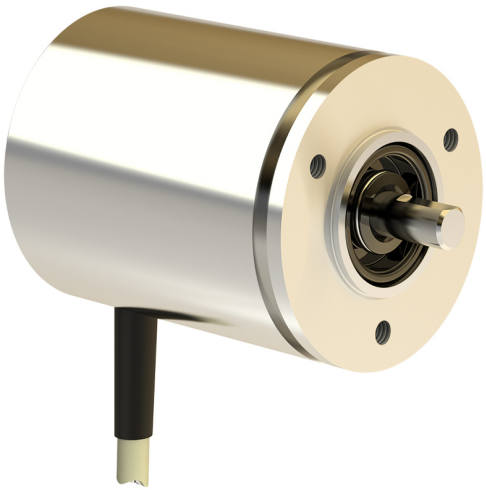
SUPREME SENSORING

Absolute rotary encoder
Model TBSN/TRSN
Interface: CANopen Safety (SIL3)

Document no.:
TXSN 16365 CE
01.12.2025



- **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 turns
- **Protection grade IP67**
  (IP69K with optional housing potting)
- **Interfaces:**
  CANopen Safety SIL3,
  CANopen (CiA DS 406 Encoder Profile, 4.1.0)

KEY INFORMATION OVERVIEW

DESIGN AND FUNCTION

- 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
- TBSN for single rotation measurement with a resolution of up to 16 bit (65,536 steps)
- TRSN for multiturn measurement (4096 rotations) via an absolute multiturn transmission gear
- Electrical connections via connector M12-A, 5-pole (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

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

FEATURES INTERFACE

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.

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.

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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: < 2.5 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

CANOPEN CYCLIC DATA

SRDO1 + PDO1	4 bytes position data
SRDO2 + PDO2	2 bytes velocity data (under development)

CANOPEN / CANOPEN SAFETY SIL3 OVERVIEW OF SPECIFICATIONS

CiA DS301	CANopen Application Layer and Communication Profile, Version 4.2.0
CiA DS406	CANopen - Device Profile for Encoders, Version 4.1.0
CiA DS305	CANopen - Layer Setting Services and Protocol (LSS), Version 3.0.0
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 (www.peak-system.com) including USB cable for PC connection CANopen tester TWK software, hex file for updating Shaft encoder connecting cable
Number of PDOs	2 Tx
Number of SRDOs	2 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 TXN/TXSN15469. The CRC calculation for changing parameters is carried out using the CRC-Calculator program, which can be provided to the customer on request.

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

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	9 Bit (2.8°)
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^{-1} (more on request)
Angular acceleration	10^5 rad/s^2 max.
Moment of inertia (rotor)	< 20 gcm^2
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	≥ 10^9 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	500 m/s², 11 ms, in 2x3 axes every 1000x (higher values optional) DIN EN 60068-2-27
	to vibration	250 m/s², 10 Hz ... 2000 Hz, in 2 h in 3 axes, (higher values optional) DIN EN 60068-2-6
Protection grade (DIN EN 60529)	IP67, IP69K optional	

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. electromagnetic 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 (±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

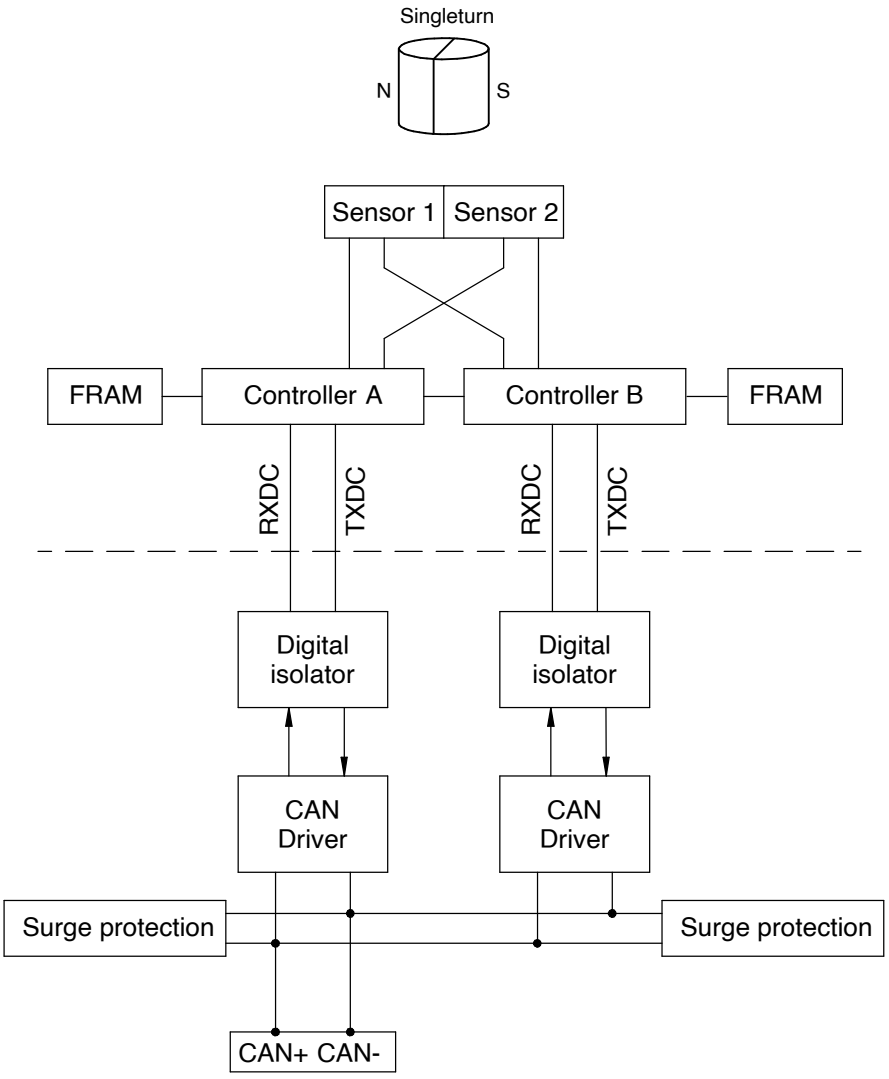
HFT	1	Hardware fault tolerance
SFF	99.25 %	Safe failure fraction
PFH	$3.95 * 10^{-9}$	Probability of dangerous Failure per hour

SAFETY DATA TRSN

HFT	1	Hardware fault tolerance
SFF	99.24 %	Safe failure fraction
PFH	$4.01 * 10^{-9}$	Probability of dangerous Failure per hour

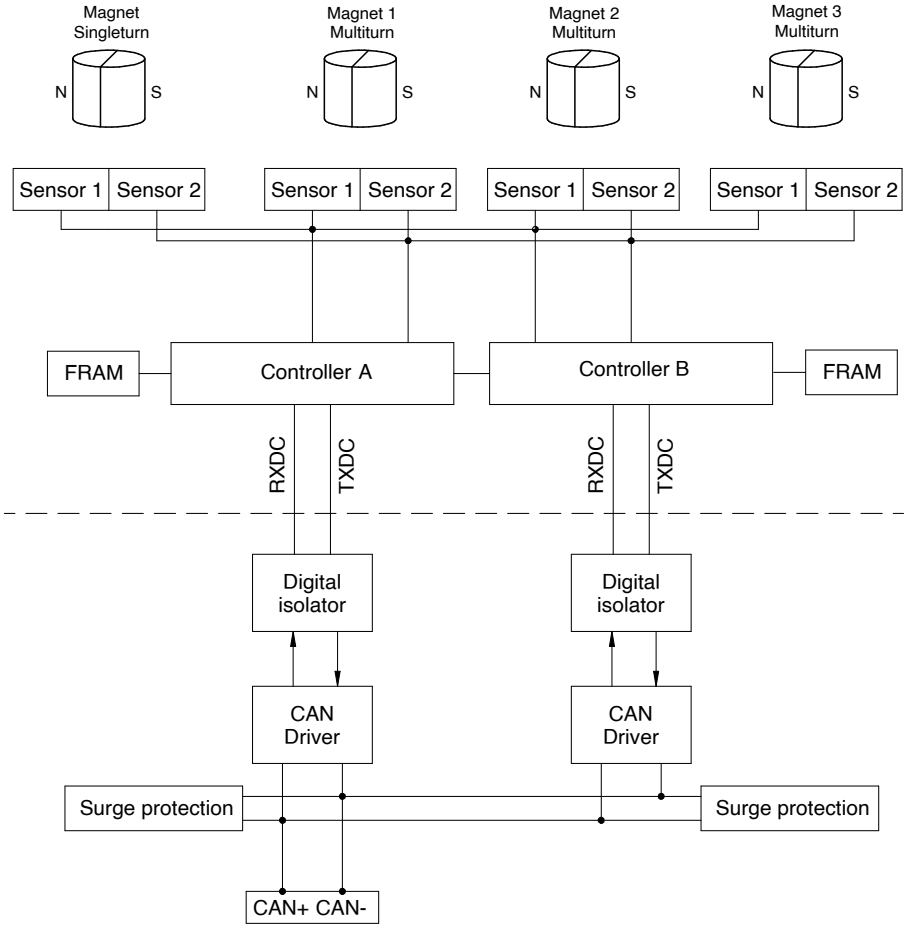
TECHNICAL DATA

PRINCIPAL CIRCUIT DIAGRAM MODEL: TBSN...S41... SAFETY



TECHNICAL DATA

PRINCIPAL CIRCUIT DIAGRAM MODEL: TRSN...S41...SAFETY

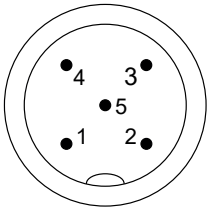


ELECTRICAL CONNECTION - PINOUT

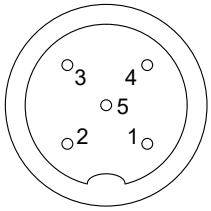
ELECTRICAL CONNECTION

All TBSN/TRSN . . . . . Axial or radial cable output, twisted pair, e.g. 2 x 2 x 0.25 mm², shielded (standard)
TBSN/TRSN Ø 58 or Ø 50 . . . . . One connector M12, male, 5-pole, A-coded or
two connectors M12, male and female, 5-pole, A-coded, Bus In and Bus Out
The connection assignment TYxxxxx is part of the scope of supply and is included with each device.

CONTACT CONFIGURATION OF THE M12, 5-POLE CONNECTOR, CONNECTOR SIDE VIEW



male



female

Note: The 5-pole M12 connector is used as standard.
There are three different galvanic concepts for potential isolation (V1, V2 and V3). See page 7.

PRODUCT CHARACTERISTICS

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

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ORDER CODE FORMAT

TBSN	42 -	ST	6	A -	16	S41	K1	V2	N	01	STANDARD VERSION

TBSN **TRSN**	Singleturn rotary encoder with SIL3 CANopen-interface Multiturn rotary encoder with SIL3 CANopen-interface		
42	Design form*	42 50 58	Design form Ø 42 mm Design form Ø 50 mm Design form Ø 58 mm
ST	flange type*	KT KF KP KZ ST SN SP	Clamped flange, shaft with flattend area (design forms ≥ 50 only) Clamped flange, shaft with woodruff key (design forms ≥ 50 only) Clamped flange, shaft with parallel key (design forms ≥ 50 only) Clamped flange with shaft for measuring gear ZRS (df ≥ 50 only) Synchro flange, shaft with flattened area Synchro flange, clamping shaft with groove for parallel key Synchro flange, shaft with parallel key
6	Shaft size*	6 10 12	Ø 6 mm Ø 10 mm Ø 12 mm
A	Housing material	A S V U	Aluminium 3.2315 Stainless steel 1.4305 Stainless steel 1.4404 Stainless steel 1.4104 for shielding strong magnetic fields
16	Resolution per turn	16	16 bits = 65,536 steps per 360° (12 to 15 bits on request)
S41	Profile	S01 S41	CANopen Safety SIL3, Profile version 4.1.0, not certified CANopen Safety SIL3, Profile version 4.1.0, certified according to this datasheet
K1	Electrical connection	Kx Lx Sx Tx	Radial cable output, x: cable length in m Axial cable output, x: cable length in m Radial device connector M12, x: number of connectors (design forms ≥ 50 only) Axial device connector M12, x: number of connectors (design forms ≥ 50 only)
V2	Galvanic isolation	V1 V2 V3	$-V_S \neq$ CAN_GND $\neq$ shielding/housing $-V_S =$ CAN_GND $\neq$ shielding/housing $-V_S =$ CAN_GND = shielding/housing
N	Output	N	CANopen interface
01	Electrical and mechanical variants	01 xx	According to this datasheet Further versions on customer request

* STANDARD COMBINATIONS OF DESIGN FORM, FLANGE TYPE AND SHAFT DIAMETER (MM)

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

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

ACCESSORIES (SELECTION) - TO BE ORDERED SEPARATELY

MATING CONNECTORS

Order number	Type	Design & wire fixing	Housing-material	Cable ø & wire size	Shielding & IP grade
STK5GS56	M12-A 5-pole, female	Straight, screws	zinc die cast, nickel-plated	6 – 8 mm ≤ 0.75 mm²	On housing IP67
STK5GP90	M12-A 5-pole, male	Straight, screws	zinc die cast, nickel-plated	6 – 8 mm ≤ 0.75 mm²	On housing IP67
STK5WS58	M12-A 5-pole, female	Angled, screws	zinc die cast, nickel-plated	6 – 8 mm ≤ 0.75 mm²	On housing IP67
STK5WP102	M12-A 5-pole, male	Angled, screws	zinc die cast, nickel-plated	6 – 8 mm ≤ 0.75 mm²	On housing IP67
STK5GS107	M12-A 5-pole, female	Straight, screws	Stainless steel 1.4404	5.5 – 8.6 mm ≤ 0.75 mm²	On housing IP67
STK5GP106	M12-A 5-pole, male	Straight, screws	Stainless steel 1.4404	5.5 – 8.6 mm ≤ 0.75 mm²	On housing IP67

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.

PLAY-FREE BELLOWS COUPLING

x and y: Bore diameter for shaft support
BKM 26 / x - y . . . . . See data sheet BKM 11995
BKK 32 / x - y . . . . . See data sheet BKK 11840

PLAY-FREE CLAMP COUPLING

x and y: Bore diameter for shaft support
KK14S / x - y (without groove) . . . . . See data sheet KK 12301
KK14N / x - y (with groove) . . . . . 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 shaft version, for the offsetting of radial and axial drive shaft play. See data sheet ZMS 12939

TOOTHED GEARS

ZRS . . . . . Play-free measuring wheel ZRS. See data sheet ZRS 11877

DOCUMENTATION

DOCUMENTATION

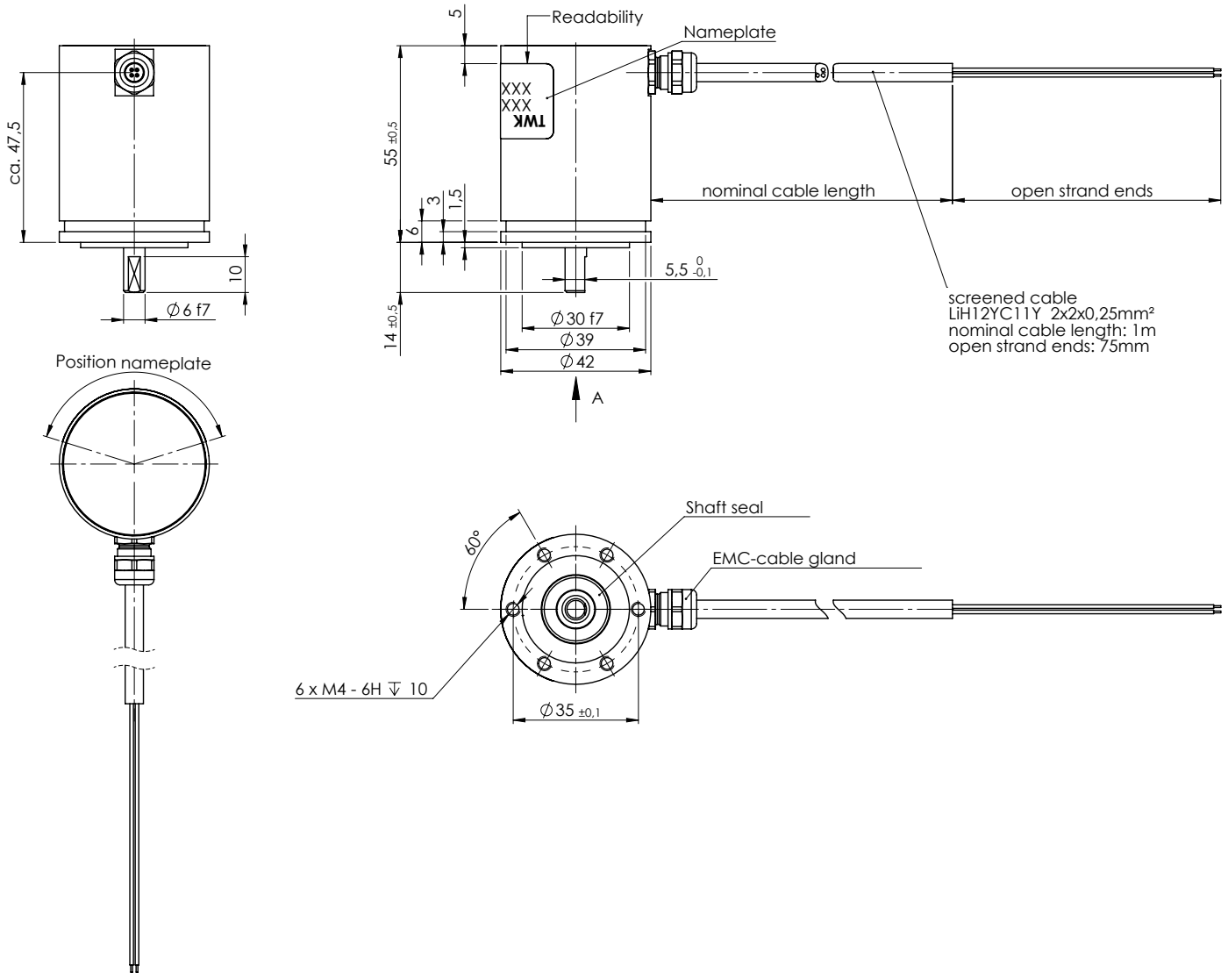
The following documents can be found in the Internet under www.twk.de/en in the documentation area, model TBSN/TRSN.

Data sheet	TXSN16365
Manual	TXSN15469
Certificate SIL3	tbd
Installation instructions	AN16169
Reach compliant	QS15286
RoHS compliant	QS13284
POP Declaration of conformity	QS17238
CE Declaration of conformity	ZE12467
UKCA Declaration of conformity	ZE16569
CRC checksum program for parameterisation	www.twk.de/files/CRC-Calculator20.zip

INSTALLATION DRAWINGS

MODEL TBSN42 - ST6A - 16 S41 K1 V2 N01

Dimensions in mm



INSTALLATION DRAWINGS

MODEL TRSN42 - ST6A - 16 S41 K1 V2 N01

Dimensions in mm