Your Global Automation Partner

TURCK

REM…|RES…
Encoders with CANopen Interface

Instructions for Use

Contents

1 About these instructions

These instructions for use describe the structure, functions and the use of the product and will help you to operate the product as intended. Read these instructions carefully before using the product. This is to avoid possible damage to persons, property or the device. Retain the instructions for future use 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 used

The following symbols are used in these instructions:

	**DANGER** DANGER indicates a dangerous situation with high risk of death or severe injury if not avoided.
	**WARNING** WARNING indicates a dangerous situation with medium risk of death or severe injury if not avoided.
	**CAUTION** CAUTION indicates a dangerous situation of medium risk which may result in minor or moderate injury if not avoided.
	**NOTICE** NOTICE indicates a situation which may lead to property damage if not avoided.
	**NOTE** NOTE indicates tips, recommendations and useful information on specific actions and facts. The notes simplify your work and help you to avoid additional work.
▶	**CALL TO ACTION** This symbol denotes actions that the user must carry out.
⇨	**RESULTS OF ACTION** This symbol denotes relevant results of actions.

1.3 Other documents

Besides this document, the following material can be found on the Internet at www.turck.com:

- 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

These instructions apply to the following encoders with CANopen interface:

- RES-25
- RES-33
- RES-52
- RES-53
- RES-184
- RES-185
- RES-188
- RES-189
- REM-101
- REM-102
- REM-105
- REM-106
- REM-E-121

2.2 Scope of delivery

The scope of delivery includes:

- Encoder – sensor
- Quick Start Guide

2.3 Turck service

Turck supports you with your projects, from initial analysis to the commissioning of your application. The Turck product database under www.turck.com contains software tools for programming, configuration or commissioning, data sheets and CAD files in numerous export formats.

The contact details of Turck subsidiaries worldwide can be found on p. [▷ 43].

3 For your safety

The product is designed according to state-of-the-art technology. However, residual risks still exist. Observe the following warnings and safety notices to prevent damage to persons and property. Turck accepts no liability for damage caused by failure to observe these warning and safety notices.

3.1 Intended use

The encoders with a CANopen interface are used to measure angular movements. To do this, the devices record mechanical rotary movements and convert them into digital output signals.

The devices may 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 industrial areas. When used in residential areas, take measures to avoid radio interference.
- The device may only be assembled, installed, operated, parameterized and maintained by professionally-trained personnel.
- The device may only be used in accordance with applicable national and international regulations, standards and laws.
- If safe operation is no longer guaranteed: Take the device out of operation and ensure that it cannot be switched on again accidentally.

4 Product description

The REM… and RES… encoders with a CANopen interface are available as solid shaft or hollow shaft versions. Devices are available in three sizes ranging from 36 to 58 mm.

The CANopen encoders supply the current angle position in digital form via process data objects (PDO).

4.1 Device overview

fig. 1: Example — encoder with hollow shaft

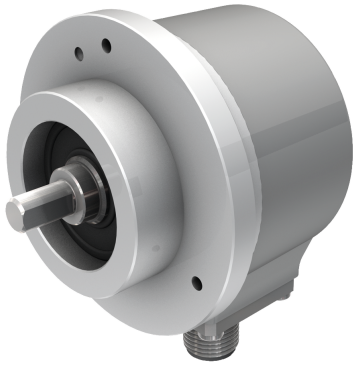


fig. 2: Example — encoder with solid shaft

4.1.1 Display elements

The device has two LED displays.

4.2 Operating principle

Encoders detect rotational movements, such as the angle velocity of a shaft. Encoders convert the rotational movements into electrical signals. The devices pass on the electrical signals to a higher-level controller for evaluation. Encoders are designed as absolute and incremental encoders with hollow or solid shafts.

Absolute encoders also supply the angle value after a startup if the value has changed when deactivated. Incremental encoders only detect position changes when active by counting periodic patterns. This normally involves the optical scanning of a rotating disk.

4.3 Functions and operating modes

4.3.1 Output function

The device has a CANopen interface that complies with the following standards:

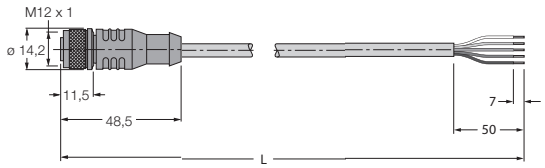
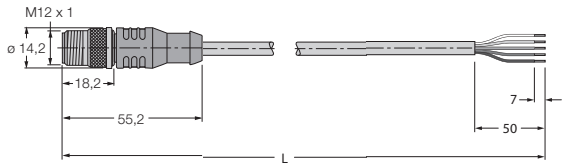
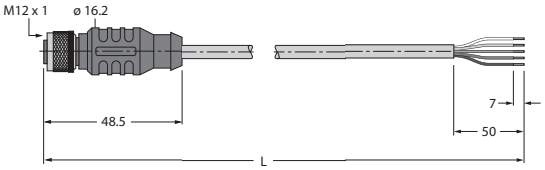
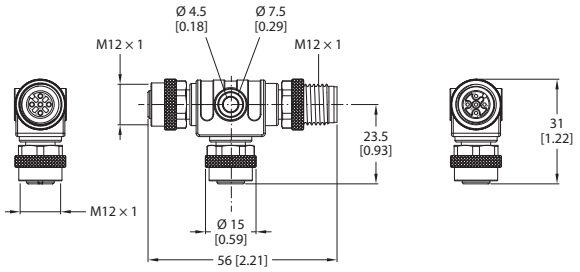
- CAL-based Communication Profile for Industrial System
- CiA Draft Standard 301 Communication Profile
- CiA Draft Standard 302-3 Framework for CANopen Managers (Bootloader)
- CiA Draft Standard 305 Layer Setting Services
- CiA Draft Standard 406 Device Profile for Encoders

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.

4.3.2 Terminating resistor

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

4.4 Technical accessories

Dimension drawing	Type	ID	Description
	RKC5701-5M	6931034	Bus cable for CAN (DeviceNet, CANopen), M12 female connector, straight, A-coded, cable length 5 m, jacket material: PUR, anthracite, open end; other cable lengths and versions available, see www.turck.com
	RSC5701-5M	6931036	Bus cable for CAN (DeviceNet, CANopen), M12 male connector, straight, A-coded, cable length 5 m, jacket material: PUR, anthracite, open end; other cable lengths and versions available, see www.turck.com
	RKC 572-2M	U5311-02	Bus cable for CAN (DeviceNet, CANopen), M12 female connector, straight, A-coded, cable length 2 m, jacket material: PVC, gray, open end; other cable lengths and versions available, see www.turck.com
	RKC 572-xM/ S3117	U-54470	Bus cable for CAN (DeviceNet, CANopen), M12 female connector, without drain connection to pin 1 on BUS, straight, A-coded, cable length 2 m, jacket material: PVC, gray, open end; other cable lengths and versions available, see www.turck.com
	FSM-2FKM57	6622101	T-splitter without cable for CAN (DeviceNet, CANopen), M12 adapter, 5-pin

5 Installing

NOTICE
Incorrect mounting
Risk of damage to the sensor

- Do not modify or disassemble the encoder.
- Do not make adjustments to the shaft after mounting.
- Do not use a hammer to align the device.
- Avoid impact loads.
- Load the encoder shaft only within the permissible values (see technical data).
- Do not rigidly connect the rotary encoder to shafts and flanges at the same time. Use the coupling between the drive shaft and the encoder shaft or the hollow shaft encoder flange.

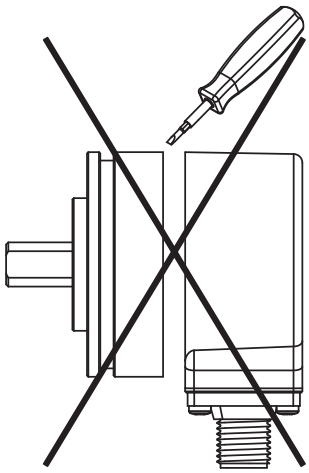


fig. 3: Mounting view — do not open

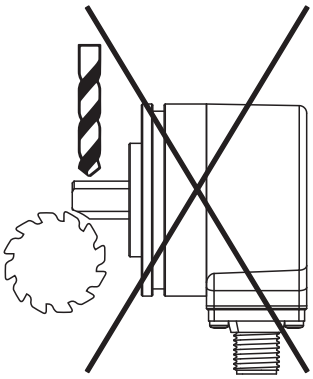


fig. 4: Mounting view — do not make adjustments after mounting

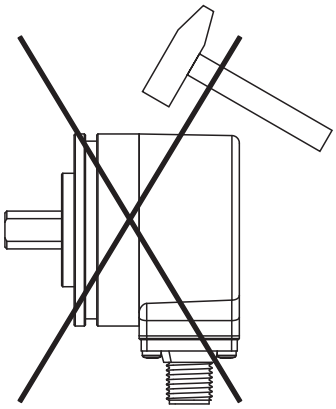


fig. 5: Mounting view — do not use a hammer to align the device

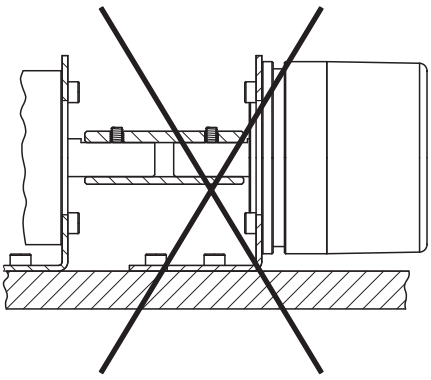


fig. 6: Mounting view — do not rigidly connect the device to shafts and flanges at the same time

5.1 Mounting the solid shaft encoder using a coupling

- Check shaft for displacement.
- Refer to the technical data for the coupling for the maximum axial displacement, radial displacement, and angular displacement values.

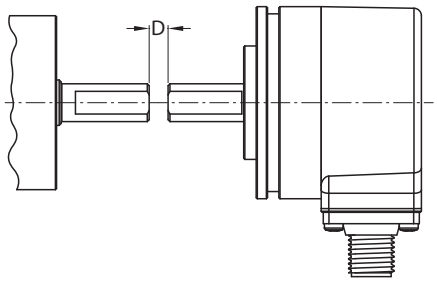


fig. 7: Axial displacement

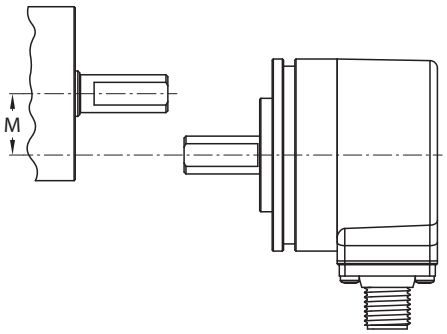


fig. 8: Radial displacement

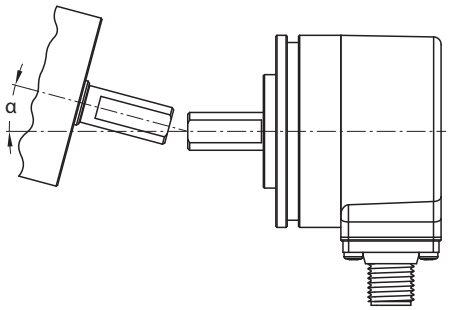


fig. 9: Angular displacement

- During mounting, protect the coupling against excessive bending and damage.
- Align the coupling on the shaft.
- Secure the coupling on the device using tensioning screws or clamping screws. For the maximum tightening torque, refer to the data sheet of the screws used.

5.2 Mounting the hollow shaft encoder using a coupling

▶ Mount the encoder with the coupling on the shaft.

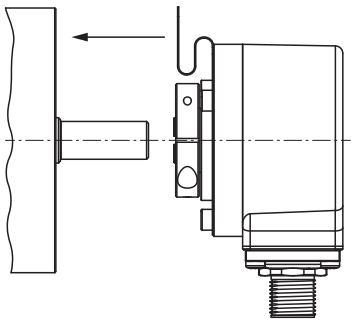


fig. 10: Mounting on the shaft with the coupling

▶ Screw the coupling to the drive flange.

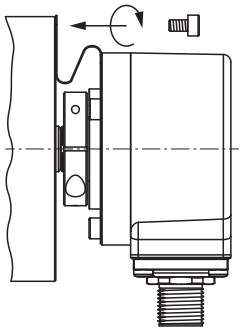


fig. 11: Screwing the coupling to the drive flange

▶ Carefully tighten the clamping hub.

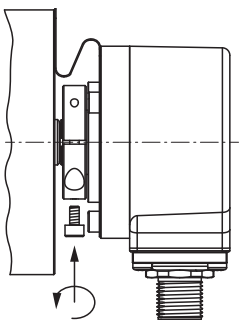


fig. 12: Tightening the clamping hub

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

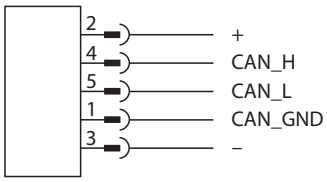


fig. 13: Wiring diagram

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 Tcoupler and looped-through bus. An optional T-coupler is available [▶ 9], see **www.turck.com**.

7 Commissioning

▶ If the red LED flashes for one second after commissioning, check the following CAN connection parameters:

- CAN_H
- CAN_L
- Active CAN node must be present.
- Termination
- Transmission rate (default 250 kbps)

▶ Set the bus parameters via **LSS services** or **bus parameters**:

- Transmission rate: Object 0x2100 transmission rate 250 kbps
- Node address: Object 0x2101 node address 0x3F
- Termination: Object 0x2102 termination 0x1
- Save: Object 0x2105 Save All Bus Parameters

If the bus parameters are set correctly, the LED flashes green (pre-operational mode) and bootup message 00 is sent.

▶ Set asynchronous transmit parameter **TPDO1**:
Event timer for asynchronous operation: Object 0x1800, subindex 0x05 (e.g. 10 ms) (see [▶ 20]) or Object 0x6200 (see [▶ 32])

▶ Save device parameters:
Set Object 0x1010 to the value 0x01.

▶ Automatic device restart:
Execute Reset Node command via 0x81 0x00.

⇨ If the parameters were correctly set, the LED flashes green (pre-operational mode).

▶ Send NMT Start Operational command (0x01 0x00).

⇨ If the parameters were correctly set, the LED flashes green (operational mode) and the position is output on the first TPDO (e.g. 0x1BF) in the 10 ms cycle.

8 Operation

8.1 LED display

LED	Meaning
Green	Operational mode
Green flashing	Pre-operational mode
Green flashing (1 ×)	Stopped mode
Red	CAN controller in BUS OFF status
Red flashing	Faulty configuration
Green off	No connection to the master Possible causes: ■ Data cable break ■ Incorrect transmission rate ■ Reversed data cable If the red LED is lit, check the power supply.

Error indication

LED	Meaning
Green/red alternate flashing	Faulty data connection to internal sensor Contact Turck.
Green/red rapid alternate flashing (20 Hz)	LSS Layer Service active The device is waiting for a configuration.
Green/red simultaneous flashing	Internal watchdog error Contact Turck.

Bootloader status

LED	Meaning
Green/red simultaneous flashing	The device is ready for the firmware download. Contact Turck.
Green flashing, red flashing (1 ×)	Erase firmware Contact Turck.
Green and red	Firmware is being flashed.

9 Setting

The device can be set via the CANopen interface.

NOTE
All undescribed objects are used for additional information which can be obtained from device profile DS406 3.1.

The setting options of the optional device parameters are listed in the following table:

Device parameters	Object	Example
Scaling possibly required	0x6000	4 = Scaling switched on 5 = Scaling on, CCW direction
Rotation direction	0x6000	
Measuring range	0x6001, 0x6002	MUR = 360 TMR = 3600 The device has a resolution of 360 steps and will restart at zero after 10 revolutions.
Zero point or preset value	0x6003	0
Operating range	0x6401, 0x6402	
Times required for speed calculation	0x6031	
Save	0x1010, 0x01	

9.1 Communication profiles

9.1.1 Object 0x1000: Device type

The device type is specified via the object.

0x1000	VAR	Device type	Unsigned32	RO	M

Device profile number		Positioning element type	
Byte 0 (LSB)	Byte 1	Byte 2	Byte 3 (MSB)
0x96	0x01	0x0B (Multiturn)	0x00
Example: 0x000B0196 = profile DS406: Multiturn			

9.1.2 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

9.1.3 Object 0x1010: Store parameters

The **save** command is used to write the parameters to the non-volatile memory (EEPROM).

0x1010	ARRAY	Store parameters	Unsigned32	RW	O

To prevent an object from being accidentally saved, the command is only executed when the **save** string is entered as the code word in sub-index 0x01 of the 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**

9.1.4 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).

9.1.5 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

9.1.6 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

9.1.7 Object 0x1029: Error behavior

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

0x1029	ARRAY	Error behavior	Unsigned8	RW	O

Error class

Sub index	Meaning
0x01	Communication error (Default 1): ■ "Bus OFF" status ■ Heartbeat monitoring failed
0x02	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.

9.1.8 Object 0x1800: PDO1 parameters (asynchronous)

The object contains the parameters for the process data object PDO1. With the default setting, this service allows the process data of the positioning element to be asynchronously output after being triggered by the internal cycle timer (required: event timer set via sub-index 0x05).

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) Default value = 0
0x02	Transmission type = 254_{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: 2…65535 (corresponds to 2…65,535 ms) Only exact millisecond values are permitted. Intermediate values are rounded up.
0x04	Reserved
0x05	Event timer (setting in Object 0x6200) Value range: 2…65535 (corresponds to 2…65,535 ms) 0: no data output Default value: 0_{dec}

NOTE
The number of possible messages is limited by the bus speed. The minimum times for the event timer apply when operating with a PDO.

Transmission rate	Messages/ms	Event timer (min)
1000 kbps	7.8	1 ms
500 kbps	3.9	1 ms
250 kbps	1.9	1 ms
125 kbps	0.97	2 ms
50 kbps	0.39	3 ms
20 kbps	0.15	7 ms
10 kbps	0.07	15 ms

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

NOTE
The minimum time of 2 ms for the event timer applies when operating with a PDO. Cycle times of less than 2 ms lead to measurement deviations.

The object contains the parameters for process data object PDO2. With the default setting, this service allows the process data of the positioning element to be synchronously output after being triggered by the internal cycle timer (required: event timer set via sub-index 0x05).

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 = 1 (see transmission types) (Transmission type = synchronous, cyclic) (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: 2…65535 (corresponds to 2…65,535 ms) Only exact millisecond values are permitted. Intermediate values are rounded up.
0x04	Reserved
0x05	Event timer (setting in Object 0x6200) Value range: 2…65535 (corresponds to 2…65,535 ms) 0: no data output Default value: 100_{dec}

9.1.10 Transmission types

The PDO is sent at a value between 1…240 synchronously and cyclically after every nth SYNC pulse (n=1…240).

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 (2…65,535 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 the transmission type:

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 PDO (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 a mapping table

The combined size of the mapped objects within a PDO mapping table (Object 0x1A00FF) must not exceed 64 bits.

The same transmission type, the same inhibit time and the same event time must be set for all mapped objects within a PDO mapping table (Object 0x1A00FF).

Example: Entry in the mapping table

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

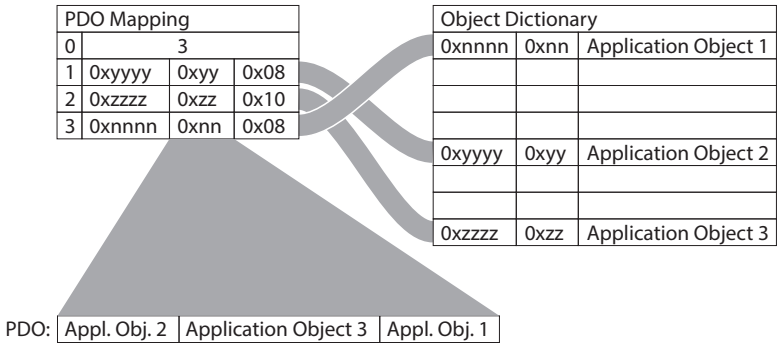


fig. 14: PDO mapping

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 application object 1 with a length of 1 byte. A total of 32 bits are used in this PDO.

9.2.1 Changing mapping parameters

- ▶ Delete PDO (0x1800, subindex 1, set bit 31 to **1**).
- ▶ Set subindex 0 in the mapping parameter (0x1A00) to **0**.
- ▶ Set subindex 0 in the mapping parameter to the valid value; the device checks the entries for consistency.
- ▶ Create a PDO by entering the identifier (0x1800, subindex 1, set bit 31 to **0**).

9.2.2 Standard settings for the mapping of transmit PDOs

Mapping	TPDO1 0x1800	TPDO2 0x1801	TPDO3 0x1802
Mapping object	0x1A00	0x1A01A	0x1A02A
Entry	0x60040020	0x6004002	0x600300120
Process	Position	Position	Speed
Object	0x6004	0x6004	0x6030
Sub index	00	00	01
Data length	0x20 (32 bits)	0x20 (32 bits)	0x20 (32 bits)
Transmission type	Asynchronous	Synchronous	Asynchronous

9.2.3 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

Example: Setting the mapping TPDO1 position value

- Object: 0x6004
- Sub index of the object: 0x00
- Data length: 0x20 (32 bits)

▶ Enter the value 0x60040020 in Objects 0x1A00 and 0x01.
▶ Save the parameter via Objects 0x1010 and 0x01: Enter 0x6576617.
▶ Reset the voltage.

9.2.4 Object 0x1A01: PDO2 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.

0x1A01	RECORD	PDO2 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: TPDO2 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

9.2.5 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.

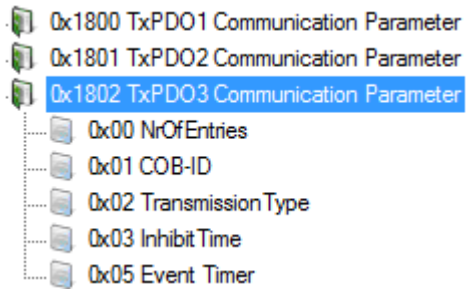


fig. 15: Communication parameters

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

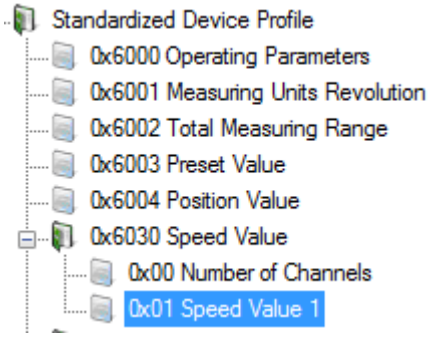


fig. 16: Record current measured values

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

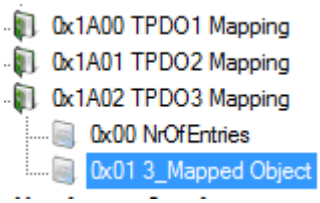


fig. 17: Mapping

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.

9.3 Setting parameters specific to the manufacturer

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

The transmission rate is set without an LSS service via the object. The default value is 250 kbps.

0x2100	VAR	Baud rate	Unsigned8	RW	M

- ▶ Data content in the Object 0x2100, specify subindex 0x00 according to the following table:

Value	Transfer rate
0	10 kbps
1	20 kbps
2	50 kbps
3	100 kbps
4	125 kbps
5	250 kbps
6	500 kbps
7	800 kbps
8	1000 kbps

- ▶ Execute **Save all bus parameters** (0x2105) to save the changes.
- ▶ 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 0x3F.

0x2101	VAR	Node number	Unsigned8	RW	M

- ▶ Specify the node address in Object 0x2101: specify the value of 0x01…0x7F (1…127_{dec}).

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

- ▶ Execute **Save all bus parameters** (0x2105) to save the changes.
- ▶ Execute a voltage reset or reset node to load the changes into the device. All changes 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 0x2105: Save all bus parameters

This object saves the bus parameters (Objects 0x2100, 0x2101, 0x2102) permanently in the Flash memory. This object is used as additional protection from accidental changes to the baud rate and node address. Only through targeted storing with the SAVE (hexadecimal 0x65766173) parameter are the bus parameters baud rate, node address and termination saved.

0x2105	VAR	Save all bus parameters	Unsigned32	RW	M

9.4 Setting default device parameters

9.4.1 Object 0x6000: Operating parameters

The following operating parameters can be set via the object:

- Reverse code sequence
- Diagnostic request
- Scaling function

0x6000	VAR	Operating parameters	Unsigned16	RW	M

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

Bit	Value	Meaning
0	**0x00**	Ascending code sequence with clockwise rotation (CW)
	0x01	Ascending code sequence with counterclockwise rotation (CCW)
1		Not used
2	0x00	Scaling function on
	0x01	Scaling function off
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	Unsigned32	RW	M

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

- Value range: 1-maximum physical resolution (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	Unsigned32	RW	M

- Value range: 1…maximum physical resolution (full range)
- Default setting: 36000

NOTE
The maximum physical resolution is factory set in Object 0x6501 (read only). In Object 0x6000 Bit 2: switch on scaling function.

If the device is used continuously (single turn), TMR = MUR/n, n = 1, 2, 3…

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

Otherwise a jump occurs in the output code with each physical zero crossing (single turn after 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 divided into 10 × 0…360.

Example 2:

Setting of Object 0x6001: MUR = 3600

Setting of Object 0x6002: TMR = 3600

Output: one revolution is divided into 0…3600.

Example 3 – jump in output code:

Setting of Object 0x6001: MUR = 3600

Setting of Object 0x6002: TMR = 3000

Output: one revolution is divided 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 0x6200: Cycle timer (cycle time of the measured value output)

NOTE
Cycle times of less than 2 ms lead to measurement deviations.

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	Unsigned16	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 ($65{,}535_{dec}$) produces the cycle time in milliseconds.
- Default value: 0x64 (100_{dec})

9.4.8 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 value. 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	Unsigned8	RO	O

Sub-index	Bit	Meaning
0x01 (Work area state register channel 1, unsigned8)	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, unsigned8)	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.

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

The working area of the device can be adjusted via the object. 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	Integer32	RW	O

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

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

- Value ranges: 0-65536$_{dec}$ (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$_{dec}$

9.4.10 Object 0x6500: Operating status

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

0x6500	VAR	Operating status	Unsigned16	RO	M

9.4.11 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

9.4.12 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

9.4.13 Object 0x6503: Alarms

The object displays error messages 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").

9.4.14 Object 0x6504: Supported alarms

The object shows the alarm messages supported by the device.

9.4.15 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	Unsigned16	RO	M/O

Data content:

Bit	Value	Meaning
0…5		Not used
6	1	Permitted speed exceeded
7…15		Not used

9.4.16 Object 0x6506: Supported warnings

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

0x6506	VAR	Supported warnings	Unsigned16	RO	M/O

Data content:

Bit	Value	Meaning
0…5		Not used
6	1	Testing of the speed is supported
7…15		Not used

9.4.17 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

9.4.18 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

9.4.19 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

9.4.20 Object 0x650B: Serial number

The object displays the serial number of the device.

0x650B	VAR	Serial number	Unsigned32	RO	M

9.5 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

9.6 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.

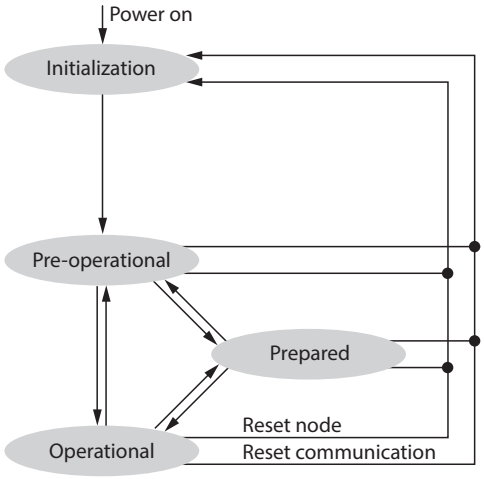


fig. 18: Status diagram in accordance with DS 301

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 that the plug connections and cables are always in good condition.

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

12 Repair

The device must not be repaired 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

Returns to Turck can only be accepted if the device has been equipped with a Decontamination declaration enclosed. The decontamination declaration can be downloaded from
https://www.turck.de/en/retoure-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 Turck subsidiaries — contact information

Germany	Hans Turck GmbH & Co. KG Witzlebenstraße 7, 45472 Mülheim an der Ruhr **www.turck.de**
Australia	Turck Australia Pty Ltd Building 4, 19-25 Duerdin Street, Notting Hill, 3168 Victoria **www.turck.com.au**
Austria	Turck GmbH Graumanngasse 7/A5-1, A-1150 Wien **www.turck.at**
Belgium	TURCK MULTIPROX Lion d'Orweg 12, B-9300 Aalst **www.multiprox.be**
Brazil	Turck do Brasil Automação Ltda. Rua Anjo Custódio Nr. 42, Jardim Anália Franco, CEP 03358-040 São Paulo **www.turck.com.br**
Canada	Turck Canada Inc. 140 Duffield Drive, CDN-Markham, Ontario L6G 1B5 **www.turck.ca**
China	Turck (Tianjin) Sensor Co. Ltd. 18,4th Xinghuazhi Road, Xiqing Economic Development Area, 300381 Tianjin **www.turck.com.cn**
Czech Republic	TURCK s.r.o. Na Brne 2065, CZ-500 06 Hradec Králové **www.turck.cz**
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Great Britain	TURCK BANNER LIMITED Blenheim House, Hurricane Way, GB-SS11 8YT Wickford, Essex **www.turckbanner.co.uk**
Hungary	TURCK Hungary kft. Árpád fejedelem útja 26-28., Óbuda Gate, 2. em., H-1023 Budapest **www.turck.hu**
India	TURCK India Automation Pvt. Ltd. 401-403 Aurum Avenue, Survey. No 109 /4, Near Cummins Complex, Baner-Balewadi Link Rd., 411045 Pune - Maharashtra **www.turck.co.in**
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