Your Global Automation Partner

TURCK

Contactless QR24 Encoders with CANOPEN Interface

Manual

Contents

1 About this manual

This manual describes the structure, functions, and the application of the product and will assist you in deploying the product according to its intended use. Please read this manual carefully before using the product and store the manual as long as the product is in use. Turck recommends this manual must be supplied to any future owner if sold.

1.1 Target groups

This manual is intended for trained personnel and must be read carefully by every individual involved in the assembly, commissioning, operation, maintenance, disassembly and disposal of the device.

1.2 Supporting documentation

You will find the following supporting documentation in addition to this document online at www.turck.com:

- Data sheet
- Catalog Pages

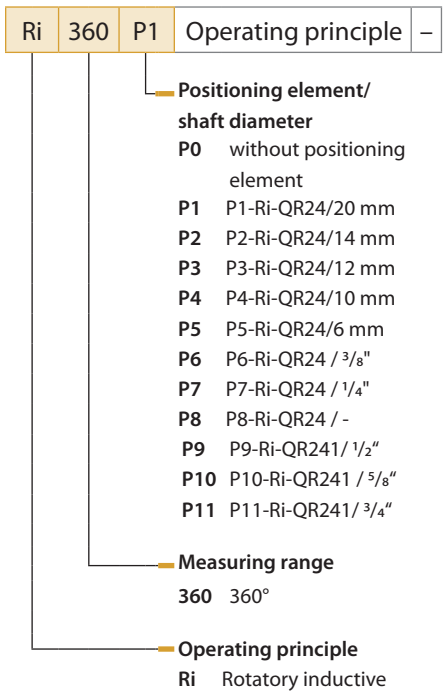
1.3 Feedback on this manual

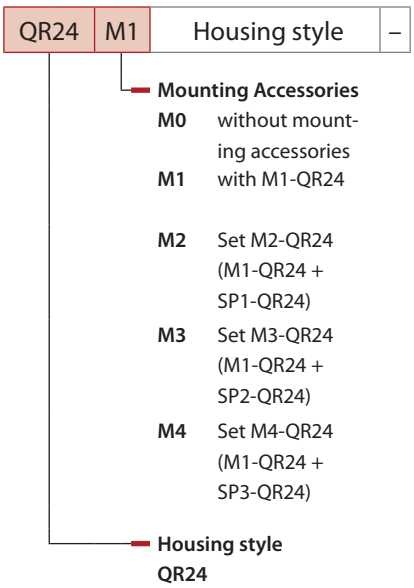
We aim to keep this manual as informative and clear as possible. Please send any suggestions to tusa.marketing@turck.com if you feel there is information missing or if you have ideas on how to improve the layout.

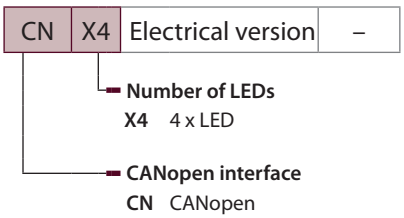
2. Notes on the product

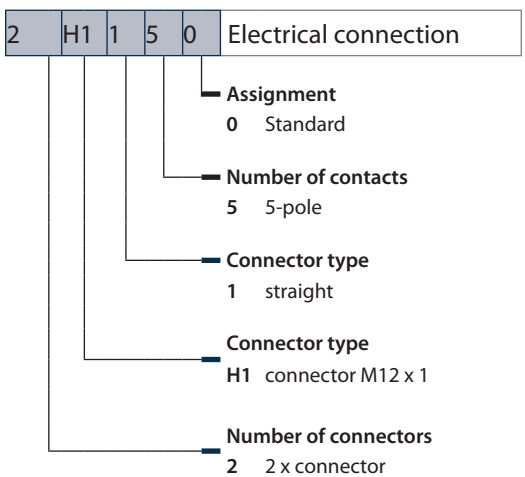
2.1 Product identification (type key)

Ri	360	P1	–	QR24	M0	–	CN	X4	–	2	H1	1	5	0









Note:
The sensor, the assembly elements, and the positioning element can be ordered as a set or individually.

2.2 Scope of delivery
The following items are included in the scope of delivery:

- Contactless QR24 encoder
- Assembly aid (MT-QR24)
- Short instructions
- VZ 3 screw plug

2.3 Legal requirements
The device is subject to the following EU directives:

- 2006/95/EC (Low voltage),
- 2004/108/EC (Electromagnetic compatibility),
- 2011/65/EU (RoHS)

2.4 Labelling
The device described in this manual complies with CE requirements in accordance with the EU directive 765/2008, and satisfies the requirements laid out in the harmonisation legislation of the European Community with regards to its application.

2.5 Manufacturer and service
TURCK offers support for your project from initial analysis to the commissioning of your application. The TURCK product database contains software tools fore the programming, configuration, commissioning, data sheets, and CAD data in various export formats. The following URL will take you directly to the product database: turck.com

Our sales and service team in Germany can be reached via the following numbers if you have any questions:
Sales: +49 208 4952-380
Technology: +49 208 4952-390
Please contact your regional Turck representative for international enquiries.

Hans Turck GmbH & Co. KG
45466 Mülheim an der Ruhr
Germany

3 For your safety

The product is designed in accordance with the state of technology. There are, however, residual risks. Please comply with the safety and warning notices to prevent injuries and damage to property. TURCK does not accept liability for damages caused by non-compliance with safety and warning notices.

3.1 Intended use
The device is intended for use in mobile machinery in industrial applications. Any other use shall be deemed improper and can result in injuries or damage to property. TURCK does not accept liability for damages caused by improper use of the the device.

3.2 Notes on the project design/implementation, and operation of the product
Compliance with the safety and accident prevention requirements applicable for the relevant use case scenario is mandatory. The device may pose hazards when used improperly or not in accordance with its intended use.

3.3 Technical advancement
Hans Turck GmbH & Co. KG reserves the right to implement technical changes or modifications to details in line with technical advancements without prior notification. This will apply to the electrical device and to the user information/operating manual, as well as any other documentation provided by Hans Turck GmbH & Co. KG.

3.4 Explanation of symbols

The following symbols are used in this manual:

WARNING:
Warning denotes a possibly hazardous situation with medium risk which could result in fatality or severe injury if not prevented.

Notes:
In connection with WARNING, you will find tips, recommendations, and important information. These notes will simplify your work, contain information about specific steps to be taken, and help prevent additional work due to incorrect procedures.

4 Product description

The encoder measures turning angles across a 360° angle range. All parameters are stored in the internal parameter memory.

Features:

- 360° angle sensor
- High resolution and accuracy
- CANopen interface in compliance with CiA DS-301, device profile CiA 406 3.1
- Baud rates between 10 kbps and 1 Mbps
- Sampling rate of typ. 1 kHz
- Functions:
  - One TPDO (RTR, cyclic, event-controlled, synchronized)
  - SYNC consumer (synchronized transmission of TPDO after receipt of SYNC message)
  - Failure monitoring via heartbeat or node-guarding/life-guarding
  - Freely configurable limit frequency (digital filter)
  - Robust, easy to assemble plastic housing
  - Suitable for industrial applications
  - Temperature range: -25…+85°C
  - Housing protection type: IP68/IP69K

4.1 Device overview

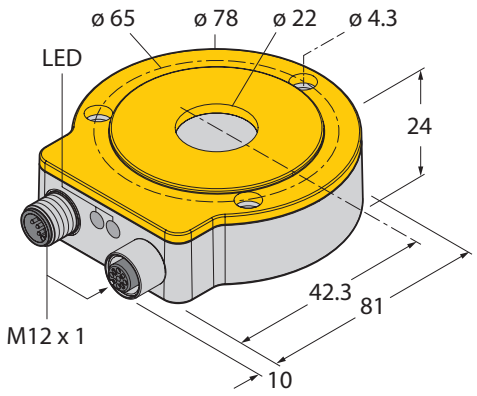


Fig.1: Device view

4.2. Functional principle

The principle of the encoder is based on the inductive RLC coupling which offers significant advantages in comparison with optical or magnetic principles. The sensor contains emitter and receiver systems in the form of PCB coils. The emitter coils are energized in a high frequency alternating field and create an inductive RLC coupling in conjunction with the positioning element (resonator). As a result, the positioning element is also inductively coupled with the receiver coils to pinpoint its exact position.

4.3 Delivery condition

At the time of delivery, the sensor comes with the following basic default settings:

- Node ID: 0x03
- Baud rate 125 kHz
- Internal terminating resistor deactivated
- TPDO1 event time: 100 ms
- TPDO1 activated
- TPDO asynchronous mode

4.4. Display elements

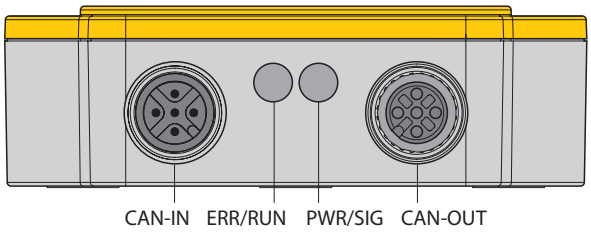


Fig. 2: LED arrangement

The encoder comes with an LED status display for the following states:

PWR LED

Colour/Status	Status	Description
OFF	No operating voltage	The device is not ready
Green	Operating voltage OK	The device is ready

Note:
The PWR LED will respond at as little as 5 V and is therefore not an indicator for having reached the operating voltage of 10...30 V.

RUN LED

Colour/Status	Status	Description
Green flashing	LSS status	The device is in LSS operation (intermittently flashing Error LED)
On short green flash	Stopped	Data transfer was stopped
Green flashing	Pre-operational	The data transfer is in preparation
Green	Operational	The device is ready

SIG LED

Colour/Status	Status	Description
OFF	Data signal OK	The device is functioning correctly.
Yellow	Data signal is weak but valid.	The device is working with reduced accuracy.
Green	No data signal	The device is not functioning

.

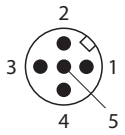
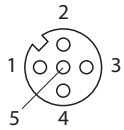
Error LED (ERR)

Colour/Status	Status	Description
OFF	No error	The device is functioning correctly
Red flashing	LSS status	The device is in LSS operation (intermittently flashing RUN LED)
Two short red flashes	Guard event occurrence	A guard event (NMT slave or master) or heartbeat event has occurred
Three short flashes	SYNC error	The SYNC message was not received within the preconfigured cycle time (see also object 0x1006)
Red	Bus deactivated	The CAN controller was deactivated by the bus

4.5. Connection assignment

The sensor comes equipped with a CAN input connection and a CAN output connection in accordance with CiA DR-303-1.

Wiring Diagram

	Pin	**Signal**	**Assignment**
CAN-IN 	1	CAN_SHLD	Shield
	2	CAN_V+	Supply voltage (+24 VDC)
CAN-OUT 	3	CAN_GND	GND/0 V/V-
	4	CAN_H	CAN_H bus line
	5	CAN-L	CAN_L bus line

4.6 Terminating resistor

An integrated terminating resistor can be activated as needed. (See object **0x2102**).

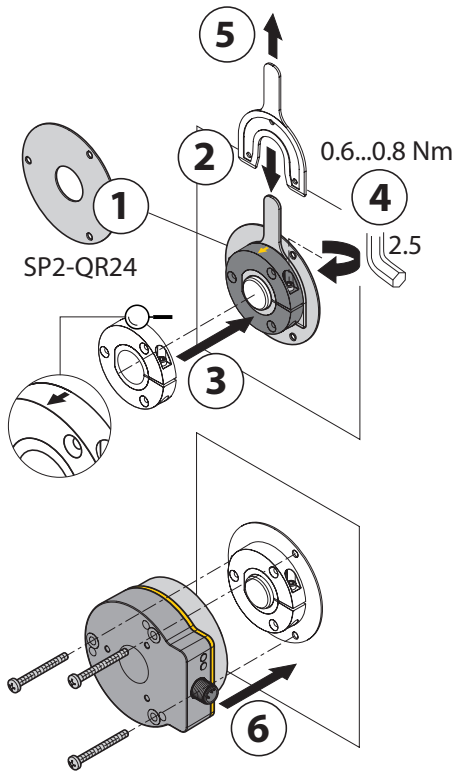
5 Assembly

An extensive range of assembly accessories (see chapter 6) allows the easy installation to many different shaft diameters. The shield plates SP1-QR24, SP2-QR24 or SP3-QR24 can be used (depending on assembly type) to increase the permissible distance between the positioning element and the sensor. The illustrations below show the simple design of the separate sensor and resonator units, making them virtually resistant to errors. The assembly can be done as types **A**, **B**, and **C**.

Warning:
The positioning element is prone to detaching from its mounting position if assembled incorrectly. **Danger possible if parts disassemble while in use!**

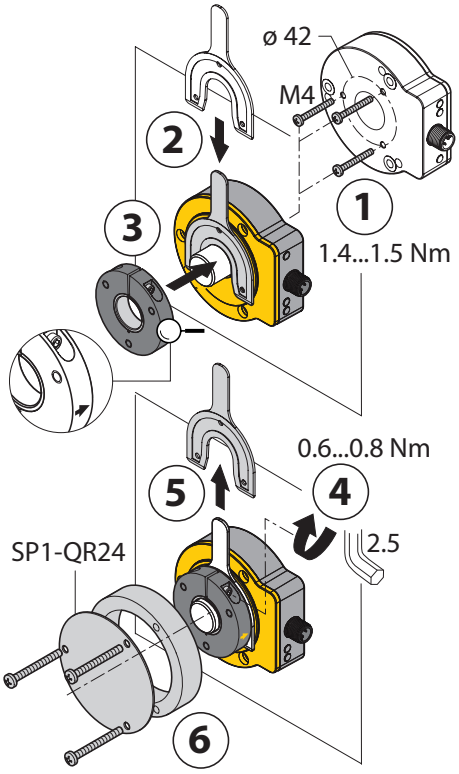
- Assembly instructions must be complied with
- Ensure the correct attachment of the positioning element, tightening torque: M = 0.6…0.8 Nm

A



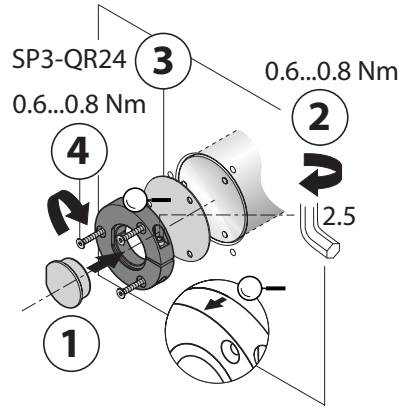
① Optional shield plate SP2-QR24 can be inserted.
② Attach assembly aid for optimised alignment of the positioning element.
③ Slide the positioning element onto the rotatable shaft; ensure correct directionality of the active surface (see inscription on the side of the positioning element).
④ Affix the clamping bracket using a hex key.
⑤ Remove the assembly aid.
⑥ Place the encoder with the aluminium ring over the positioning element, and affix with three screws, to create a closed, and protected unit.

B



① Slide the encoder on the back of the shaft and affix.
② Attach assembly aid for optimised alignment of the positioning element.
③ Slide the positioning element onto the rotatable shaft; ensure correct directionality of the active surface (see inscription on the side of the positioning element).
④ Affix the clamping bracket using a hex key.
⑤ Remove the assembly aid.
⑥ The protective aluminium unit and the shield plate SP1-QR24 can optionally be added.

C



Proceed as follows if the positioning element is screwed onto a rotating machine part
and not onto a shaft:
① Insert the blind plug RA8-QR24.
② Affix the clamping bracket using a hex key.
③ Insert the optional SP3-QR24 shield plate.
④ Affix the positioning element using three sunken head screws, ensuring the correct directionality of the active surface (see inscription on the side of the positioning element).
Mount the encoder depending on application requirement.

6 Configuration

The wear-resistant encoder with CANopen interface is ideally suited for use in mobile machinery and industrial applications. Short latencies and cyclic, event-controlled communication are only two of the many advantages of the CANopen protocol, which is often used in this area of application. A particular highlight is the software-controlled, bus-activated terminating resistor.

6.1 Objects 1000h – 1FFFh (communication profiles)

6.1.1 Object 1000h: Device type

This object specifies the device type.

1000h	VAR	Device type	Unsigned 32	RO	M

Device profile number		Encoder type	
Byte 0 (LSB)	Byte 1	Byte 2	Byte 3 (MSB)
96h*	01h*	01h (absolute encoder single-turn)	
		02h (absolute encoder multi-turn)	00h

*196h = 406 decimal (encoder profile)

Example: 0001 0196h = profile DS406, absolute encoder single-turn

6.1.2 Object 1001h: Error Register

This register displays occurring device errors.

1001h	VAR	Error register	Unsigned 8	RO	M

Bit 0 = 0: no error
Bit 0 = 1: Error "No RLC coupling" (actuator not in range)
Bit 1...7: free

6.1.3 Object 1002h: Manufacturer status register

This register stores various error bits and the current status of the set limit values from object 6400h. The limit values are additionally stored in object 6401h and object 6402h.

1002h	VAR	Manufacturer status register	Unsigned 32	RO	M

Data content object 1002h :

Bit 0 =1: EEPROM error
Bit 1 =1: No RLC coupling (no resonator in range, no angle calculation possible)
Bit 2 =1: Minor RLC coupling (poss. increased non-linearity)
Bit 3…7: free (0)
Bit 8 =1: Operating range 1 out of range
Bit 9 =1: Operating range 1 underrun
Bit 10 =1: Operating range 1 underrun
Bit 11 =1: Operating range 2 out of range
Bit 12 =1: Operating range 2 underrun
Bit 13 =1: Operating range 2 underrun

6.1.4 Object 1005h: COB ID SYNC (COB ID for SYNC message)

The object defines the COB ID for the SYNC message. The object furthermore specifies, whether the device is a generator or receiver of SYNC objects.

1005h	VAR	COB ID SYNC	Unsigned 32	RW	O

Data content:
Bit 0...10: 11 bit identifier; default ID = 80h
Bit 11...29: 0 (reserved for 29-bit identifier devices)
Bit 30: 0 (device does not generate SYNC messages)
Bit 31: 1 (device is receiver for SYNC messages)

6.1.5 Object 1008h: Manufacturer device name

Contains the manufacturer's device name.

1008h	VAR	Manufacturer device name	Vis string	RO	O

Example:

RI360P0-QR24M0-CNX4-2H1150

6.1.6 Object 1009h: Manufacturer hardware version

Contains the manufacturer's version number.

1009h	VAR	Manufacturer hardware version	Vis string	RO	O

Data content:

e.g. "HW-12718801 -" in ASCII code
Hardware version (127xxxxx) incl. change index (-, A, B…)

6.1.7 Object 100Ah: Manufacturer software version

Contains the manufacturer's software version number.

100Ah	VAR	Manufacturer software version	Vis string	RO	O

Data content:

e.g. "SW-1.0.0.1" in ASCII code

6.1.8 Object 1010h: Store parameters

Writing the command "save" initiates the storing of the parameters to the non-volatile memory (EEPROM).

1010h	ARRAY	Store parameters	Unsigned 32	RW	O

The following commands are stored with this command: 1005h, 1014h, 1800h (sub-index 1 and 3), 1802h (sub-index 1), 2000h, 2001h, 2005h, 6000h, 6001h, 6002h, 6003h, 6200h.
The command will only be executed when the string "save" is entered as the codeword in this sub-index to prevent accidental saves.

NOTE
The values stored in EEPROM (power ON values) will be irretrievably overwritten with this command!

A read access to the CANopen device provides information about its capability to store these values. (Data: 01h = storage possible)

Data content:
Write access:
Byte 0: 73h (ASCII code for "s")
Byte 1: 61h (ASCII code for "a")
Byte 2: 76h (ASCII code for "v")
Byte 3: 65h (ASCII code for "e")
s a v e = 0x65766173

6.1.9 Object 1011h: Restore default parameters

This command deletes the parameters in the working memory, and rep[laces them with default values (manufacturer values, resetting of the encoder to values at time of delivery). A read access to the CANopen device provides information about its capability to restore these values. (Data: 01h = reset possible)

1011h	ARRAY	Restore default parameters	Unsigned 32	RW	O

Multiple parameter groups are distinguished:
Sub-index 00h: contains the highest supported sub-index.
Sub-index 01h: Restore all parameters refers to all parameters than can be reset.
Sub-index 02h: Restore communication parameters refers to communication-relevant parameters (index from 1000h to 1FFFh).
Sub-index 03h: Restore application parameters refers to application-relevant parameters (index from 6000h to 9FFFh).

Example: Restore all parameters
Writing the command 0x64616F6C (=load) under sub-index 01h will reset all parameters in the encoder RAM to their default values.

A read access to the sub-index offers information of whether a reset to default values is possible.
Data content:
Write access:
Byte 0: 6Ch (ASCII code for "l")
Byte 1: 6Fh (ASCII code for "o")
Byte 2: 61h (ASCII code for "a")
Byte 3: 64h (ASCII code for "d")

Read access:
Bit 0 = 1: Device supports the loading of default values

Bit 1...31 = 0: reserved

The default values become valid only after a "NMT reset". After a "NMT reset" the command "Save parameter" (see object 1010h) must also be executed if the default values are to be applied to EEPROM as well.
l o a d = 0x64616F6C

6.1.10 Object 1014h: COB D emergenc

The object defines the COB ID for emergency messages The behaviour in case of an error is described in Object 1029h "Error behaviour".

1005h	VAR	COB ID EMCY	Unsigned 32	RW	O

Data content:
Bit 0...10: 11 bit identifier; default ID = 80h + node number
Bit 11...29: reserved for 29-bit identifier devices
Bit 30, 31: reserved

Emergency objects occur in error situations within a CAN network, and will be triggered depending on the type of event, and are then transmitted via the bus with high priority.

NOTE

An emergency object will only be triggered once per event. No new object will be generated while the error persists. Once the error has been remedied, a new emergency object with content 0000h ("Error reset" or "No error") will be generated and sent to the bus.

Emergency messages for TURCK CANopen sensors:

Code 0000h = No error
An "Emergency clear" message (code 0000h) will be transmitted during startup and after the "Boot up" message.
Code 5000h = Internal software error (device return to manufacturer)
An emergency message with the code 0x5000 with the following code class will be generated if the encoder has an internal hardware error:
0x5001: Hardware ROM check error: Device defective, please return to manufacturer!
Code 6100h = Internal software error
An emergency message with the code 0x6100 with the following code class will be generated if the encoder has an internal software error:
0x4000: only warning message, no program abort
0x4810: Write buffer overflow, TPDO message lost
0x4820: Write buffer overflow, TPDO message lost
0x4830: Write buffer overflow, SDO message lost
0x4840: Write buffer overflow, heartbeat message lost
0x8000: Grave error, abort required/reset
0x8010: MCO initialisation failed
0x8021: Not in the CAN receipt filter, NMT
0x8022: Not in the CAN receipt filter, PDO
0x8023: Not in the CAN receipt filter, SDO
0x8031: Initialisation of PDO parameters out of range
0x8032: Access to process image out of range
0x8041: Outside of TPDOs
0x8042: Outside of RPDOs
0x8043: No RPDO mapping found

Code 8130h = Heartbeat error
An emergency message with code 8130h is generated if heartbeat monitoring is activated and a loss of heartbeat information is detected. The error range shows the node ID of the affected node.
Code 8200h = Protocol error
An emergency message with code 8200h is generated if a faulty NMT command (CAN message ID = 0) is received.

6.1.11 Object 1015h: Inhibit time emergency

The object defines the inhibit time for emergency messages. This object specifies the pre-configured inhibit time for the EMCY message.
The value is given in multiples of 100 µs. Select the value "0" to deactivate the inhibit time. (max. 6553 ms)

1015h	**VAR**	**Inhibit time EMCY**	**Unsigned 16**	**RW**	**O**

Default value: 0_{dec}

Value range: 0, 10…65530_{bin} (corresponds to 1 ms….6553 ms)

NOTE
Only full millisecond values are stored. In-between values are rounded up.

6.1.12 Object 1017h: Producer heartbeat time

The producer heartbeat time defines the heartbeat cycle. The time must be set to "0" if this function is not needed. The function is activated with a value of min. 1 ms. (1 ms ….32767 ms).

1017h	VAR	Producer heartbeat time	Unsigned 16	RW	O

Value range: 0…32767_{bin} (corresponds to 0 ms….32767 ms)

Default value: 0_{dec}

NOTE
A heartbeat producer transmits the heartbeat message at the specified cycle times.

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

Pre-operational: Data 7Fh
Operational: Data 05h
Stopped: Data 04h

6.1.13 Object 1018h: Identity object

This object reads the device ID.

1018h	RECORD	Device identification	Identity (23h)	RW	O

Sub-index 0h : delivers the number of entries (4 entries)
Sub-index 1h: delivers the Turck vendor ID (0000009Ch)
Sub-Index 2h: delivers the product code (e.g. Turck QR24 CANopen)
Sub-Index 3h: delivers the SW revision number (e.g. 1.0.0.1), see table "3-Point notation"
Example: Version 1.0.0.1 = 10_{dec}_01_{dec} = 0Ah_01h = 0A01h
Sub-index 4h: delivers the 8-digit serial number of the encoders

6.1.14 Object 1029h: Error behavior

In case of a grave error, the device reacts with the behaviour parametrised here.

1029h	ARRAY	Error behavior	Unsigned 8	RW	O

Error classes:

0x1029, sub-index1 / communication error
(Default 1 = sensor does not change mode):

- Bus OFF status
- Heartbeat monitoring failed

0x1029, sub-index 2 / device profile-specific
(Default 1 = sensor does not change mode):

- Error positioning element: No RLC coupling

0x1029, sub-index 3 / manufacturer-specific
(Default 1 = sensor does not change mode):

- NV RAM / EEPROM error
- System monitoring error

Value range (8 bit unsigned):
0 = sensor changes to pre-operational mode
1 = sensor does not change mode
2 = sensor changes to stopped mode

6.1.15 Object 1800h: PDO1- Parameter (asynchronous)

PDO1: Metering value output "Position" in set time cycles
The object contains the parameter for the process data object PDO1. Via this service, the process data of the encoder is output asynchronously, triggered by the internal cycle timer (prerequisite: the cycle timer was set via object 6200h).

1800h	RECORD	PDO1 parameter	PDO COMMPAR (20h)	RW	M/O

Data content:

Sub-index 0h: Number of supported sub-indices.
Read only
Value range: 2...5

Sub-index 1h: COB ID and release
Bit 0…10: 11 bit identifier; default ID = 180h + node number
Bit 11...29: 0 (reserved for 29-bit identifier devices)
Bit 30: 0 = RTR permitted (cannot be modified)
Bit 31: 0 (PDO enabled), 1 (PDO disabled);
Default value = 0

Sub-index 2h: Transmission type = 255 dec. (see overview of transmission types)
(Transmission type = asynchronous)
(Overview see object1800h)

Sub-index 3h: Inhibit time, min. waiting time until PDO can be sent again. Default value = 0h (no inhibit time)
Value range: $10…65530_{bin}$ (corresponds to 1 ms….6553 ms)

NOTE
Only full millisecond values are stored. In-between values are rounded up. Application of the values to the non-volatile memory (EEPROM) via object 1010h. Default value: 0

Sub-index 4h: Assigned

Sub-index 5h: Event timer (Setting in object 6200h)
The value range for the timer is between 1…65535 x 1 ms = 1 ms ... 65535 ms.
Event timer = 0 -> no data output
Default value:100_{dec}

NOTE
The number of possible messages is limited by the bus speed. Minimum times for event timer are valid for the operation with one PDO.

Baud rate	Messages/ms	Event timer (min)
1000 kBit/s	7,8	1 ms
500 kBit/s	3,9	1 ms
250 kBit/s	1,9	1 ms
125 kBit/s	0,97	2 ms
50 kBit/s	0,39	3 ms
20 kBit/s	0,15	7 ms
10 kBit/s	0,07	15 ms

6.1.16 Object 1801h: PDO2 parameters (synchronous, cyclic)

PDO2: Metering value output "Position" at SYNC request (80h)
The object contains the parameters for the process data object PDO 2. Via this service, the process data of the encoder are output synchronously in the default setting, initiated by SYNC objects.

NOTE
The number of possible SYNC messages is limited by the bus speed.

1801h	RECORD	PDO2 parameters	PDO COMMPAR (20h)	RW	M/O

Data content:
Sub-index 0h: Number of supported sub-indices.
Read only
Value range: 2...5

Sub-index 1h: COB ID and release
Bit 0…10: 11 bit identifier; default ID = 280h + node number
Bit 11...29: 0 (reserved for 29-bit identifier devices)
Bit 30: 0 = RTR permitted (cannot be modified)
Bit 31: 0 (PDO enabled), 1 (PDO disabled);
Default value = 0

Sub-index 2h: Transmission type = 1 dec (see overview of transmission types)
(Transmission type = synchronous, cyclic)
(Overview see object 1800h)

Sub-index 3h: Inhibit time, min. waiting time until PDO can be sent again. Default value = 0h (no inhibit time)
Value range: 10…65530bin (corresponds to 1 ms….6553 ms)

NOTE
Only full millisecond values are stored. In-between values are rounded up. Application of the values to the non-volatile memory (EEPROM) via object 1010h. Default value: 0

Sub-index 4h: Assigned

Sub-index 5h: Event timer (Setting in object 6200h)
The value range for the timer is between 1…65535 x 1ms = 1ms...65535 ms.
The event timer is without function when transmission type 1h = synchronous, cyclic
Default value: 0
Operational: Data 05h
Stopped: Data 04h

NOTE
The number of possible messages is limited by the bus speed. Minimum times for event timer are valid for the operation with one PDO. This is also valid for SNC times.

Baud rate	Messages/ms	Event timer (min)
1000 kBit/s	7,8	1 ms
500 kBit/s	3,9	1 ms
250 kBit/s	1,9	1 ms
125 kBit/s	0,97	2 ms
50 kBit/s	0,39	3 ms
20 kBit/s	0,15	7 ms
10 kBit/s	0,07	15 ms

6.1.17 Object 1802h: PDO3 parameters (asynchronous)

PDO3: Metering value output "Position" at value change
The object contains the parameters for the process data object PDO3. Via this service, the process data of the encoder is output in transmission type "Manufacturer, asynchronous" when triggered by a change in the process value.

1802h	RECORD	PDO3 parameters	PDO COMMPAR (20h)	RW	M/O

Data content:
Sub-index 0h: Number of supported sub-indices.
Read only
Value range: 2...5

Sub-index 1h: COB ID and release
Bit 0…10: 11 bit identifier; default ID = 380h + node number
Bit 11...29: 0 (reserved for 29-bit identifier devices)
Bit 30: 0 = RTR permitted (cannot be modified)
Bit 31: 0 (PDO enabled), 1 (PDO disabled);
Default value = 0

Sub-index 2h: Transmission type = 254 dec (see overview of transmission types)
(Transmission type = manufacturer, asynchronous)
(Overview see object 1800h)

Sub-index 3h: Inhibit time, min. waiting time until PDO can be sent again. Default value = 0h (no inhibit time)
Value range: 10…65530bin (corresponds to 1 ms….65535 ms)

NOTE
Only full millisecond values are stored. In-between values are rounded up. Application of the values to the non-volatile memory (EEPROM) via object 1010h. Default value: 0

Sub-index 4h: Assigned
Sub-index 5h: Event timer (Setting in object 6200h)
The value range for the timer is between 1…65535 × 1 ms = 1 ms...65535 ms.
In transmission type 254 dec = manufacturer, asynchronous and event timer ≠0, the metering values will also be output cyclically and not only in case of a value change.
Default value: 0

Baud rate	Messages/ms	Event timer (min)
1000 kBit/s	7,8	1 ms
500 kBit/s	3,9	1 ms
250 kBit/s	1,9	1 ms
125 kBit/s	0,97	2 ms
50 kBit/s	0,39	3 ms
20 kBit/s	0,15	7 ms
10 kBit/s	0,07	15 ms

6.1.18 Object 1803h: PDO4 parameters (asynchronous)

PDO4: Metering value output "Speed" in set time cycles
The object contains the parameters for the process data object PDO 4. Via this service, the process data of the encoder is output asynchronously, triggered by the internal cycle timer (prerequisite: the cycle timer was set via object 6200h).

1803h	RECORD	PDO4 parameters	PDO COMMPAR (20h)	RW	M/O

Sub-index 0h: Number of supported sub-indices.
Read only
Value range: 2...5

Sub-index 1h: COB ID and release
Bit 0…10: 11 bit identifier; default ID = 480h + node number
Bit 11...29: 0 (reserved for 29-bit identifier devices)
Bit 30: 0 = RTR permitted (cannot be modified)
Bit 31: 0 (PDO enabled), 1 (PDO disabled);
Default value = 0

Sub-index 2h: Transmission type = 255dec (see overview of transmission types)
(Transmission type = asynchronous)
(Overview see object 1800h)

Sub-index 3h: Inhibit time, min. waiting time until PDO can be sent again. Default value = 0h (no inhibit time)
Value range: 10…65530bin (corresponds to 1 ms….6553 ms)

NOTE
Only full millisecond values are stored. In-between values are rounded up. Application of the values to the non-volatile memory (EEPROM) via object 1010h. Default value: 0

Sub-index 4h: Assigned

Sub-index 5h: Event timer (Setting in object 6200h)
The value range for the timer is between 1…65535 × 1 ms = 1 ms...65535 ms.
Event timer = 0 -> no data output
Default value: 100dec

NOTE
The number of possible messages is limited by the bus speed. Minimum times for event timer are valid for the operation with one PDO.

Baud rate	Messages/ms	Event timer (min)
1000 kBit/s	7,8	1 ms
500 kBit/s	3,9	1 ms
250 kBit/s	1,9	1 ms
125 kBit/s	0,97	2 ms
50 kBit/s	0,39	3 ms
20 kBit/s	0,15	7 ms
10 kBit/s	0,07	15 ms

6.1.19 Overview transmission types

A value between 1...240 means that the PDO is sent synchronously or cyclic. The transmission type number means the number of SYNC impulses required to send the PDOs. Transmission type 252 and 253 mean that the PDO is only sent on request via RTR. Type 254 means that the event is triggered application-dependently, while number 255 is device profile-dependent. Additionally, a time-controlled event timer can be implemented for the numbers 254/255. The value range for the timer is between 1 ms…65535 ms.

Code (dec.)	Transmission type				
	cyclic	acyclic	synchronous	asynchronous	only RTR
0		X	X		
1-240	X		X		
241-251	reserved				
252*			X		X
253*				X	X
254				X	
255				X	

* not supported

Meaning of the transmission type codes:

0: Synchronous = 0x00h, after SYNC, but only in case of value change after last SYNC
1-240: Cyclic-synchronous = 0xEF , send value after SYNC
241-251: Assigned
252: Synchronous with RTR = 0xFC
SYNCH leads to internal value storage, but value must be called via RTR;
253: Asynchronous with RTR = 0xFD
Value is updated and sent after RTR(request)
254: Manufacturer (asynchronous) = 0xFE
a) Value is updated and sent after a value change (if device timer = 0) or after completion of cycle time (device timer ≠ 0)
b) Value is updated and sent after RTR(request);
c) Cyclic RTR output with event- timer possible.
d) Combination with inhibit timer (inhibit time) possible
255: Asynchronous = 0xFFh, value is updated and sent after completion of cycle time (device timer ≠ 0)

6.2 Variables PDO mapping

Variables mapping of the various objects means that the user can configure the content of the transmit PDOs application-independently.

There are two basic mapping options:

1. The properties of the PDOs can be configured individually via the object 1800h ff. (Transmission type, inhibit time, event time)Time
2. Multiple PDOs up to max. 64 bit can be transmitted using one CAN telegram. These PDOs are listed in a mapping table. -> Objects 0x1A00ff, 0x01ff = mapping table

The max. data length of the CAN telegram is 65 bit (8 byte), therefore allowing the mapping of e.g. two application object entries with 32 bit each, or four entries with 16 bit each in a mapping table (= objects 0x1A00ff, 0x01ff)

Two prerequisites must be met:

1. The overall size of the mapped objects within a PDO mapping table (objects 0x1A00ff) must not be surpass 64 bit.
2. All mapped objects in a PDO mapping table (objects 0x1A00ff) have the same transmission type, inhibit time, and event time.

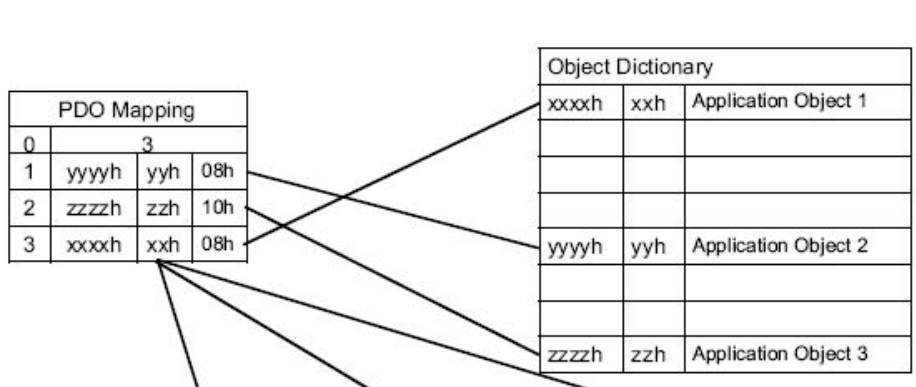
Example: Mapping tables for TPDO1 and TPDO2

1800h mapping table TPDO 1	
• Position value • Position raw value	
COB ID 1800h, 0x01	xxxxxxxx
Transmission type 1800h, 0x02	255 asynchronous
Inhibit time 1800h, 0x03	0
Event time 1800h, 0x05	100
Mapping object1 1A00h,0x01	Position value 32 bit
Mapping object 2 1A00h,0x02	Position raw value 32 bit
Mapping object 3 1A00h,0x03	No entry, as 64 bits assigned
Mapping object 4 1A00h,0x04	No entry, as 64 bits assigned

1801h mapping table TPDO 2	
• Position value • Speed value • Alarms	
COB ID 1801h, 0x01	xxxxxxxx
Transmission type 1801h, 0x02	254 synchronous
Inhibit time 1801h, 0x03	0
Event time 1801h, 0x05	0
Mapping object1 1A01h,0x01	Position value 32 bit
Mapping object 2 1A01h,0x02	Speed value 16 bit
Mapping object 3 1A01h,0x03	Alarms 16 bit
Mapping object 4 1A01h,0x04	No entry, as 64 bits assigned

Sample entry in the mapping table:

The mapped PDO consists of 3 application object entries with varying lengths:



Application object 2 occupies byte 1 (08h) in the transmission PDO. Application object 3 with a length of 16 bit (10h = 2 byte) follows, and then comes application object 1 with 1 byte length. Overall, 32 bit are assigned in this PDO.

6.2.1 Object 1A00h: PDO1 mapped object
Up to four application objects (position, speed, ...) can be transmitted in one PDO. The max. data length is 64 bit. The PDO mapping is possible only with the objects 6000h – 6FFFh.

1A00h	RECORD	PDO1 mapping parameter	PDO MAPPING (21h)	RW	M/O

Data content:

Sub-index 0h: Number of supported sub-indices.
Read only
Value range: 1...4

Sub-index 1h: 1_mapped_object (default: 0x60040020, position value)

Example:

Mapping	**TPDO1 position value**
Object:	6004h
Sub-index of the object:	00h
Data length:	20h (32 bit)

The value 0x60040020 is entered in the object 0x1A00, 0x01.
0x1010, 0x01: Save parameters, data: 0x6576617 (PWR on reset required)

Sub-index 2h: 2_mapped_object (default: no entry)

Sub-index 3h: 3_mapped_object (default: no entry)

Sub-index 4h: 4_mapped_object (default: no entry)

6.2.2 Object 1A01h: PDO2 mapped object

Up to four application objects (position, speed, ...) can be transmitted in one PDO. The max. data length is 64 bit.

1A01h	RECORD	PDO2 mapping parameter	PDO MAPPING (21h)	RW	M/O

Data content:

Sub-index 0h: Number of supported sub-indices.
Read only
Value range: 1...4

Sub-index 1h: 1_mapped_object (default: 0x60040020, position value)

Sub-index 2h: 2_mapped_object (default: no entry)

Sub-index 3h: 3_mapped_object (default: no entry)

Sub-index 4h: 4_mapped_object (default: no entry)

6.2.3 Object 1A02h: PDO3 mapped object

Up to four application objects (position, speed, ...) can be transmitted in one PDO. The max. data length is 64 bit.

1A02h	RECORD	PDO3 mapping parameter	PDO MAPPING (21h)	RW	M/O

Data content:

Sub-index 0h: Number of supported sub-indices.
Read only
Value range: 1...4

Sub-index 1h: 1_mapped_object (default: 0x60040020, position value)

Sub-index 2h: 2_mapped_object (default: no entry)

Sub-index 3h: 3_mapped_object (default: no entry)

Sub-index 4h: 4_mapped_object (default: no entry)

6.2.4 Object 1A03h: PDO4 mapped object

Up to four application objects (position, speed, ...) can be transmitted in one PDO. The max. data length is 64 bit.

1A03h	RECORD	PDO4 mapping parameter	PDO MAPPING (21h)	RW	M/O

Data content:

Sub-index 0h: Number of supported sub-indices.
Read only
Value range: 1...4

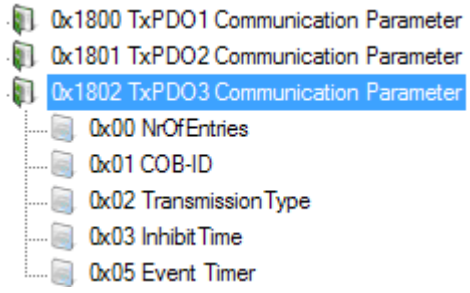
6.2.5 Example: Create mapping for PDO3 (speed)

Up to four application objects (position, speed, ...) can be transmitted in one PDO. The max. data length is 64 bit.

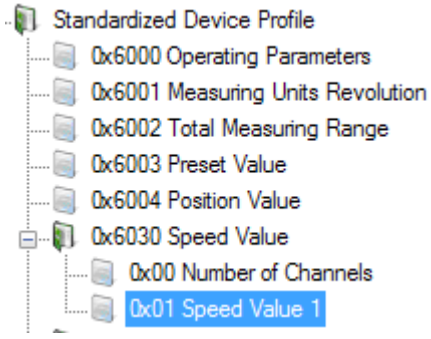
Example:

A) Configure the communication parameters via object 1802h

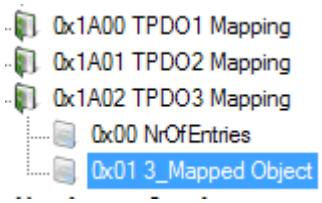
The communication parameters of the encoder are configured via object 1802h (communication parameter). These include: COB ID, transmission type, inhibit time, event time



B) Current metering values are stored in object 6030h sub-index 01h only.



C) The mapping is stored in object 1A02h sub-index 01h.



The mapping consists of the following:

Mapping TPDO3	**Speed**
Object:	6030h
Sub-index of the object:	01h
Data length:	10h (16 bit)
Mapping	0x60300110

The value 0x60300110 is entered in the object 0x1A02, 0x01.
0x1010, 0x01: Save parameters, data: 0x65766173 (PWR on reset required)

6.2.6 Default setting for transmit PDO settings

The CANopen encoder supports variable mapping on all transmit PDOs.

PDO	TPDO1	TPDO2	TPDO3	TPDO4
Mapping object	1A00h	1A01h	1A02h	1A03h
Transmission type Object: 0x1800 ff, 0x02	255h "Position" in set time cycles	001h "Position" at SYNCH request (80h)	254h "Position" at value change	255h "Speed" in set time cycles
Object of the metering value	6004h	6004h	6004h	6030h
Sub-index	00h	00h	00h	01h
Data length	20h (32 bit)	20h (32 bit)	20h (32 bit)	10h (16 bit)
Mapping	0x60040020	0x60040020	0x60040020	0x60300110

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

The default assignment of the process data objects (default mapping) will generally satisfy requirements. For special use cases, the assignment can be changed: Many TURCK CANopen devices support variable mapping, which allows the free assignment of application objects (input and output data) to PDOs. This will require a configuration of the mapping tables: Only the following procedure is permissible as of CANopen version 4, which must be complied with to the letter:

1. 0x1800ff, sub-index 1, COB ID, set bit 31 to "1" (lock PDO)
   Data: 0x4000 019B -> 0xC000 019B (example)
2. 0x1A00ff, sub-index 0, set number of mapping entries to"0"
   Data: 0x01 -> 0x00 (example: one entry to zero entries)
3. 0x1A00ff, change sub-index 1(…8)
   Data: 0x6004 0020 -> 0x600C 0020 (example)
4. 0x1A00ff, sub-index 0, set number of mapping entries to "1, 2, 3…".
   Data: 0x00 -> 0x01 (example: one entry)
5. 0x1800ff, sub-index 1, COB ID, set bit 31 to "0" (unlock PDO)
   Data: 0xC000 019B -> 0x4000 019B (example)

6.3 Objects 2000h – 2FFFh (manufacturer specifications)

6.3.1 Object 2100h: Baud rate

The Baud rate without LSS service is set via this object.

2100h	VAR	Baud rate	Unsigned16	RW	M

NOTE
A password is necessary to change the object. Service pass code object 0x2900, 0x01 (Unsigned32). The password is 12345 (dec) resp. 0x3039.

Takes effect after next reset/power ON reset

Object 0x2100	sub-index: 0x00	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)
		Default 125 kbps		

6.3.2 Object 2101h: Node number

The node number can be changed using software via this object. The default value is 0x03h. The device will boot with a changed node address after next activation or "Reset node" if the value is set between 1...127.

2101h	VAR	Node number	Unsigned8	RW	M

NOTE
A password is necessary to change the object. Service pass code object 0x2900, 0x01 (Unsigned32). The password is 12345 (dec) resp. 0x3039.

Value range: 1…127 or 1…7Fh
Default settings: 03h

NOTE
Node number 0 is reserved and must not be used by any other node.

A new node number is applied only after the next boot-up (Reset/Power ON) of the encoder, or via a NMT Reset Node command. All other settings in the object table remain unchanged.

6.3.3 CANbus termination

This object enables/disables the bus termination. An integrated 120 Ω terminating resistor will be enabled/disabled accordingly.

2102h	VAR	CAN bus termination	Unsigned8	RW	M

The change takes effect when "Save all bus parameters" (0x2105) is executed

Access: R/W
Value range: 8 bit unsigned

1=termination on
0=termination off

6.3.4 Object 2104h: NMT autostart

The start-up mode of the encoder is specified via this object.

2104h	VAR	NMT autostart	Unsigned8	RW	M

Object 0x2104 sub-index: 0x00 Data: 0 = Pre-operational
Data: 1 = Operational

6.3.5 Object 2105h: PDO trigger threshold

Up to four application objects (position, speed,...) can be transmitter in one PDO. The max. data length is 64 bit.

2105h	VAR	PDO trigger threshold	Unsigned8	RW	M

Setting the PDO trigger threshold:

Configure the trigger threshold for the angle change as follows:
Object 0x2105 sub-index: 0x00 Data: 0…255 (unsigned 8)
Default = 20

Example: For the PDO to be transmitted automatically, the position value must change by at least 10 if the value is set to 10.

NOTE

The PDO function "Transmit when angle changes" (transmission type = 254 dec.) must be enabled. Configure the desired PDOs as follows: Object: 0x1800ff , sub-index:0x02, Data: 0xFE(Manufacturer).

6.3.6 Object 2106h: Filter configuration

Two filter types can be selected for filtering metering values. A configurable low pass filter and a configurable dynamic filter.

2106h	VAR	Filter configuration	Unsigned8	RW	M

At standstill (motion detection), the filter is operated with a low threshold frequency (high group delay), allowing for minimal signal noise at high resolution. A low pass filter (moving average) is a first order type. The dynamic digital filter is status and speed-dependent. The filter constant can be set in object 2106h, sub-index 0x02. A switchover to a high threshold frequency occurs (low group delay), when the positioning element is moved.

The filters can be selected as follows:

Object: 0x2106 sub-index: 0x01 Data: 0 = Filter OFF
1 = Low pass filter ON
2 = Dynamic IIR filter ON

Configuring the filter constant. The setting applies for both filter types:

Object: 0x2106 sub-index: 0x02 Data: 1…255 (Default =20)

NOTE

It will take several seconds for the current metering value to level out if the values selected for the filter constant are very high (higher than 50).

6.3.7 Object 2110h: Customer memory

The start-up mode of the encoder is specified via this object.

2110h	VAR	Customer memory	Unsigned32	RW	M

0x2110, 0x01…0x04 Customer memory range
- Four number values can be stored here in the range unsigned 32.
- The stored data is informal and have no impact on the function of the encoder.
- e.g. Installation date: 2014 = 11111011110b

6.3.8 Object 2200h: Sensor Amplitude (Manufacturer)

The access on the actually sensor amplitude (resonant circuit coupling) is possible via this object.

2200h	VAR	Sensor Amplitude	Unsigned16	RO	M

0x2200, 0x00 - The value should be min. 1200dec.
- Can be mapped via PDO.
- Not available in the EDS file.

NOTE

A password is necessary to change the object. Service-pass code object 0x2900, 0x01 (Unsigned32). The password is 12345 (dec) resp. 0x3039.

6.3.9 Object 2201h: Target Frequence Deviation (Manufacturer)

The access on the actually frequency deviation of the resonant circuit is possible via this object.

2201h	VAR	Target Frequence Deviation	Integer16	RO	M

0x2201, 0x00 - The value of ±9375dec should not be exceeded/underrun
- Can be mapped via PDO.
- Not available in the EDS file.

NOTE

A password is necessary to change the object. Service-pass code object 0x2900, 0x01 (Unsigned32). The password is 12345 (dec) resp. 0x3039.

6.4 Objects 6000h – 6FFFh (default device parameters)

6.4.1 Object 6000h: Operating parameters

This object activates: code sequence reversal, diagnostics request, scaling function.

6000h	VAR	Operating parameters	Unsigned16	RW	M

Data content:

Bit 0: Code sequence; 0 = Ascending when rotation is clockwise (cw)
1 = Ascending when rotation is counter-clockwise (ccw)
Default: Bit = 0

Bit 1: free (0)

Bit 2: Scaling function; (scaling configuration via object 6001,6002)
0 = disable (sensor outputs raw data)
1 = enable (see object 6001h, 6002h)
Default: Bit = 1

NOTE
The scaling function is available only for Device_Type 0 and 1. See: Objects 2900h 0x03 and 2900h, 0x04.

Bit 3...12: free (0)

Bit 13: Speed format;
0 = Revolutions/minute (RPM)
Default: Bit = 0

Bit 14…15: free (0)

6.4.2 Object 6001h: MUR (Measuring Units per Revolution)

This parameter sets the desired resolution per revolution.

6001h	VAR	Measuring units per revolution	Unsigned32	RW	M

The encoder calculates the relevant scaling factor internally. Prerequisite: Scaling function bit 2 of object 6000h = 1

Value range: 1 … max. physical resolution (full range)
RI360P0-QR24M0-CNX4-2H1150: 327680 = full range
Default settings: 36000

NOTE
The max. physical resolution is a factory setting in object 6501h (read only). In object 6000h bit 2: Set scaling function to enable (1).

6.4.3 Object 6001h: TMR (Total Measuring Range)

This object specifies the measuring range.

6002h	VAR	Total measuring range	Unsigned32	RW	M

Value range: 1…max. physical resolution (full range)
RI360P0-QR24M0-CNX4-2H1150: 327680 = full range

Default settings: 36000
TMR = MUR / n, n=1, 2 ,3… applies if the encoder us used in single-turn mode.

MUR: Object 6001h
TMR: Object 6002h
At a physical zero crossover, a skip will occur in the source code (in single-turn mode after every rotation).

NOTE
In object 6000h bit 2: Set scaling function to enable (1).

Example 1:

Setting: 6001h: MUR= 3600 (value range: 1 … max. phys. resolution)
6002h: TMR= 360 (value range: TMR = MUR/n, n=1, 2 ,3…)

Output: One revolution is divided into 10 × 0…360

Example 2:

Setting: 6001h: MUR= 3600
6002h: TMR= 3600

Output: One revolution is divided into 0…3600

Example 3 skip in the source code:

Setting: 6001h: MUR= 3600
6002h: TMR= 3000

Output: One revolution is divided into 0…3000 and 0…600

NOTE
The max. physical resolution is a factory setting in object 6501h (read only). In object 6000h bit 2: Set scaling function to enable (1).

6.4.4 Object 6003h: Preset value

The position value of the encoder is configured to this preset value. This allows e.g. an endpoint alignment of the encoder with the machine endpoint.

6003h	VAR	Preset value	Unsigned32	RW	O/M

Value range: Ri360P0-QR24M0-CNX4-2H1150: 1…327680

Default settings: 0

During the input of the preset value, the device automatically checks whether the point is within the enabled scaling or the total measuring range, otherwise the input will be rejected.

Example 1:
Currently read measuring value: 33
Preset value: Write the value 0 to object 6003h.
Result offset: The measuring value changes from 33 to 0. The endpoint is moved by -33.

Example 2:
Currently read measuring value: 33
Preset value: Write the value 50 to object 6003h.
Result offset: The measuring value changes from 33 to 50. The endpoint is moved by +17.

The offset value is calculated and stored additionally in object 0x6509, 0x00.

Offset value = preset value - position measuring value

6.4.5 Object 6004h: Position value

The encoder outputs the current position value (poss. after calculation with scaling factor).

6004h	VAR	Position value	Unsigned32	RO	M

Data:

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

Value range: 0... max. physical resolution
Default: actual position

6.4.6 Object 600Ch: Position raw value

The encoder outputs the current position value in max. physical resolution (no scaling).

600Ch	**VAR**	**Position raw value**	**Unsigned32**	**RO**	**O/M**

Value range:

RI360P0-QR24M0-CNX4-2H1150: 0…327680 (full range)

6.4.7 Object 6030h: Speed value

The encoder outputs the currently calculated speed in rpm.

6030h	**VAR**	**Speed value**	**Signed16**	**RO**	**O**

This value is output in a read access with object 6030h as a signed 16 bit value.
Positive value = clockwise rotation
Negative value = counter-clockwise rotation

Value range: 0…max. speed 1500 rpm.

Example: 500 rpm counter-clockwise -> - 500dec

A warning message is issued for speeds higher than 1500 rpm, and the warning bit "Speed range" bit 6 in object Warnings 6505h is set. Relevant mapping will allow the output of the speed via PDO.

NOTE
Prerequisite here is that bit 13 (Speed format) in object 6000h is set to 0.

6.4.8 Object 6200h: Cycle timer

Defines the cycle time in which the current position is output via PDO1 (see object 1800h). The timer-controlled output is enables as soon as a cycle time >0 is entered. Applies to PDO1 only.

6200h	**VAR**	**Cyclic timer**	**Unsigned16**	**RW**	**M/O**

Note: This object only remains for reasons of compatibility with older profile versions. In the current transmit PDO, the event timer sub-index (05h) should be used instead.

Value range: 0…FFFFh (65535dec) provides the cycle time in milliseconds.
Default value: 100dec

NOTE
No measuring value output occurs if cycle time = 0.

6.4.9 Object 6400h: Work area state register

This object contains the current status of the encoder position in relation to the programmed limits. Depending on position of the two endpoints, flags are set or reset. Where the measuring values are within the work area, bits 0...7 will have **the value 0.**

6400h	VAR	Area state register	Unsigned8	RO	O

Object 0x6400, 0x01, work area state register channel 1 (Unsigned8)

Bit 0 =1: Outside of work_area_1
Bit 1 =1: Greater than high_limit_1
Bit 2 =1: Less than low_limit_1
Bit 3…7:free (0)

Data: 05h = Position value < low limit
Data: 00h = Position value within limit
Data: 03h = Position value > high limit

Object 0x6400, 0x02, work area state register channel 2 (Unsigned8)

Bit 0 =1: Outside of work_area_2
Bit 1 =1: Greater than high_limit_2
Bit 2 =1: Less than low_limit_2
Bit 3…7:free (0)

Data: 05h = Position value < low limit
Data: 00h = Position value within limit
Data: 03h = Position value > high limit

NOTE

The two end value objects 6401h and 6402h must be checked to ensure the correct activation of the output signals. These limit values are additionally stored in the object 0x1002 "Manufacturer status register", and can therefore also be mapped as PDO.

6.4.10 Objects 6401h and 6402h: Working area limits

These two parameters set the working area. The status can be reported via flag bytes within and outside of this area (object 6400 "Working area state"). These area markers can also be used as software end switches.

6401h/02h	VAR	Working area limits H/L	Integer32	RW	O

Object 6401h: Working area LOW limit 2 values
Object 6402h: Working area HIGH limit 2 values

Value ranges:

Ri360P0-QR24M0-CNX4-2H1150: 0… 327680 dec. (full range)

Default setting:

Working area LOW limit: 0_{dec}
Working area HIGH limit: 0_{dec}

Example 1:

Set measuring range to 3600 using 6001h and 6002h.
Limit values range 1: 0…3600, range 2: 0…3600, i.e. all measuring values 0…3600 must be in the range.

0x6400, 0x00 = 0x01 -> 1 channel
0x6400, 0x01 = 0x09 -> 0000 1001-> values in range 1 and range 2 (see 6400h)

0x6401,0x00 = 0x02
0x6401,0x01 = 0 (low limit 1)
0x6401,0x02 = 0 (low limit 2)

0x6402,0x00 = 0x02
0x6402,0x01 = 3600 (high limit 1)
0x6402,0x02 = 3600 (high limit 2)

Example 2:

Limit values range 1: 900…3600 (90°…360°), range 2: 1800…3600 (180°…360°)
Current measuring value: 450 (45°)

0x6400, 0x00 = 0x01 -> 1 channel
0x6400, 0x01 = 0x24 -> 0100 0100 -> values in range 1 and range 2 < low limit (see object 6400h)

0x6401,0x00 = 0x02
0x6401,0x01 = 900 (low limit 1)
0x6401,0x02 = 1800 (low limit 2)

0x6402,0x00 = 0x02
0x6402,0x01 = 3600 (high limit 1)
0x6402,0x02 = 3600 (high limit 2)

6.4.11 Object 6500h: Operating status read only

This is where the basic settings can be read from object 6000h.

6500h	**VAR**	**Operating status**	**Unsigned16**	**RO**	**M**

6.4.12 Object 6501h: Single-turn resolution (read only)

This is where the basic settings can be read from object 6000h. Resolution value (max. phys. resolution) is stored in the encoder, and can only be read.

6501h	VAR	Single-turn resolution	Unsigned32	RO	M

Resolution value:

RI360P0-QR24M0-CNX4-2H1150: 327680
Item No.: 1590914

6.4.13 Object 6502h: Number of distinguishable revolutions (read only)

Number of possible multi-turn revolutions

6502h	VAR	Number of distinguishable revolutions	Unsigned16	RO	M

Number of revolutions:

RI360P0-QR24M0-CNX4-2H1150: 1
Item No.: 1590914

6.4.14 Object 6503h: Alarms (read only)

The object 6503h offers more error message options in addition to the errors reported in emergency messages. The relevant error bit is set to 1 until the error has been remedied.

6503h	VAR	Alarms	Unsigned16	RO	M/O

Data content:

Bit 0…14: free
Bit 15: 1 = no RLC coupling, no position metering possible

In the event of an alarm, an emergency message (ID = 80h + node number) with error code 1000h (generic error) is sent simultaneously.

6.4.15 Object 6504h: Supported alarms (read only)

This object offers information about which alarm messages are supported by the encoder (see object 6503h).

6504h	VAR	Supported alarms	Unsigned16	RO	M/O

Data content:

Bit 0…14: free
Bit 15: 1 = Check for "No RLC coupling" is supported

6.4.16 Object 6505h: Warnings (read only)

Warning messages show that tolerances of internal encoder parameters have been breached. When a warning message is displayed, the measuring value can still be valid (other than with alarm or emergency messages). The relevant warning bit is set to 1 until the tolerance breach has been remedied.

6505h	VAR	Warnings	Unsigned16	RO	M/O

Data content:

Bit 0…5: free
Bit 6: 1 = Overrun of permissible speed (speed range);
Bit 7…14: free
Bit 15: 1 = Amplitude (RLC coupling) weak, but measuring value OK

6.4.17 Object 6506h: Supported warnings (read only)

This object offers information about which warning messages are supported by the encoder (see object 6505h).

6506h	VAR	Supported warnings	Unsigned16	RO	M/O

Data content:

Bit 0…5: free
Bit 6: 1= Warning message "Overspeed" is supported.
Bit 7…14: free
Bit 15: 1= Warning message "RLC coupling weak" is supported.

6.4.18 Object 6507h: Profile and software version (read only)

The first 16 bit contain the version number of the encoder profile applied. The second 16 bit contain the number of the software version implemented in the encoder.

6507h	VAR	Profile and software version	Unsigned32	RO	M/O

Software version
Example: 1.2.3.4

Profile version

The version of the CiA DS-406 profile is stored

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} = 03h_02h

Software version: 1.0.0.1= 10_{dec}_01_{dec} = 0Ah_01h

Byte 3	Byte 2	Byte 1	Byte 0
0Ah	01h	03h	02h

6.4.19 Object 6509h: Offset value (read only)

A preset value entered via object 6003h is converted internally into a relevant offset value. Object 6509h displays the calculated offset value.

6509h	**VAR**	**Offset value**	**Signed32**	**RO**	**M/O**

The offset value is calculated as follows: Offset = preset - position

6.4.20 Object 650Ah: Module identification (read only)

This object contains various manufacturer-specific data. These include the manufacturer-specific offset value, and the min. and max. position values. All values are stated in the number of steps following the basic resolution of the encoder.

650Ah	**VAR**	**Module identification**	**Signed32**	**RO**	**M/O**

Data content:

0x650A, 0x00	Number of entries
0x650A, 0x01	Manufacturer offset value
0x650A, 0x02	Manufacturer minimum position value
0x650A, 0x02	Manufacturer maximum position value

6.4.21 Object 650Bh: Serial number (Read only)

This object contains the serial number of the encoder.

650Bh	**VAR**	**Serial number**	**Unsigned32**	**RO**	**M**

NOTE

All other objects not listed here are for additional information purposes only, and can be found in the encoder profile DS406 3.1.

6.5 LSS services DS 305 V2.0

CiA DSP 305 CANopen layer setting service and protocol (LSS) were created to allow the reading and modification of the following parameters via the network:

- Node address
- Baud rate
- LSS address

These capabilities enhance the plug & play compatibility of the device, and significantly simplify the configuration options. The LSS master is in charge of the configuration of these parameters for one or more slaves in the network.

LSS services

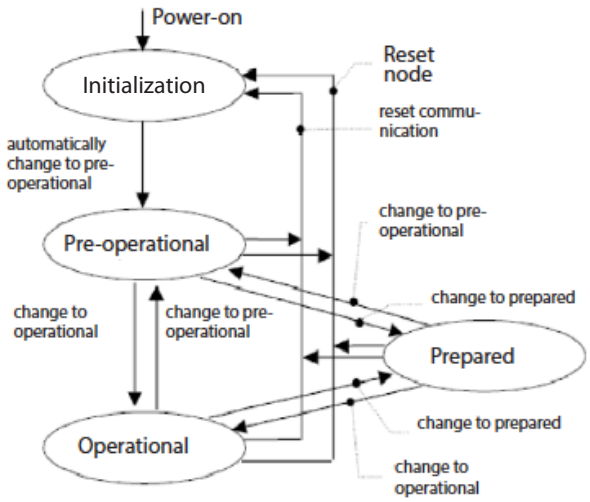
LSS hardware requirements (LSS address)

All LSS slaves must have a valid object entry for the identity object [1018h] in the object register to allow a selective node configuration. This object consists of the following sub-indices:

- 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

6.6 Network management

The encoder supports the simplified network management (minimum boot-up) defined in the profile for minimum capability devices.
The following status diagram in accordance with DS 301 shows the various node states and relevant network commands (controlled by the network master via NMT services):



Initialization: This is the initial state of the device after connection to the power supply following a reset or power-up. The node automatically cycles to the status "pre-operational", once the reset/initialisation routines are completed. The LEDs show the current device status.

Pre-operational: The CAN node can now be addressed via SDO messages or with NMT commands under the default identifier. The programming of the encoder and communication parameters is executed.

Operational: The node is enabled. Process values are output via the PDOs. All NMT commands can be evaluated.

Prepared or stopped: In this state, the node is no longer enabled, i.e. no SDO or PDO communication is possible. The node can be cycled to the status "Operational" or "Pre-operational" via NMT commands.

NOTE
The Encoder-LED might be different from the selected node-condition.

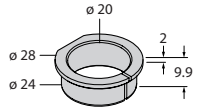
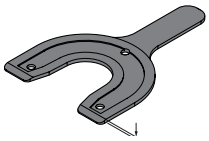
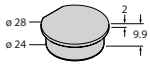
7 Accessory

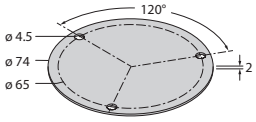
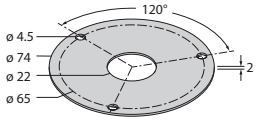
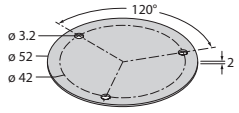
7.1 Assembly accessories

A wide range of accessories is available for the assembly of the sensor.

7.2 Standard assembly accessories

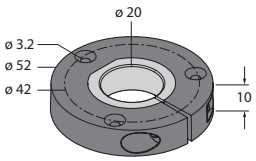
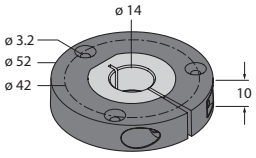
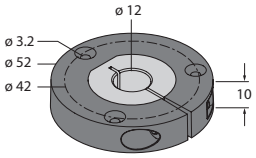
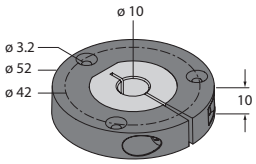
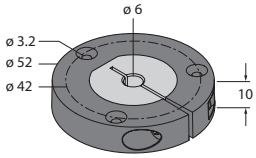
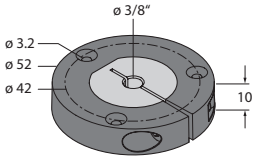
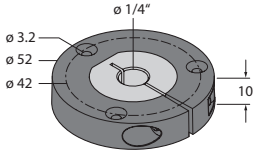
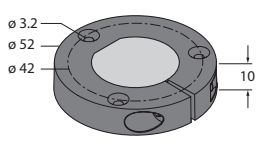
A matching assembly set is available for each device type (see type key, chapter 2.2). The assembly sets contain the aluminium ring M1-QR24 and a shield plate (SP1-QR24 or SP2-QR24, or SP3-QR24).

Dimension drawing	Type	Description
not shown	RKC 572-*M	Cordset for the connection of the sensor to CANopen (female)
	RSC 572-*M	Cordset for the connection of the sensor to CANopen (male)
	RA1-QR24	Adapter sleeve for connection on shafts with Ø 20 mm
	RA2-QR24	Adapter sleeve for connection on shafts with Ø 14 mm
	RA3-QR24	Adapter sleeve for connection on shafts with Ø 12 mm
	RA4-QR24	Adapter sleeve for connection on shafts with Ø 10 mm
	RA5-QR24	Adapter sleeve for connection on shafts with Ø 6 mm
	RA6-QR24	Adapter sleeve for connection on shafts with Ø 3/8"
	RA7-QR24	Adapter sleeve for connection on shafts with Ø 1/4"
	MT-QR24	Mounting aid for optimised alignment of positioning element
	RA8-QR24	Blind plug for the assembly of the positioning element

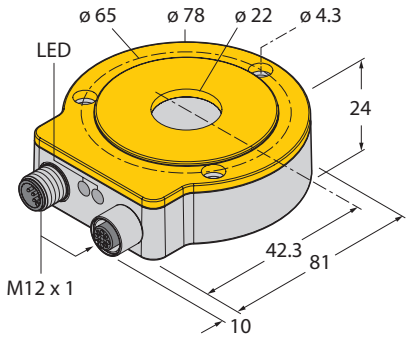
Set	Description
M2-QR24	M1-QR24 + SP1-QR24 Shield plate Ø 74 mm, aluminium 
M3-QR24	M1-QR24 + SP2-QR24 Shield plate Ø 74 mm, with borehole for shaft feed through, aluminium 
M4-QR24	M1-QR24 + SP3-QR24 Shield plate Ø 52 mm, aluminium 

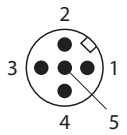
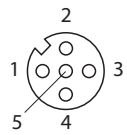
7.3 Positioning element

A variety of positioning elements can be implemented.
The positioning elements are connected to the moving parts of the machine, but are themselves capable of free movement (without any mechanical connection to the sensor) across the active surface of the sensor.

Dimension drawing	Type	Description
	P1-Ri-QR24	Positioning element for connection on shafts with Ø 20 mm
	P2-Ri-QR24	Positioning element for connection on shafts with Ø 14 mm
	P3-Ri-QR24	Positioning element for connection on shafts with Ø 12 mm
	P4-Ri-QR24	Positioning element for connection on shafts with Ø 10 mm
	P5-Ri-QR24	Positioning element for connection on shafts with Ø 6 mm
	P6-Ri-QR24	Positioning element for connection on shafts with Ø 3/8"
	P7-Ri-QR24	Positioning element for connection on shafts with Ø 1/4"
	P8-Ri-QR24	Positioning element with blind plug

8 Technical data



Connection diagram	
CAN IN	**CAN OUT**
	

Measuring range specifications	
Measuring range	0…360° Single-turn operation
System	
Resolution	16 bit
Repeatability	0.01 %
Linearity deviation	≤ 0.05 % full scale
Temperature drift	≤ ± 0.003 %/K
Ambient temperature	-25…+85 °C
Electrical data	
Operating voltage	15…30 VDC
Residual ripple	≤ 10 % U_{ss}
Rated insulation voltage	≤ 0.5 kV
Reverse polarity protection	yes (voltage supply)
Output function	5-core, CANopen
Process data area	parametrisable
Sampling rate	800 Hz … 1 kHz
Current consumption	< 50 mA
Design	
Dimensions	81 × 78 × 24 mm
Housing material	metal/plastic, ZnAlCu1/PBT-GF30-V0
Connection	2 × male connectors, M12 x 1, 5-pin CAN IN and CAN OUT
Vibration resistance	EN 60068-2-6, 55 Hz
Oscillation resistance	20 g; 10...3000 Hz; 50 cycles; 3 axes
Shock resistance	EN 60068-2-27, 30 g
Continuous shock resistance	40 g; 6 ms ½ sinus; 4000x each; 3 axes
Protection type	IP67 / IP69K
LED displays	
Operating voltage display	LED green
Signal status	LED, yellow, flashing yellow
Operating status	LED green, flashing green
Error indication	LED red, flashing red
Miscellaneous	
Included in the scope of delivery	Assembly aid MT-QR24 VZ 3 screw plug

9 Service

The fault-free condition of the connections and cables must be verified periodically. The device itself is maintenance-free; clean with dry cloth where necessary.

10 Repairs

This device is not intended for repair by the user. Please take the device offline if it is defective. Please note our returns conditions for any returns to TURCK.

11 Device returns

Please note that we can only accept the return of devices accompanied by a decontamination declaration, should it become necessary to return a device. The declaration form is available for download at http://www.turck.de/static/media/downloads/Dekontamination_de.pdf, must be filled out completely, and must be attached to the exterior of the packaging in a transport-safe and weather-proof sleeve.

12 Disposal

This device is intended for integration in large industrial plants and tool assemblies. The devices must be disposed of correctly and cannot be disposed of in regular household waste.

Turck Inc. sells its products through Authorized Distributors. These distributors provide our customers with technical support, service and local stock. Turck distributors are located nationwide – including all major metropolitan marketing areas.
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1-800-544-7769

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