Baumer

Passion for Sensors

Manual

Absolute encoders EAx with PROFINET interface

Firmware Version V1.2.0.0 and later

05.18· 174.02.072/5

Subject to modification in technic and design.
Errors and omissions excepted.

Contents

	Page
1. Introduction	**5**
1.1. Scope of delivery	**5**
1.2. Product classification	**5**
2. Safety and operating instructions	**6**
3. Commissioning	**7**
3.1. Mechanical mounting	**7**
3.2. Electrical connection	**7**
3.2.1. Cabling	7
3.2.2. Connecting	8
3.2.3. Push Button for Preset / Reset	9
4. Engineering (Siemens® Step7®)	**10**
4.1. Importing the GSDML file	**10**
4.2. Encoder implementation into the project	**12**
4.3. Assigning the device name	**12**
4.3.1. Setting the Device Name in the Project	12
4.3.2. Automatic Name Assignment	12
4.3.3. User-operated name assignment	13
4.4. Realtime Class Selection	**15**
4.4.1. Domain Management	15
4.4.2. Realtime (RT) Class 1	16
4.4.2.1. Address-Assignment within the Process Image	16
4.4.2.2. Synchronization Setup	17
4.4.3. Isochronous Realtime (IRT) Class 3	18
4.4.3.1. Address Assignment within the Process Image	19
4.4.3.2. Synchronization Setup	19
4.4.3.3. IO system Assignment to Synchronous Cycle Interrupts	21
4.5. Topology Planning	**22**
4.6. Parameterization	**23**
4.6.1. Encoder Class Selection	23
4.6.2. Compatibility Mode	23
4.6.3. Measuring Units per Revolution	24
4.6.4. Total measuring range	24
4.6.5. Code Sequence	24
4.6.6. Speed Measuring Unit	24
4.6.7. Speed Update Period	24
4.6.8. Speed Filter Depth	24
4.6.9. Scaling Functionality	24
4.6.10. Preset affects G1_XIST1	24
4.6.11. Alarm Channel Control	24
4.6.12. Maximum Master Sign-of-Life Failures	25
4.6.13. Gear Factor Activation	25
4.6.14. Gear Factor Numerator	26
4.6.15. Gear Factor Denominator	26
4.6.16. Important Note for Multiturn Encoder Operation	26
4.7. Implementation of system functions for alarm handling	**28**
4.7.1. I/O Point Fault OB	28
4.7.2. Loss Of Rack Fault - OB	29
4.8. Compilation and load of hardware and software configuration	**29**
4.9. Restore Factory Defaults	**29**
4.9.1. Factory Setup using the Engineering Tool	29
4.9.2. Parameter Reset using the Push Button	29
5. Engineering (Siemens® TIA-Portal®)	**30**
5.1. Importing the GSDML file	**30**
5.2. Inserting the Encoder into the network	**32**
5.3. Device name allocation	**35**

5.3.1. Device name allocation in the project 35
5.3.2. Automated name allocation 35
5.3.3. User-operated name allocation 36
5.4. Realtime Class Selection 38
5.4.1. Domain Management 38
5.4.2. Realtime (RT) Class 1 38
5.4.2.1. Address assignment within the process image 39
5.4.2.2. Selecting the update time 39
5.4.3. Isochronous Realtime (IRT) Class 3 40
5.4.3.1. Address assignment within the process image 41
5.4.3.2. Selecting the update time 41
5.4.3.3. Encoder projecting as a technology object 41
5.5. Topology planning 45
5.6. Parameterization 46
5.7. Implementation of system functions for alarm handling 47
5.7.1. I/O Point Fault OB 47
5.7.2. Loss Of Rack Fault OB 47
5.8. Compilation and load of hardware and software configuration 47
5.9. Restore Factory Defaults 47
5.9.1. Factory Setup using the Engineering Tool 47
5.9.2. Parameter Reset using the Push Button 48
6. PROFINET operation 50
6.1. PLC (IO Controller) 50
6.2. Operating status indicator (multi-color LED) 50
6.3. Link / Activity LEDs (green/yellow) 51
6.4. Input and output data 51
6.4.1. Telegram 870: 32 Bit I/O 51
6.4.2. Telegram 100: 32 Bit I/O + 16 Bit Speed 51
6.4.3. Telegram 101: 32 Bit I 51
6.4.4. Telegram 860: 32 bit I/O + 32 bit Speed 51
6.4.5. PROFIdrive telegram 81 52
6.4.6. PROFIdrive Telegram 82 52
6.4.7. PROFIdrive Telegram 83 53
6.4.8. Control Word STW2 53
6.4.9. Control Word G1_STW1 54
6.4.10. Status Word ZSW2 54
6.4.11. Status Word G1_ZSW1 55
6.5. Speed 55
6.5.1. Speed Measuring Unit 55
6.5.2. Speed Update Period 56
6.5.3. Speed Filter Depth 56
6.6. Preset function 57
6.6.1. Preset in standard telegrams 57
6.6.2. Preset in PROFIdrive telegrams 81 - 83 57
6.6.3. Preset using the Push Button 58
7. Acyclic parameters 59
7.1. Acyclic data communication 59
7.2. I&M functions: identification and maintenance 59
7.3. Base Mode Parameter 59
7.3.1. Write access 59
7.3.2. Read access 59
7.3.3. Base Mode Parameter Access 60
7.4. Supported parameters 61
7.4.1. PROFIdrive Parameters 61
7.4.2. Interface Parameters 61
7.4.3. Encoder Parameters 61
7.4.4. Parameter 922: Telegram selection 61
7.4.5. Parameter 925: Number of Controller Sign-Of-Life failures which may be tolerated 62

7.4.6. Parameter 964: Drive Unit identification 62
7.4.7. Parameter 965: Profile identification number 62
7.4.8. Parameter 974: Base Mode Parameter Access service identification 63
7.4.9. Parameter 975: DO identification 63
7.4.10. Parameter 979: Sensor format 63
7.4.11. Parameter 980: Number list of defined parameter 64
7.4.12. Parameter 61000: NameOfStation 64
7.4.13. Parameter 61001: IpOfStation 64
7.4.14. Parameter 61002: MacOfStation 65
7.4.15. Parameter 61003: DefaultGatewayOfStation 65
7.4.16. Parameter 61004: SubnetMaskOfStation 65
7.4.17. Parameter 65000: Preset Value 65
7.4.18. Parameter 65001: Operating status 66
8. Troubleshooting – Frequently Asked Questions – FAQ 67
8.1. FAQ: Project Work 67
8.1.1. Where do I get an encoder manual? 67
8.1.2. Where do I get the applicable GSDML file? 67
8.2. FAQ: Operation 67
8.2.1. What is the significance of the LEDs provided at the encoder? 67
8.2.2. How to adapt the resolution? 67
8.3. FAQ: Troubleshooting 68
8.3.1. No encoder communication (BF-LED active) 68
8.3.2. No encoder communication (LED flashing red once per second) 68
8.3.3. No position data 69
8.3.4. PLC error LED is lit 69

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At any time we should be pleased receiving your comments and proposals for further improvement of the present manual.

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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
- GSDML file and manual (also available under www.baumer.com)

1.2. Product classification

Product	Product family	Suitable input 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 ”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

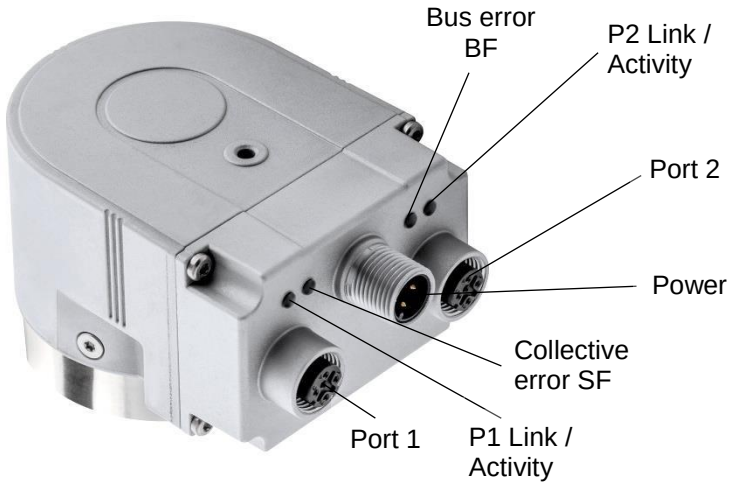
3.2.1. Cabling

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.

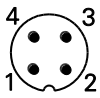


- For voltage supply use A-coded M12 connector only.
- For the bus lines both D-coded M12 connectors may be used at will. However, together with a planned Topology it may be necessary to observe the correct assignment (P1/P2).
- Seal up the unused cable gland using a sealing bolt (transport and dust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

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

Pin assignment

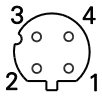
Supply voltage



1 x M12 flange connector (male)
A-coded

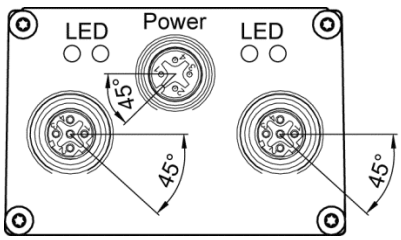
Pin	Assignment
1	UB (10...30 VDC)
2	Do not connect
3	GND
4	Do not connect

PROFINET (Bus line)



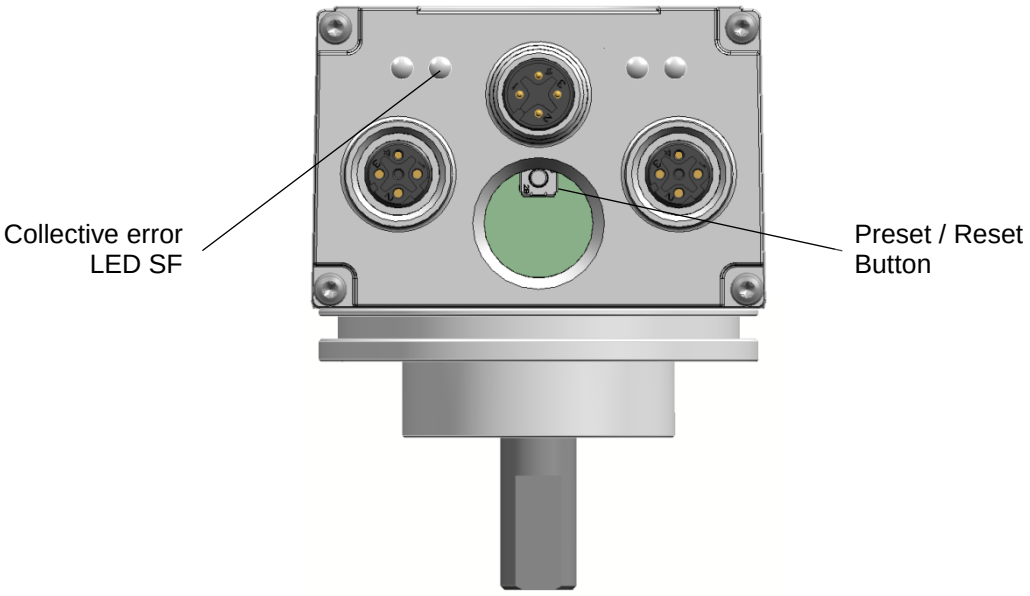
2 x M12 flange connector (female)
D-coded

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



3.2.3. Push Button for Preset / Reset

Depending on encoder 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 performs two different actions:

- With PROFINET *not* being connected, the encoder performs a “Parameter Reset“.
- With PROFINET being connected, 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 6.6.3 „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.
For engineering in the TIA-Portal®, see 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

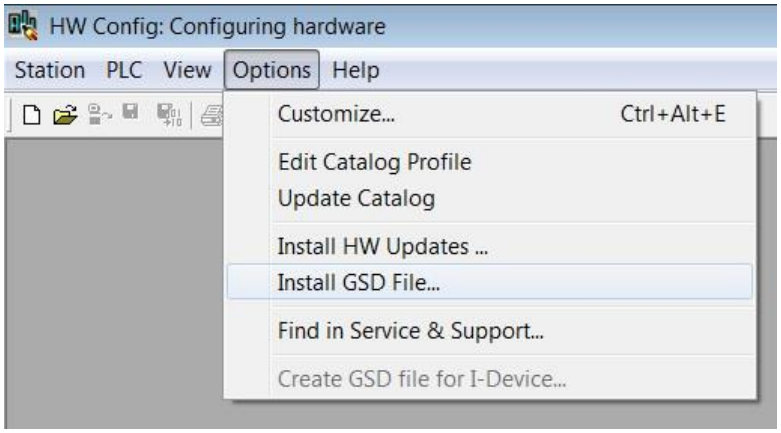
First, the attached GSDML file must be imported to enable implementation of the encoder in the engineering tool. The file format is xml ("Extended Markup Language"). With reference to the Profibus GSD files, GSDML is the common term.

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 V01.02.02 or later
  The date in the filename just indicates the GSDML file version and may change without notice.

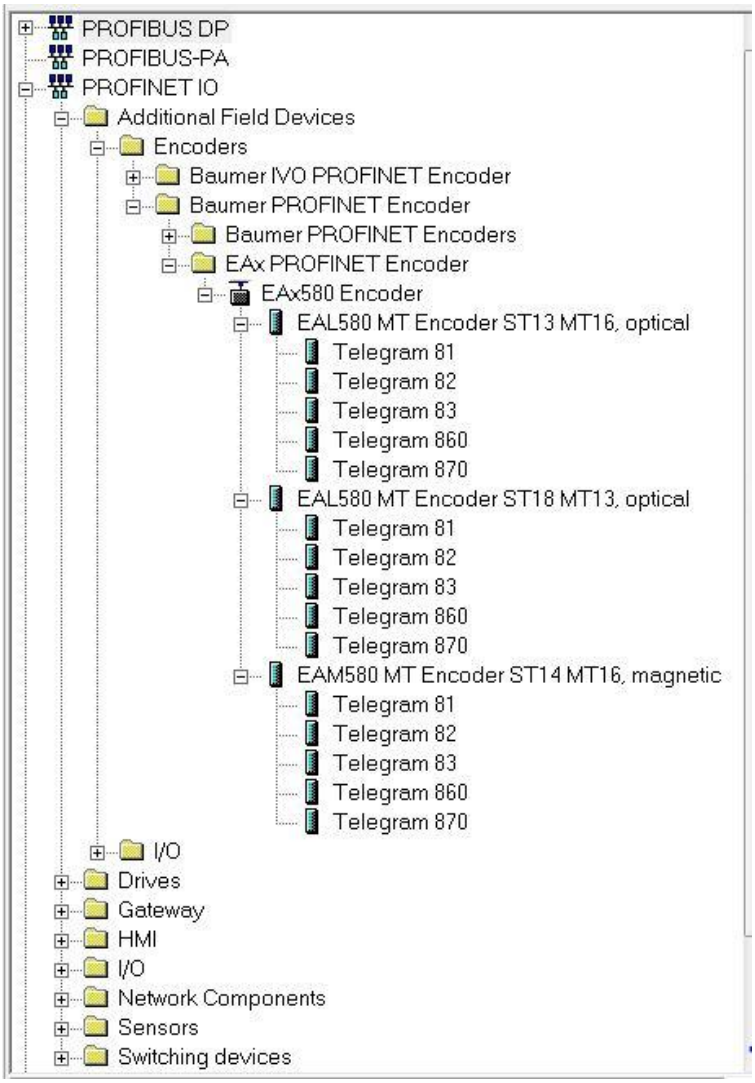
The import operation is performed by Step7® software in the hardware window (HW-config. „Options – Install GSD File…"). As a prior step it may be necessary to close the actual hardware project („Station - close") to enable successful import. Based on the default settings, any change is configured as 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).

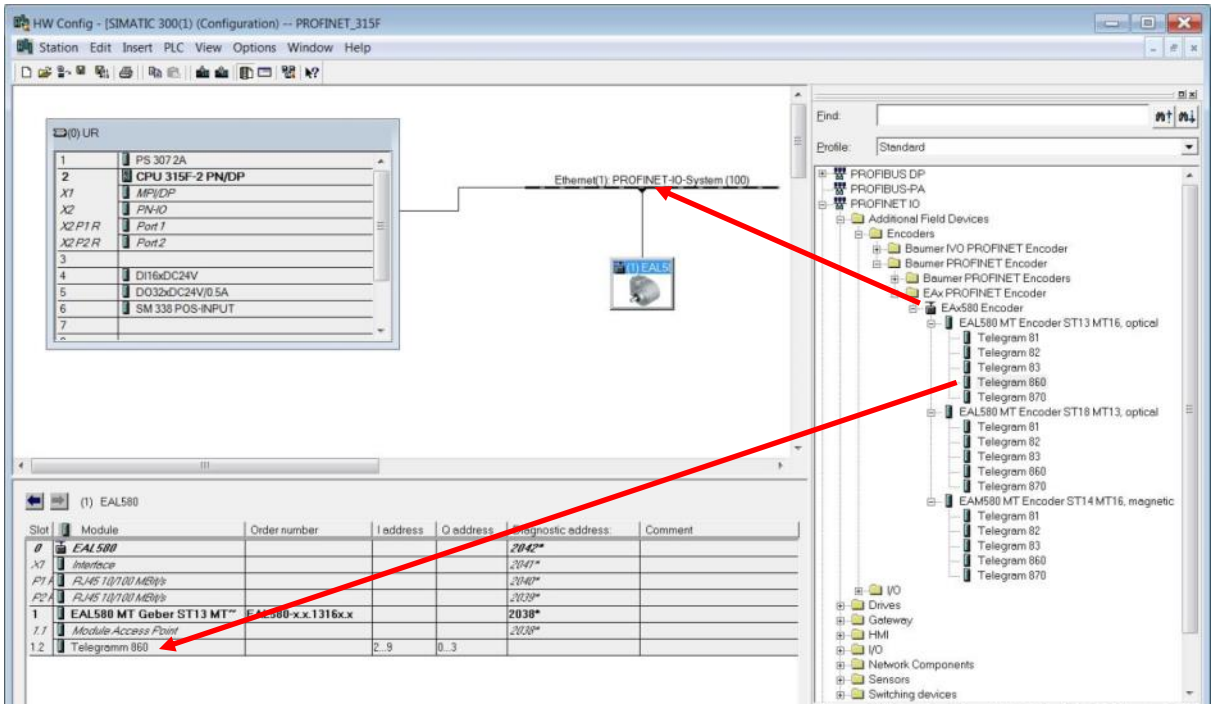


4.2. Encoder implementation into the project

Use the mouse to drag 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 submodule (I/O telegram, e.g. „860“) for drop in subslot 1.2.



4.3. Assigning the device name

Device identification in the network requires the worldwide unique MAC Device 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 (“baptizing”) within the engineering tool, and, identically, to the encoder itself.

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.

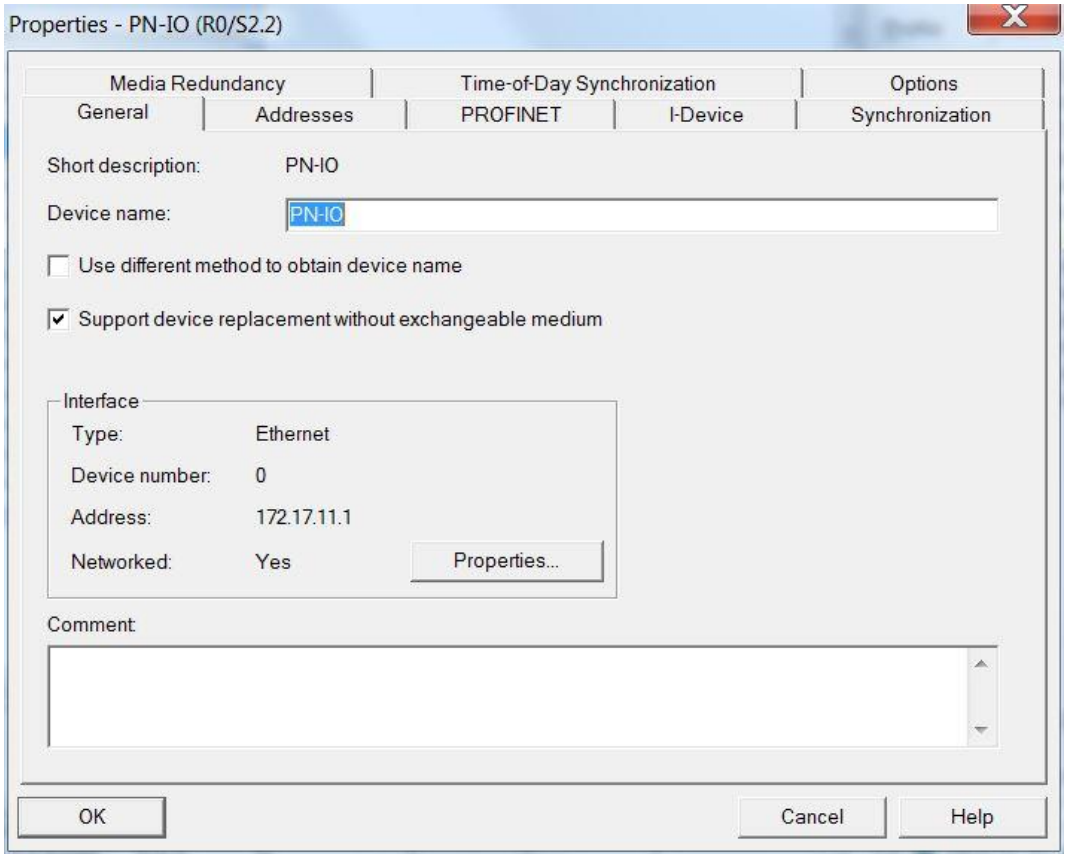
4.3.2. Automatic Name Assignment

The encoder‘s device name may also be set automatically.
When shipped (or after a factory setup), the device name is clear.

Preconditions for automatic name assignment:

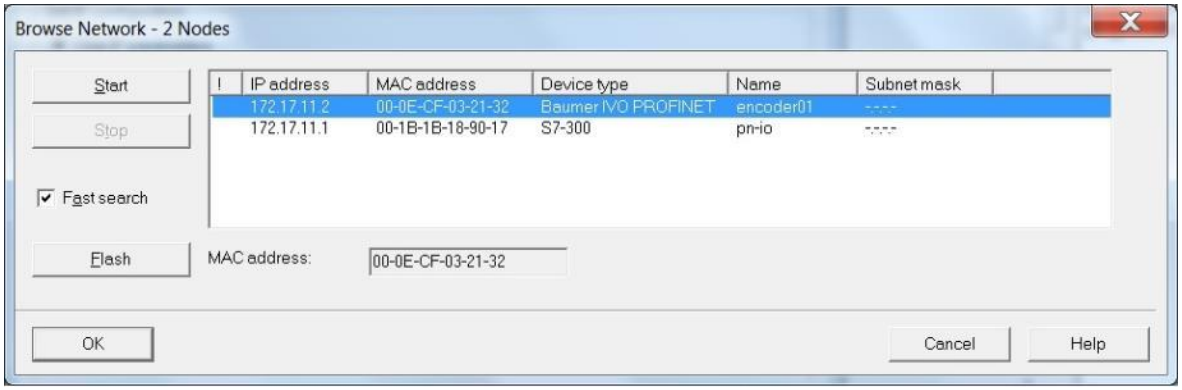
- Cleared device name
- Active option „Support device replacement without exchangeable medium“ in the properties window of the PLC – PN-IO – General (see screenshot below)
- Topology planning.

Automatic name assignment runs as soon as the installed encoder is accessed in the network.



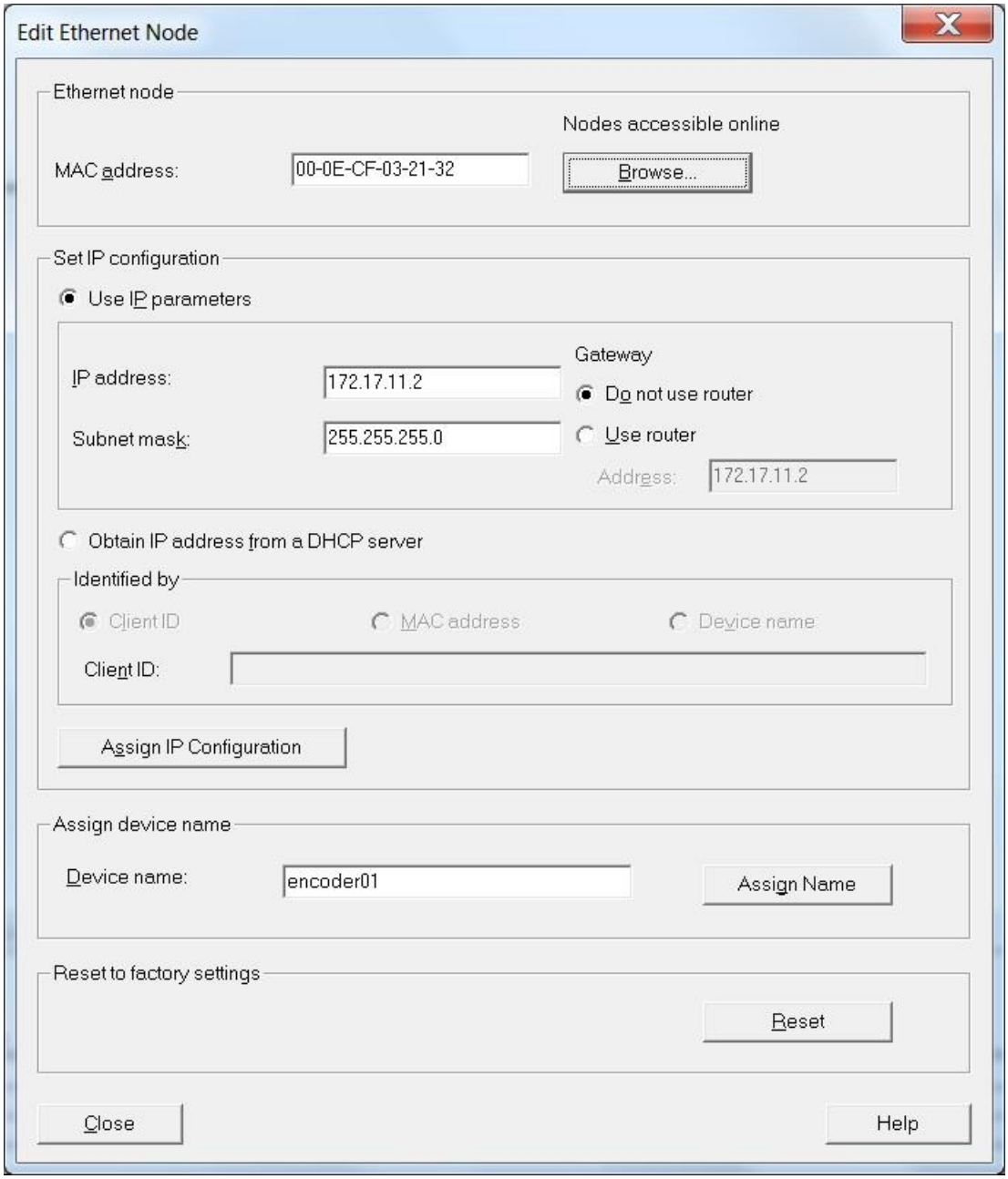
4.3.3. User-operated name assignment

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 PLC and encoder „encoder01“ were 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.

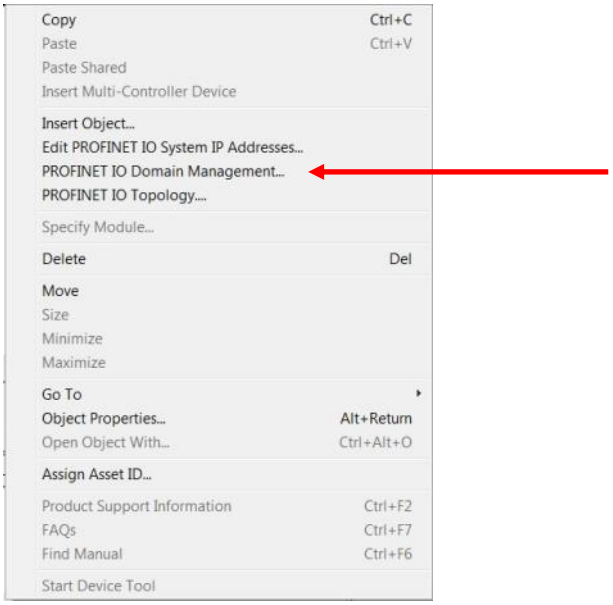
4.4. Realtime Class Selection

Both PROFINET encoder supports the realtime classes “Realtime” (RT) and “Isochrone Realtime” (IRT) Class 3. Which one to use depends on the application and PLC.

4.4.1. Domain Management

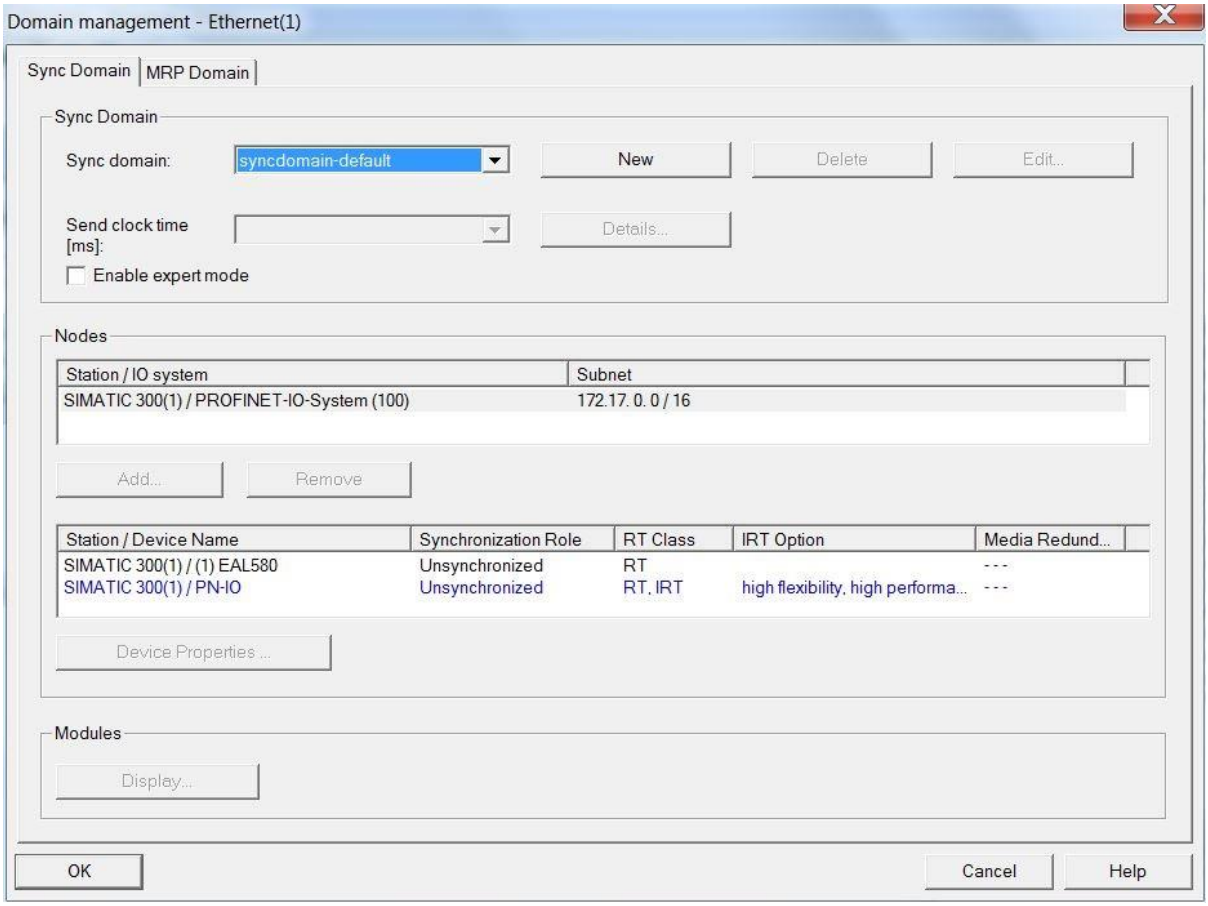
The Domain-Management determines the PROFINET bus properties.

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



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

The send clock will be applied by the PLC to any device within this sync domain, which is decisive in overall system performance.



4.4.2. Realtime (RT) Class 1

Typical cycle time in realtime is 100 ms or better.
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.

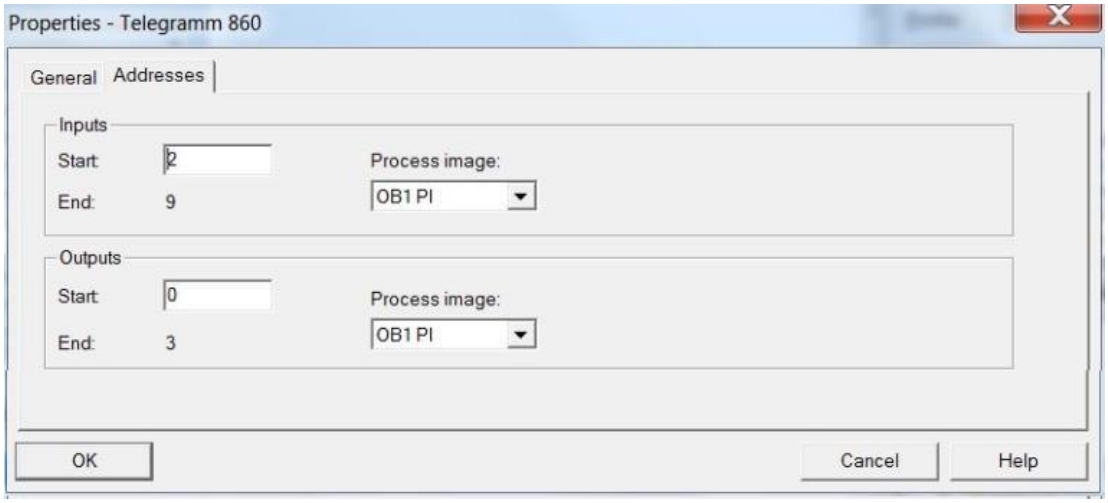
4.4.2.1. Address-Assignment within the Process Image

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).

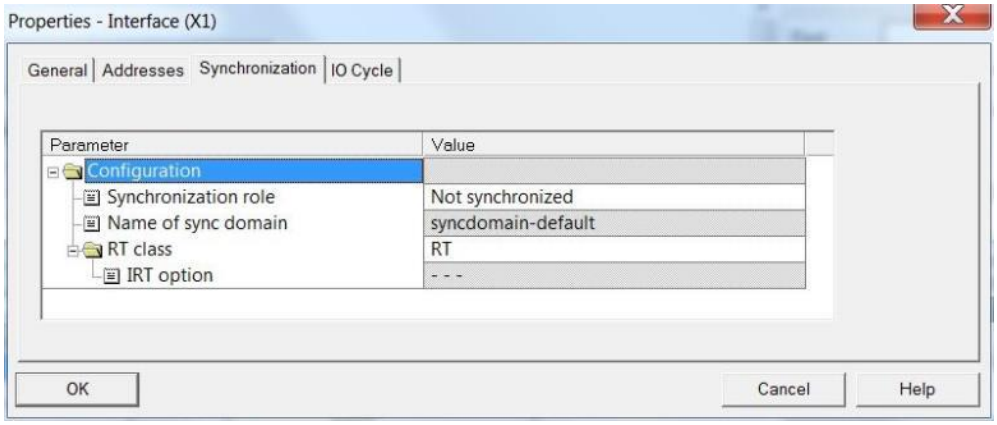


4.4.2.2. Synchronization Setup

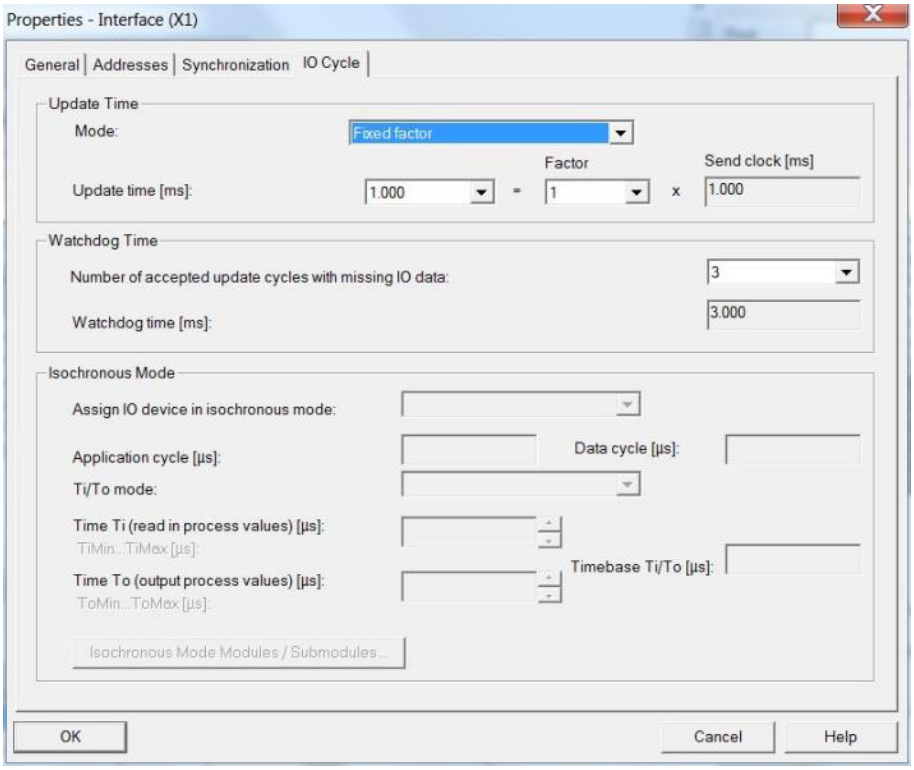
Go to the Step7® HW-config. window and click on the encoder symbol on the bus rail to select it. Bottom left in the module window the various encoder modules are shown. Enter the interface properties with a double click on the „Interface“ module.

The „Synchronization“-Tab shows the assignment to a certain sync domain. Realtime (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 Realtime (IRT) Class 3

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

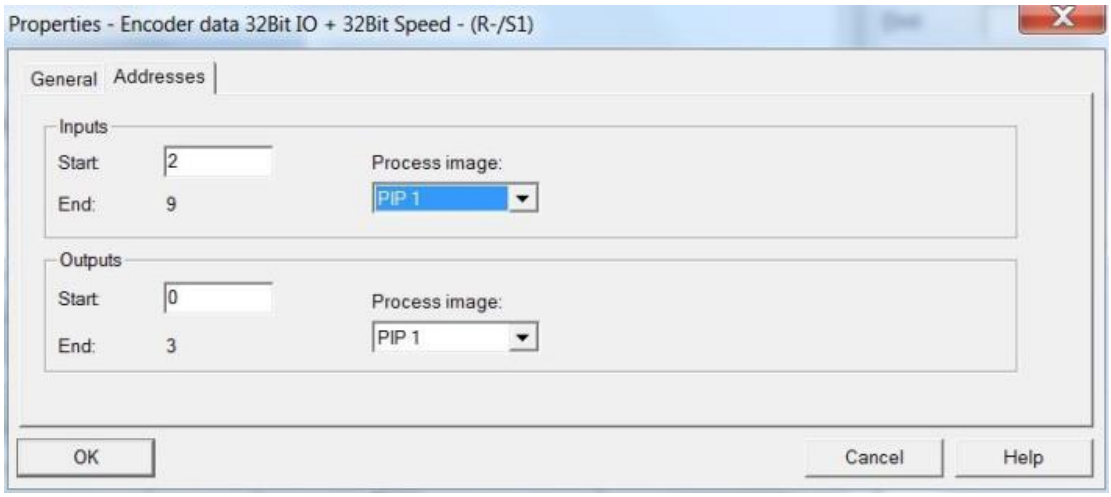
Topology planning is mandatory. Make sure ports P1/P2 are correctly assigned as planned.

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)

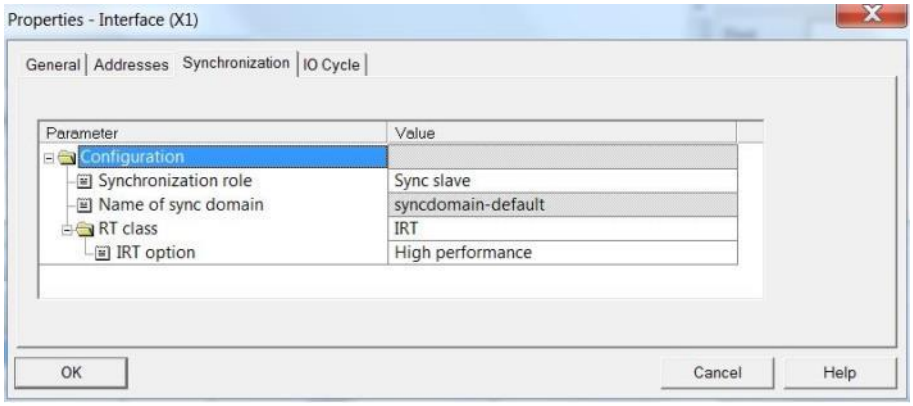


4.4.3.2. Synchronization Setup

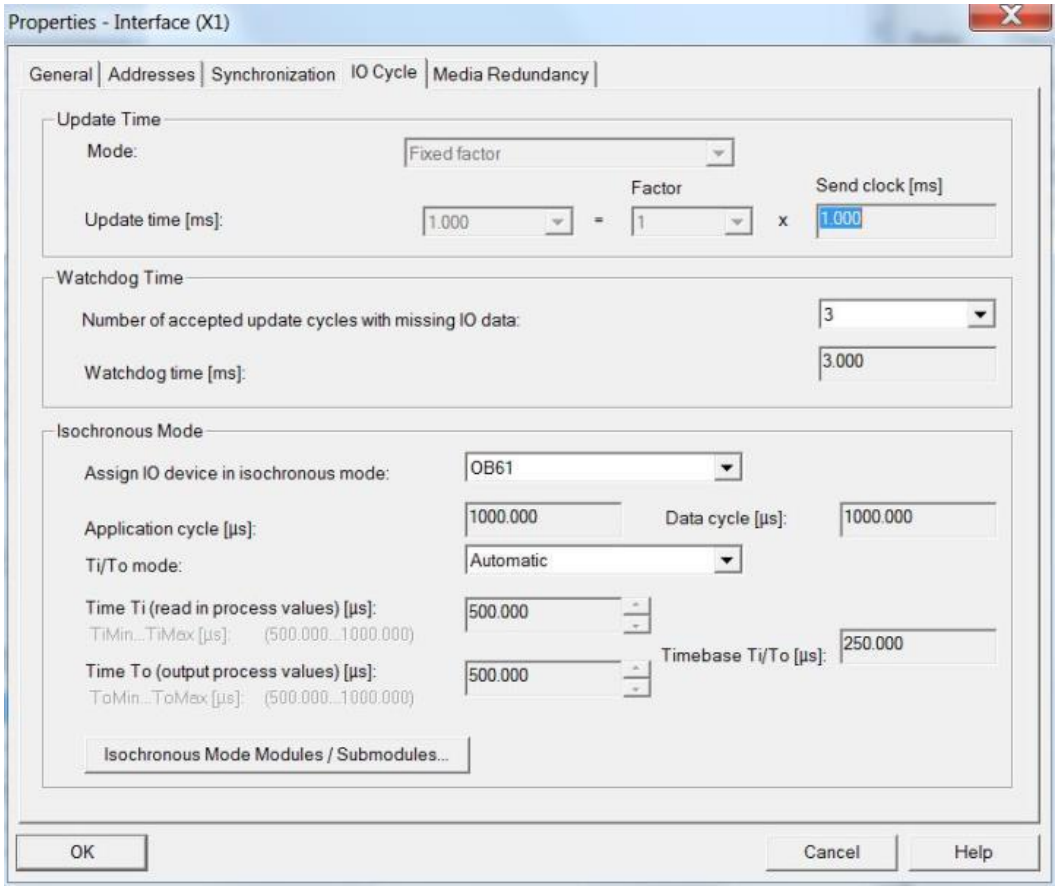
Go to the Step7® HW-config. window and click on the encoder symbol on the bus rail to select it. Bottom left in the module window the various encoder modules are shown. Enter the interface properties with a double click on the „Interface" module.

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".

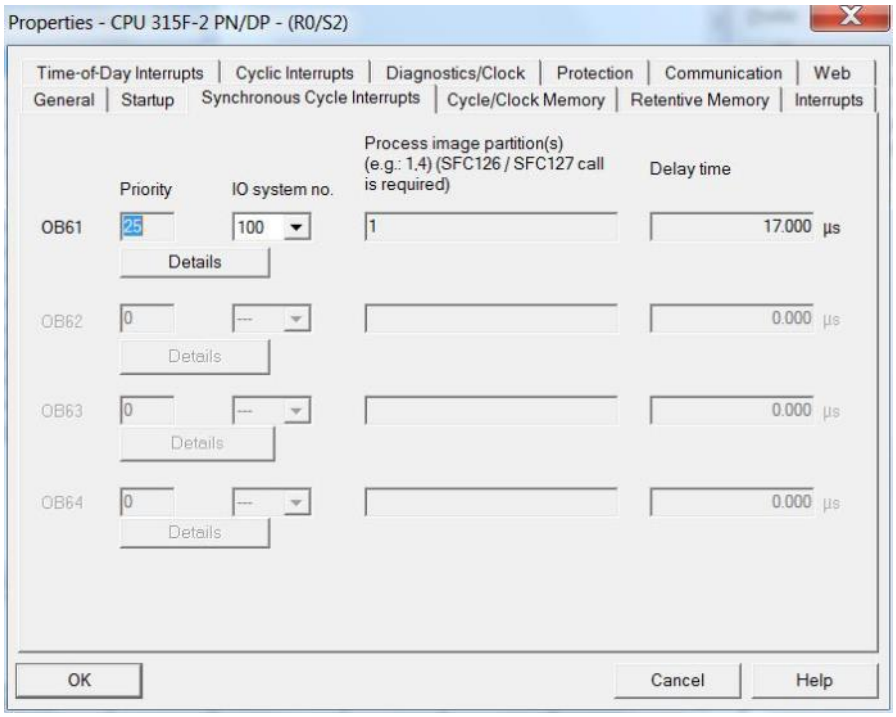


Property tab „IO cycle“ only provides option „Assign IO device in isochronous mode“. Assign isochronous module OB61 here.



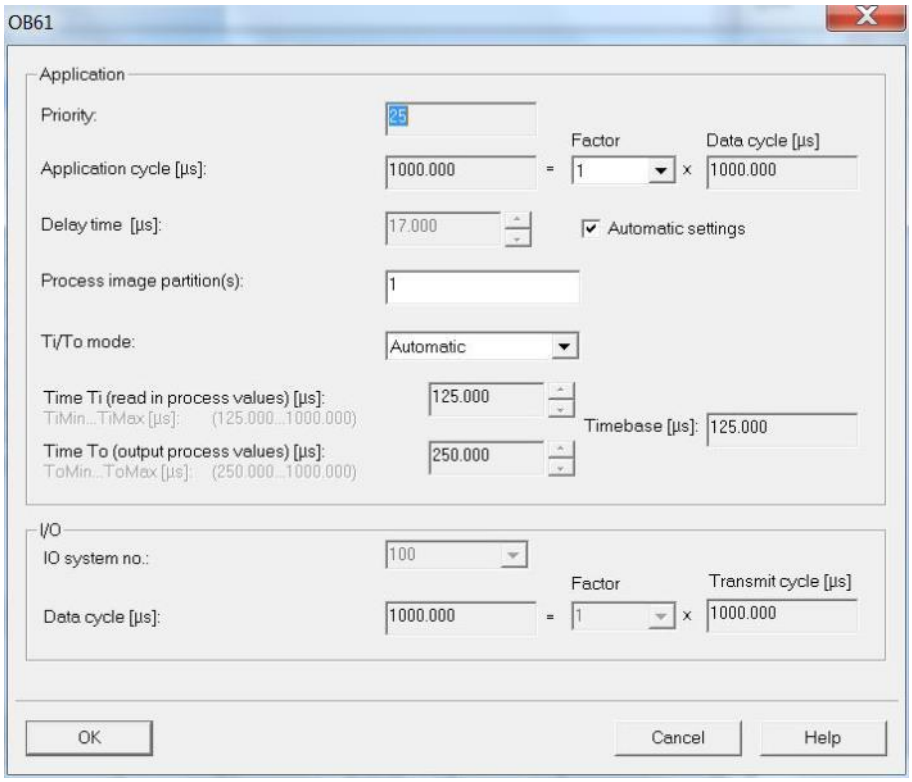
4.4.3.3. IO system Assignment to Synchronous Cycle Interrupts

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 assigned sub-process image 1.

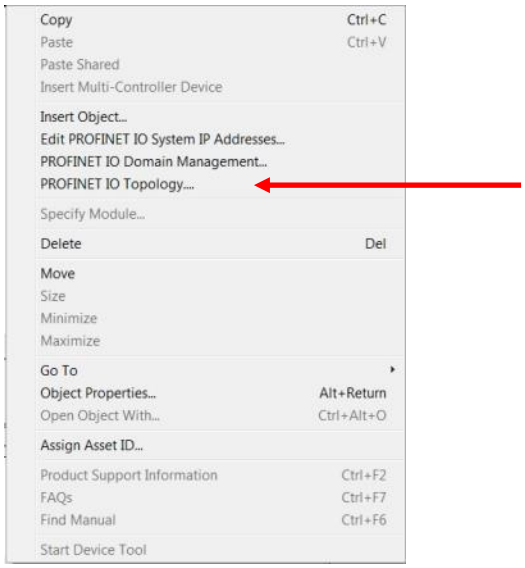
The application cycle is selected in the view below.



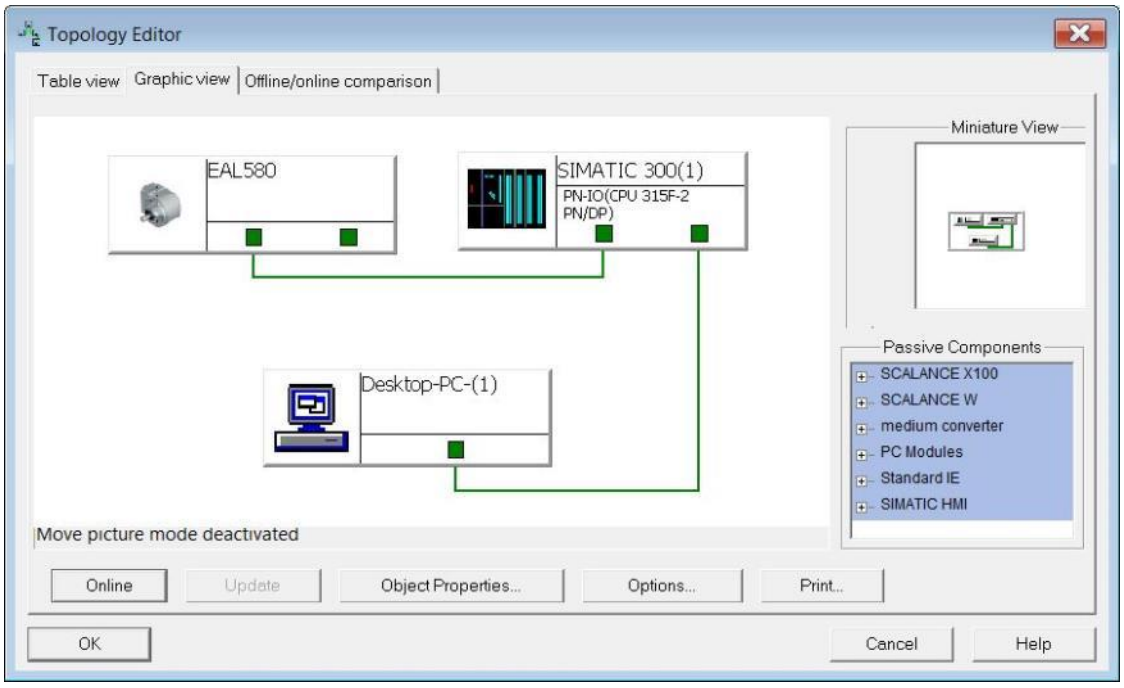
4.5. Topology Planning

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 Topology Planning e.g. by right-clicking the PROFINET bus rail in the Hardware window of Step7® software, which opens the following pull-down menu.



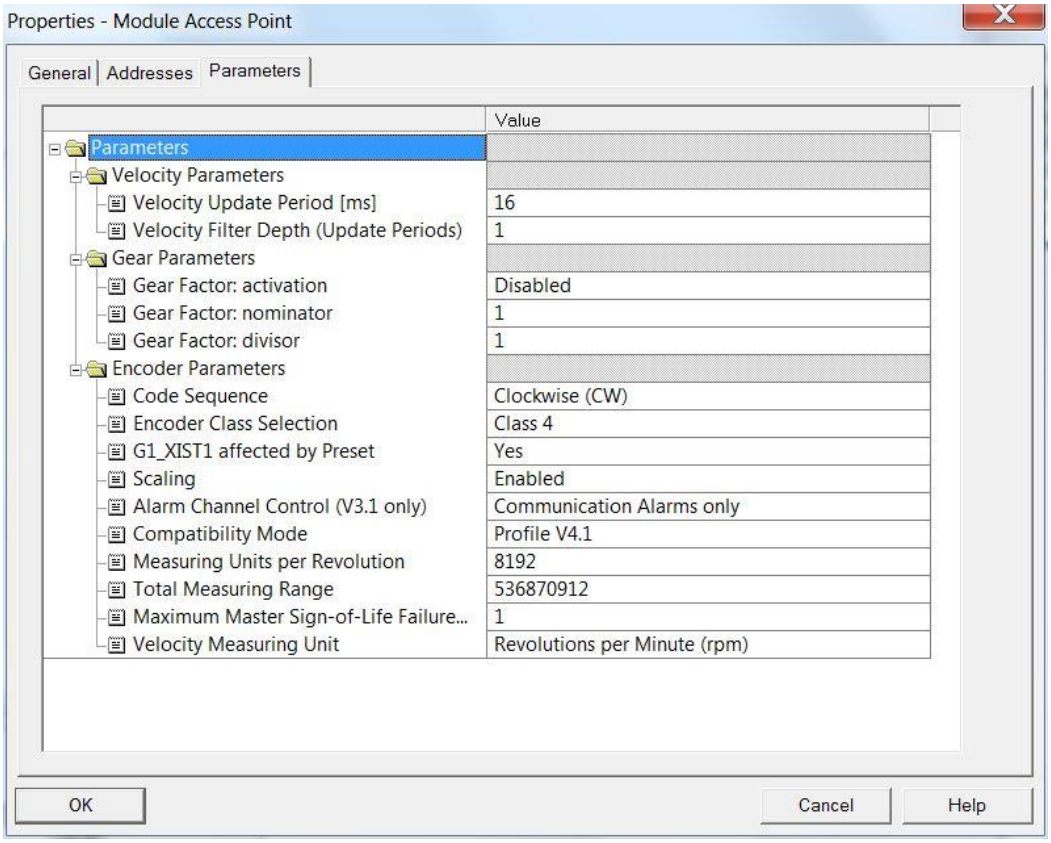
The Graphic View clearly shows port assignment of all bus components. The assignment made here must fit to the real conditions. In the example below, controller port 1 is linked to port 1 of the encoder. The programming tool (PG/PC) is connected to port 2 of the controller.
A double click on the collections 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 „Parameter“ 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
- rotation sense is fixed to cw
- preset functionality not supported

4.6.2. Compatibility Mode

Compatibility mode according to encoder profile V3.1,

- considers parameter „max. master life sign error“
- „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

Enter the desired singleturn resolution within the range from 1 to maximum encoder resolution.
In general, related limits are provided in the configuration software.
Only Class 4 encoders will take this parameter into consideration.

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

Parameterization of the required total measuring range „TMR“.
With singleturn encoders, enter the same value here as for the “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.

A change in “Total measuring Range” clears the internal position offsets (if any) 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

Position data behavior relates to the rotation direction of the encoder shaft when looking at the flange.
CW („clockwise“) = Ascending values with clockwise rotation
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. (see chapter 4.6.1).
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 is not significant where utilizing 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.

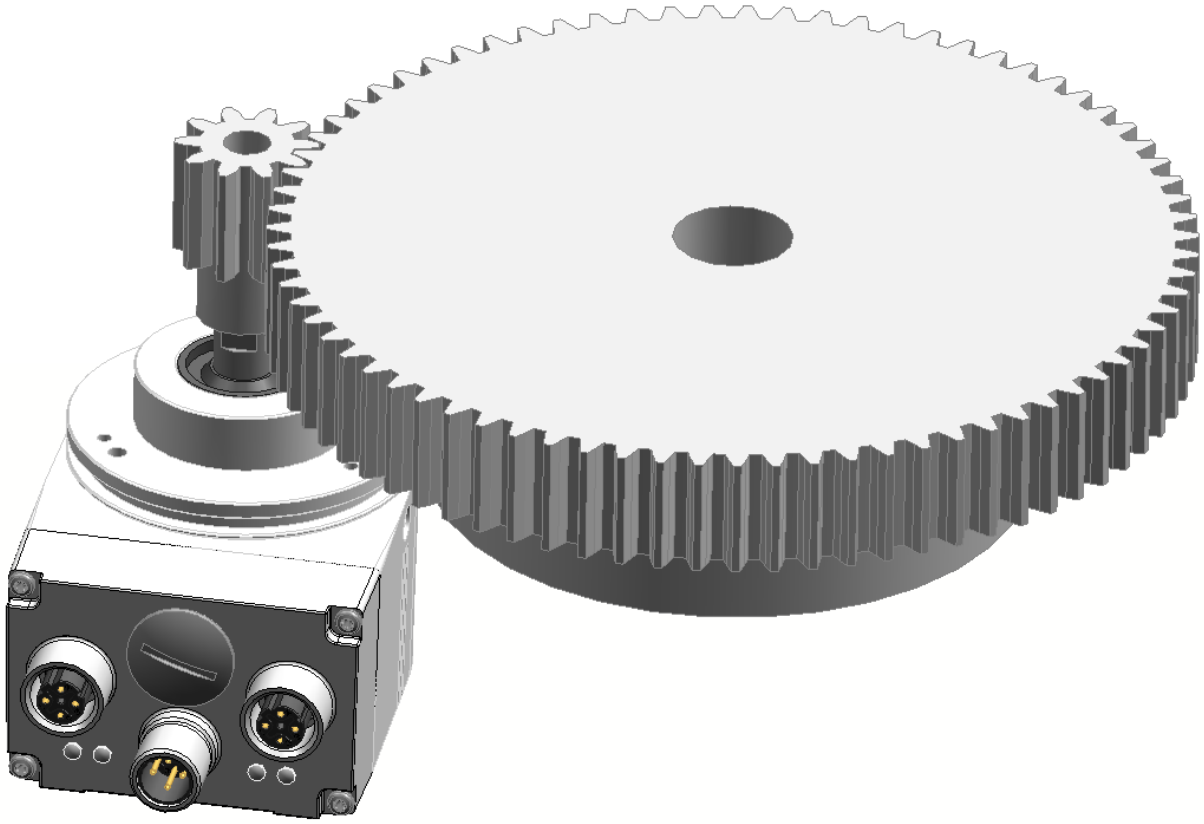
4.6.12. Maximum Master Sign-of-Life Failures

Compatibility mode according to profile V3.1:
Parameter for maximum tolerated master life sign failures (MLS) monitoring.
Setting „255“ means no monitoring („off“) .
Acyclic PROFIdrive parameter 925 is without effect.

Mode according to profile V4.1:
Total of tolerated errors is „1“ by default (factory settings) but can be changed in acyclic PROFIdrive parameter 925. Encoder parameter „Maximum Master Sign-of-Life Failures“ 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, while it outputs position data as if it were mounted on the secondary side of the gearbox. The parameter „Total Measuring Range“ always defines the number of requested steps for *one* turn of the secondary gear box shaft.



Gear Factor functionality does not take the parameter „Measuring Units per Revolution“ into account. Instead, the „Measuring Units per Revolution“ result from the parameters „Total Measuring Range“ and the Gear Factor, consisting of Numerator and Denominator. The resulting number of „Measuring Units per Revolution“ is not necessarily an integer value, but may be a rational number (includes a fractional portion) as well.

$$\text{Measuring Units per Revolution} = \text{Total Measuring Range} * \frac{Denominator}{\text{Numerator}}$$

Example:
A Reduction Gear of 7.5 : 1 shall be used (see figure above).
One turn of the secondary side of the gearbox shall resolve to 10000 Steps.

The numerator is 75 and the denominator is 1. Only integer values are admissible for numerator and denominator, so the fraction must be expanded to numerator = 75 und denominator = 10 or, equivalent, numerator = 15 and denominator = 2.
As „Total Measuring Range“ the value of 10000 must be provided.

The encoder turns 7.5 revolutions for one revolution on the secondary gearbox side. The resulting „Measuring Units per Revolution“ for the encoder are 10000 / 7.5 = 1333,3333.

The „Endless Operation“ is automatically active also when using Gear Factor functionality, if necessary.

Note:
An activation change in “Gear Factor” (On / Off) clears internal position offsets (if any) so that the current position reference will be lost. See also “6.6 Preset function”.

Note:
The Gear Factor functionality is also known as „Numerator/Denominator Scaling“ or „Round Axis Function“.

4.6.14. Gear Factor Numerator

Integral numerator of the gear factor.
When using a reduction gear (n2 < n1) the numerator is always >1.

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

Note:
For the „Numerator“ the following restrictions apply:

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

4.6.15. Gear Factor Denominator

Integral denominator of the gear factor.
This parameter is only taken into account when using gear factor functionality.

When using a reduction gear (n2 < n1) the divider is „1“. However, with a non-integral gear ratio it may be necessary to expand the fraction (see example above) so that the divider is >1.

When using a step-up gear, (n2 > n1) the Denominator is larger than the Numerator.

4.6.16. 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.

With endless operation active, the encoder shaft must not rotate when the encoder is unpowered. In those cases where powerless motion cannot be avoided, the encoder has to be referenced (presetted) after every power-up. With Endless Operation inactive, the encoder shaft may rotate unlimitedly when encoder is not powered.

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	(8192 x 3600)
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

The following channel-specific diagnostic alarms are supported:

Alarm	Alarm text
0x0102	SSI frame error
0x0103	SSI CRC error
0x0104	SSI frame error (extended)
0x0105	SSI 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 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	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.

$$\text{Measuring Units per Revolution} = \text{Total Measuring Range} * \frac{Denominator}{\text{Numerator}}$$

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 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 has to be disabled in project „Device exchange without removable media“ prior to executing the Factory Setup.

4.9.2. Parameter Reset using the Push Button

Please refer to the description in 5.9.2.

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

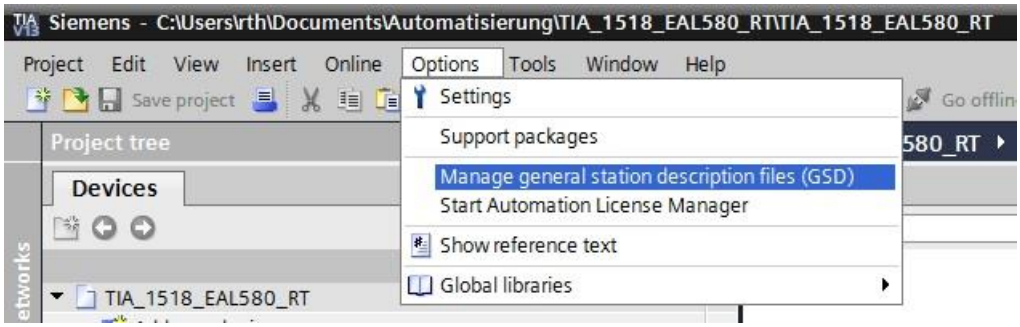
Encoder implementation in the engineering tool first requires importing the attached GSDML file in format XML („Extended Markup Language“). In accordance with Profibus GSD files, the standard name is GSDML.

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 V01.02.02 or later
  The date in the filename just indicates the GSDML file version and may change without notice.

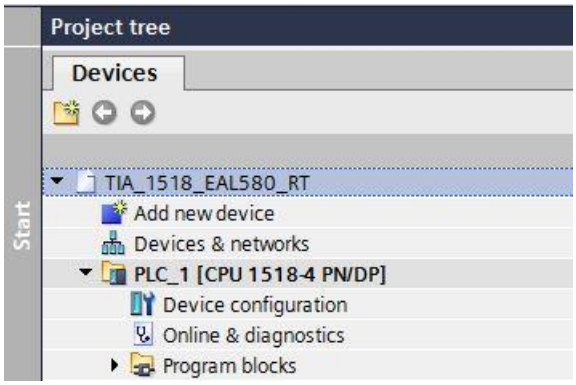
GSDML file import is in the TIA-Portal® in the project view („Options – Manage general station description files GSD“).



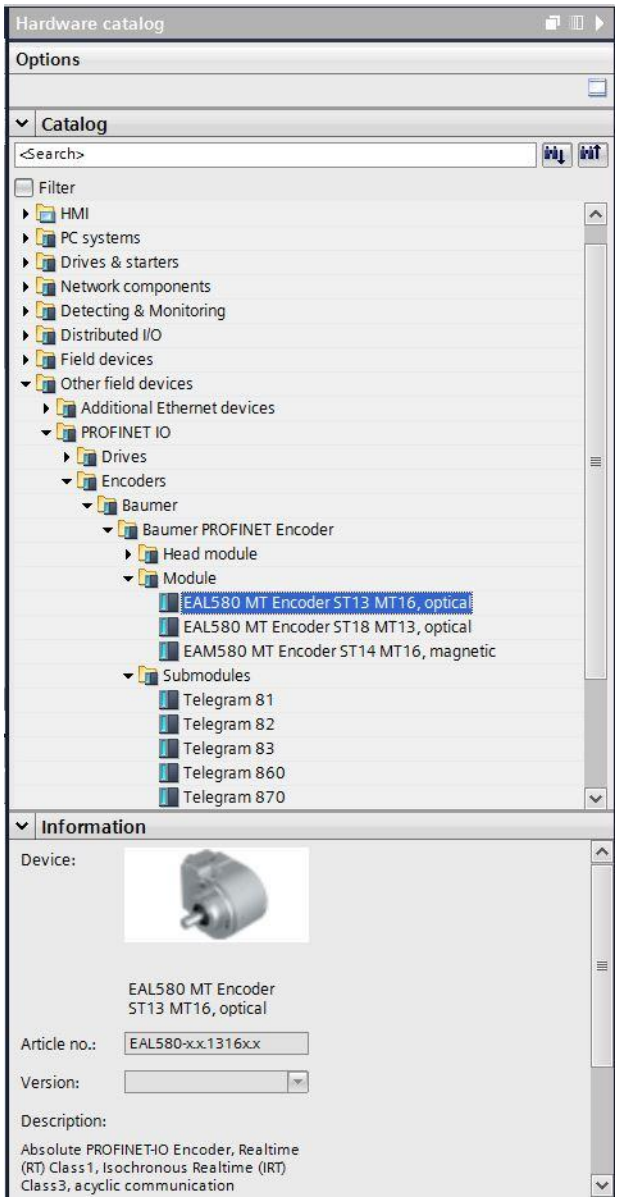
In the following dialogue please select the directory where to find the GSDML file which shall be installed.
It is useful (but not necessary) to work with the program directory„…Dokumente\Eigene Dokumente\Automatisierung\<Projektname>\AdditionalFiles\GSD“.

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

Hardware catalog opens via the device configuration window:

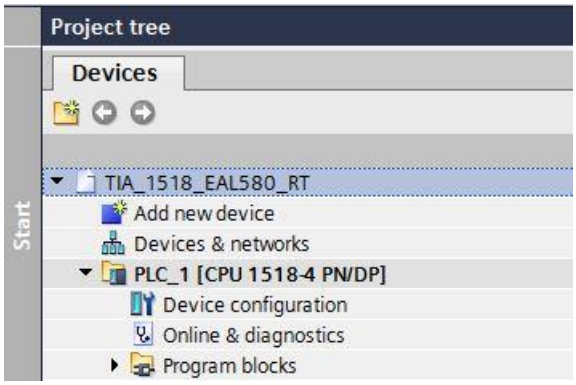


The encoder appears in the hardware catalog under „Other field devices “ - „PROFINET IO“ – „Encoders“ – Baumer - „Baumer PROFINET Encoder“. Head module “EAx PROFINET Drehgeber“, Module „EAx580…“ Submodules (telegrams) are displayed separately.

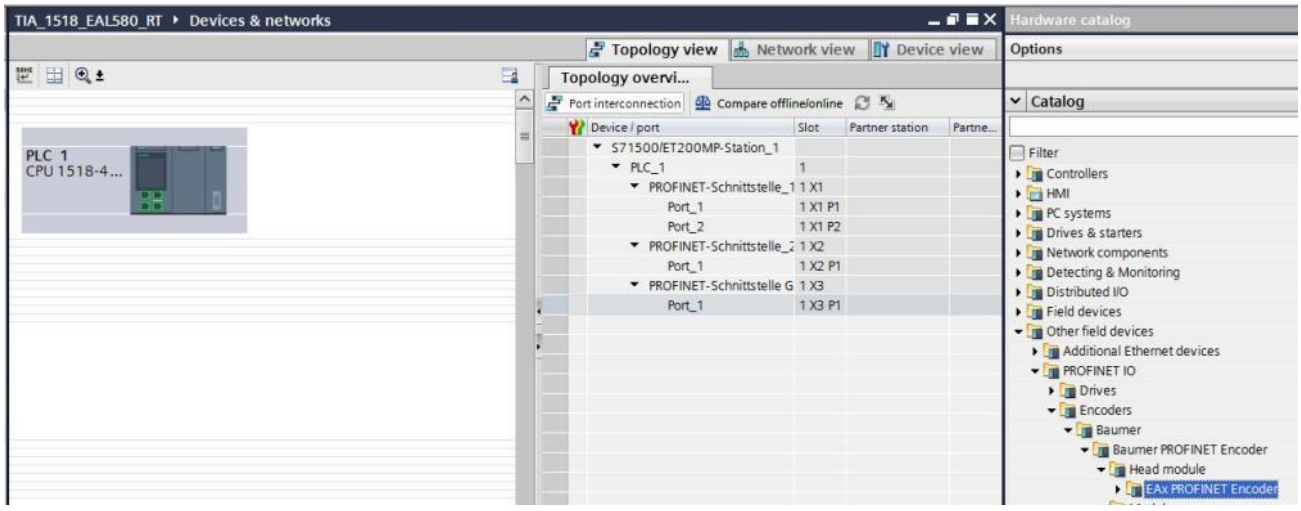


5.2. Inserting the Encoder into the network

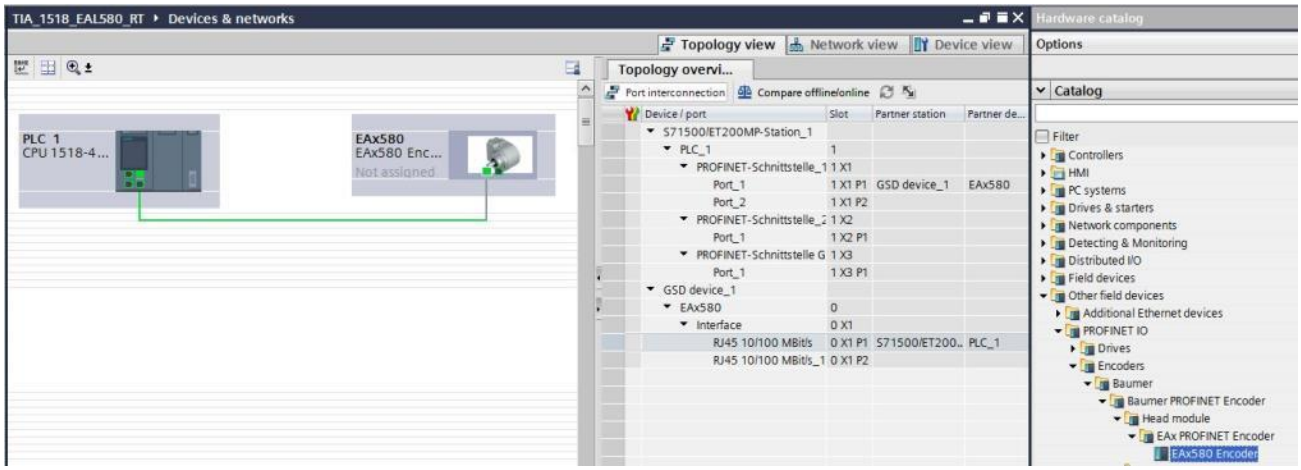
Hardware catalog opens via the device configuration window.



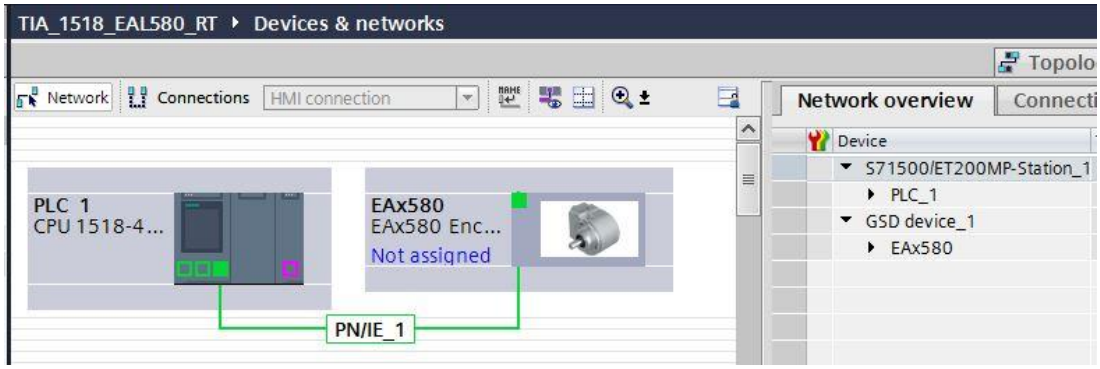
PLC is displayed in the topology view. The hardware catalog displays the encoder head module (not yet showing modules and submodules).



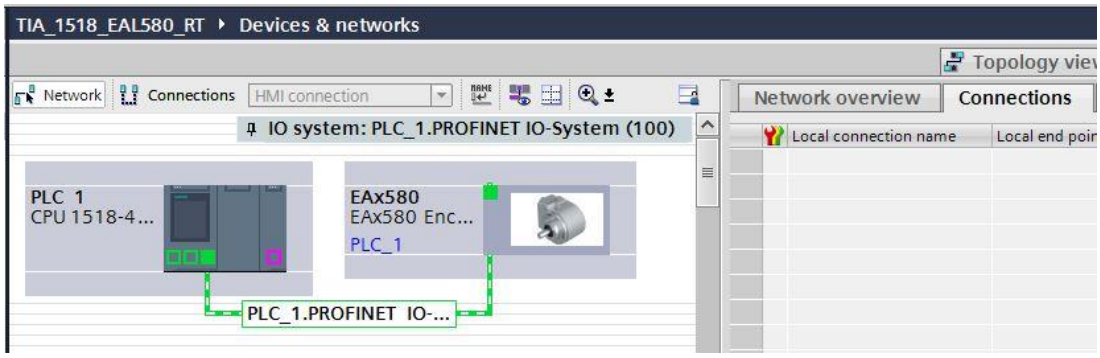
Use the mouse to drag head module „EAx580 encoder“ from the hardware catalog for drop in PLC (framed slot). Next, use the mouse to draw the required connections between PLC and encoder ports.



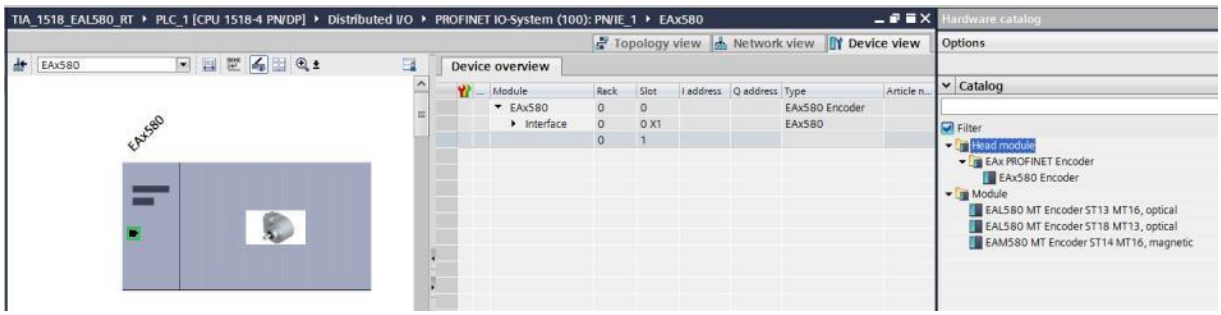
Switching to „network view“ reveals the encoder has not yet been assigned, meaning not yet connected to the network.



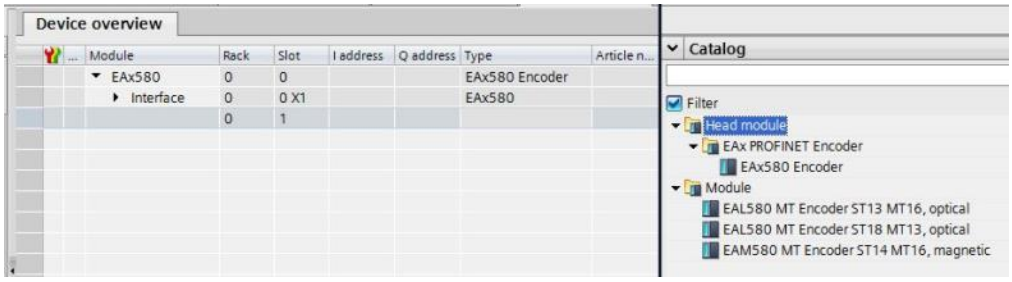
Clicking „not assigned“ provides the available controller connections. After having selected the connection (in the „PLC_1.PROFINET-interface_1“) the encoder assigns to the PLC.



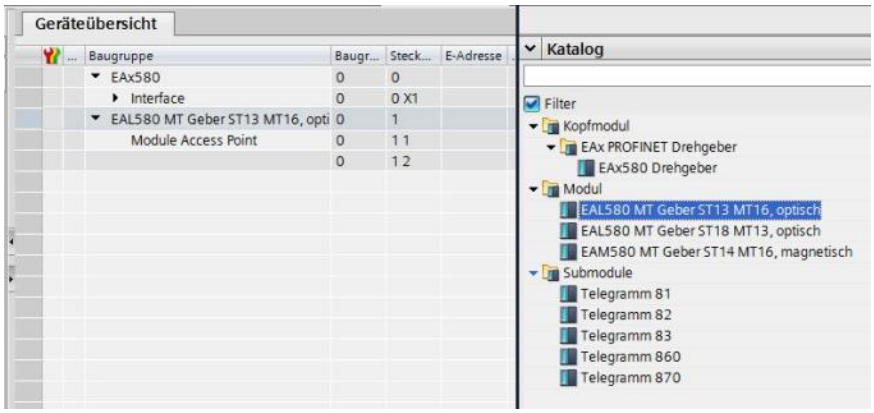
Change to „device view“ and select encoder „EAx580“ provided top left.
The hardware catalog presents the already projected top module and the modules available (different encoder types).



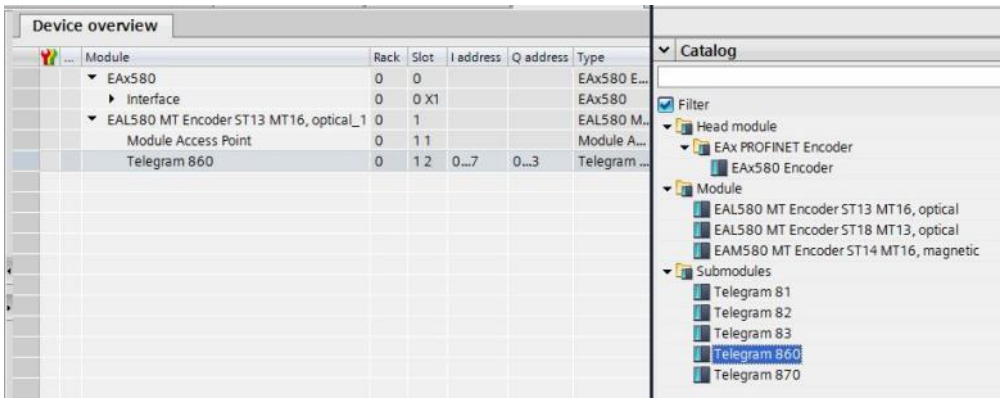
Select module in the hardware catalog (your encoder, e.g. "EAL580 MT encoder ST13 MT16, optical") and drag and drop in slot 1 below „Interface“.



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).

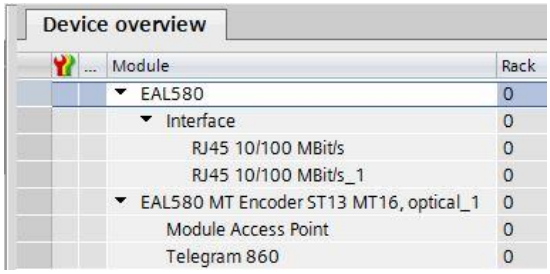


5.3. Device name allocation

Device identification in the network requires the worldwide unique MAC Device 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.



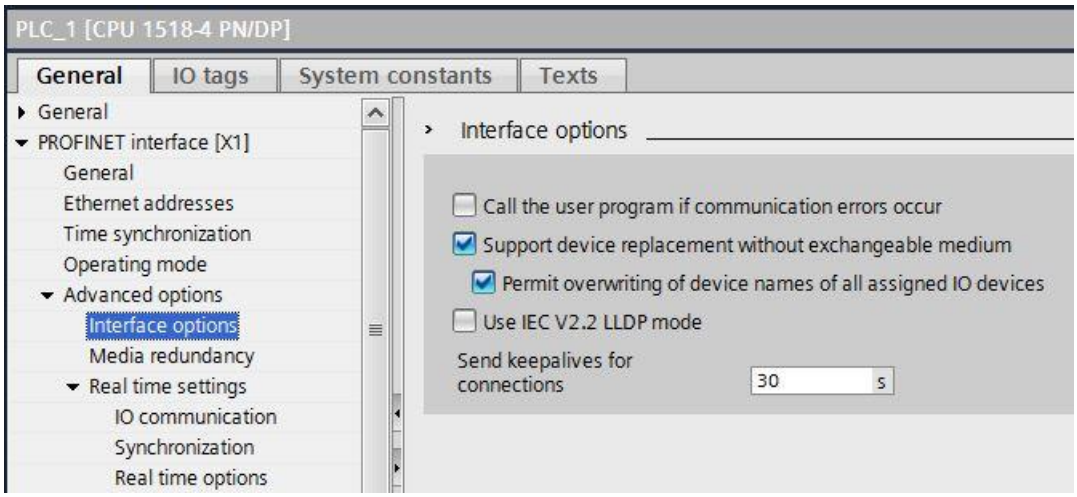
5.3.2. Automated name allocation

Optionally, device name is allocated in an automated, system-operated process.

Precondition for automated name allocation:

- The previous device name having been deleted (e.g. by “factory reset”).
- Option „support device replacement without exchangeable medium““ enabled in PLC topology view „Interface options“ (see following screenshot)
- Topology planning has been executed.

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

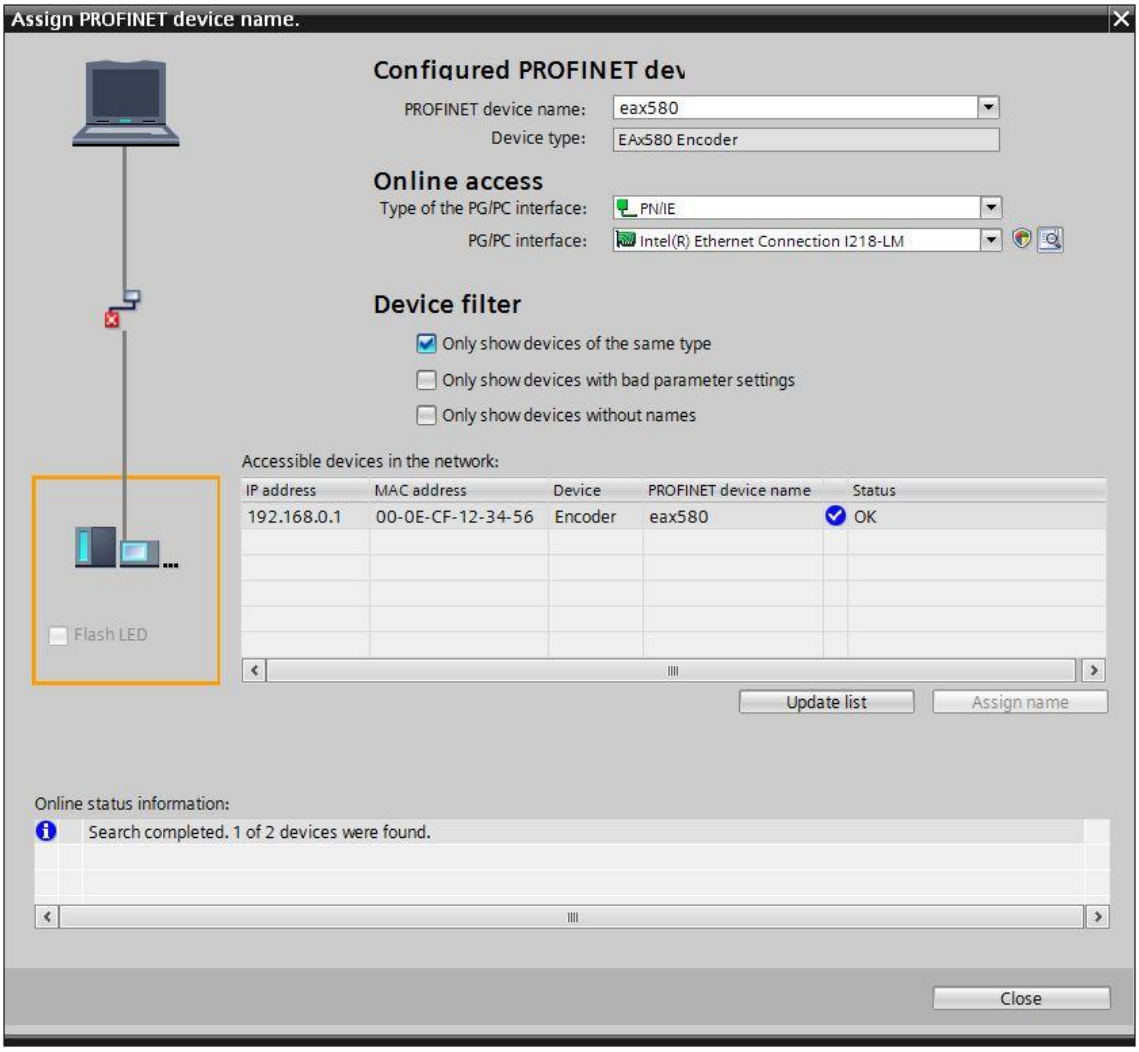


5.3.3. User-operated name allocation

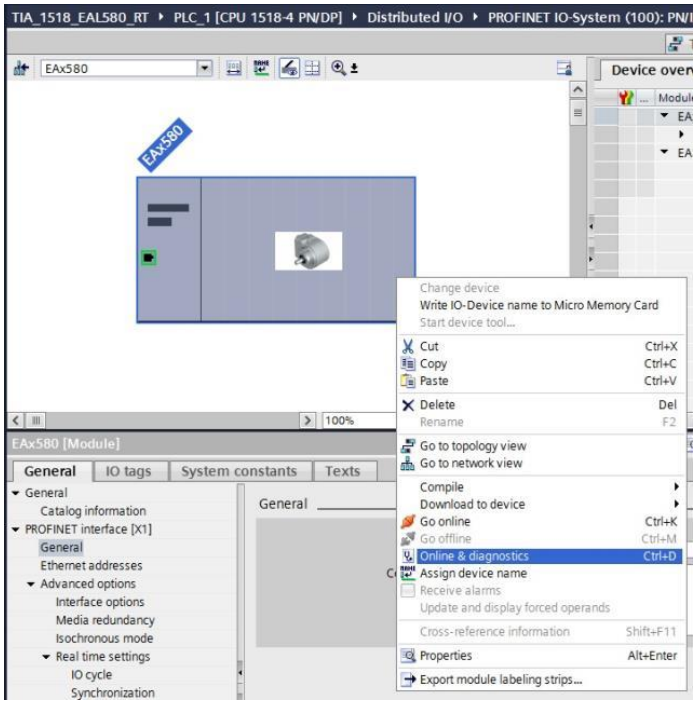
Access encoder device view, either in the topology view or click the encoder icon.

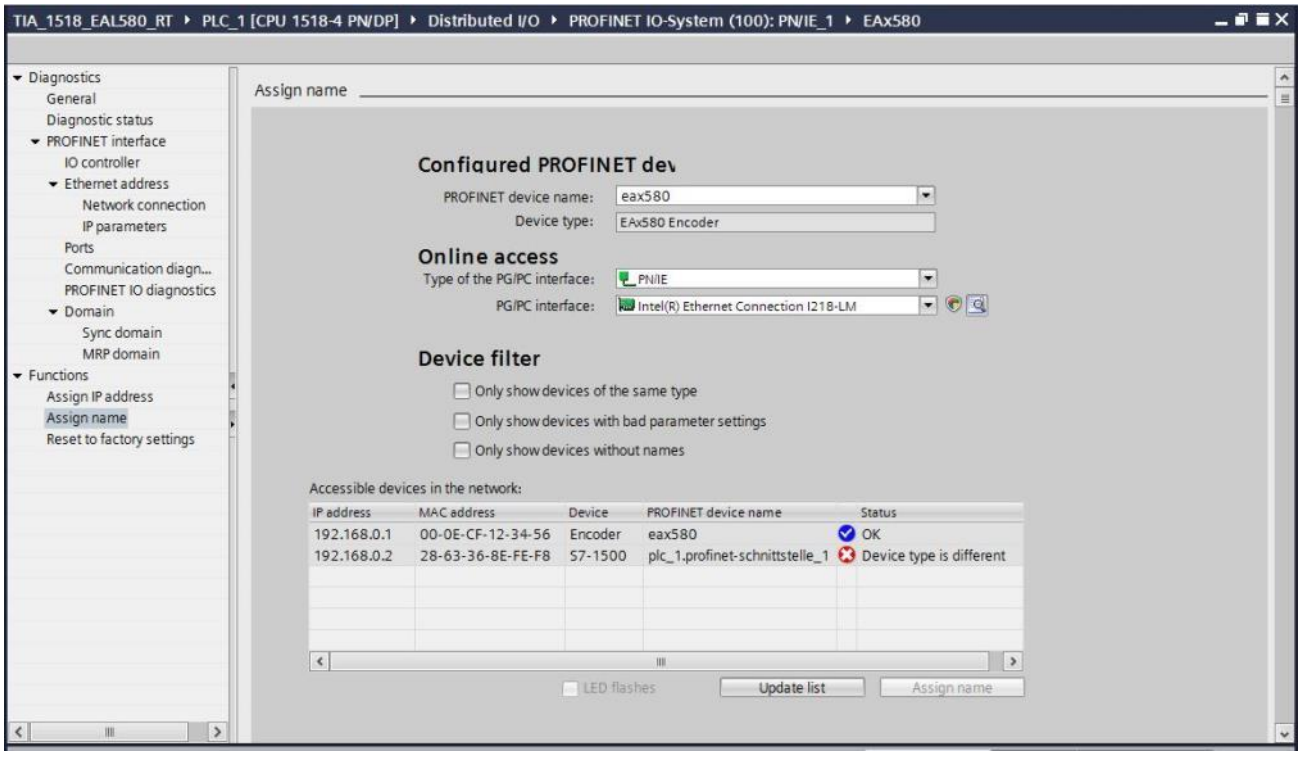
The context menu below the encoder icon (right mouse key) displays option „allocate device name“.

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 & Diagnose“.





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.

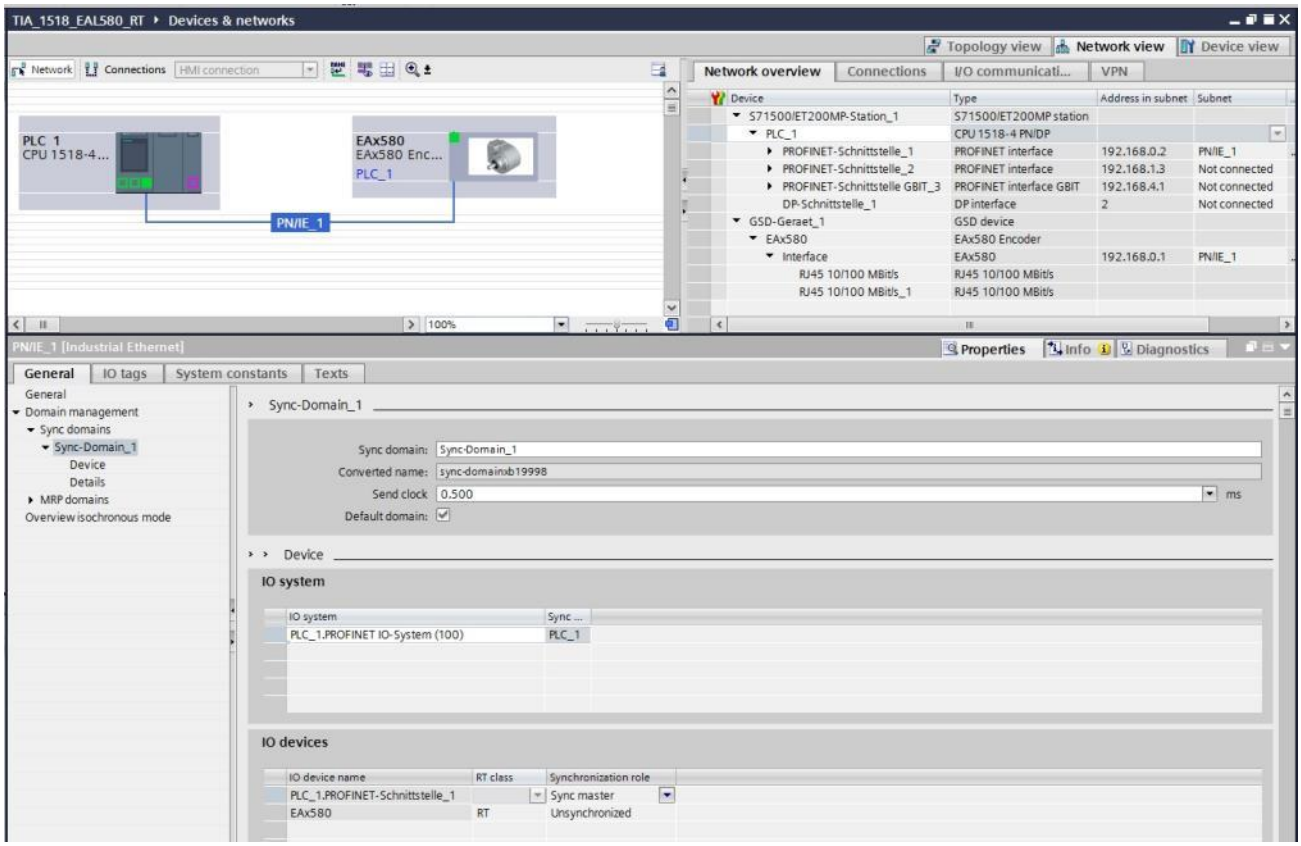
5.4. Realtime Class Selection

Both PROFINET Realtime (RT) and Isochronous Realtime (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 not sychronised (RT) under „IO devices“ , together with the encoder’s realtime class.

5.4.2. Realtime (RT) Class 1

Typical cycle time in realtime is 100 ms or less.
The bus system allows 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.

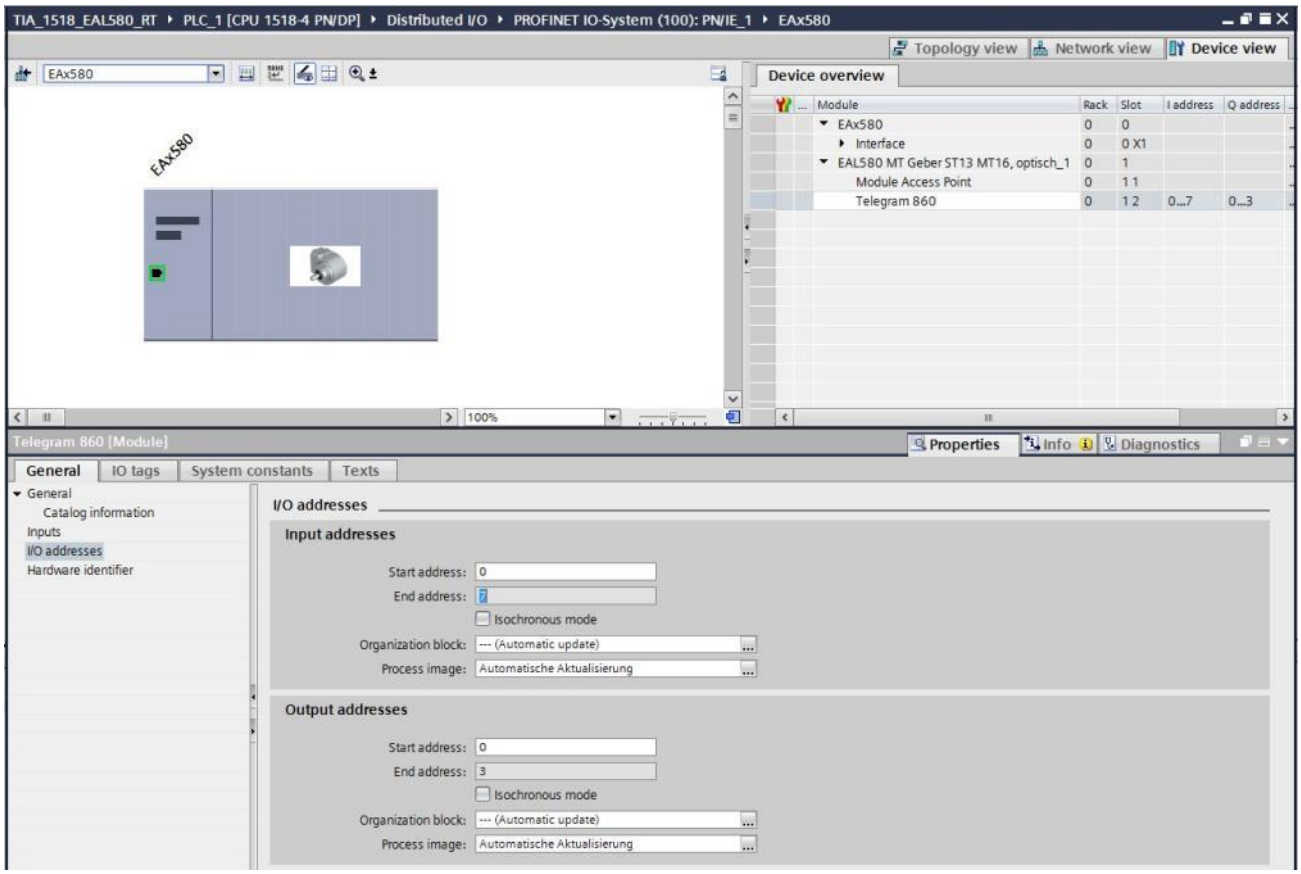
5.4.2.1. Address assignment within the process image

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.

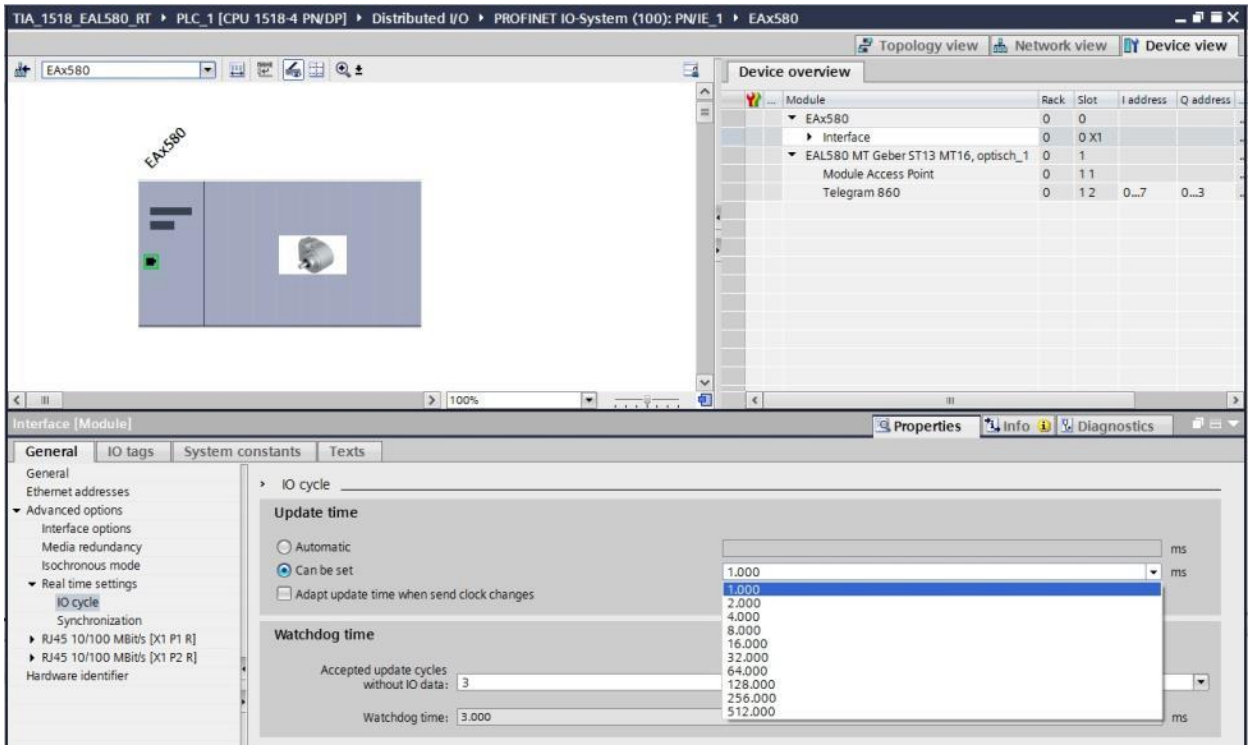
The process image will be that of the cyclic main program OB1 (not synchronized). “Automated Update“ as shown in the screenshot below means system-selected settings, but also manual input is allowed.



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 select the update time, i.e. 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 Realtime (IRT) Class 3

- Clock-synchronous realtime considering signal delay
- Typical cycle time 1 ms or less

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

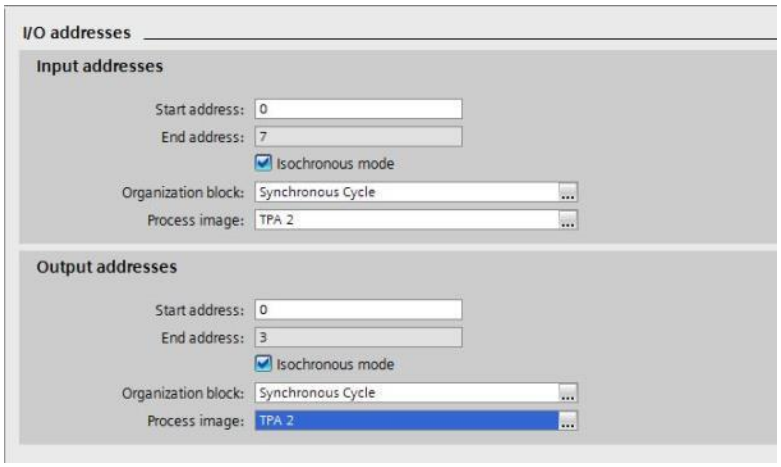
5.4.3.1. Address assignment within the process image

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.

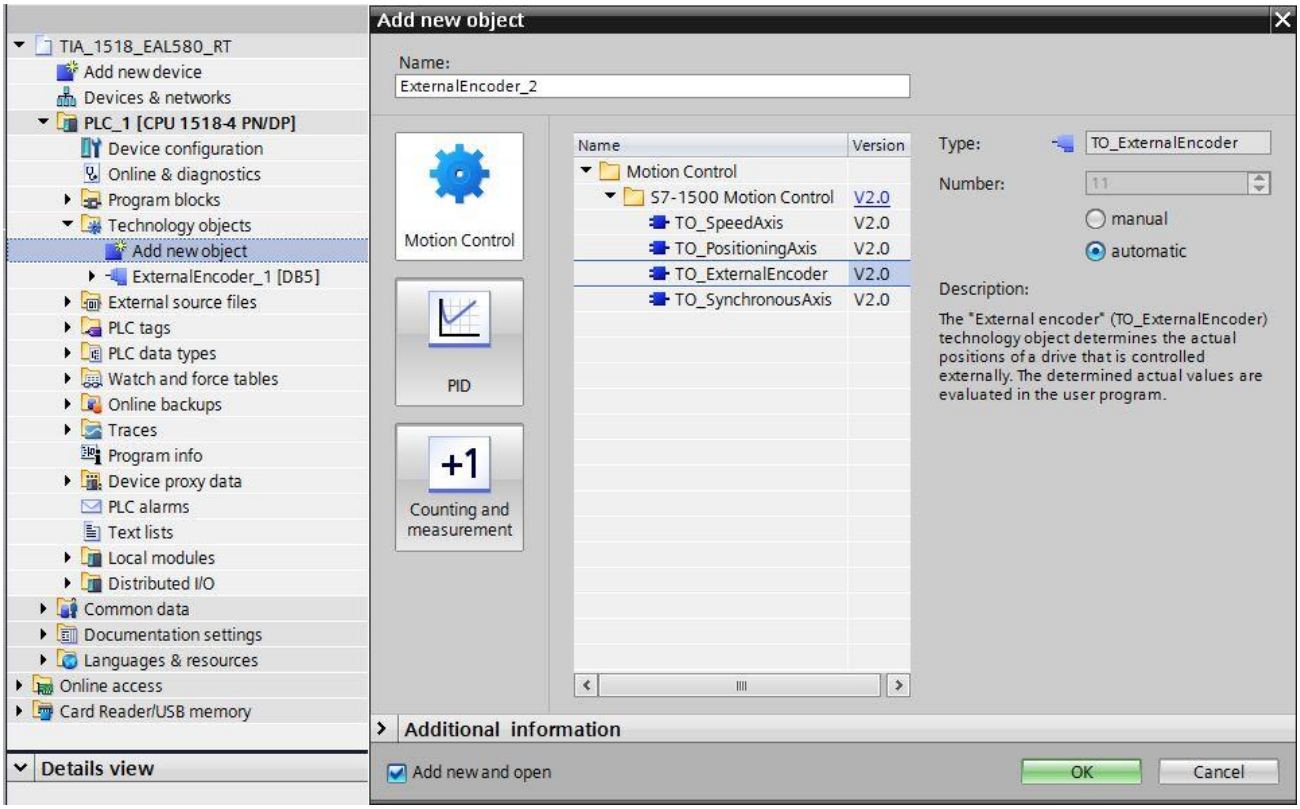
Setting the update time follows the proceedings in chapter “5.4.2.2 Selecting the update time”.

5.4.3.3. Encoder projecting as a technology object

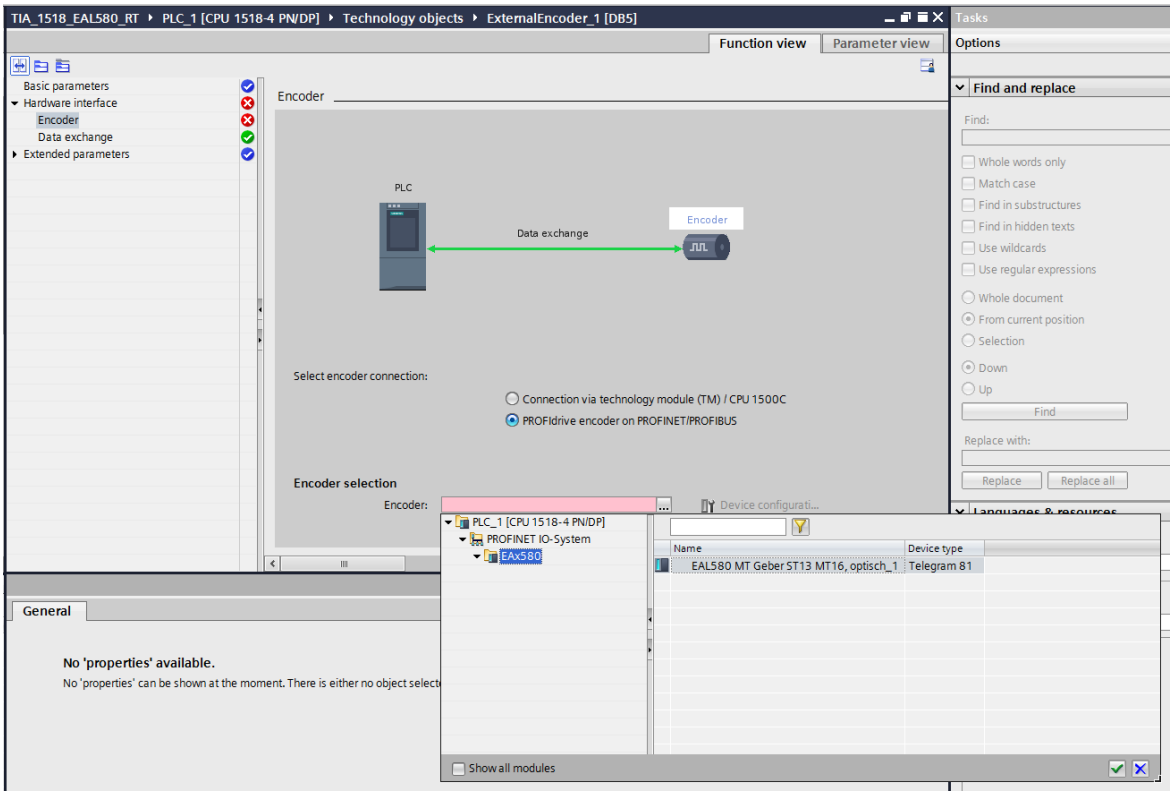
The encoder also allows for configuration as a technology object via TIA-Portal®. Settings are analog to „IRT Class 3“ proceedings, see chapter 5.4.3. Precondition however is utilizing either PROFIdrive telegram 81 or 83. Further, PIP/TPA selection is different.

Here, process image partition (PIP/TPA) is 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.

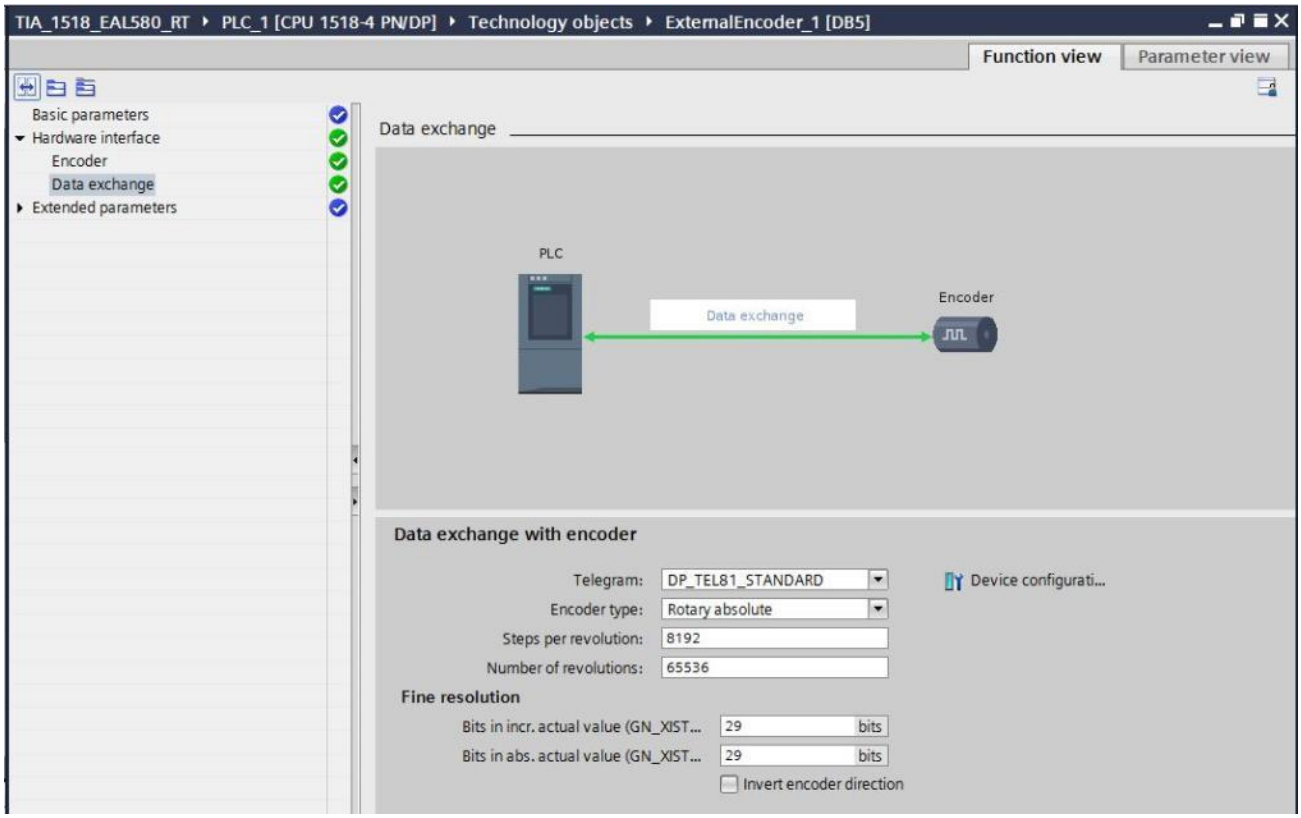
Add technology object „external encoder“ to the project. The parametrizations in the following screenshots are only examples and may have to be adapted application-specific.



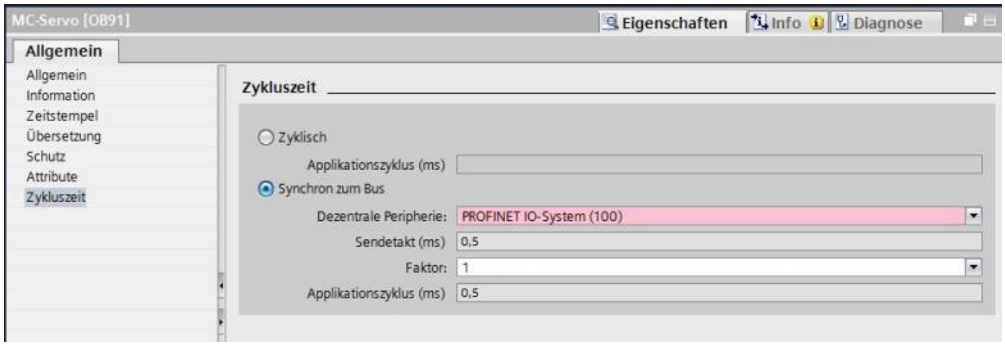
Select PROFIdrive encoder in the technology object properties.



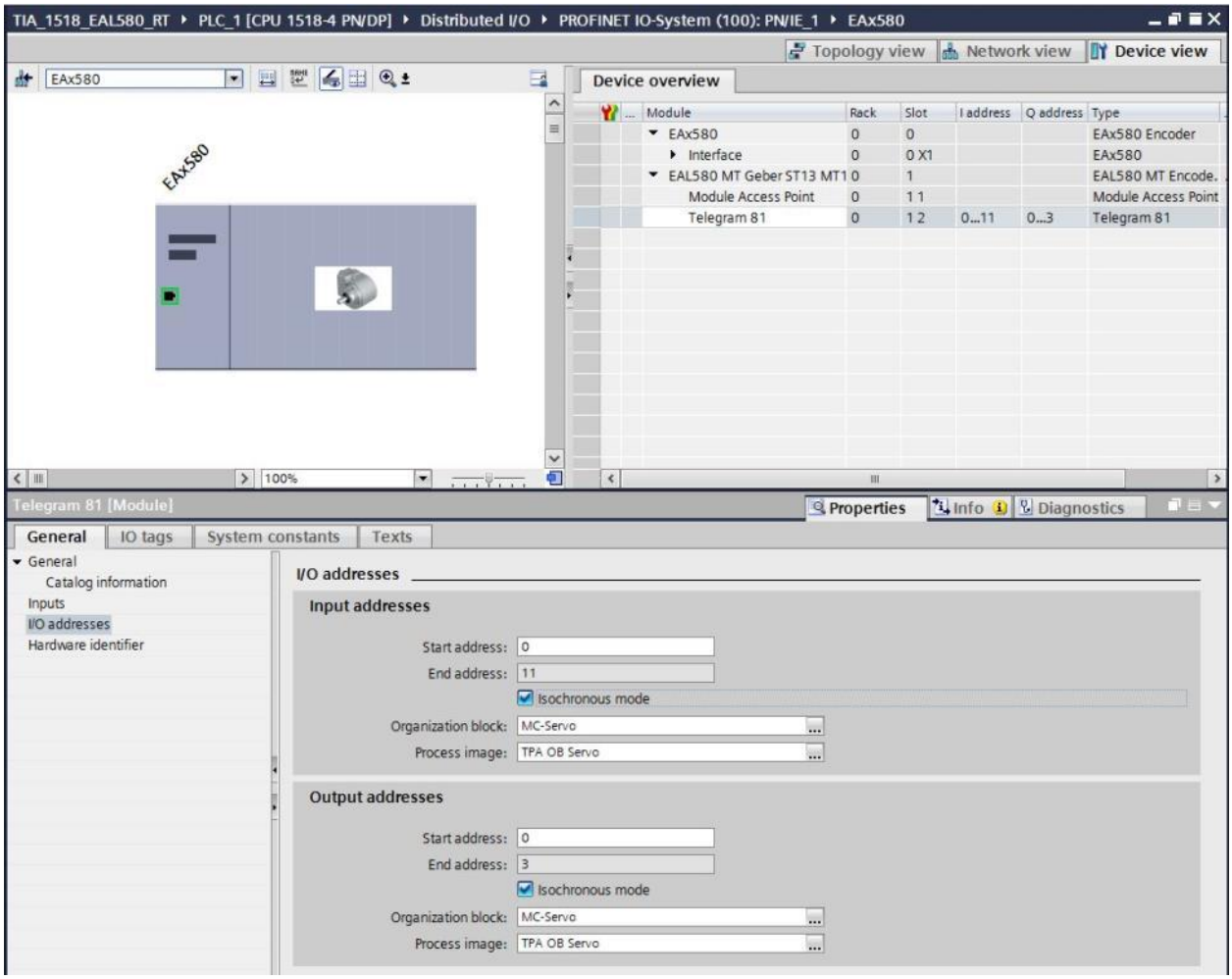
Window „data exchange“ adopts telegram type, singleturn resolution, total number of revolutions as well as the telegram’s bit number in both position values.



Clock-synchronous system function must be assigned to clock-synchronous I/O system in the „MC-Servo“(OB91) properties.



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

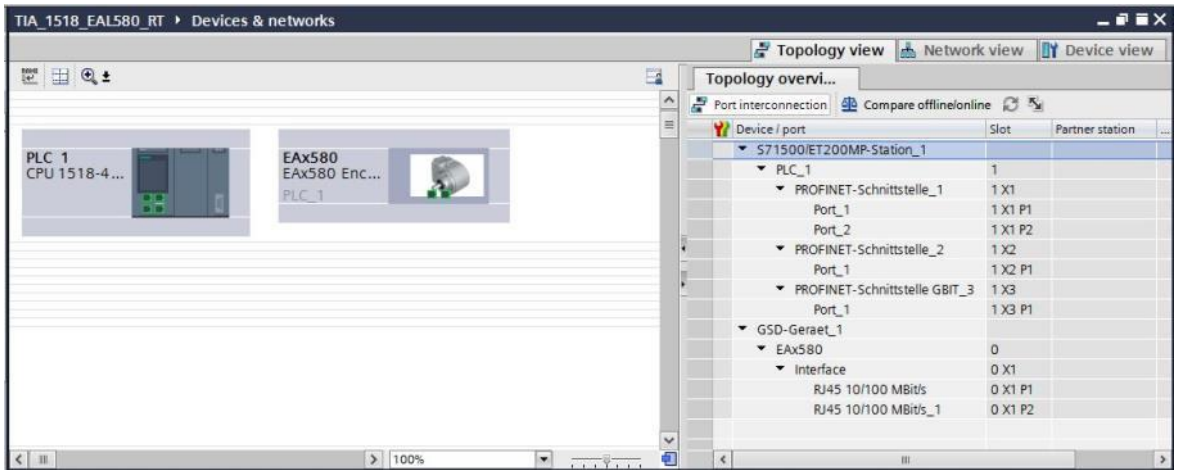

TIA_1518_EAL580_RT ▸ PLC_1 [CPU 1518-4 PN/DP] ▸ Distributed I/O ▸ PROFINET IO-System (100): PN/IE_1 ▸ EAx580
Topology view
Network view
Device view
EAx580
Device overview
Module
Rack
Slot
I address
Q address
Type
EAx580 0 0 EAx580 Encoder
Interface 0 0 X1 EAx580
EAL580 MT Geber ST13 MT1 0 1 EAL580 MT 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

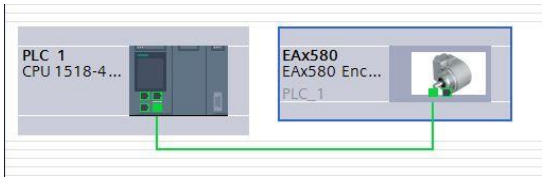
Topology planning is mandatory for IRT Class 3 operation and / or retrieving feature „support device replacement without exchangeable medium“ to communicate component wiring and cable length to the system. This way, the system will consider individual component runtimes for optimum performance.

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

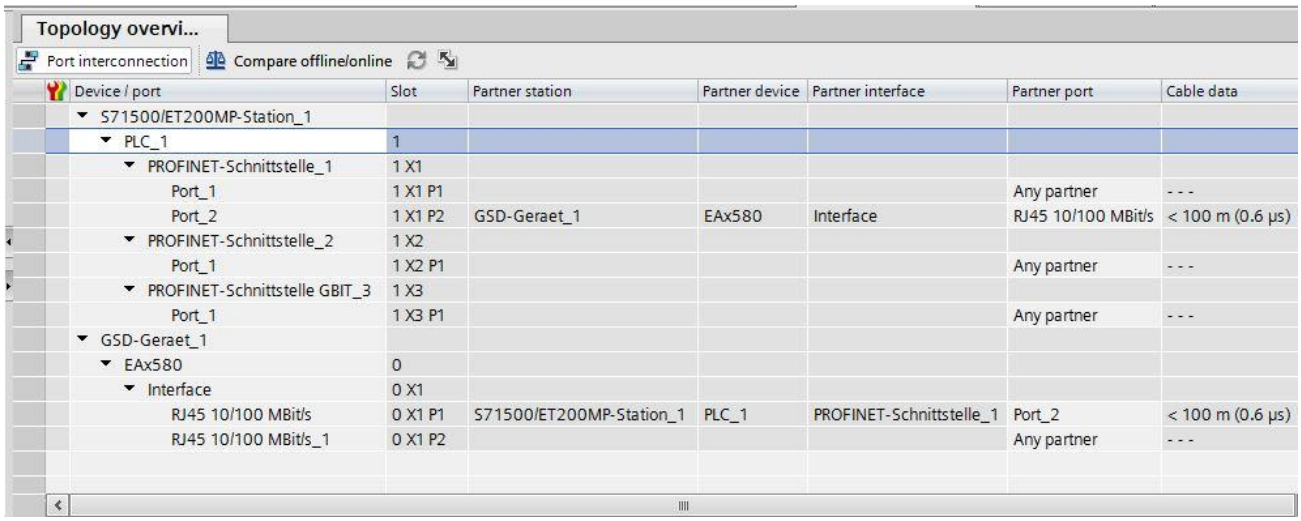
The screenshot below (topology view / topology overview) shows a project without topology planning. PLC (left) and encoder are not interconnected. The table at right does not include any partner data.



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



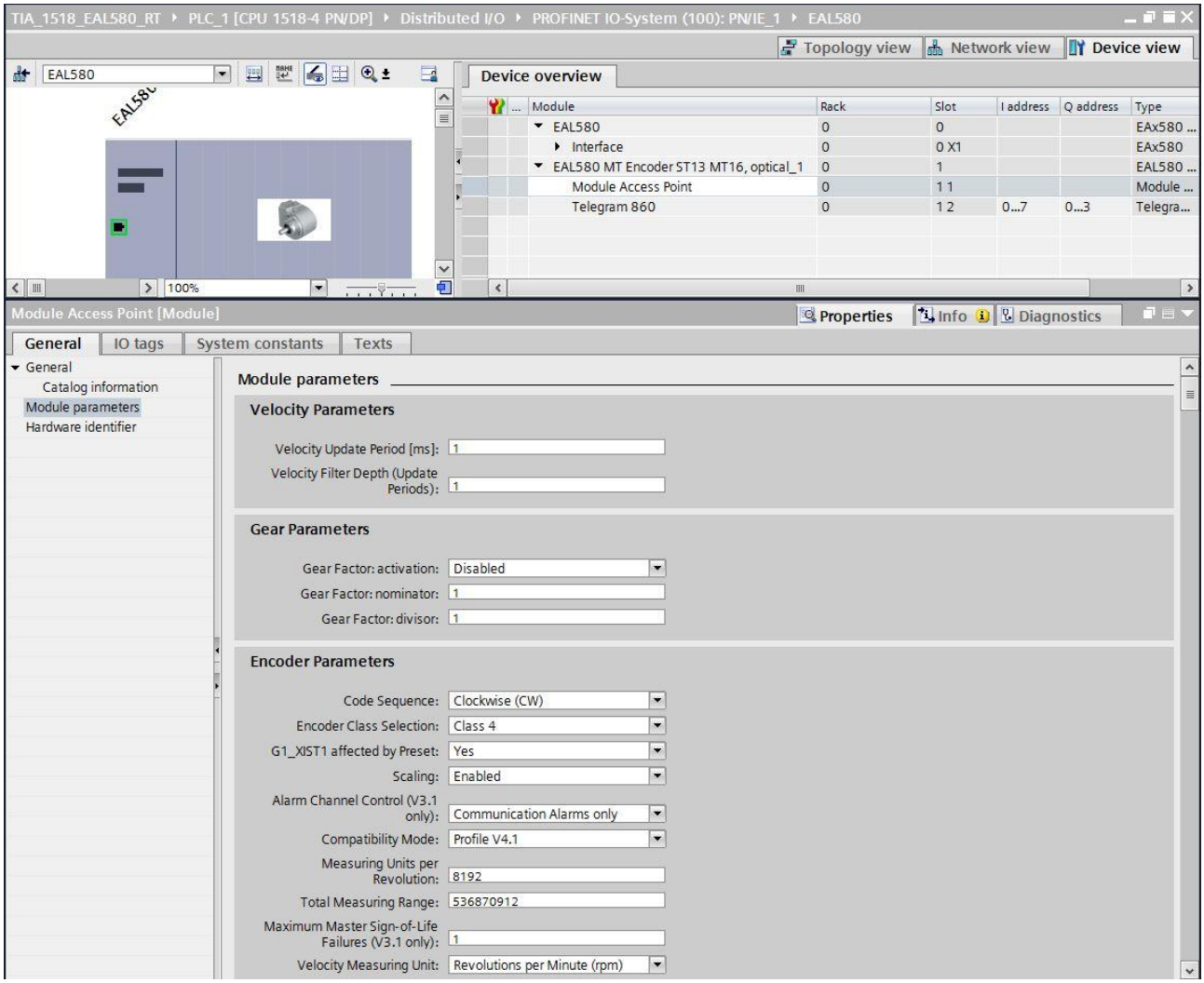
The table now contains partner interface information. The values can be modified as required.



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

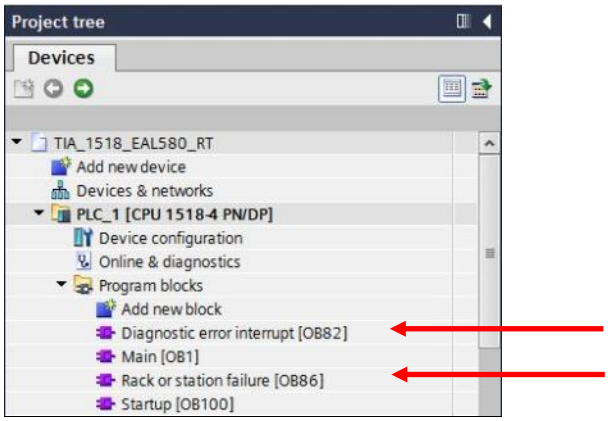
Enter the required encoder parameters in device view / device overview, Module Access Point, „module parameters“.



For Encoder Parameter details, see chapter 4.6.1 to 4.6.16. Informations 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. 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 state STOP in case of alarm.



5.7.1. I/O Point Fault OB

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

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“).

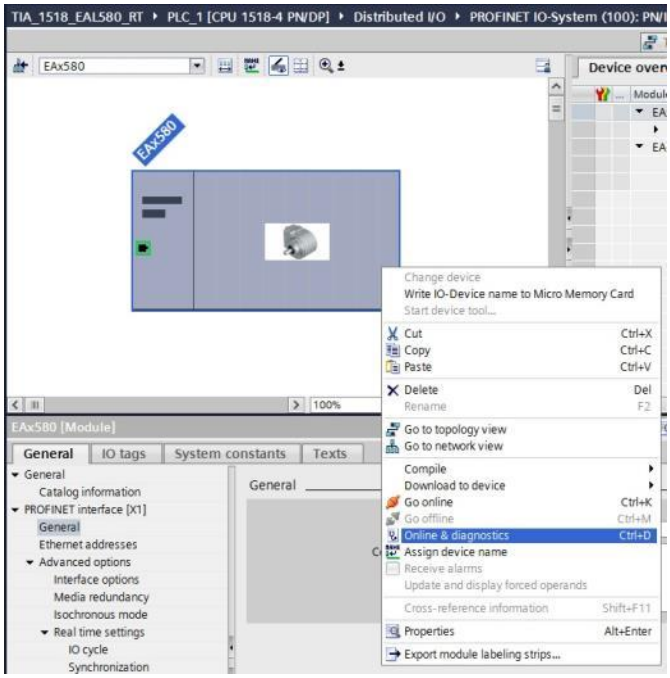
5.8. Compilation and load of hardware and software configuration

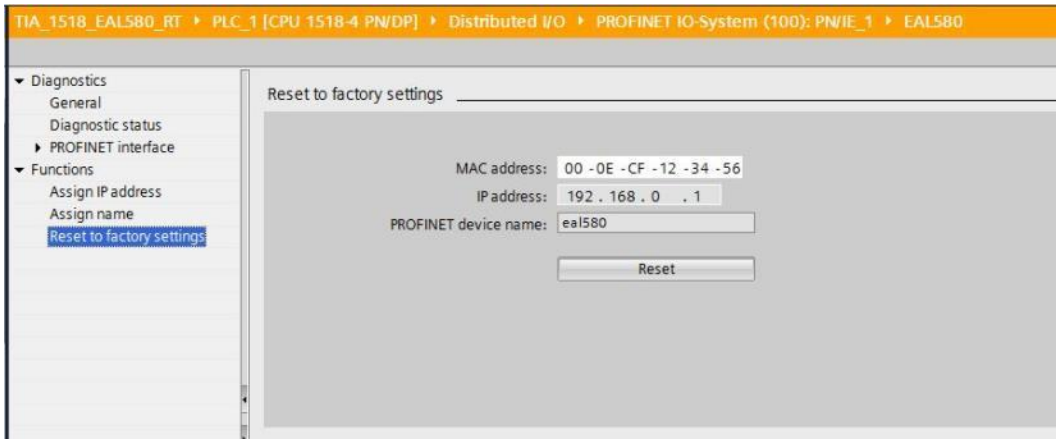
After complete hardware project configuration and once having entered all parameters, the project must be compiled („translated“) and exported to the PLC.

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 & Diagnose“.





„Reset“ will delete entire customer configuration including device name and IP. MAC-ID and serial number will remain. Switch off/on encoder 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 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.
For a picture, see 3.2.3 “Push Button for Preset / Reset”.

If the encoder is *not* connected to the PROFINET, operating the push button resets the following settings:

- All IP-Settings (IP-Address, Subnet Mask, Standard-Gateway) are reset to 0.0.0.0
- The Station Name („Device Name“) is cleared to an empty string.

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).

In order to perform a parameter Reset, the push button must be pressed within 60 seconds after power-on for a duration of at least three seconds and longest five seconds. A feedback is given by the „SF“ LED being lit green for ten seconds after a successful Reset operation.
A subsequent power cycle must be performed for the changes to take effect.

Note:
The parameter Reset using the push button is not fully congruent with „Factory Setup“ conform to PROFINET specification via the DCP-Protocol (see 5.9.1 „Factory Setup using the Engineering Tool“).

6. PROFINET operation

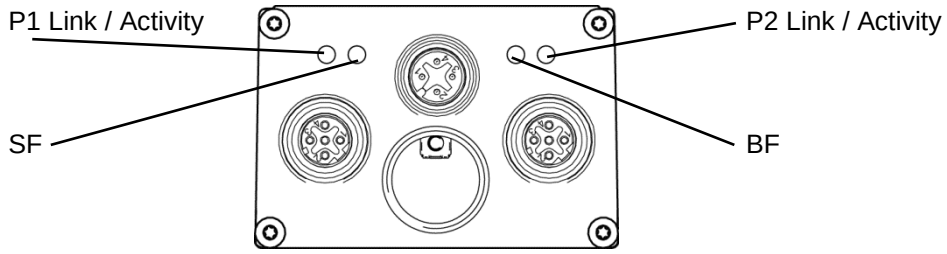
6.1. PLC (IO Controller)

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

6.2. Operating status indicator (multi-color LED)

The encoder provides four LEDs (multi-color) to indicate the device activity status. Provided encoder supply is present, the LED 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 power 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 an „position jump“ and at speeds exceeding 6400 rpm SF LED is red continuous. The LED remains on red for the time the error is present.

A preset value outside 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 LEDs (green/yellow)

The two green/yellow Link/Activity LEDs indicate the P1 and P2 status. Non-cyclic data transmission (e.g. during boot-up) is indicated by the LEDs flashing yellow while yellow flickers (activity) on green basis (link) would visualize cyclic data transmission.

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

Cycle time optimized telegram with raw position data. No scaling or 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 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: „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 Life sign				**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 w/o 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 16 bit speed information NIST_A.

Input data

ZSW2	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Slave Life sign				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 w/o preset offset																												

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

NIST_A	15															0
	Speed information as a 16bit 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 Life sign				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 w/o preset offset																											

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

NIST_B	31																											0
	Speed information as a signed 32bit 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 only 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 word and actual values are output independently from the state of 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 performs 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 „parks“ the encoder using this bit. With the encoder parked, • bit PSA (Parking Sensor Active) is set in ZSW1, • all present errors are cleared and • no output of future errors.
SEA	Sensor Error Acknowledge	I/O controller request for error message reset. Static encoder signal evaluation (no edge detection).

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) bit is starts with “zero”. 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. • Error identified by encoder • Encoder sets SE bit in G1_ZSW1 and error code in G1_XIST2. • Error is recognized by the controller, setting the SEA bit in G1_STW1. • Encoder sets the EAIP bit for as long as error removal lasts (usually not necessary). After error removal the encoder clears the bit independently. • 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. Bit reset is in parallel with PR bit reset by controller.
TAA	Transfer Absolute Acknowledge	The bit is set as soon as G1_XIST2 supplies valid position data and will be reset upon setting the „SE“ or „PSA“ bit.
PSA	Parking Sensor Active	Acknowledgement reaction on PS bit by 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 being reset. Error codes in G1_XIST2: • 0x0001 position error • 0x0F01 invalid command in G1_STW1 • 0x0F02 failure of Master Sign-of-Life (MLS)

6.5. Speed

PROFIdrive telegrams 82 and 83 as well as manufacturer-specific telegram 860 provide rotational speed information together with the absolute position information.

6.5.1. Speed Measuring Unit

Speed scaling provides four options:

- rpm revolutions per minute.
- steps /10ms number of steps in the configured singleturn resolution every 10ms
- steps /100ms number of steps in the configured singleturn resolution every 100ms
- steps /1000ms number of steps in the configured singleturn resolution per second

Scaling is defined by encoder parameterization, see also chapter „4.6 Parameterization”.

Each scaling option provides measured value output 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.

If speed is outside the +32767 to -32768 range (16 bit speed format), the encoder will output the respective maximum value. Depending on the type of encoder and configuration, the maximum value may be achieved even at very low speed. The 32 bit speed format will prevent any overrun.

6.5.2. Speed Update Period

Encoder speed is measured during an update period. Input data are updated at the end of each period.

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 application requirements.

The update period can be configured within the range from 1 ms to 255 ms.
For configuration refer to chapter „4.6 Parameterization".

6.5.3. Speed Filter Depth

The speed information acquired within in the update period can be filtered throughout several update cycles. Regardless the configured filter depth, the speed information in the input data is updated at the end of every update cycle.

A shallow filter depth (number of update cycles) 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 update time depends on the application requirements.

The filter depth, which is the total number of average update cycles, is configurable within the range from 1 to 255. For configuration refer to chapter „4.6 Parameterization".

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 it may also execute while encoder rotates for less accurate requirements.

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 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 +100.000 write cycles, frequent software- 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 I/O bus 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 - 83

A preset operation in control word STW2 requires the PLC having bit “CP” (Control by PLC) set. Usually, the PLC should have this bit set from the beginning when it establishes the Application Relationship (AR).
The „TAR“ bit must not be set during 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 signed preset value.

The „PR“ bit in G1_STW1 is the preset bit. Upon changing from “0” to “1”, it triggers the preset operation. 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“. In a relative preset operation, the 32bit value is interpreted as a complement on 2, i.e. „-1“ will be saved as „0xFFFFFFFF“.

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 ist 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).

In order to perform a Preset, the push button must be pressed for a duration of at least three seconds and longest five seconds. A feedback is given by the „SF“ LED being lit green for ten seconds after a successful Preset operation.

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 are I&M data, PROFIdrive-specific parameters, encoder-specific parameters and PN-interface linked parameters.

7.2. I&M functions: identification and maintenance

The encoder supports I&M0 Record according encoder profile 3162 V4.1. chapter 5.4.3.3.
Access (read only) is via Record Index 0xAFF0.

I&M Data block:

Block Header	Block Type	WORD	0x0020	
	Block Length	WORD	0x0038	56d
	Block Version Hi	BYTE	0x01	
	Block Version Lo	BYTE	0x00	
I&M Block	MANUFACTURER_ID	WORD	0x012A	Baumer
	ORDER_ID	BYTE[20]	ASCII	
	SERIAL_NUMBER	BYTE[16]	ASCII	
	HARDWARE_REVISION	WORD	0x0002	
	SOFTWARE_REVISION	BYTE[4]	ASCII	
	REV_COUNTER	WORD	0x0001	
	PROFILE_ID	WORD	0x0000	
	PROFILE_SPECIFIC_TYPE	WORD	0x0003	
	IM_VERSION (major)	BYTE	0x01	
	IM_VERSION (minor)	BYTE	0x01	
	IM_SUPPORTED	WORD	0x0000	

Encoder supports records I&M1 to I&M4 in compliance to IEC 61158-6-10 (PROFINET)
Access (both read and write) is via record indices 0xAFF1 to 0xAFF4

7.3. Base Mode Parameter

Parameter access is using Base Mode Parameter Access–Local, Record Data Object 0xB02E, according to PROFIdrive profile V4.1 chapter 6.2.3.

Encoder supports single- and multi-parameter access and sub-indices.
Maximum parameter access: 240 byte.

7.3.1. Write access

Write parameter access is in two steps:

- PLC Write Request
  including parameter number and user data to be written
- Device Write Response (encoder)
  (formal acknowledgement)

7.3.2. Read access

Read parameter access comprises:

- PLC Write Request
  Transmission which parameter to read
- Write Response Device
  (formal acknowledgement)
- PLC Read Request
- Device Read Response
  including the requested parameter user data

7.3.3. Base Mode Parameter Access

Parameter Access is via request block comprising:

- Address (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 Request
		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	Write Request only
		Number of values	BYTE	Write Request only
		values to write (if any)	BYTE	Write Request only

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	Buffer length (max. 255)

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 (no bytes)
		values	s. Fmt	

Data type

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

- 0x04 INT32 (signed) (32 bit / 4 byte)
- 0x06 UINT16 (16 bit / 2 byte)
- 0x07 UINT32 (32 bit / 4 byte)
- 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 32 bit I/O + 32 bit speed
Type 870: Standard telegram 32 bit I/O
Type 100: Manufacturer specific telegram 32 bit I/O + 16 bit speed
Type 101: Manufacturer specific telegram 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 life sign failures.
Only profile 3.1 will consider this parameter. When running profile no. 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 life sign failures

Write: The parameter is to read the number of tolerated Master life sign failures.
Only profile 3.1 will consider this parameter. Where running profile no. 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 life sign failures

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

Note:
In “Compatibility Mode”, only the user-specific parameter of the project HW-configuration (record 0xBF00) will be considered. Parameter 925 is of no significance.

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]	0x0000	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 the 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]	
to	
61000 [n]	with n+1 = String length name of station

7.4.13. Parameter 61001: IpOfStation

Read: This parameter is to read the IP of station (encoder 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]	Encoder 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:	00:0E:CF:xx:xx:xx	
Data: 61002 [0]	0x00	OUI (Organizationally Unique Identifier)
61002 [1]	0x0E	
61002 [2]	0xCF	
61002 [3]	0x03	(*) Individual part of MAC
61002 [4]	0x20	(*)
61002 [5]	0x00	(*)

(*) example only, device-specific

7.4.15. Parameter 61003: DefaultGatewayOfStation

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

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

7.4.16. Parameter 61004: SubnetMaskOfStation

Read: This parameter is to read the subnet mask of the encoder-connected network.

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 format of PROFIdrive profile telegrams 81 to 83 will reset the encoder position to the preset value. Parameter format is „signed 32 bit“, since relative preset is also permitted.

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

Read: This parameter reads the 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

7.4.18. Parameter 65001: Operating status

Read: Parameter 65001 reads the current operation status and configuration.

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]	0x00000020	Supported Warnings
65001 [6]	0x00000401	Encoder Profile (*)
65001 [7]	0xFFFFFFFF	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)
(****) Value 0xFFFFFFFF means that function is not supported.

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 applicable GSDML file?

If included in the order, the GSDML file required for the engineering tool is attached to the encoder on data carrier (CD). The GSDML file is also available under www.baumer.com .
To find out the GSDML file that is applicable for your encoder, please use 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.

8.2. FAQ: Operation

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

The encoder integrates several 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 7.2.

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 parameter parameterization in the PROFINET device project.

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

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

Important: The encoder’s total measuring range (“total measuring range (units “hi/lo“) must be aligned w 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 are capable of a 13 bit 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, reason why 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.
  BF-LED is on while Link/Activity-LED is off.
- The encoders´s device name is not the same as entered in the engineering tool. BF-LED is flashing and Link/Activity-LED flickers in green/yellow.
- Incomplete encoder implementation in the PROFINETproject, meaning encoder unknown to PLC.
  BF_LED is active, and the Link/Activity LED assigned to the connected port is flickering in green/yellow.
- Correct encoder implementation in the PROFINET project, but inadvertently the compiled project has not yet been exported to the PLC.
- Should the above troubleshooting prove unsuccessful try to connect the encoder by the other port.

8.3.2. No encoder communication (LED flashing red once per second)

SF-LED is continuously lit red while the Link/Activity-LEDs (indicating the port status) flicker in green-yellow. More information may be available as a text message in the PLC's diagnostic memory.

Possibly it's an encoder parameter error (one or more parameters outside limits).
Typically happens when changing the encoder resolution ("steps per turn", "measuring units per revolution") if the encoder's total measuring range was not correspondingly aligned.

Singleturn encoders
The total measuring range of a singleturn encoder comprises exactly one complete revolution, this is why the value in parameter "total measuring range" must always be equal to the parameter "measuring units per revolution".

Multiturn encoders
Multiturn encoders are capable of sensing max. 65536 revolutions (or 8192 revolutions). Maximum admissible limit for the total measuring range is the product of "steps per turn" multiplied by the encoder's maximum number of revolutions (65536 respectively 8192). Excess values in parameterization will result in an error signal (SF LED lit) together with a "parameterization alarm" in the diagnostic data.

However, any smaller value may be set. All PROFINET encoders feature integrated endless operation 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 standard multiturn encoder features a 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.
The total measuring range now is reduced to 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 149.130 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 clear (""), and PLC cannot automatically assign the proper name because automatic assignment wasn't projected or no Topology Planning was done.
- Make sure the I/O encoder addresses are within the cyclic updated process mapping. Size and position of process mapping or encoder I/O address may require adjustment.
- Encoder hardware configuration does not provide a device module („EA580 MT…" resp. „EAM580 MT…") in Slot1, 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.
- Topology planning was executed but encoder port connection other than projected (mode IRT). SF-LEDs at PLC is lit, but not the encoder's SF-LED.

8.3.4. PLC error LED is lit

Encoder operational, but error LED at PLC is lit

- Operating mode RT: Topology planning executed. Other port than projected has been connected.
- Diagnostic alarm is present