

segFORCE

Quick Start Guide for PROFINET

PLC Examples and Configuration

Document version 1.0

Document date February 27, 2023

Author

Thomas Zörjen

Contents

1	SIMATIC PROFINET.....	1
1.1	Prerequisites.....	1
1.2	Introduction.....	1
1.3	Use the Step 7 SIMATIC Manager example.....	2
1.3.1	Setting up the project.....	2
1.3.2	How to use the example program.....	3
1.4	Use the TIA Portal example.....	5
1.4.1	Setting up the TIA project.....	5
1.4.2	How to use the TIA example program.....	7
1.5	Use the segFORCE in your project.....	9
1.5.1	Step 7 SIMATIC Manager.....	9
1.5.2	TIA Portal.....	16
2	PLC Operation Commands.....	25
2.1	How to reset a PLC to factory settings.....	25
2.1.1	Resetting PLC with Step 7 SIMATIC Manager.....	25
2.1.2	Resetting PLC with TIA Portal.....	26
2.2	How to assign the PROFINET device name.....	27
2.2.1	Name assignment with Step 7 SIMATIC Manager.....	27
2.2.2	Name assignment with TIA Portal.....	28
3	Appendix.....	29
3.1	PROFINET Interface.....	29
3.1.1	Cyclic Data Traffic.....	29
3.1.2	Acyclic Data Traffic.....	32

1 SIMATIC PROFINET

1.1 Prerequisites

- SIMATIC PLC
- PC with Step 7 SIMATIC Manager or TIA Portal installed and ready to use.
- The FMS segFORCE roller with at least two segments and a PROFINET controller.

1.2 Introduction

This document intends to give you a fast way to use our segFORCE in conjunction with a PROFINET PLC. It shows what to do at first to get the data into your PLC. **But we can give you no further support in PLC programming or problems that may occur using the PLC.** In case of difficulties with the PLC configuration or programming, please refer to the Siemens documentation or contact Siemens support. But we are sure this document will help you get the first results.

There are two options to start using the segFORCE in a PLC. Either take one of our example programs or configure and integrate it directly into your PLC project. All options are explained in different chapters. So jump straight to the chapter that explains the option you want to use.

FMS provides two example programs for PROFINET. One is for the Step 7 SIMATIC Manager, and the other is for the TIA Portal.



If you have a PLC of the SIMATIC 300 series, we suggest taking the Step 7 SIMATIC Manager example. But it is also possible to use the TIA Portal as well. In this case, **make sure to increase the input process image size to a minimum of 640 bytes.**



Suppose you have a PLC of the SIMATIC 1200 or 1500 series. In that case, we suggest taking the TIA Portal example. But if you prefer the Step 7 SIMATIC Manager example, you can still use it on such PLCs.

The GSDML for the segFORCE provided by the FMS can be used for all options.

1.3 Use the Step 7 SIMATIC Manager example

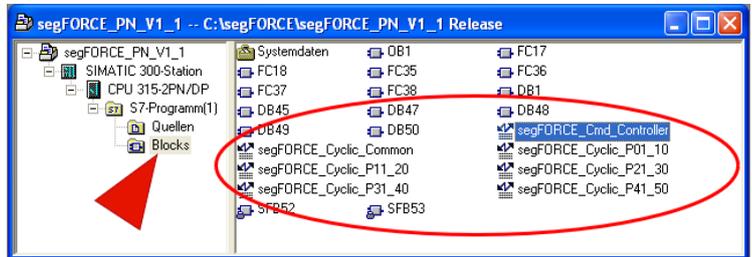
1.3.1 Setting up the project

- Download the example programs contained in the segFORCE_PN_Vx_x Release.zip from our web page. (x is a placeholder for the container file version that includes the example programs)
Link: <https://www.fms-technology.com/en/downloadcenter/profinet>
- Unpack the example project to your preferred directory on your PC on which the **SIMATIC Manager** development software is installed.
The Quick Start Guide uses the directory c:\segFORCE, and all further explanations start from this directory without explicitly mentioning it again.
- Execute the **SIMATIC Manager** program.
- Make sure you have a cleared PLC. Therefore do a factory reset before downloading the example program to the PLC.
- Open the project c:\segFORCE\Step7_PN_Vx_x (x is a placeholder for the example program version).
- Open the Hardware Configuration and change the SIMATIC Controller (PLC) if yours differs from the one the example program is using.
The example program uses the PLC controller CPU 315-2 PN/DP Article no. 6ES7 315-2EH14-0AB0. Please refer to the Siemens documentation if you have difficulty changing the controller.
- Search for all PROFINET devices, and assign the segFORCE the name **segforce**. The PLC gives after that the segFORCE the IP 192.168.10.82. If the IP does not fit your network environment, change the IP before downloading the program to the PLC.
- Download program to the PLC.
- Continue with the next chapter when the example program has been configured and downloaded successfully. Therefore the LEDs DCV5 and RUN must permanently light green, and no other LEDs should be blinking. If that is not the case, fix the problems first.



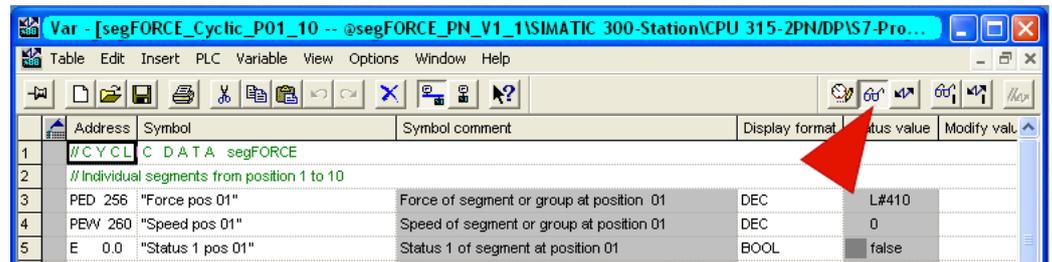
1.3.2 How to use the example program

- Execute the SIMATIC Manager.
- Open the Blocks folder.
- The project contains several predefined variable tables for displaying the segment's values.
- Open the appropriate variable table depending on what values you are interested in. There are the following variable tables for cyclic data available:

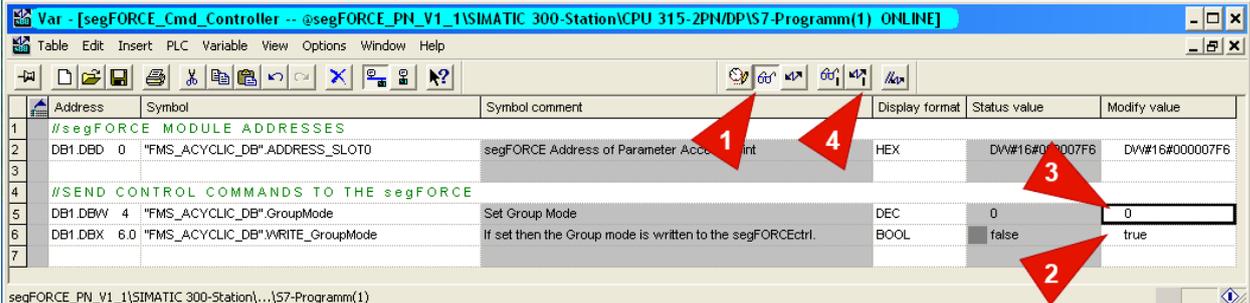


- segFORCE_Cyclic_Common General information about the entire roller.
- segFORCE_Cyclic_P01_10 Segments at positions 1 to 10
- segFORCE_Cyclic_P11_20 Segments at positions 11 to 20
- segFORCE_Cyclic_P21_30 Segments at positions 21 to 30
- segFORCE_Cyclic_P31_40 Segments at positions 31 to 40
- segFORCE_Cyclic_P41_50 Segments at positions 41 to 50

- Once the variable table is open, click on the icon with the glasses. This will start the monitoring process of the variables, and the values will be displayed continuously. To stop the monitoring click the icon again.



- One more variable table is used to switch between single and group force return values:
 - segFORCE_Cmd_Controller Send commands to the PLC.
- Once the variable table is open,
 - 1 click on the icon with the glasses
 - 2 set the write enable to *true*
 - 3 set the value to 1 to activate group mode
 - 4 click on the icon with the flash to send the command to the PLC



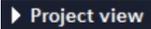
Address	Symbol	Symbol comment	Display format	Status value	Modify value
1	// segFORCE MODULE ADDRESSES				
2	DB1.DBD 0	"FMS_ACYCLIC_DB".ADDRESS_SLOT0	segFORCE Address of Parameter Access Point	HEX	DW#16#000007F6
3					
4	// SEND CONTROL COMMANDS TO THE segFORCE				
5	DB1.DBW 4	"FMS_ACYCLIC_DB".GroupMode	Set Group Mode	DEC	0
6	DB1.DBX 6.0	"FMS_ACYCLIC_DB".WRITE_GroupMode	If set then the Group mode is written to the segFORCEctrl.	BOOL	false
7					

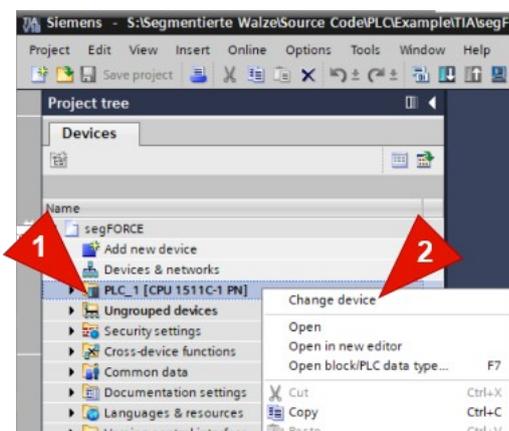


For further information on how the grouping of segments works and how the data are transferred to the PLC, consult the segFORCE Operation Manual.

1.4 Use the TIA Portal example

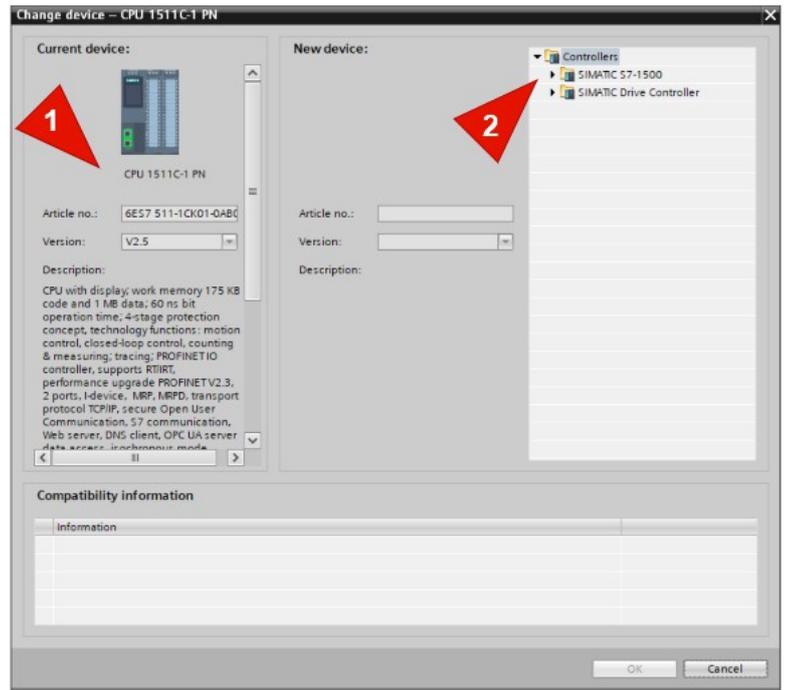
1.4.1 Setting up the TIA project

- Download the example programs contained in the segFORCE_PN_Vx_x Release.zip from our web page. (x is a placeholder for the container file version that includes the example programs)
Link: <https://www.fms-technology.com/en/downloadcenter/profinet>
- Unpack the example project to your preferred directory on your PC on which the **TIA Portal** development software is installed.
The Quick Start Guide uses the directory c:\segFORCE, and all further explanations start from this directory without explicitly mentioning it again.
- Execute the **TIA Portal** program.
- The program normally starts with the portal view. Switch to the project view by clicking the  **Project view** menu at the bottom left.
- Make sure you have a cleared PLC. Therefore do a factory reset before downloading the example program to the PLC. Refer to the chapter 2.1 *How to reset a PLC to factory settings*.
- Open the project c:\segFORCE\TIA_PN_Vx_x\segFORCE (x is a placeholder for the example program version).
- The example program uses the PLC CPU 1511C-1 PN. You must change the configuration accordingly if you have a different device of the same SIMATIC series. Right-click on the item **PLC_1 [CPU 1511C-1 PN]**  and click after that on **Change devices** . That action opens the Change device dialog.



But if you have a device from a different SIMATIC series, e.g., 1200, it's best not to use the example program and configure everything from scratch. Hence go to the chapter 1.5 *Use the segFORCE in your project*.

- The change device dialog shows the currently configured device on the left-hand side **1**. On the right, you can select your utilized device **2**.



- Search for all PROFINET devices, and assign the segFORCE the name **segforce**. Refer to the chapter 2.2 *How to assign the PROFINET device name* for a detailed description. The PLC gives after that the segFORCE the IP 192.168.10.82. If the IP does not fit your network environment, change the IP before downloading the program to the PLC.
- Download program to the PLC.
- Continue with the next chapter when the example program has been downloaded successfully and configured. Therefore the left LED must permanently light green, and the other two LEDs must be dark. If that is not the case, fix the problems first.

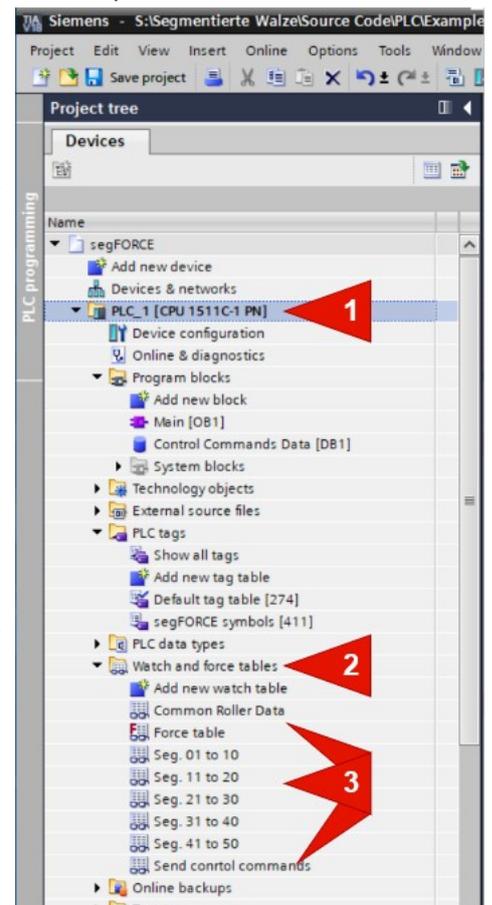


1.4.2 How to use the TIA example program

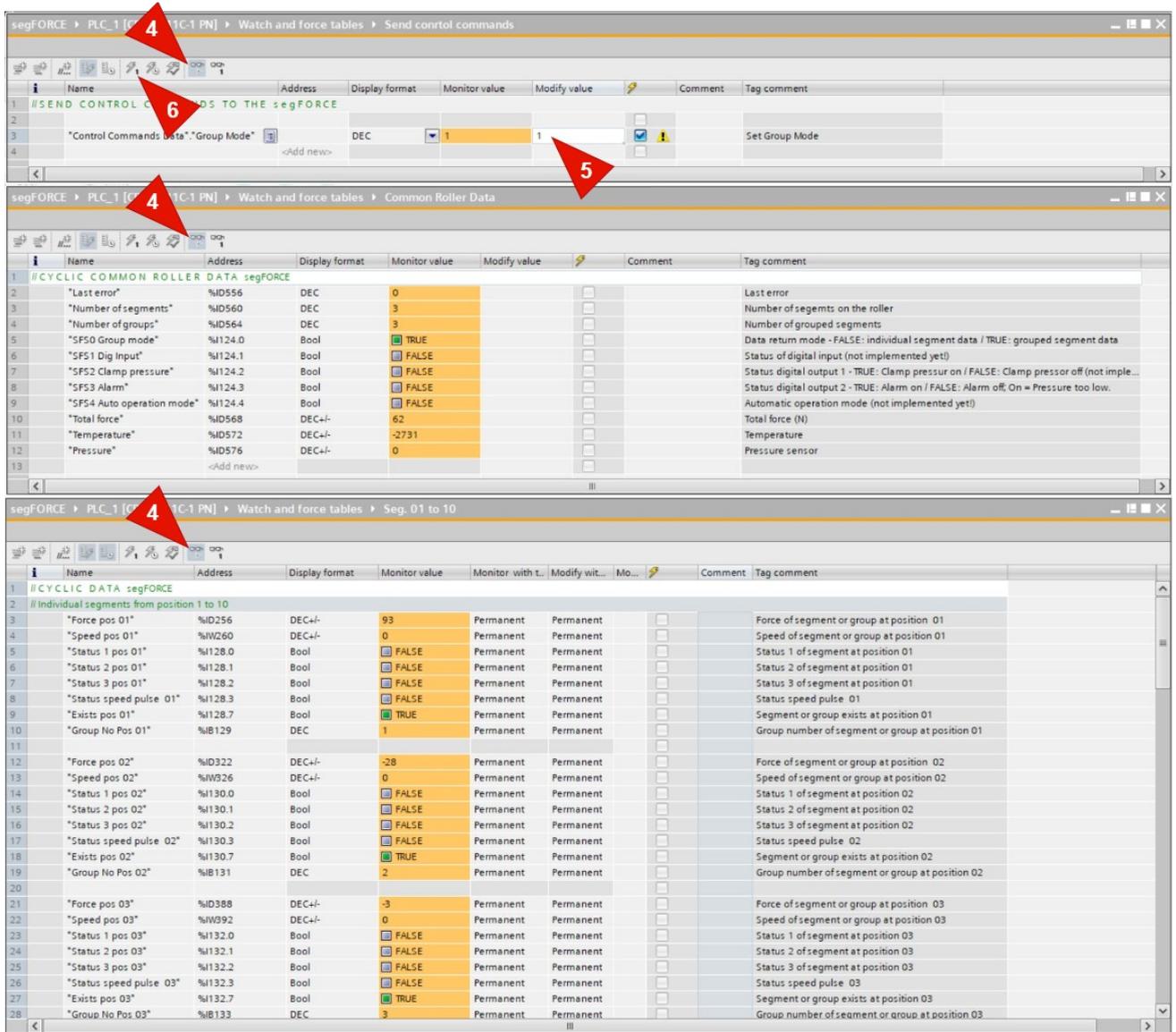
- Execute the **TIA Portal** program.
- The program normally starts with the portal view. Switch to the project view by clicking the **Project view** menu at the bottom left.
- Open the project . . . \TIA_PN_Vx_x\segFORCE
(x is a placeholder for the example program version and TIA portal version).
- Open the folder **Watch and force tables** **2** under the PLC project tree **1**.
- The project contains several predefined tables to display the segment's value and control the roller.
- Open the appropriate watch tables **3** depending on what segment values you are interested in or if you want to control the group mode. There are the following watch tables available:

- | | |
|-------------------------|--|
| - Common Roller Data | General information about the entire roller. |
| - Seg. 01 to 10 | Segments at positions 1 to 10 |
| - Seg. 11 to 20 | Segments at positions 11 to 20 |
| - Seg. 21 to 30 | Segments at positions 21 to 30 |
| - Seg. 31 to 40 | Segments at positions 31 to 40 |
| - Seg. 41 to 50 | Segments at positions 41 to 50 |
| - Send control commands | Switch between single segment values and group values. |

- Once the watch tables are open, click on the icon with the glasses **4**. This will start the monitoring process of the variables, and the values will be displayed continuously. To stop the monitoring click the icon again.



- The watch table **Send control commands** is used to switch between single and group force return values. Once the variable table is open,
 - 4 click on the icon with the glasses
 - 5 set the value to 1 to activate group mode or 0 to get back to the single segment mode
 - 6 click on the icon with the flash to send the command to the PLC



The screenshot displays three watch tables in SIMATIC Manager:

- Send control commands:** Shows a table with columns: Name, Address, Display format, Monitor value, Modify value, Comment, Tag comment. Row 3: Name: "Control Commands Data"."Group Mode", Address: %I124.1, Display format: DEC, Monitor value: 1, Modify value: 1. A red arrow (4) points to the glasses icon, and another red arrow (6) points to the flash icon.
- Common Roller Data:** Shows a table with columns: Name, Address, Display format, Monitor value, Modify value, Comment, Tag comment. Row 6: Name: "SFS1 Dig Input", Address: %I124.1, Display format: Bool, Monitor value: FALSE. A red arrow (4) points to the glasses icon.
- Seg. 01 to 10:** Shows a table with columns: Name, Address, Display format, Monitor value, Monitor with t..., Modify wit..., Mo..., Comment, Tag comment. Row 3: Name: "Force pos 01", Address: %ID256, Display format: DEC+/-, Monitor value: 93. A red arrow (4) points to the glasses icon.

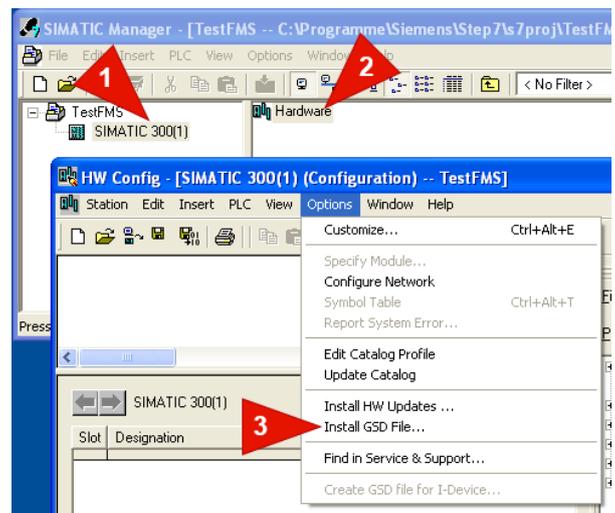


For further information on how the grouping of segments works and how the data are transferred to the PLC, consult the segFORCE Operation Manual.

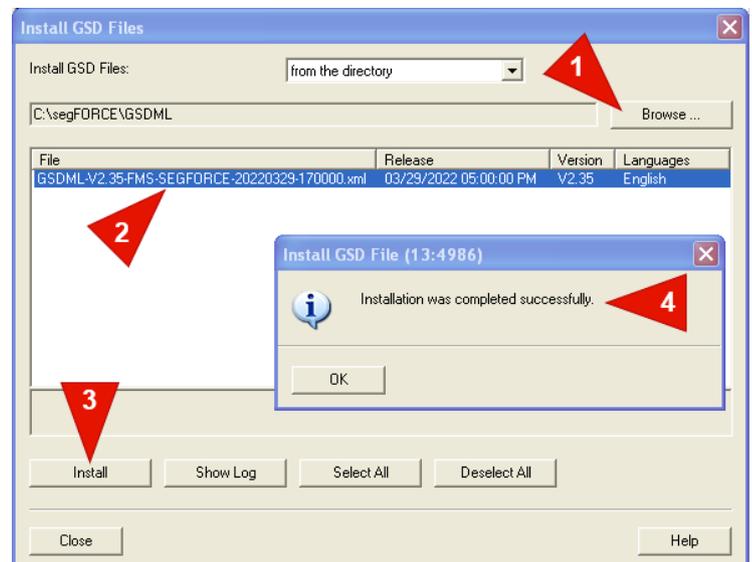
1.5 Use the segFORCE in your project

1.5.1 Step 7 SIMATIC Manager

- Execute the SIMATIC Manager.
- Open your project or create a new one. In case of a new project, insert a new object, e.g., SIMATIC 300 Station.
- Select the SIMATIC 300 Station on the tree or whatever you have named the station **1** and double-click the item Hardware on the window's right side panel **2**. That opens the dialog HW Config.
- On the HW Config dialog, choose the menu **Option -> Install GSD File 3**. That opens the dialog Install GSD Files.

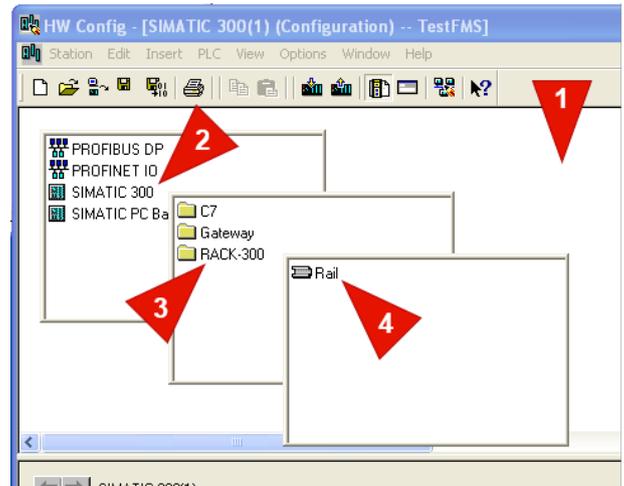


- On the Install GSD Files dialog, click on the Browse button **1**. Choose the directory where the GSDML files are located. In our case, it is c:\segFORCE\GSDML. Return to the previous dialog by clicking on OK. Select the GSDML file from the list that is to be installed **2**. Now click on Install **3** and accept all questions on the follow-up dialogs until you reach the dialog **Installation was completed successfully 4**. Close all dialogs until you are back on the HW Config dialog.

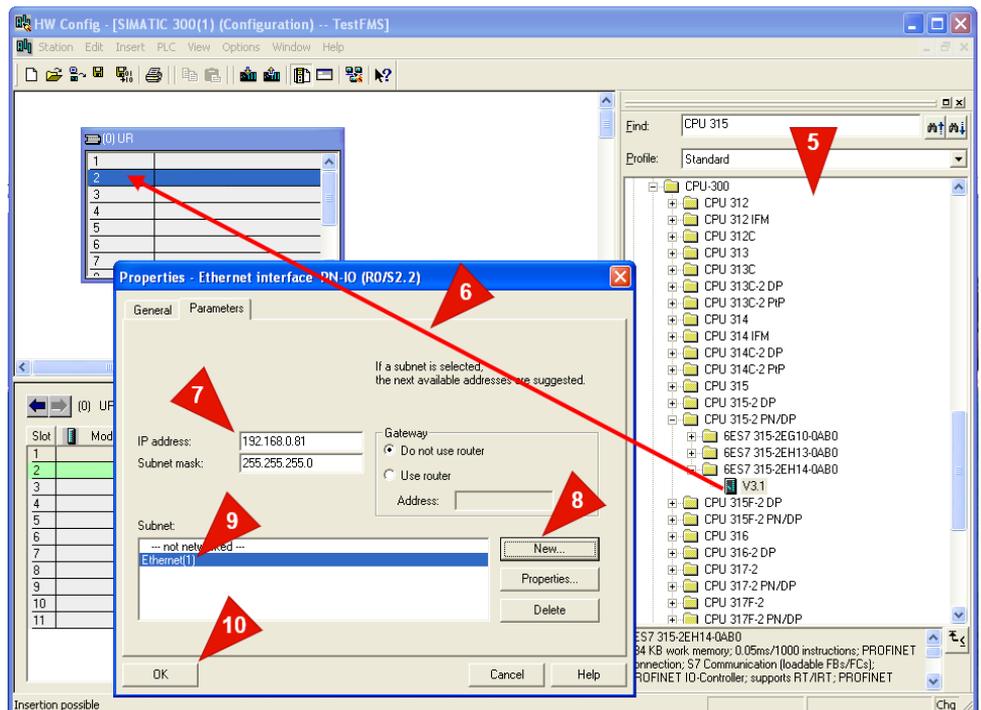


- Now as you are back on the HW Config dialog, the next step is to insert a rack and a CPU. Of course, only if they are not configured already. Otherwise, continue straight on to the next step.

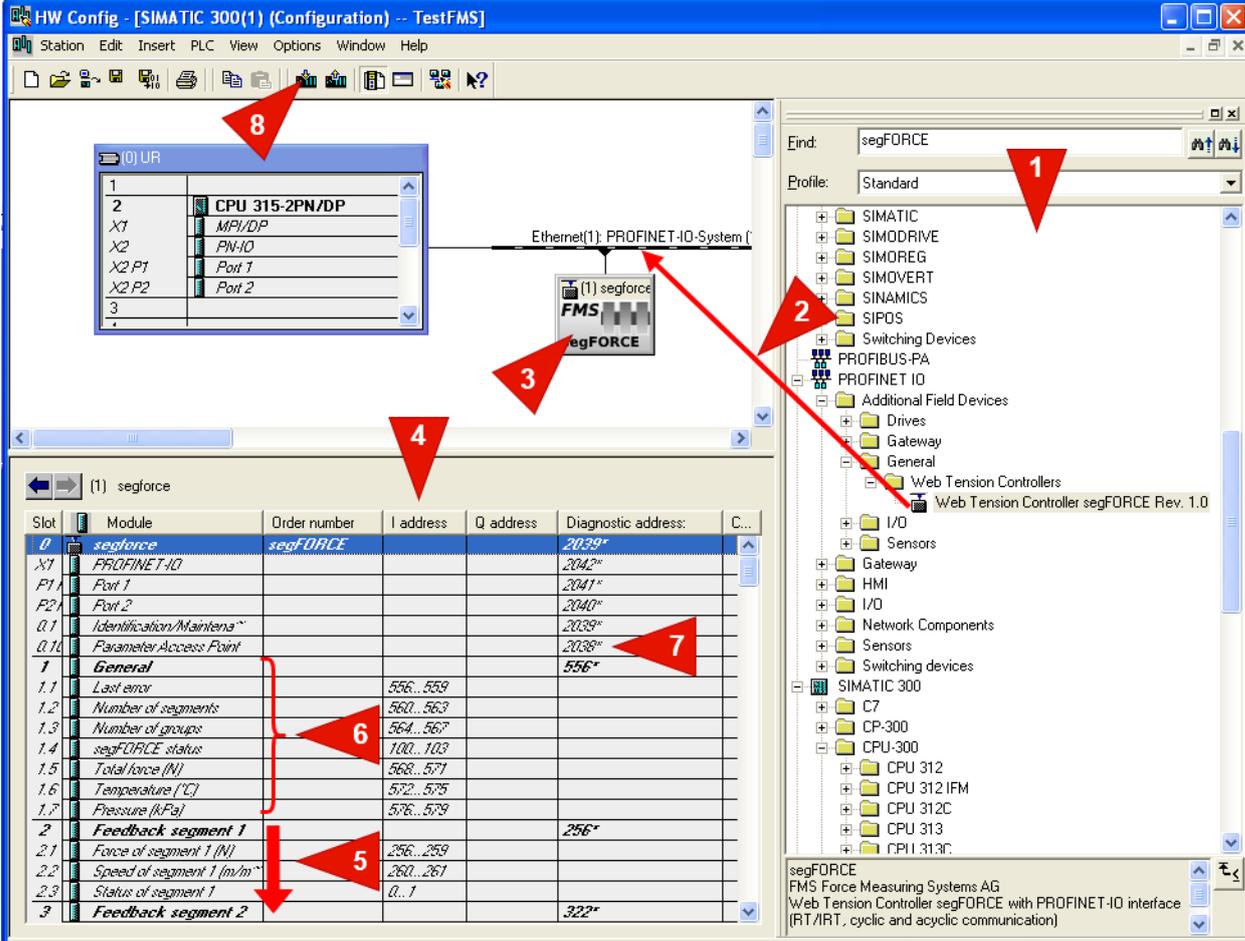
Right-click in the white area below the menu and symbol bar **1** and choose Insert Object. In the popping-up list, choose SIMATIC 300 **2**, then RACK-300 **3**, and finally Rail **4**. A table representing the rack is inserted in the white area.



Find your CPU in the hardware catalog on the right **5** and drag and drop it into slot 2 of the rack **6**. This operation opens the dialog **Properties - Ethernet interface**. Enter a not used IP address into the corresponding field **7** with which the PLC will operate on the network. Click on **New** **8** to add a Subnet if it not already exists, and click on Ok in the popping-up dialog. Back on the properties dialog, select the Subnet **Ethernet** **9**, and click on Ok **10**.



- Add the segFORCE device to the hardware configuration. Make sure the HW Config is open, as already described above once. Find the segFORCE device in the hardware catalog on the right **1** and drag and drop it to the Ethernet PROFINET-IO-System **2**. This operation inserts the segFORCE device into the hardware configuration **3**. The list below **4** always shows the assigned hardware address of all possible 50 segments **5**, although not all must be mounted on the roller. The addresses of the general roller properties can be looked up at the beginning of the list **6**. Another important module is the Parameter Access Point. This address must be used to parameterize the device. For the segFORCE, it is used to switch the Group Mode on or off **7**.

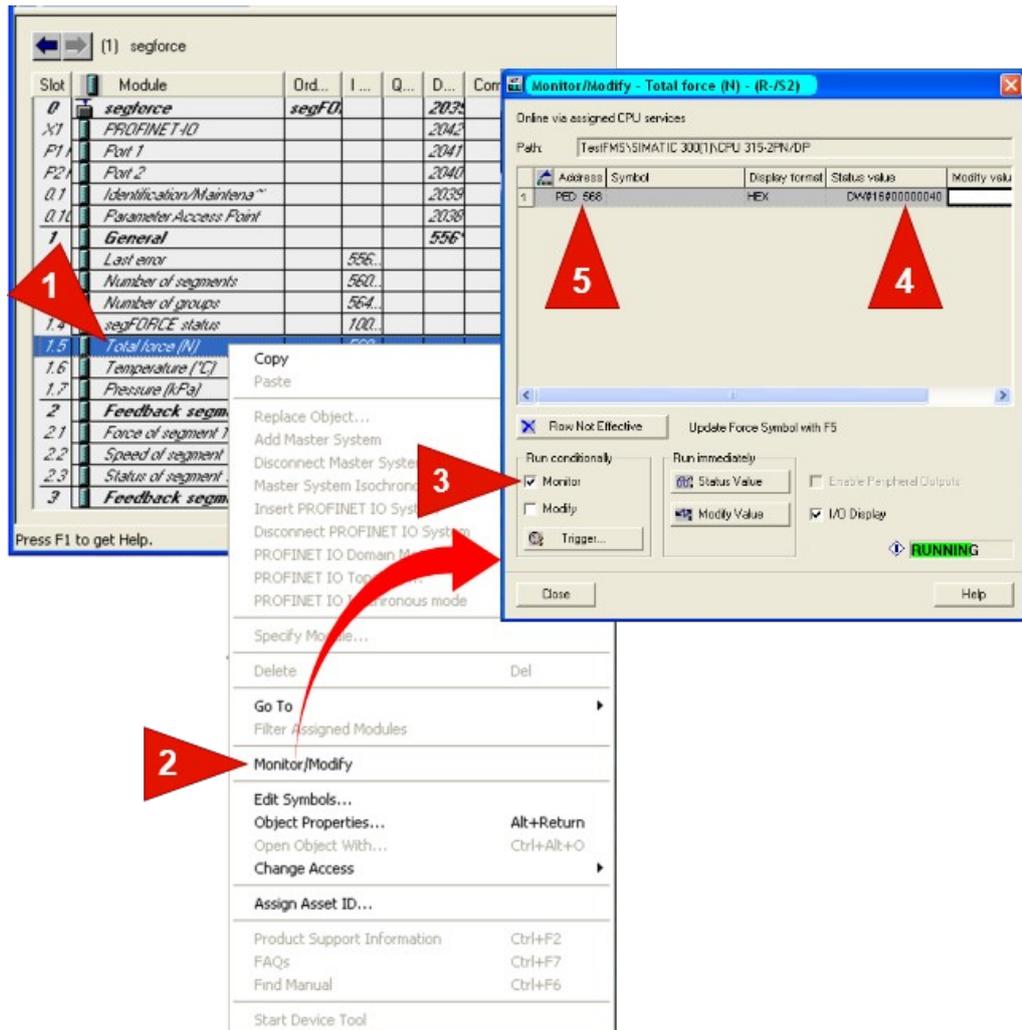


The screenshot shows the SIMATIC HW Config interface. The hardware rack (0) UR contains a CPU 315-2PN/DP in slot 1, and PROFIBUS-DP, PN-IO, and Port 1/2 modules in slots 2 and 3. The network diagram shows the segFORCE device connected to the Ethernet(1): PROFINET-IO-System. The hardware catalog on the right shows the segFORCE device selected. The parameter table below is as follows:

Slot	Module	Order number	I address	Q address	Diagnostic address:	C...
0	segforce	segFORCE			2039*	
X1	PROFINET-IO				2042*	
P1	Port 1				2041*	
P2	Port 2				2040*	
Q.1	Identification/Maintena**				2039*	
Q.10	Parameter Access Point				2038*	
1	General				556*	
1.1	Last error		556..559			
1.2	Number of segments		560..563			
1.3	Number of groups		564..567			
1.4	segFORCE status		100..103			
1.5	Total force (N)		568..571			
1.6	Temperature (°C)		572..575			
1.7	Pressure (kPa)		576..579			
2	Feedback segment 1				256*	
2.1	Force of segment 1 (N)		256..259			
2.2	Speed of segment 1 (m/m**)		260..261			
2.3	Status of segment 1		0..1			
3	Feedback segment 2				322*	

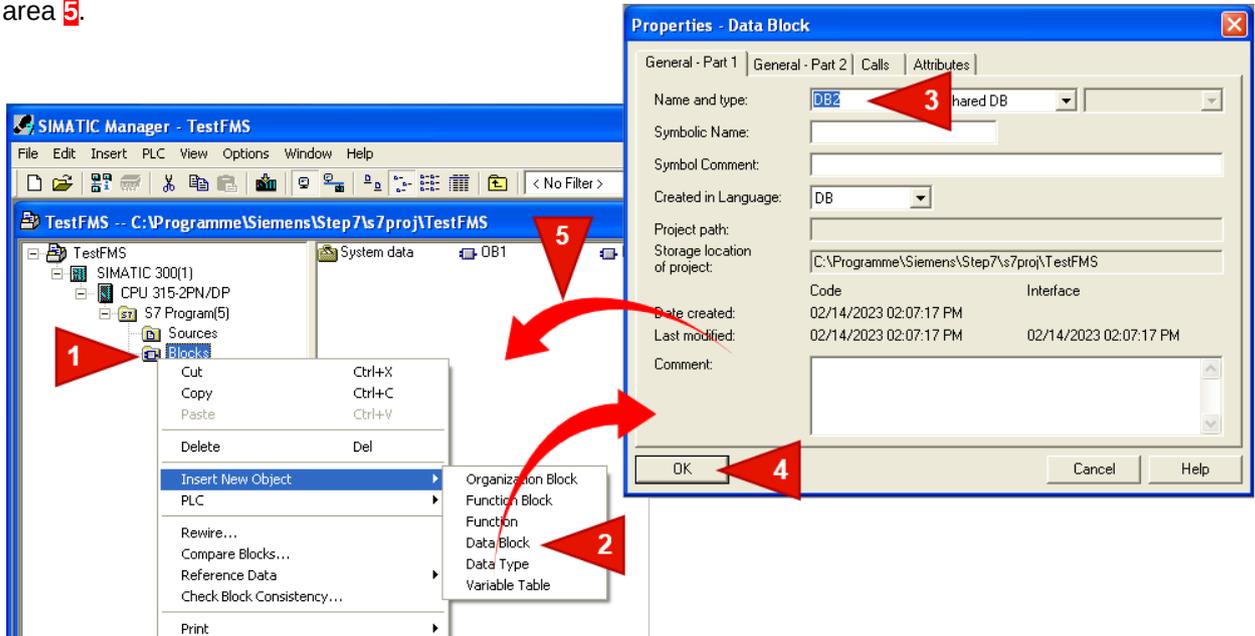
- After all hardware configuration has been made, download it to the PLC **8**. Check if the PLC is satisfied with it. Therefore the LEDs DCV5 and RUN must permanently light green, and no other LEDs should be blinking. If that is not the case, fix the problems first.

- The segFORCE is now ready to use. If you want to test the system, you can read any values of the cyclic data. There is even no program necessary for doing that. In the HW Config window, right-click a parameter (module) of interest, e.g., **Total force (N)** **1**. In the appearing context menu, click on the menu **Monitor/Modify** **2**. That opens the dialog **Monitor/Modify online**. Next, click on the check box **Monitor** **3**. In the table above, the value will be continuously updated **4**. If you push on a segment, you can observe changes in the value. Furthermore, the table shows you how the parameter can be addressed later on in your program **5**.

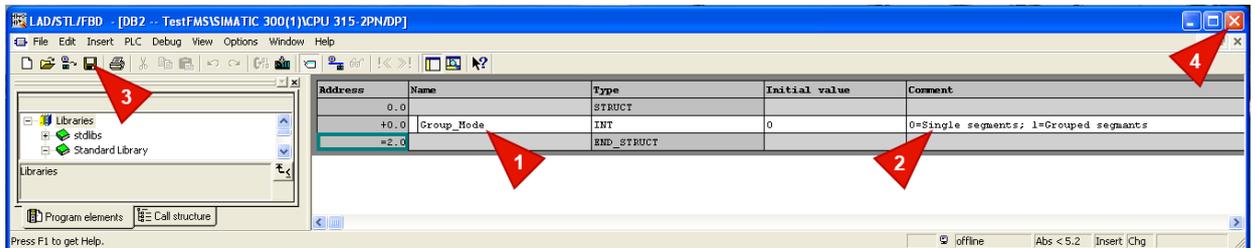


For the following steps, close all dialogs until you are back on the SIMATIC Manager main window.

- The last thing to explain is how to switch the segFORCE group mode. For that purpose, a little program is needed. First, insert a new data block by right-clicking the **Blocks** **1** item under the project tree and choosing the command **Insert New Object -> Data Block** **2**. Enter the name, e.g., **DB2** **3** or another new name, and confirm the dialog with a click on **Ok** **4**. Double-click the newly inserted data block **DB2** in this area **5**.



- The last action above **5** opens the data block definition. Enter the parameter name **Group_Mode** **1** and a comment **2**. Save the changes **3** and close the window **4**.



- Next, select the item **Blocks** **1** under the project tree and double-click the object **OB1** **2** on the right window panel. That opens the programming window. In the programming area, insert two networks **3** by hitting Ctrl-r on the keyboard. They are empty in the first place, not as shown in the picture.

Network 1 converts the digital input **Group Mode** to a variable of type WORD. To achieve that, insert the functions **WAND_W** and **SHR_W** to network 1 **4**. Edit the four inputs and two outputs as shown in the picture **5**, whereas IN1 points to the physical address of the segFORCE status bits.

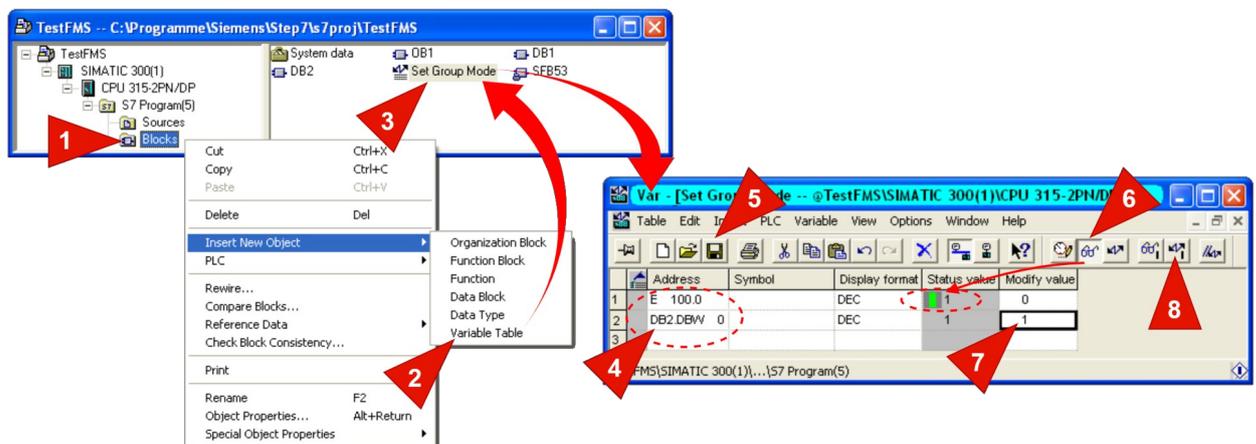
Network 2 sends the group mode value when the demanded group mode differs from the set. To achieve that behavior, select the item **System Function Blocks** on tree **6**. Further down the branch, drag the **SFB53 WRREC DP** function block **7** to the desired network. Enter the name of a data block not yet used, e.g., **DB1** **8**, and confirm the creation if it does not already exist. Insert the comparator **CMP<>I** into the input **REQ** **9**. Edit the six inputs as shown in the picture **10**, whereas ID points to the physical address of the Parameter Access Point. The address must be specified in hexadecimal format.

Slot	Module	Order number	I address	Q address	Diagnostic address	Com...
0	segforce					
1	segforce					
1.1	PROFINET-IO					
1.2	Port 1					
1.3	Port 2					
1.4	Parameter Access Point					
7	General					
7.1	Last error	556	559			
7.2	Number of segments	560	563			
7.3	Number of groups	564	567			
7.4	segFORCE status	100	103			
7.5	Total force (N)	568	571			
7.6	Temperature (°C)	572	575			
7.7	Pressure (kPa)	576	579			
2	Feedback segment 1					
2.1	Force of segment 1 (N)	256	259			
2.2	Speed of segment 1 (m/s)	260	263			
2.3	Status of segment 1	0	1			

- Download program to the PLC.

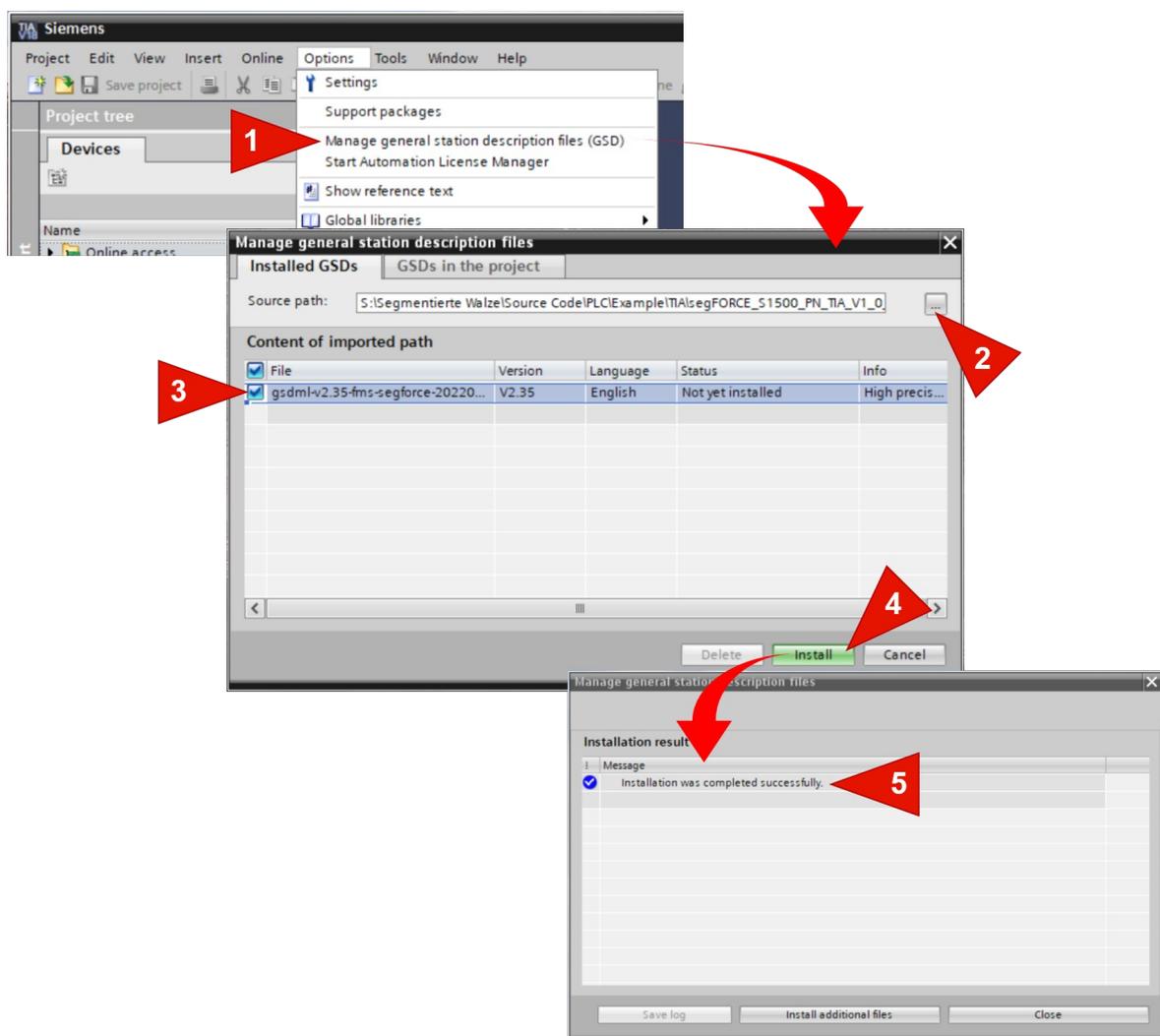
- How to use the program. First, right-click on the tree item **Blocks** **1**, and select the submenu **Insert New Object -> Variable Table** **2**. In the popping-up dialog, enter the Symbolic Name, e.g., **Set Group Mode**, and click on Ok. The variable table is now available in the area on the right of the window. Double-click the item to open the variable table **3**. Enter the two addresses as shown in the picture **4**, or take the ones you have used during the configuration above. They may differ from this description. In the first line, the address E 100.0 indicates the status of the Group Mode bit of the segFORCE. The second line with the address DB2DBW 0 is used to change the Group Mode. Click on Save to save the changes to the table **5**.

Click on the glasses icon to start the variables' monitoring process **6**. Now you can see the actual setting of the Group Mode. If you want to change the Group Mode, enter the desired value into **Modify value** **7**, and click next on the flash icon **8**. That action sends the new value to the PLC, and the **Group Mode** bit must also change accordingly **6** when the communication to the PLC works correctly.

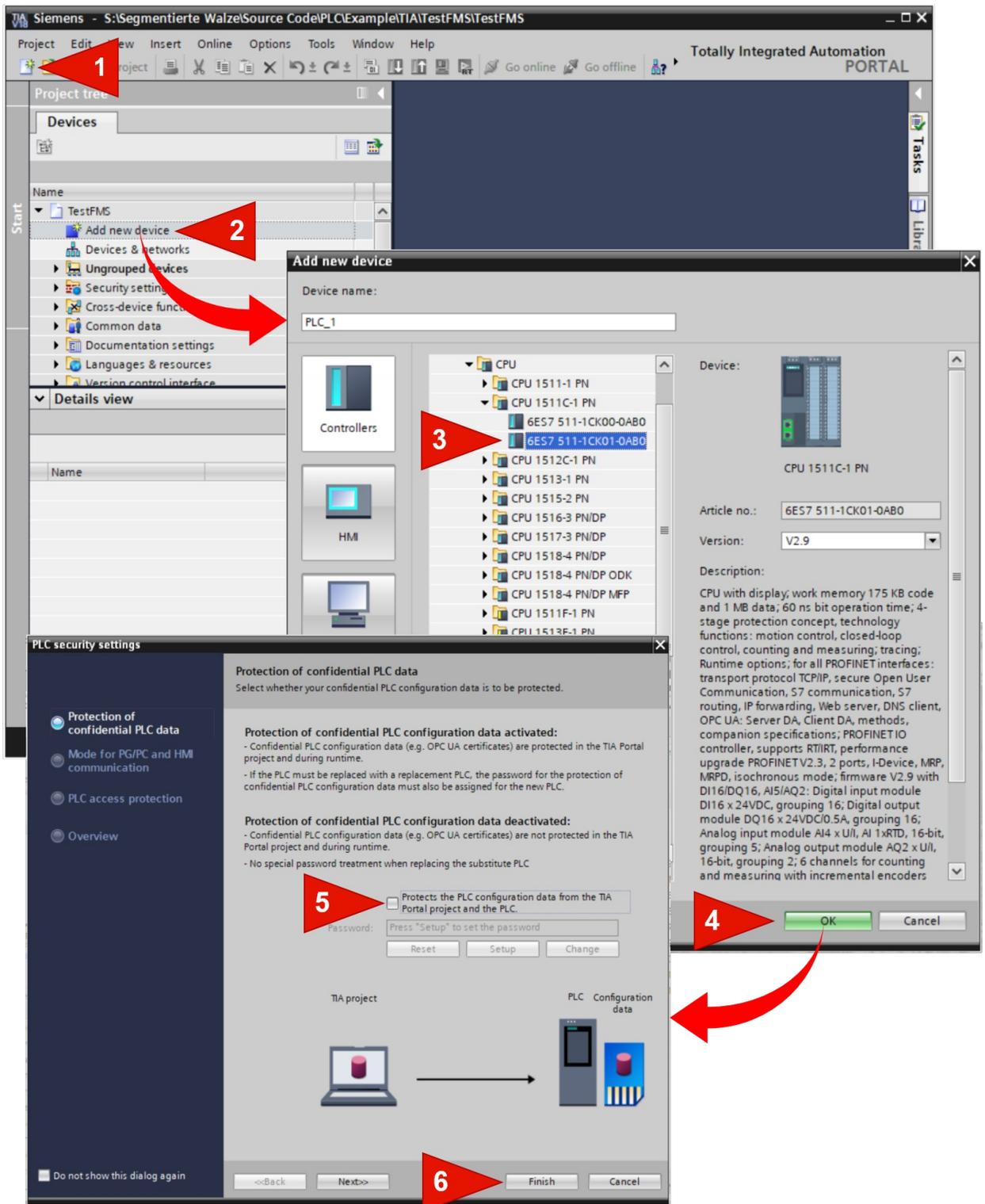


1.5.2 TIA Portal

- Execute the **TIA Portal** program.
- The program normally starts with the portal view. Switch to the project view by clicking the **Project view** menu at the bottom left.
- On the TIA Portal main window, choose the menu **Option -> Manage general station description files (GSD) 1**. That opens the dialog for installing GSD files.
- On the **Manage...** dialog, click on the **Browse** button **2**. Choose the directory where the GSDML files are located. In our case, it is c:\segFORCE\GSDML. Return to the previous dialog by clicking on **Select Folder**. Select the GSDML file from the list that is to be installed by ticking the check box **3**. Now click on **Install 4** and accept all questions on the follow-up dialogs until you reach the dialog **Installation was completed successfully 5**. Close all dialog windows until you are back on the main window.



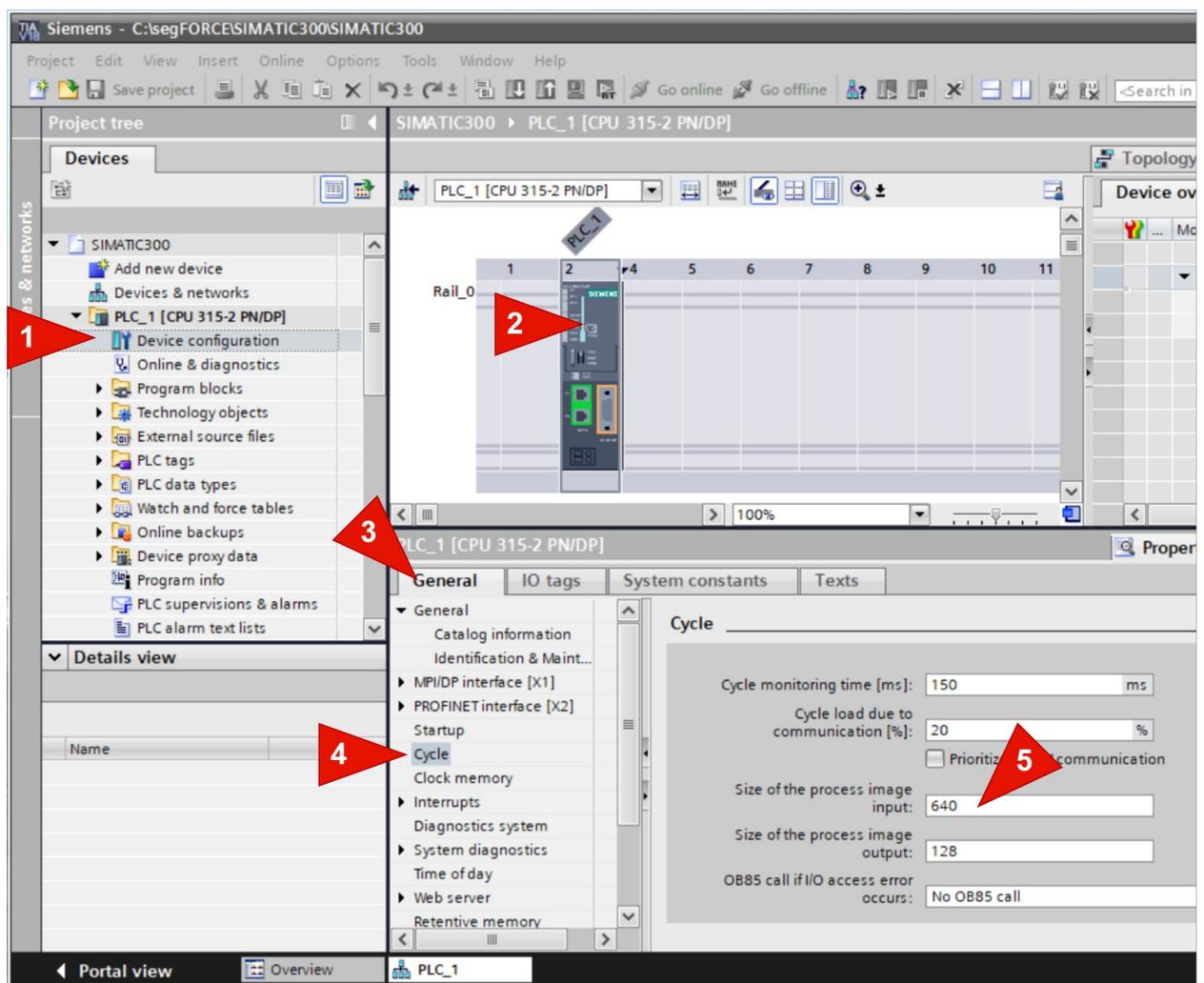
- Open your project or create a new one **1**. In case of a new project, add a new device, e.g., PLC CPU 1511C-1 PN, by double-clicking on **Add new device** **2**. After that, search your CPU **3** and click on **OK** **4**. In the opening dialog **PLC security settings** make sure the check box **Protects the PLC...** is not ticked **5**, and finally, click on **Finish** **6**.



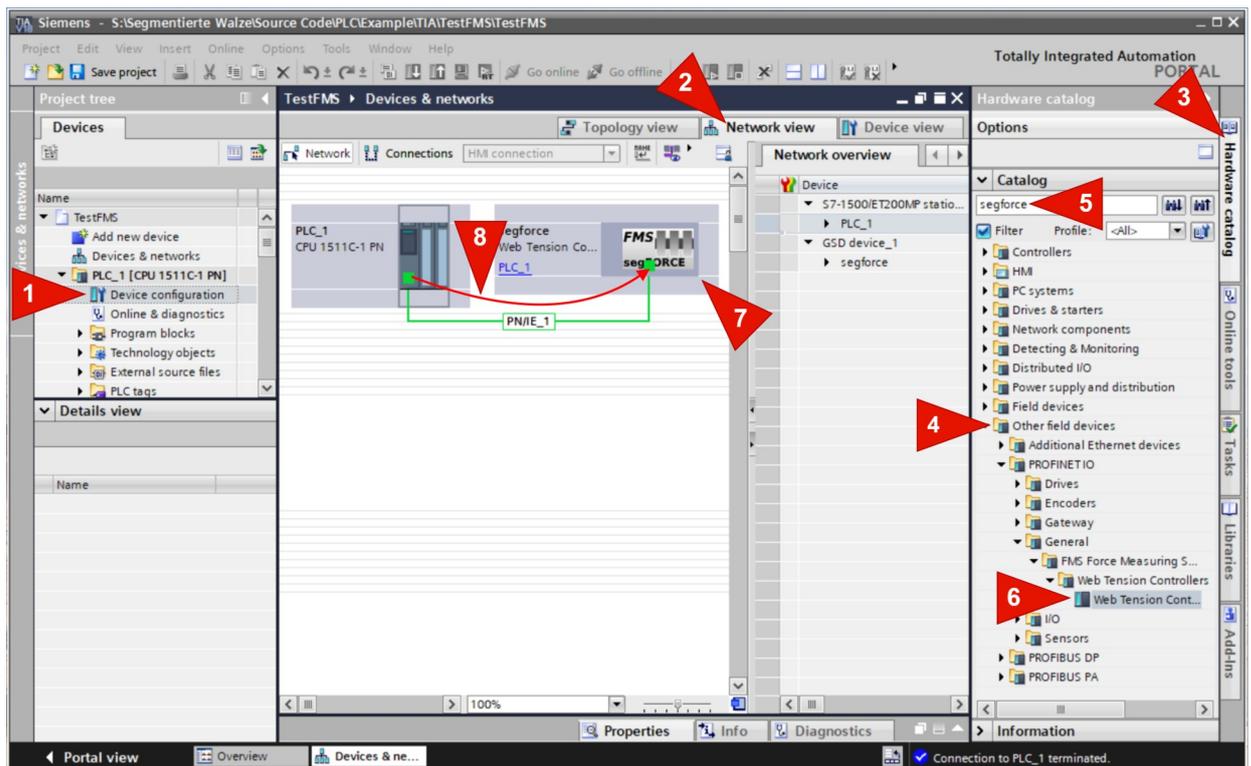


If you have a PLC of the SIMATIC 300 or maybe 400 series added, **make sure to increase the input process image size to a minimum of 640 bytes**. If you don't make that change, not all segFORCE values will be seen. Therefore when reading values from the process image, they return 0 instead of the actual value.

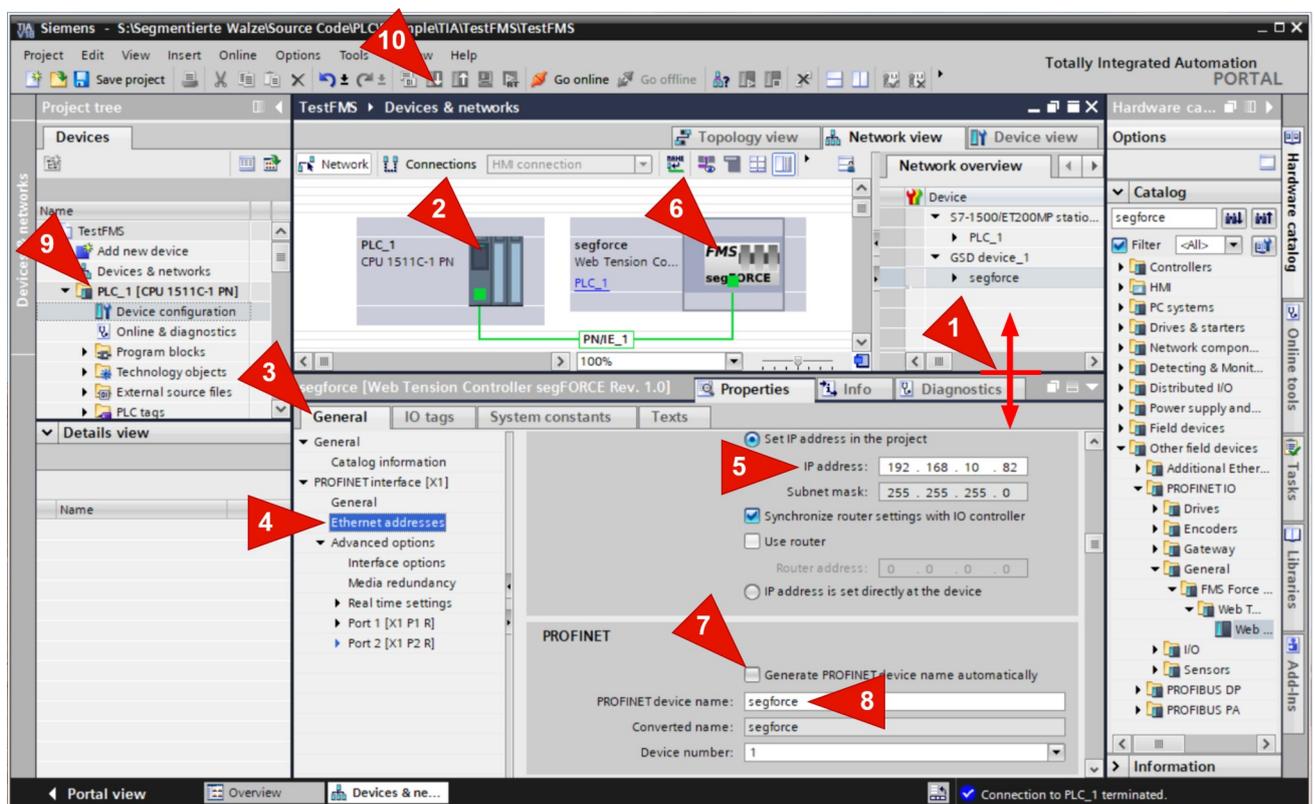
- If you have a SIMATIC 1200 or 1500 series PLC, continue with the next point. But if you have a SIMATIC 300, or maybe the same applies to the 400, double-click on the **Device Configuration** item in the Device Tree **1**. Then double-click the PLC **2**, select the tab **General** **3** and choose the tree item **Cycle** **4**. On the right panel, change the entry filed **Size of the process image input** the value to 640 **5**.



- Add the segFORCE device to the hardware configuration. Double-click in the device tree on the item **Device configuration** **1**. In the right panel, click on the tab **Network view** **2**, and at the right sidebar, on the tab **Hardware catalog** **3**. The catalog tree should be seen, and select **Other field devices** **4** in there. In the search entry field, enter segforce **5** and hit the enter key to start the search. After a while, the entry **Web Tension Controller segFORCE Rev. x.x** appears **6**. When double-clicking that item, the segFORCE is added to the hardware configuration **7**. Connect the PLC and the segFORCE by dragging a line **8** between the Ethernet ports. This action draws a green line between the two devices representing the connection.



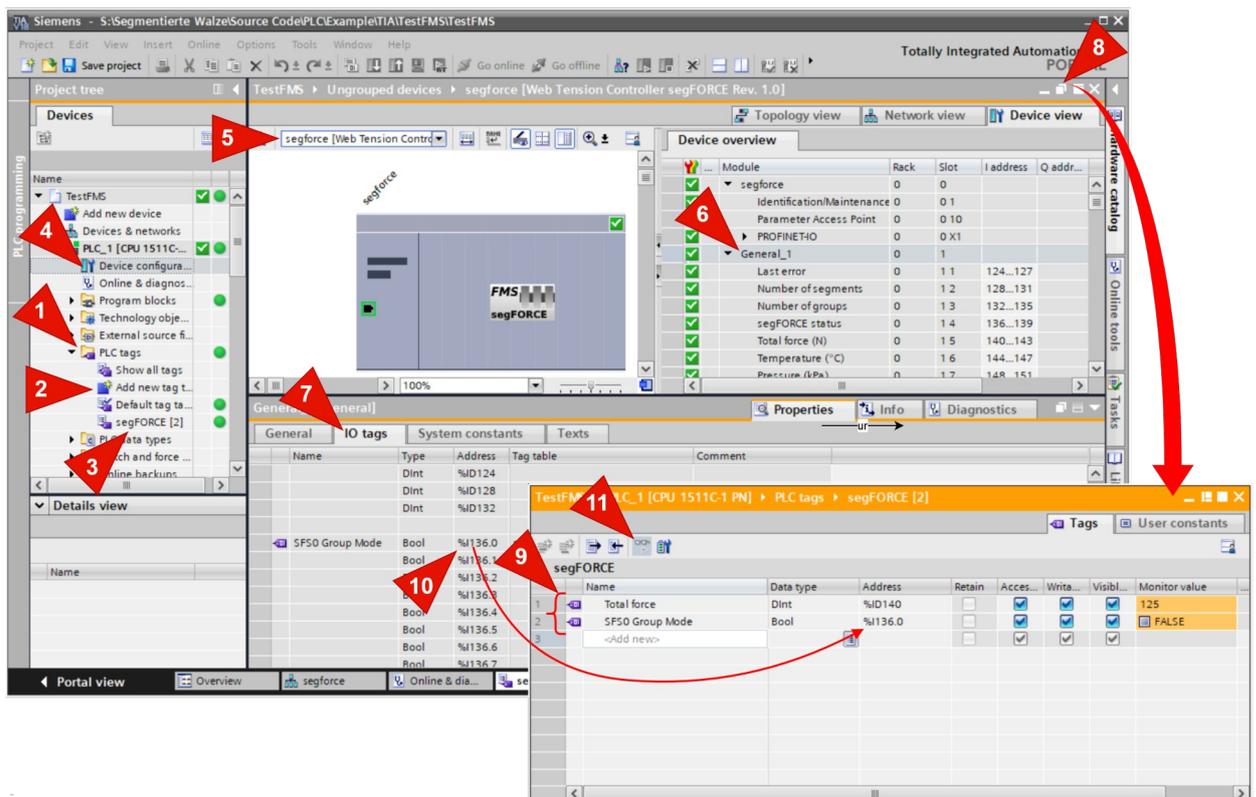
- The next step is to assign the PLC and the segFORCE an unused IP address. In the case of the PLC, that is unnecessary for an existing project because you might already have done that. First, you can stay on the panel above and uncover the lower part of the device configuration by dragging the separator line up **1**. Click on the PLC **2** and then tab General **3**. Select the tree entry Ethernet addresses **4**. Enter the IP address **5** the PLC should get on the panel right of the tree. Next, click on the segFORCE **6** and then tab General **3**. Select the tree entry Ethernet addresses **4**. Enter the IP address the segFORCE should get **5**. As we are already at the right place to set the PROFINET device name, scroll down a bit and ensure the option Generate PROFINET device name automatically is not ticked **7**. Then enter PROFINET device name **segforce** **8**.
- Now it is about time to test the configuration. Download it to the PLC. Click on the entry PLC_1 on the device tree **9** and execute the download by clicking on the download symbol **10**.



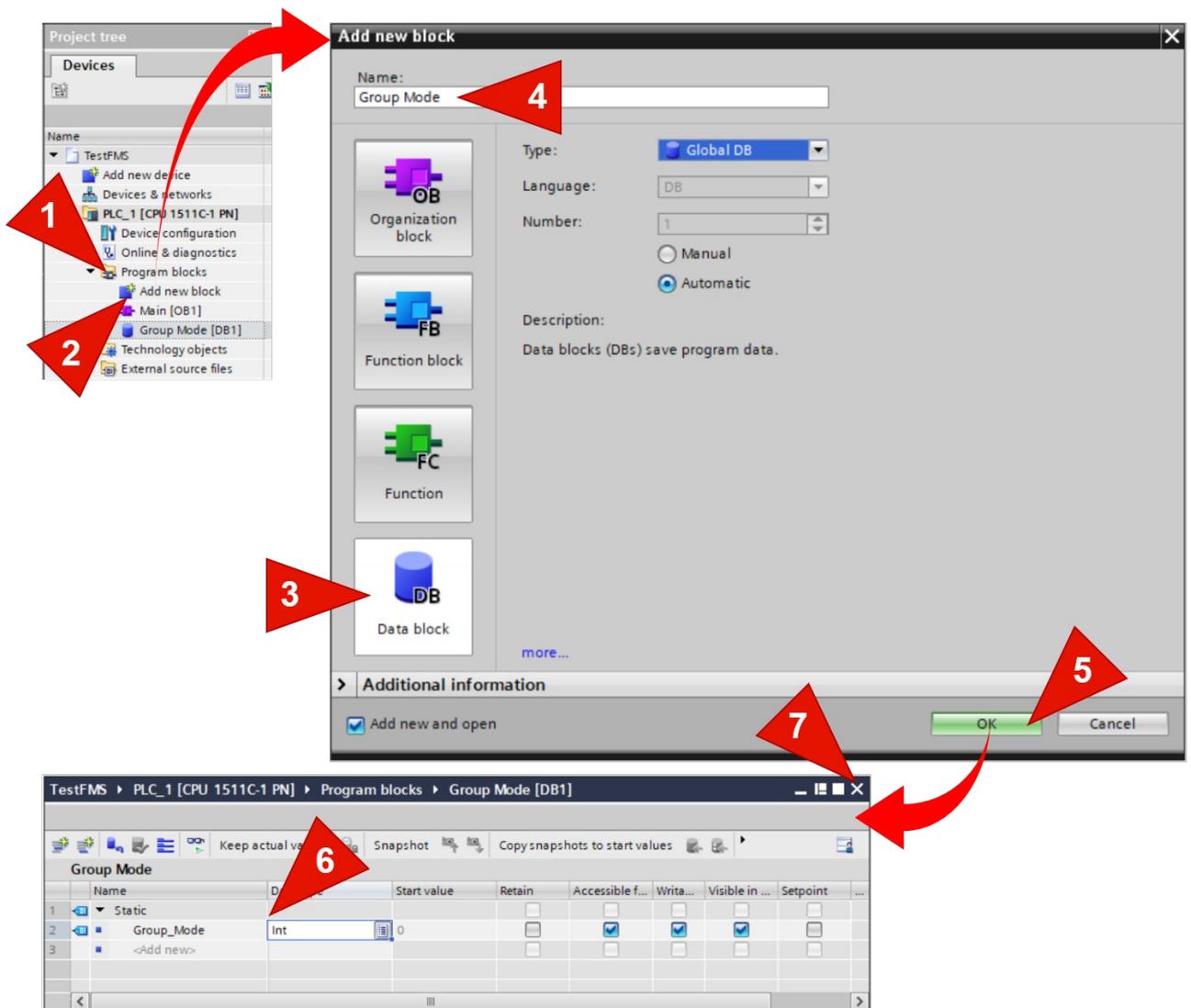
- Continue with the next step when the configuration has been downloaded successfully. Therefore the left LED must permanently light green, and the other two must be dark. If that is not the case, fix the problems first.



- The segFORCE is now ready to use. If you want to test the system, you can read any values of the cyclic data. No program is necessary to achieve this, but you must create a PLC tags table. Open the tree branch **PLC tags** **1**, and double-click on the entry **Add new tag table** **2**. A new table named **Tag table_1 [0]** or similar will be added. Rename the table to **segFORCE** **3**. By the way, the value in square brackets behind the name indicates the number of defined tags in the tag table.
- To look up the absolute addresses of the segFORCE values, which you want to insert into the tag table afterward, double-click on the tree entry **Device configuration** **4**. On the panel on the right, the Device view opens. Select the segFORCE from the drop-down list **5**. Next, select the row **General_1** **6** and make sure the tab **IO tags** **7** have been chosen on the lower panel. That uncovers the absolute addresses of the selected module. Now the tag table segFORCE can be opened for editing. Therefore, double-click on the tag table segFORCE **3** to open it. If the tag table covers the device view, click on the symbol float **8** to detach the window from the main application.
- The quick guide shows just two possible values to visualize. But all others can be added in the same manner. Edit rows 1 and 2 as shown in the picture **9**. The absolute address can be found on the table **IO tags** **10**.
- Download the program again to the PLC.
- Click on the glasses symbol to see the values live **11**.



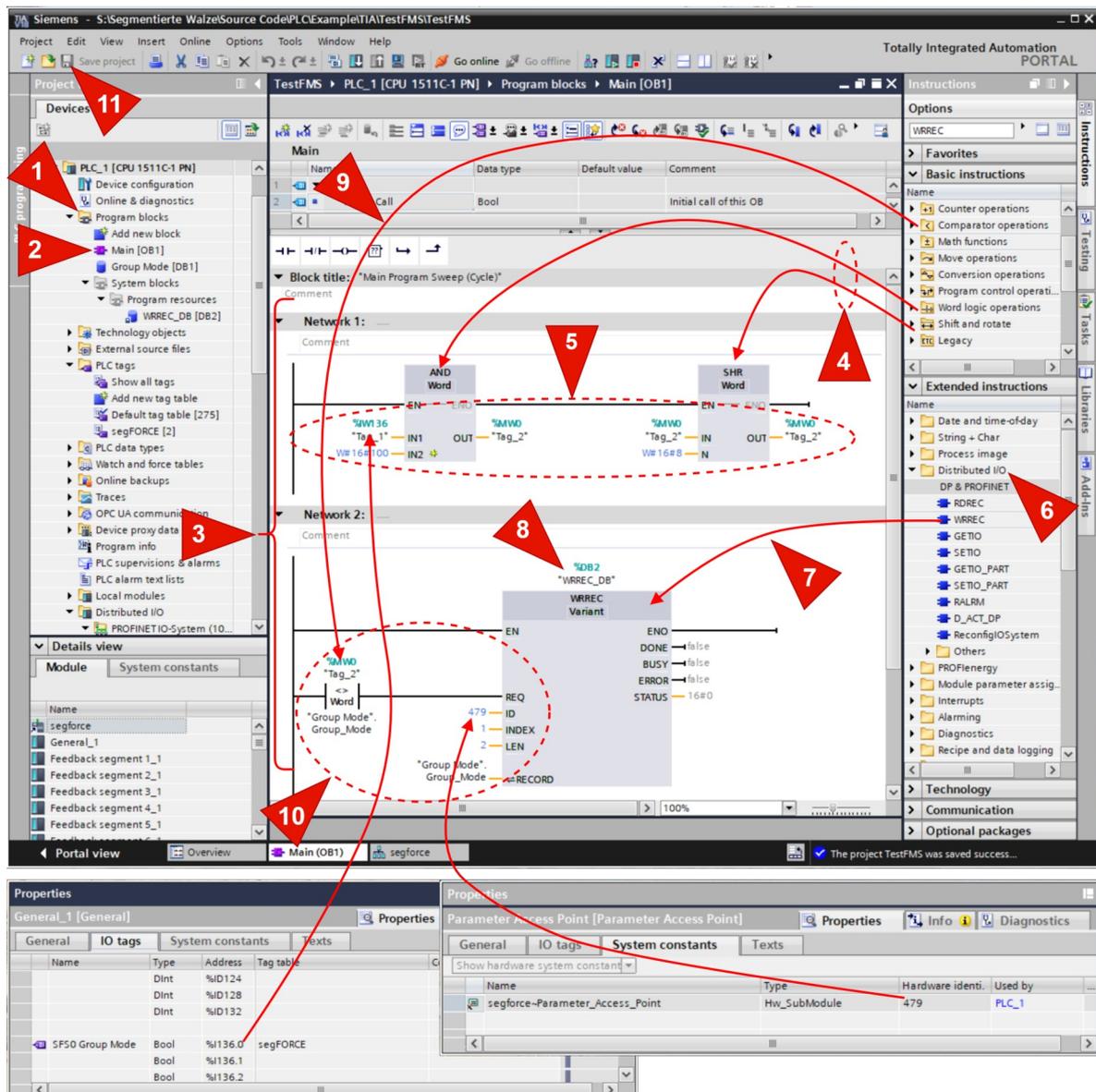
- The last thing to explain is how to switch the segFORCE group mode. For that purpose, a little program is needed. Open the tree branch **Program blocks** **1**, and double-click the tree entry **Add new block** **2**. The dialog **Add new block** pops up. Click on the symbol **Data block** **3**, enter the name **Group Mode** **4**, and confirm the changes with a click on **OK** **5**. That opens the data block for editing. Enter the parameter name **Group_Mode** **6**, the data type **Int**, and close the window **7**.



- Next, open the tree branch **Program blocks** **1**, under the Project tree, and double-click the tree entry **Main [OB1]** **2**. That opens the programming window. In the programming area, insert two networks **3** by hitting Ctrl-r on the keyboard. They are empty in the first place, not as shown in the picture.

Network 1 converts the digital input **Group Mode** to a variable of type WORD. To achieve that, insert the functions AND and SHR to network 1 **4**. Edit the four inputs and two outputs as shown in the picture **5**, whereas IN1 points to the physical address of the segFORCE status bits.

Network 2 sends the group mode value when the demanded group mode differs from the set. To achieve that behavior, open the **Extended instructions -> Distributed I/O** **6**. Drag the WRREC function block **7** to the desired network. Enter the name of a data block not yet used, e.g., WRREC_DB **8**, and confirm the creation by clicking OK. Insert the comparator CMP<> into the input REQ **9**. Edit the six inputs as shown in the picture **10**, whereas ID points to the physical address of the Parameter Access Point. Save the changes **11**.



The screenshot shows the SIMATIC Manager interface with the following components and annotations:

- Project Tree (Left):** Shows the hierarchy: Project > PLC_1 [CPU 1511C-1 PN] > Program blocks > Main [OB1]. Red arrow 11 points to the 'Program blocks' folder, and red arrow 2 points to 'Main [OB1]'.
- Main Programming Area (Center):**
 - Network 1:** Contains an AND Word block and an SHR Word block. Red arrow 4 points to the AND block, and red arrow 5 points to the SHR block. The AND block has inputs %MW 36 (IN1) and %W 16#100 (IN2). The SHR block has inputs %MW 2 (IN) and %W 16#8 (N). Both have outputs %MW 2 (OUT) labeled 'Tag_2'.
 - Network 2:** Contains a WRREC Variant block and a CMP<> block. Red arrow 6 points to the 'Extended instructions -> Distributed I/O' category in the right-hand pane. Red arrow 7 points to the WRREC block. Red arrow 8 points to the data block '%DB2 WRREC_DB'. Red arrow 9 points to the CMP<> block. Red arrow 10 points to the network wiring. The WRREC block has inputs ENO, DONE, BUSY, ERROR, STATUS, and REQ. The REQ input is connected to the output of the CMP<> block. The WRREC block has outputs ENO, DONE, BUSY, ERROR, STATUS, and RECORD.
- Properties Window (Bottom):**
 - General_1 [General]:** Shows system constants for 'segFORCE' with addresses %I136.0, %I136.1, and %I136.2.
 - Parameter Access Point [Parameter Access Point]:** Shows the 'segforce-Parameter_Access_Point' with hardware address 479 and used by 'PLC_1'.

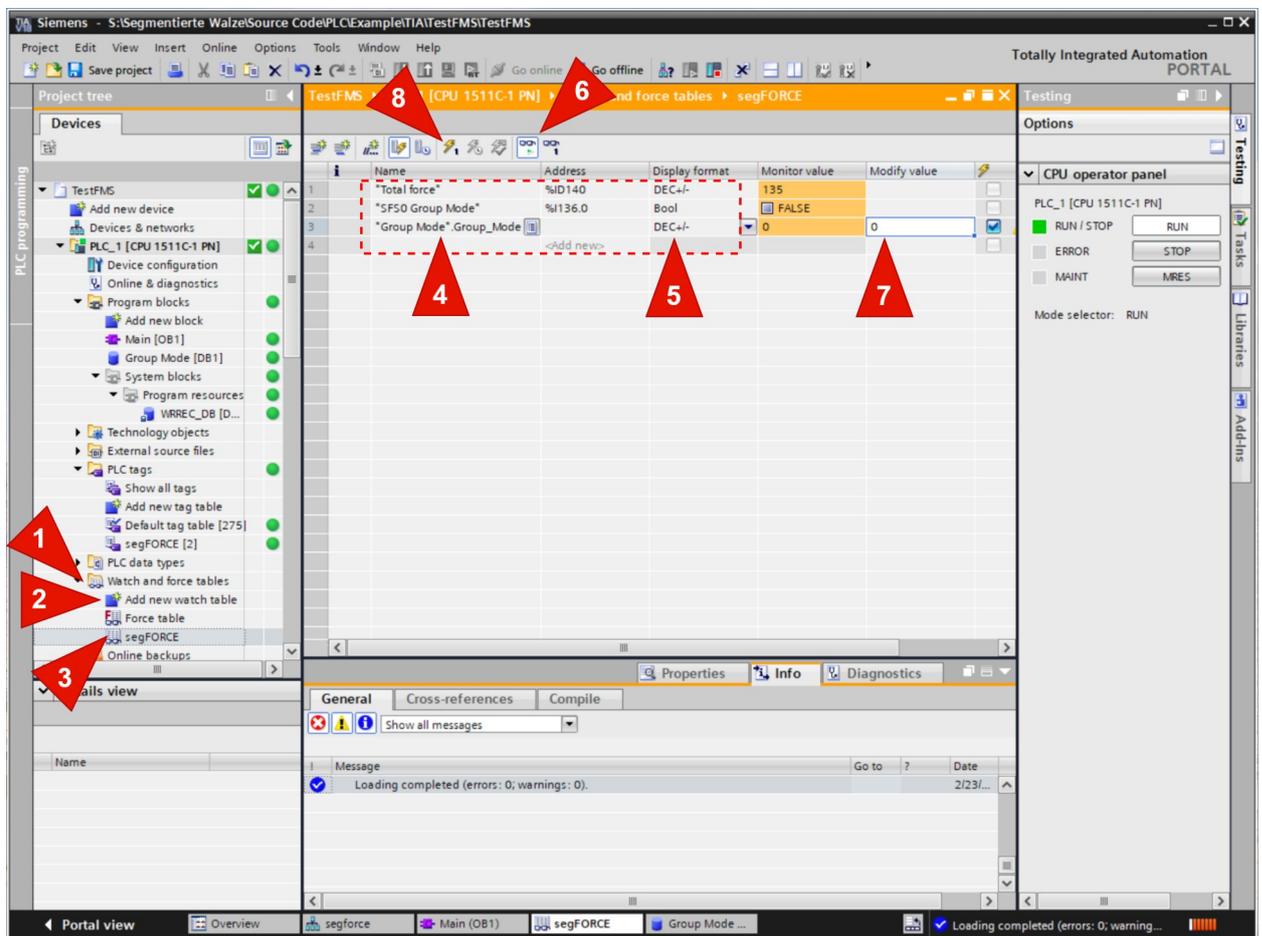
- Download program to the PLC.
- How to use the program. Open the folder **Watch and force tables** **1** under the PLC project tree, and double-click the tree entry **Add new watch table** **2**. A new table named **Watch table_1** or similar will be added. Rename the table to **segFORCE** **3**. After adding the watch table, it should already be open for editing on the right side of the tree window. Even all tags should be available when you fulfilled all steps above. Therefore, edit the table according to the picture. Just enter the name **4**. The addresses will be inserted automatically because of the tag definition. The last thing you have to do is to adapt the Display format **5**.

Once the variable table has been edited,

6 click on the icon with the glasses to see the values live.

7 set the value to 1 to activate group mode or 0 the get back to the single segment mode

8 click on the icon with the flash to send the command to the PLC



The screenshot shows the Siemens SIMATIC Manager software interface. The project tree on the left is expanded to show the 'Watch and force tables' folder, with 'segFORCE' selected. The main window displays a table with the following data:

Name	Address	Display format	Monitor value	Modify value
"Total force"	%ID140	DEC+/-	135	
"SF50 Group Mode"	%I136.0	Bool	FALSE	
"Group Mode".Group_Mode		DEC+/-	0	0

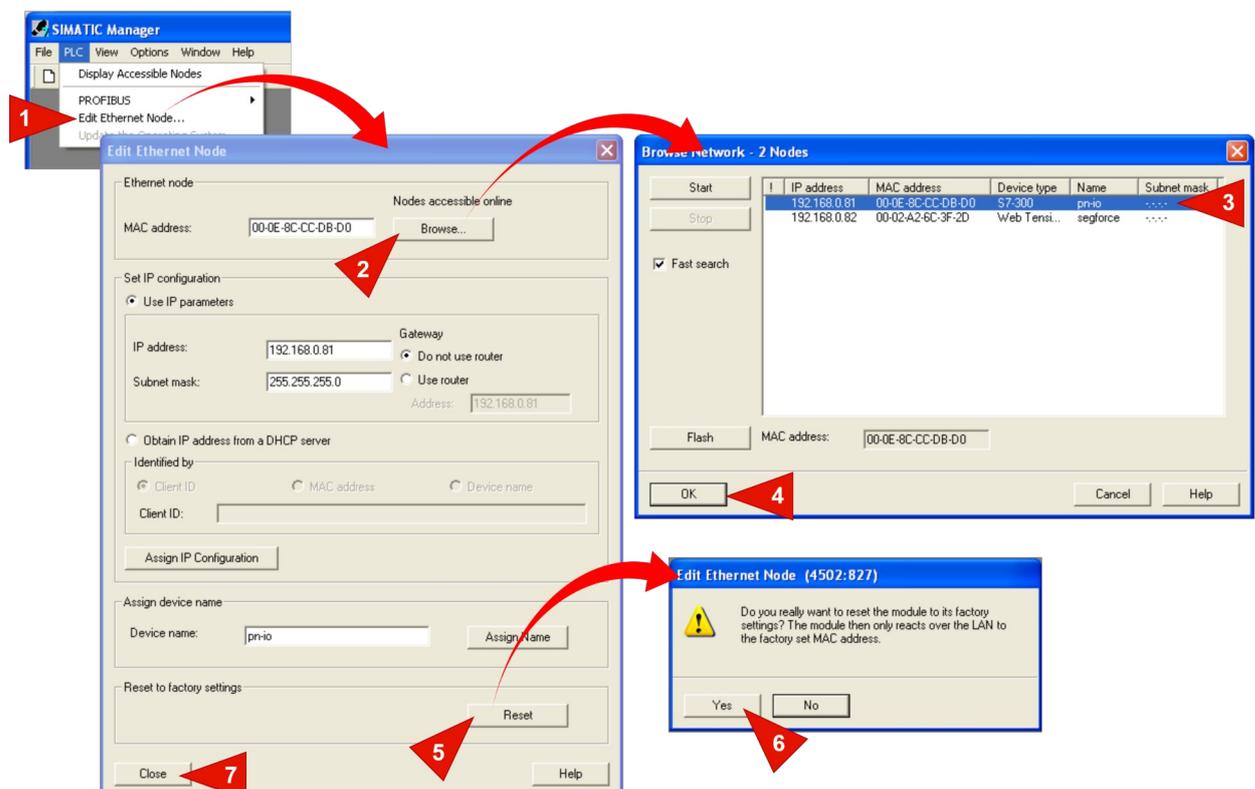
The right-hand panel shows the 'CPU operator panel' for 'PLC_1 [CPU 1511C-1 PN]' with buttons for 'RUN / STOP', 'ERROR', 'STOP', 'MAINT', and 'MRES'. The mode selector is set to 'RUN'.

2 PLC Operation Commands

2.1 How to reset a PLC to factory settings

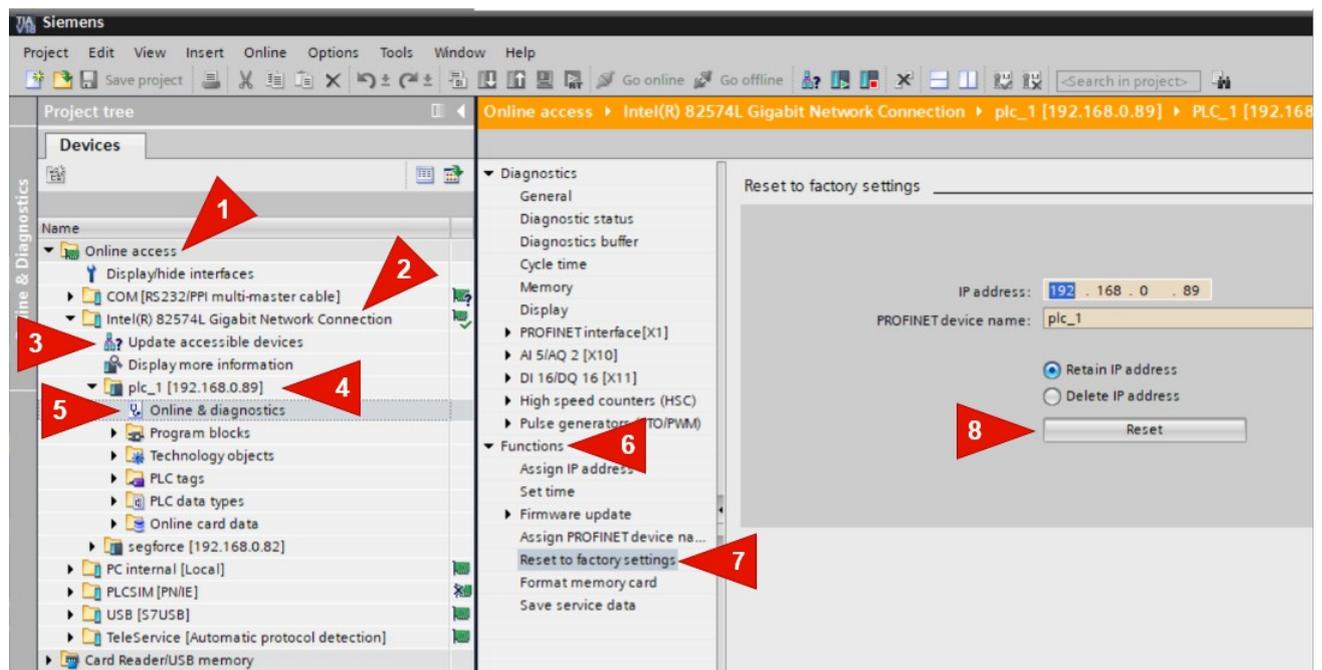
2.1.1 Resetting PLC with Step 7 SIMATIC Manager

- Execute the **SIMATIC Manager** program.
- Select the **PLC ->Edit Ethernet Node 1** menu in the main window. A project doesn't need to be open; if so, the PLC menu contains several more entries. Just select the appropriate menu. This action opens the dialog Edit Ethernet Node.
- Click on **Browse 2** which opens the dialog Browse Network. The search for PROFINET devices starts automatically after roughly 3 seconds. Just be patient until the list is filled with the found devices.
- Select the PLC from the list **3**, which should be reset to its factory defaults. If it is not listed, a network problem could be the reason, e.g., the cabling is wrong, a router is in between, or the PLC is not powered on.
- Click **OK 4** to confirm the selection and return to the previous dialog in which the properties of the chosen PLC are filled up in the entry fields.
- Finally, click **Reset 5** and confirm the action on the popped-up dialog with **Yes 6**.
- All work is done, therefore leave the dialog by clicking on **Close 7**.



2.1.2 Resetting PLC with TIA Portal

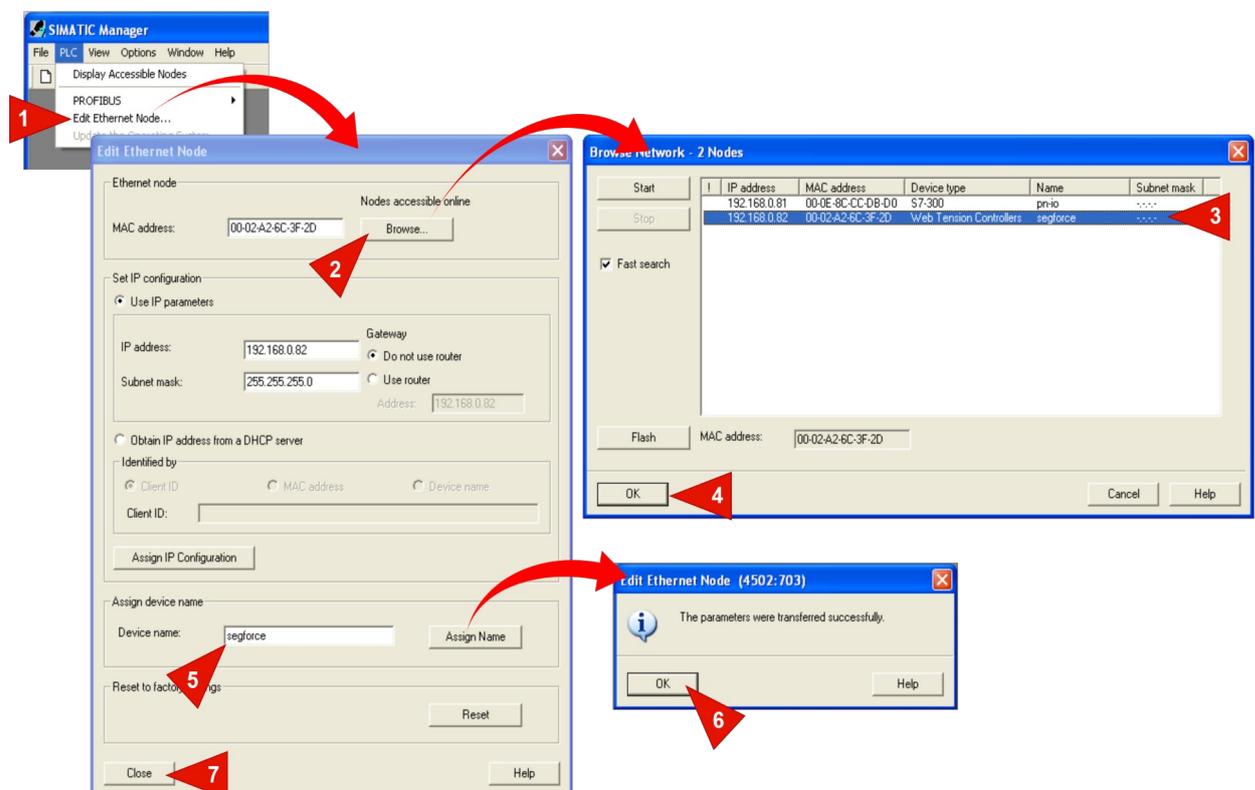
- Execute the **TIA Portal** program.
- The program normally starts with the portal view. Switch to the project view by clicking the **Project view** menu at the bottom left.
- Open the Online access tree **1** and the Ethernet interface card **2**, over which the PC is connected to the network.
- Double-click on the item **Update accessible devices** **3**. After a while, all PROFINET devices on the same network emerge.
- Open the tree of your PLC. The shown IP address may differ from yours **4**.
- Double-click on the item **Online & diagnostics** **5**. That action opens the diagnostics panel right of the tree panel.
- On the diagnostics panel, open the **Functions** tree **6** and select the item **Reset to factory settings** **7**. That action opens the appropriate entry form on the right.
- Finally, click on the button **Reset** **8**. That action takes a moment. You can observe flashing LEDs at the PLC front.



2.2 How to assign the PROFINET device name

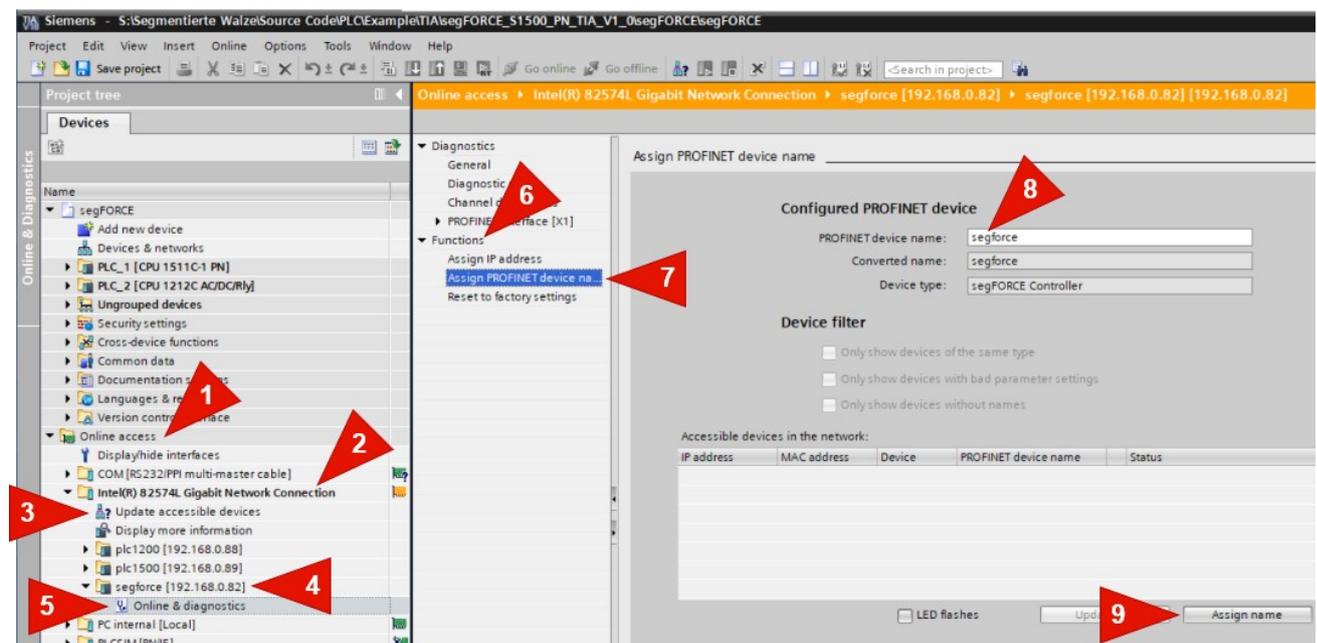
2.2.1 Name assignment with Step 7 SIMATIC Manager

- Execute the **SIMATIC Manager** program.
- Select the **PLC ->Edit Ethernet Node 1** menu in the main window. A project doesn't need to be open; if so, the PLC menu contains several more entries. Just select the appropriate menu. This action opens the dialog Edit Ethernet Node.
- Click on **Browse 2** which opens the dialog Browse Network. The search for PROFINET devices starts automatically after roughly 3 seconds. Just be patient until the list is filled with the found devices.
- Select the segFORCE from the list **3** you want to assign the device name to. If it is not listed, a network problem could be why, e.g., the cabling is wrong, a router is in between, or the segFORCE is not powered on.
- Click **OK 4** to confirm the selection and return to the previous dialog in which the properties of the chosen segFORCE are filled up in the entry fields.
- Finally, click **Assign Name 5** and confirm the action on the popped-up dialog with **OK 6**.
- All work is done, therefore leave the dialog by clicking on **Close 7**.



2.2.2 Name assignment with TIA Portal

- Execute the **TIA Portal** program.
- The program normally starts with the portal view. Switch to the project view by clicking the **Project view** menu at the bottom left.
- Open the Online access tree **1** and the Ethernet interface card **2**, over which the PC is connected to the network.
- Double-click on the item **Update accessible devices** **3**. After a while, all PROFINET devices on the same network emerge.
- Open the tree of your segFORCE. The shown name and IP address might differ **4**.
- Double-click on the item **Online & diagnostics** **5**. That action opens the diagnostics panel right of the tree panel.
- On the diagnostics panel, open the **Functions** tree **6** and select the item **Assign PROFINET device name** **7**. That action opens the appropriate entry form on the right.
- Type the PROFINET device name **segforce** into the entry field **8**. Note that the name must be all lowercase.
- Finally, click on the button **Assign name** **9**.



3 Appendix

3.1 PROFINET Interface



The PROFINET interface always uses metric units, although imperial units might be configured for the Web Interface. The reason for that behavior is that the PLC must also handle a unit system change in their program. Therefore it is much easier and less error prom to keep the Fieldbus interface consistent on what a PLC can count on.

3.1.1 Cyclic Data Traffic

The cyclic data traffic reads the data of typically measured values of the segFORCE in a defined time rate and updates it in the PLC. The PLC defines the cycle time for their protocol, e.g., PROFINET, Modbus/TCP, etc. The table below shows the available data and how they must be interpreted.

The interface is designed such that a PLC always gets the data of a fully equipped segment-roller, therefore 50 segments, even if it has not been fully build-out. Measured values of not equipped segments return zero and the segment status bit *Seg. or Group exists* is false.

Consecutive segments can be grouped into one virtual segment. The number of segments that can be grouped depends on the number of individual available segments.

The actual segment values are returned in the data structure from segment ID 1 to ID 50, either individually or grouped. What kind of values will be returned depends on set the **Group mode** status. By default, the **Group mode** is set to individual segments. Therefore the bit **Group mode** is set to false. The **Group mode** can be switched over the command interface.

PROFINET (Cyclic Data read-only)																
Slot / Subslot	Pos.	Type Parameter	Unit	Valid range and Description number format												
1/1	-	INT32 Last Error		0 No Error 1 Command allowed, accepted, and is running. <i>Not implemented yet.</i> 2 The Command is not allowed because the segFORCE controller is in automatic mode <i>Not implemented yet.</i> 3 The command is not allowed when another command already runs. <i>Not implemented yet.</i>												
1/2	-	UNIT32 Number of segments		1 to 50 This parameter shows the number of # segments mounted on the roller.												
1/3	-	UNIT32 Number of groups		0 to 50 This parameter shows the number of # configured groups.												
1/4	-	UINT32 segFORCE status		<table border="0" style="width: 100%;"> <tr> <td style="width: 50%;">Bit 0: Group mode</td> <td>True Returns grouped segment data. False Returns individual segment data.</td> </tr> <tr> <td>Bit 1: Digital Input</td> <td>True <i>Not implemented yet.</i> False</td> </tr> <tr> <td>Bit 2: Status digital output 1</td> <td>True Clamp pressure on False Clamp pressure off The purpose of the output is to control the pressure valve. <i>Not implemented yet.</i></td> </tr> <tr> <td>Bit 3: Status digital output 2</td> <td>True Alarm on False Alarm off</td> </tr> <tr> <td>Bit 4: Automatic Operation Mode</td> <td>True Automatic operation active False Manual operation active <i>Not implemented yet.</i></td> </tr> <tr> <td>Bit 5 to Bit 31</td> <td><i>Reserved for future use.</i></td> </tr> </table>	Bit 0: Group mode	True Returns grouped segment data. False Returns individual segment data.	Bit 1: Digital Input	True <i>Not implemented yet.</i> False	Bit 2: Status digital output 1	True Clamp pressure on False Clamp pressure off The purpose of the output is to control the pressure valve. <i>Not implemented yet.</i>	Bit 3: Status digital output 2	True Alarm on False Alarm off	Bit 4: Automatic Operation Mode	True Automatic operation active False Manual operation active <i>Not implemented yet.</i>	Bit 5 to Bit 31	<i>Reserved for future use.</i>
Bit 0: Group mode	True Returns grouped segment data. False Returns individual segment data.															
Bit 1: Digital Input	True <i>Not implemented yet.</i> False															
Bit 2: Status digital output 1	True Clamp pressure on False Clamp pressure off The purpose of the output is to control the pressure valve. <i>Not implemented yet.</i>															
Bit 3: Status digital output 2	True Alarm on False Alarm off															
Bit 4: Automatic Operation Mode	True Automatic operation active False Manual operation active <i>Not implemented yet.</i>															
Bit 5 to Bit 31	<i>Reserved for future use.</i>															
1/5		INT32 Total force	N	-200'000'000 to 200'000'000 The total force value shows the summed force of all segments on the roller. #.###												
1/6		INT32 Temperature	°C	-1000 to 2000 Temperature at segFORCE #. #												
1/7		INT32 Pressure	kPa	0 to 100'000'000 Pressure sensor #												
↓ further table rows ↓																

PROFINET (Cyclic Data read-only)				
Slot / Subslot	Pos.	Type Parameter	Unit	Valid range and Description number format
Individual segments from 1 to 50 or grouped segments from 0 to 50				
2/1	1	INT32 Force of the segment or group at pos. 1	N	-200'000'000 to 200'000'000 #.###
2/2	1	INT16 Speed of the segment or group at pos. 1	m/min	0 to 10000 #. #
2/3	1	UINT16 Status of the segment or group at pos. 1		Status of the segment or group at position 1.
		Bit 0: Seg. status 1		n/a when grouped segment <i>Not implemented yet</i>
		Bit 1: Seg. status 2		n/a when grouped segment <i>Not implemented yet</i>
		Bit 2: Seg. status 3		n/a when grouped segment <i>Not implemented yet</i>
		Bit 3: Seg. speed pulse status		n/a when grouped segment
		Bit:4 to 6:		<i>Reserved for future use.</i>
		Bit:7: Seg. or Group exists		True All data of the segment or group are valid. False The cyclic data structure spans over a fully equipped roller with a maximum of 50 segments. If the roller has less than 50 segments configured, then the not used segment or group entries are marked as not existing. All data of such a segment or group are initialized to zero and invalid.
		Bit 8 to 15: Group number		0 to 50 The group number is used to identify the # individual segments that belong to a group.
		v	v	v
		v	v	v
		v	v	v
51/1	50	INT32 Force of the segment or group at pos. 50	N	-200'000'000 to 200'000'000 #.###
51/2	50	INT16 Speed of the segment or group at pos. 50	m/min	0 to 10000 #. #
51/3	50	UNT16 Status of the segment or group at pos. 50		Status of the segment or group at position 50

3.1.2 Acyclic Data Traffic

A PLC can exchange acyclic data with the segFORCE. These data are used to control the behavior of the segFORCE. The table below shows all available commands. This is the control of the Group Mode. The commands can be read and written. But only writing makes sense for commands. Note that writing the same value again is possible, and that also executes the command again.

Detailed command description

The group mode determines which data is returned via the cyclic data block from PROFINET. This can be either the individual or grouped segment data structure. The PROFINET stack is limited to 170 sub-slots and cannot return both cases in one entire data block. Therefore, the PLC must distinguish between these two structures and handle the data accordingly.



Group mode is not saved permanently.

The status of the group mode is not saved permanently. After restarting the system, the group mode assumes its default value. Then the data block will return the values of individual segments.

PROFINET	Parameter Access Point / Slot 0 / Subslot 10			I address: xxxx see Device overview	
Index	Type	Commands	Unit	Possible Values	Description
1	WORD	Set Group Mode		0	The cyclic data block returns individual segment data.
				1	The cyclic data block returns grouped segment data.