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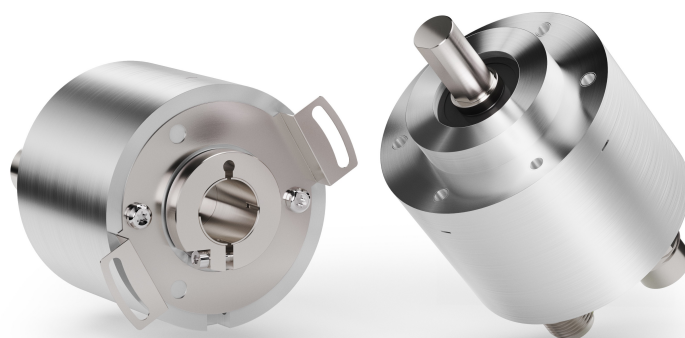**Smart encoders & actuators**

User's guide

EXM58 PT
EXO58 PT

PROFI NET®

- EXM58 up to 30-bit multiturn encoder for standard purposes
- EXO58 up to 30-bit multiturn encoder for high end applications
- Encoder Profile Specifications V4.1 version 3.162
- RT real-time transmission & IRT isochronous real-time mode
- With Energy Harvesting Technology
- Multiple mechanical and electrical options

Suitable for the following models:
- EXM58, EXM58S PT
- EXM58C, EXM59C PT
- EXO58, EXO58S PT
- EXO58C, EXO59C PT

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Typographic and iconographic conventions

In this guide, to make it easier to understand and read the text the following typographic and iconographic conventions are used:

- parameters and objects of both Lika device and interface are coloured in GREEN;
- alarms are coloured in RED;
- states are coloured in FUCSIA.

When scrolling through the text some icons can be found on the side of the page: they are expressly designed to highlight the parts of the text which are of great interest and significance for the user. Sometimes they are used to warn against dangers or potential sources of danger arising from the use of the device. You are advised to follow strictly the instructions given in this guide in order to guarantee the safety of the user and ensure the performance of the device. In this guide the following symbols are used:

	This icon, followed by the word **WARNING**, is meant to highlight the parts of the text where information of great significance for the user can be found: user must pay the greatest attention to them! Instructions must be followed strictly in order to guarantee the safety of the user and a correct use of the device. Failure to heed a warning or comply with instructions could lead to personal injury and/or damage to the unit or other equipment.
	This icon, followed by the word **NOTE**, is meant to highlight the parts of the text where important notes needful for a correct and reliable use of the device can be found. User must pay attention to them! Failure to comply with instructions could cause the equipment to be set wrongly: hence a faulty and improper working of the device could be the consequence.
	This icon is meant to highlight the parts of the text where suggestions useful for making it easier to set the device and optimize performance and reliability can be found. Sometimes this symbol is followed by the word **EXAMPLE** when instructions for setting parameters are accompanied by examples to clarify the explanation.

Preliminary information

This guide is designed to provide the most complete information the operator needs to correctly and safely install and operate the following encoders **equipped with Profinet interface**:

EXMxxx-13-14-PT4-...	**(DAP 1 : multiturn encoder 13 +14 bits)**
EXMxxx-18-12-PT4-...	**(DAP 2 : multiturn encoder 18 +12 bits)**
EXOxxx-18-00-PT4-...	**(DAP 3 : singleturn encoder 18 bits)**
EXOxxx-16-14-PT4-...	**(DAP 4 : multiturn encoder 16 +14 bits)**

For technical specifications <u>refer to the technical catalogue</u>.

To make it easier to read the text, this guide can be divided into some main sections.
In the first section (from chapter 1 to chapter 4) general information concerning the safety, the mechanical installation and the electrical connection.
In the second section (chapter 5) information on how to install and configure the encoder in TIA Portal development environment as well as tips for setting up and running properly and efficiently the unit are provided.
In the third section (from chapter 6 to chapter 11) both general and specific information is given on the Profinet interface. In this section the interface features and the parameters implemented in the unit are fully described.
In the fourth section (from chapter 12 to chapter 15) some examples of programming and advanced maintenance information are explained.
In the last section (chapter 16) the integrated web server is described.

Lika Electronic Profinet encoder documentation is complete with some **example projects** provided free of charge. These programs are designed to make your own project planning, programming, communication and diagnostics with the TIA V16 development environment user-friendly and reliable. You can find them in the **Lika TIA V16 CPU1500 Profinet example project.zip** compressed file contained in the **SW EXM58_EXO58 PT.zip** file.

WARNING
If the encoder is used as a **TO Technology Object**, please refer to the "5.7 TO Technology Objects" section on page 78.

Glossary of Profinet terms

PROFINET IO, like many other networking systems, has a set of unique terminology. Table below contains a few of the technical terms used in this guide to describe the PROFINET IO interface. Sometimes they also refer more specifically to the S7 programming environment. They are listed in alphabetical order.

Acyclic Communications	Unscheduled, on demand communications. Diagnostic messages from an IO Supervisor to an IO Device are Acyclic. Refer to page 109.
AP	Application Process - The application process running in the device. PROFINET supports a default Application Processes and additional profile specific application processes.
API	The value of the API (Application Process Identifier) parameter specifies the application that is processing the IO data. PROFINET standard IEC 61158 assigns profiles to certain APIs (PROFIdrive, PROFIslave) which are defined by the PROFINET User Organization. The standard API is 0.
Application class	An application class specifies a number of mandatory functions and addition optional functions to be supported by an IO device. The Profinet encoders can be configured as CLASS 3 and CLASS 4 PROFINET IO devices according to the encoder profile. Refer to page 92.
AR	Application Relation - The relationship between a PROFINET IO Controller and an IO device. A PROFINET IO device can support more than one Application Relationship.
Automation system	Programmable logic controller for the open-loop and closed-loop control of process chains in process and production engineering. The automation system consists of different components and integrated system functions depending on the automation task.
Bus	A bus is a communication medium connecting several nodes. Data can be transferred via serial or parallel circuits, that is, via electrical conductors or fiber optic.
Channel	A single IO point. A Channel can be discrete or analog.
Consumer Status	The Status an IO device provides to an IO Controller for the data it consumes from IO Controller.
CPU	Central Processing Unit – Central module of an automation system with a control and arithmetic unit, memory, operating system and interface for programming device.
CR	Communication Relationship - A virtual communication channel within an AR.
Cyclic Communications	Scheduled, repetitive communications. IO data and alarm transfers are cyclic.

Data block	In contrast to code blocks, data blocks (DB) do not contain Step 7 statements. They are used to save data, i.e. variable data which are processed by the user program. Global data blocks serve to accommodate user data which can be used by all other blocks.
DCP	Discovery Control Protocol - A communications protocol with PROFINET IO that allows an IO Controller or Supervisor to find every PROFINET IO device on a subnet.
Determinism	Determinism means that a system responds in a predictable (deterministic) manner.
Device name	Before an IO device can be addressed by an IO controller, it must have a device name. In PROFINET, this method was selected because it is simpler to work with names than with complex IP addresses. Refer to page 34.
Encoder Profile	The PROFINET profile for Encoders is intended to define a standard application interface for encoders. The profile is a supplement to the PROFIdrive profile, so it is mandatory to read the PROFIdrive profile before implementing the encoder profile.
Function	Functions (FC) are code blocks which can be programmed by the user. A FC does not have a "memory". Temporary variables as well as parameters transferred to the function when the latter is called are saved in a L stack. They are lost following processing of the FC.
Function block	Function blocks (FB) are code blocks with a "memory" which are programmed by the user. They have an assigned instance data block (instance DB) as memory. Parameters transferred to a FB as well as the static variables are saved in this data block. An FB contains a program which is always executed when the FB is called by another code block. Function blocks facilitate the programming of frequently repeated, complex functions.
Frame ID	The two-byte field in the Ethernet frame which defines the type of PROFINET IO message.
GSD	The properties of a PROFINET device are described in a GSD file (General Station Description) that contains all the information required for configuration. In PROFINET IO, the GSD file is in XML format. The structure of the GSD file conforms to ISO 15734, which is the world-wide standard for device descriptions. Refer to page 54.
GSDML	General Station Description Markup Language – The file containing the XML description of the PROFINET IO device. Refer to page 54.
IO Controller	Device used to address the connected IO devices. This means that the IO controller exchanges input and output signals with assigned field devices. The IO controller is often the controller on which the automation program runs. Refer to page 90.
IO Device	A decentralized field device that is assigned to one of the IO

	controllers (e.g. remote IO, encoders, valve terminals, frequency converters, switches, etc.). Refer to page 90.
IO Parameter Server	An IO Parameter Server is a server station, usually a PC, for loading and saving the configuration data (records) of IO Devices.
IO Supervisor	Programming device, PC or HMI device used for commissioning and diagnostics of IO Controllers and IO Devices. Refer to page 90.
IP address	The IP address is the name of the unit in a network using the Internet protocol. Refer to page 34.
IRT	Synchronized transmission procedure for the cyclic exchange of IRT data between PROFINET devices. A reserved bandwidth within the send clock is available for the IRT IO data. The reserved bandwidth ensures that the IRT data can be transmitted at reserved, synchronized intervals whilst remaining uninfluenced even by other greater network loads (e.g. TCP/IP communication or additional real time communication). The "high flexibility" enables simple planning and expansion of the system. A topological configuration is not required. Refer to page 140.
MAC address	The MAC address is an identifier unique worldwide consisting of two parts: the first 3 bytes are the manufacturer ID and are provided by IEE standard authority; the last three bytes represent a consecutive number of the manufacturer. Refer to page 34.
Module	Modules are user defined components that plug into slots. Modules can be real or virtual.
NRT	Non Real Time - The non Real Time PROFINET IO Channel. Configuration and diagnostic messages are transferred over the NRT Channel.
Organization block	A range of organization blocks (OB) are designed to execute the user program. OBs are the interface between the user program and the operating system of a CPU. They permit event-controlled processing of special program components within the user program. The order in which the user program is executed is defined in the organization blocks.
Profile	Profiles define application-specific functionality to ensure the openness of PROFIBUS and PROFINET is utilized consistently. PI Profiles can cover simple devices such as encoders by defining how signals are used and how they are physically connected. However, profiles are increasingly covered more complex systems or requirements. Profiles such as PROFIdrive and PROFIsafe deliver active functionality as well. An advanced profile covering active power management for end devices like lasers and robots is now under development with the aim of bringing significant reductions in energy consumption for the automotive industry. Profiles guarantee

	quicker system design and they support faster device interchange, promoting competition amongst vendors, increased choice for users and full interoperability.
Provider Status	The Status an IO device provides to an IO Controller with the data transferred to the Controller.
Proxy	A device which maps non PROFINET IO data to PROFInet.
Real-time	Real-time means that a system processes external events within a defined time. If the reaction of a system is predictable, one speaks of a deterministic system. The general requirements for real-time are therefore: deterministic response and defined response time. Refer to page 140.
RT	Real Time - The Real Time PROFINET IO Channel. I/O and Alarm Data are transferred over the RT Channel. Refer to page 140.
Slot	A group of one or more Subslots. Slots can be real or virtual.
Standard signal	The encoder profile defines a series of standard signals which are used to configure the IO data. Refer to page 97.
Submodule	A component of a module that is plugged into a subslot. A submodule is real or virtual.
Subslot	A group of one or more channels. Subslots can be real or virtual.
Sync Domain	All PROFINET devices that are to be synchronized via PROFINET IO with IRT must belong to a Sync Domain. The Sync Domain consists of precisely one Sync Master and at least one Sync Slave. IO controllers and switches can hold the role of a Sync Master or Sync Slave. Other IO devices support only the role as Sync Slave.
System function	System functions (SFC) are integral functions in the operating system of a S7 CPU. In addition, SFCs are frequently called implicitly by SFBs. SFCs can be called by the user program like normal functions. SFCs are used to implement a number of important system functions for Profinet IO.
System function block	System function blocks (SFB) are integral functions in the operating system of a S7 CPU. SFBs can be called by the user program like normal function blocks. SFBs are used to implement a number of important system functions for Profinet IO.
TCP/IP	The Ethernet system is designed solely to carry data. It is comparable to a highway as a system for transporting goods and passengers. The data is actually transported by protocols. This is comparable to cars and commercial vehicles transporting passengers and goods on the highway. Tasks handled by the basic Transmission Control Protocol (TCP) and Internet Protocol (IP) (abbreviated to TCP/IP): 1. The sender splits the data into a sequence of packets. 2. The packets are transported over the Ethernet to the correct recipient.

	3. The recipient reassembles the data packets in the correct order. 4. Faulty packets are sent again until the recipient acknowledges that they have been transferred successfully.
Telegram	A telegram is a rigidly defined bit stream carrying data. A telegram specifies the data length and the type of data which is sent to and from the IO controller. The encoder profile can support the Standard Telegrams 81, 82, 83 and 84. Refer to page 95.
Topology	Network structure. Commonly used structures: • Line topology; • Ring topology; • Star topology; • Tree topology.
Transmission rate	Data transfer rate (in bps).
User program	The user program contains all instructions, declarations and data for signal processing required to control a plant or a process. It is assigned to a programmable module (for example CPU) and can be structured in smaller units (blocks).

List of abbreviations

Table below contains a list of abbreviations (in alphabetical order) which may be used in this guide to describe the PROFINET IO interface. Sometimes they also refer more specifically to the S7 programming environment.

AR	Application Relation
API	Application Process Identifier
C-LS	Controller's Sign-Of-Life
CR	Communication Relation
DB	Data block
DO	Drive Object
DO-LS	Driver Object Sign-Of-Life
DU	Drive Unit
EO	Encoder Object
EU	Encoder Unit
FB	Function block
FC	Function
I&M	Identification & Maintenance
IRT	Isochronous Real Time Ethernet
IRT Flex	IRT "High Flexibility"
IRT Top	IRT "High Performance"
GSDML	General Station Description Markup Language
IO	Input/Output
IP	Internet Protocol
LLDP	Link Layer Discovery Protocol
LS	Sign-Of-Life
MAC	Media Access Control
MAP	Module Access Point
MLS	Master Sign-Of-Life
OB	Organization block
PAP	Parameter Access Point
PI	PROFIBUS and PROFINET International
RT	Real Time Ethernet

SFB	System function block
SFC	System function
TCP	Transmission Control Protocol
T_{MAPC}	Master Application Cycle Time

References

1– Profile Drive Technology. Encoder Profile. Technical Specification for PROFIBUS and PROFINET Version 4.2 March 2017 Order No: 3.162

2– Profile encoder. Technical Specification for PROFIBUS and PROFINET related to PROFIdrive Version 4.1 December 2008 Order No: 3.162

3- Profile Drive Technology. PROFIdrive Profile. Technical Specification for PROFIBUS and PROFINET Version 4.2 October 2015 Order No: 3.172

4- Profile Drive Technology PROFIdrive. Technical Specification for PROFIBUS and PROFINET Version 4.1 May 2006 Order No: 3.172

5- Profile Guidelines Part 1: Identification & Maintenance Functions. Guideline for PROFIBUS and PROFINET Version 1.2 October 2009 Order No: 3.502

6- Profile Guidelines Part 3: Diagnosis, Alarms and Time Stamping. Guideline for PROFIBUS and PROFINET Version 1.0 July 2004 Order No: 3.522

7- Profibus Guidelines: Profibus Interconnection Technology Version V1.4 Order No: 2.142

8- Profinet Guidelines: Profinet Cabling and Interconnection Version V1.8 Order No: 2.252

1 Safety summary

1.1 Safety

- Always adhere to the professional safety and accident prevention regulations applicable to your country during device installation and operation;
- installation and maintenance operations have to be carried out by qualified personnel only, with power supply disconnected and stationary mechanical parts;
- device must be used only for the purpose appropriate to its design: use for purposes other than those for which it has been designed could result in serious personal and/or the environment damage;
- high current, voltage and moving mechanical parts can cause serious or fatal injury;
- warning ! Do not use in explosive or flammable areas;
- failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the equipment;
- Lika Electronic assumes no liability for the customer's failure to comply with these requirements.

1.2 Electrical safety

- Turn OFF the power supply before connecting the device;
- connect according to the explanation in the "Electrical connections" section on page 31;
- connect +Vdc and 0Vdc and check the power supply is correct first before connecting the communication ports;
- in compliance with 2014/30/EU norm on electromagnetic compatibility, the following precautions must be taken:
  - before handling and installing the equipment, discharge electrical charge from your body and tools which may come in touch with the device;
  - power supply must be stabilized without noise; install EMC filters on device power supply if needed;
  - always use shielded cables (twisted pair cables whenever possible);
  - avoid cables runs longer than necessary;
  - avoid running the signal cable near high voltage power cables;
  - mount the device as far as possible from any capacitive or inductive noise source; shield the device from noise source if needed;
  - to guarantee a correct working of the device, avoid using strong magnets on or near by the unit;

- minimize noise by connecting the shield and/or the connector housing and/or the frame to ground. Make sure that ground is not affected by noise. The connection point to ground can be situated both on the device side and on user's side. The best solution to minimize the interference must be carried out by the user. Provide the ground connection as close as possible to the encoder. We suggest using the ground point provided in the housing, use one TCEI UNI M3 x 6 cylindrical head screw with two tooth lock washers.

1.3 Mechanical safety

- Install the device following strictly the information in the "Mechanical installation" section on page 26;
- mechanical installation has to be carried out with stationary mechanical parts;
- do not disassemble the unit;
- do not tool the unit or its shaft;
- delicate electronic equipment: handle with care; do not subject the device and the shaft to knocks or shocks;
- respect the environmental characteristics of the product;
- unit with solid shaft: in order to guarantee maximum reliability over time of mechanical parts, we recommend a flexible coupling to be installed to connect the encoder and user's shaft; make sure the misalignment tolerances of the flexible coupling are met;
- unit with hollow shaft: the encoder can be mounted directly on a shaft whose diameter has to respect the technical characteristics specified in the purchase order and clamped by means of the collar and, when requested, the anti-rotation pin.

2 Identification

Device can be identified through the **order code**, the **serial number** and the **MAC address** printed on the label applied to its body. Information is listed in the delivery document too. Please always quote the order code, the serial number and the MAC address when reaching Lika Electronic for purchasing spare parts or needing assistance. For any information on the technical characteristics of the product <u>refer to the technical catalogue</u>.

⚠	**Warning**: encoders having order code ending with "/Sxxx" may have mechanical and electrical characteristics different from standard and be supplied with additional documentation for special connections (Technical info).

3 Mechanical installation

⚠️ **WARNING**
Installation and maintenance operations have to be carried out by qualified personnel only, with power supply disconnected. Shaft and mechanical components must be in stop.

For any information on the mechanical data and the electrical characteristics of the encoder please <u>refer to the technical catalogue</u>.

Values are expressed in millimetres (mm).

3.1 Solid shaft encoders

- Mount the flexible coupling **1** on the encoder shaft;
- fix the encoder to the flange **2** (or to the mounting bell) by means of the M4 screws **3**;
- mount the flexible coupling **1** on the motor shaft;
- secure the flange **2** to the support (or the mounting bell to the motor);
- make sure the misalignment tolerances of the flexible coupling **1** are met.

3.1.1 Customary installation
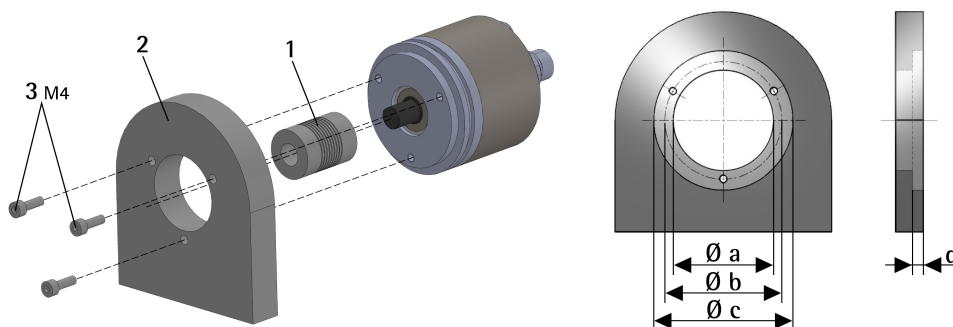
	a [mm]	b [mm]	c [mm]	d [mm]
EXM58, EXO58	-	42	50 F7	4
EXM58S, EXO58S	36 H7	48	-	-

3.1.2 Installation using fixing clamps (code LKM386)
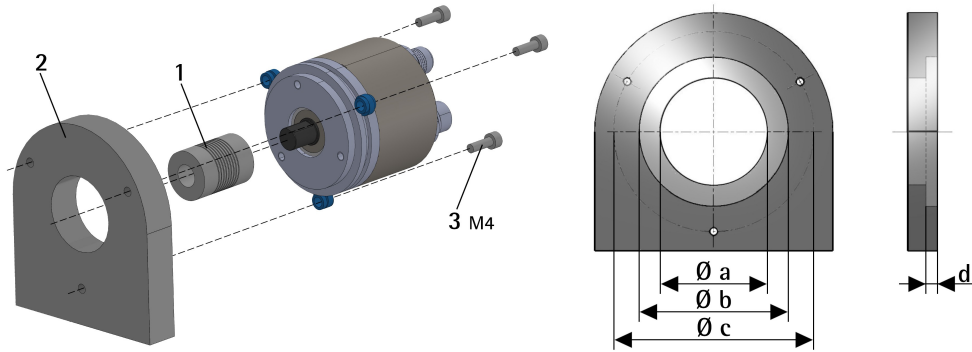
	a [mm]	b [mm]	c [mm]	d [mm]
EXM58, EXO58	–	50 F7	67	4
EXM58S, EXO58S	36 H7	–	67	–

3.1.3 Installation using a mounting bell (code PF4256)

EXM58S, EXO58S encoders only
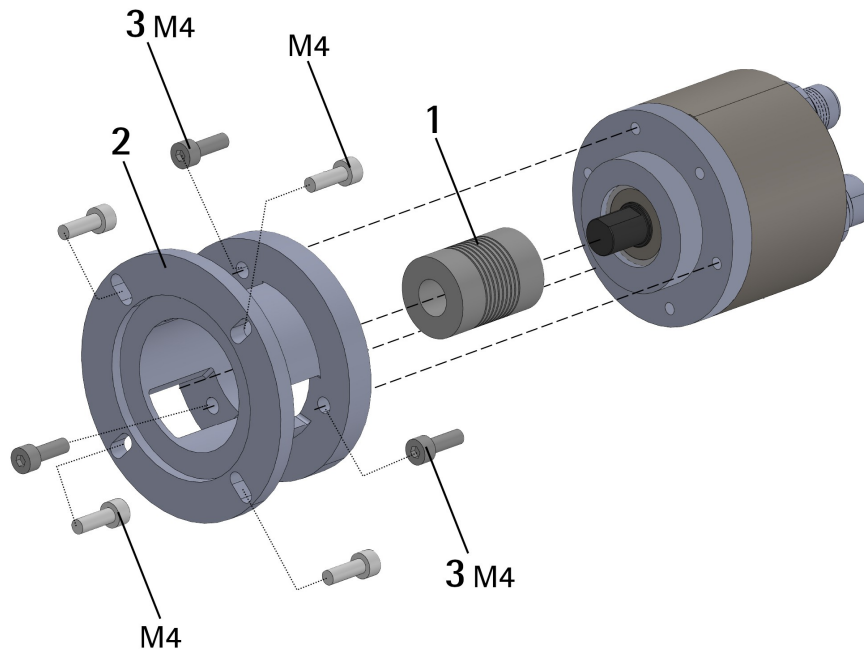
NOTE

In order to guarantee reliability over time of the encoder mechanical parts, we recommend a flexible coupling to be installed between the encoder and the motor shaft. Make sure the misalignment tolerances of the flexible coupling are met.

3.2 Hollow shaft encoders

3.2.1 EXM58C, EXO58C

- Fasten the M4 anti-rotation pin **1** to the rear of the motor (secure it using a locknut);
- mount the encoder on the motor shaft using the reducing sleeve **6** (if supplied). Avoid forcing the encoder shaft;
- insert the M4 anti-rotation pin **1** into the slot on the flange of the encoder; this secures it in place by grub screw **2**, preset at Lika;
- fix the collar to the encoder shaft (apply threadlocker to M2.5 screw **3**).
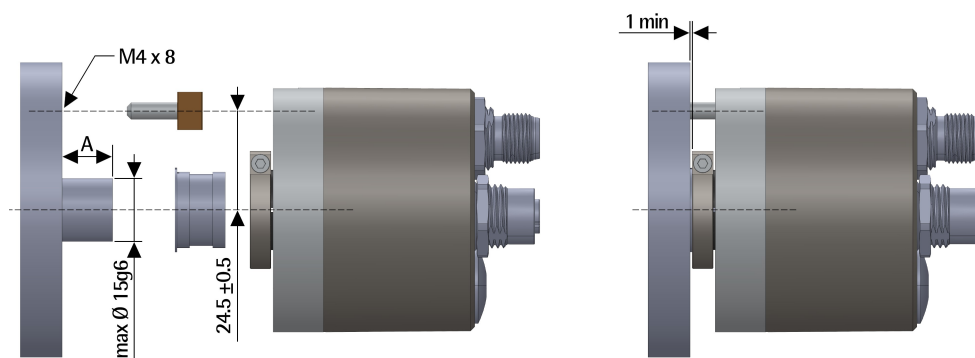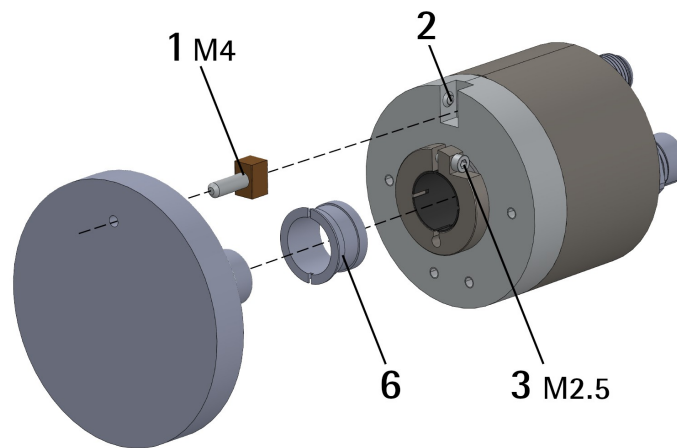
A = min. 8 mm, max. 18 mm

3.2.2 EXM59C, EXO59C

- Mount the encoder on the motor shaft using the reducing sleeve **6** (if supplied). Avoid forcing the encoder shaft;
- fasten the fixing plate **4** to the rear of the motor using two M3 cylindrical head screws **5**;
- fix the collar to the encoder shaft (apply threadlocker to M2.5 screw **3**).
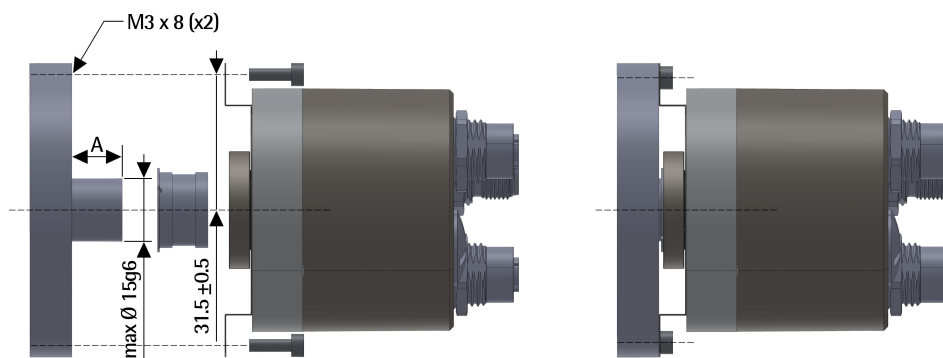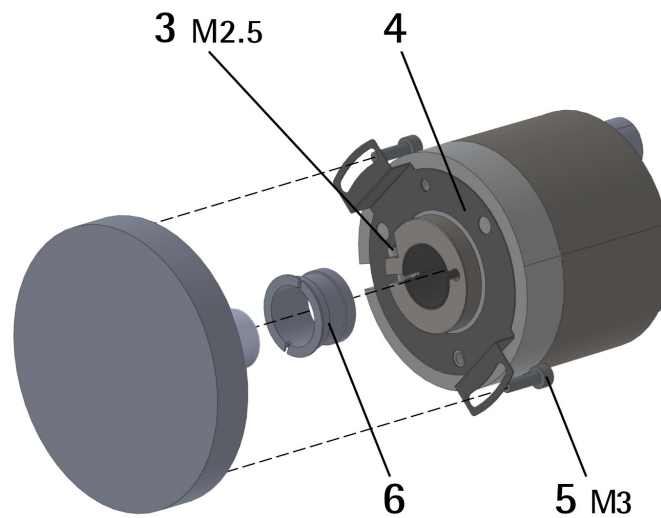
A = min. 8 mm, max. 18 mm

NOTE
You are strongly advised not to carry out any mechanical operations (drilling, milling, etc.) on the encoder shaft. This could cause serious damages to the internal parts and an immediate warranty loss. Please contact our technical personnel for the complete availability of "custom made" shafts.

4 Electrical connections

WARNING

Power supply must be turned off before performing any electrical connection! Installation, electrical connection, and maintenance operations must be carried out by qualified personnel only, with power supply disconnected. Mechanical components must be in stop.

Do not remove the plug on the rear of the encoder. Damage may be caused to internal components.

No user serviceable parts inside the encoder!
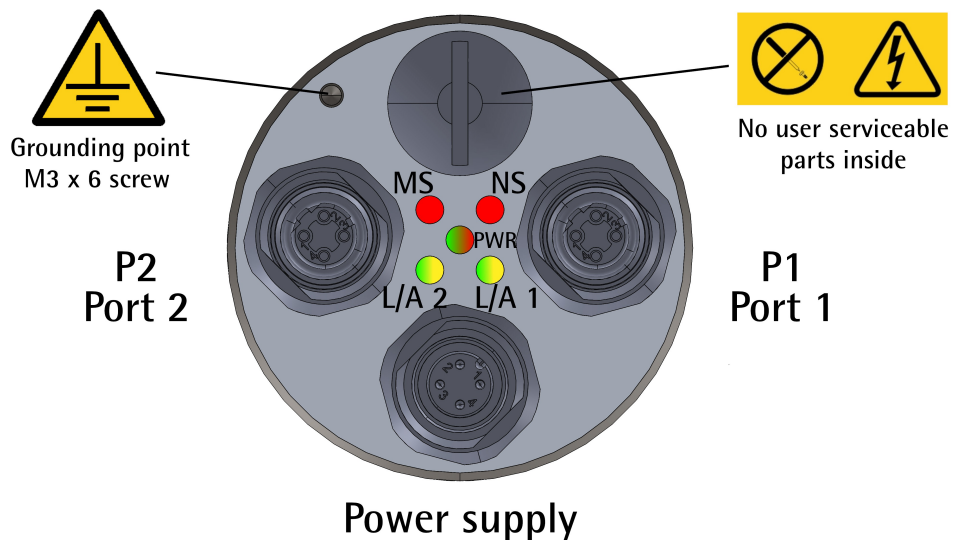
Figure 1 – Connectors and diagnostic LEDs

4.1 PWR Power supply connector (Figure 1)

M12 4-pin male connector with A coding is used for power supply.
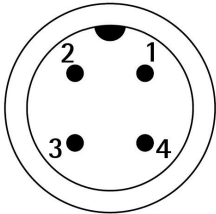
Description	Pin
+5Vdc +30Vdc	1
n.c.	2
0Vdc	3
n.c.	4

n.c. = not connected

WARNING

Connect +Vdc and 0Vdc and check the power supply is correct first before connecting the communication ports.

4.2 P1 Port 1 and P2 Port 2 connectors (Figure 1)

Two M12 4-pin female connectors with D coding are used for Ethernet connection through port 1 and port 2.
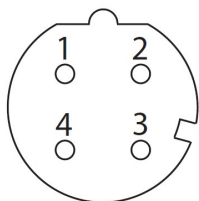
Description	Pin
Tx Data +	1
Rx Data +	2
Tx Data –	3
Rx Data –	4

The ports are equal and interchangeable - if only one connection is required, either port can be used. The Ethernet interface supports 100 Mbit/s, full-duplex operation.

WARNING

Connect +Vdc and 0Vdc and check the power supply is correct first before connecting the communication ports.

4.3 Network configuration: cables, hubs, switches – Recommendations

PROFINET is based on a 100 Mbps, full-duplex Ethernet network. Faster communication is also possible on all transmission sections (e.g., between switches, PC systems, or camera systems).

Using Ethernet several topologies of connection are supported by Profinet networks: line, tree, daisy-chain, star, ... Furthermore Profinet networks can be configured in almost any topology in the same structure.

The connection of PROFINET IO field devices occurs exclusively with switches as network components. Switches typically integrated in the field device are used for this (with 2 ports assigned). PROFINET-suitable switches must support "autonegotiation" (negotiating of transmission parameters) and "autocrossover" (autonomous crossing of send and receive lines).

Cables and connectors comply with the Profinet specifications. The cabling guide defines for all Conformance Classes a 2-pair cable according to IEC 61784-5- 3.

Standard Profinet cables commercially available can be used.

The maximum segment length for electrical data transmission with copper cables between two nodes (field devices or switches) is 100 m / 328.084 ft. The copper cables are designed uniformly in AWG 22. The installation guide defines different cable types, whose range has been optimally adapted to general requirements for industry. Sufficient system reserves allow industry-compatible installation with no limitation on transmission distance.

The PROFINET cables conform to the cable types used in industry:

- PROFINET Type A: Standard permanently routed cable, no movement after installation
- PROFINET Type B: Standard flexible cable, occasional movement or vibration
- PROFINET Type C: Special applications: for example, highly-flexible, constant movement (trailing cable or torsion)

For complete information please refer to IEC 61918, IEC 61784-5-13, and IEC 61076-2-101.

To increase noise immunity only S/FTP or SF/FTP cables must be used (CAT-5).

The maximum cable length (100 meters / 328.084 ft) predefined by Ethernet 100Base-TX must be compulsorily fulfilled.

Regarding wiring and EMC measures, the IEC 61918 and IEC 61784-5-13 must be considered.

For a complete list of the available cordsets and connection kits please refer to the product datasheet ("Accessories" list).

4.4 Line termination

Profinet network needs no line termination because the line is terminated automatically; in fact every Slave is able to detect the presence of the downstream Slaves.

4.5 MAC address and IP address

The unit can be identified in the network through the **MAC address** and the **IP address**. MAC address has to be intended as a permanent and globally unique identifier assigned to the unit for communication on the physical layer; while the IP address is the name of the unit in a network using the Internet protocol. MAC address is 6-byte long and cannot be modified. It consists of two parts, numbers are expressed in hexadecimal notation: the first three bytes are used to identify the manufacturer (OUI, namely Organizationally Unique Identifier), while the last three bytes are the specific identifier of the unit. The MAC address can be found on the label applied to the encoder. The IP address (and the subnet mask) must be assigned by the user to each interface of the unit to be connected in the network. For additional information on the MAC address refer to the "5.4 Mac address" section on page 53. For additional information on the IP address refer to the "5.5.7 Setting the device name and the IP address in the project" section on page 64.

4.6 Ground connection (Figure 1)

To minimize noise connect properly the shield and/or the connector housing and/or the frame to ground. Connect properly the cable shield to ground on user's side. Lika's EC- pre-assembled cables are fitted with shield connection to the connector ring nut in order to allow grounding through the body of the device. Lika's E- connectors have a plastic gland, thus grounding is not possible. If metal connectors are used, connect the cable shield properly as recommended by the manufacturer. Anyway make sure that ground is not affected by noise. It is recommended to provide the ground connection as close as possible to the device. We suggest using the ground point provided in the housing (see Figure 1, use one TCEI UNI M3 x 6 cylindrical head screw with two tooth lock washers).

4.7 Diagnostic LEDs (Figure 1)

Five LEDs located in the rear of the encoder (see Figure 1) are meant to show visually the operating or fault status of the encoder and the Profinet interface. The meaning of each LED is explained in the following tables.

MS Module Status LED (red)

It shows the state of the Profinet device. It is also referred to as SF (System Failure) LED.

MS LED	Description	Meaning
OFF	No error	No system error is active.
ON red	System error active	A system error has occurred. A watchdog timeout has occurred. Channel, generic, or extended diagnosis present.
FLASHING red (1Hz, 3s)	DCP service initiated	DCP signal service is initiated via the bus. The PROFINET specification defines the Discovery and basic Configuration Protocol (DCP) to change/set PROFINET device parameters over the network (set station name, set IP address, reset to factory, ...).

NS Network Status LED (red)

It shows the current state of the network. It is also referred to as BF (Bus Failure) LED.

NS LED	Description	Meaning
OFF	No error	No bus error is active.
ON red	Bus error active No connection to another device No data exchange	A bus error has occurred. The bus is disconnected. No configuration is present. Controller / Master is not available or switched off. There is no physical link or it is a low speed physical link.
FLASHING red (2 Hz)	Parameterization fault Connection to	No data exchange is occurring. Device / Slave not configured yet or wrong configuration.

	another device. However, the device / Slave did not switch to the data exchange mode	Wrong station address assigned (but not outside the permitted range). Actual configuration of the device / Slave differs from the nominal configuration.

PWR Power LED (green / red)

It shows the power supply and system state. It is also referred to as SYS (System) LED.

PWR LED	Description	Meaning
OFF	Power OFF	The encoder power supply is switched OFF. No supply voltage for the device or hardware fault.
ON green	Power ON	The encoder power supply is switched ON. The firmware is running.
BLINKING red	No firmware program installed, firmware update mode	At power ON the LED blinks red at 1 Hz. The firmware program is not installed, the encoder enters the firmware update mode and waits for the firmware file to be installed.

L/A Link/Activity LED for port 2 P2 (green / yellow)

It shows the state and the activity of the physical link (port 2 P2).

L/A LED	Description	Meaning
OFF	No link No activity	The device has no link to the Ethernet, the link through port 2 P2 is not active. There is no activity on port 2 P2, the device does not send/receive Ethernet frames through port 2 P2.
ON green	Link active No activity	Port 2 P2 link active, the device is linked to the Ethernet, there is no activity on port 2 P2.
FLICKERING yellow	Activity	Port 2 P2 link is active, there is activity on port 2 P2, the device sends/receives

		Ethernet frames through port 2 P2.

L/A Link/Activity LED for port 1 P1 (green / yellow)

It shows the state and the activity of the physical link (port 1 P1).

LED	Description	Meaning
OFF	No link No activity	The device has no link to the Ethernet, the link through port 1 P1 is not active. There is no activity on port 1 P1, the device does not send/receive Ethernet frames through port 1 P1.
ON green	Link active No activity	Port 1 P1 link active, the device is linked to the Ethernet, there is no activity on port 1 P1.
FLICKERING yellow	Activity	Port 1 P1 link is active, there is activity on port 1 P1, the device sends/receives Ethernet frames through port 1 P1.

4.8 LED state definition

LED state	Frequency	Description
Flashing	1 Hz, 3 s	The LED turns ON and OFF for 3 seconds with a frequency of 1 Hz: "ON" for 500 ms, followed by "OFF" for 500 ms.
Flashing	2 Hz	The LED turns ON and OFF with a frequency of 2 Hz: "ON" for 250 ms, followed by "OFF" for 250 ms.
Blinking	1 Hz, 4 Hz	The LED turns ON in phase with a frequency of approx.: • 1 Hz: ON color 1 for 500 ms and ON color 2 for 500 ms; • 4 Hz: ON color 1 for 125 ms and ON color 2 for 125 ms.
Flickering	Load dependent	The LED turns ON and OFF with a frequency of approximately 10 Hz to indicate high Ethernet activity: "ON" for approximately 50 ms,

		followed by "OFF" for 50 ms. The LED turns ON and OFF in irregular intervals to indicate low Ethernet activity.

4.9 States

Here follows the list of the Profinet states.

ERROR state

There is at least one serious network error. The Read Process Data shall be regarded as not valid. Write Process Data could still be forwarded to the Master, so the application must keep this data updated.

EXCEPTION state

The module has ceased all network participation due to an error. This state is unrecoverable, i.e. the system must be restarted in order to be able to exchange network data.

IDLE state

The network interface is idle; the communication establishment is in progress. The Read Process Data may be either updated or static (unchanged).

NW_INIT state

The device is currently performing network-related initialization tasks. Telegrams now contains Process Data (if such data is mapped), however the network Process Data channel is not active yet. If the process is successful, the module will shift to the WAIT_PROCESS state; or, in case of failure or if a serious error occurs (i.e. any error which prevents the system from proceeding), it will shift to the EXCEPTION state.

OFFLINE state

The IO Device has no valid configuration.

OPERATE state

The I/O connection is established and valid I/O data is exchanged between the Controller and the Device.

PROCESS_ACTIVE state

The network Process Data channel is active and error free. Perform normal data handling.

SETUP state

The setup of the device is in progress. The encoder may not send commands to the application in this state. If setup is successful, the module will shift to the NW_INIT state; or, in case of failure, it will shift to the EXCEPTION state.

STOP state

The IO Device has no communication to the IO Controller. Connection establishment is not in progress. The bus state of the IO Device may be set to ON or OFF.

WAIT_PROCESS state

The network Process Data channel is temporarily inactive. The system will consider the Read Process Data as not valid.

5 Getting started

5.1 Quick start information

The following instructions allow the operator to quickly and safely set up the device in a standard operational mode.

For complete and detailed information please read the mentioned pages thoroughly.

- Mechanically install the device, see on page 26 ff;
- execute the electrical connection and switch on the +5Vdc +30Vdc power supply, see on page 31 ff; check the soundness of the connection;
- switch off the power supply and execute the network connection, then switch on again the power supply, see on page 31 ff; check the soundness of the connection;
- install the GSDML file, see on page 56 ff;
- insert the Lika module and the type of telegram in the PROFINET-IO system, see on page 59 ff;
- set the device name, see on page 64 ff; at delivery the device name is set to a **blank string**;
- set the IP address and the subnet mask to the node, see on page 64 ff; the default address set by Lika is **0.0.0.0**;
- to set the encoder parameters, enter the **Module parameters** page, see on page 69; on this page you can, for example, set the singleturn resolution or the total resolution, enable the scaling function, or change the counting direction; after entering new values, you must download the parameters to the device; the complete list of the default parameters is available on page 179. **Please note that all the parameters listed in the Module parameters page are sent at each switching on.**
- to enable the scaling function, change the counting direction, and execute the preset, the Class 4 functionality parameter must be enabled (="1"), see on page 122.

5.1.1 Setting the resolution and the scaling function

- If you want to use the physical resolution of the encoder, please check that the Scaling function control parameter is disabled (="0"), see on page 123; this parameter is active only if the Class 4 functionality parameter is enabled (="1"), see on page 122;

- on the contrary, if you need a custom resolution, you must enable the scaling function by setting the Scaling function control parameter to ="1" first and then set the required resolution values:
  - open the **Module parameters** page and set the singleturn resolution next to the Measuring units / Revolution parameter, see on page 69 and on page 126;
  - open the **Module parameters** page and set the total resolution next to the Total measuring range parameter, see on page 69 and on page 127.

5.1.2 Reading the position

- To read the value of the absolute position use the variable tables (for instance, if the Standard Telegram 83 is installed, use the **Telegram 0x53** table available in the project example provided by Lika, see on page 96; see also the **G1_XIST1** parameter on page 99, the **G1_XIST2** parameter on page 101, and the **G1_XIST3** parameter on page 102).

NOTE
It is possible to read the current position of the encoder also by entering the web server via browser (see the "14 Integrated web server" section on page 167): in the **Encoder position and speed** page (see on page 169), the current position of the encoder is displayed. For example, it is "350253" in Figure 77.

5.1.3 Setting and executing the preset

- To set and execute the preset proceed as follows:
  - check that the **Control by PLC** bit 10 of the **STW2_ENC** control word is ="1", see on page 102;
  - check that the Class 4 functionality parameter is enabled (="1"), see on page 122;
  - check that the G1_XIST1 Preset control parameter is enabled (="0"), see on page 122;
  - set the preset value by means of an acyclic data exchange: it is possible to use the **P65000–Preset** variable table available in the project example provided by Lika (see on page 159 and the **P65000 – Preset value** parameter on page 118);
  - execute the preset by forcing high the **Request set/shift of home position** bit 12 in the **G1_STW** control word, see on page 104;

- the encoder replies by forcing high the **Set/shift of home position executed** bit 12 in the **G1_ZSW** status word, see on page 107;
- the Master must set back to 0 the **Request set/shift of home position** bit 12 in the **G1_STW** control word, see on page 104;
- the **Set/shift of home position executed** bit 12 in the **G1_ZSW** status word is set back to 0, see on page 107; see the diagram on page 163.

Setting and activating the preset via TIA PORTAL and the example project

Documentation is complete with some **example projects** provided free of charge. The projects are designed to help you set and execute the preset with the TIA PORTAL V16 development environment easily. You can find them in the **Lika TIA V16 CPU1500 Profinet example project.zip** compressed file contained in the **SW EXM58_EXO58 PT.zip** file.

To set and activate the preset, please refer also to the "9.2 Record Data Objects" section on page 110.

Refer also to the **Preset EXM58 Profinet encoder Lika.mp4** video.

To set and activate the preset via TIA PORTAL development environment we suggest getting the followings:
- EXM5XX-13-14_RT example project (see Lika TIA V16 CPU1500 Profinet example project);
- Preset EXM58 Profinet encoder Lika.mp4 explanation video.

You need to **set** the preset value through an acyclic request first. To do this proceed as follows:
- check that the **Control by PLC** bit 10 of the **STW2_ENC** control word is ="1", see on page 102;
- check that the **Class 4 functionality** parameter is enabled (="1"), see on page 122;
- check that the **G1_XIST1 Preset control** parameter is enabled (="0"), see on page 122;

- check the hardware identifier of the installed encoder module; to do this go to the **Device view** and select the **Parameter Access Point**. Then enter the **System constants** tab in the Inspector window: in the **Hardware identifier** column you will find the address of the installed encoder module ("264" in the example);
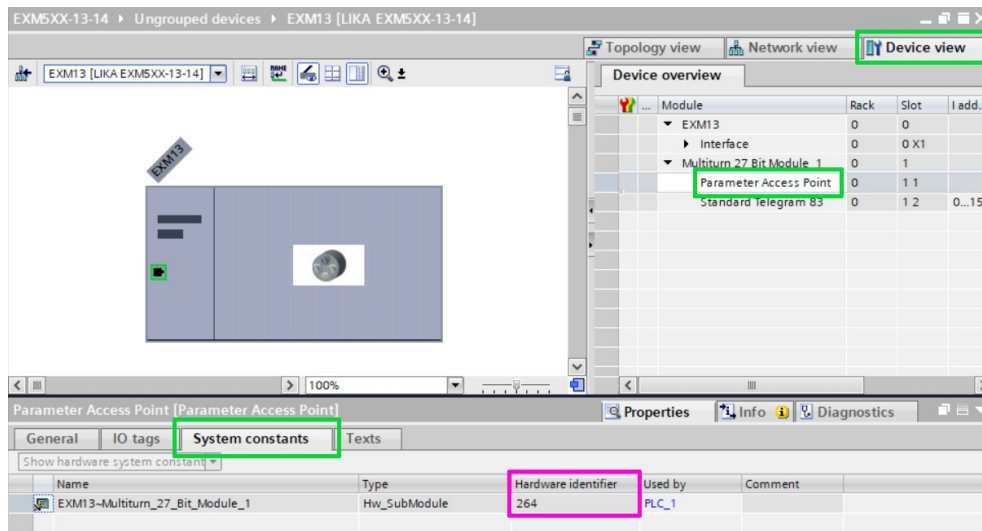
- in the Project tree on the left select **Acyclic Request** under **Watch and force tables**;
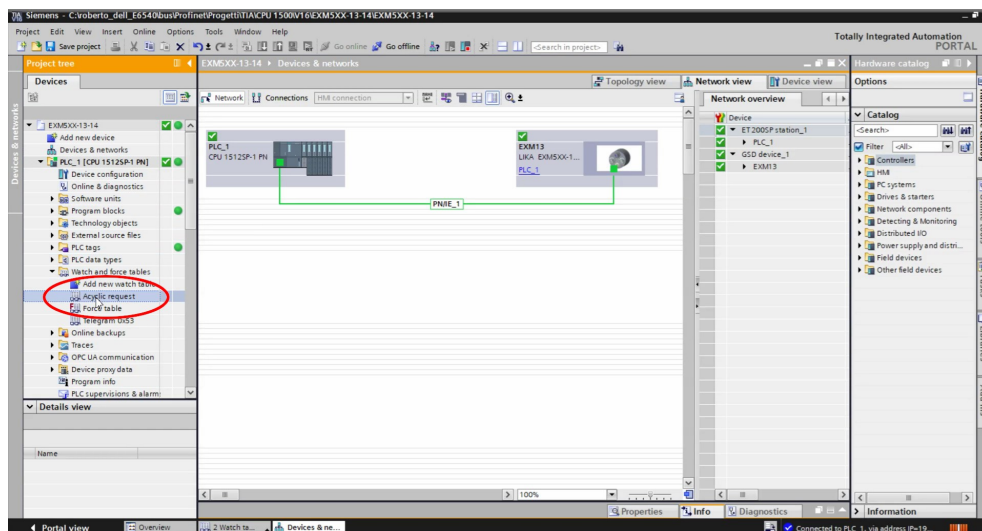
- the **Acyclic request** watch table will be displayed;
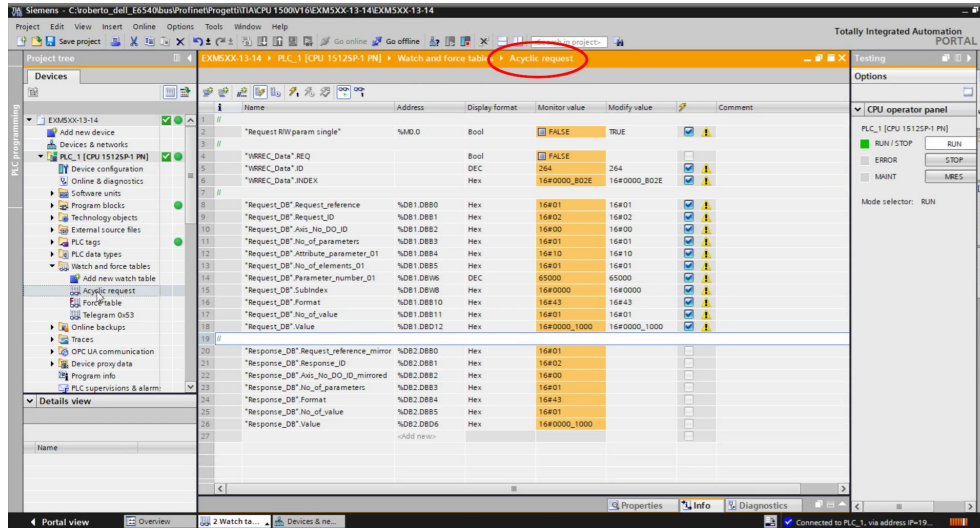
- in the **Acyclic request** table check and set -if required- the following items:
  - **WRREC_Data.ID**: it is the hardware identifier of the encoder's hardware module; please check it matches the one of your encoder ("264" in the example);
  - **WRREC_Data.INDEX**: it is the index of the PROFIdrive profile: "16#0000_B02E"; it cannot be modified;
  - **Request_DB.Request_ID**: it sets whether the parameter is to be read (value 1) or to be written (value 2); enter "2" to set the preset;
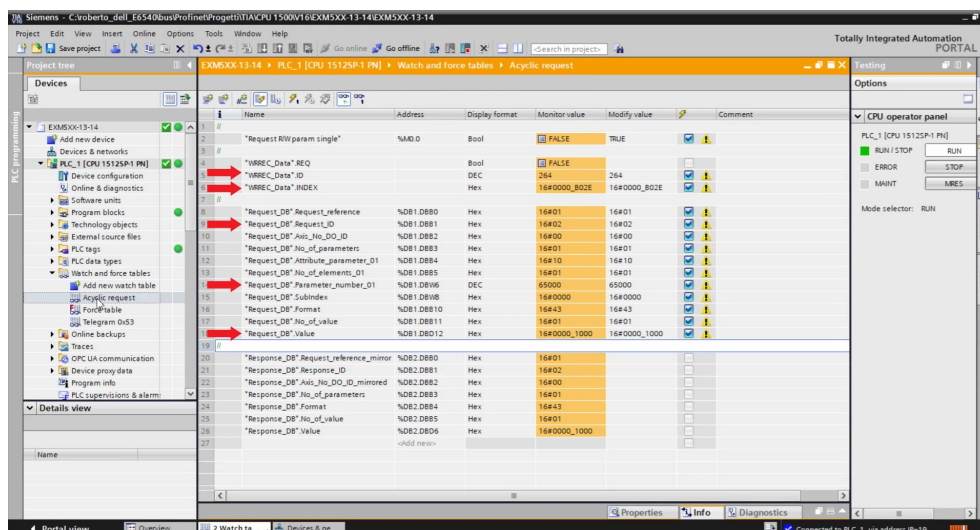
- ○ **Request_DB.Parameter_number_01**: it is the number of the parameter to access; it is "65000" for the preset value, see the **P65000 – Preset value** parameter on page 118;
- ○ **Request_DB.Value**: enter here the preset value you want to set;
- in the **Request_DB.Value** set the new preset value under the **Modify value** column: e.g. "1234" (it is set to "1000" currently, see the **Monitor value** column as well as the **Response_DB.Value** item);
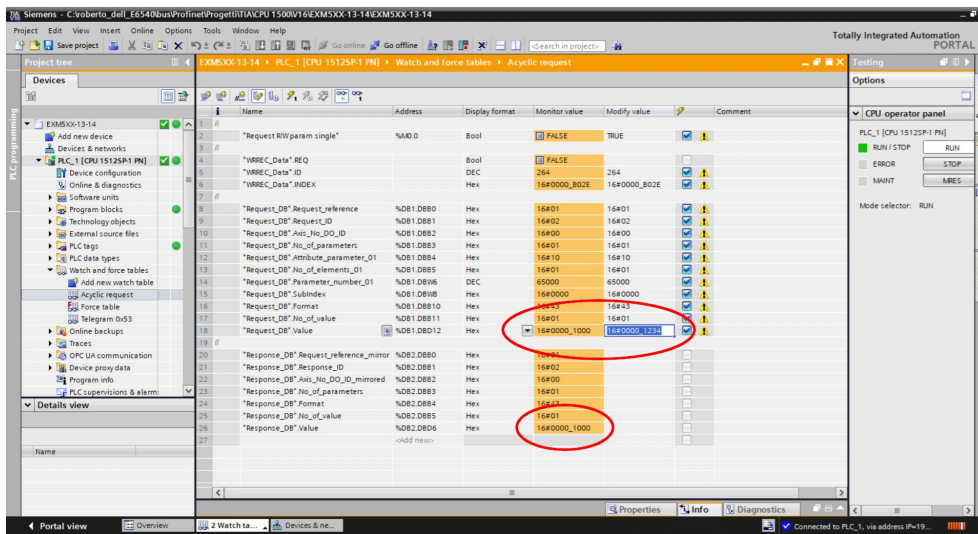
- after setting the new value press the **MODIFY ALL SELECTED VALUES ONCE AND NOW** ⚡ button in the toolbar to confirm the set value; also the **Response_DB.Value** field will be updated;
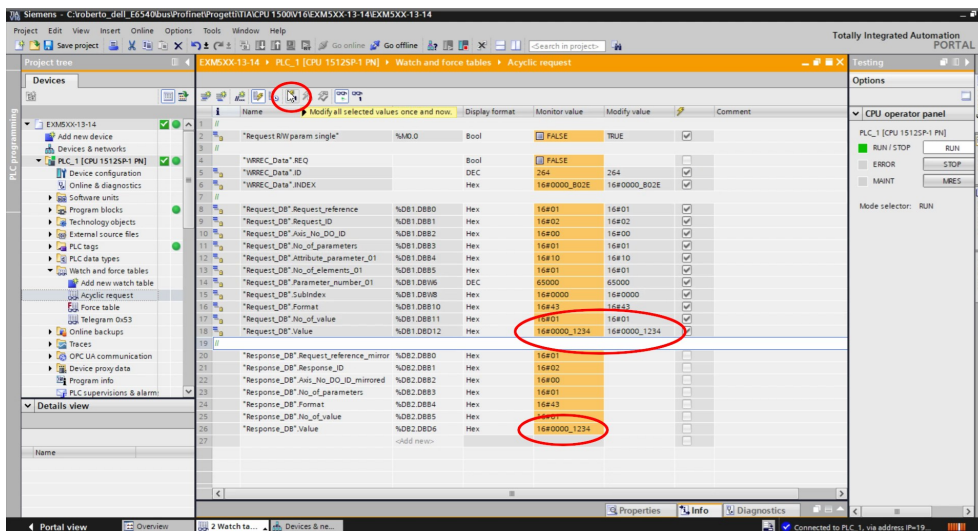
You need to **activate** **the preset value** through the set telegram now. To do this proceed as follows:

- in the Project tree on the left select the **Telegram 0x53** item under **Watch and force tables**; the **Telegram 0x53** watch table will be displayed;
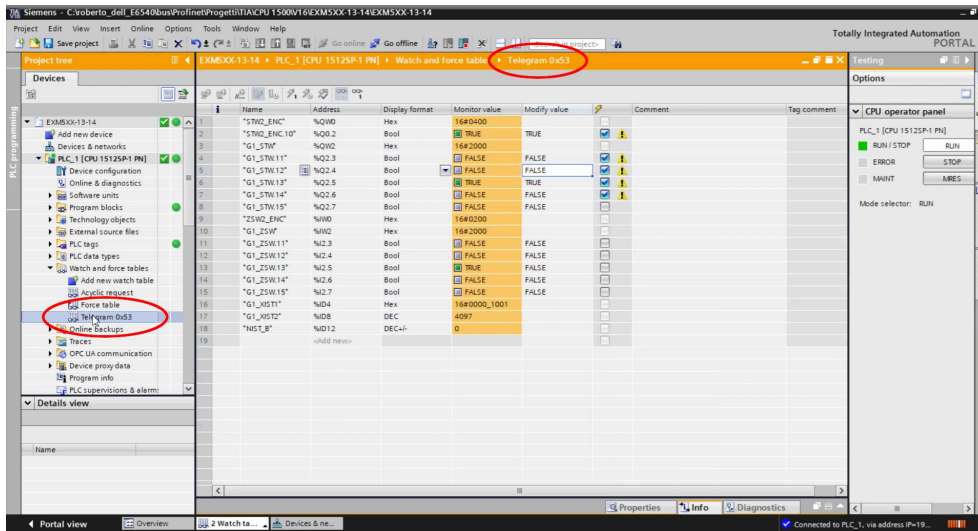
- now you need to force high the **Request set/shift of home position** bit 12 in the **G1_STW** control word, see on page 104; right click the field under the **Modify value** column next to the **G1_STW.12** item and press the **Modify** and **Modify to 1** commands in the drop-down menus that appear;
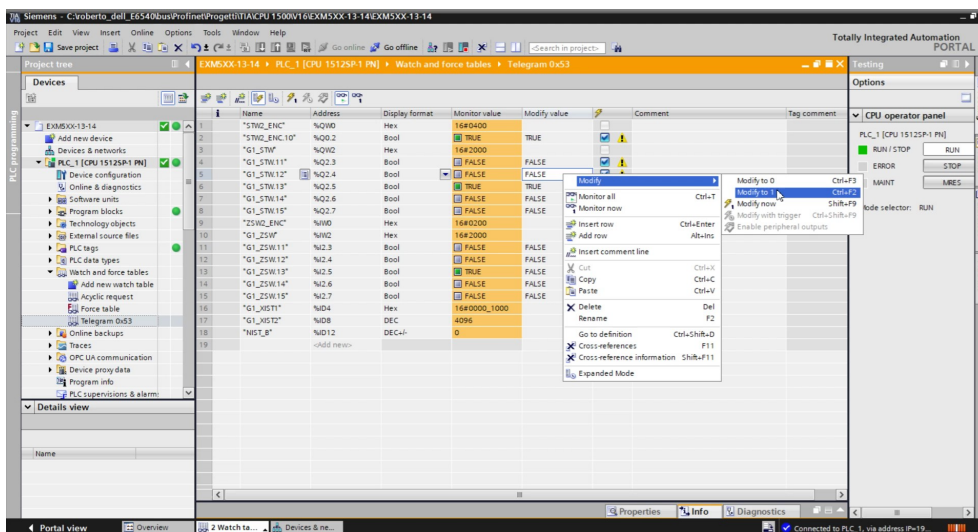
- the encoder replies by forcing high the **Set/shift of home position executed** bit 12 in the **G1_ZSW** status word, see on page 107; see the **G1_ZSW.12** item as well as the **G1_XIST1** and **G1_XIST2** items;
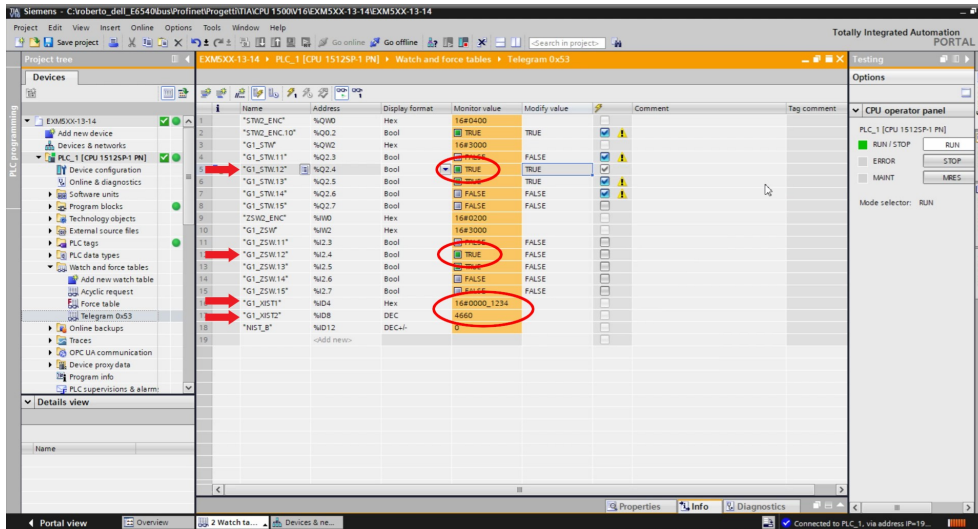
- now you must set back to 0 the **Request set/shift of home position** bit 12 in the **G1_STW** control word, see on page 104; right click the field under the **Modify value** column next to the **G1_STW.12** item and press the **Modify** and **Modify to 0** commands in the drop-down menus that appear;

- the **Set/shift of home position executed** bit 12 in the **G1_ZSW** status word is set back to 0, see on page 107; see the **G1_ZSW.12** item.

WARNING

It is mandatory to set the **G1_STW.12** item back to 0 to avoid the preset value to be entered endlessly.

NOTE

You are not required to save the preset value, it is saved automatically.

5.2 Configuring the encoder with Siemens TIA PORTAL V16

In this manual some screenshots are shown to explain how to install and configure the encoder in a supervisor. In the specific example the development environment is TIA PORTAL V16 with SIEMENS PLC CPU 1500. Therefore, the installation of the GSDML file, the assignment of the IP address and the device name, the configuration of the encoder in the network, topology, diagnostics, etc. will always refer to the aforementioned development tools. If you need to install the encoder using a different configuration tool, please follow carefully the instructions given in the documentation provided by the manufacturer.

Documentation is complete with some **example projects** provided free of charge. The projects are designed to help you set and execute the preset with the TIA PORTAL V16 development environment easily. You can find them in the **Lika TIA V16 CPU1500 Profinet example project.zip** compressed file contained in the **SW EXM58_EXO58 PT.zip** file.

WARNING

If the encoder is used as a **TO Technology Object**, please refer to the "5.7 TO Technology Objects" section on page 78. Please see the **example projects** available in the **Lika TIA V16 CPU1500 Profinet example project.zip** compressed file.

5.2.1 About TIA Portal

TIA Portal stands for Totally Integrated Automation Portal. It is an integrated engineering framework for controllers, HMI, and drives. It integrates several SIMATIC products into a single software in order to increase productivity and efficiency.

TIA portal can be used to configure both the PLC and the visualization in an homogeneous system. Data is saved in a single project. Tools for programming (STEP 7) and displaying (WinCC) are not distinct programs, but editors of a system that has access to and uses a common database. One single user interface is used to enter all functions used for displaying and programming.

5.2.2 Project overview
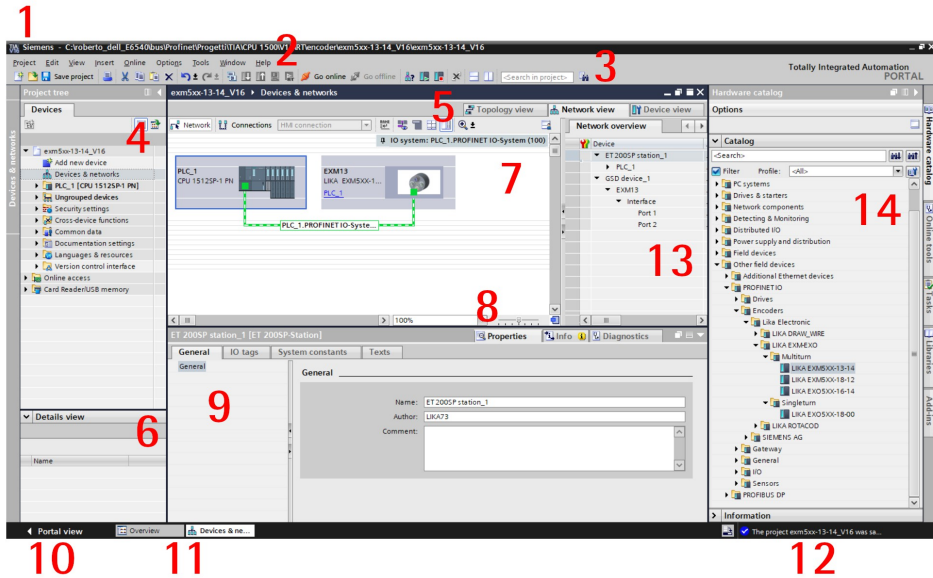
1. **Title bar**: the name of the project is displayed in the title bar.
2. **Menu bar**: the menu bar contains all the commands that you require for your work.
3. **Toolbar**: the toolbar provides you with buttons for commands you will use frequently. This gives you faster access to these commands.
4. **Project Tree**: using the Project Tree features gives you access to all components and project data. You can perform the following tasks in the Project Tree:
   - add new components
   - edit existing components
   - scan and modify the properties of existing components
5. **Changeover switches**: they allow the user to switch among the three working areas of the **Hardware and network editor**: Topology view, Network view and Device view. See point 7 for more information.
6. **Details view**: it shows certain content of the selected object in the **Overview Window** or in the **Project Tree**. This might include text lists or tags. The content of the folders is not shown, however. To display the content of the folders, use the **Project Tree** or the **Inspector Window**.
7. **Graphic Area** of the **Hardware and network editor**. The **Hardware and network editor** opens when you double-click on the **Devices and Networks** entry in the **Project Tree**. The **Hardware and network editor** is the integrated development environment for configuring, networking and assigning parameters to devices and modules. It provides maximum support for the realization of the automation project. This pane is the graphic area where the current configuration of

the installed devices with information on the topology and the network can be found. The **Hardware and network editor** provides you with three views of your project. You can switch between these three views at any time depending on whether you want to produce and edit individual devices and modules, entire networks and device configurations or the topological structure of your project.

See the **Changeover switches**, point 5: **Device view** for parametrisation and configuration of the individual devices, it allows to configure and assign both device and module parameters, see on page 52; **Network view** for graphical connections between devices, it allows to configure and assign device parameters and to network the devices with one another, see on page 52; and **Topology view** for current interconnection of Profinet devices, it allows to display and configure the Ethernet topology as well as to identify and minimize differences between the desired and actual topology, see on page 53. In the Figure above the SIEMENS PLC CPU 1512SP-1 PN is the Master device and is connected to Lika's EXM5XX-13-14 encoder, i.e. the Slave device, through the PLC_1.PROFINET IO-... connection.

8. **Overview Navigation**, it allows to quickly scroll through the objects available in the **Work Area** by pressing the left button of the mouse.

9. **Inspector window**: additional information on an object selected or on actions executed are displayed in the **Inspector window**, the available properties and parameters shown for the object selected can be edited in the Inspector window using the **Properties** tab.

10. It allows to enter the **Portal view**. The Portal view provides you with a task-oriented view of the tools.

11. **Editor bar**: it displays the open editors. If you have opened a lot of editors, they are shown grouped together. You can use the Editor bar to change quickly between the open elements.

12. **Status bar with progress display**. In the status bar, you will find the progress display for processes that are currently running in the background. This also includes a progress bar that shows the progress graphically. Hover the mouse pointer over the progress bar to display a tooltip providing additional information on the active background process. You can cancel the background processes by clicking the button next to the progress bar. If no background processes are currently running, the status bar displays the last generated alarm.

13. **Table Area** of the **Hardware and network editor**: it offers a general overview of the characteristics of the Device (when **Device view** is selected), of the Network (when **Network view** is selected) and of the Topology (when **Topology view** is selected).

14. **Task Cards**: depending on the edited or selected object, task cards are available, they allow you to perform additional actions. These actions include:

- selecting objects from a library or from the hardware catalog
- searching for and replacing objects in the project
- dragging predefined objects to the work area

The task cards available can be found in a bar on the right-hand side of the screen. You can collapse and reopen them at any time. Which task cards are available depends on the products installed. More complex task cards are divided into panes that you can also collapse and reopen.
The **Hardware catalog** can be selected in the **Task Cards**; it allows to install the available components just dragging and dropping them onto the **Work Area**. Customarily the field devices that have been integrated into the TIA Portal via GSDML files are listed under **Other field devices > Profinet IO**.

5.2.3 Device view

Press the **Device view** changeover switch in the **Hardware and network editor** to enter the **Device view**.
The configuration of devices and assigning of addresses etc. is performed in the **Device view**. All devices are represented in a photo-realistic way.

- Buffering of configured hardware modules and reuse with module clipboard
- When zoomed to at least 200%, I/Os are displayed with the symbolic names / addresses
- Automatic readout of available hardware with hardware detect
- Full text search in the Hardware catalogue
- Option of filtering the Hardware catalogue to show modules that can currently be used
- All parameters and configuration data are displayed on a hierarchical and context-sensitive basis

5.2.4 Network view

Press the **Network view** changeover switch in the **Hardware and network editor** to enter the **Network view**.
The **Network view** enables the configuration of plant communication. The communication links between individual stations are displayed here graphically and very clearly.

- Combined view of all network resources and network components
- Fully graphical configuration of the individual stations
- Resources are networked by linking communication interfaces using drag & drop

- Multiple controllers, peripherals, HMI devices, SCADA stations, PC stations, and drives possible in a single project
- Procedure for integrating AS-i devices identical to PROFIBUS/PROFINET
- Zoom and page navigation
- Copying/pasting entire stations, incl. configuration, or individual hardware modules

A subnet (PLC_1.PROFINET IO) is added to the operator panel. Click the subnet (PLC_1.PROFINET IO) to apply the network settings. Specify the required network settings under **Properties > Network Settings** in the **Properties** area (see point 9 on page 50). Make sure that you use the same settings throughout the entire network.

5.2.5 Topology view

Press the **Topology view** changeover switch in the **Hardware and network editor** to enter the **Topology view**.
Decentralised peripherals on Profinet are configured in the Network view. The controllers and the decentralised peripherals assigned to them can be shown graphically. During ongoing operation, however, it is not possible to see which ports are actually connected and communicating with each other.
Yet this is precisely what is often important for diagnostics. For Profinet networks, the **Topology view** enables this information to be displayed quickly and easily. An offline/online comparison identifies the communicating ports. By detecting, presenting and monitoring the physical connections between devices on Profinet, the administrator can easily monitor and maintain even complex networks.

5.3 Network and communication settings

The **MAC address** of the device is reported in the label applied to the device enclosure. See the following section.
The IP address and the subnet mask as well as the Profinet device name must be assigned by the user to each interface of the unit to be connected in the network. By default, before delivery the device name of the encoder is set to a **blank string** and its IP address is set to **0.0.0.0**. See on page 62.

5.4 Mac address

The MAC address is an identifier unique worldwide.

The MAC-ID consists of two parts: the first 3 bytes are the manufacturer ID and are provided by IEE standard authority; the last three bytes represent a consecutive number of the manufacturer.

NOTE
The MAC address is always printed on the encoder label for commissioning purposes.

The MAC address has the following structure:

Bit value 47 ... 24			Bit value 23 ... 0		
X	X	X	X	X	X
Company code (OUI)			Consecutive number		

5.5 Installing the encoder under TIA PORTAL environment

5.5.1 Description of the GSDML file

The functionality of a PROFINET IO device is always described in a GSDML file. This file contains all data that are relevant for engineering as well as for data exchange with the IO device.
PROFINET IO devices can be described using XML-based GSD. The description language of the GSD file, i.e. GSDML (General Station Description Markup Language) is based on international standards. As the name suggests, the GSD file is a language-independent XML file (Extensible Markup Language).

EXM58 & EXO58 Profinet encoders from Lika Electronic are supplied with their own GSDML file **GSDML-V2.35-LIKA-0239-EXM-XXXXXXXX.XML** where XXXXXXXX is the release date of the file in a 8-digit format encompassing information about year (4 digits), month (2 digits), and day (2 digits): **20230417** is the first GSDML file released by Lika Electronic for EXM58 & EXO58 Profinet encoders. Enter Lika's web site **www.lika.biz** to get the GSDML file.
The XML file has to be installed in the Profinet Controller.

Version structure of GSDML files

The GSDML file structure is in compliance with the ISO 15745 "Open Systems Application Integration Framework" and is oriented on the defined profile of a field device via the following model:

GSDML–	V2.35–	LIKA–0239–	EXM	20230417	.xml
GSD data identification	Version of GSDML scheme	Manufacturer	Name of device	Version number, format: yyyymmdd	File extension

- The version of the GSDML model used defines which scope of language a GSD file uses.
- The version date is updated, if, for example, an error is cleared or a function extended.

WARNING

Please always comply with the specifications indicated in the following table:

GSDML file version	Encoder HW version	Encoder SW version	User's guide version
20230417	1	V1.1.0	-
20230804	1	V1.1.1, V1.1.2	1.0
20230804	1	V1.1.2a	1.1

5.5.2 Installing the GSDML file

In the menu bar of the main window, press **Options** and then **Manage general station description files (GSD)** command.
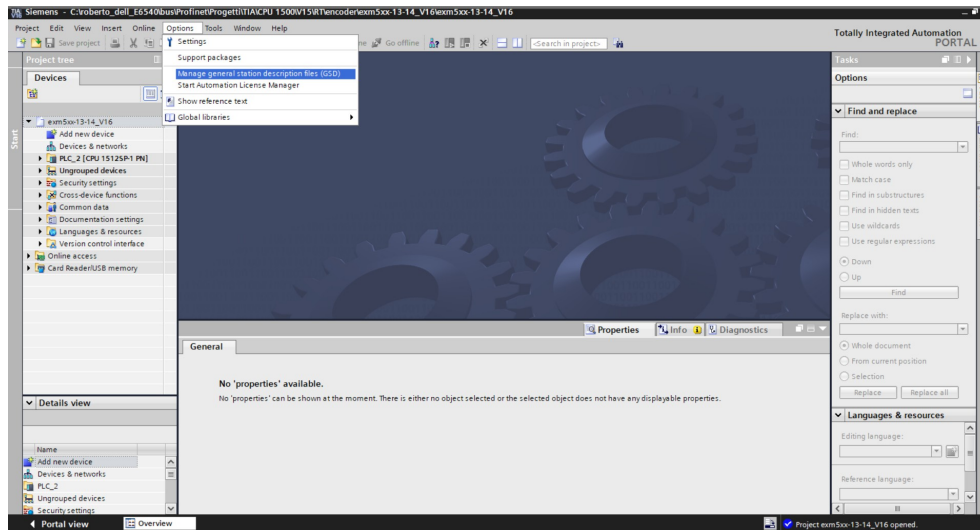
Figure 2 – Installing the GSDML file

The **Manage general station description files** dialog box will appear. Press the **SOURCE PATH** button to choose the folder where the GSDML file is located. Please make sure that the bitmap file representing the encoder is located in the same folder as the GSDML file. Select the GSDML file specific to the device you need to install and press the **INSTALL** button to install it.
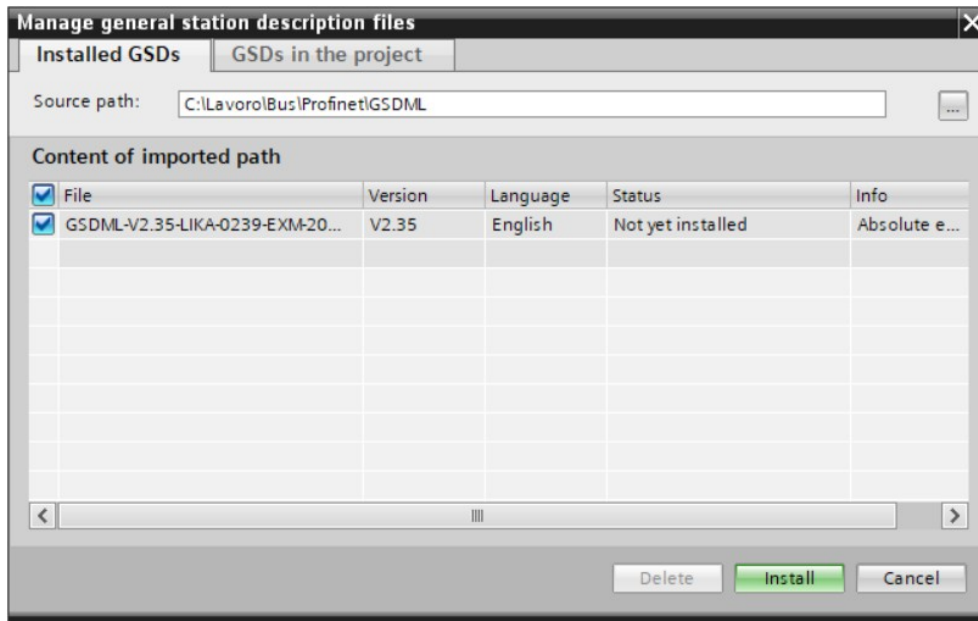
Figure 3 – Selecting the GSDML file

Wait for the installation to be completed.
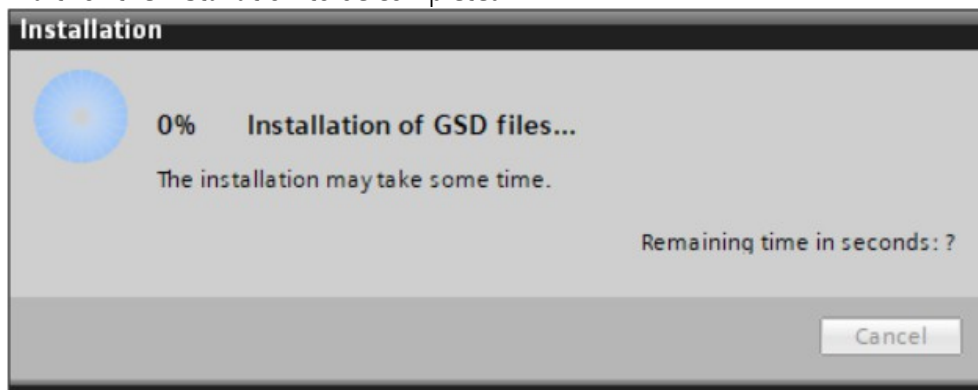
Figure 4 – GSDML file installation in progress

As soon as the operation is carried out, a confirmation message will appear on the screen. Press the **CLOSE** button to close the **Manage general station description files** dialog box.
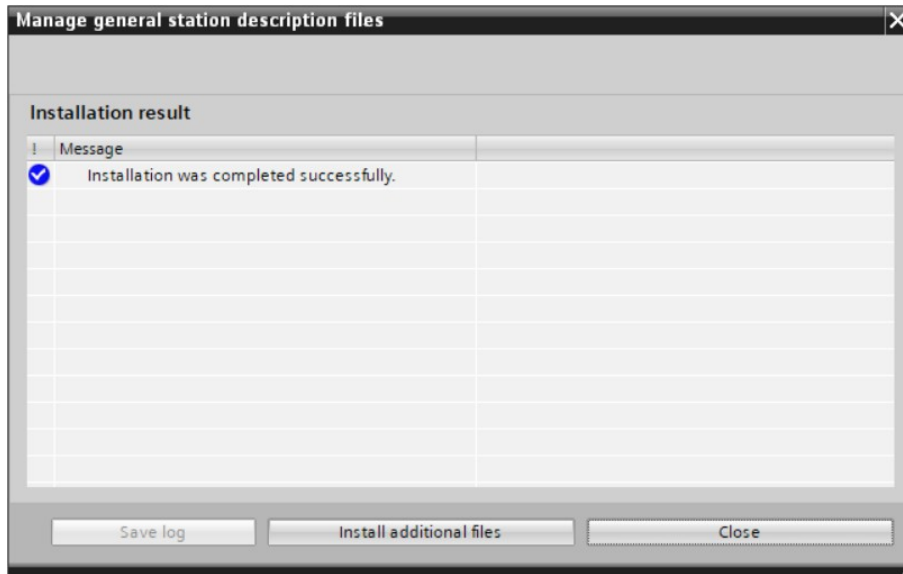
Figure 5 – GSDML file installation completed

Now scroll through the directory tree in the **Hardware Catalog** pane of the main window (task cards) and select the path **Catalog \ Other Field devices \ PROFINET IO \ Encoders \ Lika Electronic**: the **LIKA EXM–EXO** family can be found inside the folder. The installation modules are contained inside the directories MULTITURN (for multiturn version encoders) and SINGLETURN (for singleturn version encoders).
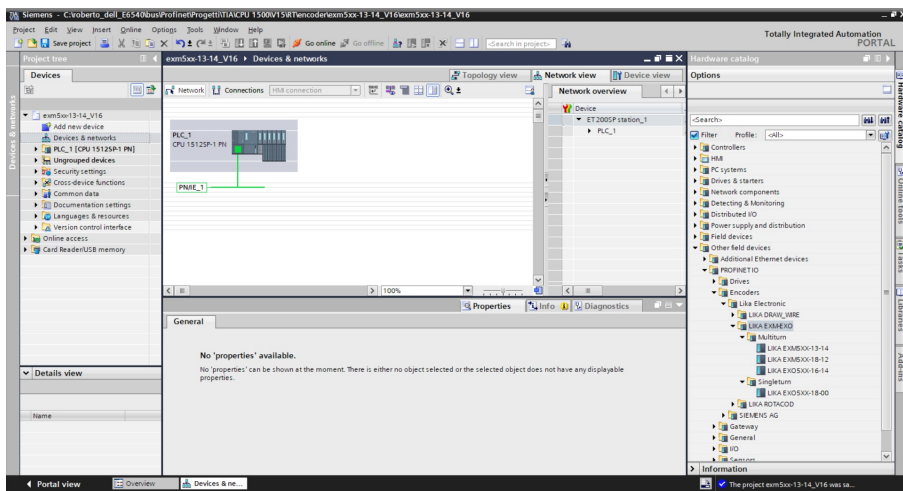
Figure 6 – Scrolling through Profinet families and categories

5.5.3 Adding a node to the project

Now we need to install the module of the desired model. For instance, we want to configure the EXMxx-13-14-PT4-... model.

In the right pane, open the **Hardware catalog** task card to display the field devices integrated into TIA Portal via the Profinet file (GSDML file); select the LIKA EXM-EXO directory; drag the required module LIKA EXM5xx-13-14 to the **Network view** and drop it next to the PLC module. Then assign the module to the network.
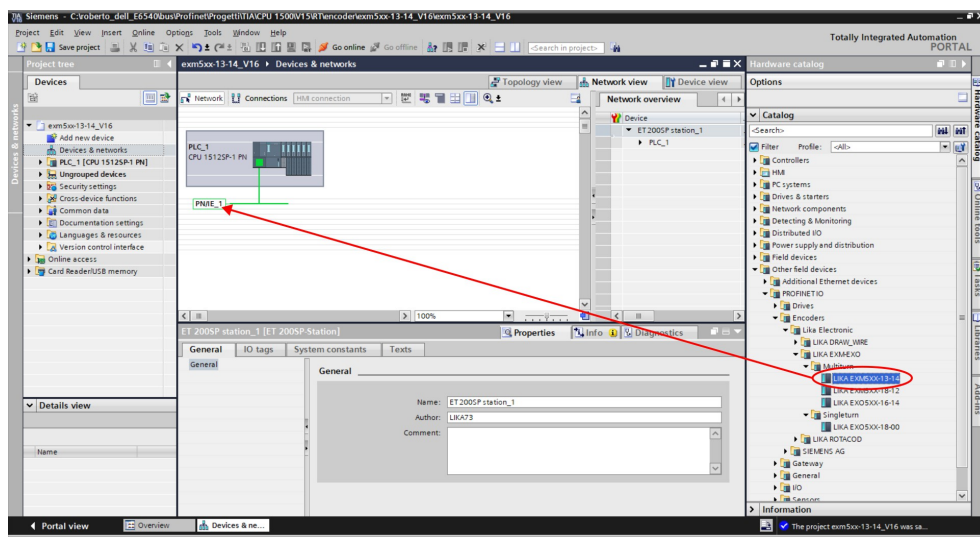
Figure 7 – Adding a node to the project

5.5.4 Establishing the bus connection

As soon as the device has been inserted into the project, the bus connection with the PLC can be established in the **Network view**.

A PROFINET IO system is comprised of a PROFINET IO controller and its assigned PROFINET IO devices. After these devices have been placed in the network or topology view, TIA assigns default values for them.

The "**Not assigned**" information message appears in the picture of the node: it warns that the connection between the PLC and the Slave device is not established yet. Right-click on the message and select, through the **Select IO controller** drop-down box, the PLC the node has to be connected to. When doing so, make sure that you are in the **Network** function mode in the **Network view**.

After configuring the networking, the device is connected to the PLC via the Profinet network.
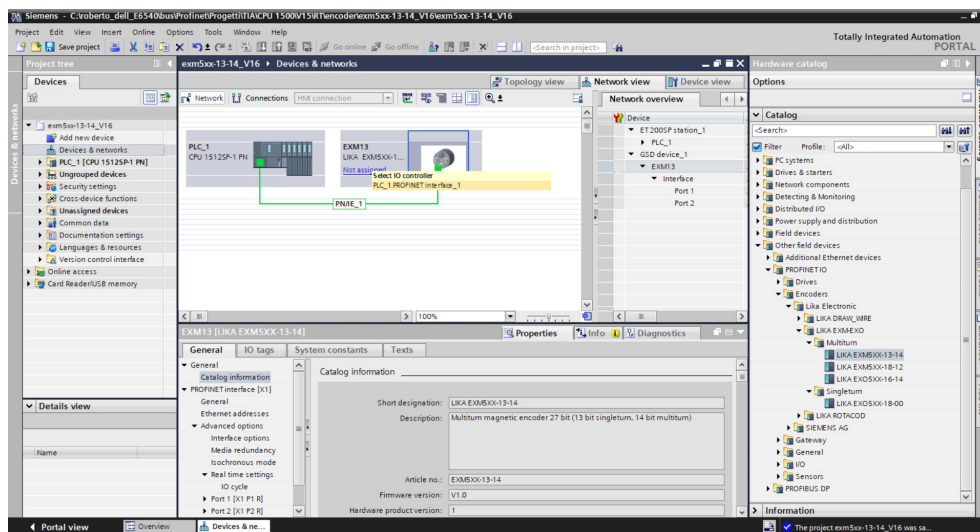
Figure 8 – Establishing the bus connection

5.5.5. Inserting the telegrams

Now we need to choose the data length and the type of data that should be sent to and from the IO controller, thus we need to install a Standard Telegram.

Four types of telegrams with different characteristics are available: Standard Telegram 81, Standard Telegram 82, Standard Telegram 83, and Standard Telegram 84. For detailed information on the Standard Telegrams refer to the "7.1 Telegrams" section on page 95.

For instance, we need to install the Standard Telegram 83. To do this switch to the **Device view** first, then select the desired Telegram available for the module LIKA EXM5xx-13-14 under the SUBMODULES directory in the **Catalog** task card. Drag and drop the STANDARD TELEGRAM 83 submodule onto the table area, as shown in the Figure.
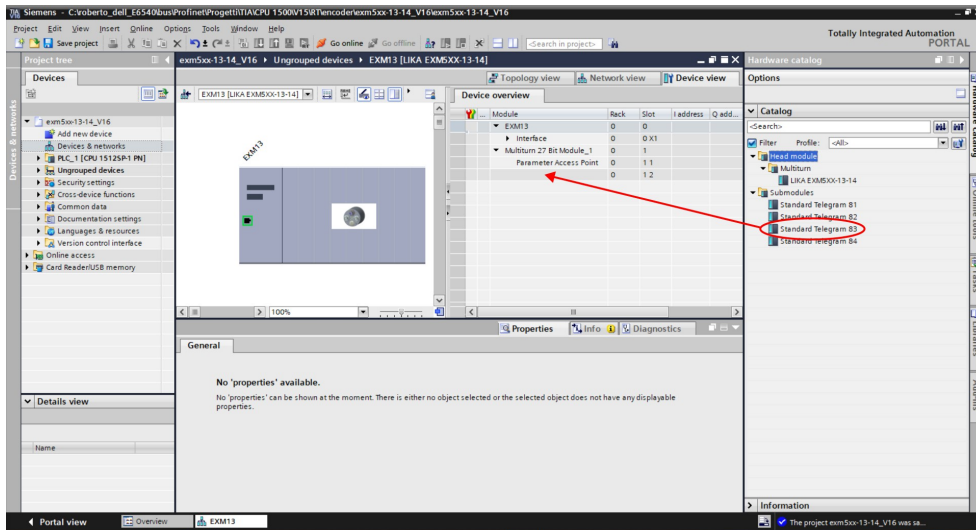
Figure 9 – Adding the Standard Telegrams

5.5.6 Device name and IP address at delivery

In a Profinet network it is mandatory that each IO device is provided with its own Device name and IP address. By default, before delivery the device name of the encoder is set to a **blank string** and its IP address is set to **0.0.0.0**.

Before the PROFINET IO controller can address a PROFINET IO device, a name has to be assigned to the PROFINET IO device. PROFINET uses this method because names are easier to use and recall than complex IP addresses. Devices on an Ethernet subnet must have unique names.

NOTE

An IO Device does not have a device name when delivered. By default, the device name of Lika's Profinet encoders is set to a **blank string**.

The device names must satisfy DNS (Domain Name System) conventions:
- Names are limited to a total of 127 characters (letters, numbers, dashes or dots).
- Any component part (that is, a character string between two dots) of the device name may only be up to 63 characters long.
- Names cannot contain any special character such as umlauts, parentheses, underscores, forward or backward slashes, empty spaces, etc. The dash is the only special character allowed.
- Names must neither start nor end with the minus "-" sign.

Steps for system start-up
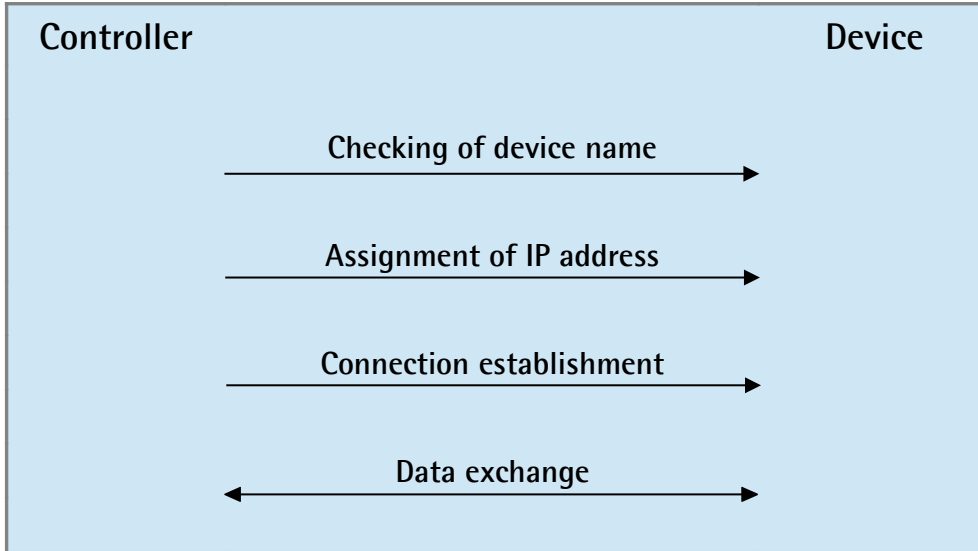
Start-up response
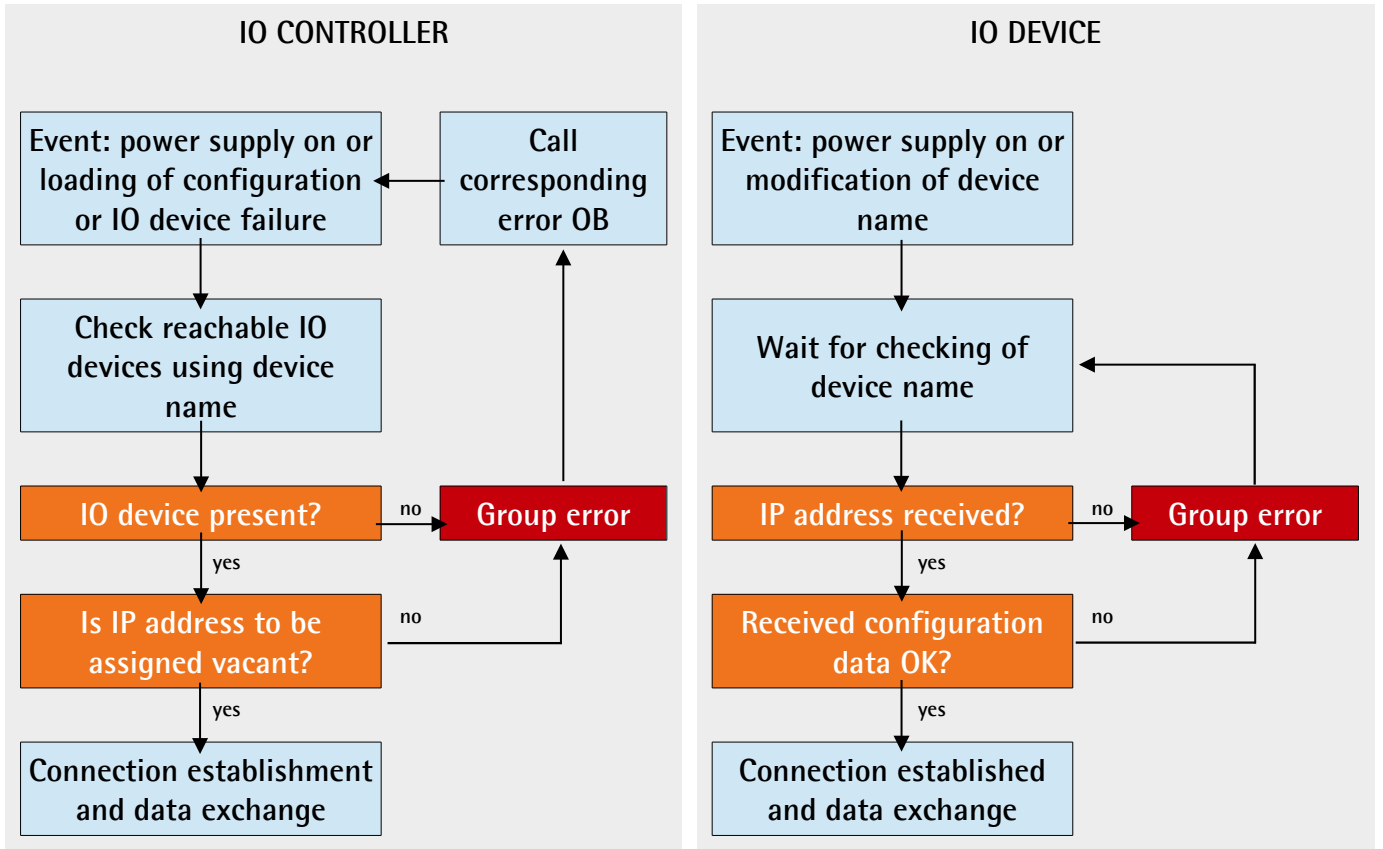
5.5.7 Setting the device name and the IP address in the project

As stated, to completely establish the connection, you have to set and assign the Profinet device name and the IP address to the Slave device. First of all you need to set the Profinet device name and the IP address in the project. To do so, enter the **Device view** working area, select the device you need to configure in the drop-down box on the top left of the graphic area, right-click on the image of the module and select the **Properties** command from the shortcut menu (or the **Assign device name** command as an alternative).
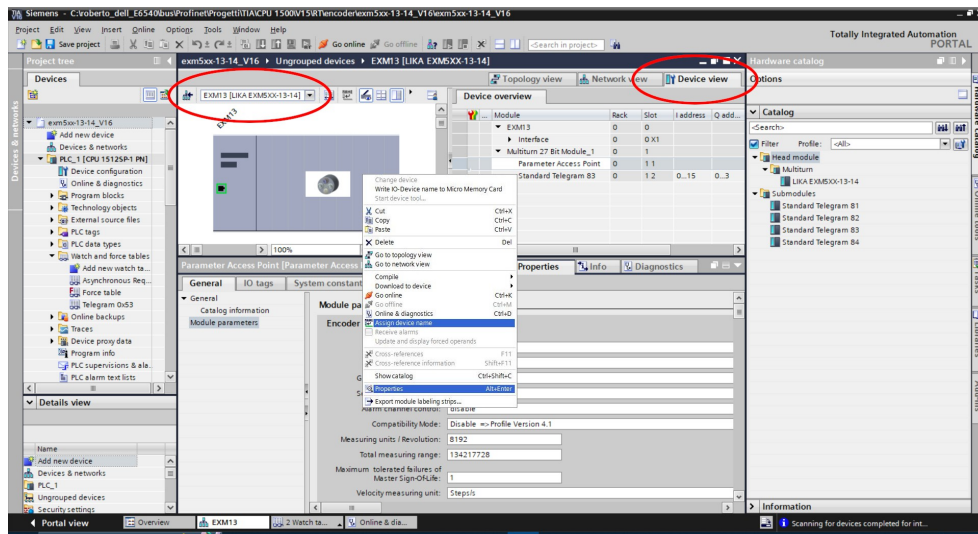
Figure 10 – Setting device name and IP address

In the **Properties** inspector window, **General** tab, you can now use the **Ethernet addresses** menu option to enter the Profinet name of the Device and set the Ethernet address (IP address, subnet mask, ...).
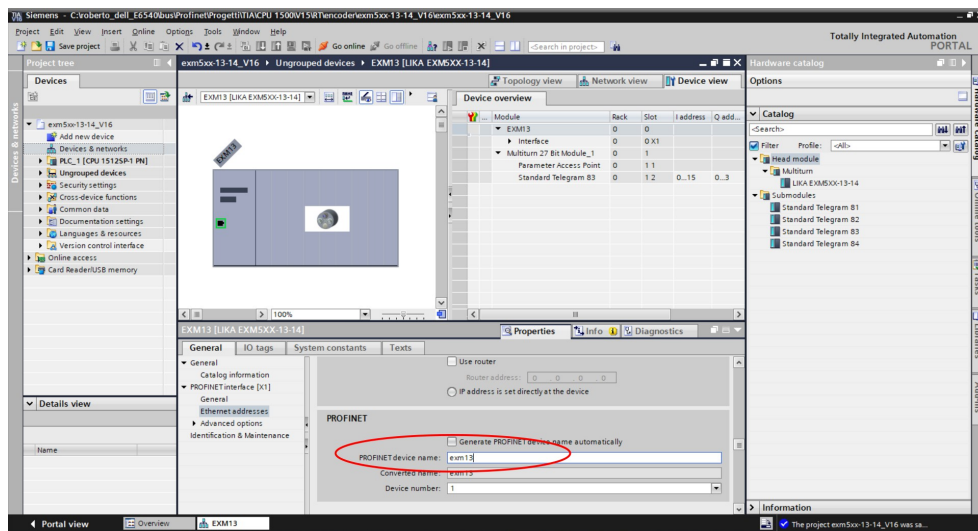
Figure 11 – Setting device name

Enter the **PROFINET** group box and set a desired name in the **PROFINET device name** field or select the **Generate PROFINET device name automatically** check box if you want the name to be generated automatically by TIA.

NOTE
The device name default setting is the name from the GSD file. With integral Profinet interfaces, the device name is derived from the short description. If several devices of the same type are arranged in the same Profinet IO system, TIA automatically supplements the name from the GSD file with a serial number. The second device is assigned the extension "-1", the third device the extension "-2", etc.

Then enter the IP Address in the **IP Protocol** group box.
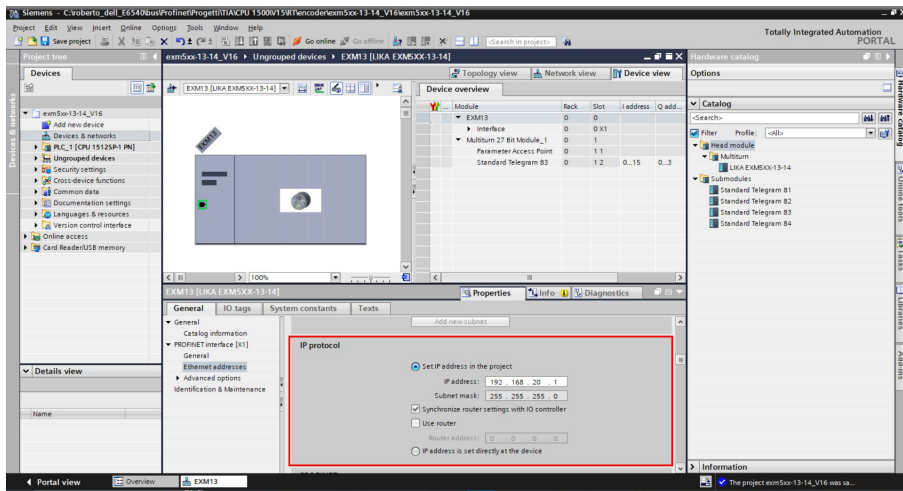
Figure 12 – Setting IP address

5.5.8 Compiling and transferring the project

After setting you must compile and then transfer the project to the device by pressing the **DOWNLOAD TO DEVICE** button ▨ in the toolbar; or by pressing the **ONLINE** button in the toolbar and the **Download to device** command in the drop-down menu that appears.
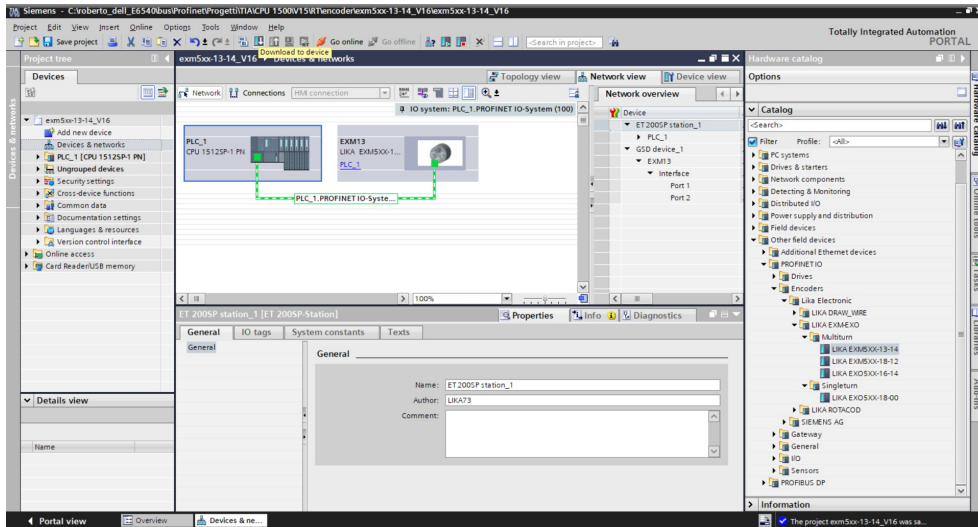
Figure 13 – Downloading the project

5.5.9 Assigning the device name and the IP address to the device

After having set the Profinet device name and the IP address to the device in the project, you must assign them to your real device in the network.

In the **Online** menu bar select the **Assign device name** command.
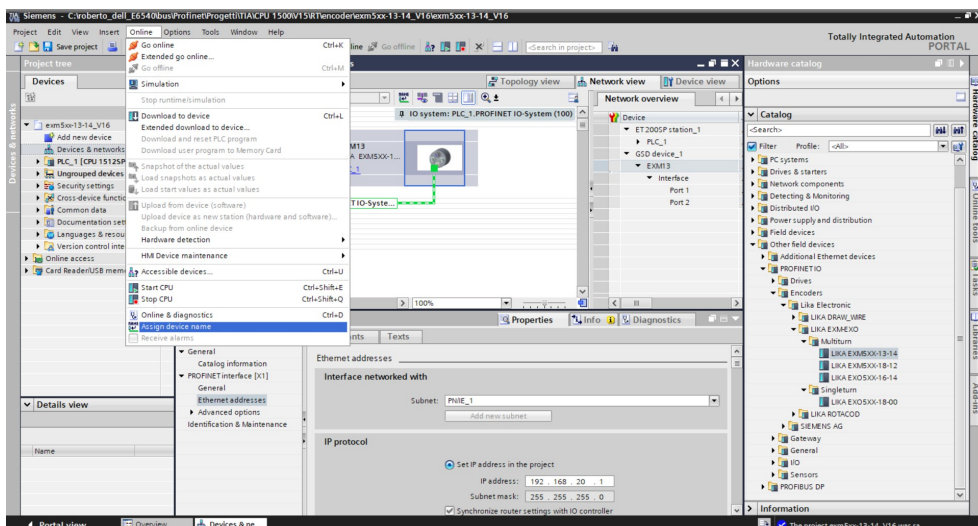
Figure 14 – Assigning the device name

The **Assign PROFINET device name** dialog box will be displayed.

In the **PROFINET device name** field the device name will be automatically displayed. It cannot be changed. If you want a different name to be assigned, you must repeat the procedure by setting the device name again in the **Ethernet addresses** menu option (see the "5.5.7 Setting the device name and the IP address in the project" section on page 64).
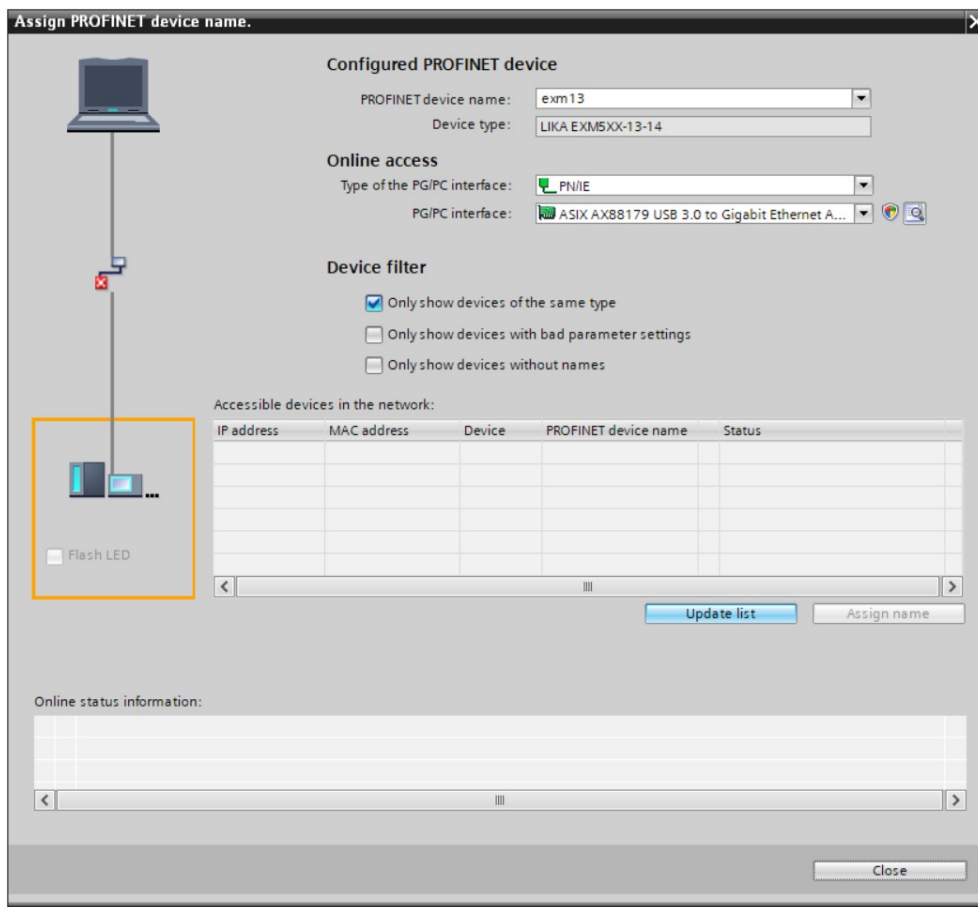
Figure 15 – Profinet device name

To pair the Profinet device name with your device, press the **UPDATE LIST** button to scroll through the network and find the accessible devices.

As soon as the search operation is carried out, the list of the accessible devices in the network will appear in the table, as shown in the Figure below.
Select the device you want the Profinet device name to be assigned to and then press the **ASSIGN NAME** button to complete the pairing operation.
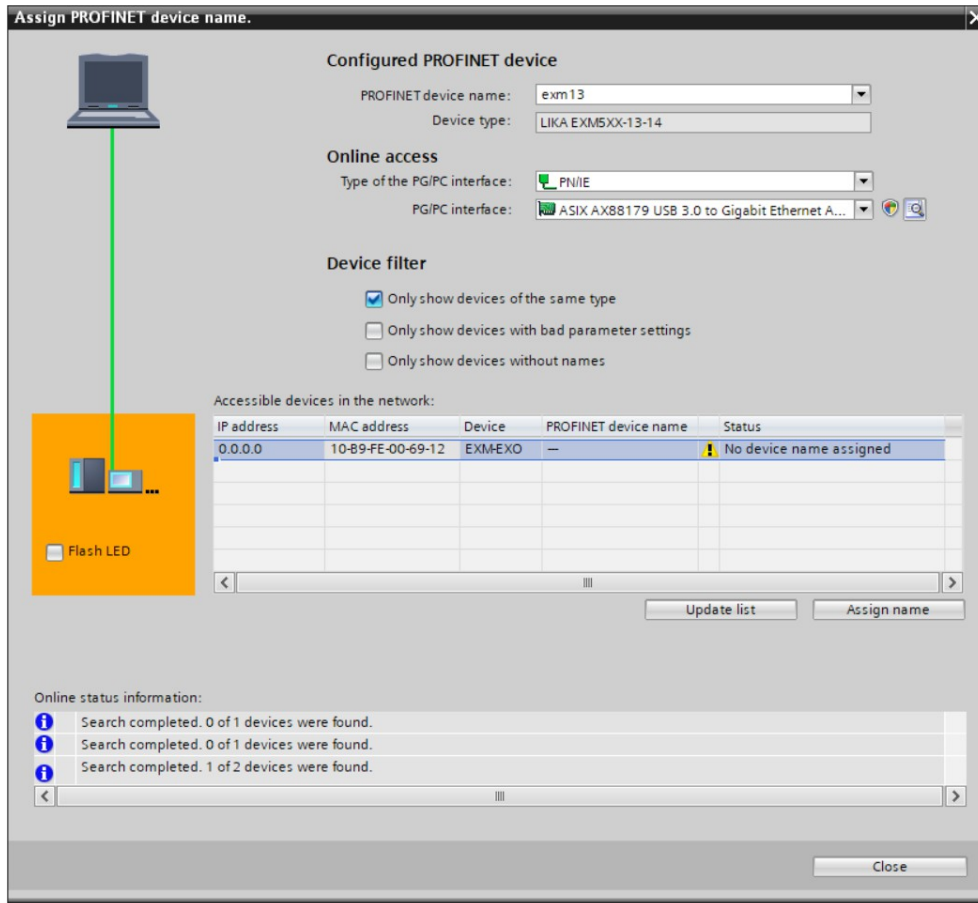
Figure 16 – Assigning the device name

⚠ **WARNING**
Finally you will be required to switch the encoder power supply OFF and then ON again to finalize the process.
The same if you change either the name or the IP address of the device in a later moment: you will be always required to switch the encoder power supply OFF and then ON again to reset the encoder and restart the communication.

5.5.10 Module parameters

Press the **Device view** changeover switch in the **Hardware and network editor** to enter the **Device view** working area, then select the device you need to configure in the drop-down box on the top left of the graphic area. Select the **Module Access Point** field in **Device view**. In the **Properties** inspector window, **General** tab, press the **Module parameters** menu option to see and set, if required, the encoder specific parameters implemented by the manufacturer.
<u>**Parameters listed in this page are sent at each switching on.**</u>
You can change the value of each parameter in the edit field. Parameter data is transferred to the encoder using 0xBF00 data record at each system boot up.
You can change the value of the module parameters also while the device is operational in the Cyclic Data Exchange mode via the Watch table. Please note that the value however will be overwritten at switching on by the value set in the **Module parameters** tabbed page.
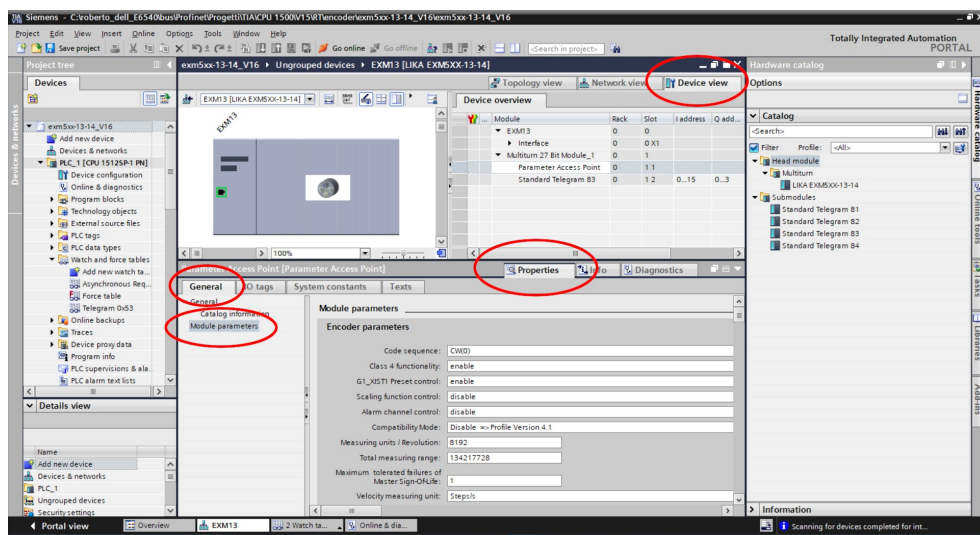
Figure 17 – Module parameters

After having changed any parameter values, you must compile and then transfer the project to the device by pressing the **DOWNLOAD TO DEVICE** button in the toolbar; or by pressing the **ONLINE** button in the toolbar and the **Download to device** command in the drop-down menu that appears.

Please note that a description / help message (tooltip) appears on the display when you move the cursor over the items listed in the table.
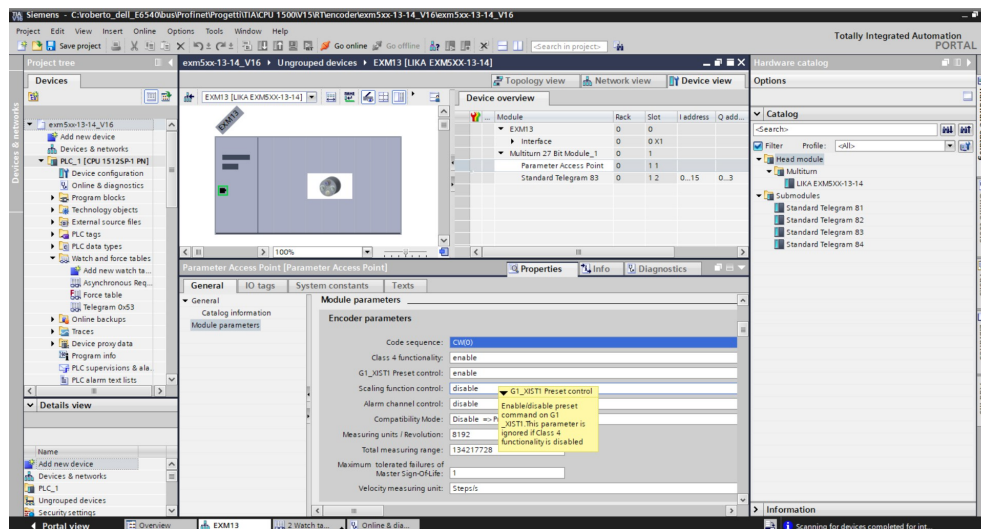
Figure 18 – Description / help message (tooltip)

For a comprehensive description of the parameters and how to set them properly refer to the specific explanation in the "9.5 Record Data Object 0xBF00: user parameter data" section on page 121.

5.5.11 Establishing an online connection (Online mode)
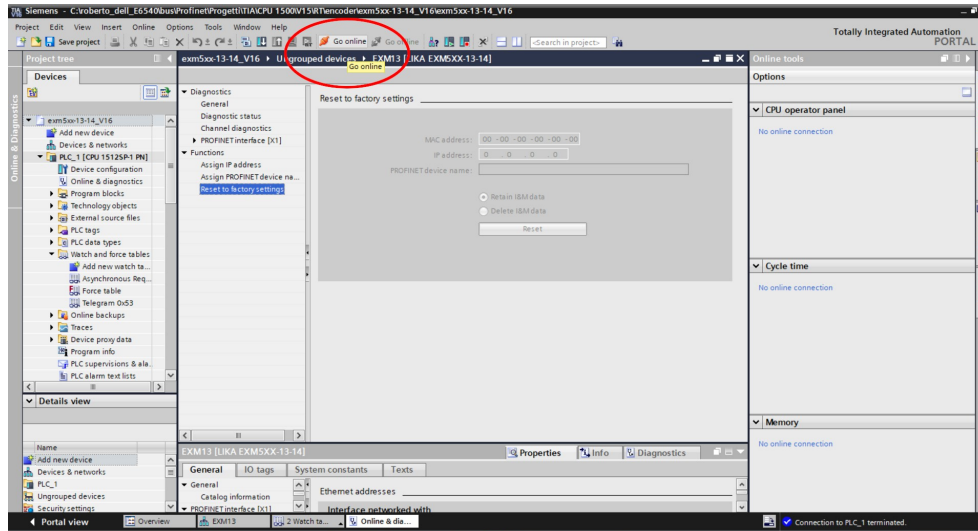
Figure 19 – Establishing an online connection

In online mode, there is an online connection between the PLC and one or more devices. An online connection between the PLC and the device is required, for example, for the following tasks:
- using the Control Table;
- testing user programs;
- displaying and changing the operating mode of the device;
- displaying module information;
- comparing blocks;
- hardware diagnostics.

Before you can establish an online connection, the PLC and the device must be physically or remotely connected.
After establishing a connection, you can use the **Online and Diagnostics view** or the **Online tools** task card to access the data on the device. The current online status of a device is indicated by an icon to the right of the device in the **Project Tree**.

To establish an online connection between the PLC (Profinet Controller) and the device (Profinet Device) proceed as follows.
- In the **Project Tree** (see point 4 in the "5.2.2 Project overview" section on page 50) mark the folder of the PLC that is configured as the Controller.
- Select the **Go online** command in the **Online** menu bar to establish an online connection to the PLC (Controller) and to the device (Device).

- If the device has already been connected online, the online connection is automatically established using the previously specified connection path.
- If there was no previous connection, the **Go online** dialog opens.
- Select the connection path:
  - select the type of interface;
  - select the interface of the PLC;
  - select the interface or the subnet for the connection.
- Click the **START SEARCH** button. Devices which can be reached by the set connection path are displayed in the **Compatible devices in target subnet**. The connection line in the graphic is displayed as solid.
- Select the device in the **Compatible devices in target subnet table** and confirm the selection with **Go online**. The online connection to the selected target device is established.
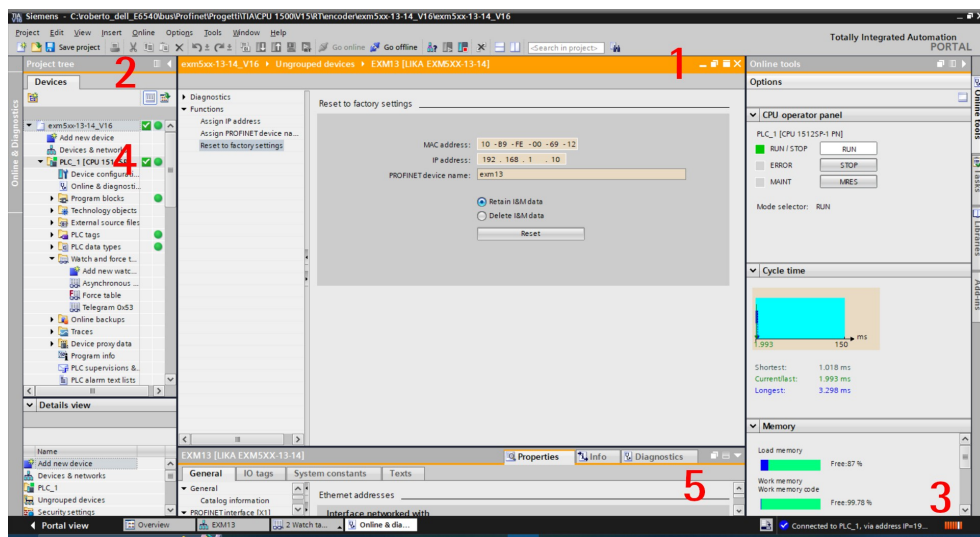
Figure 20 – Online connection established

After the online connection has been established successfully, the user interface changes (see the Figure above).

1. The title bar of the active window gets an orange background as soon as at least one of the devices currently displayed in the editor has been successfully connected online. If one or more devices are unavailable, a symbol for a broken connection appears in the title bar of the editor.
2. Now the title bars of inactive windows for the relevant station have an orange line below them.
3. An orange, pulsing bar appears at the right-hand edge of the status bar. If the connection has been established but it is not working properly, an icon for an interrupted connection is displayed instead of the bar. You

will find more information on the error in **Diagnostics** in the **Inspector window**.

4. Operating mode symbols or diagnostics symbols for the stations connected online and their underlying objects are shown in the **Project Tree**. A comparison of the online and offline status is also made automatically. Differences between online and offline objects are also displayed in the form of symbols.

5. The **Diagnostics > Device information** area is brought to the foreground in the **Inspector window**.

5.5.12 Closing an online connection

To close the existing online connection, follow these steps.

1. Select the device for which you want to disconnect the online connection in the **Project Tree**.

2. Select the **Go offline** command in the **Online** menu bar. The online connection is disconnected.

5.5.13 Diagnostics

Configuration of the diagnostics is integrated in the system in a user-friendly way and activated with just one click. When new hardware components are introduced, the diagnostic information is updated automatically via the engineering system (HWCN). System diagnostics outputs all relevant information on existing errors in the system. This information is packaged automatically in messages containing the following elements:

- module;
- message text;
- message status.

To access the diagnostics function please proceed as follows.
1. Right-click on the module to process.
2. Select the **Online & diagnostics** command from the shortcut menu.
3. If there is no online connection established, click the **CONNECT ONLINE** button in the **Diagnostics** entry.
4. The diagnostic status of the module will be displayed in the **Diagnostic status** group in the **Diagnostics** folder in the **Online and diagnostics view** of the module to be diagnosed.

The following status information is displayed in the **Diagnostic status** area:
- Status of the module as viewed by the CPU, for example:
  - Module available and OK.
  - Module defective.
    If the module experiences a fault and you have enabled the diagnostic error interrupt during configuration, the "Module defective" status is displayed.
  - Module configured, but not available.
    Example: Diagnostics data is not available because the current online configuration differs from the offline configuration.
- Detected differences between the configured and the inserted module. Provided it can be ascertained, the article number will be displayed for the set and actual type.

The scope of the displayed information depends on the selected module.

5.6 Resetting the parameters to the default factory values

Default values are provided to each parameter of the device and are preset at the factory by Lika Electronic engineers. For the complete list of machine data and relevant default parameters, please refer to page 179. The first time you install the encoder, it will operate using the default values. They allow the operator to run the IO device for standard and safe operation. They are not plainly optimized for specific application yet provide maximum performance for most systems. To suit the specific application requirements it may be advisable and even necessary to enter new parameters instead of the factory default settings.
There could be exceptional circumstances where it would be necessary for you to restore the default values of the settable parameters. When this is the case, you have to use the **Reset** command.

NOTE

When you restore the default values, please always consider that:
- the encoder parameters will be restored to the default values (see on page 179);
- the encoder offset will be reset;
- the Device Name will be lost and replaced with a blank string;
- the IP address will be set to 0.0.0.0;
- the parameters associated with the IP range will be set to 0.

WARNING

The execution of this command causes all the values which have been set previously next to each parameter to be overwritten!

NOTE

The complete list of machine data and relevant default parameters preset by Lika Electronic engineers is available on page 179.

When you need to restore the default values proceed as follows.

Enter the **Device view** working area, select the device you need to configure in the drop-down box on the top left of the graphic area, right-click on the image of the module and select the **Online & diagnostics** command from the shortcut menu (or double-click the **Online & diagnostics** command in the project tree). Confirm your request in the dialog box that appears.
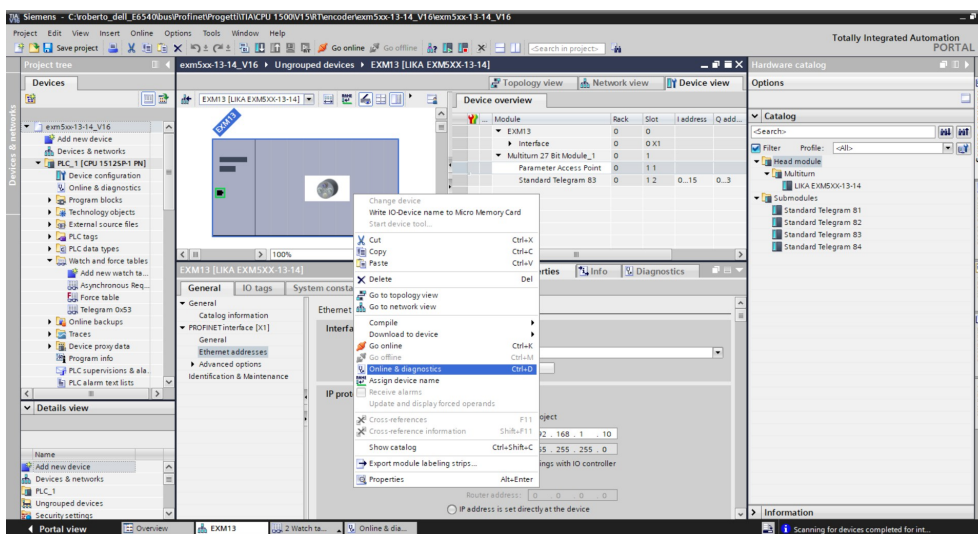
Figure 21 – Restoring default values

To get started with the diagnostic functions you must go online. To do this you must press the **Go online** command in the **Online** menu bar (see also the "5.5.11 Establishing an online connection (Online mode)" section on page 71).
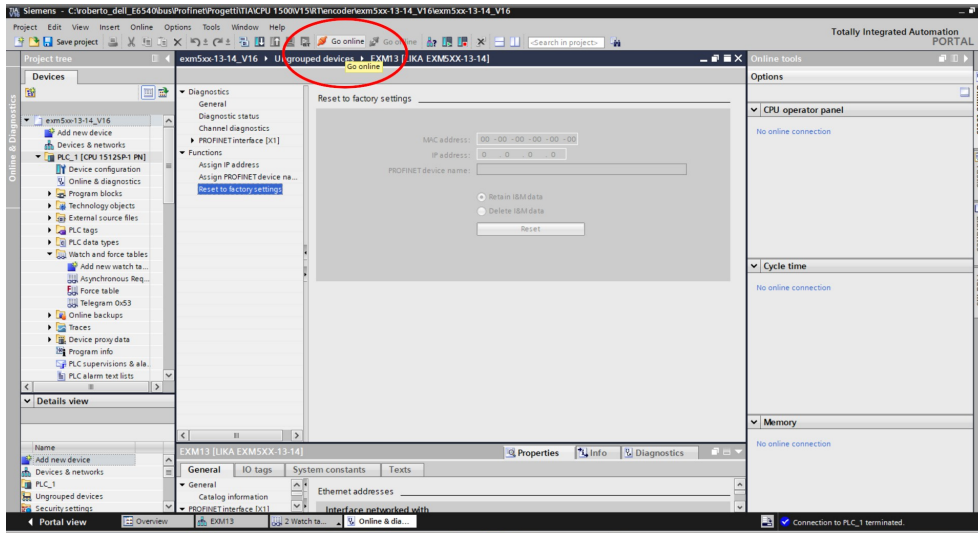
Figure 22 – Going online

The **Diagnostics** working area window contains information about the encoder, statuses, events, etc.
Under **Functions** press **Reset to factory settings**.
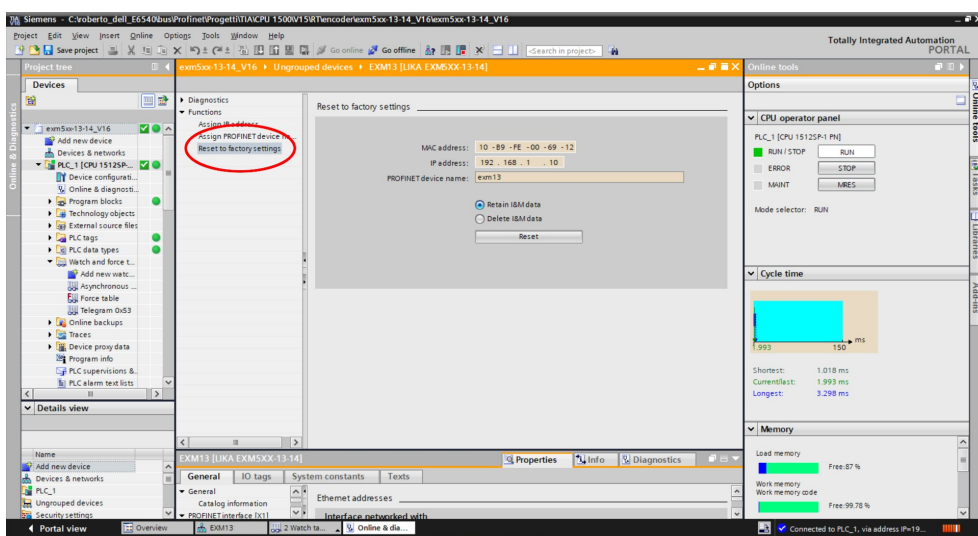
Figure 23 – Reset to factory settings

Next to the **MAC address** item in the **Reset to factory settings** graphic area enter the MAC address of the encoder you need to reset (it is written on the encoder label) and then press the **RESET** button to confirm.

As soon as you press the **RESET** button in the **Reset to factory settings** graphic area, a warning message (**Do you really want to reset the module?**) appears on the screen: it warns the operator about the awkwardness of the operation, thus he is required to confirm the procedure before continuing.
Press the **YES** button to proceed, otherwise press the **NO** button to abort the procedure.
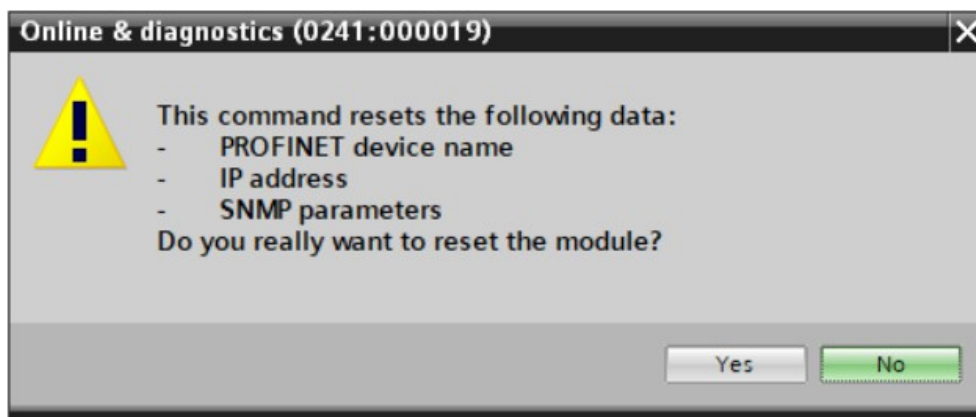
Figure 24 – Confirming the reset to factory settings

When the operation is carried out, if you browse the network to find the accessible devices, you will see the value 0.0.0.0 under the **IP address** item and three dashes under the **PROFINET device name** item, they are followed by the message "No device name assigned". Refer to the "5.5.9 Assigning the device name and the IP address to the device" section on page 66.
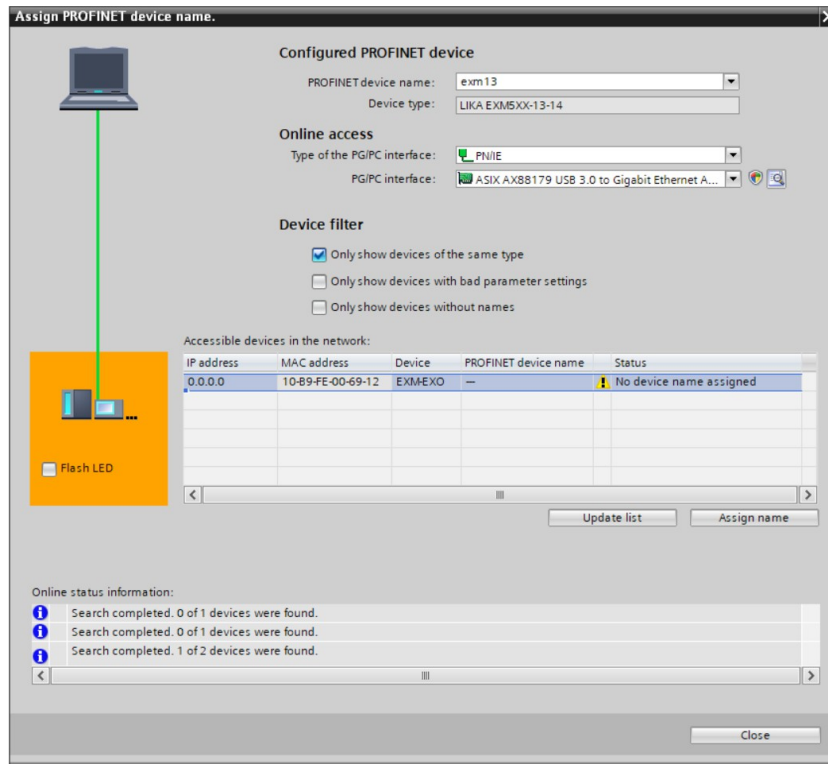
Figure 25 – Encoder reset

5.7 TO Technology Objects

In order to be able to facilitate the use of technological functions that can be used with a SIMATIC controller, what is known as **Technology Objects** have been introduced in the programming environment of SIMATIC. Within these technology objects, the available functions are encapsulated and provided to the creator of the user program for easy access and the easy use in the programming environment.

In particular these technology objects are used in the "motion control" area to simplify the control and handling of axes and additional motion control functionalities and to support the user in the creation of a user program with motion control functionalities.

5.7.1 Properties of a technology object (TO)

A technology object (TO) for motion control in the SIMATIC has the following properties:

- The technology object represents a software object in the controller.
- The technology object represents the mechanical components.
- The technology object encapsulates the technological functionality.
- The technology object allows a uniform setting and configuration.
- The technology object ensures a simple connection of the drives and encoders as well as the distributed I/O.
- The technology object encapsulates the mechanical configuration, the monitoring and limitations of the drive and the mechanic that is connected to it.
- The technology object is addressed via PLCopen motion control instructions from the user program.

This guarantees a simple and standardized use of the motion control functionalities in the SIMATIC.

5.7.2 Installing the encoder as a technology object (TO)

First of all, if the encoder has to be used as a TO Technology Object, please set the Compatibility Mode parameter to 0 = Enable = Compatible with Encoder Profile V3.1, see on page 125.
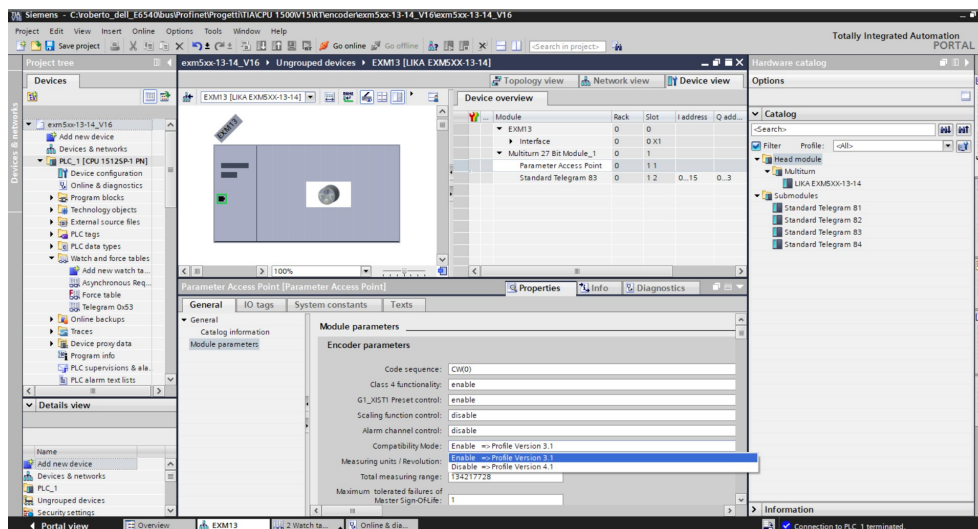
Figure 26 – Checking the Compatibility Mode parameter setting

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EXM58 • EXO58 Profinet

When you need to add a new technology object, click **Add new object** under the **Technology objects** item in the project tree: the **Add new object** dialog box will be displayed.
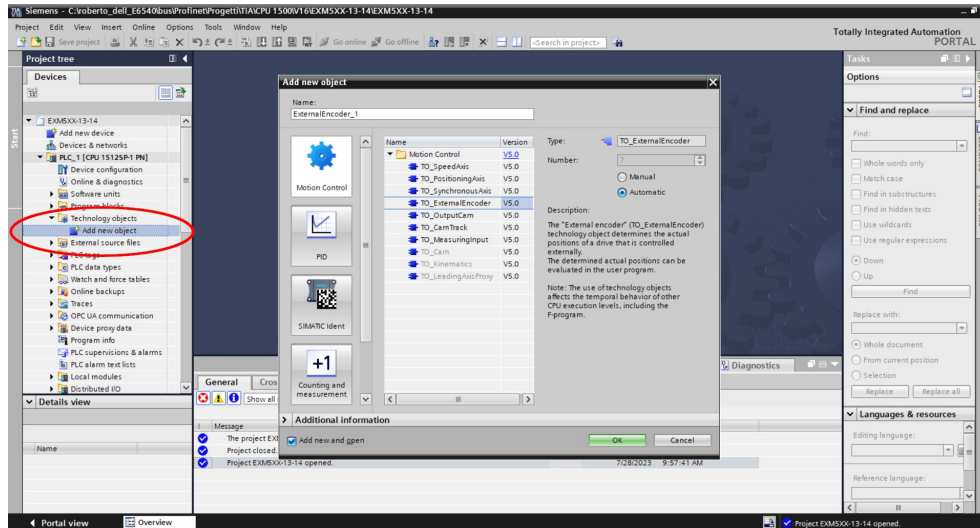
Figure 27 – Adding a new technology object

In the **Add new object** dialog box, select the entry **TO_ExternalEncoder** under the **Motion Control** list. Press the **OK** button to confirm.
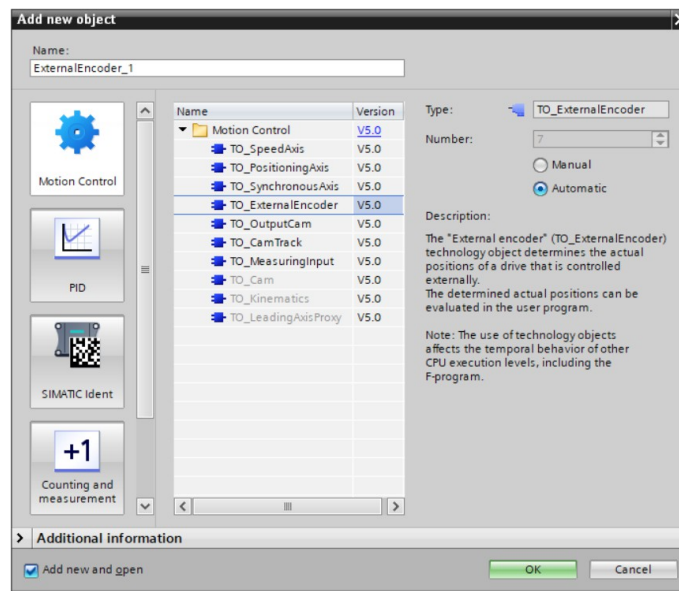
Figure 28 – Adding an External Encoder technology object

Under **Basic parameters** in the **Function view** working area set the available items according to the technical features of the encoder to be connected.

Please note that when a new object is successfully added, the object node is added to the Project tree and the configuration for this newly added device is opened.
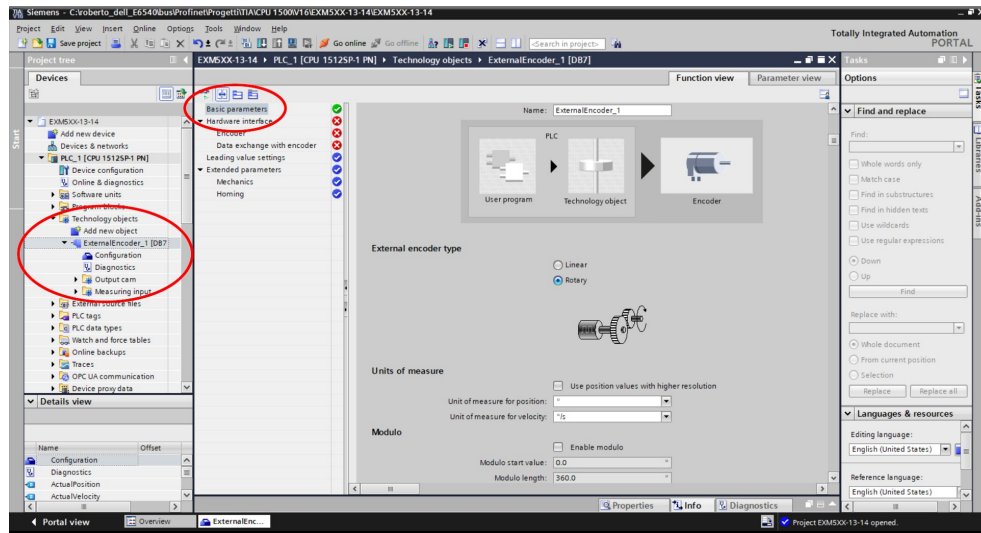
Figure 29 – Setting the TO basic parameters

Under **Hardware interface** set both the **Encoder** parameters and the **Data exchange** parameters. Select the telegrams to be used and set the singleturn resolution and the number of revolutions. In the example an EXM58-13-14-PT4-... encoder is to be connected as TO.
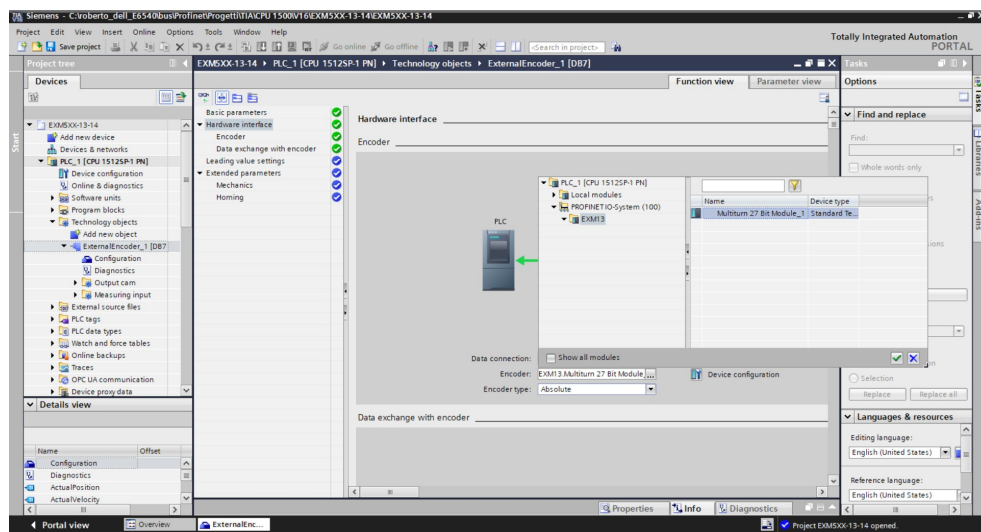
Figure 30 – Setting the TO hardware interface

As soon as the parameters are set, some green ticks will appear in the lateral bar to indicate the proper configuration.

When the TO is configured, the **Encoder** page will appear as in the following view:
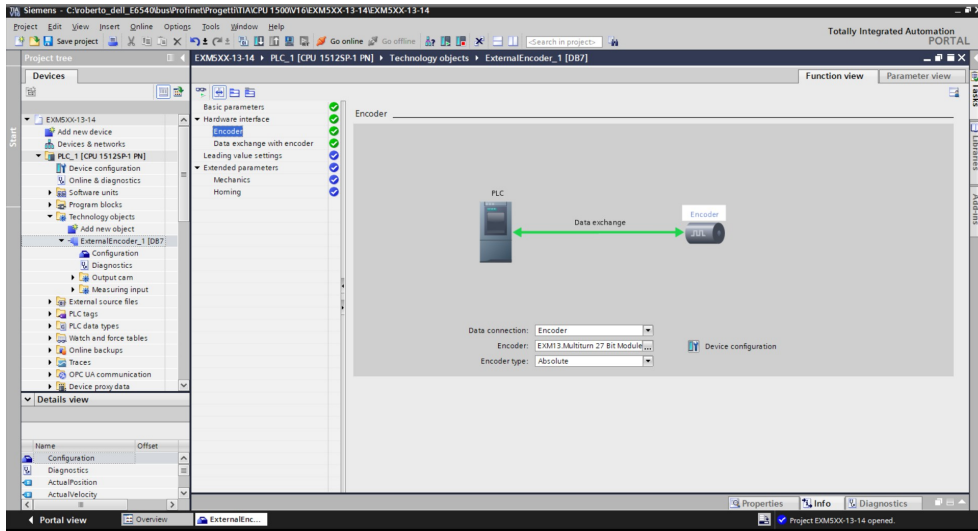
Figure 31 – Encoder area with configured TO

When the TO is configured, the **Data exchange with encoder** page will appear as in the following view:
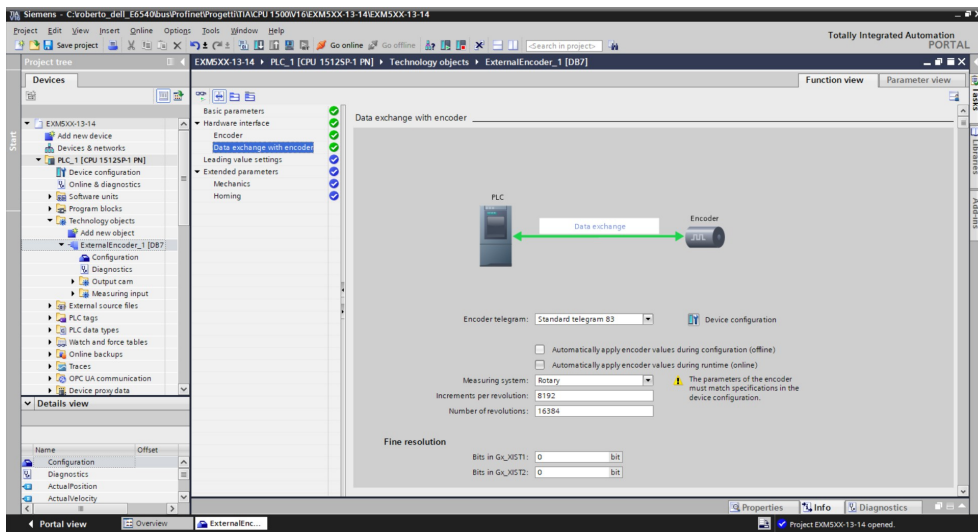
Figure 32 – Data exchange area with configured TO

5.7.3 Adding additional data blocks and function blocks

Some data blocks and function blocks are added automatically when you install the new encoder object.

Network 1:
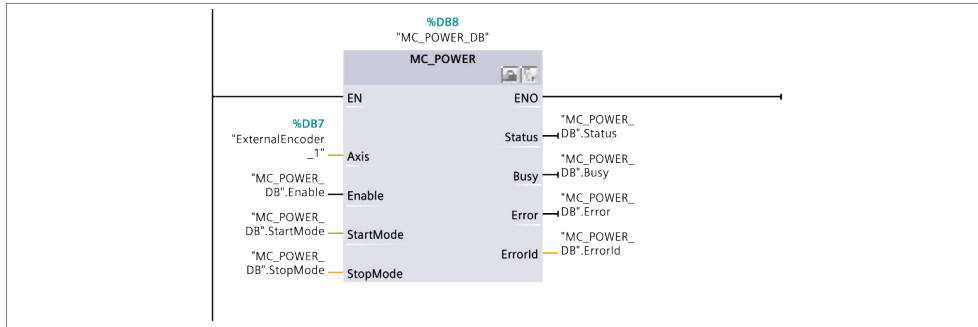
Network 2:
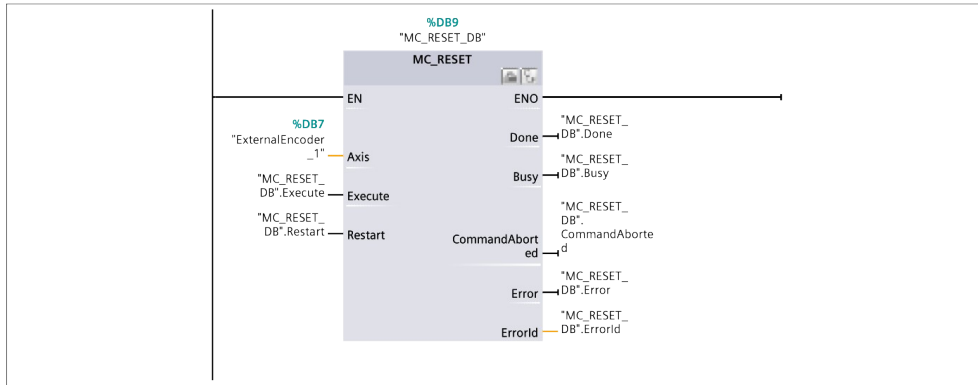
Network 3:
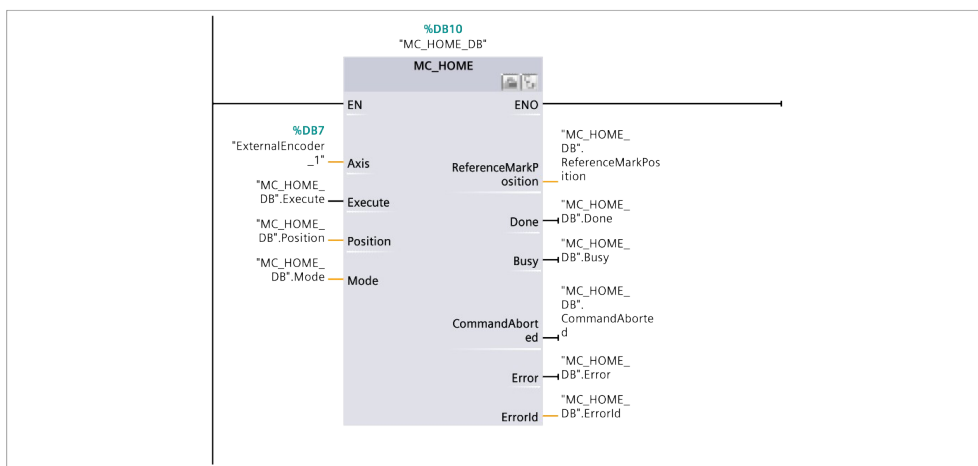
Figure 33 – Implemented functions

Some other blocks need to be added by the operator autonomously.
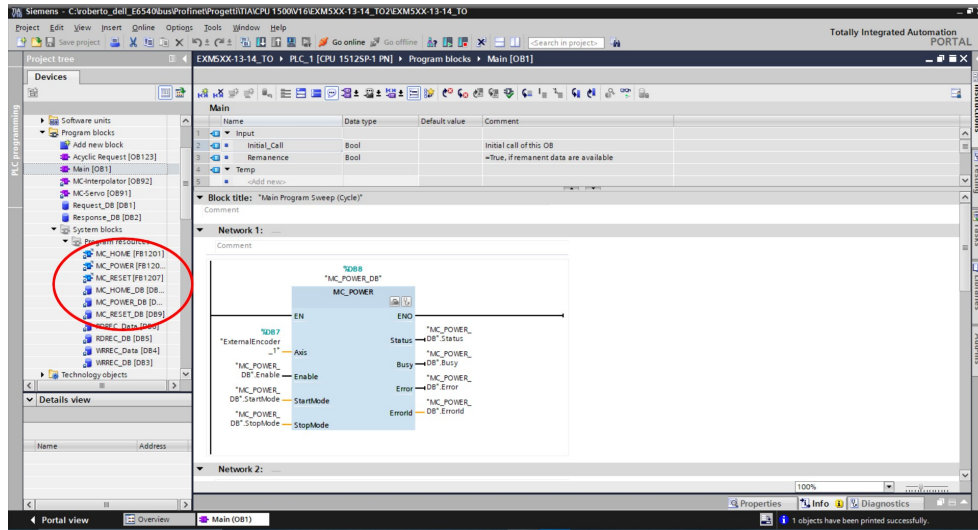
Figure 34 – Data blocks and function blocks

They can be found already created in the projects that are supplied by Lika Electronic. See the watch table in the Figure below. Refer to the **Lika TIA V16 CPU1500 Profinet example project.zip** compressed file contained in the **SW EXM58_EXO58 PT.zip** file.
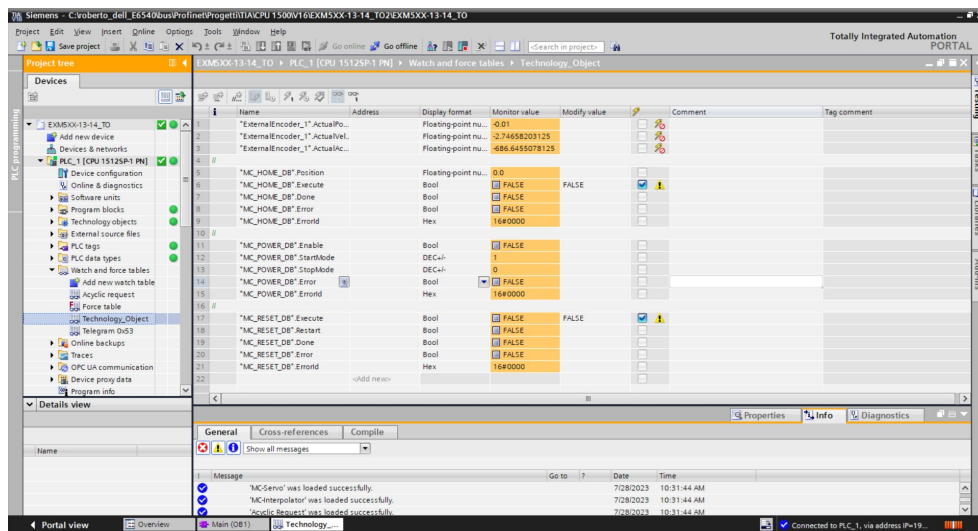
Figure 35 – Data blocks and function blocks

5.7.4 Downloading the project and going online

After the project has been successfully completed, the controller can be selected and the created program can be downloaded. To do this press the **DOWNLOAD TO DEVICE** button ![icon] in the toolbar.
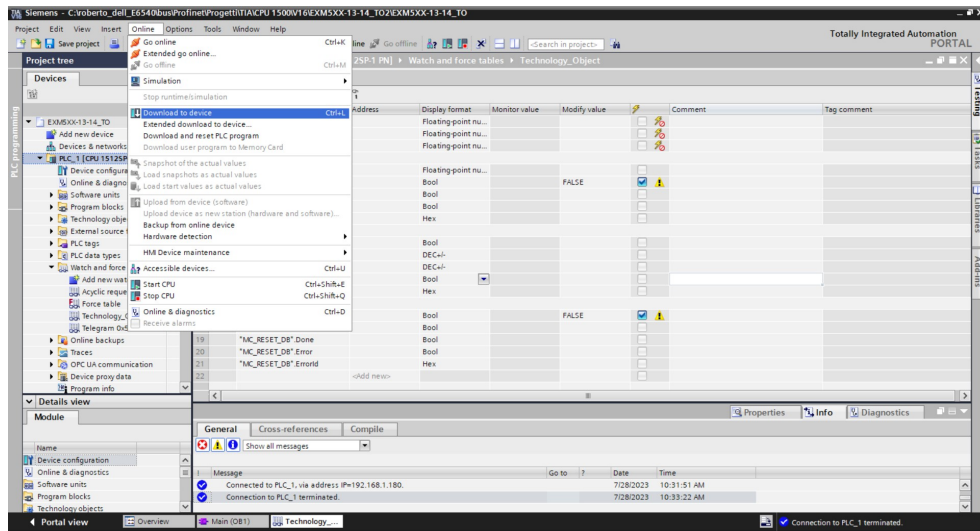
Figure 36 – Downloading the TO project

After the download is carried out, you can go online by pressing the **GO ONLINE** button ![Go online] in the toolbar.

Once the online connection to the controller is established, you can enter the diagnostic functions. To do this select the Technology Object and then the **Diagnostics** item in the Project tree.

The **Status and error bits** area will be displayed.
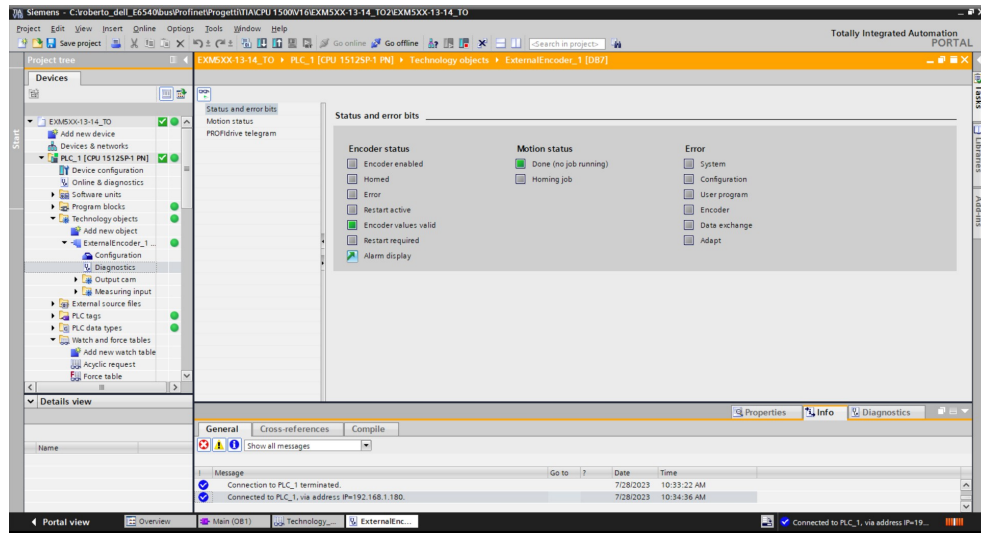
Figure 37 – TO status and error bits area

5.7.5 Enabling the encoder

Please note that the encoder is disabled now: it must be enabled.
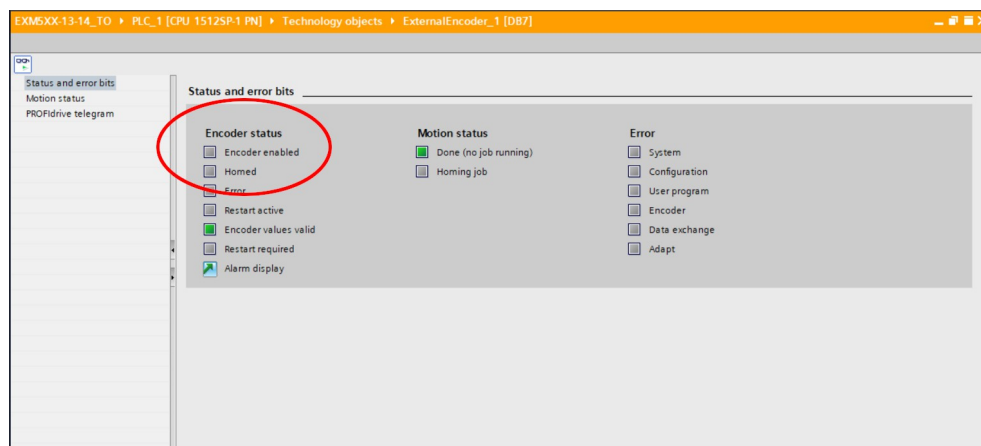
Figure 38 – TO encoder disabled

To enable the encoder select the **Watch and force tables** and then the **Telegram 0x53** (Telegram 83) item in the Project tree. The **Telegram 83** watch table will be displayed.
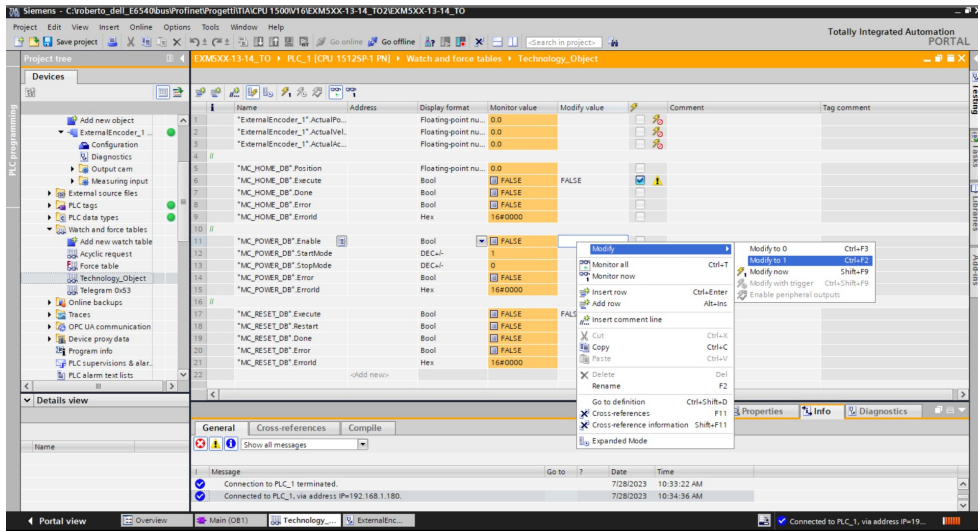
Figure 39 – TO Watch and force tables

Select the **MC_POWER_DB.Enable** function, right-click on the item in the **Monitor value** column and then press **Modify** and **Modify to 1** commands in the drop-down menus that appear.
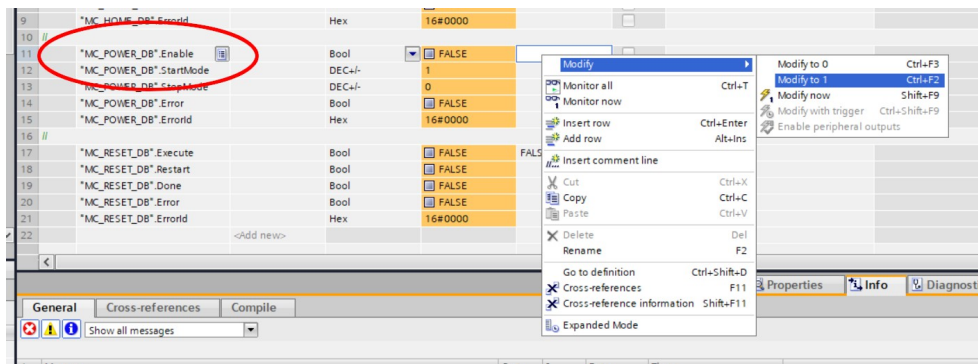
Figure 40 – TO enabling the encoder

In the **Status and error bits** pane check that the encoder is enabled now.
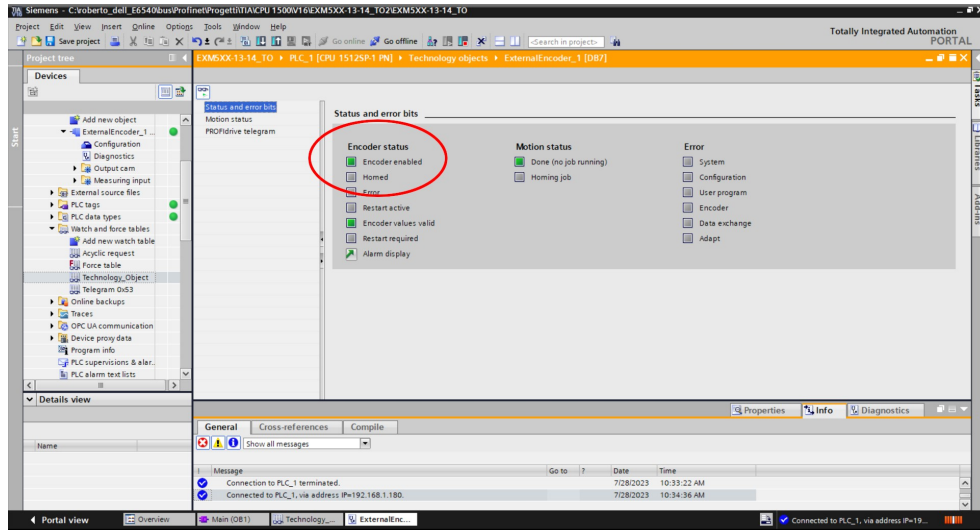
Figure 41 – TO encoder enabled

5.7.6 Setting and activating the preset value

NOTE
We suggest activating the preset value when the encoder is in stop.

Preset function is meant to assign a desired value to a known physical position of the system. The chosen physical position will get the value set next to this index and all the previous and following mechanical positions will get a value according to it.

Open the **Watch and force tables** and select the **Telegram 0x53** (Telegram 83) item in the Project tree. The **Telegram 83** watch table will be displayed.
Please check the current position of the encoder, see the **ExternalEncoder_1.ActualPosition**. It is "2129.853" currently.
To set the preset value select the **MC_HOME_DB.Position** function and set a desired value in the **Monitor value** field (for example, "50" in Figure 42). Press **ENTER** to confirm. Then select the **MC_HOME_DB_Execute** function and right-click in the **Monitor value** column. Then press **Modify** and **Modify to 1** commands in the drop-down box that appears. Finally deactivate back the function by using the commands **Modify** and **Modify to 0**.
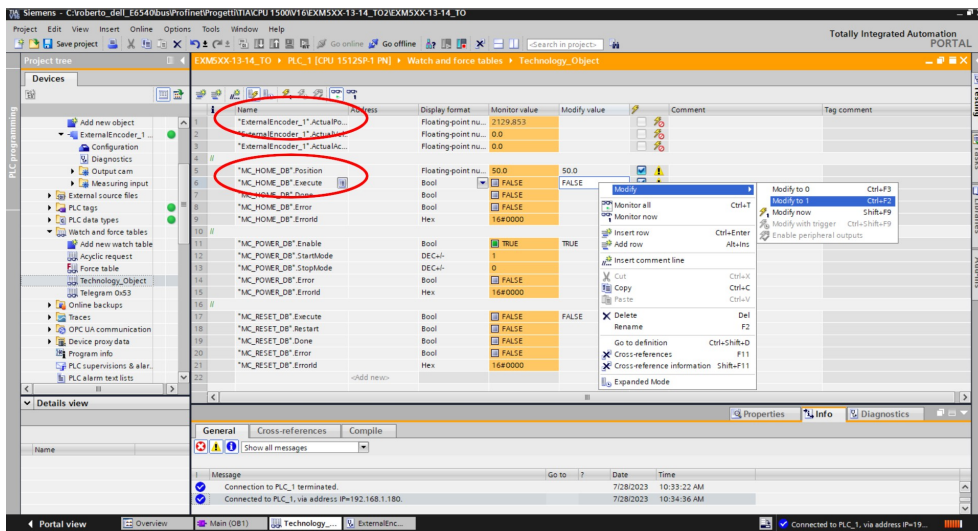
Figure 42 – TO setting and activating the preset

Now check again the current position of the encoder, see the **ExternalEncoder_1.ActualPosition**. It is "50.000" now.

6 Profinet interface

6.1 A brief introduction to Profinet

PROFINET IO is the open industrial network devised for automation applications and built on the Ethernet application layer (TCP/IP and IT standards). For PROFINET IO the layers 1 through 7a of the ISO/OSI (Open Systems Interconnection) reference model are exclusively based on internationally proven standards. The functionality of PROFINET is defined in layer 7b. PROFINET IO complies with IEEE802.3 Ethernet Standard and follows the standards IEC 61158 and IEC61784, so it is 100% Ethernet compatible.
Its technology development and standardization are entrusted to Profibus & Profinet International (PI), the international umbrella organization including members of more than 1400 companies (**www.profibus.com**).

PROFINET IO is expressly developed to connect controllers (named IO controllers, equivalent to Profibus DP Masters), peripheral devices (named IO devices, similar to Profibus DP Slaves) and programming devices / PCs (named IO supervisors) with Ethernet Real Time (RT) and Isochronous Real Time (IRT) communication all the way. Real Time channel is used for time-critical process data and allows to meet the real-time requirements of the automation engineering (cycle times < 500 μs, jitter < 1 μs); while IRT is suitable for sophisticated motion control and high performance applications in factory automation and permits cycle times lower than 250 μs with less than 1 μs jitter. The standard TCP/IP channel is used for parametrization, configuration, and acyclic read/write operations.
A PROFINET IO system requires at least one IO Controller and one IO Device. The most frequent network topologies can be implemented and even mixed together including Star, Line, Tree, and Ring structures by means of copper or fiber-optic cables. The number of devices (each one fitted with its own MAC address, IP address, and device name) which can be connected in the PROFINET network is virtually unlimited. The transmission rate is 100Mbit/s with full duplex communication (Fast Ethernet).
PROFINET IO Devices are configured using a configuration tool which acts as the IO Supervisor. The IO Supervisor uses a GSD (General Station Description) file based on XML language, thus it is called GSDML file, see on page 54.

6.2 Profinet encoders from Lika Electronic

PROFINET encoders from Lika Electronic fully comply with the specifications of the encoder profile V4.1 version 3.162, the encoder profile is based on the PROFIdrive profile. For any information on the encoder profile please refer to the following document:

PROFILE ENCODER. Technical Specification for PROFIBUS and PROFINET related to PROFIdrive

edited by PI International.

They also fulfil the requirements of the Application Classes 3 and 4, thus they are intended for clock-synchronous (isochronous) real-time applications with cyclic and synchronous data transmission. Anyway they can also be used in applications without clock synchronization. For detailed information on the application classes refer to the "6.3 Application Class definition" section on page 92.

PROFINET encoders support the Standard Telegrams 81, 82, 83, and 84. Further information can be found in the "7.1 Telegrams" section on page 95.

The IO data is transferred to and from the Encoder Object (EO, see the "6.4 Encoder Object model" section on page 93) via the Cyclic Data Exchange Service. The EO comprises the following mandatory functionalities:
- parameters;
- measuring task (i.e. position value, velocity value, …);
- IO data (cyclical transmission of control and actual values);
- support for Alarm Mechanism.

Among the parameters available in the Profinet encoders from Lika Electronic: code sequence, scaling function, preset (Class 4 functionalities), position readout, offset value, velocity value, velocity measuring unit, acyclic Error Data communication, and diagnostic information.

PROFINET at a glance

Number of stations	Setting the IP-Address	Setting the baud rate	Transmission rate	Cable length	Connection
Virtually unlimited	Software / automatic via DCP	–	100 Mbit/s full duplex	Up to 100 m / 330 ft	M12 D-coded Profinet connectors

6.2.1 Overview of the encoder profiles
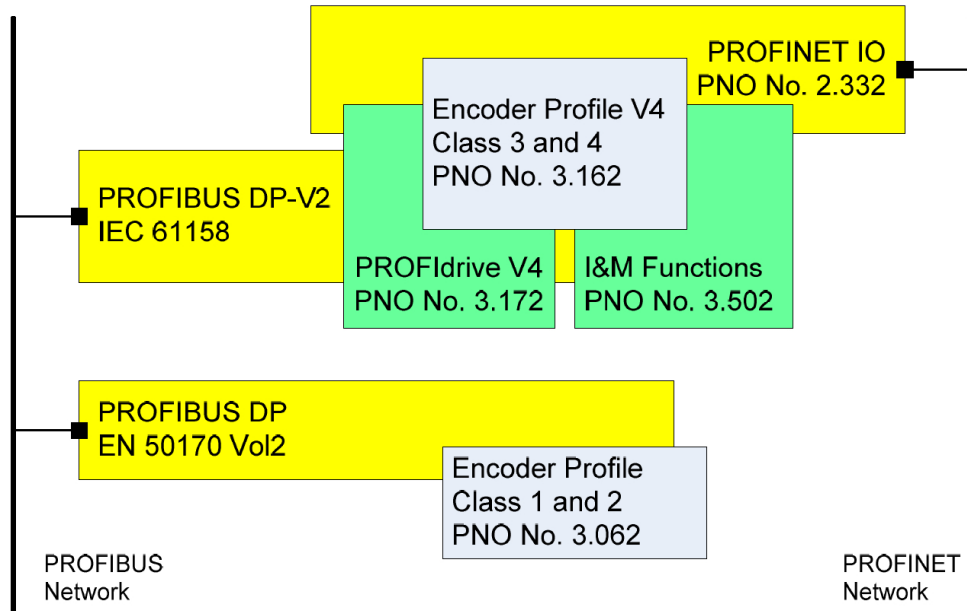
6.3 Application Class definition

The encoder supports two application classes: **Class 3** and **Class 4**. A number of mandatory functions are specified for each application class, in addition all optional functions must be recognized by the encoder and handled so that the controller is able to determine whether an optional function is supported.

NOTE
There is no relation between the Encoder application classes and the application classes defined in the PROFIdrive profile.

6.3.1 Application Class 3

Encoder with base mode parameter access and limited parametrization of the encoder functionality. Isochronous mode is not supported.

6.3.2 Application Class 4

Encoder with scaling, preset, isochronous mode, and base mode parameter access. A Class 4 configured encoder fully supports all functionalities according to the encoder profile 4.1.

<u>Lika Electronic encoders fulfil the requirements of CLASS 4</u>

6.4 Encoder Object model

The Figure shows the general Encoder Object (EO) architecture. The central element of the EO is the Process Control Task where the measurements are made and the results are calculated. The properties of the EO and the Process Control task are represented and controlled by parameters. The parameters are administered in the Parameter Data Base. To access EO parameters, the Acyclic Data Exchange service is used. For periodic transportation of control values to the EO and actual values from the EO, the Cyclic Data Exchange service is used. Exceptions which occur in the Process Control Task shall be signalled by the Alarm Mechanism to the controlling device.

The EO shall comprise as minimum mandatory functionality:

- Parameters;
- Measuring Task;
- IO Data (control value, actual value);
- Support for Alarm Mechanism;
- Optional functionality;
- Clock Synchronous operation.
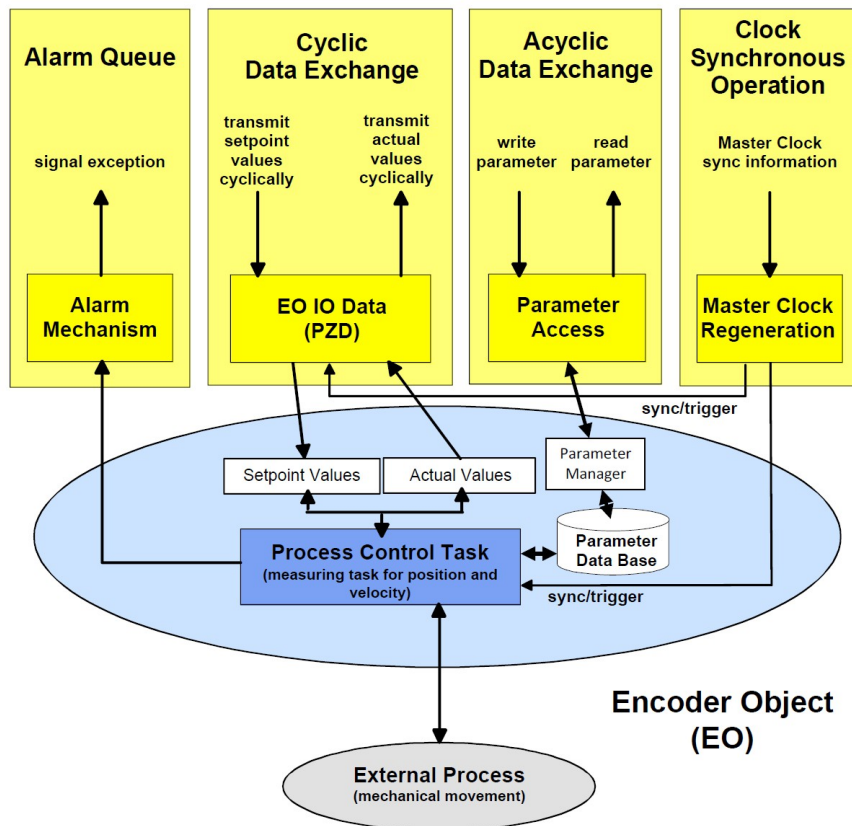
6.5 Encoder object architecture

The Figure shows the general architecture and the mapping of the Encoder Object (EO) architectural elements to Communication Objects of the Peripheral Device for PROFINET IO. Generally with PROFINET IO the EO is mapped exactly to one Module/Slot. Slot 0 is exclusively reserved for Device representative purpose and therefore shall not be used for any Encoder module. Valid Slot numbers for Encoder Objects are from 1 to 0x7FFF. Every EO contains at least the mandatory Module Access Point (MAP) which is mapped to a dedicated EO representative Submodule. This MAP Submodule contains at least the mandatory Parameter Access Point (PAP) which is mapped to a dedicated Record Data Object. Via the EO representative Submodule (MAP) and the specified Record Data Object the access to the EO parameter manager is possible. The EO parameter manager has access to the EO local Parameter Data Base. In addition to the mandatory MAP submodule, the EO may contain additional submodules which may be used:

- to represent communication end points for IO Data (cyclic data channel) and also to structure the IO Data in data blocks (telegrams, signals).
- to represent physical or logical Subobjects of the EO.
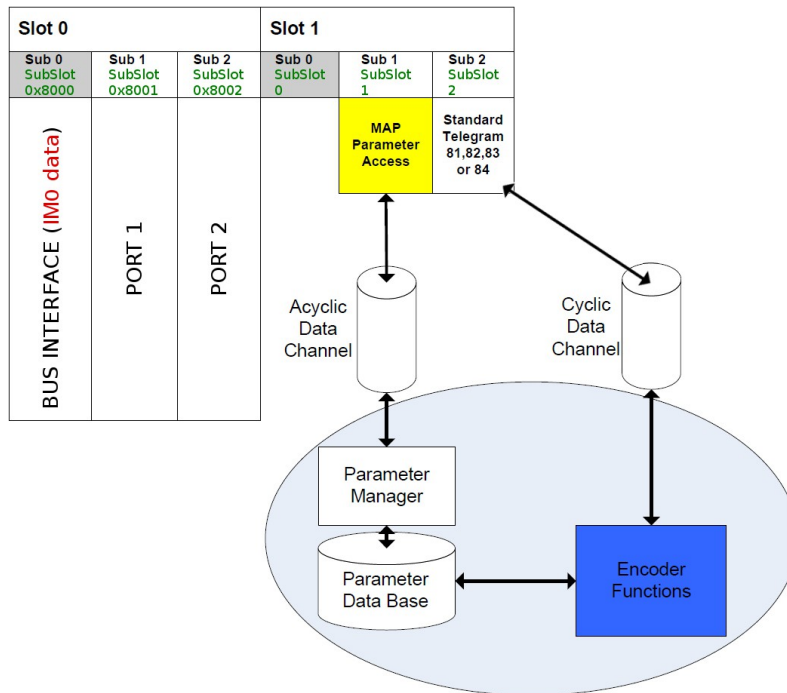
7 PROFINET IO data description

7.1 Telegrams

A telegram is a rigidly defined bit stream carrying data and an aggregation of one or multiple Signals. In each telegram the data length and the type of data which is sent to and from the IO controller is specified. PROFINET interface devices communicate and stay in sync by sending telegrams each other. The encoder profile supports four types of telegrams: Standard Telegram 81, Standard Telegram 82, Standard Telegram 83, and Standard Telegram 84. They are described hereafter. Standard signals are fully described in the "Cyclic Data Exchange – Std signals" section on page 97.

7.1.1 Standard Telegram 81

The Standard Telegram 81 is the default telegram and mandatory for all classes. It uses 4 bytes to output data from the IO controller to the encoder and 12 bytes to input data from the encoder to the IO controller.

Output data CONTROLLER => DEVICE

	2 bytes	2 bytes
IO Data	1	2
Set point	STW2_ENC	G1_STW

Input data DEVICE => CONTROLLER

	2 bytes	2 bytes	4 bytes		4 bytes	
IO Data	1	2	3	4	5	6
Actual value	ZSW2_ENC	G1_ZSW	G1_XIST1		G1_XIST2	

7.1.2 Standard Telegram 82

The Standard Telegram 82 uses 4 bytes to output data from the IO controller to the encoder and 14 bytes to input data from the encoder to the IO controller.

Output data CONTROLLER => DEVICE

	2 bytes	2 bytes
IO Data	1	2
Set point	STW2_ENC	G1_STW

Input data DEVICE => CONTROLLER

	2 bytes	2 bytes	4 bytes		4 bytes		2 bytes
IO Data	1	2	3	4	5	6	7
Actual value	ZSW2_ENC	G1_ZSW	G1_XIST1		G1_XIST2		NIST_A

7.1.3 Standard Telegram 83

The Standard Telegram 83 uses 4 bytes to output data from the IO controller to the encoder and 16 bytes to input data from the encoder to the IO controller.

Output data CONTROLLER => DEVICE

	2 bytes	2 bytes
IO Data	1	2
Set point	STW2_ENC	G1_STW

Input data DEVICE => CONTROLLER

	2 bytes	2 bytes	4 bytes		4 bytes		4 bytes	
IO Data	1	2	3	4	5	6	7	8
Actual value	ZSW2_ENC	G1_ZSW	G1_XIST1		G1_XIST2		NIST_B	

7.1.4 Standard Telegram 84

The Standard Telegram 84 uses 4 bytes to output data from the IO controller to the encoder and 20 bytes to input data from the encoder to the IO controller.

Output data CONTROLLER => DEVICE

	2 bytes	2 bytes
IO Data	1	2
Set point	STW2_ENC	G1_STW

Input data DEVICE => CONTROLLER

	2 bytes	2 bytes	8 bytes				4 bytes		4 bytes	
IO Data	1	2	3	4	5	6	7	8	9	10
Actual value	ZSW2_ENC	G1_ZSW	G1_XIST3				G1_XIST2		NIST_B	

NOTE

In the Standard Telegram 84, **G1_XIST2** is used to transfer the error codes and optionally the position values if the measuring length exceeds 64 bits.

8   Cyclic Data Exchange – Std signals

IO data is transferred via the Cyclic Data Exchange, i.e. cyclically, between the EO and other devices (controller, supervisor, device). A series of standard signals is defined to configure the IO data. In the following table the standard signals are summarily described. A telegram is the aggregation of one or multiple Signals.

Significance	Abbreviation	Length (bits)	Data type	Page
Sensor 1 current position value 1	**G1_XIST1**	32	Unsigned	99
Sensor 1 current position value 2	**G1_XIST2**	32	Unsigned	101
Sensor 1 position current value 3	**G1_XIST3**	64	Unsigned	102
Encoder Control word 2	**STW2_ENC**	16	Unsigned	102
Encoder Status word 2	**ZSW2_ENC**	16	Unsigned	103
Sensor 1 Control word	**G1_STW**	16	Unsigned	104
Sensor 1 Status word	**G1_ZSW**	16	Unsigned	107
Speed current value A	**NIST_A**	16	Signed	108
Speed current value B	**NIST_B**	32	Signed	108
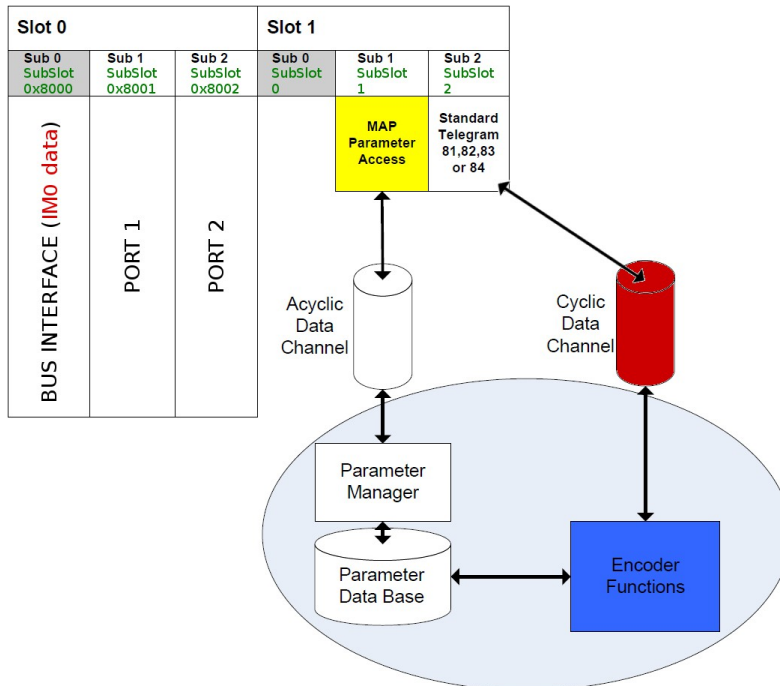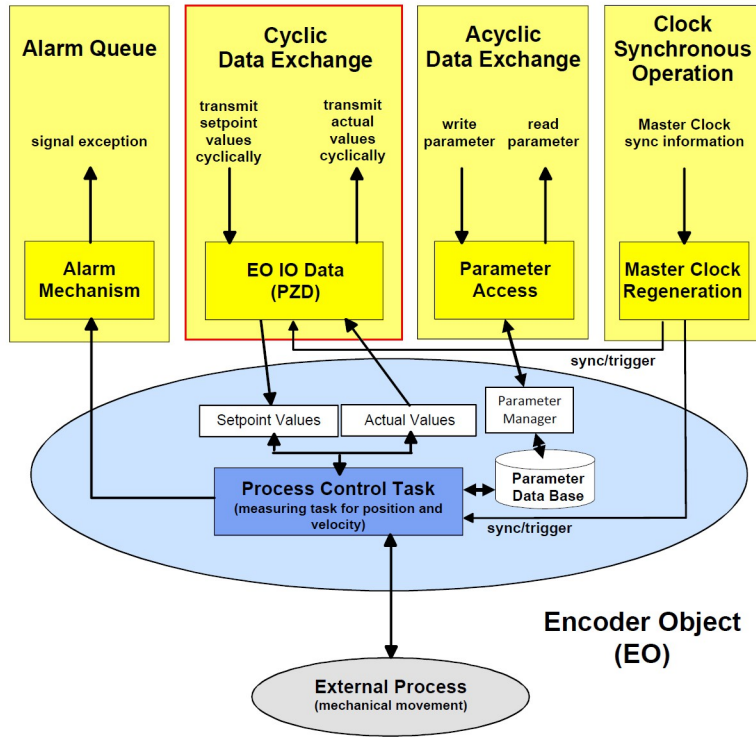
8.1 List of the available standard signals

G1_XIST1

[Unsigned, 32 bits]

It is defined as Sensor 1 current position value 1. This signal is the current (real) absolute position of the encoder expressed in binary notation.

Format definition:
- all values are represented in binary notation;
- the shifting factors in **P979 – Sensor format** (see on page 117) display the actual format; the recommended default shift factor is zero (0, right aligned value) for both **G1_XIST1** and **G1_XIST2**;
- the settings in the encoder parameter data affect the position value in both **G1_XIST1** and **G1_XIST2**;
- when the Scaling function control parameter is disabled = 0, **G1_XIST1** provides the current position value in a 32 bit format: position values are from 0 to 4,294,967,295; integrated position values (between 2^{28} and 2^{32} for EXM58-13-14-…; between 2^{19} and 2^{32} for EXO58-18-00-…; between 2^{31} and 2^{32} for EXM58-18-12-… and EXO58-16-14-…) are retained as long as the power supply is ON; if you turn the power supply OFF, the integrated position values are lost. At next power on, the physical position value will be provided;
- when the Scaling function control is enabled = 1, **G1_XIST1** provides the current position value according to the resolution values set next to the parameters Measuring units / Revolution and Total measuring range (see on page 126 and ff).

EXAMPLE

We install the EXM58-13-14-… encoder with 27-bit resolution. The Scaling function control parameter is disabled = 0, so **G1_XIST1** provides the current position value in a 32 bit format: position values are from 0 to 4,294,967,295. Let's say the encoder reaches the max. physical position value (2^{27} = 134,217,727) and then adds further 1,500,000 counts: **G1_XIST1** will show 135,717,727. If we switch the power OFF and then ON, **G1_XIST1** will show 1,499,999 instead.

NOTE

The data type for **G1_XIST1** and **G1_XIST2** is Unsigned32. Therefore there are no negative position values. The next position value after 0, if the encoder is moved in the negative direction, is 0xFFFFFFFF or the (total resolution – 1) for **G1_XIST1**; it is the (total physical/scaled resolution – 1) for **G1_XIST2**.

EXAMPLE

Here follows a format example.

EXM58-13-14 27-bit absolute multiturn encoder, 13-bit singleturn resolution (8,192 counts per revolution), 14-bit multiturn resolution (16,384 revolutions)

M = Multiturn value, number of revolutions

S = Singleturn value, number of counts per revolution

MSB   LSB

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	S	S	S	S	S	S	S	S	S	S	S	S	S

Absolute position value in **G1_XIST1** with integrated position increments (when the **Scaling function control** parameter is disabled = 0): it is 32 bit long regardless of the physical resolution of the encoder.

MSB   LSB

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
					M	M	M	M	M	M	M	M	M	M	M	M	M	M	S	S	S	S	S	S	S	S	S	S	S	S	S

Absolute position value in **G1_XIST1** (when the **Scaling function control** parameter is enabled = 1): it is according to the values set next to the **Measuring units / Revolution** and **Total measuring range** parameters; they are set to default in the example.

MSB   LSB

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
					M	M	M	M	M	M	M	M	M	M	M	M	M	M	S	S	S	S	S	S	S	S	S	S	S	S	S

Absolute position value in **G1_XIST2**: it is according to either the physical resolution (raw encoder position, when the **Scaling function control** parameter is disabled = 0) or the values set next to the **Measuring units / Revolution** and **Total measuring range** parameters (when the **Scaling function control** parameter is enabled = 1); they are set to default in the example.

NOTE

The preset operation always affects **G1_XIST2** and **G1_XIST3**. It does not affect **G1_XIST1** if **G1_XIST1 Preset control** is disabled = 1.

G1_XIST2

[Unsigned, 32 bits]

It is defined as Sensor 1 current position value 2. By default this signal is the current (real) absolute position of the encoder expressed in binary notation yet it has a different meaning if an error is active.

If no error is active:

this signal informs about the current position value of the encoder, provided that the bit **Request absolute value cyclically** (bit 13 of **G1_STW** control word) is set to 1; otherwise this value is 0.

If an error is active:

this signal informs about the active error. For the complete list of the error codes refer to the "10.3 Error codes in G1_XIST2" section on page 133.

Format definition:

- all values are represented in binary notation;
- the shifting factors in **P979 – Sensor format** (see on page 117) display the actual format; the recommended default shift factor is zero (0, right aligned value) for both **G1_XIST1** and **G1_XIST2**;
- the settings in the encoder parameter data affect the position value in both **G1_XIST1** and **G1_XIST2**;
- **G1_XIST2** displays the error telegram instead of the position value if an error occurs.

NOTE

Be aware that **G1_XIST2** always shows the absolute position delivered from the encoder sensor (raw encoder position). This means that **G1_XIST2** will never show a position count value which exceeds the maximum physical position value.

NOTE

The preset operation always affects **G1_XIST2** and **G1_XIST3**. It does not affect **G1_XIST1** if the G1_XIST1 Preset control parameter is disabled = 1.

For the format example see **G1_XIST1** above.

G1_XIST3

[Unsigned, 64 bits]

It is defined as Sensor 1 current position value 3. This 64-bit position value is intended to support the encoders having a measuring length which exceeds 32 bits. **G1_XIST3** has the following format:

- binary format;
- the current position value is always right aligned, a shifting factor is not used;
- the settings in the encoder parameter data affect the position value in **G1_XIST3** if the Class 4 functionality parameter is enabled.

IO data	1	2	3	4
Format	64-bit position value			

NOTE

The preset operation always affects **G1_XIST2** and **G1_XIST3**. It does not affect **G1_XIST1** if the G1_XIST1 Preset control parameter is disabled = 1.

STW2_ENC

[Unsigned, 16 bits]

It is defined as Encoder control word 2. Control word **STW2_ENC** includes the **Control by PLC** mechanisms from PROFIdrive STW1 and the **Controller Sign-Of-Life** mechanism from PROFIdrive STW2.

Bit	Meaning
0 ... 6	Reserved
7	Not used
8 & 9	Reserved
10	**Control by PLC**
11	Reserved
12 ... 15	**Controller Sign-Of-Life**

Control by PLC

Bit 10

If the Compatibility Mode parameter is enabled (see on page 125: 0 = Compatibility with Encoder Profile V3.1), then the bit 10 **Control by PLC** is ignored. In this case the control word **G1_STW** and the setpoint are always checked.

If the **Compatibility Mode** parameter is disabled (see on page 125: 1 = Compatibility with Encoder Profile V4.1), then the bit 10 **Control by PLC** is checked. So the control word **G1_STW** and the setpoints are checked only if the bit **Control by PLC** is set.

Bit	Value	Significance	Comment
10	1	Control by PLC	Control via interface, EO IO Data is valid.
	0	No control by PLC	EO IO Data not valid, except Sign-Of-Life.

Controller Sign-Of-Life

Bits 12 ... 15

For complete information on the Sign-Of-Life mechanism refer to the PROFIdrive Technical Specification document.

For more information on the control word **STW2_ENC** please refer to the PROFIdrive Technical Specification document.

ZSW2_ENC

[Unsigned, 16 bits]

It is defined as Encoder status word 2. The encoder status word 2 **ZSW2_ENC** includes the Control by PLC mechanism from PROFIdrive ZSW1 and the Slave Sign-Of-Life mechanism from PROFIdrive ZSW2.

Bit	Meaning
0 ... 2	Reserved
3	Not used
4 ... 8	Reserved
9	**Control requested**
10 & 11	Reserved
12 ... 15	**Encoder Sign-Of-Life**

Control requested

Bit 9

Bit	Value	Significance	Comment
9	1	Control Requested	The automation system is requested to assume control.

	0	No Control requested	Control by the automation system is not possible, only possible at the device or by another interface.

Encoder Sign-Of-Life
Bits 12 ... 15
For complete information on the Sign-Of-Life mechanism refer to the PROFIdrive Technical Specification document.

For more information on the status word 2 **ZSW2_ENC** please refer to the PROFIdrive Technical Specification document.

G1_STW

[Unsigned, 16 bits]
It is defined as Sensor 1 control word. This control word controls the functionality of major encoder functions.

Bit	Meaning
0 ... 7	Not used
8 ... 10	Reserved
11	**Home position mode**
12	**Request set/shift of home position**
13	**Request absolute value cyclically**
14	**Activate parking sensor**
15	**Acknowledging a sensor error**

NOTE
If the **Activate parking sensor** is activated (bit 14 = 1) the encoder is still operational with the Slave Sign-Of-Life active and the encoder error and diagnostics switched off.

Home position mode
Bit 11

Request set/shift of home position
Bit 12

The preset function is controlled by bits 11 and 12 in this Sensor 1 control word **G1_STW** and acknowledged by the bit 12 **Set/shift of home position executed** in the sensor status word **G1_ZSW**. The preset value is 0 by default and can be set by an acyclic data exchange parameter defined in the parameters section (see **P65000 – Preset value** on page 118). The preset function has an absolute and a relative operating mode selectable by means of the bit 11 **Home position mode** in this Sensor 1 control word **G1_STW** (0 = absolute; 1 = relative). Bit 11 and bit 12 in the Sensor 1 control word **G1_STW** control the preset function as described in the table below.

Bit 12	Bit 11	Action
0	X	**Normal operating mode.** The encoder will make no change in the output value.
1	0	**Preset mode absolute** The encoder reads the current position value and calculates an internal offset value from the preset value **P65000 – Preset value** and the read position value. The position value is then shifted with the calculated offset value to get the current position value equal to the preset value. The encoder acknowledges the preset by setting the bit 12 **Set/shift of home position executed** in the sensor status word **G1_ZSW**. Now the bit 12 **Request set/shift of home position** in the sensor 1 control word **G1_STW** can be set to zero by the Master. The encoder will end the preset cycle by clearing the bit 12 **Set/shift of home position executed** in the sensor status word **G1_ZSW**. The new internal offset value can be read with an acyclic data exchange parameter (if implemented) and is securely stored in case of voltage breakdown and uploaded again at each power on.
1	1	**Preset mode relative (offset)** The encoder uses the preset value **P65000 – Preset value** as a relative offset value. In this mode the current position value is shifted by the value deriving from the preset value. **EXAMPLE** A preset value "1000" is intended to shift the current position value by 1000 steps in the positive counting direction. So a "real" position value of "5000" will have the value "6000" after the relative shifting sequence. The encoder will set the bit 12 **Set/shift of home position executed** in the sensor status word **G1_ZSW** to acknowledge the execution of the shifting. The bit 12 **Request set/shift of home position** in the sensor control word **G1_STW** can be set to zero by the

		Master now. The encoder will end the preset cycle by clearing the bit 12 **Set/shift of home position executed** in the sensor status word **G1_ZSW**. The internal offset value will be shifted according to the transferred preset value. The new offset value is securely stored in case of voltage breakdown and uploaded again at each power on.

The Preset command <u>automatically saves</u> the calculated internal offset values.

NOTE
Refer also to the index **P65000 – Preset value** on page 118; to the **G1_XIST1 Preset control** on page 122; and to the "15.2 Preset diagram" section on page 163. See also the "5.1.3 Setting and executing the preset" section on page 41.

EXAMPLE
An example of setting the Preset value is provided on page 41.

Request absolute value cyclically
Bit 13

Bit	Significance	Comment
13	=1 : **Request absolute value cyclically**	Request of additional cyclic transmission of the current absolute position in **G1_XIST2**.

Activate parking sensor
Bit 14

Bit	Significance	Comment
14	=1 : **Activate parking sensor**	Request to stop monitoring the measuring system and the current value measurements in the drive. This makes it possible to disconnect the encoder from the line without needing to change the drive configuration or causing a fault. In this case all current errors of the encoder are cleared. The parking of the encoder while the drive

		is running is not allowed and will result in a sensor interface error (error code **0x0003 │ Failure parking sensor** in **G1_XIST2**, see on page 133).

See also "15.3 Parking sensor diagram" on page 164.

Acknowledging a sensor error
Bit 15

Bit	Significance	Comment
15	=1 : **Acknowledging a sensor error**	Request to acknowledge a sensor error (bit 15 **Sensor error** of **G1_ZSW**).

G1_ZSW
[Unsigned, 16 bits]
It is defined as Sensor 1 status word. This status word defines the states, acknowledgements, and error messages of the encoder and its main functions.

Bit	Meaning
0 … 9	Not used
10	Reserved
11	**Requirement of error acknowledge detected**
12	**Set/shift of home position executed**
13	**Transmit absolute value cyclically**
14	**Parking sensor active**
15	**Sensor error**

NOTE
If the bit 13 **Transmit absolute value cyclically** or the bit 15 **Sensor error** are not set, there is no valid value or error code transferred in **G1_XIST2**.

NOTE
The bit 13 **Transmit absolute value cyclically** and the bit 15 **Sensor error** cannot be set at the same time as they are used to indicate either a valid position value transmission (bit 13) or the error code transmission (bit 15) in **G1_XIST2**.

NIST_A

[Signed, 16 bits]

It is defined as current velocity value A expressed in a <u>16 bit format</u>.

Velocity value is calculated every 100 ms.

Refer also to the **Velocity measuring unit** parameter on page 128.

NIST_B

[Signed, 32 bits]

It is defined as current velocity value B expressed in a <u>32 bit format</u>.

Velocity value is calculated every 100 ms.

Refer also to the **Velocity measuring unit** parameter on page 128.

9 Acyclic Data Exchange

In addition to the Cyclic Data Exchange (see the "Cyclic Data Exchange – Std signals" section on page 97), the Acyclic Data Exchange gives the possibility to read and write parameters over the non real time channel.
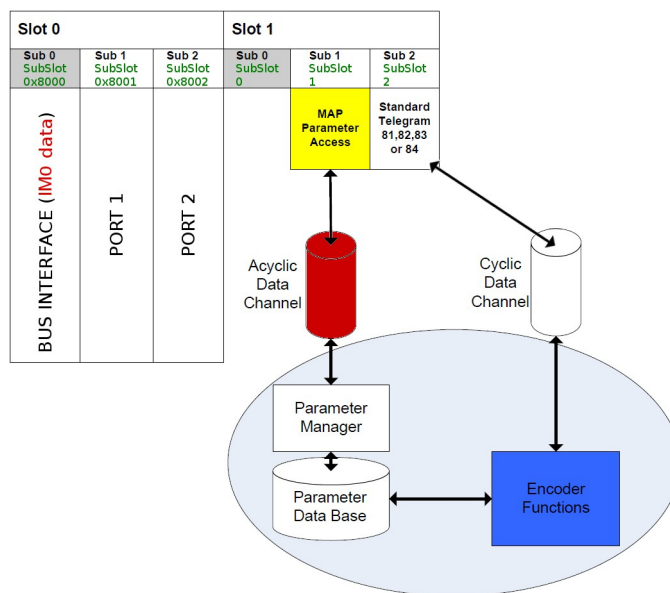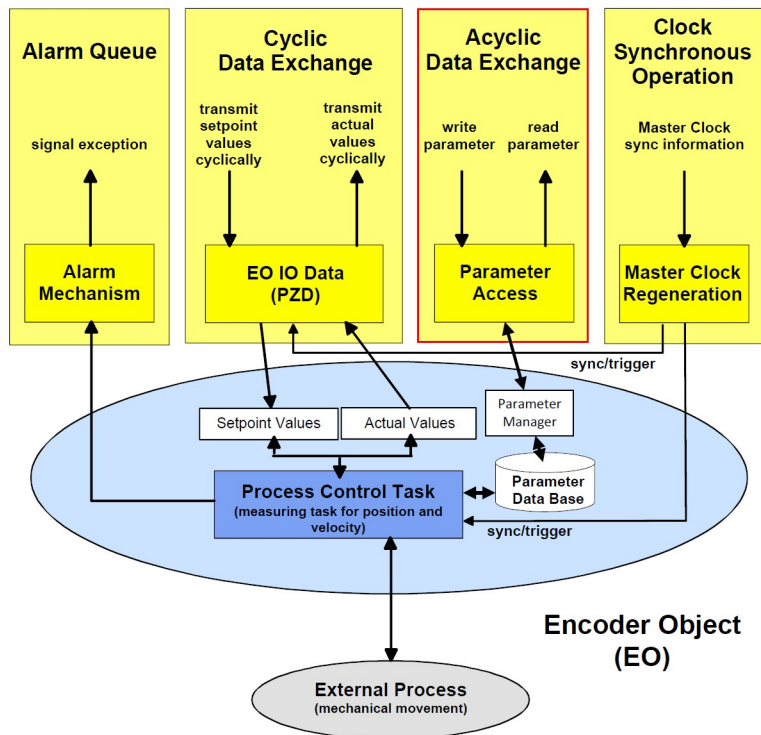
9.1 Index 0xAFF0: Identification & Maintenance (I&M) functions

Profinet encoders from Lika Electronic only implement I&M 0 Module (IM0).

IM0 is accessible with record 0xAFF0 and provides general information on the device such as vendor ID, order ID, serial number, etc.

Description	Number of bytes
BLOCKHEADER	6
MANUFACTURER ID (VENDOR ID)	6
ORDER ID	20
SERIAL NUMBER	16
HARDWARE REVISION	2
SOFTWARE REVISION	4
REVISION COUNTER	2
PROFILE ID (API)	2
PROFILE SPECIFIC TYPE	2
IM VERSION	2
IM SUPPORTED	2

9.2 Record Data Objects

Record Data Objects are used as PAP to transfer requests to the parameter manager and to transfer responses from the parameter manager to the Controller or the Supervisor.

MAP Index (Record Data Object) 0xB02E parameters which are specific to the PROFIdrive profile are described in the "9.3 Record Data Object 0xB02E: supported PROFIdrive specific parameters" section on page 115. They are not sent to the encoder at each start-up and are not available in the **Module parameters** tabbed page under TIA Portal. To access these parameters follow the description in the next "9.2.1 How to access (read and write) acyclic parameters" section on page 111.

MAP Index (Record Data Object) 0xB02E parameters which are specific to the Encoder profile are described in the "9.4 Record Data Object 0xB02E: supported encoder specific parameters" section on page 118. They are not sent to the encoder at each start-up and are not available in the **Module parameters** tabbed page under TIA Portal. To access these parameters follow the description in the next "9.2.1 How to access (read and write) acyclic parameters" section on page 111.

MAP Index (Record Data Object) 0xBF00 parameters which are specific to the user are described in the "9.5 Record Data Object 0xBF00: user parameter data" section on page 121. They are sent to the encoder at each start-up using the

record data object 0xBF00 and are available in the **Module parameters** tabbed page under TIA Portal, see the "5.5.10 Module parameters" section on page 69.

9.2.1 How to access (read and write) acyclic parameters

As previously stated, only Index (Record Data Object) 0xBF00 parameters can be accessed by using the **Module parameters** tabbed page under TIA Portal.
Index (Record Data Object) 0xB02E parameters must be accessed for reading and writing purposes only by using the program described hereafter. Please refer also to the example projects provided by Lika. See the **Lika TIA V16 CPU1500 Profinet example project.zip** compressed file contained in the **SW EXM58_EXO58 PT.zip** file.
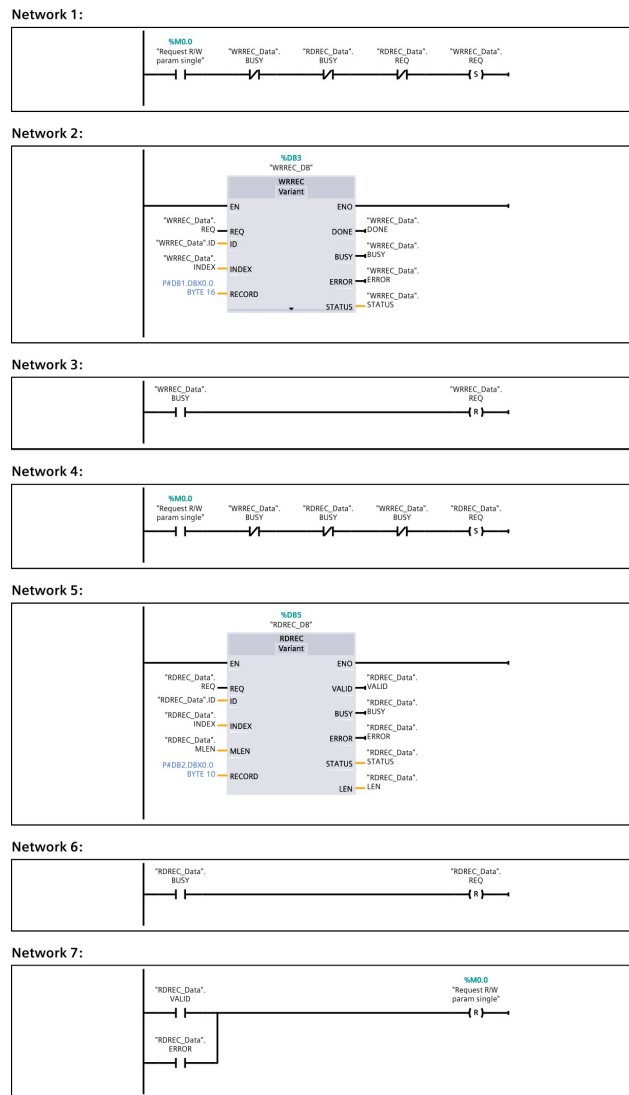
Figure 43 – Acyclic parameters – Main program

The program shown above must be inserted into a cyclic Organization Block. It is possible to use the main OB1 organization block or add a new organization block according to the user's needs, as in the example (OB123).
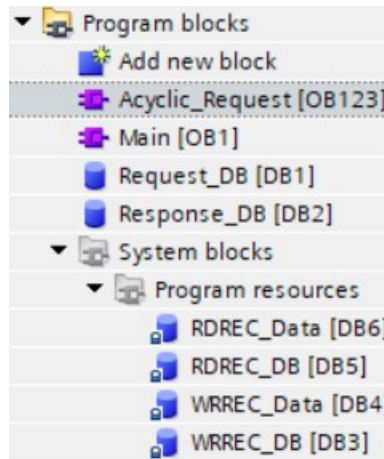
Figure 44 – Acyclic parameters – Adding a new block

In the example two Global DB type data blocks have been added further. **Request_DB [DB1]** data block is used to group request data.

Figure 45 – Acyclic parameters – Request_DB [DB1] data block

Response_DB [DB2] data block is used to group response data.

Figure 46 – Acyclic parameters – Response_DB [DB2] data block

Their addresses are set in the **Record** field of **WRREC_DB** and **RDREC_DB** function blocks respectively (see Network 2 and Network 5 in the main program shown in Figure 43).

A boolean **Request R/W param single** variable at address %M0.0 is used as a flag to start the parameter read/write process.

	i	Name	Address	Display format	Monitor value	Modify value	⚡	
1	//					**Start flag**		
2		"Request R/W param single"	%M0.0	Bool	☐ FALSE	TRUE	☑	⚠
3	//	**Input WRREC DB**					☐	
4		"WRREC_Data".REQ		Bool	☐ FALSE		☐	
5		"WRREC_Data".ID		DEC	264	264	☑	⚠
6		"WRREC_Data".INDEX		Hex	16#0000_B02E	16#0000_B02E	☑	⚠
7		"WRREC_Data".LEN		DEC	1	1	☑	⚠
8	//	**Request data**						
9		"Request_DB".Request_reference	%DB1.DBB0	Hex	16#01	16#01	☑	⚠
10		"Request_DB".Request_ID	%DB1.DBB1	Hex	16#01	16#01	☑	⚠
11		"Request_DB".Axis_No_DO_ID	%DB1.DBB2	Hex	16#00	16#00	☑	⚠
12		"Request_DB".No_of_parameters	%DB1.DBB3	Hex	16#01	16#01	☑	⚠
13		"Request_DB".Attribute_parameter_01	%DB1.DBB4	Hex	16#10	16#10	☑	⚠
14		"Request_DB".No_of_elements_01	%DB1.DBB5	Hex	16#01	16#01	☑	⚠
15		"Request_DB".Parameter_number_01	%DB1.DBW6	DEC	65000	65000	☑	⚠
16		"Request_DB".SubIndex	%DB1.DBW8	Hex	16#0000	16#0000	☑	⚠
17		"Request_DB".Format	%DB1.DBB10	Hex	16#43	16#43	☑	⚠
18		"Request_DB".No_of_value	%DB1.DBB11	Hex	16#01	16#01	☑	⚠
19		"Request_DB".Value	📋 %DB1.DBD12	Hex	▼ 16#0000_1000	16#0000_1000	☑	⚠
20	//							
21		"Response_DB".Request_reference_mirror	%DB2.DBB0	Hex	16#01		☐	
22		"Response_DB".Response_ID	%DB2.DBB1	Hex	16#01		☐	
23		"Response_DB".Axis_No_DO_ID_mirrored	%DB2.DBB2	Hex	16#00		☐	
24		"Response_DB".No_of_parameters	%DB2.DBB3	Hex	16#01		☐	
25		"Response_DB".Format	%DB2.DBB4	Hex	16#43		☐	
26		"Response_DB".No_of_value	%DB2.DBB5	Hex	16#01		☐	
27		"Response_DB".Value	%DB2.DBD6	Hex	16#0000_1000		☐	
28		**Response data**	\<Add new\>				☐	

Figure 47 – Acyclic parameters – Acyclic Request control table

To execute the parameter read/write process the **Acyclic Request** control table has been created in the example project, see the previous Figure 47.
It contains all the variables required by the process. Variables are grouped in four sections highlighted by coloured borders in the Figure.

In the first section (Start flag, highlighted in blue in Figure 47) the **Request R/W param single** start flag is available: it must be set to TRUE to start the process.

The second section (Input WRREC DB, highlighted in violet in Figure 47) groups the headers of the function block that is used to write the parameter (see also Network 1 in Figure 43).
In details, the **WRREC_Data.ID** field (it is highlighted in pink in Figure 47) must contain the address (hardware identifier) of the encoder's hardware module.

To know the hardware identifier of the installed encoder module, go to the **Device view** and select the **Parameter Access Point**. Then enter the **System constants** tab in the Inspector window: in the **Hardware identifier** column you will find the address of the installed encoder module ("264" in the example).
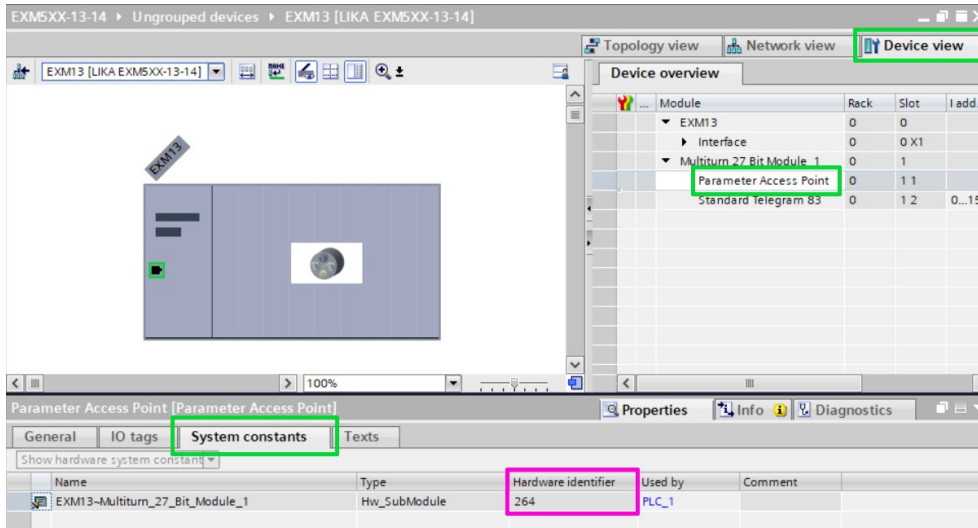
Figure 48 – Acyclic parameters – Finding the hardware identifier

The **WRREC_Data.INDEX** field (it is highlighted in dark violet in Figure 47) contains the index of the record you have to access to. It is 16#B02E (45102 in decimal notation) for encoders complying with the PROFIdrive profile, this value is fixed and cannot be modified.

The third section (Request data, highlighted in green in Figure 47) groups the request data to be entered.

Request_reference shows an arbitrary value that is used to identify the request and then is sent back in the response.

Request_ID allows you to set whether the parameter is to be read (value 1) or to be written (value 2).

Axis_No_DO_ID contains the number of the axis; for an encoder it is "0" (first and only axis of the device).

No_of_parameters contains the number of parameters to read/write; in the example, only one parameter can be set at a time.

Attribute_parameter_01 contains the type of data contained in the parameter; 16#10 identifies a single value (not an array or a record, for example).

No_of_elements_01 contains the number of items of the parameter to read (again, in the example one item only can be accessed).

Parameter_number_01 contains the number of the parameter to access (it is "65000" for the preset value in the example, see the **P65000 – Preset value** parameter on page 118).

SubIndex contains the sub-index of the desired item, if required.

Format contains the data type of the item: 16#41 is used for an 8 bit integer, 16#42 for a 16 bit integer, 16#43 for a 32 bit integer (as in the case of the preset value).

No_of_value contains the number of values contained in the request, they are set in the following fields. Also in this case the example allows to enter one value only.

Value contains the parameter value; enter one value only when you need to send a writing request; if you need to read a parameter this value has not to be considered.

The fourth section (Response data, highlighted in red in Figure 47) groups the response data following a request.

The first six fields (**Request_reference_mirror**, **Response_ID**, **Axis_No_DO_ID_mirrored**, **No_of_parameters**, **Format**, **No_of_value**) contain the same data as in the relevant fields in the request, see the explanation above.

Value contains the value of the parameter requested. If you are writing to a parameter, it will contain the value just entered.

9.3 Record Data Object 0xB02E: supported PROFIdrive specific parameters

P922 – Telegram Selection
[Unsigned16, RO]
It shows the type of telegram which is currently in use. Possible values: 81, 82, 83, and 84.

P964 – PROFIdrive Parameter : Device identification
[Array[0 … 5], unsigned16, RO]

Index	Sub	Meaning	Value	Access
964	0	Manufacturer ID (Vendor ID assigned by PI)	0x239	RO
964	1	DU Drive unit type (Vendor specific)	1	RO
964	2	Software version	xxyy	RO
964	3	Software year	yyyy	RO
964	4	Software day and month	dd.mm	RO
964	5	Number of Drive Object (DO)	1	RO

NOTE

Software version, Software year, and Software day and month are expressed in decimal notation.
For example: Software version = xxyy (decimal).
Version 2.1 results in 0201 decimal.

P965 – Encoder profile number

[Octet string 2, RO]
Parameter **P965 – Encoder profile number** is the Profile identification number which identifies the profile and the profile version.

Index	Sub	Meaning	Value	Access
965	0	Encoder profile number	0x3D	RO
965	1	Encoder profile version, set by customer	31 or 41	RO

P971 – Transfer to non volatile memory

[Unsigned16, RW]
It is used to save the current local parameters on the non volatile memory. Write "1" to save the parameters. The encoder confirms the operation by writing "0" to this parameter.

Index	Sub	Meaning	Value	Access
971	0	Save on non volatile memory	variable	RW

P975 – Encoder object identification

[Array[0 … 7], unsigned16, RO]
It contains the encoder object identification.

Index	Sub	Meaning	Value	Access
975	0	Manufacturer ID (Vendor ID assigned by PI)	0x239	RO
975	1	DO type (Vendor specific)	0x101	RO
975	2	Software version	xxyy	RO
975	3	Software year	yyyy	RO
975	4	Software day and month	dd.mm	RO
975	5	PROFIdrive DO type classification	0x05 encoder interface	RO
975	6	PROFIdrive DO subclassification 1	0x8000 (encoder	RO

			Application Class 4 supported)	
975	7	Drive object ID (DO ID)	0x01	RO

NOTE

Software version, Software year, and Software day and month are expressed in decimal notation.
For example: Software version = xxyy (decimal).
Version 2.1 results in 0201 decimal.

P979 – Sensor format
[Array[0 … 5], unsigned16, RO]

Index	Sub	Meaning	Value	Access
979	0	Header	0x00005011	RO
979	1	Sensor type (0 = rotary sensor)	0x80000000	RO
979	2	Sensor Resolution	variable	RO
979	3	Shift factor for **G1_XIST1**	0	RO
979	4	Shift factor for **G1_XIST2**	0	RO
979	5	Determinable revolutions	variable	RO

P980 – Number list of defined parameter
[Array[0 … 8], unsigned16, RO]
The parameter **P980 – Number list of defined parameter** contains the list for the identification of all parameters the encoder supports.

Index	Sub	Meaning	Value	Access
980	0	**P922 – Telegram Selection**	922	RO
980	1	**P964 – PROFIdrive Parameter : Device identification**	964	RO
980	2	**P965 – Encoder profile number**	965	RO
980	3	**P971 – Transfer to non volatile memory**	971	RO
980	4	**P975 – Encoder object identification**	975	RO
980	5	**P979 – Sensor format**	979	RO
980	6	**P61001 – IP of station**	61001	RO
980	7	**P65000 – Preset value**	65000	RO
980	8	**P65001 – Operating status**	65001	RO

P61001 – IP of station

[Unsigned32, RO]

Index	Sub	Meaning	Value	Access
61001	0	IP address assigned to the encoder	variable	RO

9.4 Record Data Object 0xB02E: supported encoder specific parameters

P65000 – Preset value

[Unsigned32, RW]

Preset mode absolute

Preset function is meant to assign a desired value to a known physical position of the system. The chosen physical position will get the value set next to this index and all the previous and following mechanical positions will get a value according to it.

Preset mode relative (offset)

The encoder uses the preset value **P65000 – Preset value** as a relative offset value. In this mode the current position value is shifted by the value deriving from this preset value.

Preset value can be saved on the internal memory using the parameter **P971 – Transfer to non volatile memory**.

See also **Home position mode** and **Request set/shift of home position** in **G1_STW** on page 104; and **G1_XIST1 Preset control** on page 122.

Index	Sub	Meaning	Value	Access
65000	0	Preset value	variable	RW

EXAMPLE

An example of setting the Preset value is provided on page 41.

NOTE

The preset operation always affects **G1_XIST2** and **G1_XIST3**. It does not affect **G1_XIST1** if **G1_XIST1 Preset control** is disabled = 1.

P65001 – Operating status

[Array[0 … 11], unsigned32, RO]

This parameter has a read only structure. It provides information on the operating status of the encoder and on the current status of the Faults and Warnings. It is a complement to the PROFIdrive parameter **P979 – Sensor format** described in the PROFIdrive profile.

Index	Sub	Meaning	Value	Access
65001	0	Header	0x000C0101	RO
65001	1	**Operating status**	See "Operating status table values"	RO
65001	2	**Faults**	See "Table of faults"	RO
65001	3	**Supported faults**	0x0031	RO
65001	4	**Warnings** (*)	0x0	RO
65001	5	**Supported warnings** (*)	0x0	RO
65001	6	**Encoder profile version** (**)	0x401	RO
65001	7	**Operating time** (not used)	0xFFFFFFFF	RO
65001	8	**Offset value** (related to **G1_XIST1**)	variable	RO
65001	9	**Measuring units per revolution**	variable	RO
65001	10	**Total measuring range in measuring units**	variable	RO
65001	11	**Velocity measuring unit** (user setting)	variable (***)	RO

(*) Warnings are not supported in this encoder.

(**) The encoder profile version is the version of the encoder profile document implemented in the encoder. This parameter is not affected by the Compatibility Mode parameter setting.

(***) See the Velocity measuring unit parameter in the "9.5 Record Data Object 0xBF00: user parameter data" section on page 128.

Operating status table values

Bit	Meaning
0	Code sequence
1	Class 4 functionality
2	G1_XIST1 Preset control
3	Scaling function control
4	Alarm channel control
5	Compatibility Mode
6	Not used

7 ... 27	Reserved for future use by the profile
28 ... 31	Reserved to the encoder manufacturer

Table of faults

Bit	Meaning
0	**Position error**
1 ... 3	Not used
4	**Commissioning diagnostics**
5	**Memory error**
6 ... 31	Not used

For complete information refer to the "10.2.1 Use of the ChannelErrorType" section on page 133.

Table of supported faults

Bit	Meaning
0	**Position error** supported
1 ... 3	Not used
4	**Commissioning diagnostics** supported
5	**Memory error** supported
6 ... 31	Not used

9.5 Record Data Object 0xBF00: user parameter data

The 31-byte user parameter data listed in the table below is sent to the encoder at each start-up using the record data object 0xBF00. These parameters are available in the **Module parameters** tabbed page under TIA Portal, see the "5.5.10 Module parameters" section on page 69.

Parameter	Data Type	Default	Comment	User Data Octet Number
Code sequence	Bit	0 (CW)		Byte 0 bit 0
Class 4 functionality	Bit	1 (enabled)		Byte 0 bit 1
G1_XIST1 Preset control	Bit	0 (enabled)		Byte 0 bit 2
Scaling function control	Bit	0 (disabled)		Byte 0 bit 3
Alarm channel control	Bit	0 (disabled)	Only supported in Compatibility Mode	Byte 0 bit 4
Compatibility Mode	Bit	1 (disabled) (profile V4.1)		Byte 0 bit 5
Reserved		0	Set to 0	Byte 0 bits 6-7
Measuring units / Revolution	Unsigned64	variable		Bytes 1-8
Total measuring range	Unsigned64	variable		Bytes 9-16
Maximum tolerated failures of Master Sign-Of-Life	Unsigned8	1	Only supported in Compatibility Mode	Byte 17
Velocity measuring unit	Unsigned8	0 (Steps/s)		Byte 18
Reserved		0x00	Set to 0	Bytes 19-30

NOTE
Default values are highlighted in **bold** in the following tables.

Code sequence

This parameter is processed only if **Class 4 functionality** is enabled.
Code sequence sets whether the absolute position value output by the encoder increases (count up information) when the encoder shaft rotates clockwise (0 = CW) or counter-clockwise (1 = CCW). CW and CCW rotations are viewed from the shaft end.

Attribute	Meaning	Value
CW	Absolute position value increasing (count up information) when the shaft rotates clockwise (viewed from shaft end)	**0**

CCW	Absolute position value increasing (count up information) when the shaft rotates counter-clockwise (viewed from shaft end)	1

Default = 0 = CW (min. = 0, max. = 1)

WARNING

Changing this value causes also the position calculated by the controller to be necessarily affected. Therefore it is mandatory to execute a new preset after setting this parameter.

Class 4 functionality

For any information on the implemented Application Classes refer to the "6.3 Application Class definition" section on page 92.

If it is enabled, **Code sequence**, **G1_XIST1 Preset control**, and **Scaling function control** affect the position value in **G1_XIST1**, **G1_XIST2**, and **G1_XIST3**. However the preset will not affect the position value in **G1_XIST1** if the parameter **G1_XIST1 Preset control** is disabled; it will always affect **G1_XIST2** and **G1_XIST3** instead.

Attribute	Meaning	Value
Disable	**Code sequence**, **G1_XIST1 Preset control**, and **Scaling function control** do not affect the position value	0
Enable	**Code sequence**, **G1_XIST1 Preset control**, and **Scaling function control** affect the position value	1

Default = 1 = enable (min. = 0, max. = 1)

G1_XIST1 Preset control

This parameter is available only if **Class 4 functionality** is enabled.

This parameter controls the effect of a preset on the **G1_XIST1** current value. When it is enabled, Preset will affect the position value in **G1_XIST1**. For complete information on **G1_XIST1** signal see on page 99.

Attribute	Meaning	Value
Enable	**G1_XIST1** is affected by a Preset command	0

Disable	Preset does not affect **G1_XIST1**	1

Default = 0 = enable (min. = 0, max. = 1)

WARNING

G1_XIST1 Preset control is disabled by setting the value 1.

NOTE

There is no functionality of this parameter if the **Class 4 functionality** parameter is disabled.

EXAMPLE

An example of setting the Preset value is provided on page 41.

Scaling function control

This parameter is processed only if **Class 4 functionality** is enabled.

This parameter enables / disables the Scaling function. When this parameter is disabled, the device uses the **hardware** singleturn and multiturn resolutions (but see the **NOTE** below); when it is enabled, the device uses the resolutions set next to the parameters **Measuring units / Revolution** and **Total measuring range**. Refer also to the "Scaling function parameters" section on page 126.

Attribute	Meaning	Value
Disable	Scaling function disabled	**0**
Enable	Scaling function enabled	1

Default = 0 = disable (min. = 0, max. = 1)

NOTE

There is no functionality of this parameter if the **Class 4 functionality** parameter is disabled.

NOTE

When the **Scaling function control** parameter is disabled = 0, **G1_XIST1** provides the current position value in a 32 bit format: position values are from 0 to 4,294,967,295; integrated position values (between 2^{28} and 2^{32} for EXM58-13-14-…; between 2^{19} and 2^{32} for EXO58-18-00-…; between 2^{31} and 2^{32} for EXM58-18-12-… and EXO58-16-14-…) are retained as long as the power supply

is ON; if you turn the power supply OFF, the integrated position values are lost. At next power on, the physical position value will be provided.

When the Scaling function control is enabled = 1, **G1_XIST1** provides the current position value according to the resolution values set next to the parameters Measuring units / Revolution and Total measuring range (see on page 126 and ff).

EXAMPLE

We install the EXM58-13-14 encoder with 27-bit resolution. The Scaling function control parameter is disabled = 0, so **G1_XIST1** provides the current position value in a 32 bit format: position values are from 0 to 4,294,967,295. Let's say the encoder reaches the max. physical position value (2^{27} = 134,217,727) and then adds further 1,500,000 counts: **G1_XIST1** will show 135,717,727. If we switch the power OFF and then ON, **G1_XIST1** will show 1,499,999 instead.

Alarm channel control

This parameter enables / disables the encoder specific Alarm channel transferred as Channel Related Diagnosis. This functionality is used to limit the amount of data sent in isochronous mode.

If the value is zero (0 = default value), only the communication related alarms are sent via the alarm channel. If the value is one (1), also the encoder specific faults and warnings are sent via the alarm channel.

For further information refer also to the "10.2 Error messages via the Alarm Channel" section on page 132.

Attribute	Meaning	Value
Disable	No profile specific diagnosis	**0**
Enable	Profile specific diagnosis	1

Default = 0 = disable (min. = 0, max. = 1)

NOTE

This parameter is only supported in compatibility mode (see the Compatibility Mode parameter hereafter).

Compatibility Mode

This parameter defines whether the encoder has to run in a mode compatible with Version 3.1 of the Encoder Profile. See the table below for an overview of the functions affected when the compatibility mode is enabled.

Attribute	Meaning	Value
Enable	Compatibility with Encoder Profile V3.1	0
Disable	No backward compatibility, compatible with Encoder Profile V4.1	**1**

Default = 1 = disable (min. = 0, max. = 1)

Function	Compatibility mode Enabled (=0)	Compatibility mode Disabled (=1)
Control by PLC (STW2_ENC)	Ignored. The control word **G1_STW** and setpoint values are always valid. **Control requested (ZSW2_ENC)** is not supported and is set to 0	Supported
User parameter **Maximum tolerated failures of Master Sign-Of-Life**	Supported	Not supported. One Sign-Of-Life failure tolerated.
User parameter **Alarm channel control**	Supported	Not supported. The application alarm channel is always active and controlled by a PROFIdrive parameter
P965 – Encoder profile number	31 (V3.1)	41 (V4.1)

⚠ **WARNING**

If the encoder is used as a TO Technology Object (see the "5.7 TO Technology Objects" section on page 78), the **Compatibility Mode** parameter must be set to 0 = Enable = Compatible with Encoder Profile V3.1.

Scaling function parameters

Using the scaling function parameters the absolute position value of the encoder is converted by the software in order to customize the resolution of the encoder according to needs. The scaling parameters will only be activated if the parameters **Class 4 functionality** (see on page 122) and **Scaling function control** (see on page 123) are enabled.
The permissible range for the scaling parameters is limited by the hardware resolution of the encoder.

EXAMPLE

In a 27-bit encoder having a singleturn resolution of 13 bits (8,192 cpr) and a number of revolutions of 14 bits (16,384 revolutions), the permissible value for the **Measuring units / Revolution** is between 2^0 and 2^{13} (2^{13} = 8,192) while the permissible value for the **Total measuring range** is between 2 and 2^{27} (2^{27} = 2^{13} * 2^{14} = 134,217,728).

Measuring units / Revolution

It is used to program a user specific resolution per each revolution (singleturn resolution). Allowed values are less than or equal to the number of hardware counts per revolution (**physical singleturn resolution**). We suggest setting values that are a power of 2 (1, 2, 4, ... 2048, 4096, ...). See the **Total measuring range** parameter below.

Default = 8,192 (min. = 1, max. = 8,192)   for EXM58-13-14
             262,144 (min. = 1, max. = 262,144)   for EXM58-18-12 and EXO58-18-00
             65,536 (min. = 1, max. = 65,536)   for EXO58-16-14

NOTE

There is no functionality of this parameter if the **Scaling function control** parameter is disabled.

EXAMPLE

The EXO58-18-00-PT4-… singleturn encoder has a singleturn resolution of 18 bits (262,144 cpr); the permissible value for the **Measuring units / Revolution** parameter will be between 2^0 and 2^{18} (2^{18} = 262,144).

NOTE
When you change the value next to this parameter, then you are required to enter a new preset.

Total measuring range

This parameter sets the number of distinguishable steps over the total measuring range. Allowed values are less than or equal to the total hardware resolution value (**physical overall resolution** = number of physical counts per revolution * number of physical revolutions).

We recommend the **Number of revolutions** to be set to a power of 2.

The set **Number of revolutions** results from the following calculation:

$$\text{Number of revolutions} = \frac{\text{Total measuring range}}{\text{Measuring units / Revolution}}$$

Setting the **Number of revolutions** to a value which is a power of 2 is meant to avoid problems when using the device in endless operations requiring the physical zero to be overstepped. If you set the **Number of revolutions** which is not a power of 2, a so-called "Red Zone" is generated before the physical zero. For more detailed information refer to the 9.6 "Red Zone" section on page 129).

Default = 134,217,728 (min. = 1, max. = 134,217,728)   for EXM58-13-14
        262,144 (min. = 1, max. = 262,144)   for EXO58-18-00
        1,073,741,824 (min. = 1, max. = 1,073,741,824) for EXM58-18-12
                                and EXO58-16-14

NOTE
There is no functionality of this parameter if the **Scaling function control** parameter is disabled.

EXAMPLE
The EXO58-16-14-PT4-… encoder has a singleturn resolution of 16 bits (65,536 cpr) and a number of revolutions of 14 bits (16,384 revolutions). The permissible value for the **Measuring units / Revolution** will be between 2^0 and 2^{16} (2^{16} = 65,536) while the permissible value for the **Total measuring range** will be between 2 and 2^{30} ($2^{30} = 2^{16} * 2^{14} = 1,073,741,824$).

NOTE

When you change the value next to this parameter, then you are required to enter a new preset.

Maximum tolerated failures of Master Sign-Of-Life

This parameter sets the number of allowed failures of the Master's sign of life. The default value is one (1).
Default = 1 (min. = 1, max. = 255)

NOTE

This parameter is only supported in compatibility mode (see the **Compatibility Mode** parameter on page 125).

Velocity measuring unit

This parameter defines the engineering unit of the velocity value used to configure the signals **NIST_A** and **NIST_B**. Standard telegram 81 has no velocity information included and the encoder does not use the velocity measuring unit information in that case. Standard telegrams 82, 83, and 84 include velocity output (**NIST_A** and/or **NIST_B**) and need a declaration of the velocity measuring unit.

Parameter	Meaning	Value
Velocity measuring unit	Definition of the engineering unit for the encoder velocity output value	See the table below

Velocity measuring units	Value
Steps / s	**0**
Steps / 100 ms	1
Steps / 10 ms	2
RPM	3

Default = 0 = Step/s (min. = 0, max. = 3)

NOTE

Please note that the velocity value is always calculated every 100 ms.

9.6 "Red Zone"

The so-called "Red Zone" problem occurs when the **Number of revolutions** (i.e. the Total measuring range / Measuring units / Revolution) is not a power of 2.

When this problem arises, the device must operate within the "red zone" for a certain number of positions. The size of the "red zone" is variable. To calculate it we must subtract the overall set resolution from the overall physical resolution of the device as many times as until the difference is less than the overall set resolution. When the encoder crosses the limit of the last value in the overall physical resolution, a counting error occurs, i.e. a jump in the position count. The problem is represented graphically in the following Figure.
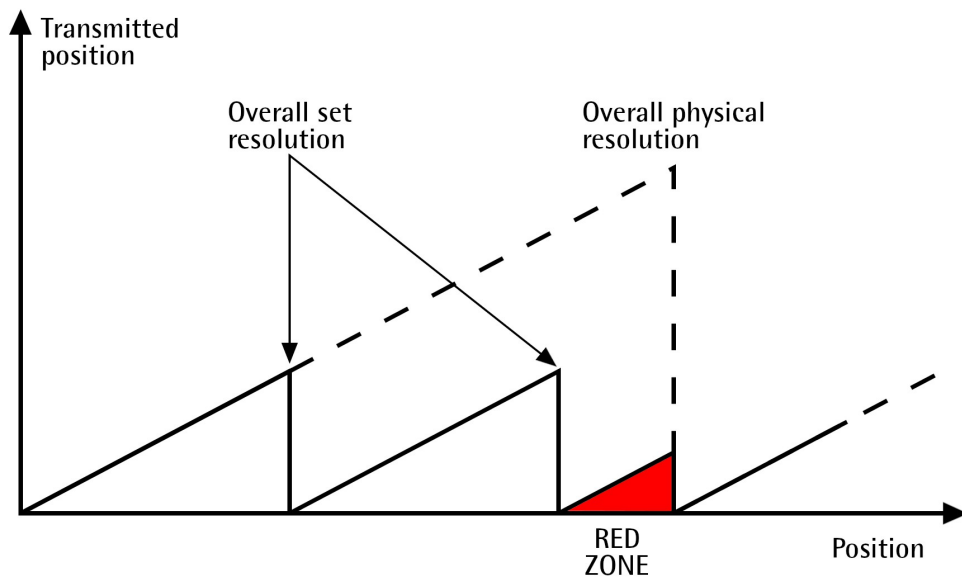
EXAMPLE
EXO58-16-14-PT4-... multiturn encoder

Physical resolution:
- Singleturn physical resolution = 65,536 counts/rev. = 16 bits (2^{16})
- Multiturn physical resolution = 16,384 revolutions = 14 bits (2^{14})
- Overall physical resolution = 1,073,741,824 = 30 bits (2^{30})

Set values:
- Measuring units / Revolution = 65,536 = 2^{16}
- Total measuring range = 442,236,928 = it is NOT a power of 2

It results from this:

- **Number of revolutions** = 6,748 = it is NOT a power of 2

This can be proved easily:

$$\frac{\textbf{Overall physical resolution}}{\textbf{Overall set resolution}} = \frac{1,073,741,824}{442,236,928} = 2.427...$$

It follows that for 189,267,968 positions (1,073,741,824 – 442,236,928 * 2 = 189,267,968), i.e. for 11,552 revolutions, the encoder will work within the limits of the so-called "red zone". After position 189,267,968 (i.e. at the end of the "red zone") a position error (namely, a "jump" in the position count) would happen as the following position would be "0". See the Figure in the previous page.

NOTE
Make attention using the values sent by the encoder while working within the limits of the "Red Zone". When the encoder changes from "Red Zone" status to normal status (and vice versa) a jump of position occurs.

10 Diagnostics and Alarms

Diagnostics data is always transferred <u>acyclically</u> using Record Data communication over the non real time channel. A PN-IO controller can request diagnostic data from the PN-IO device using RDO (Record Data Object) services.

Alarm data is transmitted from the IO device to the IO controller via the RT channel.

The encoder errors are divided into **Faults** and **Warnings**, they are defined as follows.

FAULT
A Fault is set if a malfunction in the encoder could lead to incorrect position values.

WARNING
Warnings indicate that the tolerance for certain internal parameters of the encoder has been exceeded. Unlike faults, warnings do not imply incorrect position values.

NOTE
Please note that warnings are not supported in this encoder.

There are several diagnosis mechanisms that are used to monitor encoder diagnostics.
Please refer to the table below for an overview of the available diagnosis mechanisms.

Function	Reference
Acyclic diagnosis parameter **P65001 – Operating status**	See on page 132
Channel related diagnosis via the Alarm Channel	See on page 132
Error codes in **G1_XIST2**	See on page 133
LEDs indication	See on page 136

10.1 Acyclic diagnosis parameter P65001 – Operating status

With the **P65001 – Operating status** Acyclic parameter the current status of the Encoder Faults and Warnings as well as the support of the individual Fault and Warning bits can be read from the encoder. For detailed information on the **P65001 – Operating status** parameter please refer to page 119.

10.2 Error messages via the Alarm Channel

The encoder diagnosis is reported to the controller via the Alarm channel as Channel Related Diagnosis. Both warnings and faults are reported in the same manner but with different error types.

NOTE

In compatibility mode (see the Compatibility Mode parameter on page 125), channel related diagnostics can be switched off by setting the Alarm channel control parameter, please refer to its description on page 124.

For a detailed definition of the use of the channel related diagnosis please refer to the Alarm mechanism definition for the respective communication system in the mapping part of the profile.
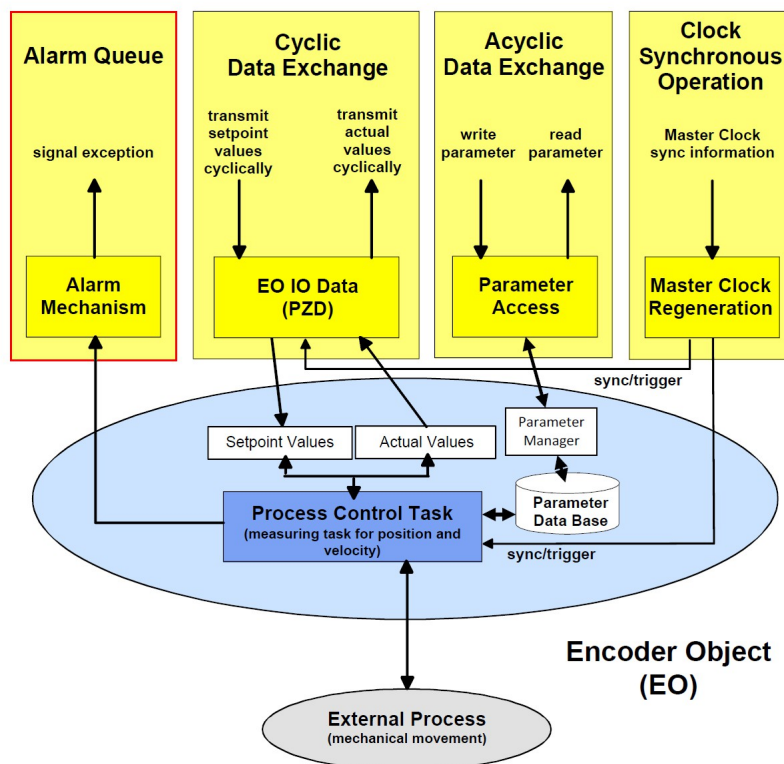
10.2.1 Use of the ChannelErrorType

For Profinet the encoder faults and warnings are mapped to the ChannelErrorTypes defined in the PROFIdrive profile, see the tables below. This means that there are no specific codes defined for stand-alone encoders and a PROFINET controller will interpret the errors from an encoder in the same ways as an error coming from a drive. Refer also to the **P65001 – Operating status** parameter on page 119.

Error type	Definition	Explanation
0x9000	**Memory error**	The encoder failed to read saved offset or preset values from the internal non volatile memory.
0x900B	**Position error**	Error and malfunction of the encoder position measurement system or the measured value processing unit. This error causes an invalid position and speed actual value, it may be due to the hardware or the signal quality.
0x9011	**Commissioning diagnostics**	User parameter data assignment error.

10.3 Error codes in G1_XIST2

Error codes are sent in **G1_XIST2** if an error in the sensor channel occurs. The list below shows all defined error codes for the sensor channel state machine, they are described even when not implemented in the specific encoder. In case of multiple errors, the error code of the most severe error is transmitted in **G1_XIST2**. For information about **G1_XIST2** refer to page 101.

0x0001 | Sensor group error
Error in the processing of the sensor signal which causes an invalid G1_XIST (e.g. electronic malfunction, invalid sensor signal input, ...).

0x0002 | Zero mark monitoring
Warning about inconsistency between correctly processed G1_XIST and sensor reference signal (e.g. lost pulses, ...).

0x0003 | Failure parking sensor

Error because transition to SD12 | Parking is not possible. This may be e.g. because the drive is currently running (state S4 operation) and the motor measurement system is forced to parking.

0x0004 | Abort reference value search

Error occurred during the initialisation or during the search for reference mark. There was an internal error or **G1_STW** bit 7 changed to 1 while the position feedback interface was in state SD5 | Wait for reference marks.

0x0005 | Abort reference value retrieval

Error occurred during reading of the reference value. There is no valid reference value or the command is not allowed or **G1_STW** bit 7 changed to 1 while the position feedback interface was in state SD4 | Reference value in G1_XIST2.

0x0006 | Abort measurement on the fly

Error occurred during the initialisation or during the action of the function "measurement on the fly". There was an internal error or **G1_STW** bit 7 changed to 0 while the position feedback interface was in state SD10 | Wait for measured value.

0x0007 | Abort measured value retrieval

Error occurred while reading the result of the function "measurement on the fly". There is no valid value or the command is not allowed or **G1_STW** bit 7 changed to 0 while the position feedback interface was in state SD11 | Measured value in XIST2.

0x0008 | Abort absolute value transmission

Error because the absolute value transmission from the encoder to the feedback interface is not possible. This may be e.g. because of an absolute value encoder (with serial interface) not present or not working.

0x0009 | Abort absolute value transmission

Reserved.

0x000A | Abort absolute value transmission

Absolute value track of encoder not readable.

0x000B | Abort absolute value transmission
Reserved.

0x000C ... 0x0F00 | reserved
0x000C ... 0x0F00

0x0F01 | Command not supported
Error because optional function (e.g. shift/preset home position) is not supported.

0x0F02 | Master's sign of life fault
The number of permissible failures of the Master's sign of life was exceeded. [1]

0x0F04 | Synchronization fault
The number of permissible failures for the bus cycle was exceeded. [1] [2]

0x0F05 | Overtemperature fault
The maximum operating temperature of the sensor was exceeded. [1]

0x1001 | Memory error
Error while writing on or reading the internal non volatile memory.

0x1002 | Parametrization error
User parameter data assignment error.
Example: **Measuring units / Revolution** and **Total measuring range** parameter values not compatible.

NOTE 1
Error codes **0x0F02 | Master's sign of life fault**, **0x0F04 | Synchronization fault**, and **0x0F05 | Overtemperature fault** are defined here for compatibility to Encoder Profiles V3.1 and V4.1.

NOTE 2

In Clock cycle synchronous applications the encoder additionally indicates the error described by **0x0F04 | Synchronization fault** error code by setting the encoder's Sign-Of-Life to zero.

10.4 LEDs indication

Errors are further indicated through LEDs. Five LEDs located in the rear of the encoder (see Figure 1) are designed to show visually the operating or fault status of the encoder and the Profinet interface.

For detailed information refer to the "4.7 Diagnostic LEDs (Figure 1)" section on page 35.

10.5 States

State │ Name	Action	Explanation	Identification / Status information
SD1 │ Normal operation	None	The position feedback interface operates normally. Transmission of XIST2 in **G1_XIST2** is possible if requested by **G1_STW** bit 13=1.	**G1_ZSW** bit 0-7 = 0000 0000b, **G1_ZSW** bit 10-15 = 00x000b
SD2 │ Error acknowledgement	Error is acknowledged	Error acknowledgement is being processed.	**G1_ZSW** bit 11 = 1, bit 0-7 = 0000 0000b, **G1_ZSW** bit 15 = 1 as long as valid Error code is posted in **G1_XIST2** (as long as error is present).
SD3 │ Error	Error code is posted in **G1_XIST2**	An error is present.	**G1_ZSW** bit 15 = 1, Gx_ZSW bit 11 = 0, bit 0-7 = 0000 0000b
SD4 │ Reference value in G1_XIST2	Load reference value in **G1_XIST2**	The reference value is loaded in **G1_XIST2**.	**G1_ZSW** bit 4-7 <> 0000b, bit 0-3 = 0000b
SD5 │ Wait for reference marks	Wait for reference marks	The reference mark is expected.	**G1_ZSW** bit 0-3 <> 0000b, bit 4-7 = 0000b
SD7 │ Set / shift home position	Set or shift value in **G1_XIST1** and **G1_XIST2**	**G1_XIST1** and **G1_XIST2** are set or shifted by a predefined preset value. Set or shift is controlled by the mode bit **G1_STW**, bit 11.	**G1_ZSW** bit 12 = 1 (edge triggered), bit 0-7 = 0000 0000b
SD10 │ Wait for measured value	Waiting for measured values	Measurement Task active, waiting for measured values. At least one of the four measurement latch processes is active and waiting for measured values. Transmission of XIST2 in **G1_XIST2** is possible if requested by **G1_STW** bit 13=1.	**G1_ZSW** bit 0-3 <> 0000b, bit 4-7 = 0000b
SD11 │ Measured value in XIST2	Load measured value in **G1_XIST2**	The requested measured value is loaded into **G1_XIST2**.	**G1_ZSW** bit 4-7 <> 0000b, for bits 0-3: bit related to the requested measured value = 0
SD12 │ Parking	All errors are cleared if **G1_STW** bit 14 = 1.	The position feedback interface is in a state where it is inactive and does not deliver a valid **G1_XIST1** value. This is also the position feedback interface initial state.	**G1_ZSW** bit 14 = 1

10.6 Transitions

Transition Number	Source State	Destination State	Condition
TD1	SD2 │ Error acknowledgement	SD1 │ Normal operation	**G1_STW** bit 15 = 0 and error removed
TD2	SD4 │ Reference value in G1_XIST2	SD1 │ Normal operation	**G1_STW** bit 4-6 = 000b
TD3	SD1 │ Normal operation	SD4 │ Reference value in G1_XIST2	**G1_STW** bit 7 = 0 and **G1_STW** bit 4-6 = 010b and **G1_STW** bit 0-3 <> 0000b and Reference value is found
TD4	SD5 │ Wait for reference marks	SD1 │ Normal operation	**G1_STW** bit 4-6 = 000b and reference mark found
TD5	SD5 │ Wait for reference marks	SD1 │ Normal operation	**G1_STW** bit 4-6 = 011b
TD7	SD1 │ Normal operation	SD7 │ Set / shift home position	**G1_STW** Bit 12 = 1
TD8	SD7 │ Set / shift home position	SD1 │ Normal operation	**G1_STW** Bit 12 = 0
TD11	SD1 │ Normal operation	SD10 │ Wait for measured value	**G1_STW** bit 7 = 1 and **G1_STW** bit 4-6 = 001b and **G1_STW** bit 0-3 <> 0000b
TD12	SD10 │ Wait for measured value	SD1 │ Normal operation	**G1_STW** bit 4-6 = 011b
TD13	SD10 │ Wait for measured value	SD1 │ Normal operation	**G1_STW** bit 4-6 = 000b and measured values found
TD14	SD1 │ Normal operation	SD11 │ Measured value in XIST2	**G1_STW** bit 7 = 1 and **G1_STW** bit 4-6 = 010b and **G1_STW** bit 0-3 <> 0000b and related measured value found
TD15	SD11 │ Measured value in XIST2	SD1 │ Normal operation	(**G1_STW** bit 4-6 = 000b while no measurement process is active (all measured values found)) or (**G1_STW** bit 7 = 1 and **G1_STW** bit 4-6 = 011b)

Transition Number	Source State	Destination State	Condition
TD16	Every state	**SD12 │ Parking**	**G1_STW** bit 14 = 1 additional condition, when SD13, SD14 are implemented: or when (**G1_XIST1** is invalid and no error is occurred or present) Notice: If the sensor related to this position feedback interface is the motor measurement system, the condition **G1_STW** bit 14 = 1 may alternatively result in a sensor interface error (Error code **0x0003 │ Failure parking sensor**) when the drive is running and no transition to **SD12 │ Parking** will be performed.
TD17	**SD12 │ Parking**	**SD1 │ Normal operation**	**G1_STW** bit 14 = 0 and **G1_ZSW** bit 14 were set for at least 100 ms additional condition, when SD13, SD14 are implemented: and **G1_XIST1** is valid.
TD20	Every state	**SD3 │ Error**	Error occurred or a command is illegal
TD21	**SD3 │ Error**	**SD2 │ Error acknowledgement**	**G1_STW** bit 15 = 1 and **G1_XIST1** valid

11 Real time class communication

Within PROFINET IO, process data and alarms are always transmitted in real time. Real-Time for PROFINET (RT) is based on the definitions of IEEE and IEC for high-performance data exchange of I/O data. RT communication constitutes the basis for data exchange in PROFINET IO.

Real-time data are handled with higher priority compared to TCP(UDP)/IP data. This method of data exchange allows bus cycle times in the range of a few hundred milliseconds to be achieved.

Isochronous data exchange with PROFINET is defined in the Isochronous-Real-Time (IRT) concept. IRT communication is always clock synchronized and only possible within an IRT domain. Isochronous real-time communication differs from real-time communication mainly in its isochronous behaviour: the start of a bus cycle can deviate by a maximum of 1 µs (jitter is less than 1 µs). IRT is required in motion control applications (positioning operations), for example. This communication is required, for example, for high-accuracy closed-loop control tasks.

11.1 Real-time classes in PROFINET IO

To enable enhanced scaling of communication options and, thus, also of determinism in PROFINET IO, real-time classes have been defined for data exchange. From the user perspective, these classes involve unsynchronized and synchronized communication.
PROFINET IO differentiates the following classes for RT communication.
They differ not in terms of performance but in determinism.

11.2 Real-Time class 2 (RT2) – Not synchronized

In real-time class 2, frames are transmitted via unsynchronized communication (anisochronous communication).

11.2.1 Setting an anisochronous communication

To activate the real-time class 2 both the IO controller and the IO device must be configured. To do this proceed as follows.

IO controller (Figure 49)
1. Press the **Network view** changeover switch in the **Hardware and network editor** to enter the **Network overview** working area;

2. select the IO controller (PLC_1) in the table area;
3. in the **Properties** inspector window, **General** tab, press the **Synchronization** menu option;
4. enter the **Synchronization** group box and set the **Unsynchronized** option through the drop-down list box in the **Synchronization role** item.
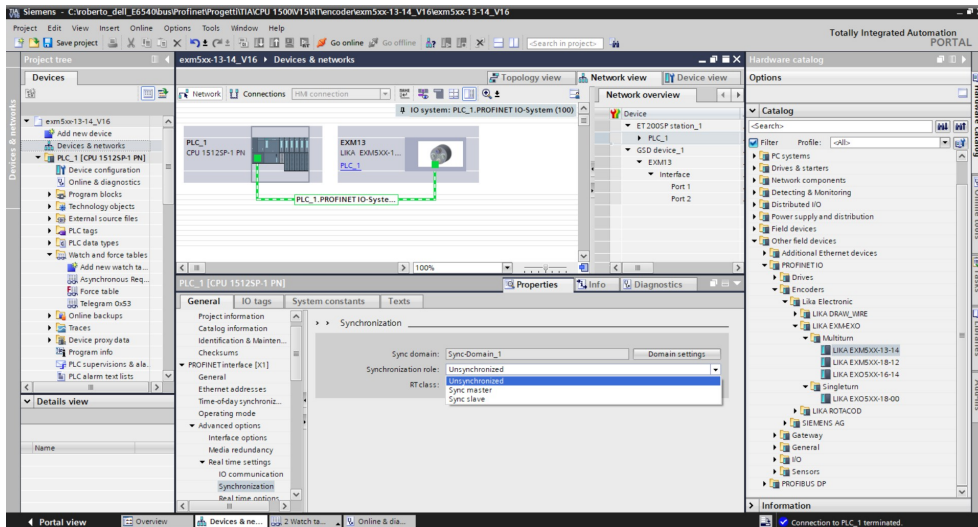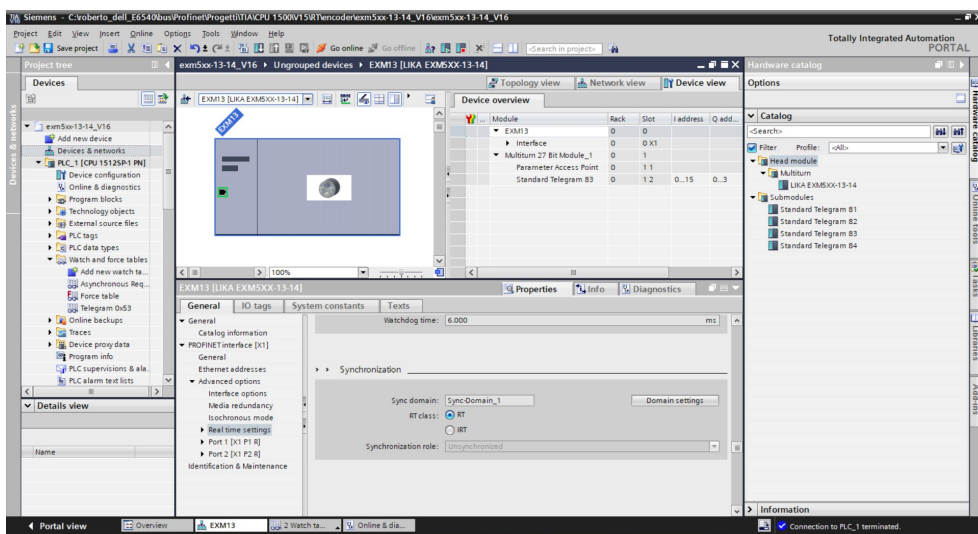

Figure 49 – Setting the unsynchronized role of the IO controller

IO device (Figure 50)

1. Press the **Device view** changeover switch in the **Hardware and network editor** to enter the **Device overview** working area;

Figure 50 – Setting the unsynchronized role of the IO device

2. if needed, select the device you need to configure in the drop-down box on the top left of the graphic area;
3. select the encoder;
4. in the **Properties** inspector window, **General** tab, press the **Real time settings** menu option;
5. enter the **Synchronization** group box and select the **RT** option button next to the **RT class** item.

11.3 Real-Time class 3 (IRT_TOP) (RT3)

Isochronous data exchange with PROFINET is defined in the Isochronous-Real-Time (IRT) concept. IRT communication is always clock synchronized and only possible within an IRT domain. Isochronous real-time communication differs from real-time communication mainly in its isochronous behaviour: the start of a bus cycle can deviate by a maximum of 1 μs (jitter is less than 1 μs).
This communication is required, for example, for high-accuracy closed-loop control tasks.
Only industrial IRT switches can be used.
Typical cycle time is 1 ms or less. All network components must support PROFINET IRT frame priority processing. Position values are captured with an accuracy of ±1 μs or better, with respect to the highly accurate bus clock.

11.3.1 Setting an isochronous communication

To activate the real-time class 3 both the IO controller and the IO device must be configured. To do this proceed as follows.

IO controller (Figure 51)
1. Press the **Network view** changeover switch in the **Hardware and network editor** to enter the **Network overview** working area;
2. select the IO controller (PLC_1) in the table area;
3. in the **Properties** inspector window, **General** tab, press the **Synchronization** menu option;
4. enter the **Synchronization** group box and set the **Synch master** option through the drop-down list box in the **Synchronization role** item.
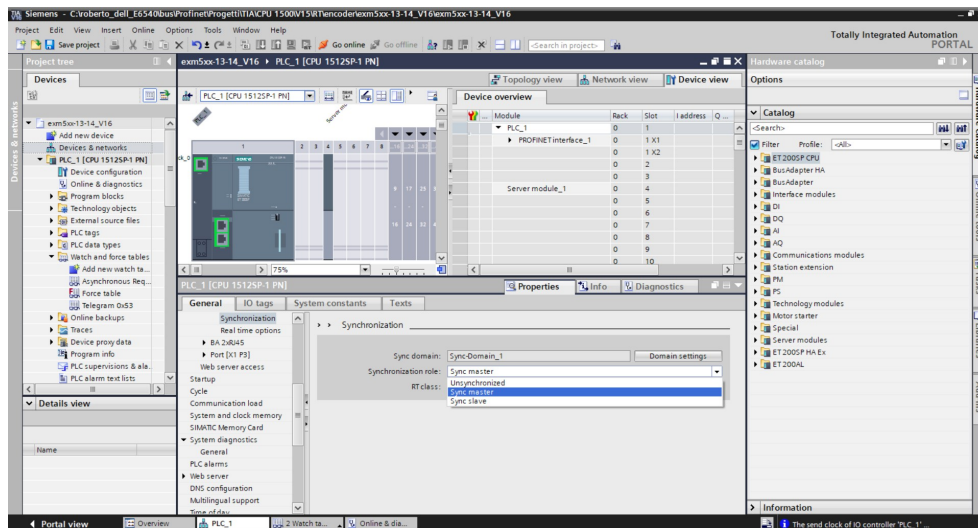
Figure 51 – Setting the synchronized role of the IO controller

IO device (Figure 52)

1. Press the **Device view** changeover switch in the **Hardware and network editor** to enter the **Device overview** working area;
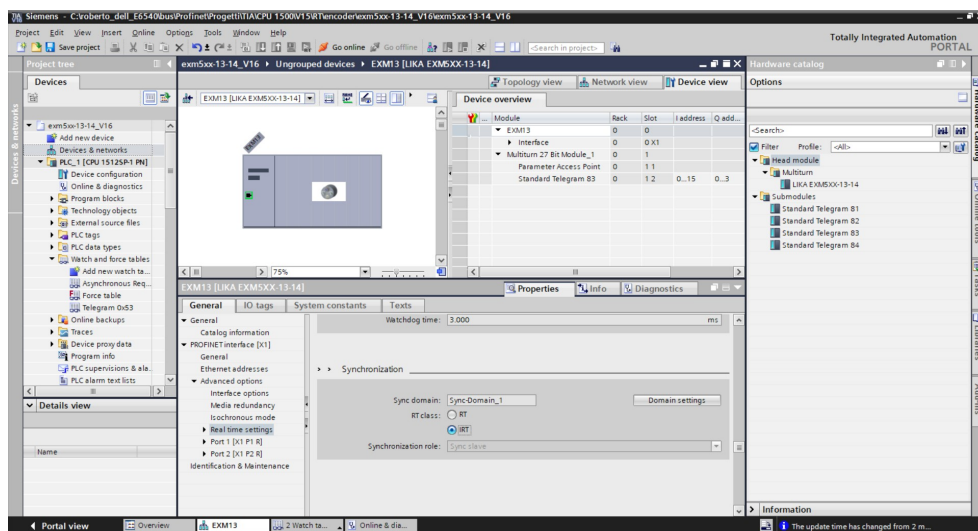

Figure 52 – Setting the synchronized role of the IO device

2. if needed, select the device you need to configure in the drop-down box on the top left of the graphic area;
3. select the encoder;
4. in the **Properties** inspector window, **General** tab, press the **Real time settings** menu option;
5. enter the **Synchronization** group box and select the **IRT** option button next to the **RT class** item;

6. now in the **Device overview** working area select the telegram you have installed (Standard Telegram 83 in Figure 53);
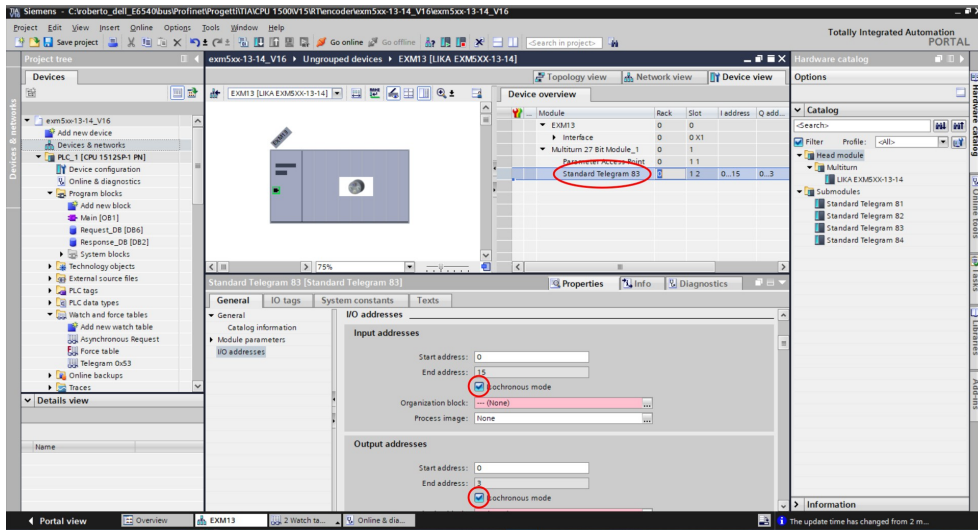

Figure 53 – Setting the isochronous mode for the telegram

7. in the **Properties** inspector window, **General** tab, press the **I/O addresses** menu option;
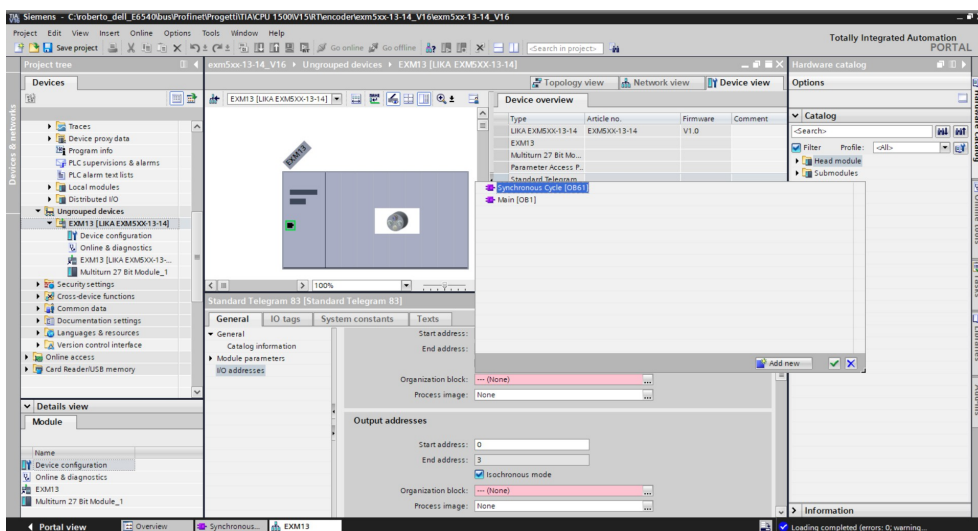8. enter the **Input addresses** group box and select the **Isochronous mode** check box;

Figure 54 – Setting the Synchronous Cycle [OB61]

9. then press the kebab menu next to the **Organization block** item below and open the additional option menu;

10. select the **Synchronous Cycle [OB61]** organization block; if it is not present in the menu press the **ADD NEW** button and select it in the **Add new block** page that appears;

11. press the green tick button to confirm and close the menu;

12. the **PIP 1** option will be selected automatically next to the **Process image** item;

13. do the same for the output address: enter the **Output addresses** group box and select the **Isochronous mode** check box;

14. then press the kebab menu next to the **Organization block** item below and open the additional option menu;

15. select the **Synchronous Cycle [OB61]** organization block; if it is not present in the menu press the **ADD NEW** button and select it in the **Add new block** page that appears;

16. press the green tick button to confirm and close the menu;

17. the **PIP 1** option will be selected automatically next to the **Process image** item;

18. at the end of the setting operation the standard telegram I/O addresses will be set as shown in the following Figure 55;
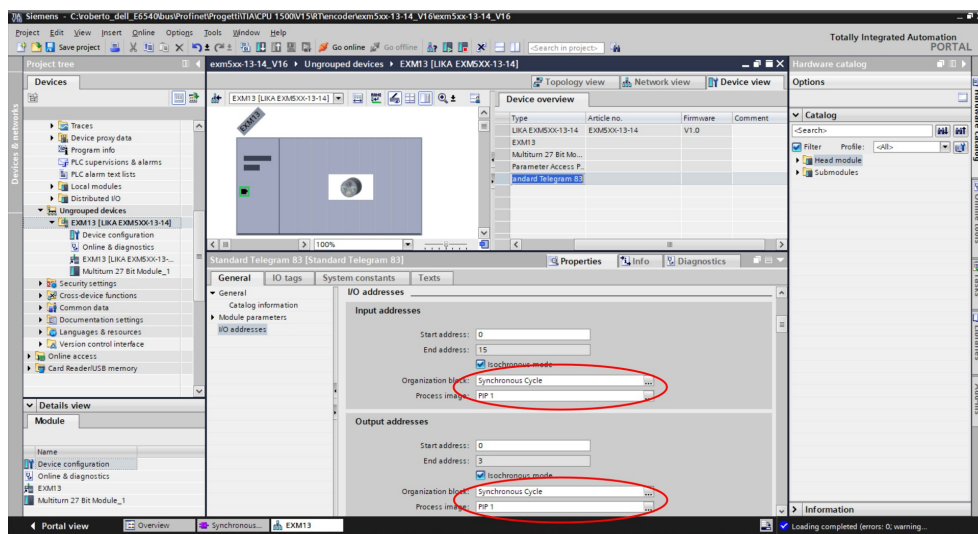
19. finally transfer your project.

Figure 55 – I/O addresses set

NOTE
For more information on PIPs (Process Image Partitions) refer to the "11.5 PIP (Process Image Partition)" section on page 147.

11.4 OB61

WARNING
Use of OBs requires both in-depth skills and specific expertise in TIA PORTAL programming environment. For detailed information please consult the TIA PORTAL Programmer's handbook and documentation.

Organization blocks (OBs) form the interface between the CPU operating system and the user program. The order in which the user program is executed is defined in the organization blocks.

The synchronization with the user program is maintained through the clocked interrupt OB61. OB61 is a synchronous cycle interrupt; in other words it is an isochronous event that is called with the start of every PROFINET cycle. It is synchronous with the Profinet send clock.
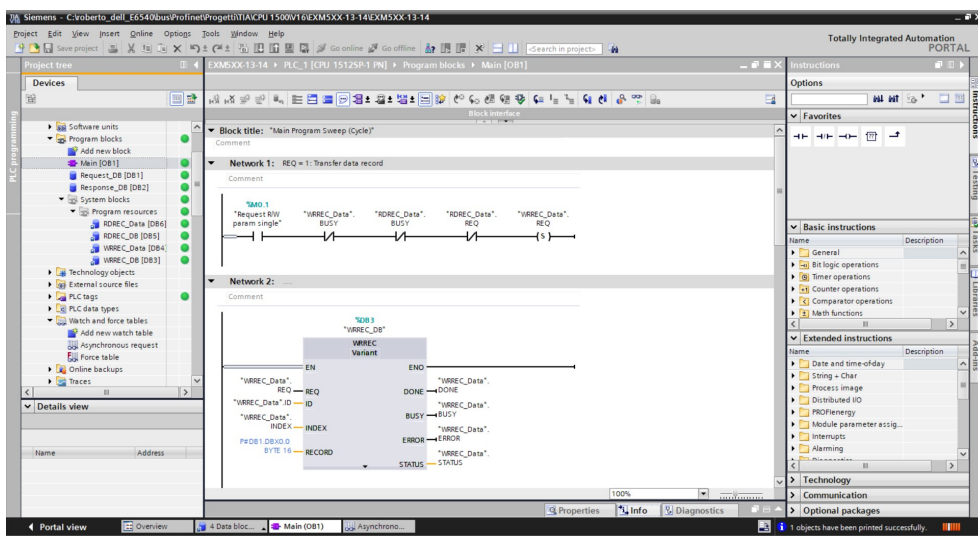
Figure 56 – OB61

11.5 PIP (Process Image Partition)

WARNING
Use of PIPs requires both in-depth skills and specific expertise in TIA PORTAL programming environment. For detailed information please consult the TI PORTAL Programmer's handbook and documentation.

11.5.1 Consistency

PIPs (Process Image Partitions) are used to update the distributed IO device synchronously with the constant bus cycle time clock.
Compared with direct access to the input/output modules, the main advantage of accessing the process image is that the CPU has a consistent image of the process signals for the duration of one program cycle. If a signal state on an input module changes while the program is being executed, the signal state in the process image is retained until the process image is updated again in the next cycle. The process of repeatedly scanning an input signal within a user program ensures that consistent input information is always available. You define process image partition with TIA PORTAL when you assign addresses (which input/output addresses of the modules are listed in which process-image partition). The process image partition is updated by the user with SFCs.

Figure 57 – Process Image Partition

12 Encoder replacement using LLDP

LLDP (Link Layer Discovery Protocol) is a Layer 2 protocol that is used to detect the closest neighbours in the network. It enables a device to send information about itself and to save information received from neighbouring devices, i.e. it provides the option of communicating data between neighbouring devices (e.g. device name, port, MAC address). This information allows a network management system to determine the network topology. The protocol is formally referred to by the IEEE as *Station and Media Access Control Connectivity Discovery* specified in standards document IEEE 802.1AB.
Among the main uses, LLDP allows to replace a device of the Profinet network.
The partner ports before and behind the replaced device save the relevant information so that no additional configuration is necessary. The flag **Support device replacement without exchangeable medium** must be activated in the Controller.

When you need to activate / deactivate the **Support device replacement without exchangeable medium** function in the IO controller, proceed as follows:
1. In the Device or Network view of TIA Portal select the PROFINET interface of the corresponding IO controller. The properties of the PROFINET interface are displayed in the inspector window.
2. In the **Properties** of the PROFINET interface, under **Advanced options > Interface options** enable the **Support device replacement without exchangeable medium** option.
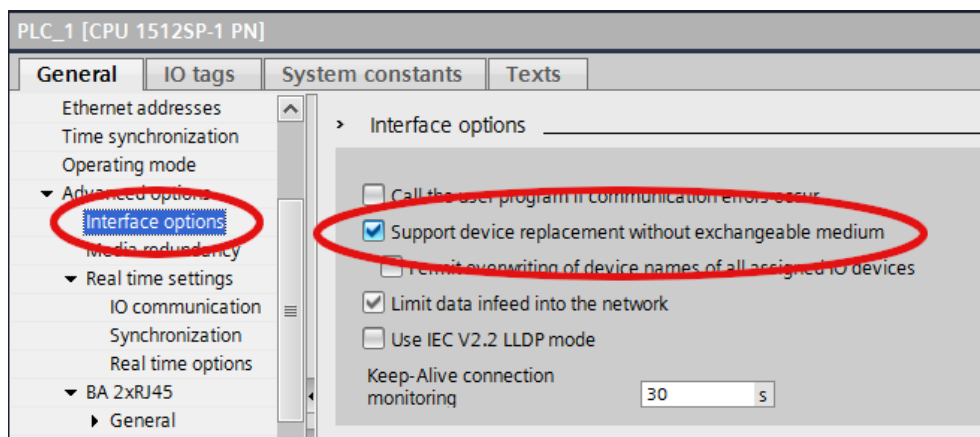

Figure 58 – Link Layer Discovery Protocol (LLDP)

NOTE

When you replace a device, make sure that the PROFINET cable is then inserted into the correct port as it is configured in TIA Portal. Otherwise, the system will not run.

13 Media Redundancy Protocol (MRP)

MRP (Media Redundancy Protocol) is a redundancy protocol supported by all Profinet capable devices that will allow a network to be configured in a ring topology. It is standardized by the International Electrotechnical Commission as IEC 62439-2. It is suitable to most Industrial Ethernet applications. Since Profinet is an open standard, this means that MRP is a manufacturer independent protocol and can be used to form a ring with devices from different manufacturers (so long as all devices are fully IEC 62439-2 compliant).

It allows rings of Ethernet devices to overcome any single failure with recovery time much faster than achievable with Spanning Tree Protocol. In other words, it allows to prevent interruptions in an automation machine caused by a defect of a cable or a device. In an MRP ring, the ring manager is named **Media Redundancy Manager** (**MRM**), while ring clients are named **Media Redundancy Clients** (**MRCs**). Any MRC is connected to the MRM via two ways of communication. During normal work status (network without failure in the ring) the telegrams will only be sent via one way of communication; the second way of communication will be blocked by the MRM. If a failure in the ring occurs (for instance because of a cable break), the second way of communication will be opened by the MRM.

Requirements are:
- all devices in the ring support MRP;
- you have complied with the rules for topology.

For complete information on the MRP please refer to the documentation provided by Siemens.
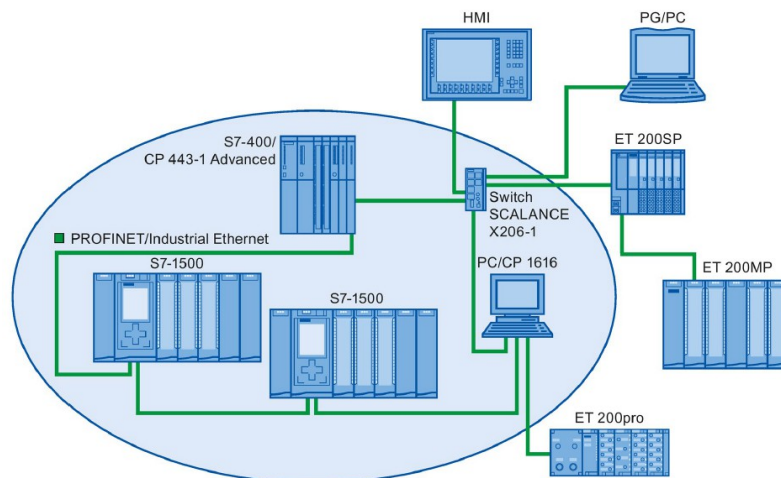

Figure 59 – Example of a ring topology with the MRP media redundancy protocol

13.1 Setting MRP roles

Within an MRP ring, each device must be assigned a role. One device will be the MRP Manager (MRM) and will be responsible for sending out test frames to detect for a network failure and for blocking network traffic on one port (except for the test frames) to prevent a network loop. The other devices must be assigned a Client role (MRC) so they know how to handle the test frames.

So let's set our PLC as the manager.
Go to the **Device view** for the PLC and look at the properties of the network interface. Under **Advanced Options**, look for **Media redundancy** item. Here you can select the role for the device: set the **Manager (Auto)** option in the **Media redundancy role** drop-down menu.
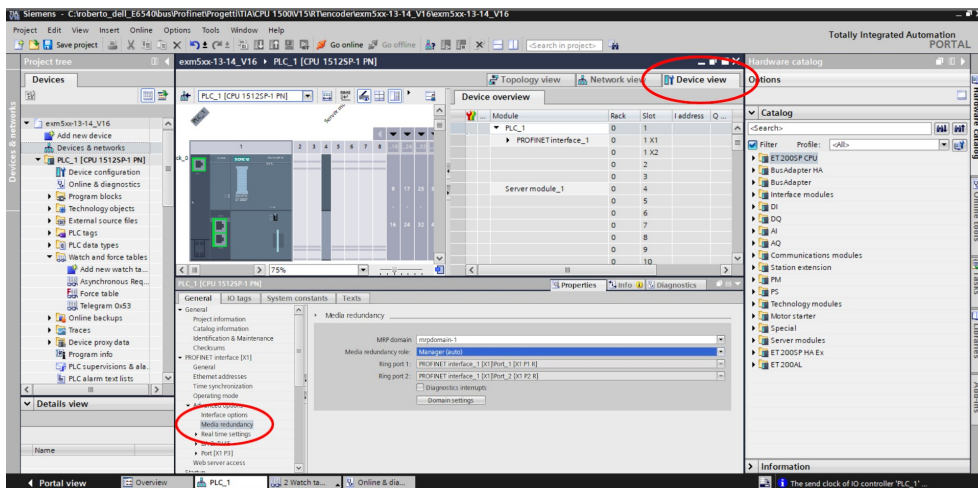
Figure 60 – Setting the PLC as the MRM

We do the same for the encoder: it must be set as a client.

Go to the **Device view** for the encoder and look at the properties of the network interface. Under **Advanced Options**, look for **Media redundancy** item. Here you can select the role for the encoder: set the **Client** option in the **Media redundancy role** drop-down menu.
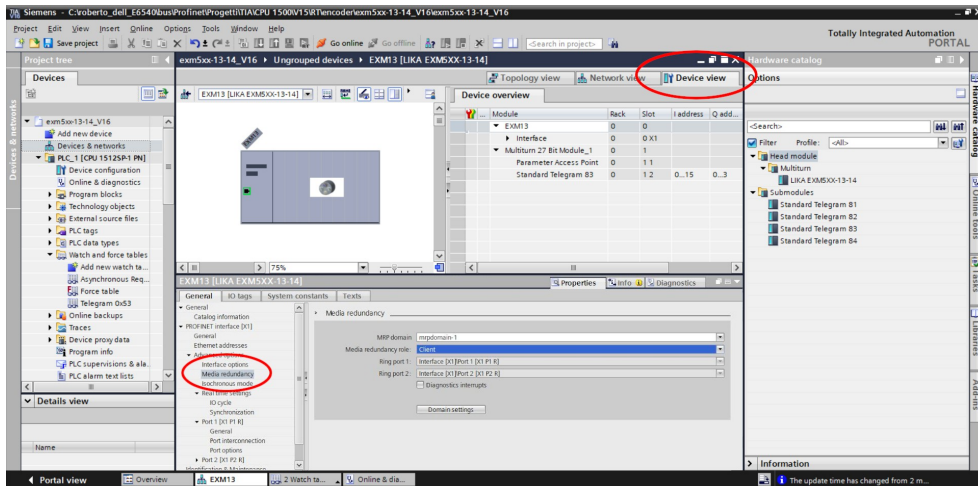

Figure 61 – Setting the encoder as the MRC

13.2 Configuring the network topology

To configure the network topology proceed as follows.

Navigate to the **Topology view** tab of the **Devices and Networks** view.

Configure the topology to create a ring by connecting the ports, for instance as shown in the Figure. Of course you must comply with the rules for topology as required by your own network. For detailed information please refer to specific documentation.
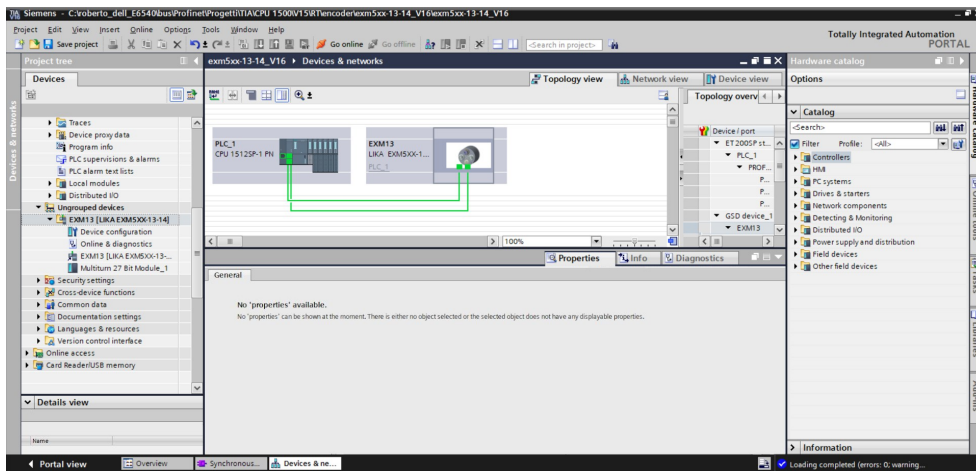
Figure 62 – Configuring the network topology

13.3 Interconnecting the ports in the Inspector window

To interconnect the ports, follow these steps.

1. In the **Device view** tab or **Network view** tab, select the PROFINET device or PROFINET interface.
2. In the **Table Area** of the **Hardware and network editor** select the port which you want to configure (Port 1 and Port 2).
3. In the Inspector window, navigate to the **Properties** tab and select **Port interconnection** in the navigation area.
4. In the **Local port** section, you can find the settings at the local port.
5. In the **Partner port** area, select the drop-down list for **Partner port** in order to display the available partner ports and make a selection.
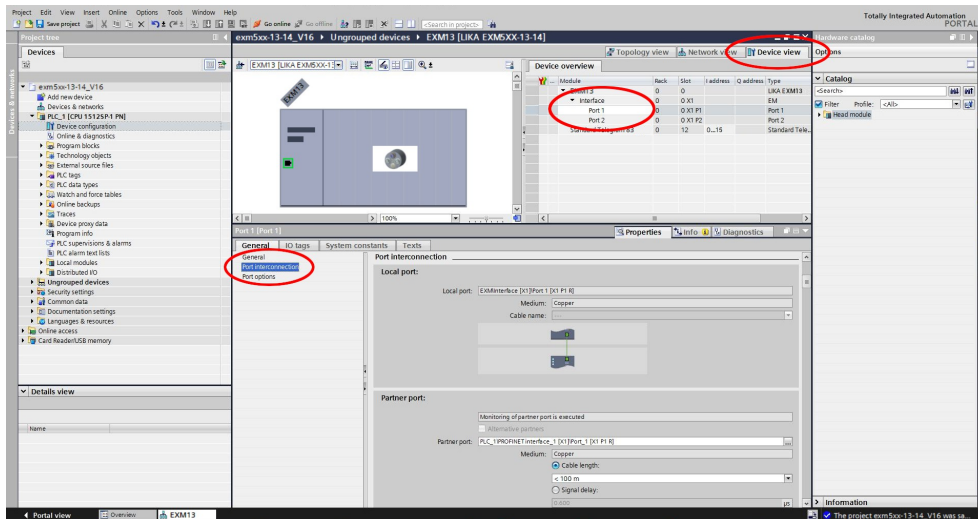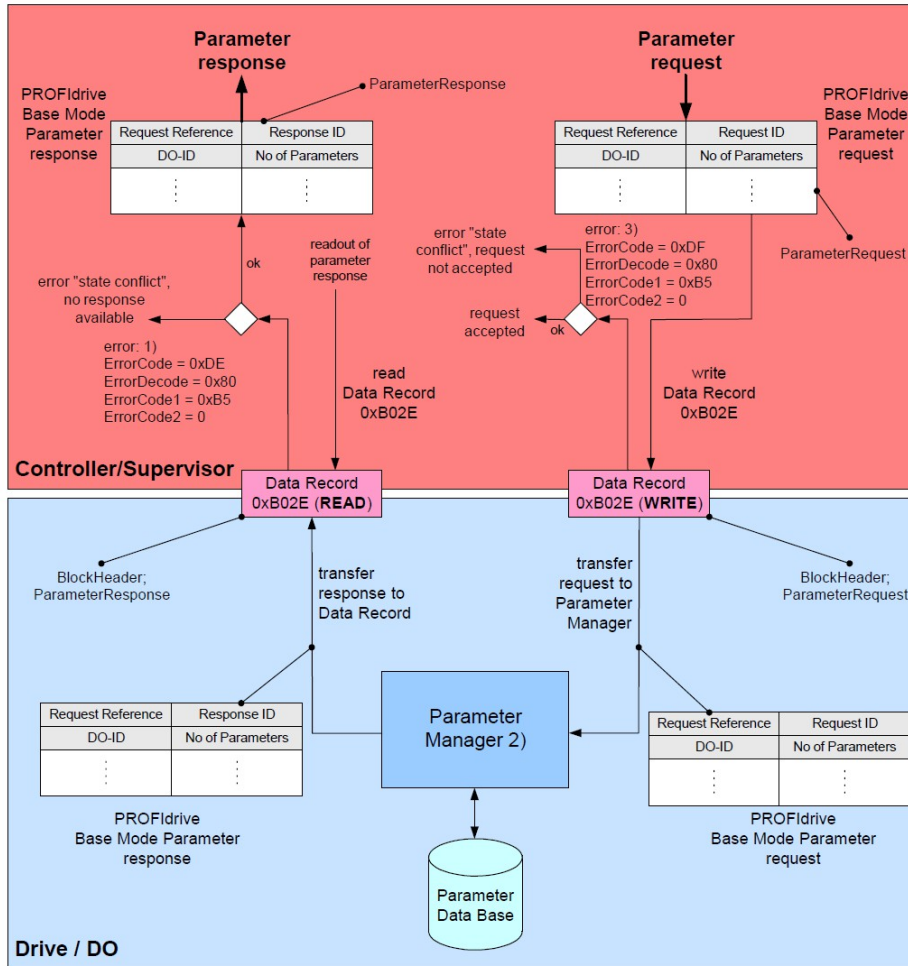

Figure 63 – Interconnecting port 1
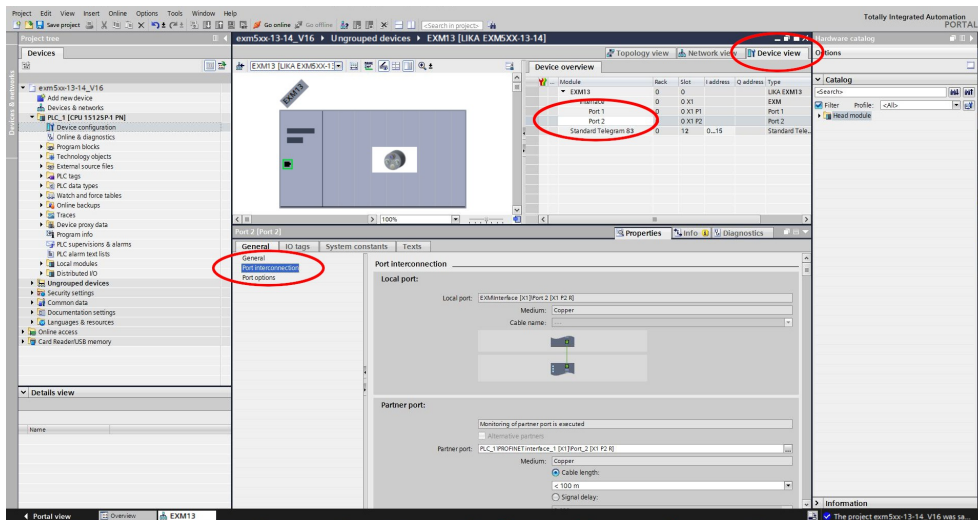
Figure 64 – Interconnecting port 2

14 Read & write in acyclic comm

Figure 65 – Base mode parameter request and response

14.1 Example: reading and writing a parameter (Preset Value)
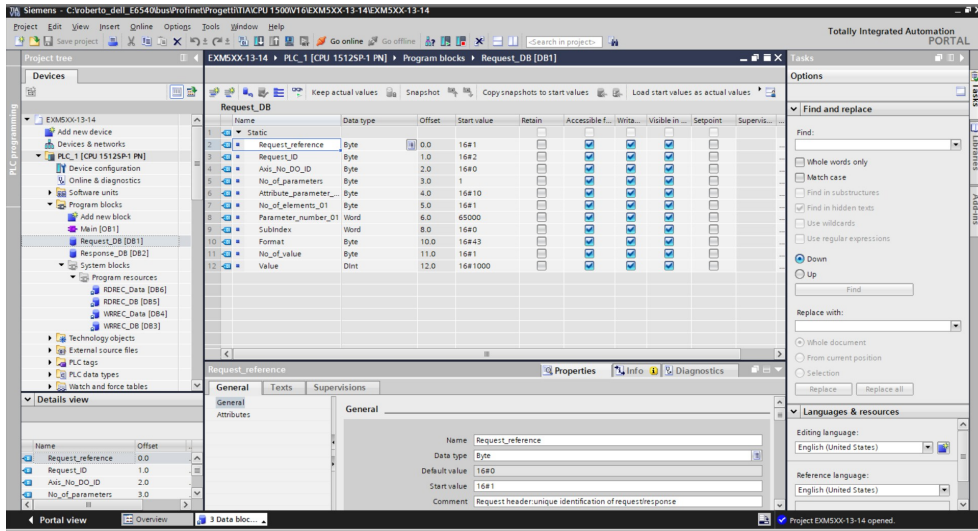
14.1.1 Data Block 1 (DB1)

Figure 66 – DB1
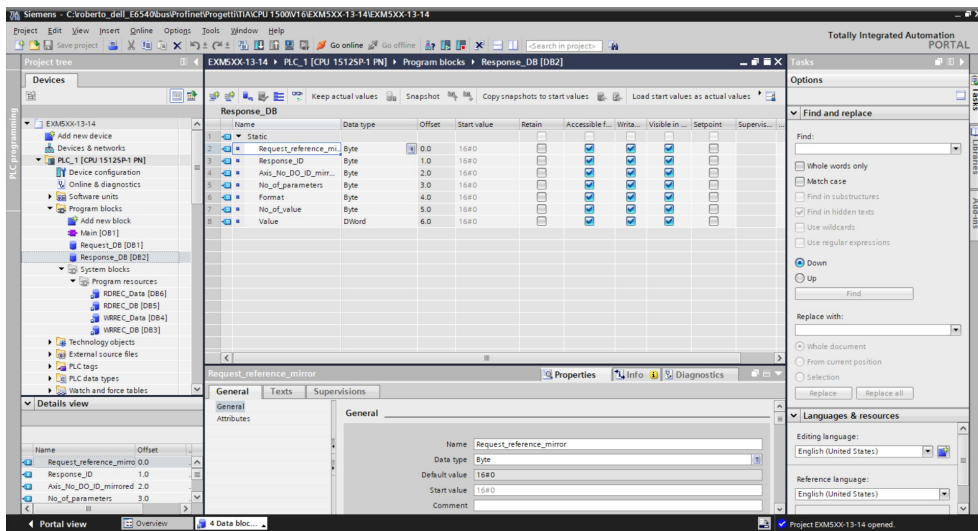
14.1.2 Data Block 2 (DB2)

Figure 67 – DB2
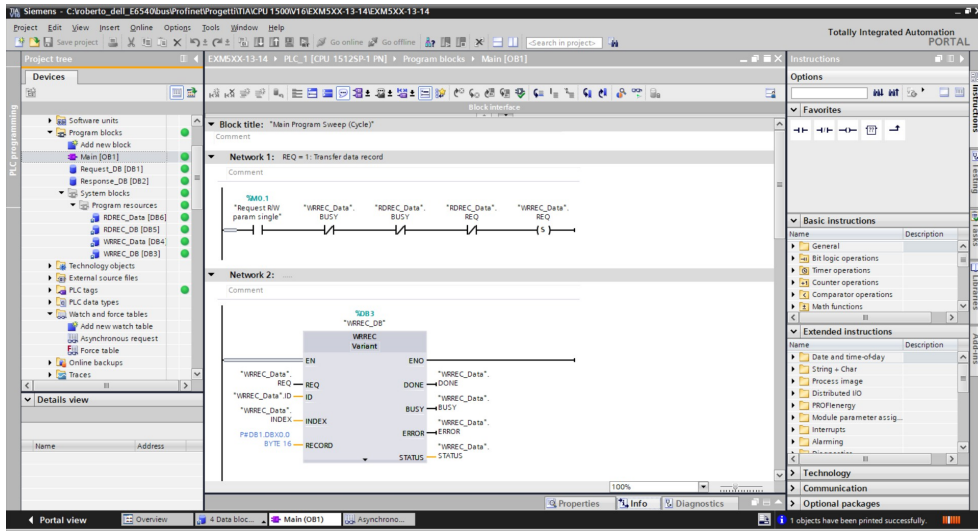
14.1.3 Organization Block 1 (OB1)

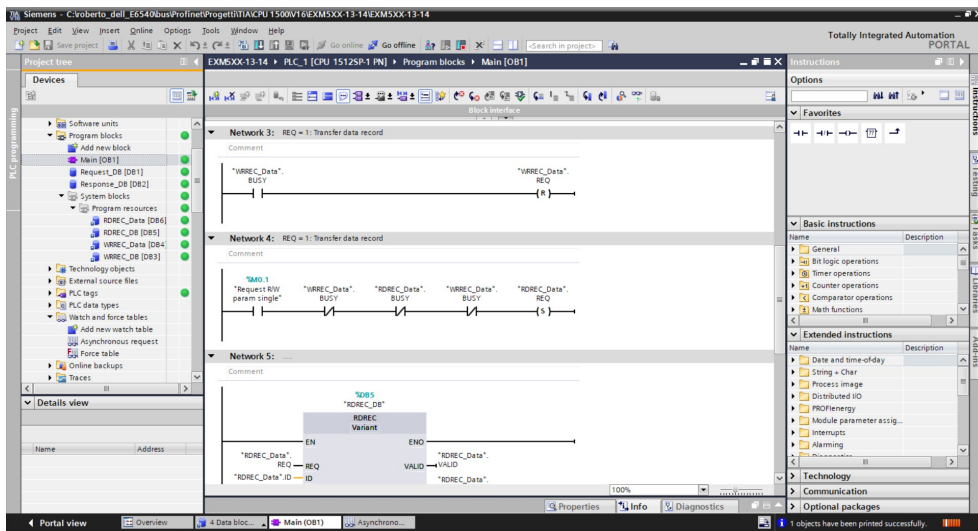**Figure 68 – OB1**

14.1.4 Function 1 (FC1)
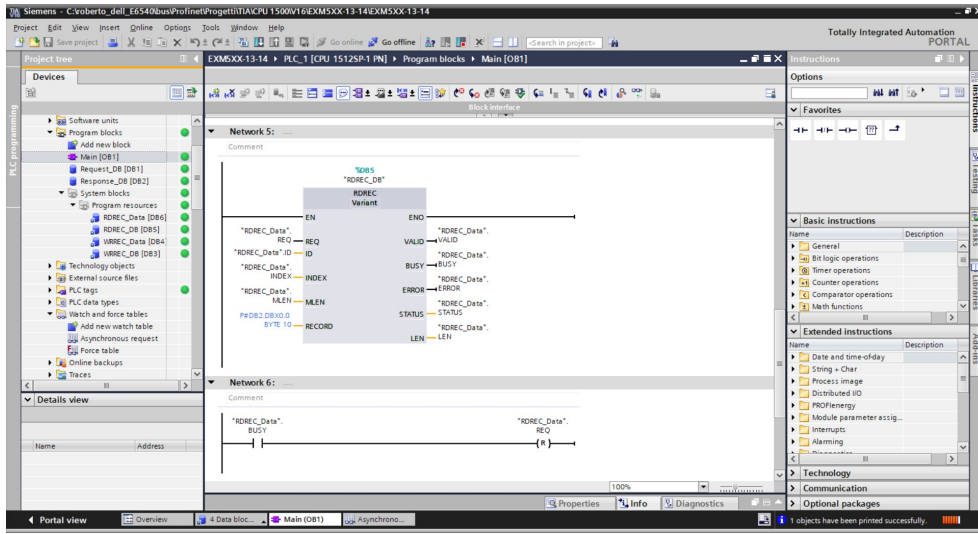

Figure 69 – FC1

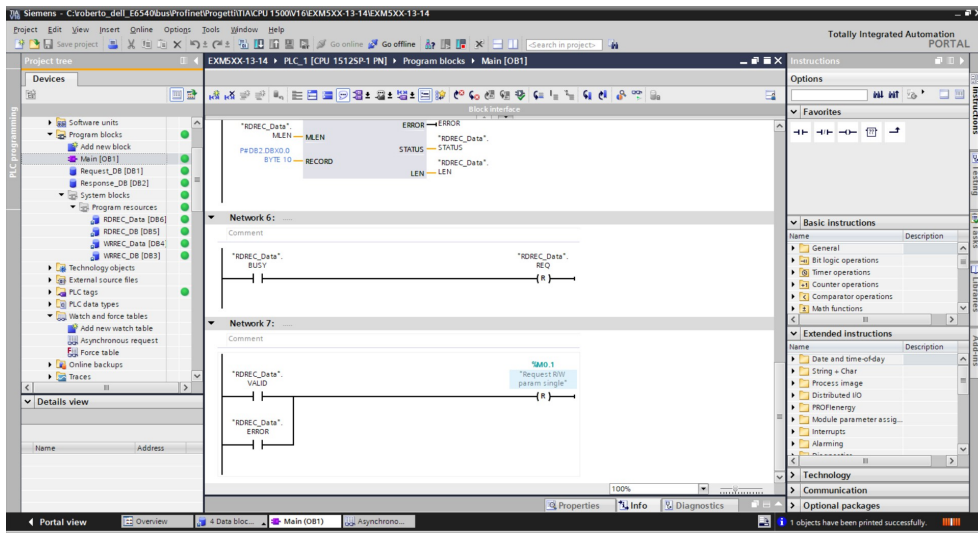Figure 70 – FC1

14.1.5 Function 2 (FC2)

Figure 71 – FC2

14.1.6 Acyclic request of Preset

See **P65000 – Preset value** on page 118.
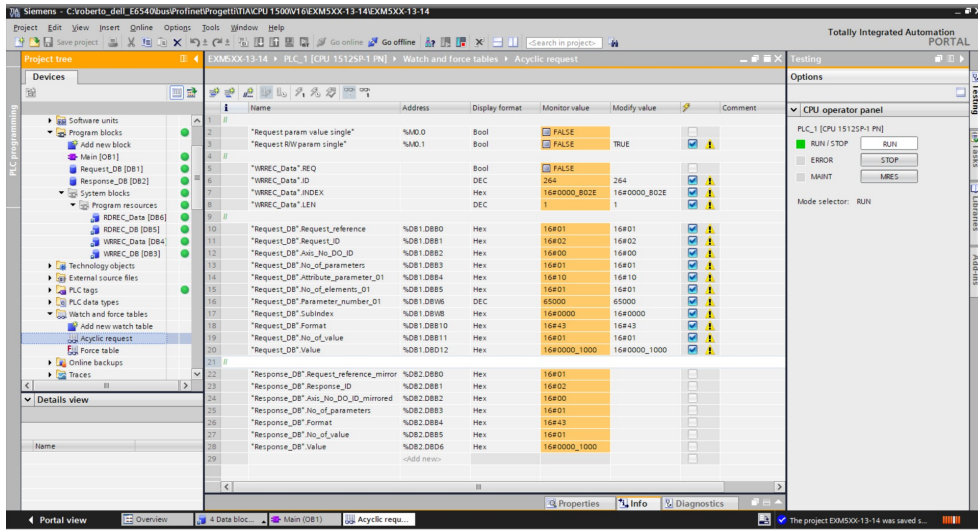
Figure 72 – Acyclic request of Preset value

NOTE
Please always ascertain that **Data.ID** is the same as the **hardware identifier** of the installed module.
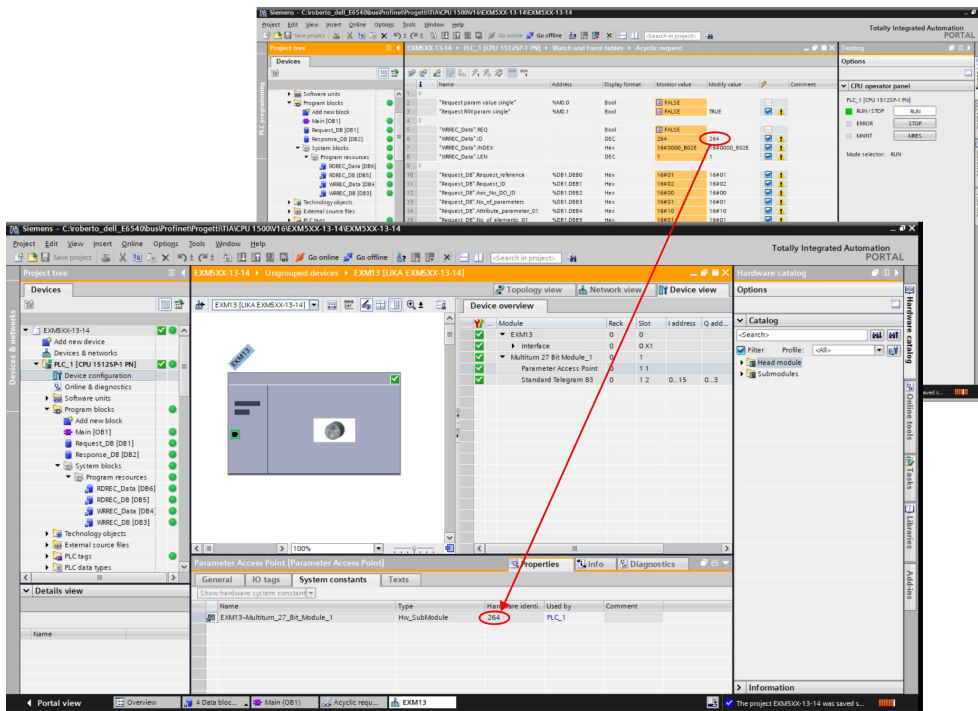
14.2 Monitoring a variable

Below is an example of variable monitor in case of Telegram 83 and IRT communication.

NOTE
Controller Sign-Of-Life is active.

Figure 73 – Monitoring a variable

15 Encoder state machine
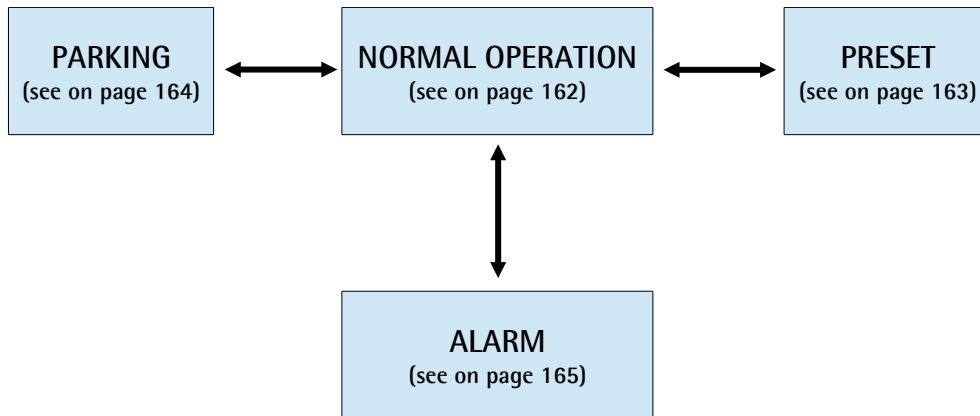
Figure 74 – Encoder state machine

15.1 Normal operation diagram

| Profile 3.1
(Compatibility Mode enabled = 0)
ZSW2_ENC.09 (Control requested) = 0 | Profile 4.1
(Compatibility Mode disabled = 1)
ZSW2_ENC.09 (Control requested) = STW2_ENC.10 (Control by PLC) |

STW2_ENC.10 = 1 ?   STW2_ENC.10 = 0 ?

| DATA IN THE CONTROL WORD IS VALID | DATA IN THE CONTROL WORD IS NOT VALID |

G1_STW.13 (Request absolute value cyclically) = 1 ?

G1_ZSW.13 (Transmit absolute value cyclically) = 1

15.2 Preset diagram

lika

EXM58 • EXO58 Profinet
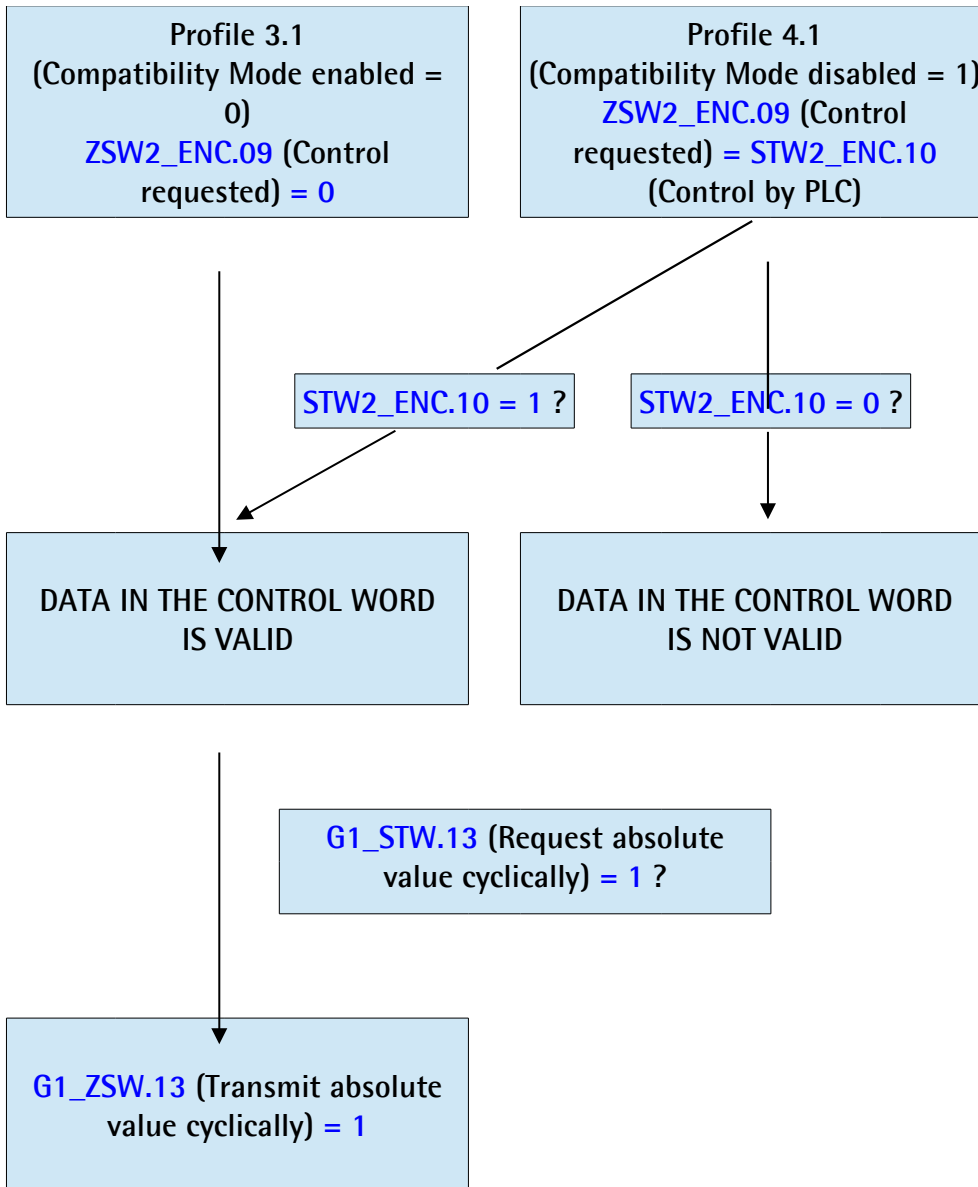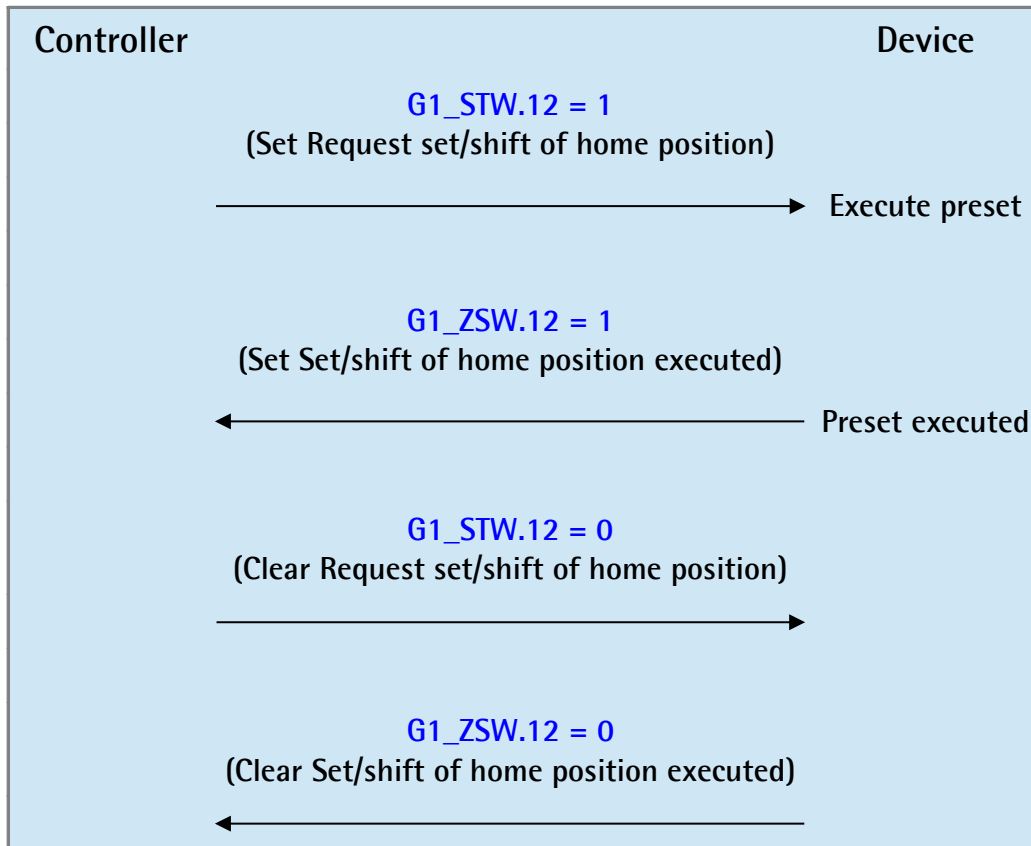
15.3 Parking sensor diagram
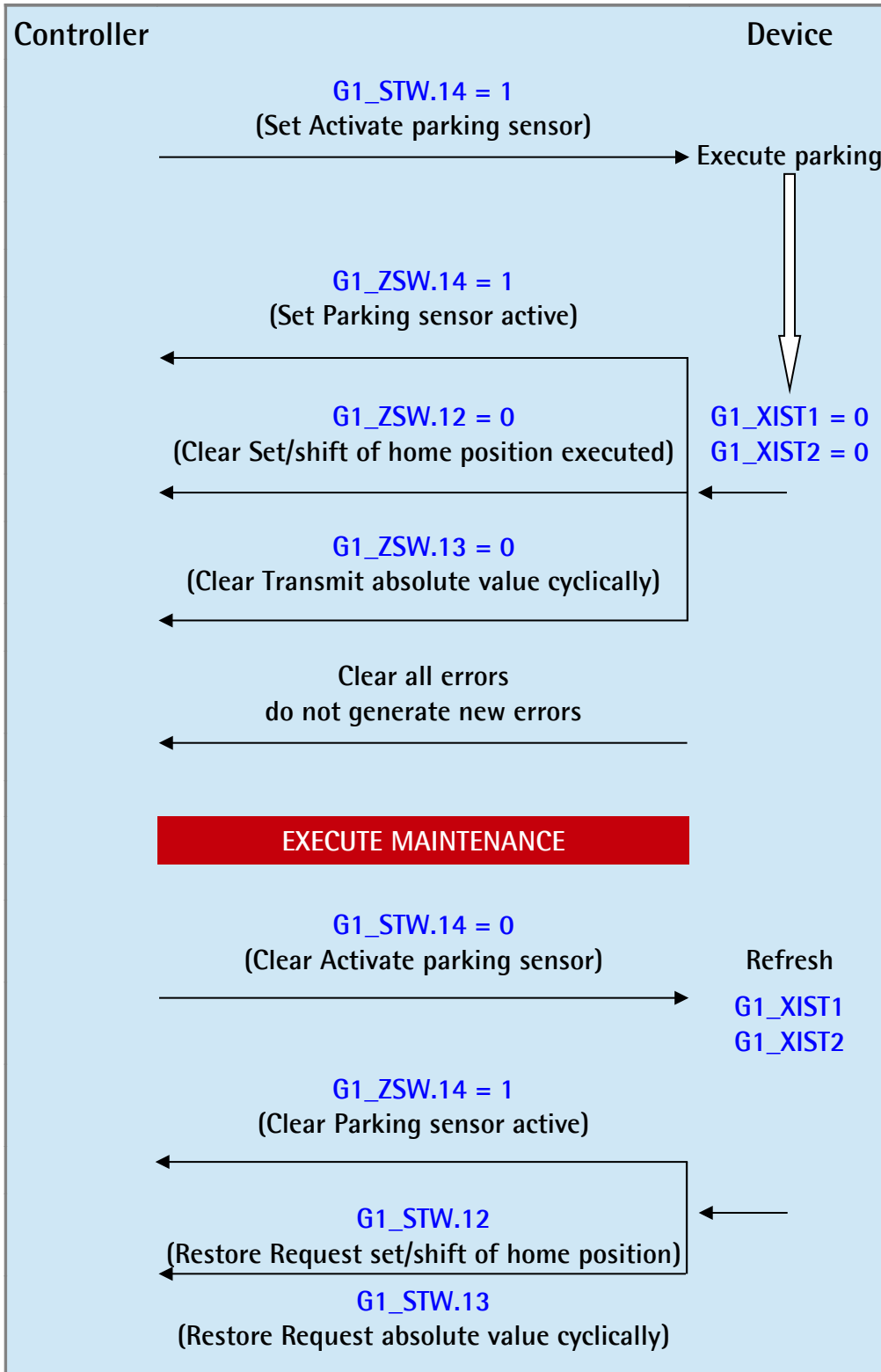
15.4 Error diagram

15.4.1 Acknowledgement of acknowledgeable sensor error

Controller   **Device**

G1_XIST2 = ERROR CODE

FAULT

G1_ZSW.15 = 1
(Sensor error)

G1_STW.15 = 1
(Acknowledging a sensor error)

G1_ZSW.11 = 1
(Requirement of error acknowledge
detected: acknowledgement in process)

G1_STW.15 = 0
(Acknowledging a sensor error)

ERROR SOLVED

G1_XIST2 = POSITION VALUE

G1_ZSW.15=0
(Sensor error)

G1_ZSW.11=0
(Requirement of error acknowledge
detected: acknowledgement in process)
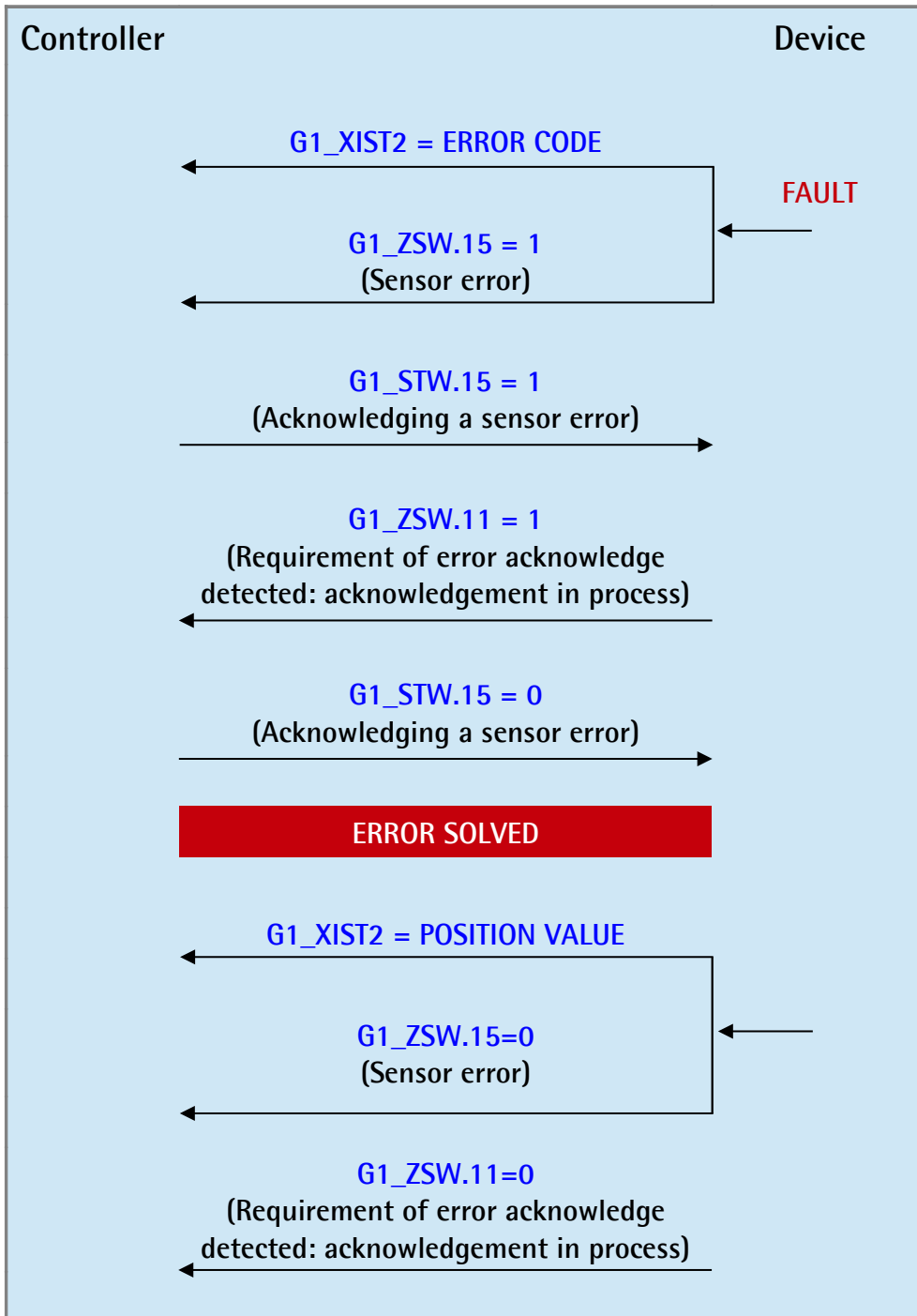
15.4.2 Acknowledgement of not acknowledgeable sensor error

Controller   Device

G1_XIST2 = ERROR CODE

FAULT

G1_ZSW.15 = 1
(Sensor error)

G1_STW.15 = 1
(Acknowledging a sensor error)

G1_ZSW.11 = 1
(Requirement of error acknowledge
detected: acknowledgement in process)

G1_STW.15 = 0
(Acknowledging a sensor error)

ERROR NOT SOLVED

G1_ZSW.11 = 0
(Requirement of error acknowledge
detected: acknowledgement in process)
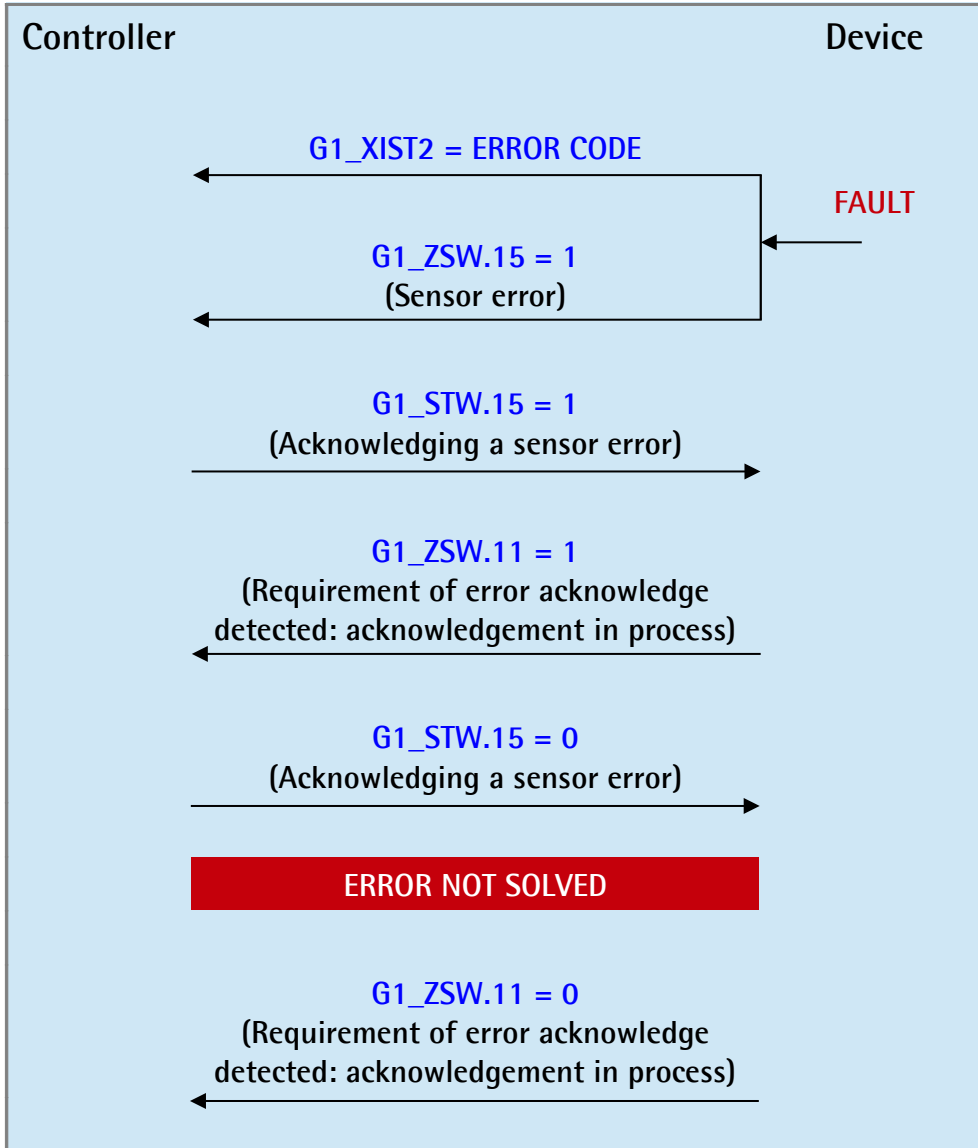
16 Integrated web server

Profinet encoders from Lika Electronic integrate a web server. This web-based user interface is designed to offer helpful functions and deliver complete information on the device that can be accessed through the Internet.
In particular it allows:
- to display the current position and speed values;
- to display and check the currently set parameters;
- to set and activate the preset;
- to update the firmware.

The web server can be accessed from any PC running a web browser. Since its only requirement is an HTTP connection between the web browser and the web server running on the device, it is perfectly fitted also for remote access scenarios.

Before opening the web server of the Profinet encoder please ascertain that the following requirements are fully satisfied:
- the encoder is connected to the network;
- the encoder has valid device name and IP address;
- the PC is connected to the network;
- a web browser (Internet Explorer, Mozilla Firefox, Google Chrome, Opera, ...) is installed in the PC or in the device used for connection.

NOTE
This web server has been tested and verified using the following web browsers:
- Internet Explorer IE11 version 11.1593.14393.0
- Mozilla Firefox version 116.0.1
- Google Chrome version 115.0.5790.111
- Opera version 68.0.3618.165

NOTE
Please note that the appearance of the snapshot may vary depending on the web browser used. The following snapshots were taken from Google Chrome.

16.1 Web server Home page

To open the Profinet encoder web server proceed as follows:

1. type the IP address of the encoder you want to connect to (in the example: 192.168.20.1) in the address bar of your web browser and confirm by pressing **ENTER**;
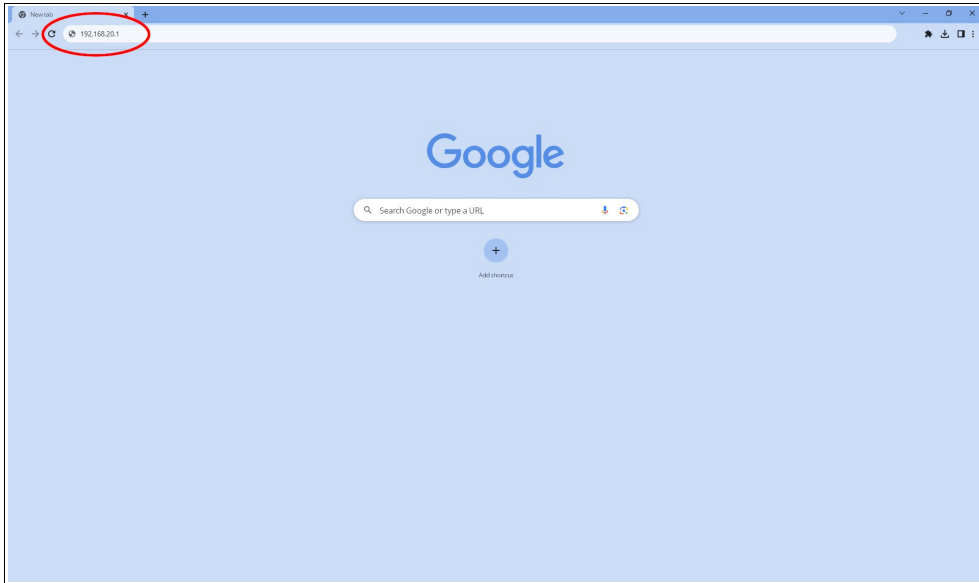

Figure 75 – Opening the web server

2. as soon as the connection is established, the web server **Home** page will appear on the screen;
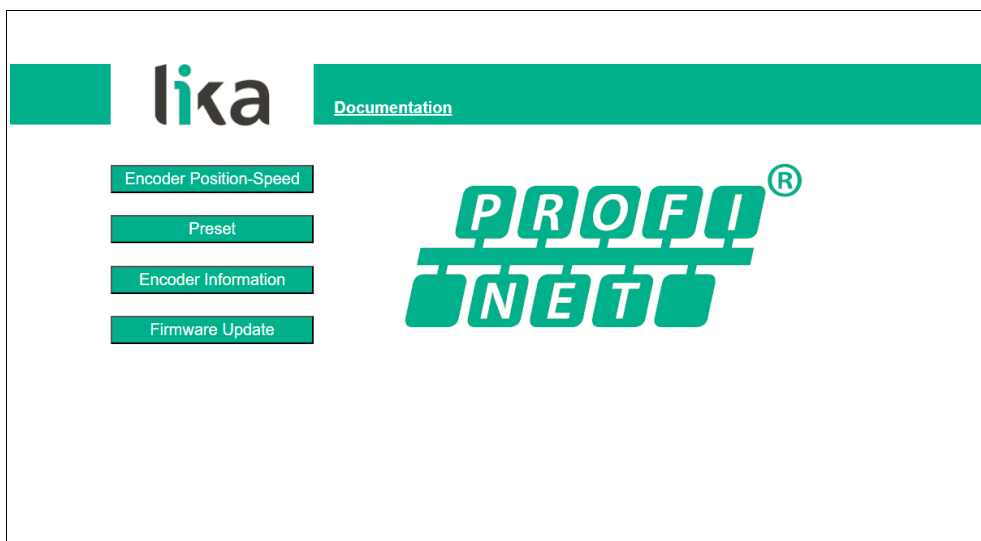

Figure 76 – Web server Home page

Some buttons are available in the menu bar of the **Home** page.
Press the **Lika logo** to enter Lika's web site (www.lika.biz).

Press the **DOCUMENTATION** button to enter the Profinet encoder technical documentation page available on Lika's web site (https://www.lika.it/eng/products/rotary-encoders/absolute/ethernet/) where specific technical information and documentation concerning the Profinet encoder can be found.

Furthermore some buttons are available in the left navigation bar. All the pages except the **Firmware update** page are freely accessible through the buttons in the bar. The **Firmware update** page requires a password.
These buttons allow to enter specific pages where information and diagnostics on the connected encoder as well as useful functions can be achieved.
They are described in the following sections.

16.2 Encoder position and speed

Press the **ENCODER POSITION-SPEED** button in the left navigation bar of the Web server **Home** page to enter the page where the current encoder position and the current encoder speed are displayed.
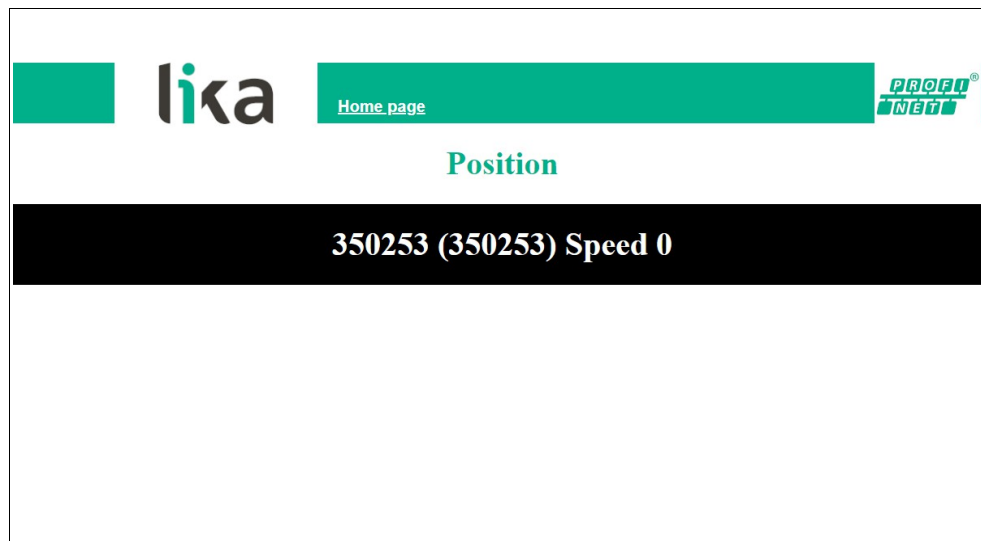

Figure 77 – Encoder position and speed page

The first value is the absolute position calculated considering scaling and preset functions, if activated; the value in brackets is the raw value (physical absolute

position). Both encoder positions are expressed in counts. For any information refer to **G1_XIST1**, **G1_XIST2**, and **G1_XIST3** signals on page 99.
The current speed is expressed according to the setting next the **Velocity measuring unit** parameter on page 128 (by default it is expressed in counts per second). For any information refer to the **NIST_A** and **NIST_B** signals on page 108.

NOTE
The current encoder position and speed values are real-time processed and continuously updated (every 200 msec. on the screen).

Press the **HOMEPAGE** button to move back to the Web server **Home** page.

16.2.1 Specific notes on using Internet Explorer

The following options must be set properly on Internet Explorer in order to get the **Encoder position and speed** page to be continuously updated.

- Open the **Settings** menu;
- open the **Internet Options** property sheet;
- in the **General** tabbed page, press the **Setting** button available in the **History Browsing** section;
- under **Check for newer versions of stored pages**, click **Every time I visit the webpage**;
- press the **OK** button to confirm whenever requested.

16.3 Setting and activating the preset

Press the **PRESET** button in the left navigation bar of the Web server **Home** page to enter the **Preset** page and set/activate a Preset value. If you need to set the preset occasionally, we suggest using the web server. For complete information on the preset function please refer to the **P65000 – Preset value** parameter on page 118.

To set and execute the preset via web server proceed as follows:
- press the **PRESET** button in the left navigation bar of the Web server **Home** page and enter the **Preset** page;
- as soon as you press the **PRESET** button a warning message (**Are you sure you want to change Preset Value?**) appears on the screen: it warns the operator about the awkwardness of the operation, thus he is required to confirm the procedure before continuing;
- press the **OK** button to proceed;
- otherwise press the **EXIT** button to abort the procedure. The **Set Preset cancelled!** message will appear on the screen. Press the **OK** button to move back to the Web server **Home** page;
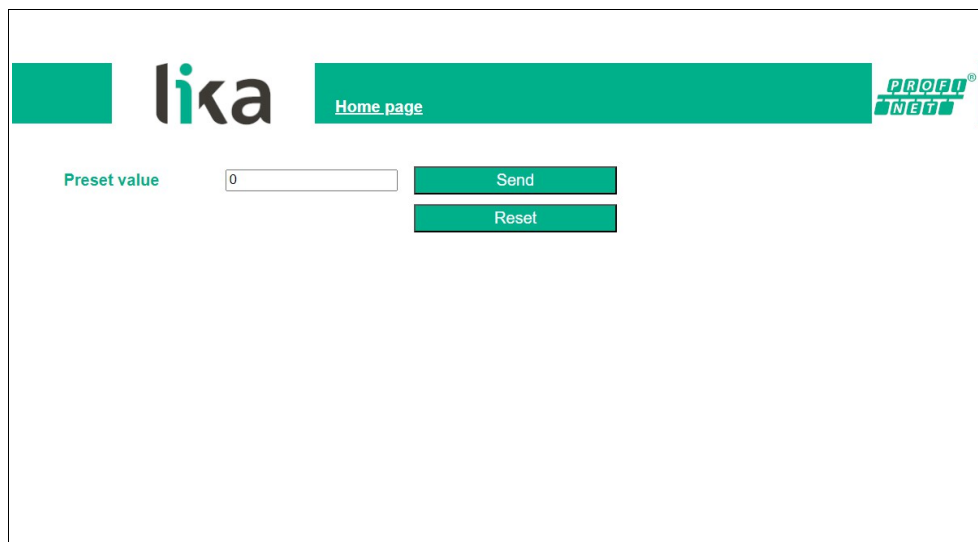- if you confirm the procedure, the **Preset** page will appear on the screen;

Figure 78 – Preset page

- to change the Preset enter a suitable value next to the **Preset value** item and then press the **SEND** button to confirm. The value has to

be set in decimal notation. The preset value is set and activated at the same time.
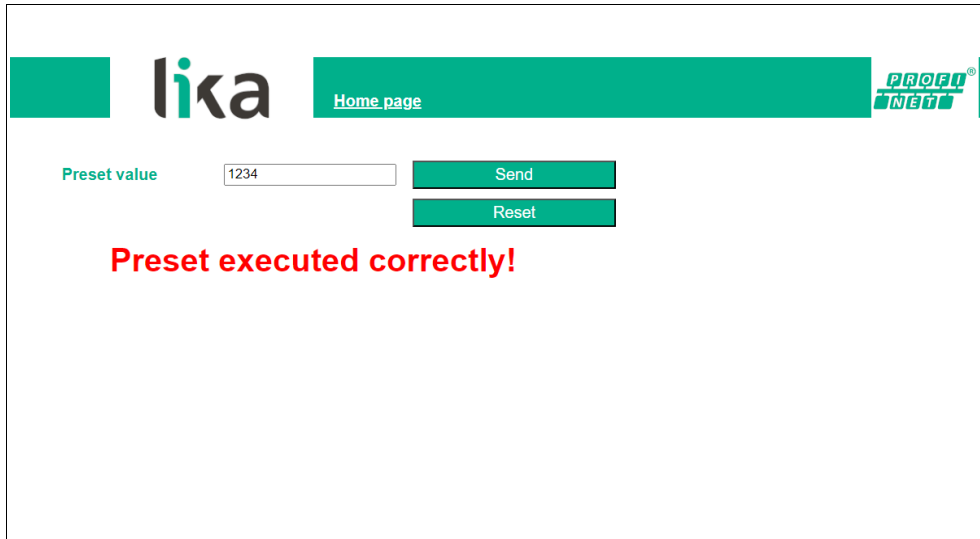

Figure 79 – Setting the preset value

WARNING

The preset value is set and activated for the position of the encoder in the moment when the preset value is transmitted. It is activated as soon as the value is confirmed by pressing the **SEND** button. We suggest activating the preset value when the encoder is in stop.

NOTE

At each confirmation / activation of the Preset setting, a message will appear under the button (e.g. **No Command sent** message). It informs whether the operation has been accomplished properly or an error occurred (for example **Preset executed correctly!** if everything went well, see Figure 79; or **Command Error!** if something went wrong).

Press the **RESET** button to zero set the internal offset value. For complete information please refer to the **P65000 – Preset value** parameter on page 118 and to the **Offset value** status bit on page 119.

Press the **HOMEPAGE** button to move back to the Web server **Home** page.

16.4 Encoder information (Profinet user parameters)

Press the **ENCODER INFORMATION** button in the left navigation bar of the Web server **Home** page to enter the **Encoder Information** page. In this page the complete list of the available Profinet parameters is displayed. Parameters are specific to each DAP.

MAC address	10:b9:fe:00:69:ac		Code Sequence	0=CW
Order ID	EXM5XX-13-14		Class4 functionality	1=enabled
Serial Number	232800942		G1_XIST1 preset control	0=enabled
			Scaling function control	0=disabled
Hardware revision	1		Alarm channel control	1=enabled
Software revision	V 1.1.0		Compatibility mode	0=enabled => Profile version 3.1
Production Date	2023-08-04 15:09:20		Measuring units/rev	8192
			Total measuring range	134217728
Preset Value	0		Master sign of life	1
Faults	0x0		Velocity unit	steps/s

this page is not updated automatically

Figure 80 – Encoder Information page

For a complete description of the available encoder parameters please refer to the "9.5 Record Data Object 0xBF00: user parameter data" section on page 121.

NOTE

Please note that the values shown in the **Encoder Information** page are "frozen" in the moment when the page is displayed. To update the values you must refresh the web page.

NOTE

The parameters in the **Encoder Information** page cannot be changed. User parameters can be changed only in the **Module parameters** tabbed page under TIA Portal, see the "5.5.10 Module parameters" section on page 69. For the preset parameter see the previous "16.3 Setting and activating the preset" section on page 171.

Press the **Homepage** command to move back to the Web server **Home** page.

16.5 Firmware update

Press the **FIRMWARE UPDATE** button in the left navigation bar of the Web server **Home** page to enter the **Firmware Update** page. Please note that this is a password protected page, thus a password is requested to access the page.

Password: **LiKa** ("L" and "K" in uppercase letters; "i" and "a" in lowercase letters)

WARNING
Firmware updating process has to be accomplished by skilled and competent personnel. It is mandatory to perform the update according to the instructions provided in this section.
Before installation always ascertain that the firmware program is compatible with the hardware and software of the device. Furthermore never turn off power during flash update. In case of flash update error, the program is lost irreversibly (there is not a bootloader) and the device must be sent back to Lika Electronic for restoring.

This operation allows to update the unit firmware by downloading updating data to the flash memory.
Firmware is a software program which controls the functions and operation of a device; the firmware program, sometimes referred to as "user program", is stored in the flash memory integrated inside the unit. These encoders are designed so that the firmware can be easily updated by the user himself. This allows Lika Electronic to make new improved firmware programs available during the lifetime of the product.
Typical reasons for the release of new firmware programs are the necessity to make corrections, improve and even add new functionalities to the device.
The firmware upgrading program consists of a single file having .ZIP extension. It is released by Lika Electronic Technical Assistance & After Sale Service.

If the latest firmware version is already installed in the unit, you do not need to proceed with any new firmware installation. The firmware version currently installed can be read next to the **Software revision** item in the **Encoder Information** page after connection to the web server (see on page 173).
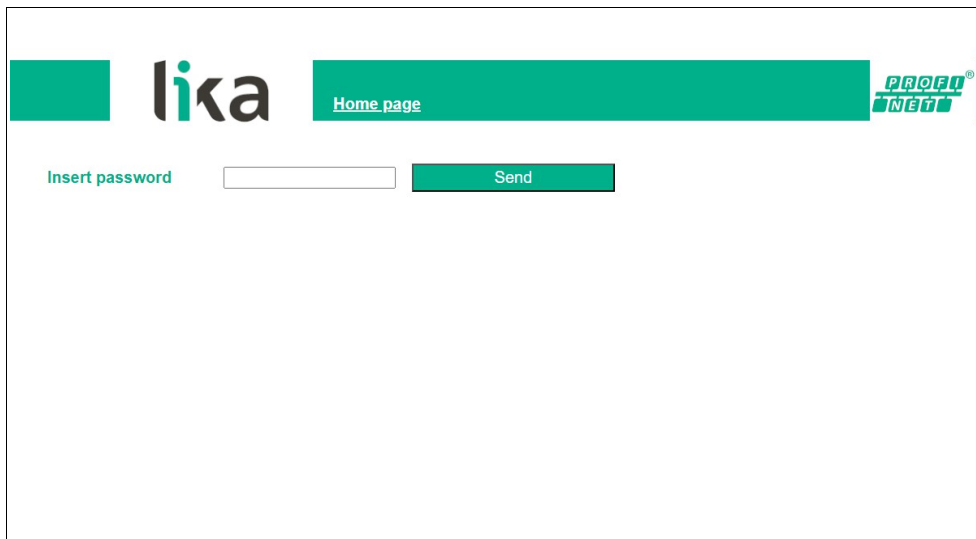
NOTE
If you are not confident that you can perform the update successfully please contact Lika Electronic Technical Assistance & After Sale Service.

Before proceeding with the firmware update please ascertain that the following requirements are fully satisfied:

- the encoder is connected to the Ethernet network;
- the encoder has valid device name and IP address;
- the PC is connected both to the network and to the IO controller;
- a web browser (Internet Explorer, Mozilla Firefox, Google Chrome, Opera, ...) is installed in the PC or device used for connection;
- you have the .ZIP file for firmware update.

To update the firmware program please proceed as follows:

1. press the **FIRMWARE UPDATE** button in the left navigation bar of the Web server **Home** page to enter the **Firmware Update** page;
2. the operator is requested to submit a password before starting the firmware update procedure;

Figure 81 – Firmware Update page

3. in the **Insert password** text box type the password **LiKa** ("L" and "K" in uppercase letters; "i" and "a" in lowercase letters) and then press the **SEND** button;
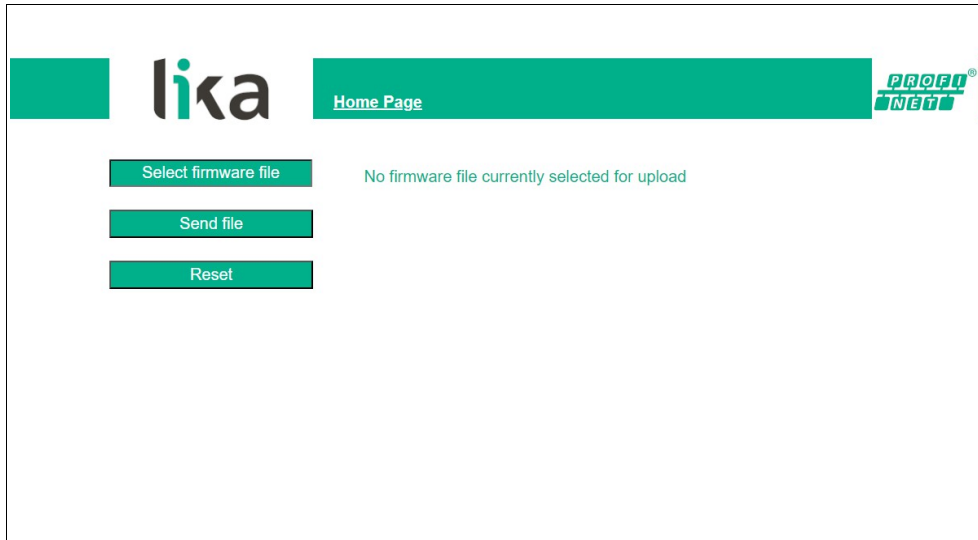
Figure 82 – Firmware Update page

4. if the password you typed is correct, the **Firmware Update** page will appear on the screen;
5. press the **SELECT FIRMWARE FILE** button; once you press the **SELECT FIRMWARE FILE** button an **OPEN** dialog box appears on the screen: open the folder where the firmware updating .ZIP file released by Lika Electronic is located, select the file and confirm. The name of the .zip file will show the Ethernet protocol (Profinet) and the software version of the firmware updating file (e.g. V1.1.0). Please check the file properties and ascertain that you are installing the correct update file;
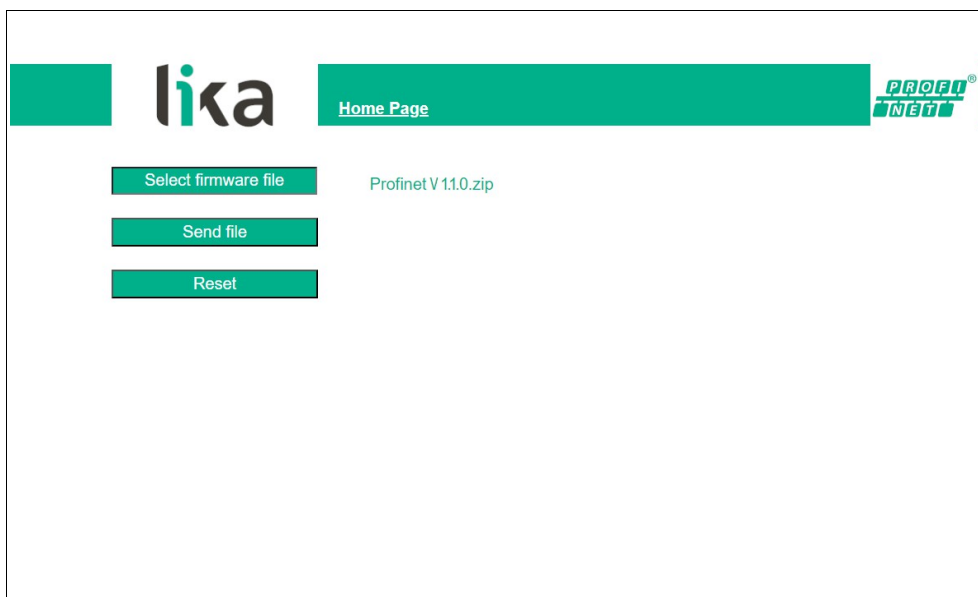

Figure 83 – Selecting the firmware update .zip file

WARNING

Before installation always ascertain that the firmware program is compatible with the hardware and software of the device.

Never turn the power supply off during the flash update operation.

6. press the **SEND FILE** button to start the upload of the firmware program;

7. during the operation and as soon as the operation is carried out successfully, some messages will appear on the screen;
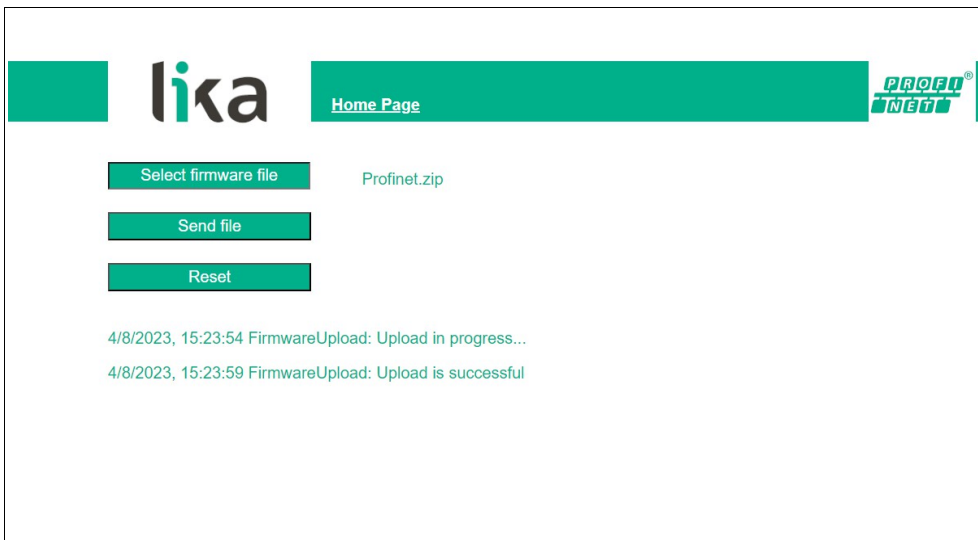

Figure 84 – Messages during firmware upload

8. finally press the **RESET** button to automatically reset and restart the encoder and complete the operation.
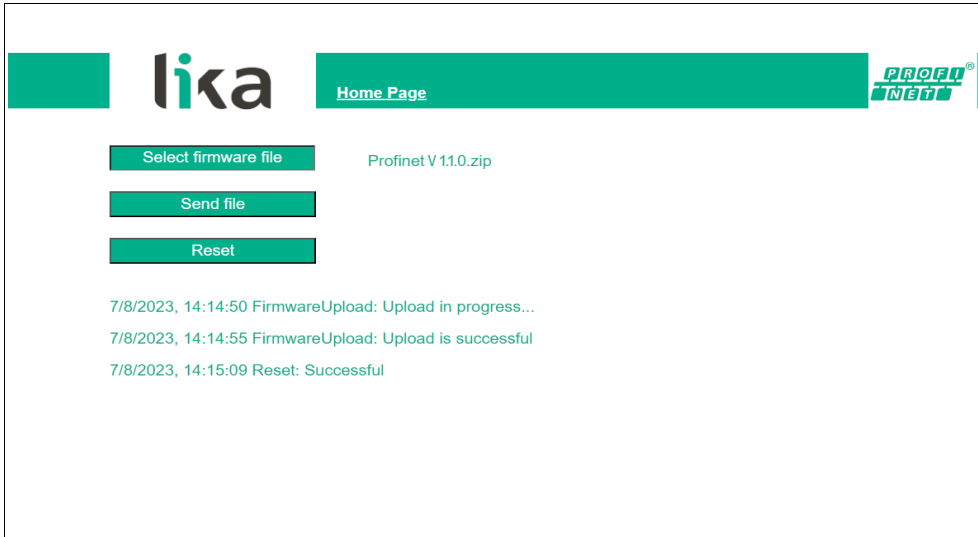

Figure 85 – Firmware update process accomplished

NOTE

While downloading the firmware updating program, unexpected conditions may arise which could lead to a failure of the installation process. When such a matter occurs, the download process cannot be carried out successfully and thus the operation is aborted. In case of flash update error, please switch the encoder off and then on again and retry the operation.

Press the **Homepage** command to move back to the Web server **Home** page.

17 Default parameters list

Parameters list	Default value		
Code sequence	0 = CW(0)		
Class 4 functionality	1 = enable		
G1_XIST1 Preset control	0 = enable		
Scaling function control	0 = disable		
Alarm channel control	0 = disable		
Compatibility Mode	1 = disable = Profile version 4.1		
Measuring units / Revolution	8192 = EXM58-13-14-… 262144 = EXM58-18-12-… 262144 = EXO58-18-00-… 65536 = EXO58-16-14-…		
Total measuring range	134217728 = EXM58-13-14-… 1073741824 = EXM58-18-12-… 262144 = EXO58-18-00-… 1073741824 = EXO58-16-14-…		
Maximum tolerated failures of Master Sign-Of-Life	1		
Velocity measuring unit	0 = steps/s		

Document release	Release date	Description	HW	SW	GSDML file version
1.0	28.09.2023	First issue	1	V1.1.0 V1.1.1 V1.1.2	20230417 20230804
1.1	10.10.2023	New firmware, web server's Preset page updated	1	V1.1.2a	20230804

This device is to be supplied by a Class 2 Circuit or Low-Voltage Limited Energy or Energy Source not exceeding 30 Vdc. Refer to the order code for supply voltage rate.
Ce dispositif doit être alimenté par un circuit de Classe 2 ou à très basse tension ou bien en appliquant une tension maxi de 30Vcc. Voir le code de commande pour la tension d'alimentation.

Dispose separately

lika

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