Absolute Rotary Encoders
Integration into PROFINET

Manual

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1 Introduction

1.1 Content of this Document

This document contains information required to use the product in the relevant phases of the product life cycle. This may include information on the following:

- Product identification
- Delivery, transport, and storage
- Mounting and installation
- Commissioning and operation
- Maintenance and repair
- Troubleshooting
- Dismounting
- Disposal

Note

For full information on the product, refer to the further documentation on the Internet at www.pepperl-fuchs.com.

Note

For specific device information such as the year of construction, scan the QR code on the device. As an alternative, enter the serial number in the serial number search at www.pepperl-fuchs.com.

The documentation comprises the following parts:

- This document
- Datasheet

In addition, the documentation may comprise the following parts, if applicable:

- EU-type examination certificate
- EU declaration of conformity
- Attestation of conformity
- Certificates
- Control drawings
- Instruction manual
- Functional safety manual
- Other documents

1.2 Target Group, Personnel

Responsibility for planning, assembly, commissioning, operation, maintenance, and dismounting lies with the plant operator.

Only appropriately trained and qualified personnel may carry out mounting, installation, commissioning, operation, maintenance, and dismounting of the product. The personnel must have read and understood the instruction manual and the further documentation.

Prior to using the product make yourself familiar with it. Read the document carefully.

1.3 Symbols Used

This document contains symbols for the identification of warning messages and of informative messages.

Warning Messages

You will find warning messages, whenever dangers may arise from your actions. It is mandatory that you observe these warning messages for your personal safety and in order to avoid property damage.

Depending on the risk level, the warning messages are displayed in descending order as follows:

Danger!

This symbol indicates an imminent danger.

Non-observance will result in personal injury or death.

Warning!

This symbol indicates a possible fault or danger.

Non-observance may cause personal injury or serious property damage.

Caution!

This symbol indicates a possible fault.

Non-observance could interrupt the device and any connected systems and plants, or result in their complete failure.

Informative Symbols

Note

This symbol brings important information to your attention.

Action

1. This symbol indicates a paragraph with instructions. You are prompted to perform an action or a sequence of actions.

1.4 Intended Use

Absolute rotary encoders detect the rotation angle—and, in the case of a multiturn absolute rotary encoder, the revolutions of the rotary encoder shaft—with high precision and resolution. The absolute position value derived from this is provided by the rotary encoder via the PROFINET interface in accordance with the standard from the "PROFIBUS & PROFINET International (PI)" organization. The rotary encoder is to be integrated into a PROFINET network, and should be used only in this way. Typical applications include positioning tasks and length measurement, for example, for cranes, construction machinery, elevators, and packaging machines.

Read through this manual carefully. Familiarize yourself with the device before installing, mounting, or operating.

Always operate the device as described in these instructions to ensure that the device and connected systems function correctly. The protection of operating personnel and the plant is guaranteed only if the device is operated in accordance with its intended use.

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1.5 General Safety Instructions

Responsibility for planning, assembly, commissioning, operation, maintenance, and dismounting lies with the plant operator.

Installation and commissioning of all devices may be performed only by trained and qualified personnel.

It is dangerous for the user to make changes and/or repairs. Additionally, doing so voids the warranty and excludes the manufacturer from any liability. In the event of any serious errors, stop using the device. Secure the device against unintended operation. To have the device repaired, return it to your local Pepperl+Fuchs representative or your sales center.

Note

Disposal

Electronic waste is dangerous. When disposing of the equipment, observe the current statutory requirements in the relevant country of use and local regulations.

2 Declaration of Conformity

2.1 CE Conformity

This product was developed and manufactured under observance of the applicable European standards and guidelines.

Note

A declaration of conformity can be requested from the manufacturer.

3 Introduction

3.1 Using this Manual

This manual describes how Pepperl+Fuchs absolute rotary encoders equipped with a PROFINET interface are integrated into a PROFINET network.

The manual is valid for the following absolute rotary encoder types:

- ENA58PL-...B17
- ENA58IL-...B17

The descriptions for the following topic areas cover all the important aspects for a simple PROFINET integration:

- Integration into the PROFINET master interface connection
- Setting the physical parameters
- Activating PROFINET communication
- Communicating with the absolute rotary encoder

Note

More information on technical data, mechanical data, pin assignments, and available connection cables for the relevant absolute rotary encoder types "ENA58PL-...B17" and "ENA58IL-...B17" can be found in the corresponding datasheet.

3.2 Absolute Rotary Encoders

Absolute rotary encoders output a uniquely coded numerical value at each shaft position. Depending on the design type, the measured value is recorded via the optical scanning of a transparent code disc (ENA58PL-...B17), or via a magnetic sensing principle (ENA58IL-...B17).

The maximum steps per revolution is 65,536 steps (16 bits). The multiturn version can detect up to 16,384 revolutions (14 bits). As such, the highest possible resolution is 30 bit.

3.3 Communication via PROFINET

3.3.1 General Information on Communication via PROFINET

PROFINET is an open standard for industrial automation based on industrial Ethernet. PROFINET integrates information technology with established standards such as TCP/IP and XML in automation technology.

Within PROFINET, PROFINET IO is the communication concept for the construction of decentralized applications. This means that decentralized field devices are integrated through PROFINET IO. The familiar IO view of PROFIBUS DP is used where the usable data of the field devices is transferred to the controller process image in cycles. PROFINET IO is a device model consisting of slots and channels, which is based on the main features of PROFIBUS DP. The field device properties are written in a Generic Station Description Markup Language (GSDML) based on XML. PROFINET IO is engineered in the same way as has long been the case for system integrators of PROFIBUS DP. The decentralized field devices are assigned in the design of a controller.

PROFINET IO distinguishes between the following three device types:

- IO controller: Controller that executes the automation program.
- IO device: Decentrally assigned field device that is assigned to an IO controller.
- IO supervisor: Programming unit/PC with commissioning and diagnostic functions.

3.3.2 PROFINET IO Interface

The absolute rotary encoders are PROFINET IO devices that communicate cyclically with the assigned PROFINET IO controller during operation.

The PROFINET interface of the absolute rotary encoder supports:

- A transfer rate of 100 Mbit/s
- The RT (Real Time) and IRT (Isochronous Real Time) real-time categories
- The range of device functions in accordance with **Conformance Class A, B (RT Communication)** and **Conformance Class C (IRT Communication)**.

3.3.3 Project Planning Using Device Description

As with PROFIBUS DP, a field device is integrated into the project planning tool by way of a device description. The properties of the field device are described in the device description GSDML (Generic Station Description Markup Language) file. The GSDML file contains the field device data (technical features and information for communication) that you need to operate the device in a PROFINET network. The GSDML file is referred to as a GSD file in some project planning tools and other informational documents.

The GSDML file is imported into a project planning tool. Peripheral addresses are assigned to the individual channels of the field devices. The peripheral input addresses incorporate the received data. The user program evaluates and processes this data. The user program generates the peripheral output values and sends them to the control interface.

Once project planning is complete, the IO controller receives the planning and configuration data. The IO controller parameterizes and configures the field devices automatically.

Downloading the GSDML

You can find the relevant GSDML file in the **Software** section of the product detail page for the device.

To access the product detail page for the device, go to http://www.pepperl-fuchs.com and type information about the device (e.g., the product description or the item number) into the search function.

3.3.4 PROFINET Address and Identifying a Device

Every PROFINET IO device has a unique device identification in the PROFINET network. This device identification consists of the following:

- A unique **MAC address**. This MAC address is printed on the nameplate of the device.
- A **device name**. This must be specified in the project planning software.
- An **IP address**. This must be specified in the project planning software. On delivery, the rotary encoder has the IP address "0.0.0.0."

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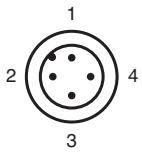
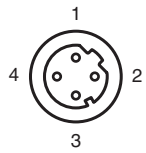
4 Installation

4.1 Electrical Connection

The absolute rotary encoder is connected to the field environment via the "Power/PWR" connector along with "Port 1" and "Port 2" for the PROFINET connection.

Connector and pin assignment

Connection	Power/PWR Connector plug, M12 x 1, 4-pin, A-coded	Port 1, port 2 Connector socket, M12 x 1, 4-pin, D-coded
1	Operating voltage +U_B	Tx +
2	-	Rx +
3	0 V	Tx-
4	-	Rx -
		

4.1.1 Signal List for Cyclic Data Transfer

The table below lists the standard signals that are used to configure IO data. The signals are described in more detail in the following sections.

Signal no.	Meaning	Abbreviation	Length (bit)	Sign
3	Rotary encoder control word 2	STW2_EWC	16	Unsigned
4	Rotary encoder status word 2	ZSW2_ENC	16	Unsigned
6	Velocity value A	NIST_A	16	Signed
8	Velocity value B	NIST_B	32	Signed
9	Rotary encoder control word 1	G1_STW	16	Unsigned
10	Rotary encoder status word 1	G1_ZSW	16	Unsigned
11	Format of position value 1	G1_XIST1	32	Unsigned
12	Format of position value 2	G1_XIST2	32	Unsigned
39	Format of position value 3	G1_XIST3	64	Unsigned
82	Preset control word 31 bit + 1 trigger bit	G1_XIST_PRESET_B	32	Unsigned
83	Preset control word (64 bits)	G1_XIST_PRESET_C	64	Unsigned
84	Preset control word 32 bit	G1_XIST_PRESET_B1	32	Unsigned
–	Acceleration value	Acceleration	32	Signed
–	Temperature value	Temperature	32	Signed

4.2 LED Indicators

The absolute rotary encoder features 6 LED indicators for displaying the operating status and diagnostic information in the event of a fault.

The LEDs light up as follows, depending on their function:

- On
- Off
- Flashing

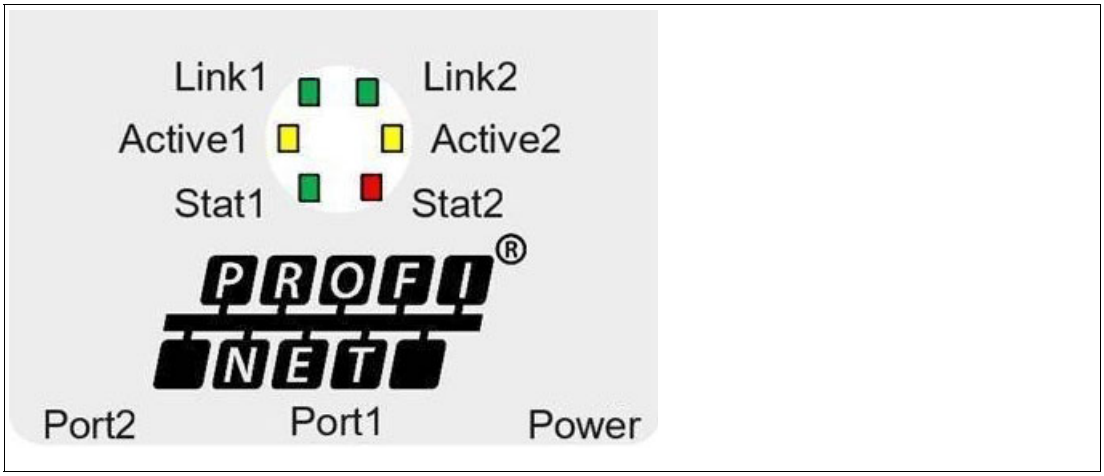


Figure 4.1 LED indicator with ENA58IL-R*** B17 as an example

Description of the LEDs

LED	Color	Description for LED = on
Active 1	Yellow	Incoming and outgoing data traffic for port 1
Link	Green	• Connection to other Ethernet devices on port 1 • Flashes at 2 Hz during an identification call during the configuration with an existing link connection
Active 2	Yellow	Incoming and outgoing data traffic for port 1
Link 2*	Green	• Connection to other Ethernet devices on port 2 • Flashes at 2 Hz during an identification call during the configuration with an existing link connection
Stat 1	Green	Status 1, see below for details
Stat 2	Red	Status 2, see below for details

Status LEDs: Stat1, Stat2

Stat 1 (multi-color)	Stat 2 (multi-color)	Description	Possible cause
Off	Off	No voltage supply	Defective cable, defective fuse, etc.
Red	Green	• No connection to another node • Criterion: no data exchange	• Bus not connected • Master is not available or switched off
Flashes red (0.5 Hz)	Green	• Parameterization error, no data exchange • Criterion: correct data exchange, but the slave has not switched to data exchange operating mode. • Flashing frequency: 0.5 Hz for at least 3 s	• Slave has not yet been configured or is configured incorrectly • Wrong address assigned, but address is within the permitted address range • Current slave configuration differs from the target configuration
Green	Red	• System error • Pending error in rotary encoder application process	• Class error diagnosis available • Rotary encoder in data exchange
Green	Orange	• System error • Pending error in rotary encoder application process	• Class error diagnosis available • Rotary encoder in data exchange
Green	Green	• Data exchange • Slave and function OK	

4.3 Instructions for Mechanical and Electrical Installation

Note

More installation-relevant information on technical data, mechanical data, and available connection cables for the relevant absolute rotary encoder types "Exx58N-...PN..." and "ENA58IL-...B17" can be found in the corresponding datasheet.

Please observe the following instructions to ensure safe operation of the absolute rotary encoder:

Warning!

Work must be performed by trained and qualified personnel only!

Commissioning and operation of this electrical device must be performed by trained and qualified personnel only. This means individuals who are qualified to commission (in accordance with safety engineering), connect to ground, and label devices, systems, and circuits.

Warning!

Perform work only when the device is de-energized!

De-energize your device before performing work on the electrical connections. Short circuits, voltage peaks, and similar events can lead to faults and undefined statuses. This presents a significant risk of personal injury and property damage.

Warning!

Check electrical connections before switching on the plant!

Check all electrical connections before switching on the plant. Incorrect connections present a significant risk of personal injury and property damage. Incorrect connections can lead to malfunctions.

Caution!

Do not remove the rotary encoder housing!

Do not remove the rotary encoder housing under any circumstances, since damage and contamination can occur as a result of taking improper action. It is, however, permitted to remove connector covers.

Caution!

Do not perform any electrical modifications!

It is not permitted to perform electrical modifications on the rotary encoders. If you open or modify the device yourself, you are endangering yourself and others, voiding any warranty, and absolving the manufacturer of any liability.

Caution!

Ensure that the data cable and power supply cable are physically separated!

Route the cordset of the rotary encoder so that it is a suitable distance away from power supply cables to avoid faults. Shielded cables must be used to ensure reliable data transfer. A perfect ground connection must be ensured.

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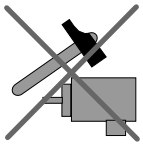
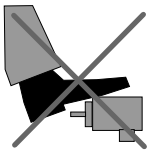
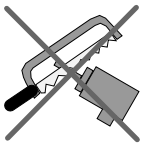


Do not allow the rotary encoder to fall or expose it to strong vibrations. The rotary encoder is a precision instrument.



Rotary encoders from Pepperl+Fuchs are rugged; however, they should nevertheless be protected against damage from the environment by taking appropriate protective measures. In particular, the devices must not be installed in a location where they could be misused as a handle or climbing aid.



Do not make any alterations to the drive shaft or the housing of the rotary encoder.

Note

Rotary encoder with solid shaft

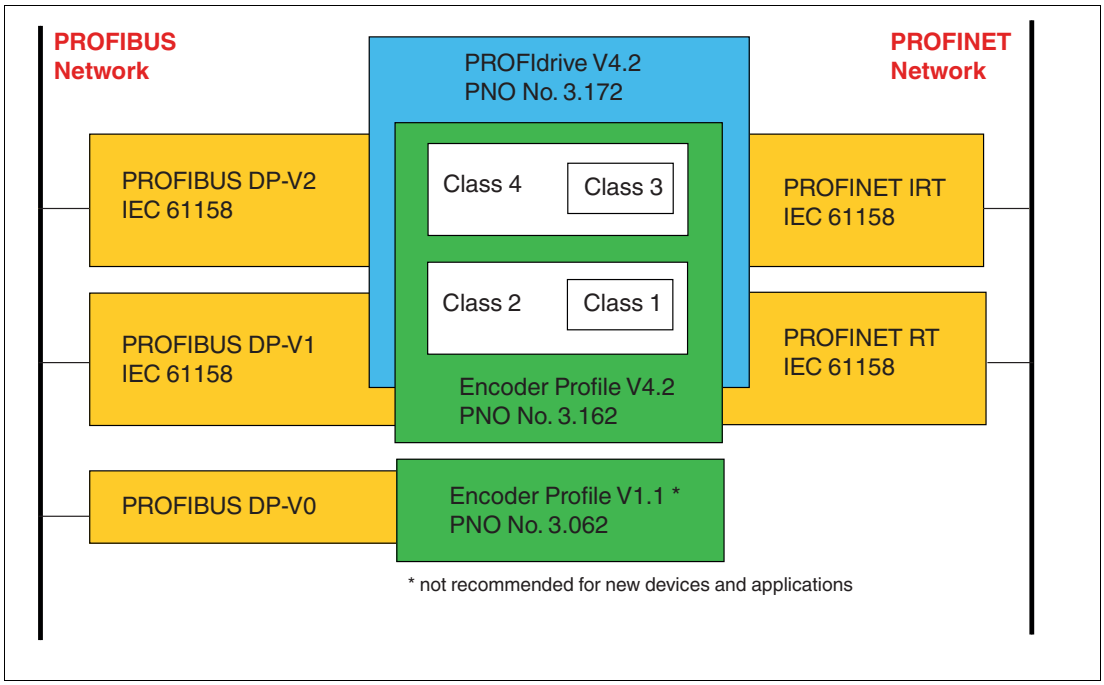
The drive shaft on the rotary encoder must be connected to the drive shaft on the part to be measured via a suitable coupling. The coupling is required to protect the drive shaft on the rotary encoder against excessive levels of force, to compensate for shaft offset, and to reduce the impact of vibrations. Suitable couplings are available as accessories from Pepperl+Fuchs.

5 Data Model for the Device Configuration

5.1 Using Encoder Profile V4.2

The current generation of PROFINET rotary encoders are based on encoder profile V4.1 (PNO no. 3.162). This standardization makes it possible to use products that fulfill this specification together or exchange them for compatible products.

The operational functions of rotary encoders are divided into two application classes (Class 3 and 4) based on their profile. The figure below provides an overview of the profiles for PROFIBUS and PROFINET in accordance with the standards.



5.2 Rotary Encoder Classes and Functions

Rotary Encoder Classes

Application class	Description
1	Standard rotary encoders with preset functionality. Isochronous mode is possible, but sign-of-life support only with Telegram 89.
2	Includes functionality of Class 1 rotary encoders with access to additional basic parameters, velocity value, and additional scaling functionality.
3	Isochronous mode is not supported (IRT) Device with "Base Mode Parameter Access" and limited parameterization of the device functionality
4	Isochronous mode is supported (IRT) Device with scaling and preset functions and "Base Mode Parameter Access"

Table 5.1

Functions

Function	Telegram									
	81	82	83	84	86	87	88	89	860	862
Preset, easy to configure	–	–	–	–	Yes	Yes	Yes	Yes	Yes	Yes
Preset value 64 bit	–	–	–	Yes	–	–	Yes	Yes	–	–
Speed signal 16 bit	–	Yes	–	–	–		–	–	–	–
Speed signal 32 bit	–	–	Yes	Yes	Yes	–	Yes	Yes	Yes	Yes
Speed units and filters	–	Yes	Yes	Yes	Yes	–	Yes	Yes	Yes	Yes
Speed signal 32 bits	–	–	–	–	–	–	–	–	–	Yes
Temperature signal 32 bits	–	–	–	–	–	–	–	–	–	Yes
Rotary axis (endless axis)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Non-integer scaling factor	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Counting direction	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Scaling function	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
G1_XIST1 preset control	yes*/ –	yes*/ –	yes*/ –	yes*/ –	–	–	–	–	–	–
Warning in case of excess temperature	Yes	Yes	Yes	Yes	–	–	–	Yes	–	–
PROFIdrive error memory	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
Maximum sign-of-life faults	Yes	Yes	Yes	Yes	–	–	–	Yes	–	–
Class 1	–	–	–	–	Yes	Yes	Yes	Yes	Yes	Yes
Class 2	–	–	–	–	Yes	Yes	Yes	Yes	Yes	Yes
Class 3	Yes	Yes	Yes	Yes	–	–	–	–	–	–
Class 4	Yes	Yes	Yes	Yes	–	–	–	–		–

Table 5.2

* Only for encoder profiles V4.0 and V4.1

5.3 Signal List for Cyclic Data Transfer

The table below lists the standard signals that are used to configure IO data. The signals are described in more detail in the following sections.

Signal no.	Meaning	Abbreviation	Length (bit)	Sign
3	Rotary encoder control word 2	STW2_EWC	16	Unsigned
4	Rotary encoder status word 2	ZSW2_ENC	16	Unsigned
6	Velocity value A	NIST_A	16	Signed
8	Velocity value B	NIST_B	32	Signed
9	Rotary encoder control word 1	G1_STW	16	Unsigned
10	Rotary encoder status word 1	G1_ZSW	16	Unsigned
11	Format of position value 1	G1_XIST1	32	Unsigned
12	Format of position value 2	G1_XIST2	32	Unsigned
39	Format of position value 3	G1_XIST3	64	Unsigned
82	Preset control word 31 bit + 1 trigger bit	G1_XIST_PRESET_B	32	Unsigned
83	Preset control word (64 bits)	G1_XIST_PRESET_C	64	Unsigned
84	Preset control word 32 bit	G1_XIST_PRESET_B1	32	Unsigned
–	Acceleration value	Acceleration	32	Signed
–	Temperature value	Temperature	32	Signed

5.4 Standard Telegrams and Manufacturer Telegrams

The PROFINET rotary encoder is configured using various telegram structures. The telegrams are used to specify the data length and type of data for data traffic with the IO controller. The telegrams consist of different signals (e.g., STW2_ENC). These signals are described in more detail in the following sections.

5.4.1 Telegrams according to Encoder Profile 4.0 and 4.1

Standard Telegram 81

Output data from the IO controller

IO data (word)	1	2
Byte	0, 1	2, 3
Target value	STW2_ENC	G1_STW

Input data to the IO controller

IO data (word)	1	2	3	4	5	6
Byte	0, 1	2, 3	4, 5	6, 7	8, 9	10, 11
Actual value	ZSW2_ENC	G1_ZSW	G1_XIST1		G1_XIST2	

Standard Telegram 82

Output data from the IO controller

IO data (word)	1	2
Byte	0, 1	2, 3
Target value	STW2_ENC	G1_STW

Input data to the IO controller

IO data (word)	1	2	3	4	5	6	7
Byte	0, 1	2, 3	4, 5	6, 7	8, 9	10, 11	12, 13
Actual value	ZSW2_ENC	G1_ZSW	G1_XIST1		G1_XIST2		NIST_A

Standard Telegram 83

Output data from the IO controller

IO data (word)	1	2
Byte	0, 1	2, 3
Target value	STW2_ENC	G1_STW

Input data to the IO controller

IO data (word)	1	2	3	4	5	6	7
Byte	0, 1	2, 3	4, 5	6, 7	8, 9	10, 11	12, 13
Actual value	ZSW2_ENC	G1_ZSW	G1_XIST1		G1_XIST2		NIST_B

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Standard Telegram 84

Output data from the IO controller

IO data (word)	1	2
Byte	0, 1	2, 3
Target value	STW2_ENC	G1_STW

Input data to the IO controller

IO data (word)	1	2	3	4	5	6	7	8	9	10
Byte	0, 1	2, 3	4, 5	6, 7	8, 9	10, 11	12,13	14, 15	16, 17	18, 19
Actual value	ZSW2_ENC	G1_ZSW	G1_XIST3				G1_XIST2		NIST_B	

Manufacturer Telegram 860

With this telegram, it is not necessary to set specific bits for cyclic data transfer. The telegram is based on PROFIBUS functionality and enables simple configuration of the preset value during regular operation of the PLC. For the velocity value, the format defined in the velocity measuring step is used.

The preset function is activated when bit 31 (most significant bit, MSB) is set to "1." After the preset value has been transferred, reset bit 31 to "0."

Manufacturer telegram 860 has the following characteristics:

- No control word
- No status word
- No status indicator
- Output data: 32-bit unsigned preset value (preset value must be less than the total resolution, bit 31 is a preset trigger bit
- Input data: 32-bit unsigned position value + 32-bit integer velocity value

Output data from the IO controller

IO data (word)	1			2	
Byte	0		1	2	3
Bit	31 (MSB)	30-24	23-16	15-8	7-0 (LSB)
Meaning	Preset trigger bit	Preset value < total resolution			

Input data to the IO controller

IO data (word)	1	2	3	4
Byte	0 (MSB), 1	2, 3 (LSB)	4 (MSB), 5	6, 7 (LSB)
Actual value	Position value: 32 bit, unsigned		Velocity value: 32 bit, signed	

5.4.2 Telegram according to Encoder Profile 4.2

Standard Telegram 81

Output data from the IO controller

IO data (word)	1	2
Byte	0, 1	2, 3
Target value	STW2_ENC	G1_STW

Input data to the IO controller

IO data (word)	1	2	3	4	5	6
Byte	0, 1	2, 3	4, 5	6, 7	8, 9	10, 11
Actual value	ZSW2_ENC	G1_ZSW	G1_XIST1		G1_XIST2	

Standard Telegram 82

Output data from the IO controller

IO data (word)	1	2
Byte	0, 1	2, 3
Target value	STW2_ENC	G1_STW

Input data to the IO controller

IO data (word)	1	2	3	4	5	6	7
Byte	0, 1	2, 3	4, 5	6, 7	8, 9	10, 11	12, 13
Actual value	ZSW2_ENC	G1_ZSW	G1_XIST1		G1_XIST2		NIST_A

Standard Telegram 83

Output data from the IO controller

IO data (word)	1	2
Byte	0, 1	2, 3
Target value	STW2_ENC	G1_STW

Input data to the IO controller

IO data (word)	1	2	3	4	5	6	7
Byte	0, 1	2, 3	4, 5	6, 7	8, 9	10, 11	12, 13
Actual value	ZSW2_ENC	G1_ZSW	G1_XIST1		G1_XIST2		NIST_B

Standard Telegram 84

Output data from the IO controller

IO data (word)	1	2
Byte	0, 1	2, 3
Target value	STW2_ENC	G1_STW

Input data to the IO controller

IO data (word)	1	2	3	4	5	6	7	8	9	10
Byte	0, 1	2, 3	4, 5	6, 7	8, 9	10, 11	12,13	14, 15	16, 17	18, 19
Actual value	ZSW2_ENC	G1_ZSW	G1_XIST3				G1_XIST2		NIST_B	

Manufacturer Telegram 860

With this telegram, it is not necessary to set specific bits for cyclic data transfer. The telegram is based on PROFIBUS functionality and enables simple configuration of the preset value during regular operation of the PLC. For the velocity value, the format defined in the velocity measuring step is used.

The preset function is activated when bit 31 (most significant bit, MSB) is set to "1." After the preset value has been transferred, reset bit 31 to "0."

Manufacturer telegram 860 has the following characteristics:

- No control word
- No status word
- No status indicator
- Output data: 32-bit unsigned preset value (preset value must be less than the total resolution, bit 31 is a preset trigger bit
- Input data: 32-bit unsigned position value + 32-bit integer velocity value

Output data from the IO controller

IO data (word)	1			2	
Byte	0		1	2	3
Bit	31 (MSB)	30-24	23-16	15-8	7-0 (LSB)
Meaning	Preset trigger bit	Preset value < total resolution			

Input data to the IO controller

IO data (word)	1	2	3	4
Byte	0 (MSB), 1	2, 3 (LSB)	4 (MSB), 5	6, 7 (LSB)
Actual value	Position value: 32 bit, unsigned		Velocity value: 32 bit, signed	

Note

It is not necessary to set special bits for cyclic data transfer for the following Telegrams 86, 87, 88, and 862. These Telegrams allow easy configuration of the preset value during regular operation of the PLC.

For the velocity value, the format defined in the velocity measuring step is used. The preset function is activated for Telegrams 86, 87, and 862, when you set preset trigger bit 31 (Most Significant Bit MSB) to "1." After the preset value has been transferred, reset bit 31 to "0." For Telegram 88, the bit is 63.

Standard Telegram 86

Output data from the IO controller

IO data (word)	1	2
Byte	0, 1	2, 3
Target value	G1_XIST_PRESET_B	

See chapter 5.10

Input data to the IO controller

IO data (word)	1	2	3	4
Byte	0, 1	2, 3	4, 5	6, 7
Actual value	G1_XIST1		NIST_B	

Standard Telegram 87

Output data from the IO controller

IO data (word)	1	2
Byte	0, 1	2, 3
Target value	G1_XIST_PRESET_B	

See chapter 5.10

Input data to the IO controller

IO data (word)	1	2
Byte	0, 1	2, 3
Actual value	G1_XIST1	

Standard Telegram 88

Output data from the IO controller

IO data (word)	1	2	3	4
Byte	0, 1	2, 3	4, 5	6, 7
Target value	G1_XIST_PRESET_C			

See chapter 5.11

Input data to the IO controller

IO data (word)	1	2	3	4	5	6
Byte	0, 1	2, 3	4, 5	6, 7	8, 9	10, 11
Actual value	G1_XIST3				NIST_B	

Standard Telegram 89

Output data from the IO controller

IO data (word)	1	2	3
Byte	0, 1	2, 3	4, 5
Target value	STW2_ENC	G1_XIST_PRESET_B1	

Input data to the IO controller

IO data (word)	1	2	3	4	5
Byte	0, 1	2, 3	4, 5	6, 7	8, 9
Actual value	ZSW2_ENC	G1_XIST1		NIST_B	

Manufacturer Telegram 862

Manufacturer Telegram 862 has the following characteristics:

- No control word
- No status word
- No status indicator
- Output data: 32-bit unsigned preset value (preset value must be less than the total resolution, bit 31 is a preset trigger bit
- Input data: 32-bit unsigned position value + 32-bit integer speed value + 32-bit integer acceleration value + 32-bit temperature value

Output data from the IO controller

IO data (word)	1			2	
Byte	0		1	2	3
Bit	31 (MSB)	30-24	23-16	15-8	7-0 (LSB)
Meaning	Preset trigger bit	Preset value < total resolution			

Input data to the IO controller

IO data (word)	1	2	3	4	5	6	7	8
Byte	0, 1	2, 3	4, 5	6, 7	8, 9	10, 11	12,13	14, 15
Actual value	Position value		Velocity value		Acceleration value		Temperature value	

5.5 Format of Position Value (G1_XIST1 ... 3)

The 32-bit signals G1_XIST1 and G2_XIST2 are the output position values in binary format. G1_XIST3 is a 64-bit position value in binary format to support devices with a resolution greater than 32 bits.

The alignment in the data frame—left-aligned or right-aligned—is taken into consideration for each individual resolution. An example for absolute rotary encoders is given below.

Note

The alignment of the output format—left-aligned or right-aligned—remains constant and affects the actual resolution set. The number of transferred bits depends on the resolution.

For example:

25-bit multiturn absolute rotary encoder (8192 steps per revolution, 4096 revolutions)

- All values are output in binary format.
- If an error occurs, G1_XIST2 displays the error telegram instead of the right-aligned position value.
- The shifting factors in the P979 "Sensor Format" show the current format. P979, subindex 4 (shifting factor for G1_XIST2) = 0.
- The settings in the rotary encoder parameters affect the position value in both G1_XIST1 and G1_XIST2.

G1_XIST1

- The default setting for G1_XIST1 is right alignment.
- G1_XIST1 is a 32-bit counter and starts with the current position value.
- A 32-bit counter starts with the current position value. When the maximum numerical value is reached, the counter starts again at 0 and counts up to the maximum numerical value or counts downward from the maximum numerical value to 0.
- P979, subindex 3 (shifting factor for G1_XIST1) = 0
- G1_XIST1 transmits values independent of bit 10 in STW2 and Bit 13 in G1_STW1.

Bit 31 ... 13	Bit 12 ... 0
M Number of revolutions (multiturn value)	S Steps (singleturn steps per revolution)

G1_XIST2

The following information is an example of an absolute rotary encoder with 12-bit multiturn resolution and 13-bit singleturn resolution.

Bit 31 ... 25	Bit 24 ... 13	Bit 12 ... 0
	M Number of revolutions (multiturn value)	S Steps (singleturn steps per revolution)

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Error codes in G1_XIST2

If an error occurs in the sensor channel, specific error codes are sent in Telegram 81-84 in G1_XIST2. These correspond to the definition of the PROFIdrive sensor channel machine status in the PROFIdrive profile.

The following table lists all defined error codes for the sensor channel machine status. If there are multiple errors, the error code of the most serious error is entered in G1_XIST.

G1_XIST2	Meaning	Description
0x0001	Sensor group error	Error in the processing of the sensor signal that results in an invalid Gx_XIST (e.g., electronic fault, invalid sensor signal input, ...)
0x0003	Park sensor error	Failure due to inability to transition to SD12 (parking). This may be due to the drive being running (state S4), and the motor measuring system being forced to park.
0x000A	Transfer of the absolute value aborted	Absolute value track of the rotary encoder cannot be read
0x0F01	Command is not supported	Error due to unsupported optional function (e.g., Shift/Preset Home Position)
0x0F02*	Master's sign-of-life faults	The number of permitted failures of the captain's sign of life has been exceeded.
0x0F04*	Synchronization error	The number of permitted failures for the bus cycle signal has been exceeded.
0x0F05*	Excess temperature error	The maximum permissible operating temperature of the rotary encoder has been exceeded.

* Only for encoder profiles V4.0 and V4.1

G1_XIST3

The G1_XIST3 signal for resolutions greater than 32 bits is transmitted in binary format with right alignment and without a shifting factor.

IO data (word)	1	2	3	4
Byte	0, 1	2, 3	4, 5	6, 7
Format	64-bit position value			

5.6 Rotary Encoder Control Word 2 (STW2_ENC)

Rotary encoder control word 2 is referred to as the "master sign of life" and is used to control isochronous mode. The status word includes the "Control by PLC" mechanism and the "Controller sign of life" mechanism.

- 4-bit counter, left-aligned.
- The master application starts the sign of life counter with any value between 1 and 15. Only values between 1 and 15 are valid for the sign of life counter.
- The master increases the sign of life counter in every cycle of the master application.
- "0" indicates an error and is not possible in normal operation.

Bit	Function	Implementation		
		Class 3 + 4	Telegram 89	Telegram 81 ... 84
0	Preset trigger bit	–	Yes	–
1 ... 6	Reserved, not currently used	–	–	–
7	Error confirmation	–	Yes	–
8, 9	Reserved, not currently used	–	–	–
10	Control by PLC	Yes	Yes	Yes
11	Reserved, not currently used	–	–	–
12 ... 15	Master sign of life "Sign-Of-Life (MSL)"	Yes	Yes	Yes

Bit	Value	Meaning	Comment
0	1	Preset trigger bit 0 -> 1	When the bit changes from 0 to 1, the value from G1_XIST_PRESET_B1 is set as the new position value in G1_XIST1. The newly calculated offset value is stored in a non-volatile memory. This process takes approximately 10 ms, during which the position is not updated. **Only run when stationary** A successful preset function is confirmed by changing "bit 0" from 0 to 1 in ZSW2_ENC (preset confirmation). You must reset the preset trigger bit to 0.
	0	No-load operation	Before executing a new preset function (preset cycle), the bit must be set to 0.
7	1	Error confirmation	Current errors in the error memory are confirmed when the bit changes from 0 to 1
	0	No meaning	
10	1	Control by PLC	Control via interface, EO/IO data is valid
	0	No control by PLC	EO/IO data is not valid, except sign of life
12 ... 15		Controller sign of life	Continuously sends numerical values from 1 ... 15

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5.7 Rotary Encoder Status Word 2 (ZSW2_ENC)

Rotary encoder status word 2 is referred to as a "slave sign of life" and is used to control isochronous mode. The status word includes the "Control by PLC" mechanism and the "Slave sign of life" mechanism.

- 4-bit counter, left-aligned.
- The slave application starts the sign of life counter with any value between 1 and 15 after successfully synchronizing with the clock pulse. Only values between 1 and 15 are valid for the slave sign of life counter.
- The sign of life counter is increased by the slave application in every DP cycle.
- "0" indicates an error and is not possible in normal operation.

Bit	Function	Implementation		
		Class 3 + 4	Class 1 +2 Telegram 89	Telegram 81 ... 84
0	Preset confirmation	–	Yes	–
1	XIST_VALID	–	Yes	–
2	NIST_VALID	–	Yes	–
3	Error has occurred	Yes	Yes	Yes
4 ... 6	Reserved, not currently used	–	–	–
7	There is a warning	Yes	Yes	Yes
8	Reserved, not currently used	–	–	–
9	Control by PLC	Yes	Yes	Yes
10, 11	Reserved, not currently used	–	–	–
12 ... 15	"Sign of life" rotary encoders	Yes	Yes	Yes

Bit	Value	Meaning	Comment
0	1	Preset confirmation	Changing the bit from 0 to 1 confirms that the preset value has been taken as the current position value. The recalculated internal position offset value has been stored in a non-volatile memory in the rotary encoder.
	0	No-load operation	The rotary encoder is ready to perform a preset process (preset cycle).
1	1	G1_XISTx position value in XISTx is valid	This bit indicates whether there is a valid position value in the relevant XISTx signals of a Class 1 or Class 2 rotary encoder. Note: This bit is only used for Telegram 89 of Class 1 and Class 2.
	0	No error	This bit is only used for Telegram 89 of Class 1 and Class 2.
2	1	NISTx velocity value in XISTx is valid	This bit indicates whether there is a valid velocity value in the relevant NISTx signals of a Class 1 or Class 2 rotary encoder. Note: This bit is only used for Telegram 89 of Class 1 and Class 2.
	9	No error	This bit is only used for Telegram 89 of Class 1 and Class 2. If the rotary encoder does not support velocity value output, this bit is always 0.

Bit	Value	Meaning	Comment
3	1	Error exists	The rotary encoder has detected one or more errors (error objects). This means that one or more of the current values are invalid or must be considered invalid. If the cause of the fault is rectified, the pending fault is automatically deleted.
	0	No error	
7	1	A warning has occurred	The rotary encoder has detected one or more warning(s) (warning objects). This means that one or more of the critical limits have been reached, but the rotary encoder functionality is still available according to the specification. All current values are also valid. If the cause of the warning has been resolved, the pending warning bit is automatically deleted.
	0	No warning	
9	1	Control requested	Control by PLC requested
	0	No control by PLC	No control by PLC requested
12 ... 15		Sign-of-life rotary encoder	As soon as the controller sends the master sign of life, the rotary encoder in turn begins to send the sign of life. This is a bit-by-bit incremented signal with the possible values 0 ... 15. The output value is 0.

5.8 Rotary Encoder Control Word 1 (G1_STW)

The control word determines the functionality of key rotary encoder functions.

Bit	Value	Function	Note
0 ... 10			Reserved, currently not used
11	0/1	Home position mode	Defines whether the position value is set to the previously programmed preset value or whether it is shifted by the preset value. • 0: Set home position to preset value (absolute) • 1: Shift home position by preset value (relative = offset)
12	1	Request to set/shift home position	The home position is set absolutely if bit 12 is changed to "1" (rising edge). Default setting of bit 12 (shift) is 0. **Warning!** After this function has been triggered, the new offset is stored in non-volatile memory. During these 5 ms ... 10 ms, the rotary encoder does not send any position values.
13	1	Request absolute value cyclically	Request for additional, cyclic transmission of the absolute current position in G1_XIST2. If no other data needs to be transmitted due to commands or errors, the absolute position value is transmitted automatically.
14	1	Activate "Sensor parking"	If the "Sensor parking" bit is activated, the rotary encoder does not send any diagnostic messages or error messages.
15	1	Acknowledge sensor fault	Request to acknowledge/reset a sensor fault.

5.9 Rotary Encoder Status Word 1 (G1_ZSW)

The status word defines the encoder statuses, confirmations, and error messages for key rotary encoder functions.

Bit	Value	Function	Note
0 ... 10			Reserved, currently not used
11		Acknowledgement of a sensor fault during operation	This is set when the reset of a sensor fault takes longer than one bus cycle.
12	1	Set home position/reference point shift carried out (preset)	Confirmation of "Set home position/reference point shift carried out"
13	1	Cyclical transmission of the absolute value	Confirmation of request for cyclical transmission of the absolute value.
14	1	"Sensor parking" activated	Confirmation that "Sensor parking" is activated. The rotary encoder does not send error messages.
15	1	Sensor fault	Indicates a sensor fault. The rotary encoder transmits a device-specific error code in G1_XIST2.

5.10 Sensor Preset Control Word 32-bit (G1_XIST_PRESET_B)

Bit	Value	Function	Comment
0 ... 30		Sensor preset value	Preset value (31 bits) for G1_XIST1 in the format/resolution of G1_XIST1
31		Preset trigger bit	Control bit to activate the preset mode. • 1 = activate preset. In preset mode, the preset value is taken as the current value in G1_XIST1 and the new internal offset value is calculated • 0 = Preset mode not active This bit is used as preset control for Telegrams 86 and 87.

5.11 Sensor Preset Control Word 64-bit (G1_XIST_PRESET_C)

Bit	Value	Function	Comment
0 ... 62		Sensor preset value	Preset value (63 bits) for G1_XIST3 in the format/resolution of G1_XIST3
63		Preset trigger bit	Control bit for activating the transfer of the preset value (transition from 0 to 1) in G1_XIST3. This bit is used as a preset control for Telegram 88.

5.12 Sensor Preset Control Word 32-bit (G1_XIST_PRESET_B1)

Bit	Value	Function	Comment
0 ... 31		Sensor preset value	Preset value (32 bits) for G1_XIST2 in the format/resolution of G1_XIST2. Preset is triggered by XIST_PRESET_CONTROL (bit 0 in STW2_ENC)

6 Configuration Principle

The absolute rotary encoder for PROFINET can be programmed to meet your specific user requirements. To do this, you must download the appropriate GSDML file from the product detail page for the device from the Pepperl+Fuchs internet portal and import this into your project planning tool to configure it there.

To access the product detail page for the device, go to http://www.pepperl-fuchs.com and type information about the device (e.g., the product marking or the item number) into the search function. You can find the GSDML file in the **Software** area of the product detail page.

6.1 Rotary Encoder Function at a Glance

Function	Communication channel
Position value	Cyclic input (IO device >> IO controller)
Preset	Cyclic output (IO controller >> IO device)
Counting direction	Acyclic input/output
Scaling function	Acyclic input/output
Master's sign of life	Cyclic input (IO device >> IO controller)

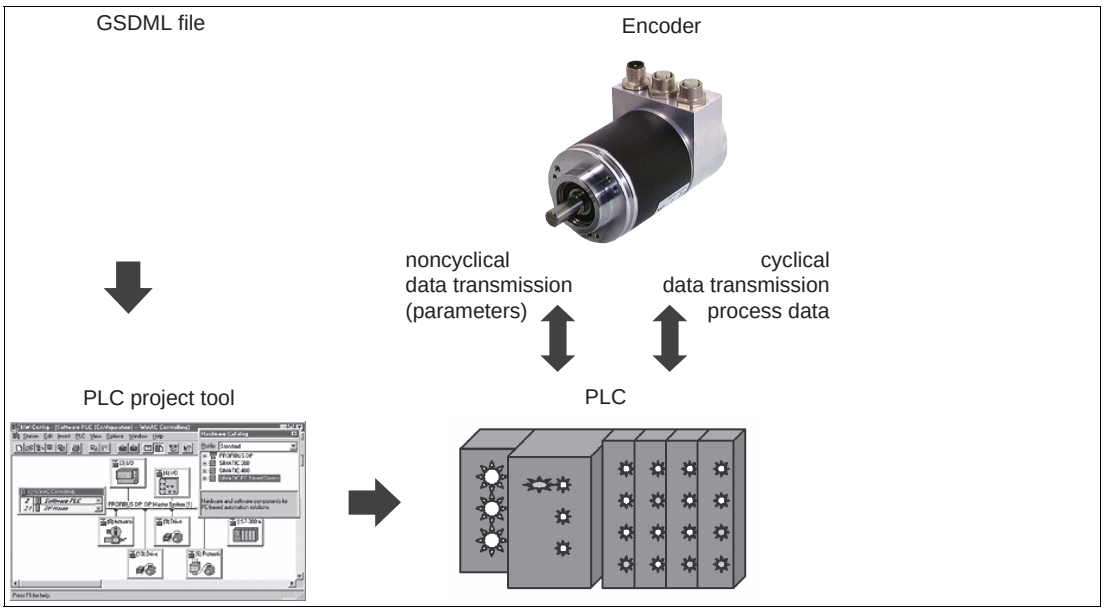
6.2 Rotary Encoder Functions—Data Links

PROFINET IO devices are set up in modules. These modules can be inserted into physical and/or logical slots. The slots are divided into subslots that contain additional data in a hierarchical structure. A subslot can contain several cyclic input/output channels and acyclic record channels (required for parameters).

Different controllers (PLCs) are available from different manufacturers. Some PLCs support only one subslot. Others, such as the SIMATIC 400, support multiple subslots. There are two directories in the GSDML file to enable you to work with all controllers: "Standard" (with PDEV, supports IRT) and "Standard, no PDEV" (does not support IRT).

For older controllers that do not support multiple subslots, Pepperl+Fuchs rotary encoders feature a slot 0 with a subslot 1 for the "Standard, no PDEV" version.

The device parameters are compiled in the PROFINET interface as "Records." The tables on the following pages provide an overview of the addresses of the data channels of Pepperl+Fuchs rotary encoders.



Note

Specific GSDML files are available for the use of the absolute rotary encoder with one of the encoder profile versions 4.0, 4.1, and 4.2.

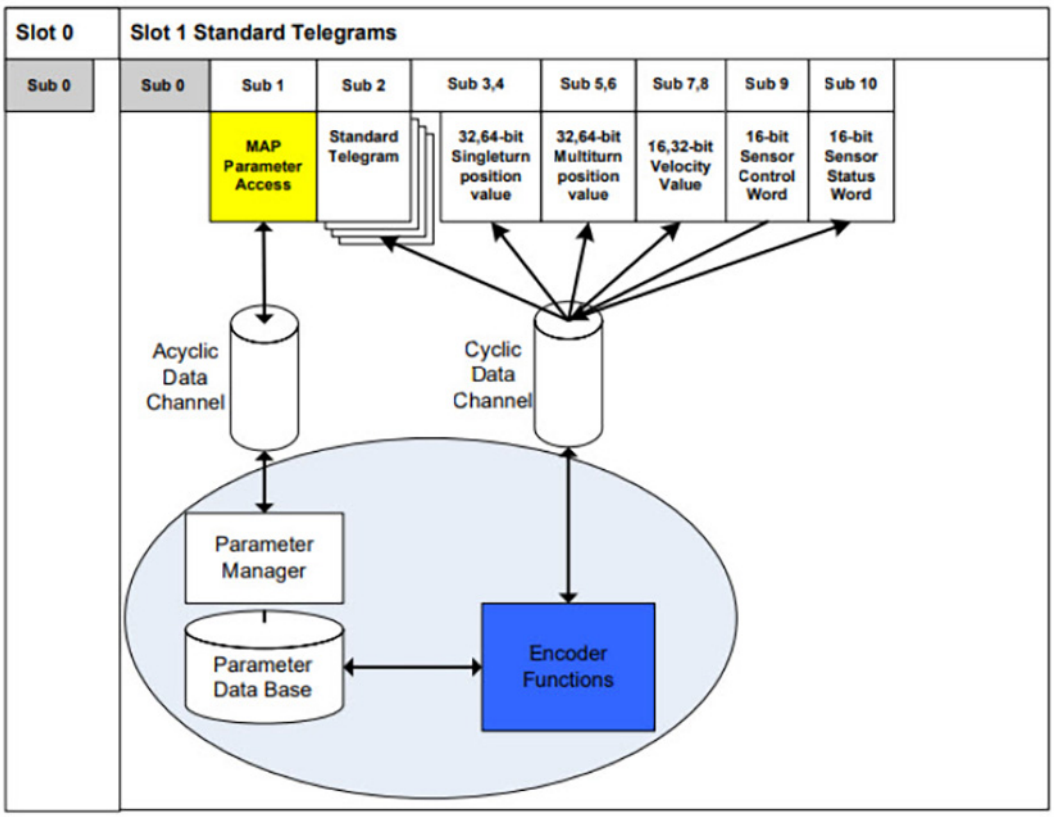
6.3 Parameters for Acyclic Data Transfer

In the startup phase, the user parameters are sent to the rotary encoder as a dataset object with the dataset 0xBF00 to map the different rotary encoder functions in the user data section. In addition to the "Data configuration" parameter, the rotary encoder supports a wide range of PROFIdrive parameters and rotary-encoder-specific parameters that can be called up via the acyclic data exchange service.

With the current GSDML file version, which can be downloaded from the product detail page for the rotary encoder (http://www.pepperl-fuchs.com), it is possible to change the telegram type without changing the MAP parameters.

Note

Specific GSDML files are available for the use of the absolute rotary encoder with one of the encoder profile versions 4.0, 4.1, and 4.2.



6.3.1 Unit Parameters (Base Mode Parameters) from GSDML File

Parameters can be read or changed via the PROFIdrive "Base Mode Parameter Access" channel defined in the PROFIdrive profile.

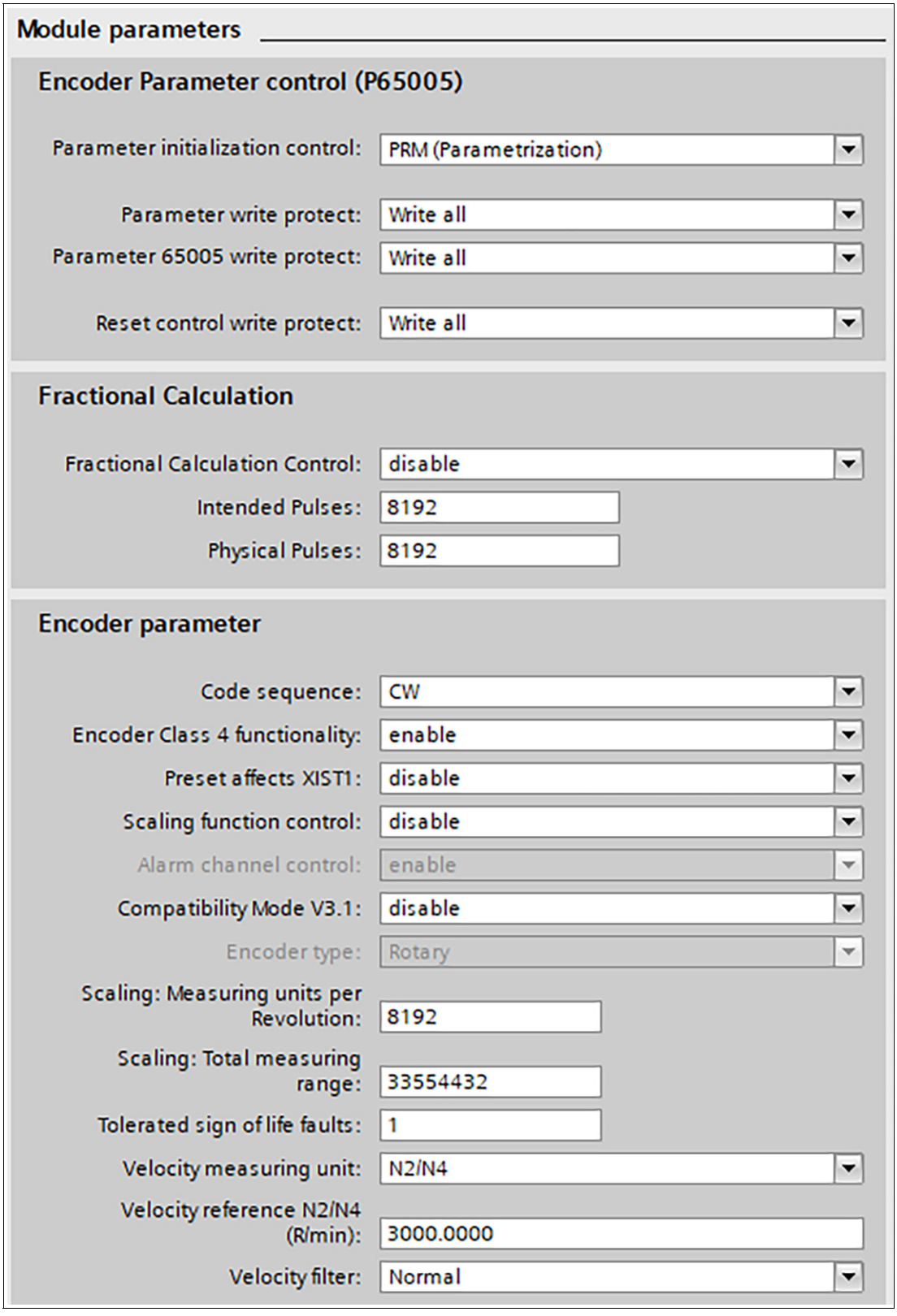


Figure 6.1

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6.3.2 Standard Parameters

Function	Slot	Subslot	Index x	Offset	Length	IO
Counting direction	1	1	0xBF00	0.0	1 bit	-
Class 4 functionality	1	1	0xBF00	0.1	1 bit	-
G1_XIST1 preset control	1	1	0xBF00	0.2	1 bit	-
Scaling function control	1	1	0xBF00	0.3	1 bit	-
Alarm channel control	1	1	0xBF00	0.4	1 bit	-
Compatibility mode	1	1	0xBF00	0.5	1 bit	-
Measuring steps per revolution	1	1	0xBF00	1	8 octet	-
Total resolution	1	1	0xBF00	9	8 octet	-
Maximum master sign-of-life faults	1	1	0xBF00	17	1 bit	-
Velocity measuring unit	1	1	0xBF00	18	1 bit	-

6.3.3 Device Parameters

Function	Slot	Subslot	Index x	Offset	Length	IO
Preset value	1	1	0xB02E	Via parameter no. 65000		-

6.3.4 Manufacturer Parameters

Function	Slot	Subslot	Index x	Offset	Length	IO
Preset value	1	1	0x1000	0	1 byte	-

6.3.5 Access to Programmable Parameters

The parameters in the parameter number range 9xx (PROFIdrive-specific parameters) and 65xxx (rotary encoder-specific parameters) can be written and/or read via the acyclic data exchange service.

The parameters are handled via the data record object with the index 0xB02E. This could be used to define a desired preset value for Telegrams 81-84.

Two S7 system function blocks (SFBs) are available for data record handling:

1. SFB 52 "RDREC" (read data record)
2. SFB 53 "WRREC" (write data record)

Note

For more information on the use of these system function blocks, refer to the relevant Siemens system documentation "SIMATIC System and Standard Functions for S7-300/400 Volume 1/2 ," Chapter 8.

6.3.6 Supported Parameters

Number	Parameter	Read access	Read/write access
922	Telegram selection	X	
925	Number of tolerated sign of life faults		X
944-952	PROFIdrive error buffer	X	
964	Device identification	X	
965	Profile identification number	X	
970	Load command		X
971	Transfer into non-volatile memory		X
972	Reset rotary encoder	X	X
974	Units parameters access service identification	X	
975	DO identification	X	
979	Sensor format	X	
980	List of supported parameters	X	
60000	N2/N4 speed reference value	X	X
60001	Velocity normalization	X	X
65000	Preset		X
65001	Operating state	X	
65002	Preset value (64 bits)	X	X
65004	Function control	X	X
65005	Parameter control	X	X
65006	Measuring steps per revolution	X	X
65007	Overall measuring range in measuring steps	X	X
65008	Measuring steps per revolution (64 bits)	X	X
65009	Overall measuring range in measuring steps 64 bit	X	X
65010	Operating hours (unit: 6 minutes)	X	X
65011	Intended pulse count	X	X
65012	Physical pulse count	X	X
65013	Scaling function with fractional calculation	X	X
65014	Velocity filter	X	X

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6.3.7 Rotary Encoder Function Description

The table below provides an overview of the available rotary encoder functions that are enabled or disabled depending on the "Class 4 functionality" setting. Detailed descriptions of these parameters can be found in the following sections.

Function	Class 4 functionality is disabled	Class 4 functionality is enabled
Counting direction	–	X
Class 4 Functionality		X
G1_XIST1 preset control	–	X
Scaling function	–	X
Alarm channel control	X	X
V3.1 compatibility mode	–	X
Preset value	–	X
Offset value	–	X
Scaling parameter	–	X
Scaling function with fractional calculation scaling	–	X
Master's sign of life	–	X
Speed unit of measurement	–	X
Velocity filter	–	X
Acceleration unit of measurement	–	X
Rotary axis functionality	Always active	Always active
Rotary encoder profile version	X	X
Warnings/error messages	X	X
PROFIdrive error buffer	X	X
Media Redundancy Protocol (MRP) for RT applications	X	X
Media Redundancy for Planned Duplication (MRDP) for IRT applications	X	X
Parameter control	–	X

6.3.7.1 Counting direction

The "Code sequence" parameter defines the direction of rotation in which the absolute position value of the rotary encoder shaft should increase. When looking down onto the rotary encoder shaft, the value increases when the shaft is rotating clockwise (CW) or counterclockwise (CCW).

Counting direction	Direction of rotation	Counting direction
0	Clockwise (CW)	Increasing
1	Counterclockwise (CCW)	Decreasing

6.3.7.2 Class 4 Functionality

The "Class 4 functionality" parameter specifies that scaling, preset, and code sequence influence the "Format of position value 1 ... 3" signals G1_XIST1 to G1_XIST3.

Class 4 control	Class 4 function
0 (standard)	Deactivated (disable)
1	Activated (enable)

6.3.7.3 Preset Control for G1_XIST1

The "Preset control" parameter defines the preset functionality. If "Class 4 functionality" is enabled and "Preset control" is disabled, the preset value in G1_XIST1 is not affected.

Preset control	Preset function
0 (standard)	Preset does not affect G1_XIST1
1	Preset affects G1_XIST1

6.3.7.4 Scaling Function Control

The "Scaling function control" parameter is used to enable or disable the scaling function. If this function is not enabled, the physical position value of the rotary encoder is returned. The scaling function is available only if "Class 4 functionality" is enabled.

Scaling Function Control	Scaling Function Function
0 (standard)	Disabled
1	Enabled

6.3.7.5 Alarm Channel Control

The "Alarm Channel Control" parameter activates or deactivates the encoder-specific alarm channel, which is transmitted as channel-related diagnosis. This function is used to limit the amount of data sent in isochronous mode.

Note

This parameter is only supported in compatibility mode.

- If the value is 0 (= disabled), only communication-related alarms are sent via the alarm channel.
- If the value is 1 (= enabled), encoder profile-specific errors and warnings are also sent via the alarm channel.

Note

This parameter cannot be disabled in encoder profile 4.2.

Alarm Channel Control	Alarm Channel Function
0 (standard)	Disabled
1	Enabled

6.3.7.6 V3.1 Compatibility Mode

The "Compatibility Mode" parameter defines whether the rotary encoder is able to function in an operating mode that is compatible with version 3.1 of the encoder profiles.

The tables below provide an overview of the functions affected if compatibility mode is activated.

Compatibility mode	Compatibility function	Meaning
0	Enabled	Compatible with encoder profile 3.0
1 (standard)	Disabled	No backward compatibility

Function	Compatibility mode is active (=0)	Compatibility mode is active (=1)
Control by PLC (STW2_ENC)	• Ignored; the rotary encoder control word 1 (G1_STW1) and the setpoint are always valid. • A control request (ZSW2_ENC) is not supported and is set to 0.	Supported
User parameter "Maximum master sign of life faults"	Not supported, One sign of life fault is tolerated, P925 can optionally monitor the sign of life counter.	Supported: If the initialization control parameter = PRM is set via GSDML or = NR-RAM via P925
User parameter "Alarm channel control"	Supported	Not supported: Profile-specific diagnosis via the alarm channel is always active.
P965 profile version	31 (V3.1)	41 (V4.1) or 42 (V4.2)

6.3.7.7 Preset value

The preset value is used to set the rotary encoder zero point to the zero point of the application or to a previously desired value. When using this function, the current rotary encoder position is set as the preset value. The integrated microcontroller calculates the internal zero point shift and saves this information in the non-volatile memory (this takes around 10 ms).

Note

Class 4 functionality must be enabled!

If the preset value is greater than the total resolution, error message 0x02 appears in the parameter response in base mode.

Parameter	Meaning	Data type
Preset value	The preset value is defined via asynchronous data exchange. Default value = 0	Integer 32

Telegram 81 ... 84

The preset value is used to set the rotary encoder zero point to the zero point of the application or to a previously desired value. When using this function, the current preset value is set as the rotary encoder position. The integrated microcontroller calculates the internal zero point shift and (offset value) and saves this information in the non-volatile memory. This takes approx. 10 ms.

Note

Only set the preset value when at a standstill!

If the controller sends the preset value to the rotary encoder, no preset is activated. The bits in rotary encoder control word 1 (G1_STW1) and rotary encoder status word 1 (G1_ZSW) control the preset function. The preset value is used when a preset is requested by bit 12 in rotary encoder control word 1 (G1_STW1).

Note

Only execute the preset function when it is stopped, otherwise the warning bit 13 "Preset failed" will be set (speed too high).

In this case observe the following points:

- Class 4 functionality must be enabled.
- To activate the preset function, you must set bit 12 (Request of home position) for sensor control and status words (G1_STW, G1_ZSW) to 1 in the rotary encoder control word G1_STW. The preset value is previously set in parameter P65000 (32 bits) or P65002 (64 bits) (0 by default).
- If the preset value exceeds the value of the total resolution, the warning bit 14 "Preset failed" is set (preset value outside the permissible value range).
- See the description in the chapter entitled "Executing a preset with Telegram 81."

Parameter	Meaning	Data type
Preset value	The preset value is defined via asynchronous data exchange. Default value = 0	Integer 32 or Integer 64

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Telegram 86, 87, 88, 860, 862

With these telegrams, it is easy to set a user-defined preset value. To do this, preset trigger bit 31 (bit 63 for Telegram 88) must be set to "1" in the predefined control words "G1_XIST_PRESET_B" or "G1_XIST_PRESET_C" that were used. After the preset function has been executed, it must be reset to "0." The preset value itself is specified in the lower-value bits of the control word used.

Output data from the IO controller (using the example 32 bits or 4 bytes for Telegrams 86, 87, 860, 862)

IO data (word)	1			2	
Byte	0		1	2	3
Bit	31 (MSB)	30-24	23-16	15-8	7-0 (LSB)
Meaning	Preset trigger bit	Preset value < total resolution			

Output data from the IO controller (using the example 64 bits or 8 bytes for Telegrams 88)

IO data (word)	1			2		3		4	
Byte	0		1	2	3	4	5	6	7
Bit	63 (MSB)	62-56	55-48	47-40	39-24	39-24	23-16	15-8	7-0
Meaning	Preset trigger bit	Preset value < total resolution							

Telegram 89

The preset function is triggered by setting the preset trigger bit (bit 0: XIST_PRESET_CONTROL) in STW2_ENC. The preset value itself is taken from G1_XIST_PRESET_B1. The preset function always affects G1_XIST1. The correct execution of the preset function is signaled by setting the preset confirmation bit (bit 0: preset confirmation) in ZSW2_ENC.

IO data (word)	1			2	
Byte	0		1	2	3
Bit	31 (MSB)	30-24	23-16	15-8	7-0 (LSB)
Meaning	G1_XIST_PRESET_B1 (Preset value < Total resolution)				

6.3.7.8 Offset Value

The "Offset value" parameter is calculated in the preset function and shifts the position value by the calculated value.

6.3.7.9 Scaling parameter

The "scaling parameters" are used to change the resolution of the rotary encoder. These parameters affect the output values only if the scaling function and class 4 functionality are enabled.

Parameter no.	Parameter	Meaning	Data type
65006	Measuring steps per revolution	Singleturn resolution in steps *1	Unsigned 32
65007	Total measuring range in measuring steps	Total measuring range *1	Unsigned 32
65008	Measuring steps per revolution with 64 bits	Singleturn resolution in steps for rotary encoders with a resolution > 32 bit *2	Unsigned 64
65009	Total measuring range in measuring steps with 64 bits	Total measuring range in steps for rotary encoders with a resolution > 32 bits *2	Unsigned 64
65011	Intended pulse count	Desired total measuring range in measuring steps *1	Unsigned 32
65012	Physical number of pulses	Total physical measuring range in measuring steps *1	Unsigned 32
65013	Fractional calculation scaling	Scaling function with fractional calculation scaling *1	Unsigned 32

*1: not with Telegrams 84 and 88

*2: not with Telegrams 84 and 88

The parameters must meet the following condition:

Total measuring range in measuring steps = measuring steps per revolution x m

m = between 1 and the maximum number of revolutions of the rotary encoder

Example

- Rotary encoders with 12 bit multiturn (= 4096 revolutions) and 13 bit singleturn (= 8192 measuring steps per revolution)
- Desired measuring steps per revolution = 1000

This results in a total measuring range in measuring steps = 1000 x 4096 = 4096000

This meansthat the total measuring range must be transferred in measuring steps to each reduced measuring step per revolution! Otherwise, the configuration will be aborted with a parameterization error.

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6.3.7.10 Scaling function with fractional calculation

With the new PROFINET generation, 3 additional parameters are available:

- Intended number of pulses
- Physical pulses
- Fractional calculation control

If "Fractional calculation control" is set to "1," the scaling factor is calculated as a quotient of numerator divided by denominator according to the following formula:

$$Scaling\ factor = \frac{Intended\ Pulses}{Physical\ Pulses}$$

Example

An absolute rotary encoder with 25-bit resolution (12-bit multiturn, 13-bit singleturn) is used.

The position value should increase by 400 measurement steps over a total of 3 revolutions. This corresponds to 400/3 = 133.33 measurement steps per revolution.

It is not possible to set this value via the parameter "Measurement steps per revolution," because only integer values can be entered.

$$Scaling\ factor = \frac{400\ Steps}{8192\left(\frac{Steps}{Revolution}\right) x\ 3\ Revolutions} = \frac{400}{24576} = 0,01627$$

You must enter the following values in the TIA Portal:

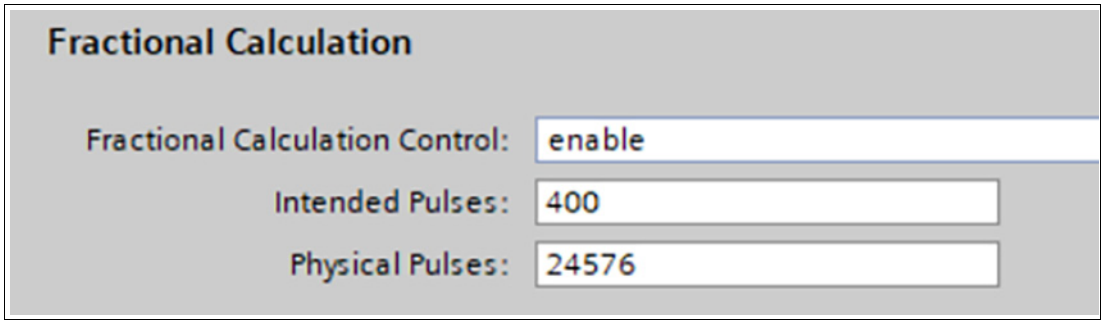


Figure 6.2

6.3.7.11 Master Sign-of-Life Monitoring

This parameter specifies the maximum number of master sign-of-life faults (Master Sign-Of-Life failure) allowed.

Parameter	Meaning	Values
Maximum master sign of life faults	Number of permissible faults of the master sign of life counter defined via the GSDML. The monitoring is disabled once the value reaches 255.	0 ... 255
	Number of permissible faults of the master sign of life counter defined via PNU 925. The monitoring is disabled once the value reaches 65536.	0 ... 65536

6.3.7.12 Speed unit of measurement

This parameter defines the unit of measurement used to output the velocity values NIST_A and NIST_B.

The velocity value is calculated from the position value in each cycle. The accuracy of the velocity value is not affected by the cycle time.

Velocity measuring unit	Value
Steps/s	0
Steps/100 ms	1
Steps/10 ms	2
Revolutions per minute	3
N2/N24 standardized	4

N2/N24 normalization

The reference value from parameter 60000 is used. The velocity value output in the NIST_A and NIST_B signals is a percentage of the specified velocity setpoint.

The center of the value range for NIST_A is 0x4000 = 16,384 and corresponds to 100 %. Therefore, NIST_A can display values of -200 % ... +200 %.

Example 1

P60000 = 3000 rpm

Current speed = 2000 rpm, which is 66.6 % of 3000 rpm

NIST_A is 66.6 % of 16,384, this corresponds to 10,912

Example 2

P60000 = 3000 rpm

Current speed = - 5000 rpm, this corresponds to -150 % of 3000 rpm

NIST_A is -150 % of 16,384, this corresponds to -24,576

6.3.7.13 Velocity Filter

The velocity value can be set using three different filter types that draw on the exponential moving average.

Parameters	Description	Data type
Velocity filter	Parameter selection: fine, normal, coarse The default setting is "Fine."	Integer 32

Relationship between the old and the current velocity value	
Fine:	7:3
Normal:	96:4
Coarse:	996:4

6.3.7.14 Acceleration unit of measurement

The unit of acceleration is "°/s^2." The acceleration value is calculated from the velocity value in each cycle. The accuracy of the acceleration value is not affected by the cycle time.

6.3.7.15 Rotary axis functionality

Normally, dividing the "Total resolution" (as a decimal number) by "Measuring steps per revolution" must result in an integer. The total resolution must fit into an integer multiple of 4096 for a rotary encoder with 12 bits per revolution. This means that 100 or 325 revolutions, for example, could result in faults.

Therefore, the following equation must be observed:

(4096 x measuring steps per revolution)/total resolution = integer value

However, this PROFINET rotary encoder manages this task automatically using an internal software routine, meaning that any deviation from this equation does not result in faults. The rotary encoder checks whether the parameters require rotary axis functionality and activates this function independently.

Following the introduction of the encoder profile 4.2, scaling factors that are not integers, i.e., fractions, can be used. To do this, the scaling parameters must be entered as a fraction with a numerator and a denominator. This property makes it possible to parameterize resolutions of 400 measuring steps over a total of 3 revolutions, for example. See the description in the section entitled "Scaling function with fractional calculation" for more information.

Caution!

Operate the rotary encoder with a voltage supply connected!

The internal software routine is active only when the rotary encoder is connected to the voltage supply. Turning the rotary encoder shaft of a rotary encoder with 4096 revolutions more than 1024 times without a voltage supply can result in faults. The same applies to rotary encoders with 16384 revolutions if the rotary encoder shaft is rotated more than 4096 times without a voltage supply. This is because the software does not work without a power supply connected. Additional values are stored in the nonvolatile memory with rotary axis functionality. If it is absolutely necessary to rotate the rotary encoder shaft without a power supply, e.g., for service purposes, the equation mentioned above must be observed.

6.3.7.16 Rotary Encoder Profile Version

The "Rotary encoder profile version" parameter is the version of the rotary encoder profile document used in the rotary encoder. This parameter is not affected by the compatibility mode settings.

Bits	Description
0 ... 7	Profile version, least significant bit (LSB), value range 0 ... 99, decimal code
8 ... 15	Profile version, most significant bit (MSB), value range 0 ... 99, decimal code
16 ... 31	Reserved

6.3.7.17 Warnings, Error Messages

Warnings

The parameter 65001 shows the current status of all warnings.

Note

BMP stands for the PROFIdrive "Base Mode Parameter Access" channel, which is defined in the PROFIdrive profile: Standard for online parameter access (Access point data record 0xB02E).

The following table lists all supported alerts:

Bit	Meaning	= 0	= 1	Remedy
7	Invalid parameter setting in RAM	Valid	Invalid	Writing rotary encoder configuration parameters using the BMP access mechanism has resulted in an invalid parameter being set.
8	Communication	Communication OK	Communication warning	Check the quality of the communication system and for possible faults in the communication infrastructure.
10	Synchronization error (IRT only)	Synchronization OK	Synchronization warning	Check the quality of the communication system and for possible interference that can result in packet loss or excessive frame jittering.
11	Master sign-of-life faults (MSL)	MSL OK	MSL warning	Check the quality of the communication system and for possible interference that can result in packet loss or excessive frame jittering.
12	Overspeed	No overspeed	Overspeed warning	A speed limit that is critical for the rotary encoder has been exceeded. Operating the rotary encoder beyond this speed limit can cause position errors or damage the mechanical system of the rotary encoder
13	Preset error (rotational speed too high)	Preset OK	Preset error	The controller must repeat the preset function with the axis in a stationary position.
14	Preset error (preset value out of permissible range)	Preset OK	Preset error	Use a preset value that is lower than the total (scaled) resolution.
15	Command is not supported	Command OK	Command unknown	Use a permissible command
19	Excess temperature	Temperature OK	Excess temperature warning	Correct the reason for the increased temperature. If the temperature falls below the "Temperature Warning" value (default = 80 °C), this bit is reset automatically.

Note

Warnings are always displayed for at least 5 s, see the following schematic diagram:

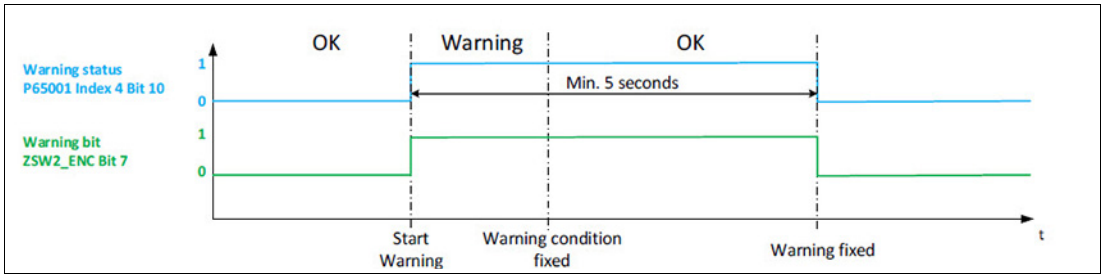


Figure 6.3

Error Messages

Bit	Meaning	= 0	= 1	Remedy
0	Position error	Position OK	Position error	Eliminate the cause of fault (e.g., restore the correct voltage supply, if necessary, replace the rotary encoder, etc.).
5	Commissioning diagnostics	Parameterization OK	Commissioning error	Create a valid parameter set for the rotary encoder and restart the rotary encoder.
6	Invalid scaling	Scaling parameter OK	Scaling parameters are incorrect	Create a valid parameter set for the rotary encoder and restart the rotary encoder.
8	Communication	No IOAR cancellation	IOAR cancellation	If communication is lost, the controller can restart the IOAR. If this is successful, the controller can continue the application if necessary. Check the quality of the communication system and check for possible interference that can result in excessive packet loss or interruptions to the connection.
10	Synchronization (IRT only)	Synchronization OK	Synchronization error	If synchronization is lost, the rotary encoder starts an automatic resynchronization. If this is successful, the controller can continue the application if necessary. Check the quality of the communication system and for possible interference that can result in packet loss or excessive frame jittering.
11	Master sign-of-life faults (MSL)	No MSL error	MSL error	If synchronization is lost, the controller can start an automatic resynchronization. If this is successful, the controller can continue the application if possible.
19	Excess temperature	Temperature OK	Excess temperature error	Check the ambient conditions of the rotary encoder.
22	Memory error	No memory error	Memory error	Replace the rotary encoder with a new one.

Note

Errors are always displayed for at least 5 s. An error confirmation can only be made after this time window has expired. See the following schematic diagram.

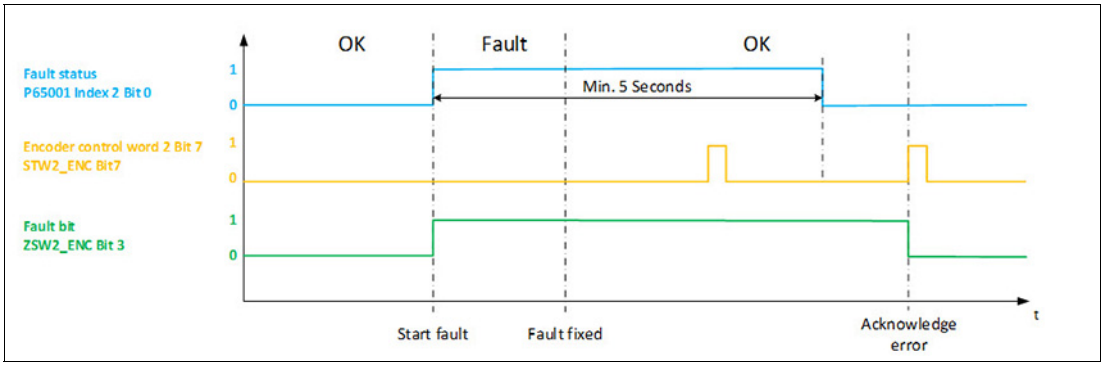


Figure 6.4

6.3.7.18 PROFIdrive error buffer

The PROFIdrive error buffer provides logbook functionality for rotary encoder diagnostics. The error buffer can store a sequence of 16 errors in 2 error situations. Please refer to the PROFIdrive and encoder profile for further details.

Error class	Meaning	Error code (error)	Error code (warning)
0	Position error	0x100	–
5	Commissioning diagnosis	0x105	–
6	Commissioning invalid scaling	0x106	–
10	Synchronization (IRT only)	0x10A	–
11	Master's sign of life (IRT only)	0x10B	–
13	Preset error (rotational speed too high)	–	0x20D
14	Preset error (value out of permissible range)	–	0x20E
15	Command is not supported	–	0x20F
19	Excess temperature	0x113	0x213

6.3.7.19 Media Redundancy Protocol (MRP) for Real-Time Applications (RT)

To increase availability, industrial communications networks are designed with redundant physical link paths between the network nodes. Special media redundancy protocols ensure a loop-free network topology and the detection of communication interruptions.

A redundant network structure significantly increases plant and machine availability, because the failure of individual devices does not affect communication. Necessary maintenance and repair work can be carried out without time pressure, since plant down time is no longer necessary. In the event of a network fault, quick network diagnostics are possible, and troubleshooting is accelerated.

The Media Redundancy Protocol (MRP) is based on a ring topology and guarantees recovery times between 200 ms and 500 ms depending on the configuration. MRP uses an MRP redundancy manager that closes the ring. The rotary encoder is integrated as an MRP client in the ring topology and is monitored by the MRP manager.

Construction Guidelines and Notes

The following conditions are required for smooth operation with the media redundancy method MRP:

- All ring participants must support MRP and have the MRP protocol activated.
- Connections in the ring must be connected via the configured ring ports (typically ports 1 and 2).
- The maximum number of ring participants is 50. Otherwise, reconfiguration times > 200 ms may occur.
- All devices connected within the ring topology are media redundancy clients and must be members of the same redundancy domain. A device cannot belong to multiple redundancy domains.
- All devices in the ring must be set to "MRP Client," "MRP Manager (Auto)/Client," or "Automatic Redundancy Detection." At least one device in the ring must have the setting "MRP Manager (Auto)/Client" or "Automatic Redundancy Detection" and is therefore the media redundancy manager.
- All partner ports within the ring must have the same settings.
- Real time communication (RT) is interrupted (station failure) if the reconfiguration time of the ring is greater than the selected watchdog time of the IO devices. If necessary, select a watchdog time of the IO devices that is large enough.

Case of a fault

In the case of a fault, the redundancy manager automatically reestablishes the PROFINET connection via a second communication path. The afflicted plant therefore continues to run while the fault is dealt with.

Please note that another PROFINET device failure may occur once the fault has been repaired, which may require another switchover.

This information is only an excerpt; for more information, see SIEMENS ID: 109739614.

6.3.7.20 Media Redundancy for Planned Duplication (MRDP) for IRT Applications

Redundant systems require a changeover time to detect an interruption and switch to the redundant structures. However, these changeover times do not always meet all the requirements of the system's application. Short-term faults are not justifiable in highly dynamic applications or in process engineering, for example.

The Media Redundancy for Planned Duplication (MRPD) is a method for smoothly switching the IRT telegrams (high performance, IRT = isochronous real-time).

The following requirements must be taken into account:

- High availability of communication between the participants in the ring.
- Short update times of the PROFINET devices.
- The concept must be applicable in an IRT network.
- During line interruptions or when replacing the device, the rest of the system must not lose any data.

The requirements are met based on the ring topology of the MRP (Media Redundancy Protocol) extension "Media Redundancy with Planned Duplication of Frames" (MRPD) extension. If a device or a line in the loop fails, all other devices continue to be supplied with IO data without interruption. MRPD is based on IRT and MRP. To avoid interruptions in the case of a fault as much as possible, the PROFINET devices involved in the ring send their data in both directions. Since the devices receive this data on both ring ports, the reconfiguration time of the ring is omitted.

The following prerequisites must be met for media redundancy with MRPD:

- All devices involved must support MRPD, including the terminals on the switch, which exchange IRT data cyclically with a ring component.
- MRP is configured and activated for all nodes in the ring. For all devices that are not in the ring, the MRP role is "Not device in the ring" .
- IRT is configured for all components involved.
- All devices must be connected via the ring ports (typically port 1 and 2).
- The maximum number of ring participants is 50.
- All devices in the ring belong to the same redundancy domain.
- At least one device in the ring is a media redundancy manager. All other devices in the ring are media redundancy clients.
- Real-time communication (RT communication) is interrupted (station failure), if the reconfiguration time of the ring is greater than the selected watchdog time of the IO devices. If necessary, select a watchdog time of the IO devices that is large enough.
- IRT (High Performance) must be activated in all devices involved.
- All devices involved must support MRPD, including the devices in the stub that cyclically exchange IRT data with a ring component.

Uninterrupted operation

Sending the cyclic IRT data over both communication channels in the ring enables uninterrupted operation. That is to say there is no error in the network if the receiver receives the same IRT telegram twice. The first IRT telegram received is used, the second is discarded. This information is only an excerpt; for more information, see SIEMENS ID: 109744035.

6.3.7.21 Parameter Initialization

Note

Select parameterization to change the parameters of the configuration program (e.g., TIA). However, if you want to set the parameters stored in the device and therefore ignore the values of the configuration tool, select Device memory. This applies to all parameters that can be written via the Base Mode Parameter Access (and not exclusively via the configuration tool), except for the parameter "Parameter Control" itself.

The following list details the adjustable parameters for parameter control:

Bit	PNU 65005	
	Parameter	Meaning
0	Initialization control	Parameter Initialization 0 = Parameterization (configuration) 1 = Device memory
1		Reserved
2	Write protect	Activate write protection for parameters, except for PNU 65005, 971, 972 0 = inactive 1 = active
3, 4		Reserved
5	65005 write protect	Write protection for PNU 65005 and 971
6	Reset control write protect	PN972 access: Write protection for the Reset parameter 0 = inactive 1 = active
7 ... 15		Reserved

7 Rotary Encoder Configuration in the TIA Portal

7.1 Introduction

The following pages describe the configuration of a Pepperl+Fuchs absolute rotary encoder with PROFINET interface using the configuration tool "Totally Integrated Automation Portal," TIA Portal (version 15) from SIEMENS. Depending on the software version, there may be deviations from the description and screenshots.

The following hardware components are used:

- Absolute rotary encoder ENA58IL-...B17... (PROFINET)
- SIMATIC S7-1500 CPU 1511C-1 PN

Note

Before starting configuration with the project planning tool, the relevant GSDML file must be downloaded from Pepperl+Fuchs and imported into the project planning tool.

Steps for Integrating the Rotary Encoder

To ensure correct installation, configuration, and parameterization of the rotary encoder, you must carry out the steps described on the following pages in the specified order:

- Install the GSDML file
- Select a Rotary Encoder
- Assign a device name and IP address
- Set the rotary encoder parameters

Note

If you want to use more than one rotary encoder in this PROFINET network, you must assign each rotary encoder with its own name and carry out the steps listed for each rotary encoder individually.

Resetting the Rotary Encoder to Factory Settings

If, for any reason, you wish to reset the rotary encoder settings back to the factory settings, you can find a description of how to do this at the end of the configuration chapter.

7.2 Installing the GSDML File

Downloading the GSDML file

You can find the relevant GSDML file in the **Software** section of the product detail page for the device.

To access the product detail page for the device, go to http://www.pepperl-fuchs.com and use the search function to search by the product description or the item number.

1. Download the appropriate GSDML file for your absolute rotary encoder and store it in any directory.
2. Start the TIA Portal and "Open" the project in which you want to integrate the rotary encoder.

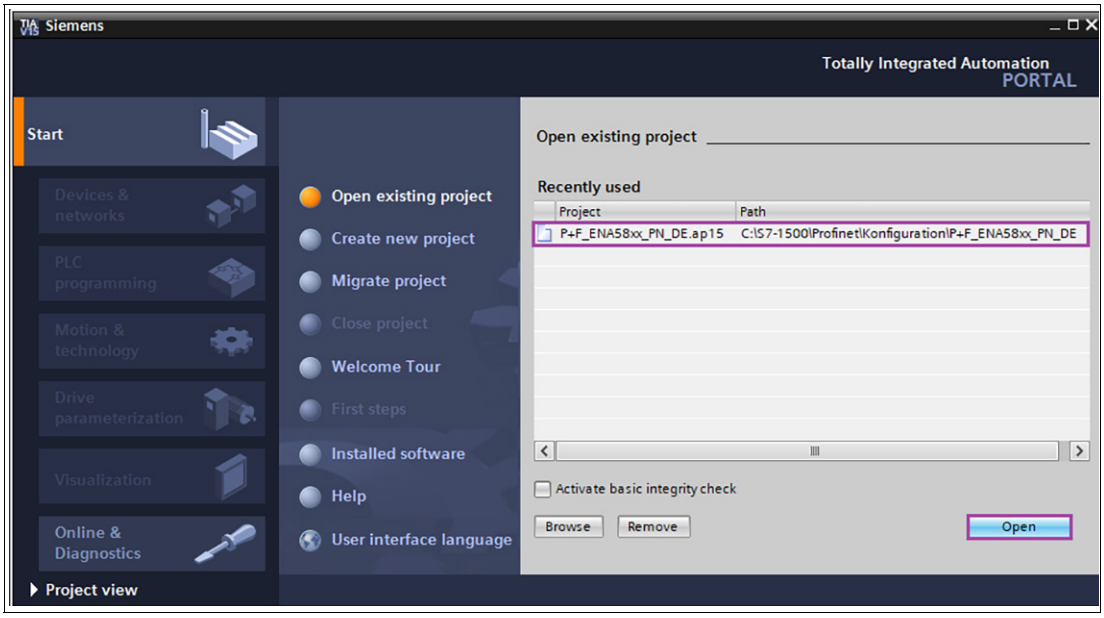


Figure 7.1

3. Choose "Open the project view."

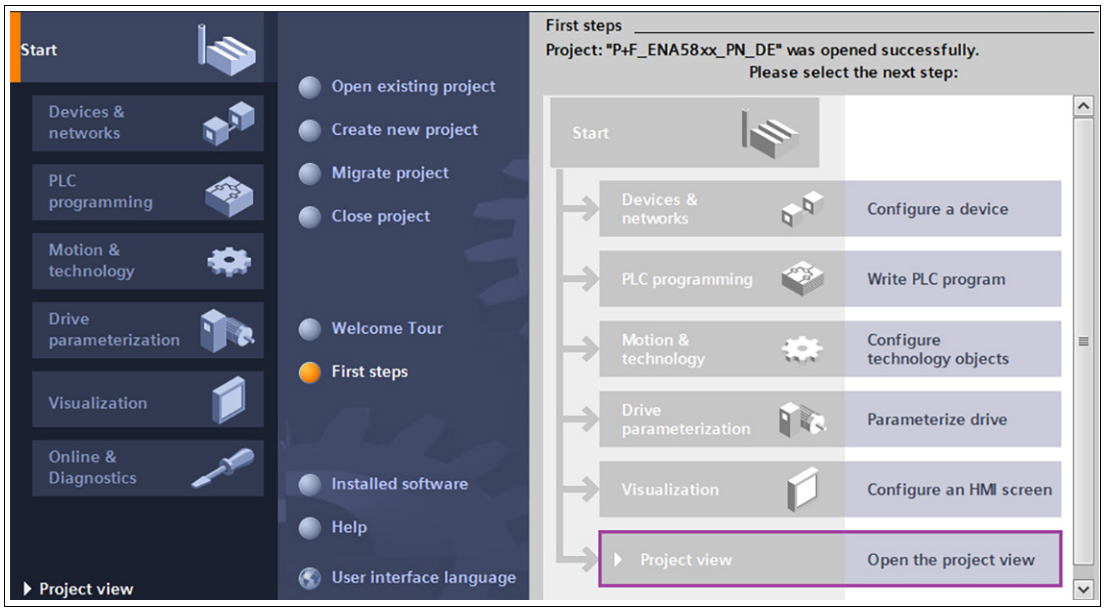


Figure 7.2

4. Under "Options," select the item "Manage generic station description files (GSD)."

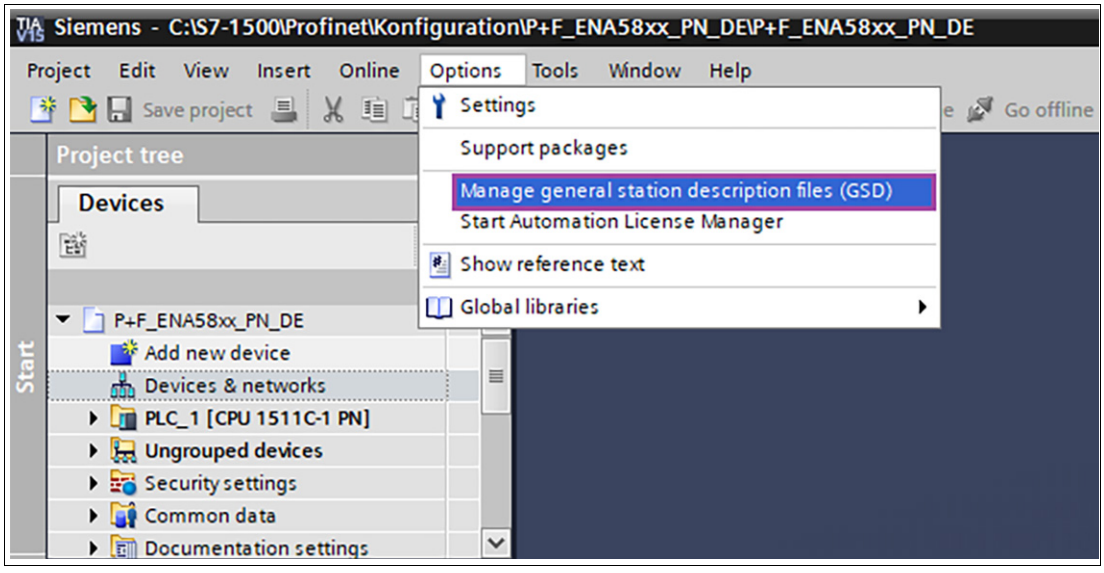


Figure 7.3

5. First, select the source path of the GSDML file. Next, select the desired GSDML file by clicking the check box, and select "Install." Close the installation window.

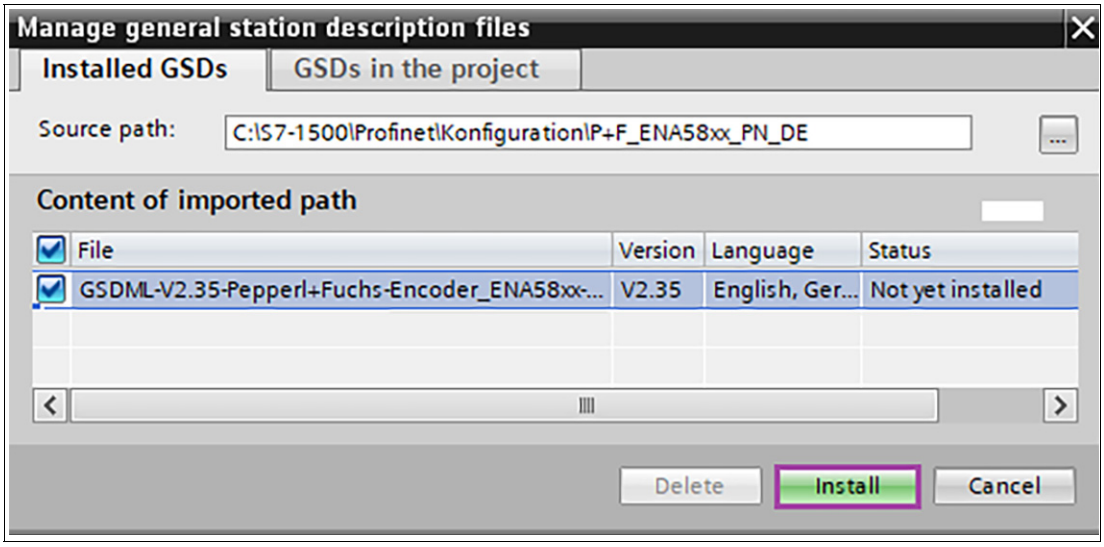


Figure 7.4

7.3 Configuring PROFINET Rotary Encoders

After you have installed the GSDML file, the next step is to configure the PROFINET rotary encoder.

1. Select "Devices & Networks" in the project tree under "Project navigation" in the left-hand column of the TIA Portal.

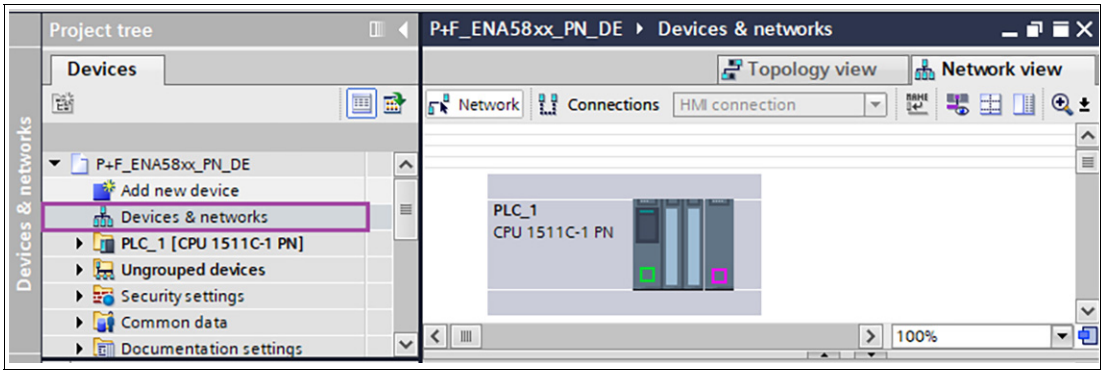


Figure 7.5

↳ The hardware view is displayed and the hardware catalog is visible in the right-hand column.

2. Insert the rotary encoder into your hardware configuration. To do this, open the path at the right edge of the screen in the hardware catalog: "Other field devices/PROFINET IO/Encoders/Pepperl+Fuchs SE/PROFINET ENA58xx/ ENA58xx."

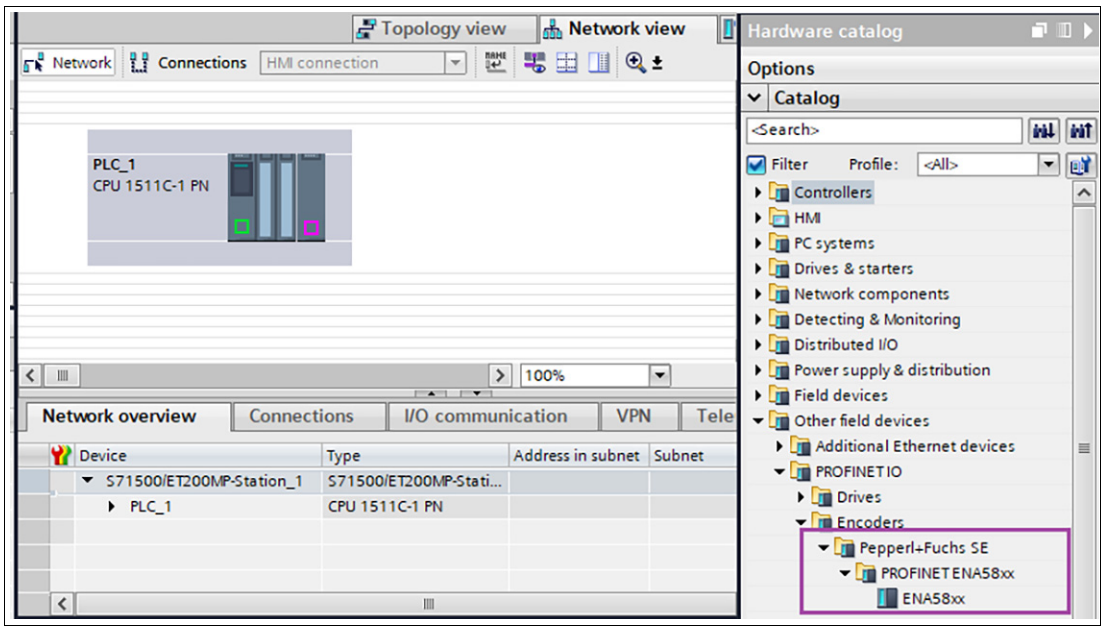


Figure 7.6

3. Drag the symbol for the rotary encoder "ENA58xx" to the network view. This adds the rotary encoder in the network view.

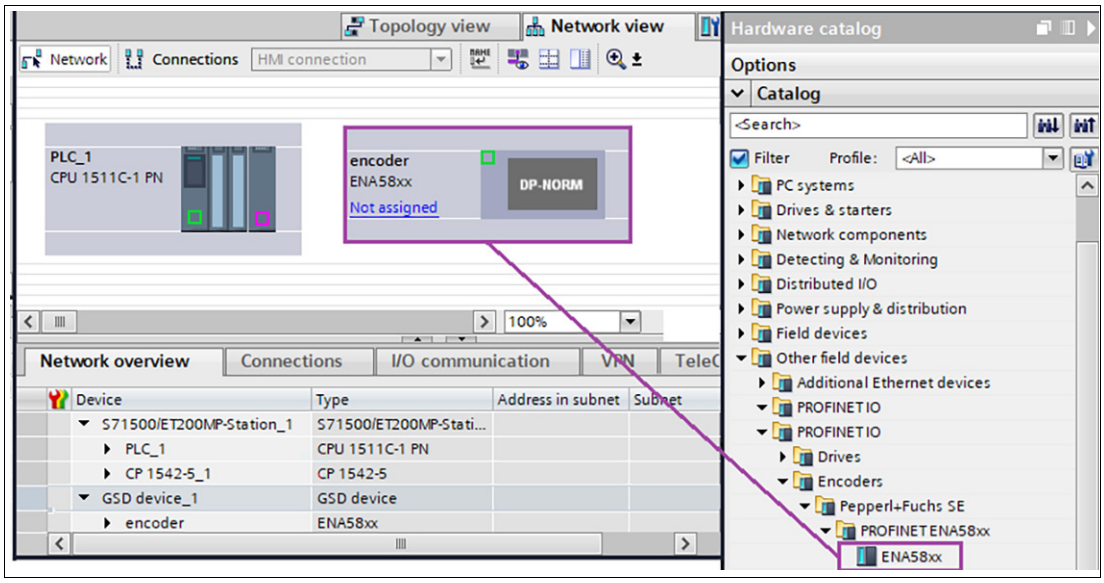


Figure 7.7

4. Next, connect the rotary encoder to the controller by dragging the encoder port to the corresponding control port.

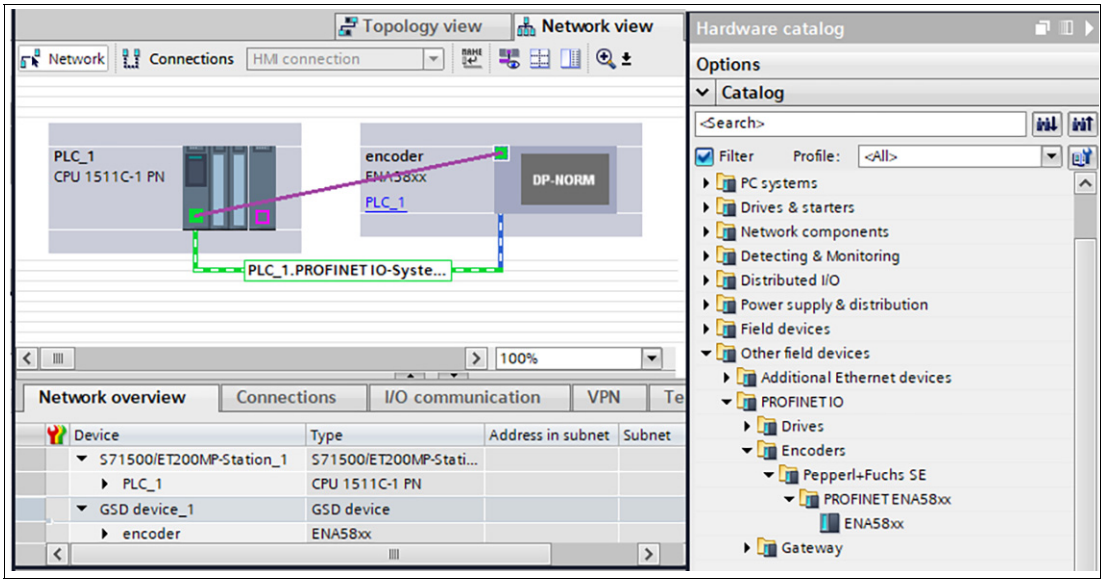


Figure 7.8

5. Select the rotary encoder and switch to the "Device view" tab.

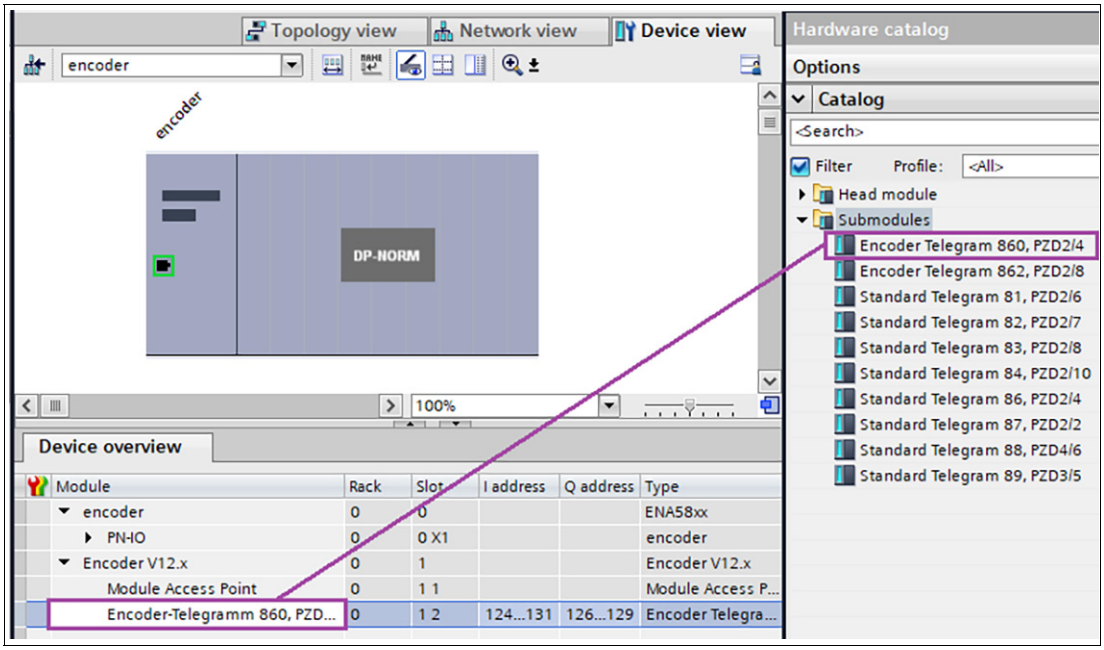


Figure 7.9

6. Next, go to the hardware catalog and open the "Submodule" folder.
7. Select the desired telegram and drag and drop it into the device overview of the rotary encoder.

8. In the device view of the rotary encoder, enter a meaningful device name by double-clicking on the default name. In this example, the name is "P+F_ENCODER."

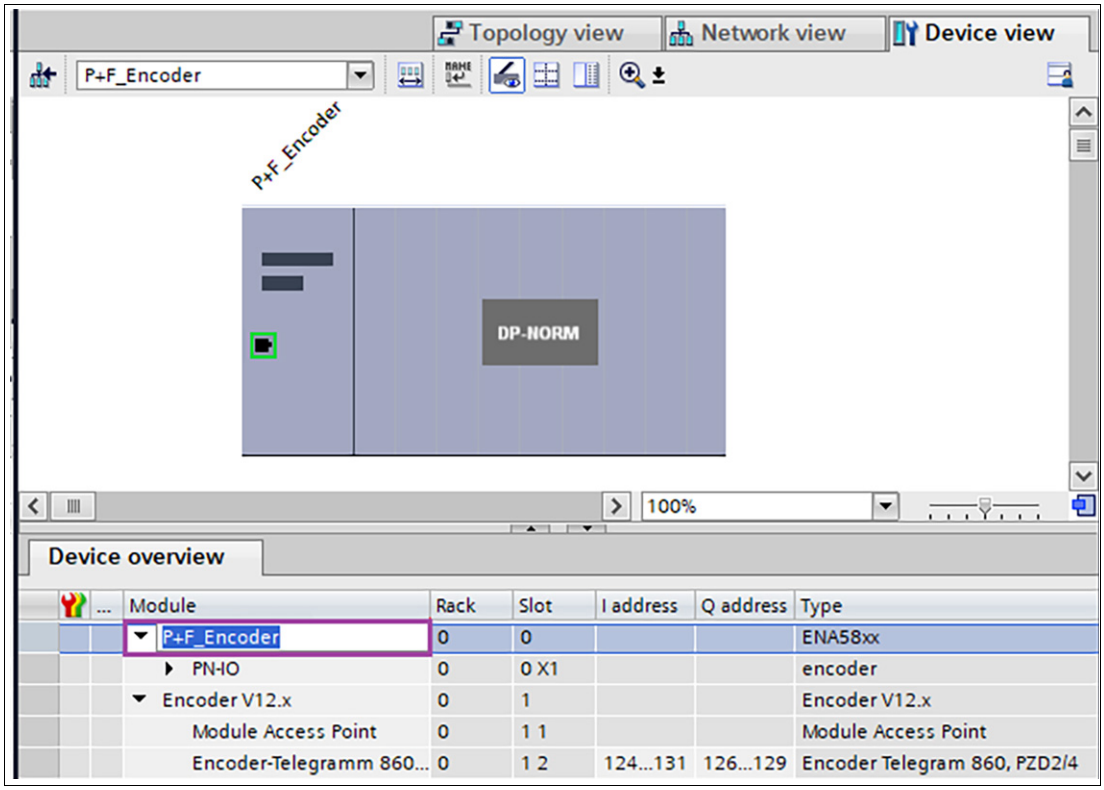


Figure 7.10

9. Optionally, you can set the associated I/O addresses in the "Device overview." To do this, double-click on the respective field and change the address.

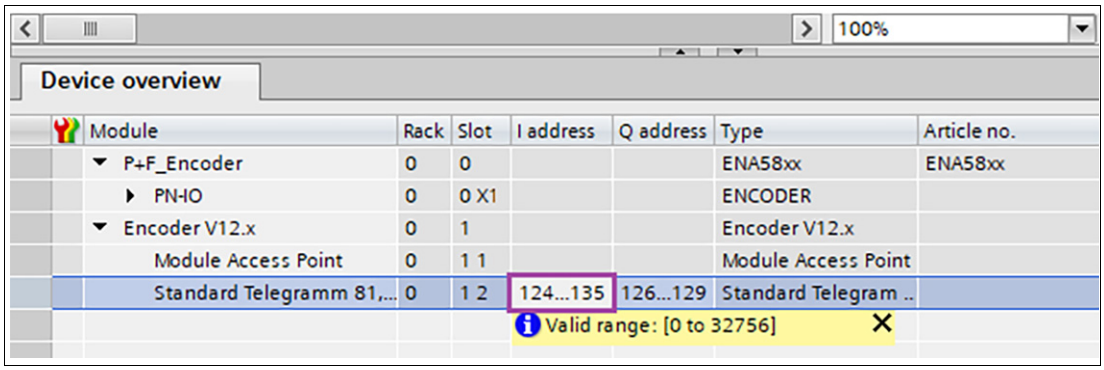


Figure 7.11

10. Open the device view of the rotary encoder and click on the "Module Access Point" field.

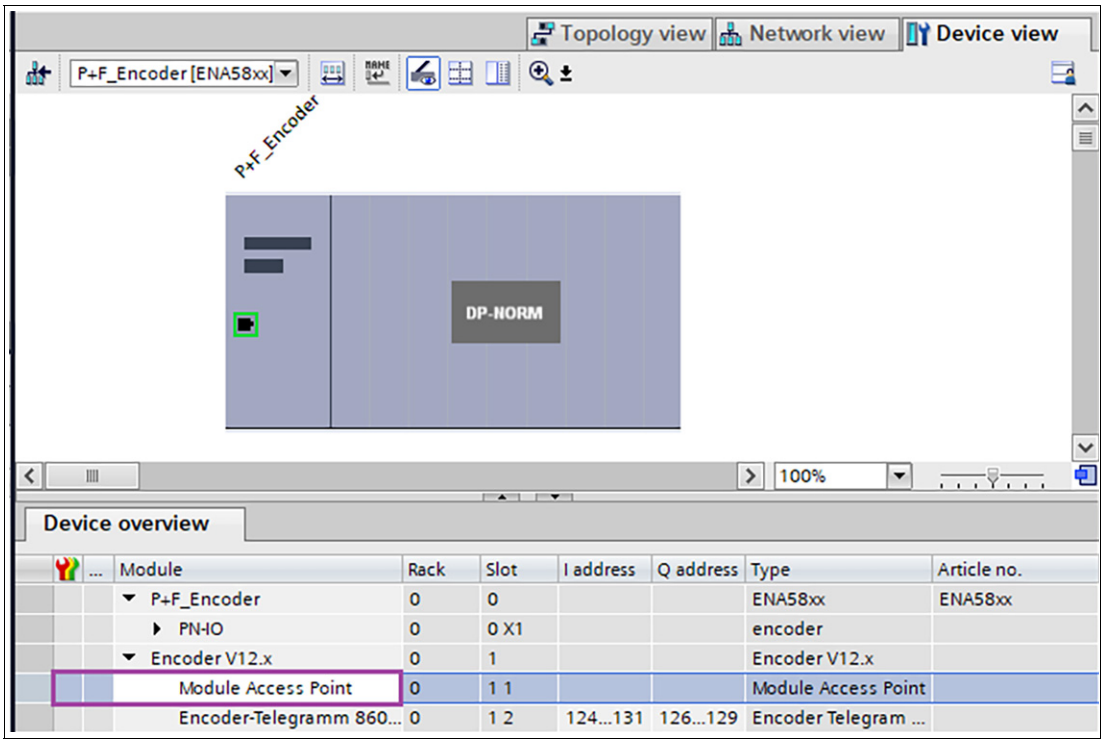


Figure 7.12

↳ The "Assembly parameters" appear in "Properties" under the "Device overview" in the "General" tab. Click on this tab and scroll to "Encoder parameters."

11. Under "Scaling: Steps per Revolution" and "Scaling: Total Resolution," enter the correct values for the rotary encoder you are using.

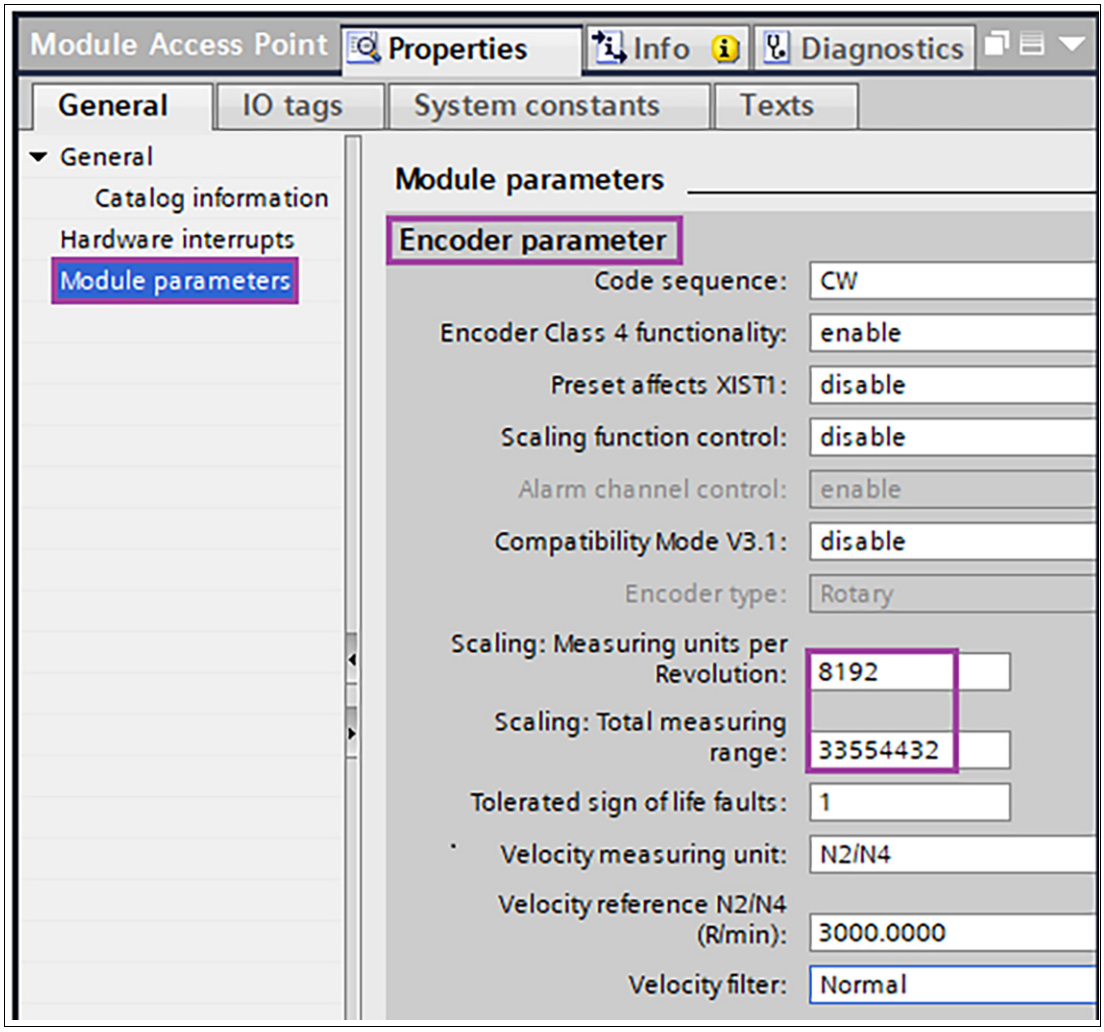


Figure 7.13

↳ In this example, the values for the resolution of a 25-bit multiturn encoder are specified: Resolution of 8192 steps per revolution and total resolution of 33,554,432 steps.

12. Switch back to the device view. Click on the rotary encoder and right-click and select "Assign device name."

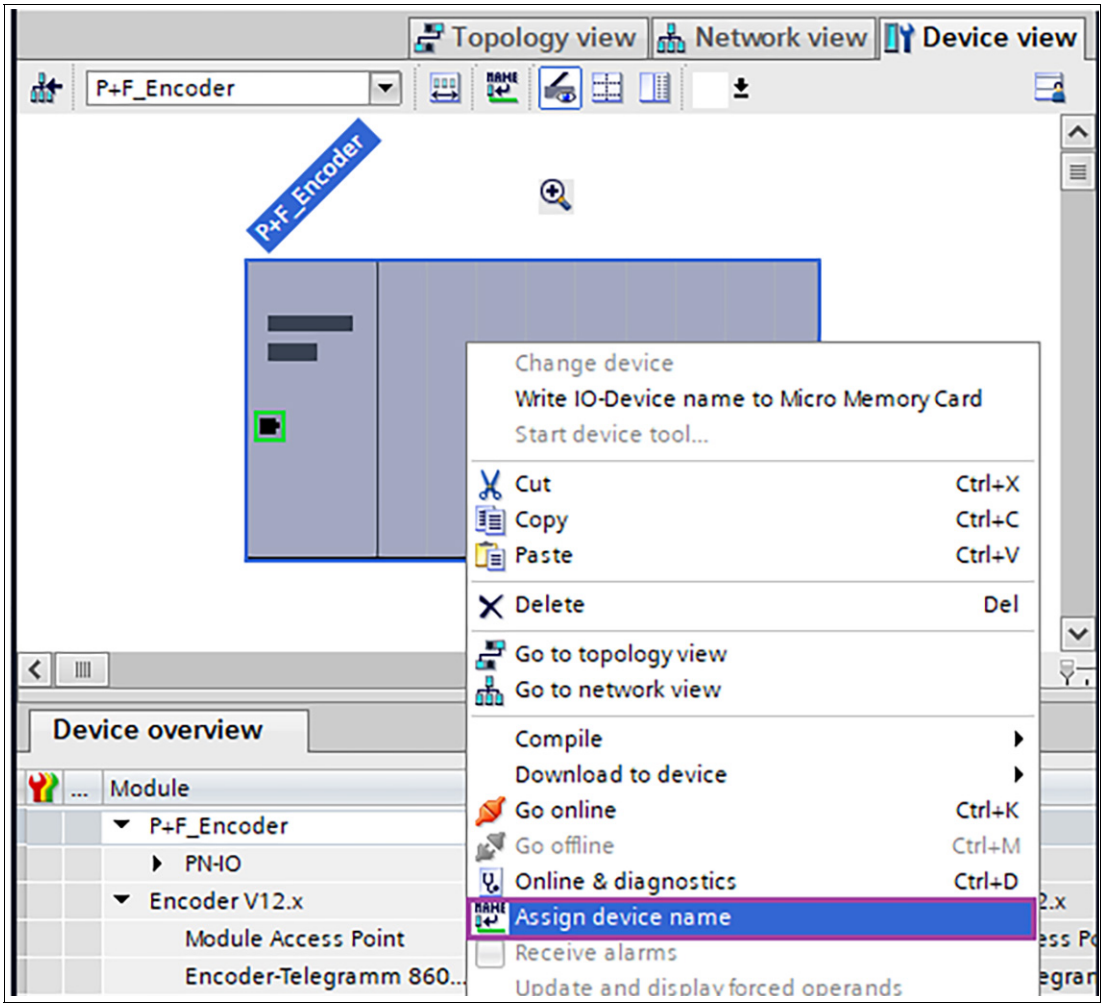


Figure 7.14

13. Then, if necessary, select your PG/PC interface and the type of PG/PC interface and click on "Update list."

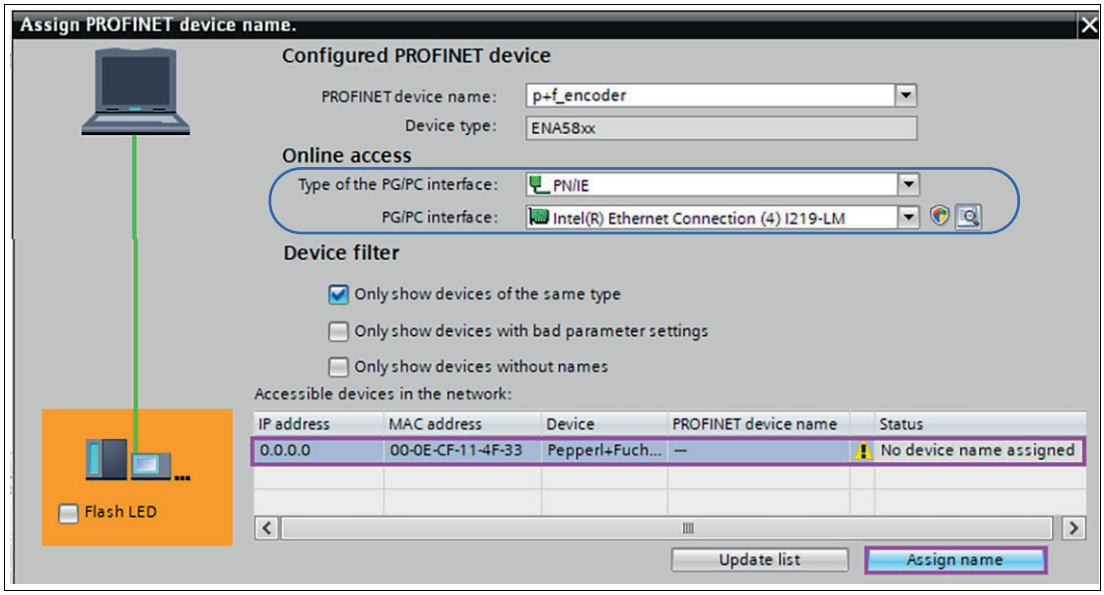


Figure 7.15

14. All nodes are displayed under "Accessible nodes in the network." Select your rotary encoder from the displayed list and click "Assign name."

15. You can now see the successfully assigned PROFINET device name in the online status information. Next, click "Close."

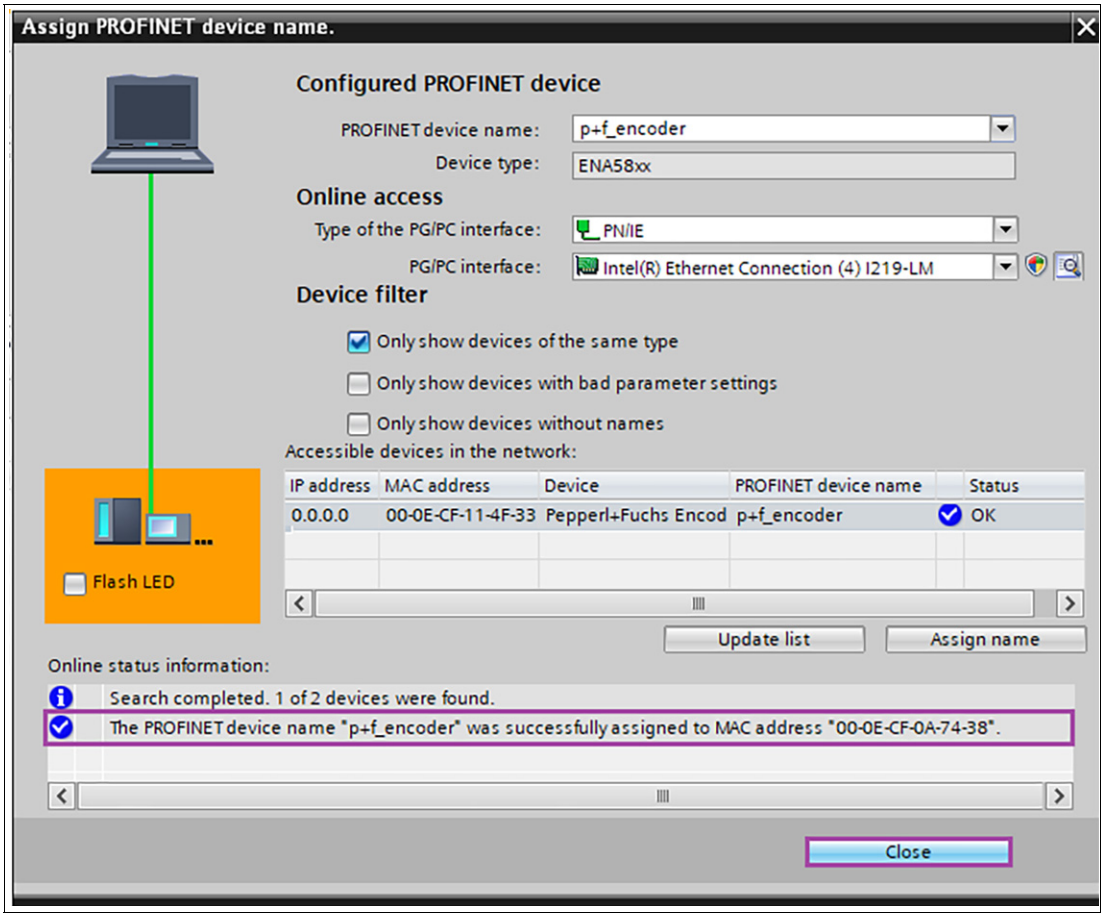


Figure 7.16

16. Click on your PLC in the project tree, compile the configuration, and download it by clicking the "Download to device" button.

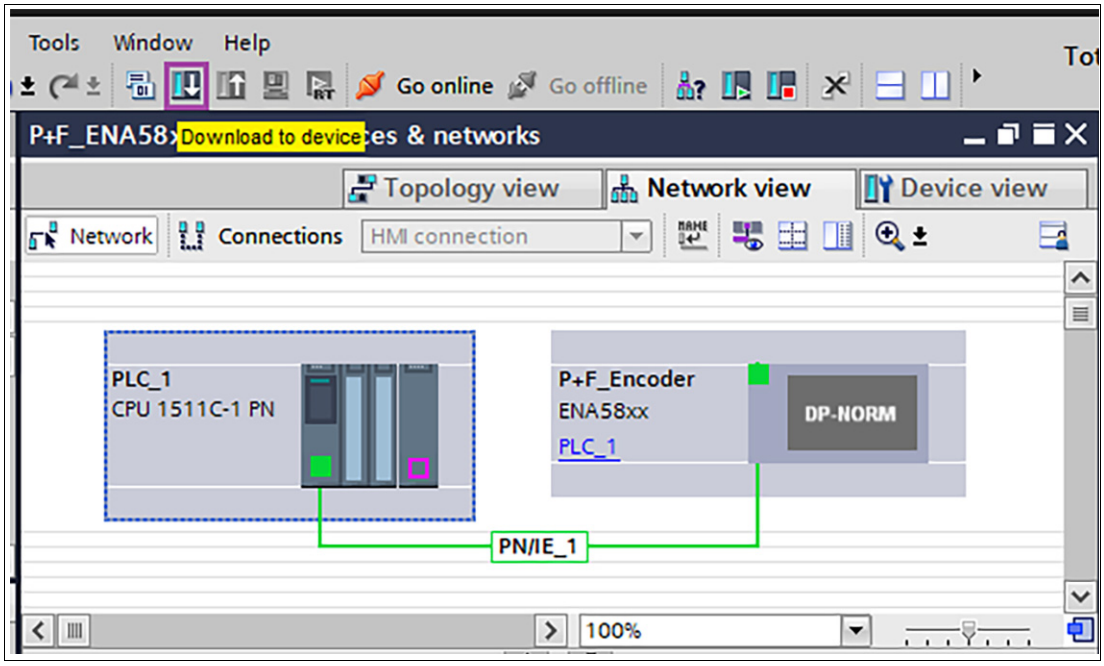


Figure 7.17

17. You can use a variable table to display the encoder I/O data for testing purposes. To do this, open the standard variable table.

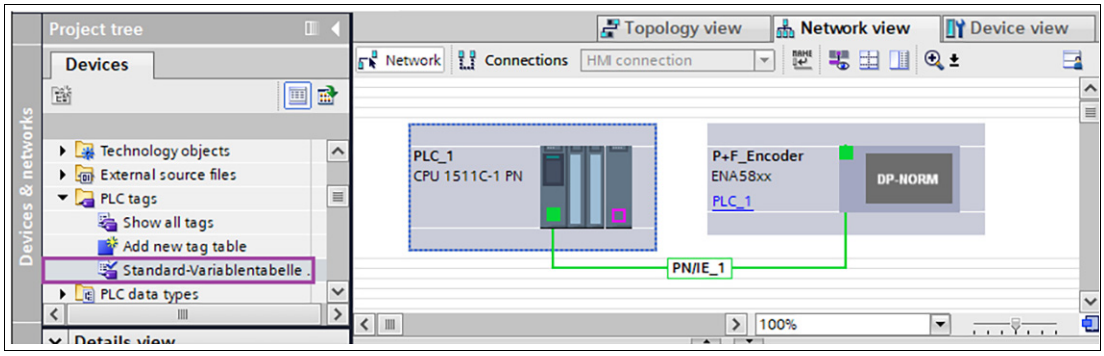


Figure 7.18

18. Specify the address of the position value from the hardware configuration. The address "%ED124" has been entered here as an example for the variable name Encoder_Position.

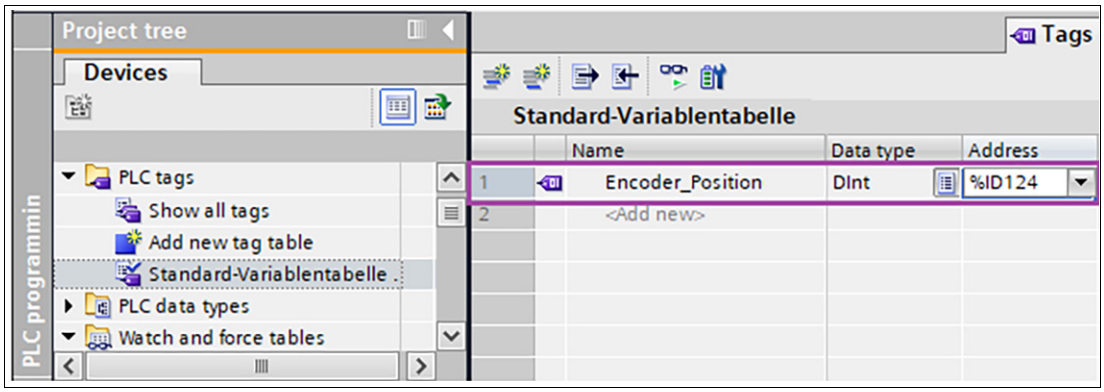


Figure 7.19

19. Then click on "Watch all" to display the position value. This is displayed in the "Monitor value" column.

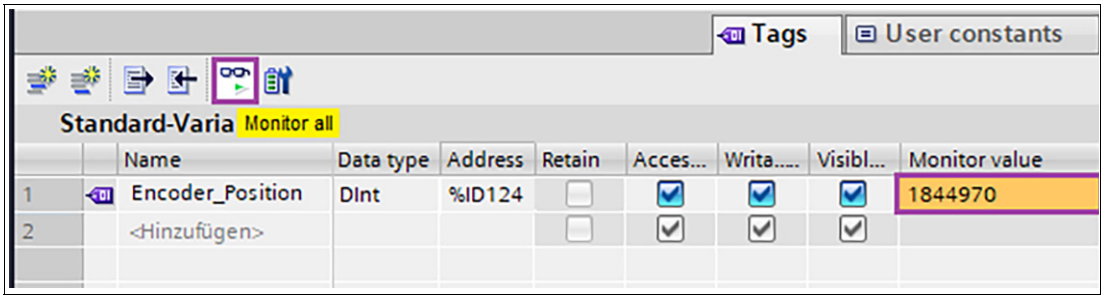


Figure 7.20

7.4 Examples of Scaling Function Multiturn Rotary Encoder

To set a number of steps/revolution or number of revolutions that deviate from the basic settings, you must activate the scaling function. The following steps explain the procedure using the example of a multiturn rotary encoder. You must first have configured the rotary encoder and your control in the TIA Portal.

Note

Depending on whether a project is newly created or modified, different "Load to Device" operations are required to enable scaling changes. Details of this are described in an example at the end of these work steps.

1. Open the "Device overview" of the rotary encoder and click on the "Module Access Point" field.

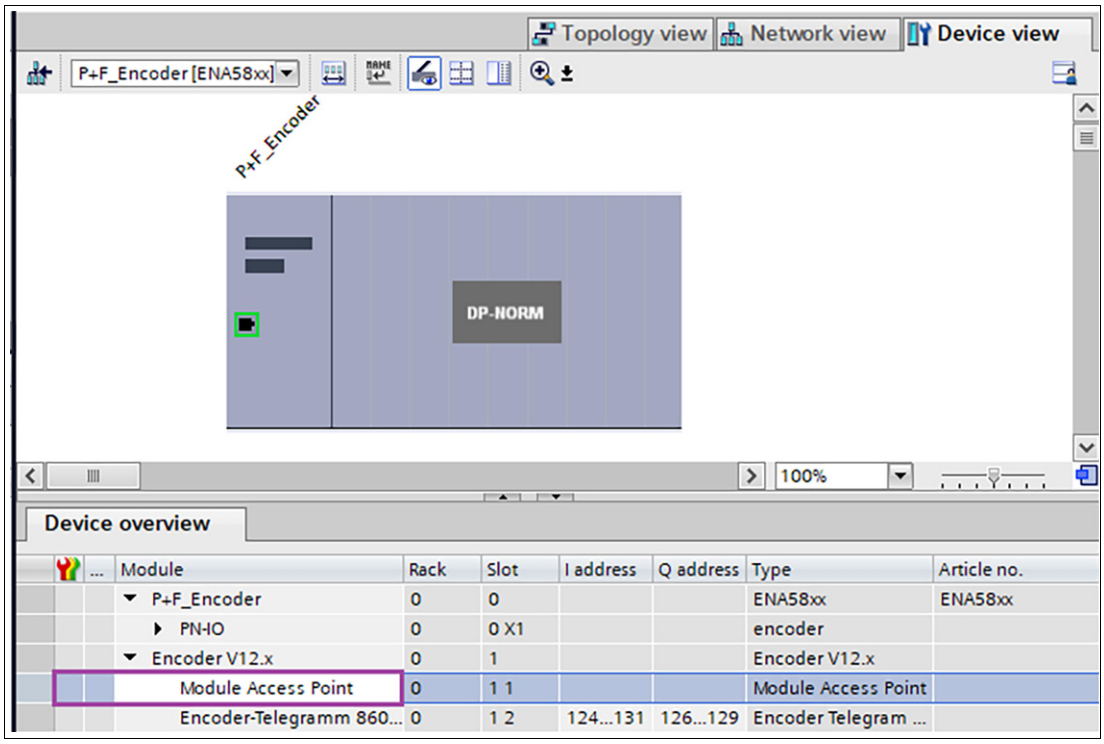


Figure 7.21

↳ The "Module parameters" appear below the "Device overview" in the "Properties" tab in the "General" subtab.

2. Click on "Module parameters" and scroll to the "Encoder parameters" in the window.

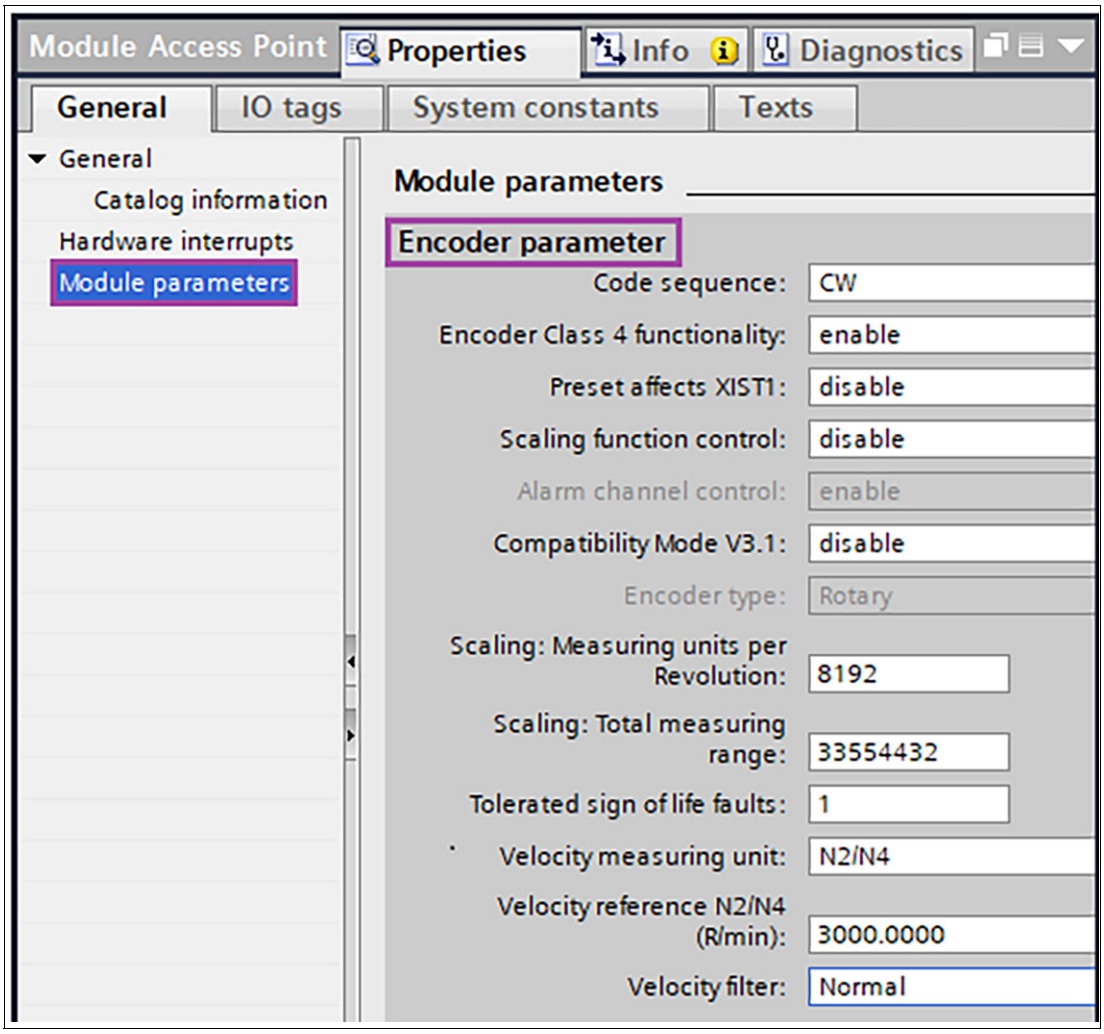


Figure 7.22

↳ In this example, the values for the resolution of a 25-bit multiturn encoder are specified: Resolution of 8192 steps per revolution and total resolution of 33,554,432 steps.

Note

The following example describes how a resolution of 3600 steps/revolution and 50 countable revolutions can be set (3600 steps x 50 revolutions = 180,000 total resolution steps).

3. First, turn on the scaling function by setting it to "enable."

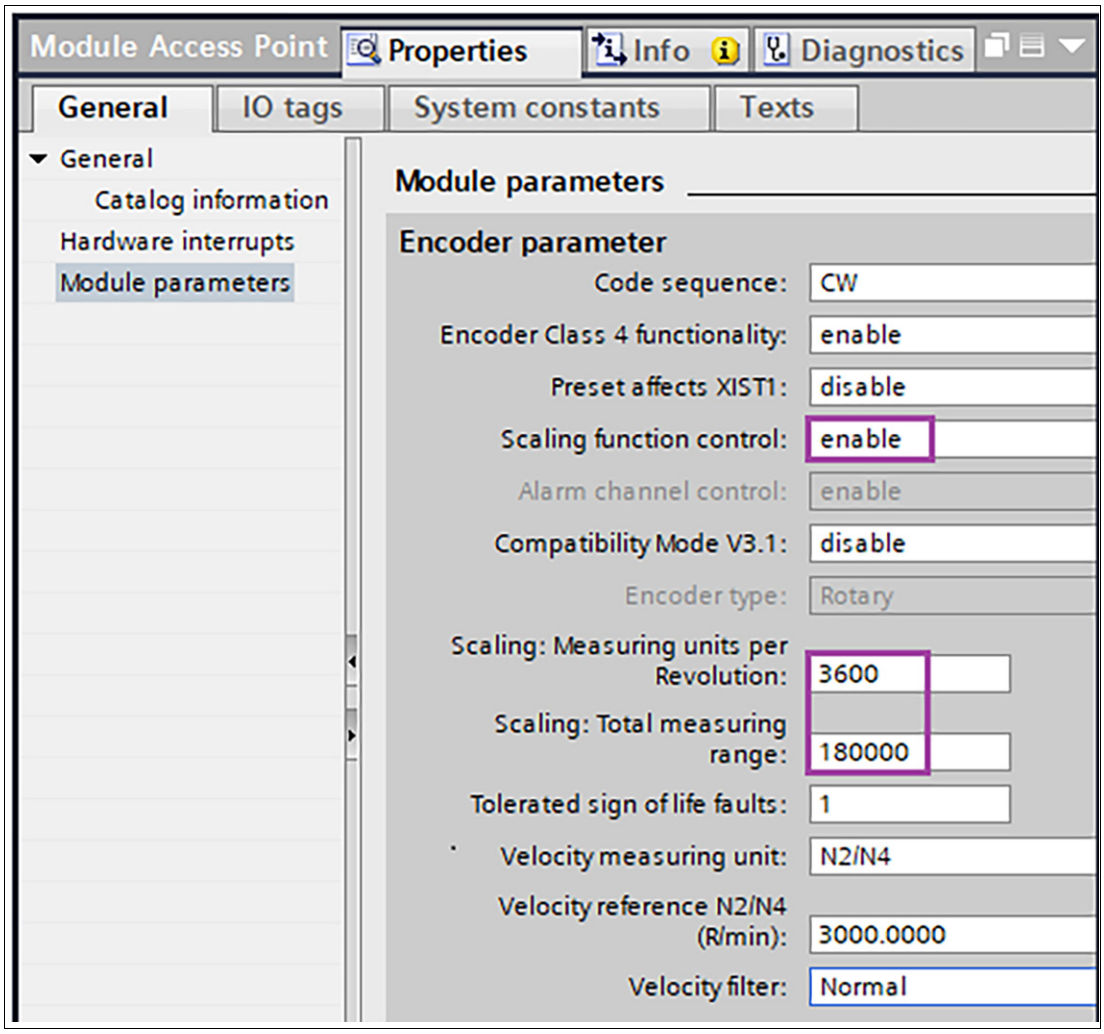


Figure 7.23

4. Then, under "Scaling: Steps per Revolution" and under "Scaling: Total Resolution," enter the correct values for the rotary encoder you are using. See figure.

5. To enable the settings, perform one of the following operations:
   - If a new project is created and the scaling function is set up, a "Load to device" is sufficient to enable this feature.
   - If an existing project is modified, the change must be transferred to the controller via "Download to device" -> "Hardware configuration" to add the scaling function.

7.5 Example: Perform a Preset with Telegram 860

When using Telegram 860, the preset is triggered by the preset trigger bit (MSB bit 31) in the output double word of the hardware configuration. For example, the preset value itself is entered in bits 0-24 for an absolute rotary encoder with 25 bits, depending on the physical resolution of the absolute rotary encoder used.

Note

Using a variable table, you can assign any desired position value to the absolute rotary encoder for test purposes using the preset function.

1. To do this, open the standard variable table, and enter the addresses from the hardware configuration listed in the following steps.

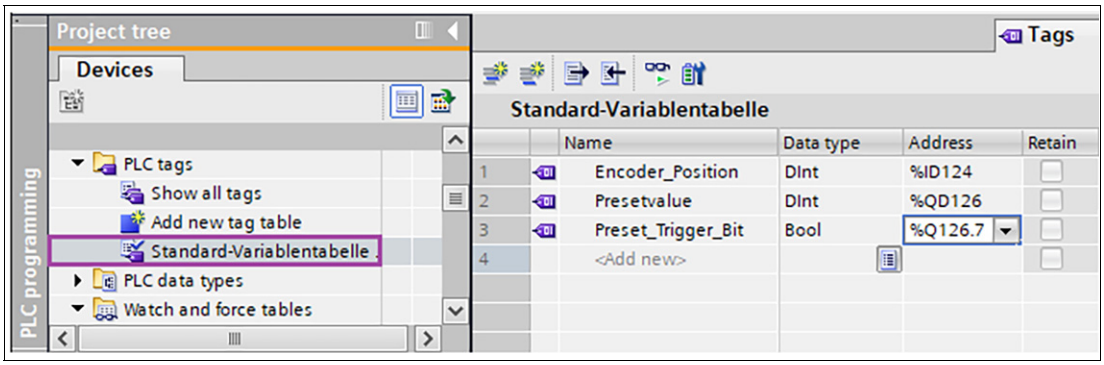


Figure 7.24

2. For "Encoder_Position," enter the input address of the position value "%ED124."
3. For "Presetvalue," enter the output address of the preset value "%AD126."
4. For "Preset_Trigger_Bit," enter the bit output address of the preset trigger bit "%AD126.7."
5. Now switch to the watch table and enter the desired preset value in the "Monitor value" column. In this example, it is 500,000.

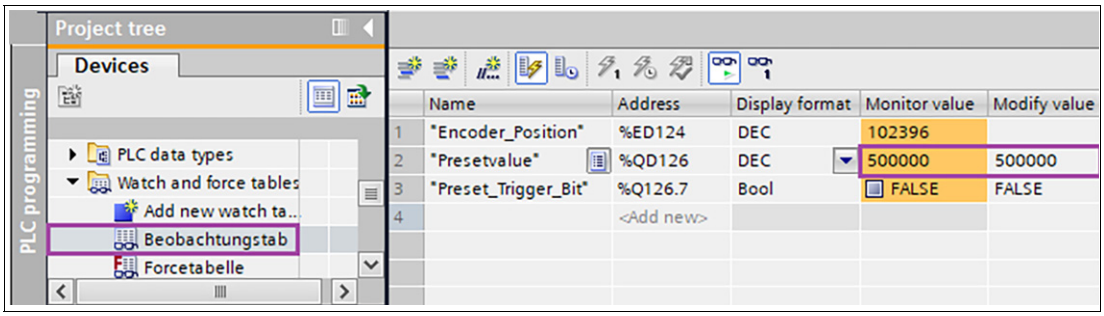
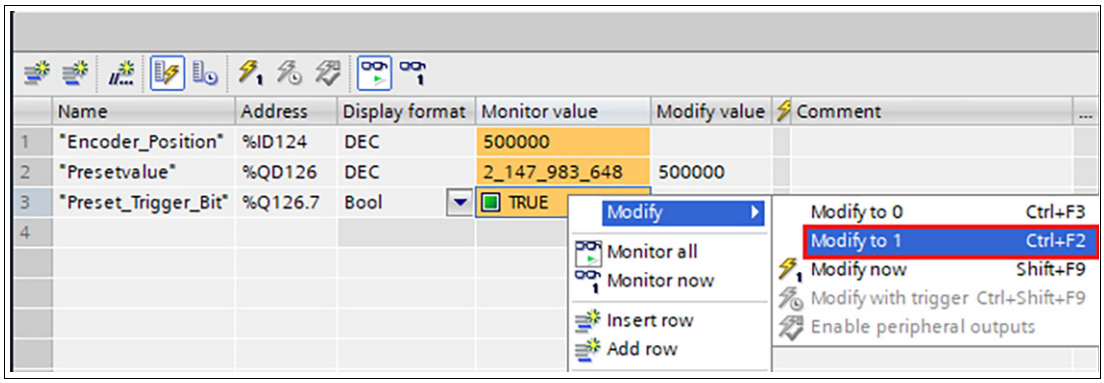


Figure 7.25

6. Set the "Preset_Trigger_Bit" as shown in the figure below to execute the Preset function.



↳ If executed correctly, the rotary encoder position is set to the previously entered preset value. See the figure below.

7. After the preset function has been completed, reset the preset trigger bit to 0 as shown in the figure below.

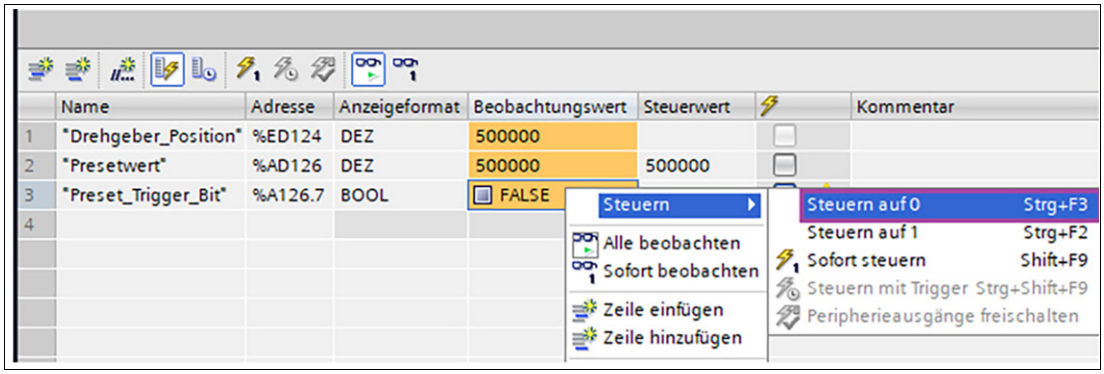


Figure 7.26

7.6 Execute a Preset with Telegram 81

1. First, in the "Module parameters" category, in the "Encoder parameters" section, set whether the preset should also affect "G1_XIST1." To do this, set the function "Preset affects XIST1" to enable.

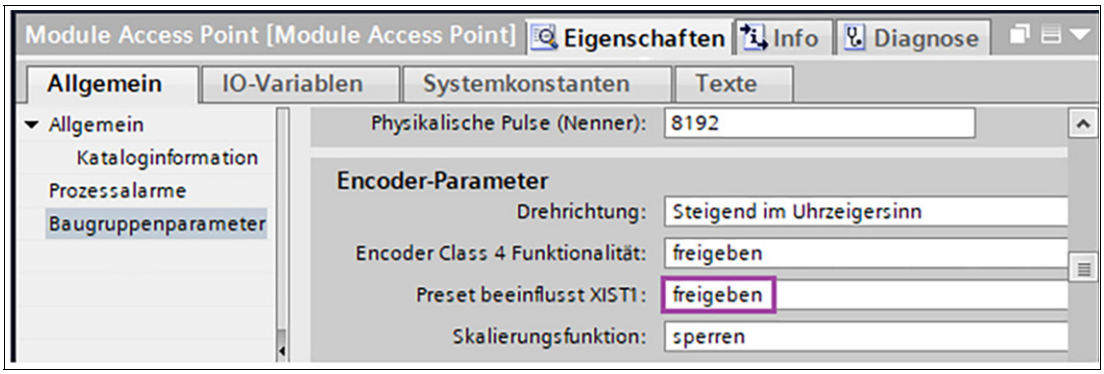


Figure 7.27

↳ Therefore, "G1_XIST1" is taken into account in the preset, otherwise the preset only acts on "G1_XIST2" and "G1_XIST3," depending on the telegram used.

Note

For the following versions, it is assumed that Telegram 81 is used. From the control point of view, the input data should be present at input addresses 124 to 135, and the output data at output addresses 126 to 129. The following illustration of the watch table is used to simplify the illustration and operating of the status and control bits.

According to the requirements, the data content of Telegram 81 is as shown in the following figure.

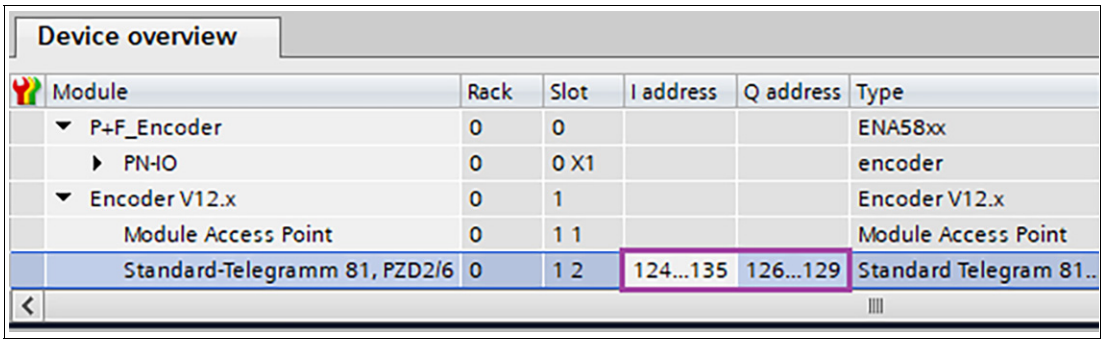
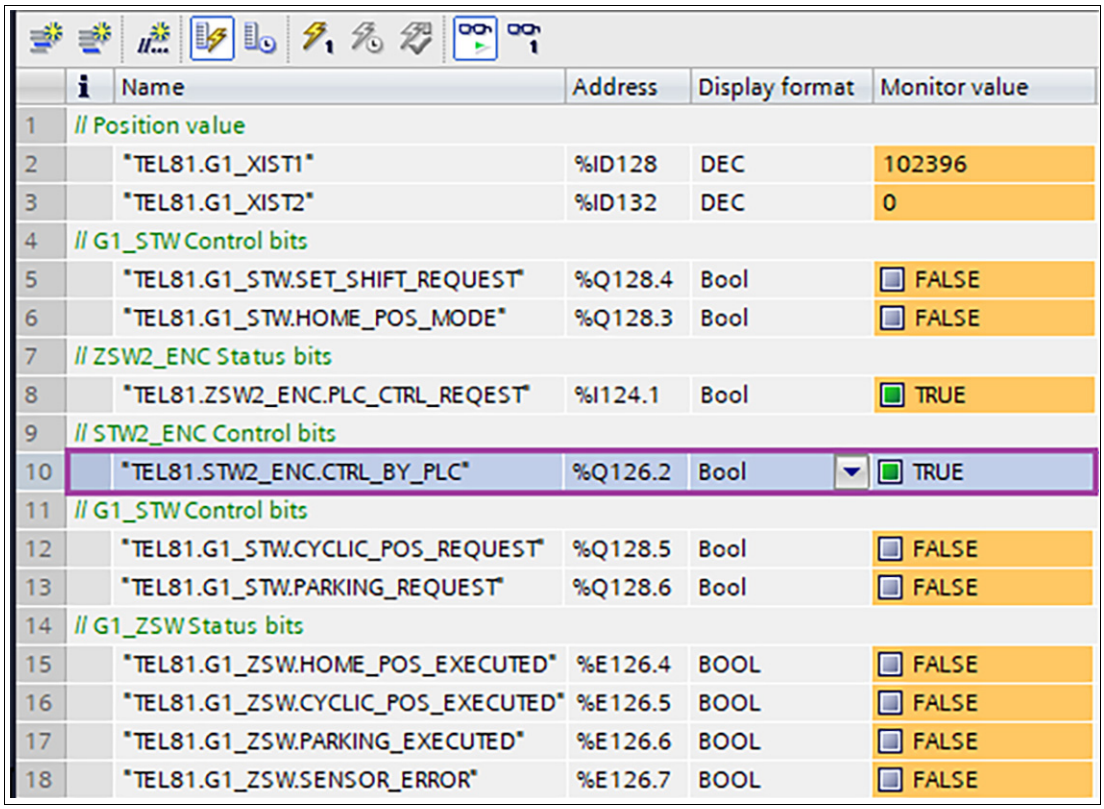


Figure 7.28

↳ After successful startup, the rotary encoder sets status bit 9 "Control requested/Control by PLC" in "ZSW2_ENC." This corresponds to bit "TEL81.ZSW2_ENC.PLC_CTRL_REQUEST" in the following watch table.

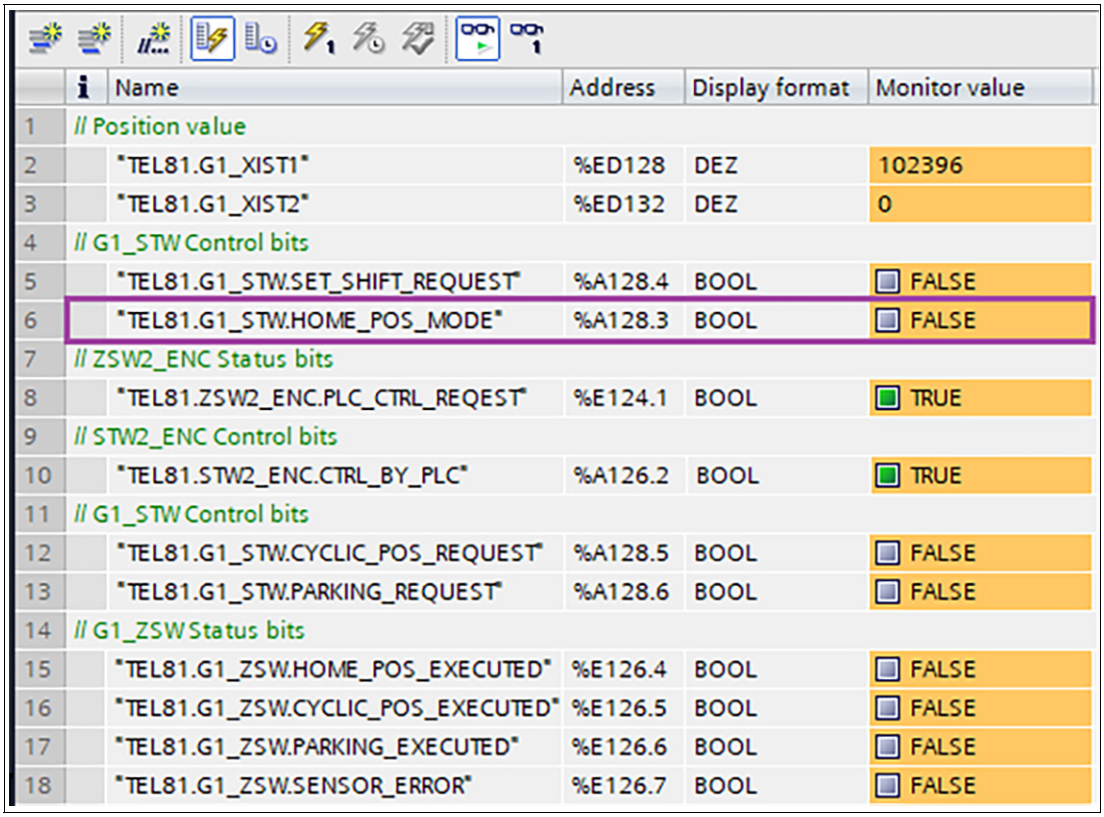


	Name	Address	Display format	Monitor value
1	// Position value			
2	"TEL81.G1_XIST1"	%ID128	DEC	102396
3	"TEL81.G1_XIST2"	%ID132	DEC	0
4	// G1_STW Control bits			
5	"TEL81.G1_STW.SET_SHIFT_REQUEST"	%Q128.4	Bool	FALSE
6	"TEL81.G1_STW.HOME_POS_MODE"	%Q128.3	Bool	FALSE
7	// ZSW2_ENC Status bits			
8	"TEL81.ZSW2_ENC.PLC_CTRL_REQEST"	%I124.1	Bool	TRUE
9	// STW2_ENC Control bits			
10	"TEL81.STW2_ENC.CTRL_BY_PLC"	%Q126.2	Bool	TRUE
11	// G1_STW Control bits			
12	"TEL81.G1_STW.CYCLIC_POS_REQUEST"	%Q128.5	Bool	FALSE
13	"TEL81.G1_STW.PARKING_REQUEST"	%Q128.6	Bool	FALSE
14	// G1_ZSW Status bits			
15	"TEL81.G1_ZSW.HOME_POS_EXECUTED"	%E126.4	BOOL	FALSE
16	"TEL81.G1_ZSW.CYCLIC_POS_EXECUTED"	%E126.5	BOOL	FALSE
17	"TEL81.G1_ZSW.PARKING_EXECUTED"	%E126.6	BOOL	FALSE
18	"TEL81.G1_ZSW.SENSOR_ERROR"	%E126.7	BOOL	FALSE

Figure 7.29

2. Move the rotary encoder to controlled mode manually or after power-up. To do this, you must set control bit 10 "Control by PLC" to TRUE in "STW2_ENC." This corresponds to the control bit "TEL81.STW2_ENC.CTRL_BY_PLC" in the watch table.

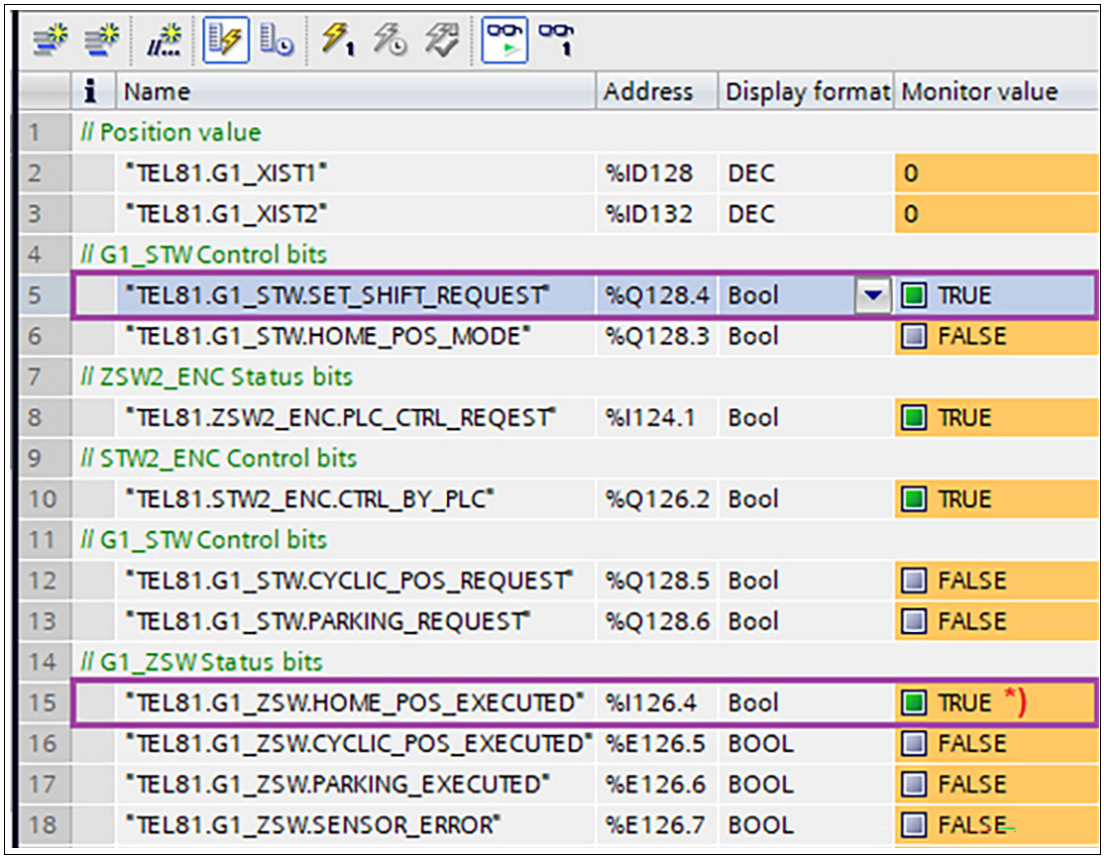
3. Set the preset mode via control bit 11 "Home position mode" in G1_STW (default setting is 0 = absolute, 1 = relative). This corresponds to the control bit "TEL81.G1_STW.HOME_POS_MODE" in the watch table. The default preset value is 0, but can be set via PNU 65000, or PNU 65002.



	Name	Address	Display format	Monitor value
1	// Position value			
2	"TEL81.G1_XIST1"	%ED128	DEZ	102396
3	"TEL81.G1_XIST2"	%ED132	DEZ	0
4	// G1_STW Control bits			
5	"TEL81.G1_STW.SET_SHIFT_REQUEST"	%A128.4	BOOL	FALSE
6	"TEL81.G1_STW.HOME_POS_MODE"	%A128.3	BOOL	FALSE
7	// ZSW2_ENC Status bits			
8	"TEL81.ZSW2_ENC.PLC_CTRL_REQEST"	%E124.1	BOOL	TRUE
9	// STW2_ENC Control bits			
10	"TEL81.STW2_ENC.CTRL_BY_PLC"	%A126.2	BOOL	TRUE
11	// G1_STW Control bits			
12	"TEL81.G1_STW.CYCLIC_POS_REQUEST"	%A128.5	BOOL	FALSE
13	"TEL81.G1_STW.PARKING_REQUEST"	%A128.6	BOOL	FALSE
14	// G1_ZSW Status bits			
15	"TEL81.G1_ZSW.HOME_POS_EXECUTED"	%E126.4	BOOL	FALSE
16	"TEL81.G1_ZSW.CYCLIC_POS_EXECUTED"	%E126.5	BOOL	FALSE
17	"TEL81.G1_ZSW.PARKING_EXECUTED"	%E126.6	BOOL	FALSE
18	"TEL81.G1_ZSW.SENSOR_ERROR"	%E126.7	BOOL	FALSE

Figure 7.30

4. You can set the preset mode via control bit 11 "Home position mode" in G1_STW: By default, 0 = absolute, 1 = relative. To do this, set the preset mode via the control bit "TEL81.G1_STW.HOME_POS_MODE"



	Name	Address	Display format	Monitor value
1	// Position value			
2	"TEL81.G1_XIST1"	%ID128	DEC	0
3	"TEL81.G1_XIST2"	%ID132	DEC	0
4	// G1_STW Control bits			
5	"TEL81.G1_STW.SET_SHIFT_REQUEST"	%Q128.4	Bool	TRUE
6	"TEL81.G1_STW.HOME_POS_MODE"	%Q128.3	Bool	FALSE
7	// ZSW2_ENC Status bits			
8	"TEL81.ZSW2_ENC.PLC_CTRL_REQEST"	%I124.1	Bool	TRUE
9	// STW2_ENC Control bits			
10	"TEL81.STW2_ENC.CTRL_BY_PLC"	%Q126.2	Bool	TRUE
11	// G1_STW Control bits			
12	"TEL81.G1_STW.CYCLIC_POS_REQUEST"	%Q128.5	Bool	FALSE
13	"TEL81.G1_STW.PARKING_REQUEST"	%Q128.6	Bool	FALSE
14	// G1_ZSW Status bits			
15	"TEL81.G1_ZSW.HOME_POS_EXECUTED"	%I126.4	Bool	TRUE *)
16	"TEL81.G1_ZSW.CYCLIC_POS_EXECUTED"	%E126.5	BOOL	FALSE
17	"TEL81.G1_ZSW.PARKING_EXECUTED"	%E126.6	BOOL	FALSE
18	"TEL81.G1_ZSW.SENSOR_ERROR"	%E126.7	BOOL	FALSE

Figure 7.31

5. You can now execute the preset function via control bit 12 "Request of home position" in G1_STW. To do this, set the control bit "TEL81.STW.CYCLIC_POS_REQUEST" to "TRUE."

↳ After the preset function has been successfully executed, this control bit 12 must be reset to FALSE (= 0).

Note

From encoder profile version 4.2 onwards, the rotary encoder confirms the execution of the preset function by setting status bit 12 "Set preset/shift reference point executed" in "G1_ZSW." In the watch table, this corresponds to the control bit "TEL81.G1_STW.HOME_POS_EXECUTED."

7.7 Resetting the Rotary Encoder to Factory Settings

It is possible to reset the PROFINET interface of the rotary encoder to factory settings. This means it is possible to delete items such as device name and IP address. However, the Preset position of the rotary encoder cannot be changed.

1. Ensure that there is a direct connection to the interface module. To do this, go to the network view and establish the connection via "Connect online."
2. In the left-hand work area of the editor, switch to the encoder entry in the project tree, in this case it is "P+F_Encoder [ENA58xx]." Then double-click on "Online & diagnostics."

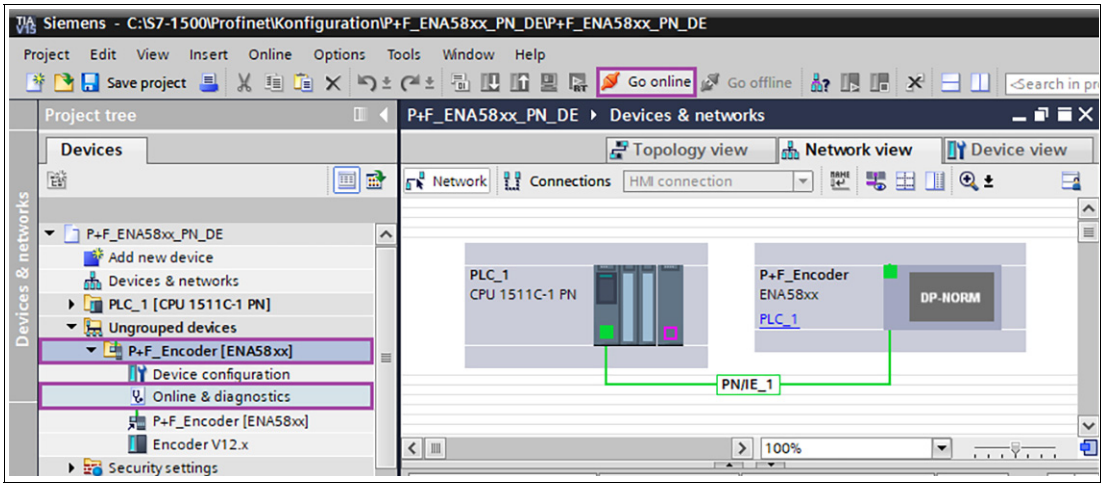


Figure 7.32

↳ The current settings of the rotary encoder are displayed in the right-hand work area of the editor: MAC address, IP address, PROFINET device name

3. Select "Functions," "Reset to factory settings," and then "Reset."

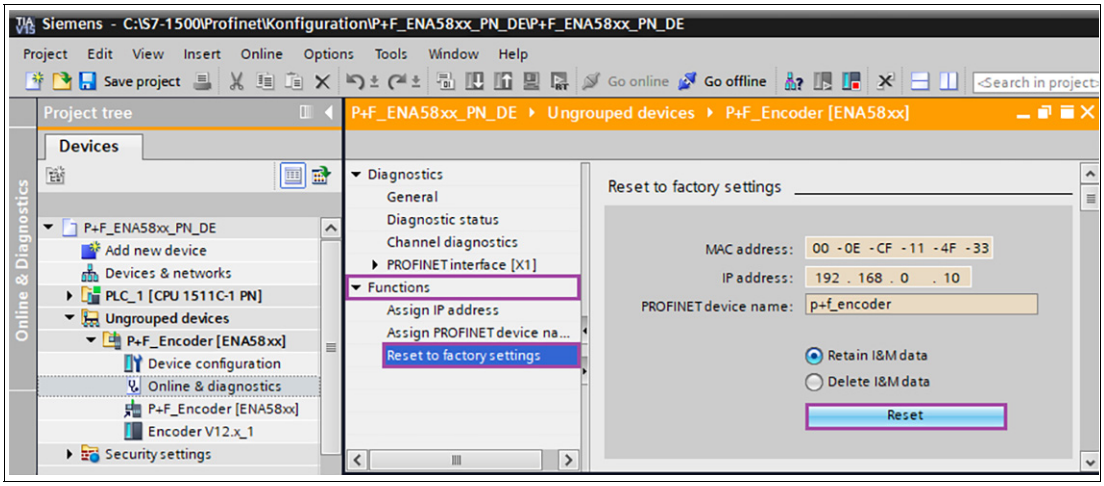


Figure 7.33

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↳ The following warning message is displayed:

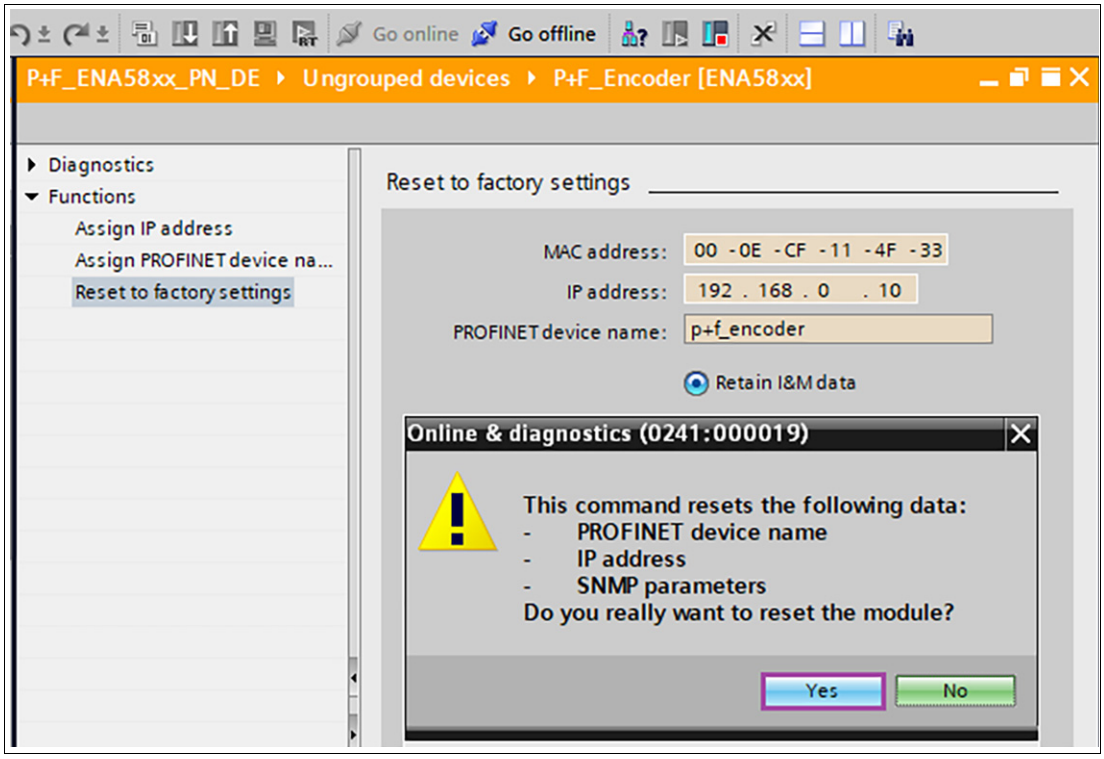

Figure 7.34

4. Press "Yes" to confirm this selection.

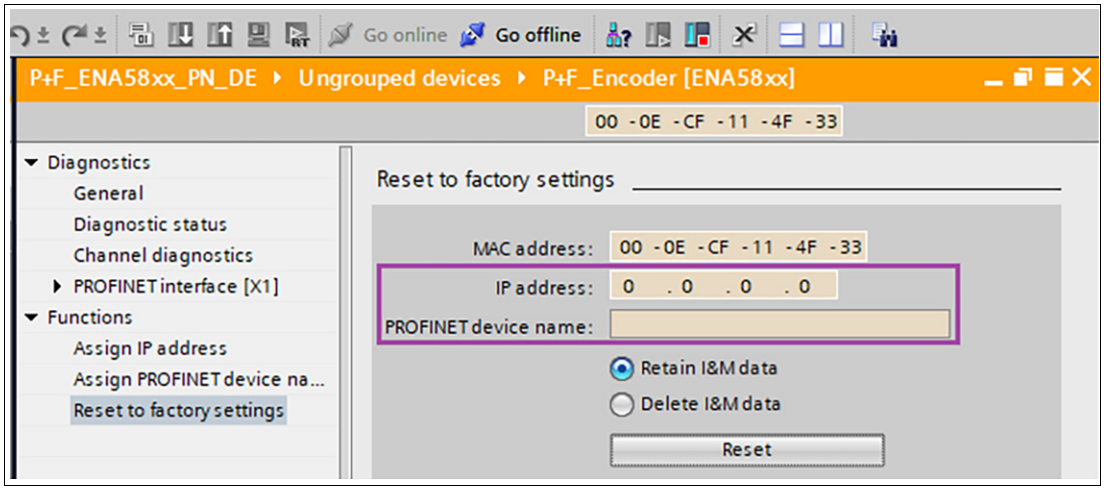

Figure 7.35

↳ The rotary encoder reverts to its factory settings.

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- Wireless Solutions
- Level Measurement

Industrial Sensors

- Proximity Sensors
- Photoelectric Sensors
- Industrial Vision
- Ultrasonic Sensors
- Rotary Encoders
- Positioning Systems
- Inclination and Acceleration Sensors
- Fieldbus Modules
- AS-Interface
- Identification Systems
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