TURCK

Your Global Automation Partner

RI360P0-QR24…CNX4… Encoders with CANopen Interface

Instructions for Use

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1 About these instructions

These instructions describe the setup, functions and use of the product and help you to operate the product according to its intended purpose. Read these instructions carefully before using the product. This will prevent the risk of personal injury and damage to property. Keep these instructions safe during the service life of the product. If the product is passed on, pass on these instructions as well.

1.1 Target groups

These instructions are aimed at qualified personal and must be carefully read by anyone mounting, commissioning, operating, maintaining, dismantling or disposing of the device.

1.2 Explanation of symbols

The following symbols are used in these instructions:

	**DANGER** DANGER indicates a hazardous situation with a high level of risk, which, if not avoided, will result in death or serious injury.
	**WARNING** WARNING indicates a hazardous situation with a medium level of risk, which, if not avoided, will result in death or serious injury.
	**CAUTION** CAUTION indicates a hazardous situation with a medium level of risk, which, if not avoided, will result in moderate or minor injury.
	**NOTICE** CAUTION indicates a situation which, if not avoided, may cause damage to property.
	**NOTE** NOTE indicates tips, recommendations and important information about special action steps and issues. The notes simplify your work and help you to avoid additional work.
▶	**MANDATORY ACTION** This symbol denotes actions that the user must carry out.
⇨	**RESULT OF ACTION** This symbol denotes the relevant results of an action.

1.3 Other documents

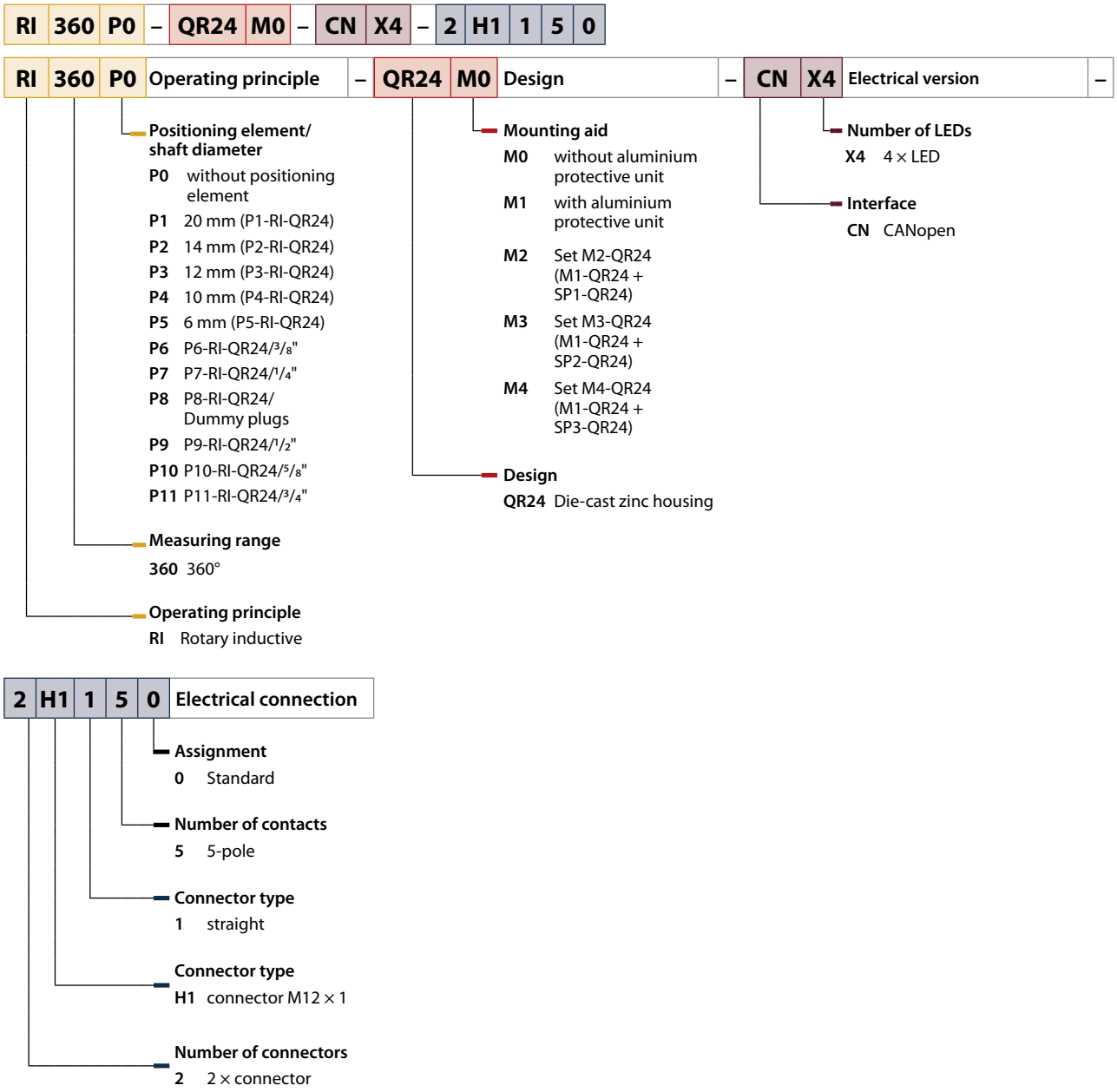
- Data sheet
- Quick Start Guide

1.4 Feedback about these instructions

We make every effort to ensure that these instructions are as informative and as clear as possible. If you have any suggestions for improving the design or if some information is missing in the document, please send your suggestions to techdoc@turck.com.

2 Information about the product

2.1 Product identification



NOTE
Sensor, mounting element and positioning element of the encoders are available both as individual components and as a complete set.

2.2 Scope of delivery

The delivery consists of the following:

- Encoder – Sensor
- Mounting aid MT-QR24
- Screw plugs VZ 3
- Quick Start Guide
- Optional: Positioning and mounting element

2.3 Turck service

Turck supports you in your projects – from the initial analysis right through to the commissioning of your application. The Turck product database at **www.turck.com** offers you several software tools for programming, configuring or commissioning, as well as data sheets and CAD files in many export formats.

The contact data for Turck branches is provided at [▷ 61].

3 For your safety

The product is designed according to state of the art technology. Residual hazards, however, still exist. Observe the following safety instructions and warnings in order to prevent danger to persons and property. Turck accepts no liability for damage caused by failure to observe these safety instructions.

3.1 Intended use

The encoders in the RI360…QR24…product series are used to measure angular movements up to 360°.

The device must only be used as described in these instructions. Any other use is not in accordance with the intended use. Turck accepts no liability for any resulting damage.

3.2 Obvious misuse

- The devices are not safety components and must not be used for personal or property protection.
- Any use that exceeds the maximum permissible mechanical speed (see technical data) is deemed to be not in accordance with the intended purpose.

3.3 General safety notes

- The device meets the EMC requirements for the industrial areas. When used in residential areas, take measures to prevent radio frequency interference.
- The device must only be fitted, installed, operated, parameterized and maintained by trained and qualified personnel.
- Only use the device in compliance with the applicable national and international regulations, standards and laws.

4 Product description

The encoders in the RI360…QR24…product series measure angular movements up to 360°. The sensor and the positioning element of the encoders are fully encapsulated and designed as two independent and sealed units with protection to IP68/IP69K and contactless operation. The encoder sensor can be connected to shafts with a diameter of up to 20 mm using the reducing bushings and mounting elements which are available as an option. A mounting element for mounting on larger rotatable machine parts is also included in the range. The device is an absolute single-turn encoder.

The devices have a CANopen interface.

4.1 Device overview

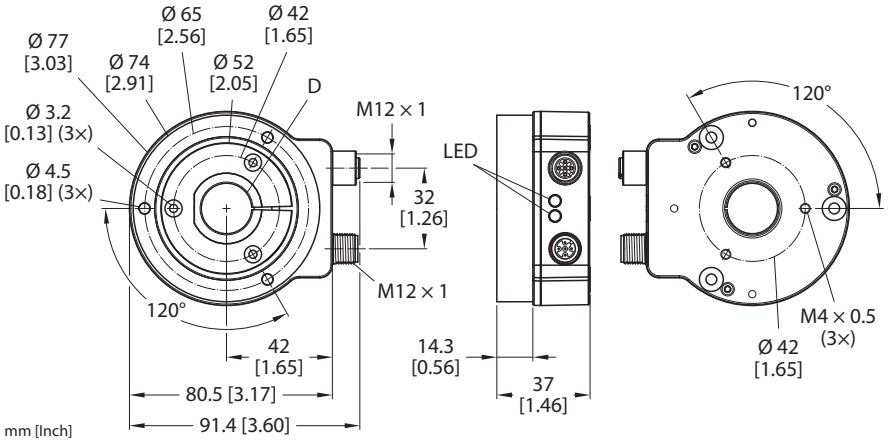


Fig. 1: Encoder QR24 with sensor, positioning element (optional) and protecting ring (optional)

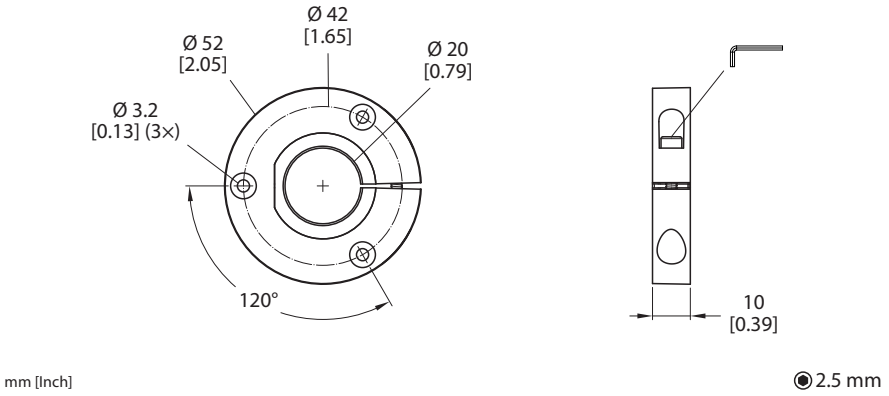


Fig. 2: Encoder – positioning element P1

4.1.1 Indication elements

The device has a red/green LED (ERR/RUN) and a yellow/green LED (PWR/SIG).

4.2 Properties and characteristics

- Compact and robust housing
- Status displayed via LED
- Immune to electromagnetic interference
- Measuring range can be parameterized
- CANopen interface, complies with CiA DS-301, device profile CiA 406 3.1
- Baud rates of 10 kbps up to 1 Mbps
- Male connector, M12 × 1.5-pin

4.3 Functional principle

The QR24 encoders have contactless operation based on the inductive resonant circuit measuring principle. This measuring principle makes it possible to design a fully encapsulated sensor housing without seals, which is separated from the positioning element. Magnetic fields cannot disturb the measuring process since the positioning element is not based on a magnet but on an inductive coil system, through which the sensor and the positioning element (resonator) can form an oscillation circuit. The inductive measuring principle of the QR24 encoder is absolute.

4.4 Functions and operating modes

4.4.1 Output function

The device is equipped with a standardized CANopen interface in accordance with CiA DS-301 and a device profile in accordance with CiA 406 3.1. Various device functions can be set and parameterized by using the control software (see "Setting" section). All measured values and parameters can be accessed via the object directory.

4.4.2 Condition on delivery

The encoder has the following basic settings when delivered:

- Node ID: 0x03
- Baud rate 125 KHz
- Internal terminating resistor switched off
- TPDO1 event time 100 ms
- TPDO1 is active
- TPDO asynchronous mode

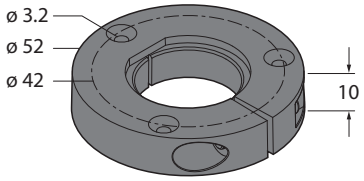
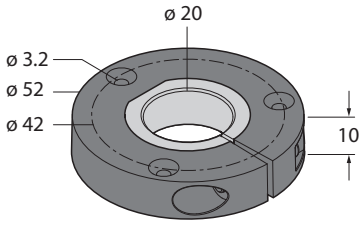
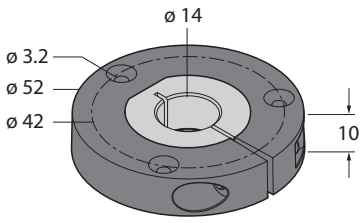
4.4.3 Terminating resistor

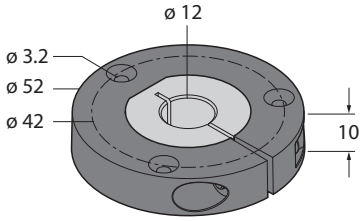
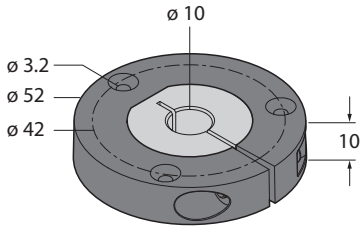
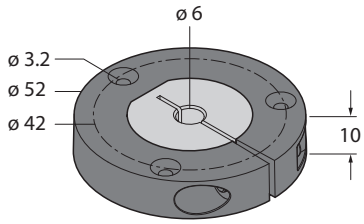
A bus terminating resistor can be switched on and off via the CANopen interface.

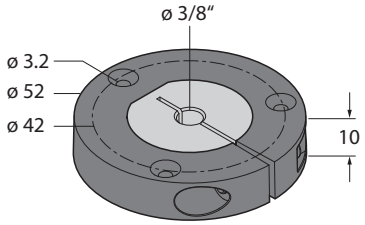
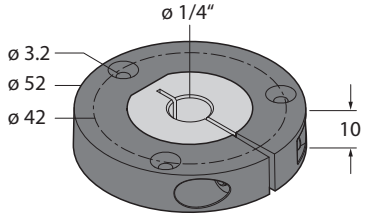
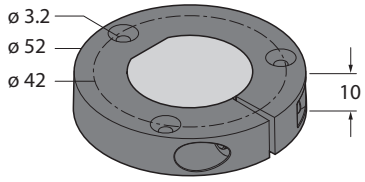
4.5 Encoder — components and accessories

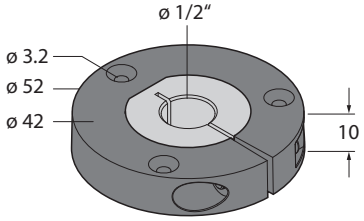
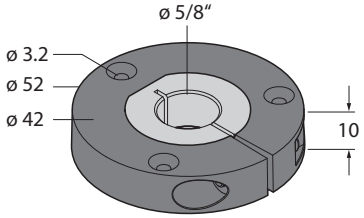
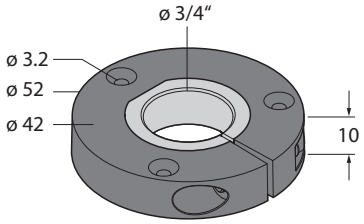
4.5.1 Encoder — QR24 positioning element

The positioning elements are connected with the moving part of the machine (shaft) but move freely (without any mechanical connection to the sensor) over the active face of the sensor. Different reducing bushings are available to adapt the positioning element to the particular shaft diameter.

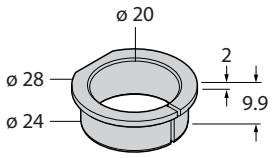
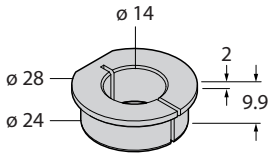
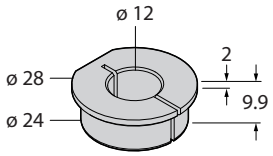
Dimension drawing	Type	Description
	PE1-QR24	Positioning element without reducing bushing
	P1-RI-QR24	Positioning element with aluminum reducing bushing to connect to Ø 20 mm shafts
	P2-RI-QR24	Positioning element with aluminum reducing bushing to connect to Ø 14 mm shafts

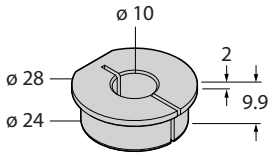
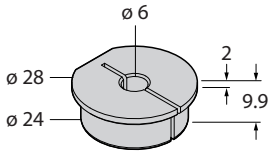
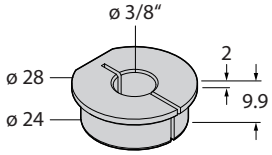
Dimension drawing	Type	Description
	P3-RI-QR24	Positioning element with aluminum reducing bushing to connect to Ø 12 mm shafts
	P4-RI-QR24	Positioning element with aluminum reducing bushing to connect to Ø 10 mm shafts
	P5-RI-QR24	Positioning element with aluminum reducing bushing to connect to Ø 6 mm shafts

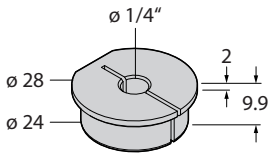
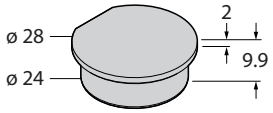
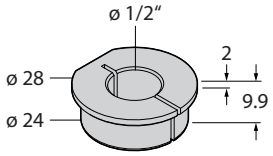
Dimension drawing	Type	Description
	P6-RI-QR24	Positioning element with aluminum reducing bushing to connect to Ø 3/8″ shafts
	P7-RI-QR24	Positioning element with aluminum reducing bushing to connect to Ø 1/4″ shafts
	P8-RI-QR24	Positioning element with aluminum blanking plug, e.g. for mounting on large rotatable machine parts

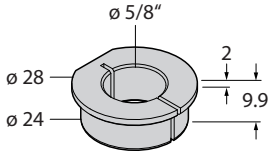
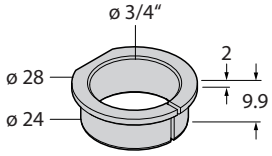
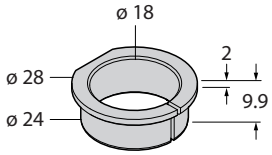
Dimension drawing	Type	Description
	P9-RI-QR24	Positioning element with aluminum reducing bushing to connect to Ø 1/2″ shafts
	P10-RI-QR24	Positioning element with aluminum reducing bushing to connect to Ø 5/8″ shafts
	P11-RI-QR24	Positioning element with aluminum reducing bushing to connect to Ø 3/4″ shafts

4.5.2 Encoder — QR24 reducing bushings for PE1-QR24 positioning elements

Dimension drawing	Type	Description
	RA1-QR24	Aluminum reducing bushing to connect to Ø 20 mm shafts
	RA2-QR24	Aluminum reducing bushing to connect to Ø 14 mm shafts
	RA3-QR24	Aluminum reducing bushing to connect to Ø 12 mm shafts

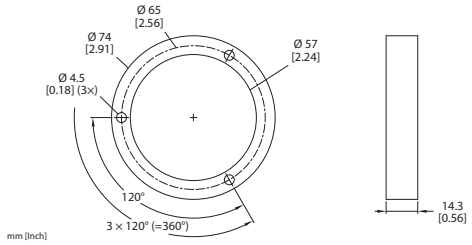
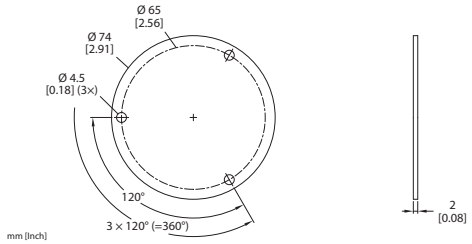
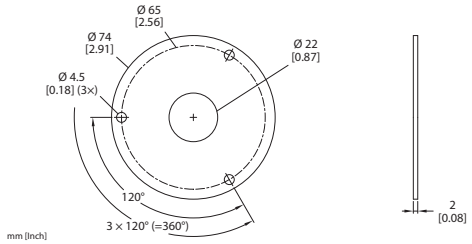
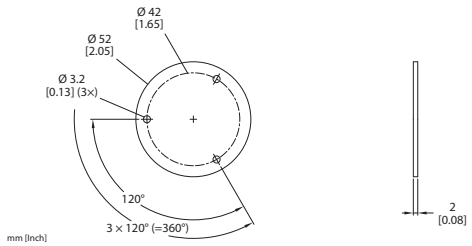
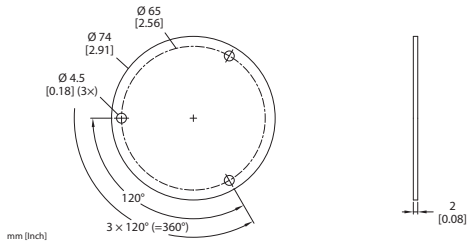
Dimension drawing	Type	Description
	RA4-QR24	Aluminum reducing bushing to connect to Ø 10 mm shafts
	RA5-QR24	Aluminum reducing bushing to connect to Ø 6 mm shafts
	RA6-QR24	Aluminum reducing bushing to connect to Ø 3/8″ shafts

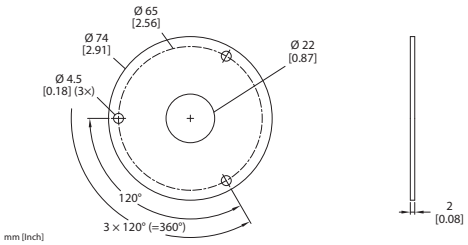
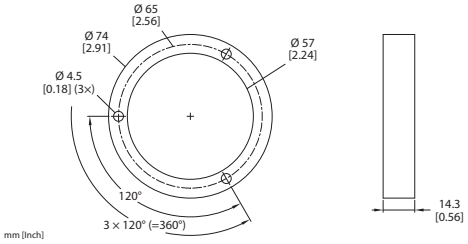
Dimension drawing	Type	Description
	RA7-QR24	Aluminum reducing bushing to connect to Ø 1/4" shafts
	RA8-QR24	Aluminum reducing bushing (e.g. for mounting the positioning element on large rotatable machine parts)
	RA9-QR24	Aluminum reducing bushing to connect to Ø 1/2" shafts

Dimension drawing	Type	Description
	RA10-QR24	Aluminum reducing bushing to connect to Ø 5/8″ shafts
	RA11-QR24	Aluminum reducing bushing to connect to Ø 3/4″ shafts
	RA12-QR24	Aluminum reducing bushing to connect to Ø 18 mm shafts

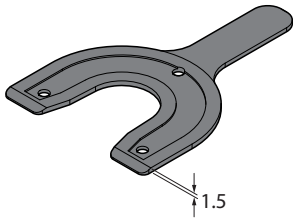
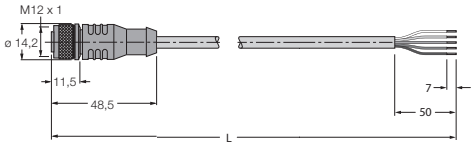
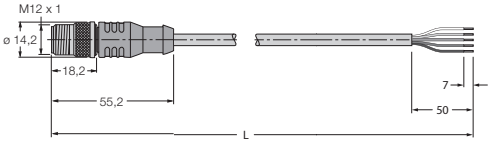
4.5.3 Encoders — protective rings and shield plates for QR24

Different mounting sets are required for different mounting types (see section “Mounting”). Each mounting set contains a protective ring and a shield plate. The shield plates enable the quality of the signal between the positioning element and the sensor to be increased depending on mounting type and application.

Dimension drawing	Type	Description
	M1-QR24	Aluminum protecting ring
	SP1-QR24	Aluminum shield plate: Ø 74 mm for rear mounting of the sensor on shafts up to Ø 20 mm
	SP2-QR24	Aluminum shield plate: Ø 74 mm, with Ø 22 mm hole for shaft feedthrough for front mounting of the sensor on shafts up to Ø 20 mm
	SP3-QR24	Aluminum shield plate: Ø 52 mm for mounting the positioning element on large rotatable machine parts
	SP5-QR24	Plastic shield plate: Ø 74 mm for rear mounting of the sensor on shafts up to Ø 20 mm

Dimension drawing	Type	Description
	SP6-QR24	Plastic shield plate: Ø 74 mm, with Ø 22 mm hole for shaft feedthrough for front mounting of the sensor on shafts up to Ø 20 mm
	M5-QR24	Plastic protecting ring

4.5.4 Encoder — general accessories

Dimension drawing	Type	Description
	MT-QR24	Mounting aid for optimum alignment of the positioning element (supplied)
	RKC5701-5M	Bus cable for CAN (DeviceNet, CANopen), M12 coupling, straight, cable length: 5 m, jacket material: PUR, anthracite; cULus approval; other cable lengths and qualities available, see www.turck.com
	RSC5701-5M	Bus cable for CAN (DeviceNet, CANopen), M12 connector, straight, cable length: 5 m, jacket material: PUR, anthracite; cULus approval; other cable lengths and qualities available, see www.turck.com

5 Installing

The optionally available adapter sleeves and mounting elements enable the front or rear of the encoder sensors to be fitted to the shafts with a diameter of up to 20 mm. With large rotatable machine parts, the positioning element is screwed directly onto the machine part and not fitted on the shaft.

WARNING
Improper fixing
Possible fatal injury from fast moving parts!

- ▶ Observe mounting instructions in all cases.
- ▶ Check the secure seating of the positioning element, tightening torque: M = 0.6…0.8 Nm.

NOTICE
Insufficient clearance from metal surrounding the positioning element
Loss of functionality due to weakening of resonant circuit

- ▶ Ensure sufficient clearance between the surrounding area and positioning element.
- ▶ Carry out a function test prior to commissioning.

NOTE
The positioning element must be located in the middle of the measuring range of the sensor before the power supply is applied.

5.1 Front mounting — shaft diameters up to 20 mm

1. Optional: Use shield plate.
2. Position the mounting aid for optimum alignment of the positioning element.

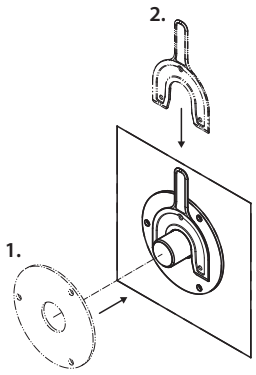


Fig. 3: Inserting the shield plate

3. Push the positioning element – with the front (active face) to the shaft – onto the shaft.
4. Fasten clamp fitting of the positioning element with hexagon spanner.

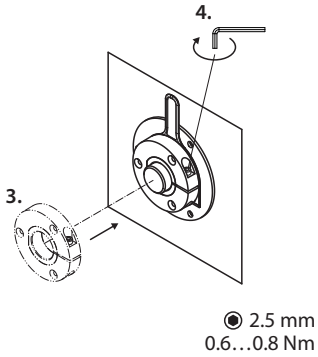


Fig. 4: Fastening the positioning element

5. Remove mounting aid.
6. Place the encoder sensor including the protecting ring with the front to the shaft over the positioning element and align to the required position of the zero point. (factory setting for 0°: yellow arrow on the positioning element pointing to the black mark on the sensor, see figure “Zero point default value”.)

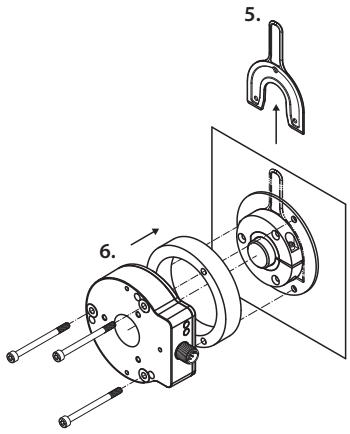


Fig. 5: Fastening the encoder

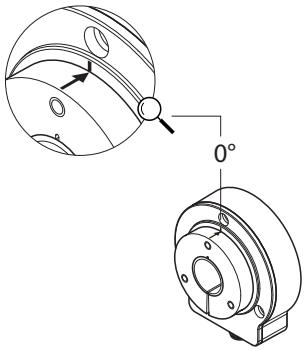


Fig. 6: Zero point default value

▶ Fasten the encoder with three screws in order to produce a closed and protected unit.

5.2 Rear mounting — shaft diameters up to 20 mm

There are different options for the first mounting step, depending on the environmental conditions.

1. Option 1: Push the encoder with the rear to the shaft onto the shaft and fasten with the three screws onto a fixing plate with a threaded hole.

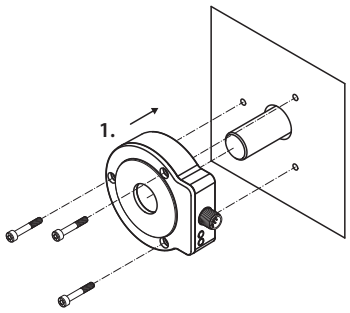


Fig. 7: Mounting the encoder on a fixing plate

1. Option 2: Push the encoder with the rear to the shaft onto the shaft and fasten with three screws in the encoder.

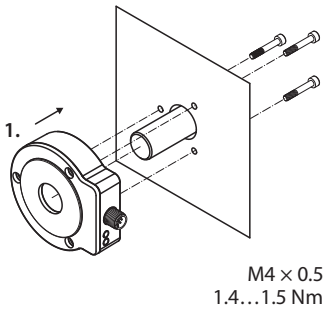


Fig. 8: Fastening screws in the encoder

2. Position the mounting aid for optimum alignment of the positioning element.
3. Push the positioning element onto the shaft and align to the required position of the zero point. (factory setting for 0°: yellow arrow on the positioning element pointing to the black mark on the sensor, see figure “Zero point default value”.)
4. Fasten clamp fitting of the positioning element with hexagon spanner.

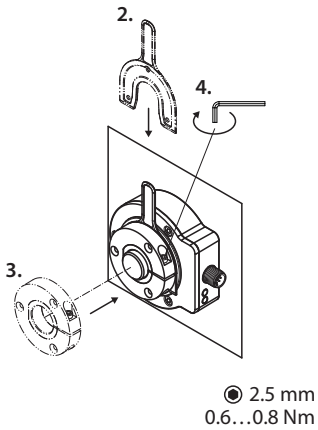


Fig. 9: Fastening the positioning element

5. Remove mounting aid.

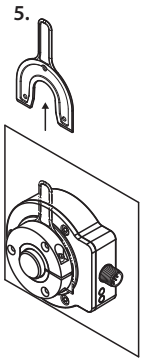


Fig. 10: Removing the mounting aid

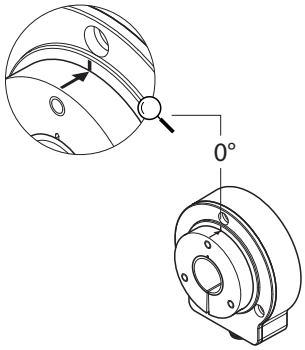


Fig. 11: Zero point default value

▶ Optional: Use protecting ring and shield plate.

5.3 Mounting on large rotatable machine part

1. If not yet present: Insert blanking plug into positioning element.
2. Fasten clamp fitting of the positioning element with hexagon spanner.

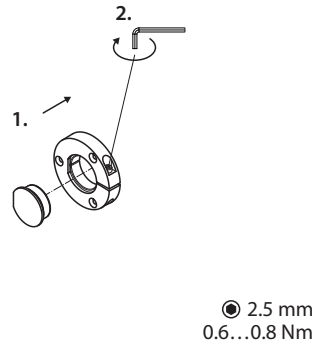


Fig. 12: Fastening the clamp fitting of the positioning element

3. Use the SP3-QR24 shield plate.

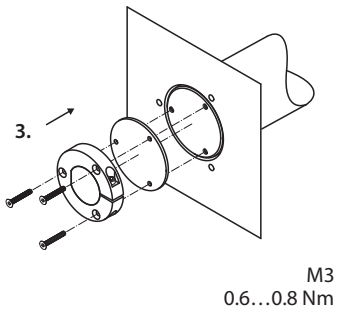


Fig. 13: Inserting the shield plate

4. Fasten the positioning element with three M3 countersunk screws (recommended: stainless steel screws).

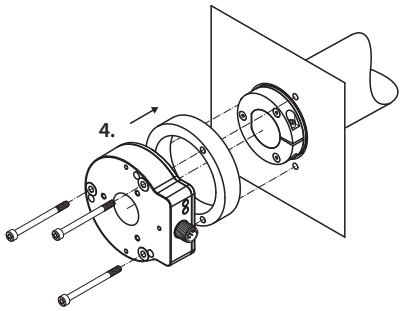


Fig. 14: Fastening the positioning element

▶ Depending on the application, mount the encoder and align to the required position of the zero point. (factory setting for 0°: yellow arrow on the positioning element pointing to the black mark on the sensor, see figure “Zero point default value”.)

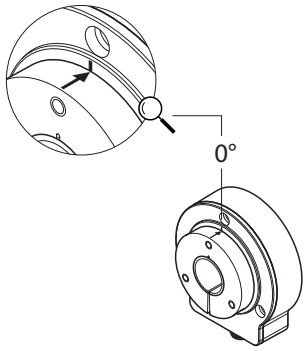


Fig. 15: Zero point default value

6 Connection

The encoder is equipped with one 5-pin M12 × 1 connector for CANopen input and output. The pin assignment can be found on the sensor label or the data sheet.

NOTE
Observe the maximum cable lengths for spurs and for the overall length of the CAN bus

Turck recommends the following cable lengths:

- For asymmetrical transmission (no inverted signals): max. 10 m
- For symmetrical transmission (e.g. RS422 standard): max. 50 m with twisted pairs

- ▶ Connect all required cable cores as per the wiring diagram. Insulate the cable ends that are not required to avoid short circuits.
- ▶ Follow the operating instructions for the connecting cable used.
- ▶ Disconnect the encoder from the connecting cable only when the encoder is de-energized.
- ▶ Connect the shielding (if present) to the encoder housing.
- ▶ The encoder and processor must always be switched on and off simultaneously.
- ▶ Observe the operating voltage and maximum permissible output current (see technical data).

EMC-compliant installation

- ▶ Use shielded connection cables as control cables.
- ▶ For symmetrical transmission (e.g. via RS422): Use twisted pair cables.
- ▶ Connect protective earth to the rotary encoder and the evaluation unit (low impedance).
- ▶ Route the connection cables separately from cables with high noise levels.
- ▶ Do not connect devices with high noise levels to the encoder's power supply (e.g. frequency converters, solenoid valves, or contactors), or ensure that suitable voltage filtering is in place.

6.1 Wiring diagram

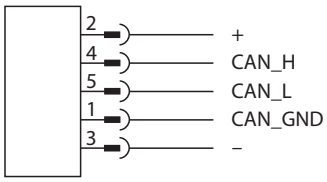


Fig. 16: Wiring diagram

The rotary encoders are equipped with a bus trunk cable in different lengths or an M12 connector, and can be terminated in the device. The rotary encoders are intended as end devices and are not equipped with an integrated T-coupler and looped-through bus. An optional T-coupler is available (see www.turck.com).

7 Commissioning

After connecting and switching on the power supply, the device is automatically ready for operation.

8 Operation

8.1 LED display

LED	Indication	Meaning
PWR/SIG	Off	Device is not operational
	Yellow	Oscillating circuit coupling weak, reduced accuracy
	Yellow flashing	No oscillating circuit coupling, device does not work
	Green	Device is operational
ERR/RUN	Off	The device is working properly
	Red	CAN controller switched off by bus
	Red flashing	LSS status active (flashes alternately with the run LED)
	Red flashing 2 ×	Guard event (NMT slave or master) or heartbeat event occurred
	Red flashing 3 ×	SYNC message was not received within the configured cycle time (see also object 0x1006)
	Green	Operational mode, device ready for operation
	Green flashing (10 Hz)	LSS status active (flashes alternately with the fault LED)
	Green flashing 1 ×	Stopped mode, data transfer stopped
	Green flashing (2.5 Hz)	Pre-operational mode, data transfer is prepared

9 Setting

The device can be set via the CANopen interface.

NOTE
All non-described objects serve as additional information and can be removed from the device profile DS406 3.1.

9.1 Setting the communication profile

9.1.1 Object 0x1000: Device type

The device type is specified via the object.

0x1000	VAR	Device type	Unsigned 32	RO	M

Device profile number		**Positioning element type**	
Byte 0 (LSB)	Byte 1	Byte 2	Byte 3 (MSB)
0x96	0x01	0x01 (absolute, single-turn)	0x00
Example: 0x00010196 = profile DS406: absolute, single-turn			

9.1.2 Object 0x1001: Error register

Device errors are displayed in the error register.

0x1001	VAR	Error register	Unsigned 8	RO	M

Bit	**Value**	**Meaning**
0	0	No error
	1	Error: no oscillating circuit coupling, positioning element is outside the detection range
1…7		Not in use

9.1.3 Object 0x1002: Manufacturer status register

The manufacturer status register contains various error bits and the current status of the set limit values from Object 0x6400. The limit values are also recorded in Object 0x6401 and 0x6402.

0x1002	VAR	Manufacturer status register	Unsigned 32	RO	M

Bit	Value	Meaning
0	1	EEPROM error
1	1	No oscillating circuit coupling (no resonator detected, angle measurement not possible)
2	1	Low oscillating circuit coupling (lower non-linearity if necessary)
3…7		Not in use
8	1	Operating range 1 out of range
9	1	Operating range 1 too low
10	1	Operating range 1 too high
11	1	Operating range 2 out of range
12	1	Operating range 2 too low
13	1	Operating range 2 too high

9.1.4 Object 0x1005: COB-ID SYNC (COB-ID for SYNC message)

The object specifies the COB-ID for the SYNC message. It also specifies whether the device is an emitter or receiver of SYNC objects.

0x1005	VAR	COB-ID SYNC	Unsigned 32	RW	O

Data content:

Bit	Value	Meaning
0…10		Identifier (11 bits), standard ID: 0x80
11…29		Reserved for devices with a 29-bit identifier
30	0	Device does not generate a SYNC message
31	1	Device is a receiver for SYNC messages

9.1.5 Object 0x1008: Manufacturer device name

The object contains the type designation of the device.

0x1008	VAR	Manufacturer device name	Vis-String	RO	O

Example: RI360P0-QR24M0-CNX4-2H1150

9.1.6 Object 0x1009: Manufacturer hardware version

The object contains the hardware version number.

0x1009	VAR	Manufacturer hardware version	Vis-String	RO	O

Data content:

e.g. "HW-12718801 -" in the ASCII code

Hardware version (127xxxxx) with revision index (-, A, B, etc.)

9.1.7 Object 0x100A: Manufacturer software version

The object contains the software version number.

0x100A	VAR	Manufacturer software version	Vis-String	RO	O

Data content:

e.g. “SW-1.0.0.1” in ASCII code

9.1.8 Object 0x1010: Store parameters

When the command "save" is written, the parameters are saved in the nonvolatile memory (EEPROM).

0x1010	ARRAY	Store parameters	Unsigned 32	RW	O

The following objects are saved using this command: 0x1005, 0x1014, 0x1800 (sub-index 1 and 3), 0x1802 (sub-index 1), 0x2000, 0x2001, 0x2005, 0x6000, 0x6001, 0x6002, 0x6003, 0x6200. To prevent an object being accidentally saved, the command is only executed when the string "save" is entered as the code word in the index (Object 0x1010).

NOTE
This command irreversibly overwrites the values saved in the EEPROM (Power ON values).

Read access to the CANopen device indicates whether values can be saved (Data: 0x01 = save possible).

Data content for write access (save = 0x65766173):

Bit	Value	Meaning
0	0x73	ASCII code for **s**
1	0x61	ASCII code for **a**
2	0x76	ASCII code for **v**
3	0x65	ASCII code for **e**

9.1.9 Object 0x1011 Restore default parameters (load default values)

This command deletes the parameters in the working memory and replaces them with default values (the manufacturer values are the same as upon delivery of the encoder).

0x1011	ARRAY	Restore default parameters	Unsigned32	RW	O

A distinction is made between multiple parameter groups:

- Sub-index 0x00: Contains the highest sub-index supported.
- Sub-index 0x01: Restore all parameters refers to all parameters that can be restored.
- Sub-index 0x02: Restore communication parameters refers to parameters relevant to communication (index from 0x1000 to 0x1FFF).
- Sub-index 0x03: Restore application parameters refers to parameters relevant to the application (index from 0x6000 to 0x9FFF).

Example: Restore all parameters

All parameters in the device RAM are reset to their default values when the command 0x64616F6C (load) is written under sub-index 0x01.

Read access to the sub-index indicates whether the default values can be loaded.

Data content for write access (load = 0x64616F6C):

Bit	Value	Meaning
0	0x6C	ASCII code for **l**
1	0x6F	ASCII code for **o**
2	0x61	ASCII code for **a**
3	0x64	ASCII code for **d**

Data content for read access:

Bit	Value	Meaning
0	1	Device supports the loading of default values.
31	Reserved	

- ▶ Execute an NMT reset to apply the default values.
- ▶ If the default values must also be applied to the EEPROM, save the parameters (see Object 0x1010).

9.1.10 Object 0x1014: COB-ID emergency (COB-ID for emergency messages)

The object specifies the COB-ID for emergency messages. Object 0x1029 (error behavior) describes what happens in the event of an error.

0x1014	VAR	COB-ID EMCY	Unsigned 32	RW	O

Data content:

Bit	Value	Meaning
0…10		Identifier (11 bits), standard ID: 0x80 + node number
10…29		Reserved for devices with a 29-bit identifier
30		Reserved
31		Reserved

Emergency objects appear in the event of an error within a CAN network and, depending on the event, are triggered and sent with a high priority via the bus.

NOTE
An emergency object is only triggered once per event. No new objects are generated while the error exists. If an error is corrected, a new emergency object is generated with the content 0x0000 ("Error reset" or "No error") and sent to the bus.

Emergency messages:

Code	Code class	Meaning
0x0000		No error; an "Emergency clear message" (0x0000) is shown following a boot-up message when starting
0x1389		No measurement possible, the positioning element is missing, no oscillating circuit coupling
0x6100		Internal software error; emergency message with code 0x6100 and a code class is created
0x6100	0x4000	Warning message, program is not terminated
0x6100	0x4810	Write buffer overflow, TPDO message lost
0x6100	0x4820	Write buffer overflow, TPDO message lost
0x6100	0x4830	Write buffer overflow, SDO message lost
0x6100	0x4840	Write buffer overflow, heartbeat message lost
0x6100	0x8000	Serious error, termination or reset required
0x6100	0x8010	MCO initialization failed
0x6100	0x8021	Not in the CAN input filter, NMT
0x6100	0x8022	Not in the CAN input filter, PDO
0x6100	0x8023	Not in the CAN input filter, SDO
0x6100	0x8031	Initialization of the PDO parameter out of range
0x6100	0x8032	Access to the process image out of range
0x6100	0x8041	Outside the TPDOs
0x6100	0x8042	Outside the RPDOs
0x6100	0x8043	No RPDO mapping found

9.1.11 Object 0x1015: Inhibit time for emergencies

The object specifies the inhibit time for emergency messages (configured inhibit time for the EMCY message).

- ▶ Specify the value for the inhibit time in multiples of 100 µs.
- ▶ Select the value 0 to deactivate the inhibit time. (max. 6553 ms)

0x1015	VAR	Inhibit time EMCY	Unsigned 16	RW	O

Default value: 1000_{dec}= 100 ms

Value range: 0, 10…65530 (corresponds to 1…6553 ms)

NOTE
Only exact millisecond values are saved. Intermediate values are rounded up.

9.1.12 Object 0x1017: Producer heartbeat time (heartbeat cycle)

The producer heartbeat time specifies the cycle of the heartbeat.

- ▶ Activating the function: Specify time in the range of 1…32767 ms.
- ▶ Deactivating the function: Enter time **0**.

0x1017	VAR	Producer heartbeat time	Unsigned16	RW	O

- Value range: $0…32767_{dec}$ (corresponds to 0…32767 ms)
- Default value: 0_{dec}

NOTE
A heartbeat producer transmits the message cyclically with the set time.

The content of the data byte corresponds to the status of the CAN node:

Status of the CAN node	Content of the data byte
Pre-operational	0x7F
Operational	0x05
Stopped	0x04

9.1.13 Object 0x1018: Identity object (device identification)

The device identification can be read via the object.

0x1018	RECORD	Device identification	Identity (0x23)	RW	O

Subindex	Meaning
0x00	Number of entries (4)
0x01	Turck vendor ID
0x02	Product code
0x03	Software revision number Example: Version 1.0.0.1: $10_{dec}01_{dec}$ = 0x0A 0x01 = 0x0A01
0x04	Serial number of the device

9.1.14 Object 0x1029: Error behavior

The behavior of the device in the event of error can be set via the object.

0x1029	ARRAY	Error behavior	Unsigned 8	RW	O

Error classes

Sub-index	Meaning
0x01	Communication error (Default 1): ■ "Bus OFF" status ■ Heartbeat monitoring failed
0x02	Specific to the device profile (Default 1) ■ Error with the positioning element: Oscillating circuit coupling unavailable
0x03	Specific to the manufacturer (Default 1) ■ Error with the NV-RAM/EEPROM ■ Error with the system monitoring

The sub-indexes can estimate the following values:

- 0: Sensor switches to pre-operational mode.
- 1: The sensor does not switch to a different status.
- 2: Sensor switches to stopped mode.

9.1.15 Object 0x1800: PDO1 parameters (asynchronous)

The object contains the parameters for the process data object PDO1. With the standard setting, this service allows the process data of the positioning element to be asynchronously issued after being triggered by the internal cycle timer (required: cycle timer set via Object 0x6200).

0x1800	RECORD	PDO1 parameters	PDO COMMPAR (0x20)	RW	M/O

Data content:

Sub-index	Meaning
0x00	Number of supported sub-indexes Read only Value range 2…5
0x01	COB-ID and release Bits 0…10: 11-bit identifier; default ID = 0x180 + node number Bits 11…29: 0 (reserved for devices with a 29-bit identifier) Bit 30: 0 = RTR enabled (cannot be changed) Bit 31: 0 (PDO enabled), 1 (PDO disabled) Standard value = 0
0x02	Transmission type = 255_{dec} (see transmission types) (Transmission type = asynchronous) (See Object 0x1800 for overview)
0x03	Inhibit time, minimum waiting time before the selected PDO can be resent Default value = 0x00 (no inhibit time) Value range: $10…65530_{dec}$ (corresponds to 1…6553 ms) Only exact millisecond values are permitted. Intermediate values are rounded up.
0x04	Reserved
0x05	Event timer (setting in Object 0x6200) Value range: 100…65535 (corresponds to 100…65535 ms) 0: no data output Default value: 100_{dec}

9.1.16 Object 0x1801: PDO2 parameters (synchronous, cyclical)

NOTE
Cycle times of less than 100 ms distort measurements.

The object contains the parameters for process data object PDO2. With the standard setting, this service allows the process data of the positioning element to be asynchronously issued after being triggered by the internal cycle timer (required: cycle timer set via Object 0x6200).

0x1801	RECORD	PDO2 parameters	PDO COMMPAR (0x20)	RW	M/O

Data content:

Sub-index	Meaning
0x00	Number of supported sub-indexes Read only Value range 2…5
0x01	COB-ID and release Bits 0…10: 11-bit identifier; default ID = 0x180 + node number Bits 11…29: 0 (reserved for devices with a 29-bit identifier) Bit 30: 0 = RTR enabled (cannot be changed) Bit 31: 0 (PDO enabled), 1 (PDO disabled) Default value = 0
0x02	Transmission type = 255_{dec} (see overview of transmission types) (Transmission type = asynchronous) (See Object 0x1800 for overview)
0x03	Inhibit time: minimum waiting time before the selected PDO can be resent Default value = 0x00 (no inhibit time) Value range: $10…65530_{dec}$ (corresponds to 1…6553 ms) Only exact millisecond values are permitted. Intermediate values are rounded up.
0x04	Reserved
0x05	Event timer (setting in Object 0x6200) Value range: 100…65535 (corresponds to 100…65535 ms) 0: no data output Default value: 100_{dec}

9.1.17 Overview of transmission types

The PDO is synchronously and cyclically sent for values between 1…240. The number of the transmission type corresponds to the number of SYNC pulses required for sending PDOs.

For transmission type 254, the event is triggered by the application. Transmission type 255 is triggered by the device profile. For transmission types 254 and 255, a time-controlled event timer (1…65535 ms) can be set.

Code (decimal)	Transmission type				
	Cyclic	Acyclic	Synchronous	Asynchronous	Only RTR
0		X	X		
1…240	X		X		
241…251	Reserved				
252 (not supported)			X		X
253 (not supported)				X	X
254				X	
255				X	

Meanings of decimal codes for transmission types:

Code (decimal)	Meaning
0	Synchronous (0x00), after SYNC (only for value changes since the most recent SYNC)
1…240	Cyclically synchronous (0xEF), value is sent after SYNC
241…251	Reserved
252…253	Not supported
254	Manufacturer, asynchronous (0xFE) Device timer ≠ 0: Value is sent after a value change Device timer = 0: Value is sent at the end of the cycle time Combination with inhibit timer possible
255	Asynchronous (0xFF) Device timer ≠ 0: Value is sent at the end of the cycle time

9.2 Creating variable PDO mapping

The content of the transmit PDOs can be configured according to the application using the variable PDO mapping of the different objects.

The mapping can be created using two procedures:

- The characteristics of the PDOs (transmission type, inhibit time, event time) can be individually configured using the Object 0x1800FF.
- Multiple PDOs up to max. 64 bits can be transferred in a CAN telegram. The PDOs are compiled in a mapping table from the Objects 0x1A00FF and 0x01FF. The max. data length of the CAN telegram is 64 bits (8 bytes). For example, two application object entries with 32 bits each or four entries with 16 bits each can be mapped in a table using a 64-bit CAN telegram.

Creating mapping tables

The combined size of the mapped objects within a PDO mapping table (Object 0x1A00FF) must not exceed 64 bits. The same transmission type, inhibit time and event time must be set for all mapped objects within a PDO mapping table (Object 0x1A00FF).

Example: Mapping tables for TPDO1 and TPDO2

0x1800 mapping table TPDO 1		**0x1801 mapping table TPDO 2**	
■ Position value ■ Position raw value		■ Position value ■ Speed value ■ Alarms	
COB ID 0x1800, 0x01	xxxxxxxx	COB ID 0x1801, 0x01	xxxxxxxx
Transmission type 0x1800, 0x02	255 asynchronous	Transmission type 0x1801, 0x02	254 synchronous
Inhibit time 0x1800, 0x03	0	Inhibit time 0x1801, 0x03	0
Event time 0x1800, 0x05	100	Event time 0x1801, 0x05	0
Mapping object 1 0x1A00, 0x01	Position value 32 bits	Mapping object 1 0x1A00, 0x01	Position value 32 bits
Mapping object 2 0x1A00, 0x01	Position raw value 32 bits	Mapping object 2 0x1A01, 0x02	Speed value 16 bits
Mapping object 3 0x1A00, 0x01	No entry, 64 bits used	Mapping object 3 0x1A01, 0x03	Alarms 16 bits
Mapping object 4 0x1A00, 0x01	No entry, 64 bits used	Mapping object 4 0x1A01, 0x04	No entry, 64 bits used

Sample of an entry in the mapping table:

The mapped PDO consists of three application object entries of different lengths:

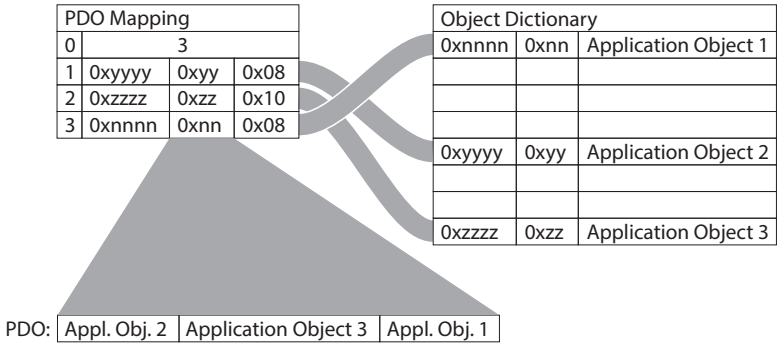


Fig. 17: PDO mapping

Application object 2 is using 1 byte in the transmitter PDO (0x08). This is followed by application object 3 with a length of 16 bits (0x10 = 2 bytes) and then finally application object 1 with a length of 1 byte. A total of 32 bits are used in this PDO.

9.2.1 Object 0x1A00: PDO1 mapped object

Up to four application objects can be transferred in a PDO (e.g. position and speed). The maximum data length is 64 bits. PDO mapping is only possible with Objects 0x6000…0x6FFF.

0x1A00	RECORD	PDO1 mapping parameters	PDO MAPPING (0x21)	RW	M/O

Data content:

Sub-index	Meaning
0x00	Number of supported sub-indexes Read only Value range 1…4
0x01	1_Mapped_Object Default: 0x60040020, position value Example: Mapping: TPDO1 position value Object: 0x6004 Sub-index of the object: 0x00 Data length: 0x20 (32 bits)
0x02	2_Mapped_Object Default: no entry
0x03	3_Mapped_Object Default: no entry
0x04	4_Mapped_Object Default: no entry

9.2.2 Example: Creating PDO mapping for PDO3 (speed)

Up to four application objects can be transferred in a PDO (e.g. position and speed). The maximum data length is 64 bits.

- ▶ Set the communication parameters via Object 0x1802. The communication parameters include COB-ID, transmission type, inhibit time and event time.

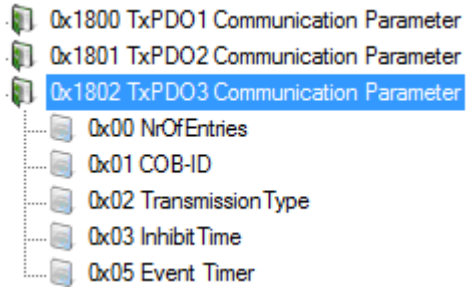


Fig. 18: Communication parameters

- ▶ Record the current values in sub-index 0x01of Object 0x6030.

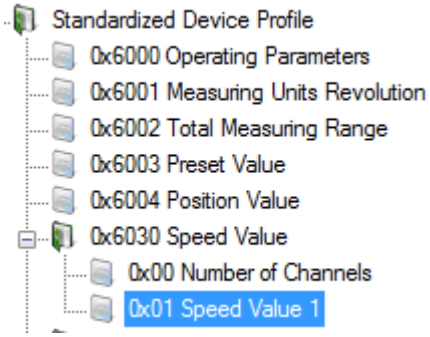


Fig. 19: Record current measured values

- ▶ Record the mapping in sub-index 0x01 of Object 0x1A02.

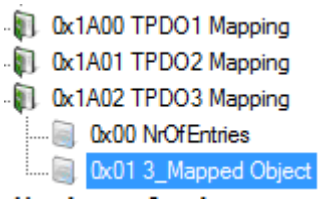


Fig. 20: Mapping

The mapping is pieced together as follows:

- Mapping TPDO3: Speed
- Object: 0x6030
- Sub index of the object: 0x01
- Data length: 0x10 (16 bits)
- Mapping: 0x60300110

- ▶ Enter value 0x60300110 in Objects 0x1A02 and 0x01.
- ▶ Save the parameter via Objects 0x1010 and 0x01: Enter 0x6576617.
- ▶ Reset the voltage.

9.2.3 Default setting for the mapping of transmit PDOs

The device supports variable mapping from all four transmit PDOs.

PDO	TPDO1	TPDO2	TPDO3	TPDO4
Mapping object	0x1A00	0x1A01	0x1A02	0x1A03
Transmission type object: 0x1800FF, 0x02	0x255 **Position** in the set time cycle	**Position** in the event of a SYNC request (0x80)	**Position** if the value changes	**Speed** in the set time cycle
Object of the measured value	0x6004	0x6004	0x6004	0x6030
Sub index	0x00	0x00	0x00	0x01
Data length	0x20 (32 bits)	0x20 (32 bits)	0x20 (32 bits)	0x10 (16 bits)
Mapping	0x60040020	0x60040020	0x60040020	0x60300110

9.2.4 PDO mapping in accordance with CiA (from CANopen version 4)

The default assignment of process data objects (default mapping) meets the requirements of the CiA. For special application cases, the assignment can be changed via the variable mapping. With variable mapping, the application objects (input and output data) of the PDOS can be assigned freely via mapping tables. Only the following procedure is permitted from CANopen version 4 onwards.

- Lock PDO: Set Object 0x1800 and subsequent objects, sub index 1, COB-ID, and bit 31 to **1**. (Data: e.g. 0x4000 019B → 0xC000 019B)
- Set the number of mapping entries in Object 0x1A00 and subsequent objects, and sub-index 0 to **0**. (Data: e.g. 0x01 → 0x00. In this example, 1 entry is changed to 0 entries.)
- Change Object 0x1A00 and subsequent objects, and sub index 1(…8) (Data: e.g. 0x6004 0020 → 0x600C 0020)
- Set the number of mapping entries in Object 0x1A00 and subsequent objects, and sub index 0 to **1**, **2**, **3**…. (Data: e.g. 0x00 → 0x01. In this example, one entry is selected.)
- Release PDO: Set Object 0x1800 and subsequent objects, sub index 1, COB-ID, and bit 31 to **0**. (Data e.g. 0xC000 019B → 0x4000 019B)

9.3 Setting parameters specific to the manufacturer

9.3.1 Object 0x2100: Baud rate (setting the baud rate)

The transmission rate is set without an LSS service via the object. The default value is 125 kbps.

0x2100	VAR	Baud rate	Unsigned 16	RW	M

- ▶ To change the object, enter the password into the Service Passcode Object 0x2900, 0x01 (unsigned 32). The password is 0x3039 (12345_{dec}).
- ▶ Specify the data content in Object 0x2100, sub-index 0x00 as shown in the following table:

Data	Transmission rate	Format
Data: 1000	1000 kbps	Unsigned 16
Data: 500	500 kbps	Unsigned 16
Data: 250	250 kbps	Unsigned 16
Data: 125	125 kbps	Unsigned 16
Data: 50	50 kbps	Unsigned 16
Data: 20	20 kbps	Unsigned 16
Data: 10	10 kbps	Unsigned 16

- ▶ Reset the voltage to load the changes into the device.

9.3.2 Object 0x2101: Node number (changing the node address)

The node address can be changed via the object. The default value is 0x03.

0x2101	VAR	Node number	Unsigned 8	RW	M

- ▶ To change the object, enter the password into the Service Passcode Object 0x2900, 0x01 (unsigned 32). The password is 0x3039 (12345_{dec}).
- ▶ Specify the node address in Object 0x2101: Enter a value between 0x00 and 0x7F ($0…127_{dec}$).

NOTE
The node number 0 is reserved and must not be used by any nodes.

- ▶ Carry out a voltage reset or a node reset to load the changes into the device. All other settings are retained.

9.3.3 Object 0x2102: CANBus termination (switching the terminating resistor on and off)

A 120-Ω terminating resistor for terminating the bus can be switched on and off via the object.

0x2102	VAR	CAN bus termination	Unsigned8	RW	M

- 1: termination active
- 0: termination inactive

- ▶ Execute **Save all bus parameters** (0x2105) to save the changes.
- ▶ Reset the voltage to load the changes into the device.

9.3.4 Object 0x2104: NMT autostart

The start mode of the positioning element can be set via the object when switched on.

0x2104	VAR	NMT autostart	Unsigned 8	RW	M

Object	Sub-index	Data
0x2104	0x00	0: pre-operational
		1: operational

9.3.5 Object 0x2105: PDO trigger threshold (specifying the trigger threshold)

Up to four application objects can be transferred in a PDO (e.g. position and speed). The maximum data length is 64 bits.

0x2105	VAR	PDO trigger threshold	Unsigned 8	RW	M

NOTE
The PDO function "Send in response to angle change" (transmission type = 254_{dec}) must be activated. Adjust the required PDOs as follows: Object: 0x1800 and subsequent objects, sub-index: 0x02, data: 0xFE (manufacturer).

▶ Enter the trigger threshold for the angle change as follows:

Object	Sub-index	Data (unsigned 8)
0x2105	0x00	$0…255_{dec}$

Example: If the value is set to 10_{dec}, the position value must change by at least 10 digits in order for the PDO to be automatically transferred.

9.3.6 Object 0x2106: Filter configuration (selecting the filter type)

The device is equipped with an adjustable low-pass filter and an adjustable dynamic filter for filtering measured values.

0x2106	VAR	Filter configuration	Unsigned 8	RW	M

During downtime (motion detection), the filter operates with a low cut-off frequency (high group delay) to reduce the signal noise at a high resolution.

The dynamic digital filter operates in accordance with the status and speed of the device. The filter constant can be adjusted in Object 0x2106, sub-index 0x02. If the positioning element moves, the device will switch to a high cut-off frequency (low group delay).

▶ Adjust the filter as follows:

Object	Sub-index	Data
0x2106	0x01	0: Filter off
		1: Low-pass filter on
	0x02	2: Dynamic IIR filter on
		$1…255_{dec}$ (default: 20)

NOTE
If the value of the filter constant selected is greater than 50, the time taken for the current measured value to reach a steady level will increase by several seconds.

9.3.7 Object 0x2110: Customer memory (setting the customer memory)

The customer memory is saved via the object.

0x2110	VAR	Customer memory	Unsigned 32	RW	M

Object	Sub-index	Data
0x2110	0x01…0x04	Numerical values in the range Unsigned 32

The recorded data has no effect on the function of the device (e.g. installation date: 2014 = 11111011110_{bin})

9.4 Adjusting the standard device parameters

9.4.1 Object 0x6000: Operating parameters

The following operating parameters can be adjusted via the object:

- Reversal of the code sequence
- Diagnosis request
- Scaling function

0x6000	VAR	Operating parameters	Unsigned 16	RW	M

Data content (default values are shown in **bold**):

Bit	Value	Meaning
0	**0x00**	The code sequence ascends during clockwise (CW) rotation
	0x01	The code sequence ascends during counterclockwise rotation (CCW)
1		Not used
2	0x00	Scaling function off
	0x01	Scaling function on
3…12		Not used
13	**0x00**	Speed format in revolutions per minute (rpm)
14…15		Not used

NOTE
The scaling function can only be used with Device_Type 0 and 1 and must also be set via Object 0x6001 and Object 0x6002.

9.4.2 Object 0x6001: MUR – Measuring Units per Revolution

The resolution per revolution can be adjusted via the object.

0x6001	VAR	Measuring units per revolution	Unsigned 32	RW	M

The device automatically calculates the relevant scaling factor if the scaling function was adjusted in Object 0x6000.

- Value range: 1…327680 (full range)
- Default settings: 36000

NOTE
The maximum physical resolution is recorded by default in Object 0x6501 (read only). In Object 0x6000 bit 2: Switch on the scaling function.

9.4.3 Object 0x6002: TMR – Total Measuring Range

The measuring range can be set via the object.

0x6002	VAR	Total measuring range	Unsigned 32	RW	M

- Value range: 1…327680 (full range)
- Default settings: 36000

NOTE
The maximum physical resolution is recorded by default in Object 0x6501 (read only). In Object 0x6000 bit 2: Switch on the scaling function.

If the device is operating continuously (single-turn), then TMR = MUR/n, n = 1, 2, 3, etc.

- MUR: Object 0x6001
- TMR: Object 0x6002

Otherwise a jump in the output code will occur for every physical zero crossing (single-turn for each revolution).

Example 1:

Setting of Object 0x6001: MUR = 3600 (value range: 1-maximum physical resolution)

Setting of Object 0x6002: TMR = 360 (value range: TMR = MUR/n, n = 1, 2, 3…)

Output: One revolution is split into 10 × 0-360.

Example 2:

Setting of Object 0x6001: MUR = 3600

Setting of Object 0x6002: TMR = 3600

Output: One revolution is split into 0-3600.

Example 3 – jump in the output code:

Setting of Object 0x6001: MUR = 3600

Setting of Object 0x6002: TMR = 3000

Output: One revolution is split into 0-3000 and 0-600.

9.4.4 Object 0x6003: Preset value (zero point adjustment)

The position value of the device can be adjusted to a preset value via the object. This enables the zero position of the device to be compared to the machine zero point, for example. The offset value is the result of the preset value minus the measured position value.

0x6003	VAR	Preset value	Unsigned32	RW	O/M

- Value range: 1-327680
- Default settings: 0

When then preset value is entered, the device automatically checks whether the point lies within the active scale or the entire measuring range. Otherwise the entry is rejected. The offset value is calculated and also saved in Object 0x6509, 0x00.

Example 1:

Current measured value: 33

▶ Preset value: Write value 0 in Object 0x6003.

⇨ Offset result: The measured value changes from 33 to 0. The zero point has been offset by -33.

Example 2:

Current measured value: 33

▶ Preset value: Write value 50 in Object 0x6003.

⇨ Offset result: The measured value changes from 33 to 50. The zero point has been offset by +17.

9.4.5 Object 0x6004: Current position value

The device determines the current position value (calculated with the scaling factor where relevant).

0x6004	VAR	Position value	Unsigned32	RO	M

Data content:

Byte	Value
0	2^{7}-2^{0}
1	2^{15}-2^{8}
2	2^{23}-2^{16}
3	2^{31}-2^{24}

- Value range: 0-maximum physical resolution
- Default setting: current position

9.4.6 Object 0x600C: Position raw value (unscaled measured value)

The device determines the current position value in the maximum physical resolution (unscaled).

0x600C	VAR	Position raw value	Unsigned32	RO	O/M

- Value range: 0-327680 (maximum physical resolution)

9.4.7 Object 0x6030h: speed value (speed)

The device outputs the current speed in rpm.

0x6030h	VAR	Speed value	Signed16	RO	O

- Positive value: Clockwise rotation (CW)
- Negative value: Counterclockwise rotation (CCW)
- Value range: 0…1500 rpm (maximum speed)

If values > 1500 rpm, a warning message is issued. Bit 6 Speed Range in object 0x6505 (Warnings) is set. Output of the speed via PDO is possible through appropriate mapping.

NOTE
Output of the speed via PDO is possible through mapping. To do this, set bit 13 in object 0x6000h to 0.

Example

Setting: 500 rpm counterclockwise = - 500_{dec}

9.4.8 Object 0x6200: Cycle timer (cycle time of the measured value output)

NOTE
Cycle times of less than 100 ms distort measurements.

The object determines the cycle time with which the current position is output via PDO1 (see Object 0x1800). The output controlled by the timer is active as soon as a cycle time of > 0 is entered. If the cycle time is 0, no measured values are output.

0x6200	VAR	Cyclic timer	Unsigned 16	RW	M/O

The object ensures compatibility with older profile versions. The event timer sub-index (0x05) must be used in place of Object 0x6200 in the current transmit PDO.

- Value range: 0…0xFFFF (65535_{dec}) produces the cycle time in milliseconds.
- Default value: 0x64 (100_{dec})

9.4.9 Object 0x6400: Work area state register (current status of the limit values)

The object contains the current status of the position according to the programmed limit values. Depending on the position of both end values, the flags are either set or reset. If the measured value is within the target range, bits 0…7 have the value 0.

0x6400	VAR	Area state register	Unsigned 8	RO	O

Sub-index	Bit	Meaning
0x01 (Work area state register channel 1, unsigned 8)	0	1: Position value outside the target range
	1	1: Position value > High_Limit_1
	2	1: Position value < Low_Limit_1
	3…7	Not used
0x01 (Work area state register channel 2, unsigned1)	0	1: Position value outside the target range
	1	1: Position value > High_Limit_2
	2	1: Position value < Low_Limit_2
	3…7	Not used

- Data: 0x05 = position value lower than the low limit
- Data: 0x00 = position value within the target range
- Data: 0x03 = position value higher than the high limit

▶ To correctly activate the output signals, check the end values in Objects 0x6401 and 0x6402.

The limit values are mapped in Object 0x1002 and can be mapped as a PDO.

9.4.10 Object 0x6401 and 0x6402: Working area limits (adjusting limit values)

The working area of the device can be adjusted via the objects. The status can be reported via flag bytes (Object 0x6400) both in and out of the working area. These area markers can also be used as a limit switch for the software.

0x6401/0x6402	VAR	Working area limits H/L	Integer 32	RW	O

Object 0x6401: Working area LOW limit (2 values)

Object 0x6402: Working area HIGH limit (2 values)

- Value ranges: Ri360P1-DSU35-CNX4-2H1650: 0…327680_{dec} (full range)
- Default setting of the working area, low limit: 0_{dec}
- Default setting of the working area, high limit: 0_{dec}

Example 1: Setting the measuring range to 3600

The measuring range for both channels must be set to 3600 via Objects 0x6401 and 0x6402. The working area must be adjusted to every measured value between 0 and 3600.

▶ Enter the channels for which the measuring range must be adjusted:

Object	Sub-index	Value
0x6400	0x01 (channel 1)	0x00
0x6400	0x02 (channel 2)	0x00

▶ Set lower limit values for the measuring range:

Object	Sub-index	Value
0x6401	0x01 (low limit 1)	0x00
0x6401	0x02 (low limit 2)	0x00

▶ Set upper limit values for the measuring range:

Object	Sub-index	Value
0x6402	0x01 (high limit 1)	3600_{dec}
0x6402	0x02 (high limit 2)	3600_{dec}

Example 2: Adjusting channel-specific measured values

The measuring range for channel 1 must be set to 0…900 (0…90°) via Objects 0x6401 and 0x6402. The measuring range for channel 2 must lie in the range of 2700…3600 (270…360°). The current measuring value of the device is 1800 (180°).

▶ Enter the channels for which the measuring range must be adjusted:

Object	Sub-index	Value
0x6400	0x01 (channel 1)	0x03 (values > high limit)
0x6400	0x02 (channel 2)	0x05 (values < low limit)

▶ Set lower limit values for the measuring range:

Object	Sub-index	Value
0x6401	0x01 (low limit 1)	900_{dec}
0x6401	0x02 (low limit 2)	1800_{dec}

▶ Set upper limit values for the measuring range:

Object	Sub-index	Value
0x6402	0x01 (high limit 1)	3600_{dec}
0x6402	0x02 (high limit 2)	3600_{dec}

9.4.11 Object 0x6500: Operating status

Operating status can be read from Object 0x6000 via the object.

0x6500	VAR	Operating status	Unsigned16	RO	M

9.4.12 Object 0x6501: Single turn resolution

The resolution set in Object 0x6000 can be read via the object.

0x6501	VAR	Single-turn resolution	Unsigned32	RO	M

9.4.13 Object 0x6502: Number of distinguishable revolutions

The number of possible multi-turn revolutions can be read via the object.

0x6502	VAR	Number of distinguishable revolutions	Unsigned16	RO	M

9.4.14 Object 0x6503: Alarms

The object displays fault signals in addition to emergency messages. The error bit is set to 1 for as long as the error exists. If an alarm is triggered, an emergency message (0x80 + node number) is sent simultaneously with the error code 0x1000 ("generic error").

0x6503	VAR	Alarms	Unsigned 16	RO	M/O

Data content:

Bit	Value	Meaning
0…14		Reserved
15	1	No oscillating circuit coupling, no position measurement possible

9.4.15 Object 0x6504: Supported alarms

The object displays the alarm messages that are supported by the device (see Object 0x6503).

0x6504	VAR	Supported alarms	Unsigned 16	RO	M/O

Data content:

Bit	Value	Meaning
0…14		Reserved
15	1	Testing of the oscillating circuit coupling is supported

9.4.16 Object 0x6505: Warnings

Warning messages are displayed via the object if the tolerances of internal positioning element parameters are exceeded. The measured value can still be valid in the event of a warning message. The bit for warning messages is set to 1 for as long as the tolerance remains exceeded.

0x6505	VAR	Warnings	Unsigned 16	RO	M/O

Data content:

Bit	Value	Meaning
0…5		Reserved
6	1	Permitted speed exceeded
7…14		Reserved
15	1	Weak oscillating circuit coupling, measured value free of errors

9.4.17 Object 0x6506: Supported warnings

The object displays the warning messages that are supported by the device (see Object 0x6505).

0x6506	VAR	Supported warnings	Unsigned 16	RO	M/O

Data content:

Bit	Value	Meaning
0…5		Reserved
6	1	Testing of the speed is supported
7…14		Reserved
15	1	Testing of the oscillating circuit coupling is supported

9.4.18 Object 0x6507: Profile and software version

The version number of the device profile is stored in the first 16 bits. The second 16 bits contain the number of the software version of the device.

0x6507	VAR	Profile and software version	Unsigned32	RO	M/O

Software version

Example: 1.2.3.4

Profile version (CiA DS-406 profile)

Data content:

Software version		DS406 version	
Byte 3	Byte 2	Byte 1	Byte 0
$2^{31}…2^{24}$	$2^{23}…2^{16}$	$2^{15}…2^{8}$	$2^{7}…2^{0}$

Example:

- CiA DS406 version: 3.2 = $3_{dec}2_{dec}$ = 0x03_0x02
- Software version: 1.0.0.1= $10_{dec}01_{dec}$= 0x0A_0x01

Byte 3	Byte 2	Byte 1	Byte 0
0x0A	0x01	0x03	0x02

9.4.19 Object 0x6509: Offset value

A preset value entered via Object 0x6003 is internally converted to an offset value (Offset = preset - position). Object 0x6509 shows the calculated offset value.

0x6509	VAR	Offset value	Signed32	RO	M/O

9.4.20 Object 0x650A: Module identification

The object shows the following manufacturer-specific data:

- Offset value
- Minimum position values
- Max position values

0x650A	VAR	Module identification	Signed32	RO	M/O

Data content:

Object	Subindex	Meaning
0x650A	0x00	Number of entries
0x650A	0x01	Offset value
0x650A	0x02	Minimum position value
0x650A	0x02	Maximum position value

9.4.21 Object 0x650B: Serial number

The object displays the serial number of the device.

0x650B	VAR	Serial number	Unsigned32	RO	M

9.4.22 LSS services DS 305 V2.0

Via the CiA DSP 305 CANopen Layer Setting Service and Protocol (LSS), the following parameters can be read and changed via the network:

- Node address
- Transmission rate
- LSS address

The following LSS services can be set:

- Change the node ID of a sensor from 3 to 5.
- Set the transmission rate to 125 kbps.
- Save settings.

An example of the settings implemented via the LSS services can be found in the following table:

Step		Object	Number of bytes	Command
Prepare	NMT Stop Mode (03 = Node 3)	0x0000	2	02 03
	LSS Switch Mode Global ON	0x7E5	8	04 01 00 00 00 00 00 00
Select	LSS Request Configure Node ID (05 = Node 5)	0x7E5	8	11 05 00 00 00 00 00 00
	LSS Request Config Bit Timing Parameters (04 = 125 kbps)	0x7E5	8	13 00 04 00 00 00 00 00
Save	LSS Request Store Configuration	0x7E5	8	17 00 00 00 00 00 00 00
	LSS Switch Mode Global OFF	0x7E5	8	04 00 00 00 00 00 00 00

LSS services — setting the transmission rate

The transmission rate can be set via LSS services as follows:

Transmission rate	Object	Command
LSS Request Config Bit Timing Parameters (08 = 10 kbps)	0x7E5	13 00 08 00 00 00 00 00
LSS Request Config Bit Timing Parameters (07 = 20 kbps)	0x7E5	13 00 07 00 00 00 00 00
LSS Request Config Bit Timing Parameters (06 = 50 kbps)	0x7E5	13 00 06 00 00 00 00 00
LSS Request Config Bit Timing Parameters (05 = 100 kbps)	0x7E5	13 00 05 00 00 00 00 00
LSS Request Config Bit Timing Parameters (04 = 125 kbps)	0x7E5	13 00 04 00 00 00 00 00
LSS Request Config Bit Timing Parameters (03 = 250 kbps)	0x7E5	13 00 03 00 00 00 00 00
LSS Request Config Bit Timing Parameters (02 = 500 kbps)	0x7E5	13 00 02 00 00 00 00 00
LSS Request Config Bit Timing Parameters (01 = 800 kbps)	0x7E5	13 00 01 00 00 00 00 00
LSS Request Config Bit Timing Parameters (00 = 1000 kbps)	0x7E5	13 00 00 00 00 00 00 00

LSS services

LSS hardware requirements (LSS address): In order to perform a selective configuration of the node, all LSS slaves must be showing a valid entry in the object directory of the identity object 0x1018. The object comprises the following sub-indexes:

- Vendor ID (numerical number)
- Product code (numerical number)
- Revision number (major and minor revision as numerical number)
- Serial number (numerical number)
- LSS master CAN-ID 2021
- LSS slave CAN-ID 2020

9.4.23 Network management

The device supports the simplified network management (minimum boot-up) concept specified in the profile for "minimum capability devices."

The status diagram in accordance with DS301 shows the different node statuses and their respective network commands. The network master controls the commands via NMT services. The node status is also indicated by the LEDs.

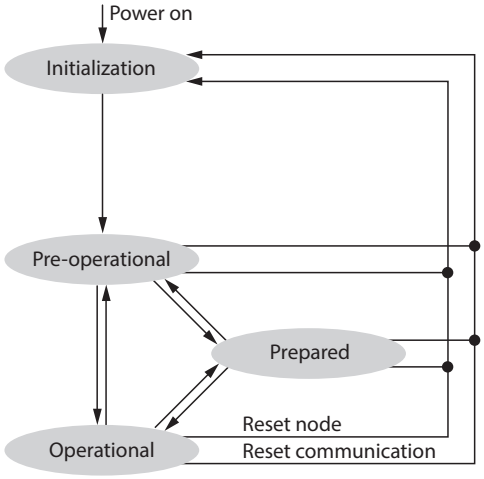


Fig. 21: Status diagram in accordance with DS 301

Initialization

After a reset or after the supply voltage is switched on, the node will be in the "Initialization" status. Once the reset or initialization cycle is completed, the node automatically switches to the "Pre-operational" status.

Pre-operational

In the pre-operational status, the CAN nodes can be activated via SDO messages or with NMT commands in the standard identifier. The device parameters or communication parameters can be programmed.

Operational

The node is active. Process values are issued via the PDOs. The NMT commands can be evaluated.

"Prepared" or "stopped"

The node is not active. SDO and PDO communication is not possible. The node can be set via the NMT commands to the "Operational" and "Pre-operational" statuses.

10 Troubleshooting

If the device does not function as expected, first check whether ambient interference is present. If there is no ambient interference present, check the connections of the device for faults.

If there are no faults, there is a device malfunction. In this case, decommission the device and replace it with a new device of the same type.

11 Maintenance

Ensure regularly that the plug connections and cables are in good condition.

The devices are maintenance-free, clean dry if required.

12 Repair

The device is not intended for repair by the user. The device must be decommissioned if it is faulty. Observe our return acceptance conditions when returning the device to Turck.

12.1 Returning devices

If a device has to be returned, bear in mind that only devices with a decontamination declaration will be accepted. This is available for download at
https://www.turck.de/en/return-service-6079.php
and must be completely filled in, and affixed securely and weather-proof to the outside of the packaging.

13 Disposal

The devices must be disposed of properly and do not belong in the domestic waste.

14 Technical data

Technical data	
Measuring range	0…360°
Output type	Singleturn
Single-turn resolution	16-bit/65536 increments per revolution
Repetition accuracy	≤ 0.01 % of full scale
Linearity deviation	≤ 0.05 % of full scale
Temperature drift	≤ ± 0.003 %/K
Electrical data	
Operating voltage	15…30 VDC
Ripple	≤ 10 % U_{ss}
Insulation test voltage	≤ 0.5 kV
Wire break/reverse polarity protection	Yes (voltage supply)
Output function	5-pin, CANopen
Sampling rate	800…1000 Hz
Current consumption	< 50 mA
Mechanical data	
Design	QR24
Dimensions	81 × 78 × 24 mm
Shaft type	Hollow shaft
Housing material	Metal/plastic, ZnAlCu1/PBT-GF30-V0
Connection	2 × connectors, M12 × 1, CAN-IN and CAN-OUT
Ambient conditions	
Ambient temperature	-25…+85 °C
Vibration resistance	55 Hz (1 mm)
Vibration resistance (EN 60068-2-6)	20 g, 10…3000 Hz, 50 cycles, 3 axes
Shock resistance (EN 60068-2-27)	100 g, 11 ms ½ sine, 3 × each, 3 axes
Continuous shock resistance (EN 60068-2-29)	40 g, 6 ms ½ sine, 4000 × each, 3 axes
Degree of protection	IP68/IP69K
MTTF	138 years acc. to SN 29500 (Ed. 99) 40 °C
Operating voltage display/ signal status display	Green/yellow
Operating status display/ error display	Green/red

15 Turck branches — contact data

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