

FMS-segFORCE

Quick Start Guide

Using the FMS-segFORCE with PLCs

Document version 1.3.1
Document date May 6, 2025

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Change log

Date	Revision	Author	Changes
27.02.2023	1.0	Thomas Ziörjen	Initial version
31.10.2023	1.1	Thomas Ziörjen	<ul style="list-style-type: none">- The document name was changed to consider several PLCs.- Description of using the EtherNet/IP interface added. Whole Chapter 3- Appendix generalized for multiple PLC interfaces.- Description of the Hilscher Ethernet Device Configuration tool added.
23.01.2025	1.2	Thomas Ziörjen	<ul style="list-style-type: none">- Description improvements - 2.4.1 Change device.
22.04.2025	1.3	Stephan Meier	<ul style="list-style-type: none">- Modified section 1.1 to include EtherCAT- Added section 1.2 with important terms and abbreviations- Added the chapter 4 about TwinCAT / EtherCAT- Extended the PLC interface tables in section 5.1 with the EtherCAT interface
06.05.2025	1.3.1	Stephan Meier	<ul style="list-style-type: none">- Corrected minor typographical issues- Corrected the use of the trademark "FMS-segFORCE"

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1 Read First Before Starting

1.1 Introduction

This document is separated into various sections. Depending on what hardware you are using, jump directly to the appropriate chapter that matches your environment. You don't have to read the whole document. However, the appendix is essential as it describes the data addressing for all PLC interfaces.

- Siemens PLC users utilize **PROFINET** start with Chapter 2, SIMATIC PROFINET.
- Allen-Bradley PLC users utilizing **EtherNet/IP** start with Chapter 3, RSLogix 5000 EtherNet/IP.
- TwinCAT users using **EtherCAT** start with chapter 4, TwinCAT 3 – EtherCAT.



This document is not intended to provide general instructions on how to program PLCs. Rather, its purpose is to guide you through the process of configuring a limited number of selected PLCs to work with the FMS-segFORCE controller.

1.2 Terminology and Abbreviations

1.2.1 Terminology

Term	Explanation
EtherCAT	The open real-time Ethernet network originally developed by Beckhoff Automation. The EtherCAT protocol which is disclosed in the IEC standard IEC 61158 is suitable for hard and soft real-time requirements in automation technology, in test and measurement and many other applications. Source: https://www.ethercat.org
EtherNet/IP	A best-in class Ethernet communication network that provides users with the tools to deploy standard Ethernet technology (IEEE 802.3 combined with the TCP/IP Suite) in industrial automation applications while enabling Internet and enterprise connectivity...data anytime, anywhere. Source: https://www.odva.org
PROFINET	Derived from "PROcess Field NETwork"; widely regarded as the most advanced Industrial Ethernet solution globally. This communication protocol serves as a vital tool within the automation industry, facilitating real-time data exchange between controllers and devices. Source: https://www.profinet.com

1.2.2 Abbreviations

Abbreviation	Full Name
CoE	CAN Application Protocol over EtherCAT
DUT	Device Under Test
ESI	EtherCAT SubDevice Information (EtherCAT Devices Description)
FoE	File Access over EtherCAT
GVL	Global Variable List
OD	Object Dictionary
PDO	Process Data Object
PLC	Programmable Logic Controller
POU	Program Organisation Unit
SDO	Service Data Object
SII	SubDevice Information Interface
TwinCAT	The Windows Control and Automation Technology

2 SIMATIC PROFINET

2.1 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.

2.2 Introduction

This document intends to give you a fast way to use your FMS-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 FMS-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 FMS-segFORCE provided by FMS Force Measuring Systems AG can be used for all options.

2.3 Use the Step 7 SIMATIC Manager Example

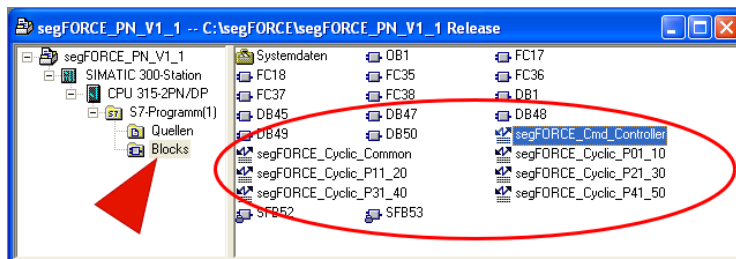
2.3.1 Setting up the Project

- Download the example programs contained in the archive segFORCE_PN_Vx_x Release.zip available on 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:\FMS_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:\FMS_segFORCE\Step7_PN_Vx_x
(again, 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 FMS-segFORCE the name **segforce**. The PLC gives after that the FMS-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.

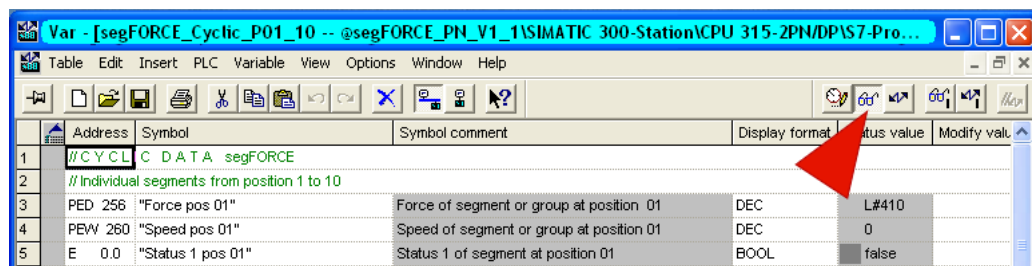


2.3.2 Using the Example Program

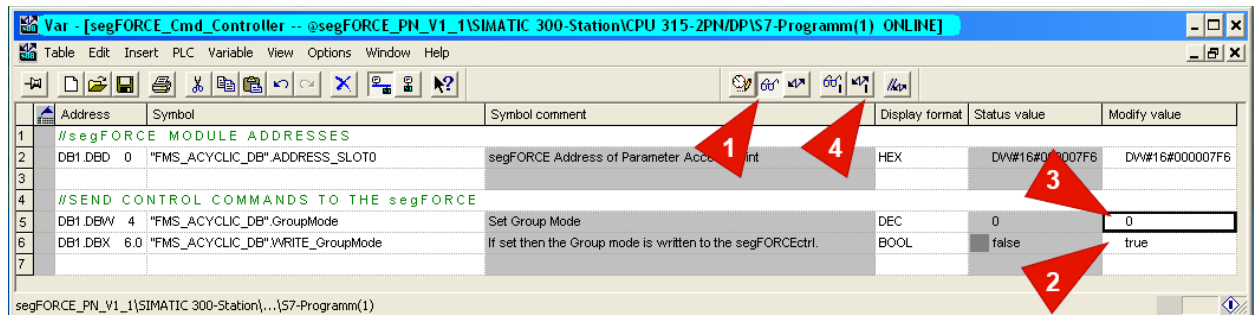
- Execute the SIMATIC Manager.
- Open the Blocks folder.
- The project contains several predefined variable tables for displaying the segment's values.
- Open the appropriate variable table depending on what values you are interested in. There are the following variable tables for cyclic data available:



- 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		<i>//segFORCE MODULE ADDRESSES</i>				
2	DB1.DBD 0	"FMS_ACYCLIC_DB" ADDRESS_SLOT0	segFORCE Address of Parameter Access Point	HEX	DW#16#000007F6	DW#16#000007F6
3						
4		<i>//SEND CONTROL COMMANDS TO THE segFORCE</i>				
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						

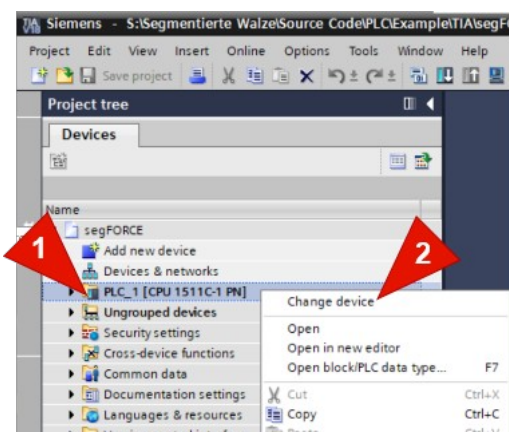


For further information on how the grouping of segments works and how the data are transferred to the PLC, consult the FMS-segFORCE Operation Manual.

2.4 Use the TIA Portal Example

2.4.1 Setting up the TIA Project

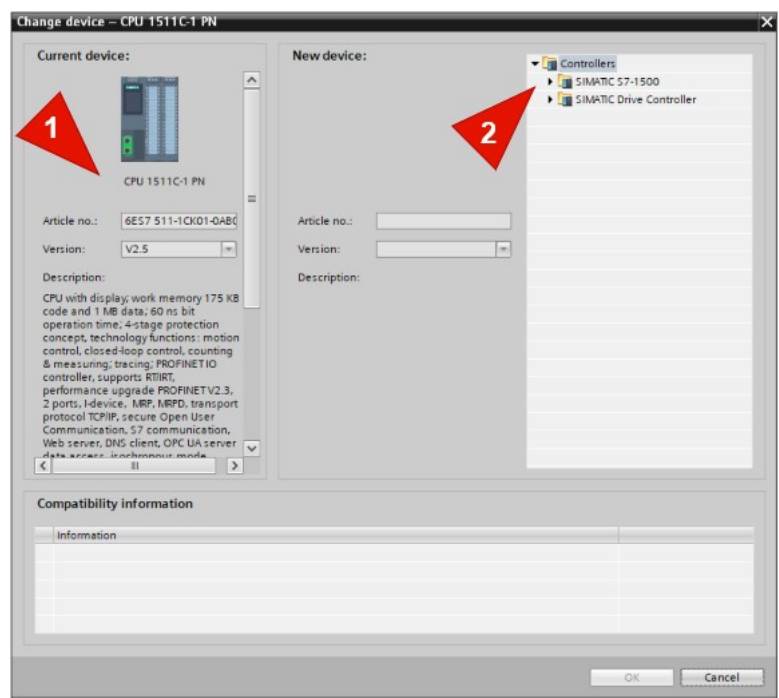
- Download the example programs contained in the archive segFORCE_PN_Vx_x Release.zip available on our web page. (x is a placeholder for the container file version that includes the example programs)
Link: <https://www.fms-technology.com/en/downloadcenter/profinet>
- Unpack the example project to your preferred directory on your PC on which the **TIA Portal** development software is installed.
The Quick Start Guide uses the directory C:\FMS_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 2.6.1 *How to Reset a PLC to Factory Settings*.
- Open the project C:\FMS_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 2.5 *Use the FMS-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**.

If your device is not displayed, use the dialog **Add new device** as described in Chapter 2.5.2 TIA Portal.

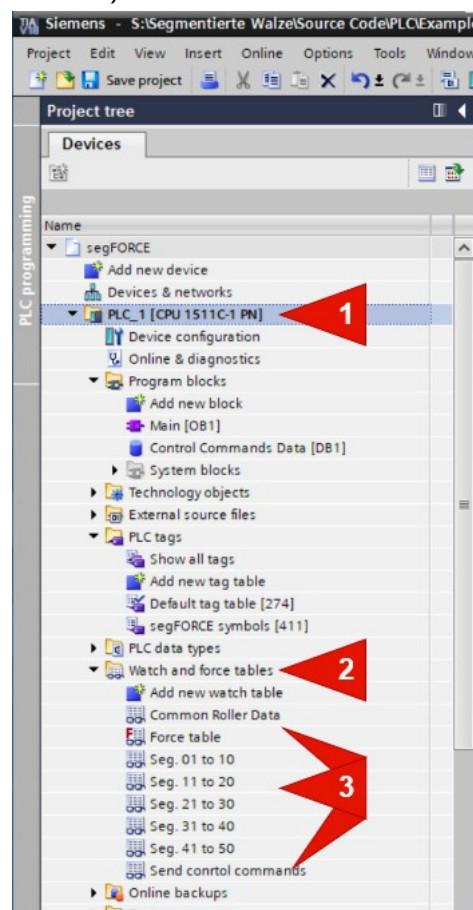


- Search for all PROFINET devices, and assign the FMS-segFORCE the name **segforce**. Refer to the chapter 2.6.2 *How to Assign the PROFINET Device Name* for a detailed description. The PLC gives after that the FMS-segFORCE the IP 192.168.10.82. If the IP does not fit your network environment, change 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.

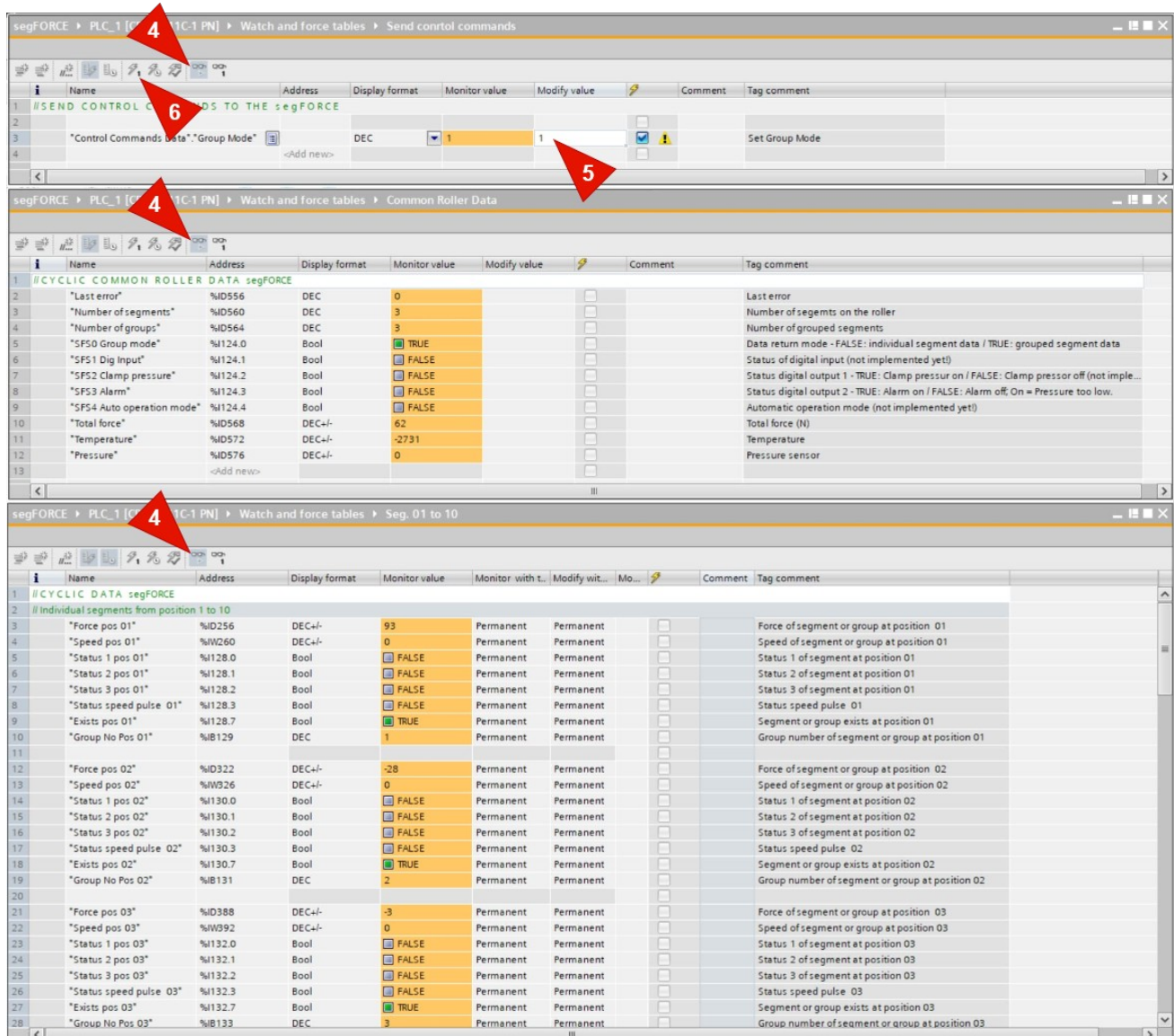


2.4.2 How to Use the TIA Example Program

- 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 show the following tables:

- Send control commands:** Contains a table with columns: Name, Address, Display format, Monitor value, Modify value, Comment, Tag comment. Row 1: "SEND CONTROL COMMANDS TO THE segFORCE". Row 2: "Control Commands Data", "Group Mode" (Address: %I124.0, Display format: DEC, Monitor value: 1, Modify value: 1, Comment: Set Group Mode).
- Common Roller Data:** Contains a table with columns: Name, Address, Display format, Monitor value, Modify value, Comment, Tag comment. Rows include: "Last error" (%ID556, DEC, 0), "Number of segments" (%ID560, DEC, 3), "Number of groups" (%ID564, DEC, 3), "SF50 Group mode" (%I124.0, Bool, TRUE), "SF51 Dig Input" (%I124.1, Bool, FALSE), "SF52 Clamp pressure" (%I124.2, Bool, FALSE), "SF53 Alarm" (%I124.3, Bool, FALSE), "SF54 Auto operation mode" (%I124.4, Bool, FALSE), "Total force" (%ID568, DEC+/-, 62), "Temperature" (%ID572, DEC+/-, -2731), "Pressure" (%ID576, DEC+/-, 0).
- Seg. 01 to 10:** Contains a table with columns: Name, Address, Display format, Monitor value, Monitor with t..., Modify wit..., Mo..., Comment, Tag comment. Rows include: "Force pos 01" (%ID256, DEC+/-, 93), "Speed pos 01" (%IW260, DEC+/-, 0), "Status 1 pos 01" (%I128.0, Bool, FALSE), "Status 2 pos 01" (%I128.1, Bool, FALSE), "Status 3 pos 01" (%I128.2, Bool, FALSE), "Status speed pulse 01" (%I128.3, Bool, FALSE), "Exists pos 01" (%I128.7, Bool, TRUE), "Group No Pos 01" (%IB129, DEC, 1), "Force pos 02" (%ID322, DEC+/-, -28), "Speed pos 02" (%IW326, DEC+/-, 0), "Status 1 pos 02" (%I130.0, Bool, FALSE), "Status 2 pos 02" (%I130.1, Bool, FALSE), "Status 3 pos 02" (%I130.2, Bool, FALSE), "Status speed pulse 02" (%I130.3, Bool, FALSE), "Exists pos 02" (%I130.7, Bool, TRUE), "Group No Pos 02" (%IB131, DEC, 2), "Force pos 03" (%ID388, DEC+/-, -3), "Speed pos 03" (%IW392, DEC+/-, 0), "Status 1 pos 03" (%I132.0, Bool, FALSE), "Status 2 pos 03" (%I132.1, Bool, FALSE), "Status 3 pos 03" (%I132.2, Bool, FALSE), "Status speed pulse 03" (%I132.3, Bool, FALSE), "Exists pos 03" (%I132.7, Bool, TRUE), "Group No Pos 03" (%IB133, DEC, 3).

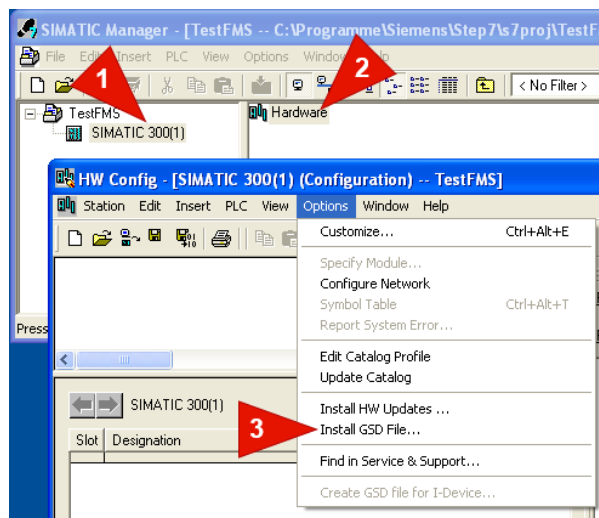


For further information on how the grouping of segments works and how the data are transferred to the PLC, consult the FMS-segFORCE Operation Manual.

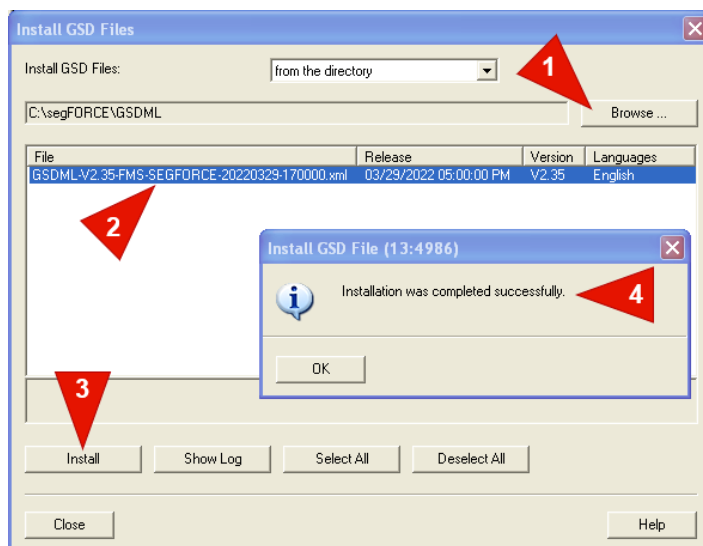
2.5 Use the FMS-segFORCE in Your Project

2.5.1 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.

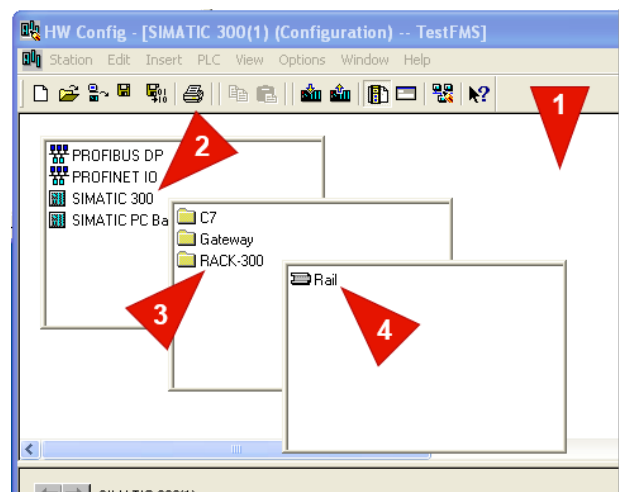


- On the Install GSD Files dialog, click on the Browse button **1**. Choose the directory where the GSDML files are located. In our case, it is C:\FMS_segFORCE\GSDML. Return to the previous dialog by clicking on OK. Select the GSDML file from the list that is to be installed **2**. Now click on Install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

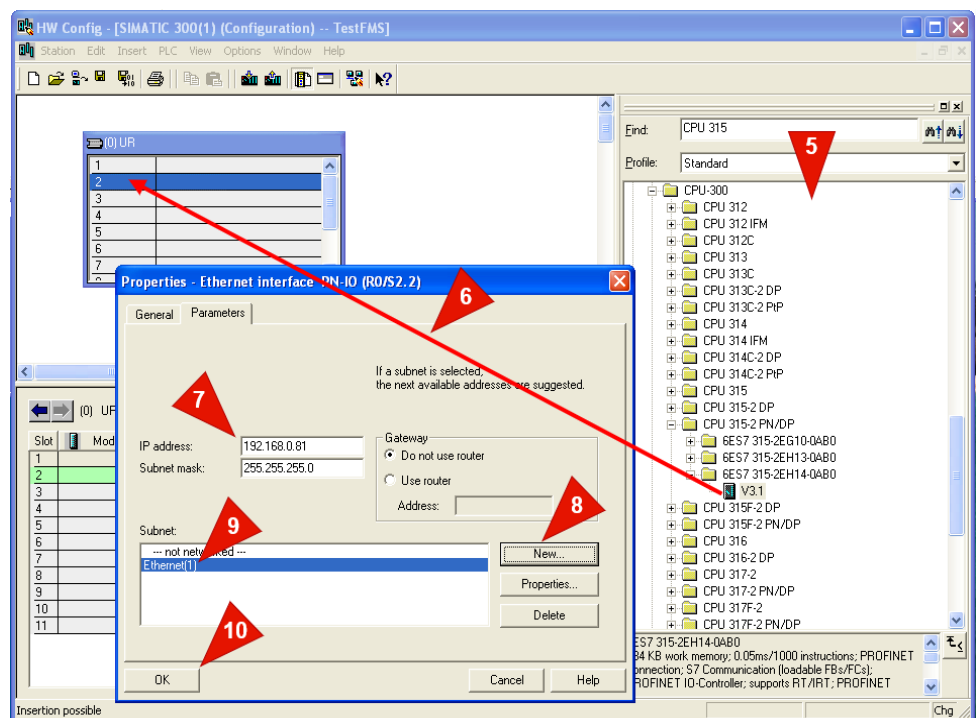


- Now as you are back on the HW Config dialog, the next step is to insert a rack and a CPU. Of course, only if they are not configured already. Otherwise, continue straight on to the next step.

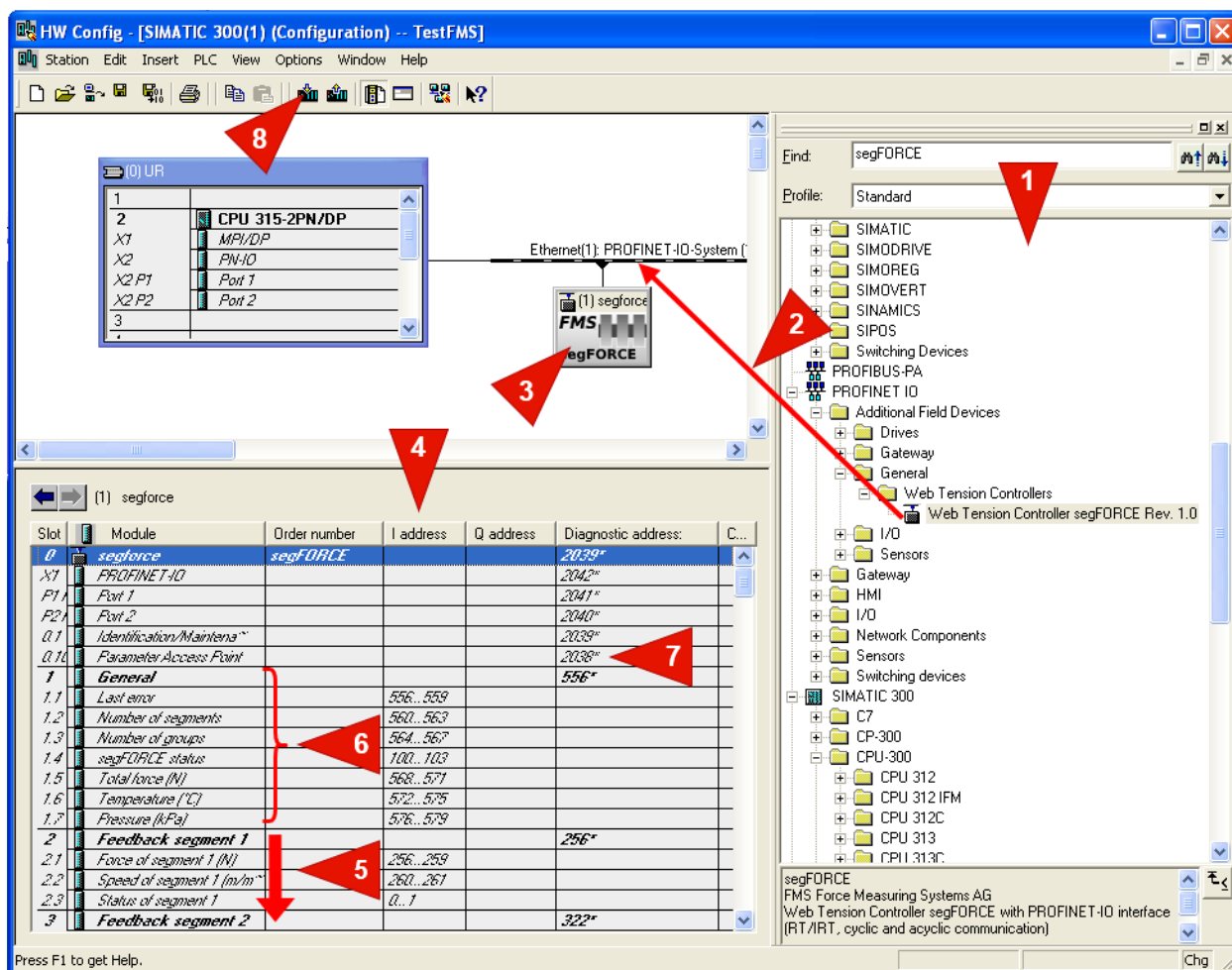
Right-click in the white area below the menu and symbol bar **1** and choose Insert Object. In the popping-up list, choose SIMATIC 300 **2**, then RACK-300 **3**, and finally Rail **4**. A table representing the rack is inserted in the white area.



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**.

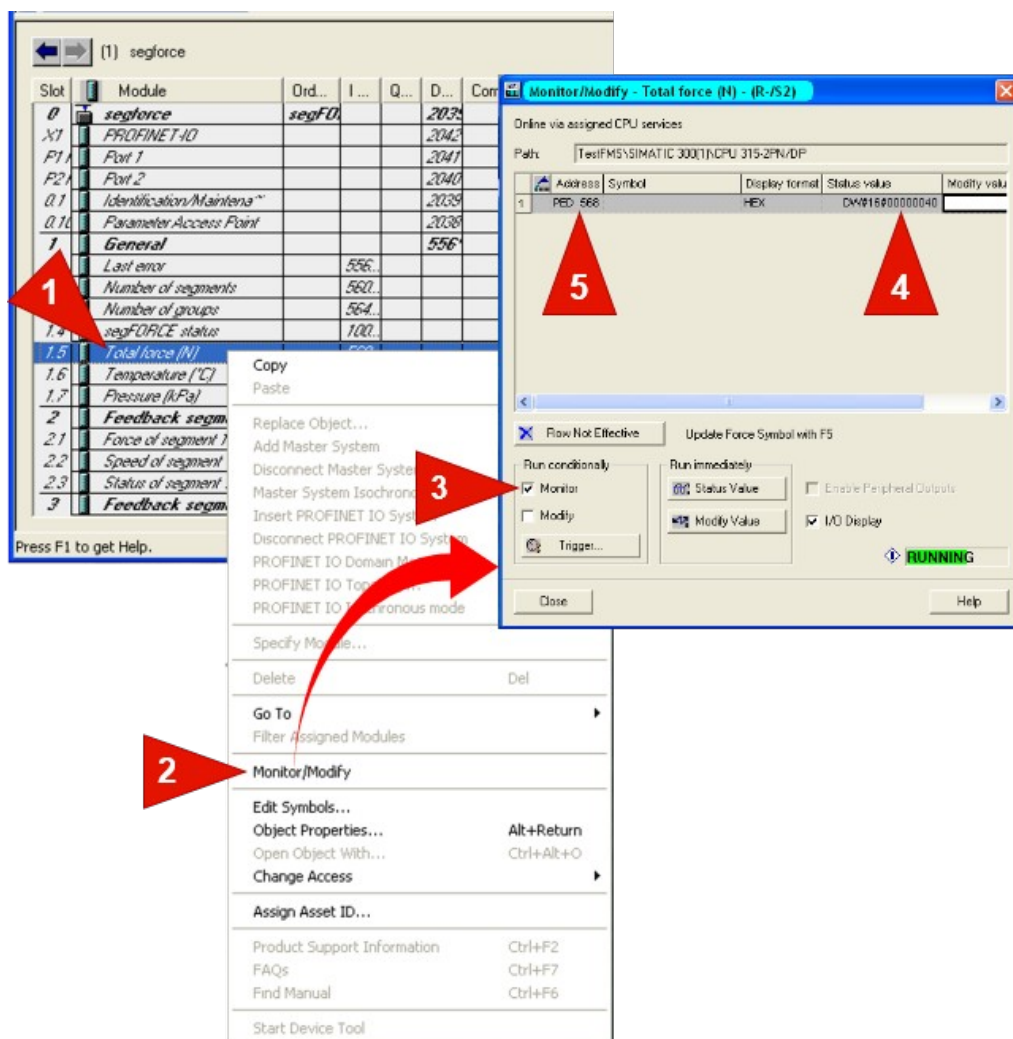


- Add the FMS-segFORCE device to the hardware configuration. Make sure the HW Config is open, as already described above once. Find the FMS-segFORCE device in the hardware catalog on the right **1** and drag and drop it to the Ethernet PROFINET-IO-System **2**. This operation inserts the FMS-segFORCE 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 FMS-segFORCE, it is used to switch the Group Mode on or off **7**.



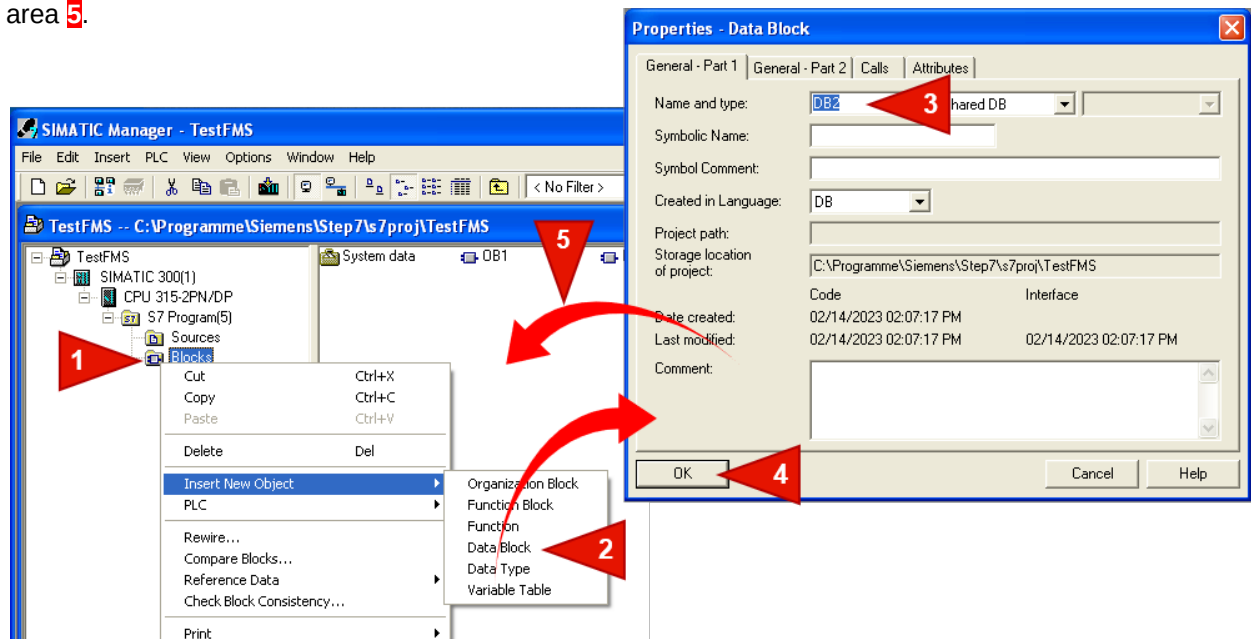
- After all hardware configuration has been made, download it to the PLC **8**. Check if the PLC is satisfied with it. Therefore the LEDs DCV5 and RUN must permanently light green, and no other LEDs should be blinking. If that is not the case, fix the problems first.

- The FMS-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**.

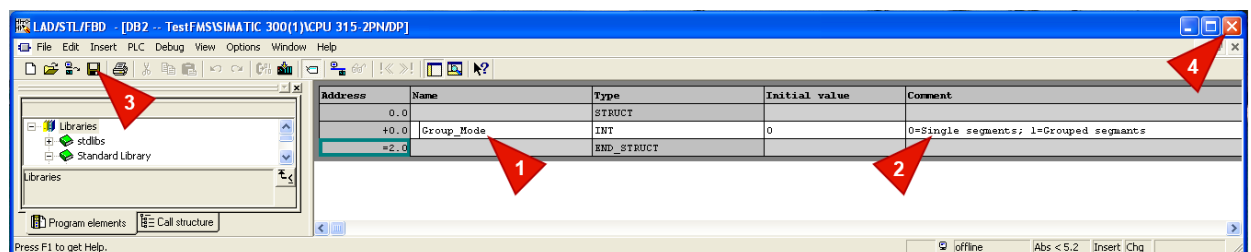


For the following steps, close all dialogs until you are back on the SIMATIC Manager main window.

- The last thing to explain is how to switch the FMS-segFORCE to 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**.



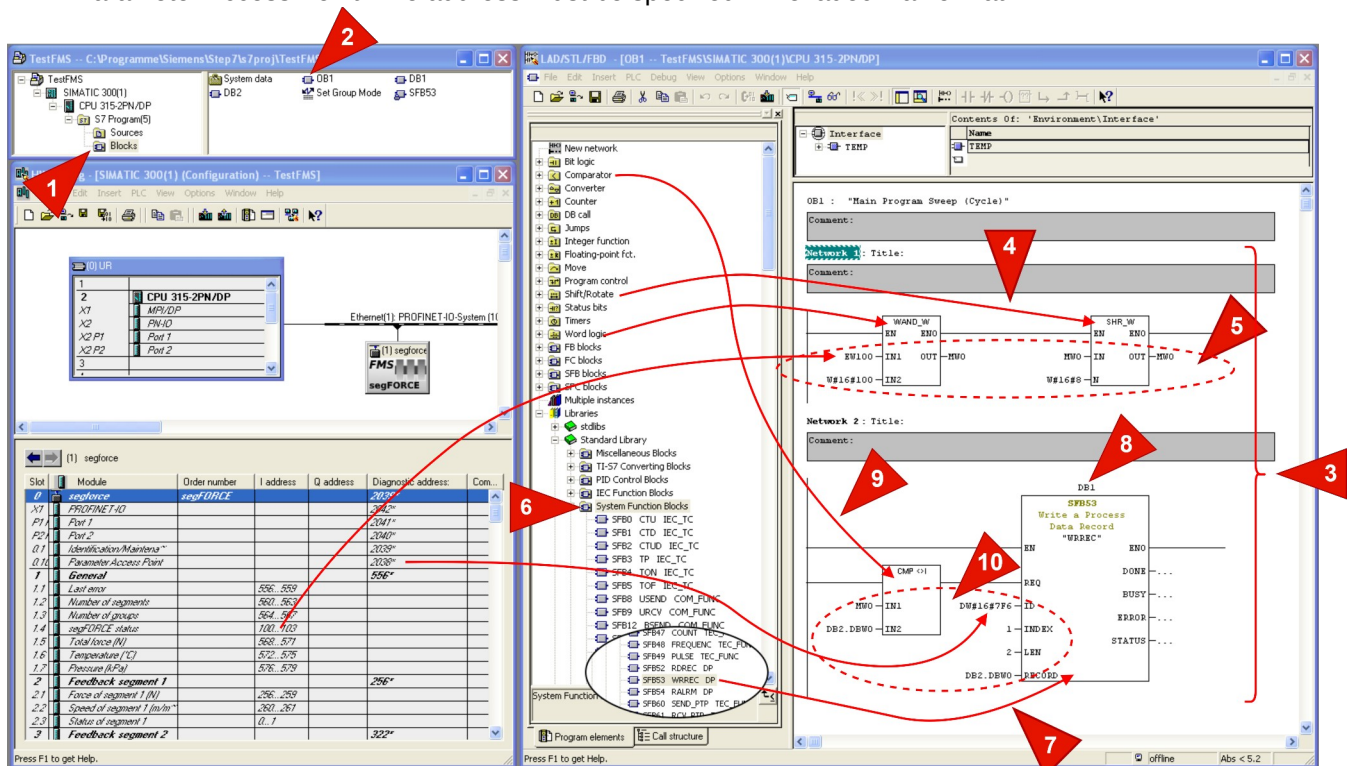
- The last action above **5** opens the data block definition. Enter the parameter name **Group_Mode** **1** and a comment **2**. Save the changes **3** and close the window **4**.



- 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.

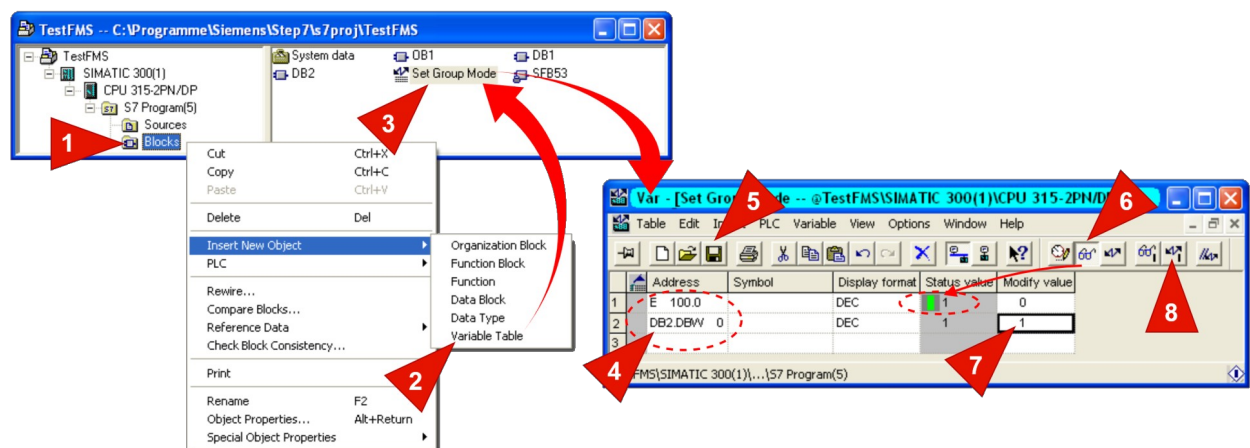
Network 2 sends the group mode value when the demanded group mode differs from the set. To achieve that behavior, select the item **System Function Blocks** on tree **6**. Further down the branch, drag the SFB53 WRREC DP function block **7** to the desired network. Enter the name of a data block not 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.

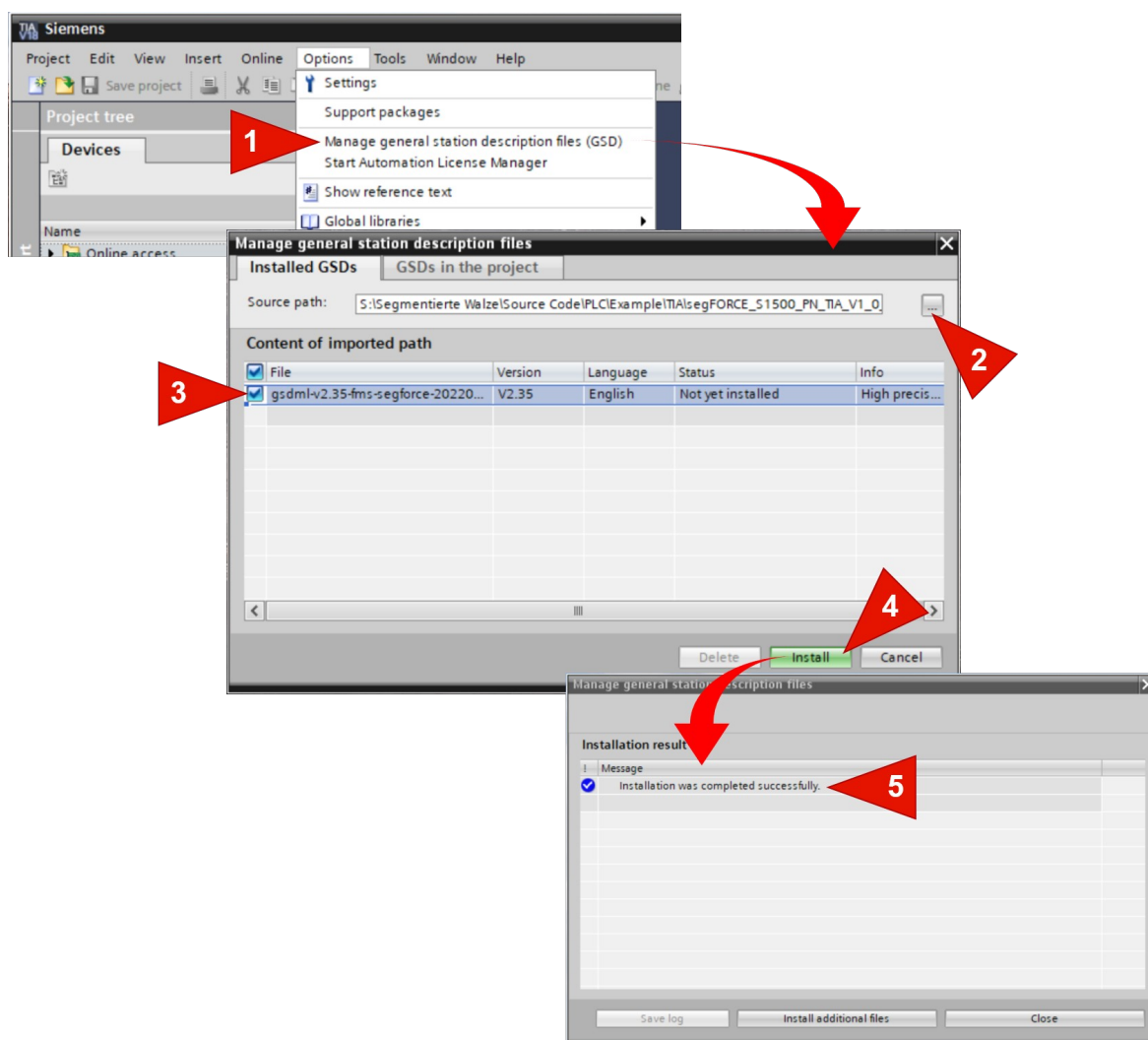
- How to use the program. First, right-click on the tree item **Blocks** **1**, and select the submenu **Insert New Object -> Variable Table** **2**. In the popping-up dialog, enter the Symbolic Name, e.g., **Set Group Mode**, and click on Ok. The variable table is now available in the area on the right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

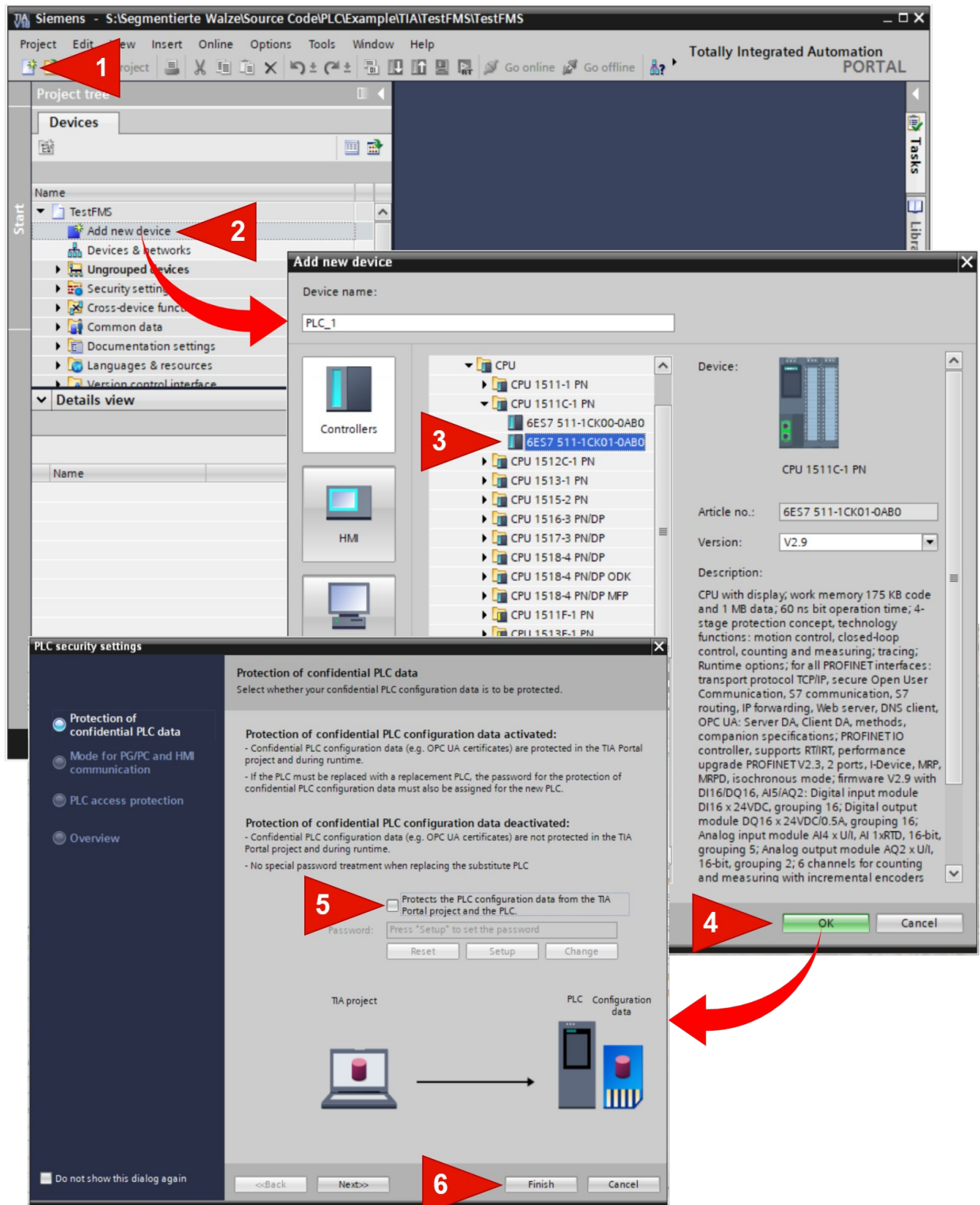


2.5.2 TIA Portal

- 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:\FMS_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.



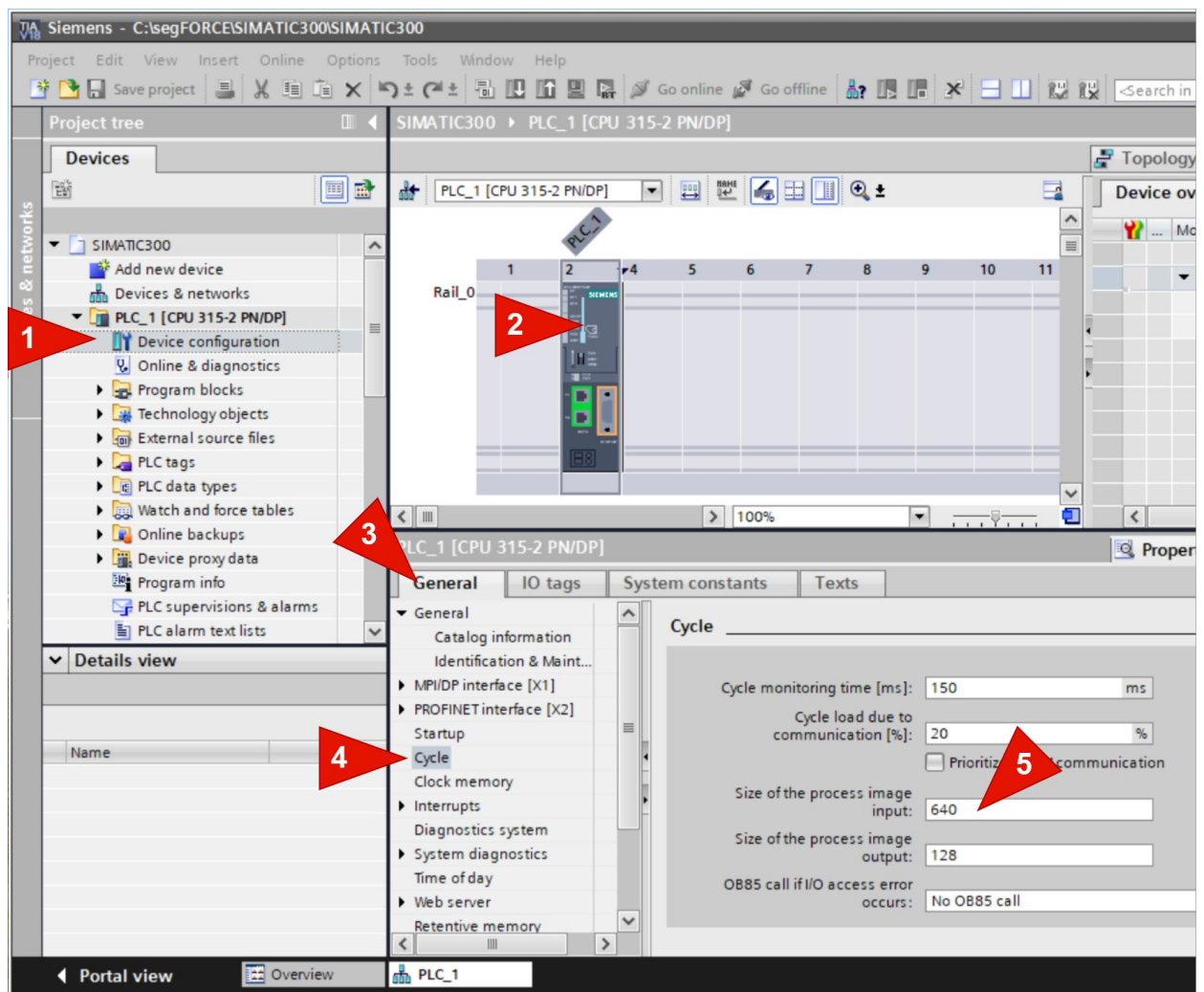
- Open your project or create a new one **1**. In case of a new project, add a new device, e.g., PLC CPU 1511C-1 PN, by double-clicking on **Add new device** **2**. After that, search your CPU **3** and click on **OK** **4**. In the opening dialog **PLC security settings** make sure the check box **Protects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



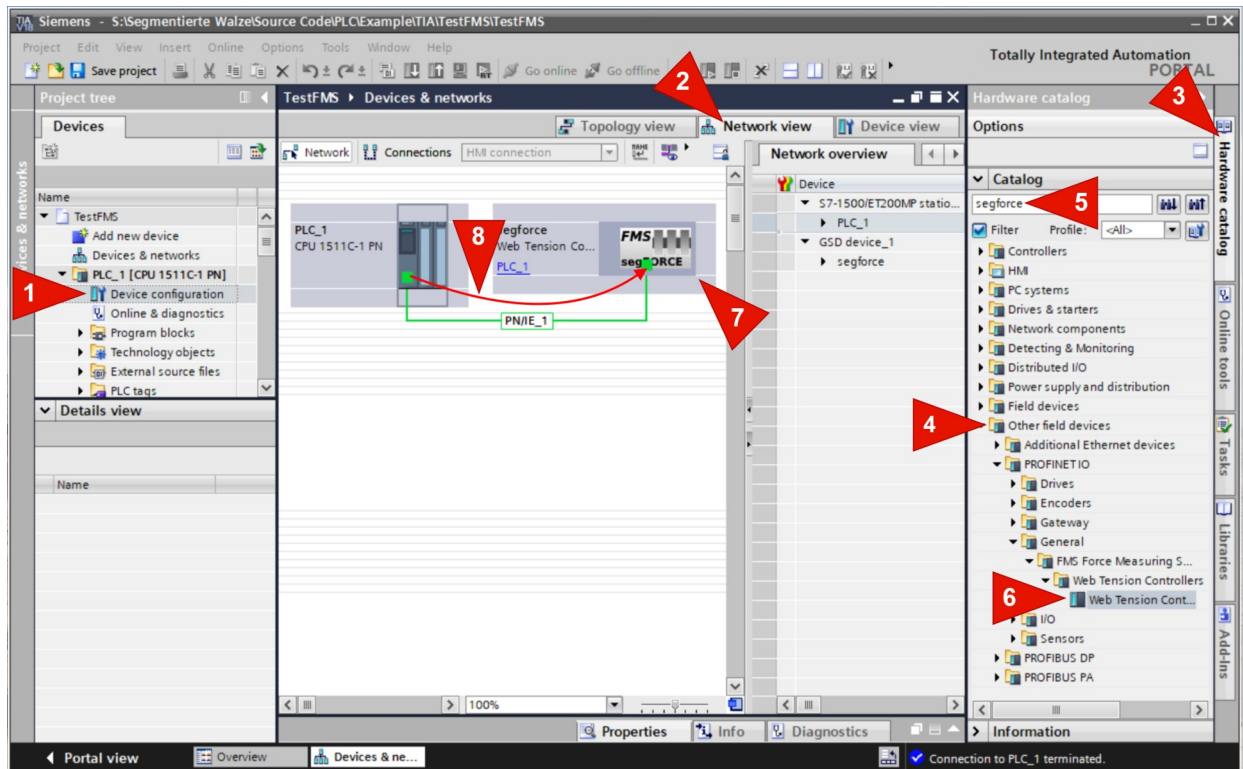


If you have a PLC of the SIMATIC 300 or maybe 400 series added, **make sure to increase the input process image size to a minimum of 640 bytes**. If you don't make that change, not all FMS-segFORCE values will be seen. Therefore when reading values from the process image, they return 0 instead of the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

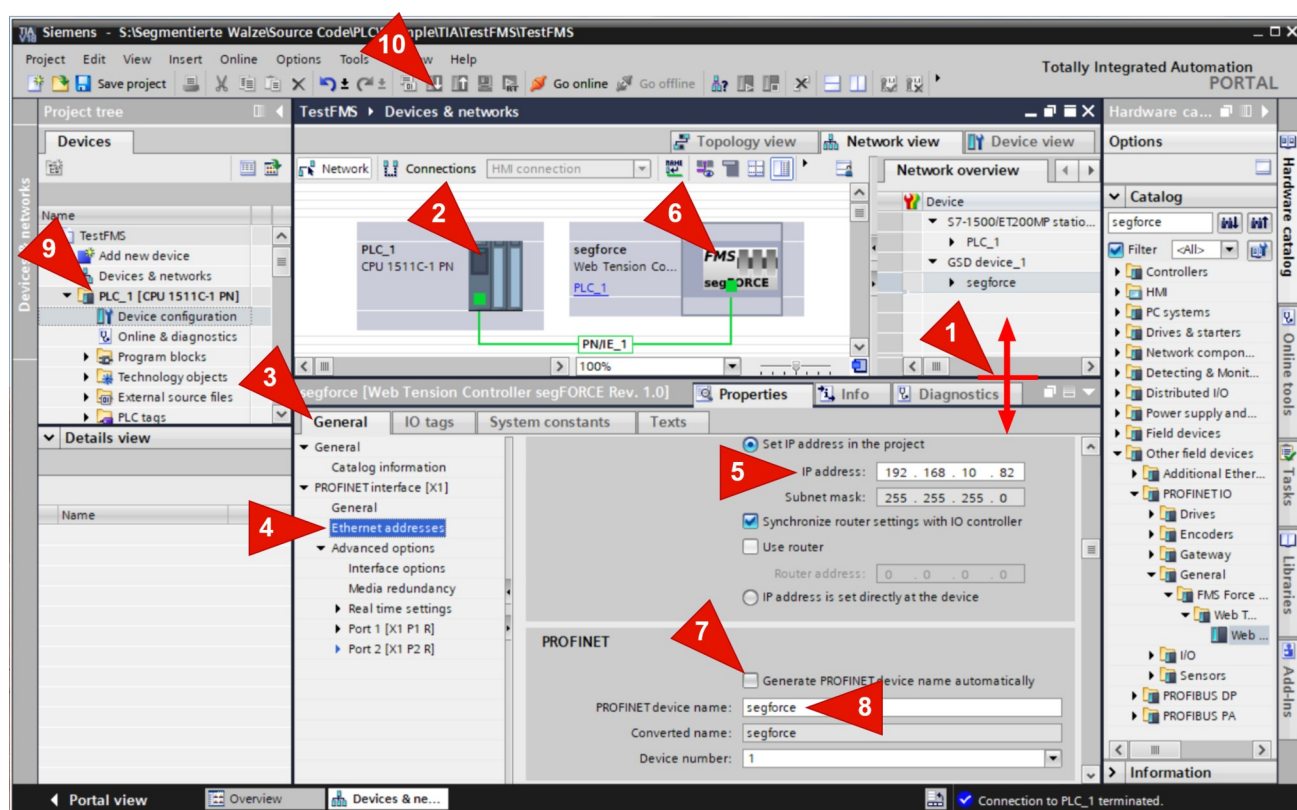
- If you have a SIMATIC 1200 or 1500 series PLC, continue with the next point. But if you have a SIMATIC 300, or maybe the same applies to the 400, double-click on the **Device Configuration** item in the Device Tree **1**. Then double-click the PLC **2**, select the tab **General** **3** and choose 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 FMS-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 FMS-segFORCE is added to the hardware configuration **7**. Connect the PLC and the FMS-segFORCE by dragging a line **8** between the Ethernet ports. This action draws a green line between the two devices representing the connection.



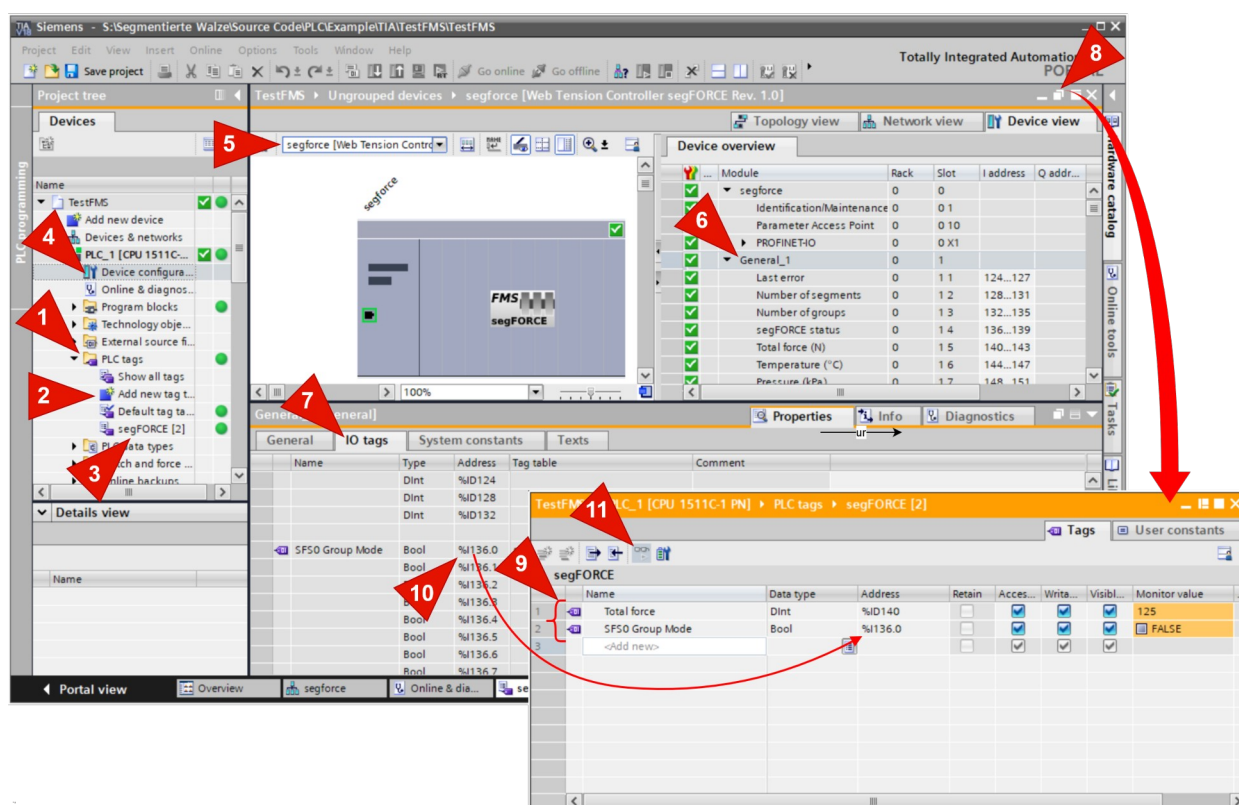
- The next step is to assign the PLC and the FMS-segFORCE an unused IP address. In the case of the PLC, that is unnecessary for an existing project because you might already have done that. First, you can stay on the panel above and uncover the lower part of the device configuration by dragging the separator 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 FMS-segFORCE **6** and then tab General **3**. Select the tree entry Ethernet addresses **4**. Enter the IP address the FMS-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**.



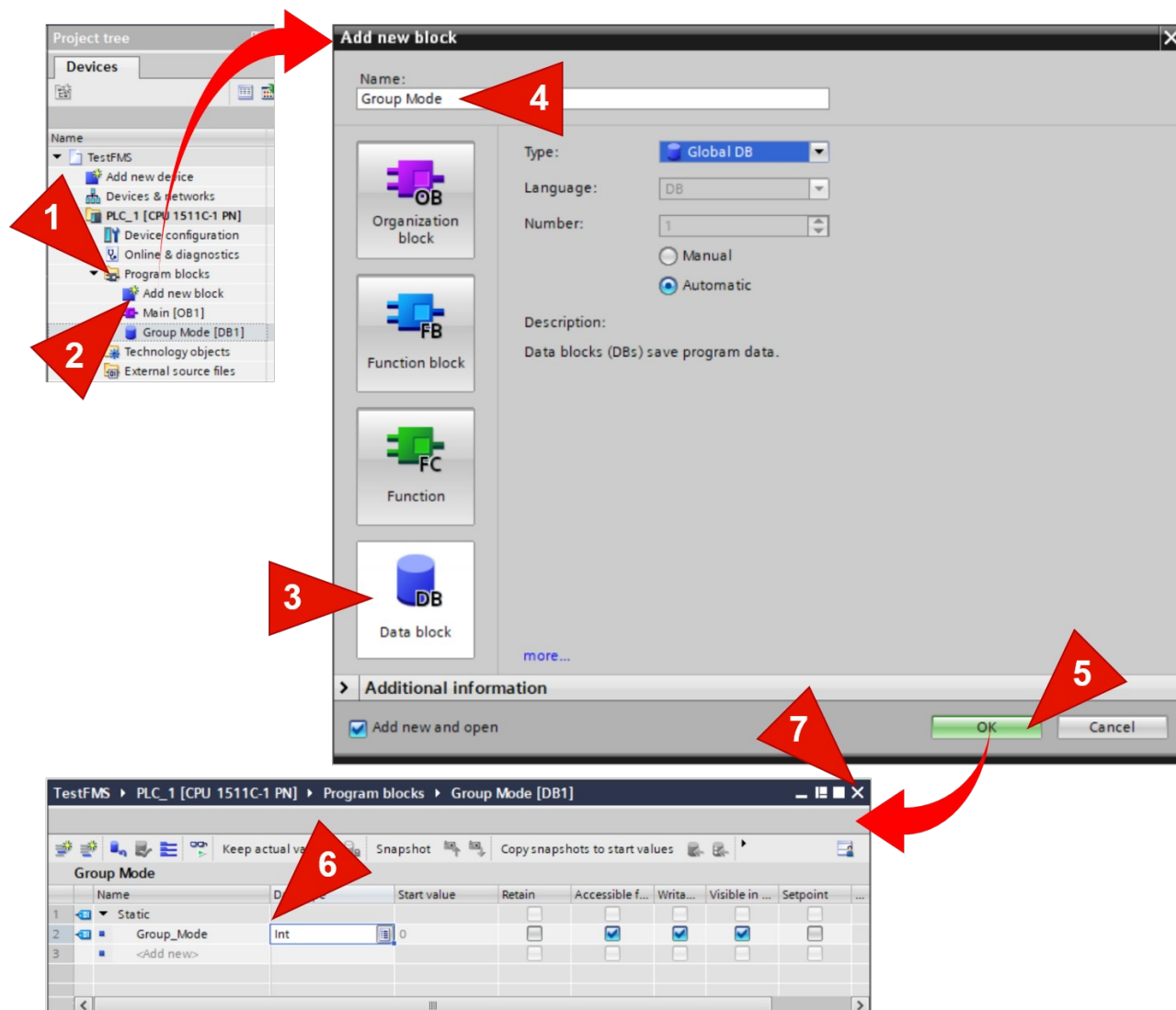
- Continue with the next step when the configuration has been downloaded successfully. Therefore the left LED must permanently light green, and the other two must be dark. If that is not the case, fix the problems first.



- The FMS-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 FMS-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 FMS-segFORCE ("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**.



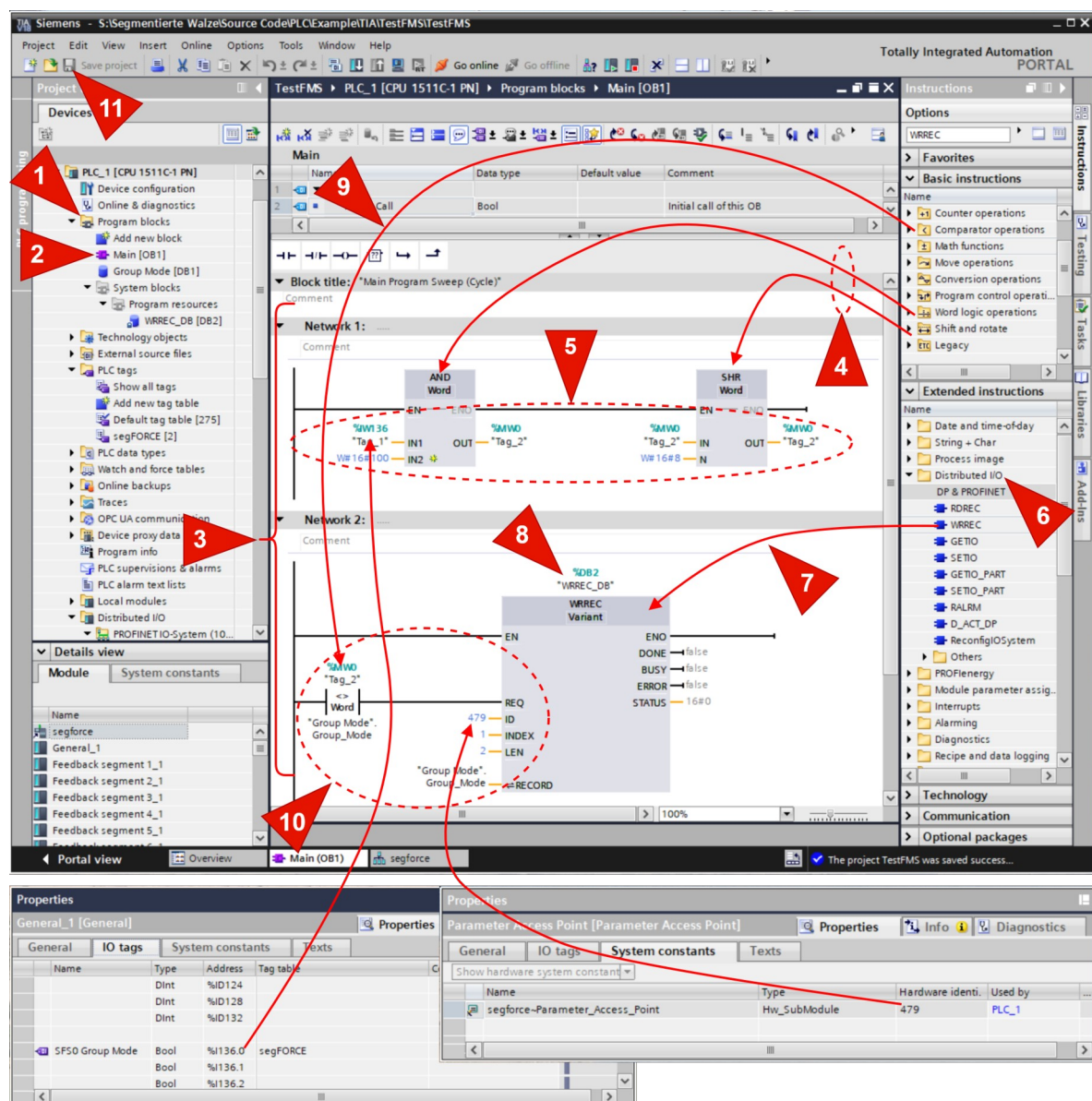
- The last thing to explain is how to switch the FMS-segFORCE to group mode. For that purpose, a little program is needed. Open the tree branch **Program blocks** **1**, and double-click the tree entry **Add new block** **2**. The dialog **Add new block** pops up. Click on the symbol **Data block** **3**, 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 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 block followed by a SHR block. Network 2 contains a WRREC block and a comparator block. Red arrows and numbers 1 through 11 highlight the steps described in the text. The left sidebar shows the project tree with 'Program blocks' expanded. The right sidebar shows the 'Instructions' palette with 'Extended instructions' selected. The bottom of the screen shows the 'Properties' window for the 'Parameter Access Point'.

General_1 [General]				
Name	Type	Address	Tag table	
General_1	Dint	%ID124		
Feedback segment 1_1	Dint	%ID128		
Feedback segment 2_1	Dint	%ID132		
Feedback segment 3_1	Bool	%I136.0	segFORCE	
Feedback segment 4_1	Bool	%I136.1		
Feedback segment 5_1	Bool	%I136.2		

Parameter Access Point [Parameter Access Point]				
Name	Type	Hardware identi.	Used by	
segforce-Parameter_Access_Point	Hw_SubModule	479	PLC_1	

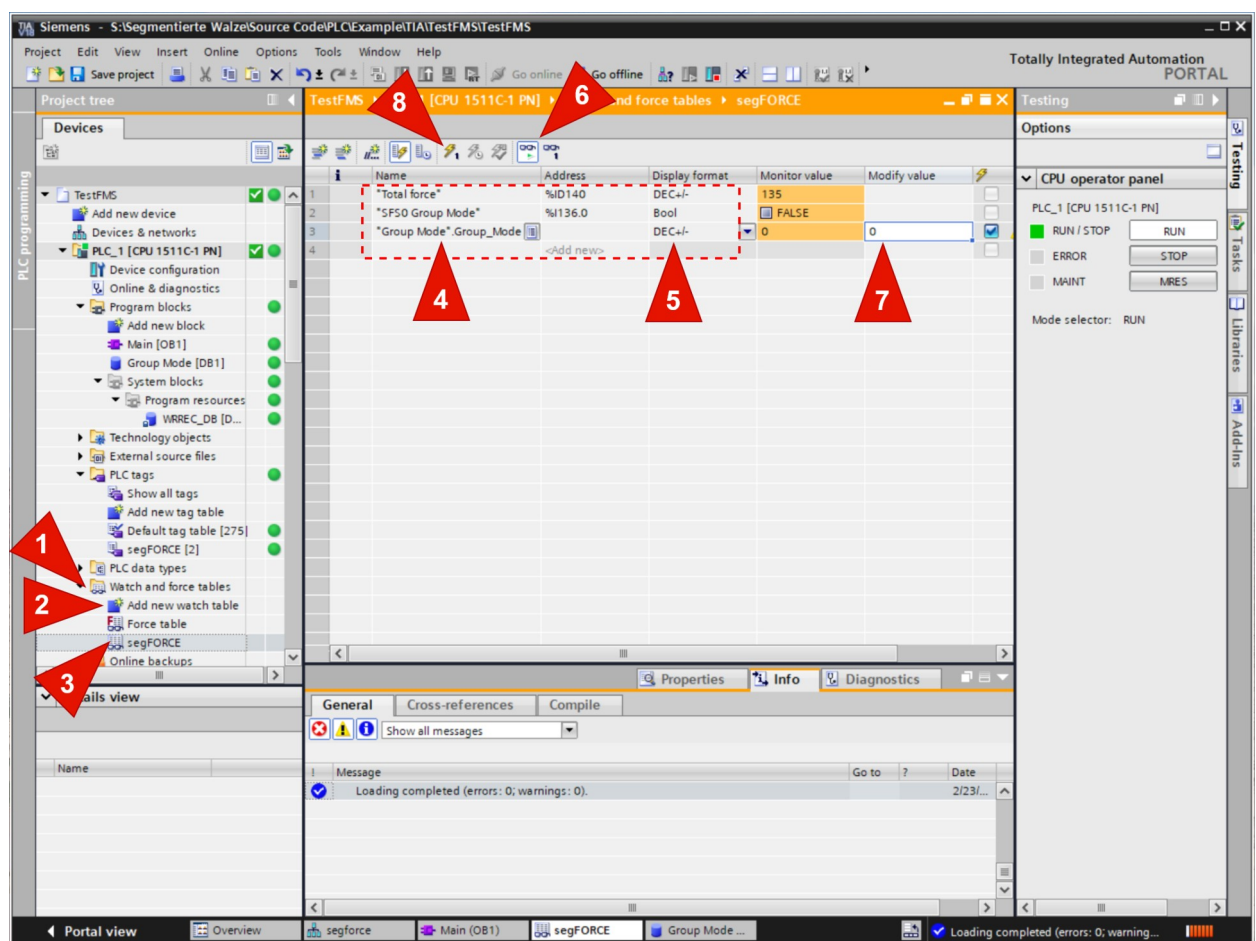
- Download program to the PLC.
- How to use the program. Open the folder **Watch and force tables** **1** under the PLC project tree, and double-click the tree entry **Add new watch table** **2**. A new table named **Watch table_1** or similar will be added. Rename the table to **segFORCE** **3**. After 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 the get back to the single segment mode

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

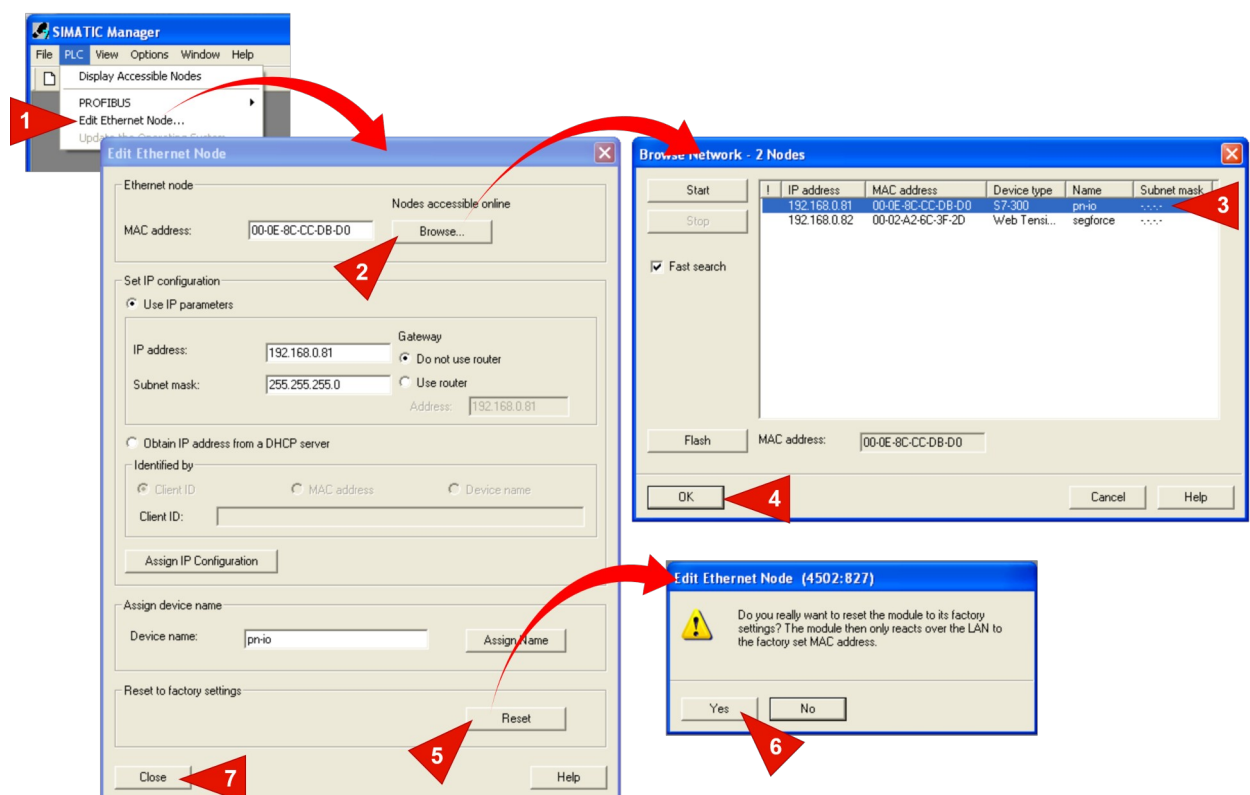


2.6 PLC Operation Commands

2.6.1 How to Reset a PLC to Factory Settings

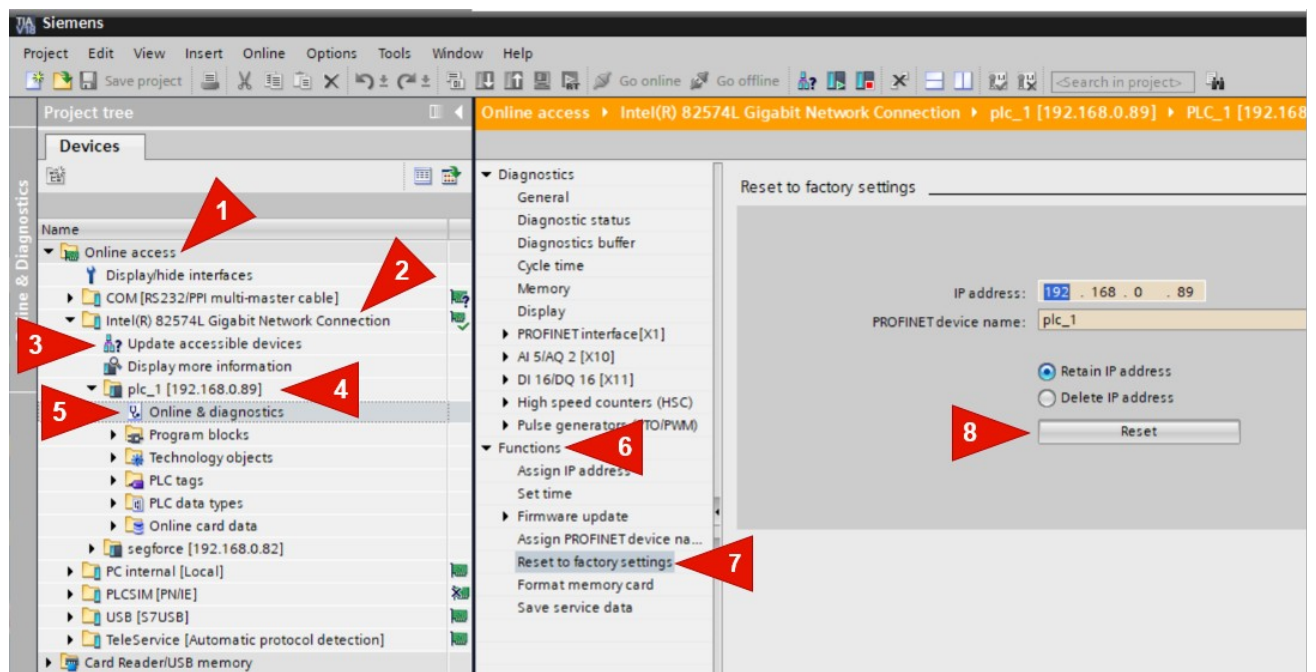
2.6.1.1 Resetting PLC with Step 7 SIMATIC Manager

- 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, therefor leave the dialog by clicking on **Close** **7**.



2.6.1.2 Resetting PLC with TIA Portal

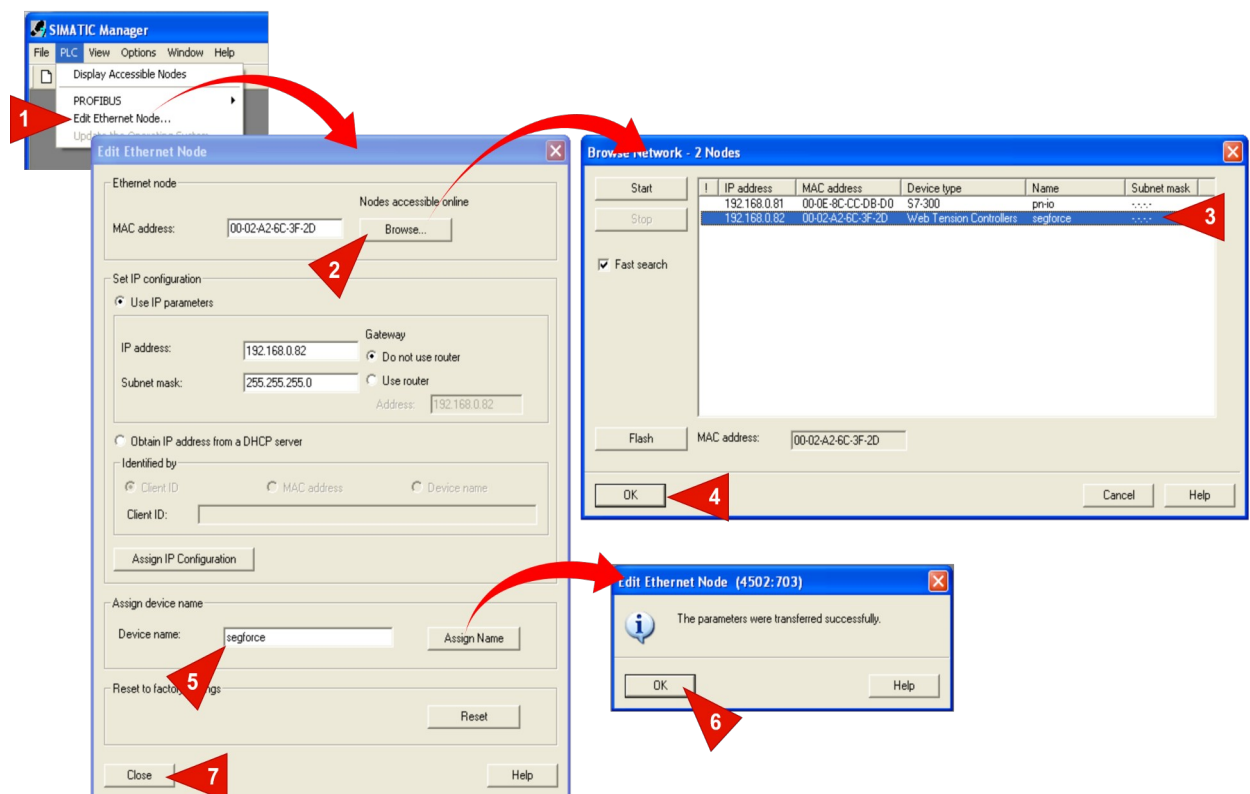
- Execute the **TIA Portal** program.
- The program normally starts with the portal view. Switch to the project view by clicking the **Project view** menu at the bottom left.
- Open the Online access tree **1** and the Ethernet interface card **2**, over which the PC is connected to the network.
- Double-click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



2.6.2 How to Assign the PROFINET Device Name

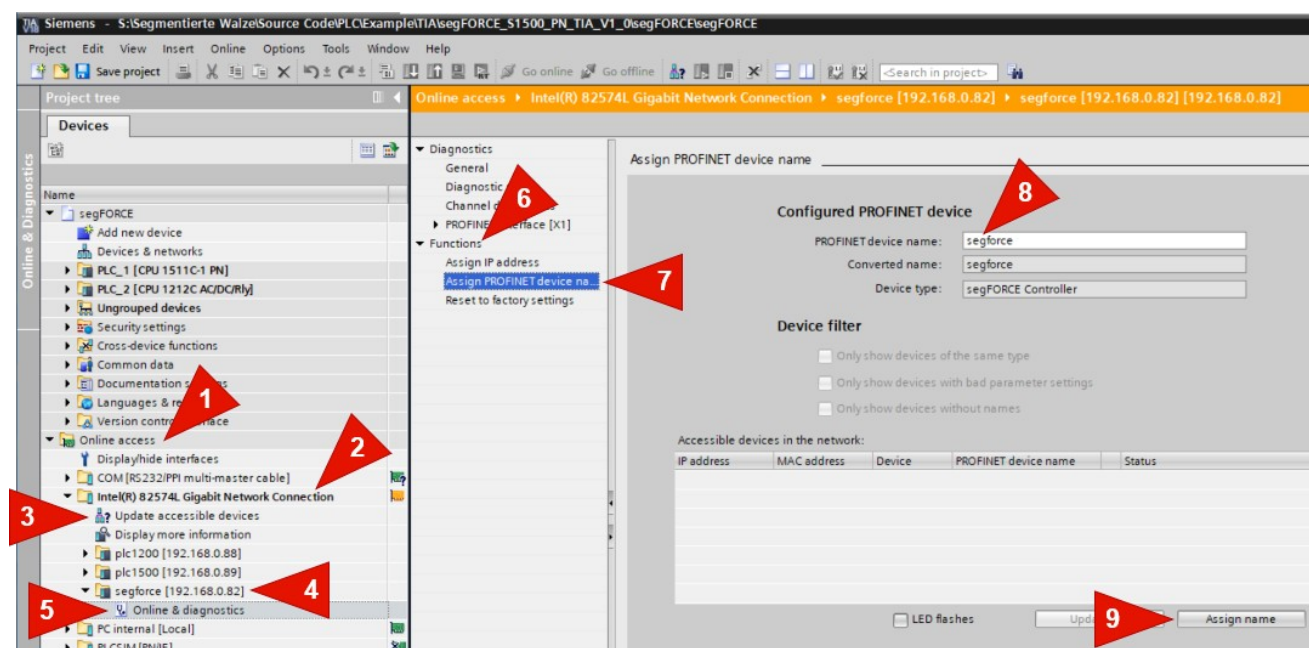
2.6.2.1 Name Assignment with Step 7 SIMATIC Manager

- 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 FMS-segFORCE ("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 FMS-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 FMS-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**.



2.6.2.2 Name Assignment with TIA Portal

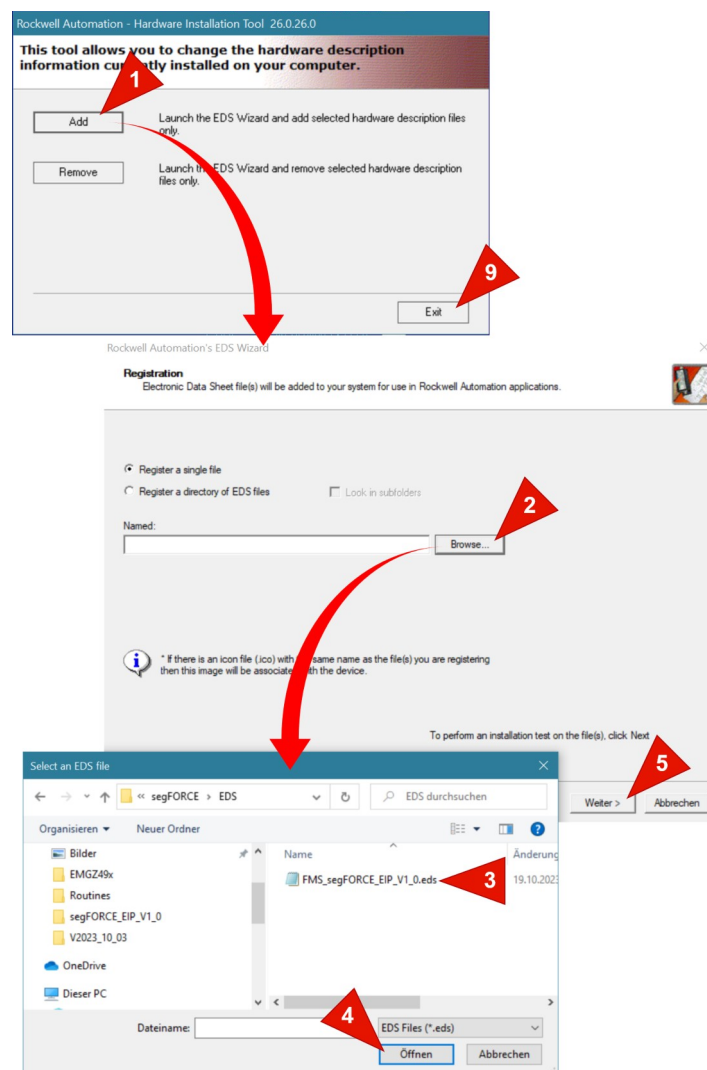
- Execute the **TIA Portal** program.
- The program normally starts with the portal view. Switch to the project view by clicking the **Project view** menu at the bottom left.
- Open the Online access tree **1** and the Ethernet interface card **2**, over which the PC is connected to the network.
- Double-click on the item **Update accessible devices** **3**. After a while, all PROFINET devices on the same network emerge.
- Open the tree of your FMS-segFORCE. The shown name ("segforce") 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**.

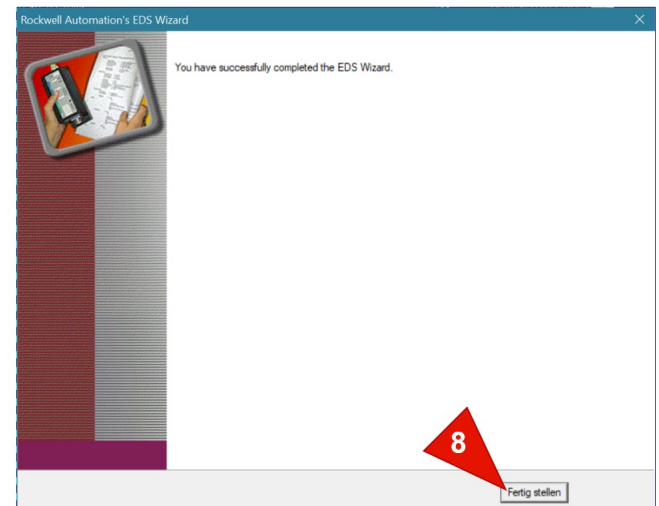
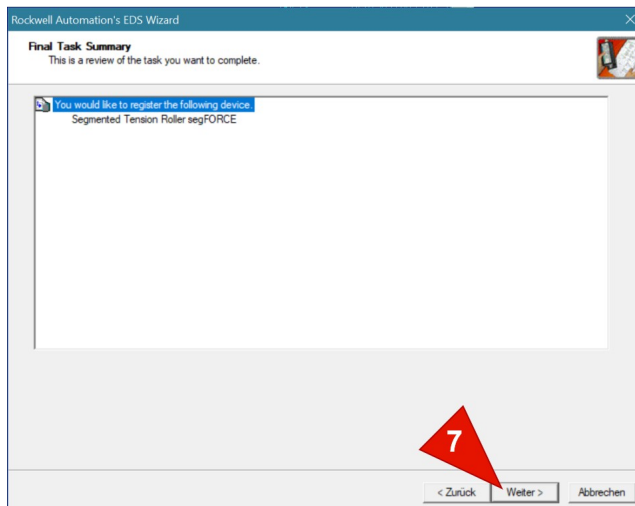
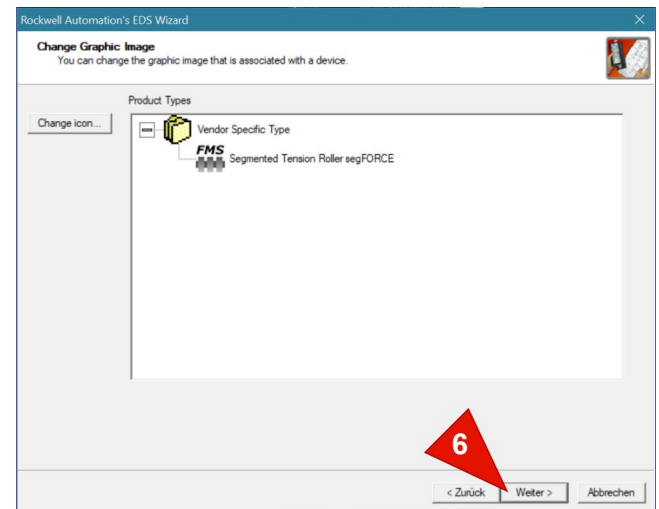
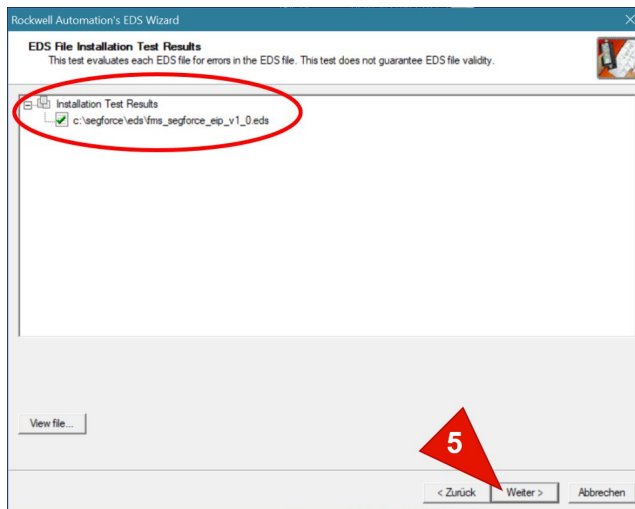


3 RSLogix 5000 EtherNet/IP

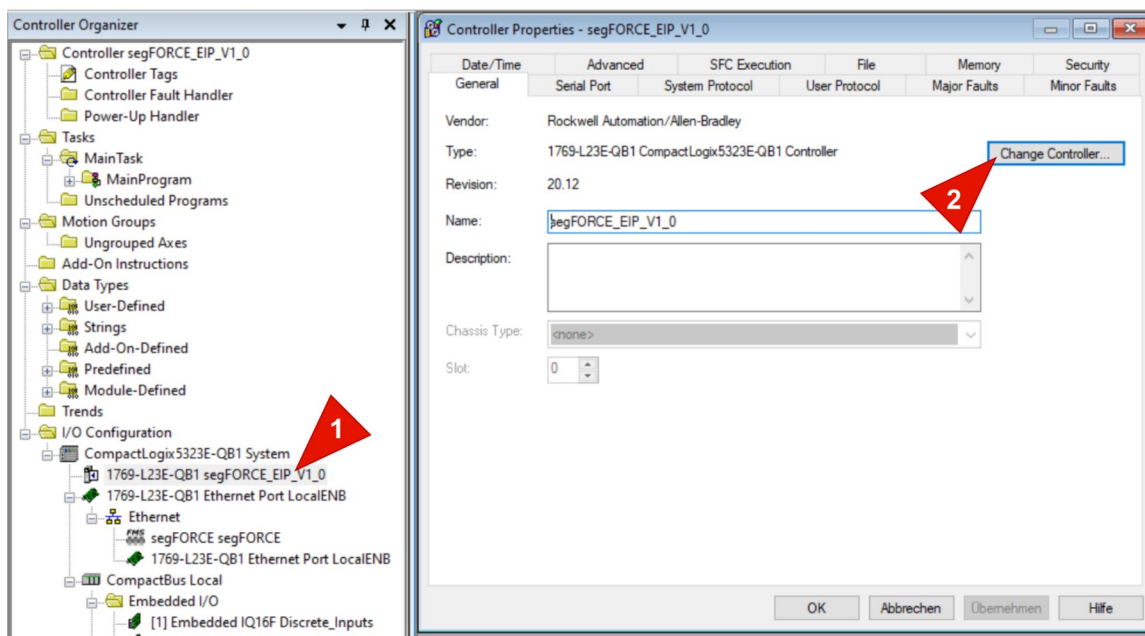
3.1 Setting up the Project

- Download the example programs contained in the archive segFORCE_EIP_Vx_x Example.zip available on 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, including the EDS file, to your preferred directory on your PC on which the **RSLogix 5000** development software is installed.
The Quick Start Guide uses the directory C:\FMS_segFORCE, and all further explanations start from this directory without explicitly mentioning it again.
- Install the EDS for the FMS-segFORCE if the newest version does not already exist on your PC. To do so, execute the **Rockwell Automation - Hardware Installation Tool** and follow the screenshots.

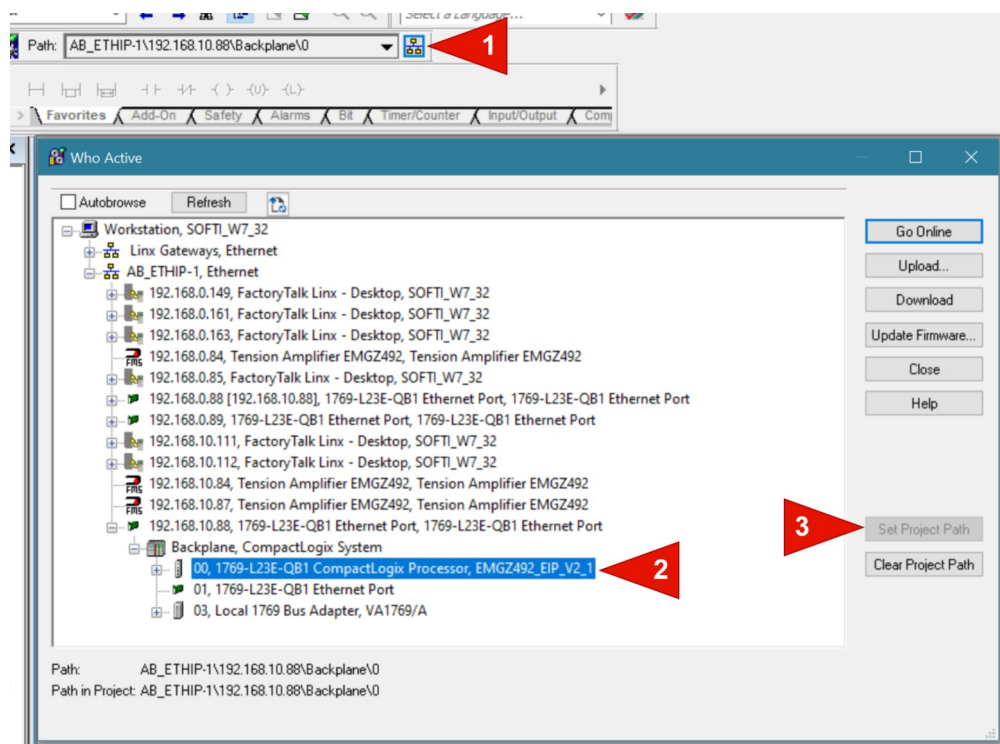




- Execute the **RSLogix 5000** program.
Open the existing project C:\FMS_segFORCE\segFORCE_EIP_Vx_x Example\segFORCE_EIP_Vx_x.ADC
(x is a placeholder for the example program version).
- Change the controller that it matches your utilized controller.



- Change the Path to the controller that you would like to use for the example program. If you have difficulty to change the path, use the Allen Bradley documentation for a further description.

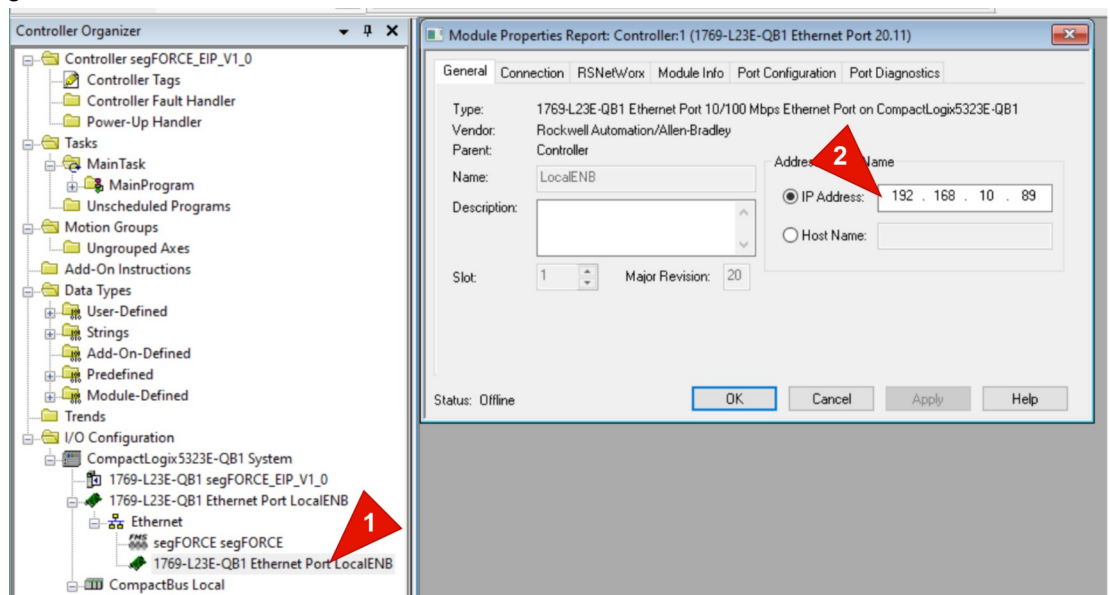


- Ensure the IP addresses of the PLC and the FMS-segFORCE controller are correctly configured, matching the set IPs of the physical devices. If not, change them accordingly. Follow the screenshots below.

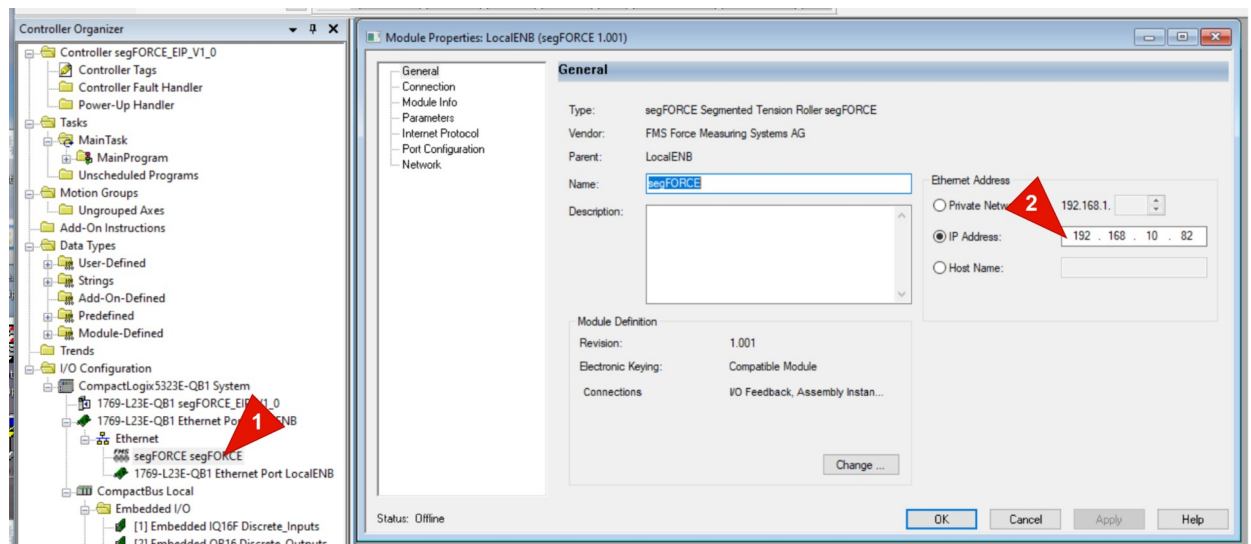


Changes here define how the PLC program addresses or expects the devices over the IPs. To set the physical IPs of devices, use either the **RSLinx** tool or the Hilscher tool **Ethernet Device Configuration**.

The IP configuration of the PLC

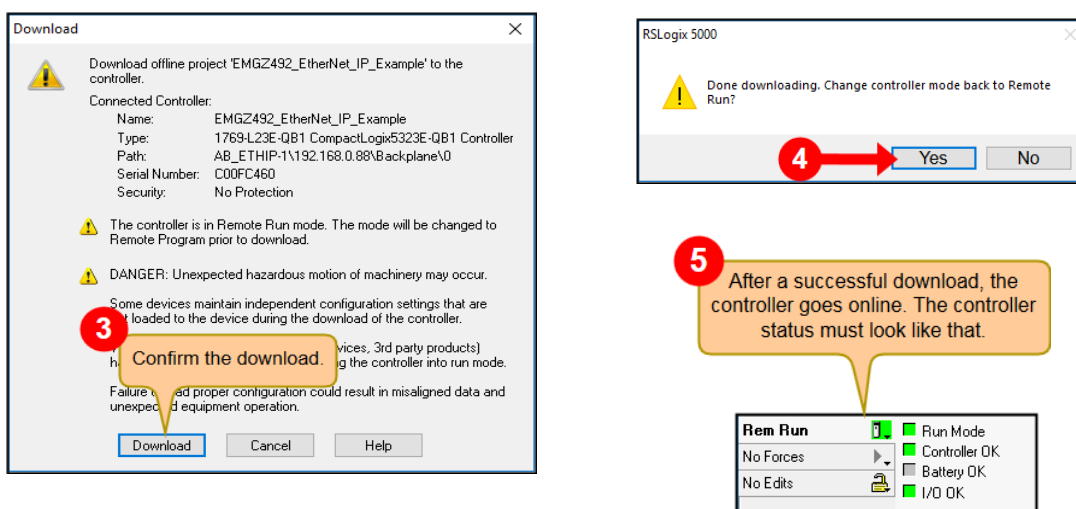
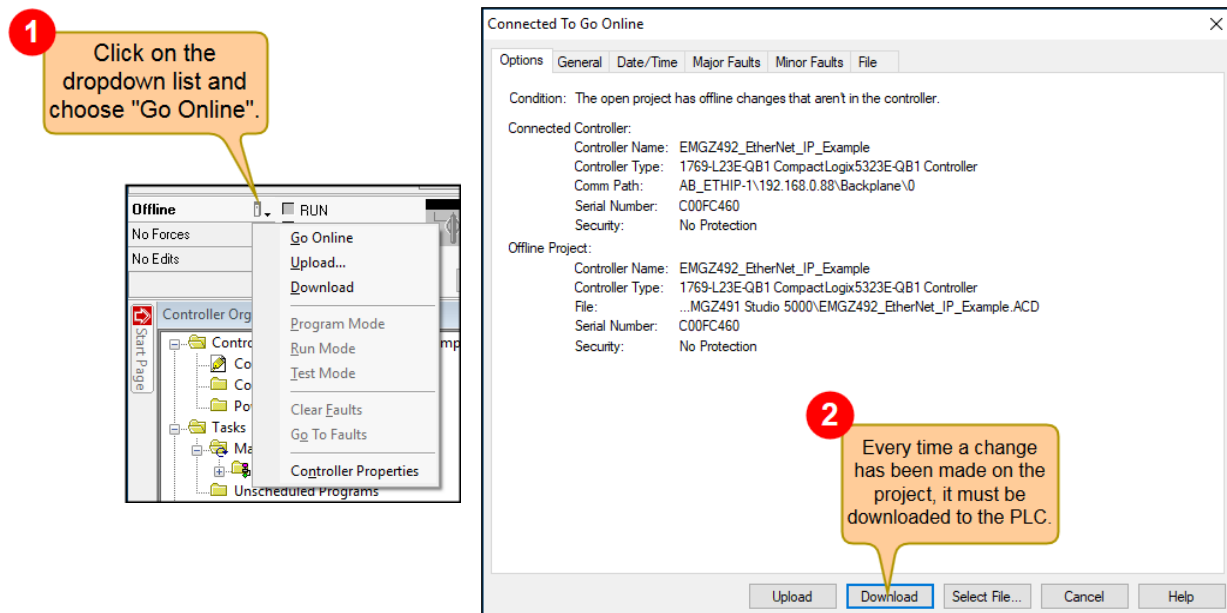


The IP configuration of the FMS-segFORCE.

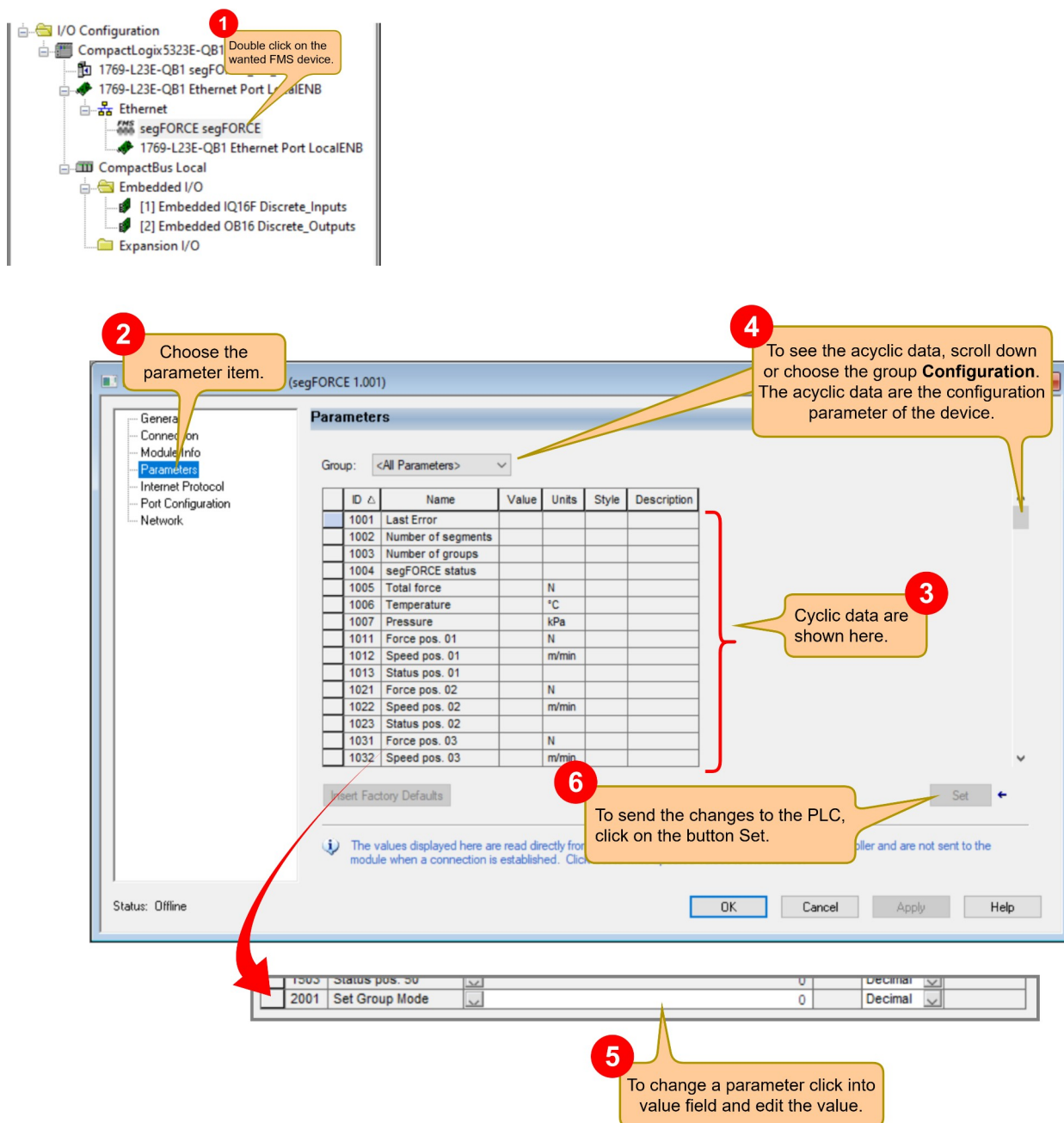


3.2 Using the Example Program

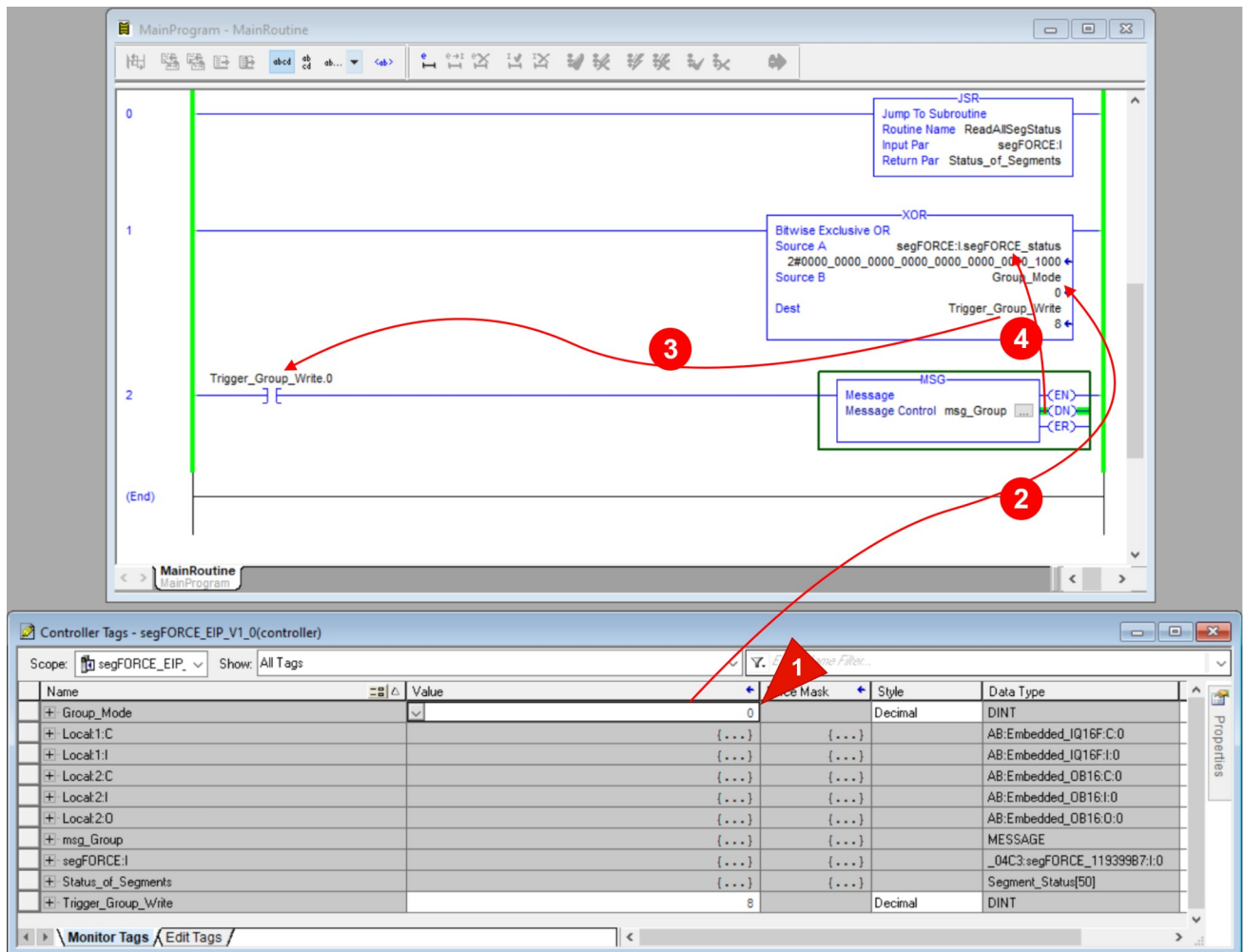
- Establish a connection with the PLC.



- Open the Module Properties dialog.



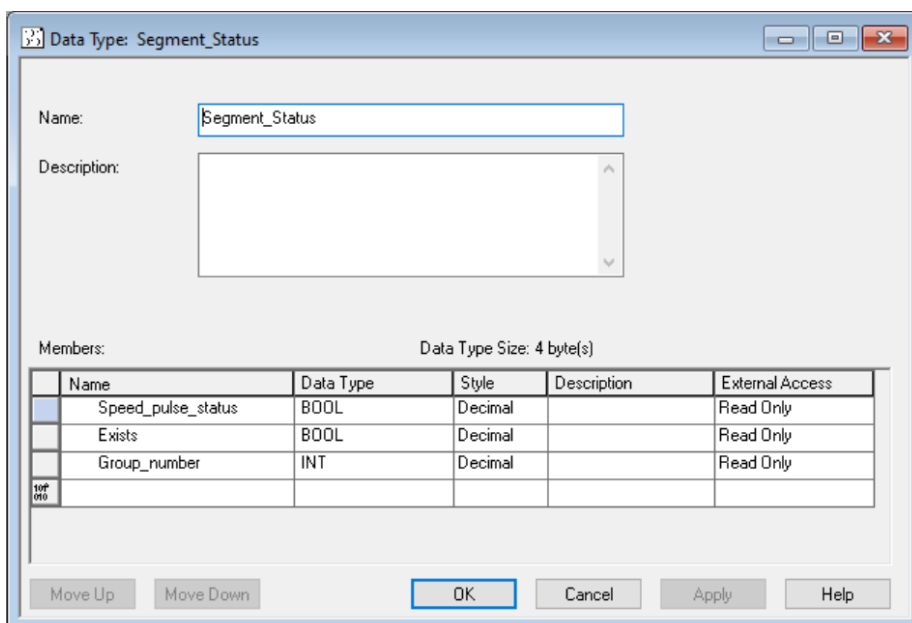
- To change device configuration parameters, follow points 4 to 6 above. If the **Group Mode** is 0, then the data of individual segments are returned. If the value is 1, then the segment group data are returned. Alternatively, the group mode can also be changed by manually writing 0 or 1 into the tag **Group_Mode**. The PLC program detects if that tag has been changed and triggers the message **msg_Group** over the flag **Trigger_Group_Write.0**. See the picture below.



3.3 Decoding the Status of the Segments

Each segment has its status register. The register's datatype is an unsigned integer of 16 bits. The bits 0 to 7 are flags. Bits 8 to 15 hold the group number of the segment. The PLC example program already includes some routines for decoding the status registers. The routines split the register into individual flags and the group number.

First, we need a *User-Defined* data type that includes the currently supported data in the segment status register. Its name is **Segment_Status**. If you do not want to define it yourself, you can import it from the file Segment_Status.L5X, which is delivered together with the example program and located under directory \segFORCE_EIP_Vx_x Example\Routines\. The *User-Defined* data type looks as follows.



Data Type: Segment_Status

Name:

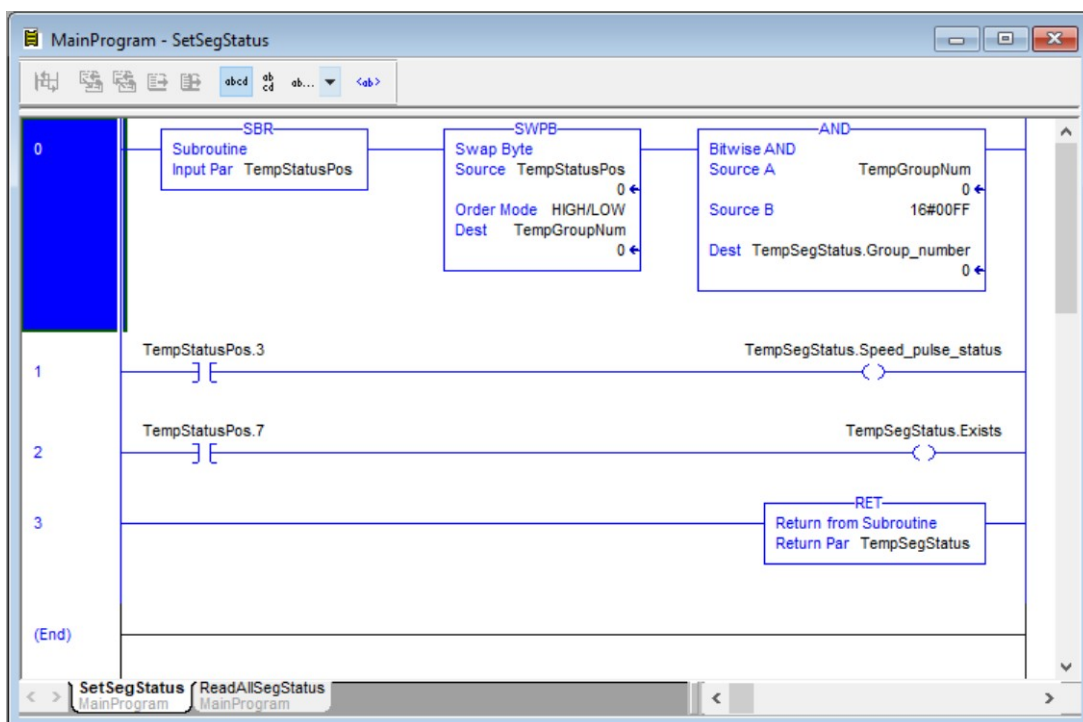
Description:

Members: Data Type Size: 4 byte(s)

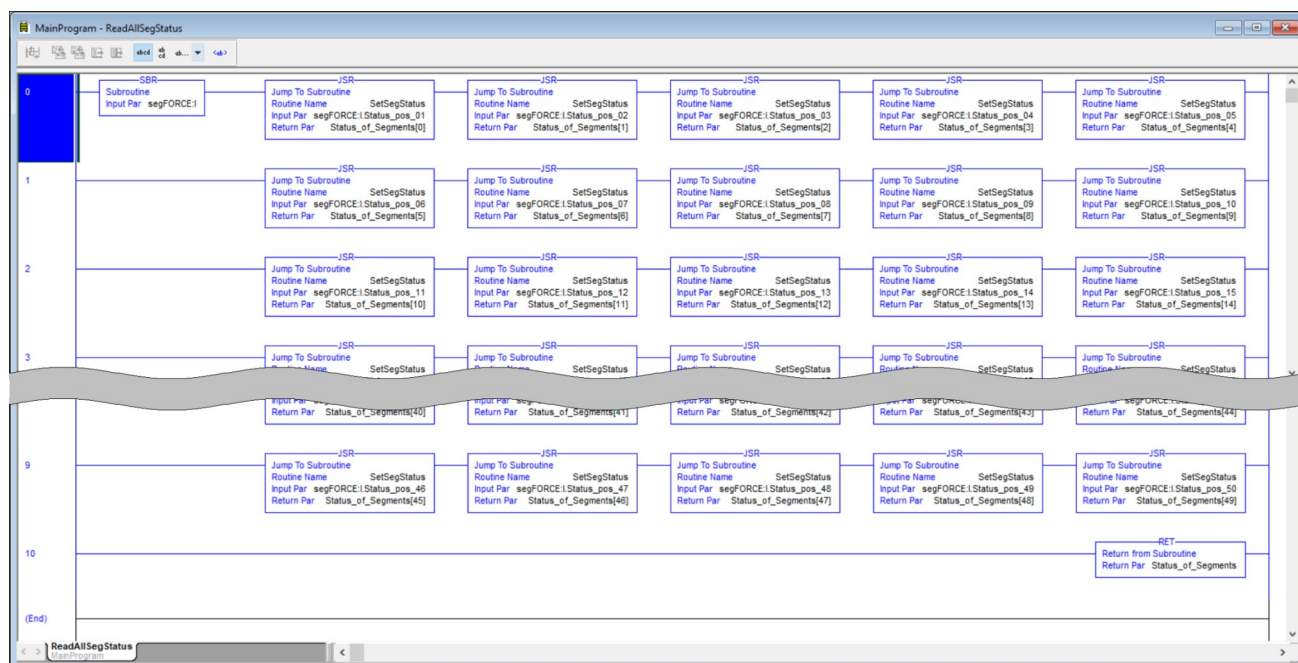
	Name	Data Type	Style	Description	External Access
	Speed_pulse_status	BOOL	Decimal		Read Only
	Exists	BOOL	Decimal		Read Only
	Group_number	INT	Decimal		Read Only
top 010					

Move Up Move Down OK Cancel Apply Help

Next, we need a routine that decodes the status register and writes the individual data entries into the variable of type Segment_Status. The routine's name is **SetSegStatus**. It can be imported with the file SetSegStatus.L5X. The routine looks as follows.



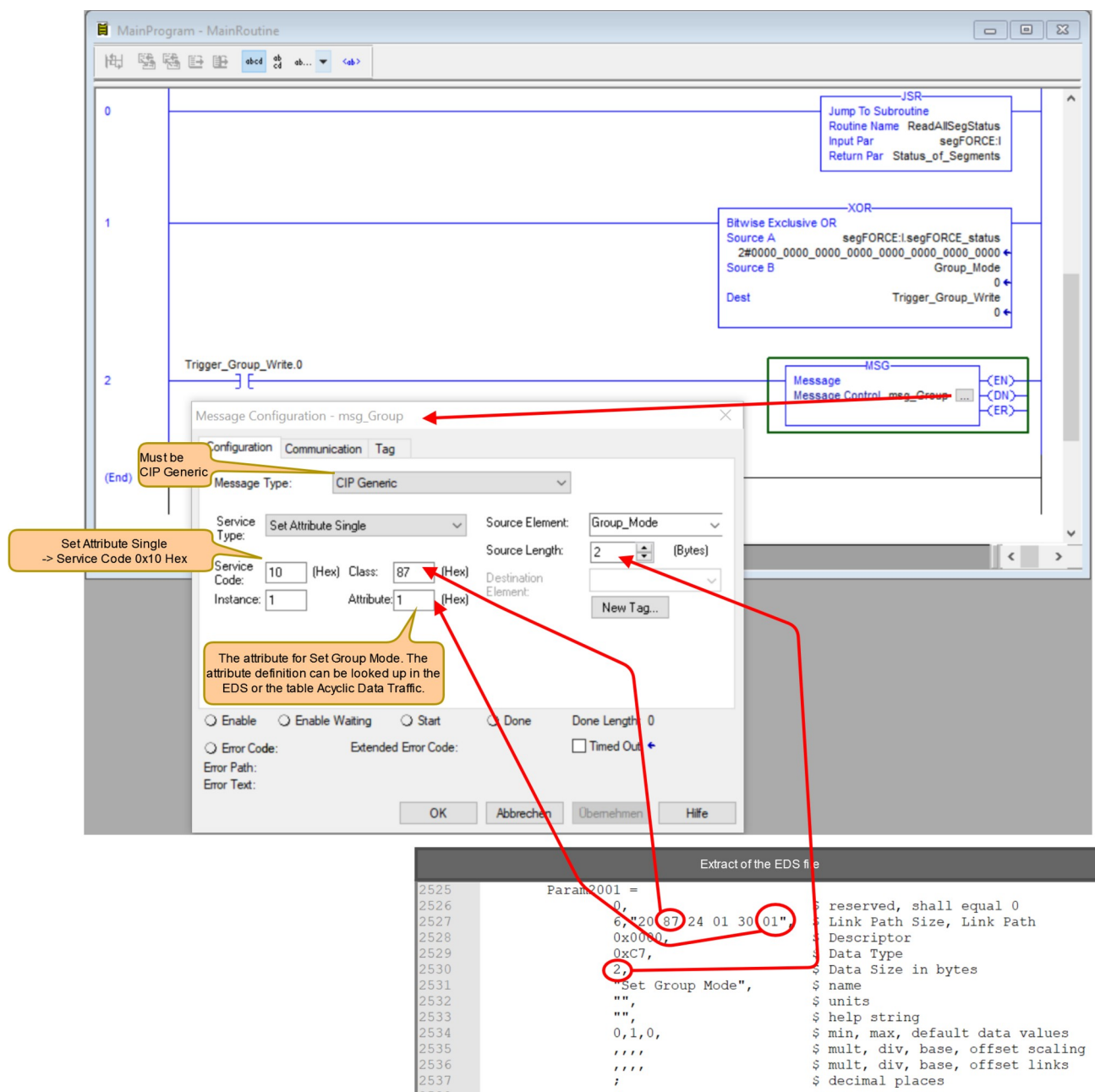
Last, we need a routine that calls the decode routine **SetSegStatus** for all 50 possible segments on the roller. The results are written into the array tagged **Status_of_Segments**. The routine's name is **ReadAllSegStatus** and is called from the **MainRoutine**. It can be imported with the file **ReadAllSegStatus.L5X**. The routine looks as follows.



3.4 Writing Parameters from a PLC Program

This chapter shows how to write parameters from a PLC program. The example code switches between the group and individual segment modes.

In general, for reading and writing parameters, messages must be used.



The screenshot displays the RSLogix 5000 MainRoutine editor. The program logic includes a JSR (Jump To Subroutine) block, an XOR (Bitwise Exclusive OR) block, and a MSG (Message) block. The MSG block is configured to send a message to the segFORCE module.

The **Message Configuration - msg_Group** dialog box is open, showing the following settings:

- Message Type:** CIP Generic
- Service Type:** Set Attribute Single
- Service Code:** 10 (Hex)
- Class:** 87 (Hex)
- Instance:** 1
- Attribute:** 1 (Hex)
- Source Element:** Group_Mode
- Source Length:** 2 (Bytes)

Annotations and callouts provide additional context:

- Must be CIP Generic:** Points to the Message Type dropdown.
- Set Attribute Single -> Service Code 0x10 Hex:** Points to the Service Code field.
- The attribute for Set Group Mode. The attribute definition can be looked up in the EDS or the table Acyclic Data Traffic.** Points to the Attribute field.
- Source Length: 2 (Bytes):** Points to the Source Length field.

Below the dialog box, an extract of the EDS file is shown, with red circles highlighting the values 87, 24, 01, 30, and 01, which correspond to the settings in the dialog box:

```

2525 Param2001 =
2526 0, $ reserved, shall equal 0
2527 6, "20 87 24 01 30 01", $ Link Path Size, Link Path
2528 0x0000, $ Descriptor
2529 0xC7, $ Data Type
2530 2, $ Data Size in bytes
2531 "Set Group Mode", $ name
2532 "", $ units
2533 "", $ help string
2534 0,1,0, $ min, max, default data values
2535 ,,,, $ mult, div, base, offset scaling
2536 ,,,, $ mult, div, base, offset links
2537 ; $ decimal places
  
```

4 TwinCAT 3 – EtherCAT

The focus of this chapter is to explain the necessary steps to integrate the FMS-segFORCE controller into your TwinCAT-based control system. It will not cover the broader aspects of PLC programming or the general functionality of the TwinCAT software.



If you are looking for more comprehensive information on PLC programming or TwinCAT usage, please refer to the manufacturer's documentation or seek additional resources on those topics.

4.1 Prerequisites

Before you start, make sure you have the following ready:

- Physical EtherCAT master
- TwinCAT 3 XAE installation
- FMS-segFORCE roller (EtherCAT variant) with at least one segment mounted

4.2 Setting up a Project

4.2.1 Launching TwinCAT

As a first step, launch your version of TwinCAT 3 XAE.

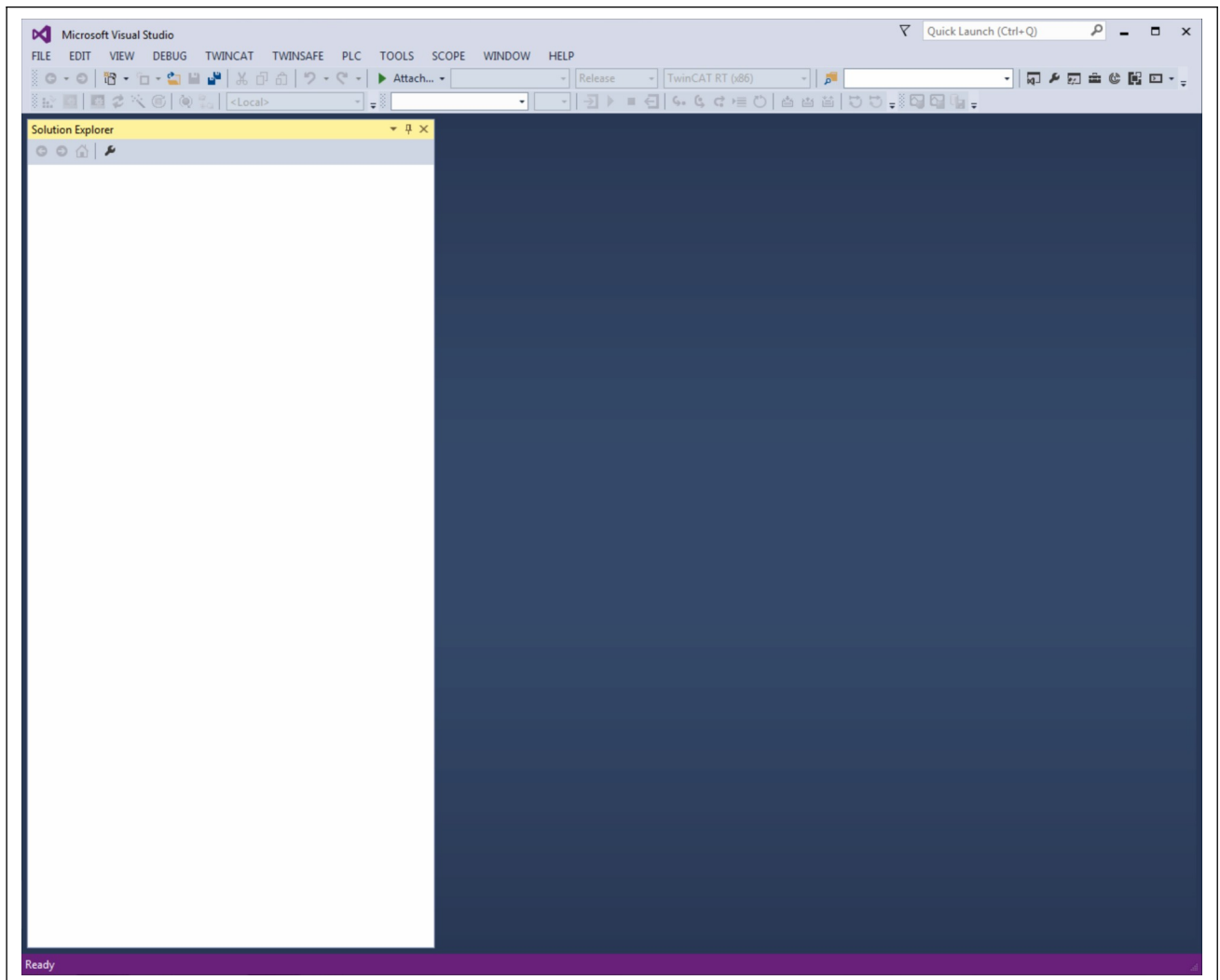


Figure 1: TwinCAT 3 (XAE) embedded in Microsoft Visual Studio.

After launching TwinCAT 3 XAE you are presented with a window similar to the one shown in Figure 1. The menu items **TWINCAT**, **TWINSAFE**, **PLC**, and **SCOPE** indicate that TwinCAT is installed.

4.2.2 Creating the TwinCAT Project

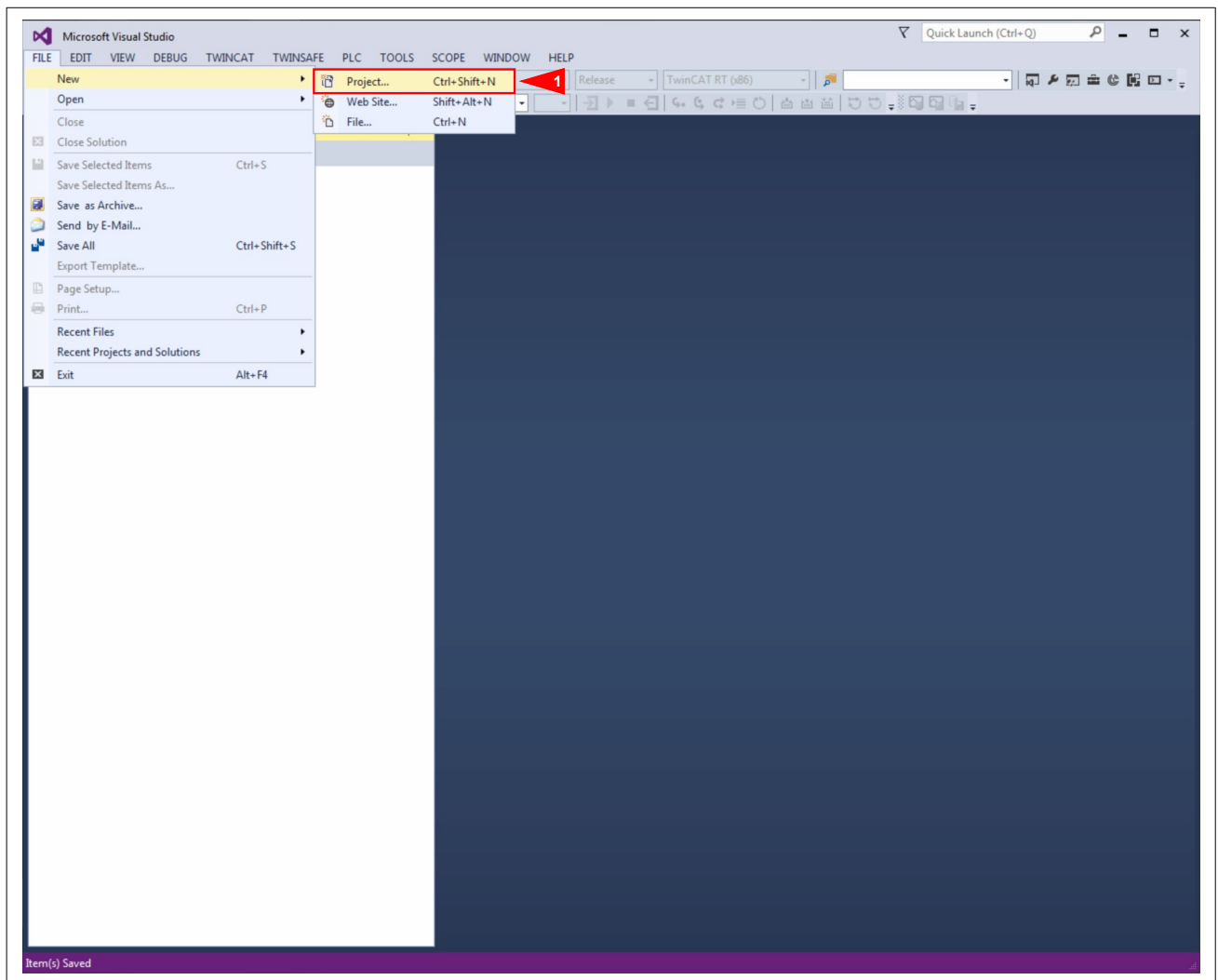


Figure 2: creating a new TwinCAT 3 (XAE) project.

To create a new project, select **File** → **New** → **Project...** (Figure 2, ►1), or press **Ctrl+Shift+N**. The dialog **New Project** appears.

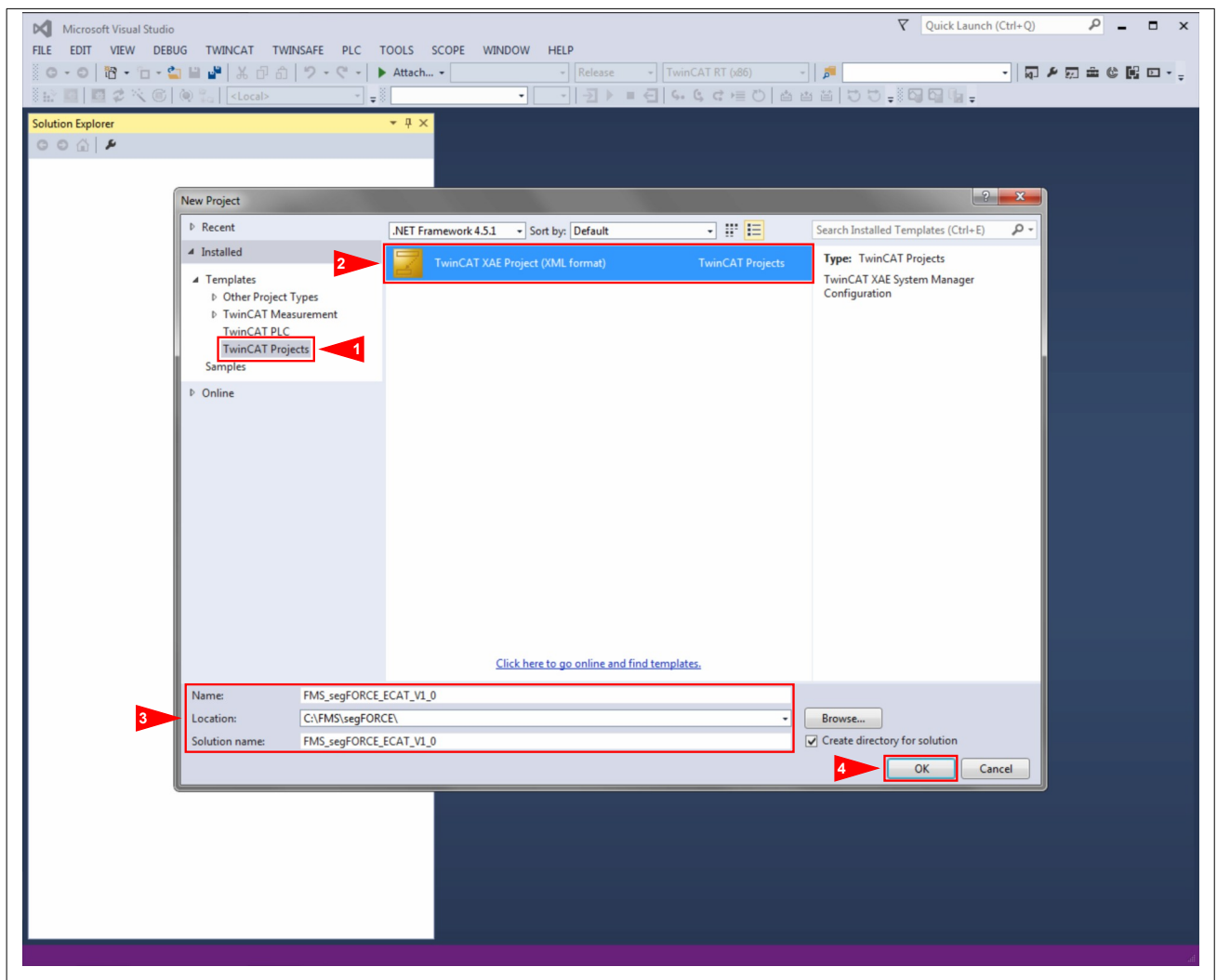


Figure 3: selecting the type and specifying the details of the new TwinCAT 3 (XAE) project.

In the dialog, navigate to **Installed** → **Templates** → **TwinCAT Projects** (Figure 3, ►1). Then, select **TwinCAT XAE Project (XML format)** (Figure 3, ►2), and enter appropriate project details (Figure 3, ►3). Press **Ok** (Figure 3, ►4) to create your new project.



The project details (including the location) do not have to match with what is shown in Figure 3.

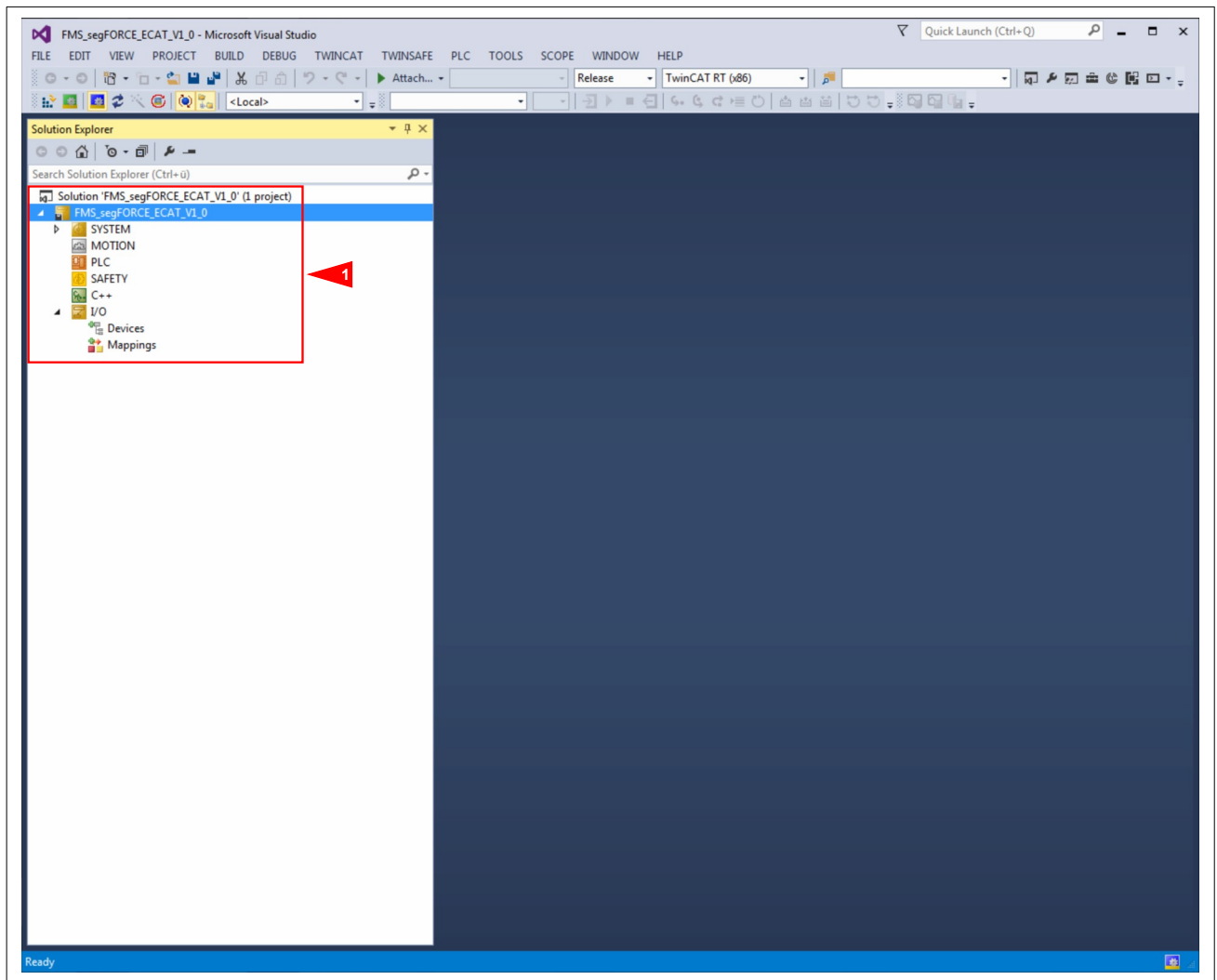


Figure 4: the newly created TwinCAT project within a Visual Studio solution.

The **Solution Explorer** should now display the new solution (Figure 4, ► 1) containing the TwinCAT project.

4.2.3 Loading the Device Descriptions

TwinCAT needs the device description files (so-called ESI files) for the devices to be used in order to generate the configuration in online or offline mode. Therefore, to make the FMS-segFORCE controller available to TwinCAT, the ESI file available from the website

<https://www.fms-technology.com/de/downloadcenter/ethercat>

has to be copied to the following directory:

```
<twincat3_install_dir>\3.1\Config\Io\EtherCAT\
```

Once the device descriptions are in place, reload them by navigating to **TWINCAT** → **EtherCAT Devices** → **Reload Device Descriptions** (Figure 5, ► 1).

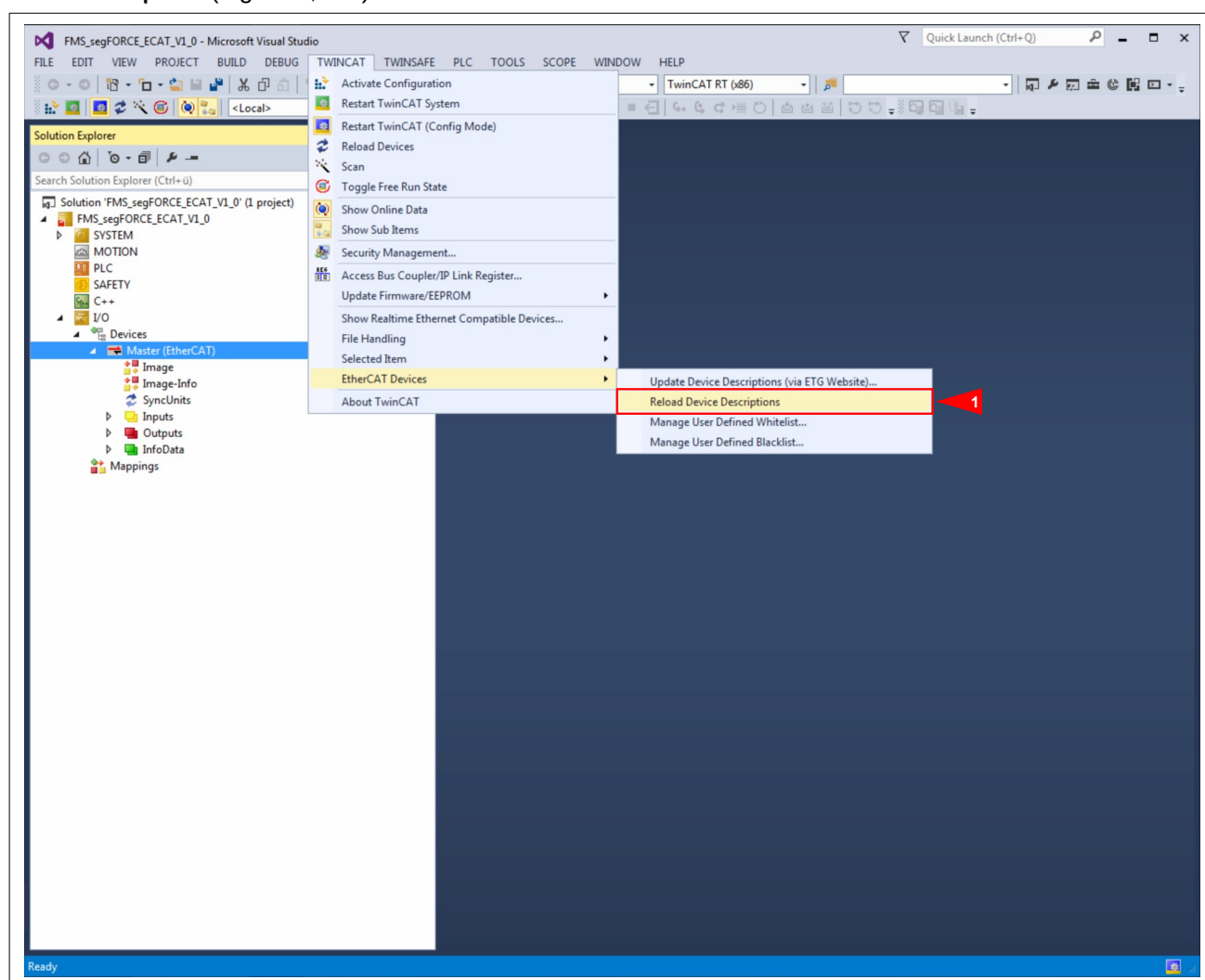


Figure 5: loading the newly installed FMS-segFORCE device description into TwinCAT.

4.2.4 Configuring the EtherCAT System

Once you have created your project and installed the required device descriptions (refer to section 4.2.3 for more details), it is time to create the digital twin of your physical EtherCAT setup. In the following, we present two approaches of doing so.

4.2.4.1 Automatic Setup

If you have your physical setup ready and TwinCAT runs on a machine connected to said physical setup, you can probably speed up the setup process as follows.

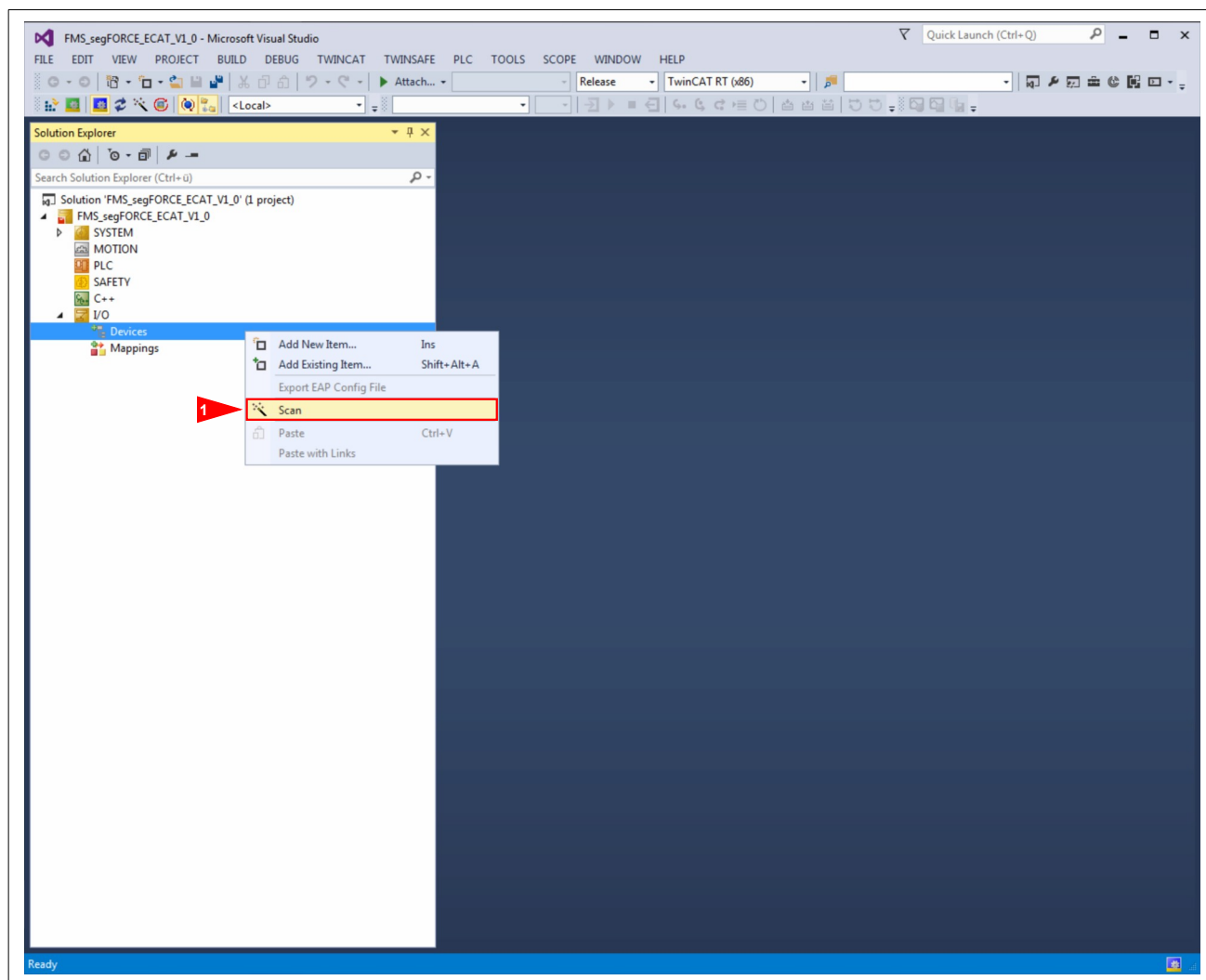


Figure 6: scanning to generate the project's I/O configuration.

Select the entry **<Solution>** → **<Project>** → **I/O** → **Devices** and select the item **Scan** from its context menu (Figure 6, ►1). TwinCAT will now warn you that “Not all types of devices can be found automatically”. Confirm by clicking **Ok** to start the scan anyway.

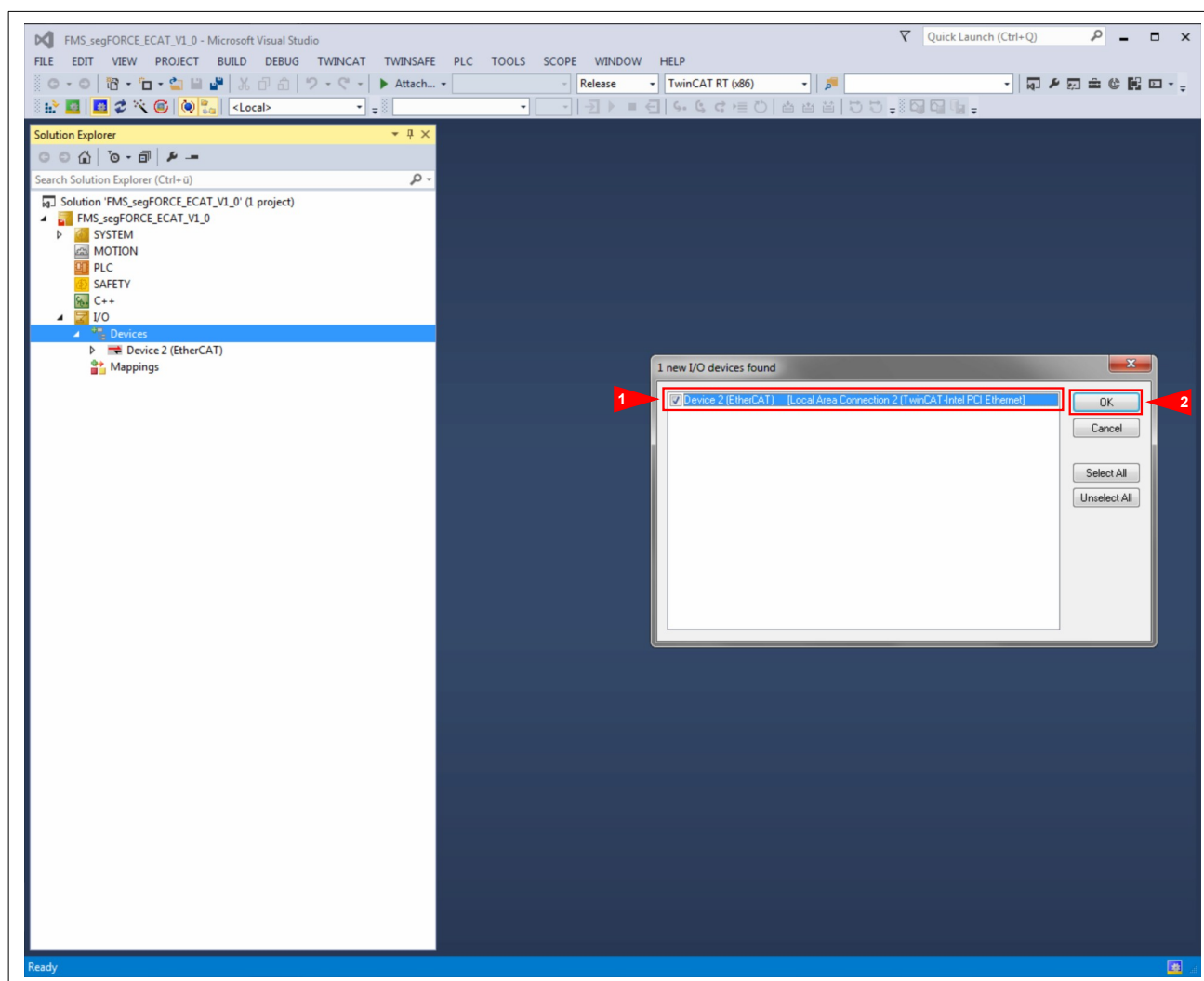


Figure 7: the scan results in a (possibly empty) list of the found I/O devices.

After a few seconds, it should present you with a list of the found I/O devices (Figure 7). Tick the checkbox(es) of the device(s) (Figure 7, ► 1) you want to add and press **Ok** (Figure 7, ► 2). If there is no device in the list, make sure you have your EtherCAT interface card(s) properly inserted and appropriate drivers installed.

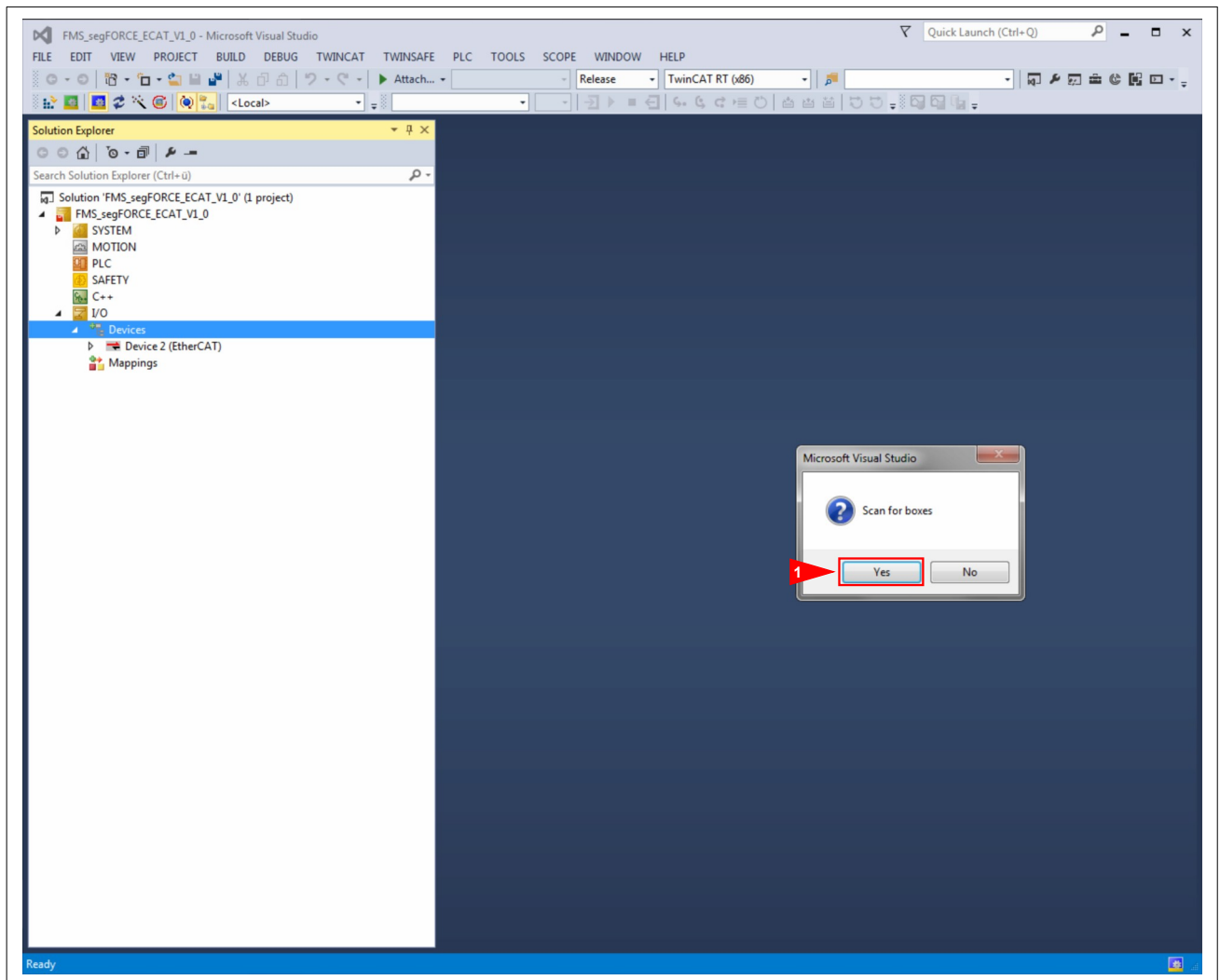


Figure 8: after adding the I/O devices, TwinCAT asks if it shall scan for connected boxes.

TwinCAT will then ask you if it shall scan for boxes; click **Yes** (Figure 8, ► 1). Once the scan finishes, TwinCAT may ask if it shall activate the **Free Run State**; choose which ever you prefer. If you choose to not yet activate the **Free Run State**, you can do so later (see section 4.2.6).

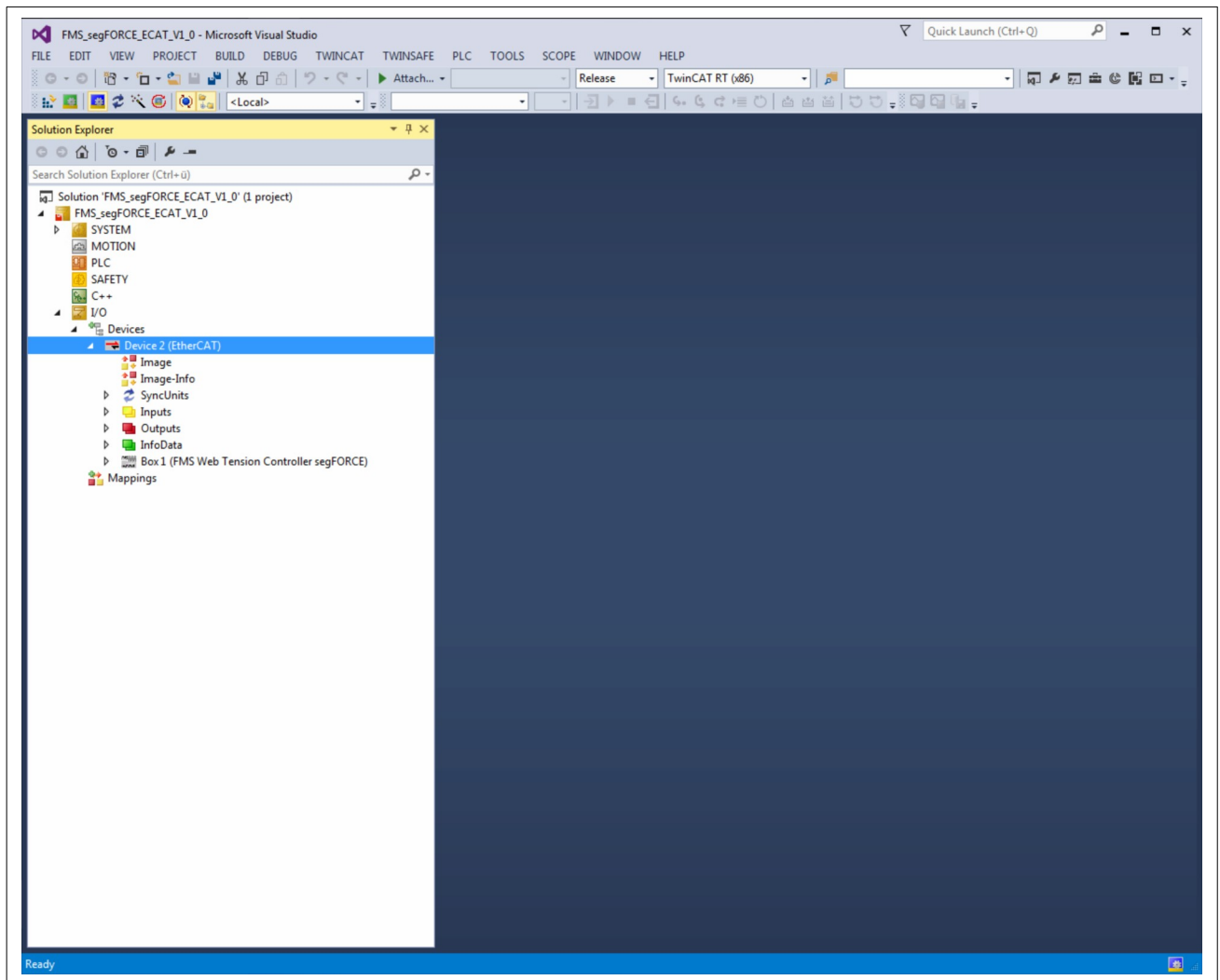


Figure 9: the TwinCAT project with the EtherCAT devices found during the scans.

If everything worked as expected, you should now see a virtual image of the physical device tree, including the FMS-segFORCE controller, which (in Figure 9) is labelled **Box 1 (FMS Web Tension Controller segFORCE)**.

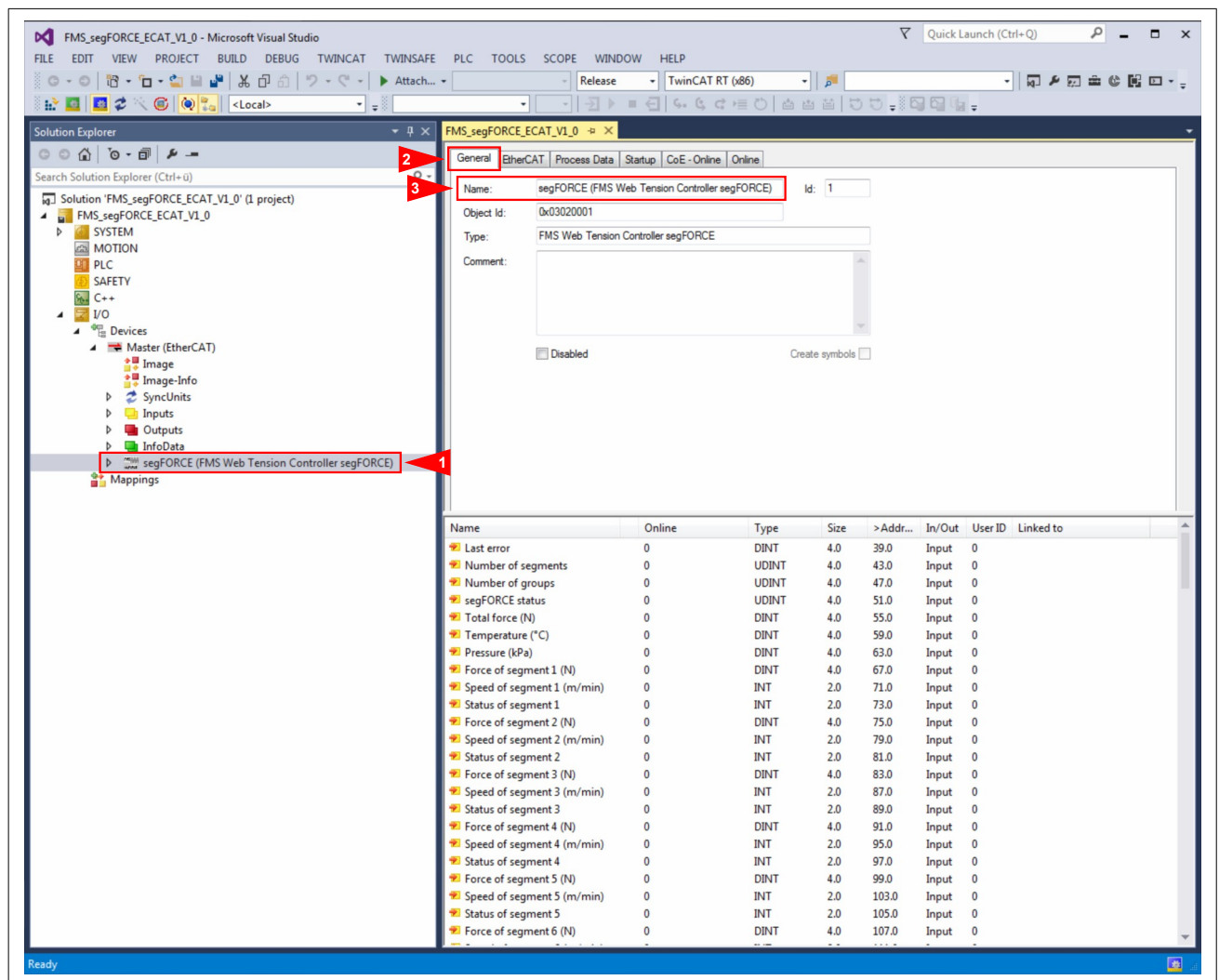


Figure 10: renaming the automatically detected and added devices and boxes.

If you want to rename the detected devices and/or boxes, select the associated entry and double click it (Figure 10, ► 1). This opens the settings pane of the selected device or box. If not selected already, select the tab **General** (Figure 10, ► 2) and enter the desired name in the field **Name** (Figure 10, ► 3).



Do not forget to save the project.

4.2.4.2 Manual Setup

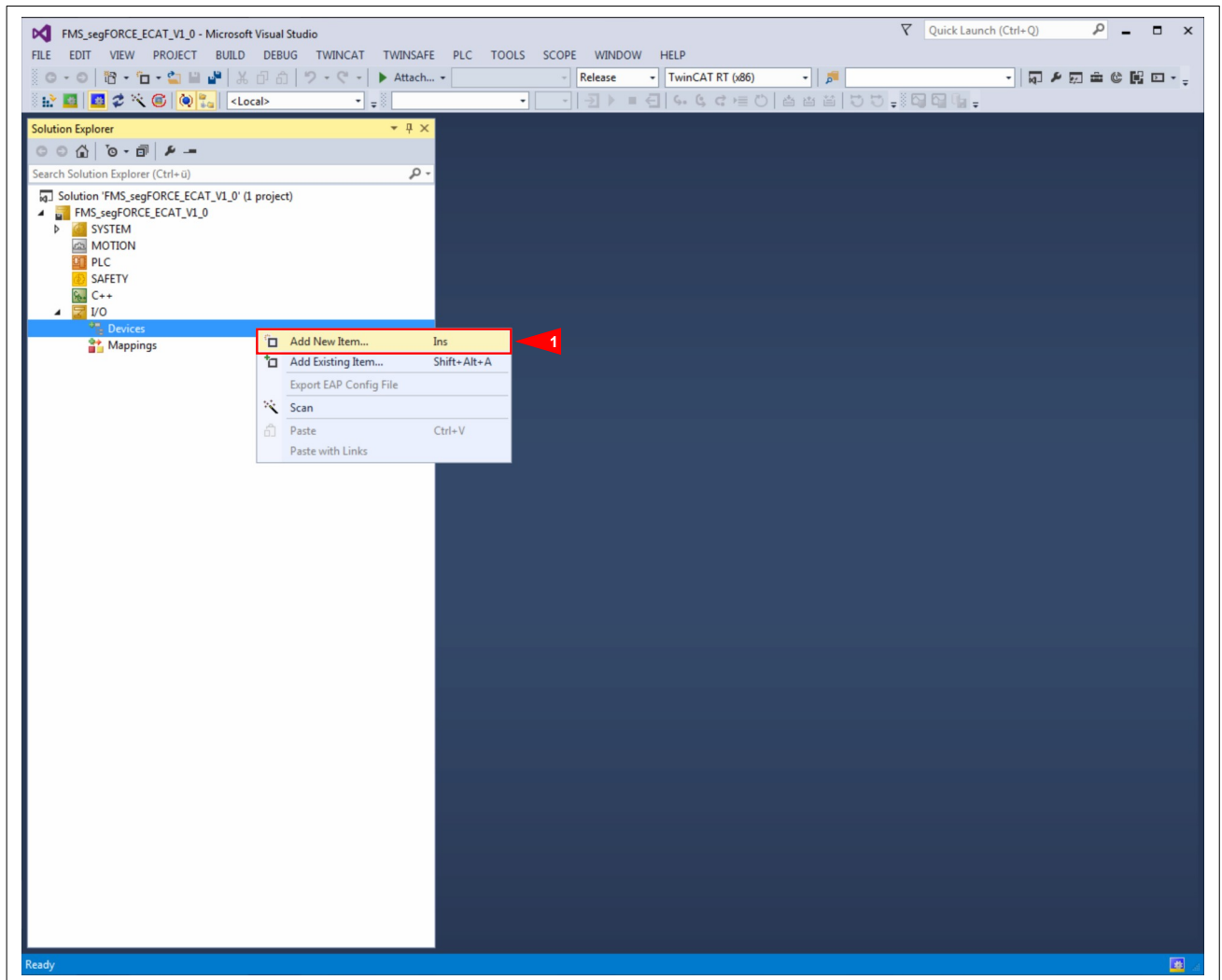


Figure 11: opening the catalog to add the EtherCAT master to the project.

As a first step, we are going to add the EtherCAT master that will handle the connected EtherCAT slave devices. To do so, select the entry **<Solution>** → **<Project>** → **I/O** → **Devices**. Then, open its context menu and select the item **Add New Item...** (Figure 11, ► 1). Alternatively, you may press **Insert**.

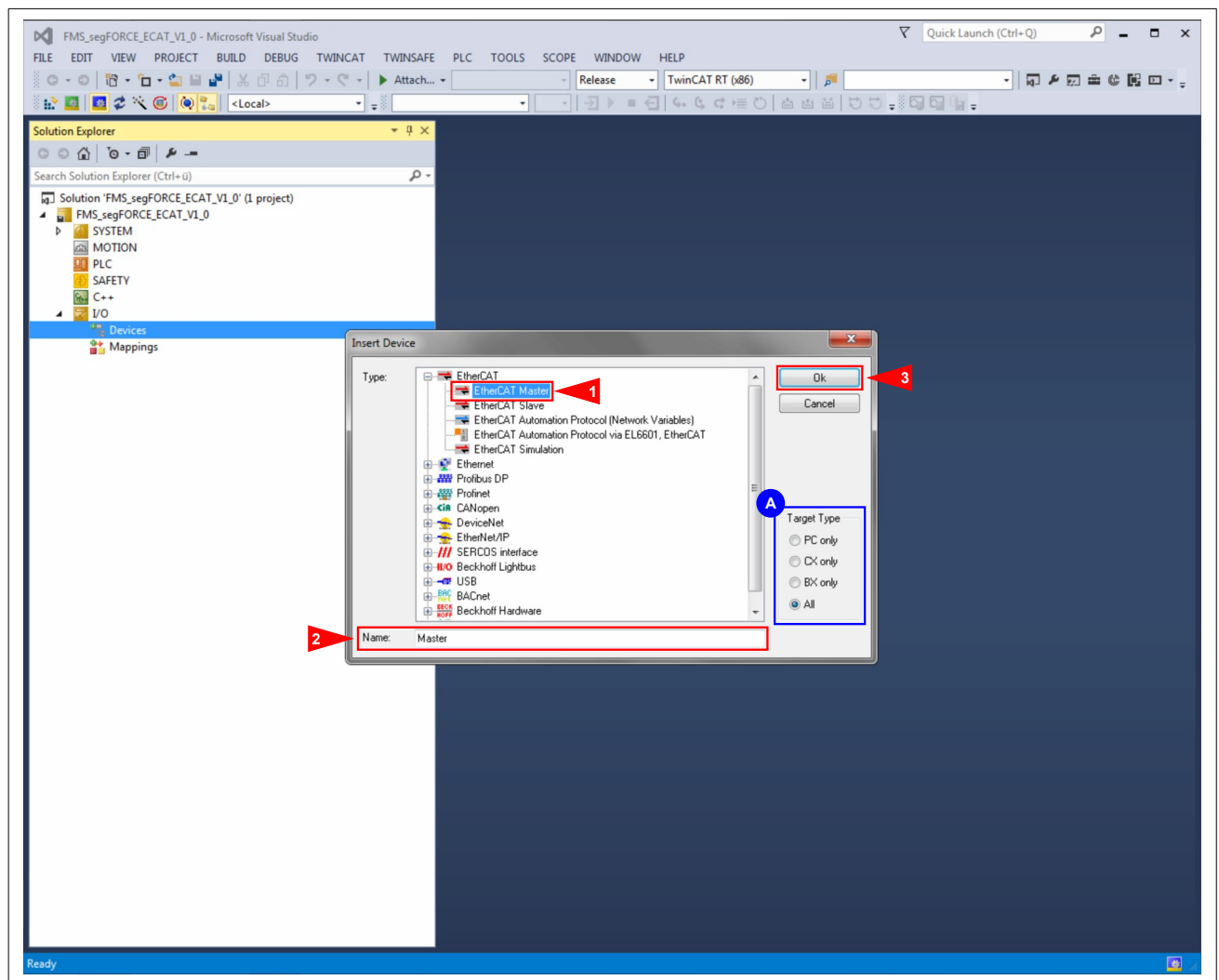


Figure 12: selecting and labelling the EtherCAT master device.

In the dialog **Insert Device**, locate the category **EtherCAT** and select the device **EtherCAT Master** (Figure 12, ► 1). Make sure you have not set the **Target Type** to **Bx only** (Figure 12, ● A), as the device will then not be visible. Use the field **Name** (Figure 12, ► 2) to label your new EtherCAT master and press **Ok** (Figure 12, ► 3) to add it to the system.

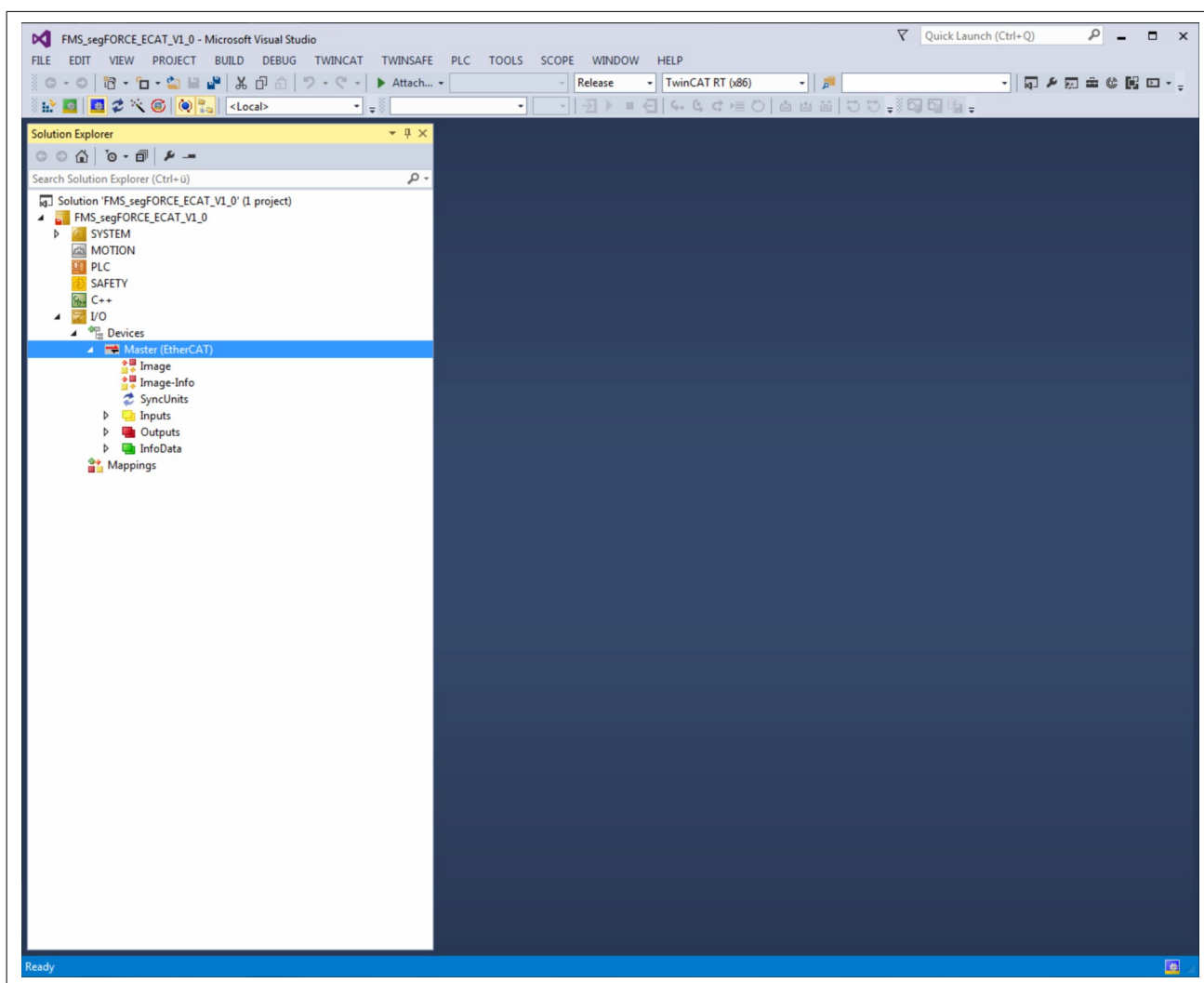


Figure 13: the TwinCAT project with added EtherCAT master device.

If the EtherCAT master has been successfully added, it should now be attached to the **I/O → Devices** entry under the TwinCAT project (Figure 13). Configure the master according to the needs of your system. The settings can be accessed by double clicking the entry **Master (EtherCAT)**.



Consult the TwinCAT user manuals for more information on the configuration of the EtherCAT master.

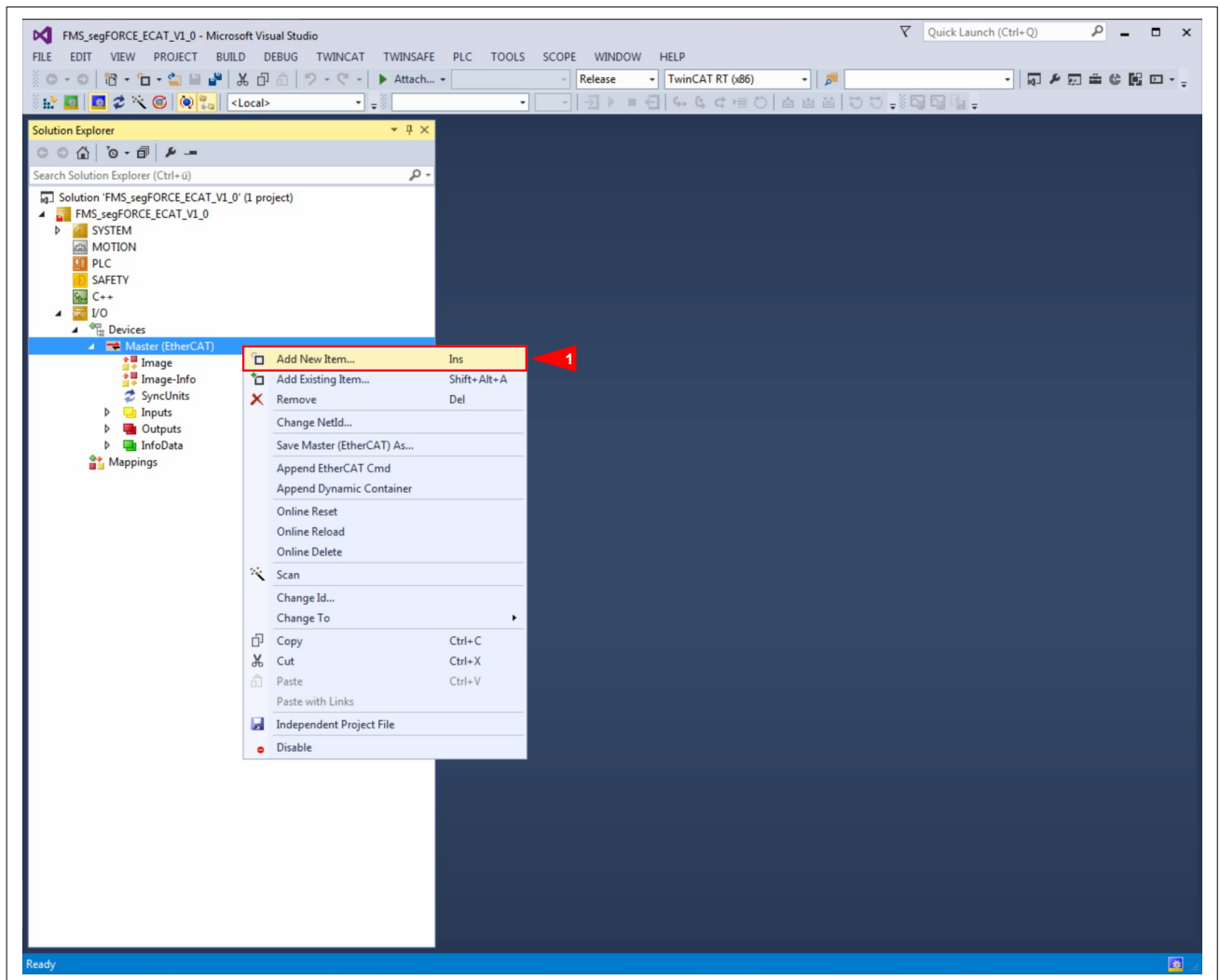


Figure 14: opening the catalog to add EtherCAT slave devices (also known as boxes) to the project.

Now that the EtherCAT master has been defined and configured, we can add the EtherCAT slaves assigned to it. To do so, select the **Master (EtherCAT)** entry. Right click to open its context menu and select the item **Add New Item...** (Figure 14) to bring up the dialog with the available EtherCAT slave devices. As before, you may alternatively press **Insert** to bring up the dialog after selecting the entry **Master (EtherCAT)**.

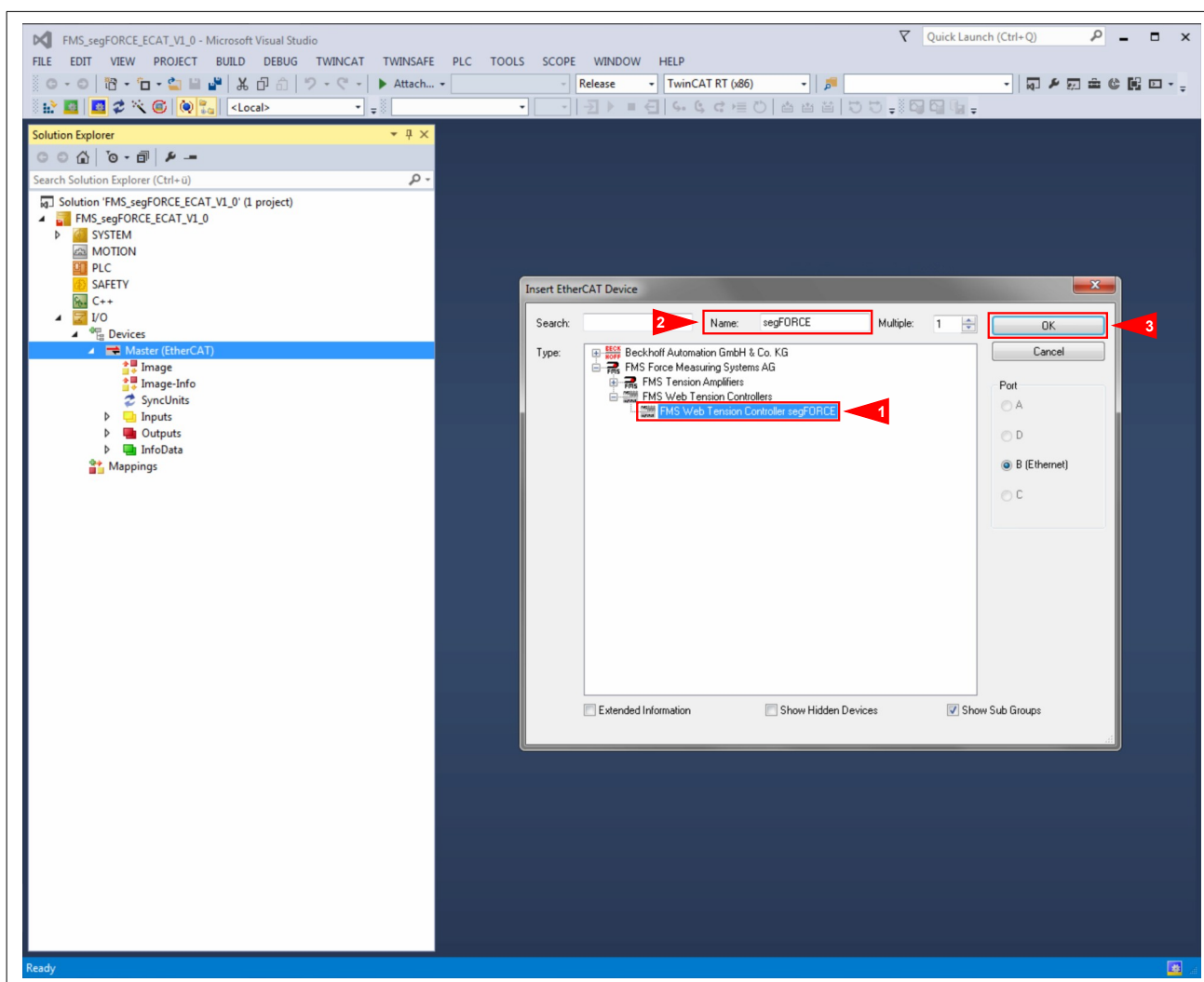


Figure 15: selecting and labelling the **FMS Web Tension Controller segFORCE** device.

In the dialog **Insert EtherCAT Device**, locate and select the **FMS Web Tension Controller segFORCE** device type (Figure 15, ► 1) within the category **FMS Web Tension Controllers** of the company **FMS Force Measuring Systems AG**. Assign a **Name** (Figure 15, ► 2) for the device to be created and press **Ok** (Figure 15, ► 3).

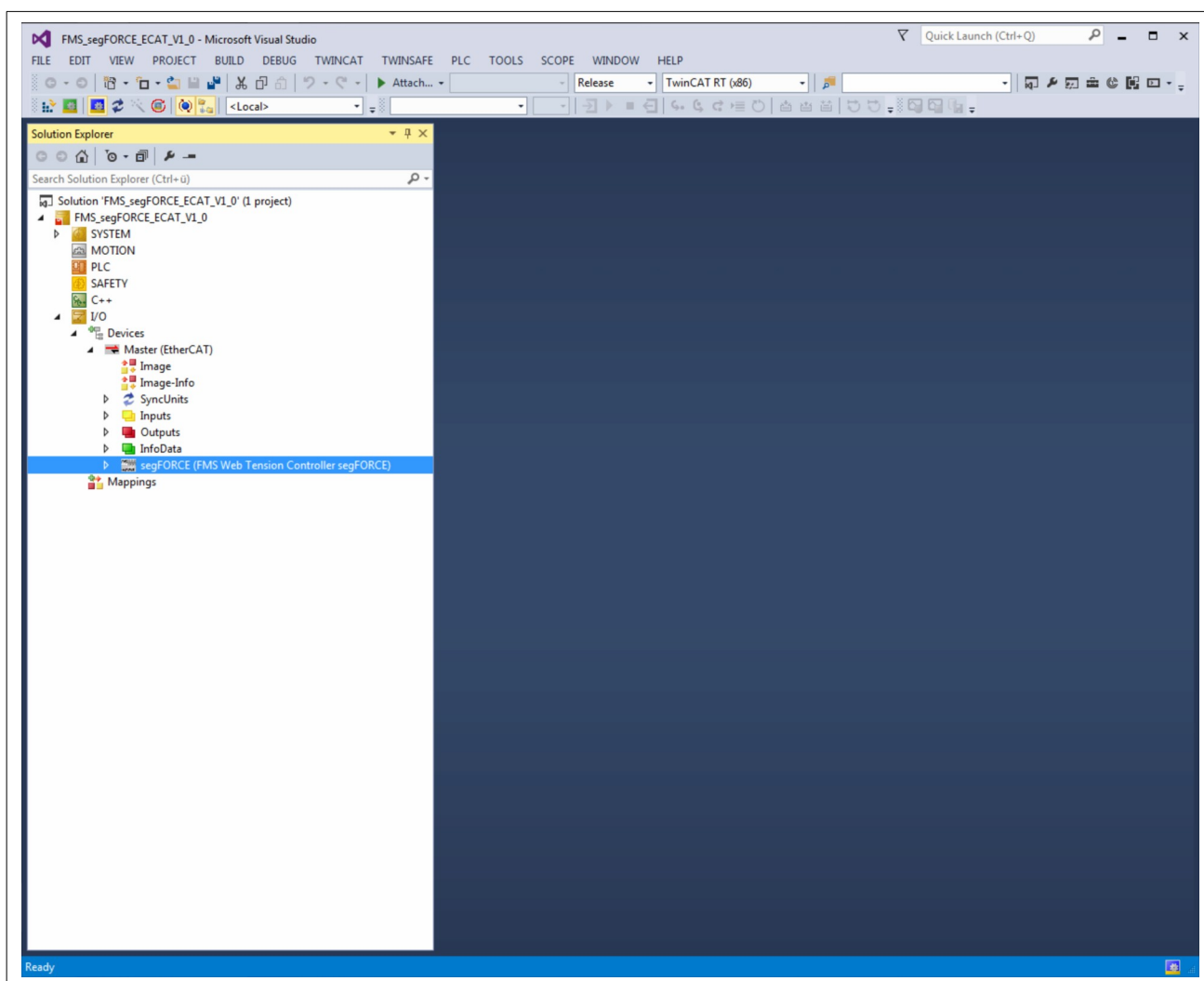


Figure 16: the TwinCAT project with added FMS-segFORCE (EtherCAT slave) device.

If the FMS-segFORCE (EtherCAT slave) device has been successfully added, it should now be attached to the **I/O** → **Devices** → **Master (EtherCAT)** entry of the TwinCAT project (Figure 16). If necessary, add other EtherCAT slave devices to the EtherCAT master following the demonstrated steps.



Do not forget to save the project.

4.2.5 Inspecting the FMS-segFORCE Device

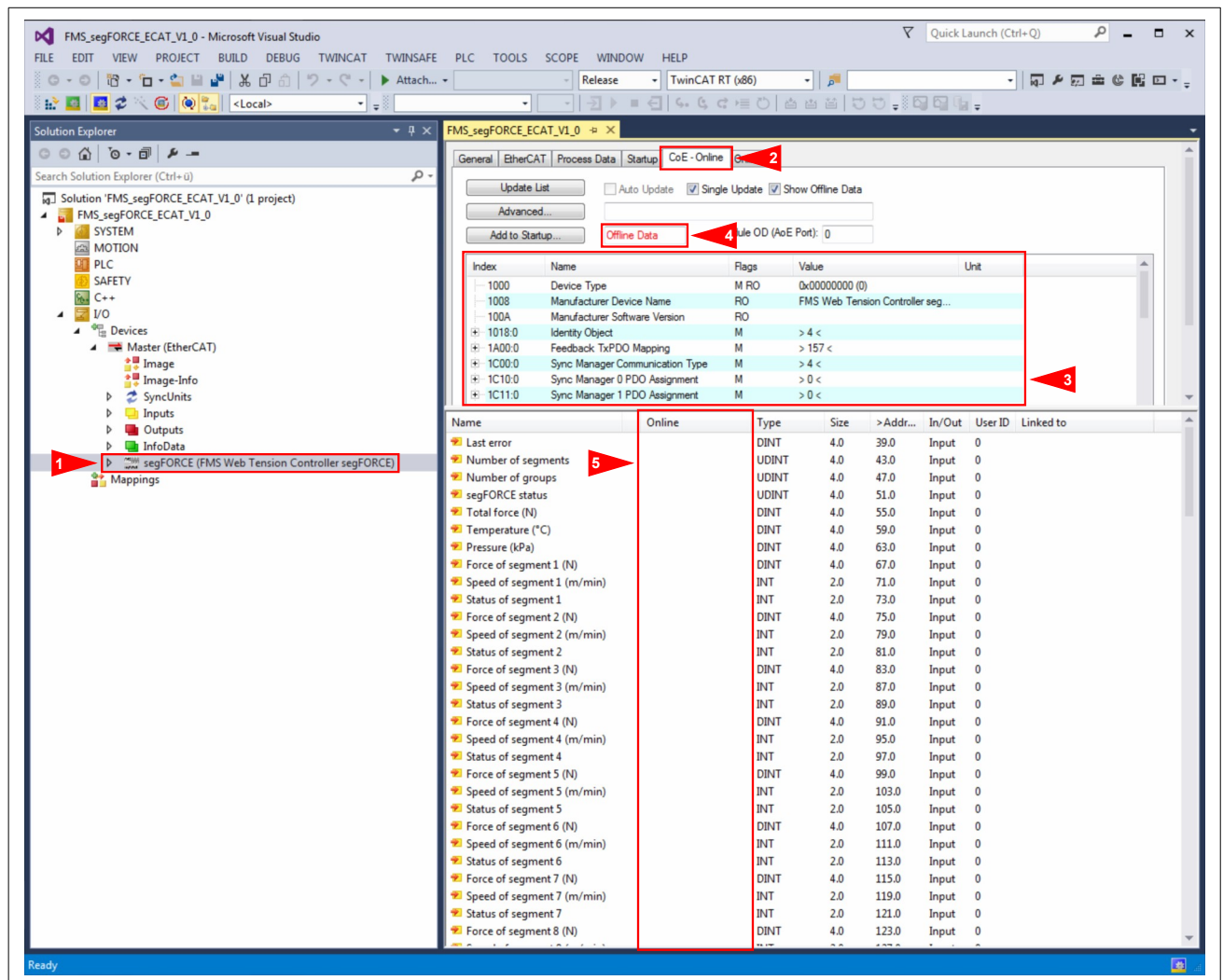


Figure 17: the available data of the FMS-segFORCE controller.

Double click on the **I/O** → **Devices** → **Master (EtherCAT)** → **segFORCE (FMS Web Tension Controller segFORCE)** entry (Figure 17, ► 1) and navigate to the **CoE – Online** tab (Figure 17, ► 2) to inspect the template of the available data (Figure 17, ► 3) of the FMS-segFORCE controller.



If the **Free Run State** is activated (see section 4.2.6), the status (Figure 17, ► 4) changes from **Offline Data** to **Online Data** and the column titled **Online** (Figure 17, ► 5) displays the actual data retrieved from the device.

4.2.6 Activating Free Run

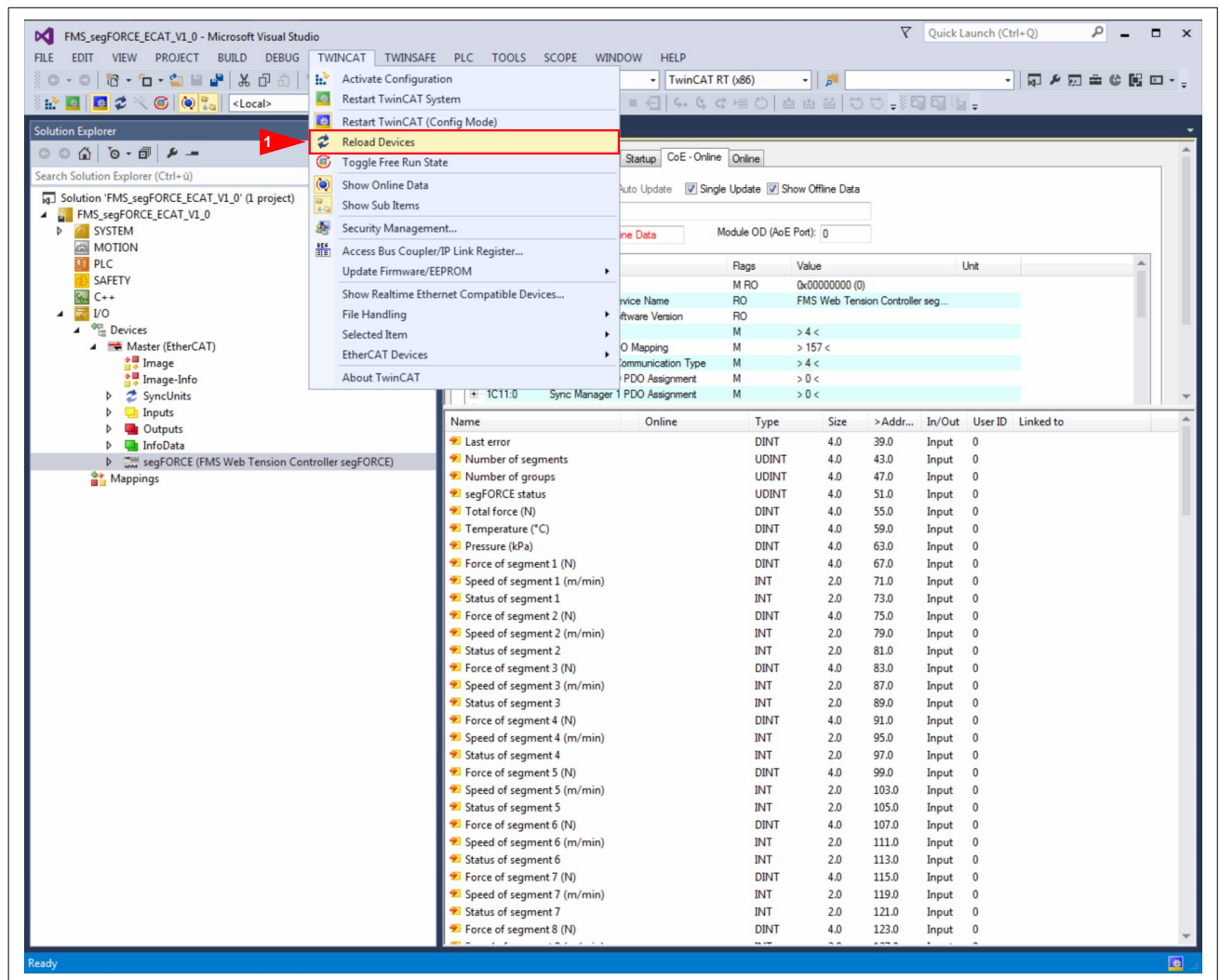


Figure 18: reload the devices before activating the **Free Run State**.

To see – without further programming – whether the FMS-segFORCE controller has been successfully integrated into the system, the TwinCAT's **Free Run State** can be activated. To do so, select **TwinCAT** → **Reload Devices** in the menu to reload the devices (Figure 18, ► 1).

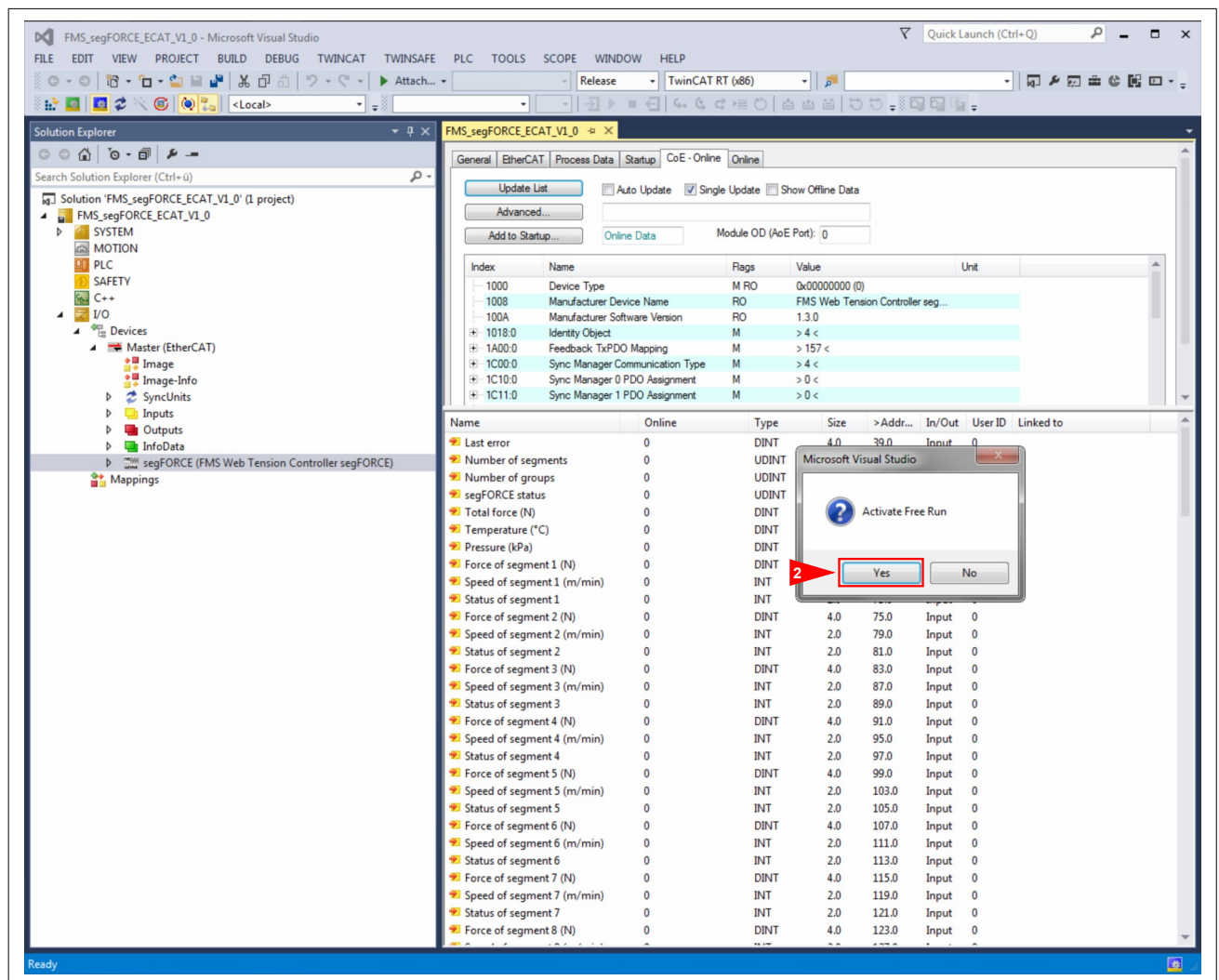


Figure 19: TwinCAT asking whether it shall activate the **Free Run State**.

Once the system has reloaded the configured devices, it will ask whether it shall enter the **Free Run State** or not. Click **Yes** (Figure 19, ► 2).

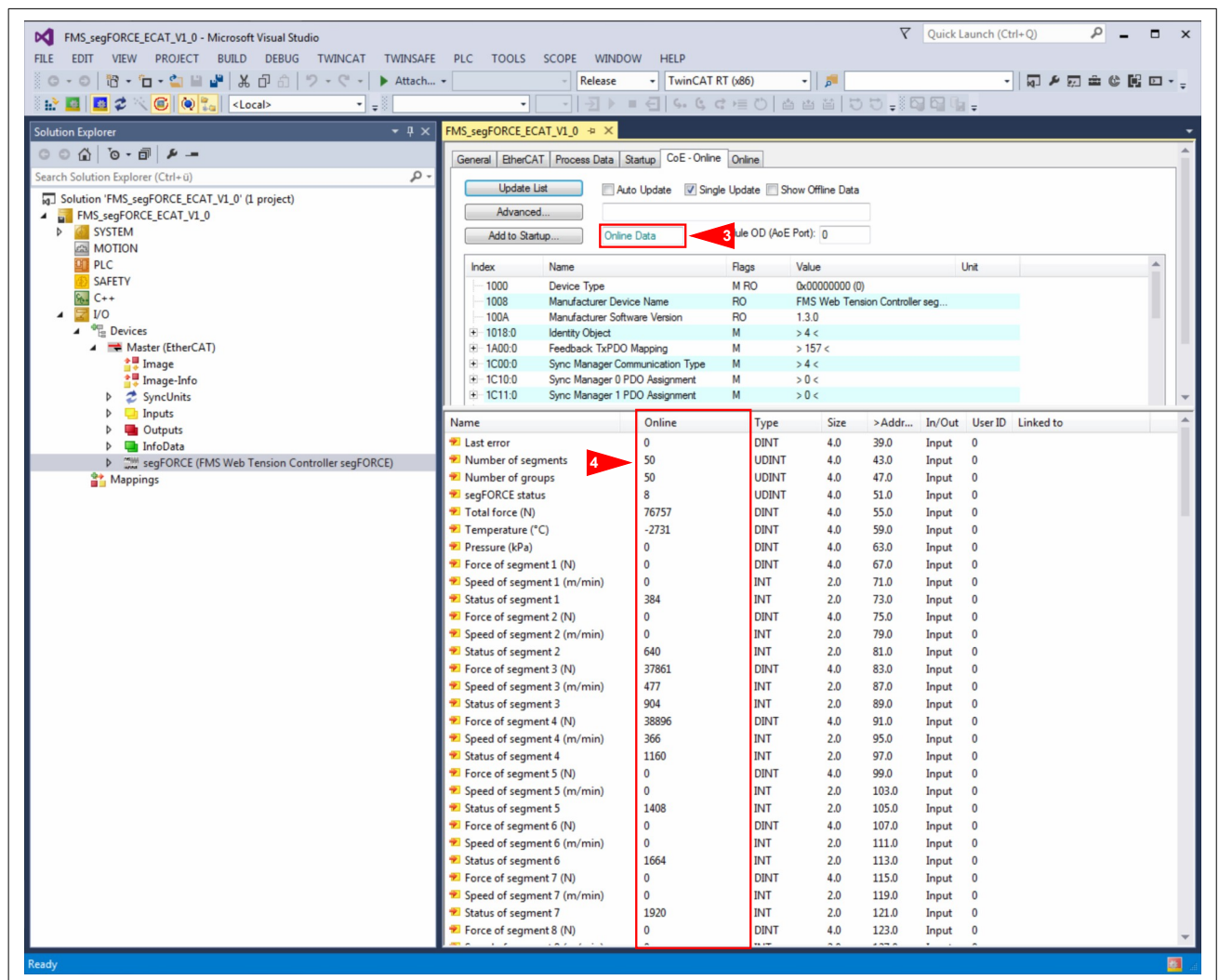


Figure 20: the available data of the FMS-segFORCE controller, supplemented by the online data.

The status (Figure 20, ► 3) has changed from **Offline Data** to **Online Data** and the column titled **Online** (Figure 20, ► 4) now displays online data.

4.2.7 Change Parameters

Currently, the FMS-segFORCE device has only one parameter that can be changed via the fieldbus: the **Group mode**. Changing the parameter programmatically is beyond the scope of this document. However, for the purpose of testing the setup, you may follow the steps below (cf. Figure 21).

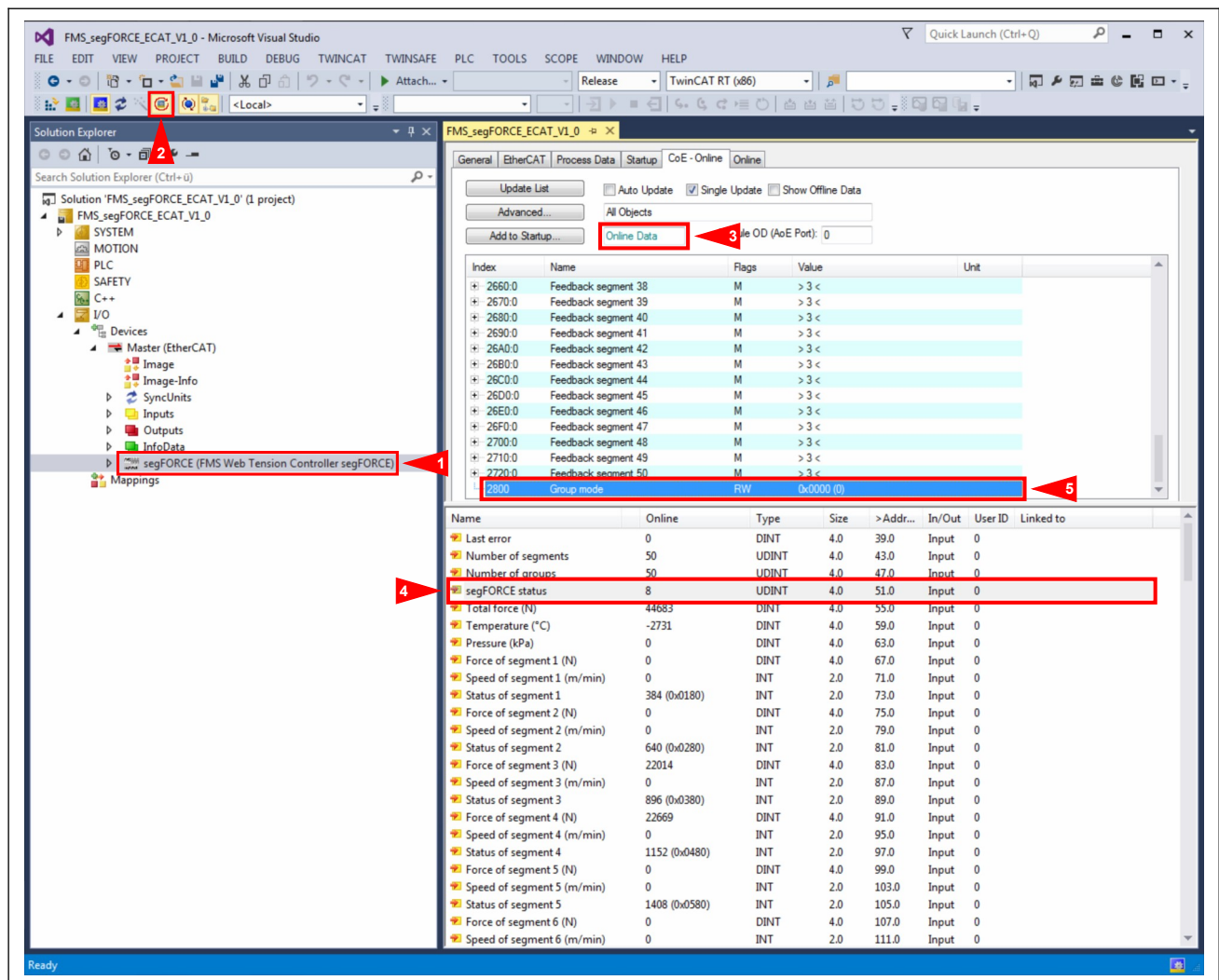


Figure 21: the steps towards manually changing the parameter **Group mode** (for testing purposes only).

Double click the FMS-segFORCE controller (Figure 21, ► 1) to open its configuration pane. Check that the **Free Run State** is active (Figure 21, ► 2) and that online data is available (Figure 21, ► 3). The **Group mode**'s current state can then be read from the LSB of the parameter **segFORCE status** (Figure 21, ► 4 ; cf. Section 5.1.1). To start changing the parameter **Group mode**, double click it (Figure 21, ► 5).

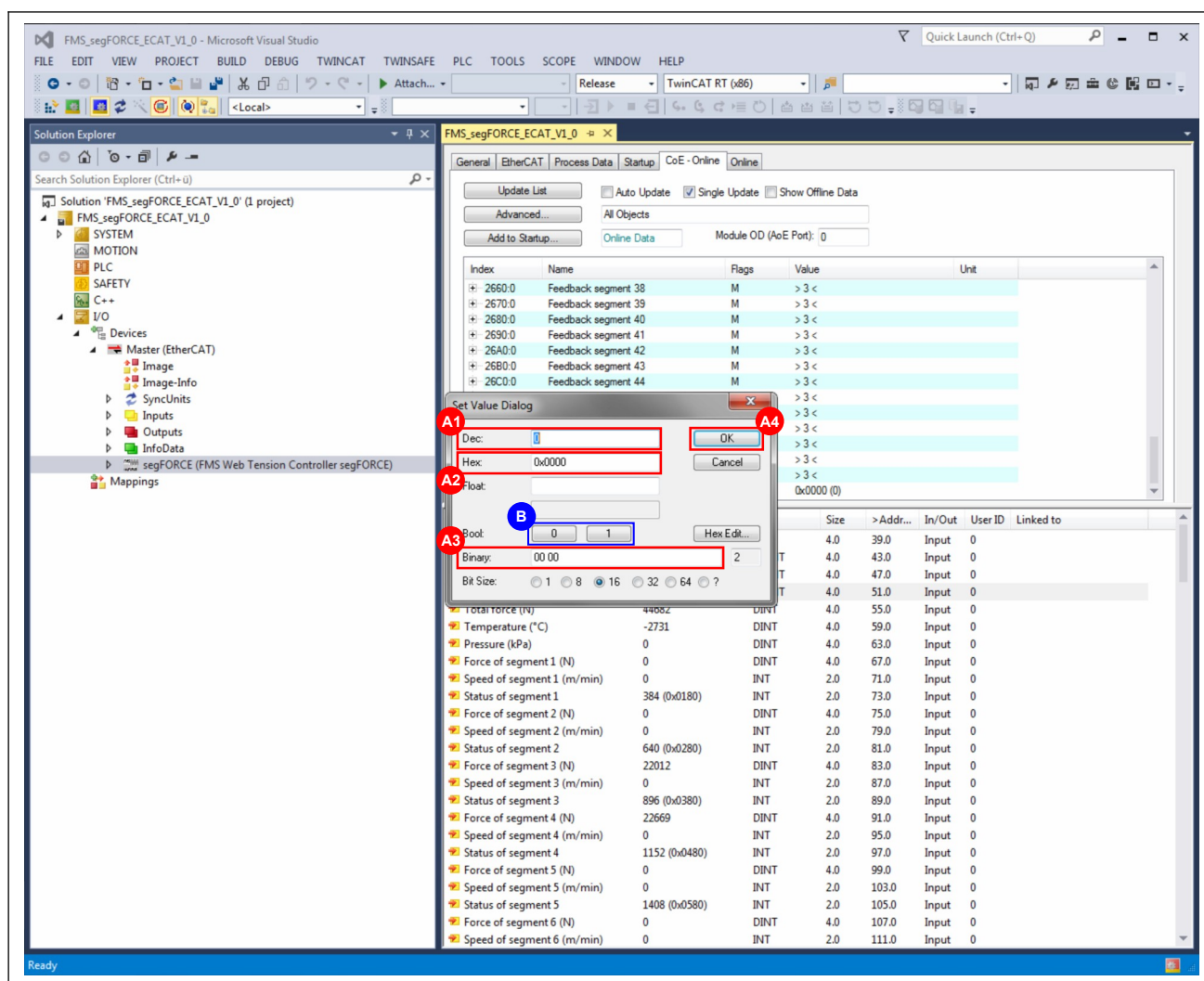


Figure 22: write the parameter value to activate / deactivate **Group mode**.

To activate **Group mode**, in the dialog window that pops up, enter a decimal 1, a hexadecimal 0x0001, or a binary 00 01 into the respective field (Figure 22, ●A1, ●A2, ●A3) and press **Ok**. (Figure 22, ●A4).

To deactivate **Group mode**, in turn, enter a decimal 0, a hexadecimal 0x0000, or a binary 00 00 into the respective field and also press **Ok**.

Alternatively, you can write the equivalent boolean value by pressing either 1 to activate or 0 to deactivate **Group mode** (Figure 22, ●B).



Make sure to not change the **Bit Size** parameter (16-bit).

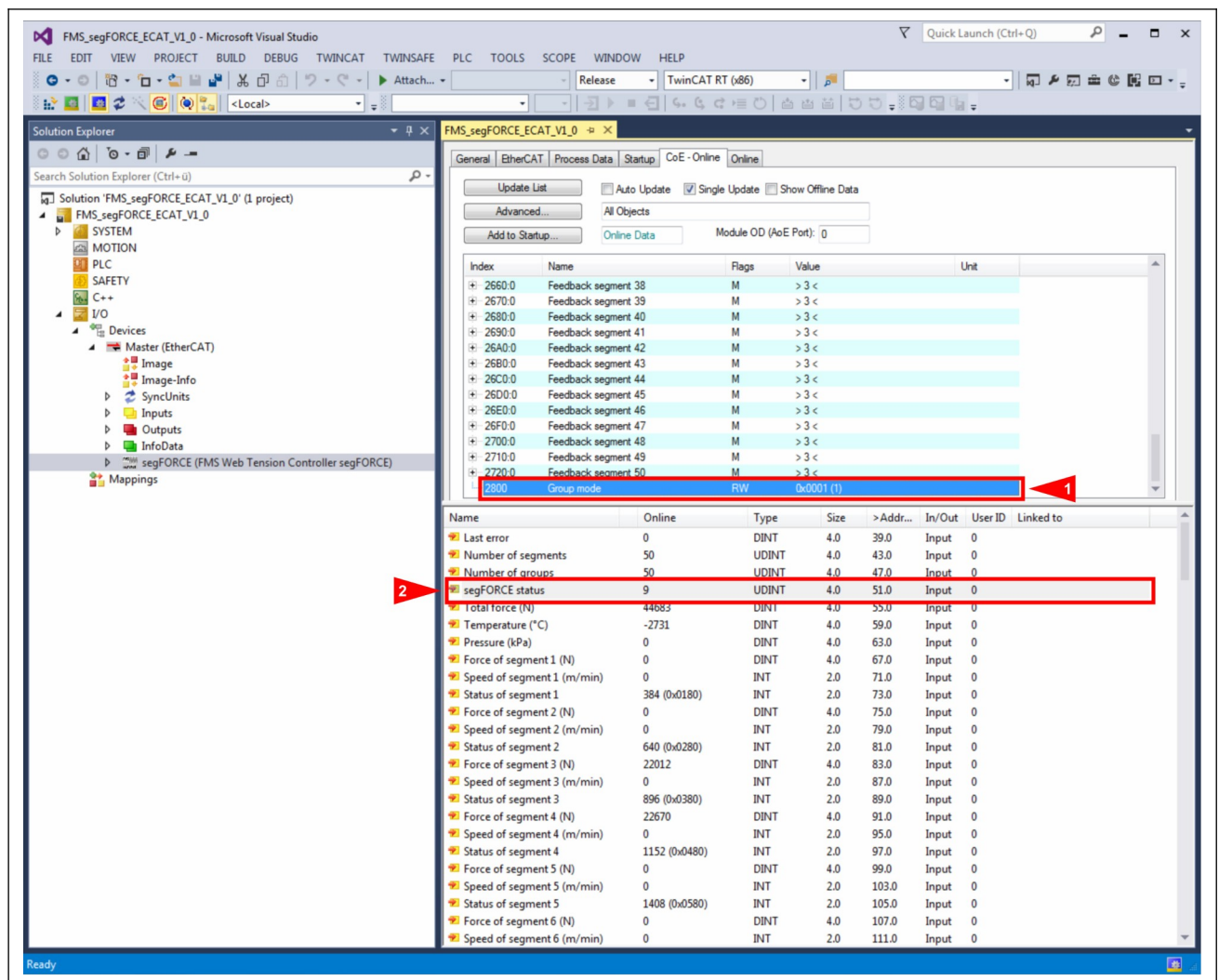


Figure 23: Group mode activated.

The value written to the parameter **Group mode** is shown in column **Value** (Figure 23, ► 1). Check bit 0 of the parameter **segFORCE status** (Figure 23, ► 2; cf. section 5.1.1) to see whether **Group mode** has been successfully activated or deactivated.

5 Appendix

5.1 PLC Interfaces



The PLC interfaces always uses metric units, although imperial units can 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.

5.1.1 Cyclic Data Traffic

The cyclic data traffic reads the data of typically measured values of the FMS-segFORCE in a defined time rate and updates it in the PLC. The PLC defines the cycle time for their protocol, e.g., PROFINET, EtherNet/IP, 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 the **Group mode** setting. 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.

Fieldbus – Cyclic Data (read only)					PROFINET						
					EtherNet/IP			Class	Inst.		
					EtherCAT			0x82	1		
Parameter	Unit	Type	Range, Format	Description	Index	Sub-Index	Param. ID	Attribute	Slot	Sub-Slot	
Last error	–	INT32	0-3 #	0: no error 1: command allowed, accepted, and running ¹⁾ 2: command not allowed in automatic mode ¹⁾ 3: command rejected due to a running command ¹⁾	2400	1	1001	1	1	1	
Number of segments	–	UINT32	1 to 50 #	The number of segments mounted on the roller	2400	2	1002	2	1	2	
Number of groups	–	UINT32	0 to 50 #	The number of segment / groups configured for the roller	2400	3	1003	3	1	3	
segFORCE status	–	UINT32	0-31 #		2400	4	1004	4	1	4	
			└ Bit 0	0 or 1 #							
					Group mode 0: inactive, i.e. returned data corresponds to individual segments 1: active; i.e. returned data corresponds to groups						
			└ Bit 1	0 or 1 #	Digital input ¹⁾ 0: off 1: on						
			└ Bit 2	0 or 1 #	Digital output 1 (pressure valve) ¹⁾ 0: off 1: on						
			└ Bit 3	0 or 1 #	Digital output 2 (alarm) 0: off 1: on						
			└ Bit 4	0 or 1 #	Operation mode ¹⁾ 0: manual 1: automatic						
			└ Bit 5 to Bit 31	0 or 1 #	Reserved						
Total force	N	INT32	-200'000'000 to 200'000'000 #.###	The sum of the forces picked up by the individual segments	2400	5	1005	5	1	5	
Temperature	°C	INT32	-1000 to 2000 #.##	Temperature as reported by the temperature sensor.	2400	6	1006	6	1	6	
Pressure	kP	INT32	0 to 100'000'000 #	Air pressure inside the hose, which holds the individual segments in position.	2400	7	1007	7	1	7	

1) Not yet implemented.

Fieldbus – Cyclic Data (read only)						PROFINET					
						EtherNet/IP				Class	Inst.
						EtherCAT				0x82	1
Seg. Pos.	Parameter	Unit	Type	Range, Format	Description	Index	Sub-Index	Param. ID	Attribute	Slot	Sub-Slot
1	Force of segment 1	N	INT32	-200'000'000 to 200'000'000 #.###	The force picked up by segment / group 1	2410	1	1011	8	2	1
1	Speed of segment 1	m/min	INT16	0 to 10'000 ##	The segment / group speed ¹⁾	2410	2	1012	9	2	2
1	Status of segment 1		UINT16	–		2410	3	1013	10	2	3
	└ Bit 0 to 2			0 to 7 #	The status of segment 1 ²⁾⁵⁾						
	└ Bit 3			0 or 1 #	The state of the segment speed-pulse signal ²⁾						
	└ Bit 4 to 6			0 to 7 #	Reserved						
	└ Bit 7			0 or 1 #	Segment / group exists ³⁾ 0: no 1: yes						
	└ Bit 8 to Bit 15			0 to 50 #	The group number related to this segment ⁴⁾						
2	Force of segment 2	N	INT32	-200'000'000 to 200'000'000 #.###	The force picked up by segment / group 2	2420	1	1021	11	3	1
2	Speed of segment 2	m/min	INT16	0 to 10'000 ##	The segment / group speed ¹⁾	2420	2	1022	12	3	2
2	Status of segment 2		UINT16	–		2420	3	1023	13	3	3
	└ Bit 0 to 2			0 to 7 #	The status of segment 2 ²⁾⁵⁾						
	└ Bit 3			0 or 1 #	The state of the segment speed-pulse signal ²⁾						
	└ Bit 4 to 6			0 to 7 #	Reserved						
	└ Bit 7			0 or 1 #	Segment / group exists ³⁾ 0: no 1: yes						
	└ Bit 8 to Bit 15			0 to 50 #	The group number related to this segment ⁴⁾						
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮

49	Force of segment 49	N	INT32	-200'000'000 to 200'000'000 #.###	The force picked up by segment / group 49	2710	1	1491	152	50	1
49	Speed of segment 49	m/min	INT16	0 to 10'000 #. #	The segment / group speed ¹⁾	2710	2	1492	153	50	2
49	Status of segment 49		UINT16	–		2710	3	1493	154	50	3
	└ Bit 0 to 2			0 to 7 #	The status of segment 49 ²⁾⁵⁾						
	└ Bit 3			0 or 1 #	The state of the segment speed-pulse signal ²⁾						
	└ Bit 4 to 6			0 to 7 #	<i>Reserved</i>						
	└ Bit 7			0 or 1 #	Segment / group exists ³⁾ 0: no 1: yes						
	└ Bit 8 to Bit 15			0 to 50 #	The group number related to this segment ⁴⁾						
50	Force of segment 50	N	INT32	-200'000'000 to 200'000'000 #.###	The force picked up by segment / group 50	2720	1	1501	155	51	1
50	Speed of segment 50	m/min	INT16	0 to 10'000 #. #	The segment / group speed ¹⁾	2720	2	1502	156	51	2
50	Status of segment 50		UINT16	–		2720	3	1503	157	51	3
	└ Bit 0 to 2			0 to 7 #	The status of segment 50 ²⁾⁵⁾						
	└ Bit 3			0 or 1 #	The state of the segment speed-pulse signal ²⁾						
	└ Bit 4 to 6			0 to 7 #	<i>Reserved</i>						
	└ Bit 7			0 or 1 #	Segment / group exists ³⁾ 0: no 1: yes						
	└ Bit 8 to Bit 15			0 to 50 #	The group number related to this segment ⁴⁾						

- 1) If **Group mode** is deactivated, this is the speed of the individual segment. If **Group mode** is activated, this is the speed of the slowest segment within the group.
- 2) Only available if **Group mode** is deactivated.
- 3) The state **Segment/Group exists** displays whether data is available for a segment or a group at the current position. If the state is false, then all subsequent positions are also unused.
- 4) The meaning of the **Group Number** field depends on the state of **Group Mode**. When **Group Mode** is inactive, the group number indicates the group to which the segment at the current position belongs to. When **Group Mode** is active, it represents the group displayed at the current position.
- 5) Not yet implemented.

5.1.2 Acyclic Data Traffic

A PLC can exchange acyclic data with the FMS-segFORCE. These data are used to control the behavior of the FMS-segFORCE. The table below shows all available commands. This is the flag **Group Mode** to control the returned data in the cyclic data traffic. The commands can be read and written. Note that writing the same value again is allowed, which executes the command again.

Detailed command description

The group mode flag determines which data is returned via the cyclic data block of the Fieldbus Interface. This can be either the individual or grouped segment data structure. The Fieldbus Interface stacks are limited in their maximum transfer size, particularly the PROFINET stack, which is limited to 170 sub-slots. Therefore, individual and grouped segments cannot be returned in one data block. 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.

Fieldbus – Acyclic Data (read/write)						PROFINET					
						EtherNet/IP				Class	Inst.
						EtherCAT				0x87	1
Seg. Pos.	Parameter	Unit	Type	Range, Format	Description	Index	Sub-Index	Param. ID	Attribute	Slot	Sub-Slot
1	Group mode		UINT16	0 or 1 #	Select mode: 0: segment mode 1: group mode	2800	–	2001	1	0	10

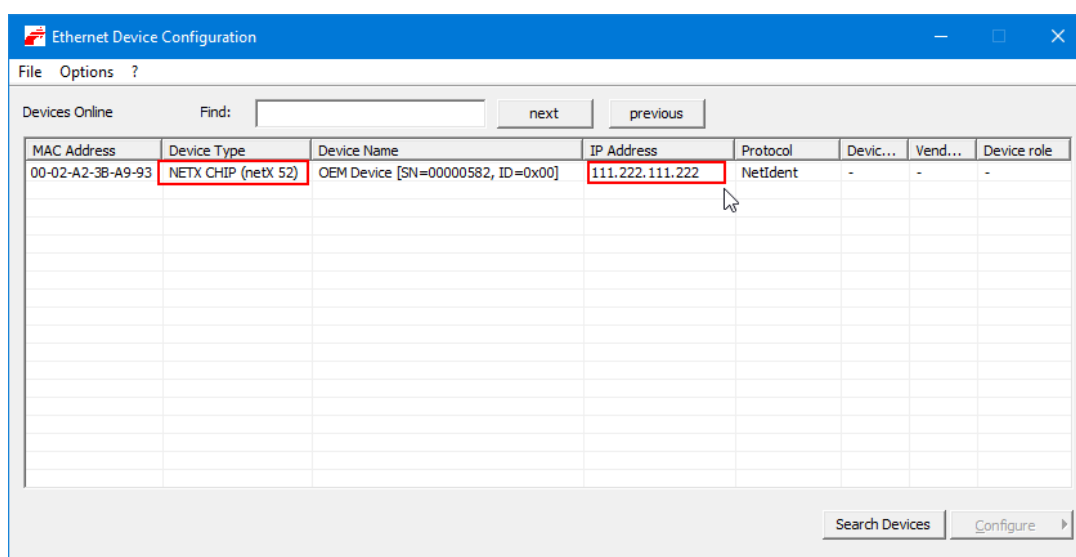
5.2 Find Out the Device's IP

In case you don't know the IP of a PROFINET or EtherNet/IP device because you entered the wrong IP by accident or there is not an IP assigned at all yet, then you can use the Hilscher tool **Ethernet Device Configuration**. Follow the steps below to use the tool.

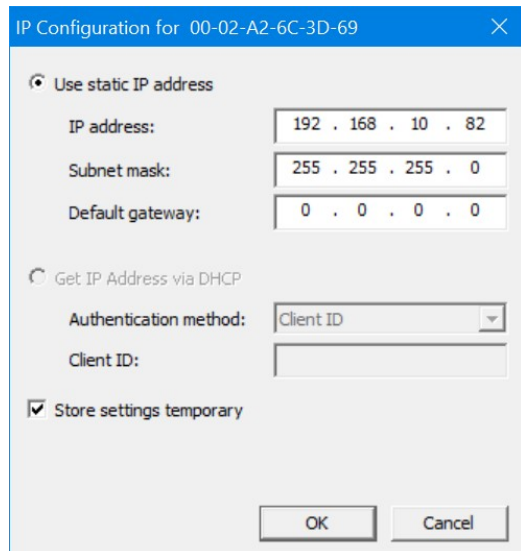
1. Download the Ethernet Device Configuration tool from the FMS website.
On the page, scroll down until you see the title **Ethernet Device Configuration** and click on EthernetDeviceConfiguration.zip.

<https://www.fms-technology.com/en/downloadcenter/profinet>

2. Unzip the contains of the EthernetDeviceConfiguration.zip archive to a temporary directory.
3. Installing the tool by double-clicking on the file **EthernetDeviceConfiguration Vx.x.x.x Setup.msi** and follow the instructions.
4. Start the tool and changing the language to your preferences.
5. Ensure that the PC and the device are connected to the Ethernet Network and powered up.
Click on button **Search Devices**. The tool finds all devices on the network that uses a Fieldbus protocol. Usually, you should only see a few devices. The device we are looking for has the Device Type NETX CHIP (netX 52) or FMS-segFORCE Controller, depending on the device's used protocol. If you are not sure which device should be selected, unplug all other devices, and repeat the search.
6. Select the line that shows the wanted device. In our example, the device has the wrong configured IP 111.222.111.222.



7. Click on button **Configure** and choose **Set IP Address...**
In the called dialog, enter the correct IP Address and Subnet mask.

PROFINET

IP Configuration for 00-02-A2-6C-3D-69

☒ Use static IP address

IP address: 192 . 168 . 10 . 82

Subnet mask: 255 . 255 . 255 . 0

Default gateway: 0 . 0 . 0 . 0

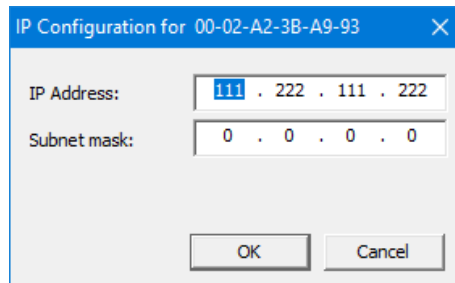
☐ Get IP Address via DHCP

Authentication method: Client ID

Client ID:

☒ Store settings temporary

OK Cancel

EtherNet/IP

IP Configuration for 00-02-A2-3B-A9-93

IP Address: 111 . 222 . 111 . 222

Subnet mask: 0 . 0 . 0 . 0

OK Cancel