Baumer

Passion for Sensors

Manual

Absolute encoders EAx with PROFINET interface

Firmware Version V1.2.0 and later

10.22· 174.02.072/7

Contents

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Change history
This document is subject to changes. The latest version is available at www.baumer.com.

Document index	Date	Firmware revision	Author	Changes
0001	05.18	1.2.0	div.	Initial version (replaces all draft documents)
0002	09.20	1.3.0	div.	Important changes: editorial changes and revision of following chapters: - 3.2.3 ("Push Button for Preset / Reset") - 4.1 ("Importing the GSDML file") - 4.3.2 ("Automatic Name Assignment") - 4.6.4 ("Total measuring range") - 4.6.13 to 4.6.16 (Getriebefaktor) - 4.6.17 ("Important Note for Multiturn Encoder Operation") - 4.7.1 ("I/O Point Fault OB") - 5.1 ("Importing the GSDML file") - 5.3.2 ("Automated name allocation") - 5.9.2 ("Parameter reset using the optional push button") - 6.3 ("Link/Activity (L/A) LEDs") - 6.4.3 ("Telegram 101: 32 Bit I") - 6.4.9 ("Control Word G1_STW1") - 6.4.11 ("Status Word G1_ZSW1") - 6.5 ("Speed") - 6.6.2 ("Preset in PROFIdrive telegrams 81 to 83") - 6.6.3 (“Preset using the Push Button”) - 7.2 ("I&M functions (identification and maintenance)") - 7.3.3 ("Base Mode Parameter Access")

				- 7.4.12 ("Parameter 61000: NameOfStation") - 7.4.14 ("Parameter 61002: MacOfStation") - 7.4.17 ("Parameter 65000: Preset Value") - 7.4.18 ("Parameter 65001: Operating status") - 8 ("Troubleshooting – Frequently Asked Questions – FAQ") New chapters: - 7.5 ("Vendor-specific parameters") - 9 ("Appendix A")
0003	10.22	1.3.0	thw	Change of address

1. Introduction

1.1. Scope of delivery

Please check the delivery upon completeness prior to commissioning.
Depending on encoder configuration and part number the delivery may include:

- PROFINET encoder
- Manual (also available under www.baumer.com)

1.2. Product classification

Product	Product family	Suitable entry in hardware catalog
EAL 580-xxx.xxPT-13160.x	optical - multiturn	EAL580 MT encoder ST13 MT16, optical
EAL 580-xxx.xxPT-18130.x	optical - multiturn	EAL580 MT encoder ST18 MT13, optical
EAM 580-xxx.xxPT-14160.x	magnetic - multiturn	EAM580 MT encoder ST14 MT16, magnetic

Placeholders marked “x” in the product reference number will not influence the selection.

GSDML file
The GSDML file is the same for all products mentioned above.
Please see chapter ”4.1 Importing the GSDML file”.

2. Safety and operating instructions

Intended use

- The encoder is a precision measuring device that is used to record positions and speeds. It provides measuring values as electronic output signals for the subsequently connected device. It must not be used for any other purpose. Unless this product is specially labeled, it may not be used for operation in potentially explosive environments.
- Make sure by appropriate safety measures, that in case of error or failure of the encoder, no danger to persons or damage to the system or operating facilities occurs.

Personnel qualification

- Installation and assembly of this product may be performed only by a person qualified in electronics and precision mechanics.

Maintenance

- The encoder is maintenance-free and must not be opened up nor mechanically or electronically modified. Opening up the encoder can lead to injury.

Disposal

- The encoder contains electronic components. At its disposal, local environmental guidelines must be followed.

Mounting

- Solid shaft: Do not connect encoder shaft and drive shaft rigidly. Connect drive and encoder shaft with a suitable coupling.
- Hollow shaft: Open clamping ring completely before mounting the encoder. Foreign objects must be kept at a sufficient distance from the stator coupling. The stator coupling is not allowed to have any contact to the encoder or the machine except at the mounting points.

Electrical commissioning

- Do not proceed any electrical modifications at the encoder.
- Do not proceed any wiring work while encoder is live.
- Do not remove or plug on connector whilst under power supply.
- Ensure that the entire system is installed in line with EMC/EMI requirements. Operating environment and wiring have an impact on the electromagnetic compatibility of the encoder. Install encoder and supply cables separately or far away from sources with high emitted interference (frequency converters, contactors, etc.).
- When working with consumers with high emitted interference provide separate encoder supply voltage.
- Completely shield encoder housing and connecting cables.
- Connect encoder to protective earth (PE) using shielded cables. The braided shield must be connected to the cable gland or connector. Ideally, aim at dual connection to protective earth (PE), i.e. housing by mechanical assembly and cable shield by the downstream devices.

Supplementary information

- The present manual is intended as a supplement to already existing documentation (e.g. catalogues, data sheets or mounting instructions).

3. Commissioning

3.1. Mechanical mounting

Shaft encoders

- Mount the encoder by help of the mounting holes and three screws provided at the encoder flange. Observe thread diameter and depth.
- There is an alternative mounting option in any angular position by eccentric fixings, see under accessories.
- Connect drive shaft and encoder shaft by using an appropriate coupling. The shaft ends must not touch each other. The coupling must compensate temperature and mechanical tolerances. Observe the maximum permitted axial or radial shaft load. For appropriate couplings please refer to accessories.
- Tighten the mounting screws firmly.

Hollow shaft encoders

- Mounting by clamping ring
  Prior to mounting the encoder open the clamping ring completely. Push encoder onto the drive shaft and tighten the clamping ring firmly.
- Adjusting element with rubber buffer
  Push the encoder onto the drive shaft and insert the cylindrical pin into the adjusting element (customer-mounted) and the rubber buffer.
- Spring washer
  Fasten the spring washer at the mounting holes of the encoder housing using screws. Push the encoder onto the drive shaft and mount the spring washer to the contact surface.

3.2. Electrical connection

3.2.1. Cabling

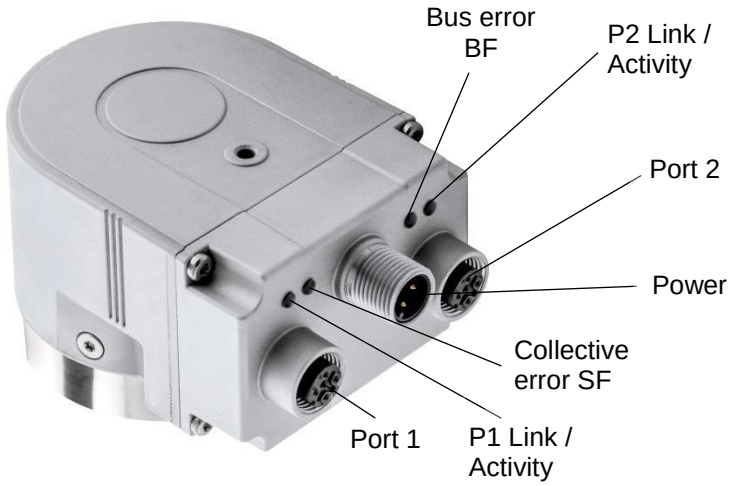
PROFINET utilizes Fast Ethernet cable (100 MBit, Cat 5) composed of four wires AWG22 (white, yellow, blue and orange).

There are three types of PROFINET cables:

- Type A – for fix or rigid cabling
- Type B – for occasional movements or vibrations (flexible)
- Type C – for permanent movements (highly flexible).

3.2.2. Connecting

The encoder provides three M12 flange connectors.
Two M12 flange connectors (D-coding, according IEC 61076-2-101) serve for PROFINET connection.

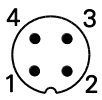


- For voltage supply use A-coded M12 connector only.
- For the bus lines both D-coded M12 connectors may be used at will. However, together with a planned topology it may be necessary to observe the correct assignment (P1/P2).
- Seal up the unused cable gland using a sealing bolt (transport and dust protection).

No settings have to be done inside the encoder. In contrast to Profibus, there is no need for setting a node ID or a terminating resistor. All settings required for encoder access are made in the engineering tool (e. g. Siemens® Step7® or TIA® Portal).

Pin assignment

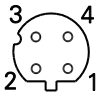
Supply voltage



1 x M12 flange connector (male)
A-coded

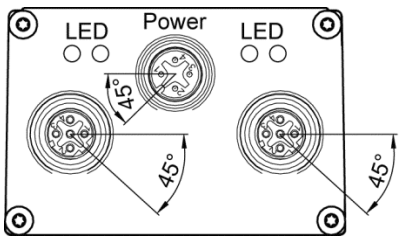
Pin	Assignment
1	UB (10...30 VDC)
2	Do not connect
3	GND
4	Do not connect

PROFINET (Bus line)



2 x M12 flange connector (female)
D-coded

Pin	Assignment
1	TxD+
2	RxD+
3	TxD-
4	RxD-



3.2.3. Push Button for Preset / Reset

Depending on encoder the type the encoder may have a screw cap located where connectors and LEDs are located as well. After removing the screw cap, the preset / reset push button is visible.

Depending on the current operating state the push button has a different functionality:

- In the first 60 seconds after switching on the encoder the encoder performs a “Factory Reset“.
  - Up to firmware version 1.2.x this only works if the encoder has no Ethernet connection.
  - Since firmware version 1.3.0 this works with and without an Ethernet connection.
- With active PROFINET operation the encoder performs a preset.

Note:
After having used the push button the screw cap must be screwed in again and tightened with a torque of **1.5 Nm**.

For functionality details see 0 „
The preset value can be set to a value unequal 0. To do this no program, PLC function block or similar things are necessary. If one of the PROFIdrive telegrams 81 to 83 is used and a preset is triggered (in operation) the value in PNU 65000 is used as preset value.

This functionality is for example very useful if the desired preset value does not change during operation.

Preset using the Push Button“ or 4.9 „Restore Factory Defaults“, respectively.

4. Engineering (Siemens® Step7®)

The following examples relate to SIEMENS® PLCs using the engineering tool SIEMENS® Step7®. The screenshots were taken from Step7® V5.5 SP3. Engineering with TIA Portal® is described in chapter 5. Of course, the encoder will also accept engineering software of other manufacturers - in this case, proceed in an analog way.

4.1. Importing the GSDML file

First, the GSDML file must be imported to enable implementation of the encoder in the engineering tool. The file format is XML ("Extended Markup Language"). With reference to the Profibus GSD files, GSDML is the common term.

The GSDML file is available for download at www.baumer.com.

Use this GSDML file:

- **GSDML-V2.32-Baumer-EAx580_PN-**20170112**.xml**
  for encoders with firmware V1.2.2 or later

- **GSDML-V2.32-Baumer-EAx580_PN-**20190715**.xml**
  for encoders with firmware V1.3.0 or later

  Relevant difference of GSDML files:
  From GSDML file «GSDML-V2.32-Baumer-EAx580_PN-20190715.xml" onwards the usage of the functionality "setting of the preset value (PNU 65000) in the module parameters" is possible.

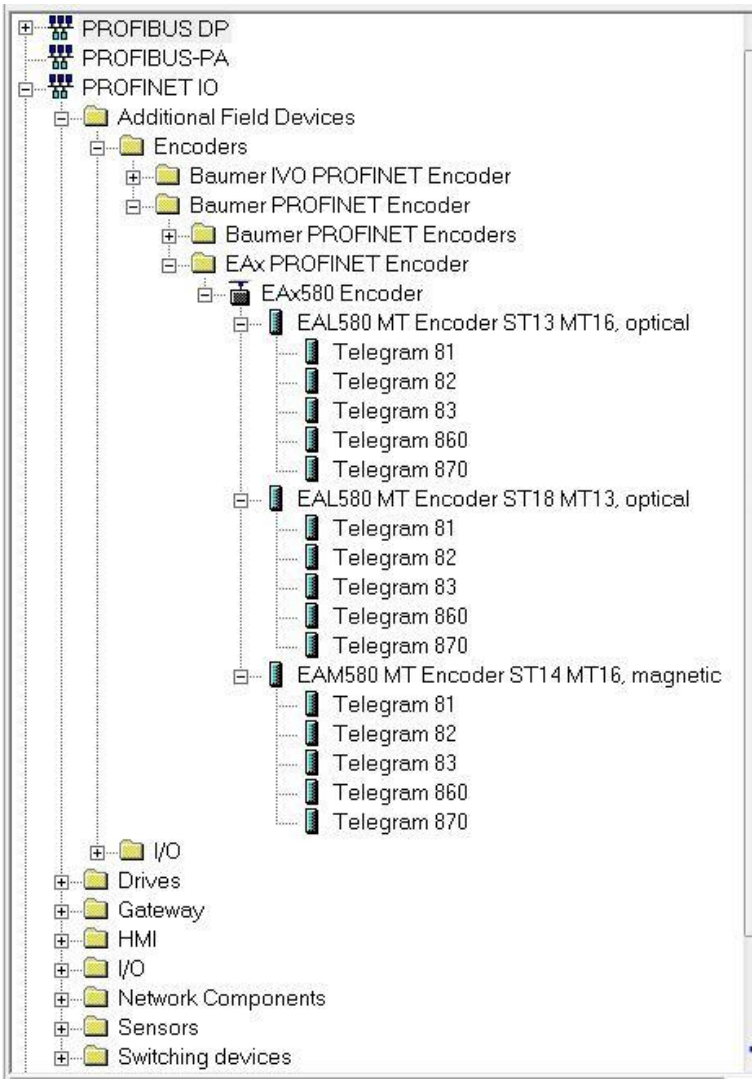
  The revision can be seen in the date at the end of the file name. Here it has to be seen as an example. The date has to be read in the format "YYYYMMDD" (Y: year, M: month, D: day). In the example above the date is January 12th 2017.

The import operation is performed by Step7® software in the hardware window („HW Config" - „Options – Install GSD File…"). As a prior step it may be necessary to close the actual hardware project („Station - close") to enable successful import. Based on the default settings any change is configured as described below. The GSDML file itself is not modified.

In the following dialogue please select the directory where to find the GSDML file which shall be installed. It is useful (but not necessary) to work with the program directory „…\Siemens\Step7® \S7Tmp".

The file is displayed and can be selected. „Close" will finalize the operation. The same directory also includes the corresponding bitmap file providing a small encoder image in the engineering tool. This file is automatically installed in parallel.

The encoder now appears in the hardware catalog under „PROFINET IO“ – „ Additional Field Devices“ – „Encoders“ – „Baumer PROFINET Encoder“ - “EAx PROFINET Encoder “ – „EAx580…“ (x according to encoder type).

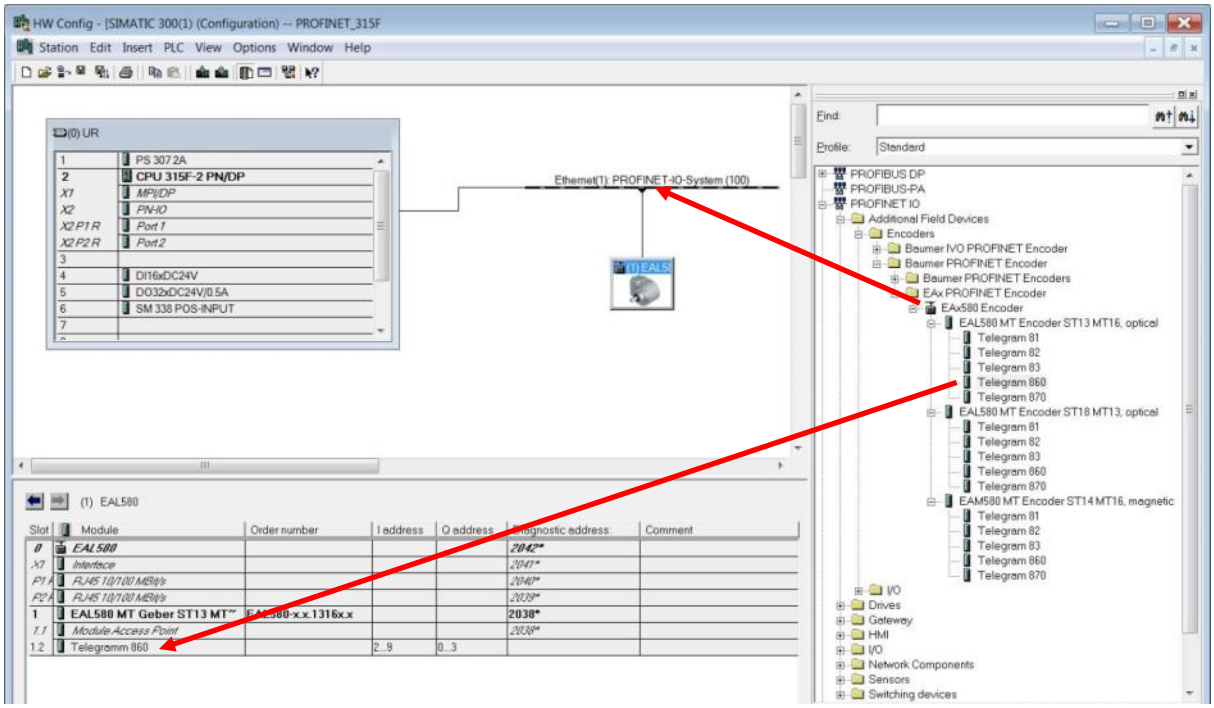


4.2. Encoder integration into the project

Use the mouse to drag the basic module „EAx580 encoder“ from hardware catalog to bus rail.

In the next step, select the encoder module (for example "EAL580 MT encoder ST13 MT16 optical") and drag from hardware catalog for drop in subslot 1.2 (bottom left) in the hardware window.

In the next step, select and drag the desired I/O telegram (e.g. telegram „860“) for drop in subslot 1.2.



4.3. Assigning the device name

Device identification in the network requires the worldwide unique MAC ID, the (statically or dynamically assigned) IP address and third a unique device name in the PROFINET network. All three identifiers are used during system bootup and during operation. Thus, engineering requires to assign the encoder’s device name.

4.3.1. Setting the device name in the Project

Double-click on the encoder symbol in HW Config. window. The properties window opens with an input field to enter the desired device name.

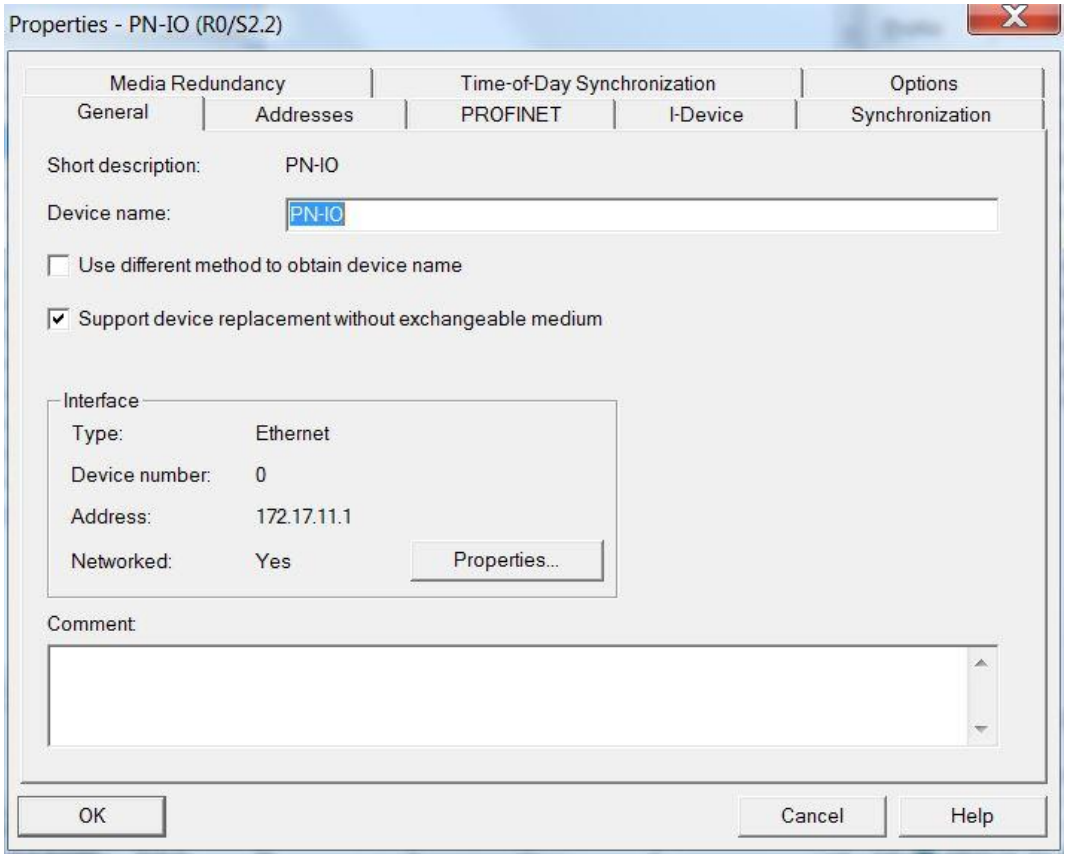
4.3.2. Automatic Name Assignment

The device name can be written automatically into the encoder. In the factory-provided state and after a “factory reset” the device name in the encoder is empty.

Preconditions for automated name allocation:

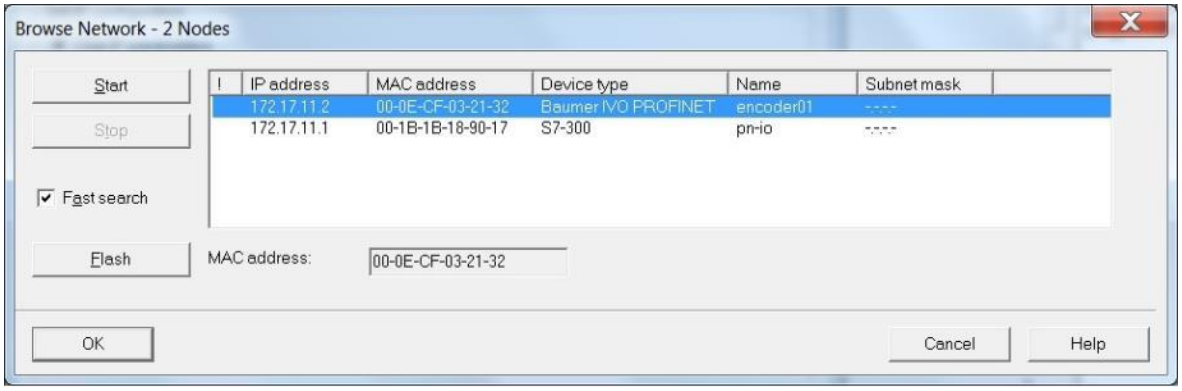
- A topology planning has been defined.
- The previous device name has been deleted (e. g. by “factory reset”).
- Option „Support device replacement without exchangeable medium“ (see following screenshot) is enabled.

Automated name allocation is executed as soon as the encoder logs on the network where projected.



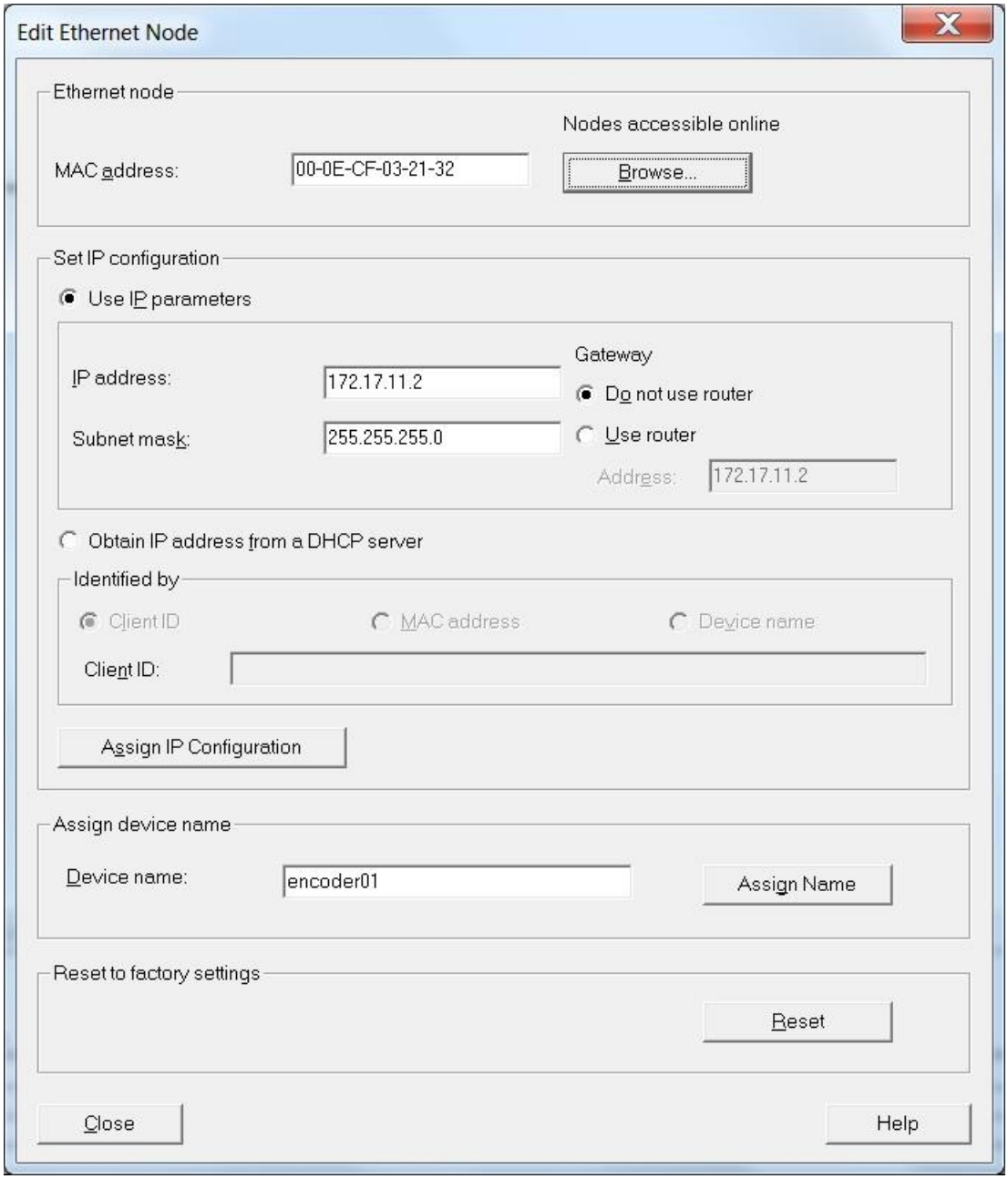
4.3.3. User-operated name assignment

To perform an I/O system network scan, go to „PLC“ – „Edit Ethernet Node“ – „Browse“. The scan provides all bus nodes. In the example the encoder „encoder01“ was found.



The MAC address ensures unique device recognition. Button „flash“ will start the identified user‘s SF LED flashing for clear identification.

A double-click on the desired line (here: encoder “encoder01”) opens the window “Edit Ethernet Node”. Enter the new name required for configuration in line “Device name“. Click “Assign name” to execute. After this, the encoder will immediately be recognized with this name in the PROFINET network.



Notes:

- It is not possible to set the device name via the MPI interface.
- When specific device data (for example the station name) is written, the power supply may not be switched off.

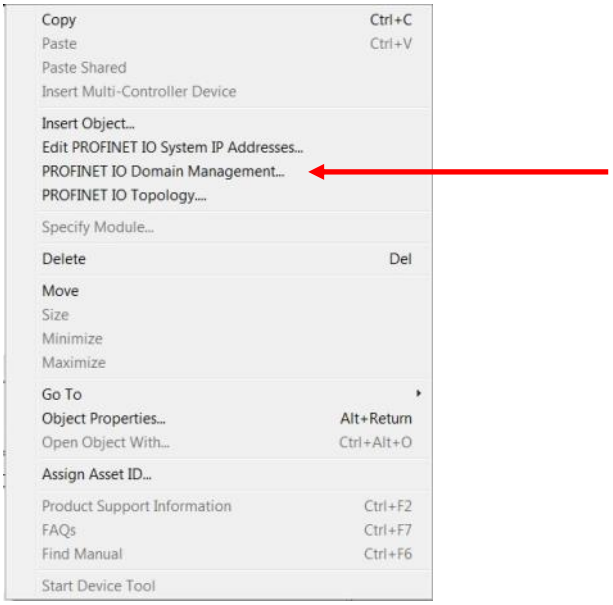
4.4. Real-Time Class Selection

The PROFINET encoder supports both real-time classes “Real-Time” (RT) and “Isochrone Real-Time” (IRT) Class 3. Which one to use depends on the application and the PLC.

4.4.1. Domain Management

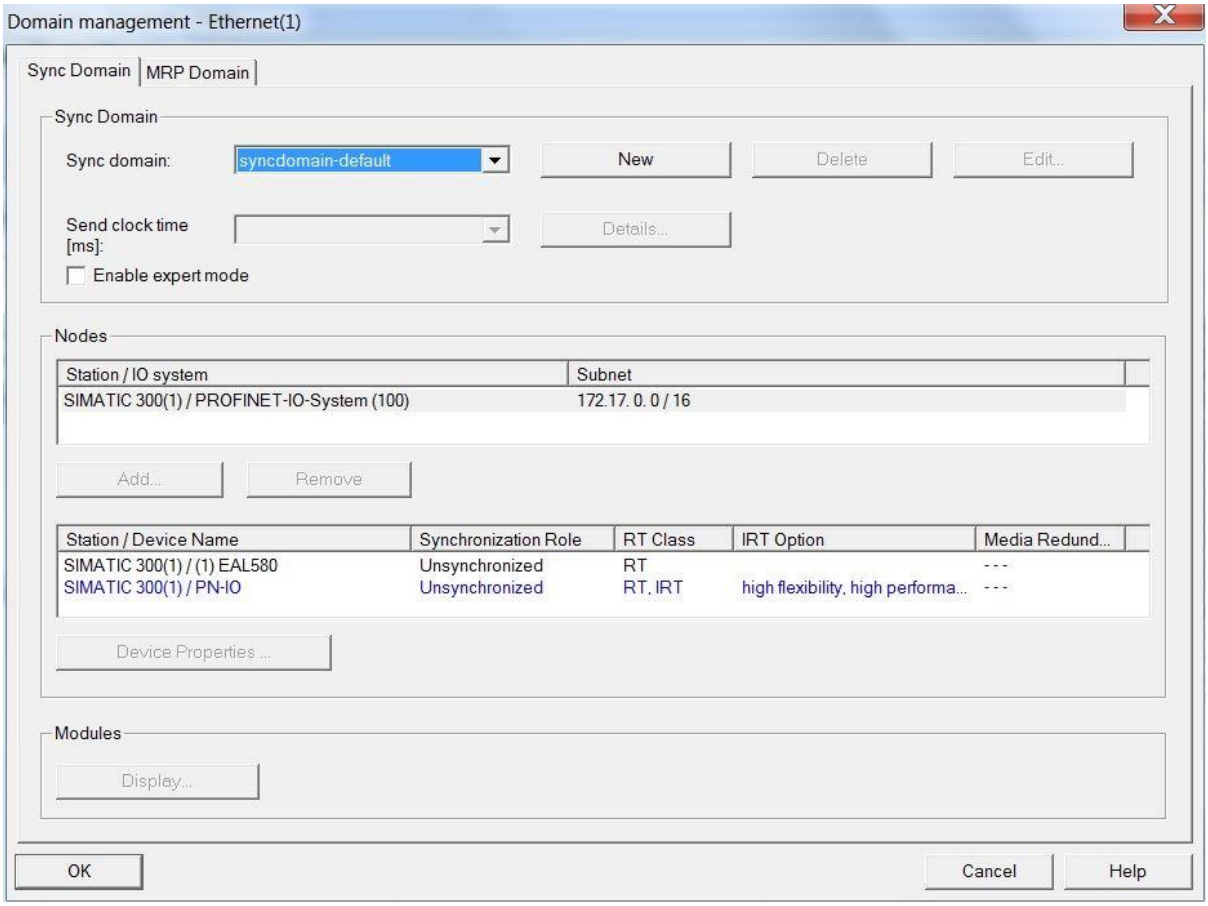
The Domain Management determines the PROFINET bus properties.

Enter the Domain Management by right-clicking the PROFINET bus rail in the hardware window.



In the following screen „Domain Management“ enter the „Sync domain” name or keep the default.
For IRT Class 3 only enter the send clock here.
For RT Class 1 open the property window of the PLC‘s PROFINET port (e. g. X2), see chapter 5.4.2.2.

The send clock applies to the IO Controller and to all IO Devices within this sync domain and is decisive for the overall system performance.



4.4.2. Real-Time (RT) Class 1

In this class a typical cycle time of 100 ms or less is possible. The bus system allows for standard Ethernet components.

Topology planning is not mandatory, but where implemented (e. g. for retrieving feature „Support device replacement without exchangeable medium"), make sure ports P1/P2 are correctly assigned as planned.

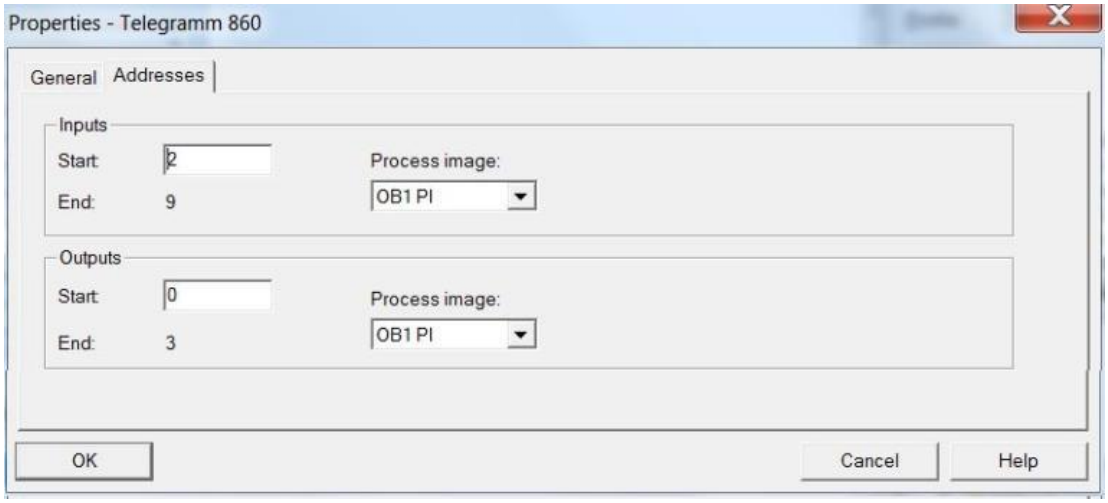
4.4.2.1. Address assignment within the process image

Access to the encoder's input and output data takes place via addresses within the PLC's process image. Assign these addresses according to the needs of the PLC software.

Go to the Step7® HW Config. window and click on the encoder symbol on the bus rail to select it. Bottom left in the module window the various encoder modules are shown. A double click on submodule 1.2 (e. g. "telegram 860") opens the property window with tab „addresses".

Enter the start address of the respective address range or accept the system's proposal. Identical or overlapping addresses for input and output are possible.

The process image (PI) will be that of the cyclic main program OB1 (not synchronized).

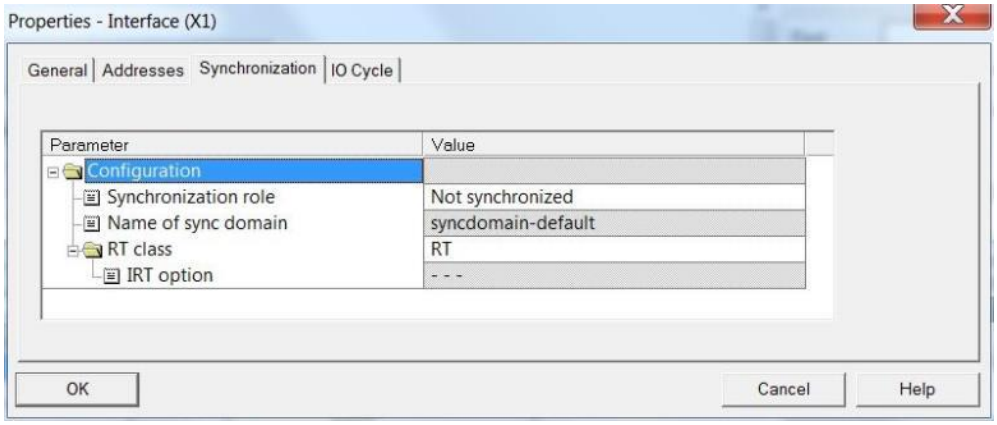


4.4.2.2. Synchronization Setup

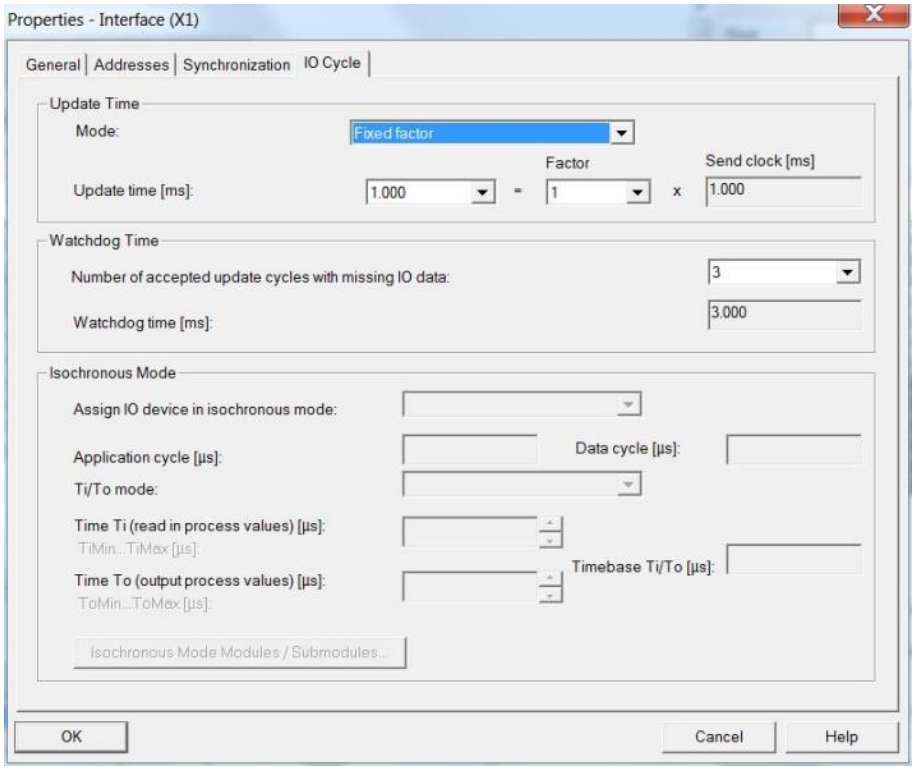
Go to the Step7® HW Config. window and click on the encoder symbol on the bus rail to select it. Bottom left in the module window the various encoder modules are shown. Enter the interface properties with a double click on the „Interface“ module.

The „Synchronization“ tab shows the assignment to a certain sync domain. Real-Time (RT) Class 1 mode is „not synchronized“. Set the synchronization role accordingly.

Go to „RT class“ to select „RT (Class 1)“ or „IRT“. „IRT Option“ is pre-assigned to „high performance“ (IRT Class 3) which requires corresponding PLC configuration.



Properties Tab „IO Cycle“, area „Update Time“ offers settings for the requested update time. In relation to the send clock a reduction ratio „factor“ applies. In case of a reduction ratio the encoder will not update and send its position value each send clock cycle, but only every 2nd, 4th or 8th cycle. Not every application needs being updated at the high send clock rate. At a high bus load this reduction may save bandwidth. Applicable factors may vary with the real-time class and send clock and are offered in the drop down area.



4.4.3. Isochronous Real-Time (IRT) Class 3

- Isochronous real-time considering signal delays
- Typical cycle time: 1 ms or less

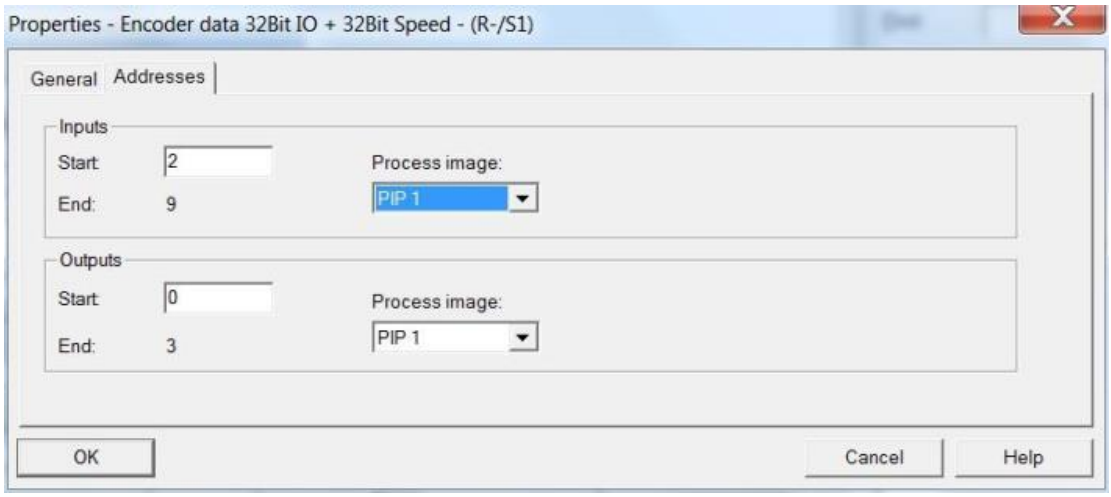
A topology planning is mandatory. Make sure ports P1/P2 at the encoder are correctly assigned as planned.

4.4.3.1. Address assignment within the process image

Access to the encoder's input and output data takes place via addresses within the PLC's process image. Assign these addresses according to the needs of the PLC software.

Go to the Step7® HW Config. window and click on the encoder symbol on the bus rail to select it. Bottom left in the module window the various encoder modules are shown. A double click on submodule 1.2 (e. g. "telegram 860") will open the property window with tab „addresses".

Enter the start address of the respective address range or accept the system's proposal. Identical or overlapping addresses for input and output are possible. Make sure that the address ranges are located inside the cyclically updated part process image "PIP" of the isochronous system task (e. g. OB61).

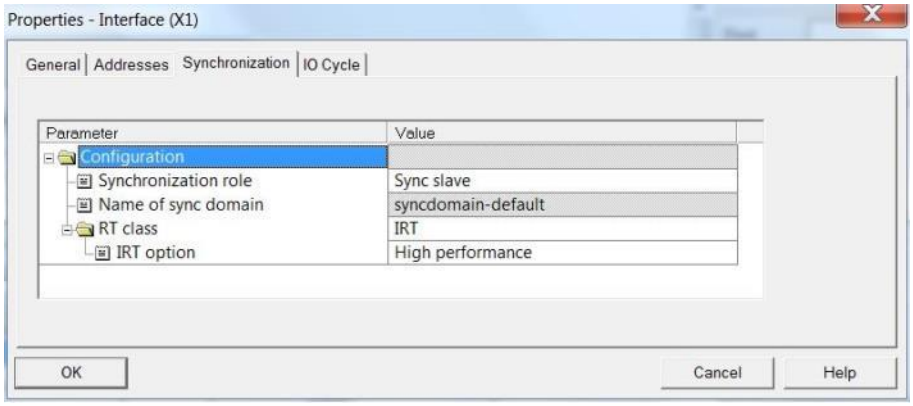


4.4.3.2. Synchronization Setup

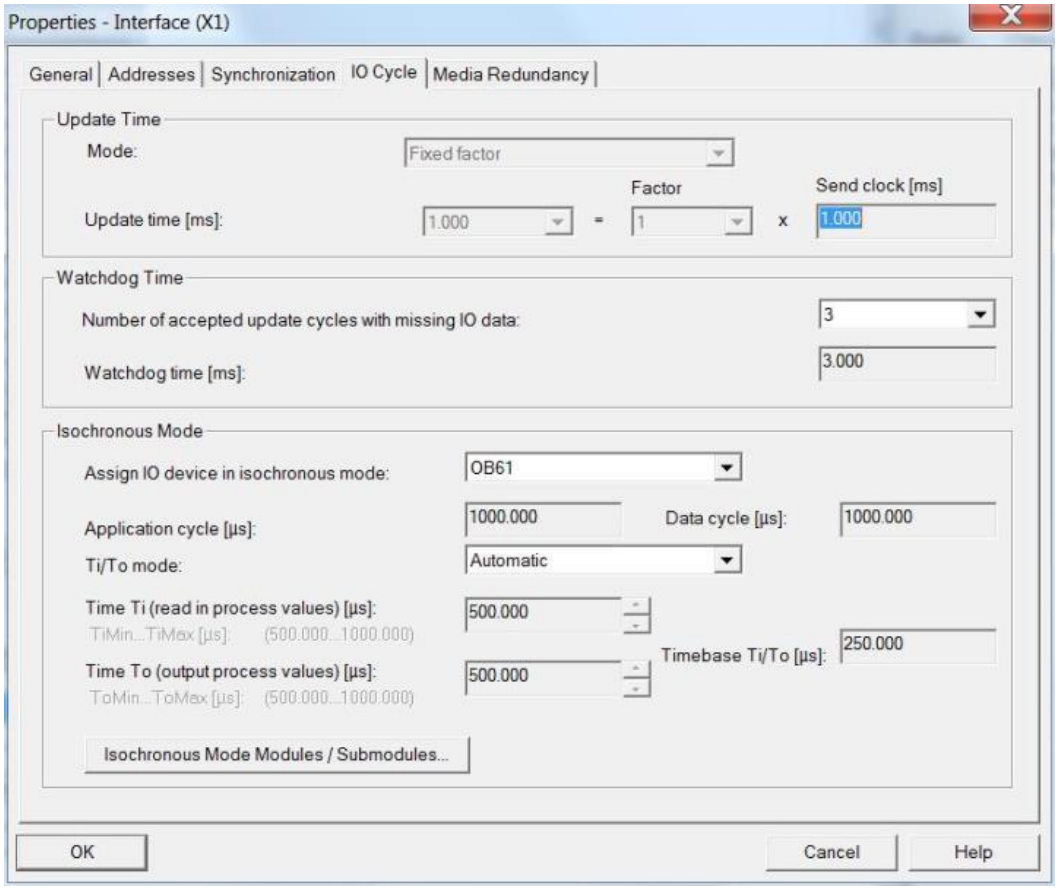
Go to the Step7® HW Config. window and click on the encoder symbol on the bus rail to select it. Bottom left in the module window the various encoder modules are shown. Enter the interface properties with a double click on the „Interface" module.

The „Synchronization" tab shows the assignment to a certain sync domain. Set the synchronization role to "Sync slave".

In the tree menu under Configuration/RT Class/IRT, option „IRT" is pre-assigned to „High performance".

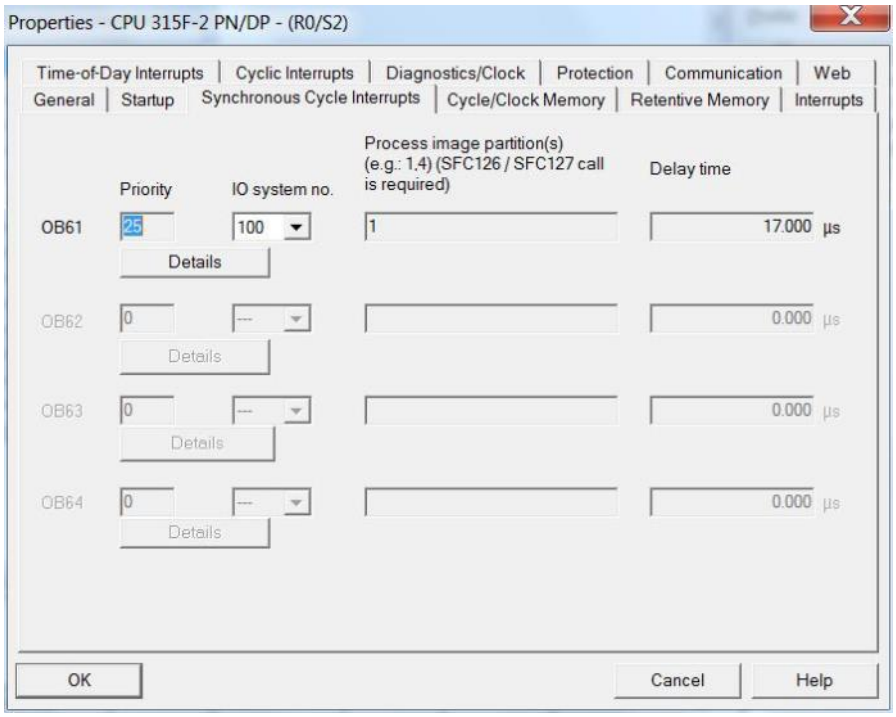


Property tab „IO cycle“ only provides option „Assign IO device in isochronous mode“. Assign isochronous module OB61 here.



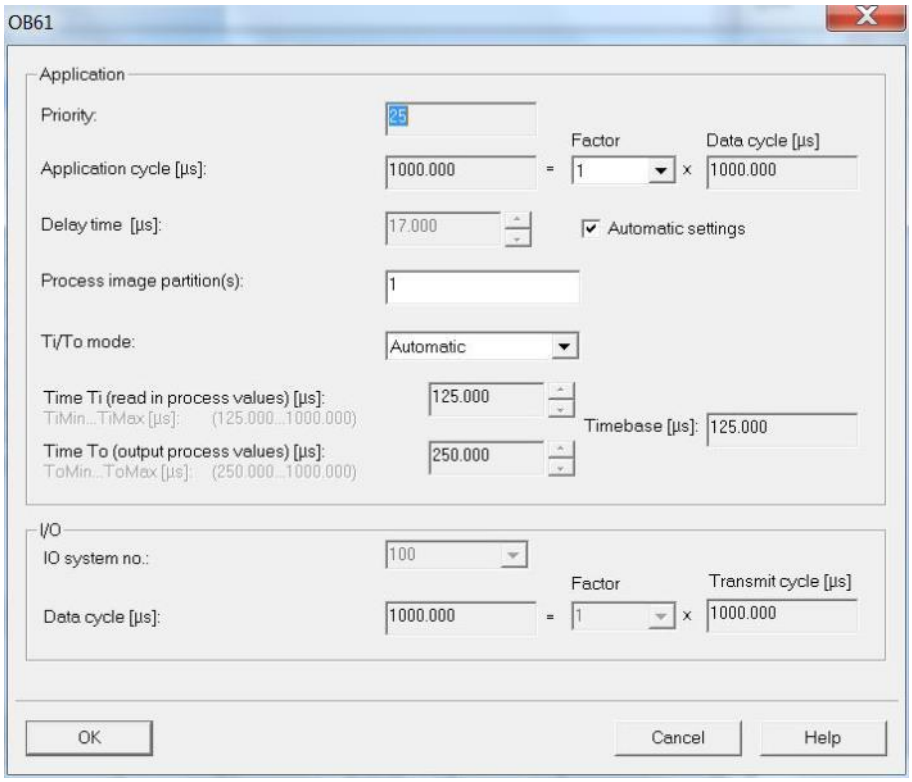
4.4.3.3. IO system assignment to Synchronous Cycle Interrupts

Open Step7® HW Config. window. Double-click on CPU main module. In „Properties“ window, tab „Synchronous Cycle Interrupts“, PROFINET string „IO System No. 100“ is assigned to Synchronous Cycle Interrupt OB61.



A click on button „Details“ provides OB61 properties. Process image partition 1 is assigned to OB61.

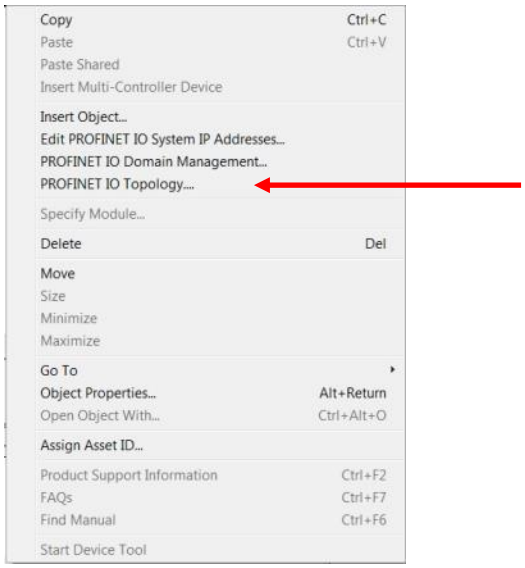
The application cycle is selected in the view below.



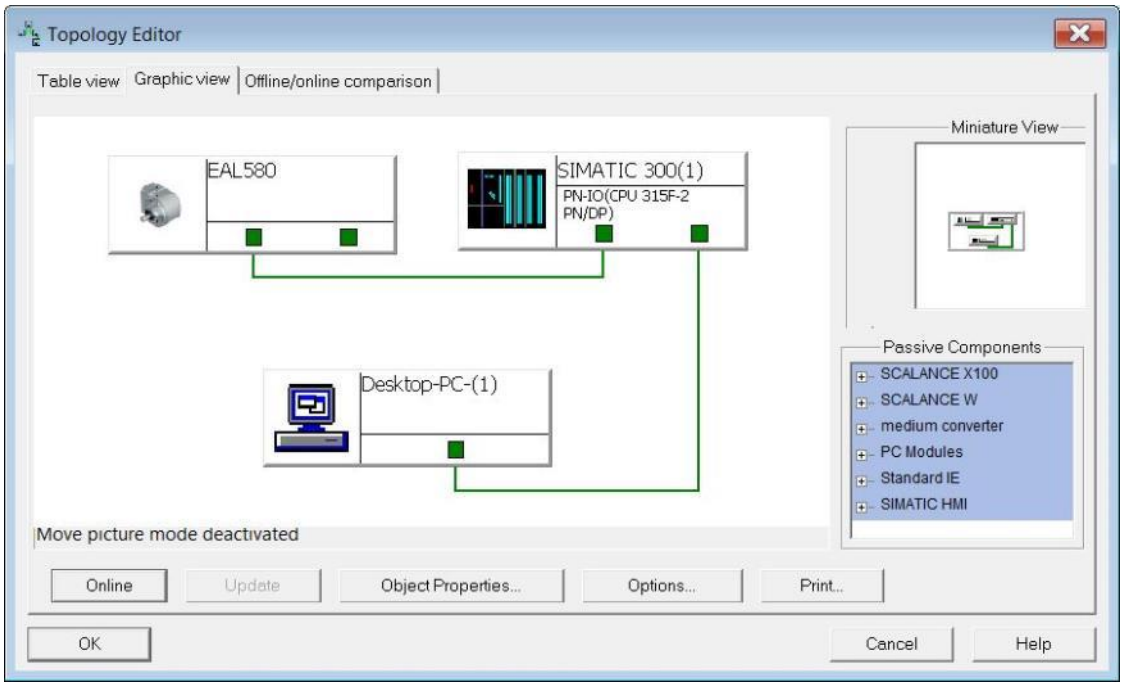
4.5. Topology Planning

It is obligatory to plan the topology in order to perform IRT Class 3 and / or to utilize the system feature “Device replacement without exchangeable medium”. Port connections and cable lengths between all system components are made known to the project. In this way the project tool is enabled to consider cable, port and switch delay times and to optimize overall performance.

Enter the topology planning e. g. by right-clicking on the PROFINET bus rail in the hardware window of Step7® software, which opens the following pull-down menu.



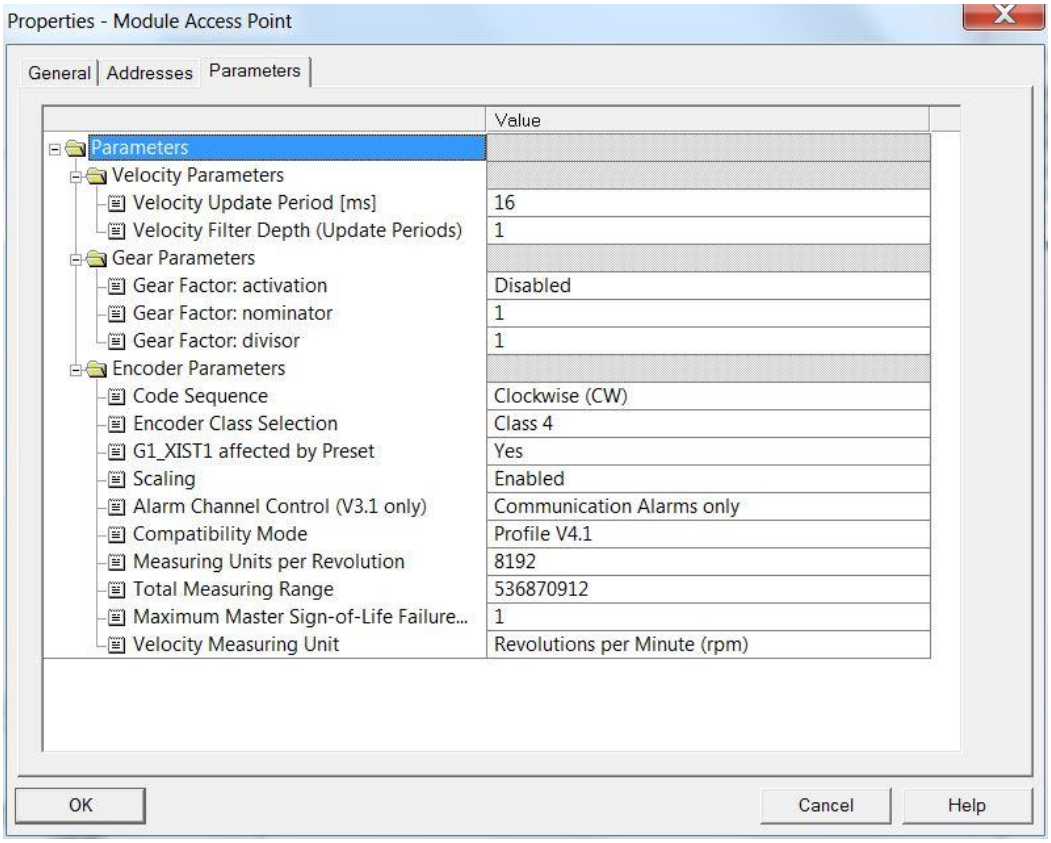
The graphic view clearly shows port assignment of all bus components. The assignment made here must fit to the real conditions. In the example below controller port 1 is linked to port 1 of the encoder. The programming tool (PG/PC) is connected to port 2 of the controller. A double click on the collections allows to input the respective cable length. “Offline/Online comparison” allows measuring the real values in order to correct data if required.



4.6. Parameterization

Double-click on the module in slot 1.1 (see screenshot in 4.2) opens window „Properties – Modul Access Point“ with tabs „General“, „Addresses“ and „Parameters“.
Open Tab „Addresses“ to change the device diagnostic address or accept the default.

Tab „Parameters“ serves for encoder configuration.



4.6.1. Encoder Class Selection

In encoder class 4 all parameter settings are enabled and affect configuration.

In encoder class 3 some parameters are permanently on default, regardless of the user configuration:

- Scaling is not enabled.
- The number of steps per revolution is fixed to the maximum of the respective basic encoder
- Total measuring range is fixed to the maximum of the respective basic encoder.
- Code sequence is fixed to cw.
- Preset functionality is not supported.

4.6.2. Compatibility Mode

Compatibility mode according to encoder profile V3.1:

- Parameter „max. master life sign error“ is considered.
- „CR“ bit in status word ZSW2 of the PROFIdrive telegrams is always „0“.
- Control words and set points will be adopted, independent of the CP bit in Control Word STW2.
- Preset will only affect position value G1_XIST2, not G1_XIST1.

4.6.3. Measuring Units per Revolution

This parameter is used for entering the desired singleturn resolution.
Only class 4 encoders will take this parameter into consideration.

Admissible are values within the range from 1 to the maximum encoder resolution. In general, related limits are provided in the configuration software.

A change in singleturn resolution will clear internal position offsets (see also chapter “6.6 Preset function”) so the current position reference is lost.

4.6.4. Total measuring range

This parameter is used for setting the desired total measuring range („Total measuring range“, „TMR“).

For singleturn encoders enter the same value here as for “Measuring units per revolution“.

Admissible values range from 2 to the product of the programmed resolution multiplied by the encoder’s maximum number of revolutions. See also “4.6.17 Important Note for Multiturn Encoder Operation”.

Note:
Since firmware version 1.3.0 an alarm with code 0x0224 is reported if the total measuring range is set to 1.

A change of the total measuring range clears the internal position offsets so that the current position reference will be lost (see also “6.6 Preset function”).

This setting will be taken into account in encoder class 4 only (see chapter 4.6.1).

4.6.5. Code Sequence

This parameter defines the position and speed data behavior when moving the encoder shaft (looking at the flange).

Setting CW	(„clockwise“)	=> ascending values with clockwise rotation
Setting CCW	(„counter-clockwise“)	=> ascending values with counter-clockwise rotation

This setting will be taken into account in encoder class 4 only (see chapter 4.6.1).

4.6.6. Speed Measuring Unit

Please refer to “6.5.1 Speed Measuring Unit “.

4.6.7. Speed Update Period

Please refer to „6.5.2 Speed Update Period“.

4.6.8. Speed Filter Depth

Please refer to “6.5.3 Speed Filter “.

4.6.9. Scaling Functionality

Parameter setting „Scaling Functionality on“ will consider the settings in „Measuring Units per Revolution“ and „Total Measuring Range“.

Parameter setting „Scaling Functionality off“ will always consider the maximum „Measuring Units per Revolution“ and maximum „Total Measuring Range“ of the basic encoder.

This functionality is only supported in encoder class 4. Encoder class 3 implicates „scaling off”.

4.6.10. Preset affects G1_XIST1

If „yes“, the preset will have an effect on both position values G1_XIST1 and G1_XIST2. If „no“, there will be only an effect on position value G1_XIST2.

This parameter is not significant when using telegrams 860 and 870.

4.6.11. Alarm Channel Control

Compatibility mode according to V3.1 enables optional suppression of transmitting channel-specific diagnostic alarms, while in profile V4.1 transmission of channel-specific diagnostic alarms is always enabled.

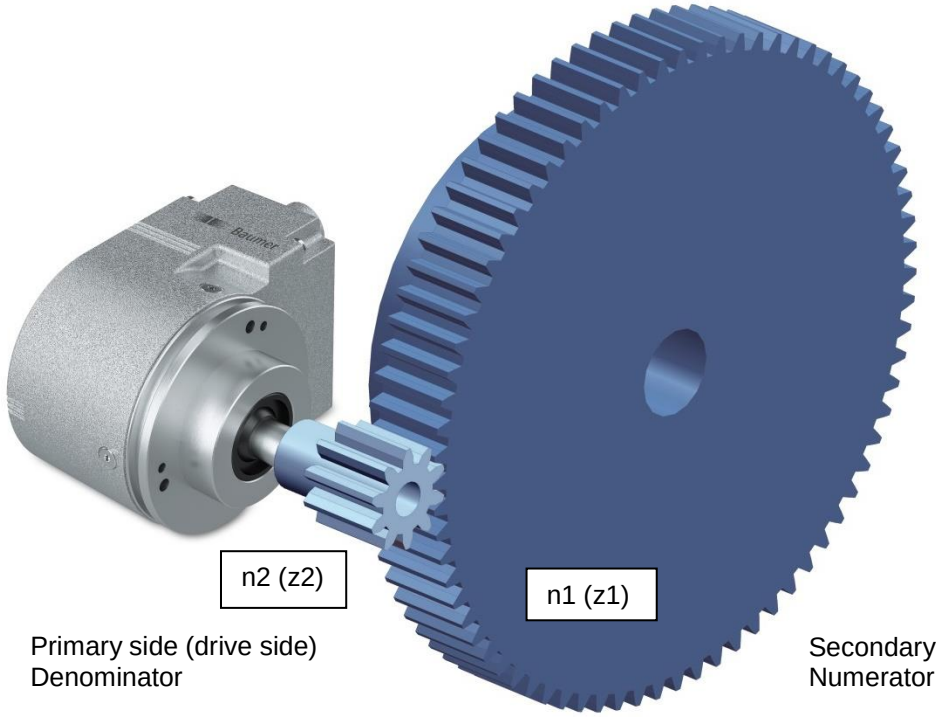
4.6.12. Maximum Master Sign-of-Life Failures

Compatibility mode according to profile V3.1:
Parameter for maximum tolerated failures for monitoring of master life sign

Mode according to profile V4.1:
Total of tolerated errors is „1“ by default (“factory settings”) but can be changed by acyclic PROFIdrive parameter 925. Value of „Maximum Master Sign-of-Life Failures“ of encoder parameters is without effect.

4.6.13. Gear factor: activation

With gear factor active the encoder is mechanically mounted on the primary side of the gearbox (drive side) of the gearbox while it outputs position data as if it was mounted on the secondary side (driven side) of the gearbox. The parameter „total measuring range“ always defines the number of requested steps for one revolution on the secondary side of the gear box.



$$\text{Gear factor } i = \frac{\text{Numerator}}{\text{Denominator}} = \frac{\text{Speed at drive side (n2)}}{\text{Speed at driven side (n1)}} = \frac{\text{Number of teeth at driven side (z1)}}{\text{Number of teeth at drive side (z2)}}$$

The values for numerator and denominator of the gear factor result directly from the number of teeth. In the example above the number of teeth at the driven side is 75. At the drive side the number of teeth is 10.

Parameter „measuring units per revolution“ is not set in the gear factor function. Instead the parameter “measuring units per revolution“ results from total measuring range, numerator and denominator.

$$\text{Measuring units per revolution} = \text{total measuring range} * \frac{\text{denominator}}{\text{numerator}}$$

Example:
The gear factor shall be 75:10 (means 7,5).
The resolution on the secondary side of the gearbox shall be “1 revolution = 10000 steps”.

The numerator is 75 and the denominator is 10. Only integer values are admissible for numerator and denominator. The total measuring range is 10000.

The encoder turns 7,5 revolutions for one revolution on the secondary side of the gearbox. The resulting value of „measuring units per revolution“ for the encoder is 10000 / 7,5 = 1333,3333.

Note:
An change of parameter “Gear factor: activation” clears internal position offsets (if any). So the current position reference is lost (see also “6.6 Preset function”).

The gear factor functionality is also called „numerator/denominator scaling“ or „round axis function“.

4.6.14. Gear factor: numerator

This parameter is only taken into account when gear factor functionality is active.

When using a reduction gear (n2 < n1) the numerator of the gear factor is larger than the denominator.

Note:
In GSDML file the word “nominator” is used equivalent to “numerator”.

For the numerator the following restrictions apply:

EAL580 MT encoder ST13 MT16, optical:	numerator <= 8192
EAL580 MT encoder ST18 MT13, optical:	numerator <= 4096
EAM580 MT encoder ST14 MT16, magnetic:	numerator <= 16384

4.6.15. Gear factor: denominator

This parameter is only taken into account when gear factor functionality is active.

When using a step-up gear (n2 > n1) the denominator is larger than the numerator.

Note:
In GSDML file the word “divisor” is used equivalent to “denominator”.

4.6.16. Gear factor: parametrization

Valid combinations of numerator, denominator and total measuring range result from the formula noted below. The parameter „measuring units per revolution“ must not exceed the maximum allowed values of the encoder. These values are different depending on the type of the encoder.

$$\text{Measuring units per revolution} = \text{total measuring range} * \frac{\text{denominator}}{\text{numerator}}$$

EAL580 MT encoder ST13 MT16, optical:	Measuring units per revolution <= 65536
EAL580 MT encoder ST18 MT13, optical:	Measuring units per revolution <= 524288
EAM580 MT encoder ST14 MT16, magnetic:	Measuring units per revolution <= 65536

4.6.17. Important Note for Multiturn Encoder Operation

„Endless operation“ is automatically supported where required.

Thus, there are no special requirements for the encoder parameters “total measuring range” and “measuring units per revolution” to stand in a certain ratio.

When endless operation is active and the encoder is unpowered the encoder shaft may rotate max. ¼ of the number of maximum possible revolutions. For an encoder with max. 65536 (2^{16}) revolutions (equals 16 „multiturn bits“) this would be 16384 (2^{14}) revolutions. For an encoder with 13 „multiturn bits“ this then would be 2048 (2^{11}) revolutions. If this number of revolutions is exceeded the encoder has to be referenced (execute Preset function) after every power-up. When endless operation is inactive the encoder shaft may rotate unlimitedly when the encoder is not powered (without influence on the position value).

How to determine if „endless operation“ is in use together with given parameters:

- Multiply the encoder’s „max. possible revolutions“ (depending on encoder 16 bit = 65536 or 13 bit = 8192) by your parameter setting „measuring units per revolution“.
- Divide this value by your parameter setting „total measuring range“.
- If there is a division remainder endless operation is in use.

Example for parameters without endless operation:

Maximum possible revolutions:	65536	(16 bit multiturn)
Measuring units per revolution:	3600	
Total measuring range:	29491200	
Calculation:	65536 x 3600 / 29491200 = 8 (no remainder)	

Example for parameters with endless operation:

Maximum possible revolutions:	65536	(16 bit multiturn)
Measuring units per revolution:	3600	
Total measuring range:	100000	
Calculation:	65536 x 3600 / 100000 = 2359 remainder 29600	

4.7. Implementation of system functions for alarm handling

Make sure that the system components required for alarm handling have been implemented in the project. To SIEMENS® Step7® projects apply in particular OB82 ("I/O Point Fault") and OB86 ("Loss Of Rack Fault"). Missing these components will result in a PLC to enter STOP state in case of alarm.

4.7.1. I/O Point Fault OB (OB82)

The following channel-specific diagnostic alarms are supported:

Alarm number	Alarm text
0x0102	Internal frame error
0x0103	Internal CRC error
0x0104	Internal frame error (extended)
0x0105	Internal CRC error (extended)
0x0106	Generic error in position acquisition unit
0x0107	Generic warning in position acquisition unit
0x0200	Position error
0x0201	Preset out of range
0x0300	Electronic device label could not be read (*)
0x0320	Battery voltage low (*)
0x9000	Master's sign of life fault
0x900A	IR-LED light control reserve reached (*)

(*) in case of an error, alarm is available already at encoder bootup

The following diagnostic alarms indicate parameter errors. Parameterization errors are available already at encoder bootup. However, the engineering tool will prevent most configuration errors.

Alarm number	Alarm text
0x0220	Measuring units per revolution is zero
0x0221	Total measuring range is zero
0x0222	Measuring units per revolution overflow
0x0223	Total measuring range overflow
0x0224	Total measuring range illegal
0x0225	Code sequence illegal
0x0240	Velocity measuring unit is out of range
0x0241	Velocity update period is zero or lower than the devices' update period
0x0242	Velocity filter depth is zero
0x0260	Gear Factor: Activation Value is out of range
0x0261	Gear Factor: Numerator is out of range
0x0262	Gear Factor: Denominator is out of range
0x0263	Gear Factor: Invalid combination of Numerator, Denominator and Total Measuring Range (may occur only if Denominator > Numerator) **(*)**

(*)

Valid combinations of numerator, denominator and total measuring range result from the formula noted below. The measuring units per revolution must not exceed the maximum allowable values, depending on the type of encoder.

$$\text{Measuring units per revolution} = \text{Total measuring range} * \frac{\text{Denominator}}{\text{Numerator}}$$

EAL580 MT encoder ST13 MT16, optical: Measuring units per revolution <= 65536
EAL580 MT encoder ST18 MT13, optical: Measuring units per revolution <= 524288
EAM580 MT encoder ST14 MT16, magnetic: Measuring units per revolution <= 65536

4.7.2. Loss Of Rack Fault - OB

Loss Of Rack Fault OB (OB86) is triggered when the encoder is available on the bus after bootup („outgoing event") or when being no longer accessible (switched off or disconnected from the bus, „incoming event").

4.8. Compilation and load of hardware and software configuration

After complete hardware project configuration and once having entered all parameters the project must be compiled ("translated") and exported to the PLC.

4.9. Restore Factory Defaults

4.9.1. Factory Setup using the Engineering Tool

The engineering tool may be used to restore encoder settings to the factory default values. Preparations and proceedings are described in chapter 4.3 "Assigning the device name". Click button „Reset" in field "Reset to Factory Settings". The restore operation must be followed up by encoder power off and on.

The entire customer-specific configuration including device name and IP address will be deleted.
By clearing internal offsets the position reference will be lost as well.
Only MAC ID and serial number are retained.

Note:
The device name being deleted may make the PLC immediately try to allocate the projected name again. If this is unwanted automated name allocation („Device exchange without removable media") has to be disabled in project prior to executing the factory setup.

4.9.2. Parameter reset using the optional push button

Please refer to the description in 0.

5. Engineering (Siemens® TIA Portal®)

The following examples relate to SIEMENS® PLCs being engineered by the SIEMENS® TIA Portal®.
The screenshots were taken from TIA Portal® V13 SP1 and CPU 1518.
Of course, the encoder will also operate on engineering tools of other manufacturers. In this case, proceed in an analog way.

5.1. Importing the GSDML file

Encoder implementation in the engineering tool first requires importing the GSDML file in format XML („Extended Markup Language“). In accordance with Profibus GSD files, the standard name is GSDML.

The GSDML file is available for download at www.baumer.com.

Use this GSDML file:

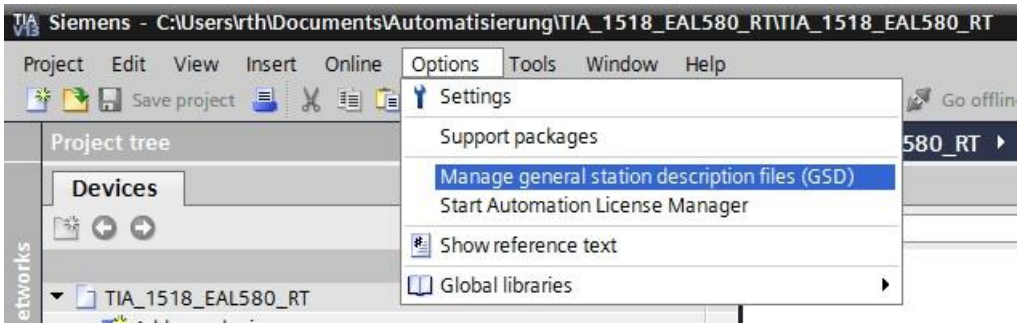
- **GSDML-V2.32-Baumer-EAx580_PN-**20170112**.xml**
  for encoders with firmware V1.2.2 or later

- **GSDML-V2.32-Baumer-EAx580_PN-**20190715**.xml**
  for encoders with firmware V1.3.0 or later

  Relevant difference of GSDML files:
  From GSDML file «GSDML-V2.32-Baumer-EAx580_PN-20190715.xml“ onwards the usage of the functionality “setting of the preset value (PNU 65000) in the module parameters“ is possible.

  The revision can be seen in the date at the end of the file name. Here it has to be seen as an example. The date has to be read in the format “YYYYMMDD” (Y: year, M: month, D: day). In the example above the date is January 12th 2017.

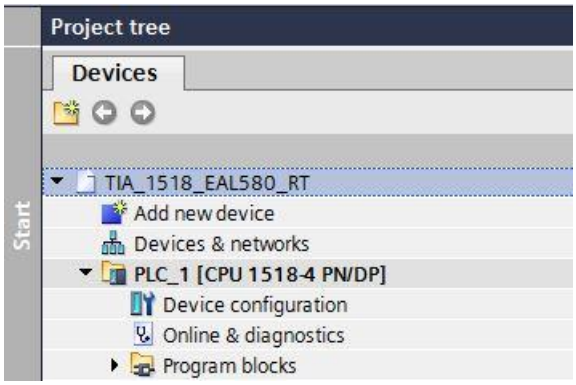
GSDML file import is in the TIA Portal® in the project view („Options – Manage general station description files (GSD)“).



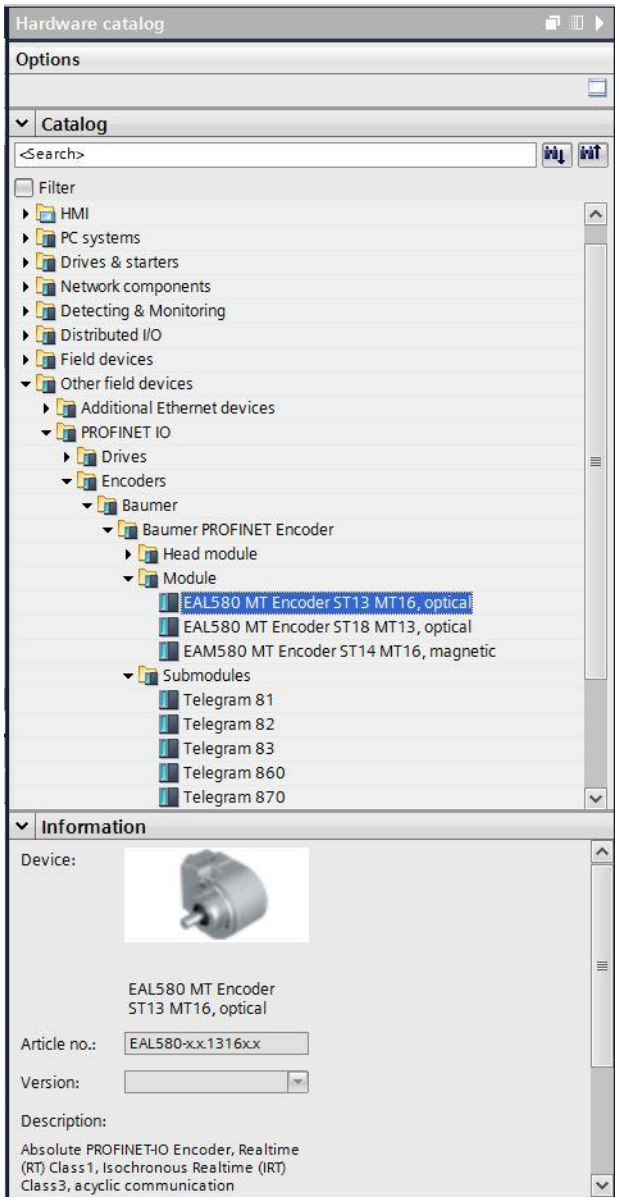
In the following dialogue please select the directory where to find the GSDML file which shall be installed. The same directory also includes the corresponding bitmap file providing a small encoder image in the engineering tool.

The file is displayed and can be selected. „Install” will finalize the operation.

Hardware catalog opens via the device configuration window:

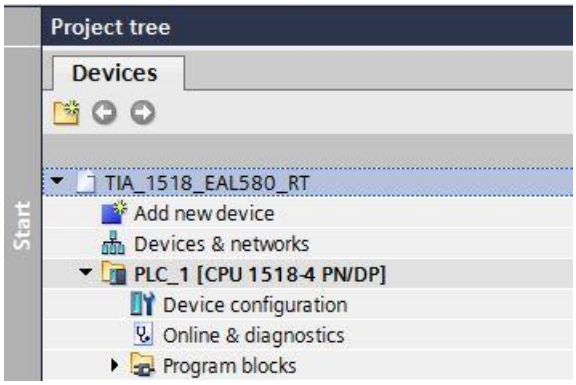


The encoder appears in the hardware catalog under „Other field devices “ - „PROFINET IO“ – „Encoders“ – “Baumer” - „Baumer PROFINET Encoder“. Head module “EAx PROFINET Drehgeber“, Module „EAx580…“. Submodules (telegrams) are displayed separately.

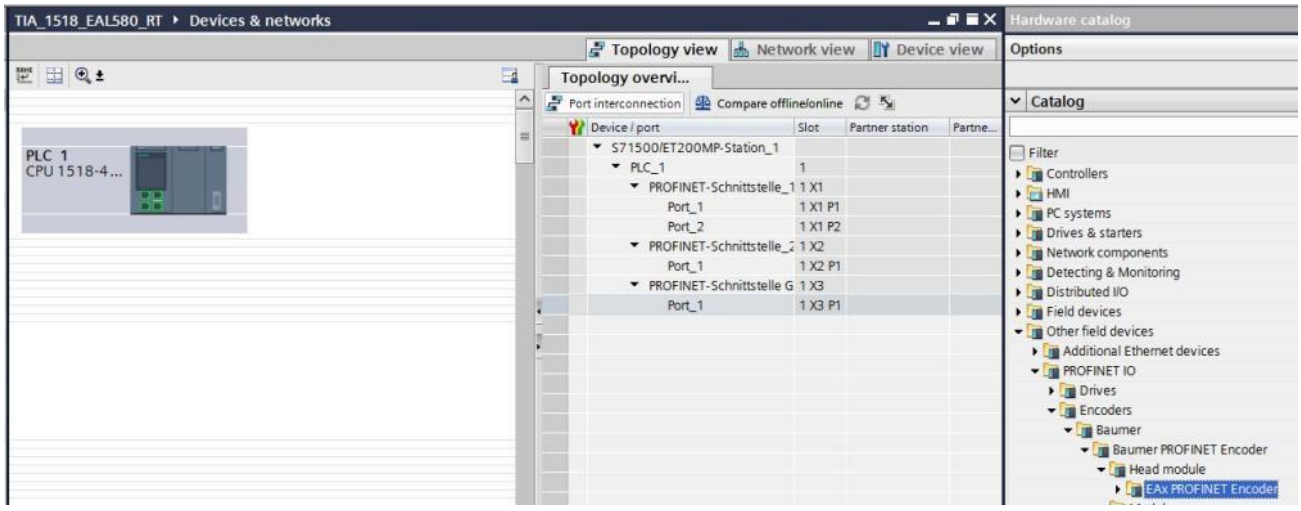


5.2. Inserting the encoder into the network

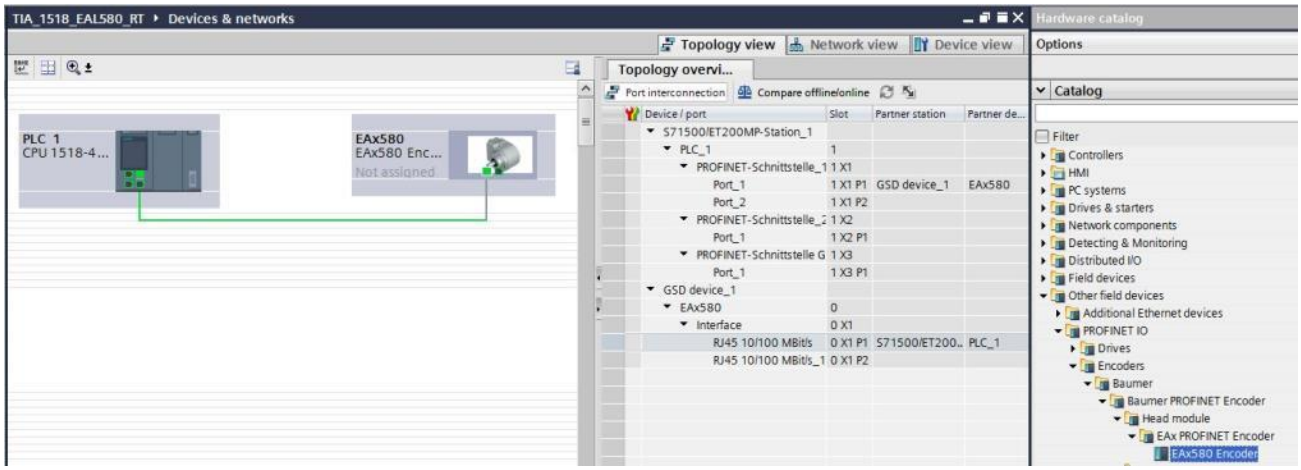
Hardware catalog opens via the device configuration window.



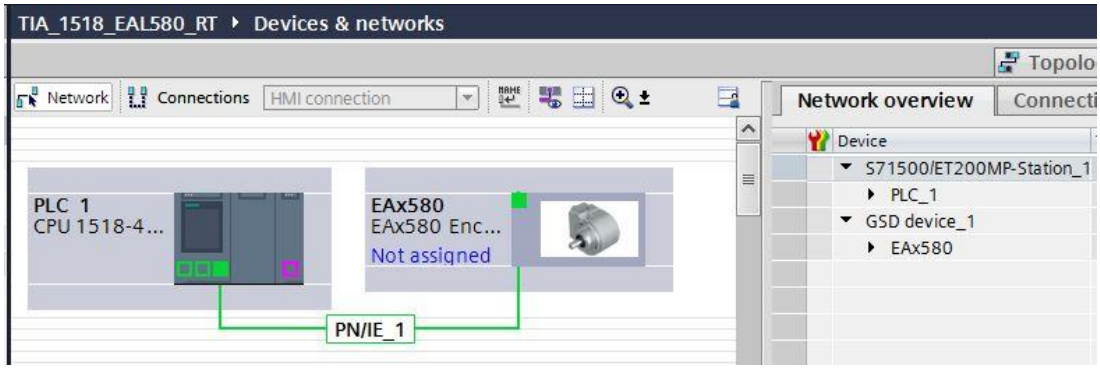
PLC is displayed in the topology view. The hardware catalog displays the encoder head module (not yet showing modules and submodules).



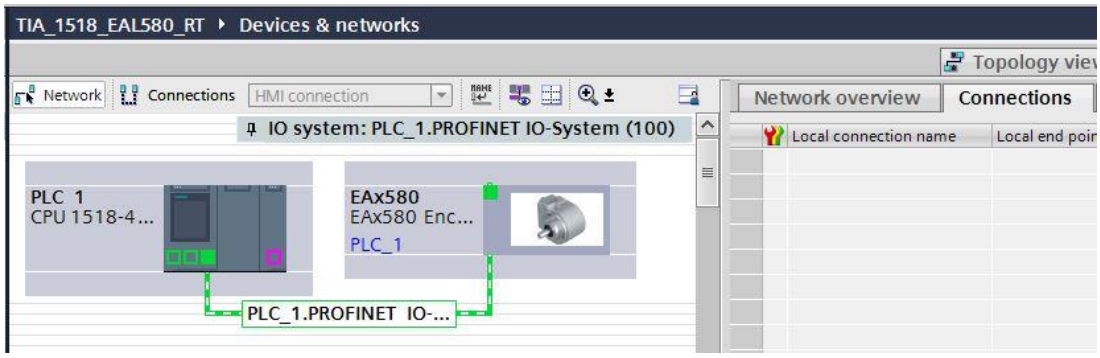
Use the mouse to drag head module „EAx580 encoder“ from the hardware catalog for drop in PLC (framed slot). Next, use the mouse to draw the required connections between PLC and encoder ports.



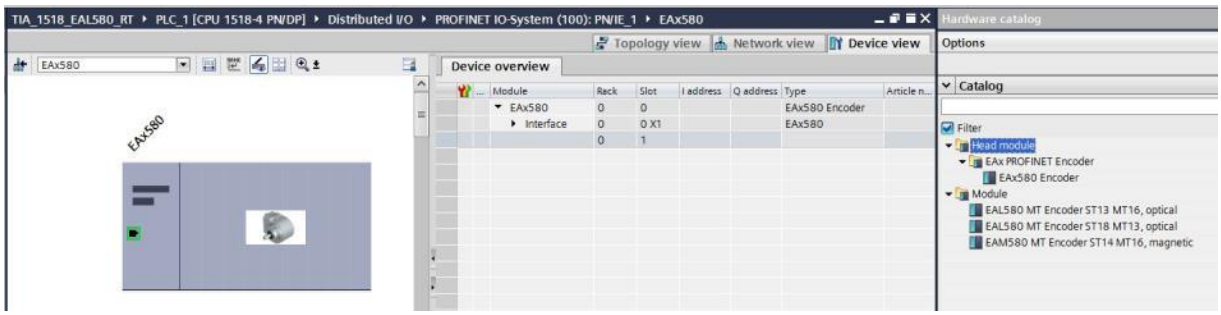
Switching to „network view“ reveals that the encoder has not yet been assigned, meaning that it is not yet connected to the network.



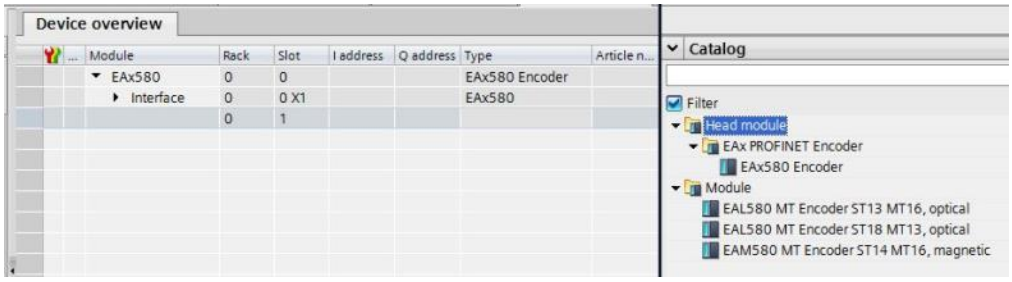
Clicking „not assigned“ provides the available controller connections. After having selected the connection (in the „PLC_1.PROFINET-interface_1“) the encoder assigns to the PLC.



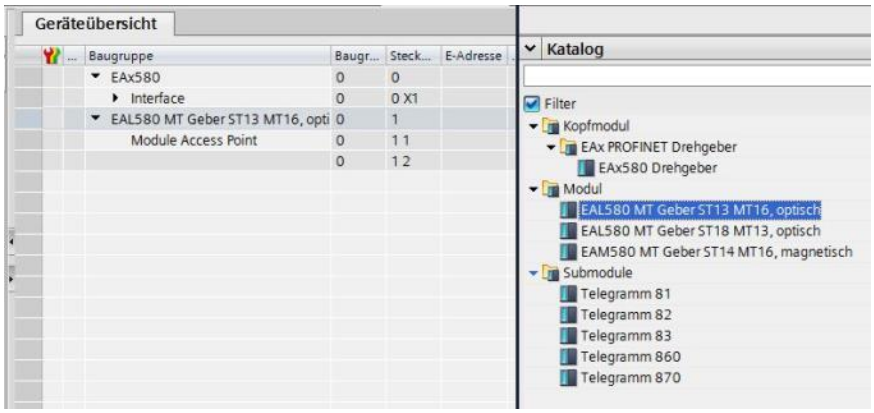
Change to „device view“ and select encoder „EAx580“ provided top left.
The hardware catalog presents the already projected top module and the modules available (different encoder types).



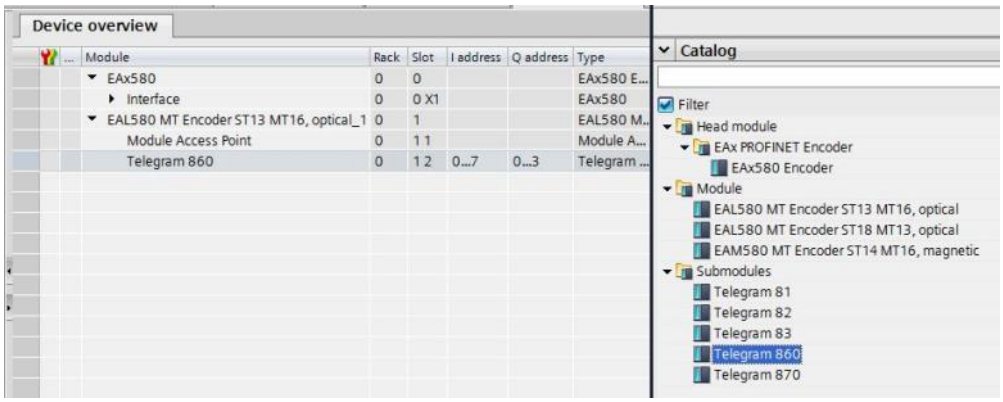
Select module in the hardware catalog (your encoder, e.g. "EAL580 MT Encoder ST13 MT16, optical") and drag and drop in slot 1 below „Interface“.



You are provided with the encoder submodules.



Select the requested submodule (telegram) and drag from hardware catalog to drop in subslot 1.2 (e.g. telegram 860).

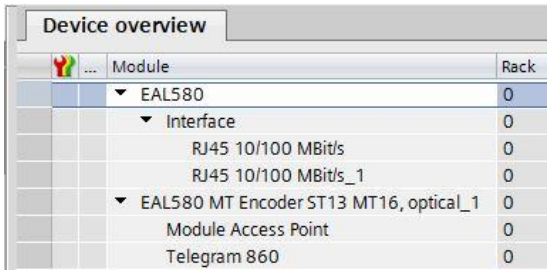


5.3. Device name allocation

Device identification in the network requires the worldwide unique MAC ID, the (statically or dynamically assigned) IP address, and third a unique device name in the PROFINET network. All three identifiers are used during system bootup and during operation. Engineering requires to assign the encoder's device name.

5.3.1. Device name allocation in the project

Double-click the present name of the top module displayed in the device overview and enter desired device name. Default setting is „EAx580". System will not consider writing in upper or lower case.



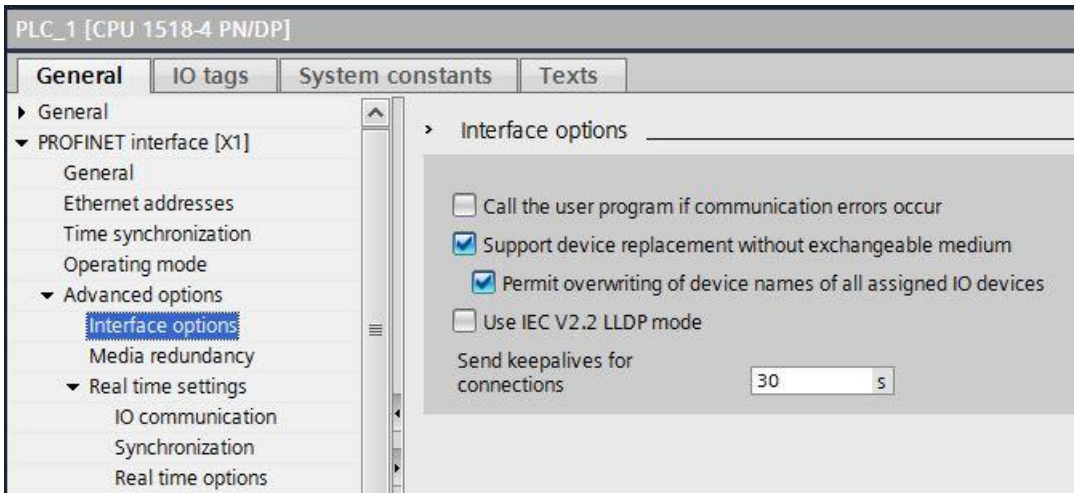
5.3.2. Automated name allocation

The device name can be written automatically into the encoder. In the factory-provided state and after a "factory reset" the device name in the encoder is empty.

Preconditions for automated name allocation:

- A topology planning has been defined.
- The previous device name has been deleted (e.g. by "factory reset") or option "Permit overwriting of device names of all assigned IO devices" (see following screenshot) is enabled.
- Option „Support device replacement without exchangeable medium" (see following screenshot) is enabled.

Automated name allocation is executed as soon as the encoder logs on the network where projected.

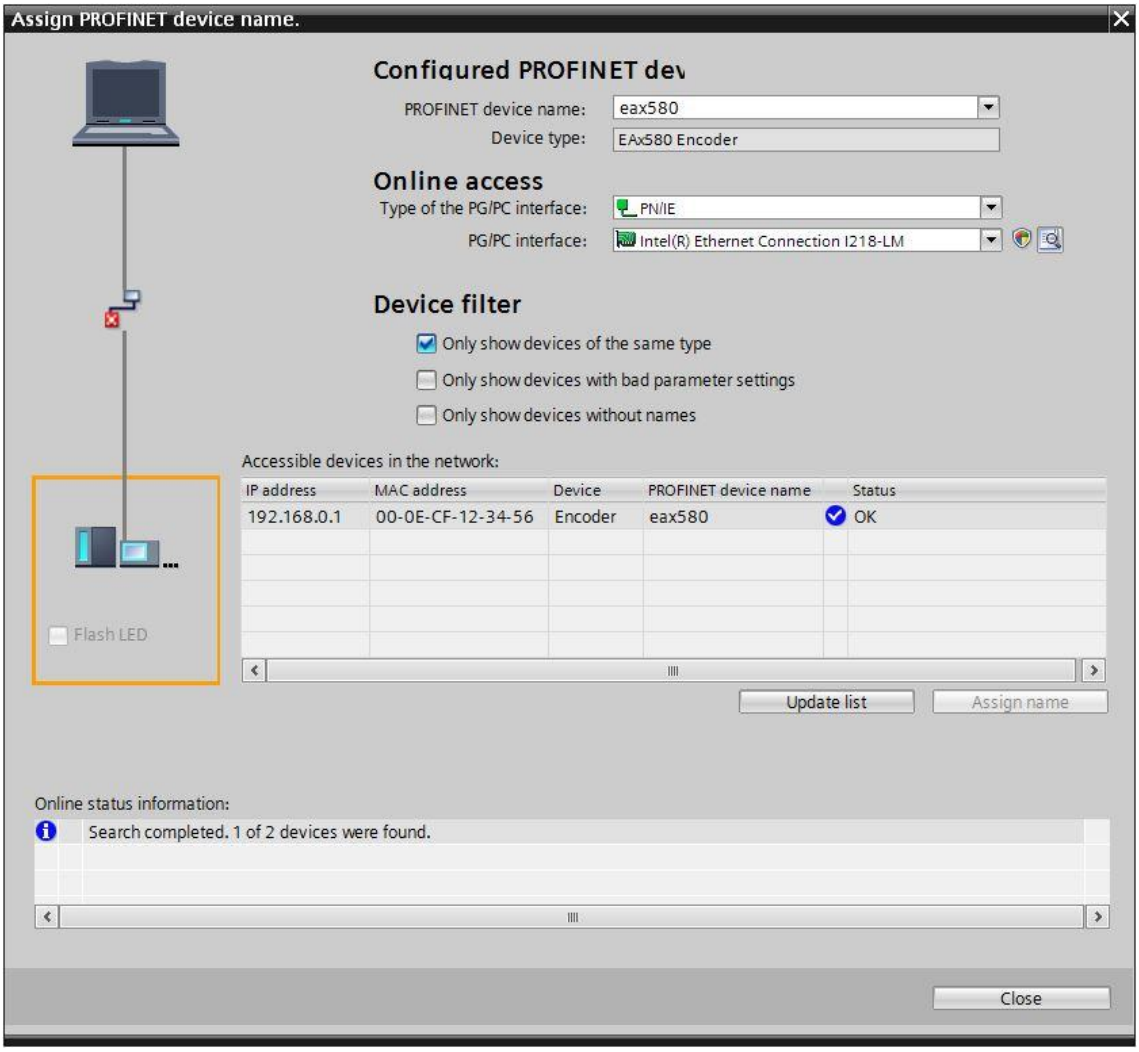


5.3.3. User-operated name allocation

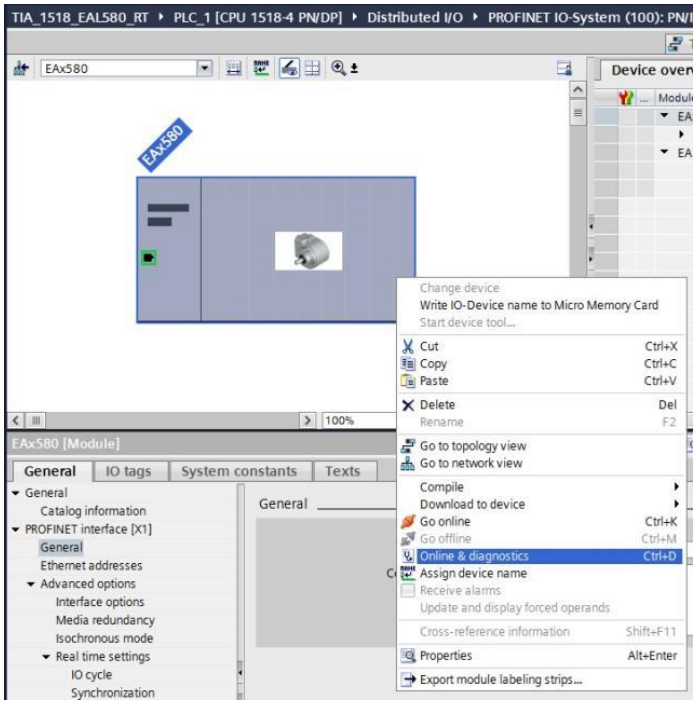
Access encoder device view, either in the topology view or click the encoder icon.

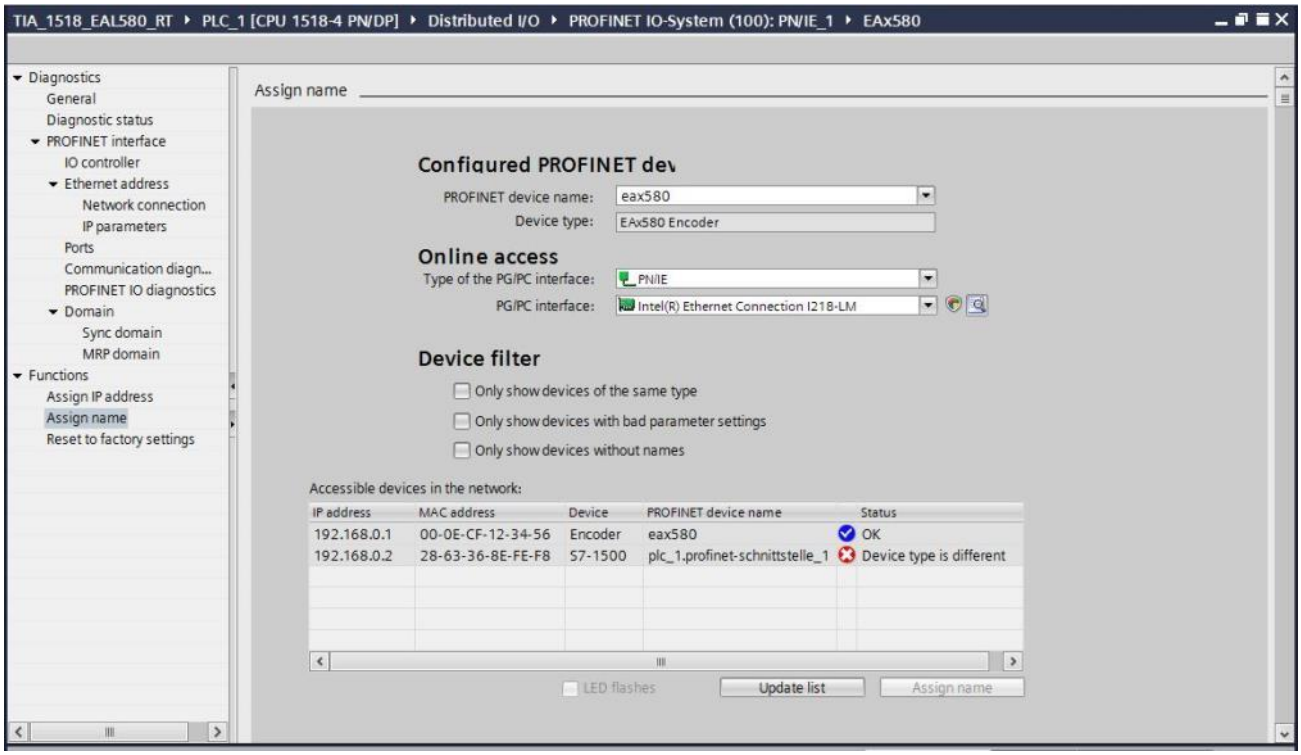
The context menu below the encoder icon (right mouse key) displays option „allocate device name“.

Make sure PG/PC interface settings are correct.
Button „flash“ makes the identified user‘s SF LED flash for clear identification in the bus. In parallel, it is verified whether network connection is present.



Alternatively, user-operated name allocation is accessed in menu item „Online & diagnostics“.





Notes:

- It is not possible to set the device name via the MPI interface.
- When specific device data (for example the station name) is written, the power supply may not be switched off.

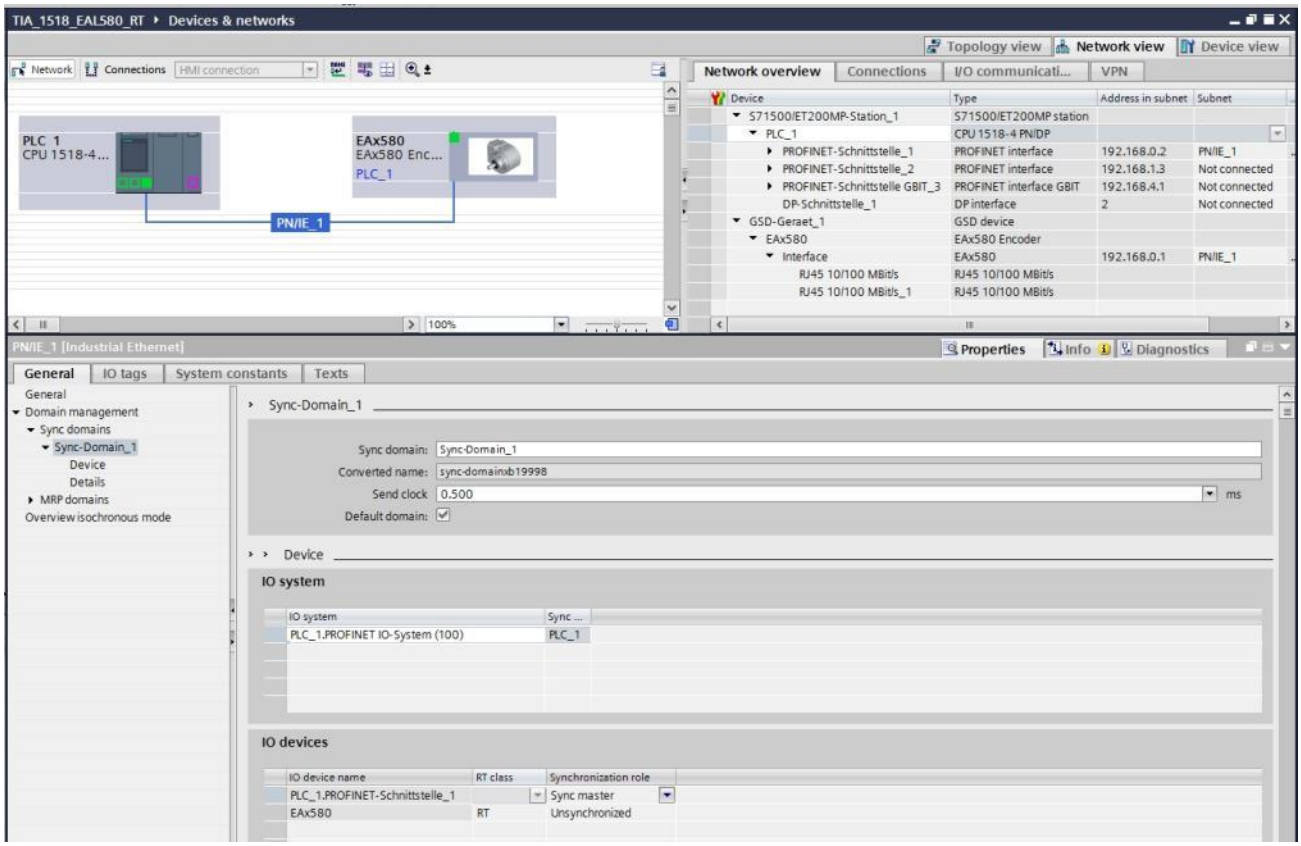
5.4. Real-Time Class Selection

Both PROFINET real-time classes Real-Time (RT) and Isochronous Real-Time (IRT) Class 3 are supported. Which one to use depends on the application and the used PLC.

5.4.1. Domain Management

The Domain Management determines the PROFINET bus properties.

Domain Management is accessed in the TIA Portal® by clicking the I/O system in the network view (here „PN/IE_1“).



Enter selected synchronization clock in „Sync-Domain_1“. The selected clock will be applied by PLC and each device within this sync domain.

Select the PLC’s synchronization role as „Sync master“ (IRT) or “unsychronized” (RT) under „IO devices“ , together with the encoder’s real-time class.

5.4.2. Real-Time (RT) Class 1

In this class a typical cycle time of 100 ms or less is possible. The bus system allows for standard Ethernet components.

Topology planning is not mandatory, but where implemented (e. g. for retrieving feature „support device replacement without exchangeable medium“) make sure ports P1/P2 are correctly assigned as projected.

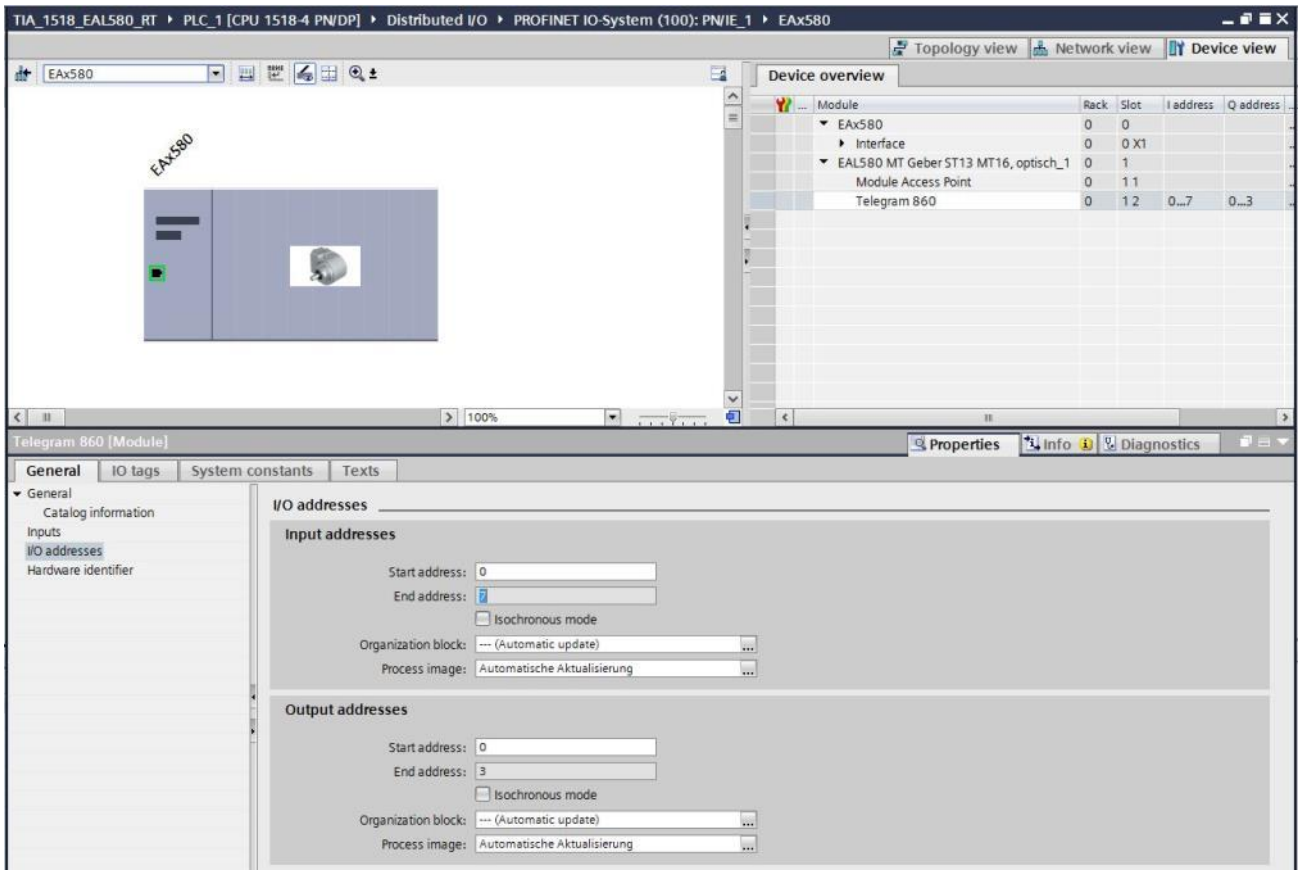
5.4.2.1. Address assignment within the process image

Access to the encoder input and output data takes place via addresses within the PLC's process image. Here, address and process image are assigned.

Mark the projected telegram in the encoder's device view. Click on module window „I/O addresses“ to open the input field.

Enter the start address of the respective address range or accept the system's proposal. Identical or overlapping addresses for input and output are allowed. Make sure addresses are within the cyclic update range of the process image.

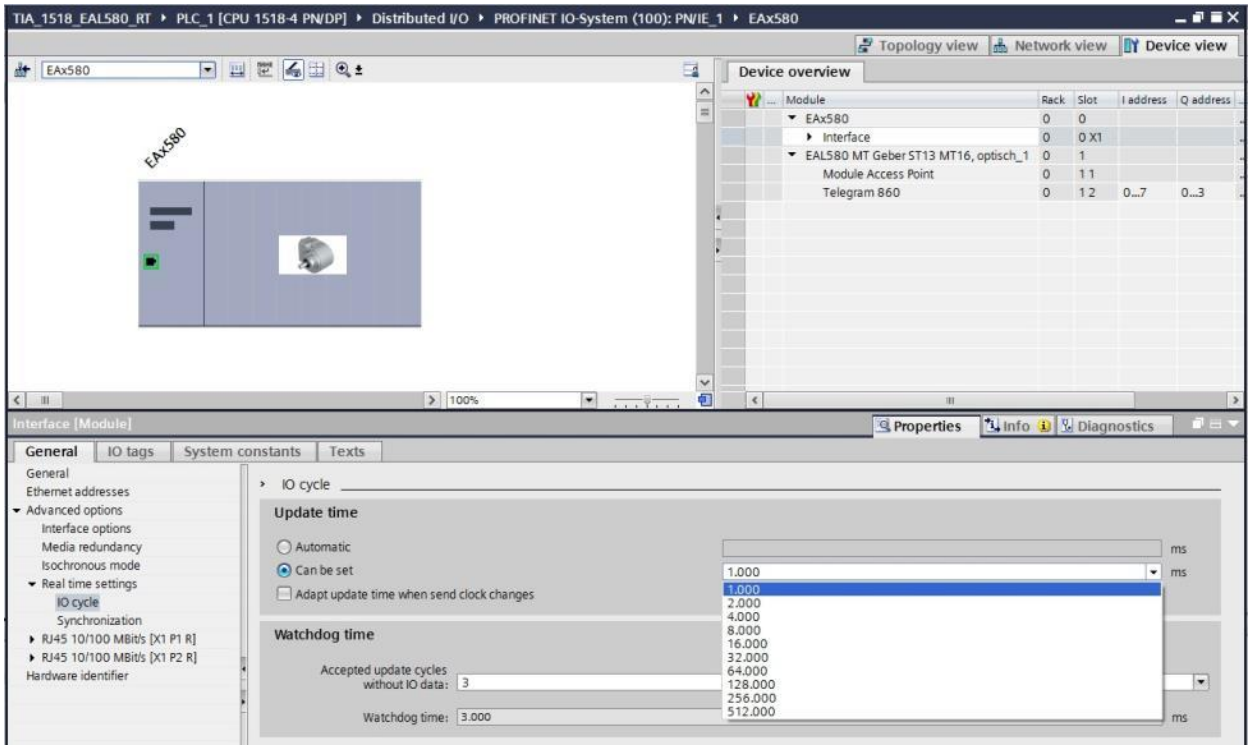
The process image will be that of the cyclic main program OB1 (not synchronized). “Automated Update“ as shown in the screenshot below means system-selected settings, but also manual input is allowed.



5.4.2.2. Selecting the update time

The check boxes „clock synchronous operation“ unchecked will set encoder to RT mode.

Device view -> Interface allows you to select at “Update time” whether the encoder position value shall update with every clock pulse transmitted. Not every application requires updating at such high clock rate. Under certain circumstances, update with every 2nd, 4th or 8th clock pulse transmitted will suffice and save bandwidth at high bus load. Which reduction factor to choose depends on the selected real time class and transmit clock pulse and is seen in the options provided in the drop-down menu.



5.4.3. Isochronous Real-Time (IRT) Class 3

- Isochronous real-time considering signal delays
- Typical cycle time: 1 ms or less

Topology planning is mandatory. Make sure encoder ports P1/P2 are correctly assigned as projected.

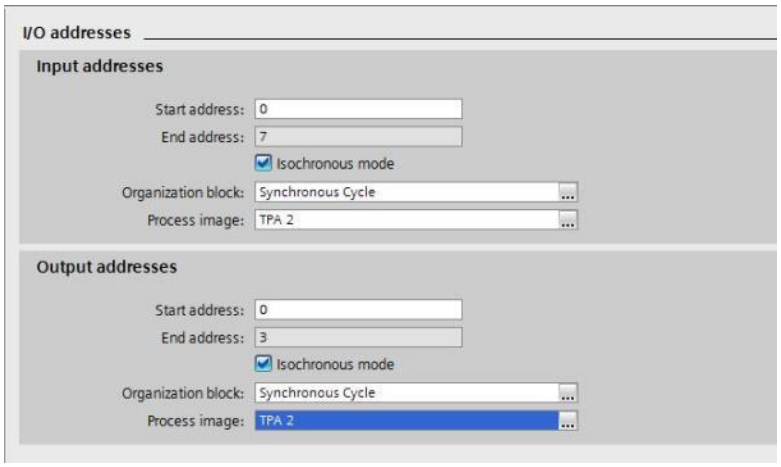
5.4.3.1. Address assignment within the process image

Access to the encoder input and output data takes place via addresses within the PLC's process image. Here, address and process image are assigned.

Mark the projected telegram in the encoder's device view. Click on module window „I/O addresses“ to open the input field.

Enter the start address of the respective address range or accept the system's proposal. Identical or overlapping addresses for input and output are possible. Make sure addresses are within the cyclic update range of the process image.

Here, process image partition (PIP/TPA) is the clock synchronous system function „Synchronous Cycle“ which first needs to be implemented into the project before in order to being accessible for selection (Project navigation -> PLC -> program modules).



5.4.3.2. Selecting the update time

A tick in check boxes „clock synchronous operation“ sets encoder to IRT mode (high performance).

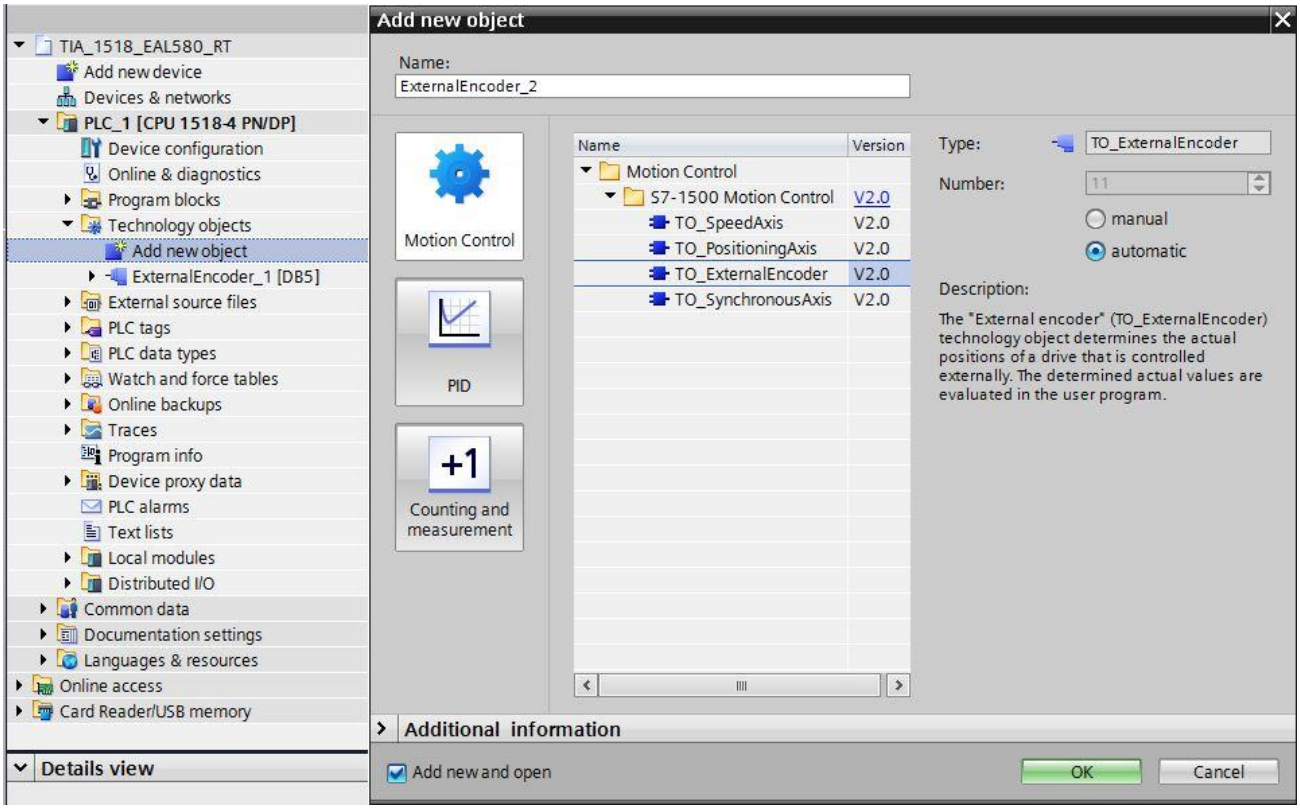
Setting the update time follows the proceedings in chapter “5.4.2.2 Selecting the update time”.

5.4.3.3. Encoder projecting as a technology object

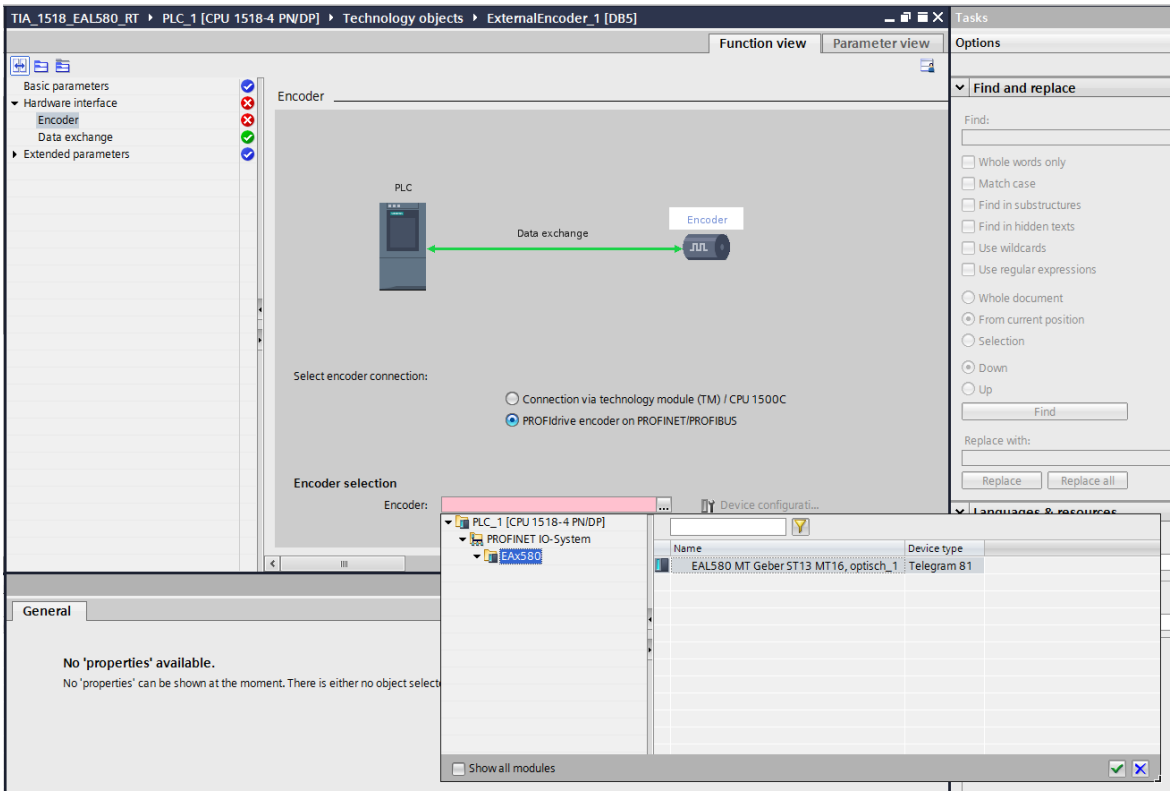
The encoder also allows for configuration as a technology object via TIA Portal®. Settings are analog to „IRT Class 3“ proceedings, see chapter 5.4.3. Precondition however is utilizing either PROFIdrive telegram 81 or 83. Further, PIP/TPA selection is different.

Here, the process image is the process image partition (PIP/TPA) of the clock synchronous system function „MC-Servo“ (OB91) which first needs to be implemented into the project before in order to being accessible for selection (Project navigation -> PLC -> program modules). Program module properties must be assigned to clock-synchronous I/O system and also the time-relevant properties are selected here.

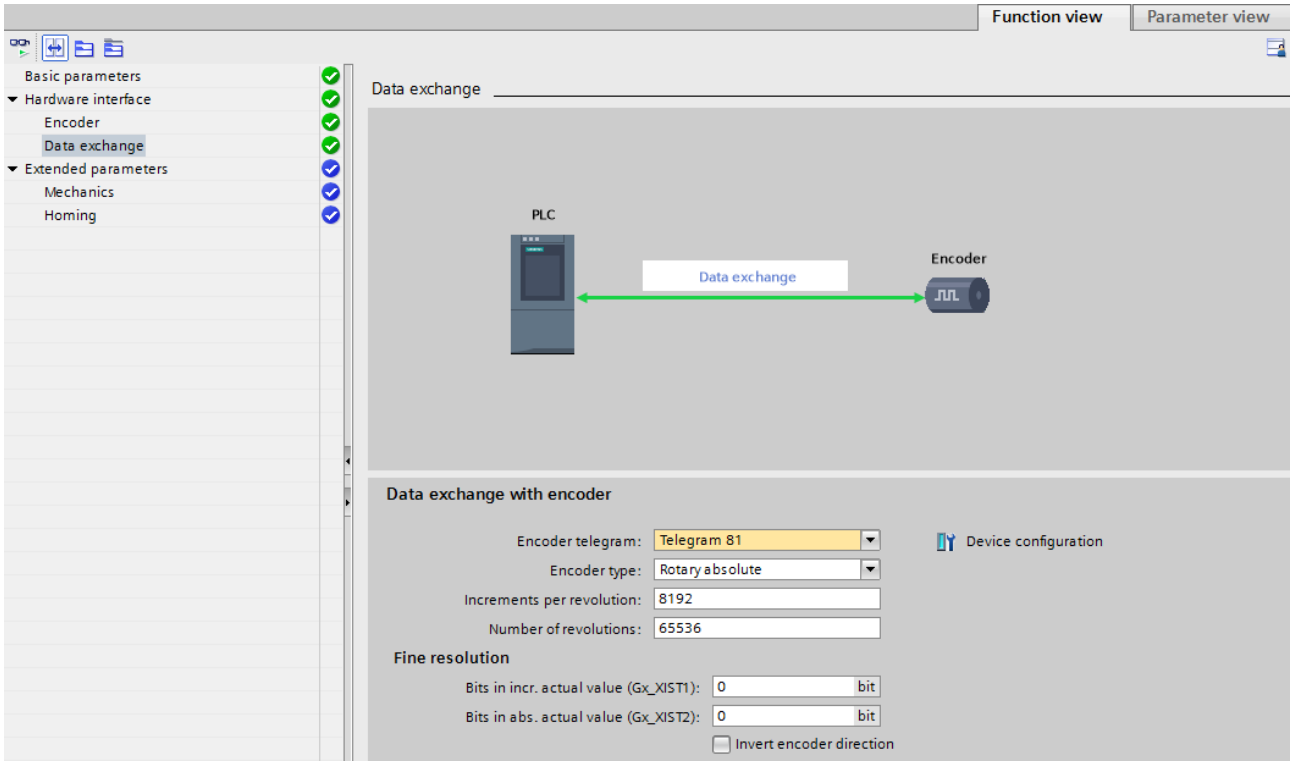
Add technology object „TO_ExternalEncoder“ to the project. The parametrizations in the following screenshots are only examples and may have to be adapted application-specific.



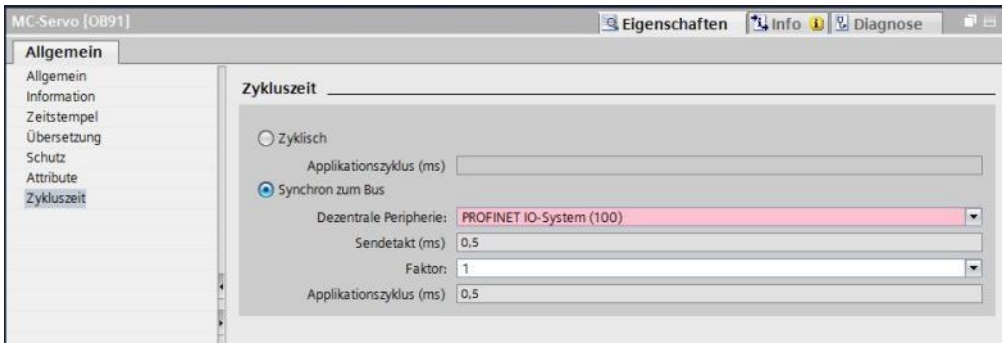
Select PROFIdrive encoder in the technology object properties.



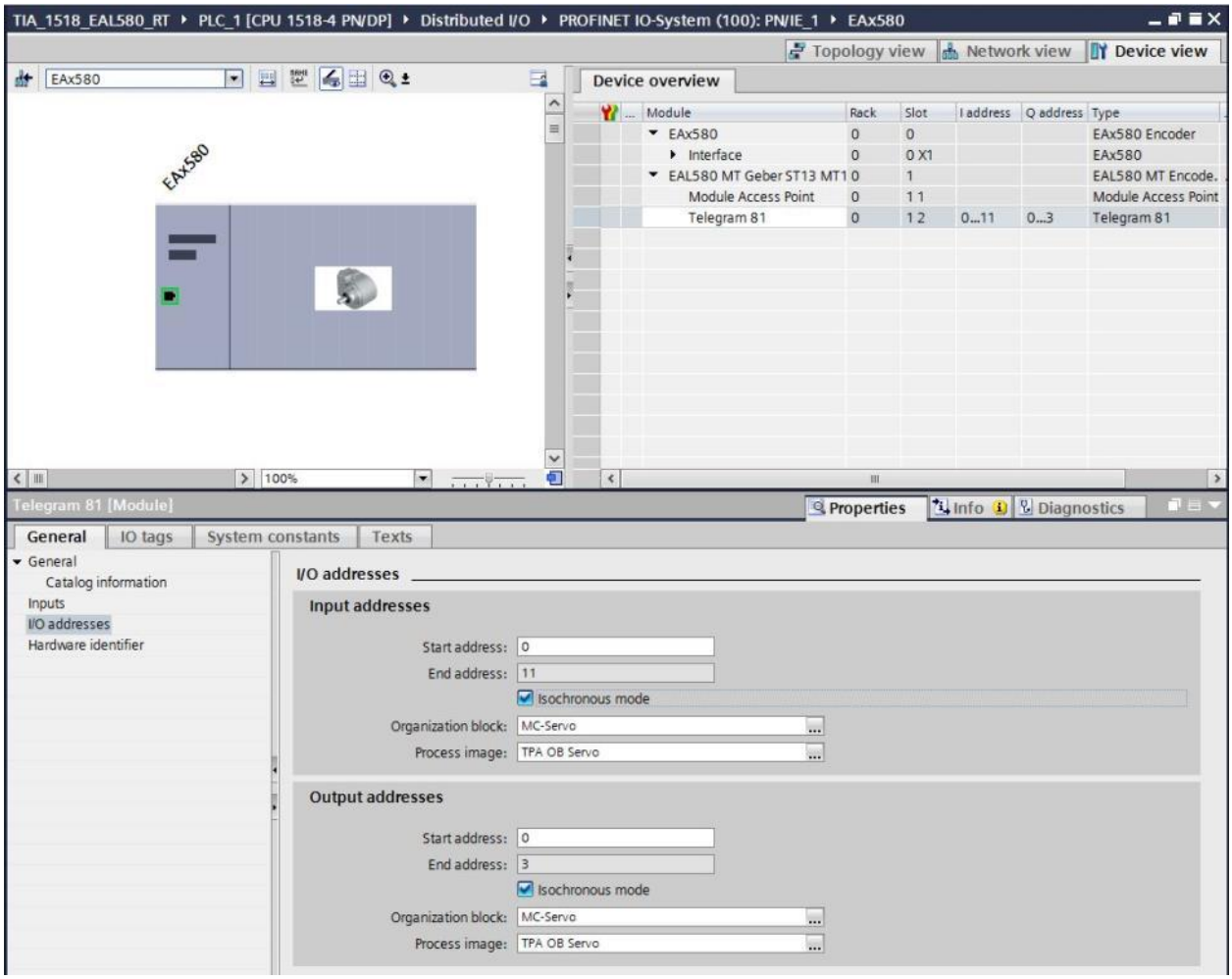
Window „data exchange“ adopts telegram type, singleturn resolution, total number of revolutions as well as the telegram’s bit number in both position values.



In the properties of the clock-synchronous system function „MC-Servo“ (OB91) the assignment to the clock-synchronous I/O system has to be done. Also timing properties can be defined there.



Enter process image partition (PIP) of clock-synchronous system function „MC-Servo“ in the encoder property window.

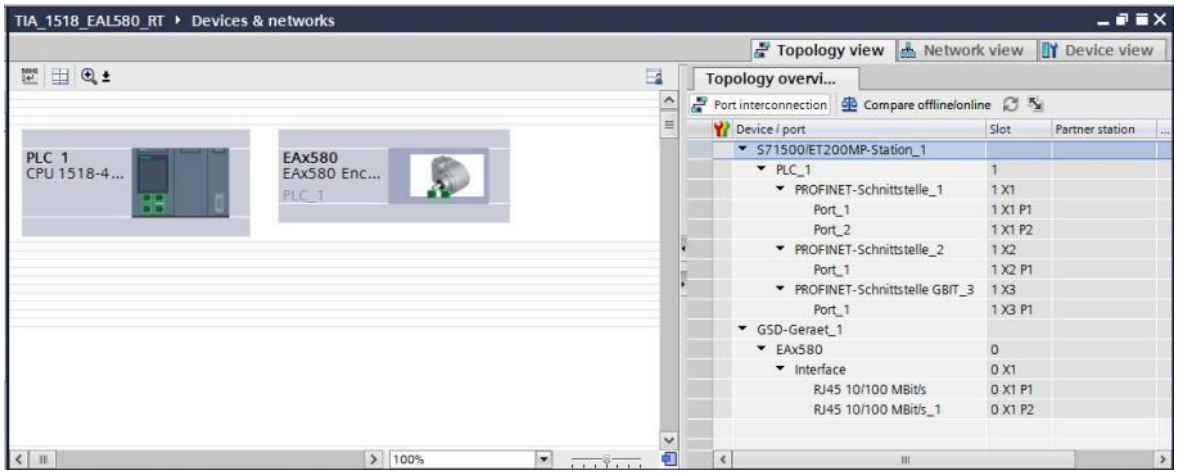

TIA_1518_EAL580_RT ▸ PLC_1 [CPU 1518-4 PN/DP] ▸ Distributed I/O ▸ PROFINET IO-System (100): PN/IE_1 ▸ EAx580
Topology view
Network view
Device view
EAx580
Device overview
Module
Rack
Slot
I address
Q address
Type
EAx580 0 0 EAx580 Encoder
Interface 0 0 X1 EAx580
EAL580 MT Geber ST13 MT1 0 1 EAL580 MT Encode.
Module Access Point 0 1 1 Module Access Point
Telegram 81 0 1 2 0...11 0...3 Telegram 81
100%
Telegram 81 [Module]
Properties
Info
Diagnostics
General
IO tags
System constants
Texts
General
Catalog information
Inputs
I/O addresses
Hardware identifier
I/O addresses
Input addresses
Start address: 0
End address: 11
Isochronous mode
Organization block: MC-Servo
Process image: TPA OB Servo
Output addresses
Start address: 0
End address: 3
Isochronous mode
Organization block: MC-Servo
Process image: TPA OB Servo

5.5. Topology planning

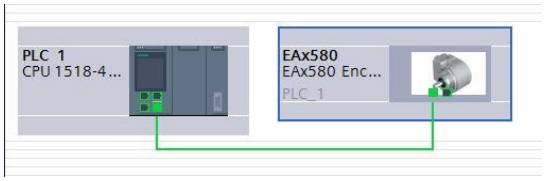
Topology planning is mandatory for IRT Class 3 operation and / or retrieving feature „support device replacement without exchangeable medium“ to communicate component wiring and cable length to the system. This way, the system will consider individual component runtimes for optimum performance.

Topology planning is included in the topology view in TIA Portal®.

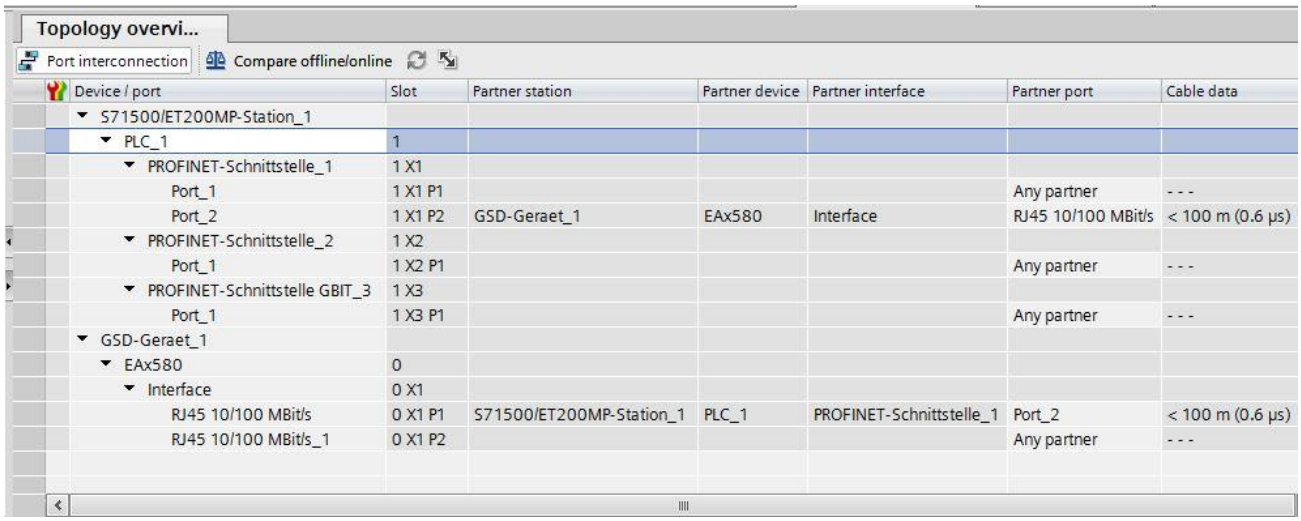
The screenshot below (topology view / topology overview) shows a project without topology planning. PLC (left) and encoder are not interconnected. The table at right does not include any partner data.



To execute topology planning use the mouse to drag a connection between the selected ports and bus users.



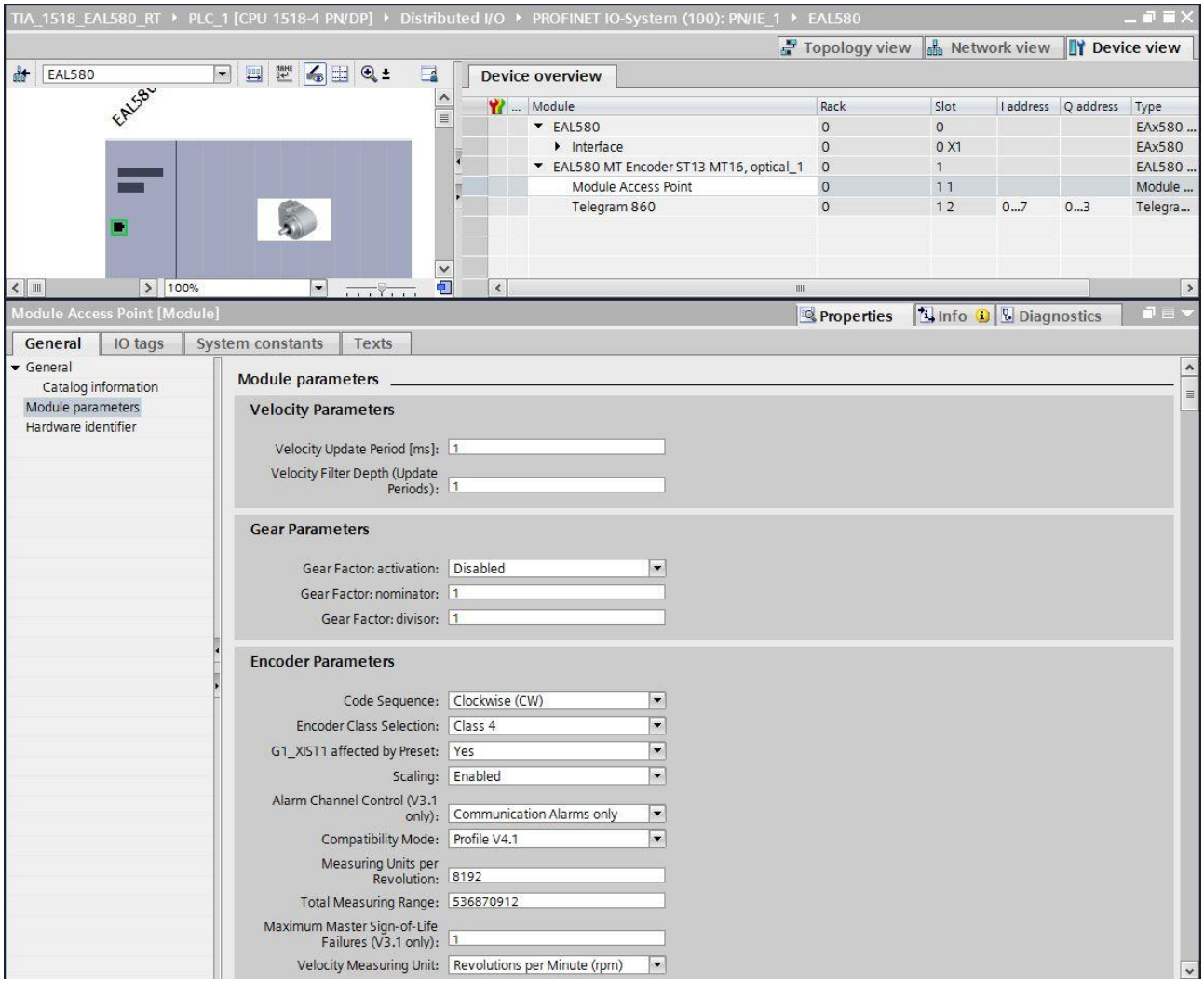
The table now contains partner interface information. The values can be modified as required.



Device / port	Slot	Partner station	Partner device	Partner interface	Partner port	Cable data
S71500/ET200MP-Station_1						
PLC_1	1					
PROFINET-Schnittstelle_1	1 X1					
Port_1	1 X1 P1				Any partner	- - -
Port_2	1 X1 P2	GSD-Geraet_1	EAx580	Interface	RJ45 10/100 MBit/s	< 100 m (0.6 µs)
PROFINET-Schnittstelle_2	1 X2					
Port_1	1 X2 P1				Any partner	- - -
PROFINET-Schnittstelle GBIT_3	1 X3					
Port_1	1 X3 P1				Any partner	- - -
GSD-Geraet_1						
EAx580	0					
Interface	0 X1					
RJ45 10/100 MBit/s	0 X1 P1	S71500/ET200MP-Station_1	PLC_1	PROFINET-Schnittstelle_1	Port_2	< 100 m (0.6 µs)
RJ45 10/100 MBit/s_1	0 X1 P2				Any partner	- - -

5.6. Parameterization

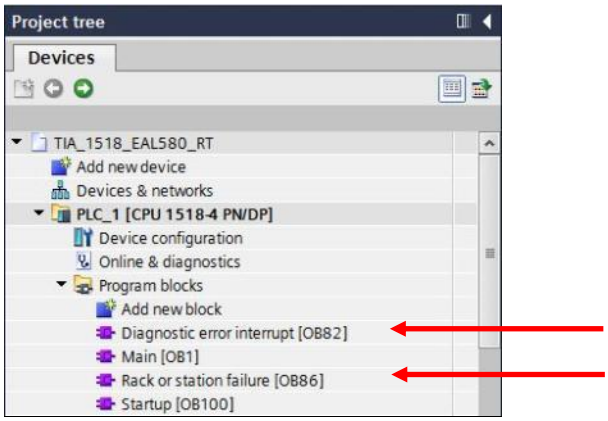
Enter the required encoder parameters in device view / device overview, Module Access Point, „Module parameters“.



For encoder parameter details, see chapter 4.6.1 to 0. Information given there do fully apply to the encoder settings in the TIA Portal®.

5.7. Implementation of system functions for alarm handling

Make sure that the system components required for alarm handling have been implemented in the project. These are in particular OB82 ("I/O Point Fault") and OB86 ("Loss Of Rack Fault"). If these components are missing the PLC will enter state STOP in case of an alarm.



5.7.1. I/O Point Fault OB (OB82)

The supported channel-specific diagnostic alarms are described under 4.7.1 „I/O Point Fault OB“ in the related chapter of Step7®.

5.7.2. Loss Of Rack Fault OB (OB86)

Loss of Rack Fault OB (OB86) is triggered when the encoder is available on the bus after bootup („outgoing event“) or when being no longer accessible because of being switched off or disconnected from the bus („incoming event“).

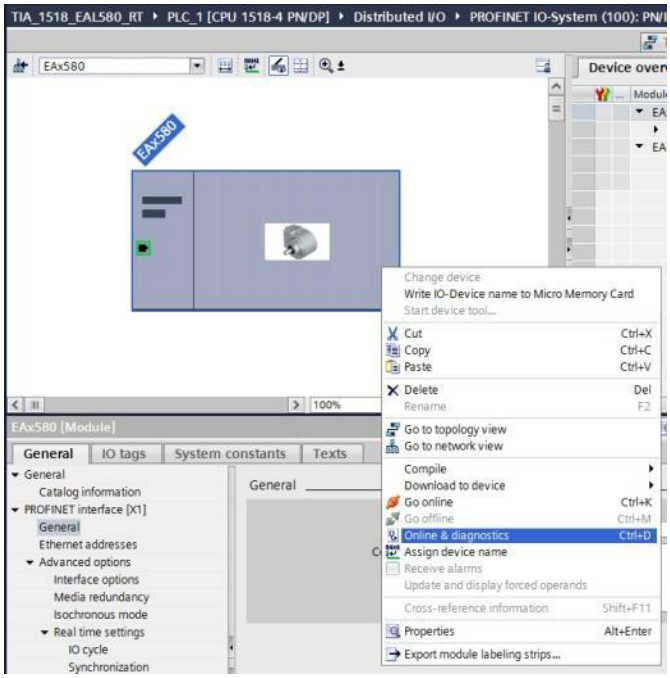
5.8. Compilation and load of hardware and software configuration

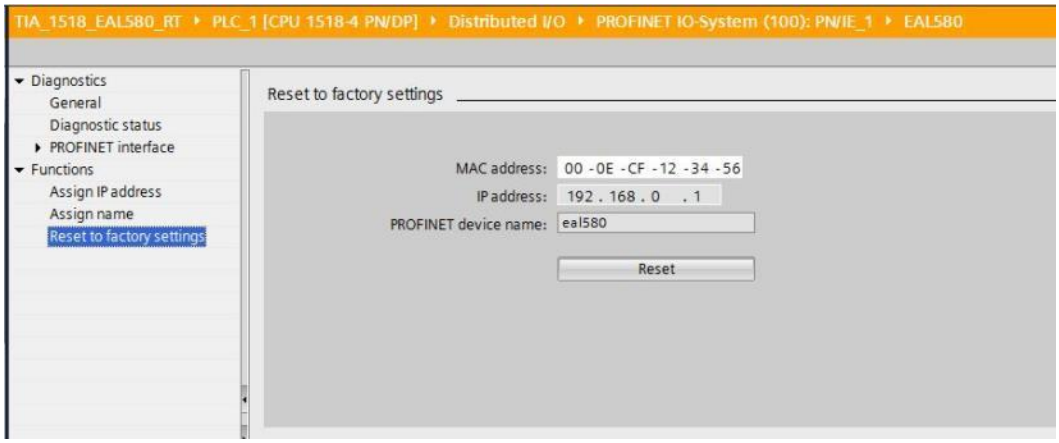
After complete hardware project configuration and once having entered all parameters the project must be compiled („translated“) and exported to the PLC.

5.9. Restore Factory Defaults

5.9.1. Factory Setup using the Engineering Tool

The engineering tool may be used to restore default values in the encoder settings. „Restore Factory Defaults“ is accessed in the device view under context menu item „Online & diagnostics“.





„Reset“ will delete entire the customer configuration including device name and IP. MAC ID and serial number will remain. Switch the encoder off and on after factory setup.

Note 1: Function „Factory Setup“ runs via the IP protocol, i.e. encoder must provide a valid IP address which is known to the TIA Portal®. In the event of both MAC ID and IP address being greyed out or zero as in the above screenshot, go to „connect online“ in the main menu of the project view.

Note 2: The device name being deleted may make the PLC immediately try to allocate the projected name again. If this is unwanted, automated name allocation should be disabled in project „device replacement without exchangeable medium“.

5.9.2. Parameter reset using the optional push button

Depending on the encoder type the encoder may have a screw cap located where connectors and LEDs are located as well. After removing the screw cap the push button is visible.

An encoder with a button is shown in chapter 3.2.3.

In the first 60 seconds after switching on the encoder pushing the button resets the following settings:

- All IP settings (IP address, subnet mask, standard gateway) are set to the value 0.0.0.0.
- The station name („device name“) is set an empty string.

For firmware version 1.2.x this has to be considered:

➔ Resetting of IP settings and station name is only done if the encoder has *no* Ethernet connection.

Since firmware version 1.3.0 this has to be considered:

➔ Resetting of IP settings and station name is done independent of the fact that the encoder has an Ethernet connection or not.

➔ Additionally to resetting of IP settings and station name the following actions are done:

- Reset of following encoder parameters to the following values:

Parameter	Value
Scaling functionality	on
Code sequence	cw
Measuring units per revolution	default value
Total measuring range	default value
“Speed measuring unit”	rpm
“Speed update period”	16 ms
“Speed filter depth”	1
“Gear factor: activation”	off
“Gear factor: numerator”	default value
“Gear factor: denominator”	1
Requested preset value (see PNU 65000)	0

- Reset of the internal preset offset to 0
- Restart (“software reset”) of the encoder

Note:
Prior to using the push button it is strictly recommended to execute a potential equalization between operator and encoder (touching the encoder housing) in order to eliminate the danger of damaging the encoder by electrostatic discharge (ESD).

For firmware version 1.2.x this has to be considered:

- In order to perform a reset the push button must be pressed within 60 seconds after power-on of the encoder for a duration of at least three seconds and longest five seconds.
- After the reset it is necessary to switch the encoder off and on again.

Since firmware version 1.3.0 this has to be considered:

- In order to perform a reset the push button must be pressed within 60 seconds after power-on of the encoder (LEDs blinking red). The button has to be released when the LEDs change from red blinking to green blinking.
- After the reset it is not necessary to switch the encoder off and on again. The encoder performs a restart autonomously.

Note:
The reset using the push button is not fully congruent with the „Factory Setup“ according to PROFINET specification via the DCP protocol (see chapter 5.9.1 „Factory Setup using the Engineering Tool“).

6. PROFINET operation

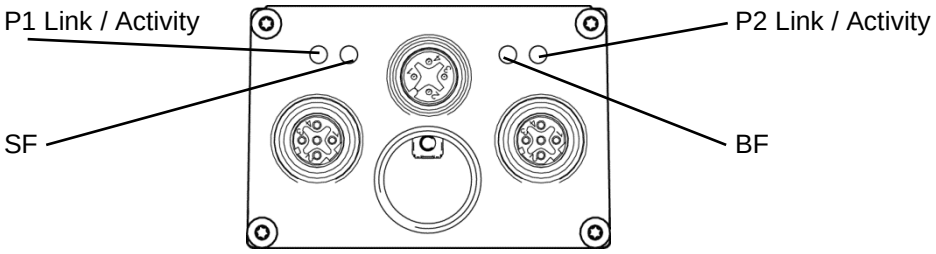
6.1. PLC (IO Controller)

After having connected the encoder and started the IO Controller (PLC) there is an automated PROFINET bootup implicating a comprehensive initialization procedure. The IO Device is assigned an IP address and the communication and application structure is built up.

6.2. Operating status indicator (LEDs)

The encoder provides four Duo LEDs to indicate the device activity status. Provided encoder supply is present the LEDs will be permanently indicating encoder activity as below:

L/A 1 L/A 2	SF	BF	Status
off	off	red	Encoder supply present but no PROFINET connection.
green/yellow flickering	off	red flashing	Encoder supply and network connection present, but encoder not active on the bus.
green/yellow flickering	off	off	Encoder is logged on in the network, active data exchange with PLC.
green/yellow flickering	red	off	Encoder is logged on in the network, active data exchange with controller, but error has occurred.
green/yellow flickering	red flashing		Encoder is logged on in the network, active data exchange with controller. (PROFINET) functionality “DCP Signal” is executed. This means that the encoder is requested to let the SF LED blink in a defined way (according to PROFINET specification) so that one can see where the encoder is located.



BF LED is red after encoder is powered on and red flashing for the time communication with the PROFINET PLC is being established. During connection establishment the BF LED is flashing red.

Once encoder configuration and parameterization are completed (in an automated process), cyclic data transmission starts. BF LED is off while Link/Activity LEDs are flickering in green/yellow. Now cyclic position data transmission to PLC is present.

In the event of a „position jump“ and at speeds exceeding 6400 rpm SF LED is red continuous. The SF LED remains on red for the time the error is present.

A preset value out of the configured total measuring range which is received by the encoder will set SF LED on red continuous until receiving a valid preset value.

Invalid master parameterization (incorrect engineering parameters) results in SF LED remaining on red. The GSDML file prevents many parameterization errors but cannot fully eliminate them.

6.3. Link/Activity (L/A) LEDs

The encoder provides two Duo LEDs to indicate the status of the Ethernet ports. The following table shows the different possible states of the link/activity LEDs.

LED	Color	Status	Description
Link (Port 1 and 2)	Green	On	The device is linked to Ethernet.
	Green	Off	The device has no link to Ethernet.
Activity (Port 1 and 2)	Red	Flickering (load-dependent)	The device sends/receives Ethernet frames.
	Red	Off	The device does not send/receive Ethernet frames.

If the device is linked to Ethernet and sends/receives Ethernet frames the related L/A LED will give a visual impression of a mix of the colors green and red.

6.4. Input and output data

6.4.1. Telegram 870: 32 Bit I/O

The encoder cyclically transmits consistent, right-aligned 4 bytes of input and 4 bytes of output data.

Output data (preset value)
Output data will set the encoder to a defined position within the configured total value range.

	31																												0
Preset	Preset value (right-aligned), bit 31 triggers preset																												

Bit 31: Preset bit (preset will be triggered when value is changed from 0 to 1)

Input data (position value)

	31																												0
Position	Encoder position (right-aligned)																												

6.4.2. Telegram 100: 32 Bit I/O + 16 Bit Speed

Output data is the same as in telegram 870.

Input data (position value and 16 bit speed)

	31																												0
Position	Encoder position (right-aligned)																												

	15															0
Drehzahl	Speed as a signed 16 bit 2's complement value															

6.4.3. Telegram 101: 32 Bit I

This telegram only contains input data. It is an optimized telegram which can be transmitted at a minimal cycle time of 500 microseconds. The telegram contains the raw position (without scaling and preset functionality).

Input data (position value)

	31																												0
Position	Encoder position (right-aligned)																												

6.4.4. Telegram 860: 32 bit I/O + 32 bit Speed

Output data is the same as in telegram 870.

Input data (position value and 32 bit speed)

	31																												0
Position	Encoder position (right-aligned)																												

	31																												0
Speed	Speed as a signed 32 bit 2's complement value																												

6.4.5. PROFIdrive telegram 81

Output data

STW2	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Master Sign-of-Life				**0**	**CP**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

G1_STW1	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	SEA	**PS**	**TAR**	**PR**	**REL**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

- CP: Control by PLC
- SEA: Sensor Error Acknowledge
- PS: Parking Sensor
- TAR: Transfer Absolut Request
- PR: Preset absolute („Request set/shift of home position“)
- REL: Preset relative („Home position mode“)

Input data

ZSW2	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Slave Sign-of-Life				**0**	**0**	**CR**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

G1_ZSW1	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	SE	**PSA**	**TAA**	**PA**	**EAIP**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

G1_XIST1	31																												0
	Encoder position (right-aligned) with or without preset offset																												

G1_XIST2	31																												0
	Encoder position (right-aligned) or error message																												

- CR: Control by PLC („Control Requested“)
- SE: Sensor Error
- PSA: Parking Sensor Active
- TAA: Transfer Absolute Acknowledge
- PA: Preset Acknowledge
- EAIP: Error Acknowledgment In Process

6.4.6. PROFIdrive Telegram 82

Output data: same as in telegram 81
Input data: same as in telegram 81, but in addition speed information NIST_A (16 bit)

Input data

ZSW2	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Slave Sign-of-Life				**0**	**0**	**CR**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

G1_ZSW1	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	SE	**PSA**	**TAA**	**PA**	**EAIP**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

G1_XIST1	31																												0
	Encoder position (right-aligned) with or without preset offset																												

G1_XIST2	31																												0
	Encoder position (right-aligned) or error message																												

NIST_A	15															0
	Speed information as a 16 bit 2's complement															

6.4.7. PROFIdrive Telegram 83

Output data: same as in telegram 81
Input data: same as in telegram 81, but in addition speed information NIST_B (32 bit)

Input data

ZSW2	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Slave Sign-of-Life				**0**	**0**	**CR**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

G1_ZSW1	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	SE	**PSA**	**TAA**	**PA**	**EAIP**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

G1_XIST1	31																											0
	Encoder position (right-aligned) with or without preset offset																											

G1_XIST2	31																											0
	Encoder position (right-aligned) or error message																											

NIST_B	31																											0
	Speed information as a 32 bit 2's complement value																											

6.4.8. Control Word STW2

STW2	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Master Sign-of-Life				**0**	**CP**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Bit	Name	Function
CP	Control by PLC	Set by PLC when transmitting valid control words and setpoints. According to encoder profile 4.1 control words and setpoints will only be accepted if CP bit is set. In compatibility mode of profile V3.1 the CP bit is of no significance so that control words and set points will unconditionally be accepted. Status information and actual values are output independently from the state of the CP bit.
MLS	Master Sign-of-Life	Encoder evaluation of master life sign (MLS) starts as soon as the MLS is non-zero. As soon as master life sign is non-zero, • encoder starts outputting the slave life sign (see ZSW2), • encoder starts monitoring MLS continuity. Any MLS discontinuity is followed by error message 0x0F02 and setting SE bit. MLS monitoring works independently from the state of CP bit.

6.4.9. Control Word G1_STW1

G1_STW1	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	SEA	**PS**	**TAR**	**PR**	**REL**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Bit	Name	Function
REL	Preset Relative	If set, the encoder will perform a relative preset operation when the PR bit is set.
PR	Preset Request	The PR bit set will make the encoder perform a preset operation.
TAR	Transfer Absolut Request	The TAR bit (set by PLC) requests the encoder to transmit position data in G1_XIST2. See also TAA bit in G1_ZSW1.
PS	Parking Sensor	The PLC is able to set the encoder inactive (“park”) using this bit. When the encoder is parked • encoder sets bit PSA (Parking Sensor Active) in G1_ZSW1 and • new errors are not reported anymore.
SEA	Sensor Error Acknowledge	The IO controller requests resetting of errors. The encoder evaluates the signal statically (no edge detection).

Prioritization of bits

Priority	Bit	
1	PS	The PS bit has the highest priority.
2	SEA	The SEA bit has the second highest priority (only if an error state is present).
3	PR	The PR bit has the third highest priority.
4	TAR	The TAR bit has the lowest priority.

6.4.10. Status Word ZSW2

ZSW2	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Slave Sign-of-Life				**0**	**0**	**CR**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Bit	Name	Function
CR	Control Requested	“Control by PLC requested” In profile 4.1 the bit remains on set as long as no parameter error is present. In compatibility mode of profile V3.1 the bit remains 0.
SLS	Slave Sign-of-Life	First, the Slave Sign-of-Life (SLS) has the value 0. As soon as the MLS being non-zero the encoder starts monitoring the MLS continuity and outputs the slave life sign (see also STW2). The SLS will not be zero again. Exception: When the MLS does not increment as expected the SLS will be zero (error case).

6.4.11. Status Word G1_ZSW1

G1_ZSW1	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	SE	**PSA**	**TAA**	**PA**	**EAIP**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Bit	Name	Function
EAIP	Error Acknowledge-ment In Process	This bit is part of the error handling. • Encoder recognizes error. • Encoder sets SE bit in G1_ZSW1 and error code in G1_XIST2. • IO Controller recognizes the error and sets the SEA bit in G1_STW1. • Encoder sets the EAIP bit. • IO Controller clears the SEA bit in G1_STW1.
PA	Preset Acknowledge	Bit is set by encoder after the preset operation has been successfully completed. Encoder resets the bit when PR bit is reset by IO Controller.
TAA	Transfer Absolute Acknowledge	The bit is set as soon as G1_XIST2 supplies valid position data and will be reset when the SE or PSA bit is set.
PSA	Parking Sensor Active	Acknowledgement reaction on PS bit of G1_STW1
SE	Sensor Error	The bit is set as soon as the encoder has identified an error. Error code is presented in G1_XIST2. Bit TAA is reset. Error codes in G1_XIST2: • 0x0001 position error • 0x0F01 invalid command in G1_STW1 • 0x0F02 failure of Master Sign-of-Life

6.5. Speed

PROFIdrive telegrams 82 and 83 as well as manufacturer-specific telegrams 100 and 860 provide the speed value and the absolute position value.

It is possible to use a filter (calculation of average value) for the calculation of the speed value. For the configuration of the filter both parameters “Speed Update Period” and “Speed Filter Depth” are used. In chapters “6.5.2 Speed Update Period” and “6.5.3 Speed Filter Depth” details can be found.

When a gear factor is used the following has to be considered for the calculation of the speed value:
- The gear factor is not taken into account in the speed value.
- The speed value refers to the drive side.

6.5.1. Speed Measuring Unit

The measuring unit for the speed value is defined by parameter “Velocity Measuring Unit” of the encoder parameters.

The following scaling options are possible:
- rpm revolutions per minute
- steps/10ms number of steps (in the configured singleturn resolution) per 10 ms
- steps/100ms number of steps (in the configured singleturn resolution) per 100 ms
- steps/1000ms number of steps (in the configured singleturn resolution) per second

For each scaling option the measured value is provided as a „signed integer“. Positive values indicate the direction of rotation with rising position values. Which rotational direction is assigned “positive” depends on the CW/CCW parameter setting.

6.5.2. Speed Update Period

The time window for the update of the speed value is defined by parameter “Velocity Update Period [ms]” of the encoder parameters.

A short speed update period entails a more dynamic speed output, whereas an extended update period ensures more stable values. The optimum speed update period depends on the requirements of the application.

The update period can be configured within a range from 1 ms to 255 ms.

The update time of the speed value shall be an integer multiple of the PROFINET bus cycle time. Additionally it must be pointed out that the update time of the speed value shall not be smaller than the PROFINET bus cycle time. An update time of the speed value of for example 1 ms at a PROFINET bus cycle time of 2 ms would not be accepted.

6.5.3. Speed Filter Depth

The filter depth is defined by parameter “Velocity Filter Depth (Update Periods)” of the encoder parameters.

A shallow filter depth entails a more dynamic speed output, whereas a higher filter depth ensures more stable values. The optimum speed filter depth in interaction with the configured speed update time depends on the requirements of the application.

The filter depth is configurable within the range from 1 to 255.

6.6. Preset function

The preset function in the encoder is triggered as soon as the PLC sets the “preset bit” (see below) in the output data. The encoder position is set to the given preset value.

For optimum alignment of mechanical position to preset we recommend to set the preset value during encoder standstill. But for lower requirements it may also be executed while encoder rotates.

It is mandatory to parameterize the required resolution or code sequence (cw/ccw) prior to performing the preset operation.

Upon performing a preset operation an internal offset (see subindex 8 of PNU 65001) is calculated and stored non-volatile in the FLASH memory to make sure the encoder will be at the same position after cycling power.
Although the FLASH provides typically 100000 write cycles, frequent software-triggered or event-triggered preset operations may consume even this capacity what has to be considered in the PLC software configuration.

Note:
Any alteration of the total measuring range, measuring units per revolution or of a gear factor parameter during encoder re-parameterization will implicate clearing the internal preset offset value. This however has no effect in practice since in these cases the position reference is lost anyway.

6.6.1. Preset in standard telegrams

Bit 31 in the 32 bit output data word is the preset bit. The lower bits (bit 30…0) hold the right-aligned position value which is adopted by the encoder in the preset operation.

The preset bit must be kept set for at least one full bus update cycle to be recognized by the encoder. A timer control of e. g. 10 ms or more will do as well. The preset bit may stay active for an unlimited period of time since only a change from „0“ to „1“ will be evaluated. We recommend however to clear the bit after completion in order to provide the original status for a subsequent preset operation.

6.6.2. Preset in PROFIdrive telegrams 81 to 83

A preset operation in control word STW2 requires the PLC having bit CP (Control by PLC) set. The TAR bit must not be set at the time of the preset operation.

The REL bit in control word G1_STW1 defines whether an absolute or relative preset operation will be performed. In a relative preset operation the current position value will be shifted by the preset value.

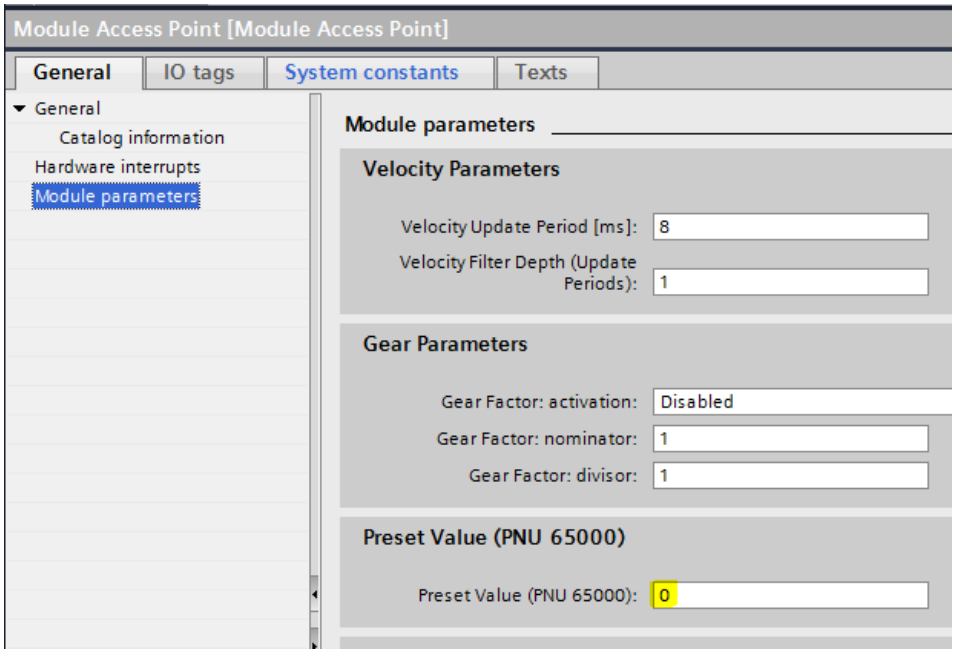
The PR bit in G1_STW1 is the preset bit. The encoder executes the preset when the preset bit changes from “0” to “1”. Once successfully completed bit PA (preset acknowledge) is set in status word G1_ZSW1. The PA bit remains active as long as the preset bit remains set by PLC.

The preset value is retrieved from the value stored in parameter 65000 (see chapter 7.4.17 „Parameter 65000: Preset Value“).

Since firmware version 1.3.0 this has to be considered:
It is possible to set the preset value (PNU 65000) directly in the “module parameters”. This means that the PLC writes PNU 65000 during startup of the encoder.

➔ **To be able to use this functionality the following GSDML file has to be used: “GSDML-V2.32-Baumer-EAx580_PN-20190715.xml”**

The following figure shows the preset value in the “module parameters” in TIA portal.



The preset value can be set to a value unequal 0. To do this no program, PLC function block or similar things are necessary. If one of the PROFIdrive telegrams 81 to 83 is used and a preset is triggered (in operation) the value in PNU 65000 is used as preset value.

This functionality is for example very useful if the desired preset value does not change during operation.

6.6.3. Preset using the Push Button

Depending on encoder type, the encoder may have a screw cap located where connectors and LEDs are located as well. After removing the screw cap, the preset / reset push button is visible.

While the encoder is connected to the PROFINET a preset can be performed using the push button. The preset sets the encoder position to the value held in parameter PNU 65000. The contained position value will be interpreted absolute, as a relative preset is not possible using the push button.

Note:
Prior to using the push button it is strictly recommended to execute a potential equalization between operator and encoder (touching the encoder housing) in order to eliminate the danger of damaging the encoder by electrostatic discharge (ESD).

For firmware version 1.2.x this has to be considered:
In order to perform a preset the push button must be pressed for a duration of at least three seconds and longest five seconds.

Since firmware version 1.3.0 this has to be considered:

- In order to perform a preset the push button must be pressed (LEDs blinking red). The button has to be released when the LEDs change from red blinking to green blinking.
- It is possible to set the preset value (PNU 65000) in the “module parameters”. This means that the PLC writes PNU 65000 during startup of the encoder. Details can be found in chapter “6.6.2 Preset in PROFIdrive telegrams 81 to 83”.
  To be able to use this functionality the following GSDML file has to be used: “GSDML-V2.32-Baumer-EAx580_PN-20190715.xml”.

7. Acyclic parameters

7.1. Acyclic data communication

Besides cyclic process data communication the encoder provides optional acyclic data block readout. Cyclic and acyclic data communication run in parallel and independently of each other. Acyclic data can be I&M data, PROFIdrive-specific parameters, encoder-specific parameters and parameters linked to the PROFINET interface.

7.2. I&M functions (identification and maintenance)

The encoder supports the “I&M 0” record according to encoder profile 3162 V4.1. chapter 5.4.3.3.
The access (read-only) is done via a record with index 0xAFF0.

I&M data block:

Block Header	Block Type	WORD	0x0020
	Block Length	WORD	0x0038
	Block Version High	BYTE	0x01
	Block Version Low	BYTE	0x00
I&M Block	MANUFACTURER_ID	WORD	0x012A (Baumer)
	ORDER_ID	BYTE[20]	ASCII
	SERIAL_NUMBER	BYTE[16]	ASCII
	HARDWARE_REVISION	WORD	
	SOFTWARE_REVISION	BYTE[4]	
	REV_COUNTER	WORD	0x0000
	PROFILE_ID	WORD	0x3D00
	PROFILE_SPECIFIC_TYPE	WORD	0x0001
	IM_VERSION (major)	BYTE	0x01
	IM_VERSION (minor)	BYTE	0x01
	IM_SUPPORTED	WORD	0x001E

The encoder also supports the records “I&M 1” to “I&M 4” in compliance to IEC 61158-6-10 (PROFINET).
The access (both read and write) is done via the records 0xAFF1 to 0xAFF4.

7.3. Base Mode Parameter

The access to parameters is done using the “Base Mode Parameter Access – Local” (record data object 0xB02E, according to PROFIdrive profile V4.1 chapter 6.2.3).

The encoder supports “single parameter access” and subindices. The maximum length of a parameter access is 240 bytes.

7.3.1. Write access

The write access to a parameter is done by

- a “Write Request” by the IO Controller (request contains parameter number and user data to be written)
- a “Write Response” of the IO Device (encoder), a “formal acknowledge”

7.3.2. Read access

The read access to a parameter is done in several steps:

- “Write Request” by the IO Controller (here amongst others it is transmitted which parameter shall be read)
- “Write Response” from the IO Device (encoder), a “formal acknowledge”
- “Read Request” by the IO Controller
- “Read Response” of the IO Device (including the requested user data of the parameter)

7.3.3. Base Mode Parameter Access

The parameter access is done by a “request block” with the segments:

- Addressing (slot, subslot, index)
- Request Header
- Parameter Address
- Parameter Value

Write Request

Slot			BYTE	ever 0x01
Subslot			BYTE	ever 0x01
Index			WORD	ever 0xB02E
Data Length			BYTE	from this point onward (excl.)
Data	Request Header	Request Reference	BYTE	optional
		Request ID	BYTE	0x01= “Read” / 0x02 = “Write“
		Drive Object ID	BYTE	ever 0x00
		Number of Parameters	BYTE	ever 0x01
	Parameter Address	Attribute	BYTE	
		No. of Elements/Values	BYTE	
		Parameter Number	WORD	
		Subindex	WORD	
	Parameter Value	Format / Data Type	BYTE	only for “Write Request”
		Number of values	BYTE	only for “Write Request”
		Values to write (if any)	BYTE	only for “Write Request”

Write Response

Slot			BYTE	ever 0x01
Subslot			BYTE	ever 0x01
Index			WORD	ever 0xB02E
Data Length			BYTE	from this point onward (excl.)

Read Request

Slot			BYTE	ever 0x01
Subslot			BYTE	ever 0x01
Index			WORD	ever 0xB02E
Data Length			BYTE	from this point onward (excl.)

Read Response

Slot			BYTE	ever 0x01
Subslot			BYTE	ever 0x01
Index			WORD	ever 0xB02E
Data Length			BYTE	from this point onward (excl.)
Data	Response Header	Response Reference	BYTE	see request (mirrored)
		Response ID	BYTE	see request (mirrored)
		Drive Object ID	BYTE	ever 0x00
		Number of Parameters	BYTE	ever 0x01
	Parameter Value	Format / Data Type	BYTE	
		Number of values	BYTE	Number of values (not bytes)
		Values	see Format	

Data types

Field “Format / Data Type” applies following encodings according to IEC61158-5-10:

- 0x04 INT32 (32 bit / 4 bytes signed)
- 0x06 UINT16 (16 bit / 2 bytes unsigned)
- 0x07 UINT32 (32 bit / 4 bytes unsigned)
- 0x0A octet string (8 bit / 1 byte)

7.4. Supported parameters

7.4.1. PROFIdrive Parameters

P922: Telegram selection
P925: Number of Controller Sign-Of-Life failures which may be tolerated
P964: Drive Unit identification
P965: Profile identification number
P974: Base Mode Parameter Access service identification
P975: DO identification
P979: Sensor format
P980: Number list of defined parameter

7.4.2. Interface Parameters

P61000: NameOfStation (read-only)
P61001: IpOfStation (read-only)
P61002: MacOfStation (read-only)
P61003: DefaultGatewayOfStation (read-only)
P61004: SubnetMaskOfStation (read-only)

7.4.3. Encoder Parameters

P65000: Preset value
P65001: Operating status

7.4.4. Parameter 922: Telegram selection

Read: Parameter reads the configured telegram type.

Type 81: PROFIdrive telegram 81
Type 82: PROFIdrive telegram 82
Type 83: PROFIdrive telegram 83
Type 860: Standard telegram with “32 bit I/O + 32 bit speed”
Type 870: Standard telegram with “32 bit I/O”
Type 100: Manufacturer-specific telegram with “32 bit I/O + 16 bit speed”
Type 101: Manufacturer-specific telegram with “32 bit I”

Parameter	922
Type	Read only
Data type	unsigned int (0x06)
Value range	81-83 (0x0051 – 0x0053), 86-87 (0x0056 – 0x0057), 100 (0x64), 101 (0x65)
Data: 922[0]	Telegram type

Value in parameter 922	Telegram
81	PROFIdrive telegram 81
82	PROFIdrive telegram 82
83	PROFIdrive telegram 83
86	Telegram 860 „32 bit I/O + 32 bit speed”
87	Telegram 870 „32 bit I/O“
100	Telegram 100 „32 bit I/O + 16 bit speed” (manufacturer-specific)
101	Telegram 101 „32 bit I” (manufacturer-specific)

7.4.5. Parameter 925: Number of Controller Sign-Of-Life failures which may be tolerated

Read: The parameter is to read the number of tolerated Master Sign-of-Life failures.
Only when running according to profile 3.1 this parameter will be considered.
When running according to profile 4.1 the number is always 1.

Parameter	925
Type	Read / write
Data type	unsigned int (0x06)
Value range	1 to 255 / value 0xFFFF means “Sign-of-Life” monitoring off
Data: 925[0]	Total number of tolerated Sign-of-Life failures of the IO Controller

Write: The parameter is to write the number of tolerated Master Sign-of-Life failures.
Only when running according to profile 3.1 this parameter will be considered.
When running according to profile 4.1 the number is always 1.

Parameter	925
Type	Read / Write
Data type	unsigned int (0x06)
Value range	1 to 255 / value 0xFFFF means “Sign-of-Life” monitoring off
Data: 925[0]	Total number of tolerated Sign-of-Life failures of the IO Controller

Note:
Writing this parameter is only possible when Master Lifesign is inactive.

7.4.6. Parameter 964: Drive Unit identification

Read: This parameter is to read a data set for encoder (IO Device) identification.
See also parameter 975.

Parameter	964	
Type	Read-only	
Data type	unsigned int (0x06)	
Value range	n/a	
Data: 964[0]	0x012A	MANUFACTURER_ID
964[1]	0x0001	Drive Unit Type (manufacturer-specific)
964[2]	0x0064	Firmware version (example only, 0x0064 = 100)
964[3]	0x07E0	Firmware year (example only, 0x07E0 = 2016)
964[4]	0x0134	Firmware day and month (example only, 0x0134 = 308 means „August 3rd“)
964[5]	0x0001	Number of Drive Objects

7.4.7. Parameter 965: Profile identification number

Read: This parameter is to read the profile ID (0x3D00) of encoder profile 3162 in abbreviation „3D“ as well as the applicable (configured) version V3.1 or V4.1.

Parameter	965	
Type	Read-only	
Data type	Octet string (0x0A)	
Value range	n/a	
Data: 965[0]	0x3D	Profile ID: 0x3D
965[1]	0x1F of 0x29	Profile version: V3.1 (31 = 0x1F) or V4.1 (41 = 0x29)

7.4.8. Parameter 974: Base Mode Parameter Access service identification

Read: Parameter „Base Mode Parameter Access service identification“ is to read out three parameter channel properties: maximum data length, multi-parameter-access capability and maximum processing time to access for customer-specific timeout.

Parameter	974	
Type	Read-only	
Data type	unsigned int (0x06)	
Value range:	n/a	
Data: 974[0]	0x00F0	max. data length (240)
974[1]	0x0027	max. number of parameter requests per multi-parameter request
974[2]	0x0000	max. processing time to access

7.4.9. Parameter 975: DO identification

Read: Parameter „Encoder Object Identification“ is to read out drive unit type, data object type, firmware version and date as well as drive object (DO) type class, subclass and ID.
See also parameter 964.

Parameter	975	
Type	Read-only	
Data type	unsigned int (0x06)	
Value range:	n/a	
Data: 975[0]	0x012A	MANUFACTURER_ID
975[1]	0x0005	Drive Unit Type (manufacturer-specific)
975[2]	0x0064	Firmware version (example only, 0x0064 = 100)
975[3]	0x07E0	Firmware year (example only, 0x07E0 = 2016)
975[4]	0x0134	Firmware day and month (example only, 0x0134 = 308 means „August 3rd“)
975[5]	0x0005	Profidrive Type Class
975[6]	0xC000	Profidrive DO Subclass 1
975[7]	0x0001	Drive Object ID

7.4.10. Parameter 979: Sensor format

Read: Parameter „Sensor Format“ is to read out the user configuration. „Determinable Revolutions“ (configured number of revolutions) and „Sensor Resolution“ (configured singleturn resolution) are generally applied, any other information relates to PROFIdrive telegrams 81 to 83.

Parameter	979	
Type	Read-only	
Data type	UINT32 (0x07)	
Value range:	n/a	
Data: 979[0]	0x00005111	Header Info
979[1]	0x80000000	1st Sensor(G1) Type (**)
979[2]	0x00002000	Sensor Resolution (*)
979[3]	0x00000000	Shift Factor for G1_XIST1
979[4]	0x00000000	Shift Factor for absolute value in G1_XIST2
979[5]	0x00010000	Determinable Revolutions (*)
979[6]	0x00000000	reserved
to		
979[10]	0x00000000	reserved

(*) example, depends on basic encoder and user configuration
(**) if 979[2] to 979[5] valid (otherwise 0x00000000)

7.4.11. Parameter 980: Number list of defined parameter

Read: Parameter 980 is to read out all supported parameters.

Parameter	980	
Type	Read-only	
Data type	unsigned int (0x06)	
Value range:		
Data: 980[0]	0x039A	922
980[1]	0x039D	925
980[2]	0x03C4	964
980[3]	0x03C5	965
980[4]	0x03CE	974
980[5]	0x03CF	975
980[6]	0x03D2	978
980[7]	0x03D3	979
980[8]	0xEE48	61000
980[9]	0xEE49	61001
980[10]	0xEE4A	61002
980[11]	0xEE4B	61003
980[12]	0xEE4C	61004
980[13]	0xFDE8	65000
980[14]	0xFDE9	65001
980[15]	0	End Mark

7.4.12. Parameter 61000: NameOfStation

Read: This parameter is to read out the name of station (encoder name). Name length is from zero (deleted) on to 240 characters (no zero termination).

Parameter	61000
Type	Read-only
Data type	octet string (0x0A)
Value range:	ASCII
Data: 61000[0]	Device name

7.4.13. Parameter 61001: IpOfStation

Read: This parameter is to read the encoder`s IP address.

Parameter	61001
Type	Read-only
Data type	UINT32 (0x07)
Value range:	0.0.0.0 to 255.255.255.255
Data: 61001[0]	IP address

7.4.14. Parameter 61002: MacOfStation

Read: This parameter is to read the encoder's MAC address.

Parameter	61002
Type	Read-only
Data type	octet string (0x0A)
Value range:	9C:C9:50:xx:xx:xx
Data: 61002[0]	MAC address (6 bytes)

7.4.15. Parameter 61003: DefaultGatewayOfStation

Read: This parameter is to read the IP address of the default gateway.

Parameter	61003
Type	Read-only
Data type	UINT32 (0x07)
Value range:	0.0.0.0 to 255.255.255.255
Data: 61003[0]	IP address of default gateway

7.4.16. Parameter 61004: SubnetMaskOfStation

Read: This parameter is to read the subnet mask of the network in which the encoder is located.

Parameter	61004
Type	Read-only
Data type	UINT32 (0x07)
Value range:	0.0.0.0 to 255.255.255.255
Data: 61004[0]	Subnet mask

7.4.17. Parameter 65000: Preset Value

A preset operation in data formats of the PROFIdrive profile (telegrams 81 to 83) will set the position of the encoder to the preset value.

This parameter is without significance when using manufacturer-specific output formats 860 and 870 (telegrams 860 and 870).

Read: current preset value

Parameter	65000
Type	Read / Write
Data type	int32 (0x04)
Value range	signed 32 bit
Data: 65000[0]	Preset Value

Write: Preset value is written in the encoder (volatile only).

Parameter	65000
Type	Read / Write
Data type	int32 (0x04)
Value range	signed 32 bit
Data: 65000[0]	Preset Value

Since firmware version 1.3.0 this has to be considered:
If a preset value which is larger than the total measuring range is written the alarm “preset out of range” (with alarm code 0x0201) is reported.

7.4.18. Parameter 65001: Operating status

Read: current operation status and parameters

Parameter	65001	
Type	Read-only	
Data type	UINT32 (0x07)	
Value range	n/a	
Data: 65001[0]	0x00010101	Header Info
65001[1]	0x0000002A	Operating Status (*)
65001[2]	0x00000000	Faults (**)
65001[3]	0x00000001	Supported Faults
65001[4]	0x00000000	Warnings (**)
65001[5]	0x00000000	Supported Warnings
65001[6]	0x00000401	Encoder Profile (*)
65001[7]	0x00000000	Operating Time (****)
65001[8]	0x00000000	Preset Offset (***)
65001[9]	0x00002000	Steps per Revolution (*)
65001[10]	0x20000000	Total Measuring Range (*)
65001[11]	0x00000003	Speed Scale (*)

(*) example only (depends on user configuration)
(**) example only (error-free status)
(***) example only (depending on preset), supported since firmware version 1.3.0
(****) Value 0xFFFFFFFF means that function is not supported. Since firmware version 1.3.0 the operating time is supported. The operating time value is presented in steps of 0,1 hours (6 minutes). A value of 20 would mean that the encoder has been running for 2 hours.

7.5. Vendor-specific parameters

The following vendor-specific parameters are provided by the encoder since firmware version 1.3.0.

Index	Access	Name	Data type	Length (in bytes)	Description
0x0005	Read-only	Temperature	Integer	1	Temperature in degree Celsius
0x0006	Read-only	Serial number	String	32	Baumer-specific serial number

7.5.1. **Temperature**

To read out the temperature via „read request“ the following parameters have to be set with the following values in the „read request“.

Parameter	Length (in bytes)	Value
API	4	0x00003D00
SlotNumber	2	0x0001
SubslotNumber	2	0x0001
Index	2	0x0005
RecordDataLength	4	0x00000001

7.5.2. **Serial number**

To read out the serial number via „read request“ the following parameters have to be set with the following values in the „read request“.

Parameter	Length (in bytes)	Value
API	4	0x00003D00
SlotNumber	2	0x0001
SubslotNumber	2	0x0001
Index	2	0x0006
RecordDataLength	4	0x00000020

8. Troubleshooting – Frequently Asked Questions – FAQ

8.1. FAQ: Project Work

8.1.1. Where do I get an encoder manual?

If ordered, the manual will come as a pdf file on data carrier (CD). The manual is also available for download at www.baumer.com (freeware „Adobe Reader®“ required). Make sure the manual is the right one for your encoder by verifying the table at the beginning of the manual. You will find the encoder type on the product label (e. g. EAL580-xxx.xxPT-13160.x).

Should your encoder not be on the list please contact Baumer.

8.1.2. Where do I get the GSDML file?

The GSDML file is available under www.baumer.com.

8.2. FAQ: Operation

8.2.1. What is the significance of the LEDs provided at the encoder?

The encoder integrates several Duo LEDs indicating the encoder activity status. Both Link/Activity LEDs visualize encoder activity on the bus, meaning data communication on each of the two Ethernet ports. In particular upon commissioning and in case of error the LEDs provide first information on the system status. For details on the respective status please refer to chapter “6.2 Operating status indicator (LEDs)”.

8.2.2. How to adapt the resolution?

The encoder resolution in steps per turn („measuring units per turn“) is programmed within the project by corresponding parameterization in the PROFINET device project.

Usually this is performed by the PLC’s engineering tool (for example SIEMENS® Step7®).

The resolution of the encoder is programmable in individual steps between the maximum limit (encoder-specific, for example 8192 for EAL580-xxx.xxPT-13160.x) and the minimum limit of 1 step/turn.

It is important align the encoder’s total measuring range with the programmed resolution. If not, this will result in parameterization errors signaled by the SF LED in the encoder being on red. The maximum total measuring range is calculated by multiplying the resolution (steps per turn) by the encoder’s maximum number of revolutions. Standard resolution is 16 bit (65536 revolutions). Encoders featuring a 18 bit singleturn resolution (e. g. EAL580-xxx.xxPT-18130.x) are capable of a 13 bit multiturn resolution (8192 revolutions).

8.3. FAQ: Troubleshooting

8.3.1. No encoder communication (BF LED active)

The connected encoder is not recognized on the bus. Neither configuration nor parameterization was successful. Thus the BF LED remains on red or is red flashing.

This effect may be due to the following reasons:

- No PROFINET connection or broken wire in the line.
  In this case the BF LED is on while Link/Activity LED of the connected port is off.
- The encoders´s device name is not the same as entered in the engineering tool. In this case the BF LED is flashing and Link/Activity LED of the connected port flickers in green/yellow. The device name of the encoder can be checked for example with tool “PRONETA”.
- The encoder was not correctly integrated into the PROFINET project, so that the encoder is unknown to the PLC. Also in this case the BF LED is blinking and the Link/Activity LED assigned to the connected port is flickering in green/yellow.
- The encoder was correctly integrated into the PROFINET project. But inadvertently the compiled project has not yet been exported to the PLC.
- Should the above troubleshooting prove unsuccessful please try to connect the encoder at the other port.

8.3.2. No encoder communication

SF LED is continuously lit red while the Link/Activity LEDs of the connected ports flicker in green/yellow. More information may be available as a text message in the PLC’s diagnostic memory.

Possibly an encoder parameter error is present (one or more parameters outside limits).
Typically when changing the resolution of the encoder (measuring units per revolution) the encoder’s total measuring range was not adjusted.

Singleturn encoders
The total measuring range of a singleturn encoder comprises exactly one complete revolution. The value in parameter “total measuring range” usually must be equal to the value in parameter “measuring units per revolution”.

Multiturn encoders
Multiturn encoders are capable of sensing max. 65536 revolutions (8192 revolutions for an encoder with 18 bit singleturn resolution). Maximum admissible limit for the total measuring range is the product of “steps per turn” multiplied by the encoder’s maximum number of revolutions. Too high values in parameterization will result in an error message.

However, any smaller value for the total measuring range may be selected. In all PROFINET encoders the so-called endless operation mode is integrated ensuring admissible values for all resolutions and total measuring ranges even during overrun. There is no need for integer ratios of singleturn resolution and total measuring range.

Example:
A multiturn encoder features a standard singleturn resolution of 13 bit (8192 steps per turn) and is capable of sensing 65536 full revolutions.

Consequently the total measuring range is 8192 x 65536 = 536870912 steps.

The singleturn resolution is reduced to 3600 steps / turn.
Now the total measuring range is only 3600 x 65536 = 235929600 steps.

If the total measuring range is not correspondingly aligned to the new maximum limit, the encoder will have to count 149130 completed revolutions. That is impossible and results in an error signal (SF LED lit).

8.3.3. No position data

Link/Activity LED of port is flashing in green/yellow but PLC is not receiving any position data.

- The encoder's device name is cleared ("") and the PLC cannot automatically assign the proper name because automatic assignment wasn't projected or no topology planning was done.
- Make sure the I/O addresses of the encoder are within the cyclic updated process mapping. Size and position of process mapping or encoder I/O addresses may require adjustment.
- The encoder hardware configuration does not provide a device module („EAL580 MT…" resp. „EAM580 MT…") in slot 1 or no I/O module (telegram) is present in subslot 1.2. In both cases neither the encoder's SF LED nor the PLC error LED is active. Yet no position data transmission is active.
- Topology planning was executed and the encoder was connected with another port than projected (mode IRT). SF LED at PLC but not the encoder's SF LED is lit.

8.3.4. PLC error LED is lit

The encoder is operational but the error LED at PLC is lit.

- Operating mode IRT: A topology planning has been done and the encoder has been connected to another port than projected.
- A diagnostic alarm is present.

9. Appendix A

9.1. Software Change Log (from firmware V1.2.2 to V1.3.0)

The following table contains important changes of firmware version (V1.3.0 compared to V1.2.2).

Change	Description
[Reset via button] With Ethernet connection possible	A reset via the button is now also possible if the encoder has an Ethernet connection ("link established"). In V1.2.2 a reset via the button was only possible when the encoder had no Ethernet connection. Details can be found here: Push Button for Preset / Reset
[Reset via button] Functionality extended	Additionally to resetting of IP settings and station name the following actions are done in firmware version 1.3.0: - reset of several encoder parameters (details: see link below) - reset of the internal preset offset to 0 - restart ("software reset") of the encoder Details can be found here: Parameter reset using the optional push button
[Temperature] Added	To provide a temperature value record 0x0005 was added. Details can be found here: Vendor-specific parameters
[Operating hours counter] Added	To provide an operating hours counter PNU 65001.7 is supported. Details can be found here: Parameter 65001: Operating status
[Baumer serial number] Added	To provide the Baumer serial number record 0x0006 was added. Details can be found here: Vendor-specific parameters
[Preset offset] Added	To provide the preset offset PNU 65001.8 is supported. Details can be found here: Parameter 65001: Operating status
[Alarms] Alarm code 0x0224 ("Total measuring range illegal")	Alarm with code 0x0224 is reported if the total measuring range is set to 1.
[Alarms] Alarm code 0x0201 ("Preset out of range")	Alarm with code 0x0201 is reported when an invalid value is written into PNU 65000.
[Preset] Set preset value (PNU 65000) directly in the «module parameters»	The PLC writes PNU 65000 during startup of the encoder. To use this functionality the following GSDML file has to be used: „GSDML-V2.32-Baumer-EAx580_PN-20190715.xml"