COMMS062

Knowledge Base Document
Technical Support Department, U79, Newtown

Title: **Unidrive M & SI-PROFINET with Siemens S7-1200 PLC**

Document Category:	Communications	**Product Category:**	Communications: Profinet
Credits:		**Circulation:**	

Revision History

Revision	Date	Revising Author	Authorised By	Comments
1	09/05/18	Joe Richardson		

Summary of Contents

This document provides a step-by-step *Getting Started* guide for using the Siemens TIA Portal to configure a Unidrive M fitted with a SI-PROFINET (RT or V2) option module to communicate over a PROFINET network with a Siemens S7-1200 PLC.

The following topics are covered in this document:

- Setting up a Unidrive M fitted with a SI-PROFINET RT or V2 option module.
- Setting up the PROFINET Controller interface using the Simatic Step 7 / TIA Portal V12 software.
- Setting up flexible IO modules for user selection of the menu and parameter used over PROFINET.
- SI-PROFINET V2 ONLY – selecting option module parameters for use over PROFINET.
- Running a simple transfer test program with Simatic Step 7 / TIA Portal V12 software.
- Running a ramp test program with Simatic Step 7 / TIA Portal V12 software.

Document Requirements

Requirements – User

- Previous experience of using PLCs.
- Previous experience of using Siemens Step 7 / TIA Portal PLC configuration software, specifically V12 upwards, would be a distinct advantage.
- The PLC handles the data transfer automatically; therefore no ladder/test logic is required to initiate data transfer between the PLC CPU & the PROFINET field device. However some example programs are provided for reference and further testing of the setup.

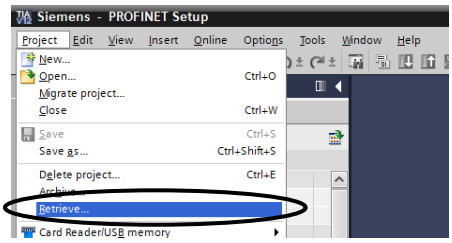
Requirements – Hardware

- Siemens **Simatic S7-1200 PLC** (1215C DC/DC/DC CPU V1 with firmware V3.0.2 used for this document).
- A PC to PLC interface (Auto-Cross-Over functionality built into the CPU hence a standard or crossover **Ethernet cable** can be used for the interface).
- **PROFINET Controller interface** if not fitted as standard (depending upon the specific variant of PLC used this may require extra hardware - however the PLC used in this document has built in PROFINET ports).
- **Unidrive M** – M200-400 or M600-M700 (Unidrive M700 used in this document)
- **SI-PROFINET RT** option module (hardware version 4.0 and V01.01.05.24 firmware used in this document) or alternatively **SI-PROFINET V2** option module. *NOTE: Unidrive M200-M400 is only compatible with SI-PROFINET V2. Furthermore as most features of the two versions overlap, the name SI-PROFINET will refer to both, hence unless otherwise stated assume any instructions apply to both versions of the module.*
- **PROFINET connection cable(s)** should be shielded twisted pair (STP) which as a minimum meets TIA Cat 5e requirements and is certified for use on a PROFINET network, to connect between CPU and SI-PROFINET module (and for Unidrive M to Unidrive M connection(s) if required).
- OPTIONAL: **SI-Applications Plus module** (Firmware V02.04.00) to explore reading/writing to an option module over PROFINET network. *NOTE: Currently this feature is not supported by either module but is coming to the SI-PROFINET V2 module in a future firmware update.*

Requirements – Software & Firmware

- **Simatic Step 7 Manager / TIA Portal** (V12 SP1 used for this document).
- **GSDML** & icon files for the drive model used (GSDML-V2.3-CT-UniDriveM-20140821.xml used in this document). Ensure that the correct GSDML file for the drive, SI-PROFINET module (RT/V2) and version of Siemens Step 7 / TIA Portal used is acquired before starting this document.

If required, all of the Step 7 / TIA Portal PLC programs used throughout this document can be provided archived in a zipped folder, obtainable from your drive support centre or the Customer Support Suite. The archived programs can be added by navigating to **Project**>**Retrieve**, from within the 'Project view' of Step 7 / TIA Portal.

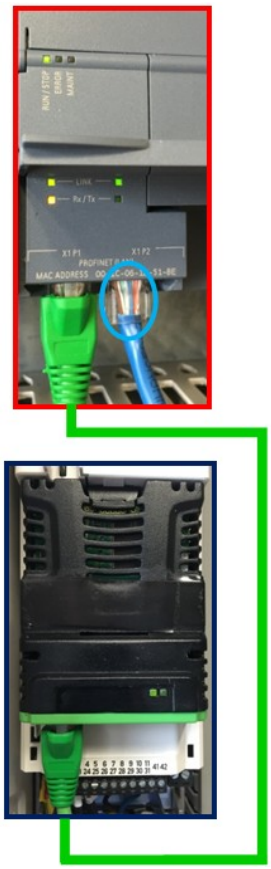


NOTE
Although specific products are mentioned in this document, Control Techniques does not endorse or recommend any third party product, it is the responsibility of the user to select appropriate equipment for the application.

Contents

1: Hardware setup and connections

Connect up the system hardware as shown below in **Figure 1-1.**



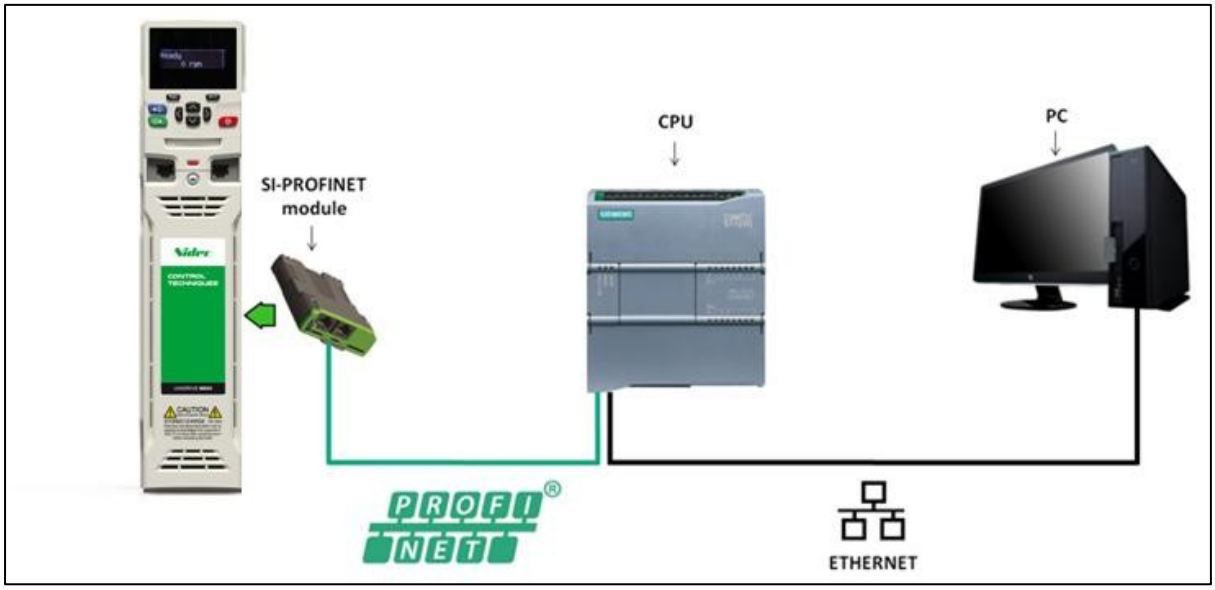
The **1215C DC/DC/DC CPU** used has a 2-port Ethernet switch built into it; these ports are used as either the Ethernet programming port or the PROFINET communication port(s). The programming cable should be connected between the programming PCs Ethernet port (or a USB-Ethernet adapter for multiple network connections) and one of the CPUs **RJ45 ports**.

The CPU used in this document has the PROFINET IO Controller Interface built in therefore no addition communication modules are required to be added to the setup. A **PROFINET certified cable** (Cat 5e or higher) is simply used to connect between one of the CPUs RJ45 Ports and the PROFINET field device (**SI-PROFINET module**). Any additional PROFINET field devices can be linked from SI-PROFINET module to SI-PROFINET module using the same standard of cabling.

For the physical installation of the option module use the manual provided for the Unidrive M variant used or the SI-PROFINET manual, however for the purpose of this document the SI-PROFINET module was installed in option slot 3 (unless otherwise stated). For the initial PLC physical setup please use the documentation provided by Siemens, as this is not covered in this documentation.

NOTE
If a different CPU is used then the hardware configuration may be different to the one shown, in which case, the CPU documentation should be consulted to determine the correct connection details.

Figure 1-1: Hardware configuration



2: Configuring the Unidrive M SI-PROFINET Interface

The entire PROFINET configuration is performed by the PLC rather than directly on the SI-PROFINET interface, therefore unless your application requires custom timeout events and actions, steps 2-4 can be ignored.

1. Power up all Unidrive M drives connected to the PROFINET network. As discussed all the key configuration is performed by the PLC, however it is still advised to default the SI-PROFINET module(s) now to ensure the same setup parameters are used as in this document, by setting **#S.00.008** to **On** before resetting the module – see Step 2.4.

NOTE

The module's menu 0 is also displayed in menu 15, 16 or 17 depending on which slot the module is installed to. Table 2-1 below shows the location of the module's menu 0 on the drive.

Table 2-1: SI-PROFINET menu 0 locations on Unidrive M

Option slot number	Menu 0 locations
1	15
2	16
3	17

2. Depending upon your application any other necessary module settings should now be configured. However as discussed all PROFINET settings are configured by the PLC, therefore it is only the timeout action and event that can be modified if required, from within **#S.05.0XX**.

3. On the Unidrive M to avoid loss of the configured settings when the drive is powered down it is required to set **mm.00** to 'Save parameters' or '1000' and press the red reset button to perform a drive save.

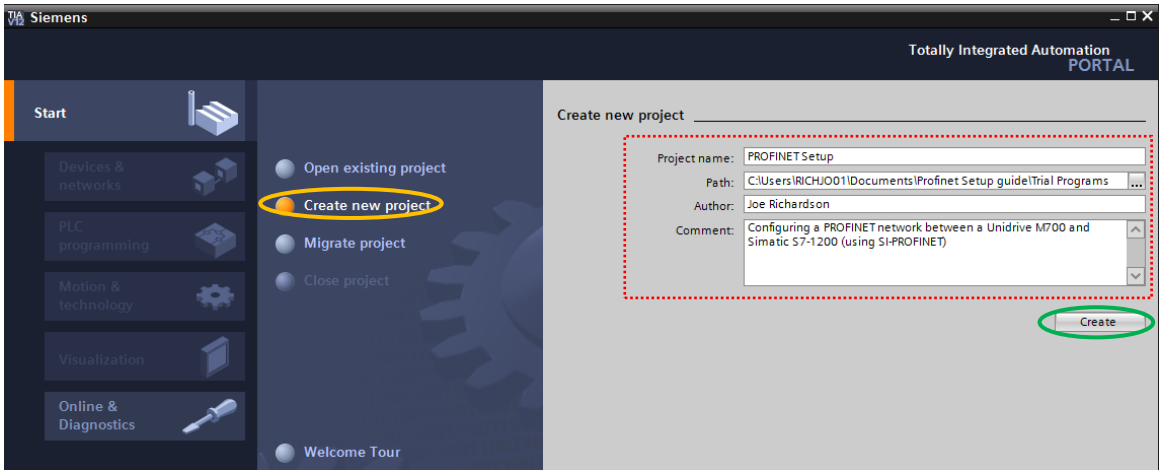
4. Changes made to the SI-PROFINET configuration parameters will not take effect until the SI-PROFINET module is reset, by setting **S.00.007** or Pr **MM.007** *to* ***On****.*

5. The Unidrive M SI-PROFINET module is now ready for the PLC to be configured and the network initialised to connect the drive to the PROFINET network.

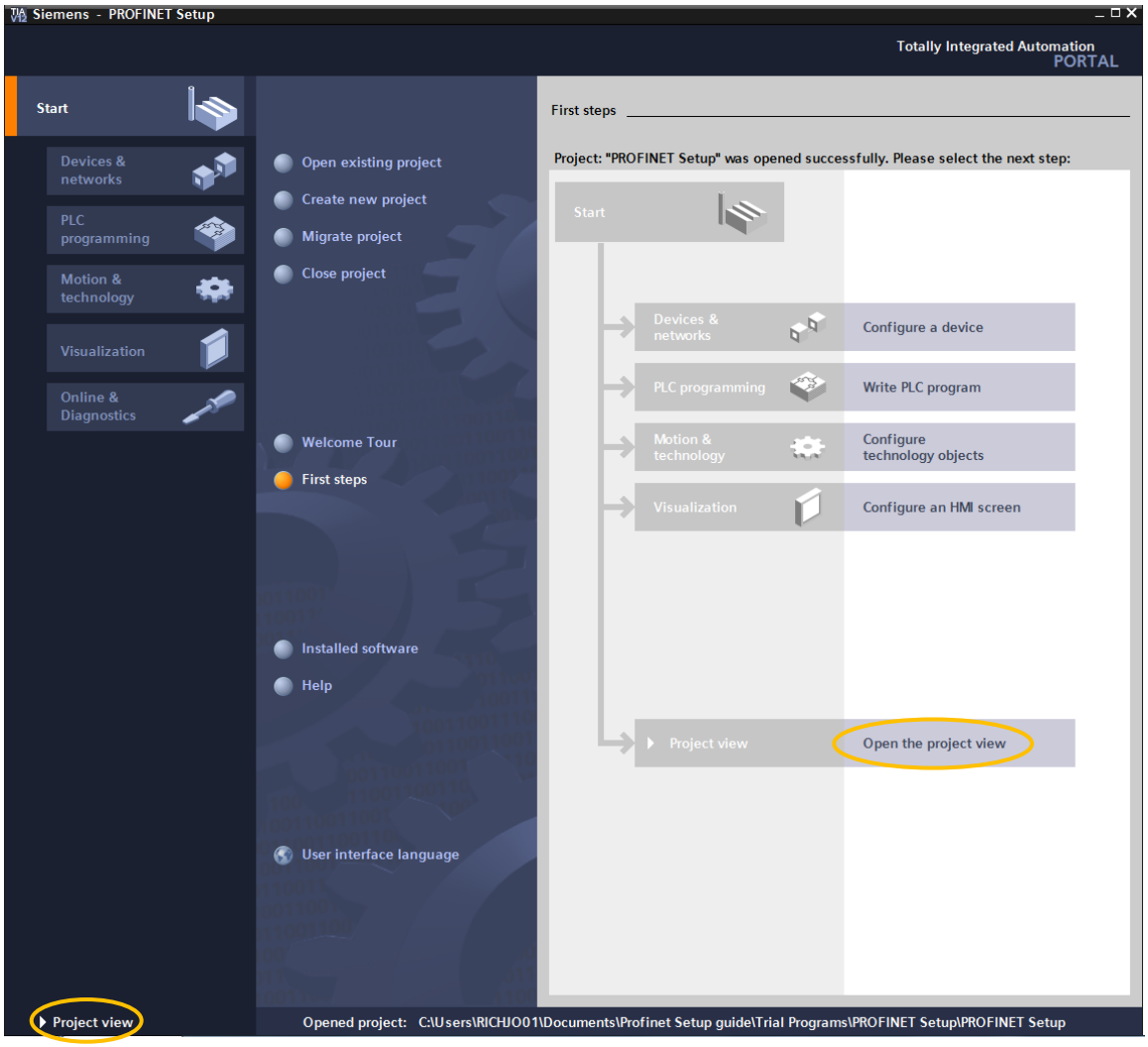
Return to Contents

3: Configuring the PLC to create a PROFINET network using standard IO modules

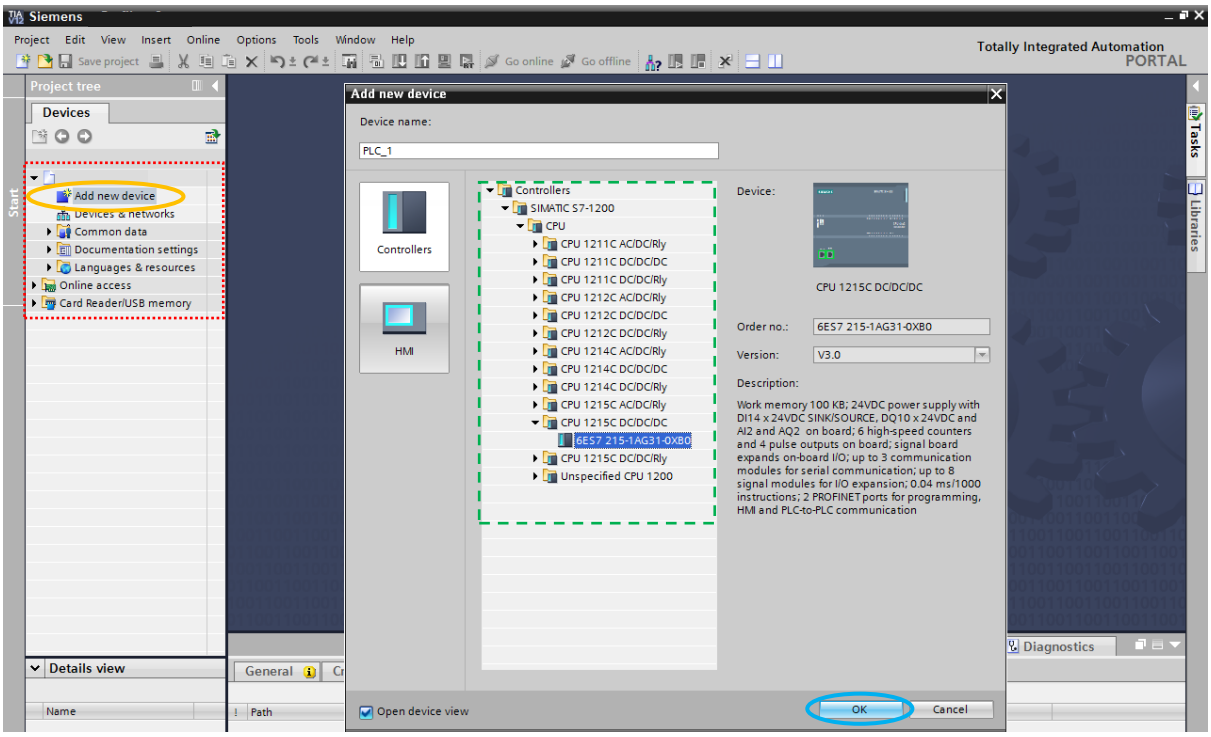
1. **Creating the project** - Run the Simatic Step 7 / TIA Portal V12 software and select **Create new project** from the start screen. Enter the **Project name** (and any other details required) as shown below (for this example the name 'PROFINET Setup' is used), then click the **Create** button.



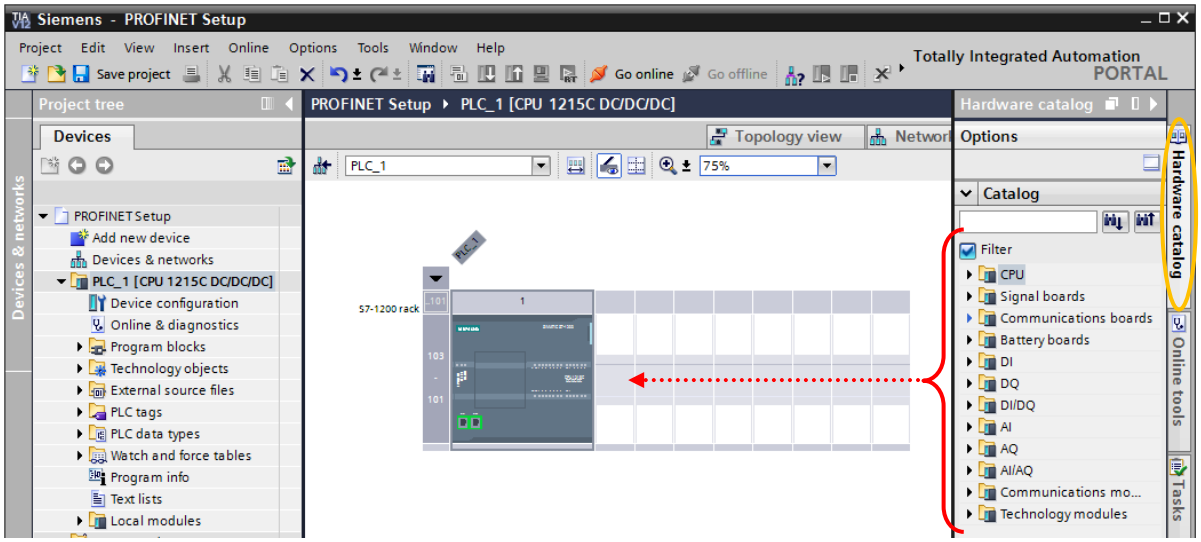
2. **Entering Project view** - Select **Open the project view** or **Project view** as illustrated below.



3. **Adding the PLC to the project** - from project view double click on **Add new device** under the project tree and then within the popup window (under Controllers) locate the correct PLC and CPU used, before selecting **OK** to add the device to the project.



4. **Adding hardware modules** – it is required to add any additional modules attached to your PLC to the configuration manually. These are located in the **Hardware Catalog** and the required device can be added by clicking and dragging it onto the PLC rack. However, for the CPU used in this document the PROFINET communication ports are located on the main unit; therefore no additional communication modules are required for the setup used.



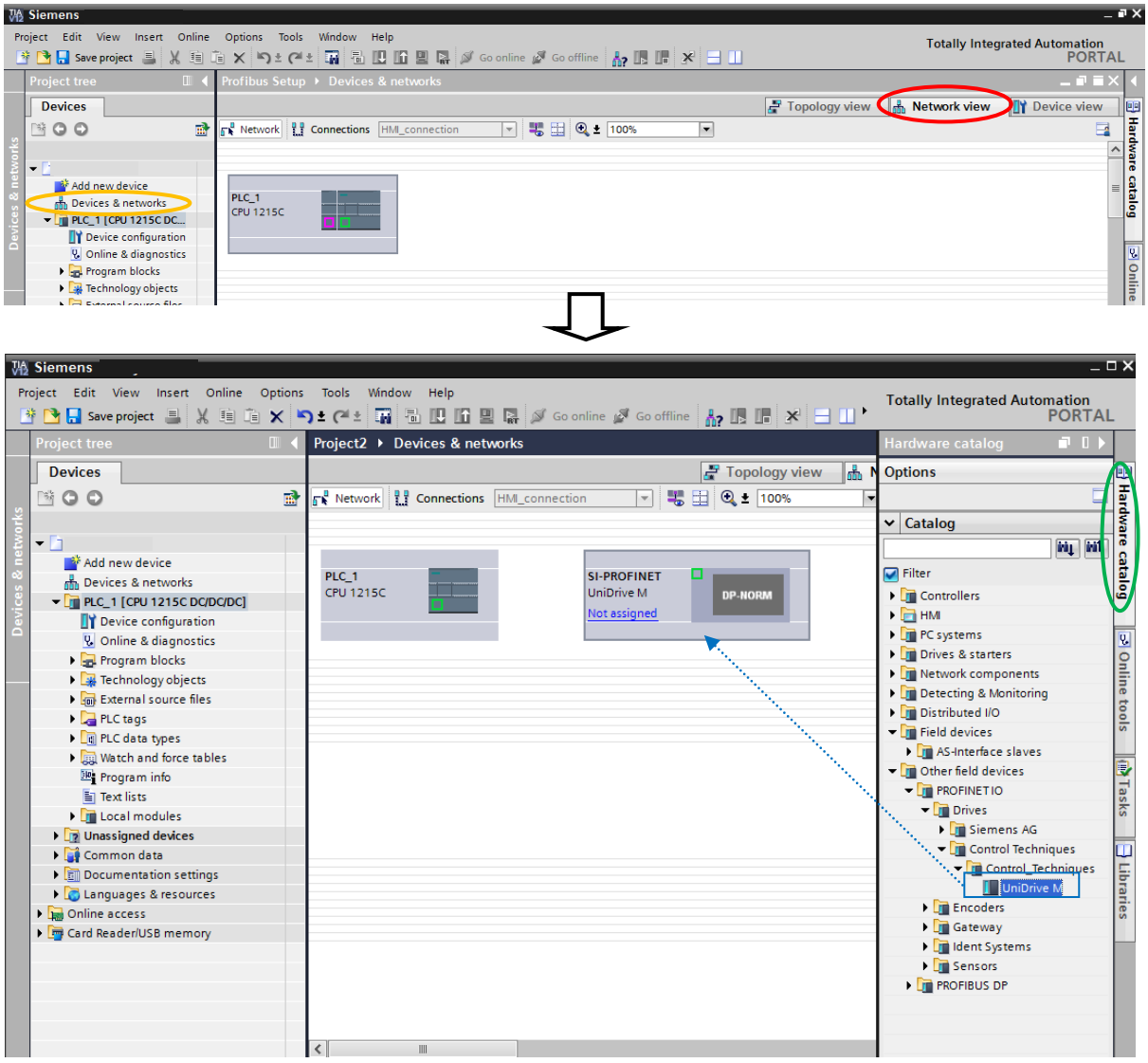
NOTE

Ensure that the connected PLC is in “Offline” mode as “Online” mode prevents the required modules from being added to the PLC rack.

IMPORTANT

Before proceeding with Step 5 you must ensure that the relevant GSDML files for the Unidrive M have been added to Simatic Step 7 / TIA Portal V12. For further instruction on this see Appendix A.

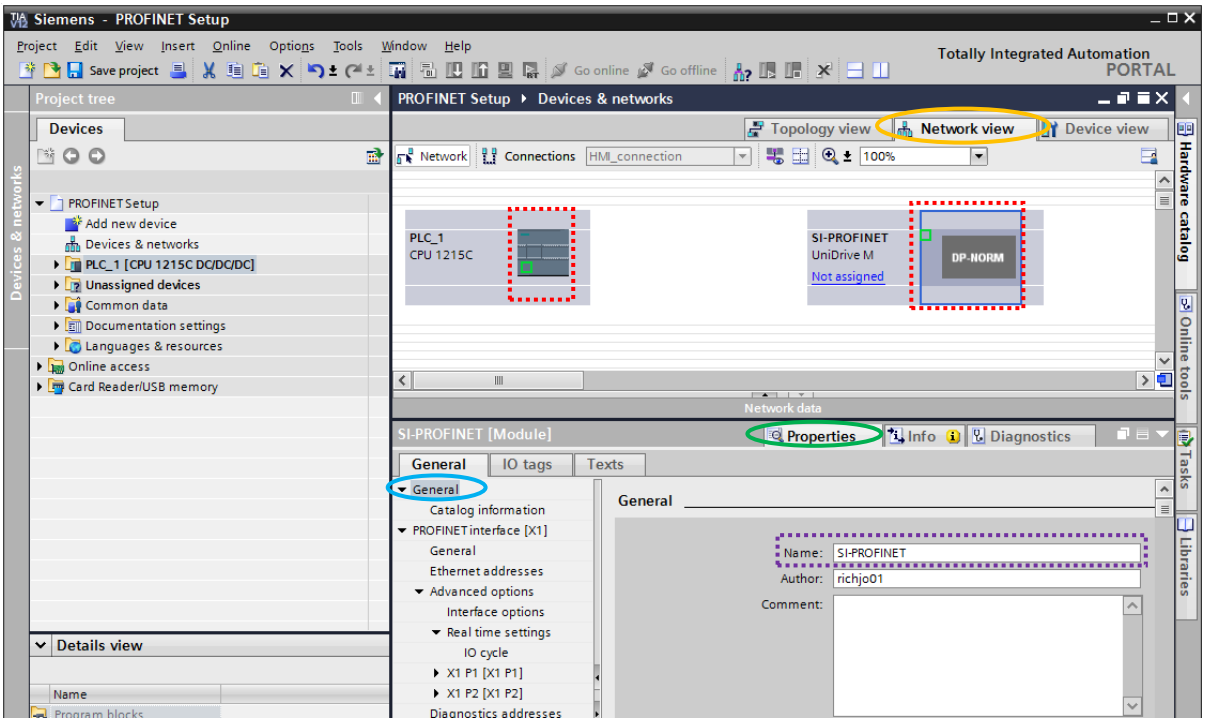
5. **Adding the PROFINET slave device** – go to **Devices & Networks** from the project tree and ensure **Network view** is selected using the tabs shown below, before opening the **Hardware catalog** and navigating to find the attached drive used for your setup. The device can then be clicked and dragged to the network view, as illustrated below.



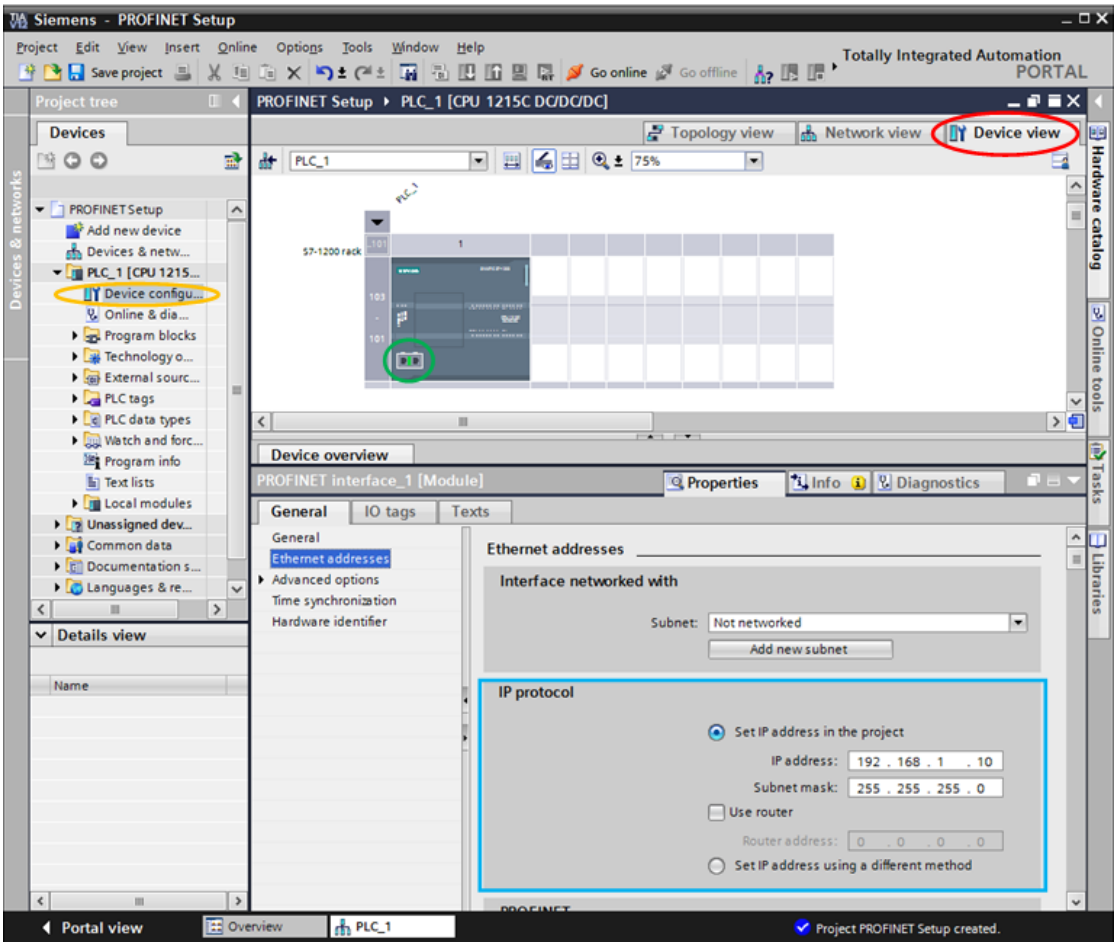
6. **Naming the PROFINET field device or controller** – from the **Network view** used in the previous step and shown below, click on the controller (PLC) or field device (SI-PROFINET module) that you wish to name (click anywhere in the area highlighted below for the required device) and ensure the **Properties** tab is selected. Under the main General menu the name of the device can then be changed. Repeat this step for all the network devices you wish to rename.

NOTE

If the SI-PROFIBUS module used is already named then this must be entered in this step.

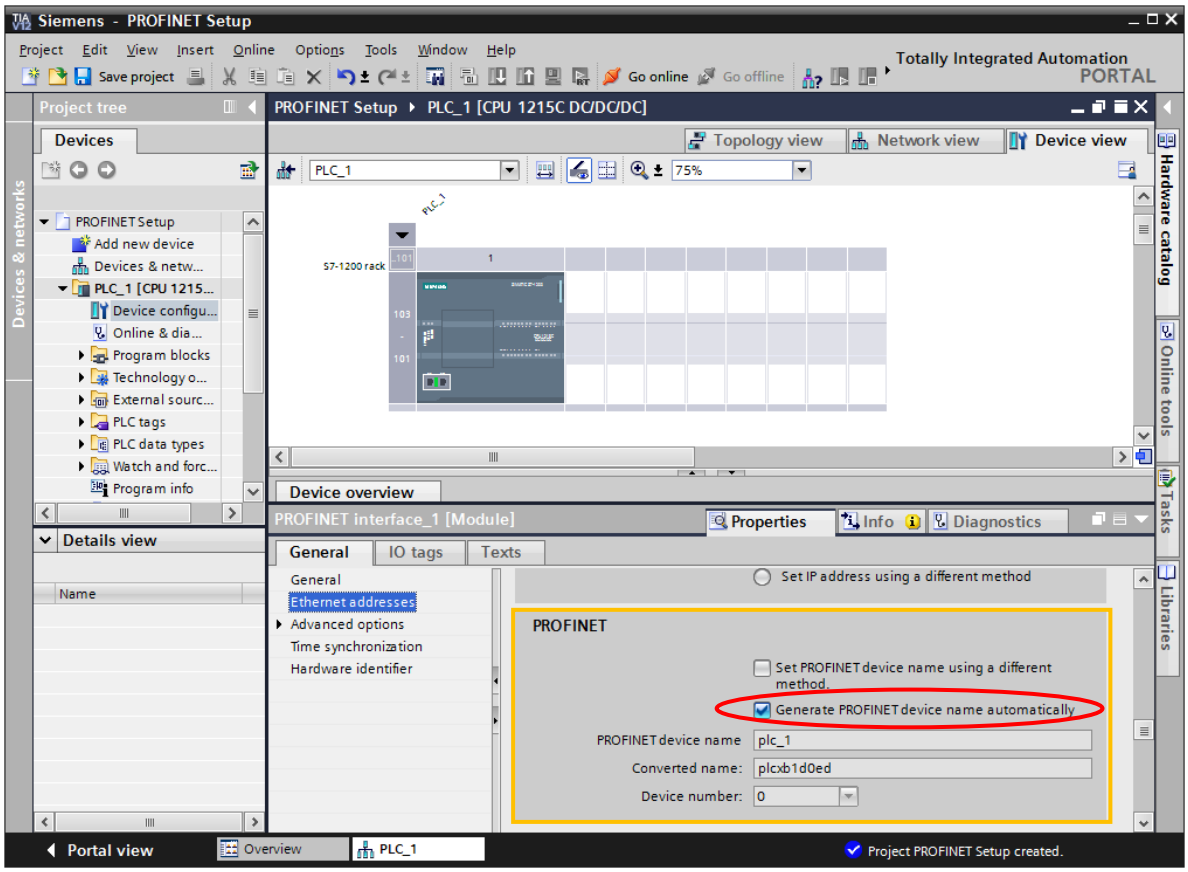


7. **Configuring the programming port** – enter the Device configuration window from the project tree and from within the Device View of the PLC double click on the two PROFINET/Ethernet ports on the CPU to enable the properties of the port to be viewed. With a standard setup only the IP protocol will need to be changed, to match the IP address assigned to the PLC (see Siemens guide for detail on assigning an IP Address to the PLC) and to suit the networking configuration of the programming PCs network adapter (whether this is built in or a USB-Ethernet adapter).



8. Configuring the PROFINET ports

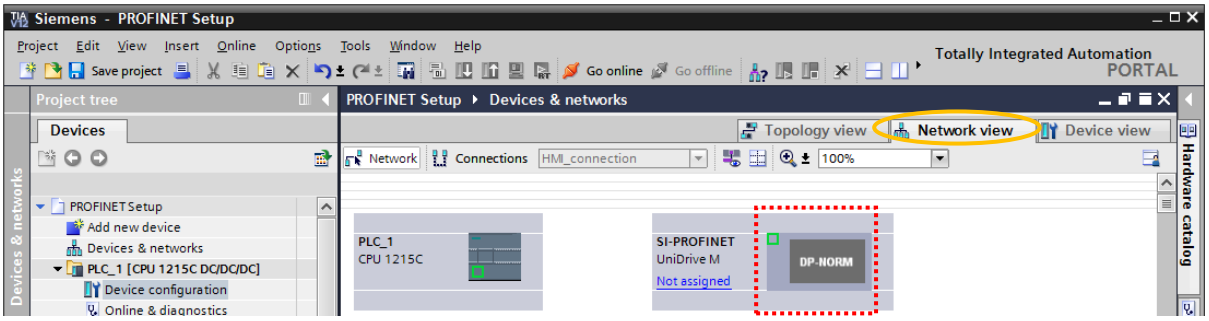
PROFINET IO Controller Configuration (PLC)



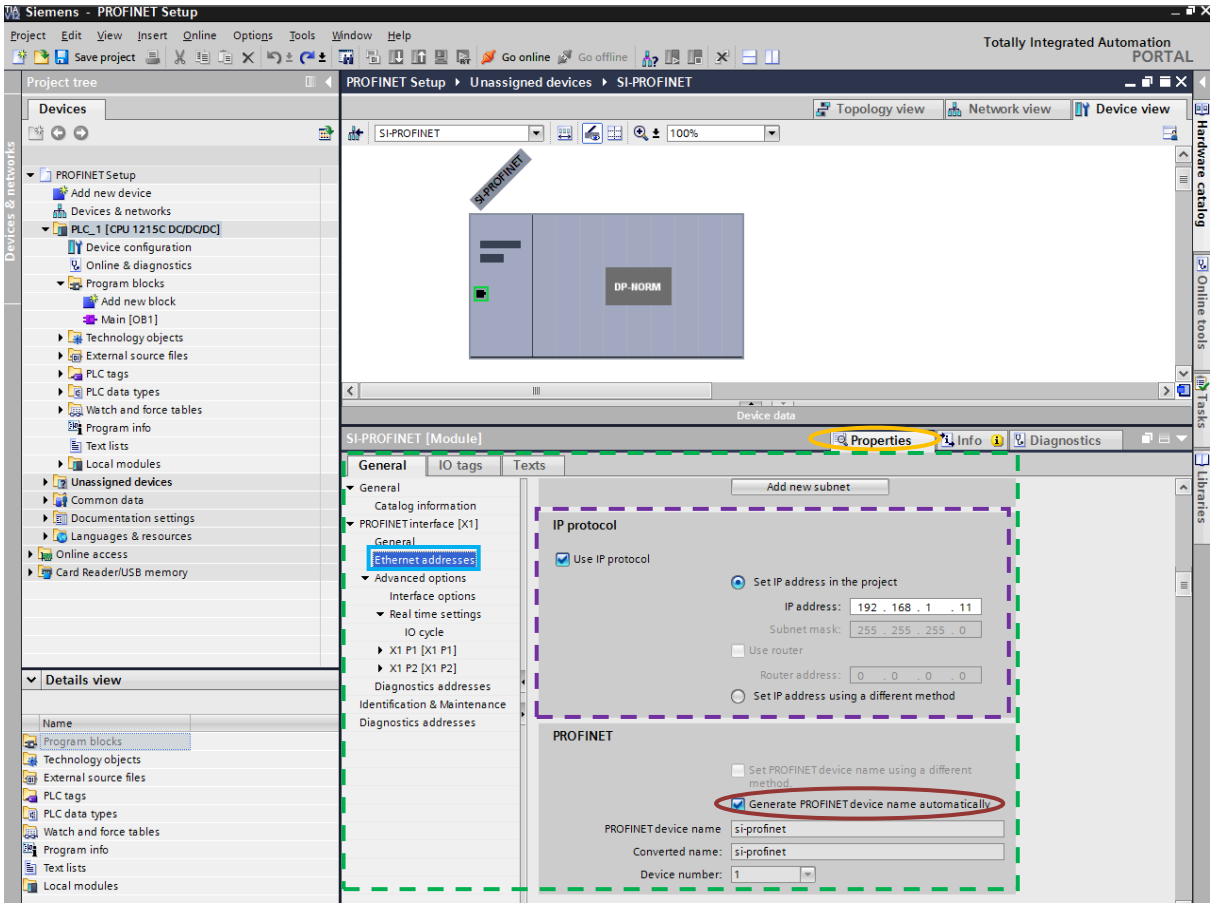
As the two RJ45 ports on the PLC are used as both Ethernet programming and PROFINET communication ports, the IP address of the PLC defined in Step 3.7 is used as the PROFINET controller's IP address. The PROFINET specific settings shown above can be changed if necessary, however for this document the default PROFINET setting "Generate the PROFINET device name automatically" is used, meaning that the PROFINET name used is taken from the default device name or the name added in Step 3.6.

PROFINET Field IO Configuration (SI-PROFINET)

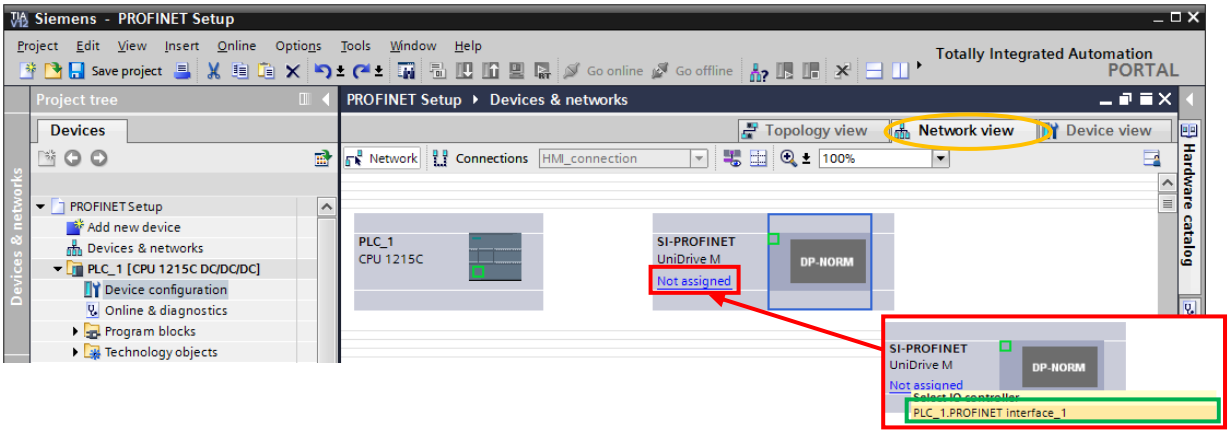
To configure the PROFINET slave return to the **Network View** (as used previously in Step 3.5 and Step 3.6) before double clicking on the slave unit in the area illustrated below.

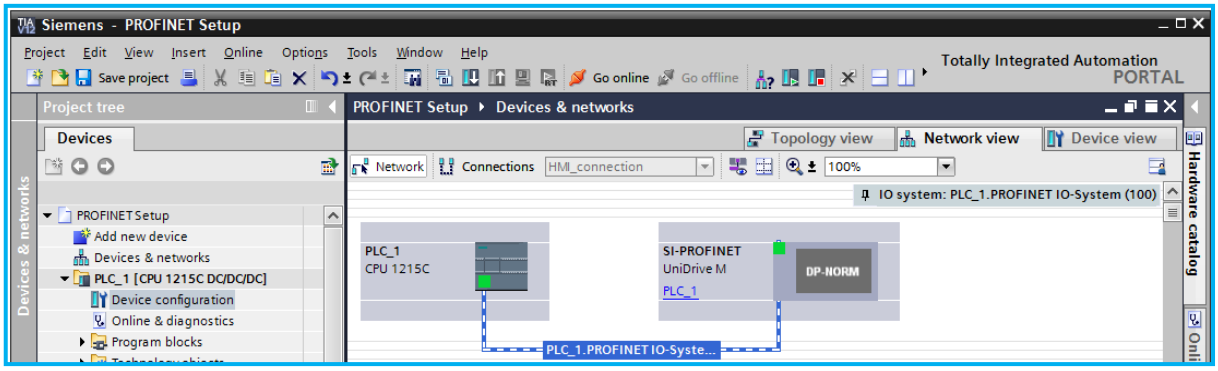


This then shows the properties of the SI-PROFINET module, and enables the Ethernet addresses menu to be opened where the IP address for the SI-PROFINET module should be set (ensure that this address does not clash with those used by any other devices on the same network, e.g. master, slaves and even the programming PCs network adapter). For this document the default PROFINET setting "Generate the PROFINET device name automatically" is again left selected to automatically generate the PROFINET device name from the default device name or that configured in Step 3.6.

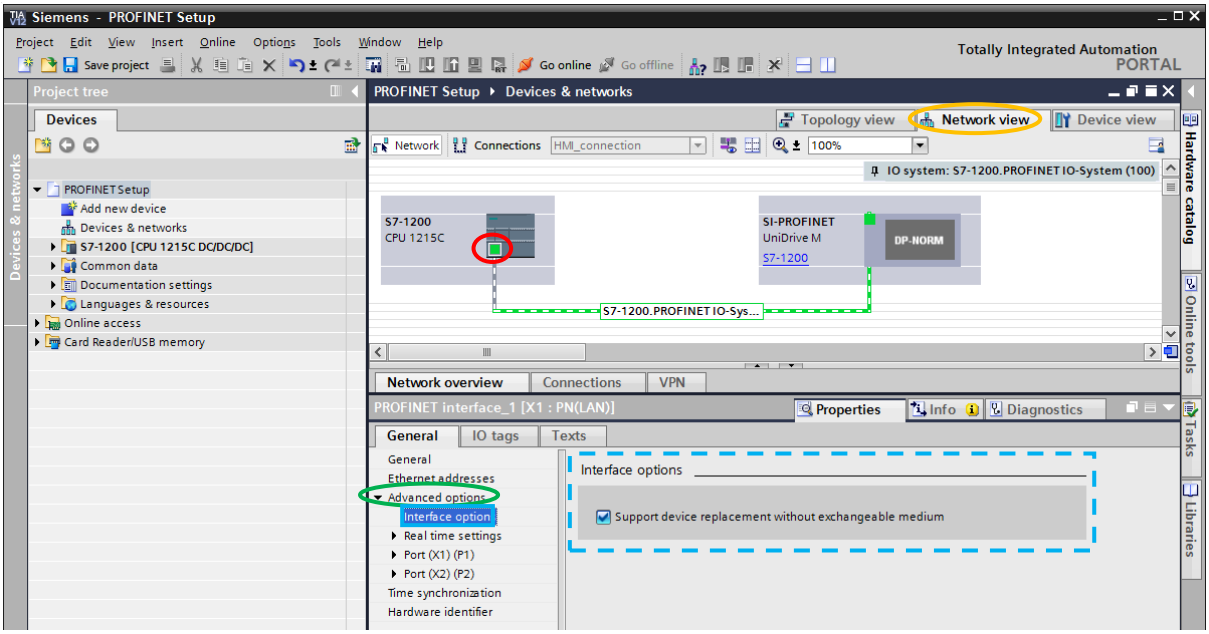


Return to the Network view and click on Not assigned, before selecting the required IO controller (in this case named PLC_1.PROFINET interface_1). This should complete the network setup, giving the network view shown in the figure below.

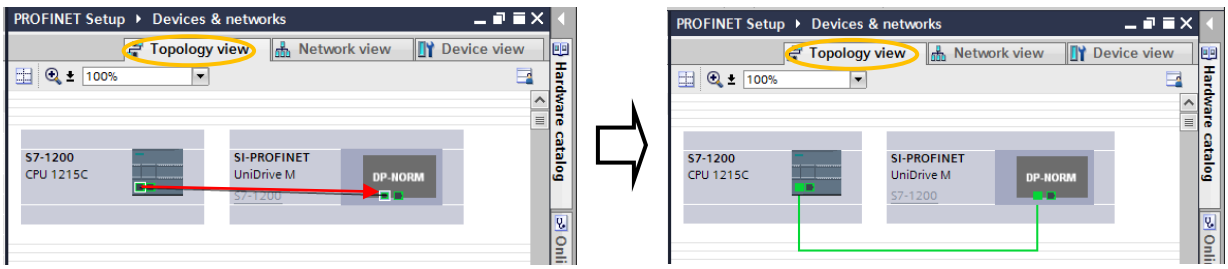




9. **Configuring the network topology** – the PLC must be configured to support device replacement, this is an option in the properties of the PROFINET port of the PLC. From within the Network view click the PROFINET port on the controller (PLC). From within the Advanced options properties, open up Interface options and ensure the option '***Support device replacement without exchangeable medium***' is selected.



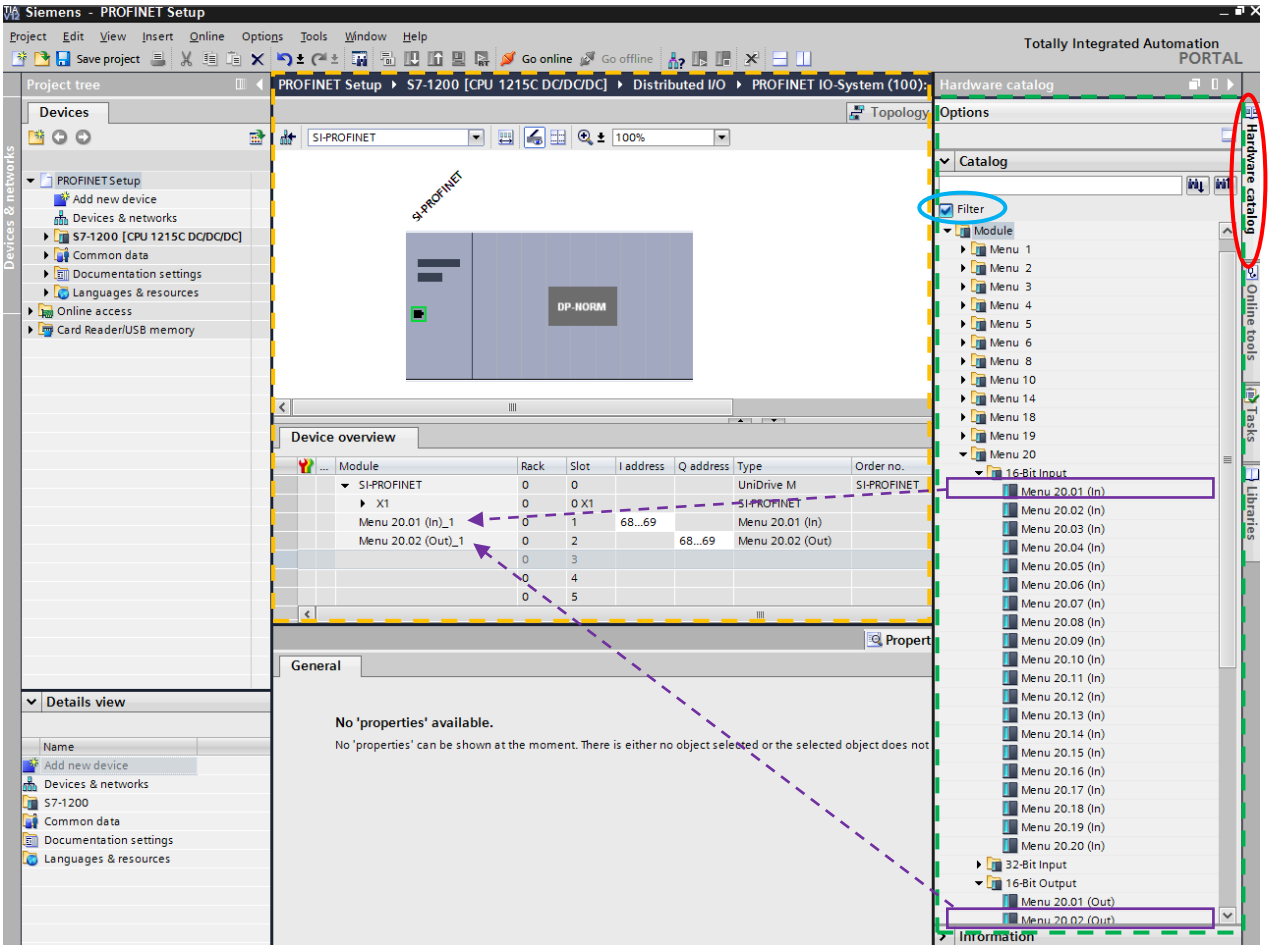
The network topology must now be configured by entering the Topology View. Then using 'drag and drop', connect the relevant device ports together to match the physical network wiring. Once the PLC has been configured, if a device is replaced then the new device will be automatically configured with the original device's properties, including the device name and IP address.



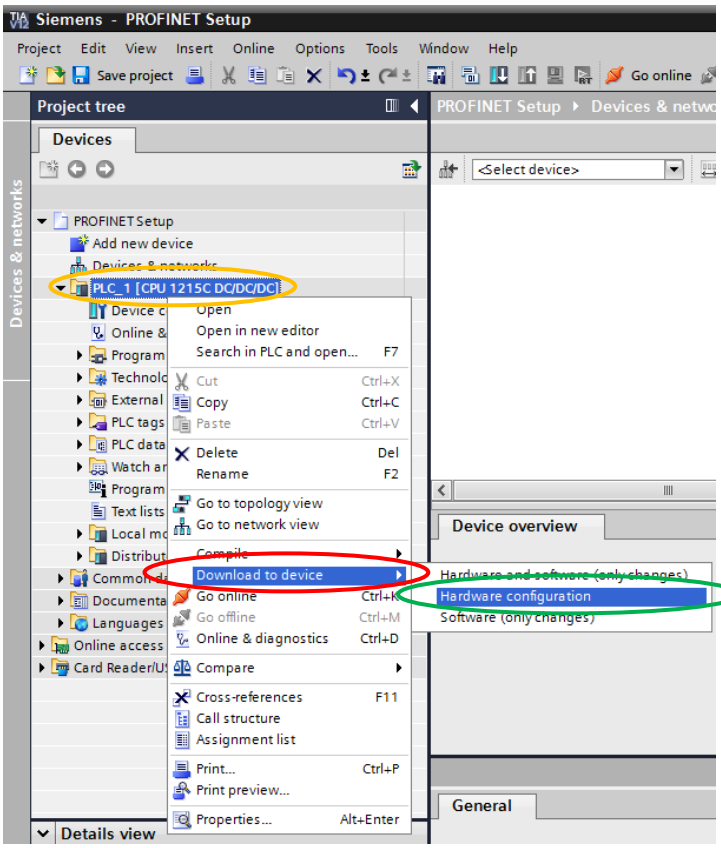
NOTE

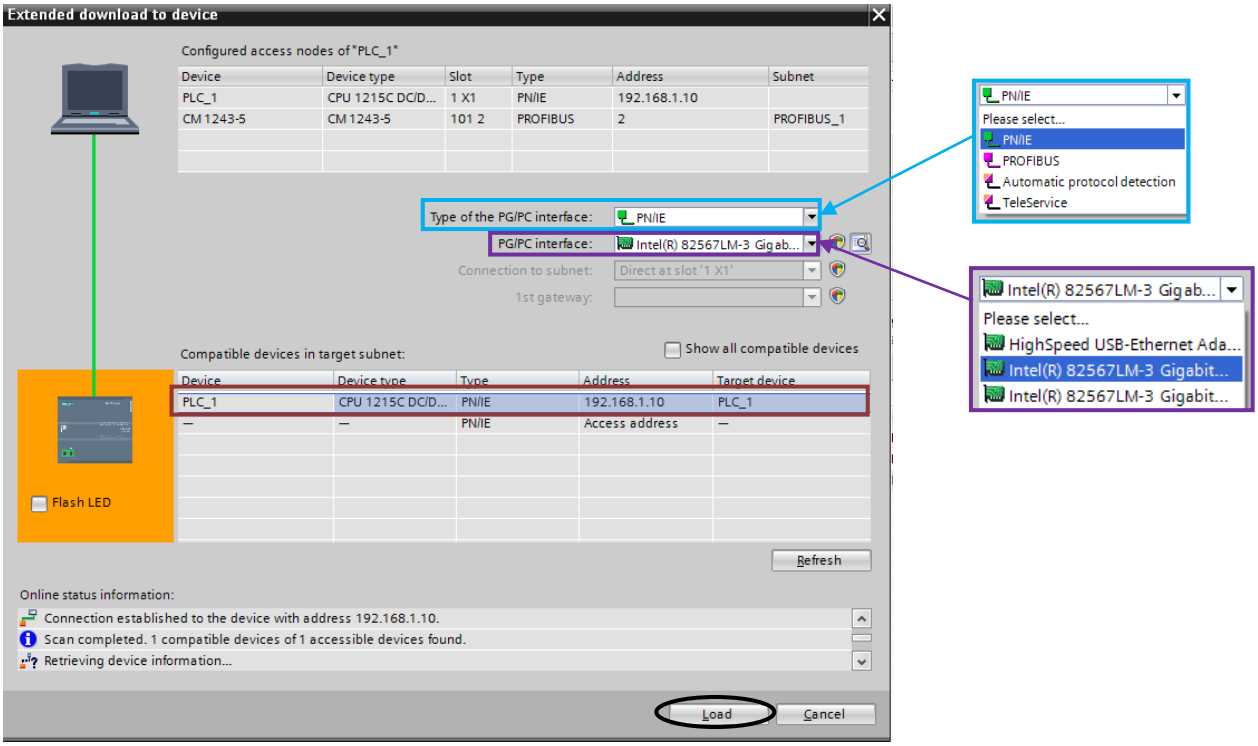
For the discovery protocol to work, the replacement device must not have a device name programmed, i.e. it must be blank or unused. If a device name exists in the module and that name is different to the device name set in the network configuration then the PLC will indicate a configuration error and will not enter data exchange with it.

10. **Adding standard cyclic IO parameters** – to add the PROFINET IO parameters to the hardware configuration double click on the required field device in the network view, to open the **device view** (as used for the PROFINET Field IO Configuration). Then navigate in the **Hardware catalog** to the Unidrive M used. In this folder will be all of the parameter modules required to configure the PROFINET network. *NOTE: if **Filter** is selected the relevant modules for the selected slave should already be shown.* Then simply click and drag any IO parameters into the module rack under 'Device Overview'. For this example Menu 20.01 (In) and Menu 20.02 (Out) are used, as illustrated below.

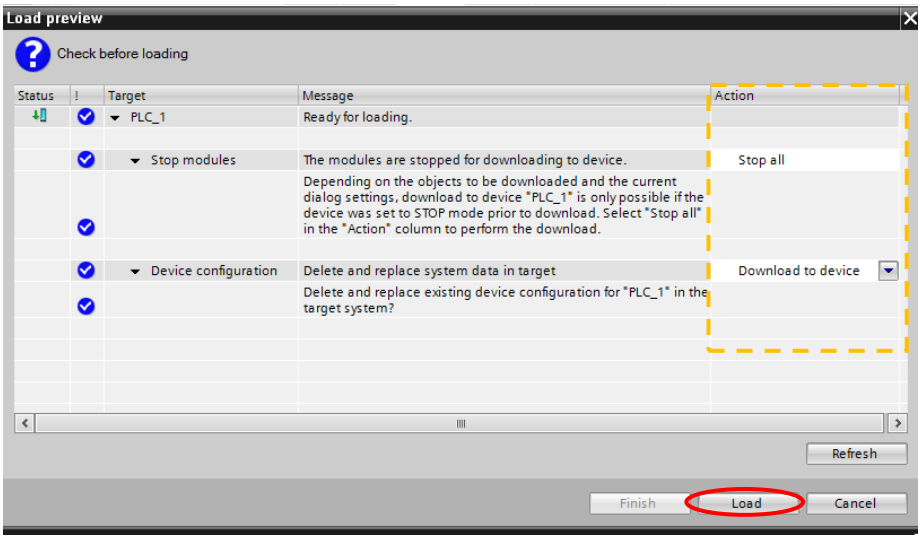


11. **Downloading the Hardware Configuration to the PLC** – right click on the PLC in the project tree, select Download to device and then Hardware configuration. A popup box will enable the PLC to be connected to the PC for loading the hardware setup. Select the Type of PG/PC interface as PN/IE and set PG/PC interface to the network adapter used to connect to the PLC. A scan for the PLC IP Address specified in Step 3.7 is then performed and the compatible devices will then be shown. Select the PLC in the list and then press **Load**.

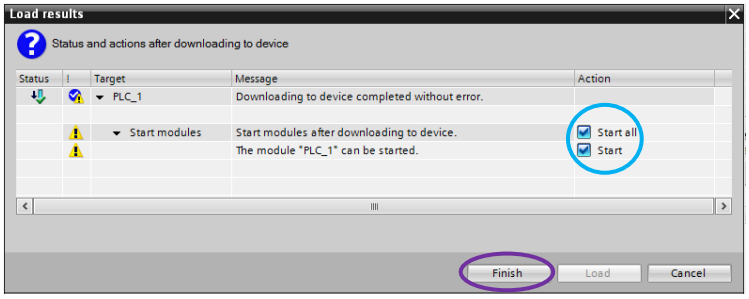




Next a ‘Load preview’ window should appear in which it is outlined what processes will occur when the hardware configuration download occurs. If any of the **Actions** listed have not already been confirmed then adjust these before clicking **Load**.

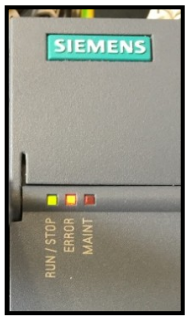


The program will then be loaded onto the PLC and the ‘Load results’ shown, as illustrated below. Then select Start and click Finish, this will put the PLC into run mode and complete the configuration of the PLC for use with the standard PROFINET parameter modules.



12. Checking the setup for successful PROFINET communication

Once the hardware configuration has successfully downloaded to the PLC and it is in ‘Start’ mode, there should only be a green LED present as shown near right. However if the configuration is incorrect you will see a flashing orange LED as shown far right, indicating an error, meaning the configuration used should be double checked.



If the PLC is reporting no errors then **S.02.003, S.02.004** and **S.05.004** on the drive should also be checked to ensure that the PROFINET network is operating correctly, where they should display that the network is active, has a cyclic data rate greater than 0 and no configuration error has occurred.

NOTE

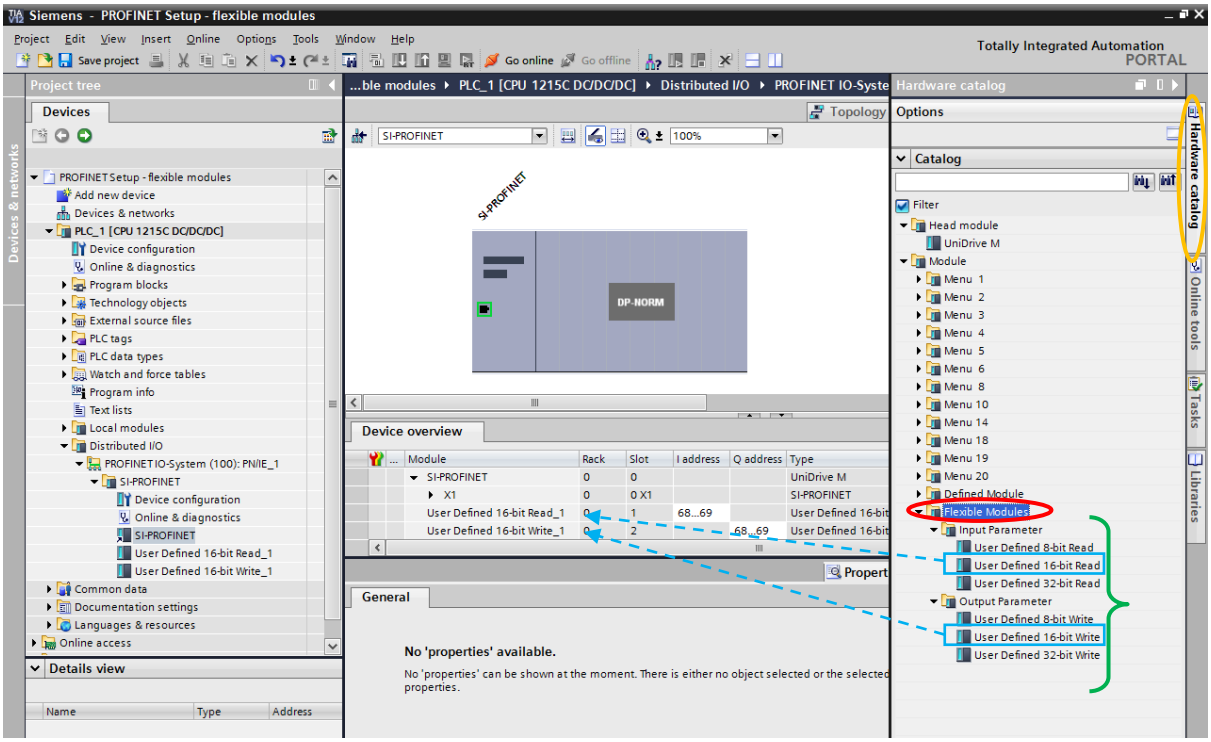
If at any point the expected output is not observed at the drives, before assuming that there is an error with the software/hardware setup, it is often worth resetting the SI-PROFINET module (**S.00.007**) and/or stopping and restarting the program on the PLC using the Simatic Step 7 / TIA Portal interface, to ensure that both the PLC and drive are running the most recent version of your program and setup. It is recommended to perform this step before each testing stage in this document.

4: Configure Flexible IO modules for user selection of Menu/Parameter – if the required parameter is not contained within the list of standard modules provided by the GSDML file (as used in Step 3.10) a 'Flexible Module' can be used to enable you to define the menu and parameter you wish to use over the PROFINET network.

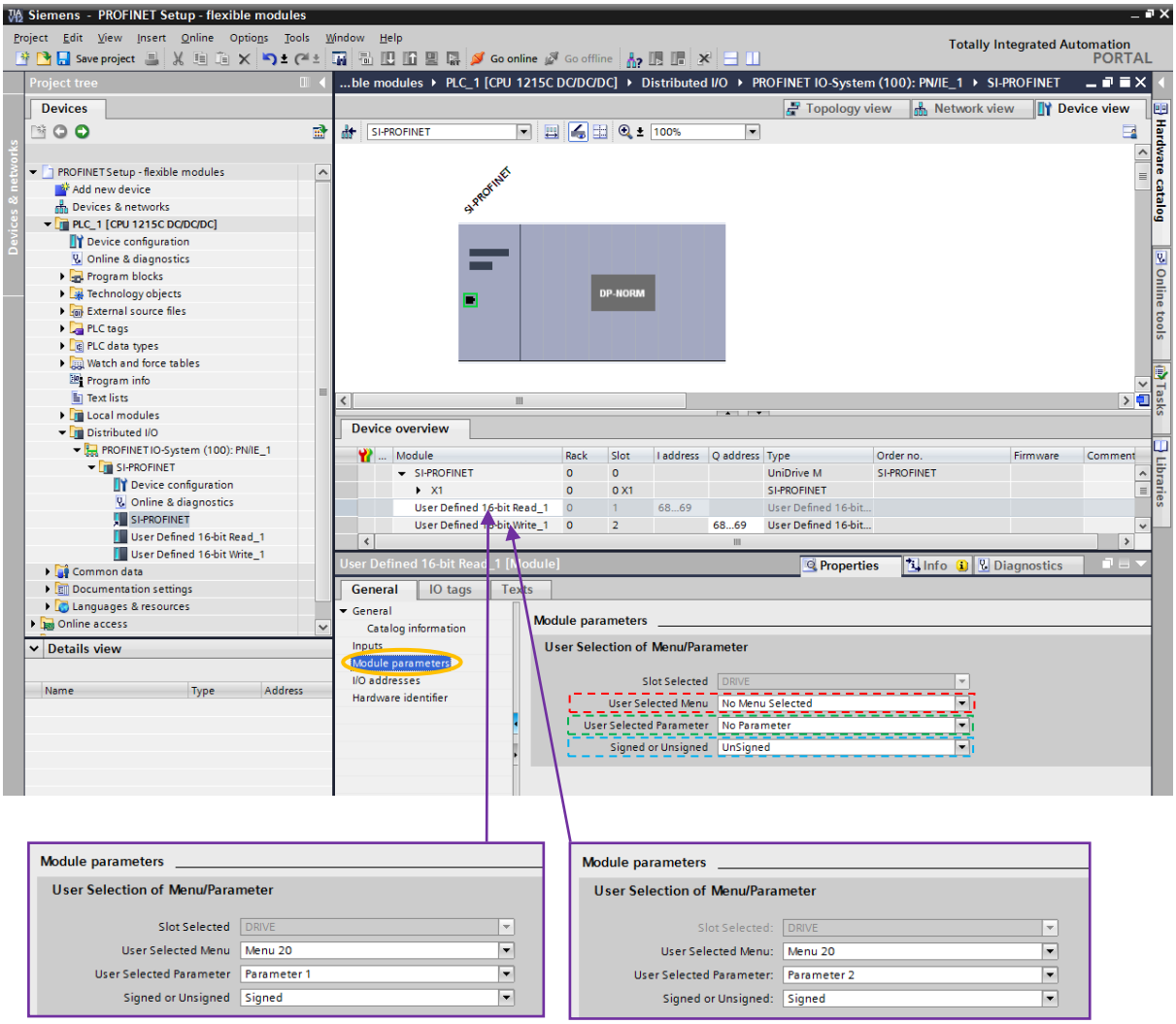
NOTE – supported in a future SI-PROFINET V2 firmware update

If the SI-PROFINET V2 module is used with compatible firmware and the relevant GSDML files are installed into Simatic Step 7 / TIA Portal, then the use of Flexible IO modules also enables the slot used to be defined, allowing option module parameters to be used over the PROFINET network (if supported by the option module) – see Step 4.2.

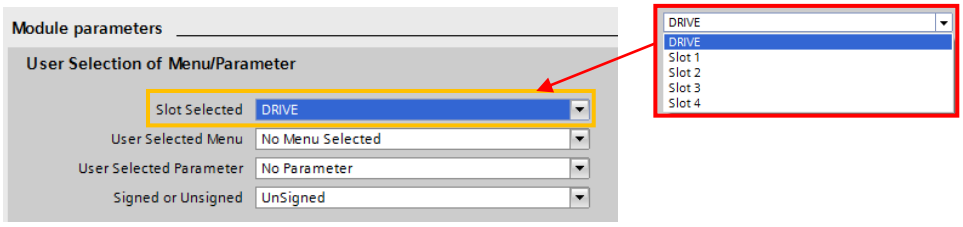
1. **Adding flexible IO modules to the field device overview** – go to the device view of the SI-PROFINET module (used previously in Step 3.10). From the **Hardware catalog** open Flexible Modules and add any Input/Output parameters required to the Device Overview as shown earlier in Step 3.10. In this case Input and Output 16-bit parameters were added.



2. **Setting the Menu/Parameter for the Flexible Module** - from the properties of the field device, click on the required module under Device overview, select **Module parameters** and within this menu select the menu, parameter and whether the parameter used should be signed or unsigned (if you select a flexible module size that is not the same size as the parameter used, you can choose to treat it as a signed or unsigned value as necessary). It is shown below which parameters are used for this part of the document (as you may note these are the same parameters selected from the standard list in Step 3.10, therefore do not actually need to use 'Flexible Modules', but are used for consistency in this document).



3. **Setting the slot used for the Flexible Module configuration (SI-PROFINET V2 with future firmware only)** – the updated SI-PROFINET V2 module enables compatible option module parameters to be used. All of the configuration carried out above in Step 4 is the same except that when using the SI-PROFINET V2 module with the latest GSDML files, the option to change the **Slot** used is accessible (as illustrated below) and can be set to the slot number of an installed option module.

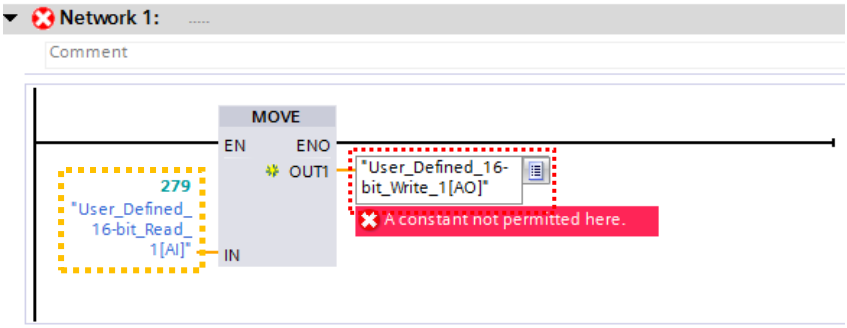


4. **Download the custom mapping hardware configuration** - finally download the updated hardware configurations to the PLC as shown previously in Step 3.11. Once the configuration has successfully downloaded to the PLC follow Step 3.12 to ensure that the setup is operating correctly.

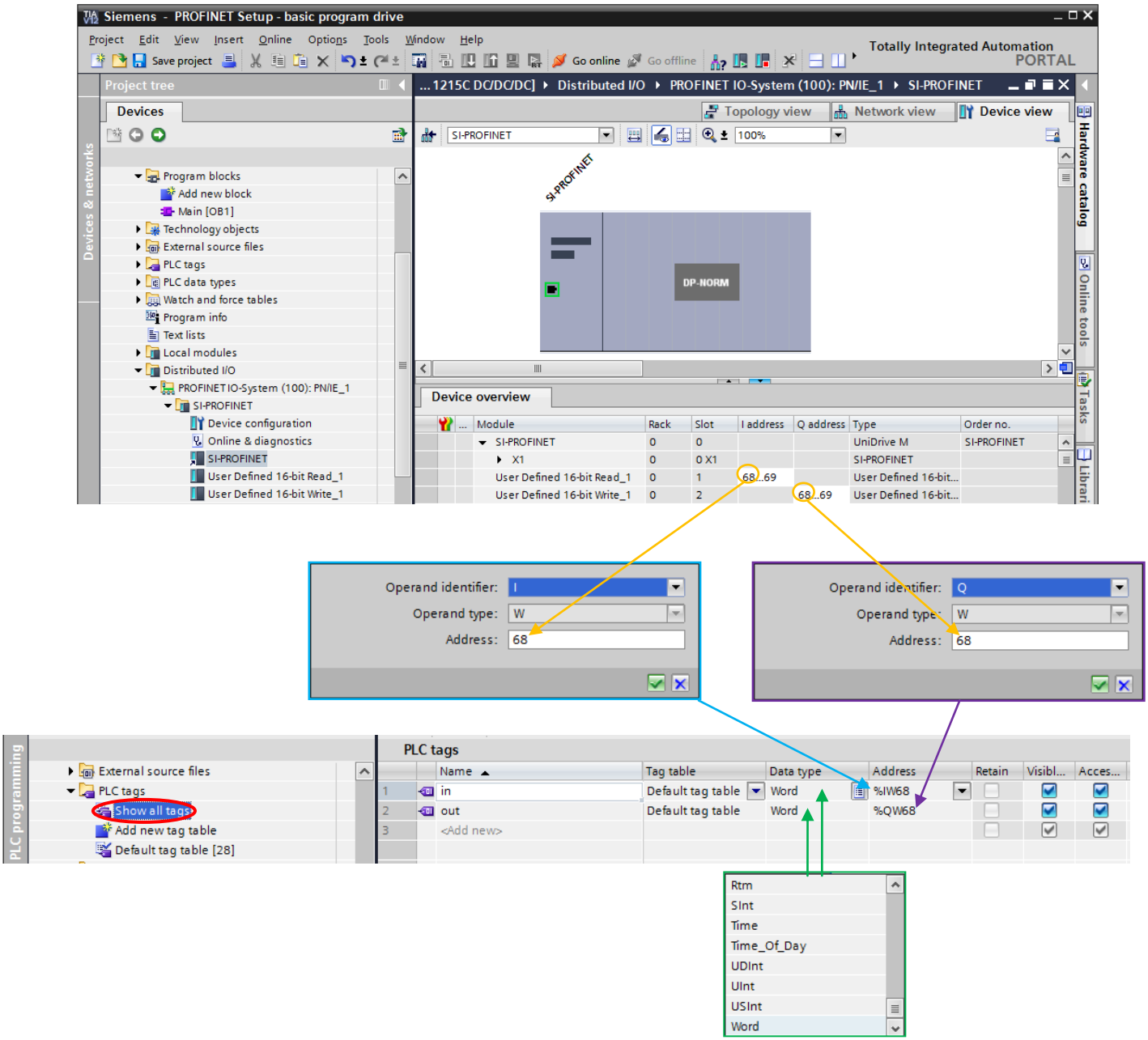
5: Example transfer test program (simple) – a ladder logic program is used to receive the output of a register (on board the drive [or an option module – SI-PROFINET V2 ONLY]) which is then copied back to a different register (again on board the drive [or an option module – SI-PROFINET V2 ONLY]), transferred over the configured PROFINET network. The source and destination used for the transfer can be any compatible parameter, using the standard list of modules (as used in Step 3.10) or using Flexible modules to select different Menus/Parameters as explained in Step 4.2 (Drive registers 20.01 and 20.02 are used in this example).

NOTE (only applies if using SI-PROFINET V2 module and SI-Applications Plus)
As the SI-Applications Plus module can only be installed in slot 3 of the M700-702, if it is used for this example, the SI-PROFINET V2 module needs to be moved to another available slot.

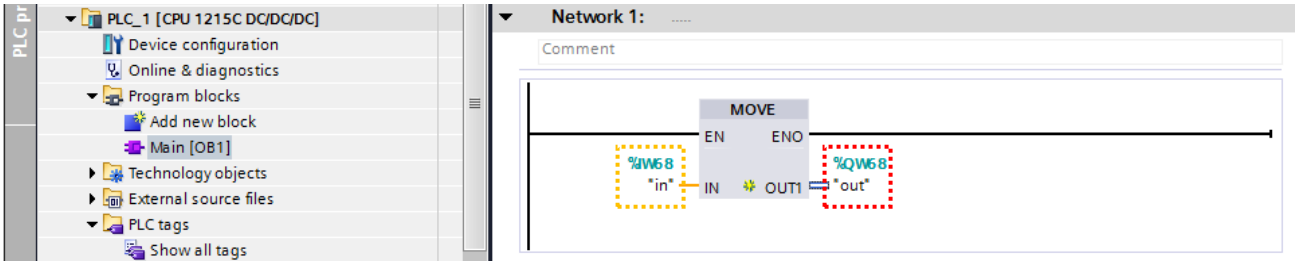
1. **Adding the required ladder block function** - this program simply requires a MOVE ladder block to be added to a network within the main cyclic block (this block is added by default when the project is created). The **input** to the block is then linked to the input parameter and the **output** of the block is linked to the output parameter, both configured earlier (see Step 3 or Step 4 depending upon the type of parameter you wish to use). However as is illustrated below the version of Simatic Step 7 / TIA Portal used (V12) prevents the output being set directly to the parameter mapping link, quoting 'A constant not permitted here.'.



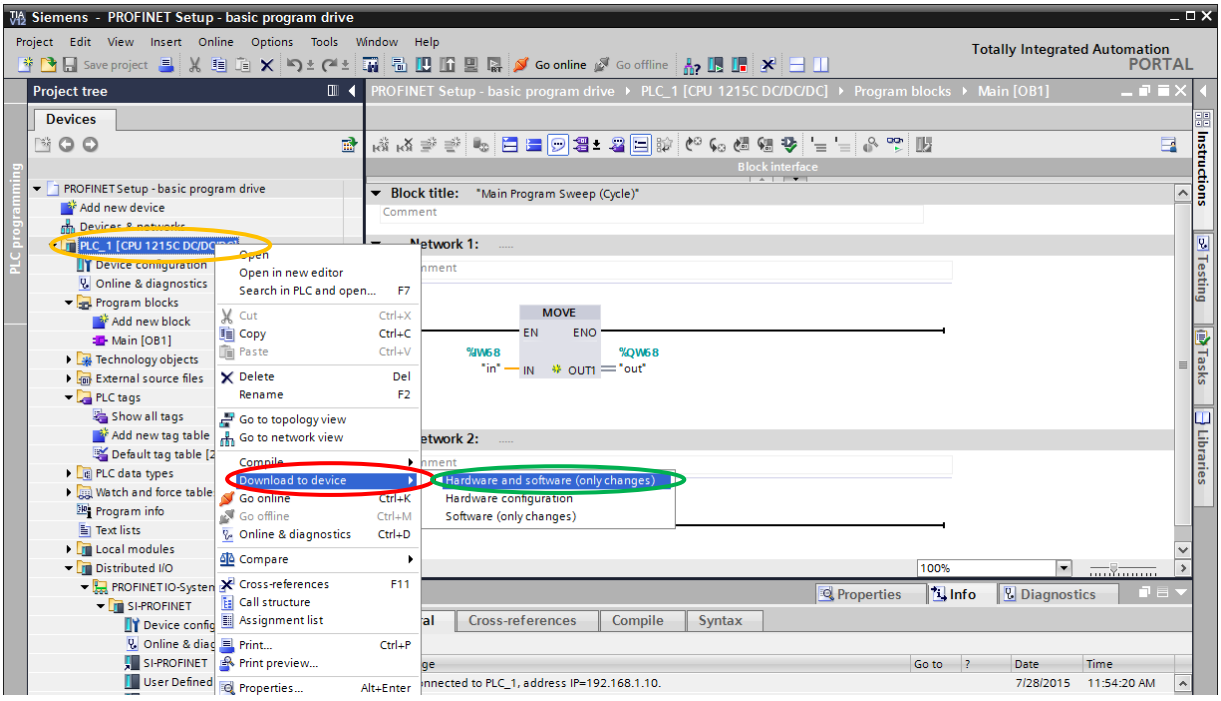
2. **Creating PLC tags linked to the parameter modules** - this issue is resolved by creating PLC tags to the parameter module(s) manually. As illustrated on the following page this involves navigating to the device overview page and noting the input (I) and output (Q) **address** linked to your modules. Then open **Show all tags** before creating the required tags with a related name. The **Data type** should be set to reflect the size of the parameter module used and the address of the tags should be set accordingly with the information gathered from any modules used. Ensure that the input and output tag use the correct operand identifier.



3. **Amending the ladder function to use the created tags** - the MOVE block should then be amended to use the newly created tags as both the input and output of the block, as shown below.



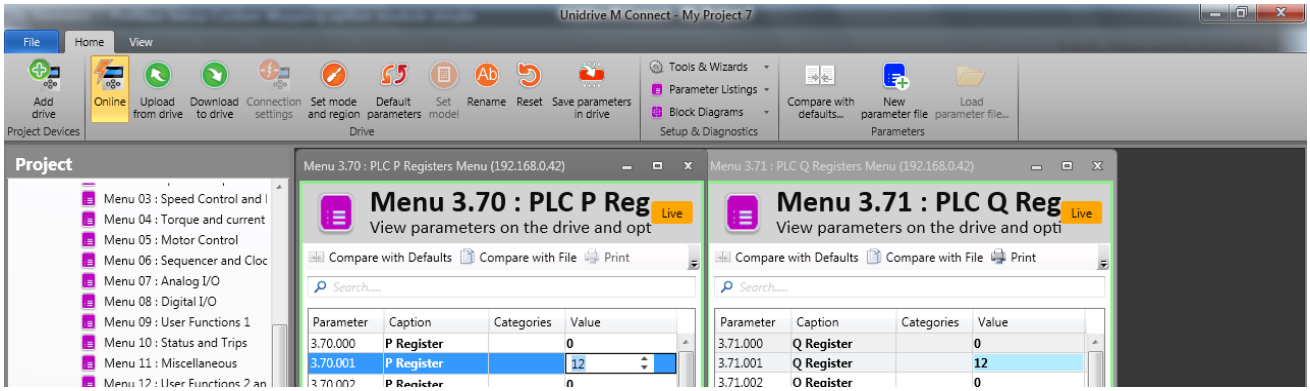
4. **Downloading the hardware and software setup to the PLC** - both the hardware configuration and software should then be downloaded to the PLC by right clicking on the **PLC**, going to **Download to device** and selecting **Hardware and software (only changes)**, as illustrated below. As in Step 3.11 you will need to navigate through the 'Load preview' and 'Load results' to complete downloading the program and start up the PLC.



5. **Testing the program** – the system can be tested by inputting a value into the parameter mapped to the input of the PLC and observing that it is copied to the parameter mapped to the output of the PLC.

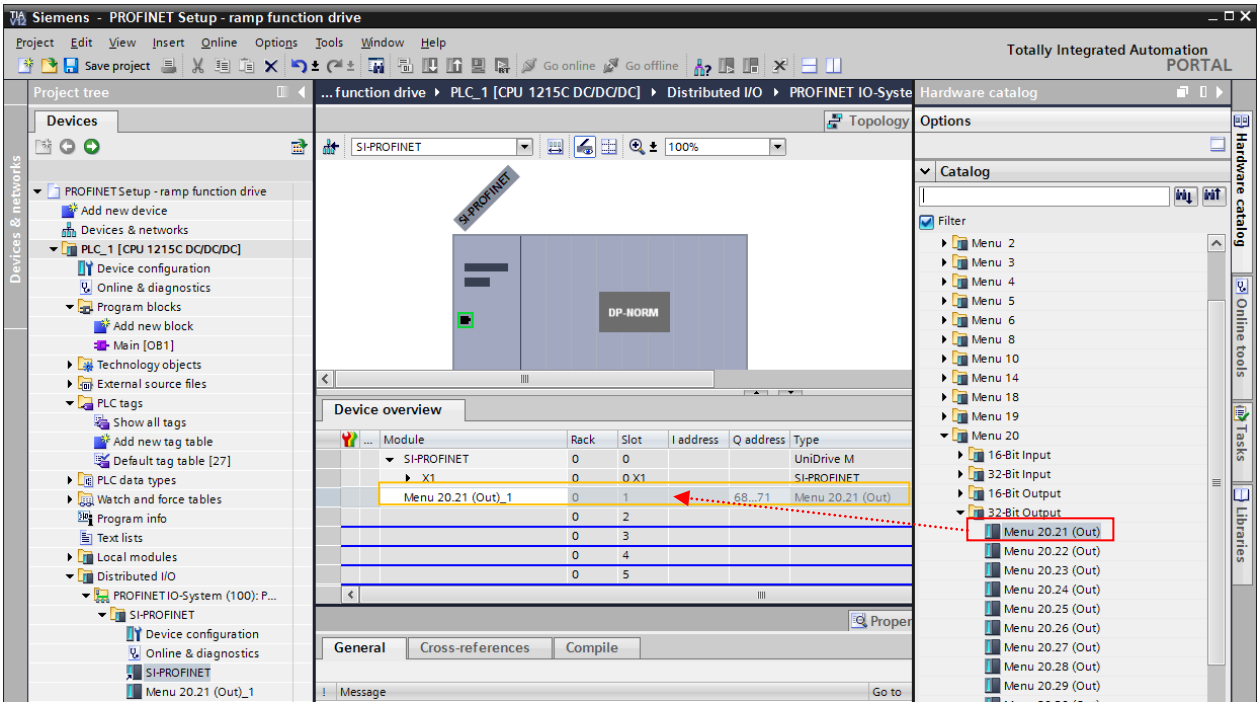
Drive results – by inputting a value into the configured input parameter (**20.001**) using the keypad (or Unidrive M Connect if desired) the same value should be shown in the configured output parameter (**20.002**), possibly after a very short delay. This shows that both the program and PLC hardware configuration have been configured correctly for using a drive register over PROFINET.

Option module results (SI-PROFINET V2 ONLY) – as above, by inputting a value into **3.70.001** and checking it appears in **3.71.001,** the operation of using SI-PROFINET V2 with an option module can be confirmed. However due to the SI-Applications Plus module being a legacy support system the register menus do not currently show on the keypad hence it is necessary to use Unidrive M Connect to see the parameters of the SI-Applications Plus module to view the program running, as shown:

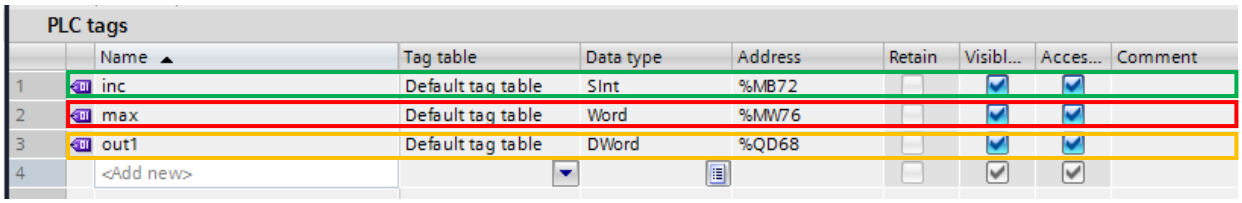


6: Example ramp test program (extension) - using the PLC to process and transfer a ramp function over PROFINET to a mapped drive parameter [or option module parameter if SI-PROFINET V2 used]. This program is written entirely using Structured Control Language (SCL), which can be copied and pasted into the relevant program blocks if required (ensure correct formatting of any copied text using screenshots provided).

1: Parameter modules used for this program – the **mapping** used in this program is shown below, and uses a Standard parameter module, to output to the 32-bit RW long-integer drive register **#20.22**. However, if required, this can simply be adjusted to output the ramp function to any parameter using the standard modules (following Step 3.10) or Flexible modules if necessary (following Step 4). NOTE: if the SI-PROFINET V2 module is used the ramp function can be outputted to an option module if required (following the setup in Step 4.3).



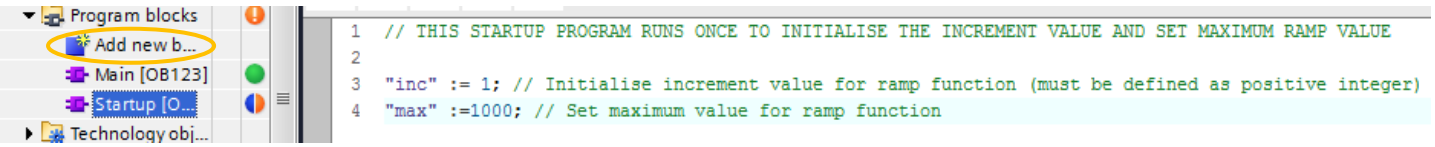
2: Tags needed for this program - as discussed previously in Step 5.2, it is necessary to manually add PLC tags to any mappings used in a program on the PLC to ensure they can be used as both inputs/outputs to blocks and functions. The PLC tag **out1** uses the memory location of the output mapping created above in Step 6.1, and is configured following the process shown in Step 5.2. It is also necessary to create any local variables required for the program, these are; a **max** variable (of Type 'Word' - for setting the limit on the highest ramp value) and **inc** variable (of type 'SInt' - for storing the current increment/decrement value for the ramp function).



3: Startup block – this block only runs once on start-up to initialise variables used in the ramp program. It can be added by selecting **Add new block** from the program tree.

```
// THIS STARTUP PROGRAM RUNS ONCE TO INITIALISE THE INCREMENT VALUE AND SET MAXIMUM RAMP VALUE

"inc" := 1; // Initialise increment value for ramp function (must be defined as positive integer)
"max" := 3000; // Set maximum value for ramp function (must  be defined as positive integer)
```

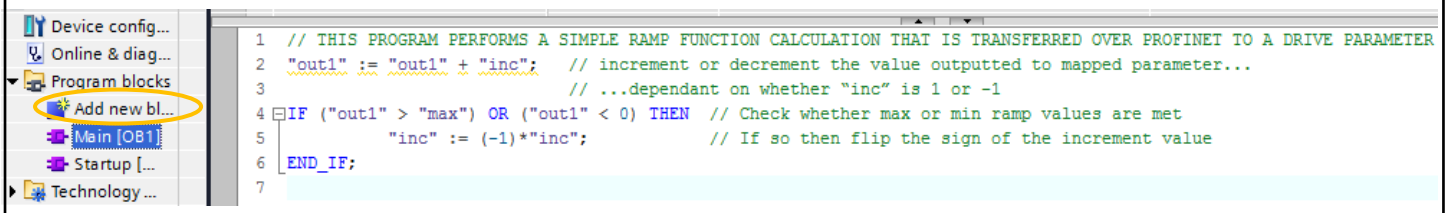


4: Main block – this block is executed cyclically and forms the main part of the ramp program. This block also needs to be added from **Add new block** to enable a cyclic block with structured control language to be used.

```
// THIS PROGRAM PERFORMS A SIMPLE RAMP FUNCTION CALCULATION THAT IS TRANSFERRED OVER PROFINET TO A DRIVE PARAMETER

"out1" := "out1" + "inc";   // increment or decrement the value outputted to mapped parameter...
                            // ...dependant on whether “inc” is 1 or -1

IF ("out1" > "max") OR ("out1" < 0) THEN   // Check whether max or min ramp values are met
      "inc" := (-1)*"inc";                 // If so then flip the sign of the increment value
END_IF;
```



5: Download and Testing – the program and updated hardware configuration can then be downloaded to the PLC following Step 5.4. The parameter used for the output mapping should then be observed on the keypad or in Unidrive M connect, where it should be seen that the values increase rapidly to your set maximum value before the sign of the increment value flips to bring the value back down zero, before the process repeats. Due to the fast CPU in the PLC and the slower update rate on the keypad display / Unidrive M connect, the values will often jump in large steps. Regardless if this output is viewed on the drive it shows that the PROFINET configuration, PLC program and mappings have been configured correctly.

Appendix A: Importing GSDML Files into Simatic Step 7 / TIA Portal V12

A GSDML (General Station Description Markup Language) file is required to describe the drive interface to a PROFINET controller or PLC. This is an XML file, the structure of which is specified by the PROFIBUS INTERNATIONAL organization (www.profibus.org).

The GSDML file is used in conjunction with the network configuration software to configure the SI-PROFINET RT module for cyclic data exchange. All relevant drive parameters are available as a 'module' to be added to the cyclic data 'slots'. A non-specific 'module' is also provided so that the user can allocate a parameter within the drive (or option module), that is not directly available as a specific 'module'. Some 'modules' require the slot position to be specified and the menu and parameter to be specified. These options will be available from a drop-down selection list within the 'Parameters' tab of the 'module' properties.

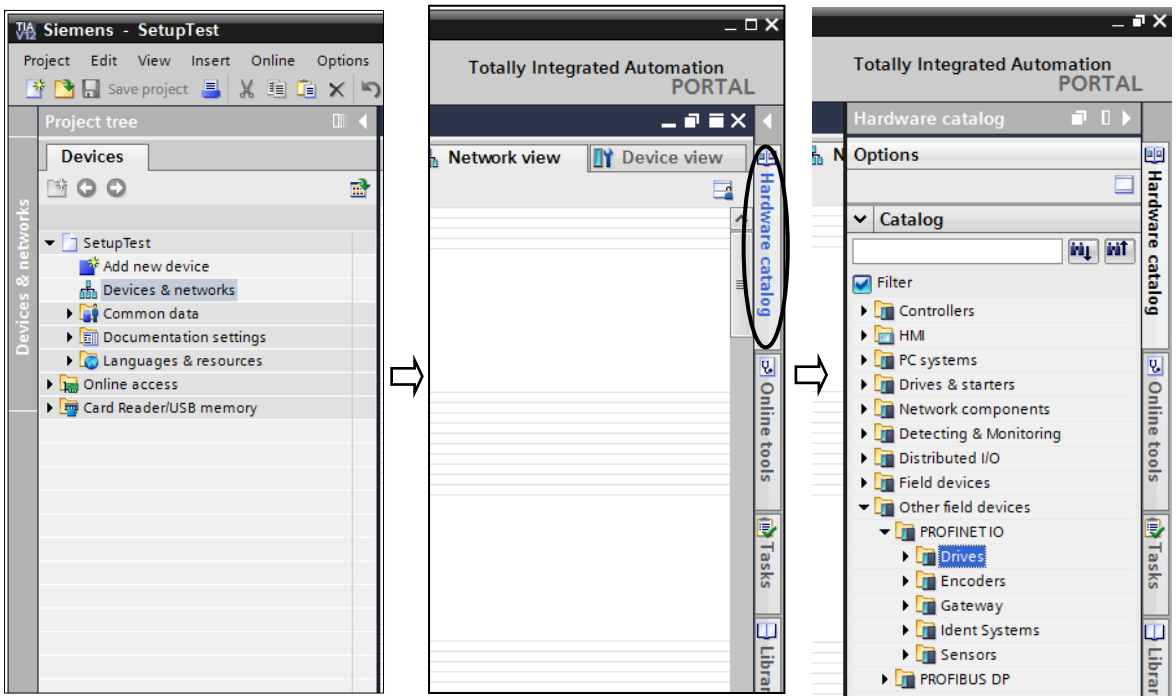
The GSDML files required (for either SI-PROFINET RT or SI-PROFINET V2) can be downloaded from the Control Techniques Support Suite website, providing you are registered, or alternatively, requested from your local Control Techniques Drive Centre or supplier.

NOTE
Ensure the correct version of GSDML file is used for both the module used (hardware and firmware version) and the version of Siemens STEP7 or TIA portal used (there is two versions of GSDML files available for each hardware setup, one to support up to Siemens STEP7 V5.5 SP1 and TIA Portal V11 and the other supports from Siemens STEP7 V5.5 SP2 and TIA Portal V12 upwards).

GSDML Files Installation

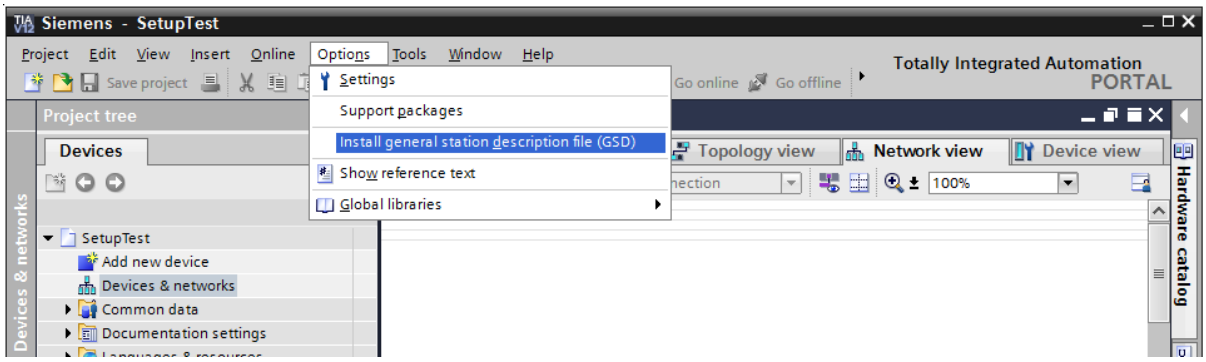
This procedure only needs to be performed once or after GSDML file updates.

1. Launch the "**TIA Portal V12**" software.
2. Create or open an existing project (see Step 3.1).
3. Enter *project view* (see Step 3.2).
4. Launch the Hardware catalog by double clicking on "**Devices & Networks**" in the project tree, then selecting the "**Hardware catalog**" from the right hand sidebar.

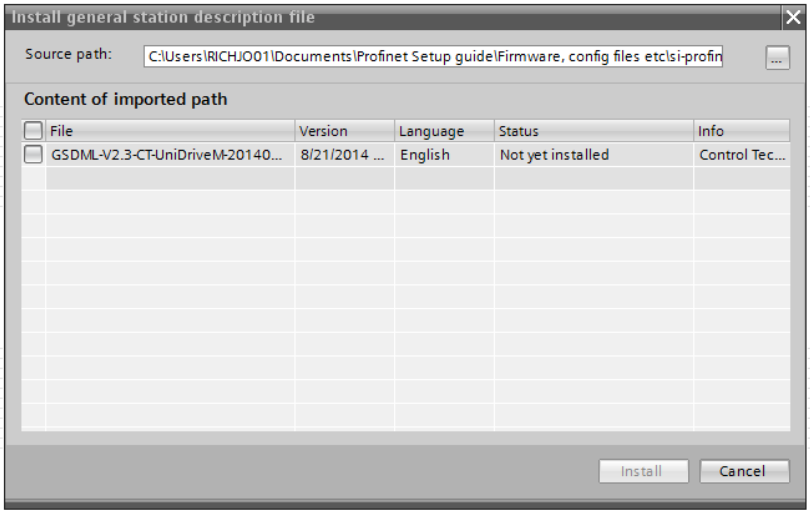


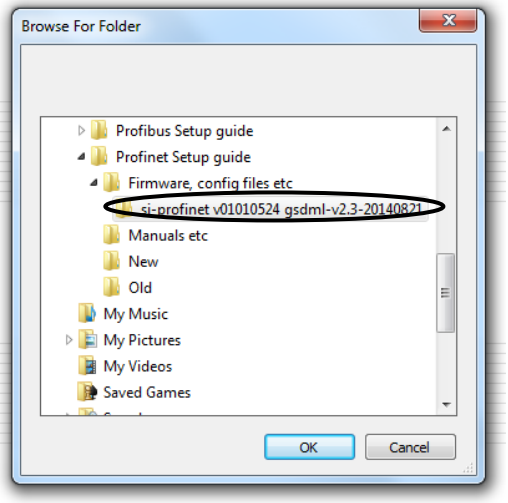
5. In this catalog it should be checked that the required hardware is not already present, to ensure that the manufacturer specific GSDML installation is even required.

6. Select **Options** from the menu followed by **Install general station description file (GSD)**.

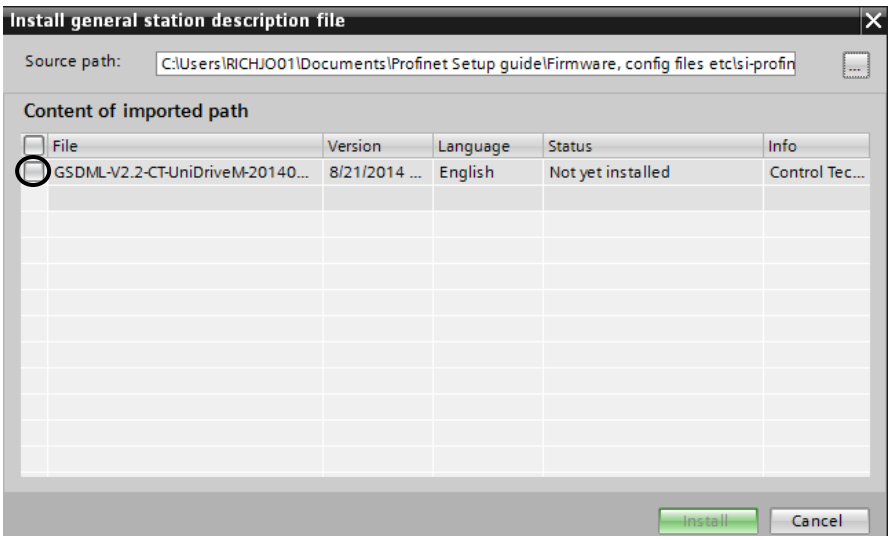


7. In the "**Install generic station description files**" dialog box, select the folder in which the GSDML files are stored. *Note: the GSD files are often provided in zipped folders, these must be properly extracted before they can be installed.*

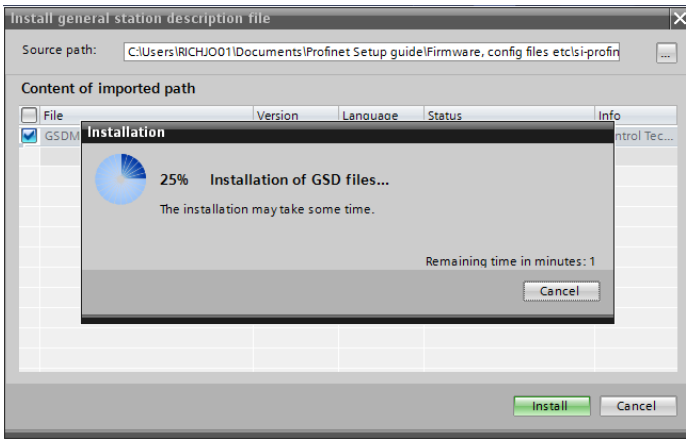


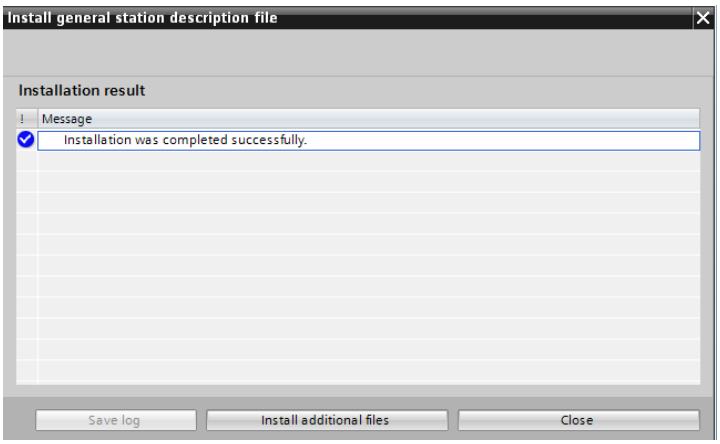


8. Choose one or more of the .xml files from the displayed list, before clicking the **Install** button.

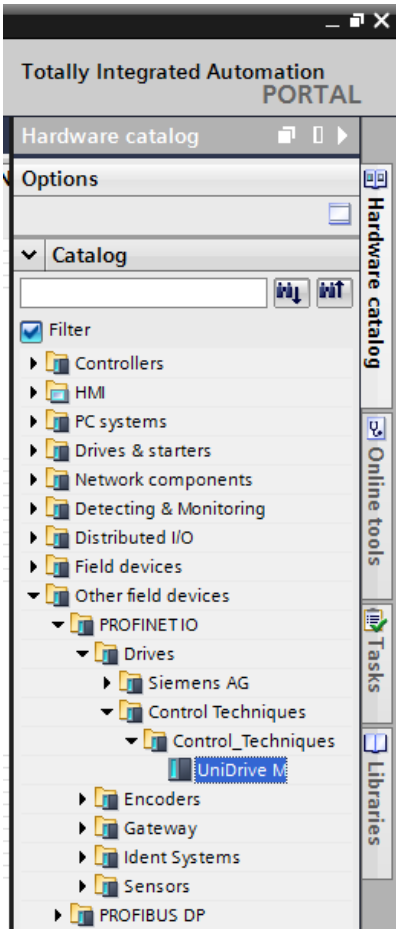


9. The files will then be installed and the Hardware catalog will be refreshed. Note: If any issues occurred in installation the log file can be saved using the **"Save log"** to track down where the errors have occurred.





10. You will find the new DP slave(s) installed by means of the GSDML file in a new folder in the hardware catalog, as illustrated below.



NOTE

Installation of a GSDML file cannot be undone from within STEP7 / TIA Portal. For use of a different release of GSDML files please refer to the built in information system to enable the revision of GSDML file used to be amended. Found under:

Contents > ***Editing devices and network*** > ***Configuring devices and networks*** > ***Creating Configurations***