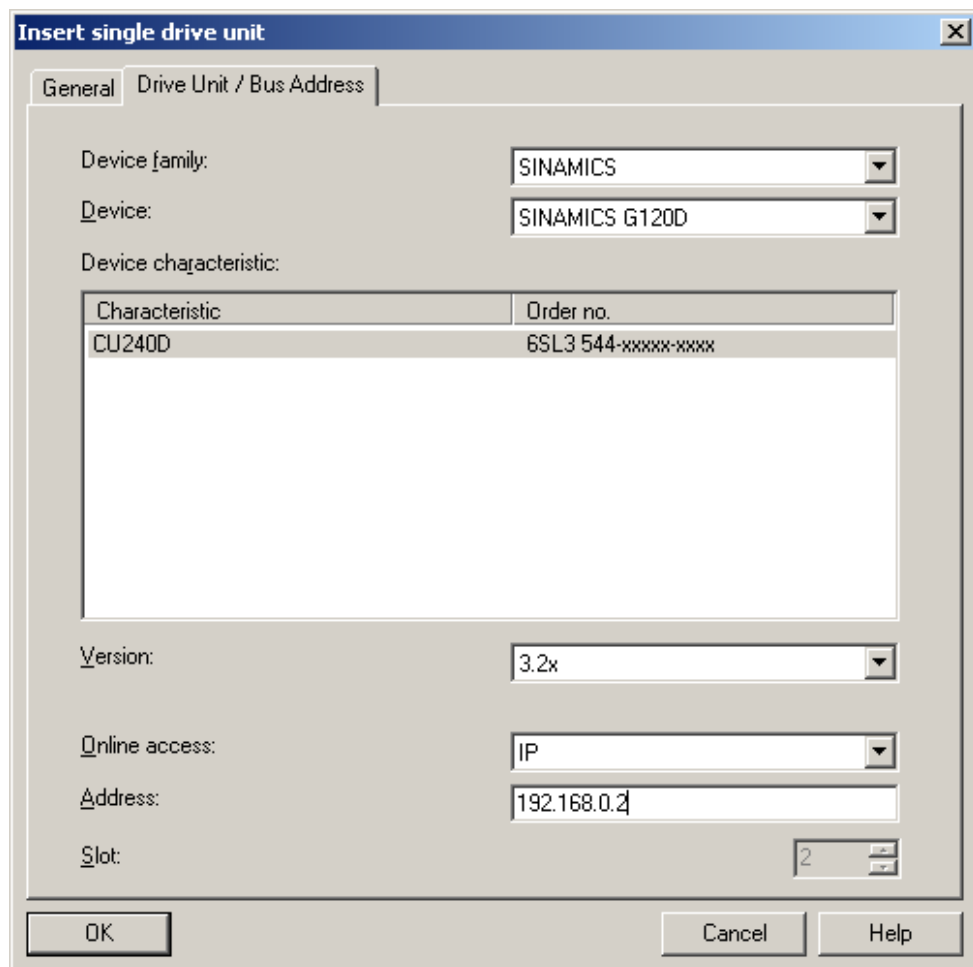
## 7.3 SINAMICS G120D parameterization

### 7.3.1 SIMATIC Manager - inserting SINAMICS G120D

- In SIMATIC Manager select the tree **G120D\_STD\_App\_2** and using **Insert > Program > SINAMICS** select a **SINAMICS G120D** type object.

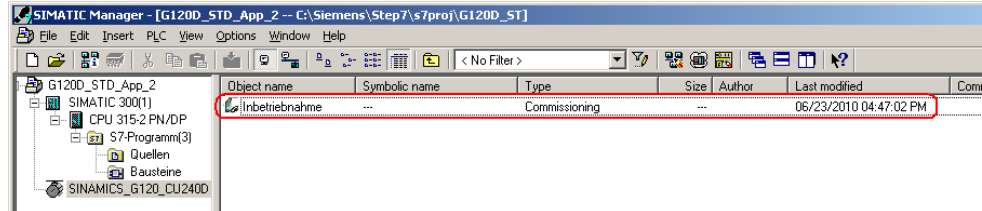


- Make the following settings and press the **OK** button.

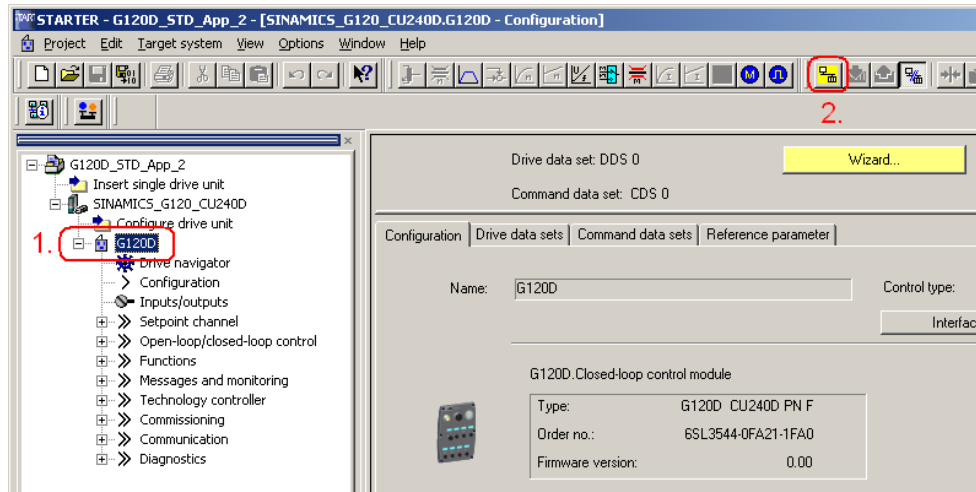


### 7.3.2 Calling the STARTER parameterization tool

- Starting from the main path of the SIMATIC Manager, start the STARTER parameterization software by selecting **SINAMICS\_G120\_CU240D** and double click on **Inbetriebnahme**.



- Then, in the Project Navigator of the STARTER parameterization software select the object **G120D (1.)** and press button **(2.)** to establish an online connection to the drive inverter.

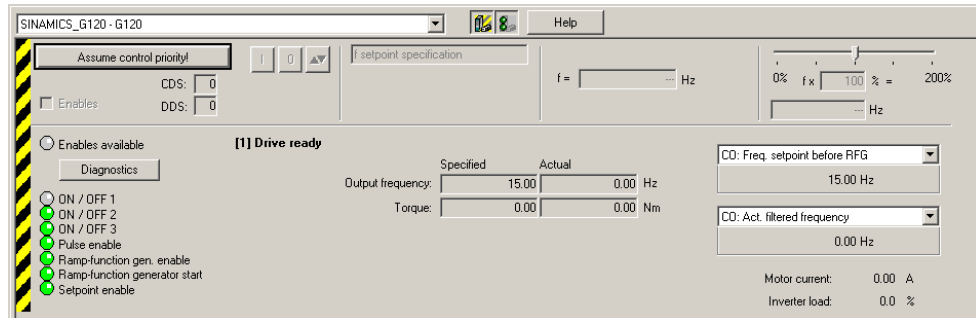


### 7.3.3 STARTER - carrying out quick commissioning

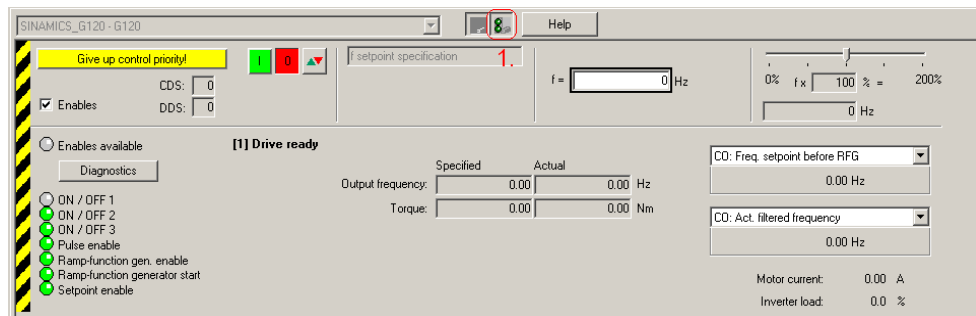
- The screen form with the actual configuration is opened by double clicking on **Configuration** in the Project Navigator.
- The quick commissioning Wizard is started after pressing the **Wizard...** button.
- Enter the appropriate values into the **Control structure to Encoder** screen forms. You can 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 all 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 not activate the function **RAM -> ROM**, but instead press the **Finish** button.






### 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**.



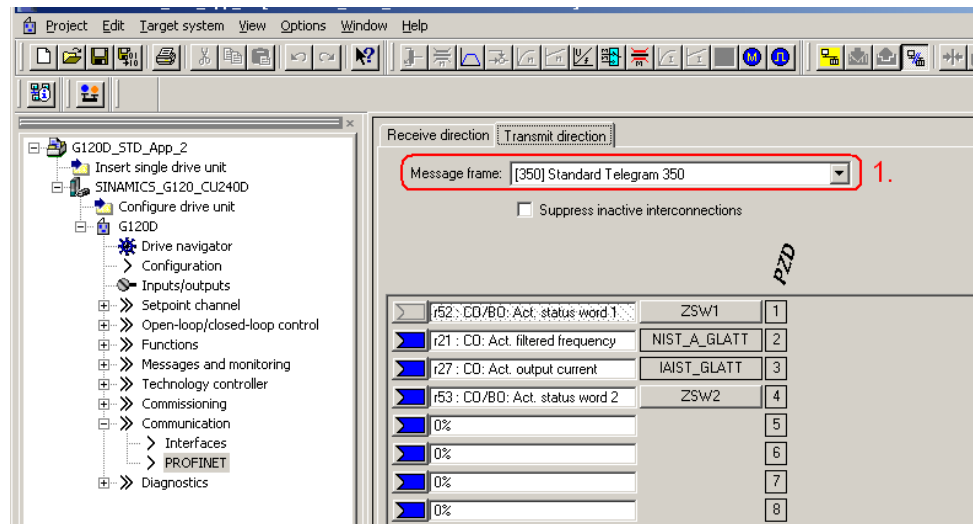
- Press **Assume control priority** and carefully note the security/safety information and instructions. Then activate **Enables**.



- **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  button.

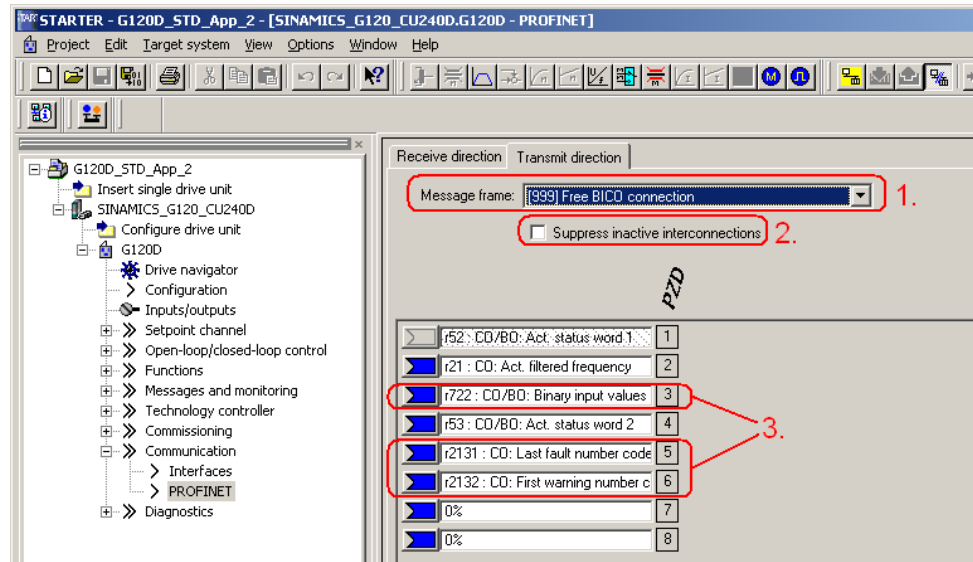
### 7.3.5 STARTER - setting the PROFINET communications

- Communications between the CPU and the SINAMICS G120D 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.

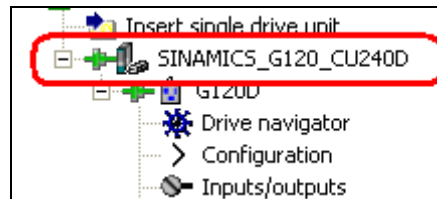





- Then replace telegram 350 by telegram type **(999) Free BICO connection (1.)**. Deactivate any possibly active **Suppress inactive interconnections** function **(2.)** and establish the following interconnections **(3.)**:
  - PZD 3 = r722 (Binary input values = Status of the digital inputs)
  - PZD 5 = r2131 (Last fault number code)
  - PZD 6 = r2132 (First warning number code)



- Finally, you only have to save the SINAMICS G120D configured software in the ROM memory of the drive inverter. To do this in the Project Navigator select the menu item **SINAMICS\_G120\_CU240D**



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

## 8 Appendix

### 8.1 Internet link data

Subject area	Title
SIEMENS Customer Support Homepage	<a href="http://support.automation.siemens.com">http://support.automation.siemens.com</a>
Safety function examples	<a href="http://support.automation.siemens.com/WW/view/en/20810941">http://support.automation.siemens.com/WW/view/en/20810941</a>
SINAMICS G120D documentation	<a href="http://support.automation.siemens.com/WW/view/en/25021636/133300">http://support.automation.siemens.com/WW/view/en/25021636/133300</a>
SINAMICS G120D Homepage	<a href="http://www.automation.siemens.com/mcms/standard-drives/en/low-voltage-inverter/sinamics-g120d/Pages/sinamics-g120d.aspx">http://www.automation.siemens.com/mcms/standard-drives/en/low-voltage-inverter/sinamics-g120d/Pages/sinamics-g120d.aspx</a>

### 8.2 History

Version	Datum	Change
V1.0	July 2010	First edition