SIEMENS

Edition 07/2022

OPERATING INSTRUCTIONS

SIMOTION/SIMATIC

Motion Control Encoder
Absolute encoder with PROFINET

Motion Control Encoder PROFINET FS15

www.siemens.com/drives

SIEMENS

SIMOTION/SIMATIC

Motion Control Encoder Absolute encoder with PROFINET

Operating Instructions

Valid for product version:
Motion Control Encoder PROFINET FS15
Firmware version: V2.x

07/2022
A5E49947309B AB

Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠ **DANGER**
indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠ **WARNING**
indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠ **CAUTION**
indicates that minor personal injury can result if proper precautions are not taken.

NOTICE
indicates that property damage can result if proper precautions are not taken.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

⚠ **WARNING**
Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

Trademarks

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Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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Introduction 1

1.1 About this documentation

Content

This documentation contains information on how to program a Motion Control Encoder with PROFINET interface to address your specific requirements.

Target group

This documentation addresses machine manufacturers, commissioning engineers and service personnel who use motion control encoders.

Benefits

This manual provides all of the information, procedures and operator actions required for the particular usage phase.

1.1.1 Standard scope

Standard scope

This documentation only describes the functionality of the standard version. This may differ from the scope of the functionality of the system that is actually supplied. Please refer to the ordering documentation only for the functionality of the supplied drive system.

It may be possible to execute other functions in the system which are not described in this documentation. This does not, however, represent an obligation to supply such functions with a new control or when servicing.

For reasons of clarity, this documentation cannot include all of the detailed information on all product types. Further, this documentation cannot take into consideration every conceivable type of installation, operation and service/maintenance.

The machine manufacturer must document any additions or modifications they make to the product themselves.

Web pages of third-party companies

This document may include hyperlinks to third-party web pages. Siemens is not responsible for and shall not be liable for these web pages and their content. Siemens has no control over the information which appears on these web pages and is not responsible for the content and information provided there. The user bears the risk for their use.

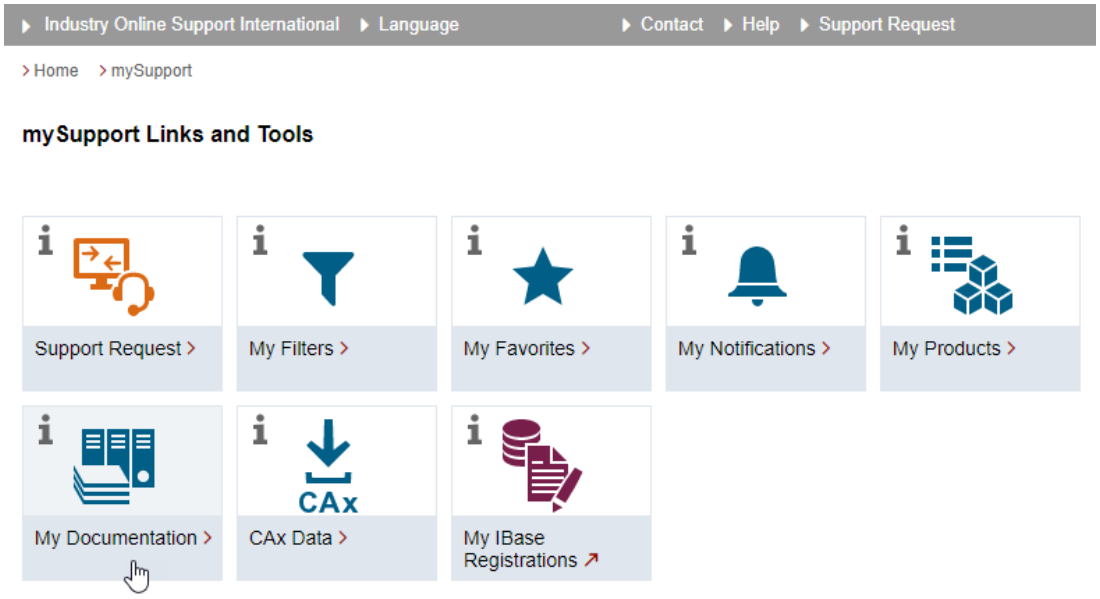
1.2 Feedback on the technical documentation

If you have any questions, suggestions or corrections regarding the technical documentation that is published in the Siemens Industry Online Support, use the "Send feedback" link that appears at the end of the entry.

1.3 mySupport documentation

With the "mySupport documentation" web-based system you can compile your own individual documentation based on Siemens content, and adapt it for your own machine documentation.

To start the application, click on the "My Documentation" tile on the mySupport homepage (https://support.industry.siemens.com/cs/ww/en/my):



The configured manual can be exported in RTF, PDF or XML format.

Note

Siemens content that supports the mySupport documentation application can be identified by the presence of the "Configure" link.

1.4 Service and Support

Product support

You can find more information about products on the internet:

Product support (https://support.industry.siemens.com/cs/ww/en/)

The following is provided at this address:

- Up-to-date product information (product announcements)
- FAQs (frequently asked questions)
- Manuals
- Downloads
- Newsletters with the latest information about your products
- Global forum for information and best practice sharing between users and specialists
- Local contact persons via our Contacts at Siemens database (→ "Contact")
- Information about field services, repairs, spare parts, and much more (→ "Field Service")

Technical support

Country-specific telephone numbers for technical support are provided on the internet at address (https://support.industry.siemens.com/cs/ww/en/sc/4868) in the "Contact" area.

If you have any technical questions, please use the online form in the "Support Request" area.

Training

You can find information on SITRAIN at the following address (https://www.siemens/sitrain). SITRAIN offers training courses for automation and drives products, systems and solutions from Siemens.

Siemens support for on the go

With the award-winning "Siemens Industry Online Support" app, you can access more than 300,000 documents for Siemens Industry products – any time and from anywhere. The app can support you in areas including:

- Resolving problems when executing a project
- Troubleshooting when faults develop
- Expanding a system or planning a new system

Furthermore, you have access to the Technical Forum and other articles that our experts have drawn up:

- FAQs
- Application examples
- Manuals
- Certificates
- Product announcements and much more

The "Siemens Industry Online Support" app is available for Apple iOS and Android.

Data matrix code on the nameplate

The data matrix code on the nameplate contains the specific device data. This code can be read with any smartphone and technical information about the device displayed via the "Industry Online Support" mobile app.

1.5 Important product information

Using OpenSSL

This product can contain the following software:

- Software developed by the OpenSSL project for use in the OpenSSL toolkit
- Cryptographic software created by Eric Young.
- Software developed by Eric Young

You can find more information on the internet:

- OpenSSL (https://www.openssl.org)
- Cryptsoft (https://www.cryptsoft.com)

Compliance with the General Data Protection Regulation

Siemens observes standard data protection principles, in particular the data minimization rules (privacy by design).

For this product, this means:

The product does not process or store any personal data, only technical function data (e.g. time stamps). If the user links this data with other data (e.g. shift plans) or if he/she stores person-related data on the same data medium (e.g. hard disk), thus personalizing this data, he/she must ensure compliance with the applicable data protection stipulations.

Fundamental safety instructions

2

2.1 General safety instructions

⚠ WARNING

Electric shock and danger to life due to other energy sources

Touching live components can result in death or severe injury.

- Only work on electrical devices when you are qualified for this job.
- Always observe the country-specific safety rules.

Generally, the following steps apply when establishing safety:

1. Prepare for disconnection. Notify all those who will be affected by the procedure.
2. Isolate the drive system from the power supply and take measures to prevent it being switched back on again.
3. Wait until the discharge time specified on the warning labels has elapsed.
4. Check that there is no voltage between any of the power connections, and between any of the power connections and the protective conductor connection.
5. Check whether the existing auxiliary supply circuits are de-energized.
6. Ensure that the motors cannot move.
7. Identify all other dangerous energy sources, e.g. compressed air, hydraulic systems, or water. Switch the energy sources to a safe state.
8. Check that the correct drive system is completely locked.

After you have completed the work, restore the operational readiness in the inverse sequence.

⚠ WARNING

Risk of electric shock and fire from supply networks with an excessively high impedance

Excessively low short-circuit currents can lead to the protective devices not tripping or tripping too late, and thus causing electric shock or a fire.

- In the case of a conductor-conductor or conductor-ground short-circuit, ensure that the short-circuit current at the point where the converter is connected to the line supply at least meets the minimum requirements for the response of the protective device used.
- You must use an additional residual-current device (RCD) if a conductor-ground short circuit does not reach the short-circuit current required for the protective device to respond. The required short-circuit current can be too low, especially for TT supply systems.

⚠ WARNING

Risk of electric shock and fire from supply networks with an excessively low impedance

Excessively high short-circuit currents can lead to the protective devices not being able to interrupt these short-circuit currents and being destroyed, and thus causing electric shock or a fire.

- Ensure that the prospective short-circuit current at the line terminal of the converter does not exceed the breaking capacity (SCCR or Icc) of the protective device used.

⚠ WARNING

Electric shock if there is no ground connection

For missing or incorrectly implemented protective conductor connection for devices with protection class I, high voltages can be present at open, exposed parts, which when touched, can result in death or severe injury.

- Ground the device in compliance with the applicable regulations.

⚠ WARNING

Electric shock due to connection to an unsuitable power supply

When equipment is connected to an unsuitable power supply, exposed components may carry a hazardous voltage. Contact with hazardous voltage can result in severe injury or death.

- Only use power supplies that provide SELV (Safety Extra Low Voltage) or PELV- (Protective Extra Low Voltage) output voltages for all connections and terminals of the electronics modules.

⚠ WARNING

Electric shock due to equipment damage

Improper handling may cause damage to equipment. For damaged devices, hazardous voltages can be present at the enclosure or at exposed components; if touched, this can result in death or severe injury.

- Ensure compliance with the limit values specified in the technical data during transport, storage and operation.
- Do not use any damaged devices.

⚠ WARNING

Electric shock due to unconnected cable shield

Hazardous touch voltages can occur through capacitive cross-coupling due to unconnected cable shields.

- As a minimum, connect cable shields and the conductors of power cables that are not used (e.g. brake cores) at one end at the grounded housing potential.

⚠ WARNING

Arcing when a plug connection is opened during operation

Opening a plug connection when a system is operation can result in arcing that may cause serious injury or death.

- Only open plug connections when the equipment is in a voltage-free state, unless it has been explicitly stated that they can be opened in operation.

⚠ WARNING

Electric shock due to residual charges in power components

Because of the capacitors, a hazardous voltage is present for up to 5 minutes after the power supply has been switched off. Contact with live parts can result in death or serious injury.

- Wait for 5 minutes before you check that the unit really is in a no-voltage condition and start work.

NOTICE

Damage to equipment due to unsuitable tightening tools.

Unsuitable tightening tools or fastening methods can damage the screws of the equipment.

- Only use screw inserts that exactly match the screw head.
- Tighten the screws with the torque specified in the technical documentation.
- Use a torque wrench or a mechanical precision nut runner with a dynamic torque sensor and speed limitation system.
- Adjust the tools used regularly.

NOTICE

Property damage due to loose power connections

Insufficient tightening torques or vibration can result in loose power connections. This can result in damage due to fire, device defects or malfunctions.

- Tighten all power connections to the prescribed torque.
- Check all power connections at regular intervals, particularly after equipment has been transported.

⚠ WARNING

Spread of fire from built-in devices

Built-in devices can cause a fire and a pressure wave in the event of a fault. Fire and smoke can escape from the control cabinet and cause serious personal injury and property damage.

- Install built-in appliances in a robust metal control cabinet that is suitable for protecting people from fire and smoke.
- Only operate built-in devices with the control cabinet doors closed.
- Ensure that smoke can only escape via controlled and monitored paths.

⚠ WARNING

Active implant malfunctions due to electromagnetic fields

Converters generate electromagnetic fields (EMF) in operation. Electromagnetic fields may interfere with active implants, e.g. pacemakers. People with active implants in the immediate vicinity of an converter are at risk.

- As the operator of an EMF-emitting installation, assess the individual risks of persons with active implants.
- Observe the data on EMF emission provided in the product documentation.

⚠ WARNING

Unexpected machine movement caused by radio devices or mobile phones

Using radio devices, cellphones, or mobile WLAN devices in the immediate vicinity of the components can result in equipment malfunction. Malfunctions may impair the functional safety of machines and can therefore put people in danger or lead to property damage.

- Therefore, if you move closer than 20 cm to the components, be sure to switch off radio devices, cellphones or WLAN devices.
- Use the "SIEMENS Industry Online Support app" only on equipment that has already been switched off.

NOTICE

Damage to motor insulation due to excessive voltages

When operated on systems with grounded line conductors or in the event of a ground fault in the IT system, the motor insulation can be damaged by the higher voltage against ground. If you use motors that have insulation that is not designed for operation with grounded line conductors, you must perform the following measures:

- IT system: Use a ground fault monitor and eliminate the fault as quickly as possible.
- TN or TT systems with grounded line conductor: Use an isolating transformer on the line side.

⚠ WARNING

Fire due to inadequate ventilation clearances

Inadequate ventilation clearances can cause overheating of components with subsequent fire and smoke. This can cause severe injury or even death. This can also result in increased downtime and reduced service lives for devices/systems.

- Ensure compliance with the specified minimum clearance as ventilation clearance for the respective component.

NOTICE

Overheating due to inadmissible mounting position

The device may overheat and therefore be damaged if mounted in an inadmissible position.

- Only operate the device in admissible mounting positions.

⚠ WARNING

Unrecognized dangers due to missing or illegible warning labels

Dangers might not be recognized if warning labels are missing or illegible. Unrecognized dangers may cause accidents resulting in serious injury or death.

- Check that the warning labels are complete based on the documentation.
- Attach any missing warning labels to the components, where necessary in the national language.
- Replace illegible warning labels.

NOTICE

Device damage caused by incorrect voltage/insulation tests

Incorrect voltage/insulation tests can damage the device.

- Before carrying out a voltage/insulation check of the system/machine, disconnect the devices as all converters and motors have been subject to a high voltage test by the manufacturer, and therefore it is not necessary to perform an additional test within the system/machine.

⚠ WARNING

Unexpected movement of machines caused by inactive safety functions

Inactive or non-adapted safety functions can trigger unexpected machine movements that may result in serious injury or death.

- Observe the information in the appropriate product documentation before commissioning.
- Carry out a safety inspection for functions relevant to safety on the entire system, including all safety-related components.
- Ensure that the safety functions used in your drives and automation tasks are adjusted and activated through appropriate parameterizing.
- Perform a function test.
- Only put your plant into live operation once you have guaranteed that the functions relevant to safety are running correctly.

Note

Important Safety instructions for Safety Integrated

If you want to use Safety Integrated functions, you must observe the Safety instructions in the Safety Integrated documentation.

⚠ WARNING

Malfunctions of the machine as a result of incorrect or changed parameter settings

As a result of incorrect or changed parameterization, machines can malfunction, which in turn can lead to injuries or death.

- Protect the parameterization against unauthorized access.
- Handle possible malfunctions by taking suitable measures, e.g. emergency stop or emergency off.

2.2 Equipment damage due to electric fields or electrostatic discharge

Electrostatic sensitive devices (ESD) are individual components, integrated circuits, modules or devices that may be damaged by either electric fields or electrostatic discharge.

NOTICE

Equipment damage due to electric fields or electrostatic discharge

Electric fields or electrostatic discharge can cause malfunctions through damaged individual components, integrated circuits, modules or devices.

- Only pack, store, transport and send electronic components, modules or devices in their original packaging or in other suitable materials, e.g conductive foam rubber of aluminum foil.
- Only touch components, modules and devices when you are grounded by one of the following methods:
  - Wearing an ESD wrist strap
  - Wearing ESD shoes or ESD grounding straps in ESD areas with conductive flooring
- Only place electronic components, modules or devices on conductive surfaces (table with ESD surface, conductive ESD foam, ESD packaging, ESD transport container).

2.3 Warranty and liability for application examples

Application examples are not binding and do not claim to be complete regarding configuration, equipment or any eventuality which may arise. Application examples do not represent specific customer solutions, but are only intended to provide support for typical tasks.

As the user you yourself are responsible for ensuring that the products described are operated correctly. Application examples do not relieve you of your responsibility for safe handling when using, installing, operating and maintaining the equipment.

2.4 Security information

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, systems, machines and networks.

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens' products and solutions constitute one element of such a concept.

Customers are responsible for preventing unauthorized access to their plants, systems, machines and networks. Such systems, machines and components should only be connected to an enterprise network or the internet if and to the extent such a connection is necessary and only when appropriate security measures (e.g. firewalls and/or network segmentation) are in place.

For additional information on industrial security measures that may be implemented, please visit
https://www.siemens.com/industrialsecurity (https://www.siemens.com/industrialsecurity).

Siemens' products and solutions undergo continuous development to make them more secure. Siemens strongly recommends that product updates are applied as soon as they are available and that the latest product versions are used. Use of product versions that are no longer supported, and failure to apply the latest updates may increase customer's exposure to cyber threats.

To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed under
https://www.siemens.com/cert (https://www.siemens.com/cert).

Further information is provided on the Internet:

Industrial Security Configuration Manual (https://support.industry.siemens.com/cs/ww/en/view/108862708)

⚠ WARNING

Unsafe operating states resulting from software manipulation

Software manipulations, e.g. viruses, Trojans, or worms, can cause unsafe operating states in your system that may lead to death, serious injury, and property damage.

- Keep the software up to date.
- Incorporate the automation and drive components into a holistic, state-of-the-art industrial security concept for the installation or machine.
- Make sure that you include all installed products into the holistic industrial security concept.
- Protect files stored on exchangeable storage media from malicious software by with suitable protection measures, e.g. virus scanners.
- On completion of commissioning, check all security-related settings.

2.5 Residual risks of power drive systems

When assessing the machine- or system-related risk in accordance with the respective local regulations (e.g., EC Machinery Directive), the machine manufacturer or system installer must take into account the following residual risks emanating from the control and drive components of a drive system:

1. Unintentional movements of driven machine or system components during commissioning, operation, maintenance, and repairs caused by, for example,
   - Hardware and/or software errors in the sensors, control system, actuators, and cables and connections
   - Response times of the control system and of the drive
   - Operation and/or environmental conditions outside the specification
   - Condensation/conductive contamination
   - Parameterization, programming, cabling, and installation errors
   - Use of wireless devices/mobile phones in the immediate vicinity of electronic components
   - External influences/damage
   - X-ray, ionizing radiation and cosmic radiation
2. Unusually high temperatures, including open flames, as well as emissions of light, noise, particles, gases, etc., can occur inside and outside the components under fault conditions caused by, for example:
   - Component failure
   - Software errors
   - Operation and/or environmental conditions outside the specification
   - External influences/damage
3. Hazardous shock voltages caused by, for example:
   - Component failure
   - Influence during electrostatic charging
   - Induction of voltages in moving motors
   - Operation and/or environmental conditions outside the specification
   - Condensation/conductive contamination
   - External influences/damage
4. Electrical, magnetic and electromagnetic fields generated in operation that can pose a risk to people with a pacemaker, implants or metal replacement joints, etc., if they are too close
5. Release of environmental pollutants or emissions as a result of improper operation of the system and/or failure to dispose of components safely and correctly
6. Influence of network-connected communication systems, e.g. ripple-control transmitters or data communication via the network

For more information about the residual risks of the drive system components, see the relevant sections in the technical user documentation.

Overview

3

The operating instructions describe the implementation and configuration of the absolute encoder (Motion Control Encoders) with PROFINET interface.

The device fulfills the following standards, and is also certified according to these:

- PROFINET RT (Real Time)
- PROFINET IRT (Isochronous Real Time)
- Encoder profile V2.x, Class 1, Class 2, Class 3 and Class 4

Note

Absolute encoders for industrial machines

Absolute encoders are exclusively intended for installation in industrial machines (according to Standard NFPA 79 in the USA).

3.1 PROFINET technology

PROFINET is an Industrial Ethernet standard that merges the system automation with other IT resources of a company. It provides functionality that is comparable with PROFIBUS along with technologies that are used by development, IT and administration personnel.

The absolute encoder (Motion Control Encoder) supports the PROFINET V2.33 Standard.

Communication

Communication is realized based on established IT standards: TCP, UDP and IP.

XML is used as a descriptive language for IO device profiles (GSDML files).

More information

More information on the principle of operation and setting up a PROFINET network are provided at the following address (https://www.profibus.com/technology/profinet/):

3.2 Absolute encoder

The absolute encoder (Motion Control Encoder) operates according to one of the following basic principles:

- Optically scanning a transparent coded disk that is mounted on the drive shaft (singleturn and multiturn encoders)
- Evaluating a rotating magnetic field that is generated using a magnet (multiturn encoder)

Note

For reasons of simplification, the absolute encoder is simply called "encoder" in the remainder of this manual.

The encoder has a maximum resolution of 65,536 steps per revolution (16 bit).

In addition, the multiturn version can scan up to 16,384 revolutions (14 bit).

As a consequence, the highest possible absolute resolution is 30 bit = 2^{30} = 1,073,741,824 steps.

The standard singleturn version has a resolution of 16 bit.

The standard multiturn version has a resolution of 30 bit.

Programming the encoder

The encoder equipped with PROFINET interface can be programmed to address user requirements. The GSDML file belonging to the encoder must be installed on the PLC using the engineering software tool.

Using the GSMDL file, the resolution per revolution can be configured between 13 and 16 bit.

3.3 Encoder profile

Introduction

The encoder profile defines a standard application interface for an encoder connected to PROFINET and PROFIBUS. In the encoder profile, a distinction is made between 4 application classes (Class 1 to 4) of encoder applications; see the following paragraph "Overview of documents relating to standards and technology assignment".

The Motion Control Encoder supports encoder profile V4.2.

As spare part for older encoder versions and by parameterizing the V3.1 compatibility mode, encoder V3.0 can also be operated with compatibility with older applications that were programmed for encoder profiles V3.1 and V4.1.

Classes 1 and 2

Class 1 and Class 2 applications are intended for applications with position encoders, which are connected to programmable logic control systems, typically not in the isochronous mode.

The encoder is operated using telegram 89 as well as 81, 86, 87, 860 or 862 in a Class 1 or 2 application.

The encoder can be operated using telegram 89, or optionally in the isochronous mode (IRT).

Classes 3 and 4

Class 3 and Class 4 applications include the complete encoder channel according to PROFIdrive.

Correspondingly, the encoder can generally be used for isochronous applications and as equivalent to a PROFIdrive encoder channel as is provided by a PROFIdrive drive of a Class 4 application.

The encoder is operated using telegrams 81, 82, 83 or 84 in a Class 3 or 4 application.

The encoder can be operated in the isochronous mode (IRT) or in the non-isochronous mode (RT).

Overview of the documents relating to the standard and technology assignment

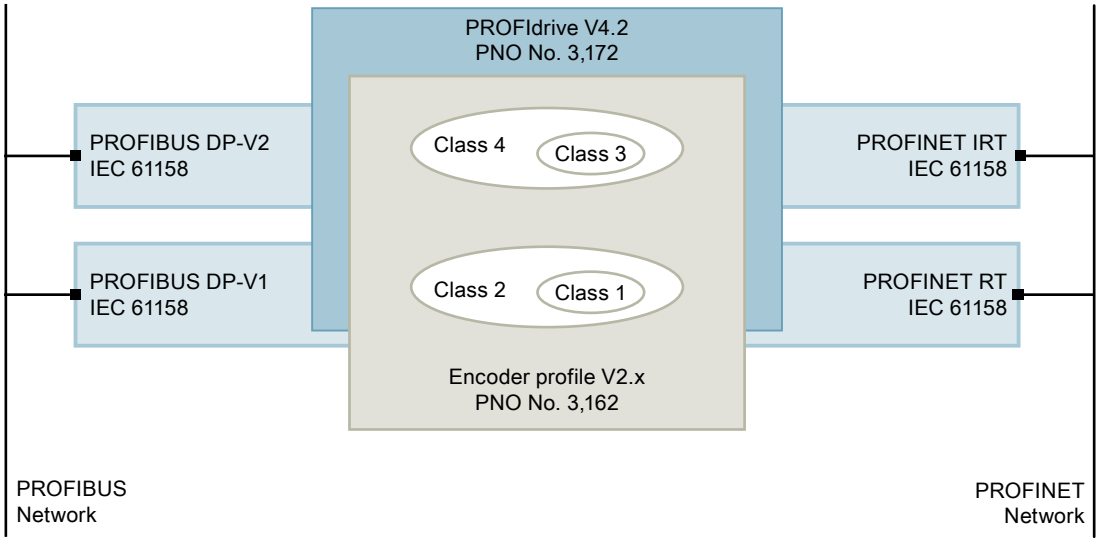


Figure 3-1 Overview of the documents relating to the standard and assignments to the individual technologies

3.4 Encoder features

Encoder with application Class 4 supports all functions of an encoder with application Class 3.

Further, using telegram 860, the encoder can also be used in applications where functions according to Class 1 and Class 2 are required.

Basic functions

- PROFINET V2.33 communication interface
- Cycle time ≥ 250 µs
- MRP for RT (media redundancy)
- MRPD for IRT (bumpless media redundancy)
- Absolute encoder (singleturn or multiturn depending on the version)
- Class 3, Class 4 (IRT)
- Class 1, Class 2 (RT or IRT)
- PROFINET neighborhood detection (for device replacement without engineering)
- Device identification using LEDs
- Support of encoder profile V4.2
- Emulation of encoder profile V3.1 (compatibility mode)
- Replacement part compatibility to encoders V4.2 and V4.1
- Support of standard telegrams 81, 82, 83, 84, 86, 87, 88, 89
- Support of manufacturer-specific telegrams 860, 862
- Support of the PROFIdrive parameter channel (acyclic communication)
- Speed/velocity value with configurable filter settings and units
- Acceleration value
- Integrated rotary axis function (endless shaft)
- Scaling function with fractional arithmetic scaling
- PROFIdrive fault memory as diagnostics logbook (for errors and alarms)
- Standard PROFINET diagnostics (alarm channel)
- Operating hours counter
- Integrated bootloader to upgrade the encoder firmware

3.5 Compatibility

The encoder with firmware V2.x is compatible with the previous versions of the Motion Control Encoder with firmware V1.x.

Version V2.x as well as V1.x DAPs are included in the GSDML file (GSDML-V2.35-SIEMENS-MC-ENCODER-20220331). Use this GSDML file with the current DAP (V2.x) if you wish to create a new project.

Use telegram 89 when configuring the encoder with application Class 1.

3.6 Encoder functions

An overview of the functions that the encoder supports in the various application classes and telegrams is provided in the following table.

Overview of the functions

Functions	Telegram									
	81	82	83	84	86	87	88	89	860	862
Preset value via telegram	-	-	-	-	✓	✓	✓	✓	✓	✓
Preset value 64 bit	-	-	-	✓	-	-	✓	✓	-	-
Velocity value 16 bit	-	✓	-	-	-	-	-	-	-	-
Velocity value 32 bit	-	-	✓	✓	✓	-	✓	✓	✓	✓
Velocity dimension unit and velocity filter	-	✓	✓	✓	✓	-	✓	✓	✓	✓
Acceleration value 32 bit	-	-	-	-	-	-	-	-	-	✓
Endless shaft (rotary axis)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Fractional arithmetic scaling function	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Direction of rotation can be set	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Scaling function	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Preset control via G1_XIST1	✓	✓	✓	✓	-	-	-	-	-	-
Overtemperature alarm and error	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Diagnostics via Profinet alarm channel	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
PROFIdrive fault memory	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
PROFIdrive parameter channel	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sign-of-life - error limit can be set	✓	✓	✓	✓	-	-	-	✓	-	-

Encoder application classes

Class	Description
1	Standard encoder (position actual value) with parameterization via GSD/Step7/TIA. Isochronous mode (IRT) is possible; however, with sign-of-life only in telegram 89.
2	Class 1 encoder with additional parameter channel, velocity actual value and with additional scaling functionality.
3	Encoder with online parameter channel and PROFIdrive position feedback signaling interface. Isochronous mode (IRT) is supported.
4	Class 3 encoder with additional scaling and set/shift home position functionality.

Functions	Telegram									
	81	82	83	84	86	87	88	89	860	862
Class 1	✓	-	-	-	✓	✓	✓	✓	✓	✓
Class 2	✓	-	-	-	✓	✓	✓	✓	✓	✓
Class 3	✓	✓	✓	✓	-	-	-	-	-	-
Class 4	✓	✓	✓	✓	-	-	-	-	-	-

Installing

4

4.1 Electrical connection

The encoder is connected using one 4-pole M12 connector for the power supply and two 4-pole D-coded M12 connectors for Ethernet.

The encoder uses a second D-coded connector and provides an integrated switch function. The installation instructions are located on or in the connector packaging.

Adapters for the field wiring can be ordered.

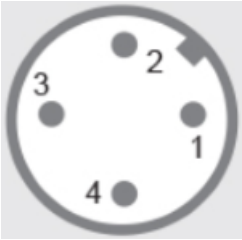
More information is provided in the catalog: D21.4 Catalog (https://support.industry.siemens.com/cs/ww/en/view/109747019)

Connector for Ethernet connection

Pin number	Signal
1	Tx +
2	Rx +
3	Tx -
4	Rx -

Figure 4-1 4-pole, socket, D-coded

Connector for the power supply



Pin number	Signal
1	V+ (10 - 30 V DC)
2	N. C.
3	GND (0 V)
4	N.C.

Figure 4-2 4-pole, plug connector, A-coded

4.2 Status LEDs

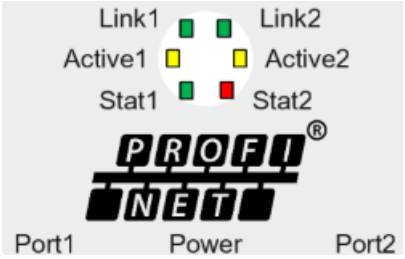


Figure 4-3 LED display - rear side of the encoder housing

Table 4-1 Significance of the diagnostics LED

LED	Color	Description for LED = on
Active1	Yellow	Incoming and outgoing data traffic via port 1
Link1*	Green	Connection to another Ethernet component via port 1
Active2	Yellow	Incoming and outgoing data traffic via port 2
Link2*	Green	Connection to another Ethernet component for port 2
Stat1	Multicolor	Communication status More information is provided in the subsequent table: LED status display
Stat2	Multicolor	Encoder status More information is provided in the subsequent table: LED status display
*Flashes at 2 Hz if flashing is activated via the engineering and a connection is available		

Table 4-2 LED status display

Status 1 Two color	Status 2 Two color	Meaning	Cause
Off	Off	No power supply	• Fuse defective • Cable defective
Red	Green	No connection to another device Criterion: No data exchange	• Bus disconnected • IO controller not available • IO controller switched off • IO controller not operational
Flashes [1)] Red	Green	Parameterization error, no data exchange Criteria: Connection available. As a result of incorrect parameterization, the IO device had not changed into the data exchange mode.	• IO device not configured or incorrect configuration • Incorrect participant (node) address assigned; however, not outside the permissible range • Actual configuration of the IO device deviates from the target configuration
Green	Red	System error Malfunction (error) in the encoder application process.	• Class error diagnostics available • Device in the data exchange mode

Status 1 **Two color**	**Status 2** **Two color**	**Meaning**	**Cause**
Green	Red/green	System alarm Alarm in the encoder application process.	• Diagnostics of the class alarm and no class error active. • Device in the data exchange mode
Green	Green	Data exchange IO device and operation OK	
[1] The flashing frequency is 0.5 Hz. The minimum display duration is 5 s			

4.3 Instructions for mechanical installation and electrical connection of the encoder

⚠ WARNING

Electric shock caused by voltage peaks or short-circuit

Short-circuits and voltage peaks can possibly result in malfunctions and uncontrolled/ unpredictable states - resulting in death, severe injury or material damage.

- Only carry out wiring work as well as opening and closing electrical connections when in the no-voltage condition.

⚠ WARNING

Electric shock caused by incorrect/poor connections

Incorrect/poor connections can mean that parts that can be touched are at a hazardous voltage level. Coming in contact with a hazardous voltage may result in serious injury or death.

- Check all the electrical connections before switching on the system.

Observe the following points when installing and electrically connecting the encoder:

- Do not allow the encoder to fall or be subject to significant levels of vibration and shock. The encoder is a precision measuring device.
- Do not open the encoder housing. Incorrectly opening and closing the device can damage it and allow dirt to enter.
- The shaft of an encoder with solid shaft must be connected to the shaft of the object being measured through a shaft coupling. This coupling is used to dampen (attenuate) vibration and imbalance of the encoder shaft, avoiding inadmissibly high forces. Suitable couplings are available through Siemens.
  More information is provided in catalog: SINAMICS S120 and SIMOTICS; Catalog D 21.4 · 2017 (https://support.industry.siemens.com/cs/ww/en/view/109747019)
- The encoders are rugged; however, in harsh ambient conditions they should be protected against damage using suitable protective measures. It is not permissible that they are used as handholds or steps.
- Only qualified personnel may commission and operate these devices. These persons are authorized to place devices, systems and circuits into operation, ground them and mark/tag them according to the latest state-of-the-art safety technology.
- It is not permissible to make any electrical changes to the encoder.
- The connecting cable to the encoder must be routed a significant distance away or it must be spatially completely separate from the line supply cables that emit interference and disturbances. To ensure reliable and secure data transfer, completely shielded cables must be used and a suitable grounding concept applied.
- The encoder must be connected to the ground connection (PE) through the largest possible surface area. If the flange does not have a good electrical connection to the machine, e.g. if a plastic mounting bracket is used, then a 30 cm long 2 cm copper strap can be used in order to establish the connection to PE, for example.

Cyclic Data Exchange

5

This chapter describes the structure of the telegrams and the content of the signals contained in them.

- Setpoints and actual values for the encoder are cyclically exchanged using standard telegrams (PROFINET RT and IRT).
  More information is provided in Chapter: Telegrams (Page 56).
- The standard telegrams encompass a fixed composition of signals
  More information is provided in Chapter: Signal list for cyclic data transmission (Page 40).

More information

More information on the encoder profile and the PROFIdrive standard is provided in Chapter: Additional references (Page 162).

5.1 Signal list for cyclic data transmission

Table 5-1 Signal list for cyclic data transfer

Signal number	Meaning	Signal abbreviation	Length (bits)	Signal
3	Master sign-of-life	STW2_ENC	16	-
4	Slave sign-of-life	ZSW2_ENC	16	-
6	Velocity value A	NIST_A	16	✓
8	Velocity value B	NIST_B	32	✓
9	Sensor control word	G1_STW	16	-
10	Sensor status word	G1_ZSW	16	-
11	Position value 1	G1_XIST1	32	-
12	Position value 2	G1_XIST2	32	-
39	Position value 3	G1_XIST3	64	-
82	Preset control word 31 bit and the activation bit contained in it	G1_XIST_PRESET_B	32	-
83	Preset control word 64 bit	G1_XIST_PRESET_C	64	-
84	Preset control word 32 bit	G1_XIST_PRESET_B1	32	-
-	Acceleration value	Acceleration	32	✓
-	Temperature value	Temperature	32	✓

5.2 Format of actual position values G1_X

Signals G1_XIST1 and G1_XIST2 represent the position actual values. For the encoder, the format for both signals is right-justified and fixed.

More information on the signals is provided in Chapter: G1_XIST1 (Page 42) and G1_XIST2 (Page 43).

As the encoder operates with a Gray code, it permanently transfers the absolute value in G1_XIST - and G1_XIST2 does not supply any additional value regarding the absolute value. If you access the position actual value in telegrams 81 – 84 directly from the user program, read the position actual value from G1_XIST1, and only use G1_XIST2 to read out the error code for an active error.

Note

Signals, right-justified or left-justified

The alignment of the data frame (right or left-justified) is taken into account for each individual resolution.

Example

25-bit multiturn encoder (65536 pulses per revolution, 4096 distinguishable revolutions).

- All values are shown in the binary format. In the case of an error, G1_XIST2 shows the error telegram instead of the right-justified position values.
- The shift factors in p0979 "Sensor format" show the actual format.
  p0979, subindex 4 (shift factor for G1_XIST2) = 0.
- The settings in the encoder parameter data influence the position value in G1_XIST1 and G1_XIST2.

Encoder profile V4.0

- The default setting is G1_XIST1, left-justified.
- p0979, subindex 3 (shift factor for G1_XIST1) = 32 – overall resolution (next binary value)
- G1_XIST1 sends values independent of bit 10 in STW2_ENC and bit 13 in G1_STW1.

Encoder profile V4.1 / V4.2

- The default setting is G1_XIST1, right-justified.
- G1_XIST1 is a 32-bit counter, which after switch on accepts the absolute position value from G1_XIST2. After reaching the maximum count value, the values starts again from 0 - or if a value of 0 is fallen below, the value is set to the maximum count value.
- p0979, subindex 3 (shift factor for G1_XIST1) = 0.
- G1_XIST1 sends values independent of bit 10 in STW2 and bit 13 in G1STW1.

5.2.1 G1_XIST1

The position value, which represents the position actual value, is right-justified (shift factor 0) according to Table "Absolute value in G1_XIST1".

After the encoder starts ("station come" and ZSW2_ENC bit 9 = 1 and G1_ZSW bit 14 = 0), G1_XIST1 indicates the absolute encoder position value.

- For a singleturn encoder, the "S" bits indicate the absolute value within one revolution.
- For a multiturn encoder, the actual multiturn information (bits 13 to 26) is also displayed.

If the encoder is ready for operational, and is turned beyond the absolute range (singleturn: up to bit 12, multiturn: up to bit 26), the encoder continues to electronically count beyond these bits until an overflow condition is reached at bit 31.

After an encoder reset/restart from the position actual value, only the value of the encoder is indicated in XIST1 that is limited to the maximum possible absolute resolution (bits 0 – 12 or 0 – 26).

Encoder profile V4.0

Table 5-2 Absolute value in G1_XIST1 for encoder profile 4.0*

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

M = distinguishable revolutions (multiturn value)

S = pulses (singleturn pulses per revolution)

*Scaling values from multiturn bit 12, from singleturn bit 13

Encoder profile V4.1 and V4.2

Table 5-3 Absolute value in G1_XIST1 for encoder profile V4.1 / V4.2

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

M = distinguishable revolutions (multiturn value)

S = pulses (singleturn pulses per revolution)

G1_XIST2

Table 5-4 Absolute value in G1_XIST2*

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

M = distinguishable revolutions (multiturn value)

S = pulses (singleturn pulses per revolution)

*Scaling values from multiturn bit 12, from singleturn bit 13

G1_XIST3

G1_XIST3 is available for 64 bit position values. The binary value is transferred right-justified and without any shift factor.

IO data	1	2	3	4
Format	64 bit position values			

5.2.2 G1_XIST2

Signal G1_XIST2 comprises the absolute position actual value and the error code. If the encoder channel is not in an error state (G1_ZSW bit 15 = 0), then the absolute actual value of the encoder is transferred in G1_XIST2 .

If the encoder is ready for operation, and is turned beyond the absolute range, then the position value in G1_XIST2 is not electronically counted any further. This means that the position actual value range according to table "Absolute value in G1_XIST2 for singleturn encoders" or table "Absolute value in G1_XIST2 for multiturn encoders" is limited corresponding to the type of encoder being used.

Table 5-5 Absolute value in G1_XIST2 for singleturn encoders

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

S = pulses (singleturn pulses per revolution)

Table 5-6 Absolute value in G1_XIST2 for multiturn encoders

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

S = pulses (singleturn pulses per revolution)

M = distinguishable revolutions (multiturn value)

If the encoder channel is in an error state (G1_ZSW bit 15 = 0), then in G1_XIST2, the error code corresponding to table "Error code G1_XIST2" is transferred in G1_XIST2. The encoder channel remains in the error state until the cause of the error has been resolved and the error state has been acknowledged using the encoder control word (G1_STW bit 15 = 0 → 1 edge).

Table 5-7 Error code G1_XIST2

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

E = Error code

Table 5-8 List of error codes in G1_XIST2

Error code	Error	Error description
0x001	Sensor group error	Error when processing the sensor signal, which results in an invalid Gx_XIST (e.g. electronic fault or invalid sensor signal).
0xF01	Command is not supported	Optional command (in G1_STW) is not supported.
0xF02	Failure of the control sign-of-life	The number of permissible failures of the master sign-of-life was exceeded.
0xF04	Synchronization error	The number of permissible failures of the bus cycle signal was exceeded.

5.2.3 G1_XIST3

The function and bit assignment of signal G1_XIST3 corresponds to that of signal G1_XIST1 (Page 42); however, with a 64-bit signal word.

Bit 32 to bit 63 contain the multiturn information "M".

Signal G1_XIST3 can be useful, for example, if you wish to electronically count the encoder position actual value directly with 64 bit so that a modulo calculation does not have to be performed in the user program if the 32 bit position actual value in G1_XIST1 overflows.

5.3 Format of actual velocity values NIST

The velocity actual value, which is transferred in NIST_A or in NIST_B , is a speed actual value that the encoder calculates based on the isochronous position detection. By calculating the speed actual value at the encoder in real time, the control can receive a high precision velocity signal, even without isochronous communication (without PROFINET IRT). Further, you can use the parameterizable filtering for the speed signal in NIST_x.

Scaling of the value in NIST_x can be parameterized.

The following options exist for parameterization:

- Increments/s
- Increments/100 ms
- Increments/10 ms
- Revolutions per minute
- N2/N4 scaling:
  This involves scaling in accordance with the PROFIdrive profile. The current speed is transferred as a percentage value of the reference parameter p60000 in the NIST_A or NIST_B signals.
  - For N2, 4000 hex corresponds to a value of 100% of the reference value in p60000.
  - For N4, 4000 0000 hex corresponds to a value of 100% of the reference value in p60000.
  - The value range of NIST_A runs from -200% to $(200\text{-}2^{-14})$%.
  - The value range of NIST_B runs from -200% to $(200\text{-}2^{-30})$%.
  - The MSB of NIST_A and NIST_B is the sign bit.
    MSB = 1 is a negative sign.
    MSB = 0 is a positive sign.

Note

If the expected speed value does not appear in signal NIST_x, then check the selected scaling and/or scaling for NIST.

Default setting:

- NIST_A = N2
- NIST_B = N4

5.4 Encoder control word (STW2_ENC)

Signal STW2_ENC is used in telegrams 81 ... 84.

The signal transfers the sign-of-life from the control to the encoder. Further, in STW2_ENC the control must set bit 10 (control realized using the PLC) to 1 to inform the devices that the cyclic data are valid.

Bit assignment of STW2_ENC

Table "Bit assignment of STW2_ENC" indicates the bit assignment of signal STW2_ENC.

Note

If the control does not set bit 10 in STW2_ENC to 1, then the encoder does not respond to commands in G1_STW.

For isochronous applications the sign-of-life (the sign-of-life counter) is used to monitor that the control process is correctly synchronized with the sampling process in the encoder.

The sign-of-life counter is a 4-bit counter. The control application starts the sign-of-life with any value from between 1 and 15. The control increments the counter in each control application cycle.

Valid values for the sign-of-life of the control lie between 1 and 15; "0" signifies an error, and is omitted in normal operation.

Bit	Value	Meaning	Remarks
0	1	Default trigger setting 0 > 1	The rising edge of this bit is the trigger for setting the preset value from G1_XIST_PRESET_x as new actual position. The result of this operation is a shifted position actual value, a new internally saved position offset value and a rising edge of ZSW2_ENC.bit0 as corresponding acknowledgment.
	0	Inactive	The controller must reset this bit to 0 before starting a new preset operation (preset cycle).
7	1	Acknowledge error	The actual error situation in the fault memory is acknowledged using a rising edge.
	0	No significance	-
10	1	Check by the control	Control via interface, EO-IO data are valid.
	0	No check by the control	EO IO data are not valid; with the exception of the sign-of-life.
12 ... 15	-	Control sign-of-life	Count value of between 1 and 15 is continuously sent.

STW2_ENC functions

4-bit counter, left-justified. The master application starts the sign-of-life with any arbitrary value between 1 and 15. The master increments the counter in each master application cycle. Valid values for the sign-of-life of the master lie between 1 and 15; "0" indicates an error, and is omitted in normal operation.

Bit	Function	Implementation		
		Classes 3 and 4	Telegram 89	Telegram 81 ... 84
0	XIST_PRESET_CONTROL	-	✓	-
1 ... 6	Reserved	-	-	-
7	Acknowledge error	-	✓	-
8 ... 9	Reserved	-	-	-
10	Check by the control	✓	✓	✓
11	Reserved	-	-	-
12 ... 15	Signoflife monitoring	✓	✓	✓

5.5 Encoder status word (ZSW2_ENC)

Signal ZSW2_ENC is used in telegrams 81 ... 84 in order to transfer the sign-of-life from the encoder to the control. Further, in ZSW2_ENC the control must evaluate bit 9 (control requested) to determine as to whether the cyclic data sent from the encoder are valid, and the encoder is ready to accept control commands.

Bit assignment of ZSW2_ENC

Table "Bit assignment of ZSW2_ENC" indicates the bit assignment of signal ZSW2_ENC.

Note

If bit 9 is not 1 in ZSW2_ENC, then the information in G1_ZSW and G1_XIST_x are invalid and the encoder does not respond to commands in G1_STW.

For isochronous applications, the sign-of-life (the sign-of-life counter) is used to check that the control process is correctly synchronized with the sampling process in the encoder.

The sign-of-life counter is a 4-bit counter. After the control has been successfully synchronized, the IO device application starts the sign-of-life with any arbitrary value from between 1 and 15. The IO device increments the counter in every data cycle.

Valid values for the sign-of-life of the IO device lie between 1 and 15; "0" signifies an error, and is omitted in normal operation.

Note

If the encoder detects an error in the sign-of-life, it stops transferring the sign-of-life to the control. This means that a missing sign-of-life (=0) from the encoder to the control can also be as a result of an error in the sign-of-life of the control to the encoder.

Bit	Value	Meaning	Remarks
0	1	Preset confirmation (0 > 1)	The preset value was accepted as new position actual value signal, which is acknowledged with a leading edge of this bit. The new offset value is retentively saved in the encoder.
	0	Waiting	The encoder position offset value (from the last preset operation) was saved in the encoder. The encoder is now ready for a new preset-set operation (preset cycle).
1	1	G1_XISTx Actual position value in XISTx is valid	This bit indicates whether there is a valid position actual value in the corresponding signals XISTx of a Class 1 or Class 2 telegram. Please note that this bit is only used for the Class 1 and Class 2 telegram 89.
	0	No fault	This bit is only valid for the Class 1 and Class 2 telegram 89.
2	1	NISTx Actual speed in XISTx is valid	This bit indicates whether there is a valid velocity actual value in the corresponding signals NISTx of a Class 1 or Class 2 telegram. Please note that this bit is only used for the Class 1 and Class 2 telegram 89.
	0	No fault	This bit is only valid for the Class 1 and Class 2 telegram 89. This bit is always "0" if the encoder does not support a velocity actual value.

Bit	Value	Meaning	Remarks
3	1	Fault is active	At least one error (error object) is available/active in the EO. This means that one or several actual values are invalid or must be considered to be invalid. As a consequence, at least one bit is set in p65001[2] and at least one error is registered in the diagnostics ASE and entered in the error buffer. If the cause of the error has been resolved, and the complete EO functionality has been reactivated, then bit "Error active" is automatically cleared.
	0	No fault	-
7	1	Alarm is active	At least one alarm (alarm object) is available/active in the EO. This indicates that one or several critical limits have been reached; however, the complete encoder functionality is still available according to its specification. All of the actual values are valid. As a consequence, at least one bit is set in p65001[4], at least one alarm is set in the diagnostics ASE and entered in the fault memory. If the cause of the alarm is resolved, bit "Alarm active" is automatically cleared.
	0	No alarm	-
9	1	Check requested	The automation system is requested to assume control, the data are valid.
	0	No control by the PLC	Data invalid, except for sign-of-life
12 ... 15		Encoder sign-of-life	Counter value of between 0 and 15 is continuously sent.

ZSW2_ENC functions

4-bit counter, left-justified. After successfully synchronizing with the cycle, the slave application starts the sign-of-life with any arbitrary value between 1 and 15. The slave application increments the counter in every DP cycle. Valid values for the sign-of-life of the slave lie between 1 and 15; "0" indicates an error, and is omitted in normal operation.

Bit	Function	Implementation		
		Classes 3 and 4	Classes 1 and 2 telegram 89	Telegram 81 ... 84
0	XIST_PRESET_ACK	-	✓	-
1	XIST_VALID	-	-✓	-
2	NIST_VALID	-	✓	-
3	Error/no error	✓	✓	✓
4 ... 6	Reserved	-	-	-
7	Alarm/no alarm	✓	✓	✓
8	Reserved	-	-	-
9	Control requested	✓	✓	✓
10 ... 11	Reserved	-	-	-
12 ... 15	Encoder sign-of-life	✓	✓	✓

5.6 Sensor control word (G1_STW)

Signal G1_STW is used to control the state machine of the PROFIdrive encoder channel. The following functions are frequently important as the encoder operates with a Gray code:

- Preset of the absolute position
- Encoder parking
- Error acknowledgment

Bit assignment of G1_STW

Bit	Value	Function	Remarks
0 ... 10	-	-	Reserved
11	0/1	Reference point mode	Specifies whether the position value is set to a preconfigured absolute value - or is shifted by this value. 0: Set reference point/preset (absolute) 1: Shift reference point/preset (relative = offset)
12	1	Request set preset/shift	Preset (or shift) is set if this bit is changed to "1" (rising edge) Default preset value (shift): 0 Note: After setting the preset, the offset is saved in a non-volatile memory. The encoder does not send any position values in this 5-10 ms.
13	1	Request absolute value cyclically	Request an additional cyclic transfer of the position actual value in G1_XIST2. The position actual value is automatically transferred if no other data have to be transferred as a result of commands or errors.
14	1	Activate park sensor	The encoder does not transfer any position values if the "Parking sensor activated" bit is set.
15	1	Acknowledge sensor error	Request to acknowledge/reset a sensor error.

By appropriately parameterizing the encoder, when accepting a preset value you can define whether this is also directly accepted in G1_XIST1 or G1_XIST3. If this preset value is accepted, then it is automatically retentively saved. This ensures that an absolute value defined using a preset also remains saved after an encoder reset/restart.

5.7 Sensor status word (G1_ZSW)

Signal G1_ZSW is used to control the state machine of the PROFIdrive encoder channel. It is the partner to control word G1_STW.

Bit assignment of G1_ZSW

Bit	Value	Meaning	Remark
0 ... 10	-	-	Reserved.
11	-	Acknowledgment of sensor errors in the process	Is set, if the reset of a sensor error (after acknowledgment) takes longer than one bus cycle.
12	1	Set preset/offset executed	Confirmation for set preset/offset value.
13	1	Transfer absolute value cyclically	Confirmation for cyclic data transfer.
14	1	Park sensor activated	Confirmation for "Parking sensor activated". The encoder is not transferring any error messages.
15	1	Sensor error	Specifies a sensor error. For encoder profiles V4.0 and V4.1 a device-specific error code is transferred in G1_XIST2. For encoder profile V4.2 in the fault memory.

5.8 Sensor preset signal bit 31 and trigger bit (G1_XIST_PRESET_B)

The sensor preset signal bit 31 and trigger bit (G1_XIST_PRESET_B) are used to control the preset operation.

Bit assignment of G1_XIST_PRESET_B and trigger bit

Bit	Value	Meaning	Remark
0 ... 30	-	Preset value	Preset value (without bit 31) for G1_XIST1
31	-	Preset control bit	Control bit to activate the preset value • 1: Activates the preset. The preset value is transferred as actual position value, the offset value calculated and retentively saved. • 0: Preset mode not active. This bit is used as "Preset control" for telegrams 86 and 87.

5.9 Sensor preset signal bit 64 (G1_XIST_PRESET_C)

The sensor preset signal bit 64 and trigger bit (G1_XIST_PRESET_C) are used to control the preset operation.

Bit assignment of G1_XIST_PRESET_C

Bit	Value	Meaning	Remark
0 ... 62	-	Preset value	Preset value (without bit 63) for G1_XIST3.
63	-	Preset trigger	Activation bit to accept the preset value (0 → 1 edge).

5.10 Sensor preset signal bit 32 (G1_XIST_PRESET_B1)

To control the preset operation in conjunction with the preset state machine according to xxx, bit 0 in STW2_ENC and bit 0 in ZST2_ENC are used.

Bit assignment of G1_XIST_PRESET_B1

Bit	Value	Meaning	Remark
0 ... 31	-	Preset value	Preset value (32 bit) for G1_XIST2 in the format/ resolution of G1_XIST2. Preset value is activated via XIST_PRESET_CONTROL (bit 0 in STW2_ENC).

5.11 Sensor preset signal bit 32 (PRESET)

To control the preset operation in conjunction with the preset state machine according to xxx, bit 0 in STW2_ENC and bit 0 in ZST2_ENC are used.

The sensor preset signal bit 32 (PRESET) is used to control the machine state.

Bit assignment of PRESET

Bit	Value	Meaning	Remark
0 ... 31	-	Preset value	Preset value (32 bit) for G1_XIST1

5.12 Telegrams

The cyclic data interface of the encoder is configured by selecting one of the following standard telegrams. The necessary standard telegram is selected by inserting the relevant telegram submodule when the PROFINETconfiguration of the encoder is set up in STEP 7 "HW Config". More information is provided in Chapter: Configuration (Page 63).

Telegrams 81 to 84

Standard telegrams 81 to 84 are typically used if the encoder is used together with a Motion Control system with PROFIdrive interface, such as SIMOTION, SINUMERIK or SIMATIC 1500/1800. Telegrams 81 to 84 provide a standard PROFIdrive sensor interface, which is the same as the sensor interface of a standard drive.

Nevertheless, telegrams 81 to 84 can also be used with a programmable controller if it is necessary to monitor signs of life or error codes via a cyclic interface.

Note

Requirement

- Only set the preset at standstill!
- To activate the preset function, in the sensor control word (G1_STW) for the sensor control, switchover bit 12 to "1". If another value such as "0" is set, then you must first enter the required preset value in parameter p65 000 (32 bit) or p65 002 (64 bit).
- Activate the functionality of user Class 4.
- If the preset value is greater than the total resolution, alarm "Preset value outside the range" is set in bit 14 of PNU 65 001[4].

Telegrams 86, 87, 88, 860, 862

Using these telegrams, it is easy to set a user-defined preset value corresponding to Profibus functionality while the application is running.

For the default control word G1_XIST_PRESET_B or G1_XIST_PRESET_C, set bit 31 (for telegram 88, it is bit 63) to a value of "1" and then back to "0".

For a preset value other than "0", the corresponding other bits should be set.

The speed value uses the format that is defined in the velocity unit.

Telegram 89

Standard telegram 89 is the new universal telegram for all application classes (Class 1 and Class 2) and is the improved successor for standard telegrams 86 and 87. It is recommended for all new applications.

We recommend using telegram 89 as a result of the combination of simple preset setting and the sign-of-life counter for isochronous operation.

Telegram 862

Telegram 862 should be used for applications that require an acceleration value or the encoder temperature.

5.12.1 Standard telegram 81

Telegram 81 offers the following:

- Standard PROFIdrive encoder channel

Structure

Output data (PZD/word)	1	2
Setpoint	STW2_ENC	G1_STW

Input data (PZD/word)	1	2	3	4	5	6
Actual value	ZSW2_ENC	G1_ZSW	G1_XIST1		G1_XIST2	

5.12.2 Standard telegram 82

Telegram 82 offers the following:

- Standard PROFIdrive encoder channel
- 16 bit speed actual value

Structure

Output data (PZD/word)	1	2
Setpoint	STW2_ENC	G1_STW1

Input data (PZD/word)	1	2	3	4	5	6	7
Actual value	ZSW2_ENC	G1_ZSW1	G1_XIST1		G1_XIST2		NIST_A

5.12.3 Standard telegram 83

Telegram 83 offers the following:

- Standard PROFIdrive encoder channel
- 32 bit speed actual value

Structure

Output data (PZD/word)	1	2
Setpoint	STW2_ENC	G1_STW1

Input data (PZD/word)	1	2	3	4	5	6	7	8
Actual value	ZSW2_ENC	G1_ZSW1	G1_XIST1		G1_XIST2		NIST_B	

5.12.4 Standard telegram 84

Telegram 84 offers the following:

- PROFIdrive encoder channel with 64 bit XIST
- 32 bit speed actual value

Structure

Output data (PZD/word)	1	2
Setpoint	STW2_ENC	G1_STW1

Input data (PZD/word)	1	2	3	4	5	6	7	8	9	10
Actual value	ZSW2_ENC	G1_ZSW1	G1_XIST3				G1_XIST2		NIST_B	

5.12.5 Standard telegram 86

Telegram 86 offers the following:

- 32 bit position actual value
- 32 bit speed actual value

Structure

Output data (PZD/word)	1	2
Setpoint	G1_XIST_PRESET_B	

Input data (PZD/word)	1	2	3	4
Actual value	G1_XIST2		NIST_B	

5.12.6 Standard telegram 87

Telegram 87 provides the following:

- 32 bit position actual value

Structure

Output data (PZD/word)	1	2
Setpoint	G1_XIST_PRESET_B	

Input data (PZD/word)	1	2
Actual value	G1_XIST2	

5.12.7 Standard telegram 88

Telegram 88 provides the following:

- 64 bit preset value
- 32 bit speed actual value

Structure

Output data (PZD/word)	1	2	3	4
Setpoint	G1_XIST_PRESET_C			

Input data (PZD/word)	1	2	3	4	5	6
Actual value	G1_XIST3				NIST_B	

5.12.8 Standard telegram 89

Telegram 89 provides the following:

- 32 bit preset value

Structure

Output data (PZD/word)	1	2	3
Setpoint	STW2_ENC	G1_XIST_PRESET_B1	

Input data (PZD/word)	1	2	3	4	5
Actual value	ZSW2_ENC	G1_XIST2		NIST_B	

Example for telegram 89

- The preset value is defined as follows:

Output data (output of data from the controller to the encoder): 4 bytes	
Preset - 32-bit unsigned integer	
Bit 31	Bit 31 ....Bit 0
	Preset value < total resolution

- This preset value is activated via XIST_PRESET_CONTROL (bit 0 in STW2_ENC).
- The preset value was accepted as new position actual value signal, which is acknowledged in XIST_PRESET_ACK with a leading edge of bit 0 in ZSW2_ENC.

5.12.9 Manufacturer-specific telegram 860

Telegram 860 offers the following:

- 64 bit position actual value XIST1
- 64 bit speed actual value
- Using cyclic data, a preset value for the position can be entered in signal G1_XIST_PRESET_B and activated.

Note

The telegram does not provide any sign-of-life monitoring functionality.

Coded diagnostics is only possible using the standard PROFINET diagnostic functionality.

Structure

Output data (PZD/word)	1	2	3	4
Setpoint	PRESET			

Input data (PZD/word)	1	2	3	4	5	6	7	8
Actual value	Position				Velocity			

5.12.10 Manufacturer-specific telegram 862

Telegram 862 offers the following:

- 64 bit position actual value XIST1
- 64 bit speed actual value
- Using cyclic data, a preset value for the position can be entered in signal G1_XIST_PRESET_B and activated.

Note

The telegram does not provide any sign-of-life monitoring functionality.

Coded diagnostics is only possible using the standard PROFINET diagnostic functionality.

Structure

Output data (PZD/word)	1	2	3	4
Setpoint	PRESET			

Input data (PZD/word)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Actual value	Position				Velocity				Acceleration				Temperature			

Example of telegrams 860 and 862

Output data (output of data from the controller to the encoder): 4 bytes	
Preset - 32-bit unsigned integer	
Bit 31	Bit 30 .....bit 0
Preset control bit	Preset value < total resolution

Configuration

6

The encoder with PROFINET interface must be appropriately configured corresponding to the purpose of the application by appropriately parameterizing it. The device description file (GSDML file) for the encoder must be installed in the PLC engineering software, which is used to create this configuration.

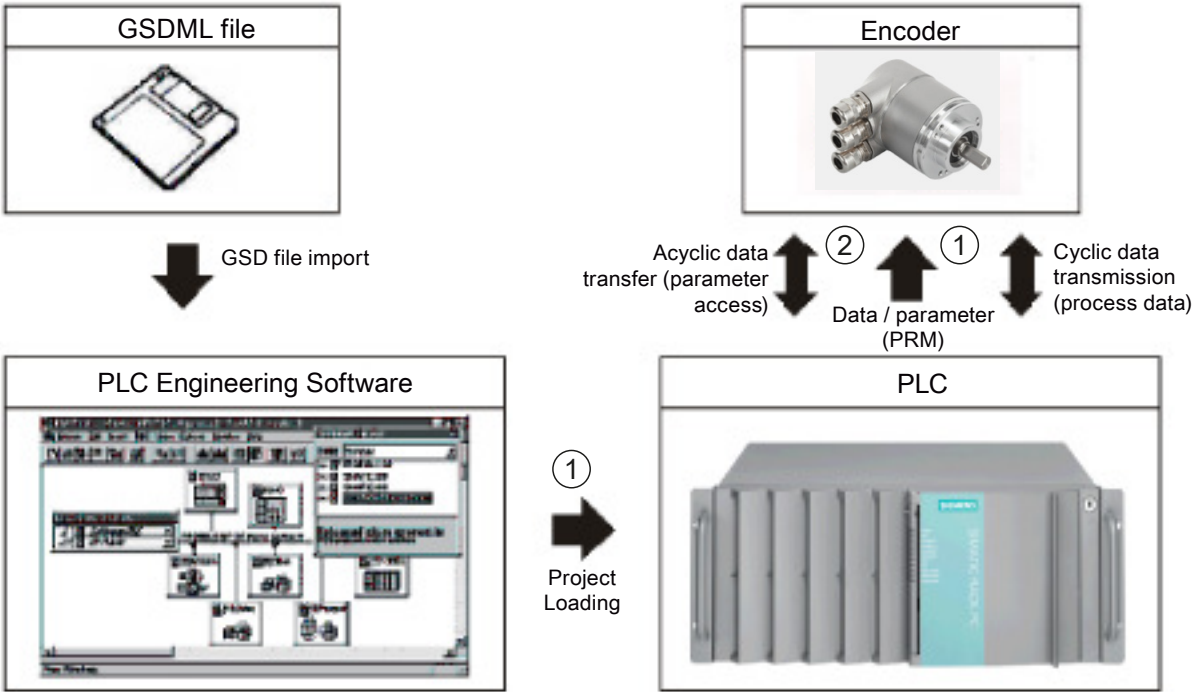
6.1 Encoder configuration overview

The encoder is mainly configured offline using STEP 7 HW Config and parameterized (Fig.: ①).

When the encoder is operated online, a non-cyclic parameter channel is also available corresponding to the encoder profile/x/or PROFIdrive profile/y/ (Fig.: ②).

Using this PROFIdrive parameter channel, parameters can be read and write accessed when operated online.

Encoder functions



① Offline configuration path via the hardware configuration

② Accessing encoder parameters online via the non-cyclic parameter channel

Figure 6-1 Encoder functions

More information

Additional information on the encoder profile and the PROFIdrive standard is provided in Chapter: Additional references. (Page 162)

6.2 Encoder offline configuration

The encoder is configured and parameterized offline using STEP7 HW Config. The encoder is set up in HW Config by importing the GSDML file of the encoder device.

Process

Once the GSDML file has been imported, the encoder is inserted in the project and configured and/or parameterized.

After compiling the project, if the project is loaded to the control (SIMATIC or SIMOTION CPU), the encoder parameterization is also transferred. If the CPU goes online and the PROFINET connection to the encoder is established, then the parameterization is also automatically transferred to the control (PRM data set) and activated.

When configuring the encoder in HW Config, a basic differentiation is made between the following three configuration areas:

Configuring PROFINET interfaces

Configuring the general communication properties of the PROFINET interface of the encoder, e.g.:

- RT/IRT communication
- Cycle time
- Times Ti and To (for IRT operation)

You configure the properties in interface submodule X1 at slot 0.

Configuring telegrams

You select the type of encoder cyclic interface by selecting the telegram. The configuration is realized by selecting and inserting the appropriate telegram submodule (81, 82, 83, 84, 860).

Configuring encoder functions

The following individual encoder functions are configured for example, using the encoder parameters in the MAP submodule:

- Parameterizing the direction of rotation
- Optional scaling function
- Speed signal
- Sign-of-life monitoring
- Setting the isochronous mode (clock cycle synchronism) in the other hardware components

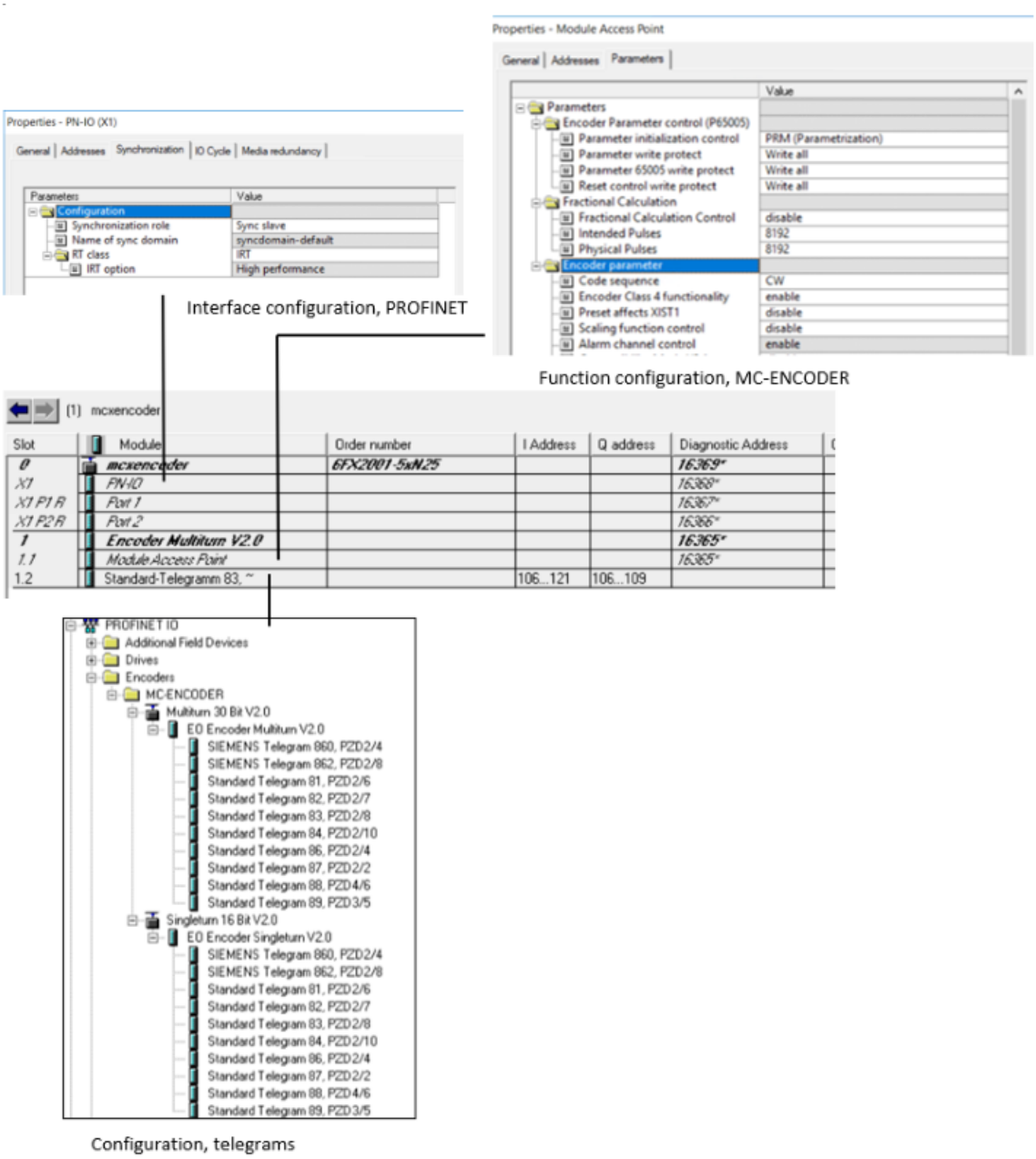


Figure 6-2 Example: Encoder access points for configuration and parameterization

6.3 Encoder parameter description

6.3.1 Encoder parameter

The encoder parameters can be set offline in HW Config or in the TIA Portal.

Certain parameters can be optionally accessed online via the non-cyclic parameter channel - or they can be permanently saved to the encoder.

More information is provided in Chapter: Encoder configuration overview (Page 64).

6.3.2 Parameterizing the position actual value

The following table provides an overview of the configuration parameters of the position actual value in XIST1 and XIST2 (telegrams 81, 82, 83, 84 and 860).

These parameters are only available via HW Config.

Overview

Table 6-1 Position actual value in XIST1 and XIST2

Parameter	Meaning	Value	
Direction of rotation	These parameters influence the positive counting direction of the encoder (viewed from the shaft side). Note: Application Class 4 must be activated.	0	Clockwise rotation, positive (default setting).
		1	Counterclockwise direction of rotation, positive.
Preset influences XIST1	This parameter is used to control whether XIST1 should also make a step when presetting. Note: Application Class 4 must be activated.	0	XIST1 is influenced by a preset command.
		1	XIST1 is not influenced by a preset command (default setting).
Application Class 4	This function is used to activate or deactivate the following supplementary functions: • Scaling • Preset (default setting) • Direction of rotation	0	No functionality of application Class 4
		1	Functionality of application Class 4 (default setting).

Activated/deactivated functions

The following table provides an overview of the activated/deactivated encoder functions, which depend on the setting of "Encoder Class 4 functionality".

Table 6-2 Overview of the functions

Function	Class 4 functionality deactivated	Class 4 functionality activated
Code-sequence	-	✓
Preset control G1_XIST1	-	✓
Control scaling functions	-	✓
Alarm channel control	✓	✓
Preset value	-	✓
Preset value 64 bit	-	-
Measurement unit per revolution / measurement step	-	✓
Total measuring range	-	✓
Measurement units per revolution 64 bit	-	✓
Total measuring range 64 bit	-	✓
Maximum failures of the control sign-of-life	-	✓
Unit of measurement for velocity	✓	✓
Operating time	-	-
Offset line	-	✓
Offset value	-	✓
Offset value 64 bit	-	✓
Rotary axis (endless shaft)	Always active	Always active
Velocity filter	✓	✓

6.3.3 Parameterizing the scaling function

The following table provides an overview of the configuration parameters of the scaling function for the position actual value in XIST1 and XIST2 (telegrams 81, 82, 83, 84 and 860).

These parameters are only available via HW Config.

Overview

Table 6-3 Scaling function in XIST1 and XIST2

Parameter	Meaning	Value	
Scaling function	The scaling function in the encoder is activated or deactivated using this parameter.	0	Scaling off (default setting)
	Note: Activate the functionality of user Class 4, otherwise the scaling function is always deactivated.	1	Scaling activated

Parameter	Meaning	Value	
Scaling: Resolution per revolution	Singleturn resolution in increments per revolution if the scaling function is active.	11	32 unsigned
Scaling: Total resolution	Absolute measuring range in increments per revolution if the scaling function is active.	11	32 unsigned

6.3.4 Parameterizing the velocity signal

The following table provides an overview of the configuration parameters of the velocity signal in NIST_A and NIST_B (telegrams 82, 83, 84 and 860).

Parameters "Speed filtering" and "Speed scaling" are only available via HW Config.

Parameter "Reference speed N2/N4" can be defined via HW Config, and can be read from parameter p2000 via the parameter channel.

Overview

Table 6-4 Velocity signal in NIST_A and NIST_B

Parameter	Meaning	Value	
Speed filtering	Activates the velocity filter for the speed actual value in NIST_x.	1	Fine (no filtering)
		2	Medium (default setting)
		3	Coarse
Speed scaling	Unit or scaling of the velocity actual value in NIST_x.	0	Increments / s
		1	Increments / 100 ms
		2	Increments / 10 ms
		3	rpm
		4	N2/N4 scaling
Reference speed N2/N4 (rpm) (setpoint speed N2/N4 (rpm))	Speed setpoint for 100 % for the selected N2/N4 scaling in rpm.	UINT 32	

6.3.5 Parameterizing the communication interface

The following table provides an overview of the parameters to configure help functions in the cyclic communication channel (telegrams 81, 82, 83, 84 and 860).

Parameter "Compatibility mode V3.1" and "Diagnostics via alarm channel" are only available via HW Config.

Parameter "Tolerable sign-of-life error" can be defined via HW Config, and additionally read and written from/to parameter 925 via the parameter channel.

Overview

Table 6-5 Help functions in the cyclic communication channel

Parameter	Meaning	Value	
Tolerable sign-of-life error (Tolerable sign-of-life error)	This parameter is used to define the maximum number of tolerated sign-of-life errors. Note: Compatibility mode V3.1 must be activated. This setting does not influence telegram 860.	0	No errors are tolerated (e.g. for the communication test)
		1... 254	Number of tolerated sign-of-life errors (1 = default setting)
		255	Monitoring off (e.g. for commissioning)
Compatibility mode V3.1 (compatibility mode V3.1)	This parameter is used to configure the response of the encoder interfaces, which is compatible with encoder profile V3.1 (only for compatibility in previous projects). Note: This setting does not influence telegram 860.	0	Compatibility with V3.1
		1	V4.x interface (default setting)
Diagnostics via alarm channel (diagnostics via the alarm channel)	Using this parameter, alarms are activated or deactivated via the PROFINET alarm channel. Note: Compatibility mode V3.1 must be activated, as otherwise the diagnostic alarms are always activated.	0	Alarm channel deactivated (default setting)
		1	Alarm channel activated

Overview

When the encoder is operated online, a non-cyclic parameter channel is also available corresponding to the encoder profile/x/or PROFIdrive profile/y/. Using this PROFIdrive parameter channel, parameters can be read and edited in the online mode.

For the encoder, the access point is located on this parameter channel at MAP submodule (module 1, submodule 1.1) via the data set with index 0xB02E.

The parameter channel is accessed via the non-cyclic communication channel, and is therefore possible for the control as well as for a supervisor.

Parameters supported via the parameter channel

The online parameters - along with their associated properties - which are available via the encoder parameter channel are listed below.

Table 6-6 Encoder PROFIdrive parameters

Number	Parameter	Meaning		Data type	Access
922	Telegram selection	Information about the currently set telegram (PROFIdrive parameter).		Unsigned16	Read only
925	Tolerated number of sign-of-life failures	Maximum number of tolerated sign-of-life errors (PROFIdrive parameters).		Unsigned16	Reading/writing
944 - 947	PROFIdrive fault memory	Information on encoder faults More information is provided in Chapter: PROFIdrive error memory (Page 81)			Read only
964	Device identification	Information on the encoder manufacturer, type and version (PROFIdrive parameters).		Array[6] Unsigned16	Read only
965	Profile version	Information on the supported encoder profile version (PROFIdrive parameters).		Octet string[2]	Read only
		0 - 7 bits	Profile version, least significant number (value range: 0...99), decimal Number		
		8 - 15	Profile version, most significant number (value range: 0...99), decimal Number		
		16 - 31	Reserved		
970	Command to load a parameter set				Reading/writing
971	Transfers the parameter set into a non-volatile memory	The parameter set is saved in the non-volatile work memory (NV RAM) (PROFIdrive parameters).		Unsigned16	Reading/writing
972	Reset encoder	More information is provided in Chapter: Reset control write protect (Page 74)			Reading/writing
974	Parameter access identification				Read only
975	Encoder object identification	Manufacturer ID, encoder object type, software version, firmware date: Year, date of the firmware: DDMM, encoder class, encoder object subclass, encoder object ID		Array[n] Unsigned32	Read only
979	Sensor format	Information on the position sensor (PROFIdrive parameters).		Array[n] Unsigned32	Read only
980	Number list of the defined parameters	List of all of the parameters available online via the parameter channel (PROFIdrive parameters). [2]		Array[n] Unsigned16	Read only
60000	N2/N4 speed reference value				Reading/writing
60001	Speed normalization type				Reading/writing

Number	Parameter	Meaning	Data type	Access
65000	Preset value 32 bit	Position preset value, which is active for telegrams 81, 82, 83 and 84, when using function set/shift reference point via G1_STW, bit 12 (encoder profile parameters).	Integer32	Reading/writing
65001	Operating status	Information on the actual configuration and on the encoder error status (encoder profile parameters).[1]	Array[n] Integer 32	Read only
65002	Preset value 64 bit			Reading/writing
65004	Function check			Reading/writing
65005	Encoder parameter control	More information is provided in Chapter: Encoder parameter control (PNU 65005) (Page 72)		Reading/writing
65006	Steps per revolution			Reading/writing
65007	Total resolution			Reading/writing
65008	Steps per revolution 64 bit			Reading/writing
65009	Total resolution 64 bit			Reading/writing
65010	Operating time	The operating time counter is incremented every six minutes		Read only
65011	Required pulses			Reading/writing
65012	Physical pulses			Reading/writing
65013	Fractional arithmetic activation			Reading/writing
65014	Velocity filter			Reading/writing

More information is provided in Chapter: Additional literature (Page 162) .

6.3.6 Encoder parameter control (PNU 65005)

6.3.6.1 Overview

If "PRM" is selected for "Encoder parameter control", then the parameters are used via the PLC project (based on the GSDML settings).

If the encoder is replaced by a new encoder, then the parameters required are immediately available after commissioning.

Overview

- "Parameter 65005 write protect" = "Write all" is selected
  You can change parameters even while the application is running. However, they are overwritten after switching on the PLC or switching on the encoder.
- "Parameter 65005 write protect" = "Read only" is selected
  You cannot change parameters while the application is running.
- "Encoder parameter control" = "NV-RAM" is selected.
  The encoder is parameterized from the internal non-volatile encoder memory. When commissioning for the first time, it is possible to parameterize the non-volatile memory before the first commissioning by connecting the new encoder to a configuration station (supervisor device).

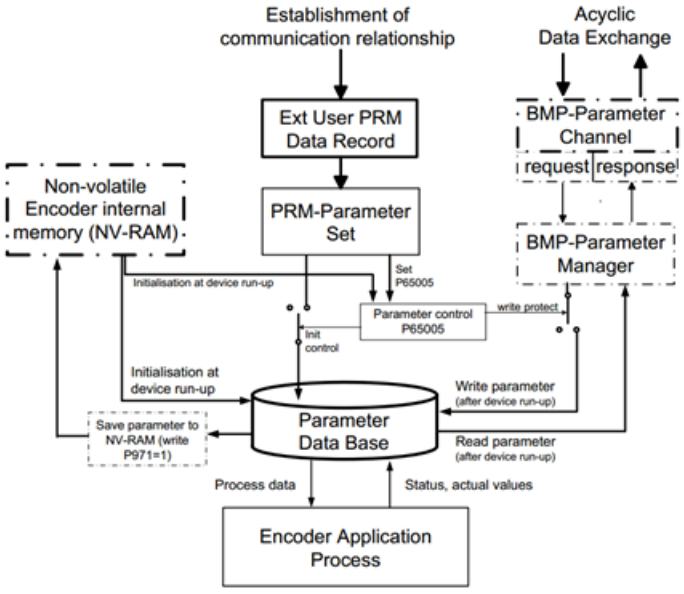


Figure 6-3 Encoder parameter control

6.3.6.2 Encoder parameter control (p65005)

Overview

Parameter	Meaning	Value
PRM	Parameters are used via a PLC project (based on the GSDML file)	0 (default)
NV-RAM	Parameters are only used from the non-volatile encoder memory. The default parameters are used if nothing is saved.	1

6.3.6.3 Parameter write protection

Overview

Parameter	Meaning	Value
All writable	All configuration parameters can be read and write accessed online via the BMP parameter channel (all CRs). p65005 (parameter control) is only accessed reading.	0 (default)
Read only	All parameters to be configured can only be read accessed online via the BMP parameter channel (all CRs).	1
Can be written by the controller	Parameters for the control-communication of the controller can be read and write accessed online via the BMP parameter channel. However, p65005 (parameter control) is only accessed reading. For all supervisor-communication relationships, only read access is possible.	2
Can be written to by the supervisor	Parameters for the supervisor communication can be read and write accessed online via the BMP parameter channel. p65005 (parameter control) can only be read accessed. For all control-communication relationships, only read access is possible.	3

6.3.6.4 Parameter write protection (p65005)

Overview

Parameter	Meaning	Value
All writable	p65005 and p971 can be read and write accessed online via the BMP parameter channel (all CRs).	0 (default)
Read only	Online access to p65005 and p971 via the BMP parameter channel (all CRs) is write protected.	1

6.3.6.5 Reset control write protect

The configuration station establishes a supervisor-application relationship (AR) to the encoder and writes the configuration parameters to the encoder.

Overview

Parameter	Meaning	Value
All writable	p972 can be read and write accessed online via the BMP parameter channel (all CRs). Reset control via p972 is activated.	0 (default)
Read only	Online access to p972 via the BMP parameter channel (all CRs) is write protected. Reset control via p972 is deactivated.	1

To save and protect the parameterization, the supervisor sets p65005 to "p65005 write protect". Parameters are then transferred into the NV-RAM of the encoder by writing p971 = 1.

If the saved parameterization is to be protected against changes via the BMP parameter channel, then set "p65005 Parameter write protect" to "Read only".

Diagnostics

7

7.1 Alarms

Parameter 65 001 [4] indicates the current status of all alarms.

Overview

A list of all of the alarm supported is shown below.

Bit	Designation	=0	=1	Troubleshooting
7	Invalid parameter setting in the RAM	Valid	Invalid	Writing encoder configuration parameters via the BMP parameter channel resulted in an invalid parameter set. Use valid parameters.
8	Communication	Communication OK	Communication alarm	Check the service quality in the communication system and for faults in the communication infrastructure.
10	Synchronization errors (only when IRT is being used)	Sync ok	Sync alarm	Check the Ethernet connection for errors and disturbances that could cause packet loss or frame jitter.
11	Master sign-of-life error (MSL)	MSL ok	MSL alarm	Check the Ethernet connection for errors and disturbances that could cause packet loss or frame jitter.
12	Velocity limit	Not exceeded	Exceeded	A critical velocity for the encoder was exceeded. Operating the encoder above this velocity limit can result in position errors or can damage the encoder mechanical system.
14	Sets the preset value (specified value outside the range)	Preset value OK	Preset value outside the permitted range	Use a preset value that is less than the overall scaled resolution.
15	Command not supported	Command OK	Incorrect command	Set a permitted command.
19	Overtemperature	Temperature OK	Overtemperature alarm	Resolve the reason for this high temperature. The bit is automatically reset if the temperature falls below value "Alarm_Temperature" (default = 80°C).

Display of alarms

Alarms are always displayed for at least 5 seconds:

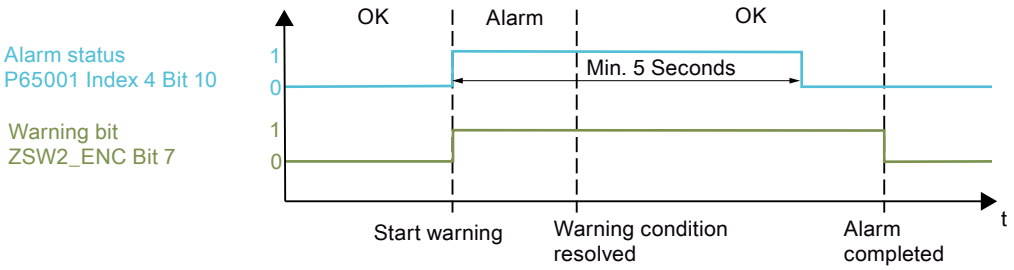


Figure 7-1 Alarm

7.2 Error

Parameter 65 001 [2] indicates the current status of all errors.

Overview

A list of all of the errors supported is listed below.

Bit	Designation	=0	=1	Troubleshooting
5	Commissioning diagnostics	Parameterization OK	Incorrect parameterization	Create a new, valid parameter set for the encoder and restart the encoder.
6	Commissioning scaling values	Scaling values OK	Scaling values incorrect	Create a new, valid parameter set for the encoder and restart the encoder.
8	Communication	Successful	Cancelled	The controller can restart communication after a communication interrupt. The controller can continue the application if this is successful. Check the Ethernet communication and avoid errors and disturbances that could cause packet loss or frame jitter.
10	Synchronization (only when IRT is being used)	No synchronization error	Synchronization error	After synchronization is interrupted, the encoder starts another synchronization attempt. The controller can continue the application if this is successful. Check the Ethernet communication and avoid errors and disturbances that could cause packet loss or frame jitter.
11	Master sign-of-life (only when IRT is being used)	No MSL error	MSL error	The controller can start an automatic re-synchronization routine after synchronization is lost. If possible, the controller can continue the application if this is successful.
19	Overtemperature	No overtemperature error	Overtemperature error	Check the encoder operating conditions.
22	Memory error	No memory error	Memory error	Replace the encoder.

Error display

At the earliest after 5 seconds after an error occurs, an error that is no longer active is no longer displayed.

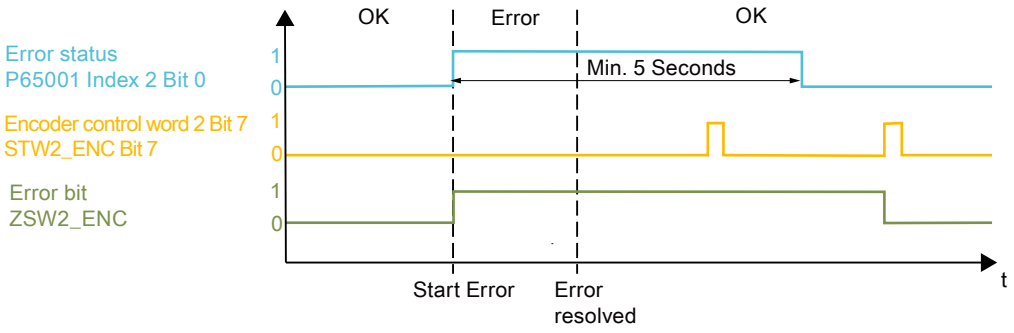


Figure 7-2 Error

7.3 PROFIdrive error memory

PROFIdrive fault memory offers a logbook function for encoder diagnostics. The fault memory can store a sequence involving several faults for each fault situation.

Refer to the PROFIdrive and encoder profiles for additional details.

Overview

Error class #	Description	Error code (error)	Error code (alarm)
5	Commissioning diagnostics	0x105	-
6	Commissioning scaling values	0x106	-
10	Synchronization (only when IRT is being used)	0x10A	-
11	Master sign-of-life (only when IRT is being used)	0x10B	-
14	Preset value (specified value outside the permitted range)	-	0x20E
15	Command not supported	-	0x20F
19	Overtemperature	0x113	0x213

Media redundancy

8

8.1 Solutions

The PROFINET interface offers it two media redundancy solutions:

- **M**edia **R**edundancy **P**rotocol (MRP)
- **M**edia **R**edundancy for **P**lanned **D**uplication (MRPD), as seamless media redundancy concept

Overview

If the ring topology is interrupted, the MRP-capable device can reroute the data backward so that it can reach the other devices of the ring.

Contact the PLC supplier to clarify which hardware is required for the control and the configuration.

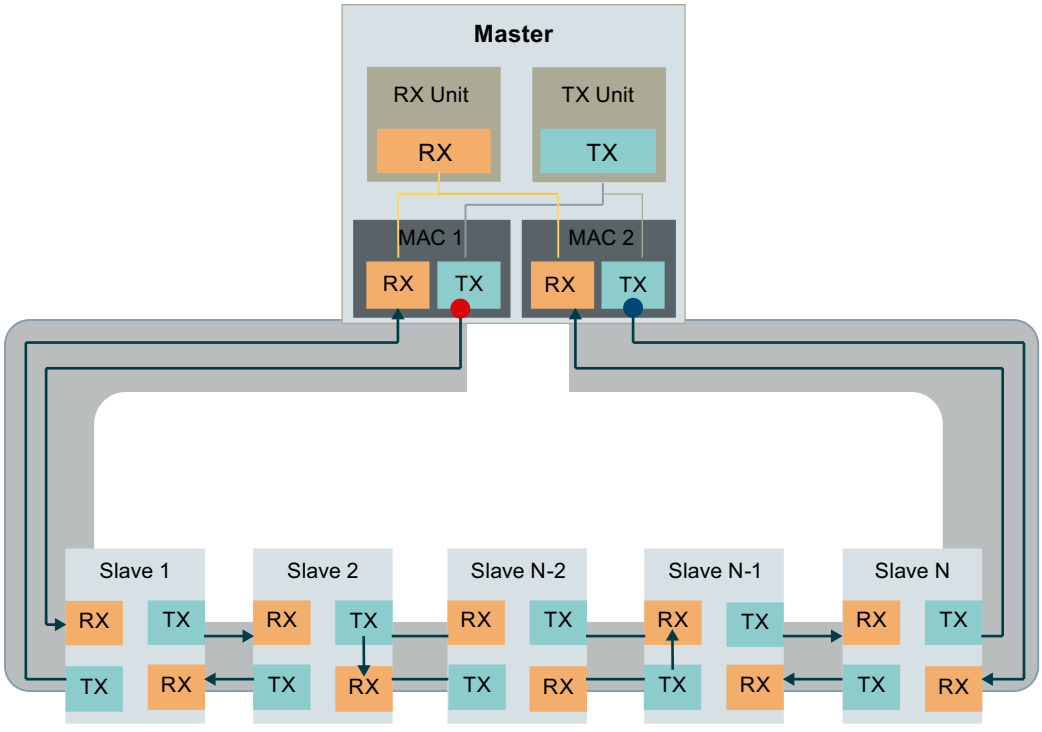


Figure 8-1 Overview MRP_MRPD

8.2 Media redundancy protocol (MRP)

The Media Redundancy Protocol (MRP) is based on a ring topology and depending on the configuration, guarantees recovery times of between 200 ms and 500 ms. MRP uses a redundancy manager that closes the ring.

Requirement

Note the following:

- "MRP" must be activated for all devices in the ring.
- All devices must be connected to one another via their ring ports (typically, ports 1 and 2).
- The ring may comprise a max. of 50 devices.
- All of the devices in the ring belong to the same redundancy domain.
- At least one device in the ring is the media redundancy manager.
- All other devices in the ring are media redundancy clients.
- RT communication is interrupted (station failure) if the reconfiguration time setting of the ring is higher than the selected response monitoring time setting of the IO devices. Ensure that the response monitoring time of the IO devices is adequately long.

Error case

In the case of an error, the redundancy manager automatically re-establishes the PROFINET connection via a second communication path. This means that an error in the network can be bypassed while the system continues to operate, however not bumplessly.

Please note that after the error has been resolved, a PROFINET device failure can occur, as a new switchover is carried out.

8.3 Media redundancy for planned duplication (MRPD)

The Media Redundancy for Planned Duplication (MRPD) is a technique to bumplessly switch over IRT telegrams (high-performance).

Requirement

Note the following:

- "MRP" must be activated for all devices in the ring.
- All devices must be connected to one another via their ring ports (typically, ports 1 and 2).
- The ring may comprise a max. of 50 devices.
- All of the devices in the ring belong to the same redundancy domain.
- At least one device in the ring is the media redundancy manager.
- All other devices in the ring are media redundancy clients.
- RT communication is interrupted (station failure) if the reconfiguration time setting of the ring is higher than the selected response monitoring time setting of the IO devices. Ensure that the response monitoring time of the IO devices is adequately long.
- IRT (High Performance) must be activated at all of the devices involved.
- All devices involved must support MRPD, also devices in the stub cable, that cyclically exchange IRT data with a ring component.

Bumpless switchover

Bumpless switchover is ensured as cyclic IRT data is sent via both communication paths in the ring. This means that if there is no error in the network, the receiver receives the same IRT telegram twice. The first IRT telegram received is evaluated, the second is rejected.

Operating with STEP7

9

In the following chapter the configuration of the encoder with the configuration tool STEP7 "HW Config" is shown as example.

9.1 Installing the GSDML file (optional)

When the encoder is used for the first time, the GSDML file must be installed in order to import the encoder description in the hardware catalog of the HW Config tool: SIEMENS provides the GSDML file.

Procedure

1. In window "HW Config-..." open menu "Options" > "Install GSD files...".

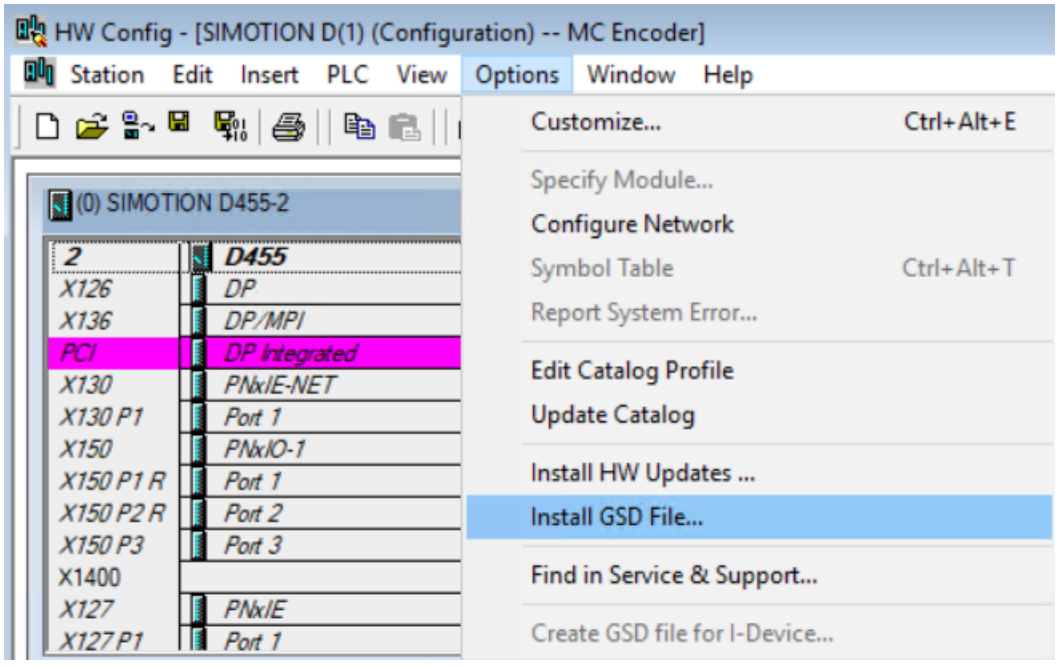


Figure 9-1 Installing the GSD file in STEP 7 HW Config

2. Then select the GSDML file.
   To display the encoder in STEP 7 using a bitmap, the bitmap file is automatically installed along with the GSDML file. This is the reason that both files must be located in the same directory.
   Once the GSDML file has been successfully installed, the encoder is displayed in the hardware catalog under "PROFINET-IO" > "Additional field devices" > "Encoders" > "MC encoder".

9.2 Setting up encoders in a STEP 7 project

Procedure

1. To setup the encoder in a project, drag the required device (e.g. Multiturn 30 bit V 2.x) to an existing PROFINET Ethernet network.
   - OR -
   Select the network and double-click on the symbol of the required device (e.g. Multiturn 30 bit V 2.x).

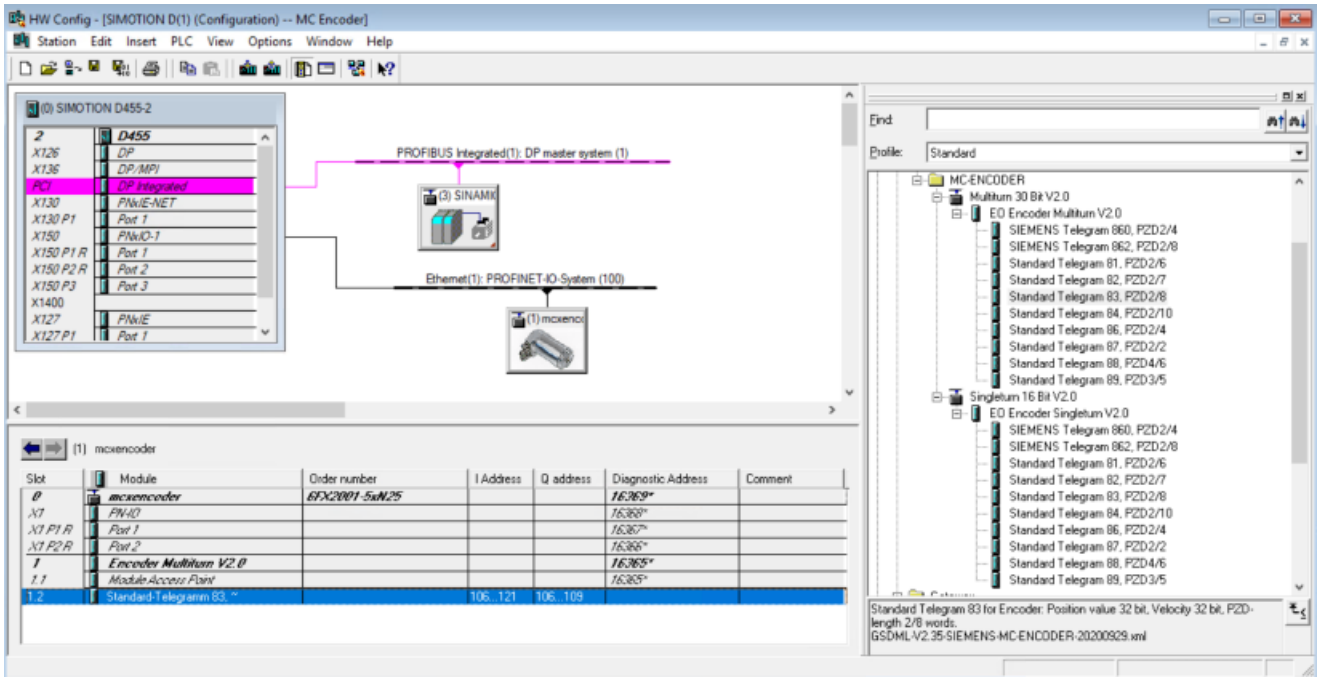


Figure 9-2 Setting up an encoder in a STEP 7 project

2. Double-click on the encoder device symbol (slot "0", module "MCxENCODER") to define the device properties.

3. Define a device name and click on button "Ethernet" to define the encoder IP address.

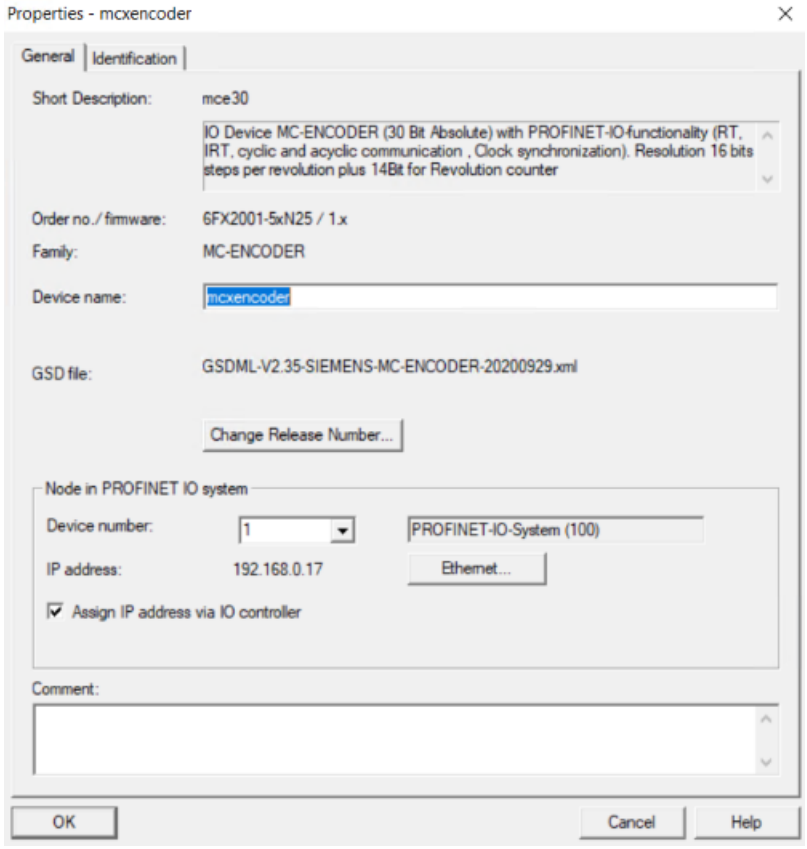
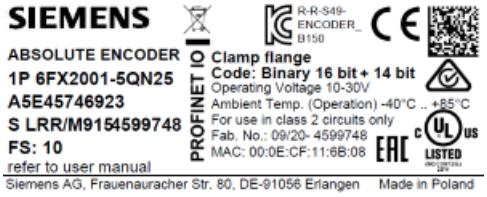


Figure 9-3 Defining device properties

4. Define the required update (refresh) time under tab "IO cycle".
   The device name and the IP address are now physically defined on the encoder.
5. Connect the control (PLC) and the encoder to the Ethernet and switch them on.

6. In the new window, click on "PLC" > "Ethernet" > "Edit Ethernet participants" and then on "Browse" to display the Ethernet participants available.
   - STEP 7 searches for the devices in the Ethernet and displays them in a window.
   - The encoder should be displayed under device type "MC-ENCODER".
   - Select this entry and click on button "Flash" so that the identification LED flashes at 2 Hz.
   - Insert the MAC address of the selected device in text box "MAC address"
     The MAC address of the encoder is stamped on the nameplate (see the following diagram).



   - Click the "OK" button to accept what you have entered.

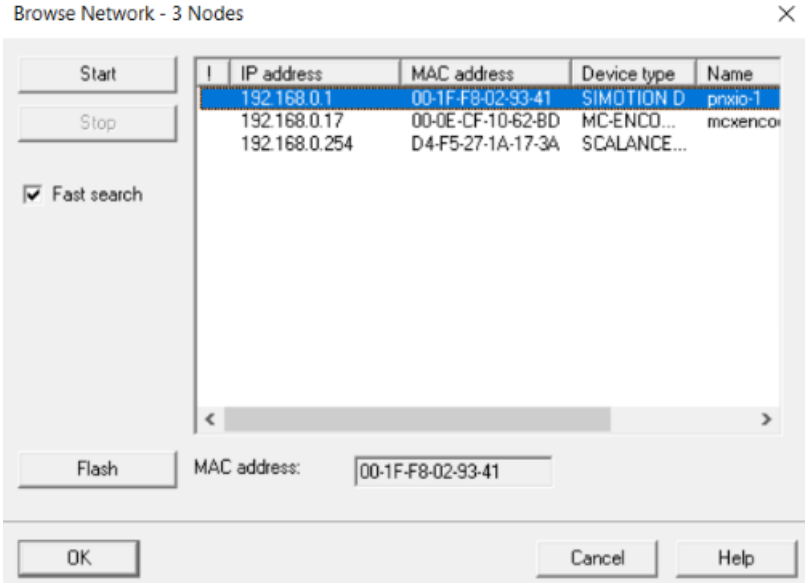


Figure 9-4 Network browser

7. Enter the following in window "Edit Ethernet Node":
   - Activate option button "Use IP parameters".
   - Enter the IP address and subnet mask for the previously assigned encoder.
   - Click on "Assign IP configuration".
   - Further, enter the device name previously selected in text box "Device name" and click on "Assign name".

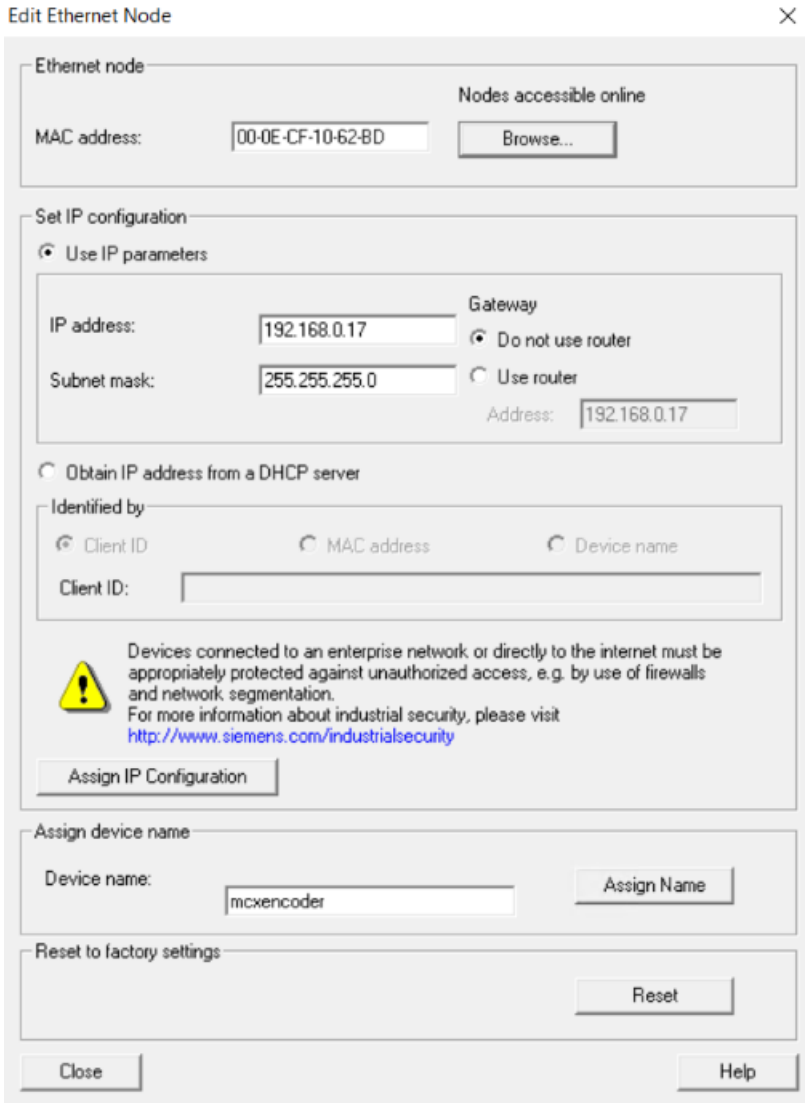


Figure 9-5 Editing an Ethernet participant

Note

If several encoders are used in the same PROFINET domain, then every encoder must be assigned a different name.

9.3 Replacing encoders in the PROFINET network using LLDP

Link Layer Discovery Protocol (LLDP) facilitates replacing a device in the PROFINET network. The partner port before and after the replaced device saves the relevant information so that no additional configuration is required.

Procedure

1. Open window "Properties for the device port" in the PROFINET network.
2. Under tab "General", check that option "Device replacement without exchangeable medium" is activated.
   Activate this option if it has still not been activated.

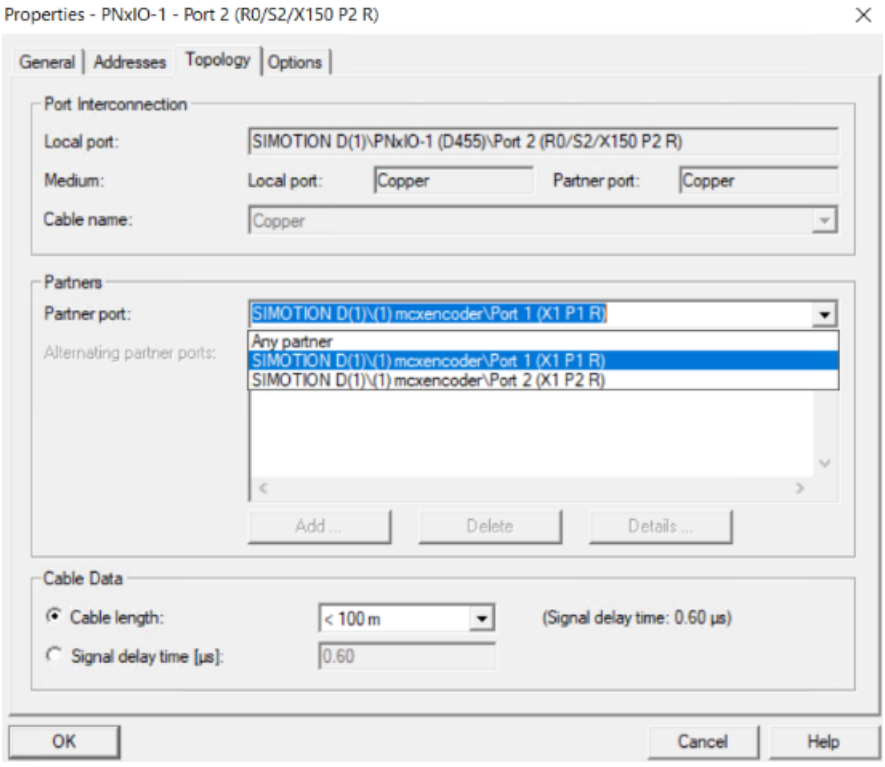


Figure 9-6 PNxIO properties

3. In the STEP 7 Hardware Manager, open window "Topology Editor".
   – You can see the connections, cable length and signal delay listed under tab "Tabular view".

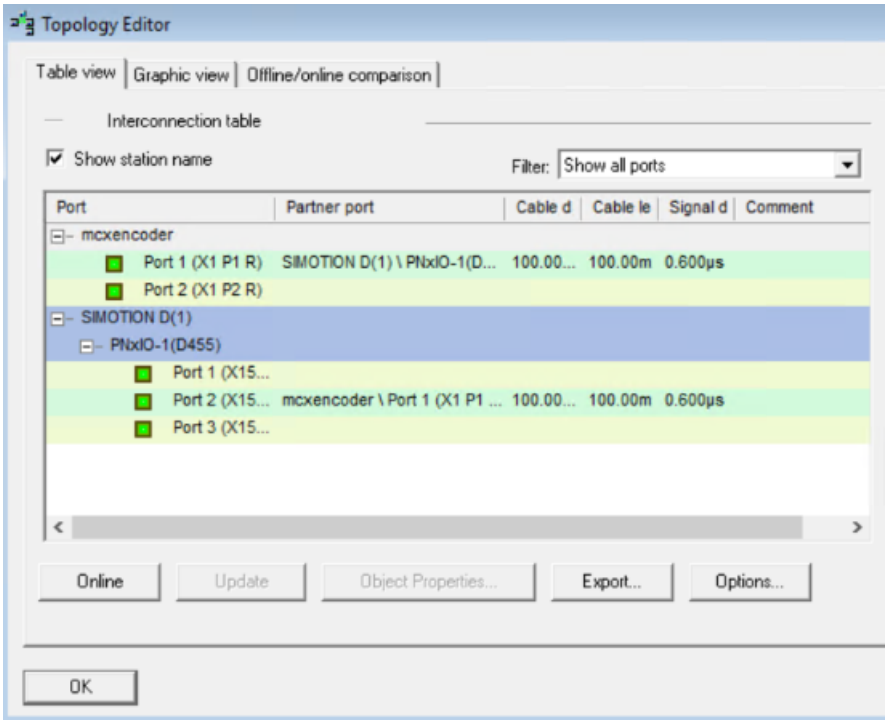


Figure 9-7 Example 1: Topology editor, tabular view

– You can see the various connections under tab "Graphic view".

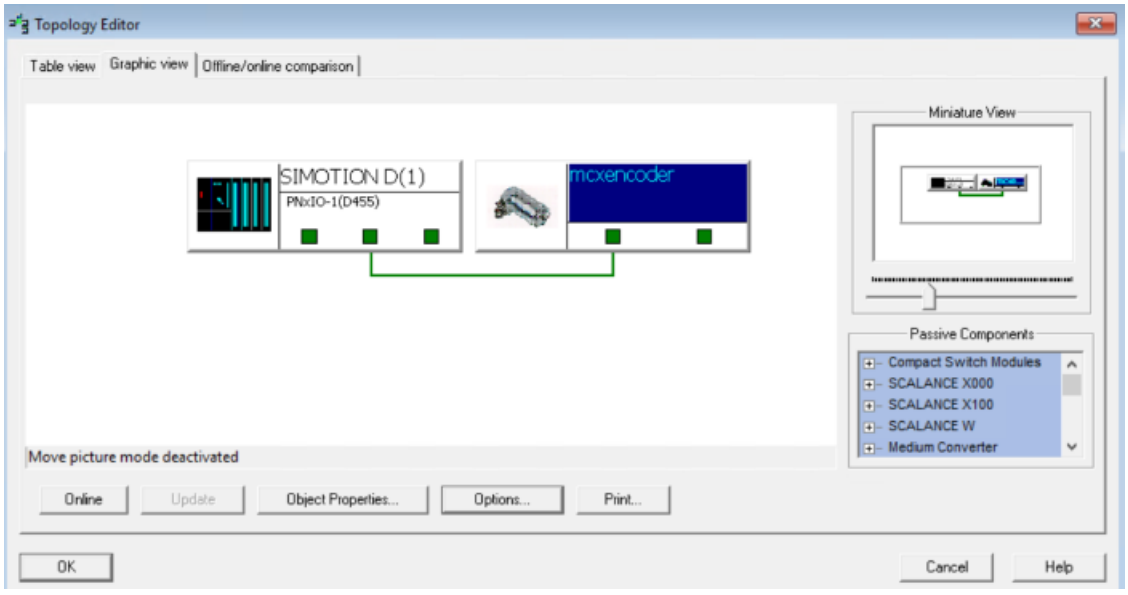


Figure 9-8 Example 2: Topology editor, graphic view

– Open tab "Offline/Online comparison" to compare the configuration with the physical network.

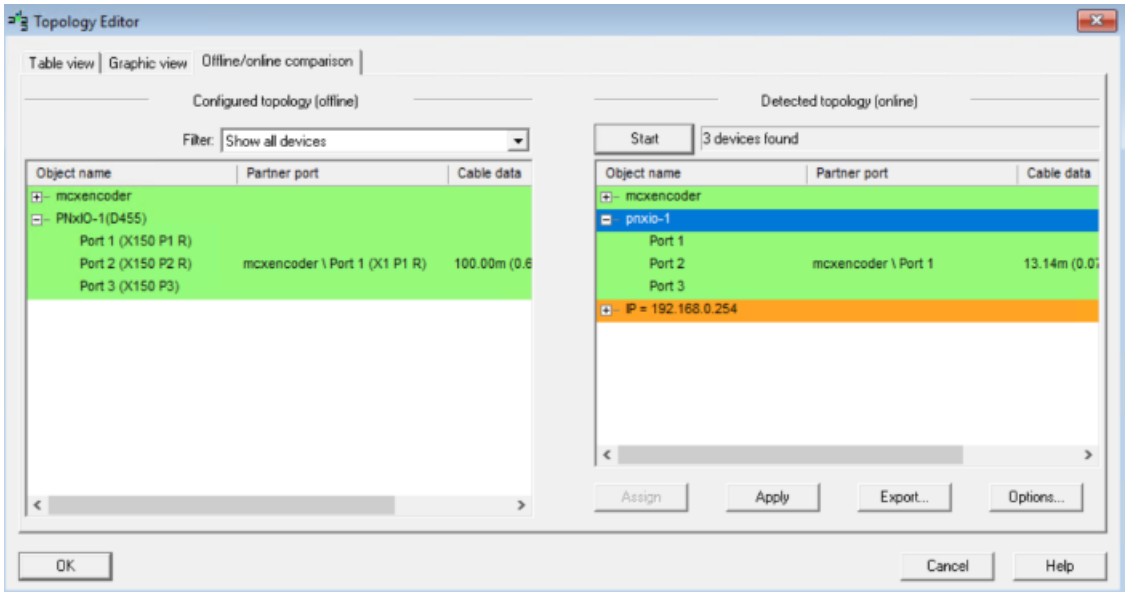


Figure 9-9 Example 3: Topology editor, offline/online comparison

9.4 Selecting an encoder telegram

The functionality and interface depend on the selected telegram. The telegram is selected by inserting the appropriate telegram submodule (81, 82, 83, 84, 86, 87, 88, 89, 860, 862).

Procedure

Insert the appropriate telegram submodule by dragging it from the hardware catalog and dropping it into subslot 1.2 of the encoder.

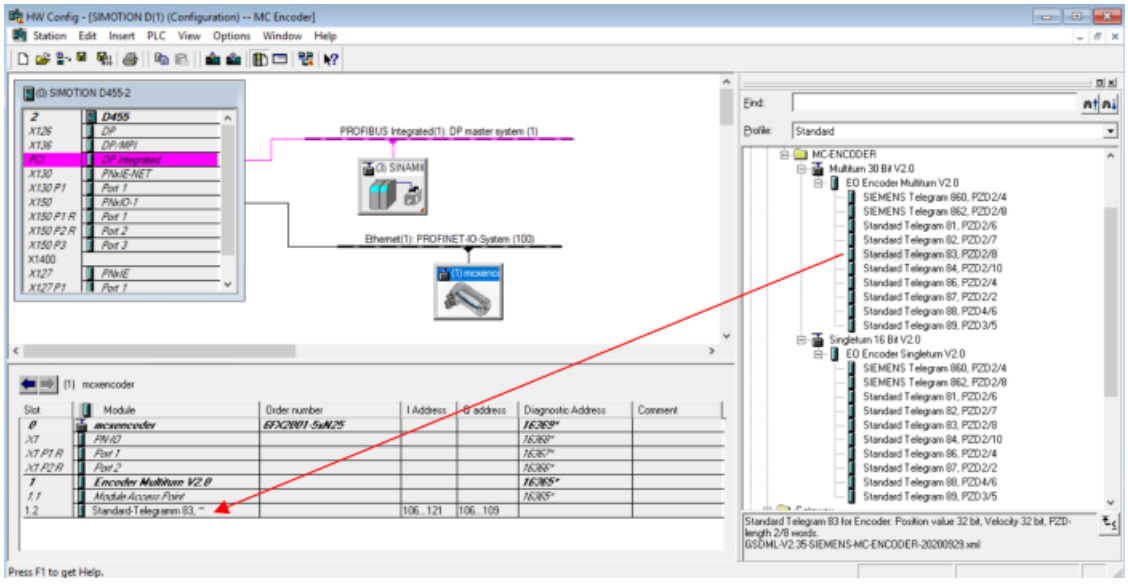


Figure 9-10 Selecting the telegram

9.5 Setting encoder parameters

Procedure

1. Select the encoder in the hardware configuration and double-click on the MAP submodule (slot 1.1).
   Dialog window "Properties" opens.
2. If you change the input addresses, open tab "Addresses" and correct the addresses.
3. If you wish to set the encoder parameters, open tab "Parameters" and configure the encoder parameters.

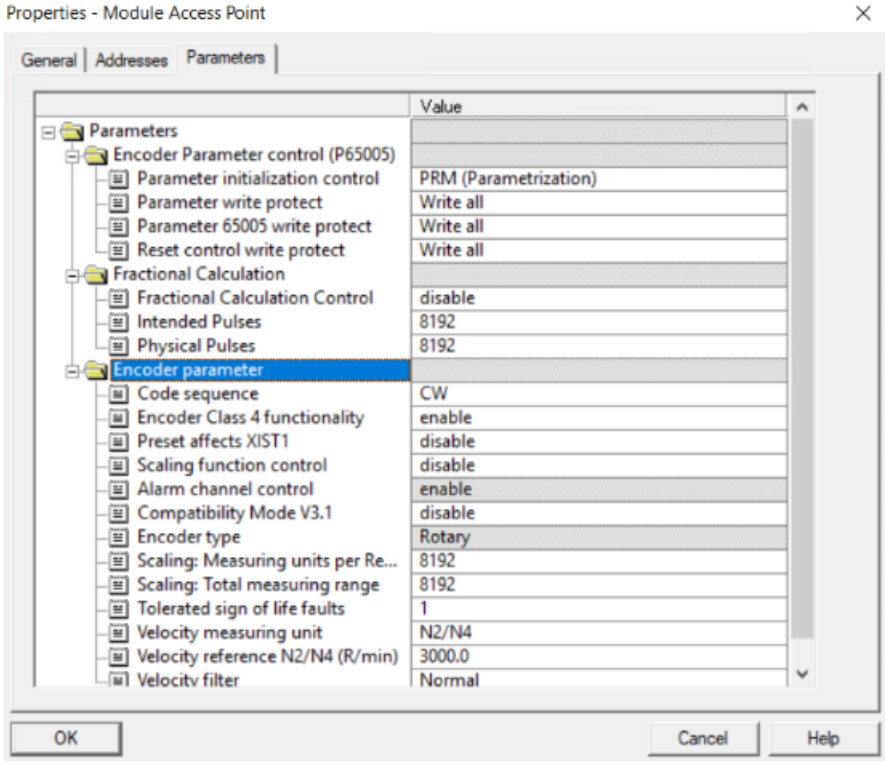


Figure 9-11 Setting encoder parameters

9.6 Defining device properties

PROFINET IO Domain Management facilitates the selection of the synchronization role and RT Class.

The following roles are possible:

- unsynchronized
  With this synchronization role, the encoder operates in the RT Class.
- Sync controller
  For this synchronization role, you can also select between "high flexibility" (FLEX) and "high performance" (TOP).

Procedure

1. Select slot 0 and call shortcut menu "Edit" -> "PROFINET IO" -> "Domain Management..."

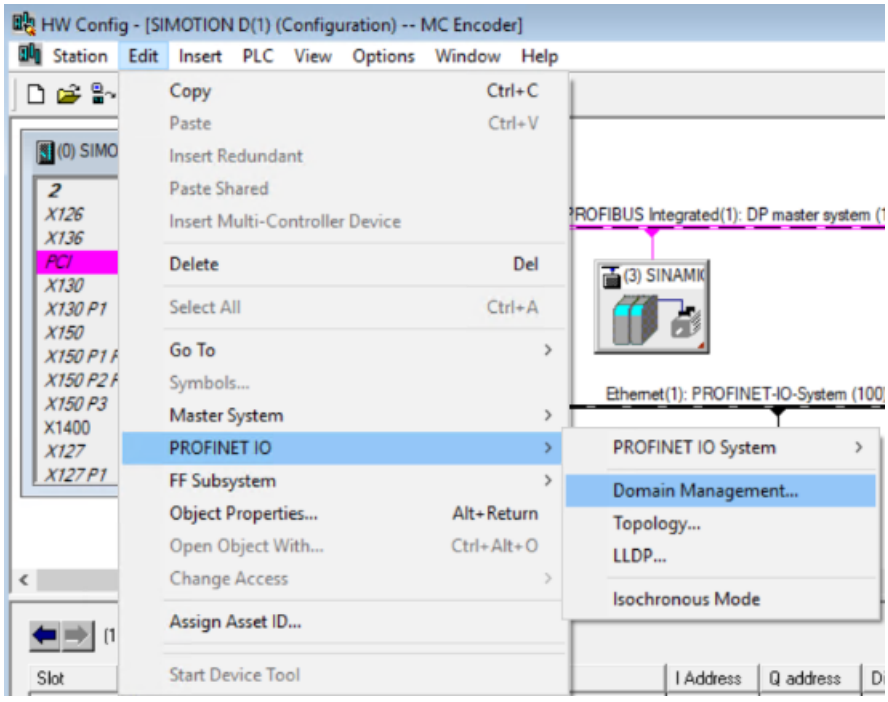


Figure 9-12 Domain Management

2. Window "Domain Management" opens and provides an overview of all of the available devices. Check that all devices use the same synchronization role and RT Class.
   - In the list below, select the required participants (e.g. the encoder), and then click on "Properties device...".
   - Define the synchronization data of the selected device in the Properties dialog.

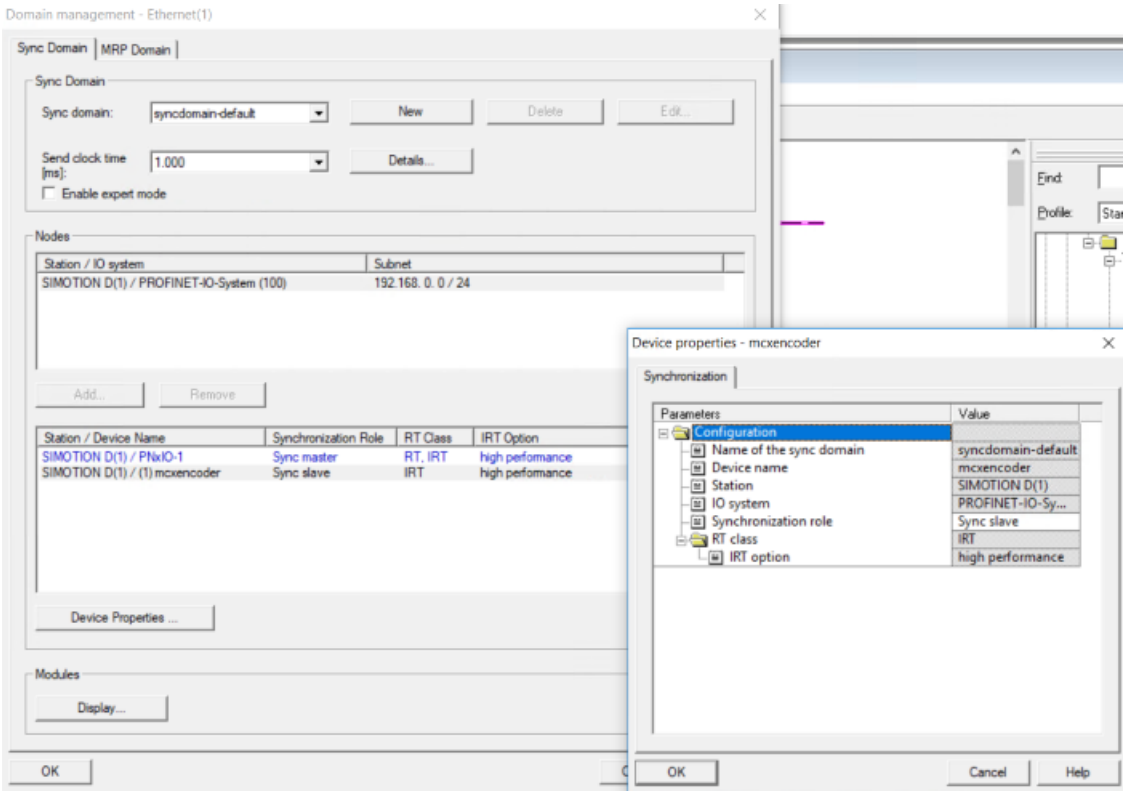


Figure 9-13 Synchronization

9.7 IRT settings

Upper limit

In window "Details - Sync Domain", you can see the value for the IRT data transfer.

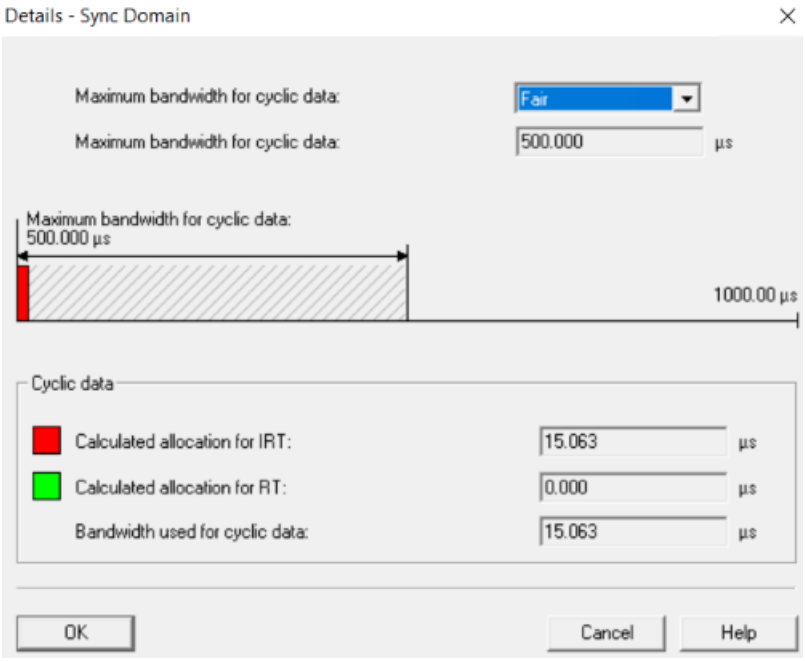


Figure 9-14 IRT data transfer

Sign-of-life error

The maximum permissible sign-of-life errors can be defined using the GSDML configuration or using parameter p0925. Check the associated encoder profile for details.

Error codes

In encoder profile V4.1, the error codes when an error occurs are transferred in G1_XIST2.

Note

For synchronous applications linked to a specific clock cycle, the encoder indicates errors described using error code 0x0F04 (synchronization error) by setting the encoder sign-of-life to zero (S-LS = 0).

G1_XIST2	Meaning	Explanation
0x0F02	Master sign-of-life error	The maximum number of master sign-of-life errors was exceeded.
0x0F04	Synchronization error	The number of permissible failures for the sign-of-life error was exceeded.

9.8 Changing and reading encoder parameters during the run-time

Encoder parameters are defined when configuring the encoder. Information about the parameters is provided at: Encoder parameter description (Page 67).

Information on changing or reading encoder parameters in a STEP 7 automation program is provided in system function blocks SFB53 and SFB52 (read/write data set) or in the variable table for tests.

More information is provided in Chapter: Additional literature (Page 162).

9.9 Accessing cyclic data

Procedure

1. To access cyclic data in the telegram, in STEP 7 create a tag for every signal used in the input and output data of the telegram.
2. As logical address, use the basis address of submodule 1.2 from HW Config and the corresponding byte offset of the signal in the telegram.

Operating with SIMOTION

10

In the following chapter the configuration and operation of the encoder with the SIMOTION controllers is shown. In this example SIMOTION SCOUT Version 4.2 is used.

10.1 Applications

Application cases

Generally speaking, there are two application cases for operating the encoder with SIMOTION.

- Encoder with TO "External encoder":
  The encoder is used as sensor device for TO "external encoder". In this case, generally the encoder is operated in the isochronous mode (IRT device).
  The encoder is completely controlled from the TO.
  The sign-of-life monitoring is automatically activated.
  Telegram 81 or 83 is used.
- Operating the encoder directly from the user program:
  The encoder telegram is directly accessed from the user program. The encoder is completely controlled from the user program. Generally, telegram 860 is used.

In addition, SIMOTION provides system functions to access parameters online via the non-cyclic standard parameter channel for the encoder. You can use these system functions for the two applications described above.

10.2 Using the encoder together with the TO external encoder

The following steps are required to configure the encoder for SIMOTION as sensor for the TO "external encoder".

The general procedure to create and configure the encoder in HW Config is described in the following chapters:

- Configuration (Page 63)
- Operating with STEP7 (Page 87)

Information on online parameter access via the parameter channel is provided in Chapter: Online parameter access (Page 118).

Configuring the encoder in HW Config

1. Make the following settings for this specific application:
   - IRT communication (high performance IRT)
   - Cycle time and Ti identical with the drive axes
   - Select telegram 81 or telegram 83 (for 32 bit speed actual value NIST_B)
2. Define the encoder parameters:
   - Accept the default setting.
   - If you use the speed actual value NIST from the encoder in the TO, then set the speed reference value in parameter "Reference speed N2/N4 (rpm)" to a suitable value for your specific application.

Example

The following example shows the configuration settings for the encoder in HW Config for telegram 83 and a reference speed (100 %) of 3000 rpm.

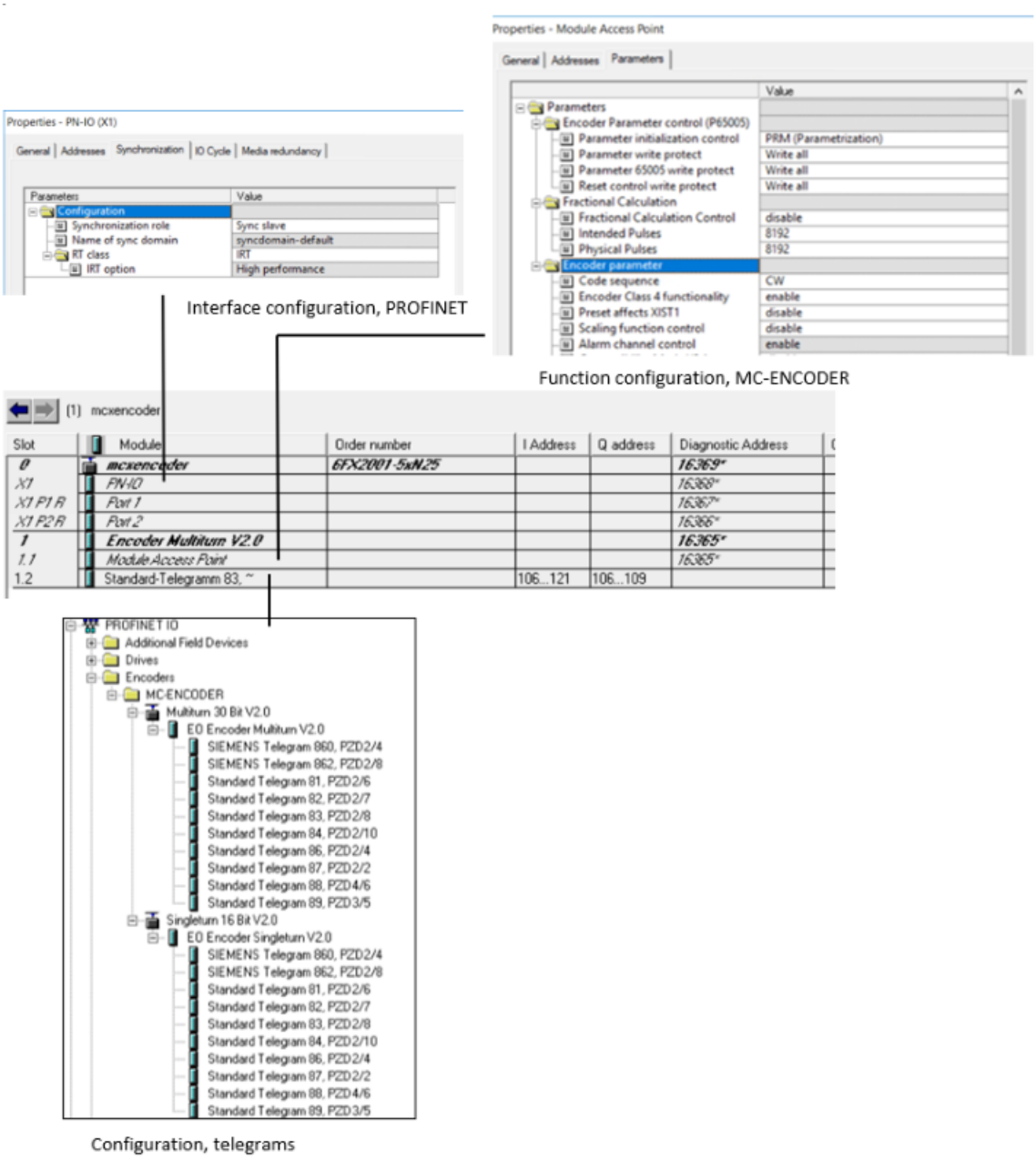


Figure 10-1 Example: Setting required in HW Config

Procedure

1. Insert a TO "external encoder" in the project, and run the Wizard for configuring the external encoder.
2. Open window "Insert external encoder", and enter a name in text box "Name". Click on "OK".

Figure 10-2 Inserting an encoder

3. Window "External encoder configuration - [encoder name]" > "Encoder type" opens.
   For "Encoder type", activate option button "rotary".
   Then click on "Next >".

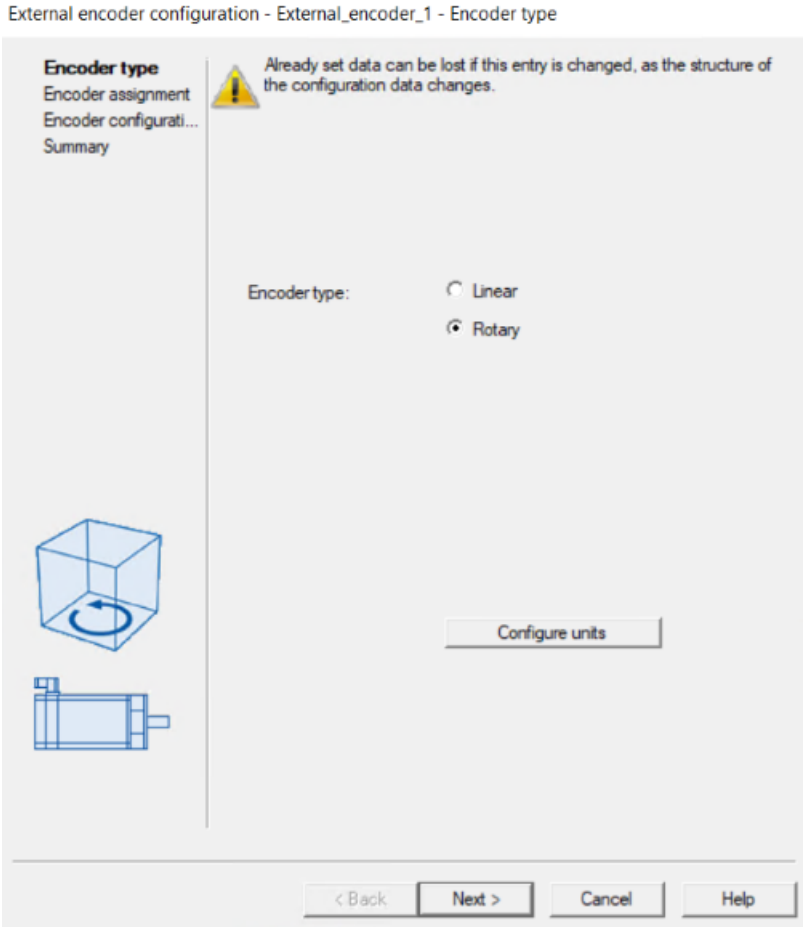


Figure 10-3 Configuring the encoder type

4. Window "External encoder configuration - [encoder name]" > "Encoder assignment" opens. Select the following under "Encoder use in SIMOTION":
   - Encoder type: Absolute encoder or absolute encoder, cyclic, absolute
   - Encoder mode: SSI

   Click on "Next >".

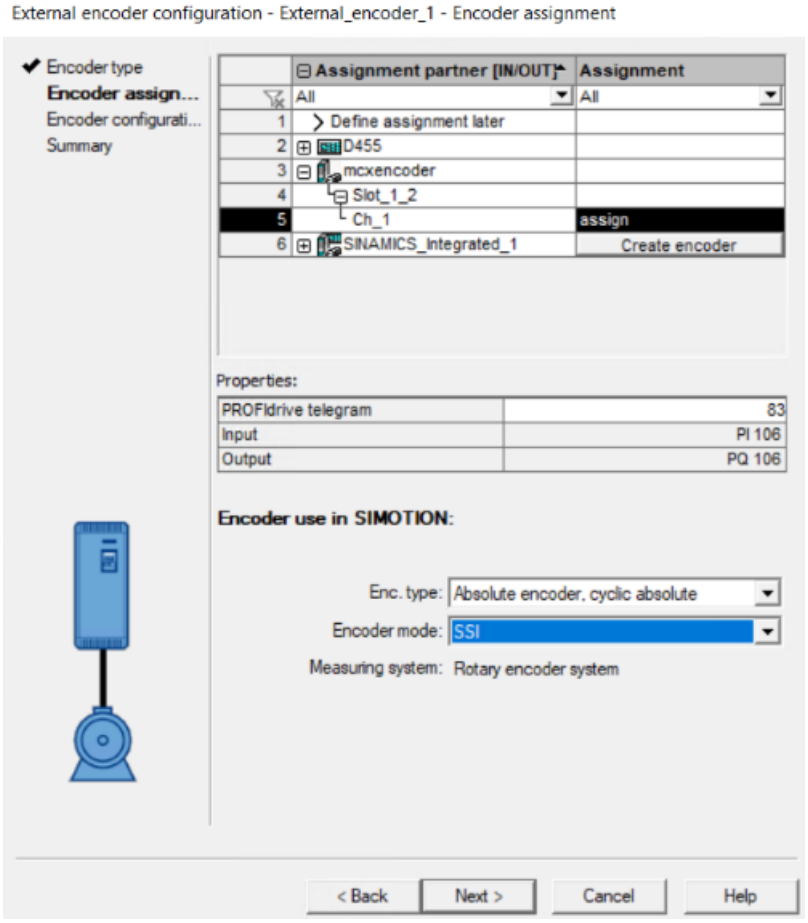


Figure 10-4 Assigning an encoder, configuring the type and mode

5. Window "External encoder configuration - [encoder name]" > "Encoder configuration" opens.
   Enter the following under "Reference variables":
   - Encoder pulse number: 65536
   - Fine resolution: 1
   - Fine resolution, absolute value in Gn_XIST2: 1
   - Data width, absolute value without fine resolution: 30 (for multiturn encoders) or 16 (for singleturn encoders)

   Under "Additional settings", activate checkbox:
   - "Activate encoder monitoring".

   Click on "Next >".

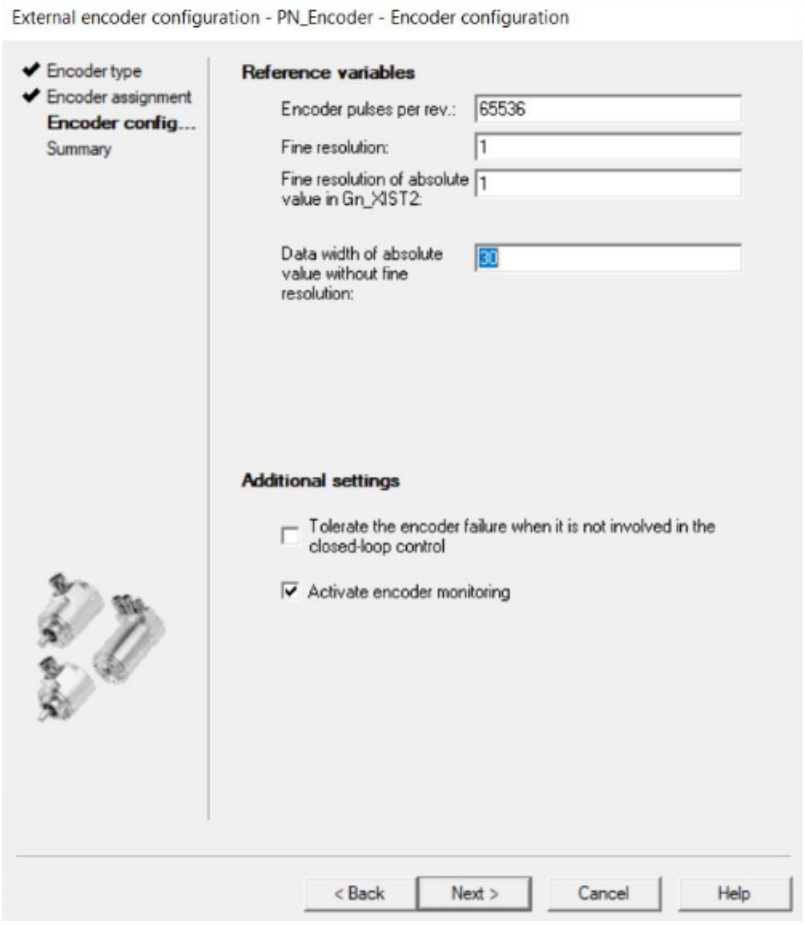


Figure 10-5 Configuring an encoder

6. Window "External encoder configuration - [encoder name]" > "Summary" opens.
   You are provided with an overview of all of the data required for the configuration.
   Click on "Finish".

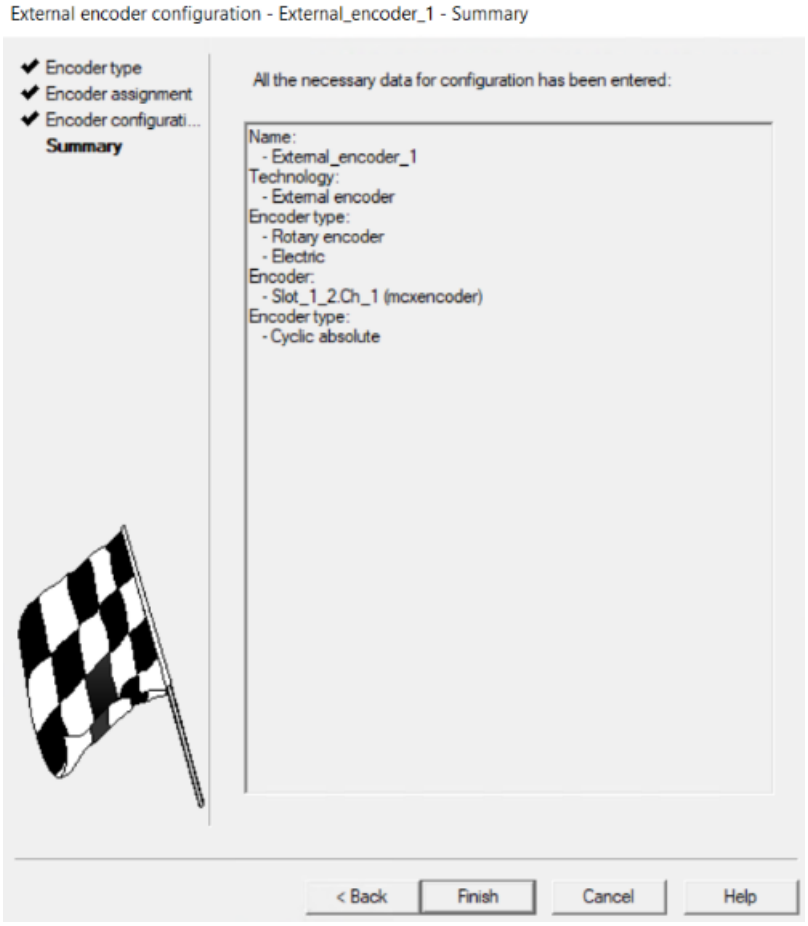


Figure 10-6 TO configuration, summary

Example

After the encoder was successfully configured at the TO, the following configuration settings are displayed at TO "EXTERNAL ENCODER".

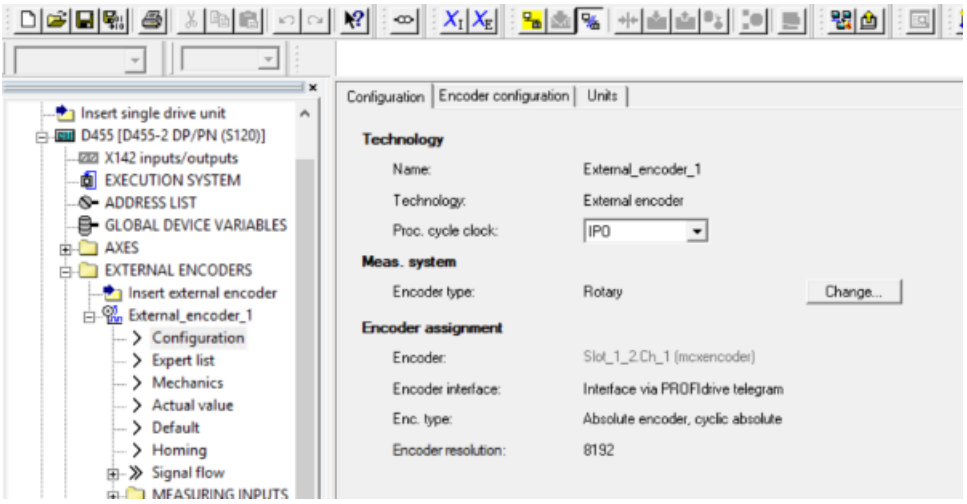


Figure 10-7 Example: TO configuration, "Configuration" tab

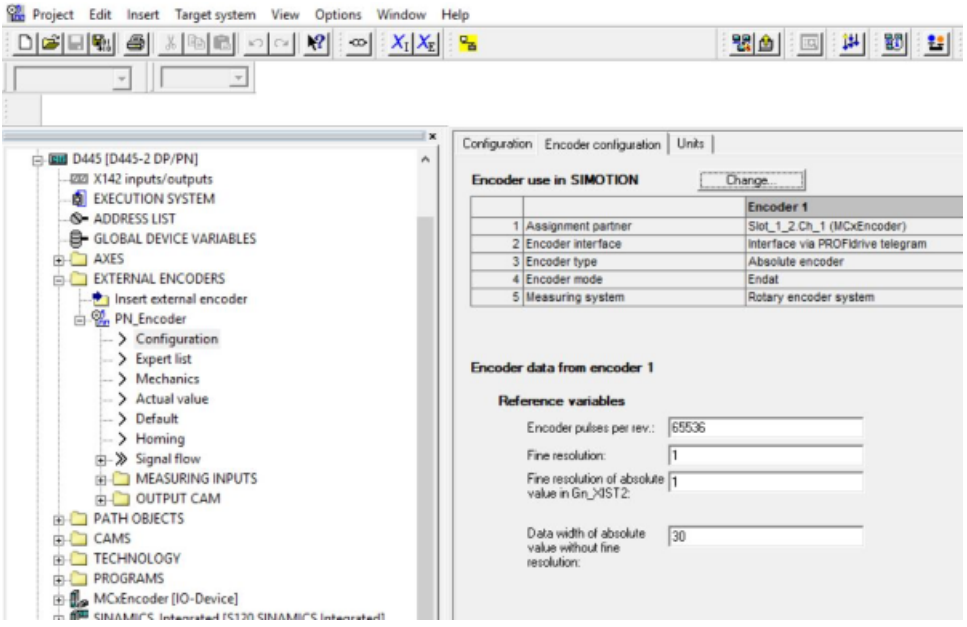


Figure 10-8 Example: TO configuration, "Encoder configuration" tab

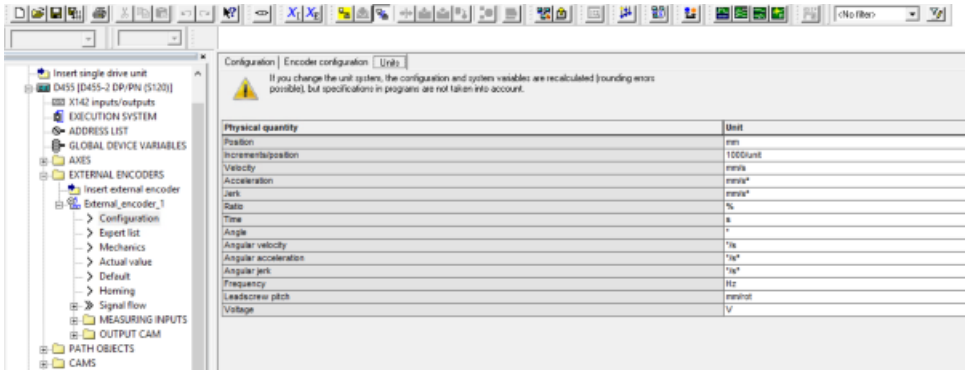


Figure 10-9 Example: TO configuration, "Units" tab

Using the speed actual value NIST of the encoder

TO "external encoder" can calculate its internal velocity actual values as follows:

- Based on the internal position actual values
- Based on the external velocity actual value NIST_B from the encoder

Using the TO expert list, you can define which velocity actual value is used in the TO.

Example

The following screenshot shows the setting options when using TO parameter "encoderValueType". In this example, the following values are relevant:

[0]:	ROTARY_SYSTEM	The velocity in the TO is calculated based on the position.
[4]:	POSITION_AND_PROFIDRIVE_ENCODER_NISTB	The velocity is taken from encoder signal NIST_B.

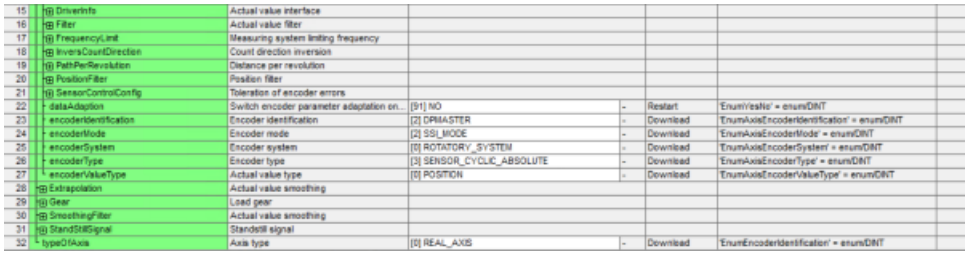


Figure 10-10 Configure the velocity source at TO "external encoder"

10.3 Using the encoder directly from the user program

The following steps are required to use the encoder directly as sensor from a SIMOTION user program:

The general procedure to create and configure the encoder in HW Config is described in the following chapters:

- Configuration (Page 63)
- Operating with STEP7 (Page 87)

Configuring the encoder in HW Config

Access via telegram 89

You can freely select the settings that address the requirements of your specific application.

The simplest option for accessing the position supplied from the encoder via the user program is to use telegram 89. If you use telegram 89 to transfer the pure position, then the user program does not need to use a control or status word. Further, the user program does not have to generate or monitor a sign-of-life, as telegram 89 does not use sign-of-life monitoring. To simplify calculating the position in the user program, the encoder has help functions that can be parameterized for scaling as well as defining a preset position actual value.

Access using telegrams 81, 82, 83, 84

If you control the encoder using telegrams 81, 82, 83 or 84, in the user program, you must program the required control and status words - as well as the sign-of-life counting and monitoring - according to the standard encoder profile or PROFIdrive profile.

Accessing cyclic data

1. To access cyclic data in the telegram, on the SIMOTION device create an IO tag for every signal used in the input and output data of the telegram.
2. As logical address, use the basis address from submodule 1.2 from HW Config along with the appropriate byte offset of the signal in the telegram.

Example

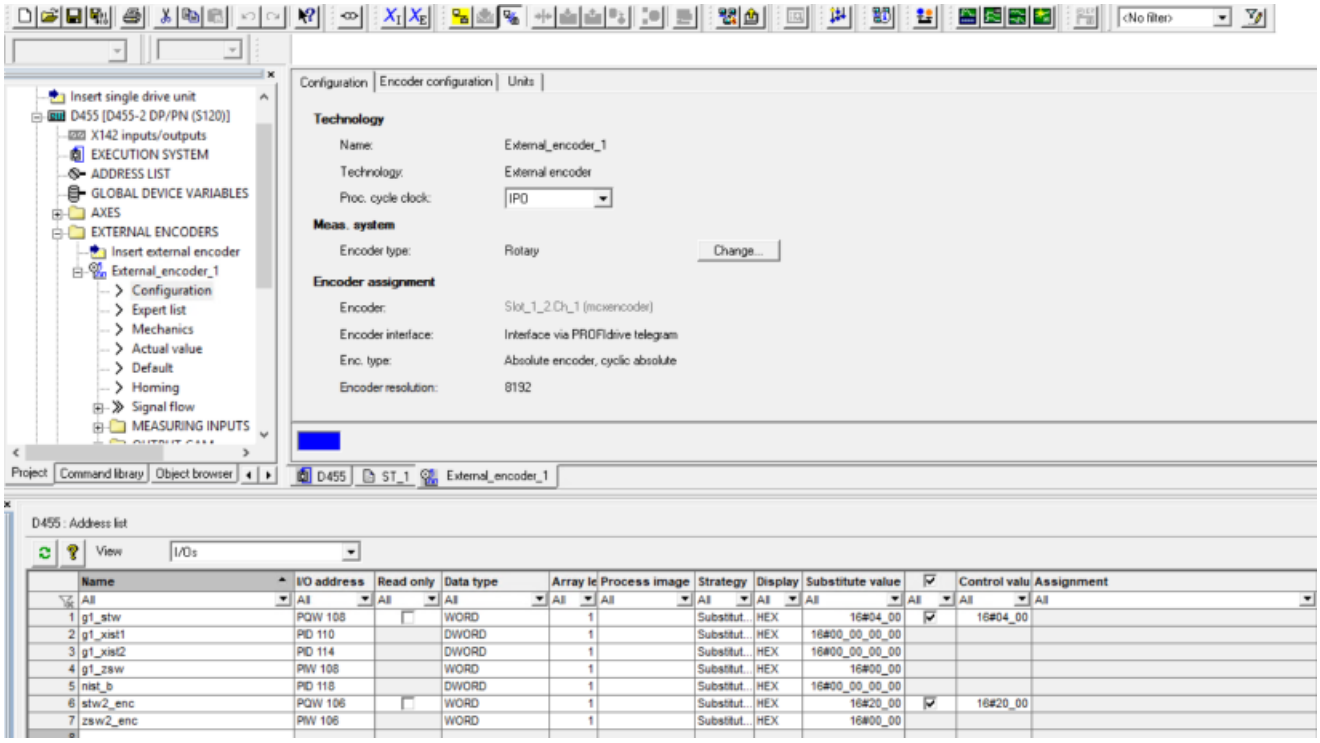


Figure 10-11 List of variables for cyclic encoder data in SIMOTION Scout

10.4 Online parameter access

Accessing parameters online via the parameter channel

The encoder has the standard parameter channel to access encoder parameters online. For the encoder, the access point is located on this parameter channel at the MAP submodule (module 1, submodule 1.1) via a data set with index 0xB02E.

The parameter channel is accessed via the non-cyclic communication channel, and is therefore possible from the control as well as from a supervisor. The access protocol for the parameter channel is standardized in the PROFIdrive profile.

Accessing parameters online using the SIMOTION system functions

SIMOTION offers the corresponding system functions to simplify accessing parameters online. These system functions can always be used for the encoder, independent of whether the encoder is connected with a TO or is directly controlled from the user program.

The following SIMOTION system functions allow encoder parameters to be simply accessed online:

- _readDriveParameter:
  Reads a value of an individual parameter
- _readDriveMultiParameter:
  Simultaneously reads values from several parameters
- _writeDriveParameter:
  Writes a value of an individual parameter

As logical address for the parameter channel, enter the address of the MAP submodule of the encoder (submodule 1.1).

The encoder parameters that can be accessed online are listed in Chapter: Parameterizing the communication interface (Page 69).

Example

ST program to read the reference parameters for the speed actual value in signal NIST_A or NIST_B:

```
INTERFACE
    PROGRAM readParaRefSpeed; // Motion Task.
END_INTERFACE
IMPLEMENTATION
    VAR_GLOBAL
        refSpeed : REAL := 0.0;
        readP60000 : structretreaddriveparameter;
    END_VAR
    PROGRAM readParaRefSpeed
       readP60000:=_readdriveparameter(
          logaddress := 256,
```

```
            parameternumber := 60000,
            nextcommand := WHEN_COMMAND_DONE,
            Commandid := _getCommandId( )
        );
        IF ((readP60000.functionResult = 0) AND
        (readP60000.parameterResult = 0)) THEN // Conversion to real.
        refSpeed := BIGBYTEARRAY_TO_ANYTYPE (byteArray :=
        readP60000.data);
        END_if;
    END_PROGRAM
END_IMPLEMENTATION
```

More information is provided in Chapter: Additional literature (Page 162).

Operation in the TIA Portal

11

11.1 Creating a project with components

Procedure

1. Open the TIA Portal.
2. To create a new project in the TIA Portal, in the portal view click on entry "Create new project". Enter the required project data in the detailed view to the right.

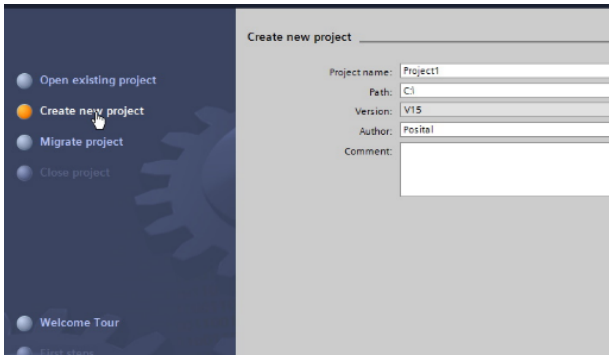


Figure 11-1 Creating a project

3. In the portal view, in the Navigation, select area "Devices and networks". Here, click on entry "Add new device".

4. Select the "Controller" area, and at the right, select the required PLC.
   If necessary, correct the suggested firmware version in the "Version" field.

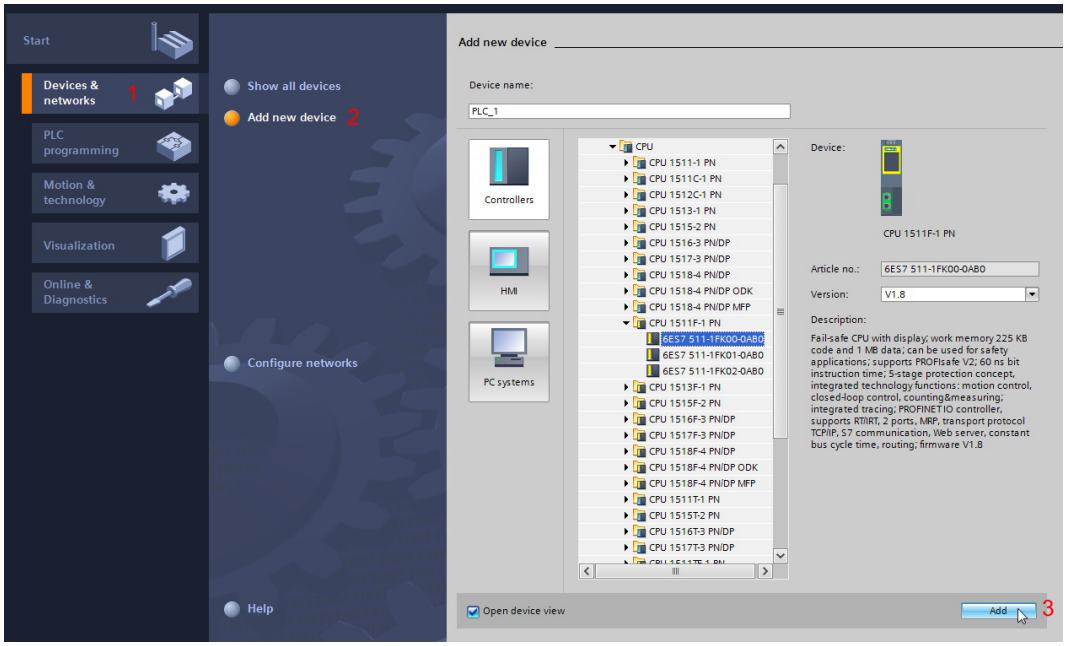


Figure 11-2 Selecting the PLC

The PLC is then inserted in the device view of the project.

5. Switch to the network view. Open the hardware catalog, and in folder "MC-ENCODER" select the required encoder.

Note

Encoder not available

If the required encoder is not included in the hardware catalog, then you must install the appropriate GSDML file of the encoder.
More information is provided in Chapter: Installing the GSDML file (optional) (Page 124).

Drag the required encoder and drop into the PLC network view.

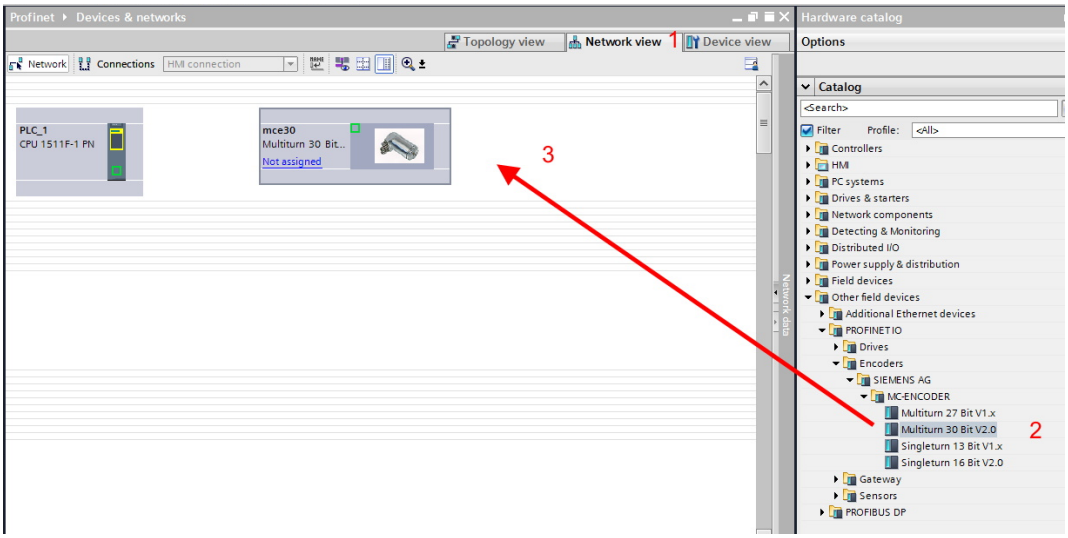


Figure 11-3 Inserting an encoder

The selected PLC and the encoder are created in the project and can then be linked and configured.

11.2 Installing the GSDML file (optional)

When the encoder is used for the first time, the GSDML file may have to be installed in order to import the encoder description into the hardware catalog of the TIA Portal. However, generally the GSDML file is already included in the hardware catalog. SIEMENS provides the GSDML file.

Procedure

1. In the open project, select menu "Options > Manage device descriptive files (GSD)".

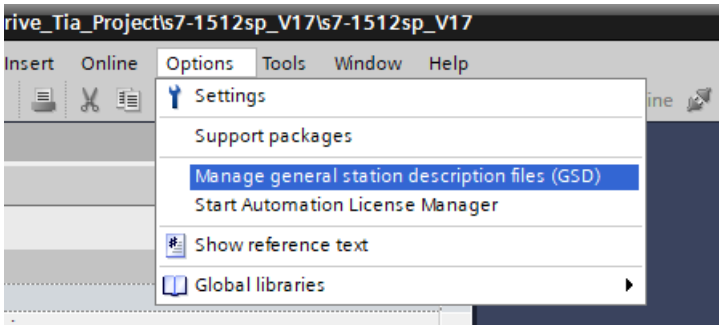


Figure 11-4 Calling GSDML

The dialog with the same name opens.

2. Select the GSDML file that you wish to install. To do this, activate the corresponding list entry in the dialog.
3. Then click on "Install".

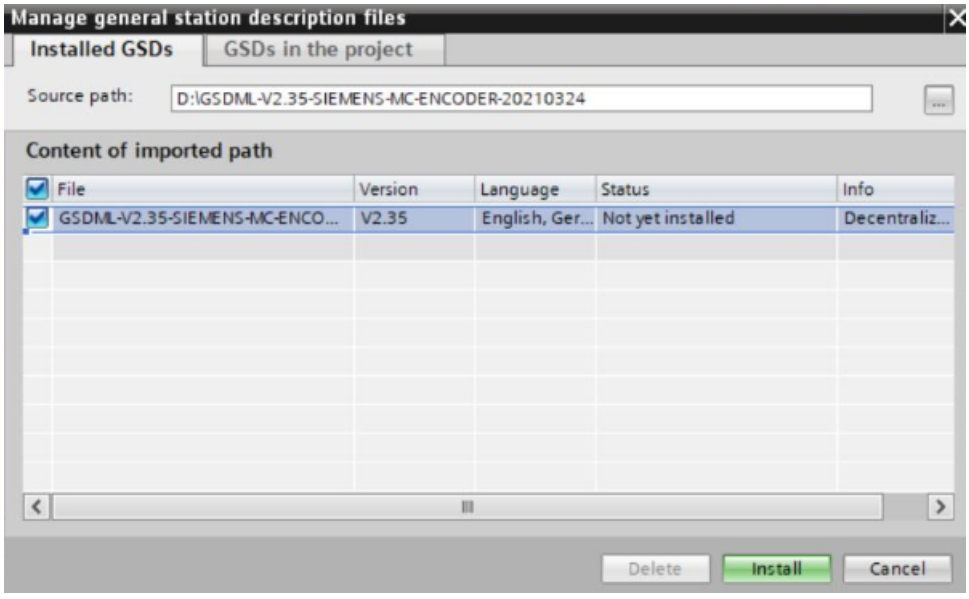


Figure 11-5 Installing GSDML

To display the encoder in STEP 7 using a bitmap, the bitmap file is automatically installed along with the GSDML file. This is the reason that both files must be located in the same directory.
Once the GSDML file has been successfully installed, the encoder is displayed in the hardware catalog under "PROFINET-IO > Additional field devices > Encoders > SIEMENS AG > MC ENCODER".

11.3 Linking components

You can link PLC and encoder in the network view.

Procedure

1. In the network view, for the encoder, click on link "Not assigned".
   All IO controllers in the project, linked with the encoder, are displayed.

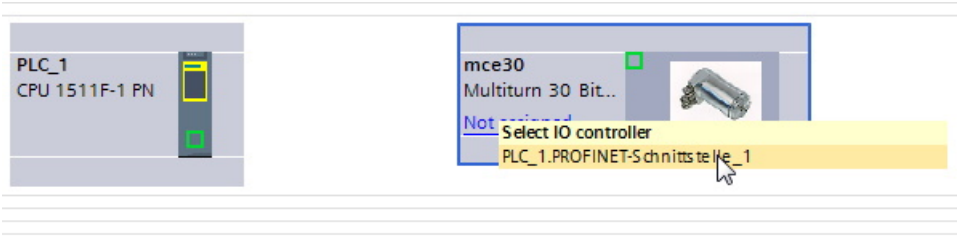


Figure 11-6 Unlinked components

2. Select the required IO controller.
   The short name of the linked PLC is then displayed in the link. The closed PROFINET connection of the two components is displayed in the network view.

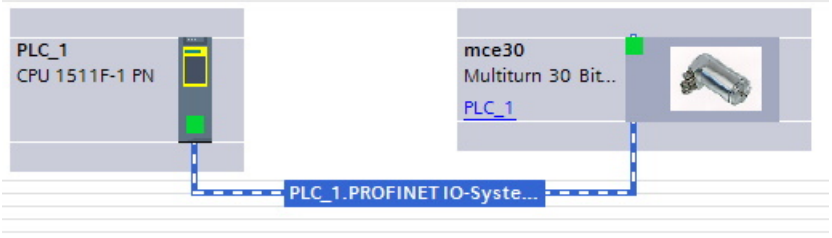


Figure 11-7 Linked components

3. Then switch from the network view into the topology view. Here, link an encoder interface with the matching PLC interface.
   To do this, click on the symbol of an encoder interface that is not linked, keep the mouse button pressed and drag a connection to an empty PLC interface. Release the mouse button there
   In the topology view, a connection is now established between the two ports of the components.

Figure 11-8 Topology linked

11.4 Configuring a telegram

Procedure

1. In the network view, select the encoder and then switch to the device view.
2. Display (if still not active) the device view and open the hardware catalog.
3. In the hardware catalog, open folder "Submodules" and there double-click on the required telegram.
   The telegram is inserted in the next free line of the device overview.

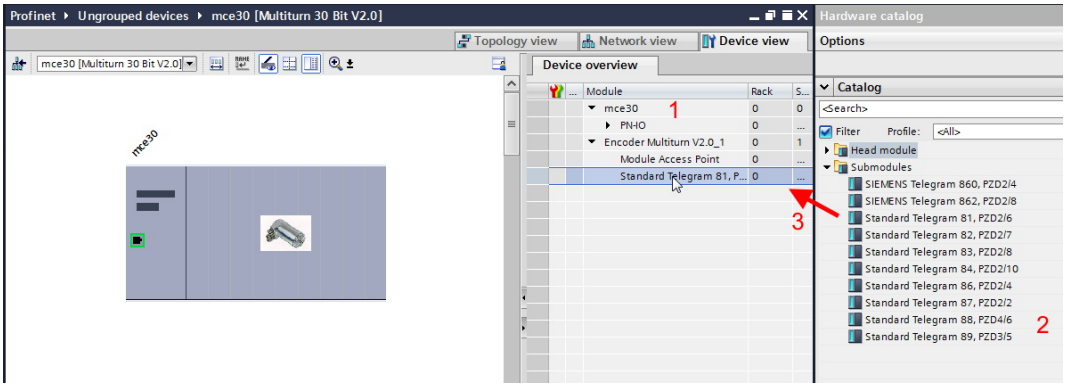


Figure 11-9 Inserting a telegram

4. Establish an online physical connection between your control and the PC on which you are running the TIA Portal.

5. In your project, open the "Online access" entry in the project navigation.
   Select the network interface of your computer. Double-click "Update accessible devices".

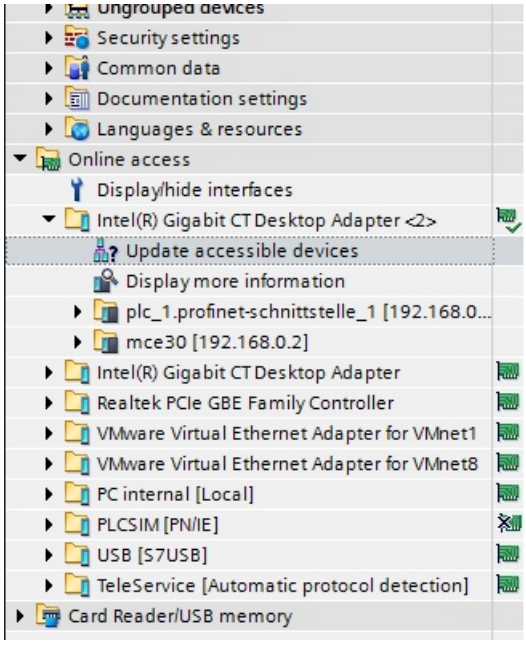


Figure 11-10 Updating accessible participants

The accessible participants are then displayed together with their IP address under "Online accesses".

6. In the project navigation, open the folder for the connected encoders that have been found.
   Double-click on subentry "Online & Diagnostics".
7. In the secondary navigation of the working area "Online & Diagnostics" select the "Functions" entry and there, assign subentry "Assign PROFINET device name".
8. When required, in screen form "Assign PROFINET device name", change the specified device name of the encoder.

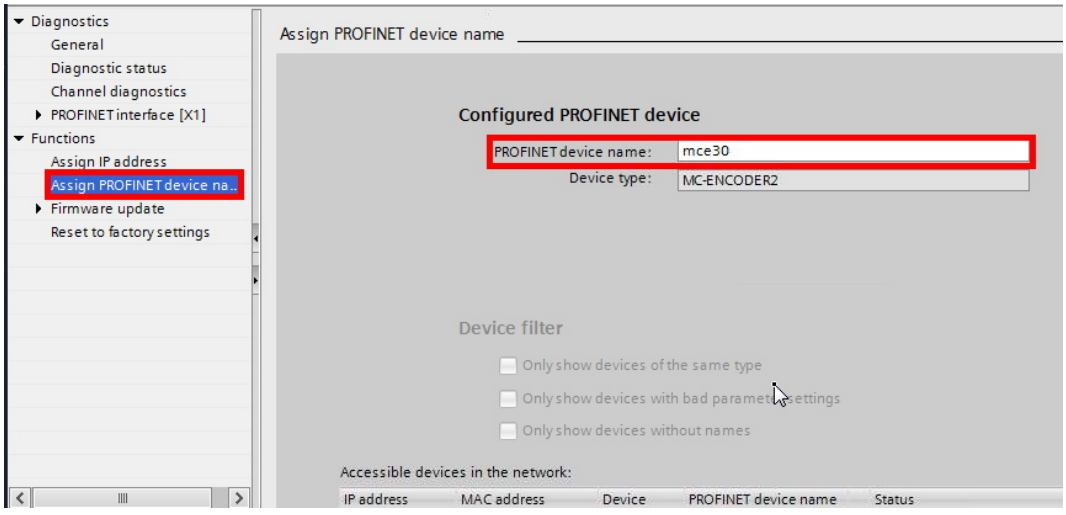


Figure 11-11 Changing device names

9. Reactivate the device overview, and there correct the specified areas for input and output addresses for the encoder (I address / O address) of the PROFINET telegram.

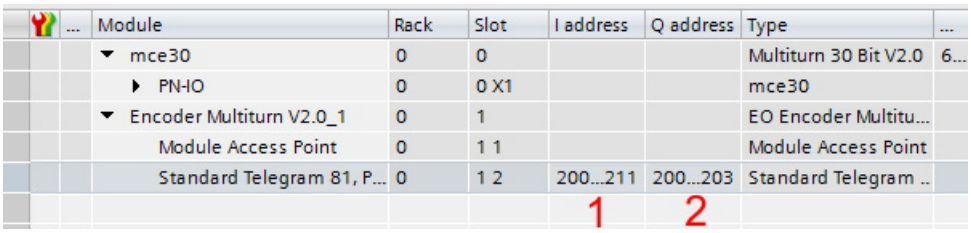


Figure 11-12 Telegram address ranges

10. Switch to the PLC device view and there select a PROFINET interface in the device overview.
11. In the secondary navigation of the inspector window, under "Extended options", select entry "Interface options".
12. In screen form "Interface options" activate (if this has not already been done) option "Support device replacement without exchangeable medium".

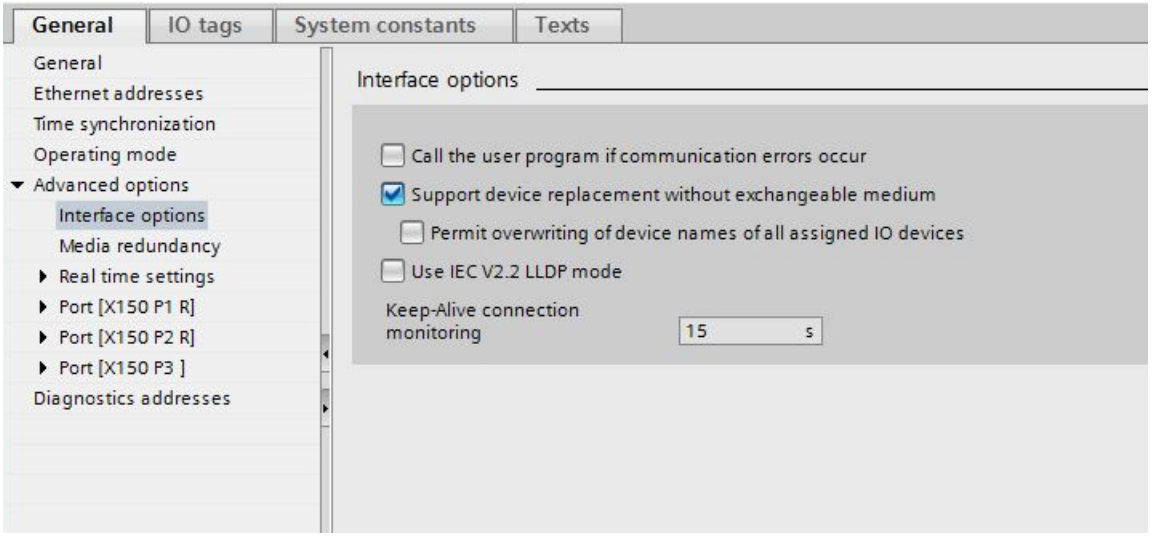


Figure 11-13 Allowing device replacement

11.5 Configuring media redundancy (optional)

Media redundancy must be configured.

Procedure

1. Activate device configuration in the network view.
2. Move the mouse pointer along the PROFINET cable between the PLC and encoder.
   A selection is displayed.
3. Click on "Sync-Domain_1".

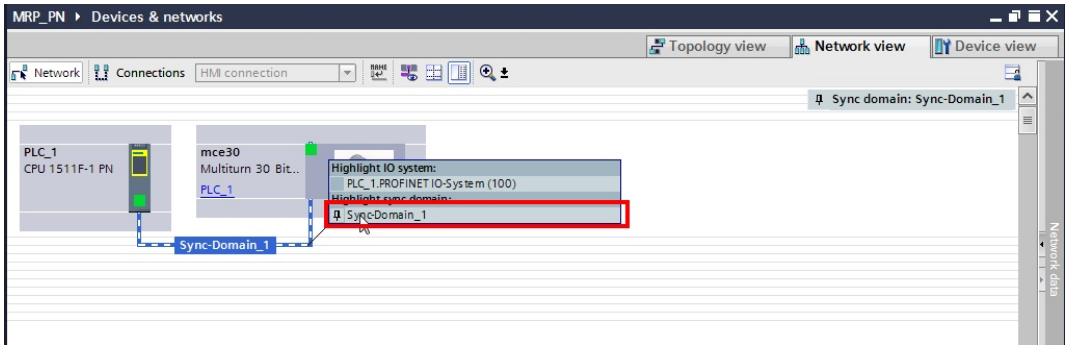


Figure 11-14 Setting the SynchDomain

The connection is correspondingly marked.

4. Click on the PROFINET cable.
   The settings for synchronization and media redundancy are now visible in the inspector window.

5. In the secondary navigation of the inspector window, select menu "PROFINET Subnet > Domain Management > "MRP Domains" > "mrpdomain-1" > "Devices".
   In list "Devices", you can set the MRP role of the two components in the network:

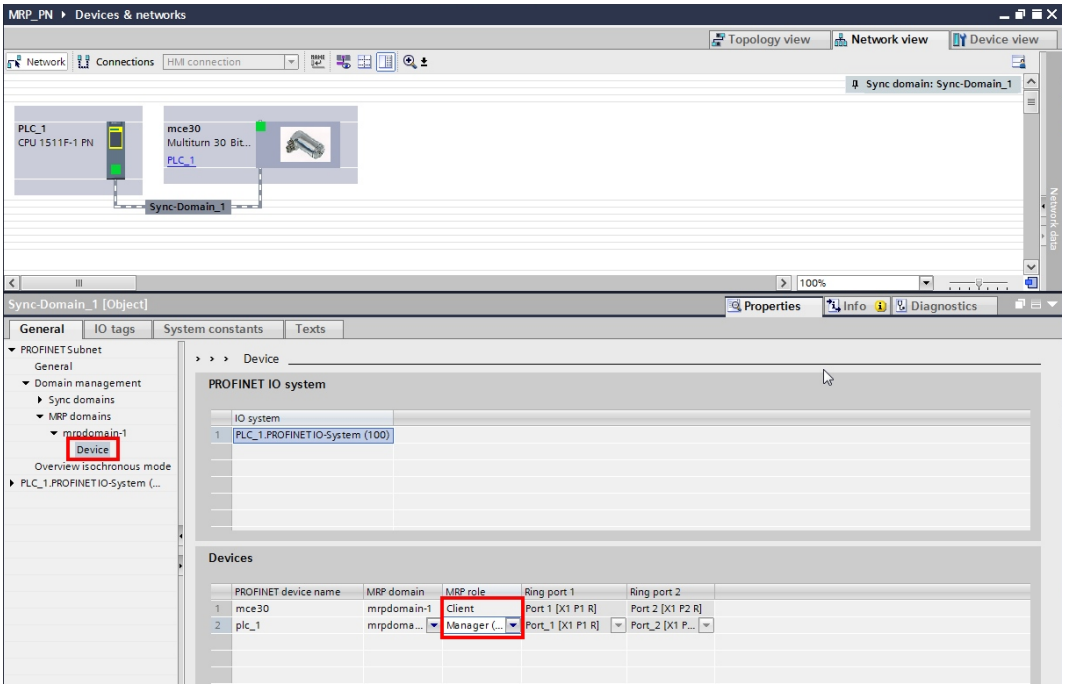


Figure 11-15 Sync domain client manager

6. For the PLC and encoder, select the corresponding MRP role in the network from the applicable drop-down list. One of the components must have the "Manager" role and the other components then have the "Client" role.
   Once the configuration has been completed, then the topology view shows the following:

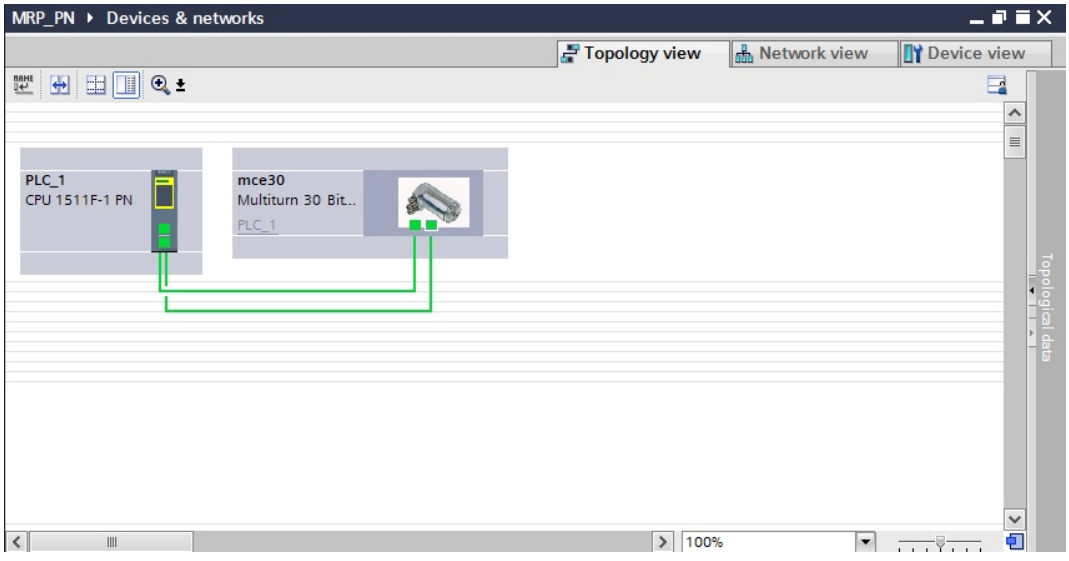


Figure 11-16 Configuration completed

11.6 Configuring the isochronous operation (optional)

Configure isochronous operation in the "Extended options" area.

Procedure

1. In the network view, select the encoder and then switch to the device view.
2. In the secondary navigation of the Inspector window, select the menu "PROFINET interface > Advanced options > Isochronous mode".
   The "Isochronous mode" screen form is displayed:

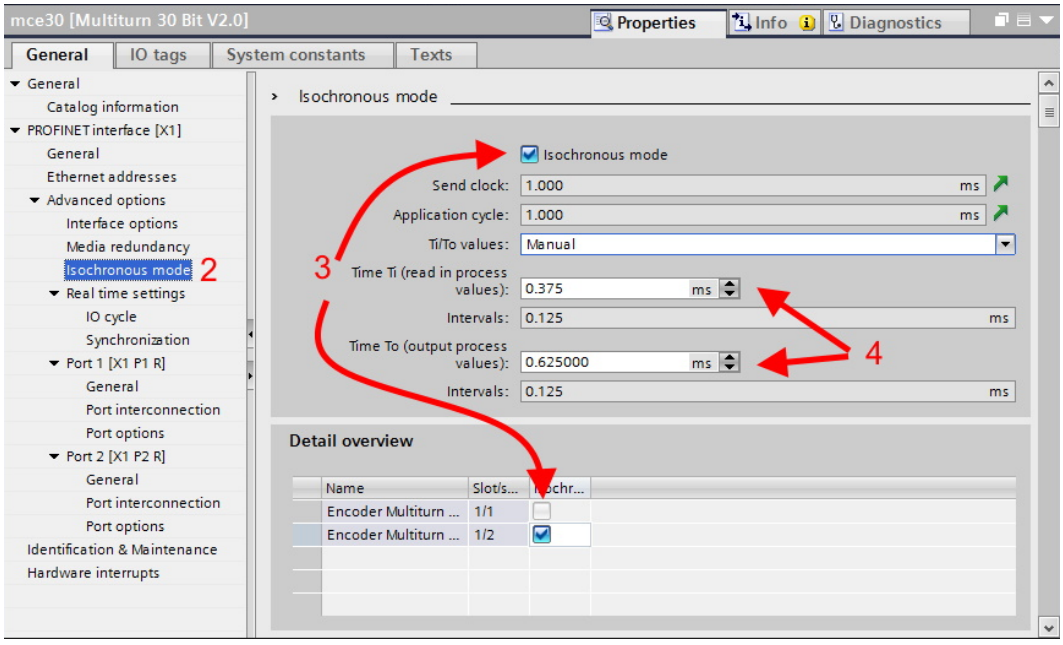


Figure 11-17 Activating isochronous mode

3. At the top of the screen form, activate the "Isochronous mode" option. In the detailed list below, again activate option "Isochronous mode" for the encoder type used.
   The screen form is then populated with default values. If you wish to change these default values, change the setting "Automatic minimal" in field "Ti/To values" to "Manual".
   Then change the suggested times for Ti and To.

4. In the encoder device overview, select the telegram that was inserted. In the secondary navigation of the Inspector window, select the menu "I/O addresses"
The "I/O addresses" screen form is displayed:

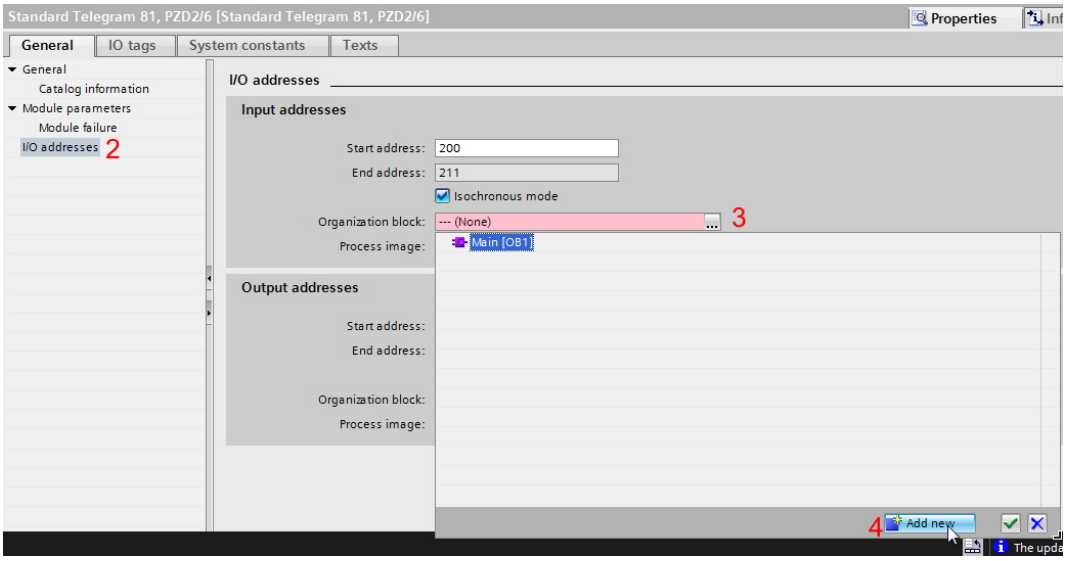


Figure 11-18 I/O addresses

Fields "Organization block" for the input and output addresses have a pink background. This means that these are mandatory entries.

5. For the input addresses, click on the 3-point symbol to the right next to field "Organization block".
   A selection box drops down below the field.
   Click on "Add".
   The "Add new block" dialog is displayed:

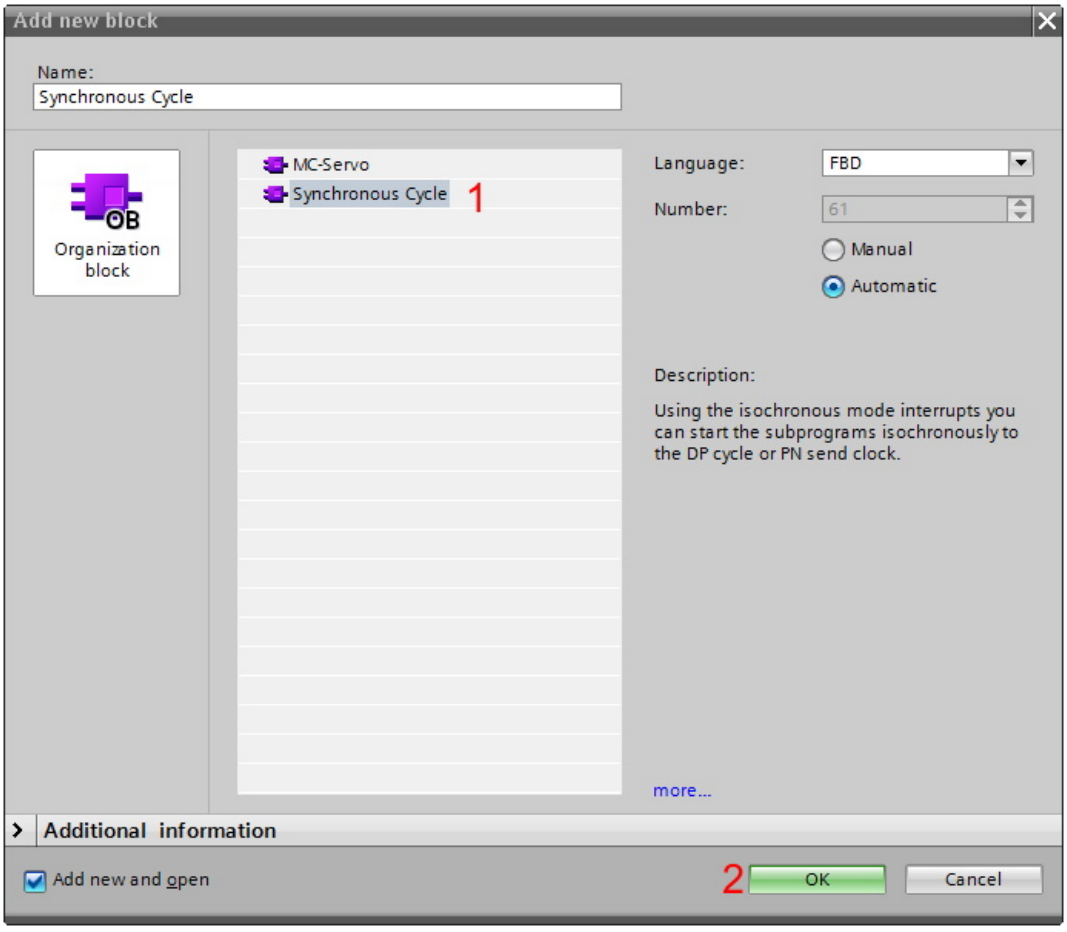


Figure 11-19 Adding a new block

6. Here, select block type "Synchronous Cycle", and confirm your selection with "OK".

Note

Block "MC-Servo" instead of "Synchronous Cycle"

If at least one technology object is created in the project, then here you can also select block type "MC-Servo".

The new block is created in the project navigation below "Program blocks". Various configuration screen forms for the new block are listed in the inspection window, which you can use to configure the block. In screen form "I/O addresses" of the inspector window, the selected "Synchronous Cycle" block is displayed in field "Organization block".

7. In the same way, select the organization block required for the output addresses (repeat steps 5 and 6).
Screen form "I/O addresses" then has the following settings:

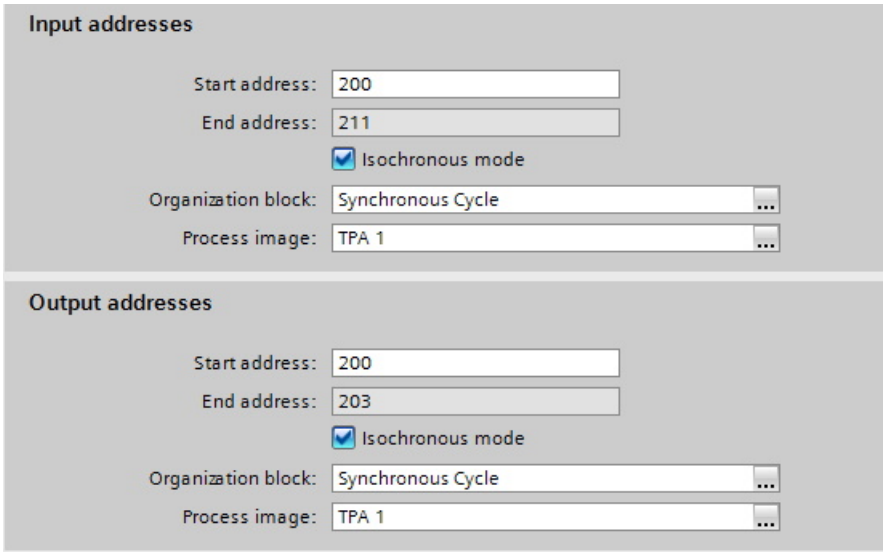


Figure 11-20 I/O addresses configured

11.7 Saving, compiling and transferring the configuration

Procedure

1. Click on "Save project" in the toolbar to save the previously made configuration settings.
2. Select the PLC in the project navigation.
3. In the shortcut menu, select "Compile" and then one of the listed compilation options (e.g. "Hardware and software" (only changes)).
   Compilation is started, and the result of this compilation is displayed in the inspector window under the "Compile" tab.

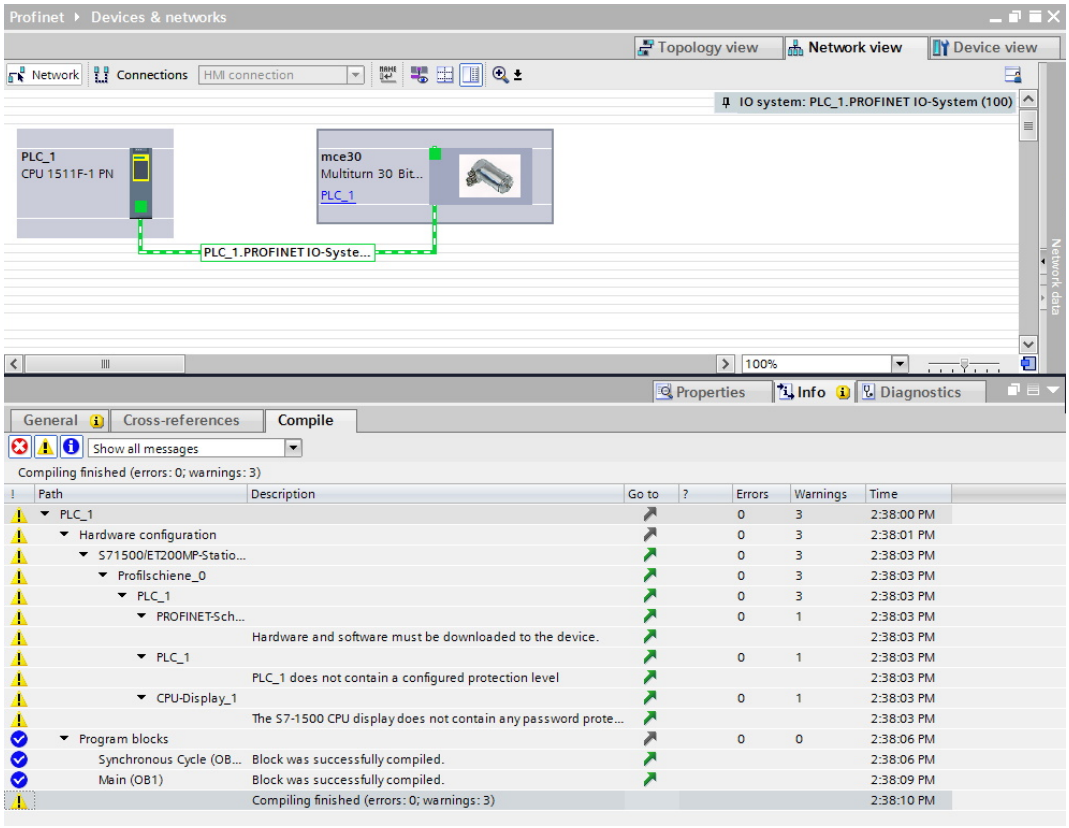


Figure 11-21 Compiling

If compilation was successful then you can load the compiled data from the project to your device. You must then establish an online connection to the device.

4. In the shortcut menu, select "Load to device" and then one of the listed compilation options (e.g. "Hardware and software" (only changes)).
   The "Extended download" dialog then opens.
5. If a correctly configured interface has still not been set, then select "Type of the PG/PC interface".
6. If an interface has not yet been preset, select the "PG/PC interface" for your PC.
7. Define the PROFINET interface (X150) of the PLC as "Connection with interface/subnet".

8. Click on "Start search" to search for the device with the set parameters. Devices that are found are displayed under "Select destination device" in a table.
9. Select your device from the table. Click on "Connect" to establish an online connection to the device.
   A connection to your PLC is now active. The program switches into the online mode. Data is transferred from the project into the PLC.

11.8 Reading out and configuring parameters

You can monitor the data values that tags currently assume in the CPU directly in the PLC tag table.

Requirement

An online connection to the PLC exists or is possible.

Procedure

1. In the project navigation below "PLC tags", double-click on the entry "Add new tag table". A new variable table is inserted in the project.
2. Right-click on the new variable table in the project navigation, select "Rename" and assign a name.
3. Double-click on the new variable table to open it.
   The tag table is displayed to the right in the working area.
4. In the "Name" column, click on "Add" and enter the variable properties:

5. Repeat step 4 for every variable that you wish to add to the variable table.

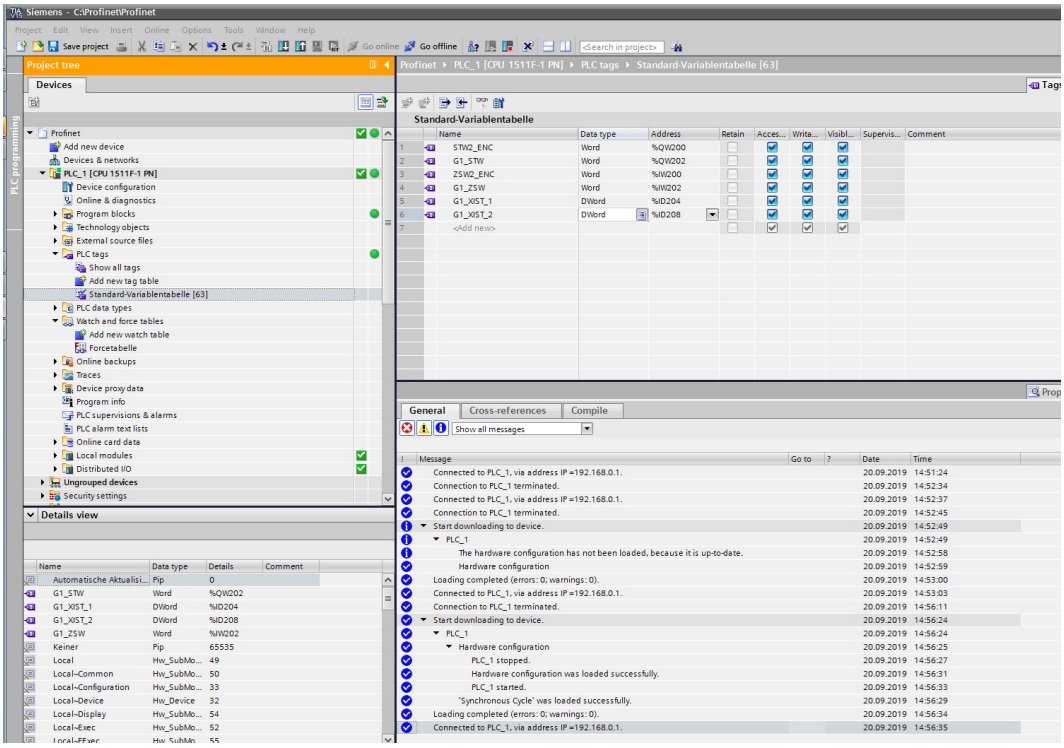


Figure 11-22 Example of a variable table

6. To start monitoring, click on the symbol (Monitor all).
   - If an online connection to the PLC does still not exist, a connection dialog opens, which you can use to establish the online connection (see "Transfer... configuration (Page 136)").
   - Monitoring is started using the "Permanent" trigger setting.
   - The "Monitoring value" column is displayed in the table. It displays the current data values.
   - The symbol for forcing variables is displayed if a variable is presently being forced.
   - You can exit monitoring by clicking on the symbol again.

Note

Editing PLC variables while monitoring variables

If variable monitoring has been started, and the PLC variable table is then edited, e.g. by adding new variables, then monitoring is restarted after editing has been completed.

Note

Additionally, you have a possibility of copying PLC tags to a monitoring or force table and monitoring, controlling or forcing them there. More information on this topic is available in the online help of the TIA Portal.

Troubleshooting/FAQs

12

12.1 FAQ

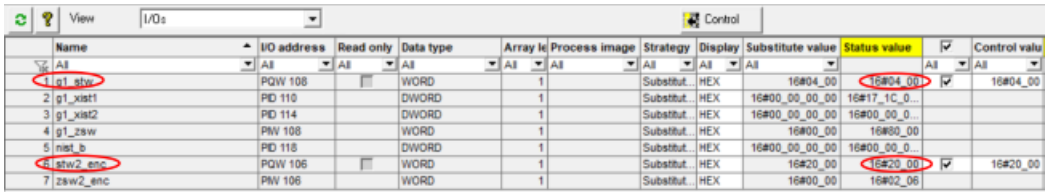
No position values in G1_XIST2

Error description

No position values are returned to G1_XIST2 (telegrams 81 ... 84).

Remedy

Set bit 10 in stw2 and bit 13 in g1_stw1 to "1" according to the encoder profile.



	Name	I/O address	Read only	Data type	Array le	Process image	Strategy	Display	Substitute value	Status value		Control valu
	All	All	All	All	All	All	All	All	All		All	All
1	g1_stw	PQW 108		WORD	1		Substitut...	HEX	16#04_00	16#04_00	☑	16#04_00
2	g1_xist1	PID 110		DWORD	1		Substitut...	HEX	16#00_00_00_00	16#17_1C_0...		
3	g1_xist2	PID 114		DWORD	1		Substitut...	HEX	16#00_00_00_00	16#00_00_0...		
4	g1_zsw	PIW 108		WORD	1		Substitut...	HEX	16#00_00	16#80_00		
5	nist_b	PID 118		DWORD	1		Substitut...	HEX	16#00_00_00_00	16#00_00_0...		
6	stw2_enc	PQW 106		WORD	1		Substitut...	HEX	16#20_00	16#20_00	☑	16#20_00
7	zsw2_enc	PIW 106		WORD	1		Substitut...	HEX	16#00_00	16#02_06		

Figure 12-1 Restoring the encoder profile

Neighborhood detection does not function

Error description

Neighborhood detection does not function

Remedy

The encoder supports the LLDP protocol.

Use the latest version of STEP 7, TIA Portal or SIMOTION Scout.

1. Open the "Properties" window.
2. Open the "General" tab.
3. Activate checkbox "Device replacement without exchangeable medium".

Replacing an encoder

Question

How do you replace an encoder with a new one?

Remedy

See answer: Why doesn't the neighborhood detection work?

- OR -

Set the device name.

Defining the preset value

Question

What is the simplest way to define the preset value?

Answer

Define the preset value in the hardware manager of STEP 7 or SIMOTION Scout.

The preset value is transferred during the encoder switch-on phase. You must set bit 12 to "1" to activate it.

In the screenshot above, it should send 3000 instead of 2000.

Setting preset values

Question

What is the simplest way to set preset values?

Answer

Use telegram 86, 87, 88 or 860.

Replacing singleturn encoders with multiturn encoders

Question

A singleturn encoder is being used in an application - and is to be replaced with a multiturn encoder.

Remedy

Nothing has to be set. A multiturn encoder is automatically replaced by a singleturn encoder.

Setting preset value or parameters

Error description

Preset values or the other parameters cannot be set.

Remedy

In Class 3, parameters can only be set with activated functionality of Class 4. When required it is important to use Class 4 or in the hardware manager, to activate the functionality of Class 4.

Synchronization error between PROFIBUS and PROFINET

Error description

When using D410, error message "Synchronization error between PROFIBUS and PROFINET" was displayed.

Remedy

Both systems must use the same cycle time. If the cycle time of PROFINET is 1 ms, then PROFIBUS must use the same time. See the next screenshot with settings for 1 ms.

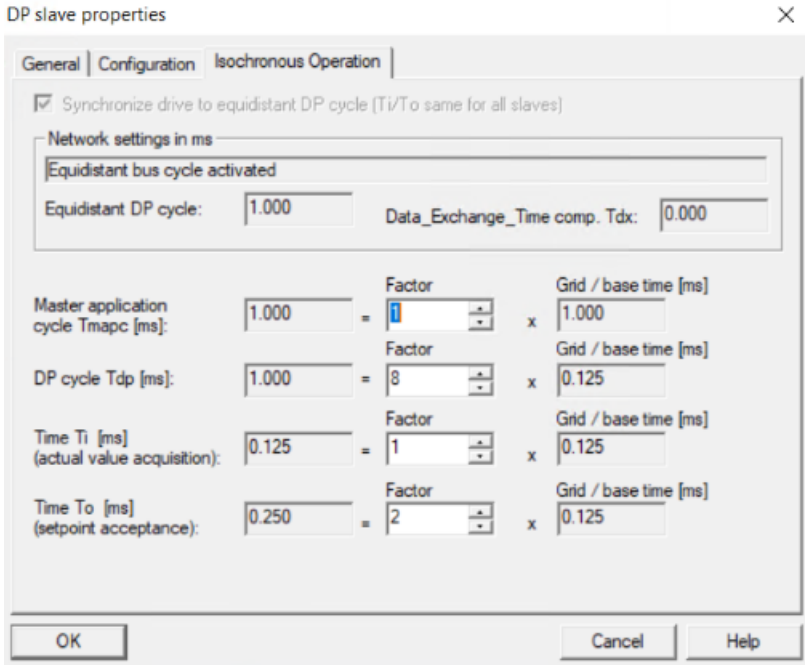


Figure 12-2 Synchronization between PROFIBUS and PROFINET

Differences between firmware 1.x and 2.x

Question

What is the difference between firmware 1.x and firmware 2.x?

Answer

Function	Firmware 1.x	Firmware 2.x
Maximum resolution	13 bit singleturn, 27 bit multiturn	16 bit singleturn, 30 bit multiturn
Only supported by one subslot	Standard, no PDEV	Not supported
Telegrams	81, 82, 83, 84 and 860	81, 82, 83, 84, 86, 87, 88, 89, 860 and 862
MRP/MRPD	Supported from product version 10	Supported
Overtemperature alarm	Not supported	Supported

Function	Firmware 1.x	Firmware 2.x
Non-integer number scaling factor	Not supported	Supported
G_XIST1	Position value, left justified	Counter value, right justified
GSDML	GSDML-V2.35-SIEMENS-MC-ENCODER-20220331 and GSDML-V2.2-SIEMENS-MC-Encoder-20121002	GSDML-V2.35-SIEMENS-MC-ENCODER-20220331
MAP parameters	Individual telegram	Separate telegrams

Position step

Question

Why is there a position step after switching on?

Answer

If the encoder according to the nameplate has e.g. DAP 1216 for revolution and resolution, then it is important to use the associated DAP in the encoder profile V4.1 and not to use DAP 1213, for example.

Technical Data

13

13.1 Electrical data

	Data
Power supply	10 – 30 V DC (absolute limits)
Power consumption	Max. 3 watts
EMC	Emission standard for industrial environments in accordance with IEC 61000-6-4 Immunity standard for industrial environments in accordance with IEC 61000-6-2
Bus connection	Ethernet
Transmission rate	10/100 Mbits Maximum cable length: 100 m
Accuracy	± 1 LSB (± 0.0439° for resolution ≤ 13 bits), ± 2 LSB (± 0.0220° for resolution 14 – 16 bits)
Speed	Max. 5800 rpm (valid code)
Cycle time	250 µs...100 ms
Electrical service life	> 10^5 h
Parameter storage cycles	50 million
Conformity class	C (IRT communication, ...), B, A (RT communication)
Addressing	Programmable IP address and network parameters

13.2 Mechanical data

	Data
Enclosure	Aluminum
Service life	Depending on shaft type and load – see following table
Max. shaft load	N <= 6000 rpm: Axial 40 N, radial 110 N N > 6000 rpm: Axial 10 N, radial 20 N
Moment of inertia of rotor	≤ 30 gcm^2
Frictional torque	≤ 3 Ncm
Rpm (continuous duty)	Max. 12,000 rpm
Shock (EN 60068-2-27)	<= 100 g (half-sine / 6 ms)
Vibration (EN 60068-2-6)	20 g (41 Hz ... 2000 Hz)
Weight (standard version) Net (incl. packaging)	Singleturn: 400 g / 500 g Multiturn: 440 g / 540 g

Flange	**Synchro (F)**	**Clamp (Q)**	**Hollow shaft (W)**
Shaft diameter	6 mm	10 mm	8, 10, 12, 15 mm
Shaft length	10 mm	20 mm	-
Hollow shaft depth min. / max.	-	-	15 mm / 30 mm

Minimum (mechanical) service life:

Flange	**Service life in 10^8 revolutions with F_a / F_r**		
	40 N / 60 N	40 N / 80 N	40 N / 110 N
Clamp flange 10 x 20	247	104	40
Synchro flange 6 x 10	822	347	133

13.3 Environmental conditions

	Data	
Working temperature range	FS: 10	-40 to +75°C
	FS: ≥15	-40 to +85°C
Storage temperature range	-40 to +70°C	
Relative humidity	Up to 98 % (without condensation)	
Degree of protection ICE 60529	Housing side: IP 67	
	Shaft side: IP 64	

IP: International Protection

1st digit: Protection against foreign bodies

2nd digit: Protection against water

- The validity refers to water as medium that can potentially ingress, not to oil or other creeping fluids.
- It is not permissible for liquid to collect in the flange.
- For applications with the shaft extension facing upward, carefully take into consideration the protective devices required.

Installing cables in moist and damp environments

If you are operating the encoder in environments in which moisture can occur, carefully comply with the following installation instructions

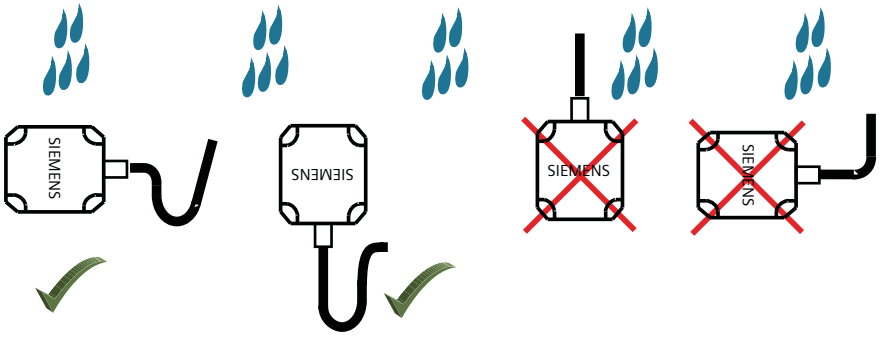


Figure 13-1 Permissible and impermissible cable routing when connecting in a damp environment

Notes regarding electromagnetic compatibility 14

14.1 Information on EMC

Further information on electromagnetic compatibility (EMC) can be found in the following literature:

- Requirements to implement EMC:
  Configuring Guide EMC Installation Guidelines / Basic system requirements (Article number: 6FC5297-0AD30-0AP3)

14.2 Electromagnetic fields in the workplace

The absolute encoders with PROFINET do not emit any significant electromagnetic fields.

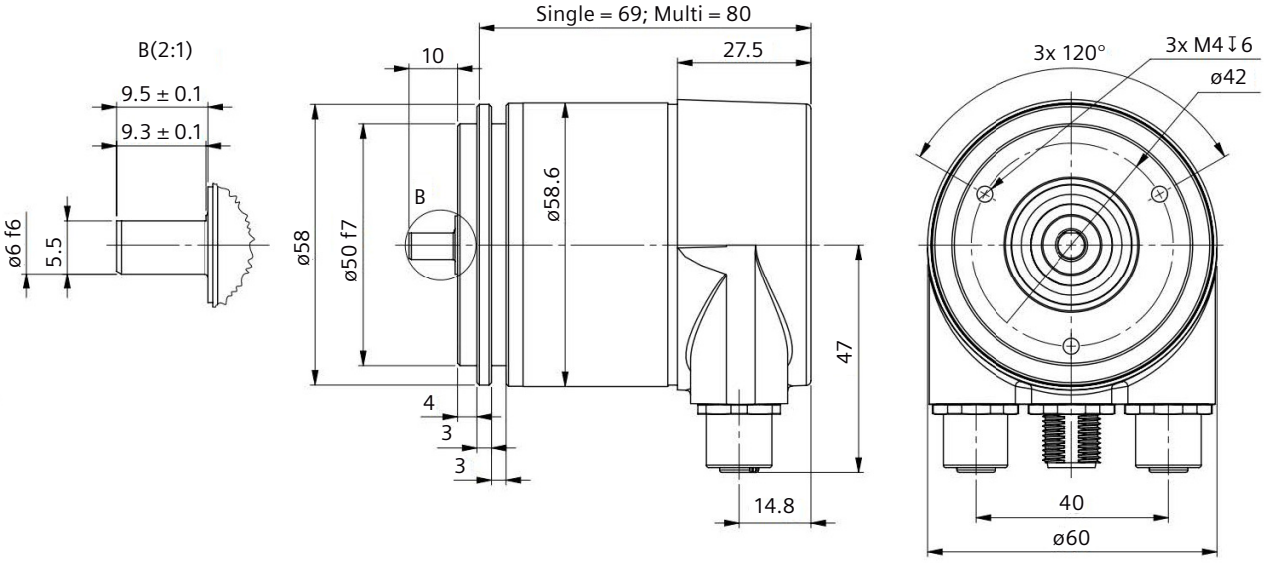
It is not necessary to maintain a minimum clearance from the absolute encoder with PROFINET.

Mechanical Drawings

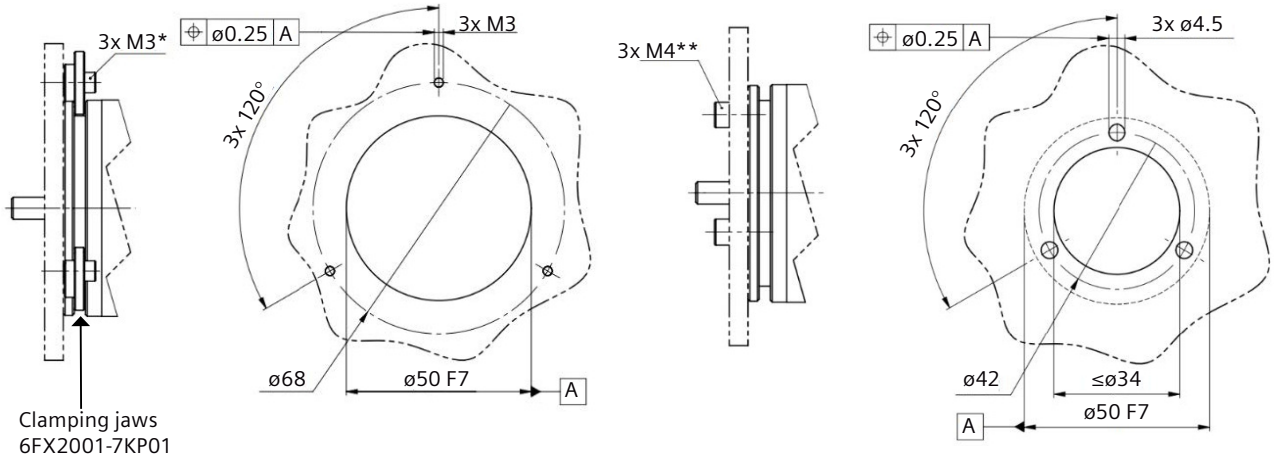
15

15.1 Synchro flange

Overview



Mounting suggestion



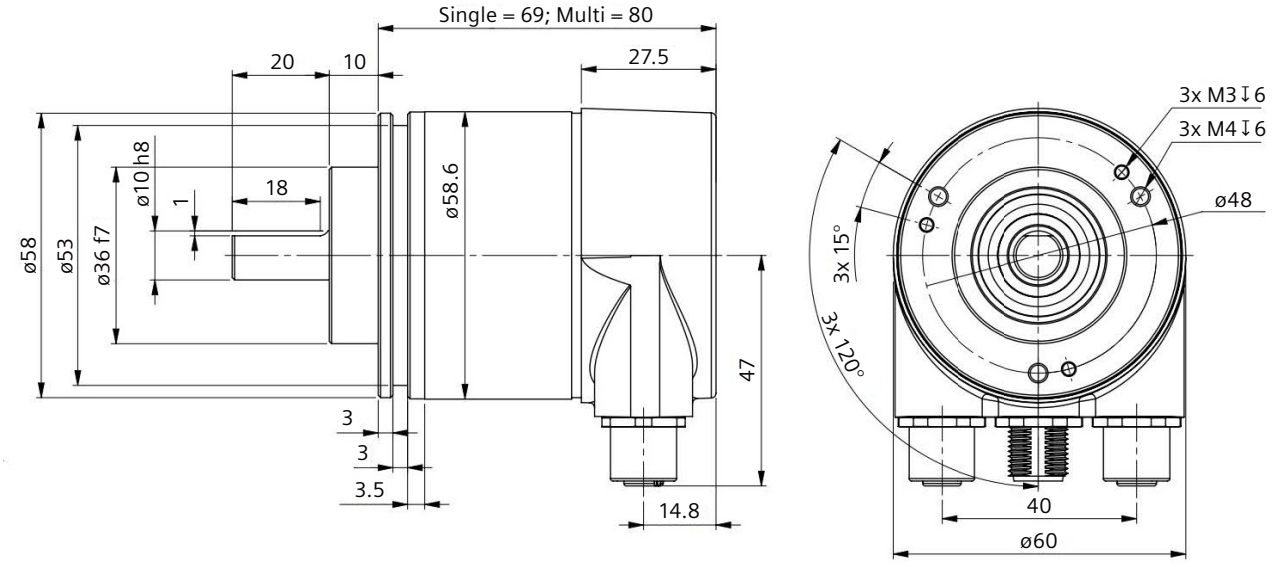
*M3 M_d = 1.1 - 1.3 Nm

**M4 M_d = 2.4 - 2.9 Nm

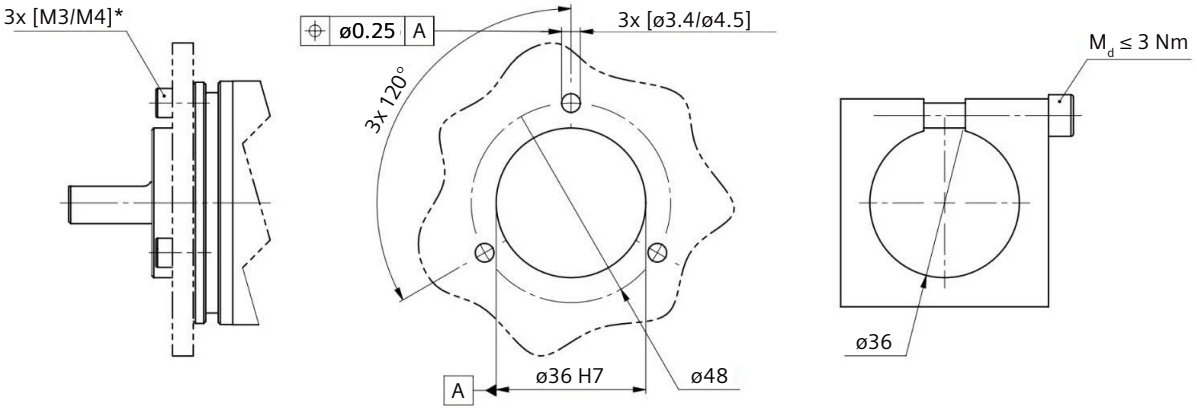
Standard metric thread according to DIN 13, property class 8.8

15.2 Clamp flange

Overview



Mounting suggestion



M4 M_d = 2.4 - 2.9 Nm

*M3 M_d = 1.1 - 1-3 Nm

Standard metric thread according to DIN 13, property class 8.8

15.3 Hollow shaft

Overview

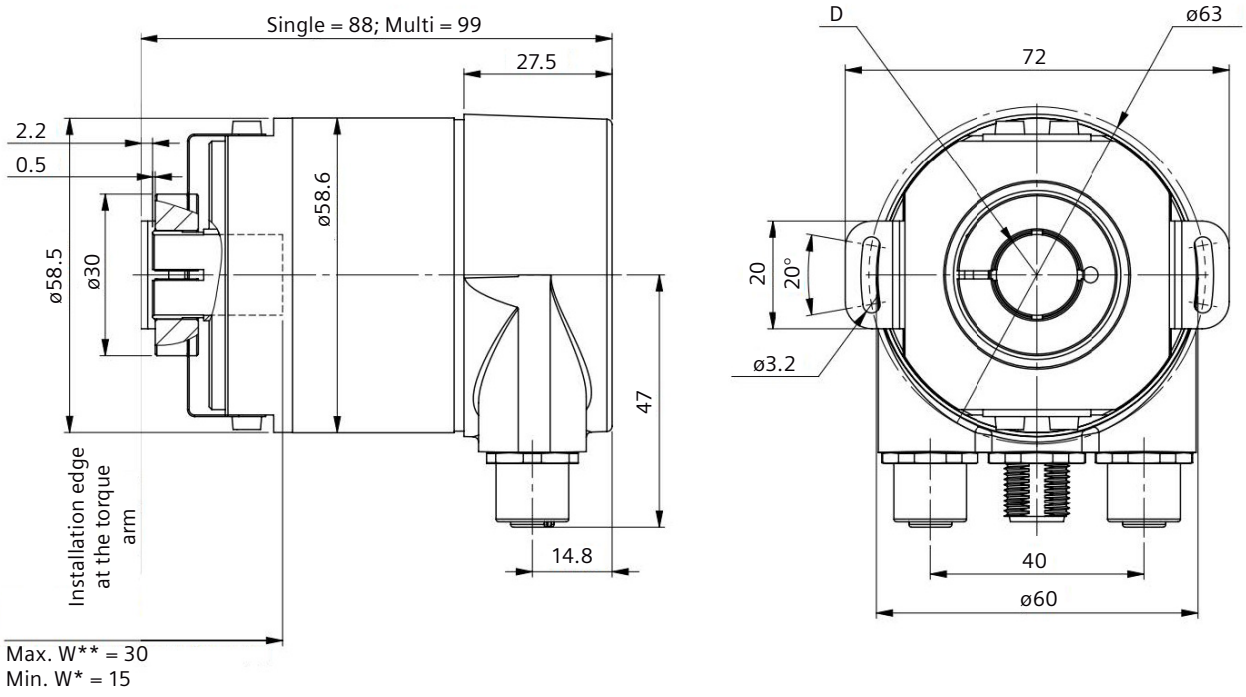


Figure 15-1 ** Insertion depth into the shaft

Inside diameter D	Shaft diameter (D1)
15F7	15f8
With reduction sleeve 12F7	12f8
With reduction sleeve 10F7	10f8
With reduction sleeve 8F7	8f8

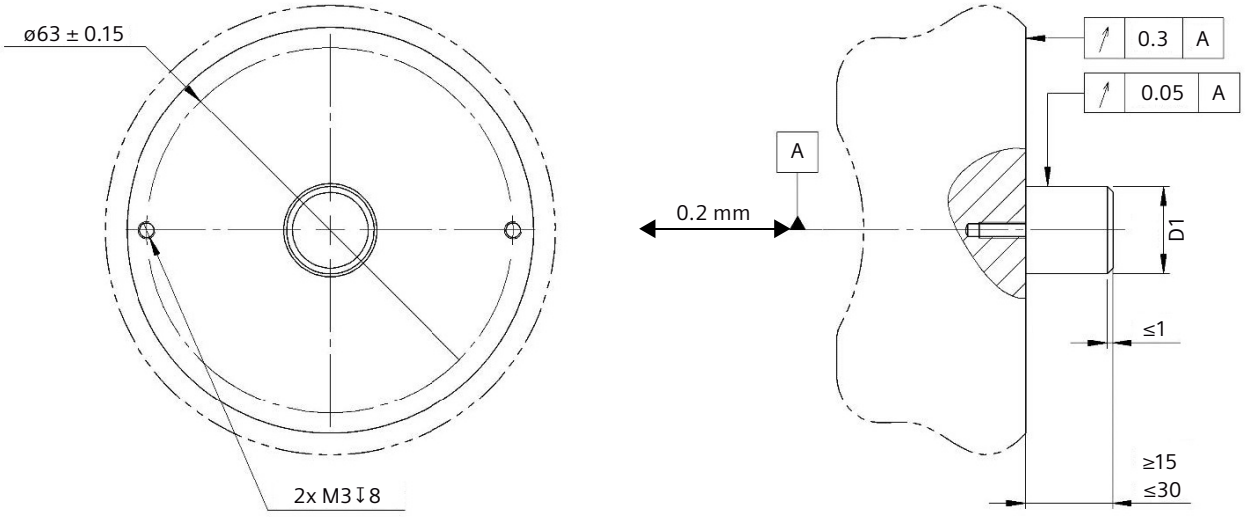
Note

Mounting instructions

It is only permissible to tighten the clamping ring if the shaft of the drive element is inserted in the hollow shaft of the encoder.

Using a reducer, the hollow shaft diameter can be adapted to 12 mm, 10 mm or 8 mm. This reducer is simply inserted into the hollow shaft.

Connection dimensions on the customer side



15.4 Installation drawings / Dimension drawings

Additional dimension drawings are provided in the DT CONFIGURATOR online.

DT CONFIGURATOR

You can find the following quickly and simply in the DT CONFIGURATOR:

- Dimension drawings
- 2D/3D CAD data

The DT CONFIGURATOR supports you when creating system documentation regarding project-specific information.

Note

Simplified representation

The 3D model in the DT CONFIGURATOR is a simplified representation that does not show every detail.

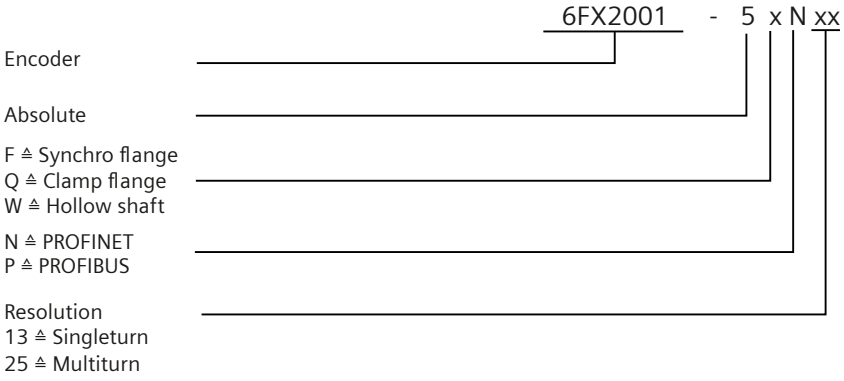
More information is provided on the Internet at: DT CONFIGURATOR (http://siemens.de/dt-konfigurator)

Accessories

16

16.1 Structure of an order number

Overview



16.2 Accessories and Documentation

SIEMENS information

Description		Order no.
Spring disk coupling	6 mm / 6 mm	6FX2001-7KF10
	6 mm / 5 mm	6FX2001-7KF06
Connecting cable, Ethernet	PAM4/RJ45 straight, 5 m	6XV1871-5TH50
Connecting cable, power supply	PAM5 2 m, shielded	6XV1801-5DH50
Coupling [1)]	Bore: Ø 10 mm	6FX2001-7KS10
Clamping washer [1)]	Set = 1 unit	6FX2001-7KP01
GSDML file	Download: GSDML-V2_x_-SIEMENS-MC-Encoder-xxxx (https://support.industry.siemens.com/cs/ww/en/view/53095298)	

[1)] Can only be used for solid shafts

Errors relating to technical information and omissions as well as technical changes reserved.

More information about the accessories is provided in Catalog:

SINAMICS S120 and SIMOTICS; Catalog D 21.4 · 2017 (https://support.industry.siemens.com/cs/ww/en/view/109747019)

Appendix

A

A.1 Abbreviations and explanations of terms

Term	Explanations
10Base-T	Data transmission cable with a data transmission rate of 10 Mbit.
100Base-T	Data transmission cable with a data transmission rate of 100 Mbit.
Autocrossing	Facilitates straight or crossed over cabling.
Auto negotiation	Is an Ethernet technique where two connected devices together select the data transmission parameters, e.g. data transfer rate and full duplex mode.
UP	User program that is run on a PLC or SIMOTION control.
Baud rate	This data transmission rate indicates the rate in bits per second.
Binary	Numerical system with values 0 and 1.
BMP	PROFIdrive "Base Mode Parameter Access" channel, which is defined in the PROFIdrive profile; standard for online parameter access (Access Point Data Record 0xB02E).
CAT5	Terminations for data transmission rates up to 100 Mbit.
DAP	Device access point
DO	Drive object
EMC	Electromagnetic compatibility is the main rule when checking/testing devices.
Ethernet	Ethernet is a computer network technology based on frames.
Endless shaft	For rotary axes, eliminates the problem of non-binary values for revolutions.
Fast Ethernet	Data transmission technology with a data transmission rate of 100 Mbit.
FS	Function release
Quick start	Optimized start time for PROFINET (< 1 s).
Flash	With this internal memory, saved data is available after running down.
GSD	TheGeneric Station Descriptionshows all available parameters, application classes, etc.
GSDML	The generic station description for Ethernet (Generic Station Description Markup Language) has an XML-based descriptive language. Shows all available parameters, application classes, etc.
Implicit message transfer	IO connection: Communication between IO controller and IO device.
IP address	Logical address of a computer in a network.
IRT	Ethernet with isochronous real time (Isochronous Real Time Ethernet).
LLDP	Protocol (Link Layer Discovery Protocol) to determine the connection layer.
MAC address	A device address that is unique globally. The encoder uses three MAC addresses: one for the internal interface and two for the ports. The basis MAC address is on the nameplate.
Mbit	Transmission rate or baud rate in millions of bits per second.
MAP	Module access point. As a minimum, a MAP submodule contains the required Parameter Access Point (PAP), which is assigned to a dedicated Record Data Object.
MRP	The Medium Redundancy Protocol is based on a ring topology and guarantees recovery times between 200 ms and 500 ms.
MRPD	Media Redundancy for Planned Duplication is a technique used for a ring topology to bumplessly switch over IRT telegrams

Term	Explanations
Non-volatile memory	A special memory in which parameters can be saved when a device is switched off.
OCD	Name of an encoder series based on an optical basis sensor.
OSI model	The Open System Interconnection reference model is an open layer model to structure communication.
PDEV	Physical device.
PZD	Process data: Process data part of a PPO.
Rotary axis	See -> endless shaft
Switch	An electronic element to connect computers, e.g. network segments in a local network. Contrary to a hub, a switch employs stacks to avoid network collisions.
TCP	The Transmission Control Protocol is a connection-orientated transmission protocol in a network.
UCD	Name of an encoder series with magnetic sensor.
UDP	The User Datagram Protocol is used to send data that do not require reliable data transfer.

A.2 Recycling and disposal

For environmentally friendly recycling and disposal of your old device, please contact a company certified for the disposal of electrical and electronic waste and dispose of the device in accordance with the regulations in your country.

A.3 Additional literature

Additional information is provided using the following sources:

- PROFIdrive information on encoder profiles and PROFIdrive profiles (https://www.profibus.com/)
  - Order number "3LEER162" for encoder profiles
  - Order number "3LEER172" for PROFIdrive profiles
- System Manual Communication with SIMOTION (https://support.industry.siemens.com/cs/ww/en/view/109767623)
  - Chapter "Acyclic communication"

More information

Siemens:
www.siemens.com

Industry Online Support (service and support):
www.siemens.com/online-support

IndustryMall:
www.siemens.com/industrymall

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