SINAMICS G120X Speed Control via SIMATIC in TIA Portal

SINAMICS G120X

https://support.industry.siemens.com/cs/ww/en/view/109772227

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Table of contents

1 Introduction

1.1 Overview

The SIMATIC S7-1200/1500 can be operated as a PROFINET-Controller. Hereby the SINAMICS G120X (PROFINET version) can be controlled by the SIMATIC as PROFINET-Device. This example shows how to do speed control with the drive controlled by the PLC.

The SINAMICS itself therefore will be commissioned via its IOP-2 (Intelligent Operator Panel) or via the SAM (Smart Access Module). The SIMATIC as well as the communication configuration between PLC and drive will be handled in TIA Portal.

1.2 Components used

This application example has been created with the following hardware and software components:

Table 1-1

Component	Number	Article number	Note
SIMATIC S7-1215C DC/DC/DC (FW 4.2.1)	1	6ES7 215-1AG40-0XB0	Other types of SIMATIC S7-1200 or S7-1500 PLCs can be used!
SINAMICS G120X FSA (FW1.0.1) with IOP-2	1	6SL32.0-3YE10-0.F0	Other types of SINAMICS G120X with PROFINET interface can be used!
Smart Access Module (optional use)	1	6SL3255-0AA00-5AA0	Use of SAM is optional. IOP-2 can be used for commissioning of G120X as well.
SIMATIC STEP7 Professional – WinCC Advanced V15.1 Upd 2	1	6ES7822-1..05-..	Other versions of TIA Portal (lower or higher) can be used to do the configuration as described. **NOTE:** Opening the example project is only possible with V15.1 or higher.
SINAMICS G120X GSDML file	1	-	The GSDML file is used for the communication configuration between PLC and drive in TIA Portal. The file can be downloaded under the following link: https://support.industry.siemens.com/cs/ww/en/view/109763250

1.3 Information within this documentation

The document is divided into the following chapters. Here you find a short explanation of which information you will find in the different chapters.

- Chapter 2: Engineering – this chapter describes the solution of the example in general.
- Chapter 3: Operation principle – this chapter describes the solution in detail. You can find detailed information about the user program, the communication principle and the usage of the function block SINA_SPEED.
- Chapter 4: Commissioning instruction – this chapter gives the step-by-step instruction how to set up your own system (drive and PLC) to reach the same state as the example project. Additionally, you will find the information how to use other telegrams than standard telegram 1.
- Chapter 5: Using the example project – this chapter explains how to use the example project in TIA Portal and how to adapt it to your hardware (different PLC / drive used compared to the one in the example project).

2 Engineering

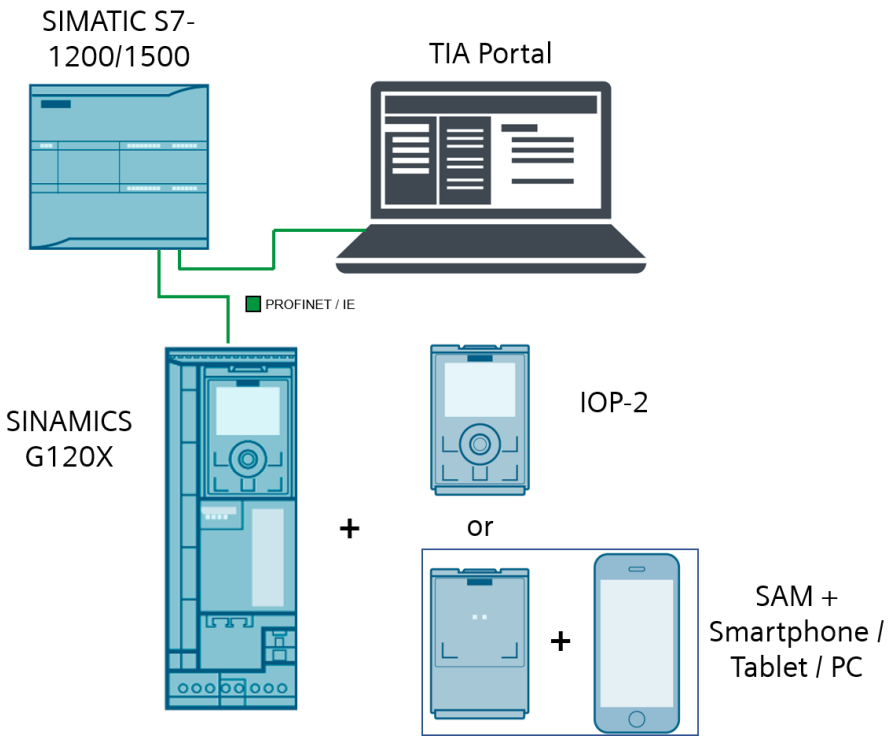
The application example shows the PROFINET connection of a SINAMICS G120X at a SIMATIC S7-1200 PLC via GSDML file. For the speed-controlled operation of the drive via SIMATIC the function block “SINA_SPEED” is used. This function block can be taken from the library “DriveLib”, which can be opened in TIA Portal.

2.1 General hardware setup

Scheme

The following figure shows the necessary components of this solution as a scheme:

Figure 2-1



2.2 General operation description

The SINAMICS drive will be set up in a way that it receives its control commands and speed setpoint via its fieldbus interface (PROFINET). The setup for the drive can be done via the IOP-2 or Smart Access Module. It is not possible to commission the drive via TIA Portal! The GSDML file of the drive is the PROFINET description file and will only be used for the communication configuration in TIA Portal.

The SIMATIC PLC will be set up in a way that it controls the drive as the PROFINET master. The drive control is done via the function block “SINA_SPEED”. The setup of the PLC and the communication configuration is done in TIA Portal.

Data exchange

The data exchange between PLC and drive is handled by the function block “SINA_SPEED”. This function block operates with standard telegram 1. By the usage of telegram 1 the PLC sends the control word and the speed setpoint to the drive. The drive sends back its status word and the actual speed to the PLC.

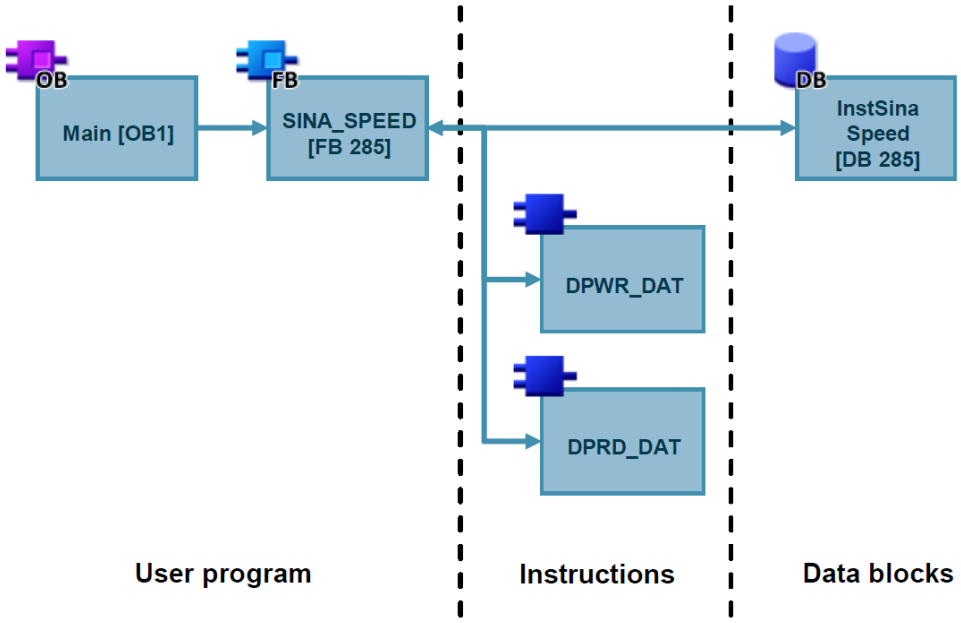
The process data will be exchanged cyclically, which means data is transferred at each bus cycle.

3 Operation Principle

3.1 Program overview

The following figure shows the structure of the function block calling in the SIMATIC user program:

Figure 3-1



3.2 Data exchange to the SINAMICS drive

Telegram structure

The SINA_SPEED function block is used to control cyclically a SINAMICS drive with standard telegram 1. The telegram consists of 2 words in send and receive direction.

Send data from the PLC to the drive:

Table 3-1

Address	Name	Content
PZD 1	STW1	Control word 1
PZD 2	NSOLL_A	Speed setpoint value (4000hex = 100% * p2000)

Receive data from the drive to the PLC:

Table 3-2

Address	Name	Content
PZD 1	ZSW1	Status word 1
PZD 2	NIST_A	Actual speed of the motor (4000hex = 100% * p2000)

Control word 1 in detail

The following table shows the bitwise content of control word 1, that is used by SINA_SPEED:

Table 3-3

Bit	Value	Meaning	Remark
0	0	OFF1	Motor brakes with deceleration ramp p1121, the motor is switched off at standstill (f < f min)
	1	ON	Upon positive edge, the converter switches to “Ready for operation”. If "Bit 3" = 1, the converter switches on the motor.
1	0	OFF2 (Coastdown)	Electrical supply of the motor is switched off. The motor coasts down.
	1	No OFF2	-
2	0	OFF3 (Quick stop)	Quick stop: The motor brakes with OFF3 deceleration ramp p1135 until standstill.
	1	No OFF3	-
3	0	Lock operation	Switch off motor
	1	Enable operation	Motor ready for switch on
4	0	Lock ramp-function generator	Ramp-function generator output is set to 0 (quickest possible brake operation)
	1	Enable ramp-function generator	Speed setpoints are ramped up and down by the ramp-function generator.
5	0	Stop ramp-function generator	The ramp-function generator output is “frozen”
	1	Continue ramp-function generator	The output of the ramp-function generator is updated
6	0	Lock setpoint	The motor brakes with deceleration ramp p1121
	1	Enable setpoint	Motor can accelerate to the setpoint value with ramp-up time p1120
7	0	No fault acknowledgement	Pending faults are not acknowledged
	1	Acknowledge fault	Pending faults are acknowledged by a positive edge
10	0	No control by PLC	Cyclic data transfer is disabled
	1	Master control by PLC	Process data valid, master control via fieldbus
11	0	No inversion of direction	No inversion of the speed setpoint value
	1	Inversion of direction	Setpoint value is inverted

Status word 1 in detail

The following table shows the bitwise content of the status word 1, that is used by SINA_SPEED:

Table 3-4

Bit	Value	Meaning	Remark
2	1	Operation enabled	Drive is switched on; motor can follow the setpoint value (control word 1 bit 3 enabled)
3	1	Fault active	A fault is active at the drive
6	1	On-inhibit active	The motor is switched on again after restarting (control word 1 bit 0)

3.3 SINA_SPEED function block

NOTE The SINA_SPEED block is part of the “DriveLib” library. The library is either preinstalled to the TIA Portal’s global libraries when Startdrive is installed to the TIA environment or can be downloaded from SIOS:

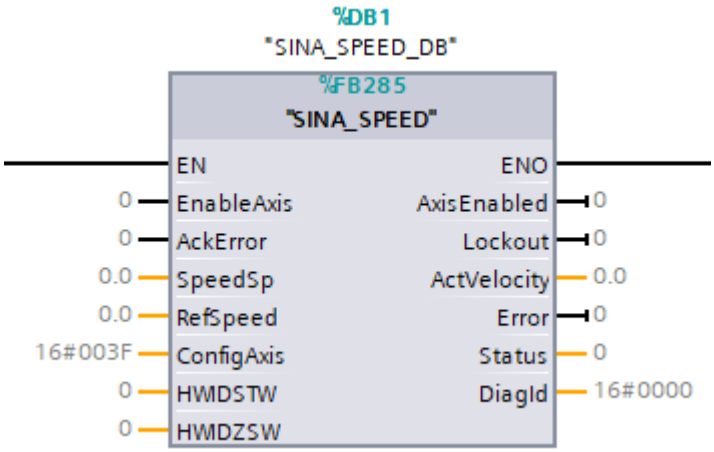
https://support.industry.siemens.com/cs/ww/en/view/109475044

Block call

The SINA_SPEED block can be called in the following organization blocks (OBs):

- Cyclic task (OB1)
- Interrupt OB (e.g. OB32)

Figure 3-2



Block interface

The following table describes the input parameters of SINA_SPEED:

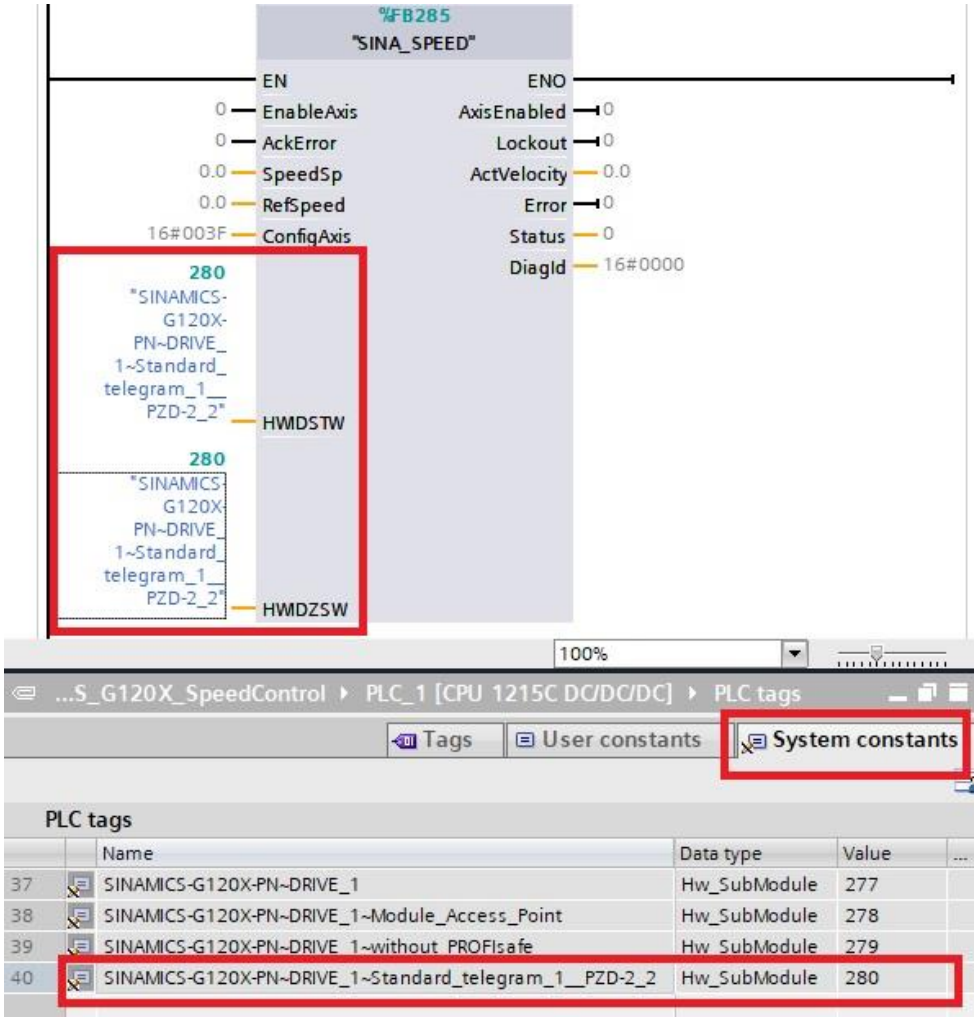
Table 3-5

Name	Type	Default value	Function
EnableAxis	BOOL	FALSE	Enable/disable the drive (ON/OFF1; assigned to control word 1 bit 0) 0: disable drive with OFF1 1: enable drive
AckError	BOOL	FALSE	Acknowledge faults in the drive (assigned to control word 1 bit 7)
SpeedSp	REAL	0.0	Speed setpoint [1/min]
RefSpeed	REAL	0.0	Define the reference speed of the drive (enter the nominal speed of the drive -> see value in parameter p2000 in the drive)
ConfigAxis	WORD	16#003F	Bitwise assignment of further control bits of control word 1, which are not separately defined as an input parameter. The default value 16#003F sets bits 1 to 6 to TRUE to make the operation possible. Functions can be deselected bitwise if necessary. Bit 1: OFF2 Bit 2: OFF3 Bit 3: Enable operation Bit 4: Enable ramp-function generator Bit 5: Continue ramp-function generator Bit 6: Enable speed setpoint
HWIDSTW	HW_IO	0	Hardware ID of the drive telegram 1 in setpoint direction (for correct setting see following chapter Telegram slot)
HWIDZSW	HW_IO	0	Hardware ID of the drive telegram 1 in receive direction (for correct setting see following chapter Telegram slot)

Telegram slot

The block inputs HWIDSTW and HWIDZSW must reference to the hardware ID of the standard telegram 1 of the controlled drive. The hardware ID is automatically defined by the PLC when assigning the drive to the PROFINET system of the PLC. The correct hardware ID of the telegram 1 can be found in the PLC's system constants under "PLC tags". For PROFINET communication the hardware ID for send and receive direction is the same and must be set at both inputs. See below figure for an example assignment.

Figure 3-3



4 Commissioning instruction

The following chapter gives a step-by-step instruction how to set up the drive, the PLC and the communication configuration. Following these steps, you will receive the same configuration as in the delivered example project.

The drive setup can be done via IOP-2 or Smart Access Module. After the drive is set up, the hardware configuration and PLC programming is done in TIA Portal.

4.1 SINAMICS G120X setup

The setup of the SINAMICS G120X can be done via Intelligent Operator Panel (IOP-2) or Smart Access Module (SAM) and smartphone/tablet. Go on with chapter 4.1.1 for setup via IOP-2 or chapter 4.1.2 for setup via SAM. After drive setup continue with the TIA Portal project generation in chapter 4.2.

4.1.1 Setup via IOP-2

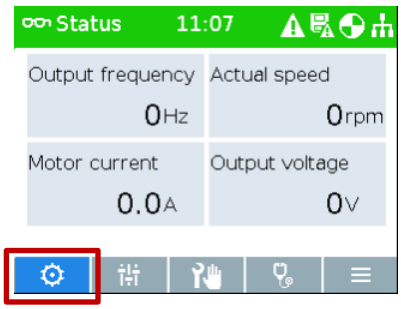
Plug the IOP-2 to your SINAMICS G120X and power on the device.

Follow the steps to setup the drive via IOP-2:

1. Navigate to the “Status” screen in case it is not shown in the beginning (you reach that screen by pressing the “ESC” button)

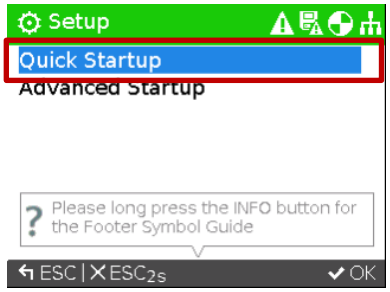
2. Select the Setup symbol of the bar at the bottom (left symbol)

Figure 4-1



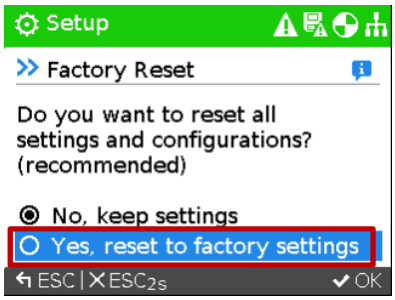
3. Select “Quick Startup”

Figure 4-2



4. Reset the drive to factory settings before starting the wizard

Figure 4-3

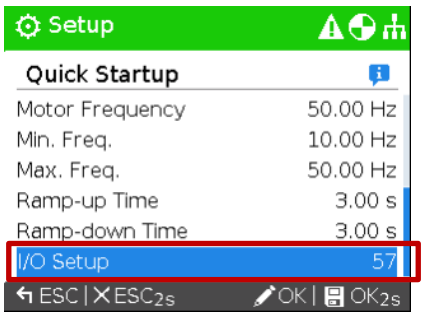


5. Define the supply voltage of the drive and the motor data according to your connected motor (Type, Motor Current, Motor Power, Motor Speed, Motor Voltage, Motor Frequency, Min. Freq., Max. Freq.)

6. Define the Ramp-up Time and Ramp-down Time

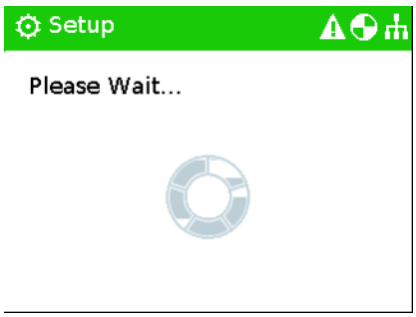
7. As I/O setup select macro **57** (this macro is used for control via PROFINET)

Figure 4-4



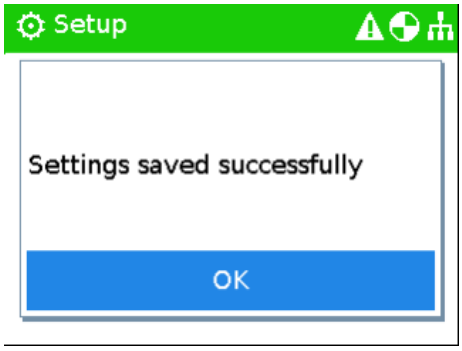
8. End the Quick Startup wizard by pressing the “OK” button for 2 seconds. The parameterization is saved now.

Figure 4-5



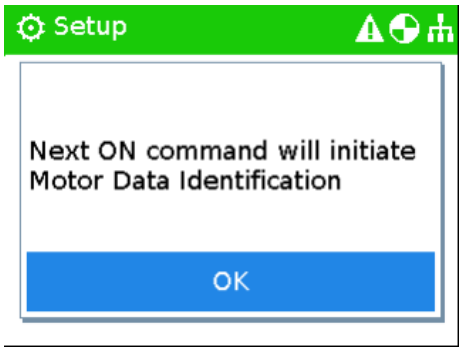
9. At the end you will get the information that the settings were saved successfully. Press OK.

Figure 4-6



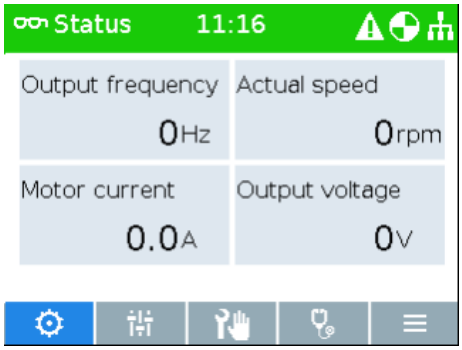
10. In the next step the information is shown that the motor identification will be executed with the next ON command. Press OK.

Figure 4-7



11. The Status screen is shown (or the Diagnostics screen in case there are faults or warnings active – you can acknowledge faults and go back to the Status screen by pressing ESC)

Figure 4-8



12. With the next ON command the motor will not start to turn, the drive will do the motor identification and switch off automatically after the identification.

Figure 4-9

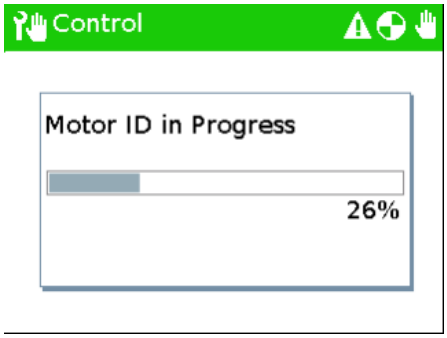


Figure 4-10

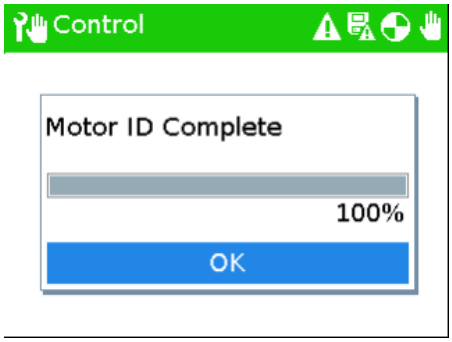
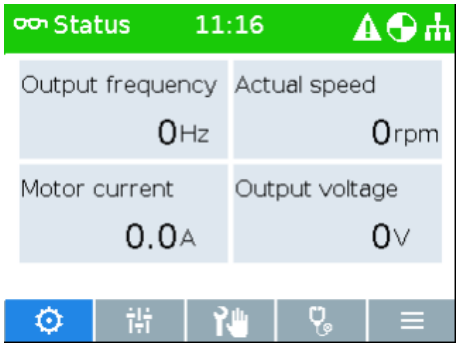


Figure 4-11



13. After the identification you can restart the drive by deselecting the ON command and starting it again with a new high signal. The motor turns with the speed setpoint. You can control the motor in Hand mode (via IOP buttons) or in Automatic mode (via PLC control). Go on with chapter 4.2 to set up the PLC in TIA Portal.

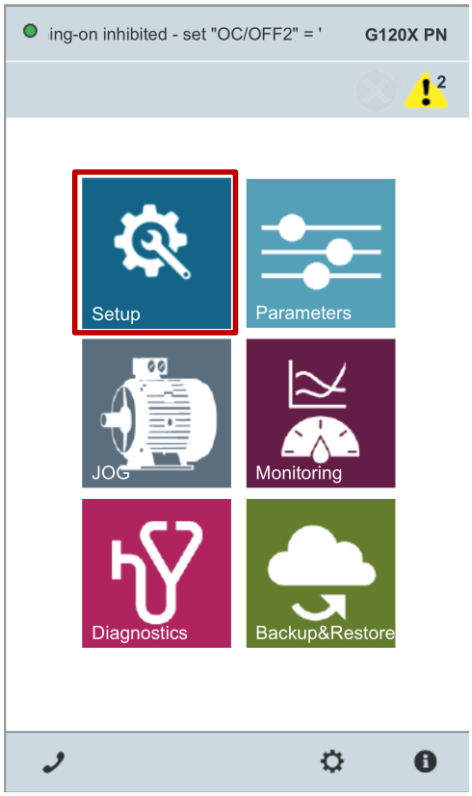
4.1.2 Setup via Smart Access Module

Plug the Smart Access Module (SAM) to your SINAMICS G120X and power on the device. Follow the steps to setup the drive via SAM:

1. Access the webpages of the drive by following the first step instructions of the Smart Access Module manual:
   https://support.industry.siemens.com/cs/ww/en/view/109763172

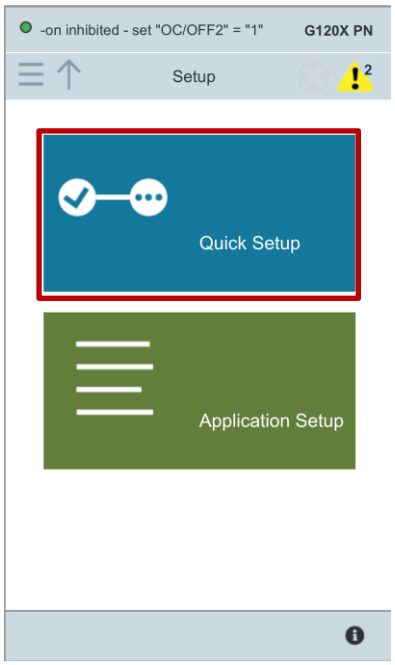
2. Select Setup

Figure 4-12



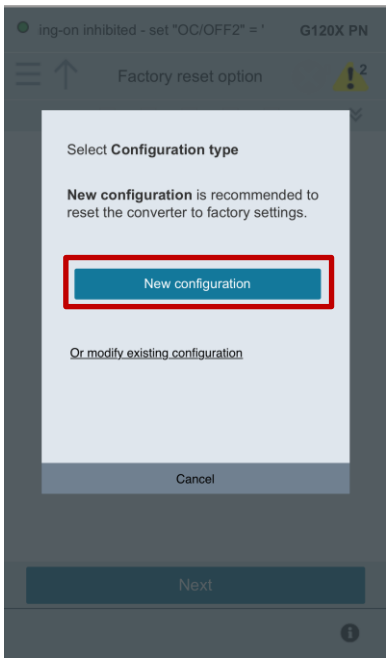
3. Start the Quick Setup

Figure 4-13



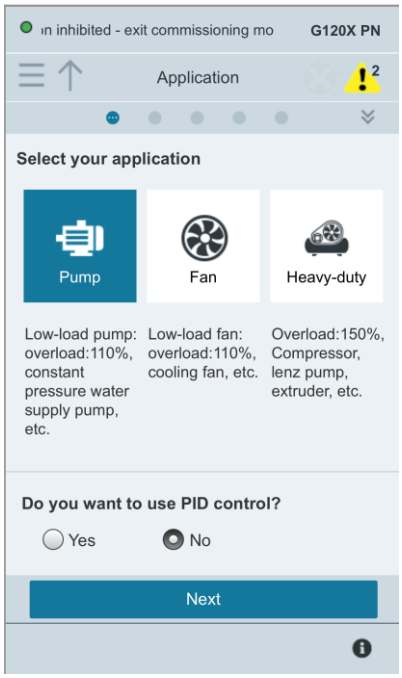
4. Start the commissioning with the recommended reset to factory setting

Figure 4-14



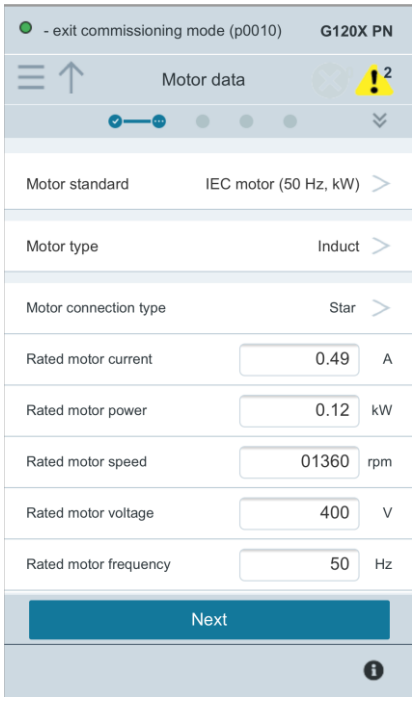
5. Select the suitable application type for your application. Here the “Pump” application is used

Figure 4-15



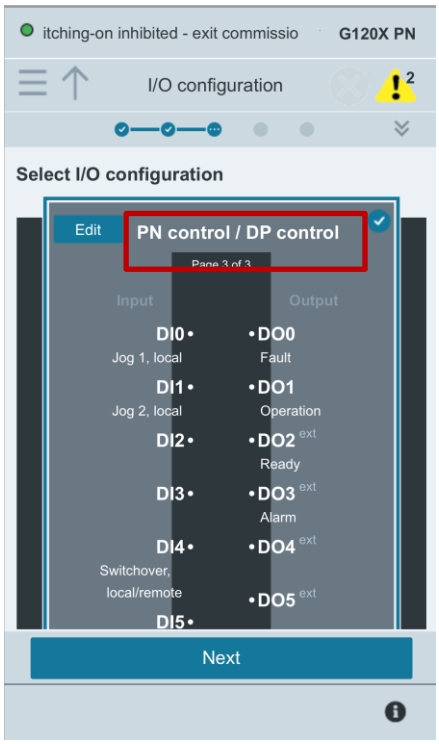
6. Define your motor data according to the faceplate data on your motor in the next window

Figure 4-16



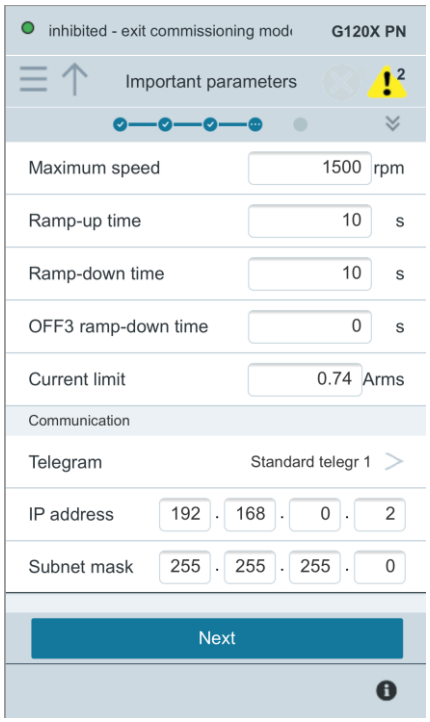
7. As I/O configuration select PN/DP control (control via PROFINET)

Figure 4-17



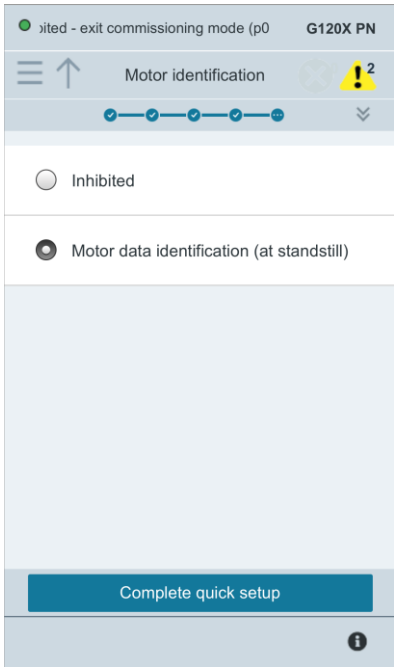
8. Adapt the values in Important parameters according to your application. Set the wanted IP address. Keep the selection of Standard telegram 1.

Figure 4-18



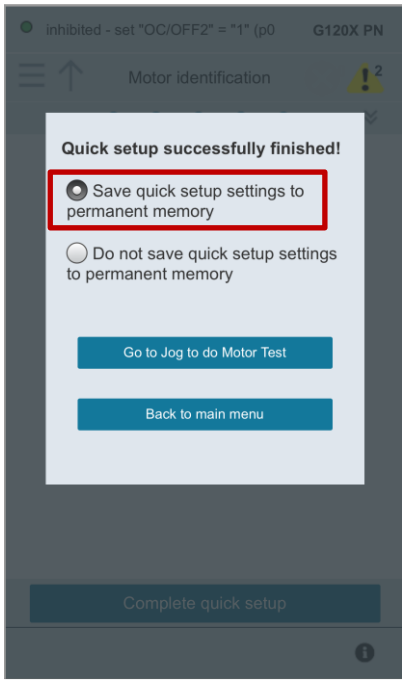
9. Select motor identification at standstill. After the first switch ON, the drive will perform a motor identification and switch off automatically when it is finished. This is done only once. Afterwards the drive can be switched on to turn the motor (a new positive edge at switch ON command is needed after the identification)

Figure 4-19



10. Finish the wizard by going to the main menu or jog menu. Save the setup settings permanently

Figure 4-20



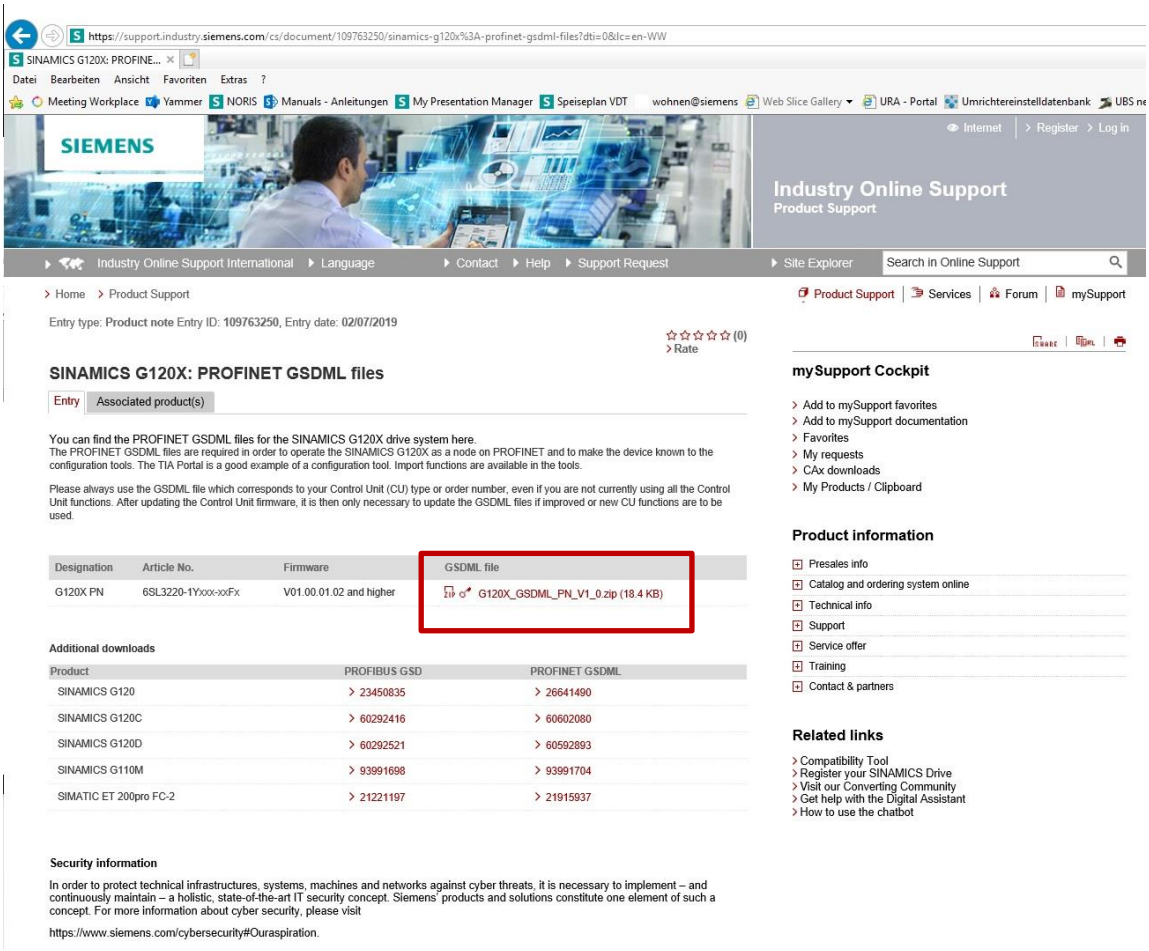
With the next ON command the motor will not start to turn, the drive will do the motor identification and switch off automatically after the identification. After the identification you can restart the drive by deselecting the ON command and starting it again with a new high signal. The motor turns with the speed setpoint. You can control the motor in Jog mode (via SAM) or in Automatic mode (via PLC control). Go on with chapter 4.2 to set up the PLC in TIA Portal.

4.2 Project generation in TIA Portal

Follow the steps to setup the project in TIA Portal:

1. Download the GSDML file of SINAMICS G120X on SIOS:
   https://support.industry.siemens.com/cs/ww/en/view/109763250

Figure 4-21

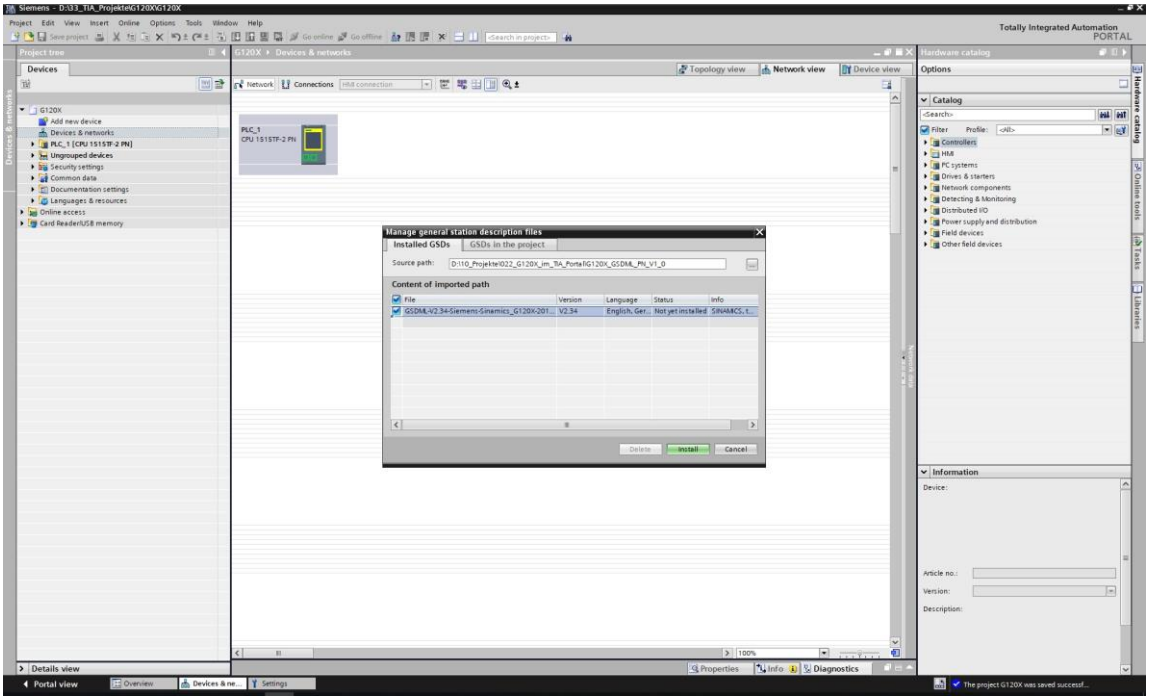


Save and unzip the file to any directory of your system.

2. Open TIA Portal

3. Install the GSDML file to TIA Portal. Therefore, click on “Options” -> “Manage general station description files”. Browse for the GSDML file on your system, select the file and click on “Install”.

Figure 4-22



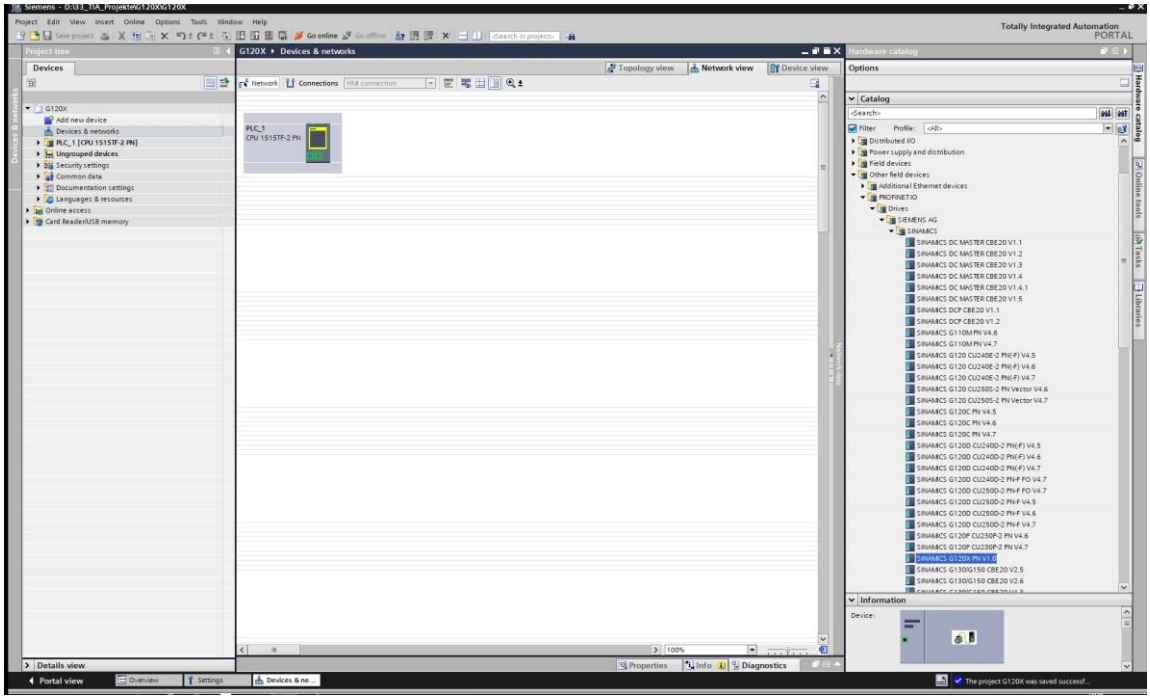
After the installation close the wizard.

4. Insert a SIMATIC S7-1200 / 1500 PLC to your project. Click on “Add new device” in the project navigator. Select the correct PLC and firmware that you are working with.

5. Open the network view by double-clicking on “Devices & networks” in the project navigator.

6. Open the Hardware catalog on the right and navigate to “Other field devices” → “PROFINET IO” → “Drives” → “SIEMENS AG” → “SINAMICS”

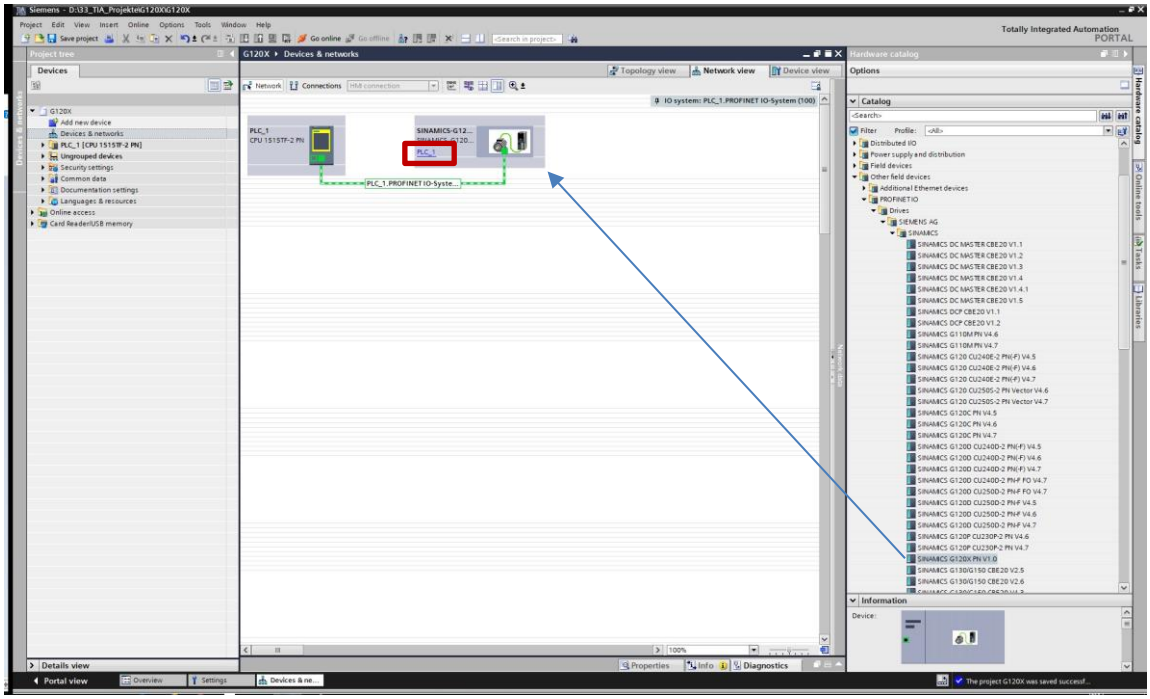
Figure 4-23



7. Drag & Drop the GSDML file of G120X to the network view

8. Assign the G120X to the PLC by clicking left on “Not assigned” and selecting the PLC interface.

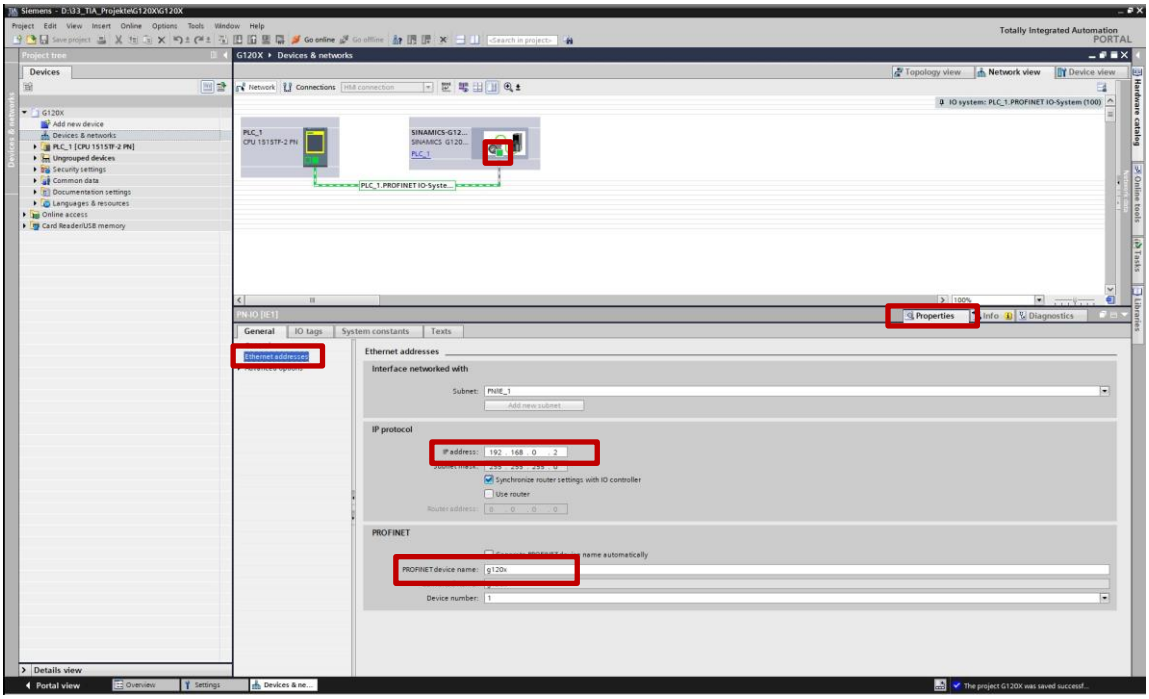
Figure 4-24



The drive is now assigned to the PLC.

9. Click on the PROFINET port of the G120X and open its properties at the bottom. Set the correct IP address and PROFINET device name according to the online drive settings.

Figure 4-25



10. Open the device view of the G120X GSDML file.

11. Add the standard telegram 1 from the submodules folder to the drive by double-clicking on it.

Figure 4-26

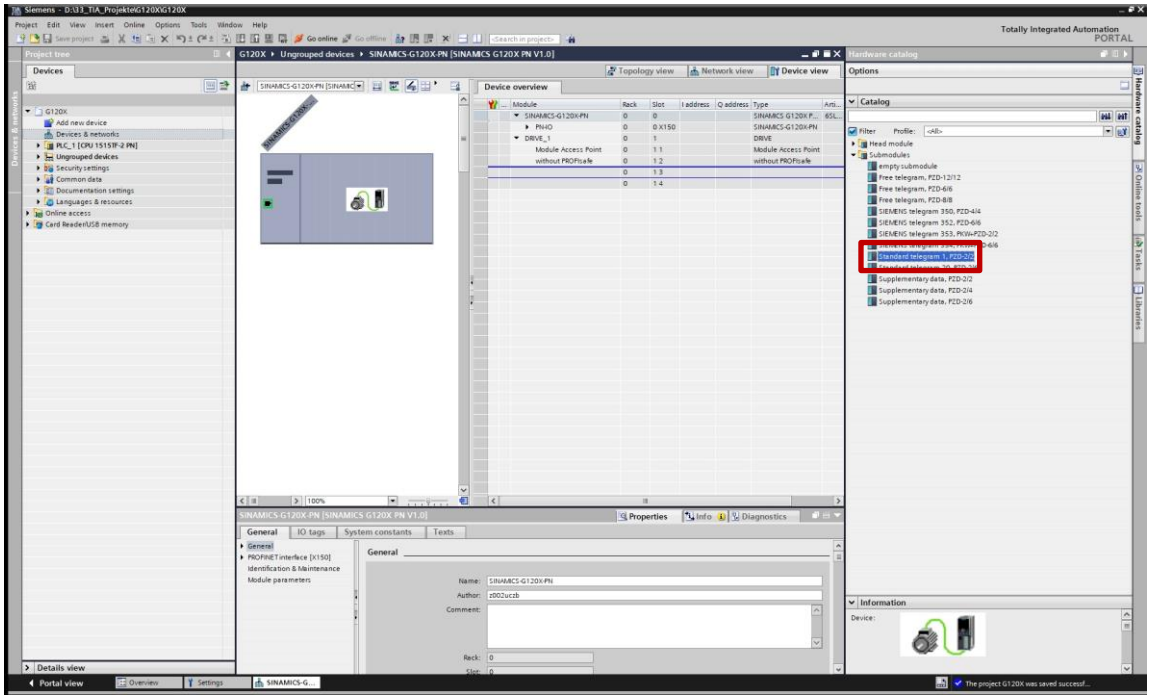
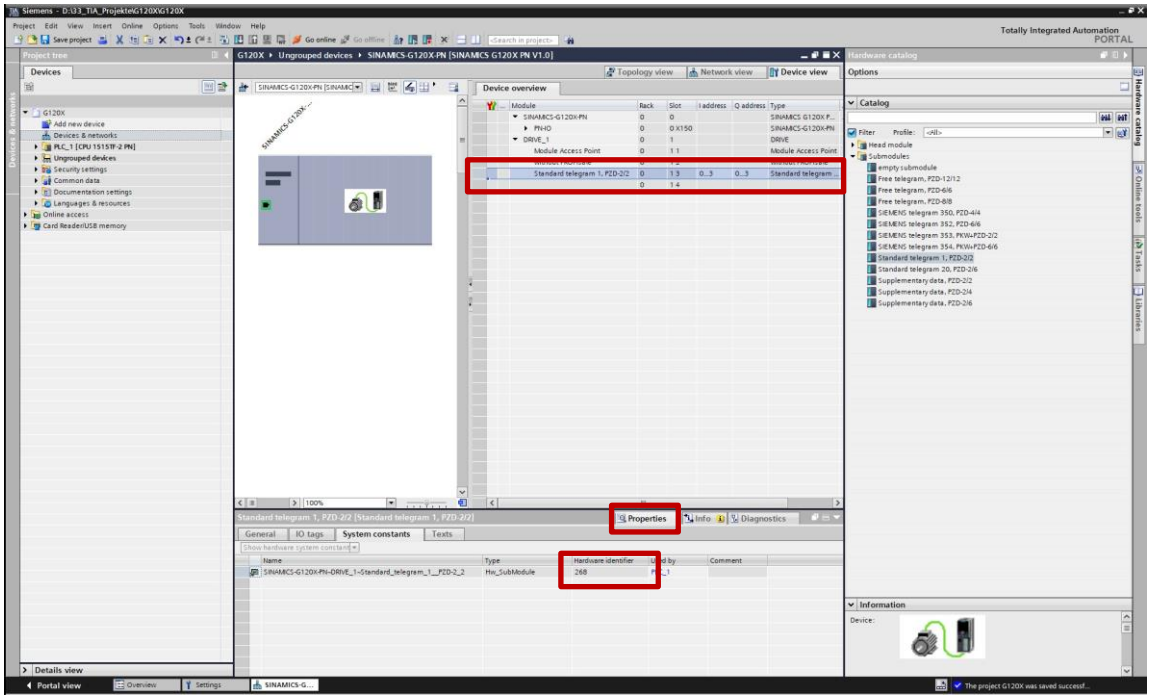


Figure 4-27



The submodule for the standard telegram 1 is inserted now. Selecting it and checking out its “Properties” → “System constants” you can already see the hardware ID of the telegram which will be later needed for the correct setup of the SINA_SPEED block.

12. Open a cyclically called OB/FB/FC of your PLC program (e.g. OB1)

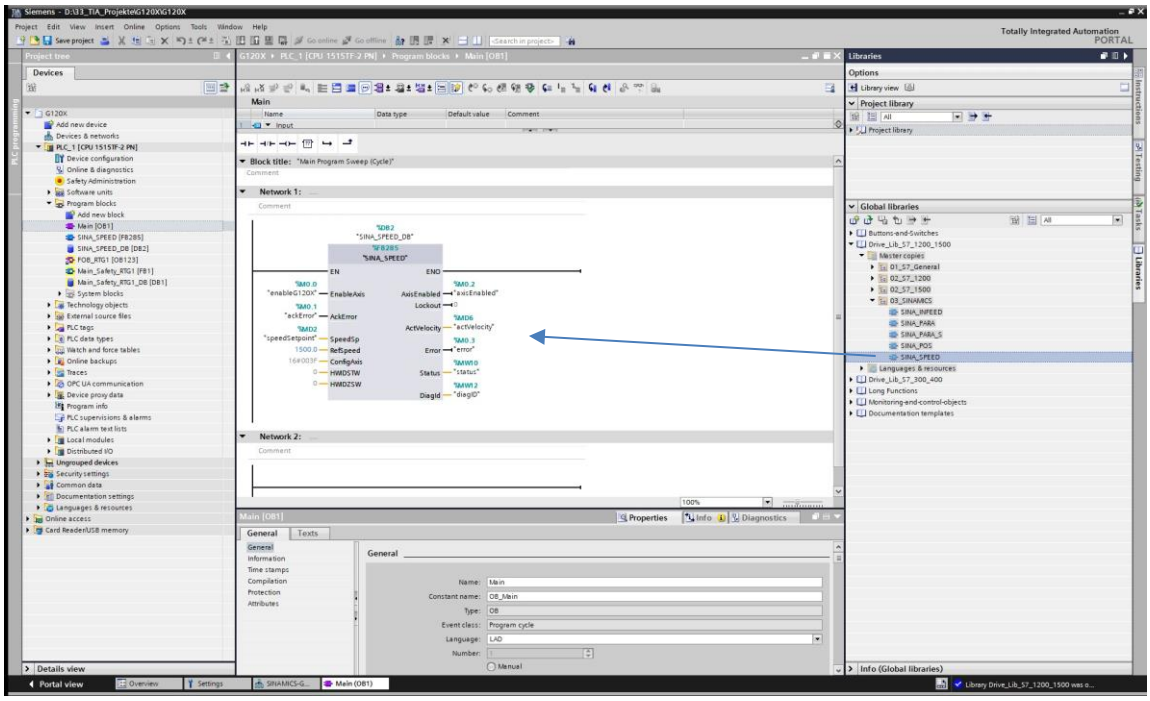
13. Open the “Libraries” tab on the right and navigate to the Global libraries. Find the SINA_SPEED FB under “Drive_Lib_S7_1200_1500” → “Mastercopies” → “03_SINAMICS”

14. Add the function block to your PLC program via drag & drop. You are asked to create an instance block – accept this

15. Interconnect variables to the inputs and outputs of the FB to be able to control the drive via those variables.

NOTE At the input RefSpeed enter the drive’s nominal speed. You can find this value in parameter p2000 of the drive.

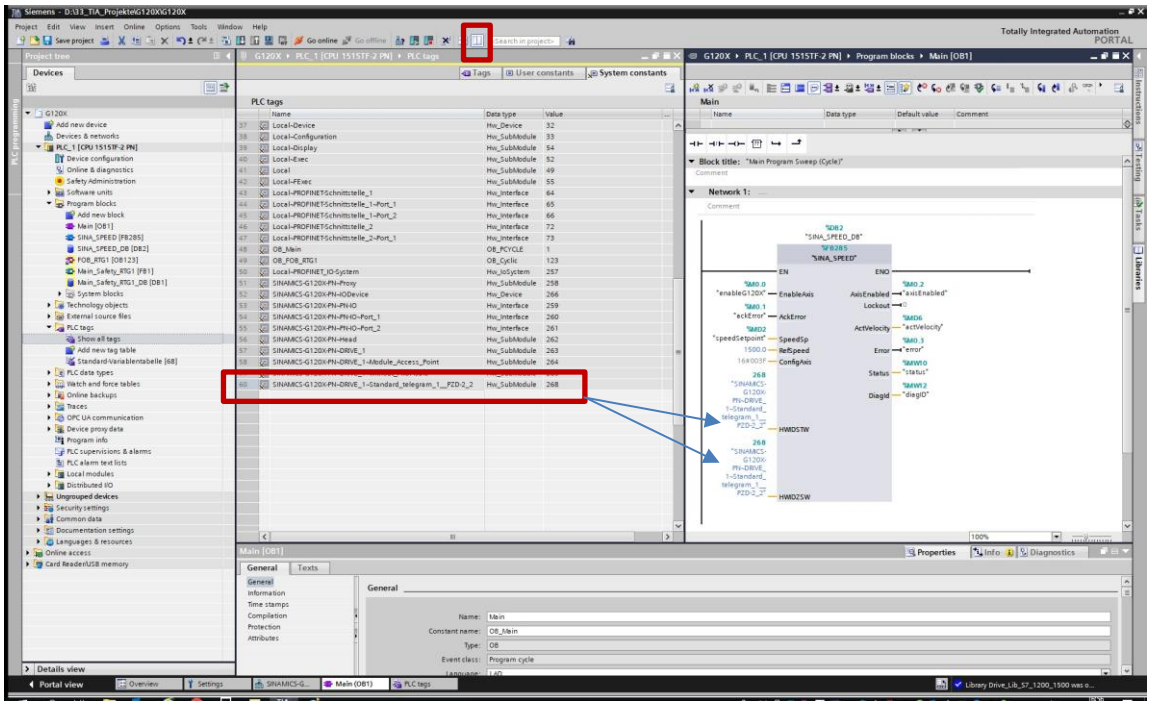
Figure 4-28



16. For the inputs **HWIDSTW** and **HWIDZSW**: Go to “PLC tags” → “Show all tags”. Open the tab “System constants”. Find the submodule of Standard telegram 1 of the G120X GSDML file. The shown identifier is the correct one to be assigned at the inputs HWIDSTW and HWIDZSW of the SINA_SPEED FB.

    Hint: If you split the TIA Portal window you can drag & drop the system constant of standard telegram 1 from the PLC tag list to the inputs of the SINA_SPEED FB in your user program. (see following figure)

Figure 4-29



17. Compile the project.

18. Download the hardware configuration and software to the PLC.

After the download and startup of the PLC the cyclic communication between PLC and drive is automatically started by the SINA_SPEED FB. You can control the drive with the assigned variables.

- EnableAxis: enables the drive
- SpeedSp: defines the speed setpoint in [1/min]

4.3 Using other telegrams for communication

Other telegrams as telegram 352 or telegram 20 can be used to exchange additional data like actual current, torque, etc.

If you want to use a different telegram than standard telegram 1, do the following steps differently than explained in chapters 4.1 and 4.2.

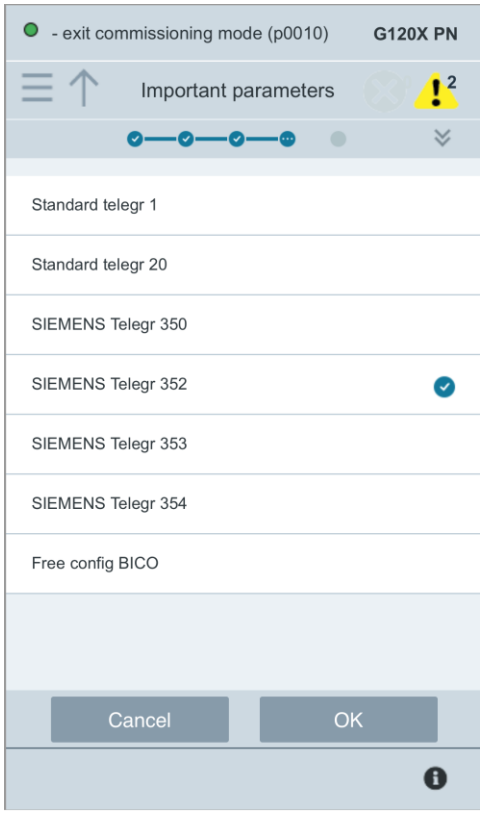
Within the next steps the usage of standard telegram 352 instead of standard telegram 1 is explained (e.g. telegram 20 would be the same way).

Setting up telegram 352 within the drive

For IOP-2: Go through the Quick Setup as described in chapter 4.1.1 and select I/O macro 57. By that macro standard telegram 1 is preselected for communication. End the Quick Setup regularly. Then go to the parameters list and change the telegram to standard telegram 352 in parameter p922. Afterwards Save the parameterization Ram to Rom and restart the drive.

For SAM: Go through the Quick Setup as described in chapter 4.1.2 and select telegram 352 in the tab “Important parameters”. End the Quick setup regularly.

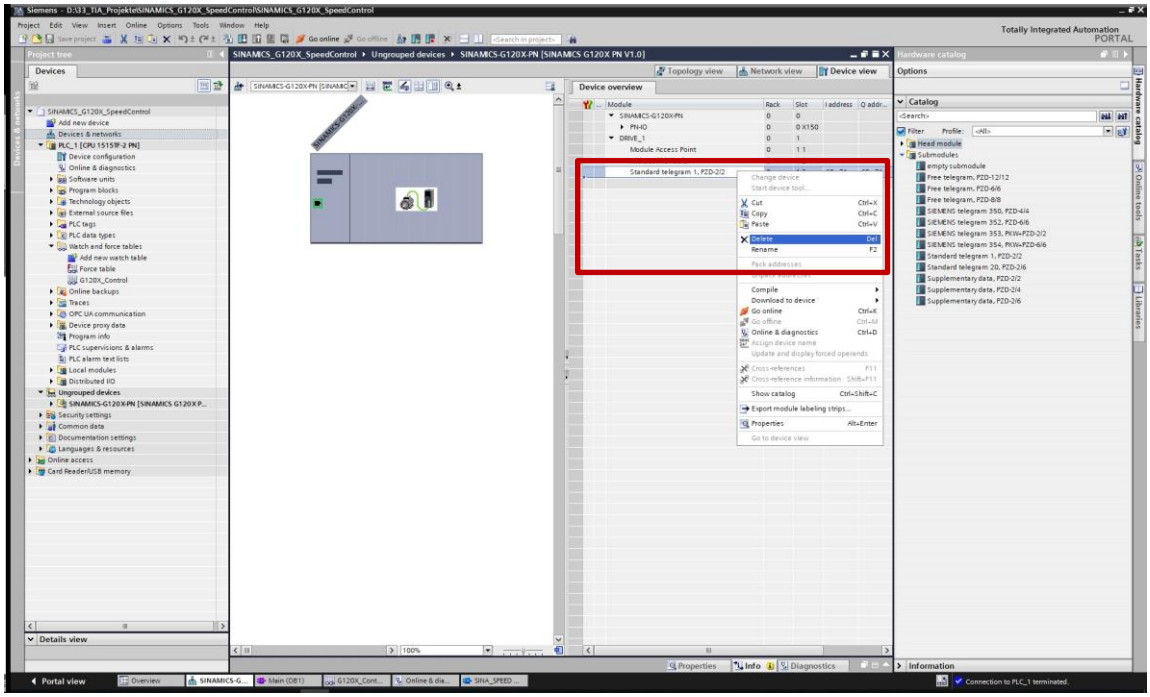
Figure 4-30



Changing the hardware configuration in TIA Portal

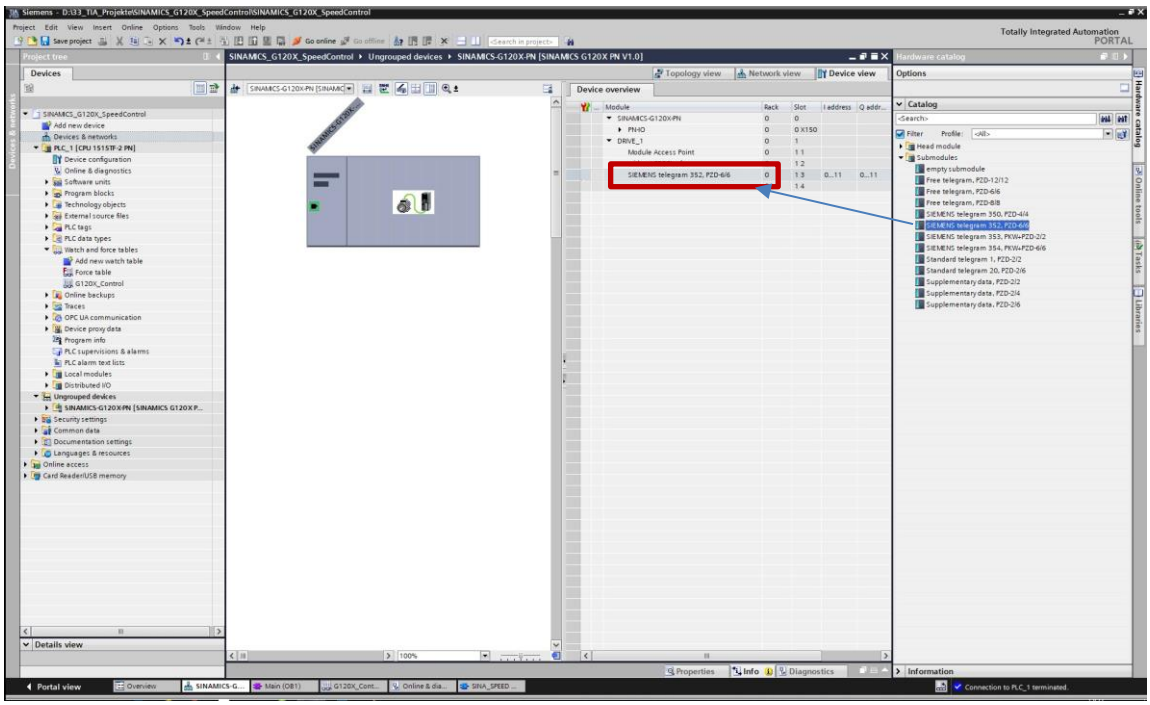
- Go to the device view of the G120X GSDML file
- Delete the slot for standard telegram 1 if it is selected

Figure 4-31



- Insert the subslot for telegram 352 to the GSDML file by double-clicking on it.

Figure 4-32



- Download the hardware configuration to the PLC.

Changing the PLC user program in TIA Portal

The SINA_SPEED function block cannot be used with a different telegram than standard telegram 1. For standard telegram 352 the function block “SINA_SPEED_TLG352” from the library “LSINAExt” is available.

- Download the library LSINAExt from SIOS:

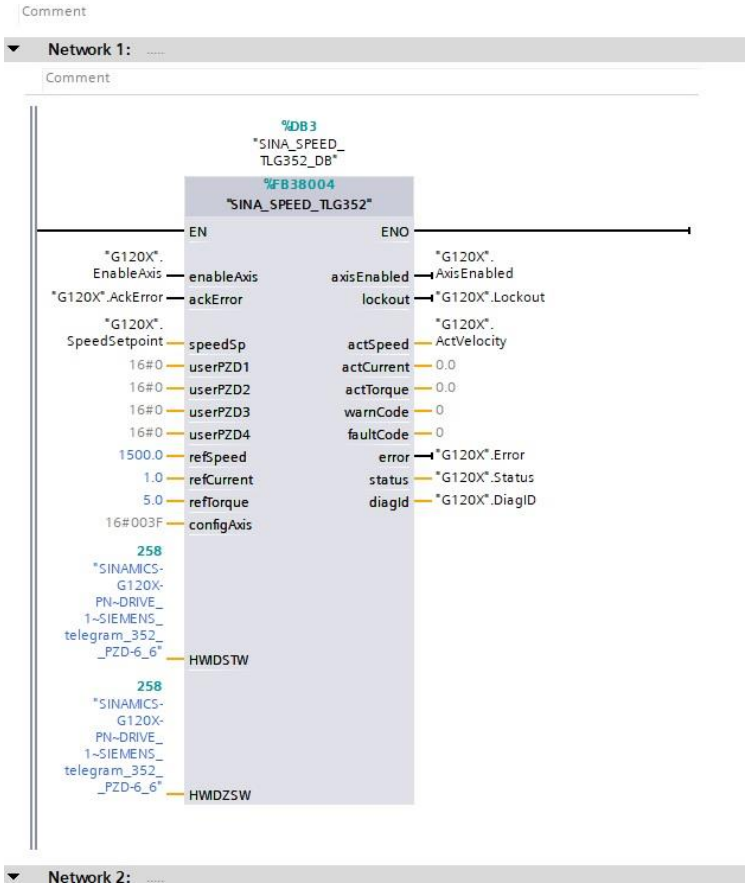
https://support.industry.siemens.com/cs/ww/en/view/109747655

- Retrieve and open the library in TIA Portal under “Libraries” → “Global libraries”

- Call the FB “SINA_SPEED_TLG352” in you user program

- Interconnect your variables to the input and output parameters

Figure 4-33



- Check for the correct hardware ID of telegram 352 for the inputs HWIDSTW and HWIDZSW. How to find the ID please see step 16 in chapter 4.2.

- Download the software changes to the PLC.

5 Using the example project

This chapter describes how to adapt and run the example TIA project. There is one project for the SIMATIC S7-1200 PLC and one for SIMATIC S7-1500 PLC. Download the project and follow the steps below:

Setting up the drive

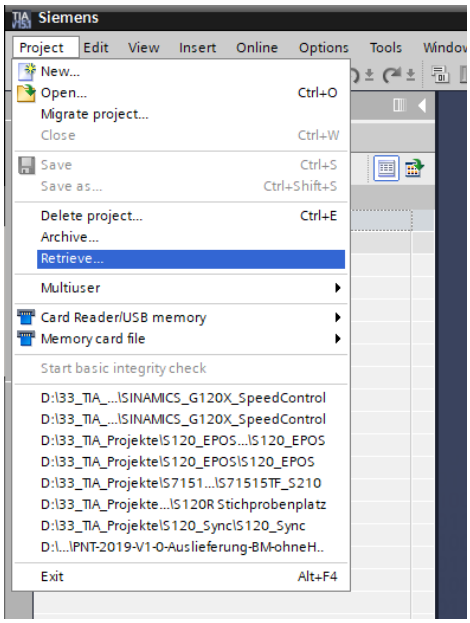
Before you can use the project you need to set up the drive as described in the commissioning chapter 4.1.

Using the TIA Portal project to run the drive via PLC

1. Open TIA portal

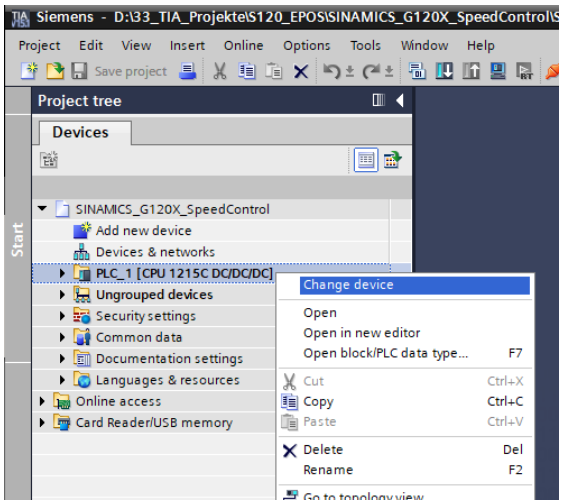
2. Retrieve and open the example project (use the one for S7-1200 or S7-1500 depending on the hardware you are using)

Figure 5-1



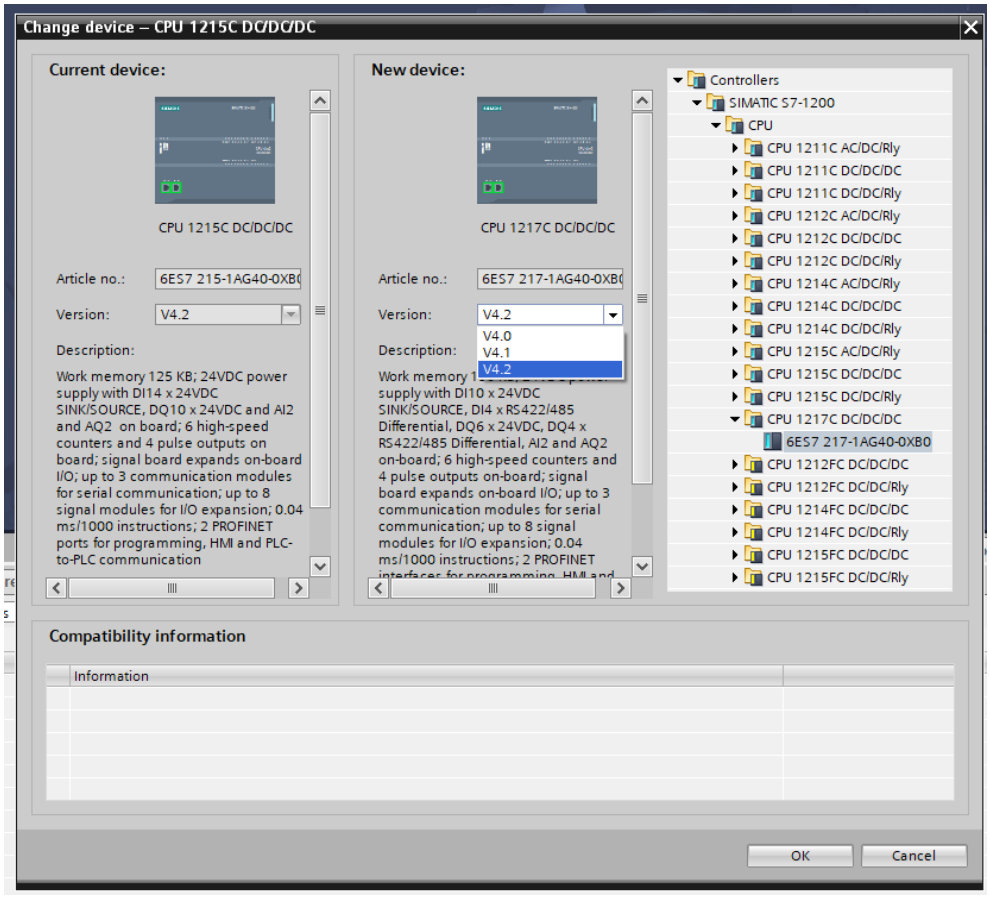
3. Click right on the PLC and select “Change device” from the context menu

Figure 5-2



4. Select the correct PLC and firmware you are using in your environment to exchange the projected PLC in the project

Figure 5-3



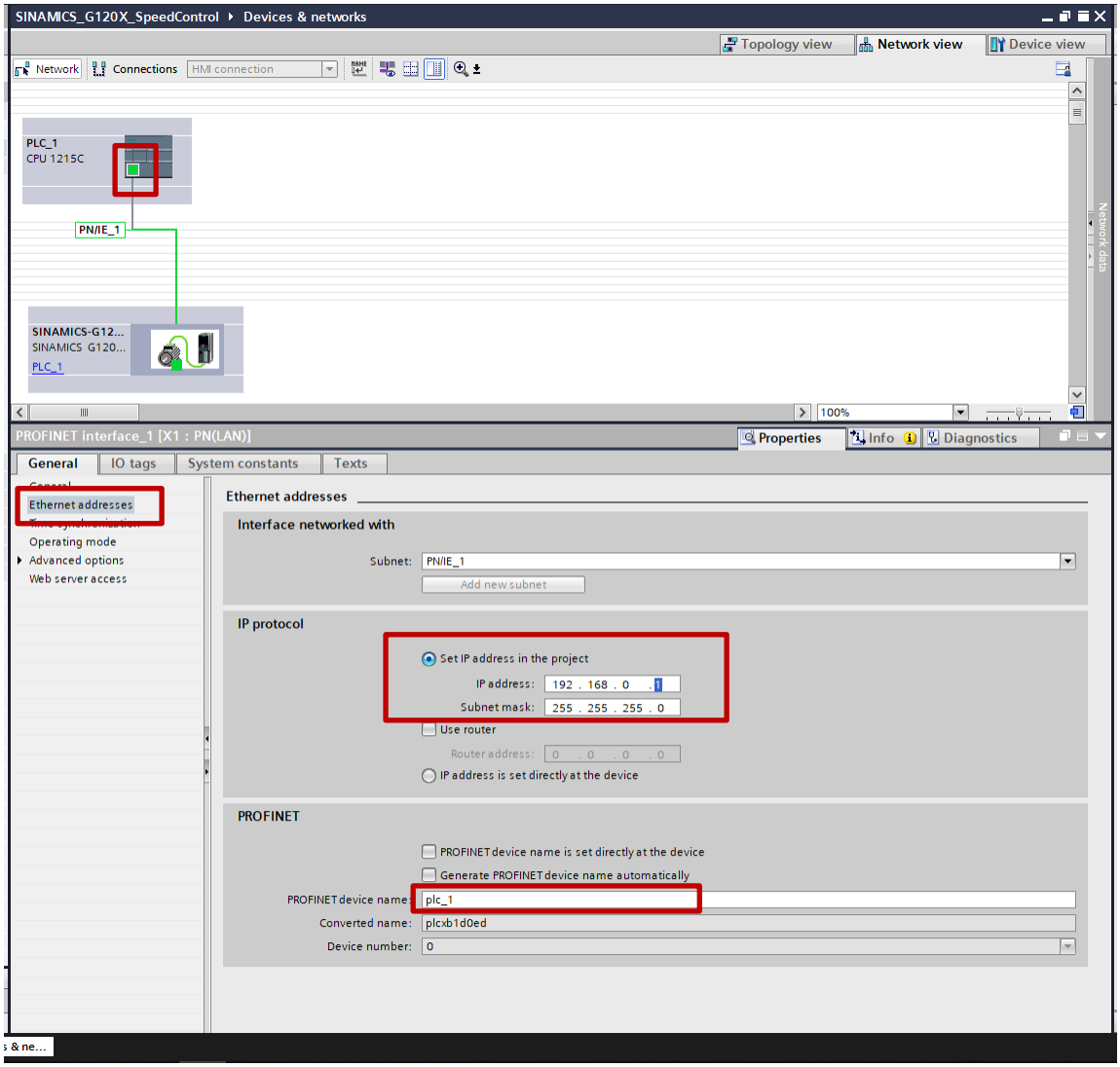
5. Go to the Network view by clicking on “Devices & networks”

6. Select the PROFINET port of the PLC and open its properties in the bottom of TIA Portal

7. Change the Ethernet settings of the port (IP address and PROFINET device name) accordingly to the online settings of the PLC

NOTE You can find out the used IP address and name of the station when searching online for accessible nodes.

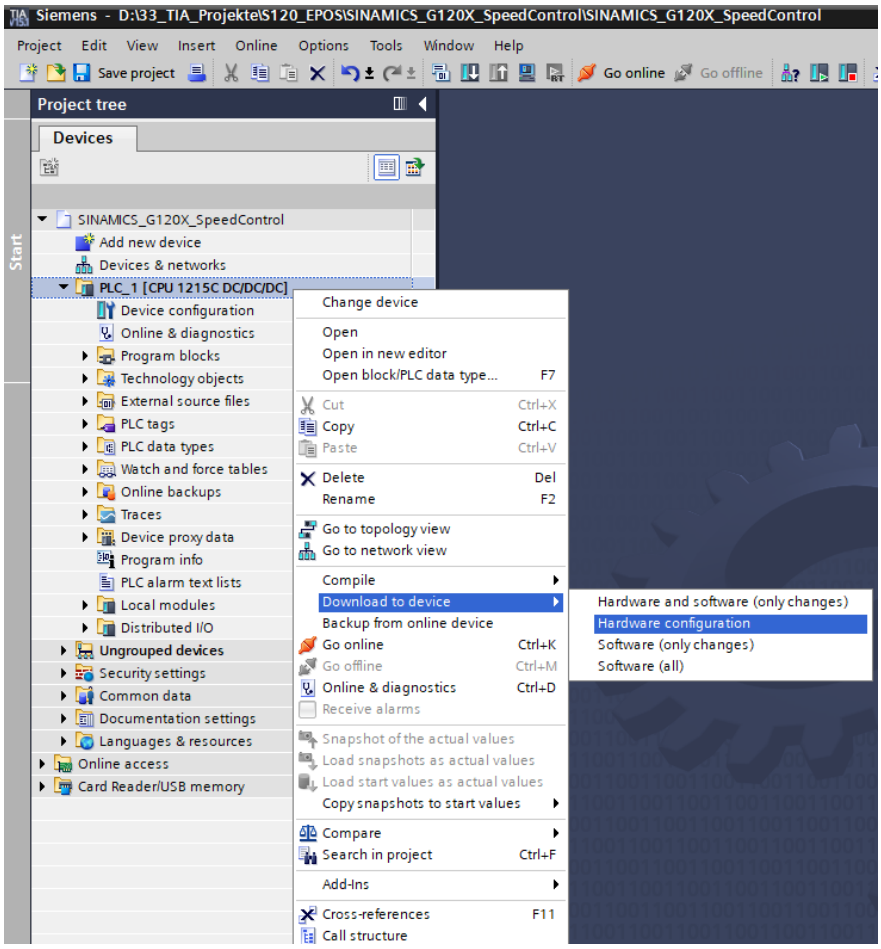
Figure 5-4



8. Repeat the same for the GSDML file of the G120X to set the correct IP address and PROFINET name for the drive

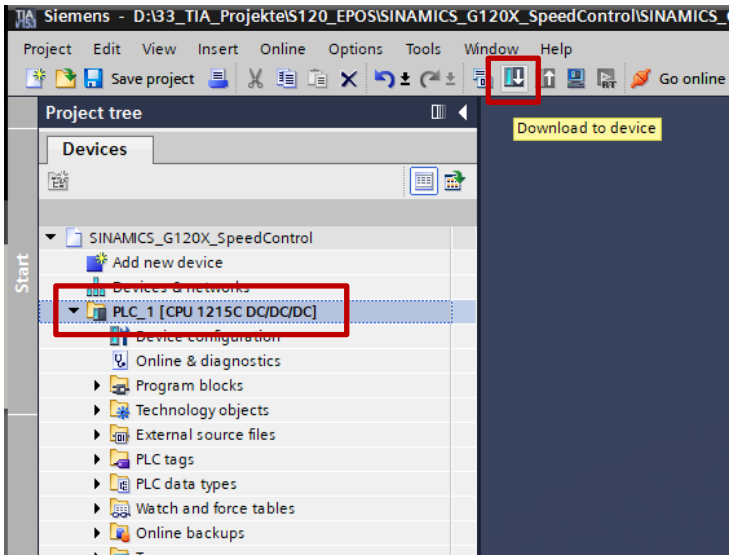
9. Download the hardware configuration to the PLC.

Figure 5-5



10. Download the software to the PLC

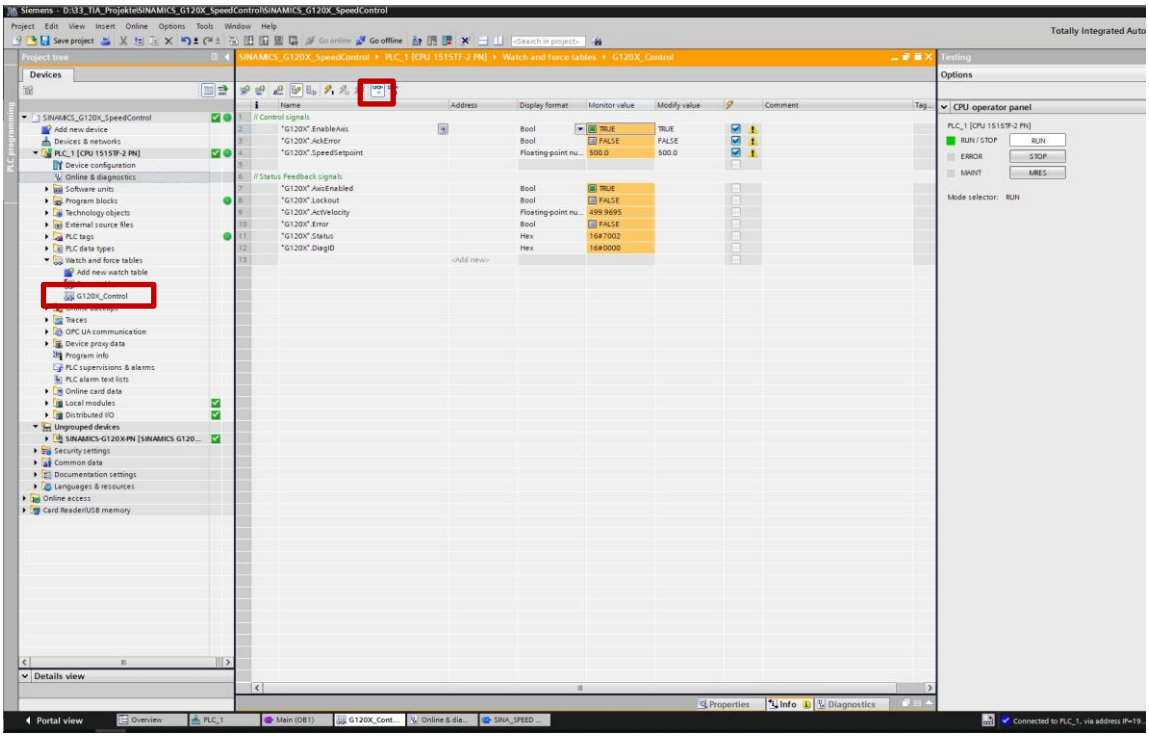
Figure 5-6



11. To control the drive a watch table is available called “G120X_Control”. Open this watch table

12. Start the Monitoring function at the top (online connection to PLC is established)

Figure 5-7



Forcing and meaning of the variables

With the control signals you can control the drive. With the status feedback signals you can monitor the drive’s status.

You can force the Control Bits and setpoint values with the following shortcuts when having them selected:

- Ctrl + F2: Setting a control bit to TRUE
- Ctrl + F3: Setting a control bit to FALSE
- Shift + F9: Forcing modified values to become active (e.g. enter speed setpoint to “Modify value” and press Shift + F9 to accept it as the active value)

Here you find the meanings of the available control signals:

- G120X.EnableAxis: Enables the drive (the motor will already turn with the minimum speed in case this was set greater than 0)
- G120X.AckError: In case the status is showing an error, you can acknowledge the drive faults with a positive edge at this control bit.
- G120X.SpeedSetpoint: Defines the speed setpoint in 1/min.

6 Appendix

6.1 Service and support

Industry Online Support

Do you have any questions or need assistance?

Siemens Industry Online Support offers round the clock access to our entire service and support know-how and portfolio.

The Industry Online Support is the central address for information about our products, solutions and services.

Product information, manuals, downloads, FAQs, application examples and videos – all information is accessible with just a few mouse clicks:
support.industry.siemens.com

Technical Support

The Technical Support of Siemens Industry provides you fast and competent support regarding all technical queries with numerous tailor-made offers – ranging from basic support to individual support contracts. Please send queries to Technical Support via Web form:
www.siemens.com/industry/supportrequest

SITRAIN – Training for Industry

We support you with our globally available training courses for industry with practical experience, innovative learning methods and a concept that's tailored to the customer's specific needs.

For more information on our offered trainings and courses, as well as their locations and dates, refer to our web page:
www.siemens.com/sitrain

Service offer

Our range of services includes the following:

- Plant data services
- Spare parts services
- Repair services
- On-site and maintenance services
- Retrofitting and modernization services
- Service programs and contracts

You can find detailed information on our range of services in the service catalog web page:
support.industry.siemens.com/cs/sc

Industry Online Support app

You will receive optimum support wherever you are with the "Siemens Industry Online Support" app. The app is available for Apple iOS, Android and Windows Phone:
support.industry.siemens.com/cs/ww/en/sc/2067

6.2 Application support

Siemens AG
Digital Industries
Factory Automation
Production Machines
DI FA PMA APC
Frauenauracher Str. 80
D-91056 Erlangen, Germany

mailto: tech.team.motioncontrol@siemens.com

6.3 Links and literature

Table 6-1

No.	Topic
\1\	Siemens Industry Online Support https://support.industry.siemens.com
\2\	Link to this entry page of this application example https://support.industry.siemens.com/cs/ww/en/view/109772227
\3\	

6.4 Change documentation

Table 6-2

Version	Date	Modifications
V1.0	10/2019	First version