

PROFINET® - Device

PLC500, PLC500ED, PLC500MC PLC410

Application Note



Application Note

PLC410, PLC500, PLC500ED, PLC500MC

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1 INTRODUCTION

This Application Note is intended to assist in the use of the **PROFINET**[®] protocol in WEG PLCs, models PLC410, PLC500, PLC500ED and PLC500MC. Throughout this document, the PLC500 is used as an example. However, the information presented is applicable to the other PLC models described above. It should be noted that the data provided may change slightly due to the continuous development and updating of products and tools.

In addition to providing an overview of the PROFINET protocol, this document presents the communication interfaces, installation recommendations, network topologies, and a guide to establish PROFINET communication using a PLC500 as a Device in **CODESYS**[®].

For more information regarding the hardware, interfaces and communication protocols, refer to the User Manual of the respective product, available on the [WEG](#) website. For a deeper and more detailed description of PROFINET network operation, access the online help at [CODESYS Online Help](#).

The text of this application note was translated from the original portuguese version using artificial intelligence, with technical review performed by WEG.



ATTENTION!

This application note is intended for professionals trained in industrial networks. The installation and configuration of the devices must be carried out according to the manufacturer's manual.



NOTE!

It is recommended to use version **CODESYS V3.5 SP19** or higher, as well as the latest version of the configuration libraries for PROFINET.

1.1 TERMS AND DEFINITIONS USED

CODESYS: Programming platform that allows developing, configuring and monitoring solutions for industrial automation and system integration.

DAP: Ethernet interface of the PROFINET Device used as an access point for communication (*Device Access Point*).

TCP: Connection-oriented protocol that performs flow control, error checking and retransmission of data packets between network devices (*Transmission Control Protocol*).

UDP: Connectionless protocol that sends data independently, without flow control, retransmission or order checking, enabling low-latency communication between devices (*User Datagram Protocol*).

LLDP: PROFINET network protocol that facilitates topology discovery, commissioning and replacement of failed devices on the network without the need for specific software.

MRP: Redundancy protocol used in PROFINET ring network topologies (*Media Redundancy Protocol*).

PNO: Industry association dedicated to the development, standardization and promotion of industrial communication and automation technologies, such as PROFIBUS and PROFINET (PROFIBUS Nutzerorganisation e.V.).

Jitter: Term used to describe variation in delay or instability in the data transmission time in a network or system.

MAC: Unique identifier assigned to network devices to ensure correct communication between them in a local network (*Media Access Control*).

RT: Real time.

IRT: Isochronous real time.

GSDML: XML file used in PROFINET networks to describe devices, including identification, configuration parameters, modules and diagnostic information.

INTRODUCTION

1.2 THE PROFINET PROTOCOL

PROFINET (**Process Field Network**) is an industrial communication protocol based on Ethernet, widely used in manufacturing and process automation. It is managed by PROFIBUS & PROFINET International and is considered the successor of PROFIBUS.

In a PROFINET network, Controllers manage communication and control of Devices. Devices, in turn, execute tasks according to the Controllers' instructions and also provide status and diagnostic data. Both Controllers and Devices can act as providers, the role of sending data, and as consumers, the role of receiving data.

PROFINET uses the TCP and UDP protocols for tasks that are not time-critical, such as configuration, parameterization and diagnostics. The RT communication mode is used for cyclic and deterministic communication, essential for applications that require real-time data transfer. The IRT mode is an extension of RT mode that enables time synchronization of devices for applications that require high precision, such as softmotion motion control.

1.3 REFERENCE DOCUMENTS

It is recommended to consult the documents related to the PROFINET network presented in [Table 1.1](#).

Table 1.1: Reference documents.

Document	Version	Source
PROFINET System Description Technology and Application	11/2018	PNO
PROFINET Design Guideline	1.59	PNO
PROFINET Assembling Guideline	2.12	PNO
PROFINET Commissioning	1.53	PNO

1.4 IMPORTANT NOTICE ABOUT CYBERSECURITY AND COMMUNICATIONS

WEG PLCs, models PLC410, PLC500, PLC500ED and PLC500MC, have the capability to connect and exchange information through communication networks and protocols. Although they have been designed and tested to ensure proper operation with other automation systems using the protocols mentioned in this manual, it is essential that the customer understands the responsibilities associated with information and cybersecurity when using this equipment.

Therefore, it is entirely the customer's responsibility to adopt defense-in-depth strategies and implement policies and measures to ensure the security of the system as a whole, including communications sent and received by the equipment. These measures include, but are not limited to, installing firewalls, antivirus and antimalware programs, data encryption, authentication control, and physical user access control.

WEG and its affiliates are not responsible for damage or losses resulting from cybersecurity breaches, including, but not limited to, unauthorized access, intrusion, leakage and/or theft of data or information, denial of service, or any other form of security breach. The use of this product under conditions for which it was not specifically designed is not recommended and may result in damage to the product, the network and the automation system.

In this sense, it is essential that the customer understands that external interventions through third-party programs, such as sniffers or programs with similar actions, have the potential to cause interruptions or restrictions in the equipment's functionality.

1.5 TRADEMARKS

PROFINET® is a registered trademark of PROFIBUS Nutzerorganisation e.V.

All other trademarks are the property of their respective owners.

2 ETHERNET INTERFACE

PROFINET communication is performed through the Ethernet interfaces, indicated in [Figure 2.1](#) for the PLC500 and PLC410. Initially, each Ethernet interface has the IP address indicated in [Table 2.1](#), which can be changed through the application in the CODESYS software.

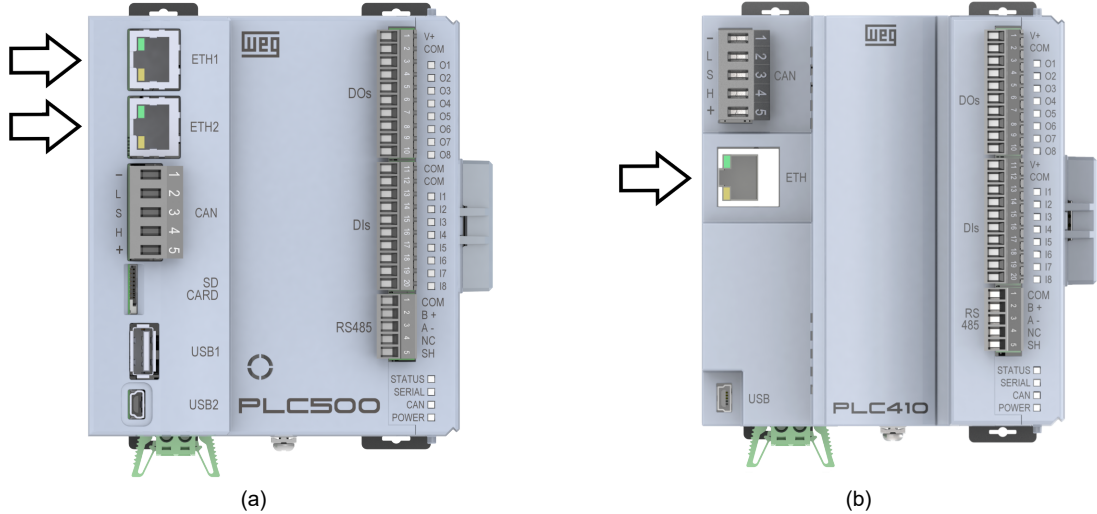


Figure 2.1: Indication of the Ethernet interfaces of the PLCs. (a) PLC500 and (b) PLC410.

Table 2.1: Default addresses for the Ethernet interfaces.

PLC410	PLC500	Default IP address
ETH	ETH1	192.168.1.10
-	ETH2	192.168.2.10

The pinout of the connector follows the Ethernet 1000BASE-TX standard. The PLC410 Ethernet interface supports speeds up to 100 Mbps, while the PLC500 Ethernet interfaces reach up to 1000 Mbps.

The interface is compatible with several communication protocols, including PROFINET. For instructions on how to configure these networks, refer to the product Application Notes available on the [WEG](#) website.

2.1 INDICATION LEDS

The Ethernet ports have LEDs to indicate speed and network link/activity, as indicated in [Figure 2.2](#). These LEDs have the behavior described in [Table 2.2](#) and [Table 2.3](#).

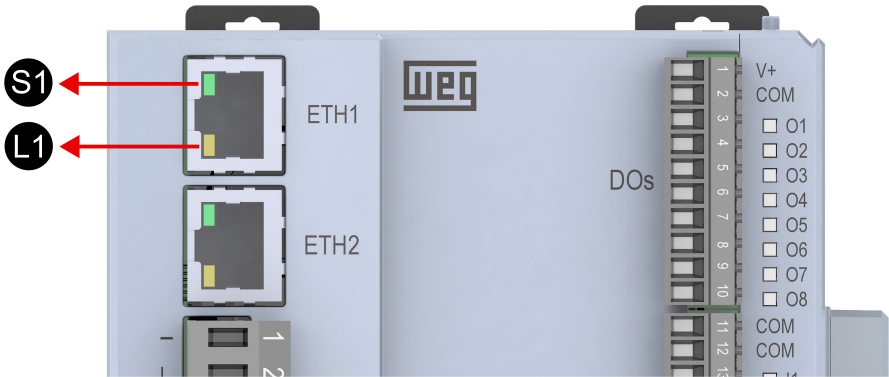


Figure 2.2: Speed and link/activity LEDs of the PLC500 Ethernet interface.

Table 2.2: S1 LED - Speed.

State	Description
Off	Equipment powered off or 10 Mbps link
Green, steady	100 Mbps link

Table 2.3: L1 LED - Link/Activity.

State	Description
Off	Equipment powered off or no link
Amber, steady	With link and no network activity
Amber, blinking	With link and with network activity

2.2 PROFINET NETWORK INSTALLATION

The PROFINET network, like many industrial communication networks, because it is often applied in harsh environments with high exposure to electromagnetic interference, requires certain precautions to ensure a low communication error rate during its operation.



ATTENTION!

The use of passive components (cables, connectors) certified for industrial applications is recommended.

The recommended characteristics for the cable used in the installation are:

- Standard Ethernet cable, 100Base-TX, CAT 6 or higher.
- Shielded cable.
- Maximum length of 100 m for connections between equipment.

Switches can be used in PROFINET networks together with other TCP/UDP network protocols, as demonstrated in [Figure 2.3](#). Switches that are compatible with the LLDP protocol offer more advanced PROFINET diagnostics, and also enable integration with devices that do not support MRP.



NOTE!

To ensure reliable network management and advanced diagnostic capabilities, it is recommended to use devices and switches compatible with PROFINET.

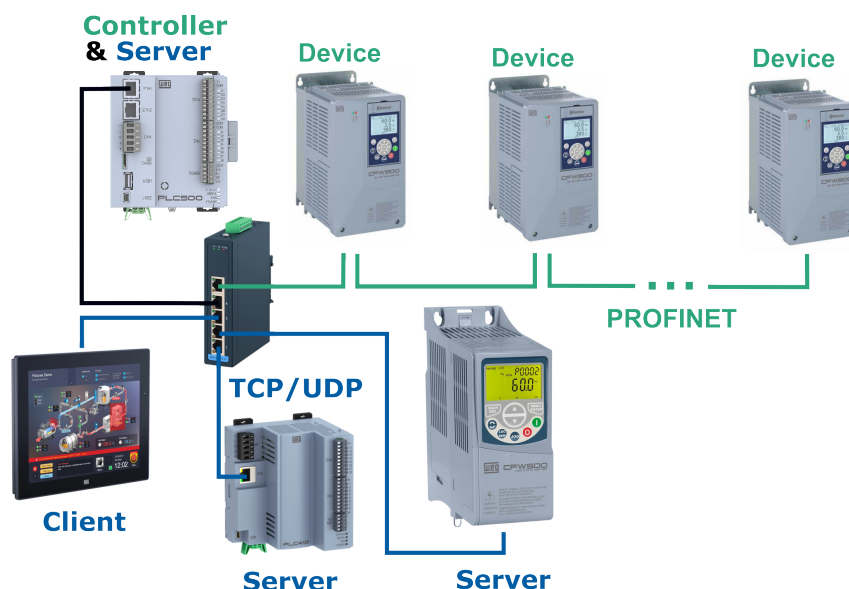


Figure 2.3: PROFINET network topology with other TCP/UDP protocols on Ethernet port 1 of the PLC500 using a switch.



ATTENTION!

The PROFINET and EtherCAT protocols do not work using the same Ethernet port. In the PLC500, PLC500MC and PLC500ED models it is necessary for each protocol to use a separate interface, as demonstrated in [Figure 2.4](#).

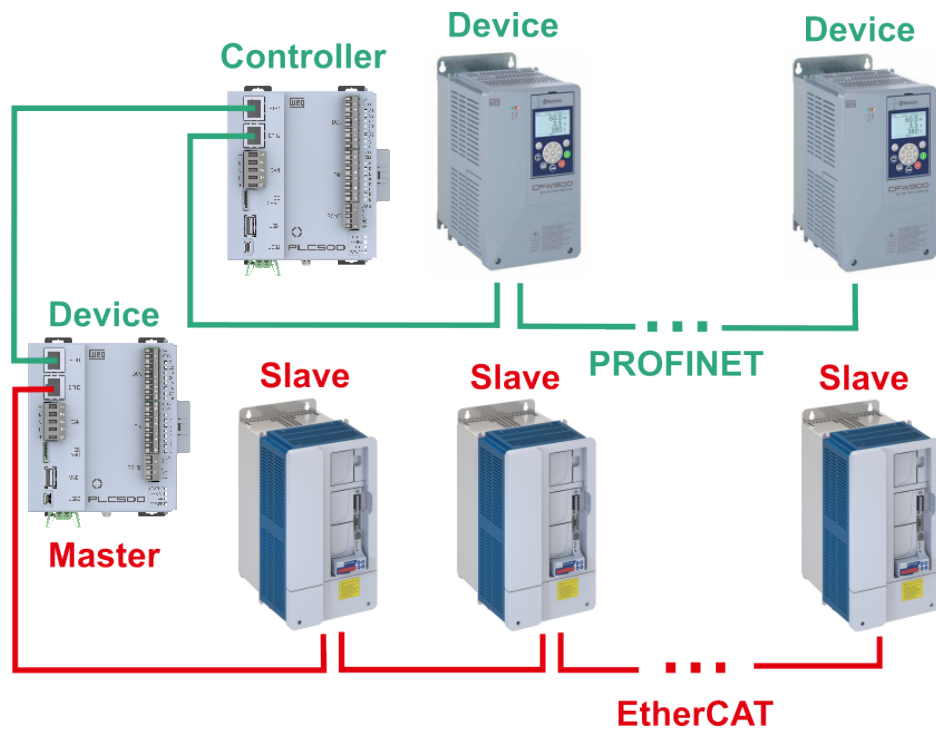


Figure 2.4: PROFINET and EtherCAT network topology using distinct Ethernet interfaces.

A proper connection to the grounding system is essential to minimize electromagnetic interference problems in industrial environments. It is important to avoid connecting the cable at multiple grounding points, especially in locations where there are potential differences between ground points. In addition, it is recommended that signal and communication cables be installed in dedicated routes, keeping distance from power cables.



DANGER!

Improper grounding installations may cause failures in the PROFINET network and represent a risk of fatal electric shock.

2.3 PROFINET NETWORK TOPOLOGIES

Network topologies in a PROFINET system may vary according to project needs and installation architecture. The protocol has network scanning functionality and is able to automatically detect the installed topology. Noteworthy are the star topology, in which a central switch connects all devices, as illustrated in [Figure 2.5](#); the daisy-chain topology, which enables sequential connection of devices, as shown in [Figure 2.6](#); and the combination of both topologies, as exemplified in [Figure 2.7](#).

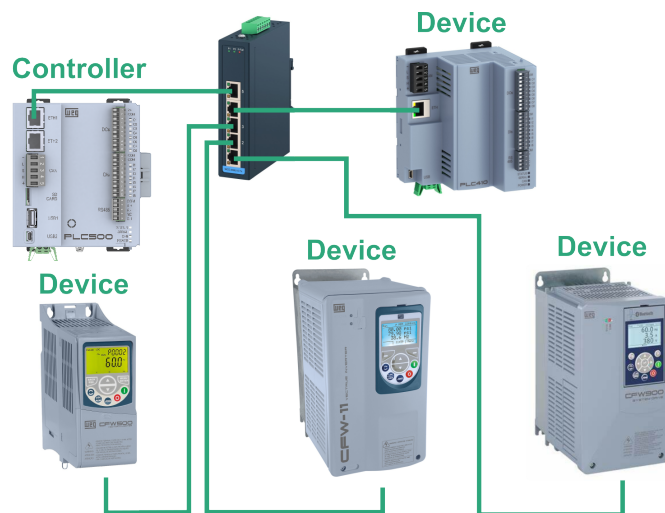


Figure 2.5: PROFINET star topology.



Figure 2.6: PROFINET daisy-chain topology (daisy-chain).

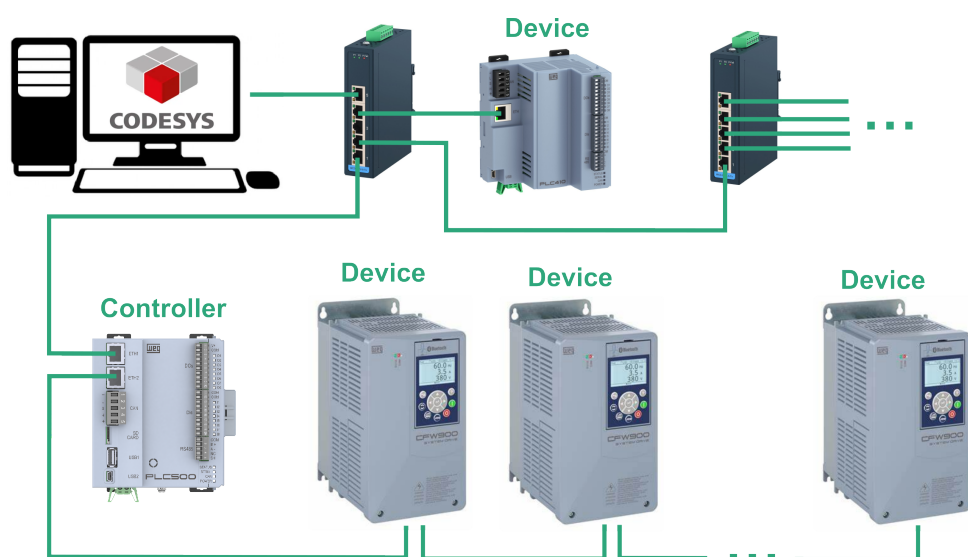


Figure 2.7: Mixed PROFINET topology.

3 CODESYS PROJECT

In this chapter, the steps on how to create a project and add the PROFINET Device are presented.

3.1 PROJECT CREATION

In the CODESYS software, create a new project using the Standard project template, choose the directory and the application name. Then, select the PLC500 device and the desired programming language, as shown in Figure 3.1.

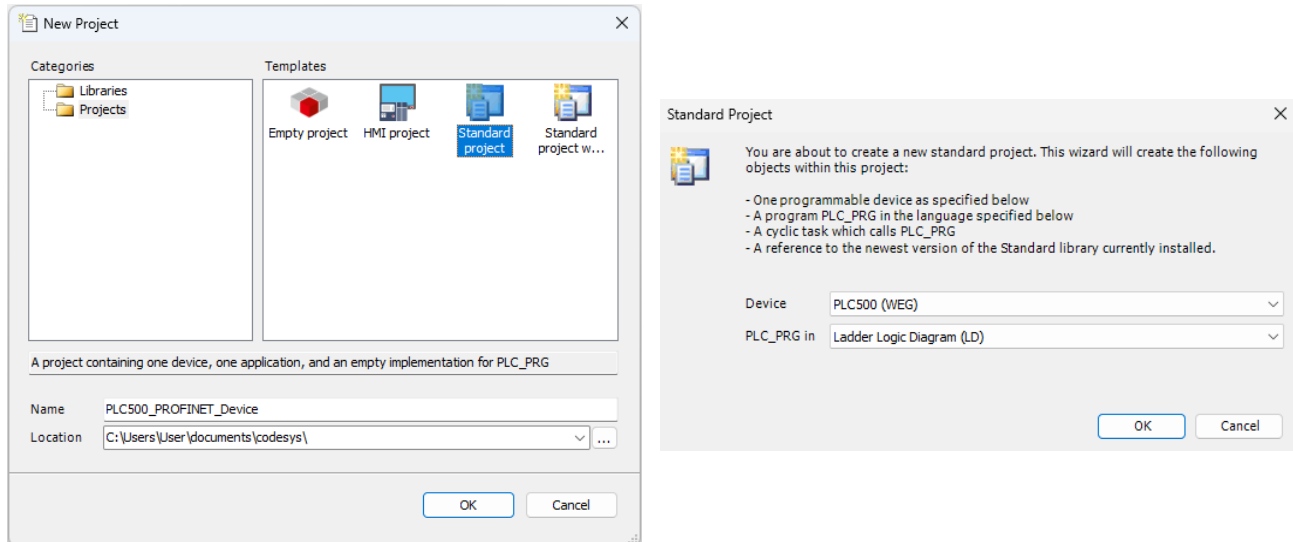


Figure 3.1: Project configuration in CODESYS.



NOTE!

If the PLC410, PLC500, PLC500ED or PLC500MC device is not yet available among the options, you must download and install the **WEG package** for CODESYS. Check the **Product Manual** available on the [WEG](#) website to find the necessary steps and settings.

When creating an application for the PLC500 Device, the standard network interfaces will be automatically pre-configured, as indicated in Figure 3.2.

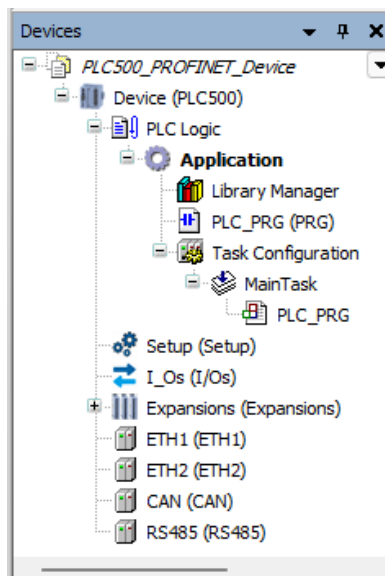


Figure 3.2: PLC500 initial project tree.

3.2 ADDING THE PROFINET DEVICE

Right-click on the Ethernet interface chosen for communication and select **Add Device**. A new window will open. Expand the **Fieldbuses**, **PROFINET IO** and **PROFINET IO Device** icons using the + symbol until the **CODESYS PROFINET Device** appears, as shown in Figure 3.3. With the device selected, click **Add Device**.

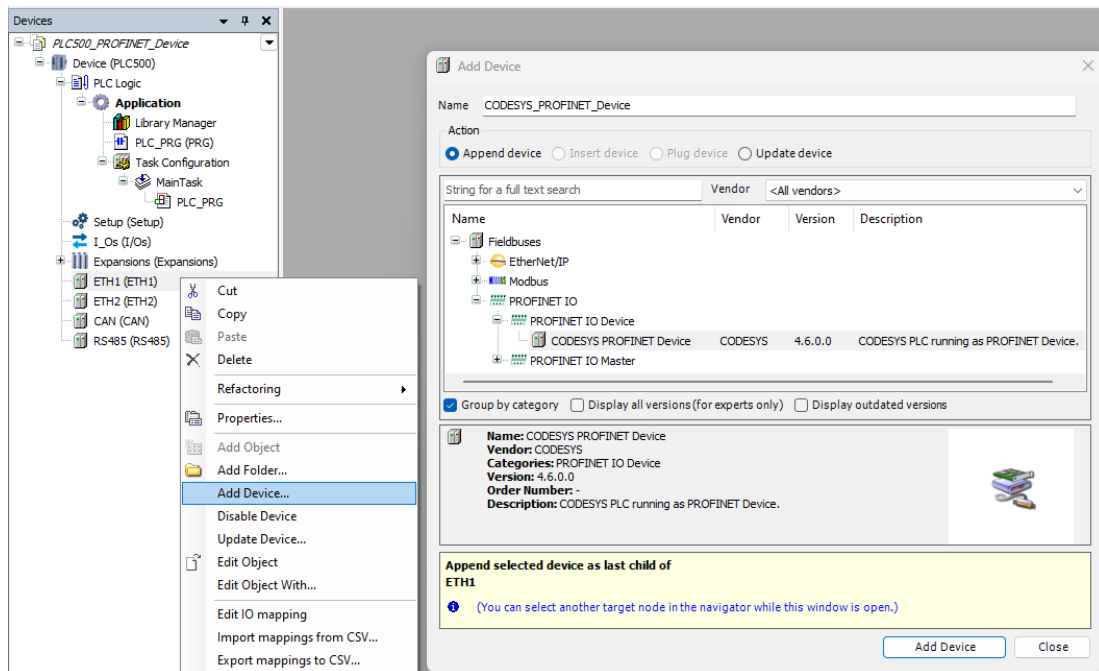


Figure 3.3: Adding the PROFINET Device.

The **CODESYS PROFINET Device** will be incorporated into the project tree and the **Profinet_CommunicationTask** and **Profinet_IOTask** tasks will be automatically added, as illustrated in Figure 3.4.

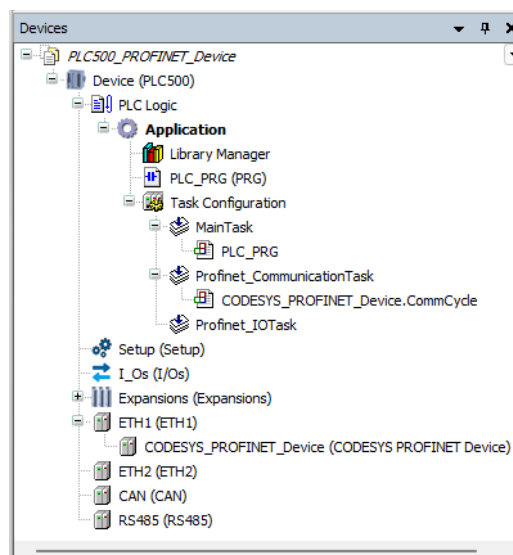


Figure 3.4: CODESYS PROFINET Device added to the project tree.



NOTE!

Profinet_IOTask is the task used for cyclic communication of PROFINET RT packets. **Profinet_CommunicationTask** is the task used for acyclic communication in the PROFINET network, having low priority because it is not critical.

3.3 ADDING SUBMODULES

The PLC500 configured as a PROFINET Device can be customized to provide I/O data to a PROFINET Controller. Depending on the application, different submodules can be included to map digital or analog inputs and outputs of the PLC or its accessories. As an example, I/O data for the PLC500 digital inputs and outputs will be configured.



NOTE! According to the application needs, more modules can be added for data exchange between the PLC500 and a PROFINET Controller. For WEG PLCs with CODESYS, the maximum number of supported data is 1440 bytes for output variables and 1440 bytes for input variables.

Right-click on the **CODESYS PROFINET Device** and select **Add Device**. A new window will open. Expand the **Fieldbuses**, **PROFINET IO** and **PROFINET IO Module** icons using the **+** symbol until the **InOut 8bit** module appears, as shown in [Figure 3.5](#). Select the module and click **Add Device**. The module will be added below the **CODESYS PROFINET Device**.

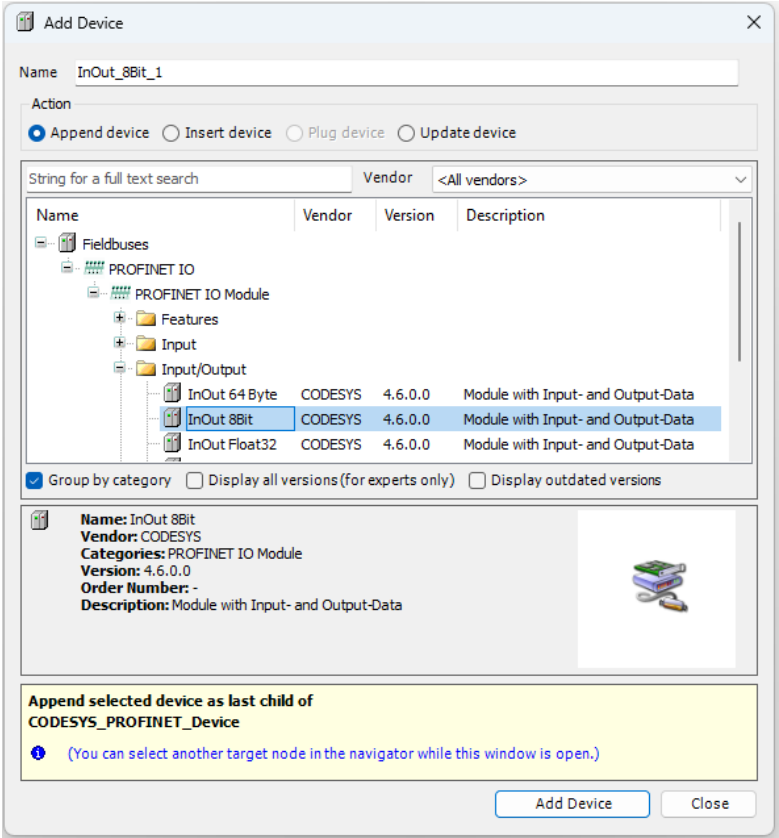


Figure 3.5: Adding a submodule to the PROFINET Device.

4 PROFINET NETWORK CONFIGURATION

In this chapter, the steps on how to configure a PROFINET network with the PLC500 acting as a Device in CODESYS are presented.

4.1 ETHERNET INTERFACE CONFIGURATION

The configuration of the PLC500 Ethernet interfaces can be done through the **Setup** tab in CODESYS, as indicated in [Figure 4.1](#).

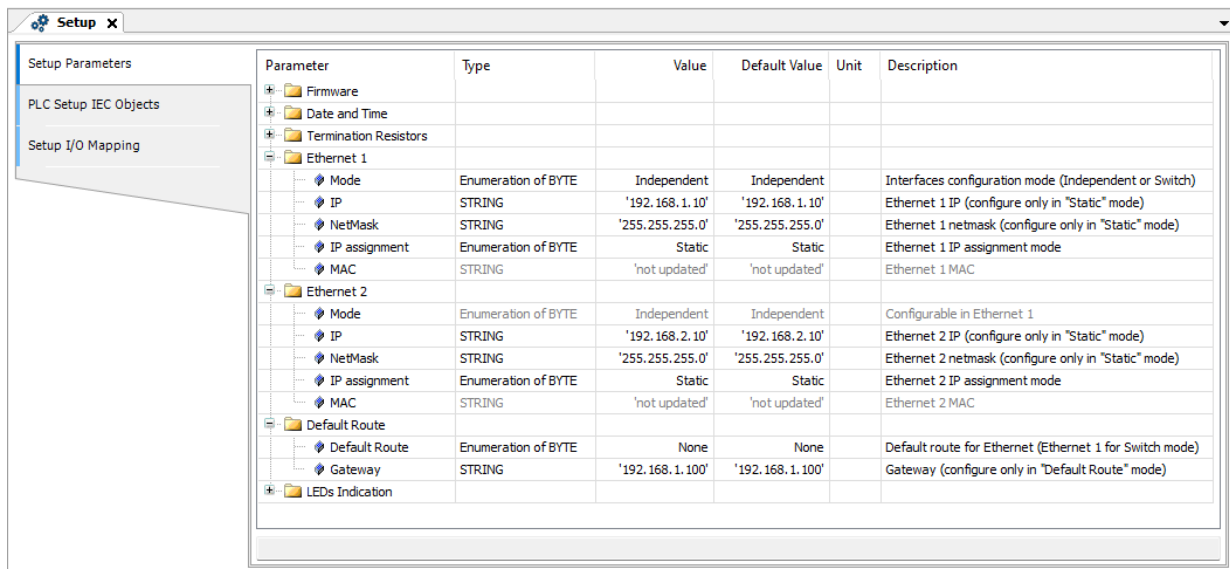


Figure 4.1: Network interface configuration for the PLC500.

To obtain the IP address of an interface automatically on the network, change the **IP assignment** field to **DHCP**. When selecting this option, the interface will request an IP address from a DHCP server available on the network, which will assign a valid IP and other settings, such as subnet mask and default gateway.



ATTENTION!

The Ethernet ports, when configured in **Independent** mode, must operate on **distinct networks**. Do not use the **192.168.234.XXX** address range, as it is reserved for access to the PLC500 through the USB2 interface. **Incorrectly configuring these ports may result in loss of access to the PLC**, making it unreachable via Ethernet until the settings are corrected.

4.2 SWITCH MODE

The PLC500 can operate in **Switch** mode, in which a new network interface called **br1** is created to virtually interconnect Ethernet 1 and Ethernet 2 interfaces, allowing both to share the same IP address configured on Ethernet 1. The user can change the operating mode of the interfaces from **Independent** to **Switch** in the **Mode** parameter of Ethernet interface 1, as demonstrated in [Figure 4.2](#).



ATTENTION!

If the PLC500, PLC500MC or PLC500ED are configured in **Switch** mode, PROFINET communication is established only through the ETH1 interface. ETH2 can be used to expand the PROFINET network in a daisy-chain topology (*daisy-chain*) or for other TCP/UDP protocols.

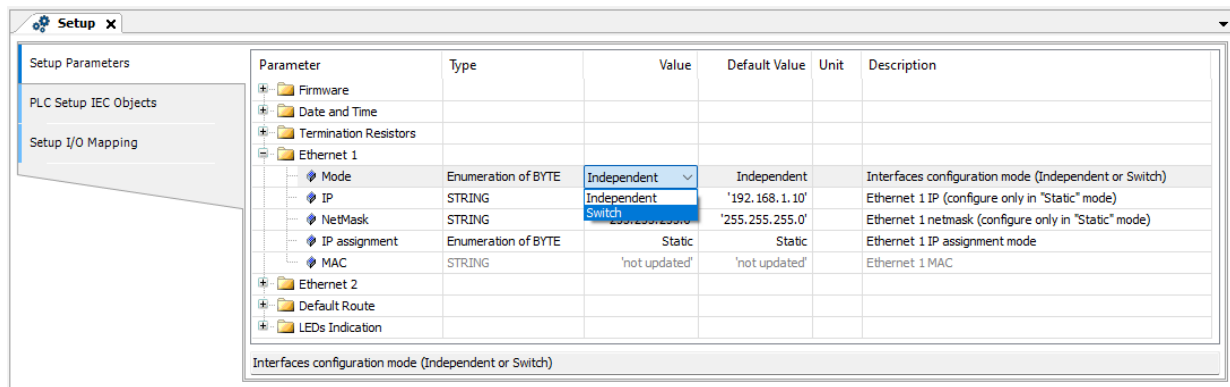


Figure 4.2: Configuration of the switch mode for the Ethernet interfaces.



NOTE!

When changing to **Switch** operating mode, it is recommended to restart the product, as this action is necessary to ensure the proper operation of some communication protocols.

4.3 NETWORK CONFIGURATION

Every device on an Ethernet network requires an IP address and a subnet mask. The network must be configured with valid addresses for each PROFINET Controller and PROFINET Device, ensuring that the addresses are unique and within the allowed IPv4 address range. Otherwise, connectivity problems may occur. By double-clicking the Ethernet interface that has the PROFINET Device, a window opens, as shown in Figure 4.3. The **Browse** box is used to select the Ethernet port. Below this box, the device IP, network mask and gateway can be changed.



NOTE!

To use the **Browse** box, the PLC500 must be correctly connected and identified on the computer. Otherwise, a network communication error will be generated.

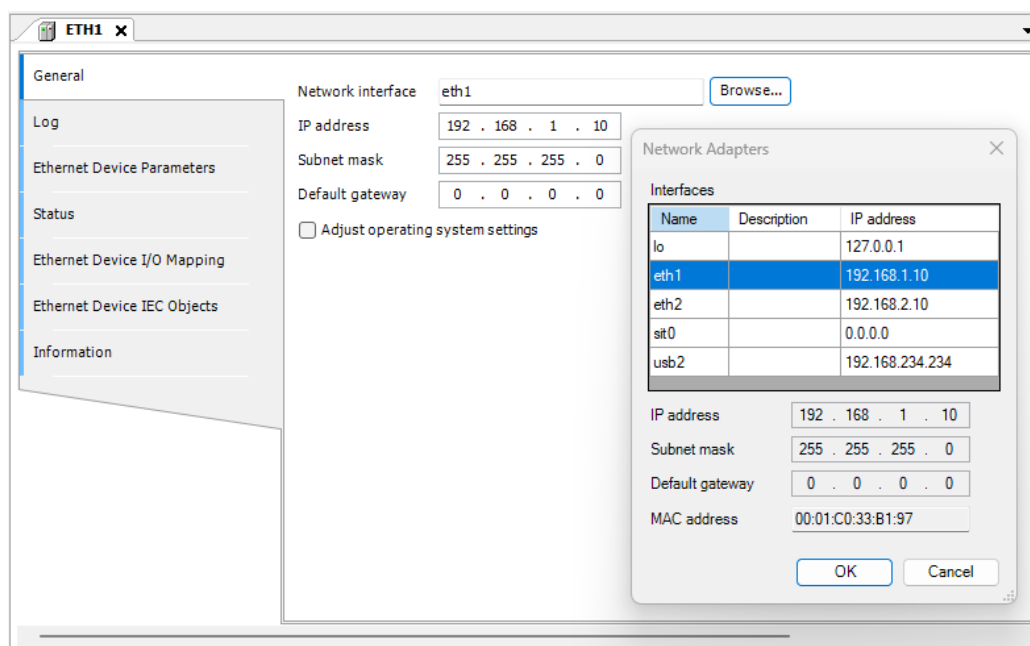


Figure 4.3: Network configuration for the PLC500 using ETH1 in independent mode.



NOTE!

In the **Network interface** field, enter the name of the interface that will be used by the PLC500 for PROFINET communication. If this field remains empty, communication will not function properly.

If the PLC500 is configured in **Switch** mode, the **br1** interface must be used for PROFINET communication, as demonstrated in [Figure 4.4](#). If the interface is not yet configured in this mode, it will not appear in the **Browse** option, and it must be typed manually. Make sure the IP address is the same as configured on Ethernet port 1 in the PLC500 **Setup**.



NOTE!

The **br1** interface appears after downloading the program to the PLC500 configured in **Switch** mode. Again, it is important to ensure that the product is restarted when this is the first time the Ethernet interface is being configured in this mode.

Network interface	br1	Browse...
IP address	192 . 168 . 1 . 11	
Subnet mask	255 . 255 . 255 . 0	
Default gateway	0 . 0 . 0 . 0	

☐ Adjust operating system settings

Figure 4.4: Network configuration for the PLC500 in switch mode.

4.4 PROFINET DEVICE CONFIGURATION

Double-click on the **CODESYS PROFINET Device** to open its general configuration window. Enable the **Use project parameters** option, so the PLC500 will configure its own IP and **Station name** according to what is entered in its field.

The IP and **Station name** must be unique on a PROFINET network for communication to be established. The **Substitute values** options configure the behavior of the output variables when the PS status bit is **Bad**; in **Inactive** the outputs are forced to zero, and in **Last value** the outputs keep their last state from when the PS status bit was **Good**.



ATTENTION!

When the PLC500 as a PROFINET Device is configured with the **Last value** option in **Substitute values**, the last value of the output variables is maintained even if the connection with the PROFINET Controller is interrupted. If the PLC500 goes to STOP, what was configured as an option in **Device** → **PLC Settings** → **Behavior for outputs in stop** will be followed.

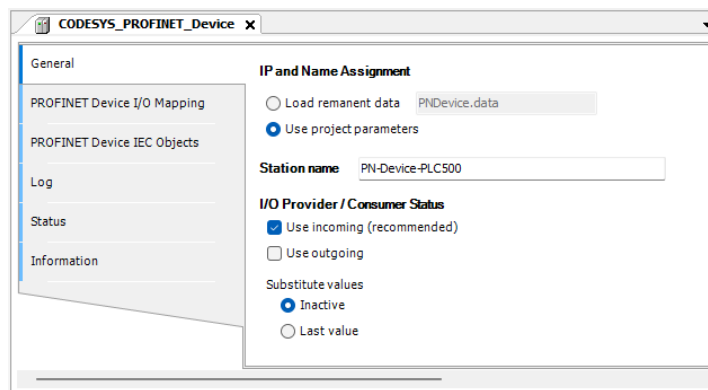


Figure 4.5: PROFINET Device general settings.

A PROFINET Controller that will establish communication must keep the option for IP configuration via the network disabled. Otherwise, communication will not be established. For example, in TIA Portal, for the PROFINET Controller, select the option **IP address is set directly at the device**, as shown in Figure 4.6. For a PROFINET Controller that uses CODESYS, refer to the PROFINET Controller application note for the PLC500/PLC410, available on the [WEG](#) website.

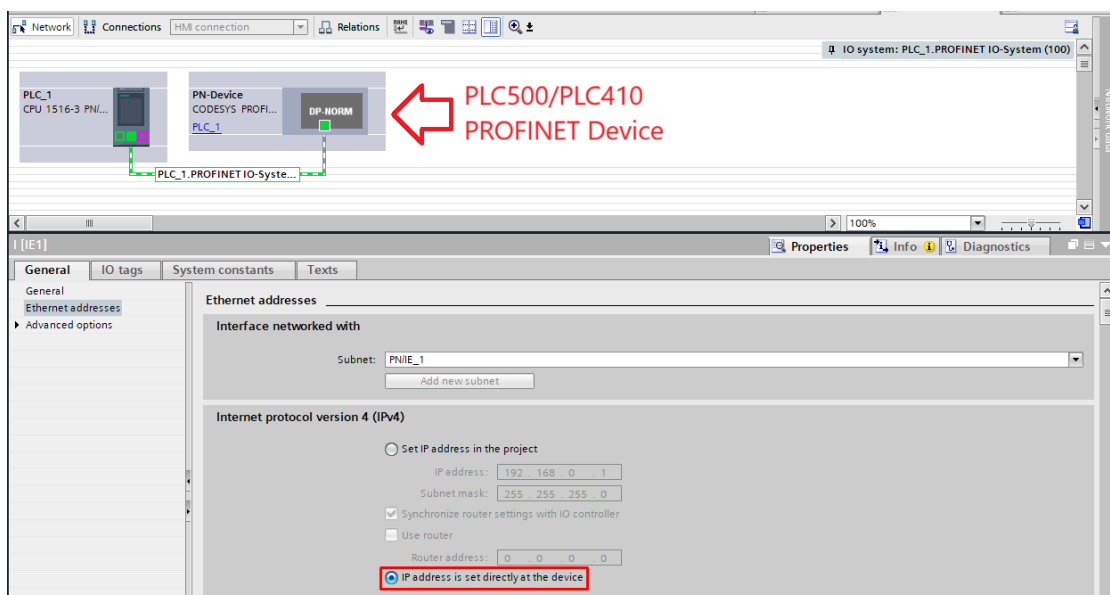


Figure 4.6: Disabling IP configuration via the network in TIA Portal.

4.5 I/O DATA CONFIGURATION

Double-click the **InOut 8bit** module and access the **PROFINET Device Module I/O Mapping** tab.

The available variables depend on the type of module selected. In the case of the **InOut 8bit** module, one input variable and one output variable of type USINT are available, which can be used to map, respectively, the PLC500 inputs and outputs.

Since the PLC500 I/Os do not have fixed PROFINET addressing, to access the device digital inputs and outputs it is necessary to perform the mapping using auxiliary variables in the application. [Figure 4.7](#) presents an example of mapping USINT-type variables using auxiliary variables in the **InOut_8bit** submodule.

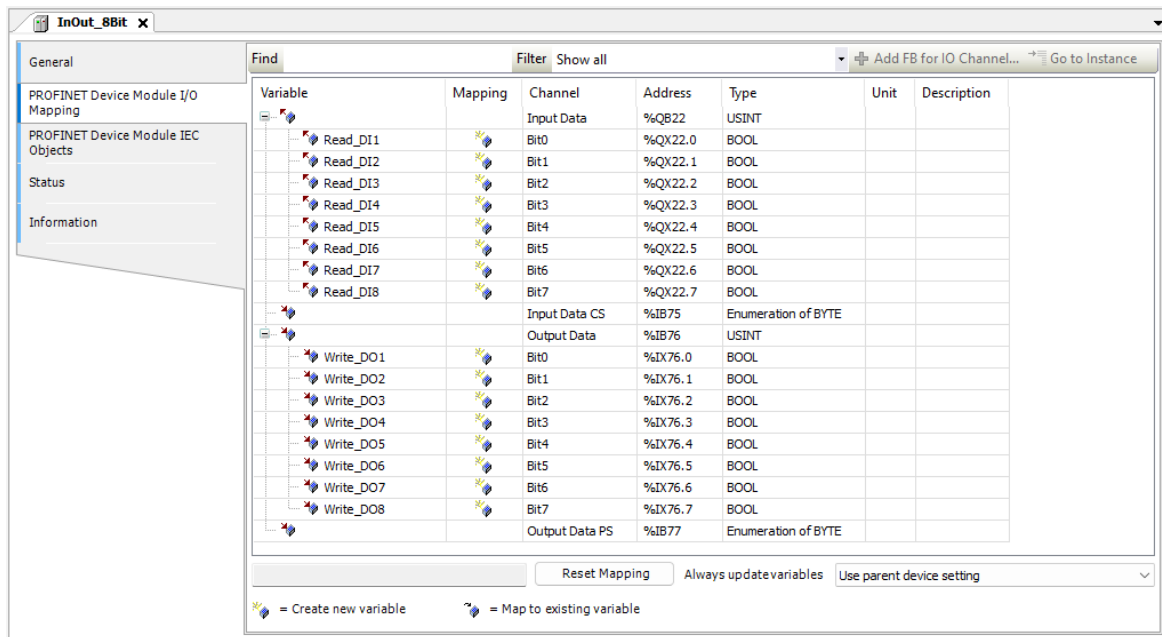


Figure 4.7: Variables declared and mapped for the PROFINET Device submodule.



NOTE!

The availability and access to data types through the PROFINET network may vary from one device to another. Therefore, during configuration, it is recommended to consult the **User Manual** to obtain information about the available data.

To interconnect the PROFINET variables with the I/Os mapped with their PLC500 standard names (DO1, DO2 ... DI1, DI2 ...), there is a simple structured text code demonstrated in [Figure 4.8](#).



ATTENTION!

Do not change the default names of the I/O variables previously declared. When updating the device to a different model and/or version, **the variables will return to their original declaration**.

```
IO_mapping - Structured text (ST)

Read_DI1 := DI1;
Read_DI2 := DI2;
Read_DI3 := DI3;
Read_DI4 := DI4;
Read_DI5 := DI5;
Read_DI6 := DI6;
Read_DI7 := DI7;
Read_DI8 := DI8;

DO1 := Write_DO1;
DO2 := Write_DO2;
DO3 := Write_DO3;
DO4 := Write_DO4;
DO5 := Write_DO5;
DO6 := Write_DO6;
DO7 := Write_DO7;
DO8 := Write_DO8;
```

Figure 4.8: IO_mapping program in structured text.



NOTE!

For larger-scale applications, in which the state of the PLC500 digital inputs and outputs is crucial, it is recommended that input variables be read at the beginning of the main program, while output variables are written at the end. For more information, consult **Bus Cycle Task** in the online help at [CODESYS Online Help](#).

4.6 EXPORTING THE GSDML FILE FROM THE CODESYS PROFINET DEVICE

The PLC500 configured as a PROFINET Device uses the **CODESYS PROFINET Device** already included in the CODESYS device repository. To establish PROFINET communication with a controller that also uses CODESYS it is not necessary to export the GSDML file; however, if another software tool is used, the file can be exported in **Tool → Device Repository**.

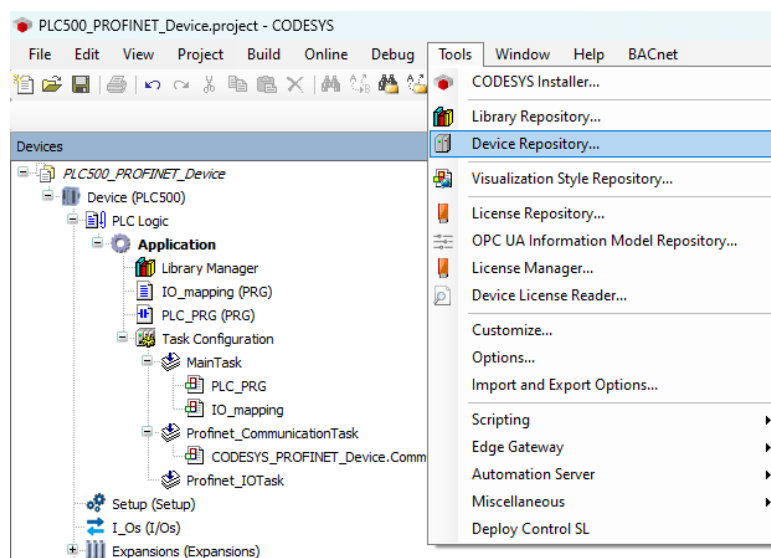


Figure 4.9: Accessing Device Repository in CODESYS.

In **Fieldbuses → PROFINET IO Slave → I/O → CODESYS PLC**, select the version corresponding to your PROFINET Device included in the project tree and click **Export...**; a zip file will be generated and saved locally on your computer.

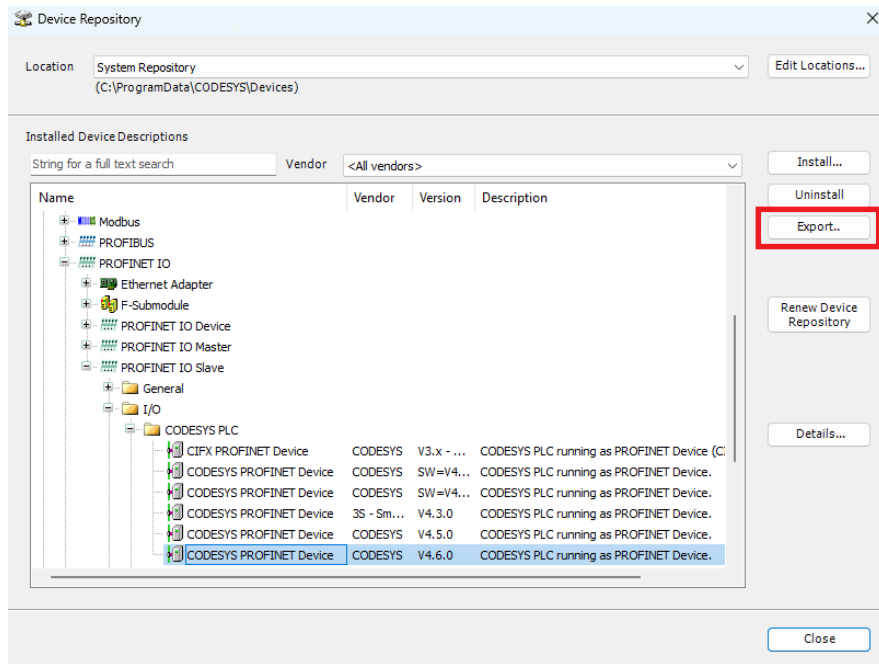


Figure 4.10: Exporting PROFINET Device GSDML from CODESYS.

Use the file inside the zip that has the format GSDML-VX.XX-CODSYS in the automation software to install the configuration file for the CODESYS PROFINET Device, as indicated in [Figure 4.11](#).

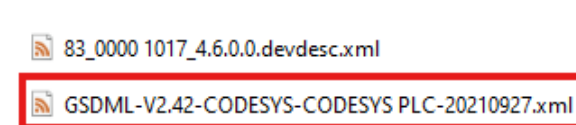


Figure 4.11: Exported GSDML files.

5 MONITORING

In this chapter, some methods for monitoring PROFINET network variables and diagnosing communication errors in CODESYS are presented.

5.1 VARIABLE MONITORING

The variables declared on the network can be monitored through two methods: the first possibility is to add them to the CODESYS program and monitor the variable values online. The second method only requires enabling **Always Update Variables** → **Enabled 1 (use bus cycle task if not used in any task)** at the bottom of the **PNIO Module I/O Mapping** tab for each submodule, as indicated by the red arrow in [Figure 5.1](#).



NOTE!

The **bus cycle task** used for PROFINET I/O variables by default is **Profinet_IOTask**.



ATTENTION!

Using PROFINET I/O input and output variables in multiple tasks may lead to unexpected behavior. It is recommended to use the variables in the default task **Profinet_IOTask**, or in another exclusive task configured in **PN-Controller** → **PNIO I/O Mapping** → **Bus Cycle Options**.

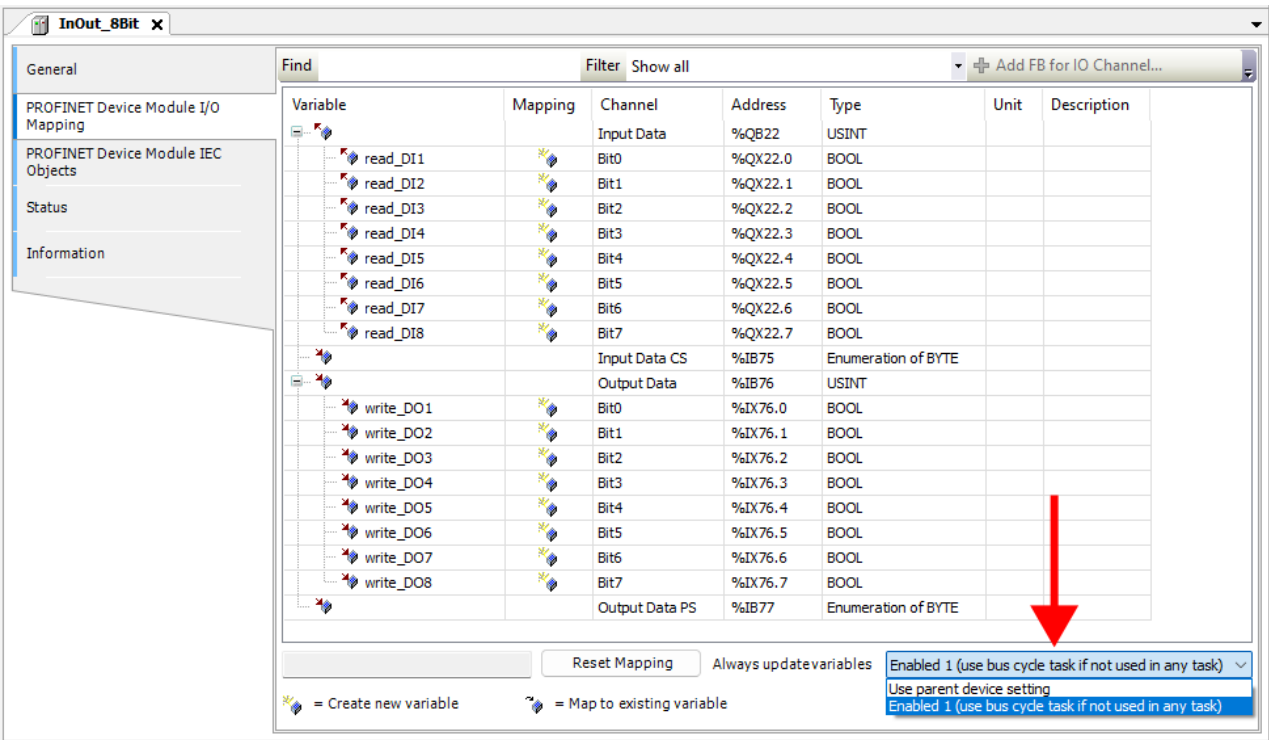


Figure 5.1: PROFINET variable update option.

[Figure 5.2](#) shows the CODESYS variable visualization screen for the PROFINET Device through online monitoring.

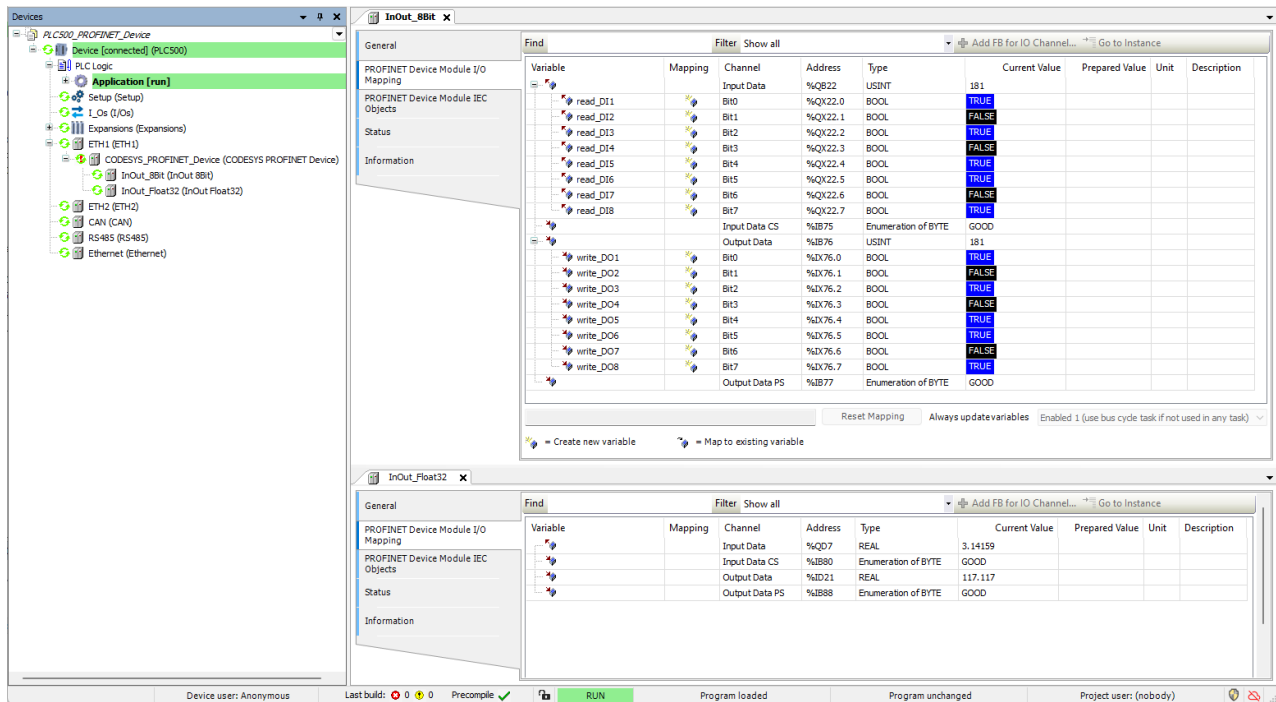


Figure 5.2: Monitoring PROFINET variables in online mode in CODESYS.



NOTE!

The PLC410, PLC500, PLC500MC and PLC500ED as a PROFINET Device do not have the functionality for a PROFINET Controller to configure the IP address via the network. Thus, the symbol  on the **CODESYS PROFINET Device** is normally shown when the connection is established with the device. In the **Status** tab of the **CODESYS PROFINET Device** a message will appear indicating that this functionality is not enabled; however, PROFINET communication works normally.

5.2 COMMUNICATION ERRORS

When communication problems are found, as shown in Figure 5.3, analyze the **Status** and **Logs** information of the devices, check whether the cables are properly connected, the state of the LED on the Ethernet port used on the PLC, and review the performed settings. Red icons or exclamation marks may represent communication or configuration failures.

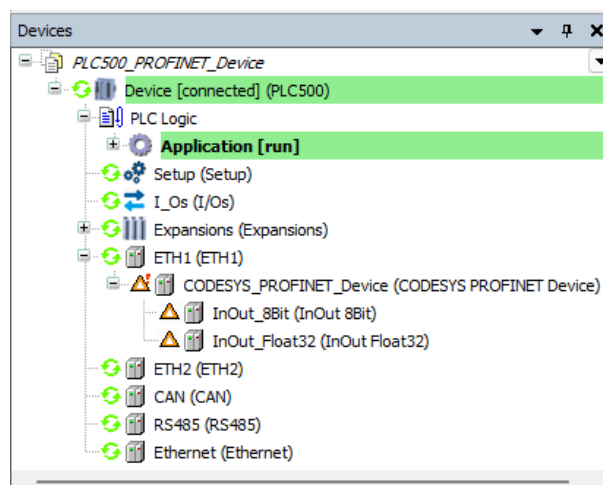


Figure 5.3: Indication of communication failures.

In the **Status** tab of the **CODESYS PROFINET Device**, network diagnostic information is displayed, such as the number of established connections, number of sent and received frames, average time for sending and receiving data, among others.

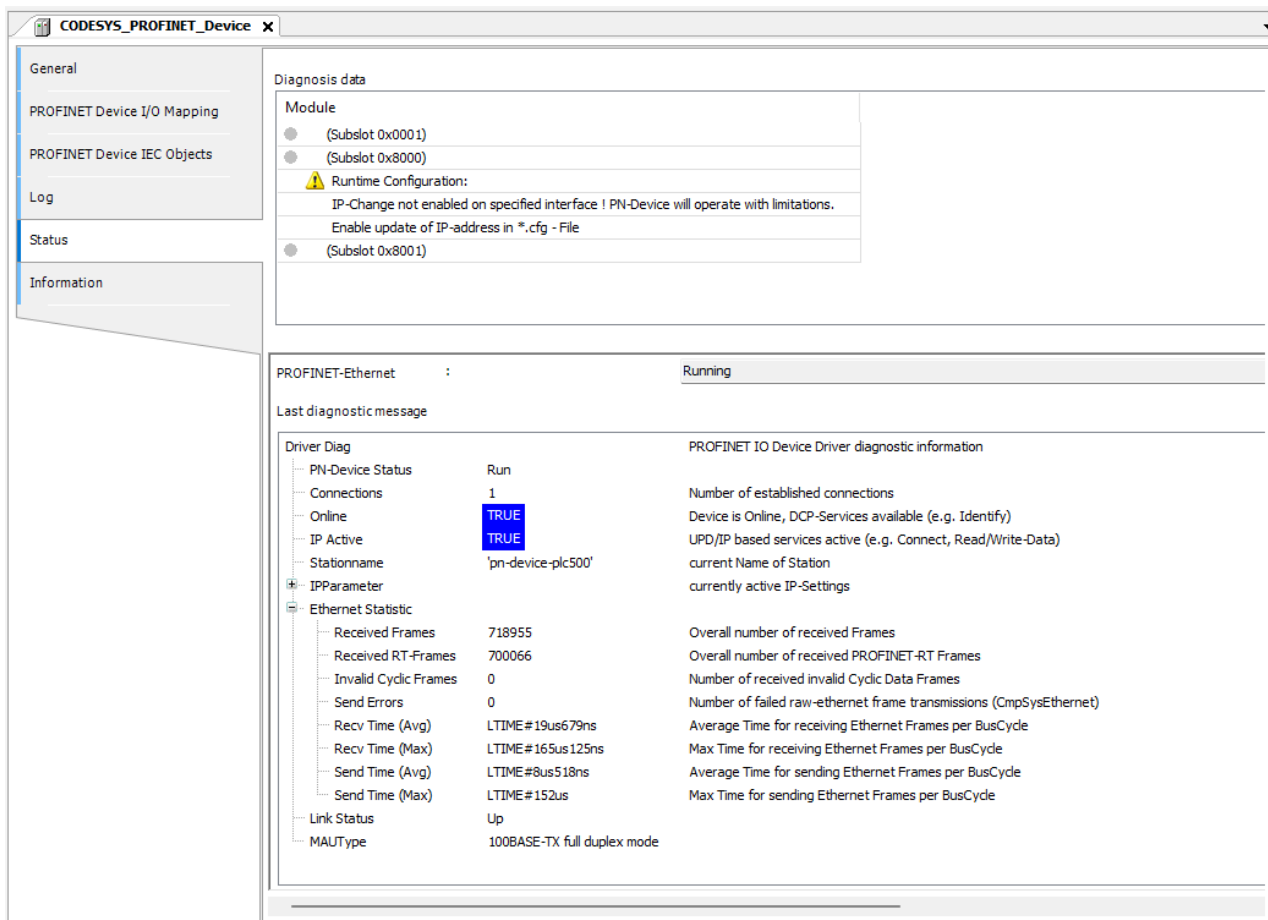


Figure 5.4: CODESYS PROFINET Device Status window.

In the **Logs** tab of the **CODESYS PROFINET Device** there is more detailed information about the PROFINET communication performed by the PLC500.

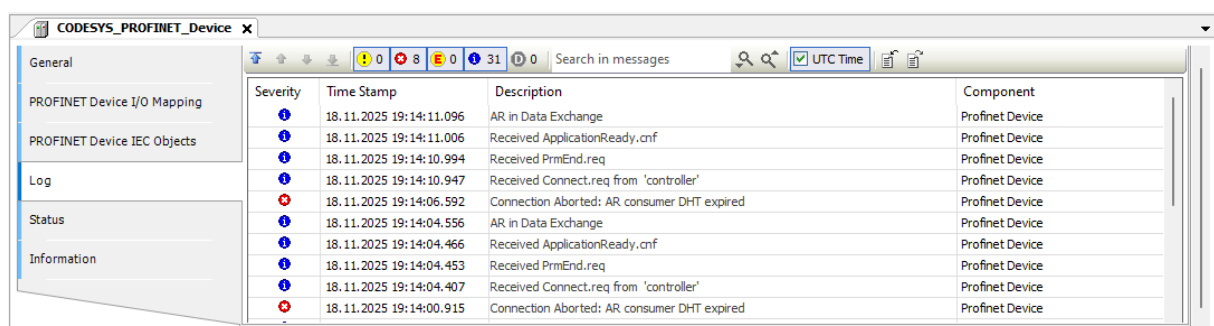


Figure 5.5: CODESYS PROFINET Device logs.

Each of its submodules has a **Status** tab in which the **Diagnosis data** and **Alarms** fields may indicate new information about communication or configuration errors. In the example below, the submodule is indicating a configuration failure, as a result of an incorrect manual configuration of one or more of its submodules (**Submodule-State: Wrong submodule**).

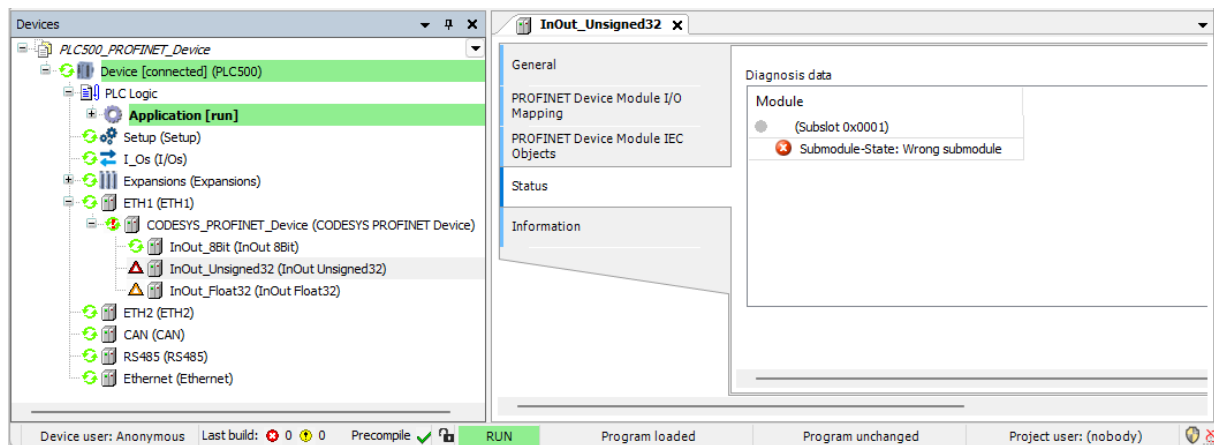


Figure 5.6: PROFINET Device submodule indicating a configuration failure.



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