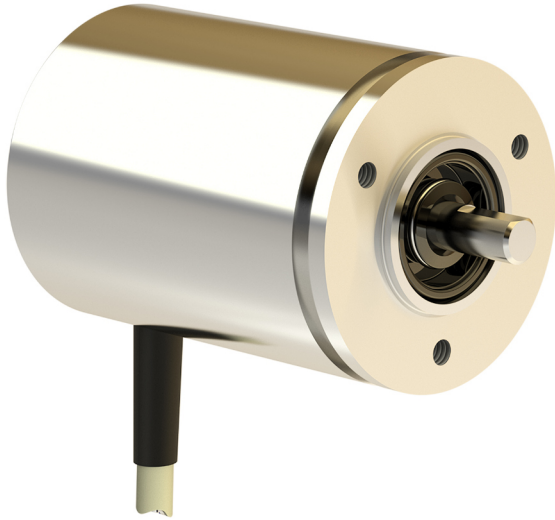


# Absolute Single/Multi-turn shaft encoder models TBSN/TRSN with CANopen Safety (SIL3) interface



- **Sturdy design for tough applications, e.g. crane technology, construction machinery and mobile working equipment**
- **Flange diameters Ø 58 mm and Ø 50 mm, miniature version Ø 42 mm**
- **Measuring range**  
TBSN: max. 65,536 steps/360°  
TRSN: max. 65,536 steps/360° x 4096 revolutions
- **Protection grade IP65/IP66 (IP69K with optional housing potting)**
- **Interfaces:**  
CANopen Safety SIL3,  
CANopen  
(CiA DS 406 Encoder Profile, 4.1.0)

## Mechanical and electrical features

- Sturdy housing made from seawater-resistant aluminium (AlMgSi1 - 3.2315), stainless steel (material: 1.4305 or 1.4404) or magnetic steel (for high requirements of resistance against magnetic fields (DIN EN 61000-4-8))
- Constructions with Ø 42, Ø 50 and Ø 58 mm housing. Other diameters can be realised on request
- Magnetic sensor systems for position detection
- Measurement of rotations via an absolute Multiturn transmission in the TRSN model
- Electrical connections via connector M12x1 (Bus In and Bus Out option) or via cable
- Optional housing potting to meet IP69K requirements
- Interface as CANopen Safety SIL3 in accordance with IEC 61508

## Function

The model series TBSN/TRSN comprises magnetic rotary encoders certified according to IEC 61508, SIL 3 and conform to ISO 26262, ASIL-D.

With the TBSN model, a single rotation with a resolution of up to 16 bit (65,536 steps) can be measured.

The TRSN is equipped with an additional gear box, which allows to measure up to 4096 rotations.

A positive-locking mechanical connection between the customer's shaft and the sensor shaft ensures that the magnet

in the sensor shaft precisely determines the rotation of the customer's shaft.

## Position detection and communication

The position of the shaft is measured by up to four redundant magnetic sensor chips. The two position values of each chip are read simultaneously by two micro-controllers. From these raw input values the two micro-controller independently calculate the output position values. Each micro-controller will then generate one part of the SRDO (Safety Related Data Object) message, the first one the normal part, the second one the bit-inverted one. Only if the two parts match, the safety master will accept and process the message.

Comprehensive checks using CRC, timing monitoring, voltage monitoring etc. further secures the reliability of the position output.

In the event of a fault, emergency protocols are issued and a fault listing is created. The target function here is to move to a safe state (no safe position output).

Optionally, the position values can be output via PDO (Process Data Object) over the CANopen standard protocol.

# Absolute Single/Multi-turn shaft encoder models TBSN/TRSN with CANopen Safety (SIL3) interface

## Technical data

### Electrical data

■ Sensor system:	Magnetic sensor systems
■ Max. resolution:	TBSN: 16 bits (65,536 steps) TRSN: 16 bits + 12 bits revolution (=28 bits)
■ Number of turns:	TBSN: 1 TRSN: 4096 (other values on request)
■ Maximum total number of steps:	TBSN: 65,536 steps TRSN: 268,435,456 steps (65,536 steps/rev. x 4096 revolutions)
■ Operating voltage:	9 to 35 VDC with reverse-polarity protection and short-circuit protection
■ Power consumption:	TBSN: < 2 W TRSN: < 3 W
■ Code sense:	CW* or CCW**, configurable
■ Reference value:	0 to (total step count -1)
■ Accuracy TBSN:	≤ ± 0.05 % with reference to one revolution
■ Accuracy TRSN:	≤ ± 0.2 % with reference to one revolution
■ Reproducibility:	≤ ± 0.02 % with reference to one revolution
■ Temperature drift:	≤ 0.02°/K

\*) CW = increasing output value when shaft rotating clockwise

\*\*) CCW = increasing output value when shaft rotating anti-clockwise

### CANopen cyclic data

- SRDO1 ( + PDO1 on request): 4 bytes position data
- On request: PDO2: 2 bytes velocity data

### CANopen/CANopen Safety SIL3 overview of specifications

CiA DS301	CANopen Application Layer and Communication Profile, Version 4.1
CiA DS406	CANopen - Device Profile for Encoders, Version 4.1.0
CiA DS305	CANopen - Layer Setting Services and Protocol (LSS)
DIN EN 50325-5: 2016-06	Industrial communication sub-system based on ISO 11898 (CAN) - Part 5: Functionally safe communication based on EN 50325-4
■ CAN-Interface:	according to ISO/DIS 11898
■ Address setting:	over LMT/LSS or SDO
■ Terminating resistance:	to be implemented separately
■ Max. transmission length:	30 m
■ Bootloader function:	yes
	System prerequisites:
	- PCAN-USB adaptor ( <a href="http://www.peak-system.com">www.peak-system.com</a> ) including USB cable for PC connection
	- CANopen tester TWK software, hex file for updating
	- Shaft encoder connecting cable
■ Number of PDOs:	2 Tx on request
■ Number of SRDOs:	1 Tx (CANopen Safety SIL3)
■ PDO-Modes:	sync, async, cyclic, acyclic
■ SRDO-Mode:	cyclic (CANopen Safety SIL3)
■ PDO mapping configurable:	no
■ Emergency Message:	yes
■ Heartbeat:	yes
■ No. of SDOs:	1 Rx/1 Tx

The profile details are described in detail in the user manual TBN/TRN15469. The CRC calculation for changing parameters is carried out using the CRC-Calculator program, which can be provided to the customer on request.

# Absolute Single/Multi-turn shaft encoder models TBSN/TRSN with CANopen Safety (SIL3) interface

## Technical data

### System data

- Duty cycle (rise time) supply voltage: 500 ms (10 % to 90 %)
- Information density: up to 10 000 messages/s
- Storage cycle time limit: 3 s per memory cycle
- Setup Time: ~ 5 s @ T ≥ +20 °C
- Maximum time between detection of a fault and the output of the emergency message: 100 ms (voltage supply, tbc.)  
5 s (RAM test, all individual bits ok, tbc.)  
2 s (ROM test, within setup time, tbc.)
- Tolerance of internal position monitoring: 3°
- Safety standard: IEC 61508: 2017: Functional Safety of Electrical/Electronic/Programmable Electronic Safety-related Systems
- EDS file: EDS file is available on request.

### Mechanical data

- Operating speed: max. 1.000 min<sup>-1</sup> (more on request)
- Angular acceleration: 10<sup>5</sup> rad/s<sup>2</sup> max.
- Moment of inertia (rotor): < 20 gcm<sup>2</sup>
- Operating torque: ≤ 8 Ncm
- Starting torque: ≤ 3 Ncm
- Permissible shaft load: 250 N axial, 250 N radial (Ø 58 and Ø 50 - design)  
50 N axial, 50 N radial (Ø 42 - standard design, other values optional)
- Bearing service life: ≥ 10<sup>9</sup> rotations (@ maximum shaft load)
- Weight: TBSN Ø 58: Aluminium approx. 0.3 kg, Steel approx. 0.4 kg  
TRSN Ø 58: Aluminium approx. 0.5 kg, Steel approx. 0.7 kg  
TRSN Ø 42: Aluminium approx. 0.3 kg, Steel approx. 0.4kg  
Weight specifications for other constructions on request.

### Environmental data

- Working temperature range: - 40 °C to + 70 °C
- Storage temperature range: - 20 °C to + 60 °C (due to packaging)
- Resistance:
  - to shock: 250 m/s<sup>2</sup>, 6 ms, in 3 axes every 100x (higher values optional)  
DIN EN 60068-2-27
  - to vibration: 100 m/s<sup>2</sup>, 5 Hz ... 2000 Hz, in 1 h in 3 axes, (higher values optional)  
DIN EN 60068-2-6
- Protection grade (DIN EN 60529): Shaft side: IP66 - shaft sealing ring, IP65 - Nilos ring  
Housing side: IP67, IP69K optional (housing potting)  
(For higher degrees of protection up to IP69K, please contact our technical support)

# Absolute Single/Multi-turn shaft encoder models TBSN/TRSN with CANopen Safety (SIL3) interface

## Technical data

### EMC standards

EN 61000-6-4:2020	EMC Part 6-4: Generic standards-Emission standard for industrial environments
EN 61000-6-2:2019	EMC Part 6-2: Generic standards-Immunity for industrial environments
EN 61000-4-2:2009	EMC Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test
EN 61000-4-3:2021	EMC Part 4-3: Testing and measurement techniques - Radiated, radio frequency. electro-magnetic field immunity test
EN 61000-4-4:2013	EMC Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test
EN 61000-4-5:2019	EMC Part 4-5: Testing and measurement techniques - Surge immunity test
EN 61000-4-6:2014	EMC Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields
EN 61000-4-8:2010	EMC Part 4-8: Testing and measurement techniques - Power frequency magnetic field immunity test: 30 A/m, test criterion A ( $\pm 65$ digits @ 16 bit resolution) 100 A/m, test criterion B
EN 61000-4-16:2016	EMC Part 4-16: Testing and measurement techniques - Test for immunity to conducted, common mode disturbances in the frequency range 0 to 150 kHz
EN 61000-4-29:2001	EMC Part 4-29: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations on d.c. input power port immunity tests- For voltage dips to 0 for 1s and for short interruptions to 0 for >1ms the evaluation criterion DS applies.
IEC 61326-3-2:2019	Electrical equipment for measurement, control and laboratory use - EMC requirements Part 3-2: Immunity for safety-related systems and for equipment intended to perform safety related functions (functional safety) - industrial applications with specified electromagnetic environment

### Safety data TBSN

HFT	tbd	Hardware fault tolerance
SFF	tbd	Safe failure fraction
DC	tbd	Diagnostic Coverage
PFH	tbd	Probability of dangerous Failure per hour

### Safety data TRSN

HFT	tbd	Hardware fault tolerance
SFF	tbd	Safe failure fraction
DC	tbd	Diagnostic Coverage
PFH	tbd	Probability of dangerous Failure per hour

### Documentation, EDS file, etc.

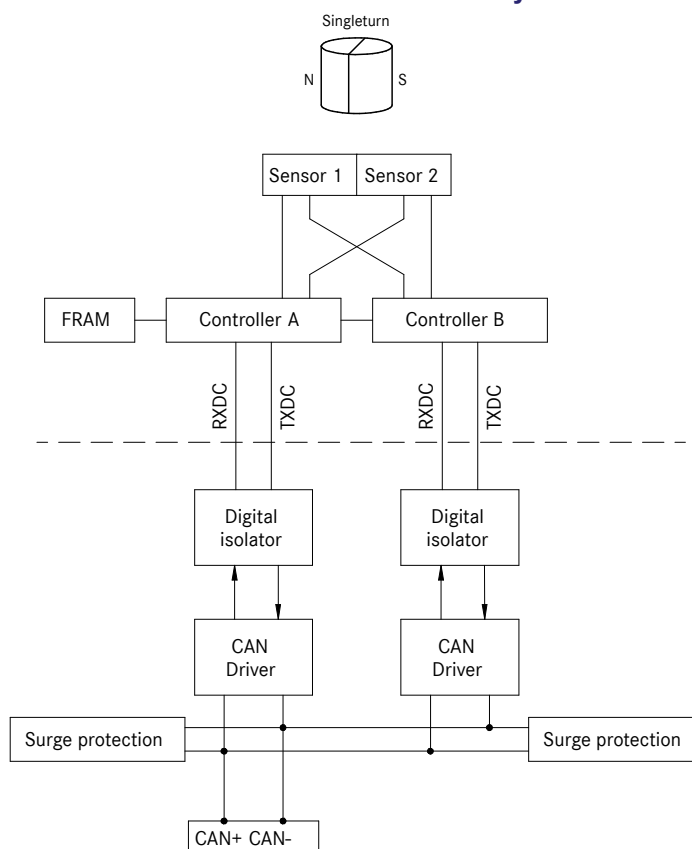
The following documents can be found on [www.twk.de/en/support-and-service/documentation](http://www.twk.de/en/support-and-service/documentation).

- Data sheet [16365](#)
- Manual No. [15469](#)
- Installation instructions [16169](#)
- Certificate SIL3/PLd No. tbd.
- CRC checksum program for parameterisation: [www.twk.de/files/CRC-Calculator20.zip](http://www.twk.de/files/CRC-Calculator20.zip)

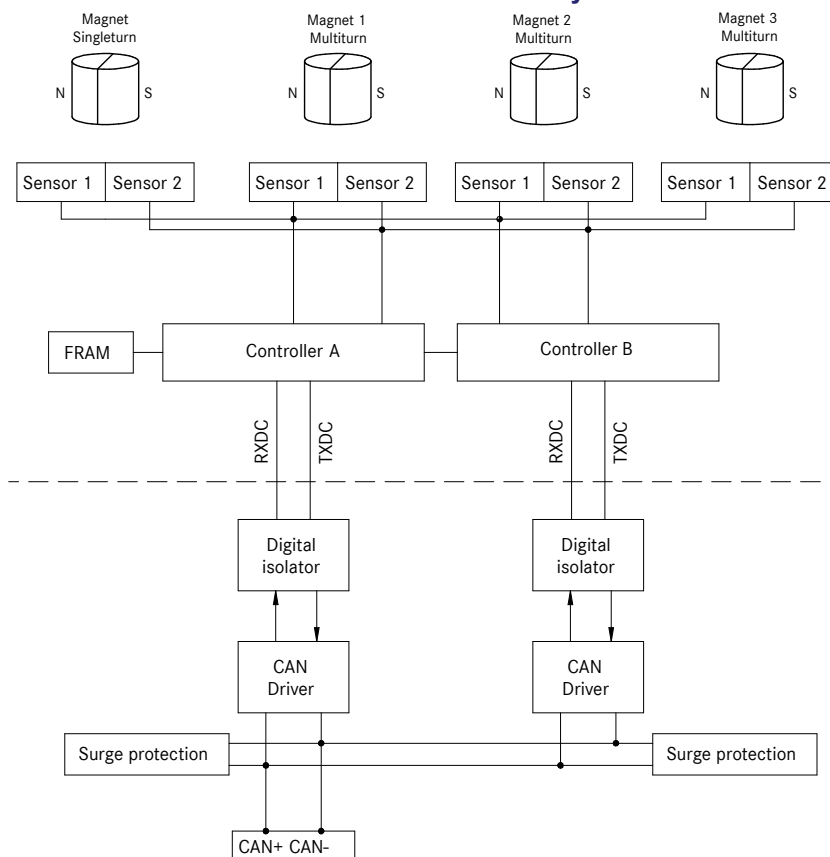
# Absolute Single/Multi-turn shaft encoder models TBSN/TRSN with CANopen Safety (SIL3) interface

## Schematic diagrams TBSN and TRSN

### Model: TBSN...S41... safety



### Model: TRSN...S41...safety



# Absolute Single/Multi-turn shaft encoder models TBSN/TRSN with CANopen Safety (SIL3) interface

## Electrical connection, mating connector, contact configuration M12x1, note

### Electrical connection

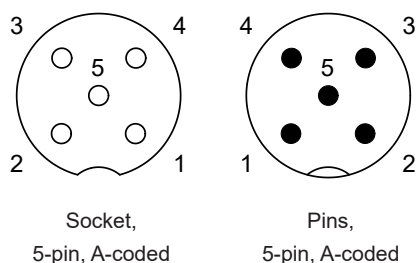
- All TBSN/TRSN: Axial or radial cable output, twisted pair, e.g. 2 x 2 x 0.25 mm<sup>2</sup>, shielded (standard)
- TBSN/TRSN Ø 58/50: One connector M12x1, pin, 5-pin, A-coded  
Two connectors M12x1, pin and socket, 5-pin, A-coded, Bus In and Bus Out
- The connection assignment TYxxxxx is part of the scope of supply and is included with each device.

### Mating connector (to be ordered separately)

Order identification	STK5GS56	STK5GP90	STK5WS58	STK5WP102	STK5GS107	STK5GP106
Type	M12x1	M12x1	M12x1	M12x1	M12x1	M12x1
Pole number	5	5	5	5	5	5
Contact design	Socket, A-coded	Pin, A-coded	Socket, A-coded	Pin, A-coded	Socket, A-coded	Pin, A-coded
Connector design	straight	straight	angled	angled	straight	straight
Housing material	Brass, nickel-plated	Brass, nickel-plated	Brass, nickel-plated	Brass, nickel-plated	stainless Steel 1.4404	stainless Steel 1.4404
Cable ø (mm)	6 - 8	6 - 8	6 - 8	6 - 8	5.5 - 8.6	5.5 - 8.6
Connection type	Screws	Screws	Screws	Screws	Screws	Screws
Degree of protection class	IP67	IP67	IP67	IP67	IP67	IP67
Shielding	On the housing (V3)	On the housing (V3)	On the housing (V3)	On the housing (V3)	On the housing (V3)	On the housing (V3)
Max. wire size (mm <sup>2</sup> )	0.75	0.75	0.75	0.75	0.75	0.75

Please note: If angled mating connectors are used, please specify the position of the coding groove so that the device connectors can be aligned accordingly.

### Contact configuration of the M12x1 5-pin connector, connector side view



### Note:

The 5-pin M12x1 connector is used as standard. There are three different galvanic concepts for potential isolation (V1-V3) (see also page 7).

## Absolute Single/Multi-turn shaft encoder models TBSN/TRSN with CANopen Safety (SIL3) interface

### Galvanic potential isolation: $-V_s$ , CAN\_GND and housing/cable shielding

The description of the different versions of galvanic potential (V1 to V3) relates exclusively to the interrelationships between the individual potentials ( $-V_s$ , CAN\_GND and housing/cable shielding), i.e. whether or not they are galvanically connected. The connection assignment (TYxxxx) should be observed. This connection assignment is included with each device and a copy can be requested as needed.

#### V1: CAN\_GND, $-V_s$ and housing/cable shielding galvanically isolated

This version has complete galvanic isolation. The housing/cable shielding are galvanically isolated from  $-V_s$  and CAN\_GND, and  $-V_s$  and CAN\_GND are also galvanically isolated from one another. The cable shielding is galvanically connected to the housing via the connector housing

PIN	Function
1	CAN GND
2	Operating voltage + $V_s$
3	Operating voltage - $V_s$
4	CAN_H
5	CAN_L

#### V2: CAN\_GND and $-V_s$ not galvanically isolated, cable shielding galvanically isolated

This version has partial galvanic isolation: The housing/cable shielding are galvanically isolated from  $-V_s$  and CAN\_GND. But:  $-V_s$  and CAN\_GND are not galvanically isolated from one another. The cable shielding is assigned to pin 1.

PIN	Function
1	Shielding
2	Operating voltage + $V_s$
3	Operating voltage - $V_s$ and CAN-GND
4	CAN_H
5	CAN_L

#### V3: CAN\_GND, $-V_s$ and cable shielding/housing not galvanically isolated

This version has no galvanic isolation: The housing/cable shielding are not galvanically isolated from  $-V_s$  and CAN\_GND, and  $-V_s$  and CAN\_GND are not galvanically isolated from one another.

PIN	Function
1	Shielding – short-circuited with PIN 3
2	Operating voltage + $V_s$
3	Operating voltage - $V_s$ and CAN-GND, short-circuited with PIN 1
4	CAN_H
5	CAN_L

# Absolute Single turn/Mult turn shaft encoder models TBSN/TRSN with CANopen Safety SIL3 and CANopen

## Order number

<b>TBSN</b> <b>TRSN</b>	<b>42 -</b>	<b>ST</b>	<b>6</b>	<b>A -</b>	<b>16</b>	<b>S41</b>	<b>K1</b>	<b>V2</b>	<b>N</b>	<b>01</b>	→ standard version
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<b>TBSN</b> <b>TRSN</b>	Single-turn rotary encoder with SIL3 CANopen-Interface Multi-turn rotary encoder with SIL3 CANopen-Interface										
<b>42</b>	<b>Design form*:</b> 42 Design form Ø 42 mm 50 Design form Ø 50 mm 58 Design form Ø 58 mm										
<b>ST</b>	<b>Flange type*:</b> KT Clamped flange, shaft with flattened area (design forms ≥50 only) KF Clamped flange, shaft with woodruff key (design forms ≥50 only) KP Clamped flange, shaft with feather key (design forms ≥50 only) KZ Clamped flange with shaft for measuring gear <a href="#">ZRS</a> (design forms ≥50 only) ST Synchroniser flange, shaft with flattened area SR Synchroniser flange, shaft with clamped shaft SP Synchroniser flange, shaft with feather key										
<b>6</b>	<b>Shaft size*:</b> 6 Ø 6 mm 10 Ø 10 mm 12 Ø 12 mm										
<b>A</b>	<b>Housing material:</b> A Aluminium 3.2315 S Stainless steel 1.4305 V Stainless steel 1.4404 B Magnetic steel										
<b>16</b>	<b>Resolution per turn:</b> 16 16 bits, equal to 65536 steps per 360°. 12 to 16 bit resolution on request.										
<b>S41</b>	<b>Profile:</b> S01 CANopen Safety SIL3, Profile version 4.1.0, not certified S41 CANopen Safety SIL3, Profile version 4.1.0, certified according to this data sheet										
<b>K1</b>	<b>Electrical connection:</b> Kx Radial cable output, x: cable length in m Lx Axial cable output, x: cable length in m Sx Device connectors (x connectors) M12, 5-pole, radial, design forms ≥50 only Tx Device connectors (x connectors) M12, 5-pole, axial, design forms ≥50 only										
<b>V2</b>	<b>Galvanic isolation</b> (see details on page above) V1 -V <sub>s</sub> ≠ CAN_GND ≠ Shield/housing V2 -V <sub>s</sub> = CAN_GND ≠ Shield/housing V3 -V <sub>s</sub> = CAN_GND = Shield/housing										
<b>N</b>	<b>Output signal:</b> CANopen interface										
<b>01</b>	<b>Electrical and mechanical variants</b> 01 According to this data sheet xx Further versions on customer request										

\* Standard combinations of design form, flange type and shaft diameter see next page



# Absolute Single/Multi-turn shaft encoder models TBSN/TRSN with CANopen Safety (SIL3) interface

## Standard combinations of design form, flange type and shaft diameter (mm)

Design form	Flange type						
	KT	KF	KP	KZ	ST	SR	SP
	42				6		
	50				12	12	
	58	10	10	10	ZRS	6	12

Standard combinations of design forms and flange types with default shaft diameter in mm. Other combinations are available on customer request.

## Accessories (please note the shaft encoder version)

### Play-free bellows coupling BKM 26 / x - y

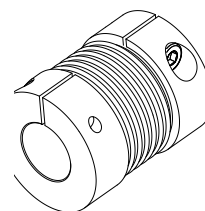
x and y: Bore diameter for shaft support

See data sheet [BKM 11995](#)

### Play-free bellows coupling BKK 32 / x - y

x and y: Bore diameter for shaft support

See data sheet [BKK 11840](#)



### Play-free clamp coupling KK14S / x - y (without groove)

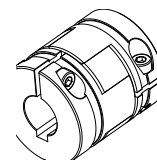
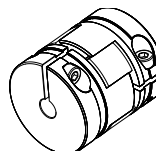
x and y: Bore diameter for shaft support

See data sheet [KK 12301](#)

### Play-free clamp coupling KK14N / x - y (with groove)

x and y: Bore diameter for shaft support

See data sheet [KK 12301](#)



### Mounting brackets KL 66-2-S

Mounting brackets for shaft encoder assembly.

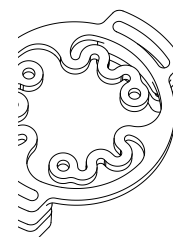
See data sheet [MZ 10111](#)



### Torque support ZMS58

Torque support/stator coupling. Suitable for use as a shaft encoder bracket for the clamping shaft version, for the offsetting of radial and axial drive shaft play for Ø 58 mm shaft encoders.

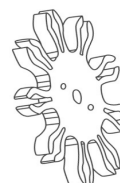
See data sheet [ZMS 12939](#)



### Play free measuring wheel ZRS

Play-free measuring wheel ZRS for Ø 58 mm shaft encoders for live ring applications.

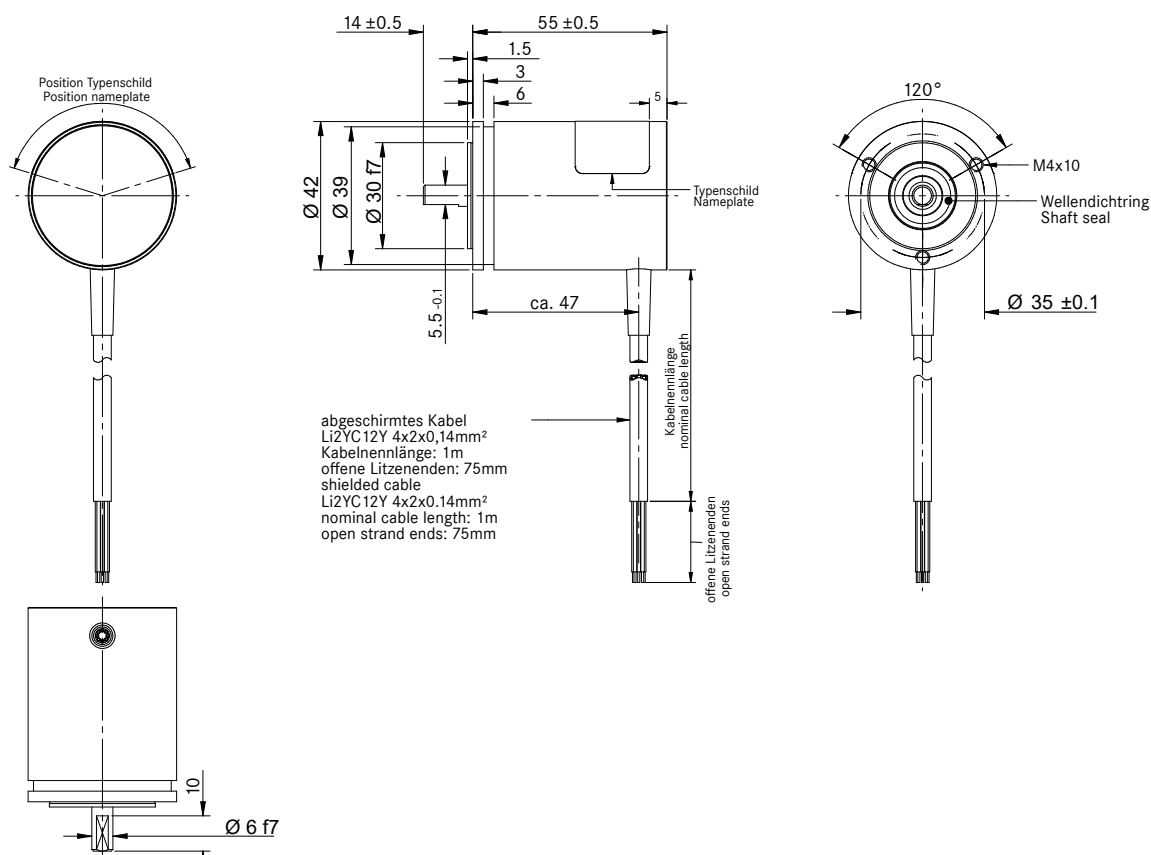
See data sheet [ZRS 11877](#)



# Absolute Single/Multi-turn shaft encoder models TBSN/TRSN with CANopen Safety (SIL3) interface

## Installation drawings (dimensions in mm)

Order identification: **e.g. TBSN42 - ST6A - 16 S41 K1 V2 N01**



Order identification: **e.g. TRSN42 - ST6A - 16 S41 K1 V2 N01**

