

# **segFORCE**

## **Quick Start Guide for PROFINET**

PLC Examples and Configuration

Document version 1.0

Document date February 27, 2023

Author

Thomas Zörjen

# Contents

<b>1</b>	<b>SIMATIC PROFINET.....</b>	<b>1</b>
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
<b>2</b>	<b>PLC Operation Commands.....</b>	<b>25</b>
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
<b>3</b>	<b>Appendix.....</b>	<b>29</b>
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

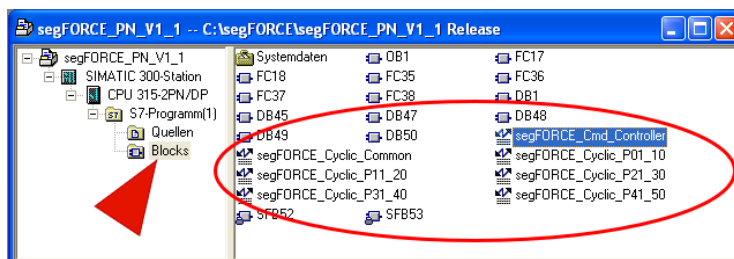
### 1.3.1 Setting up the project

- 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.



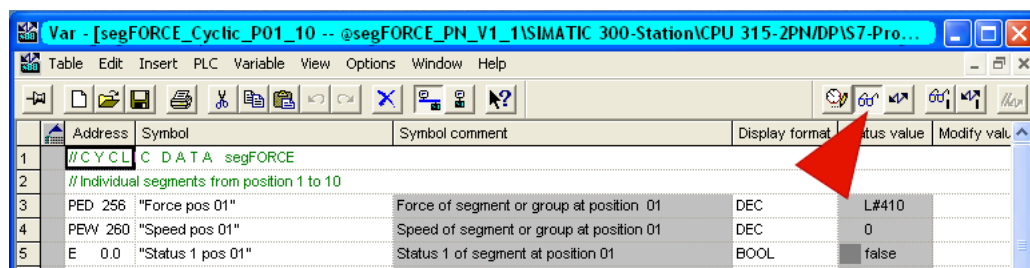
### 1.3.2 How to use the example program

- 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:

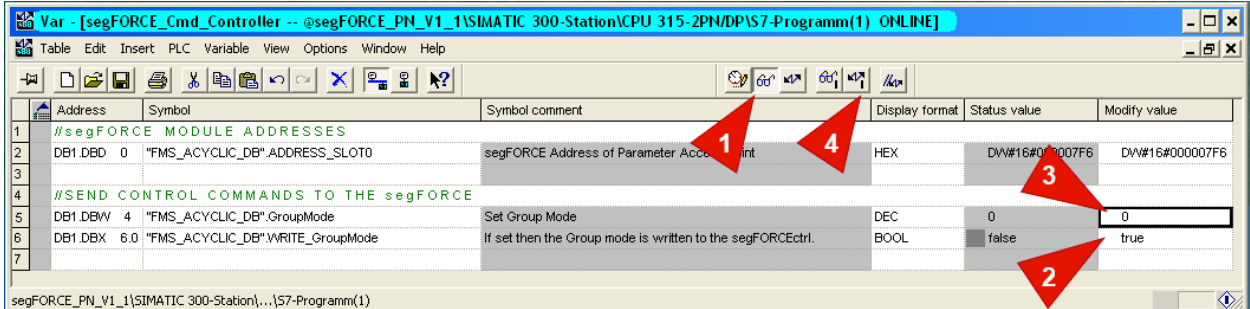


- |                          |  |
|--------------------------|--|
| - segFORCE_Cyclic_Common | General information about the entire roller. |
| - segFORCE_Cyclic_P01_10 | Segments at positions 1 to 10                |
| - segFORCE_Cyclic_P11_20 | Segments at positions 11 to 20               |
| - segFORCE_Cyclic_P21_30 | 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		<b>// segFORCE MODULE ADDRESSES</b>				
2	DB1.DBD 0	"FMS_ACYCLIC_DB".ADDRESS_SLOT0	segFORCE Address of Parameter Access Point	HEX	DW#16#000007F6	DW#16#000007F6
3		<b>// SEND CONTROL COMMANDS TO THE segFORCE</b>				
5	DB1.DBW 4	"FMS_ACYCLIC_DB".GroupMode	Set Group Mode	DEC	0	0
6	DB1.DBX 6.0	"FMS_ACYCLIC_DB".WRITE_GroupMode	If set then the Group mode is written to the segFORCEctrl.	BOOL	false	true
7						

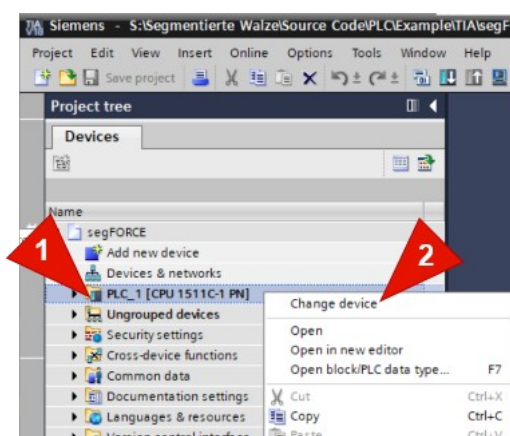


For further information on how the grouping of segments works and how the data are transferred to the PLC, consult the segFORCE Operation Manual.

## 1.4 Use the TIA Portal example

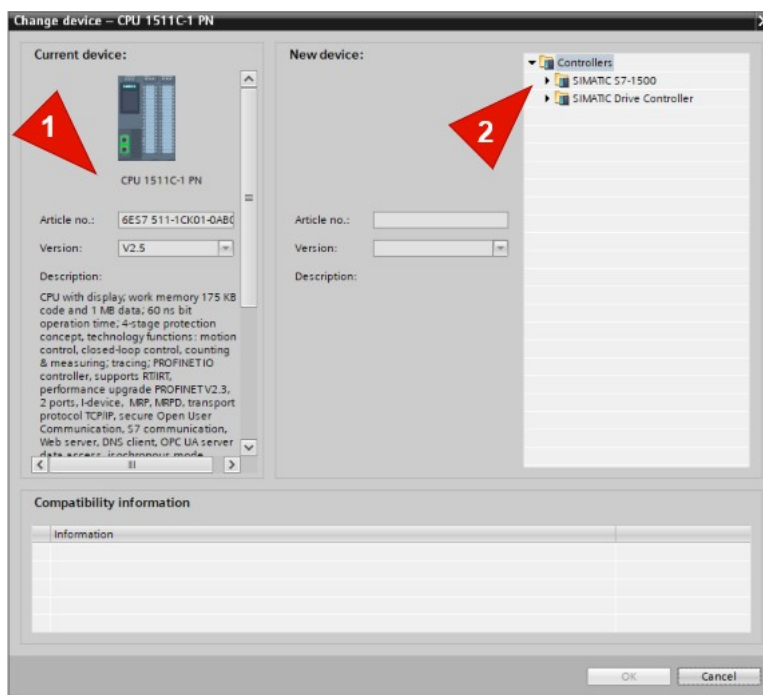
### 1.4.1 Setting up the TIA project

- 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]** **1** and click after that on **Change devices** **2**. 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.

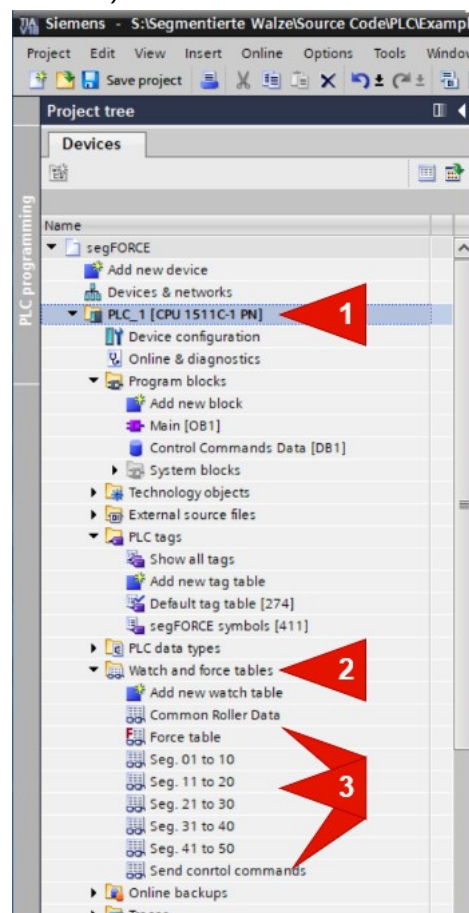
- Open the project `... \TIA_PN_Vx_x\segFORCE`

(x is a placeholder for the example program version and TIA portal version).

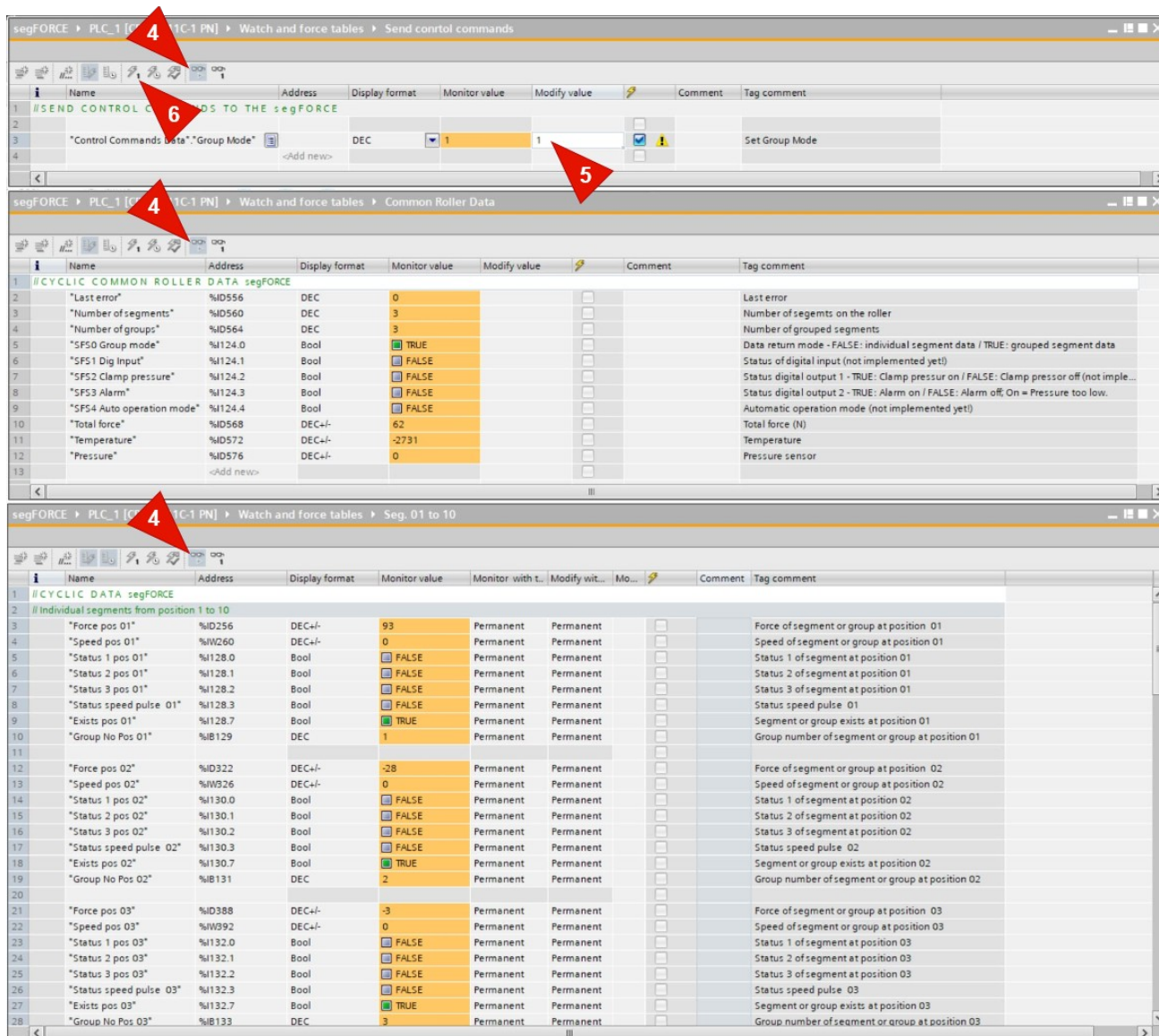
- Open the folder **Watch and force tables** **2** under the PLC project tree **1**.
- The project contains several predefined tables to display the segment's value and control the roller.
- Open the appropriate watch tables **3** depending on what segment values you are interested in or if you want 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,
  - click on the icon with the glasses
  - set the value to 1 to activate group mode or 0 to get back to the single segment mode
  - click on the icon with the flash to send the command to the PLC



The screenshots illustrate the configuration steps for the segFORCE system. The first screenshot shows the 'Send control commands' table, which is used to switch between single and group force return values. The second screenshot shows the 'Common Roller Data' table, which contains various parameters for the roller. The third screenshot shows the 'Seg. 01 to 10' table, which contains data for individual segments.

Name	Address	Display format	Monitor value	Modify value	Comment	Tag comment
1 //SEND CONTROL COMMANDS TO THE segFORCE						
2						
3 "Control Commands Data" "Group Mode"	%I124.0	DEC	1	1		Set Group Mode
4						

Name	Address	Display format	Monitor value	Modify value	Comment	Tag comment
1 //CYCLIC COMMON ROLLER DATA segFORCE						
2 "Last error"	%ID556	DEC	0			Last error
3 "Number of segments"	%ID560	DEC	3			Number of segments on the roller
4 "Number of groups"	%ID564	DEC	3			Number of grouped segments
5 "SF50 Group mode"	%I124.0	Bool	TRUE			Data return mode - FALSE: individual segment data / TRUE: grouped segment data
6 "SF51 Dig Input"	%I124.1	Bool	FALSE			Status of digital input (not implemented yet!)
7 "SF52 Clamp pressure"	%I124.2	Bool	FALSE			Status digital output 1 - TRUE: Clamp pressure on / FALSE: Clamp pressure off (not implemented yet!)
8 "SF53 Alarm"	%I124.3	Bool	FALSE			Status digital output 2 - TRUE: Alarm on / FALSE: Alarm off. On = Pressure too low.
9 "SF54 Auto operation mode"	%I124.4	Bool	FALSE			Automatic operation mode (not implemented yet!)
10 "Total force"	%ID568	DEC+/-	62			Total force (N)
11 "Temperature"	%ID572	DEC+/-	-2731			Temperature
12 "Pressure"	%ID576	DEC+/-	0			Pressure sensor
13						

Name	Address	Display format	Monitor value	Monitor with t...	Modify wit...	Mo...	Comment	Tag comment
1 //CYCLIC DATA segFORCE								
2 // Individual segments from position 1 to 10								
3 "Force pos 01"	%ID256	DEC+/-	93	Permanent	Permanent			Force of segment or group at position 01
4 "Speed pos 01"	%IW260	DEC+/-	0	Permanent	Permanent			Speed of segment or group at position 01
5 "Status 1 pos 01"	%I128.0	Bool	FALSE	Permanent	Permanent			Status 1 of segment at position 01
6 "Status 2 pos 01"	%I128.1	Bool	FALSE	Permanent	Permanent			Status 2 of segment at position 01
7 "Status 3 pos 01"	%I128.2	Bool	FALSE	Permanent	Permanent			Status 3 of segment at position 01
8 "Status speed pulse 01"	%I128.3	Bool	FALSE	Permanent	Permanent			Status speed pulse 01
9 "Exists pos 01"	%I128.7	Bool	TRUE	Permanent	Permanent			Segment or group exists at position 01
10 "Group No Pos 01"	%IB129	DEC	1	Permanent	Permanent			Group number of segment or group at position 01
11								
12 "Force pos 02"	%ID322	DEC+/-	-28	Permanent	Permanent			Force of segment or group at position 02
13 "Speed pos 02"	%IW326	DEC+/-	0	Permanent	Permanent			Speed of segment or group at position 02
14 "Status 1 pos 02"	%I130.0	Bool	FALSE	Permanent	Permanent			Status 1 of segment at position 02
15 "Status 2 pos 02"	%I130.1	Bool	FALSE	Permanent	Permanent			Status 2 of segment at position 02
16 "Status 3 pos 02"	%I130.2	Bool	FALSE	Permanent	Permanent			Status 3 of segment at position 02
17 "Status speed pulse 02"	%I130.3	Bool	FALSE	Permanent	Permanent			Status speed pulse 02
18 "Exists pos 02"	%I130.7	Bool	TRUE	Permanent	Permanent			Segment or group exists at position 02
19 "Group No Pos 02"	%IB131	DEC	2	Permanent	Permanent			Group number of segment or group at position 02
20								
21 "Force pos 03"	%ID388	DEC+/-	-3	Permanent	Permanent			Force of segment or group at position 03
22 "Speed pos 03"	%IW392	DEC+/-	0	Permanent	Permanent			Speed of segment or group at position 03
23 "Status 1 pos 03"	%I132.0	Bool	FALSE	Permanent	Permanent			Status 1 of segment at position 03
24 "Status 2 pos 03"	%I132.1	Bool	FALSE	Permanent	Permanent			Status 2 of segment at position 03
25 "Status 3 pos 03"	%I132.2	Bool	FALSE	Permanent	Permanent			Status 3 of segment at position 03
26 "Status speed pulse 03"	%I132.3	Bool	FALSE	Permanent	Permanent			Status speed pulse 03
27 "Exists pos 03"	%I132.7	Bool	TRUE	Permanent	Permanent			Segment or group exists at position 03
28 "Group No Pos 03"	%IB133	DEC	3	Permanent	Permanent			Group number of segment or group at position 03

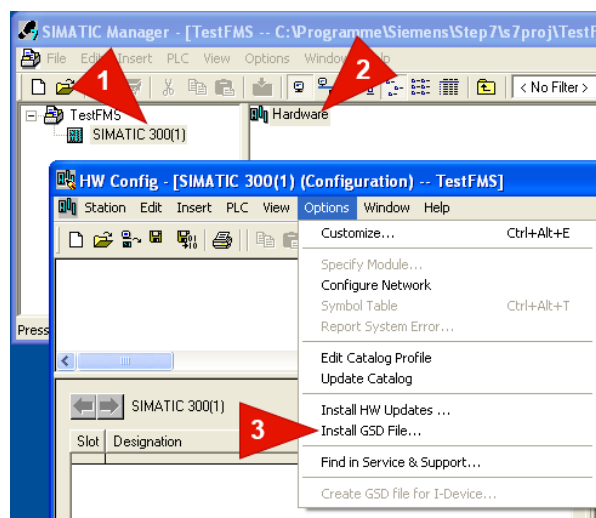


For further information on how the grouping of segments works and how the data are transferred to the PLC, consult the segFORCE Operation Manual.

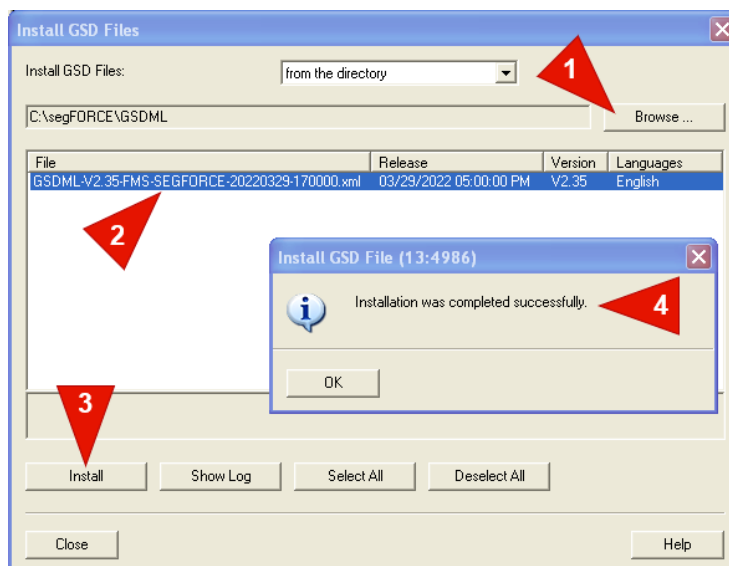
## 1.5 Use the segFORCE in your project

### 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.

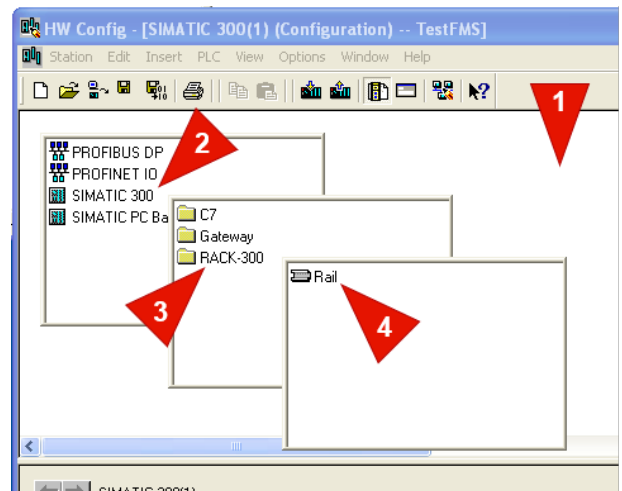


- On the Install GSD Files dialog, click on the Browse button **1**. Choose the directory where the GSDML files are located. In our case, it is c:\segFORCE\GSDML. Return to the previous dialog by clicking on OK. Select the GSDML file from the list that is to be installed **2**. Now click on Install **3** 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.

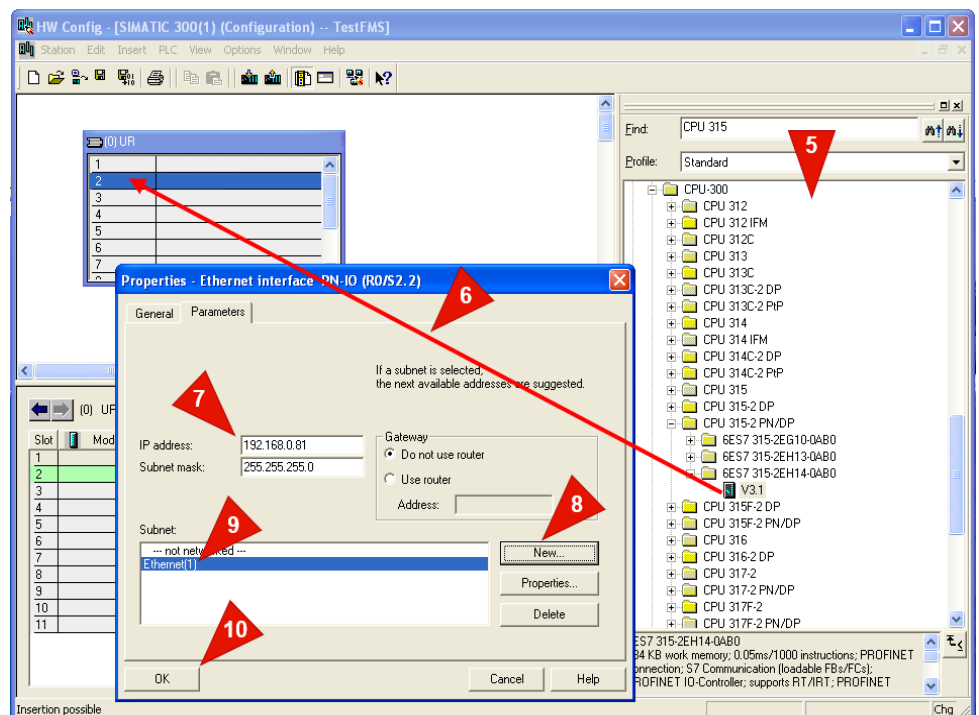


- Now as you are back on the HW Config dialog, the next step is to insert a rack and a CPU. Of course, only if they are not configured already. Otherwise, continue straight on to the next step.

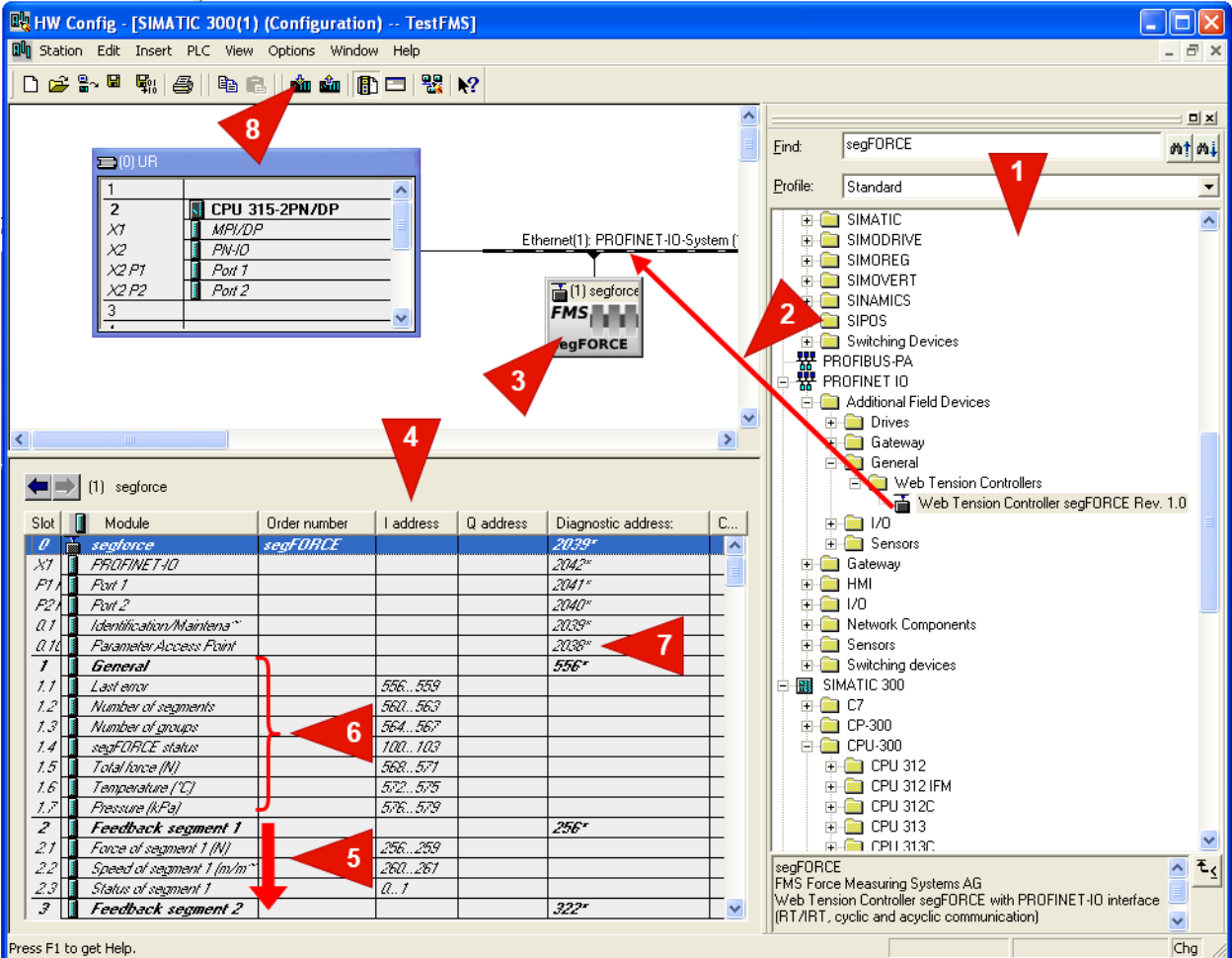
Right-click in the white area below the menu and symbol bar **1** and choose Insert Object. In the popping-up list, choose SIMATIC 300 **2**, then RACK-300 **3**, and finally Rail **4**. A table representing the rack is inserted in the white area.



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 **Ethernet1** **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**.



**HW Config - [SIMATIC 300(1) (Configuration) -- TestFMS]**

**Hardware Rack (0) UR:**

1	
2	CPU 315-2PN/DP
X1	MP/DP
X2	PN-IO
X2 P1	Port 1
X2 P2	Port 2
3	

**Hardware Catalog:** Find: segFORCE, Profile: Standard

**Hardware Configuration:** Ethernet(1): PROFINET-IO-System (1) segforce FMS segFORCE

**Parameter Table:**

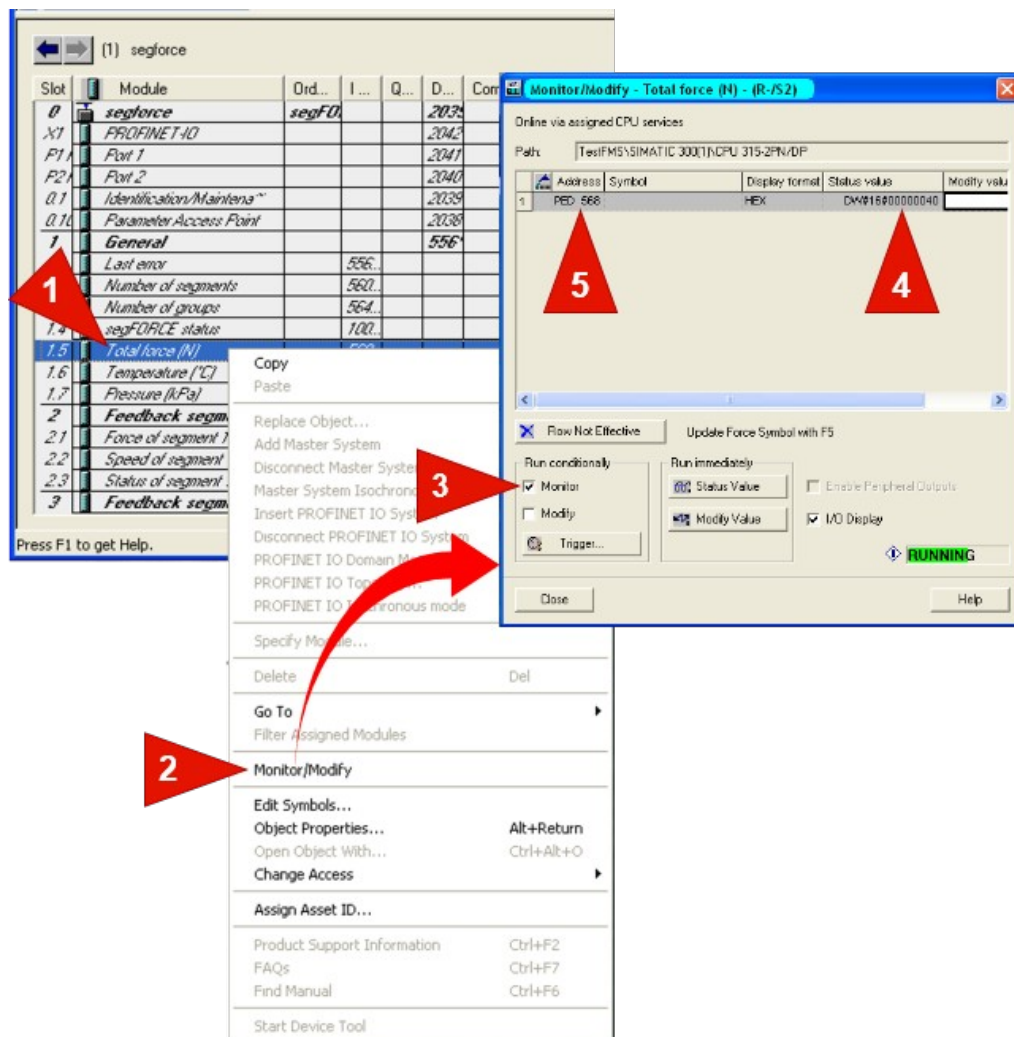
Slot	Module	Order number	I address	Q address	Diagnostic address:	C...
0	segforce	segFORCE			2039*	
X1	PROFINET-IO				2042*	
P1	Port 1				2041*	
P2	Port 2				2040*	
Q1	Identification/Maintenance				2038*	
Q10	Parameter Access Point				2038*	
1	<b>General</b>				556*	
1.1	Last error		556..559			
1.2	Number 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	<b>Feedback segment 1</b>				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	<b>Feedback segment 2</b>				322*	

Press F1 to get Help.

- 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.

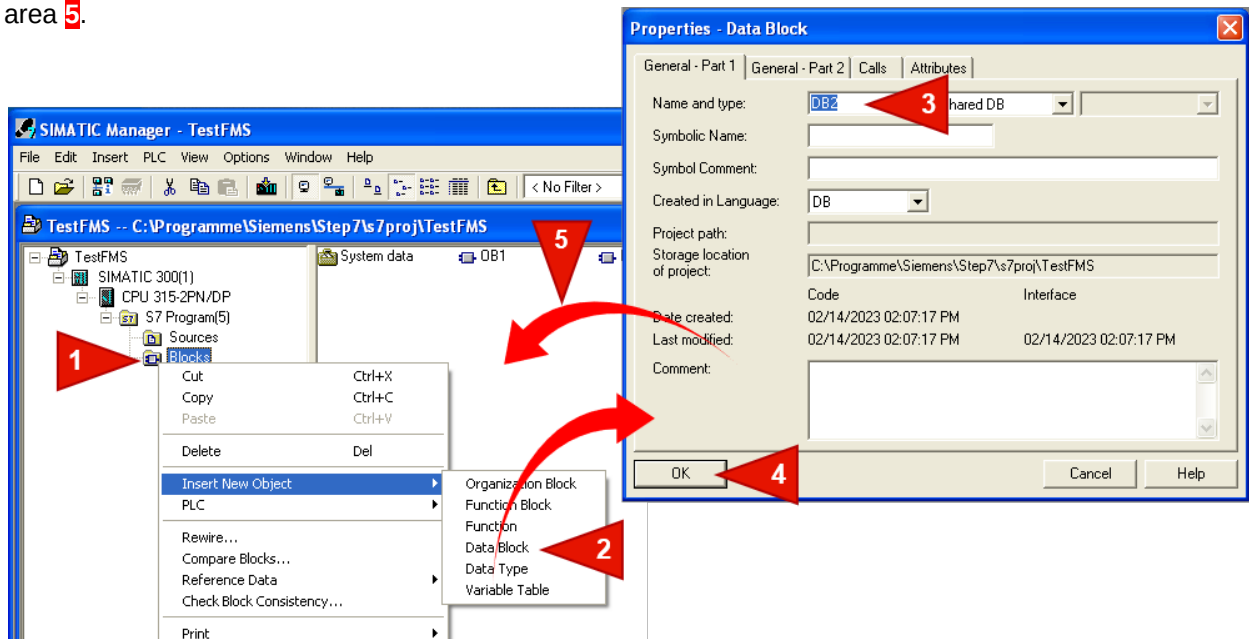


- The segFORCE is now ready to use. If you want to test the system, you can read any values of the cyclic data. There is even no program necessary for doing that. In the HW Config window, right-click a parameter (module) of interest, e.g., **Total force (N)** **1**. In the appearing context menu, click 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**.

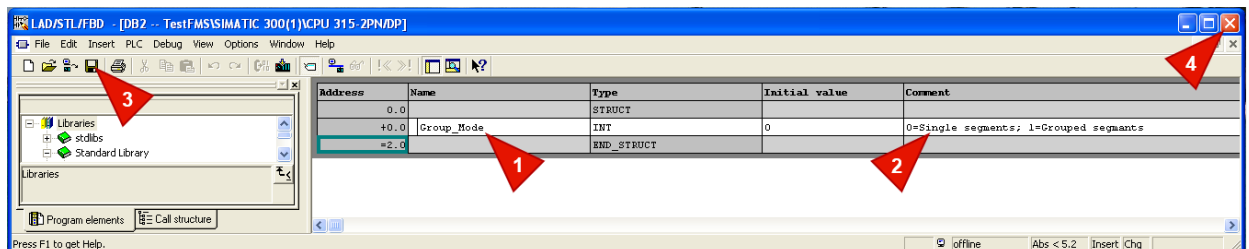


For the following steps, close all dialogs until you are back on the SIMATIC Manager main window.

- 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**.



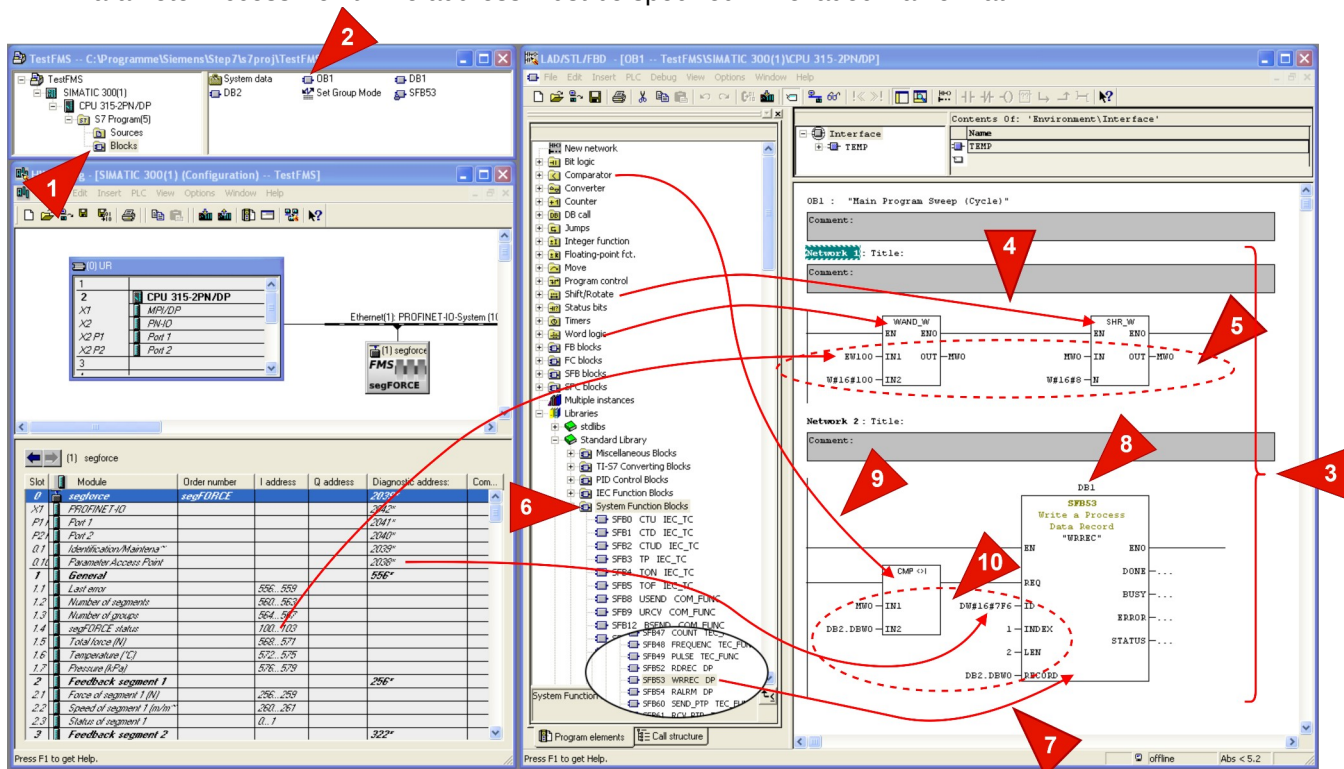
- The last action above **5** opens the data block definition. Enter the parameter name **Group\_Mode** **1** and a comment **2**. Save the changes **3** and close the window **4**.



- 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.

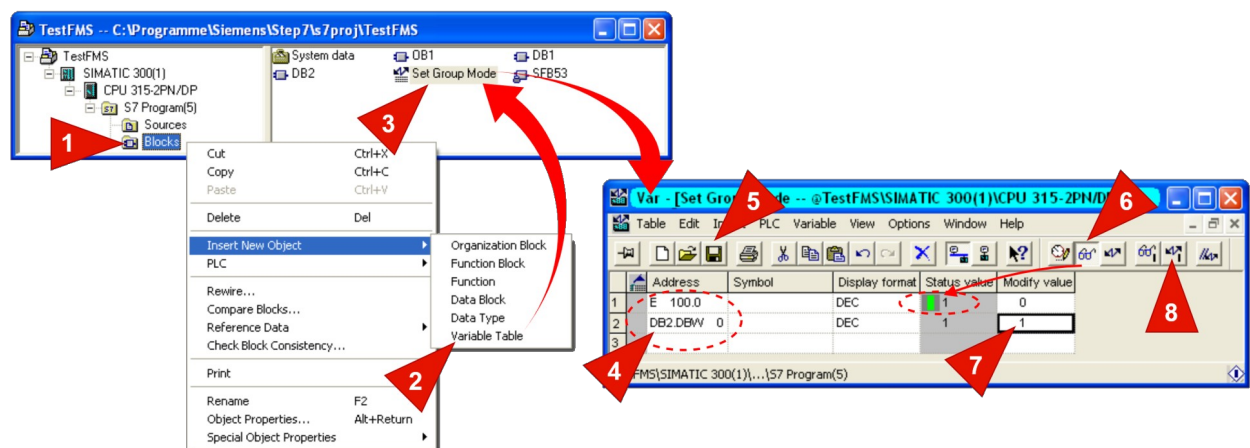


- Download program to the PLC.



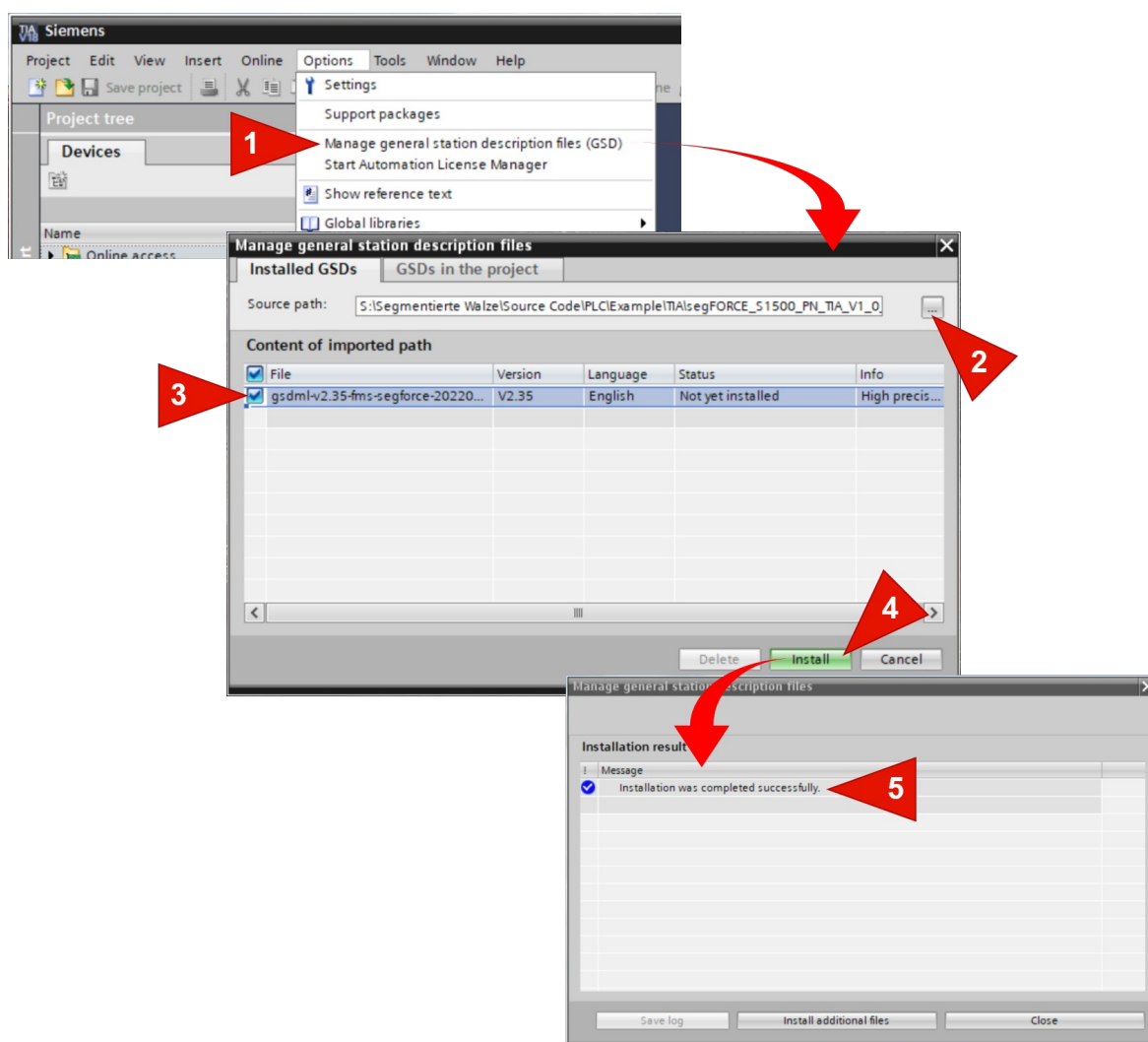
- How to use the program. First, right-click on the tree item **Blocks** **1**, and select the submenu **Insert New Object -> Variable Table** **2**. In the popping-up dialog, enter the Symbolic Name, e.g., **Set Group Mode**, and click on Ok. The variable table is now available in the area on the right 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.

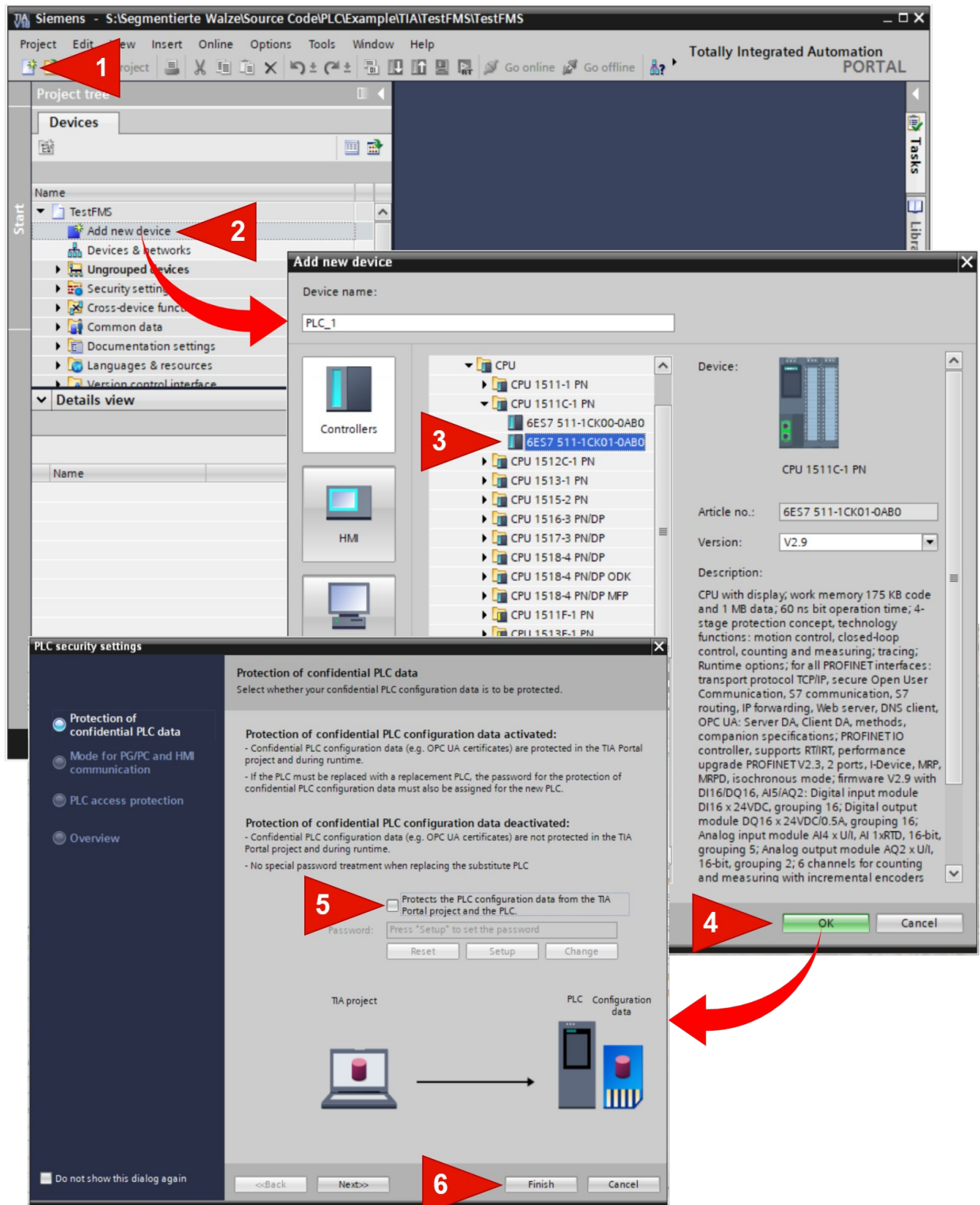


## 1.5.2 TIA Portal

- 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.



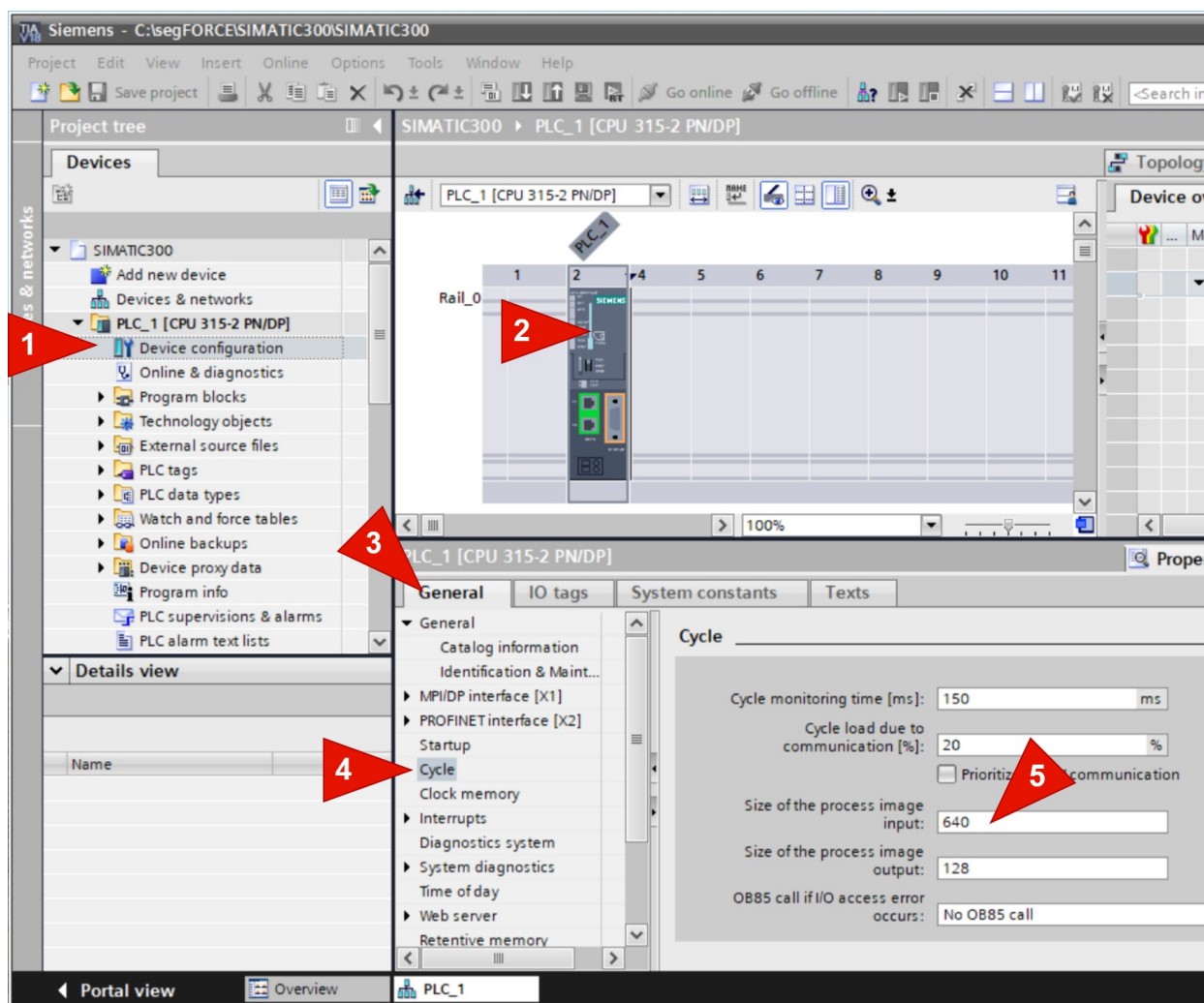
- Open your project or create a new one **1**. In case of a new project, add a new device, e.g., PLC CPU 1511C-1 PN, by double-clicking on **Add new device** **2**. After that, search your CPU **3** and click on OK **4**. In the opening dialog **PLC security settings** make sure the check box **Protects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



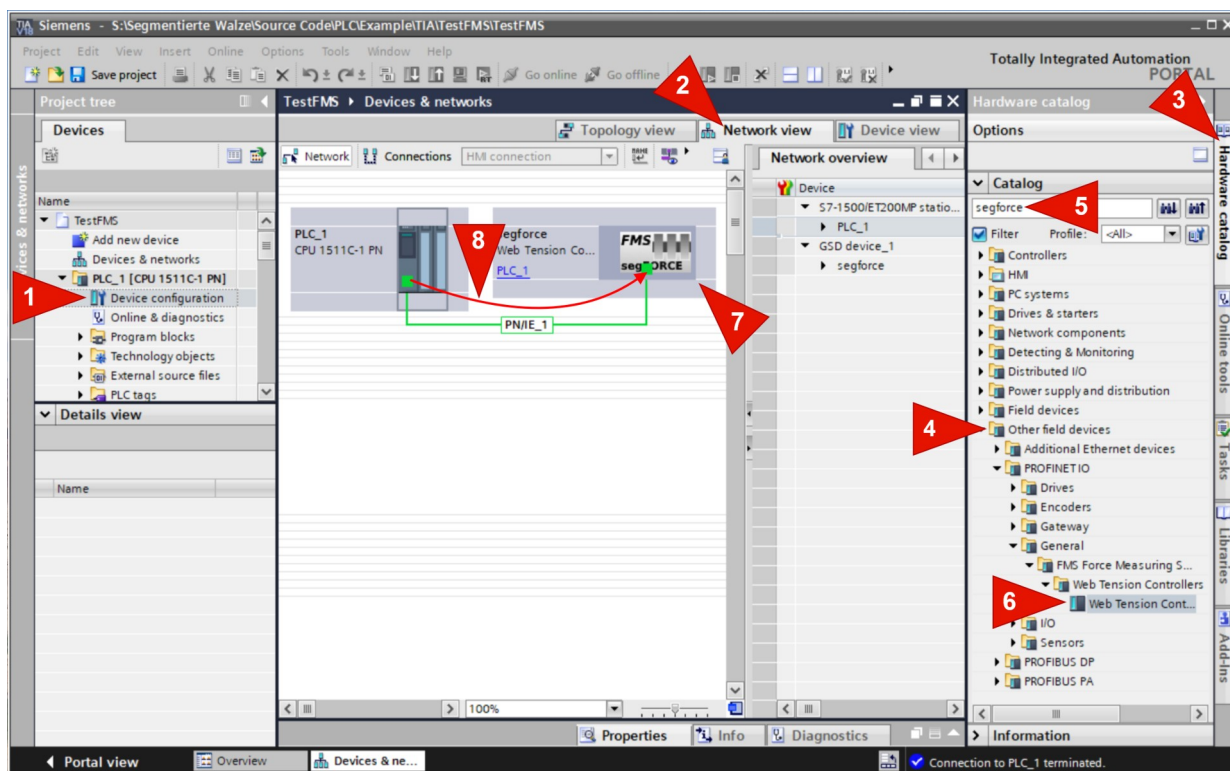


If you have a PLC of the SIMATIC 300 or maybe 400 series added, **make sure to increase the input process image size to a minimum of 640 bytes**. If you don't make that change, not all segFORCE values will be seen. Therefore when reading values from the process image, they return 0 instead of the actual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

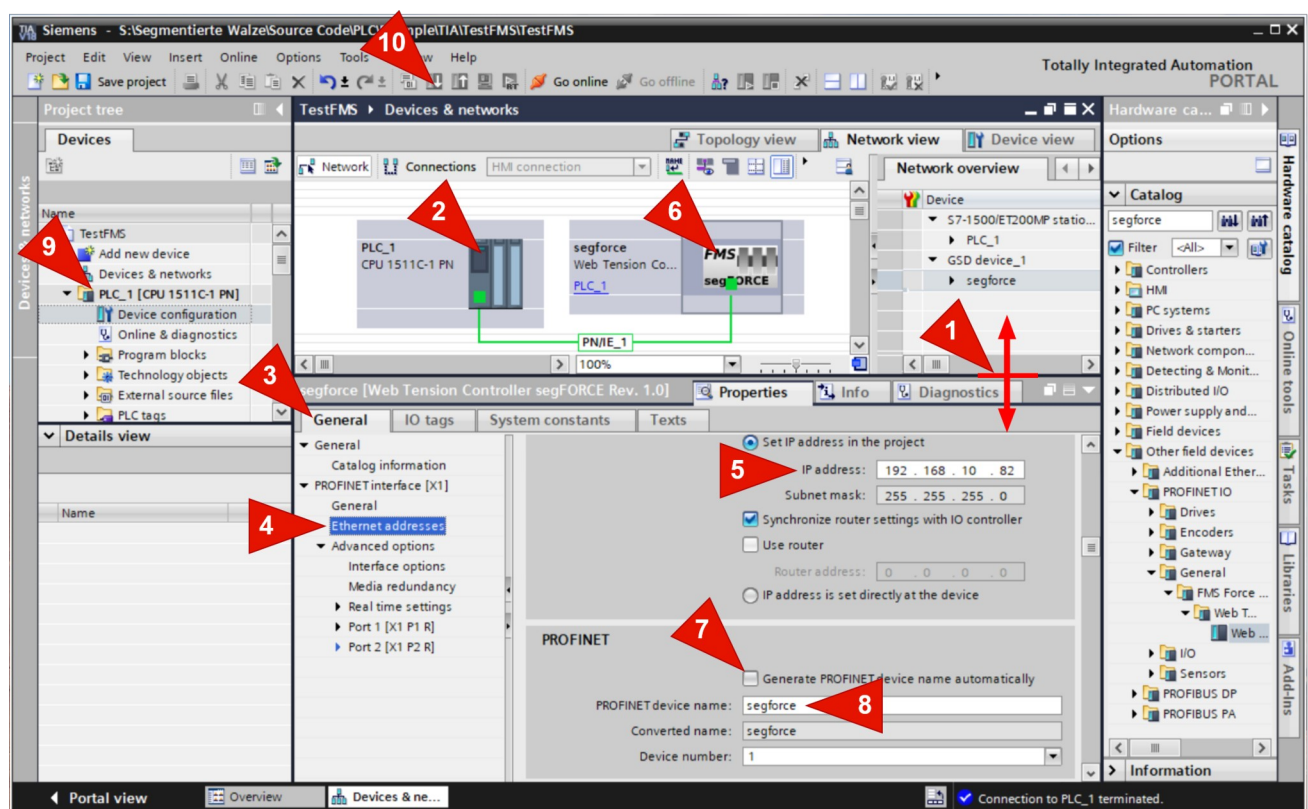


- Add the segFORCE device to the hardware configuration. Double-click in the device tree on the item **Device configuration** **1**. In the right panel, click on the tab **Network view** **2**, and at the right sidebar, on the tab **Hardware catalog** **3**. The catalog tree should be seen, and select **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.





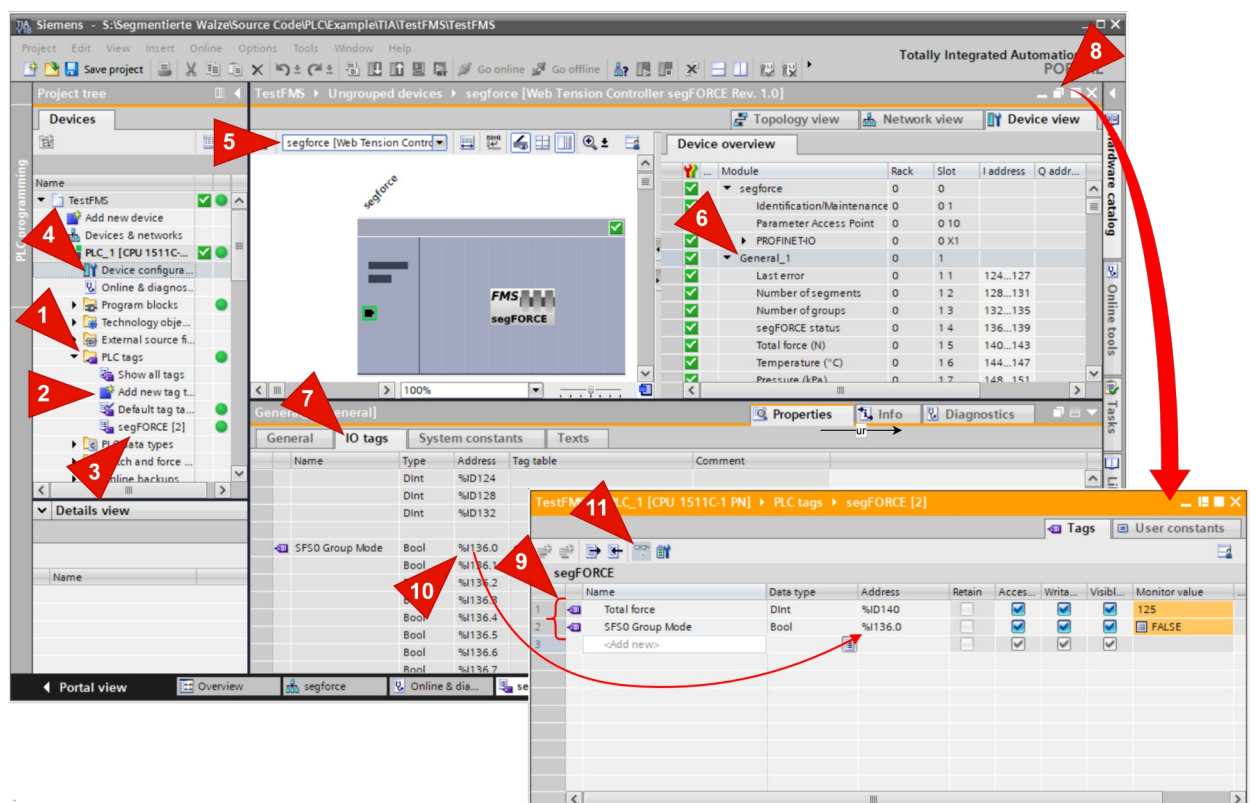
- The next step is to assign the PLC and the segFORCE an unused IP address. In the case of the PLC, that is unnecessary for an existing project because you might already have done that. First, you can stay on the panel above and uncover the lower part of the device configuration by dragging the separator 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**.



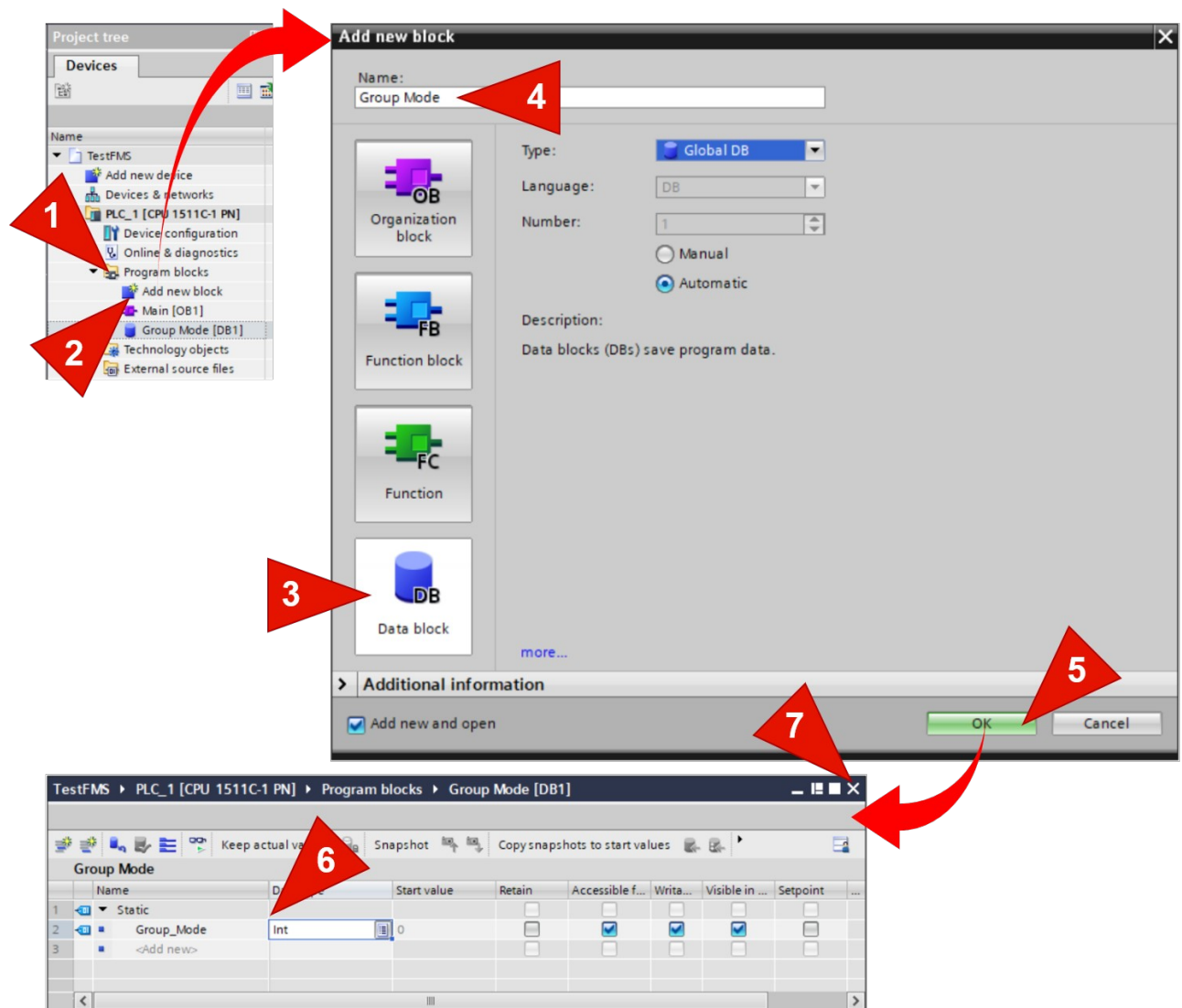
- Continue with the next step when the configuration has been downloaded successfully. Therefore the left LED must permanently light green, and the other two must be dark. If that is not the case, fix the problems first.



- 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**.

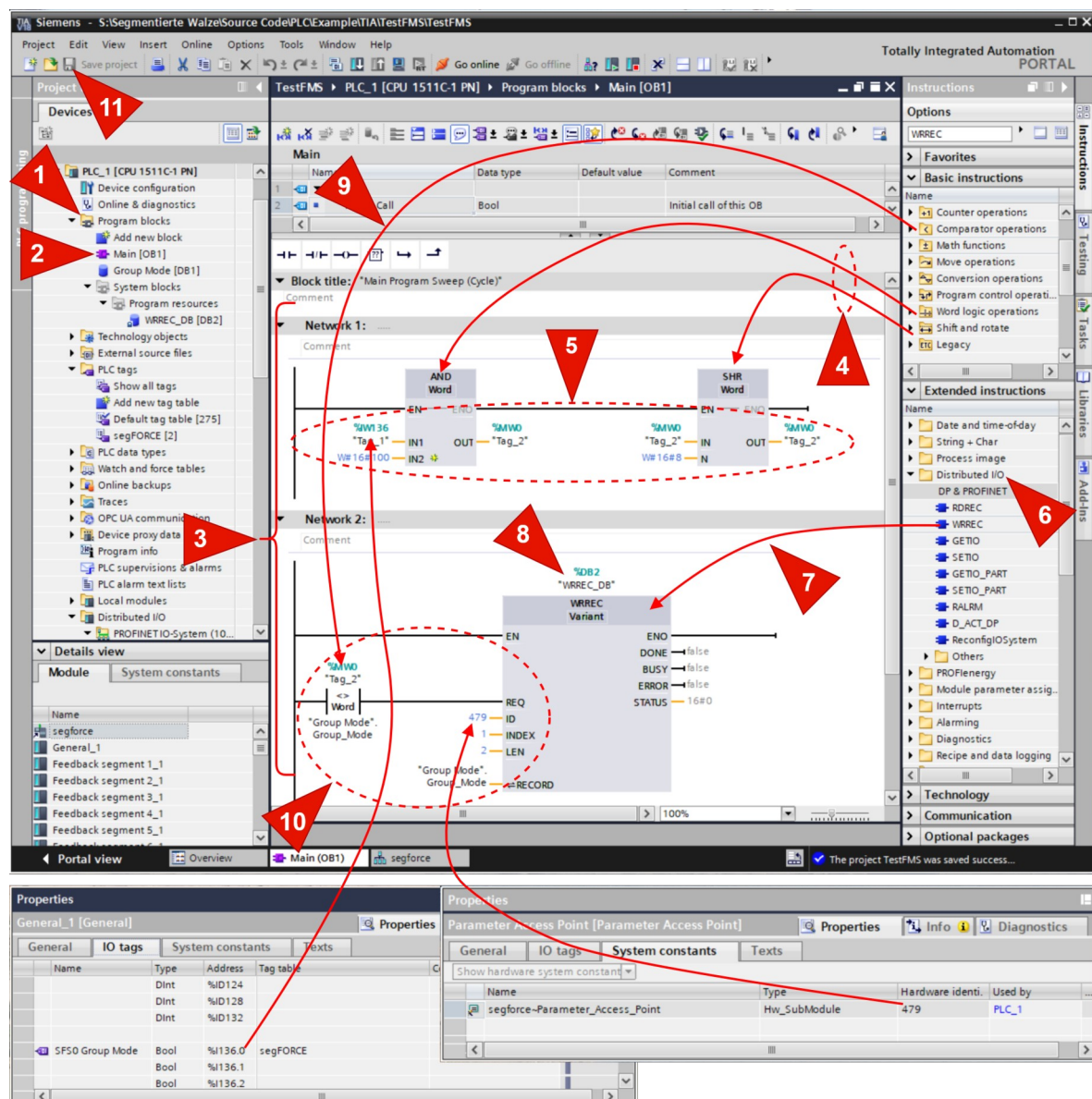




- Next, open the tree branch **Program blocks** **1**, under the Project tree, and double-click the tree entry **Main [OB1]** **2**. That opens the programming window. In the programming area, insert two networks **3** by hitting Ctrl-r on the keyboard. They are empty in the first place, not as shown 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 displays the SIMATIC Manager interface for a Siemens PLC project. The main window shows the Ladder Logic (LAD) editor for the 'Main [OB1]' program. Two networks are visible: Network 1 and Network 2. Network 1 contains an AND function block followed by a SHR function block. Network 2 contains a WRREC (Write Record) function block and a comparator (CMP<>). Red arrows and numbers 1 through 11 highlight specific elements and steps in the configuration process.

**Network 1:** This network converts the digital input 'Group Mode' to a variable of type WORD. It uses an AND function block (IN1, IN2) and a SHR function block (IN, OUT). The inputs and outputs are labeled with addresses and names.

**Network 2:** This network sends the group mode value when the demanded group mode differs from the set. It uses a WRREC function block (WRREC\_DB) and a comparator (REQ). The inputs and outputs are labeled with addresses and names.

**Properties Windows:** Two properties windows are shown at the bottom. The left window shows the 'General' tab for 'General\_1 [General]' with a table of system constants. The right window shows the 'General' tab for 'Parameter Access Point [Parameter Access Point]' with a table of system constants.

Name	Type	Address	Tag table
%ID124	Dint	%ID124	
%ID128	Dint	%ID128	
%ID132	Dint	%ID132	
SF50 Group Mode	Bool	%I136.0	segFORCE
	Bool	%I136.1	
	Bool	%I136.2	

Name	Type	Hardware identi.	Used by
segforce-Parameter_Access_Point	Hw_SubModule	479	PLC_1

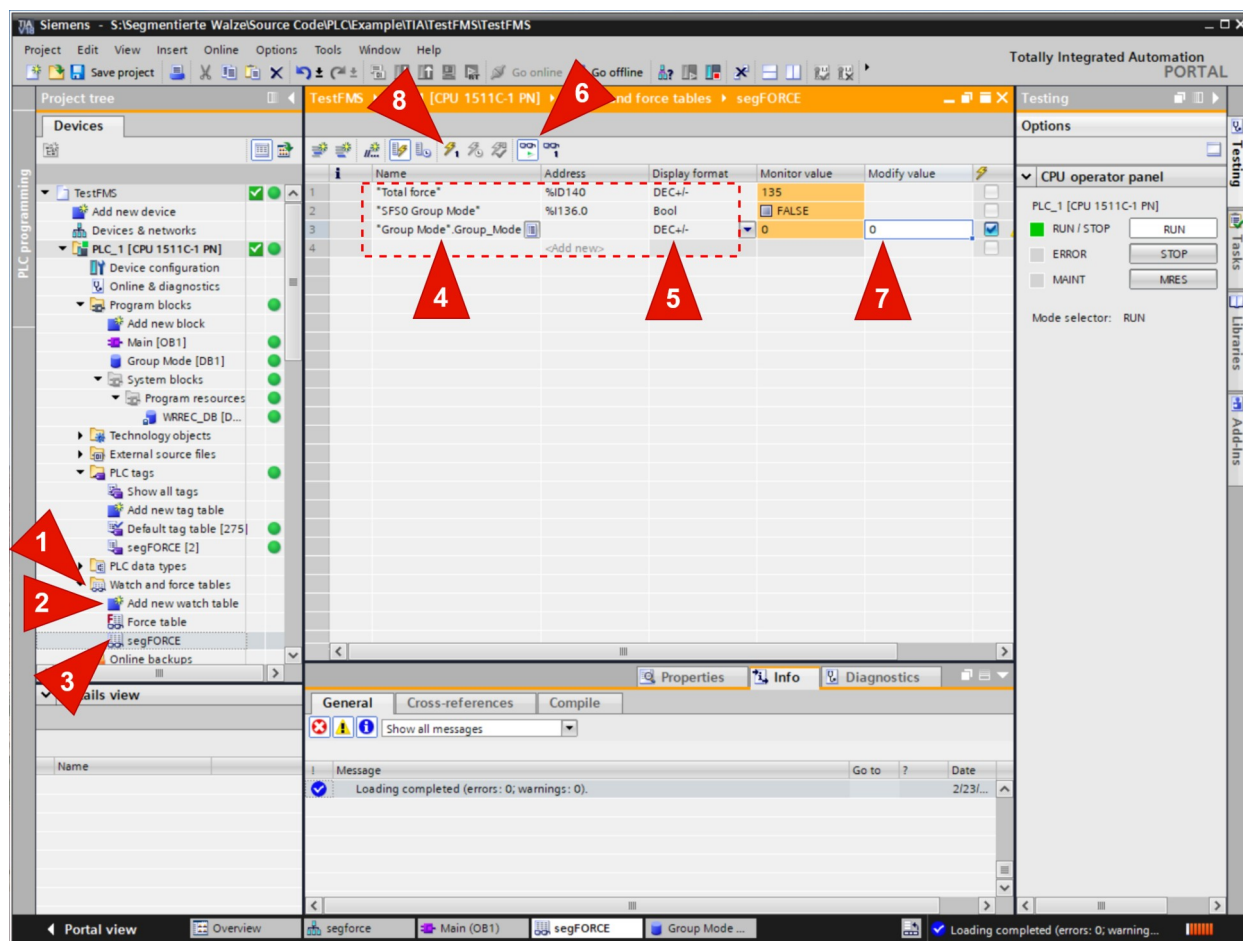
- Download program to the PLC.
- How to use the program. Open the folder **Watch and force tables** **1** under the PLC project tree, and double-click the tree entry **Add new watch table** **2**. A new table named **Watch table\_1** or similar will be added. Rename the table to **segFORCE** **3**. After 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 to get back to the single segment mode

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

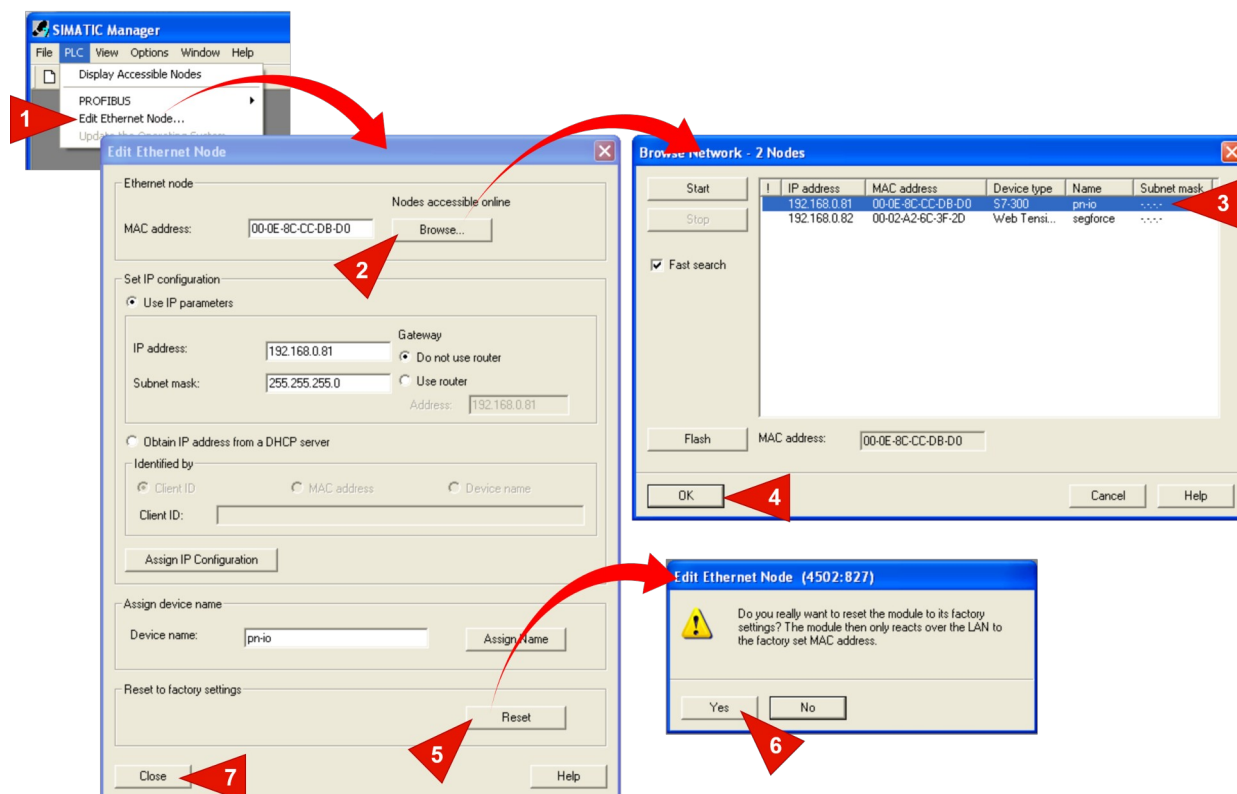


## 2 PLC Operation Commands

### 2.1 How to reset a PLC to factory settings

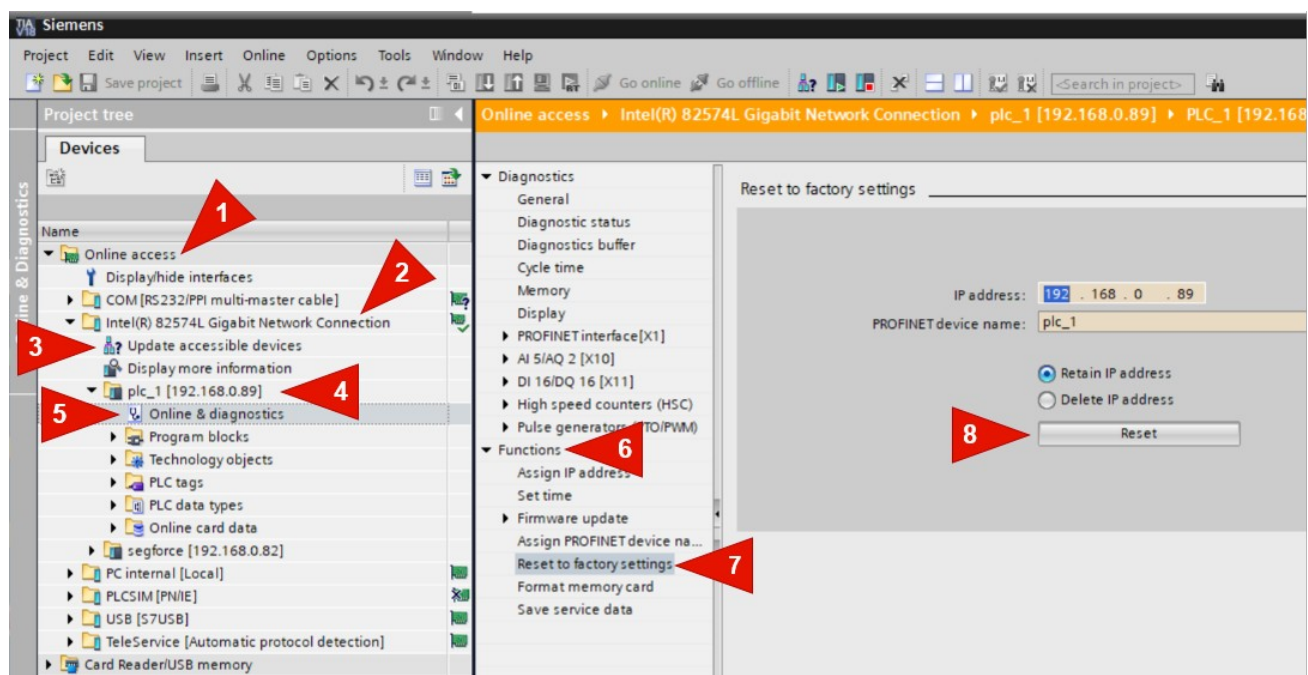
#### 2.1.1 Resetting PLC with Step 7 SIMATIC Manager

- 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

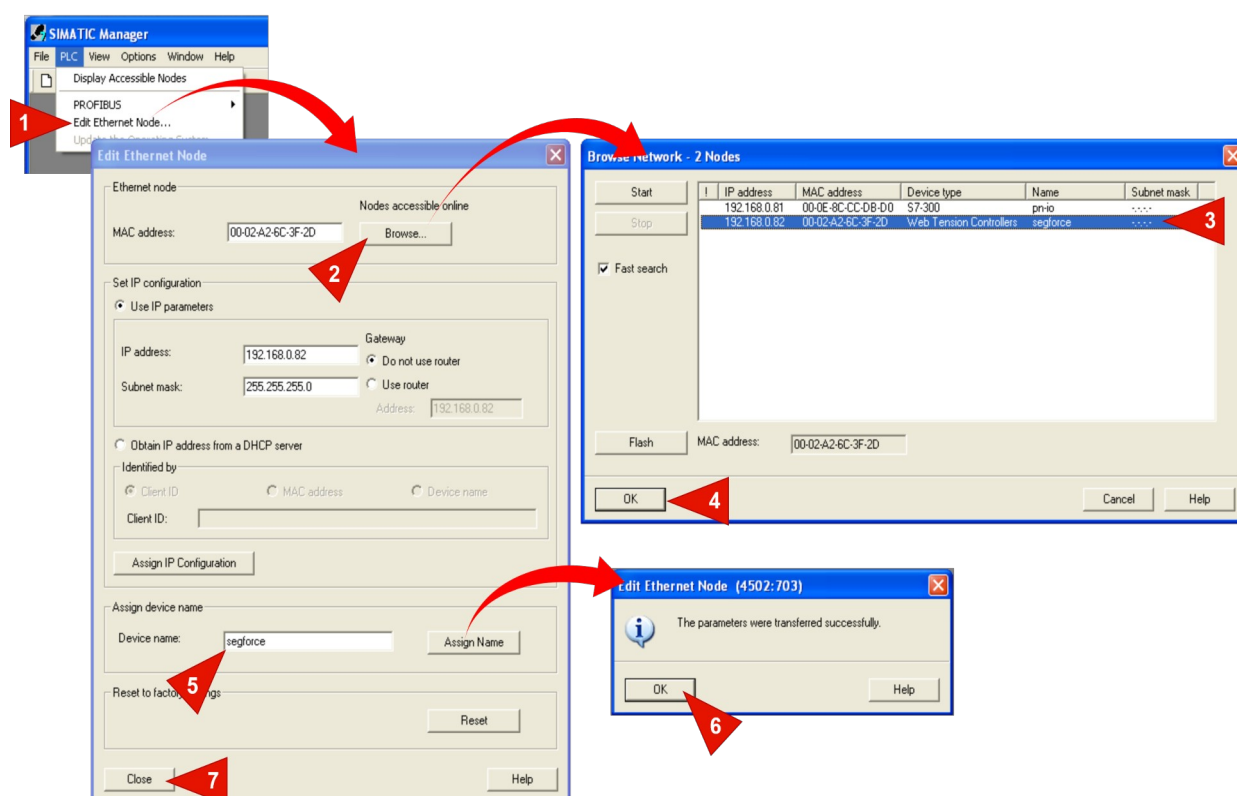
- Execute the **TIA Portal** program.
- The program normally starts with the portal view. Switch to the project view by clicking the **Project view** menu at the bottom left.
- Open the Online access tree **1** and the Ethernet interface card **2**, over which the PC is connected to the network.
- Double-click 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

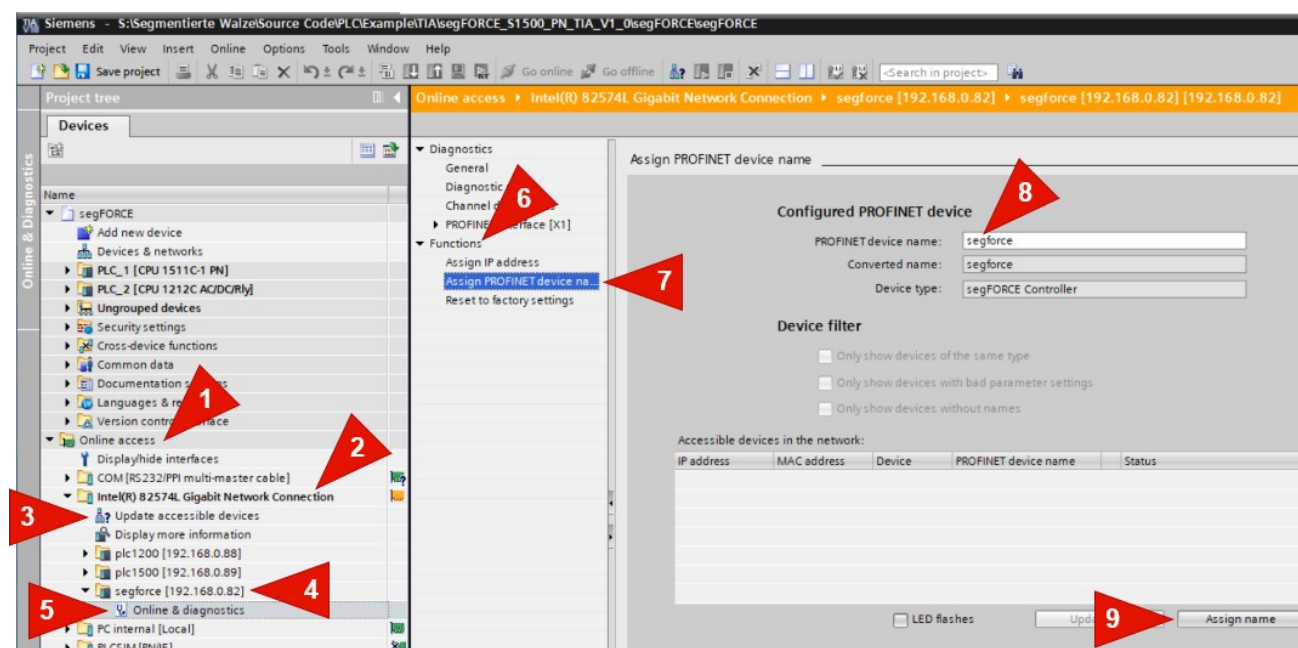
- Execute the **SIMATIC Manager** program.
- Select the **PLC ->Edit Ethernet Node** **1** menu in the main window. A project doesn't need to be open; if so, the PLC menu contains several more entries. Just select the appropriate menu. This action opens the dialog Edit Ethernet Node.
- Click on **Browse** **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, therefor 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 prone 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		
		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.
		▼	▼	▼
		▼ further segments or grouped segments up to 50		▼
		▼	▼	▼.
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.