SUPREME SENSORING

Absolute rotary encoder
Model TRK42/S3
Interface: EtherCAT - FSoE

Document no.:
TRK 17023 EE
27.03.2025

- **Ultra compact version with a diameter of 42 mm**
- **Contactless, wear-free sensor system**
- **Available as singleturn or multiturn sensor**
- **High vibration and shock resistance thanks to the robust mechanical design**
- **SIL2 and PLd certified**
- **Safe position and safe speed signal**
- **Unsafe position and speed signal (grey channel)**
- **Resolution: up to 65536 steps / 360° (16 bit)**
- **Programmable via EtherCAT**
- **Slewing ring function available**

Safety over EtherCAT | EtherCAT | SIL2 IEC 61508 FUNCTIONAL SAFETY SENSOR | PLd ISO 13849 FUNCTIONAL SAFETY SENSOR

KEY INFORMATION OVERVIEW

DESIGN & FUNCTION

The TRK42/S3 sensor is used to detect the angular position of a shaft. Absolute singleturn or multiturn for up to 4096 revolutions. The position of its shaft is magnetically scanned and output as an absolute value via EtherCAT / FSoE. A speed value is determined from the change in position over a specified time and output at the same time as the current position value. Position and speed scalings, other parameterisations and diagnosis can be done by the user via EtherCAT.

Robust housing manufactured from seawater-resistant aluminium or stainless steel - stainless steel shaft - magnetical sensor system - electrical connection via M8 connector radial.

With the code type "S", the TRK42/S3 offers a safe slewing ring functionality. This translates the position value of the sensor shaft into the position of a slewing ring or a rotary table, with a programmable transmission ratio between the slew ring and the encoder pinion.

In addition to the safety output, an unsafe output (grey channel) is available for accessing the position and speed value, which can optionally be used to process the encoder data in the unsafe program of the controller.

For protection against external magnetic fields a magnetic shielding stainless steel housing material is available.

FEATURES INTERFACE

To achieve the SIL2 level, the TRK/S3 contains a redundant sensor system and additional internal monitoring mechanisms as well as safe communication via the FSoE (FailSafe over EtherCAT) protocol. The FSoE protocol is implemented according to the Safety over EtherCAT specification ETG.5100 version 1.2.0.

- FailSafe over EtherCAT protocol (FSoE)
- Complex slave with CANopen over EtherCAT (CoE)
- "Full slave" - all addressing modes except segment addressing
- All EtherCAT write/read services
- Field-bus Memory Management Unit (FMMU)
- Sync-manager
- Firmware update via EtherCAT (FoE)

The detailed description of the integration and commissioning of a TWK absolute encoder with EtherCAT interface is described in detail in the user manual TRK 13349. The slewing ring function is described in manual TRK16798.

If the device is used in a manner not specified by the manufacturer, the protective effect of the device may possibly be impaired.

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TECHNICAL DATA

ELECTRICAL DATA

Sensor system	magnetic
Operating voltage	+ 9 VDC to + 36 VDC (reverse voltage protection)
Power consumption	< 3 W
Switch-on current	< 500 mA
Resolution	up to 65536 steps/360° (16 bit)
Measuring range	4096 revolutions (12 bit)
Total number of steps	up to 28 bit
Absolute accuracy of the position value	± 0.2 % (with reference to one revolution) ± 0,1 % (singleturn version)
Absolute accuracy of the speed signal	± 0.8 % (related to the maximum value of 32767 steps/gate time), ± 0,4% (singleturn version)
Internal updating time of the position value	2 ms
Internal updating time of the speed signal	2 ms
Output code	binary
Code sense	CW / CCW (parameterisable)
Speed signal	16-bit, with prefix, unit: steps/gate time (gate time adjustable in the 10 ... 1000 ms range, default: 10 ms)
Bootup time	450 ms

INPUT DATA*

2 bytes status word
4 bytes position data
2 bytes speed data

OUTPUT DATA*

2 bytes control word

ETHERCAT DATA

Transfer technology	100 Base-TX
Transfer rate	100 MBit/s
Cable length	max. 100 m (between two subscribers)
EtherCAT according to	IEC 61158-2 to 6 and encoder profile CiA DSP406
Safety over EtherCAT specification	ETG.5100 version 1.2.0

DIAGNOSIS LEDS (IF AVAILABLE)

LED 1 (VS, green)	power supply
LED 2 (L/A, green)	port 1 - network connection established
LED 3 (L/A, green)	port 2 - network connection established
LED 4 (ST, 2 colour: green)	status initialisation / operational
LED 4 (ST, 2 colour: red)	status / error modes

MECHANICAL DATA

Operating speed	5000 rpm max. (double sealed bearings)
Angular acceleration	10^5 rad/s^2 max.
Moment of inertia (rotor)	1 gcm^2
Operating torque	≤ 3 Ncm (at 500 rpm)
Starting torque	≤ 1 Ncm
Perm. shaft load	50 N axial and 50 N radial
Bearing service life **	> 10^9 revolutions
Weight	ca. 0.3 kg (stainless steel version ca. 0.5 kg)

* From the point of view of the control system (PLC)
** These values apply at maximum shaft load. Higher values are achievable at lower loads.

TECHNICAL DATA

ENVIRONMENTAL DATA

Operating temperature range . . . . . - 40 °C to + 70 °C
Storage temperature range . . . . . - 40 °C to + 100 °C (without packaging)
Resistance. . . . . to shock . . . . . 500 m/s^2; 11 ms (DIN EN 60068-2-27)
to vibration . . . . . 250 m/s^2; 10 ... 2000 Hz (DIN EN 60068-2-6)
Protection type . . . . . Singleturn: IP66/IP67 (optional IP69K)
Multiturn: IP64

EMC STANDARDS

EN 61000-6-4:2006 + A1:2011	EMC Part 6-4: Generic standards-Emision standard for industrial environments
EN 61000-6-2:2005	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 61000-4-3:2006 A1:2008 + A2:2010	EMC Part 4-3: Testing and measurement techniques - Radiated, radio frequency. electromagnetic field immunity test
EN 61000-4-4:2004	EMC Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test
EN 61000-4-5:2006	EMC Part 4-5: Testing and measurement techniques - Surge immunity test
EN 61000-4-6:2009	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. Power frequency magnetic field immunity test: 30 A/m, test criterion A, 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 disturbance in the frequency range 0 Hz to 150 kHz
EN 61000-4-29:2000	EMC Part 4-8: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations on d.c. input power port immunity tests
IEC 61326-3-2:2018	Electrical equipment for measurement, control and labortory 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

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TECHNICAL DATA

SAFETY DATA @ +70 °C

Acc. to standard	Singeturn	Multiturn
IEC61508	PFH = 1,763 • 10^{-8} 1/h	PFH = 1,876 • 10^{-8} 1/h
	SFF = 98,44 %	SFF = 98,51 %
	HFT = 0	HFT = 0
	SIL2	SIL2
ISO13849	MTTFd = 100 a (calc. tbd a)	MTTFd = 100 a (calc. tbd a)
	DC = tbd %	DC = tbd %
	Category: 2	Category: 2
	Performance Level (PL): d	Performance Level (PL): d
Maximum service life	20 years (please contact us for longer service lives)	
Tolerance of the internal position monitoring	1,5 % (with reference to one revolution) Smaller values possible with reduction of max. speed. Please contact us.	

PROGRAMMABLE PARAMETERS (REFER TO HANDBOOK TRK13349 FOR DETAILS)

ENCODER WITH OUTPUT CODE R (BINARY)

Code sense	CW / CCW	CW (clockwise): ascending values on rotation clockwise CCW (counter clockwise): descending values on rotation clockwise (viewed looking at the shaft)
Reference value [steps]	0 to total number of steps -1	For adaptation to the application, the position value can be set to any value within the measuring range.
Speed gate time [ms]	10 to 1000	Time basis of the velocity measurement
Speed multiplier	1 to 65536	Multiplier for speed output value
Speed divider	1 to 65536	Divider for speed output value

ENCODER WITH OUTPUT CODE S (SLEWING RING IN BINARY FORMAT)

Slewing ring function	OFF / ON	OFF: Standard multi turn-functionality ON: The position of the slewing ring is output, taking into acount the transmission ratio between the encoder pinion and the slewing ring (ON = slew ring parameters ≠ 0)
Code path	CW / CCW	CW (clockwise): ascending values on rotation clockwise CCW (counter clockwise): descending values on rotation clockwise (viewed looking at the shaft)
Number of teeth slewing ring	1 to FFFF FFFF	Number of teeth of the machine's slewing ring
Number of teeth encoder pinion	1 to FFFF FFFF	Number of teeth of the encoder pinion which gears in the slewing ring
Number of steps for 1 turn of slew. ring	1 to FFFF FFFF	Desired resolution of the slewing ring position, e.g. 3600 for a resolution of 0,1°. The maximum possible value depends on the gear ratio i*
Speed multiplier	1 to 65536	Multiplier for speed output value
Speed divider	1 to 65536	Divider for speed output value
Speed gate time [ms]	10 to 1000	Time basis of the velocity measurement. Only even values allowed.
Reference value [steps]	0 to nbr. of steps-1	To adapt to the users application the encoder can be set to any value within the measuring range. In case of the slewing ring encoder this means 0 to resolution position -1 (= max. value). The preset function is processed via the output data and can be executed in the user programm of the PLC

* i = Gear ratio Number of teeth slewing ring to Number of teeth encoder pinion

PRODUCT CHARACTERISTICS: SLEWING RING FUNCTIONALITY

DESCRIPTION

For applications in wind turbines, cranes, transport units, etc. it is desirable to emulate the function of a mechanical gearbox. For example, if the rotary encoder is coupled to the drive axle of a gearbox or if the position of a slewing ring is to be detected using a measuring gear with coupled rotary encoder.

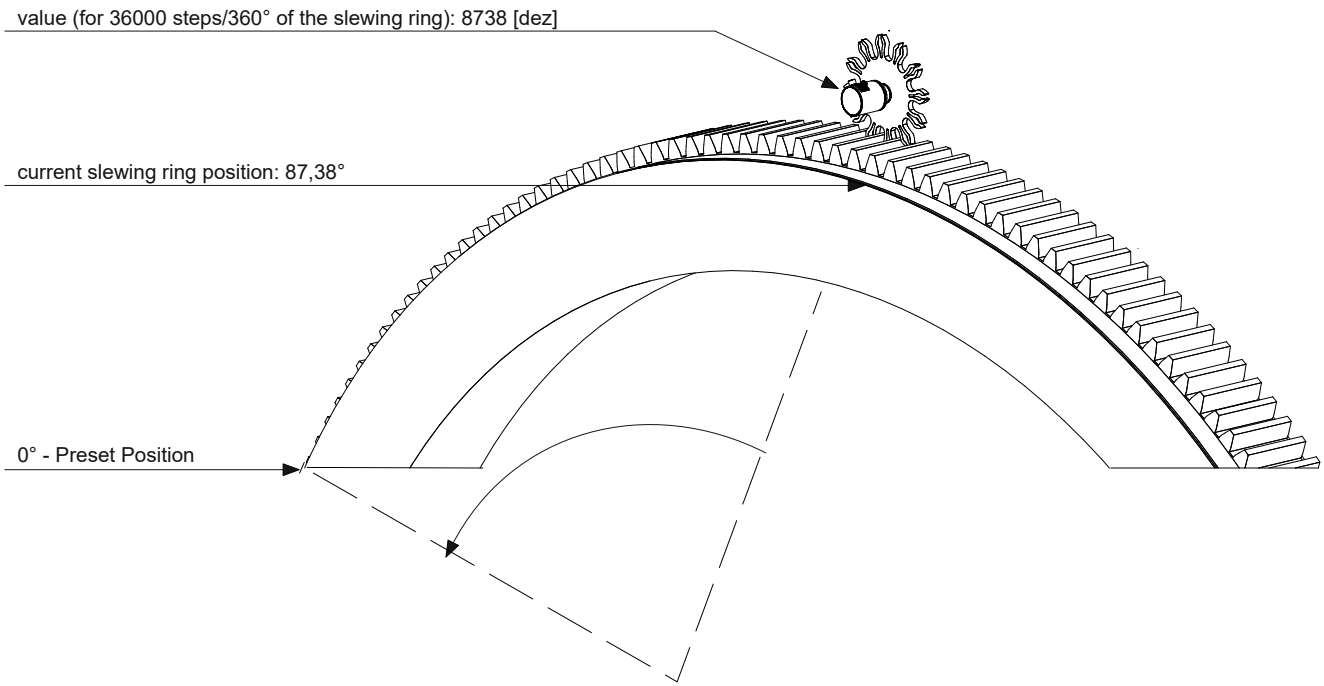
Software version ‘S’ provides this function. The encoder is located on the fast gear axis (drive wheel) and calculates the position of the slow gear axis (output wheel) via the transmission ratio. The transmission ratio and the resolution of the output axis (digit per revolution) can be freely selected. The output code is consistent beyond the code range of the encoder, regardless of the selected transmission ratio. The transmission ratio can be even or odd.

The user does not have to evaluate the gear revolutions and can run through any number of gear periods in one direction. This means that non-reversing operation is possible.

The algorithm of the slew ring software ensures that a full gear period is always available, even at the end of the encoder's code range. For the correct function of the slew-ring-module, the encoder may only be rotated a pre-determined number of revolutions **in a de-energised state** (1 024 to 2 047 revolutions in each direction by default depending on the gear ratio i). Please see manual for slewing ring functionality TRK16798 for further details, especially: Safety Notes to slewing ring functionality for "safety_gear_configuration".

ENCODER OUTPUT

The output resolution, the numbers of teeth of slew ring and drive wheel can be parameterized by the customer via EtherCAT parameters. Depending on the gear ratio i different resolutions can be parameterized e.g. 1/100° (36 000 steps/360°-slewing ring rotation) or 1/1 000° (360 000 steps/360°-slewing ring rotation). For further details please refer to manual TRK16798.



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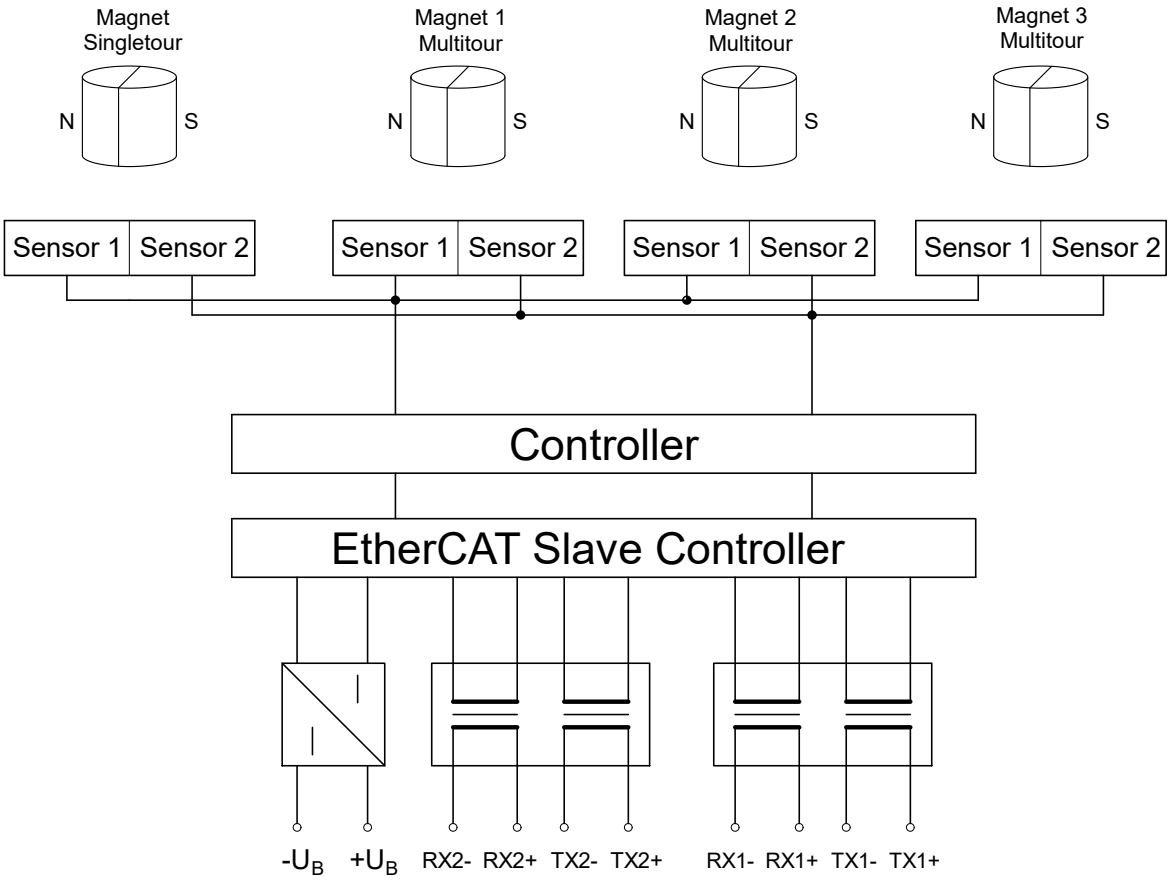
TECHNICAL DATA

PRINCIPAL CIRCUIT DIAGRAM



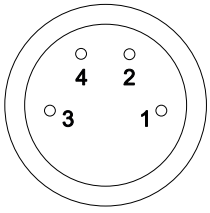
ELECTRICAL CONNECTION - PINOUT

ELECTRICAL CONNECTION

EtherCAT . . . . . 2 x M8 connector radial, A-coded, 4-pole, female for port 1 and port 2
Power supply . . . . . 1 x M8 connector radial, A-coded, 4-pole, male

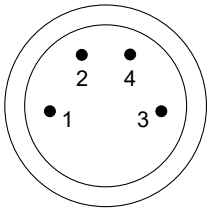
ETHERCAT CONNECTOR, 2 X M8, A-CODED, FEMALE

PIN. . . . . Function
1 . . . . . TX+
2 . . . . . RX+
3 . . . . . TX-
4 . . . . . RX-



SUPPLY CONNECTOR, M8, A-CODED, MALE

PIN. . . . . Function
1 . . . . . +UB (+24 VDC)
2 . . . . . not used
3 . . . . . -UB (0 VDC)
4 . . . . . not used



ORDER CODE FORMAT

TRK	42 -	ST	A	65536	R	4096	S3	M	K	01	STANDARD VERSION

TRK	Absolute singleturn / multiturn rotary encoder with EtherCAT / FSoE interface		
42	Design form Ø	42	Design form 42 mm
ST	Flange and shaft	ST SZ	Synchro flange, shaft 6 mm with flattened area Synchro flange, shaft for play-compensating toothed gear ZRS
A	Housing material	A S V W	Aluminium 3.2315 (AlMgSi1) Stainless steel 1.4305 (AISI 303) Stainless steel 1.4404 (AISI 316L) Stainless steel 1.4521 for shielding strong magnetic fields
65536	Resolution in steps/360°	4096 ••• 65536	12 bit ••• 16 bit
R	Code	R S	Binary code Binary code, slewing ring function
4096	Measuring range	4096	Number of revolutions (Single turn version: leave blank)
S3	Profile	S0 S3	Sample, not certified SIL2/PLd certified according to this data sheet
M	Electrical connection	M	3 x M8 connector radial
K	Output	K	EtherCAT 100Base-TX
01	Electrical and mechanical variants*	01	Standard

* The basic versions according to the data sheet bear the number 01. Deviations are marked with a variant number and documented at TWK.

ACCESSORIES (SELECTION) - TO BE ORDERED SEPARATELY

MATING CONNECTORS (IN PREPARATION)

Order number, Datasheet	Type	Design & wire fixing	Housing-material	Cable ø & wire size	Shielding & IP grade
STK4GPxxx	M8-A 4-pole, male	Straight, screws	Brass (CuZn) nickel-plated	6 – 8 mm 0.14 – 0.5 mm²	On housing IP67
STK4GPxxx	M8-A 4-pole, male	Straight, soldering	Brass (CuZn) nickel-plated	3.5 – 5 mm 0.25 mm²	On housing IP67
STK4GSxxx)	M8-A 4-pole, female	Straight, screws	Brass (CuZn) nickel-plated	6 – 8 mm 0.14 – 0.5 mm²	On housing IP67
STK4GSxxx,	M8-A 4-pole, female	Straight, soldering	Brass (CuZn) nickel-plated	3.5 – 5 mm 0.25 mm²	On housing IP67
STK4WPxxx	M8-A 4-pole, male	Angled, soldering	Brass (CuZn) nickel-plated	3.5 – 5 mm 0.25 mm²	On housing IP67
STK4WSxxx	M8-A 4-pole, female	Angled, soldering	Brass (CuZn) nickel-plated	3.5 – 5 mm 0.25 mm²	On housing IP67

SHAFT COUPLINGS

BKK . . . . . Bellows coupling, large, see datasheet BKK11840
BKM . . . . . Bellows coupling, small, see datasheet BKM11995
KK14 . . . . . Clamp coupling, see datasheet KK12301

TOOTHED GEARS

ZRS . . . . . Play-compensating toothed gear, see datasheet ZRS11877
ZRM . . . . . Standard toothed gear, see datasheet ZRM13229

STATOR COUPLING / TORQUE SUPPORT

ZVS . . . . . See datasheet ZVS16796

GENERAL MECHANICAL ACCESSORIES

Syn. clamps etc. . . . . See datasheet MZ10111

DOCUMENTATION

DOCUMENTATION

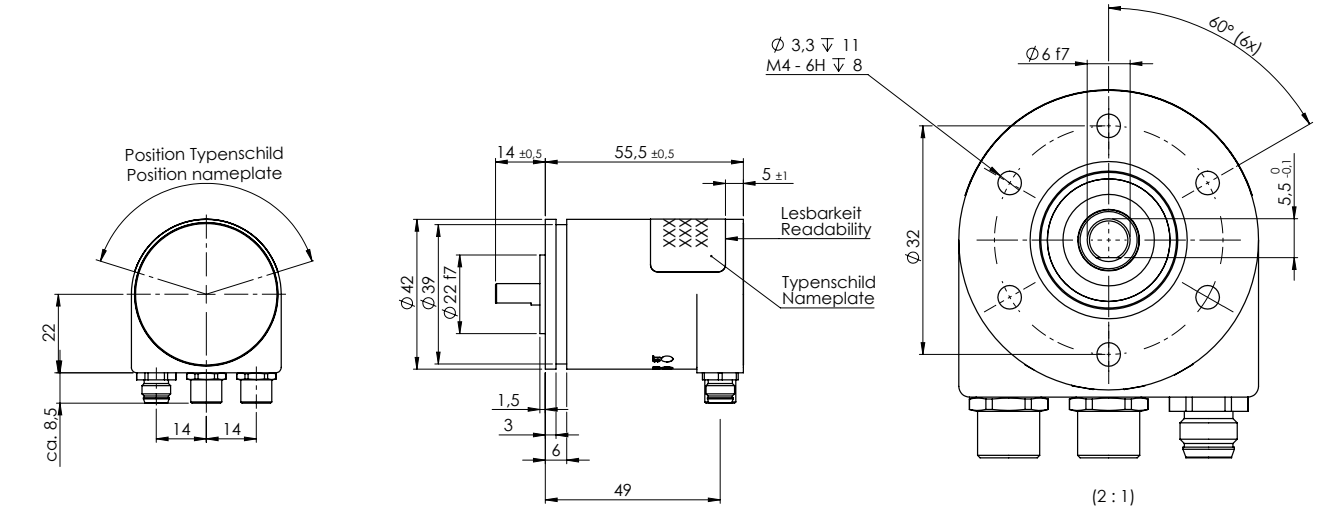
The following documents can be found in the Internet under www.twk.de/en in the documentation area, model TRK.

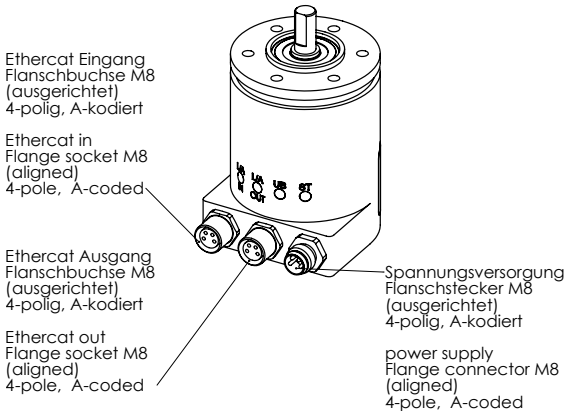
Data sheet TRK17023
Manual TRK13349
Certificate SIL2/PLd . . . . . TRKxxxxx - in preparation
EtherCAT conformance test . . . . . TRKxxxxx - in preparation
FSoE conformance test . . . . . TRKxxxxx - in preparation
FSoE conformance test (TÜV) . . . . . TRKxxxxx - in preparation
ESI files . . . . . TRKxxxxx - in preparation
Installation instructions AN16169
Safety Library (VDMA/Sistema) . . . . . Safety CRC Software TRK/S3 - in preparation
Declaration of Conformity - CE ZE12467
Declaration of Conformity - UKCA ZE16569
Reach compliant QS15286
RoHS compliant QS13284
CRC checksum calculation program www.twk.de/files/CRC-Calculator20.zip

INSTALLATION DRAWINGS

MODEL TRK42-STA65536R4096S3MK01 - MULTITURN

Dimensions in mm

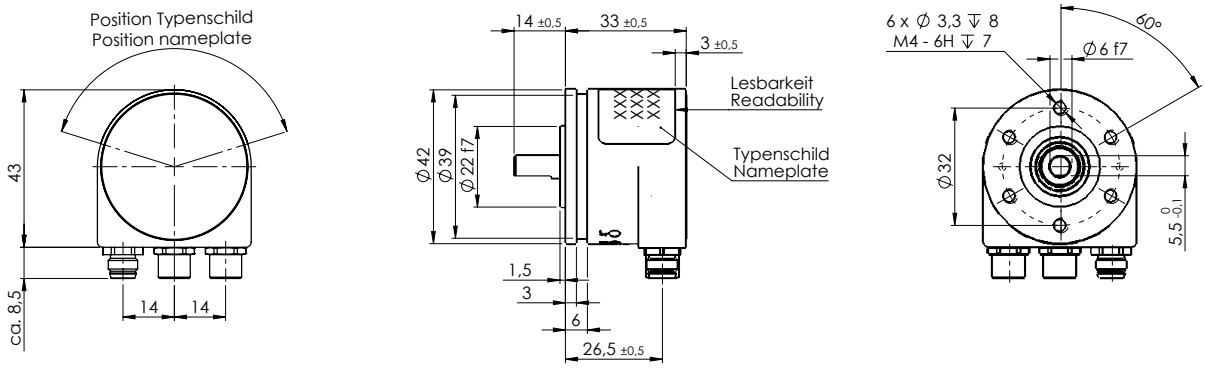


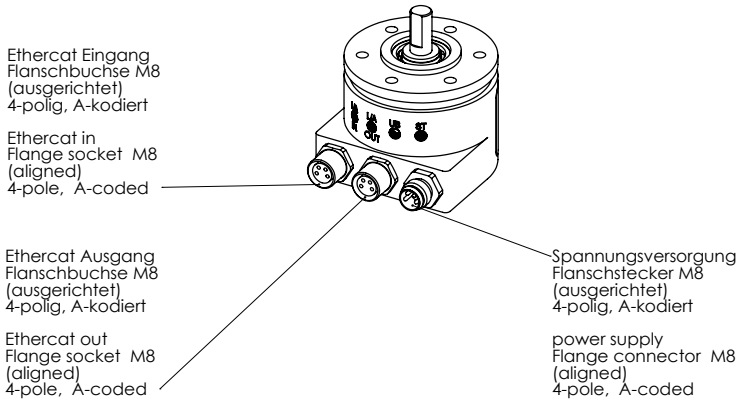


INSTALLATION DRAWINGS

MODEL TRK42-STA65536RS3MK01 - SINGLETURN

Dimensions in mm

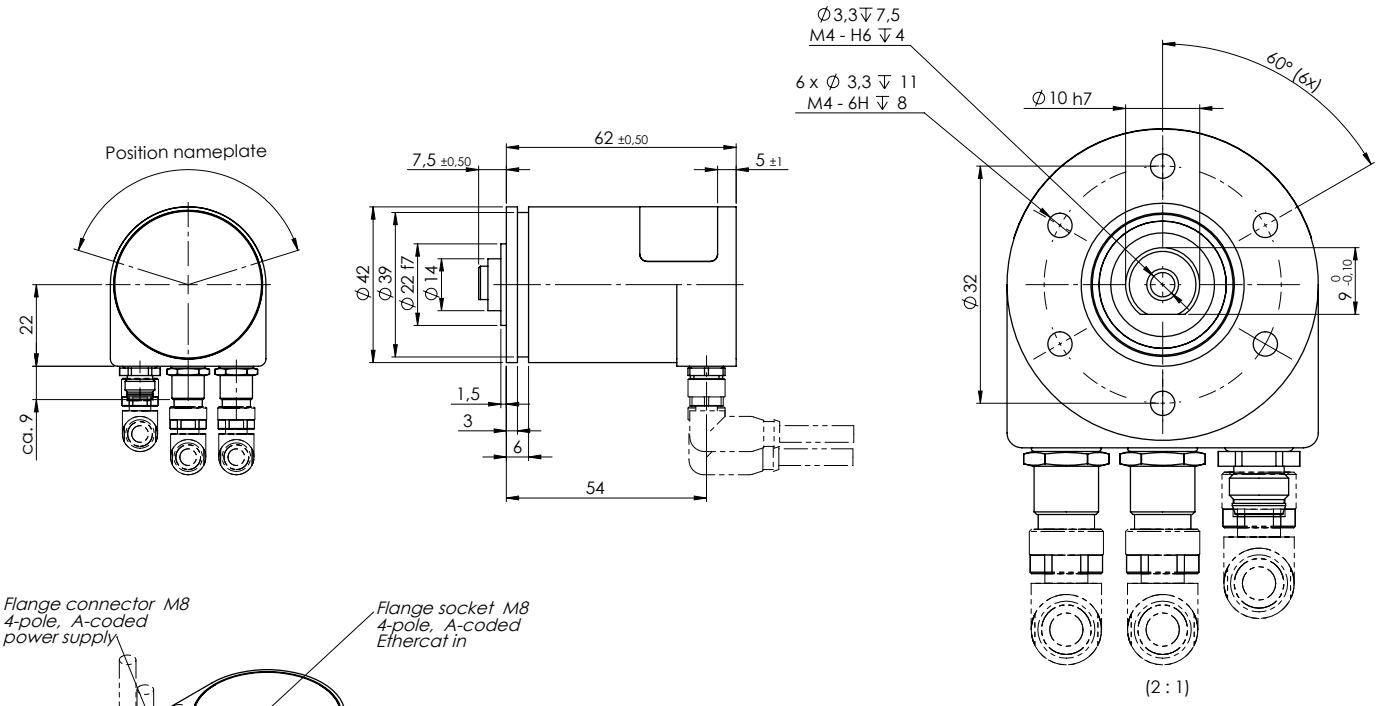


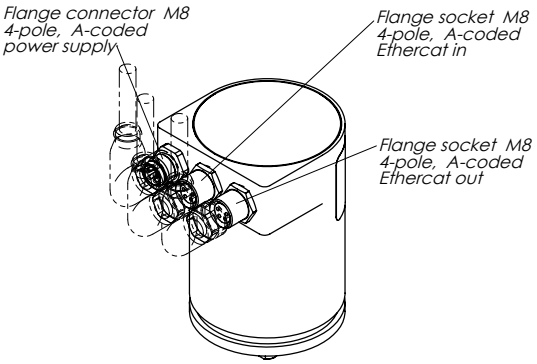


INSTALLATION DRAWINGS

MODEL TRK42-SZA65536R4096S3MK01 - MULTITURN

Dimensions in mm





INSTALLATION DRAWINGS

MODEL TRK42-SZA65536RS3MK01 - SINGLETURN

Dimensions in mm