



- 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 on request



## 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](#).

EtherCAT® and Safety over EtherCAT® is a registered brand and patented technology licensed by Beckhoff Automation GmbH, Germany.

## 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)<br>± 0,05 % (singleturn version)                                      |
| Absolute accuracy of the speed signal        | ± 0.8 % (related to the maximum value of 32767 steps/gate time),<br>± 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<br>(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 <sup>5</sup> rad/s <sup>2</sup> max.         |
| Moment of inertia (rotor) | 1 gcm <sup>2</sup>                              |
| 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 <sup>9</sup> 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<sup>2</sup>; 11 ms (DIN EN 60068-2-27)  
..... to vibration ..... 250 m/s<sup>2</sup>; 10 ... 2000 Hz (DIN EN 60068-2-6)  
Protection type ..... IP65 (double sealed bearings)

### EMC STANDARDS

|                                     |                                                                                                                                                                                                                                                                                           |
|-------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| EN 61000-6-4:2006 + A1:2011         | EMC Part 6-4: Generic standards-Emission 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 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 |

## TECHNICAL DATA

### SAFETY DATA @ +70 °C

| Acc. to standard                              | Singeturn                                                                             | Multiturn                                                                             |
|-----------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| IEC61508                                      | PFH = tbd • 10 <sup>-8</sup> 1/h<br>SFF = tbd %<br>HFT = 0<br>SIL2                    | PFH = tbd • 10 <sup>-8</sup> 1/h<br>SFF = tbd %<br>HFT = 0<br>SIL2                    |
| ISO13849                                      | MTTFd = 100 a (calc. tbd a)<br>DC = tbd %<br>Category: 2<br>Performance Level (PL): d | MTTFd = 100 a (calc. tbd a)<br>DC = tbd %<br>Category: 2<br>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)                                              |                                                                                       |

### 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<br>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<br>ON: The position of the slewing ring is output, taking into account 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<br>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 allo.                                                                                                                                                                                                                                        |
| 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.

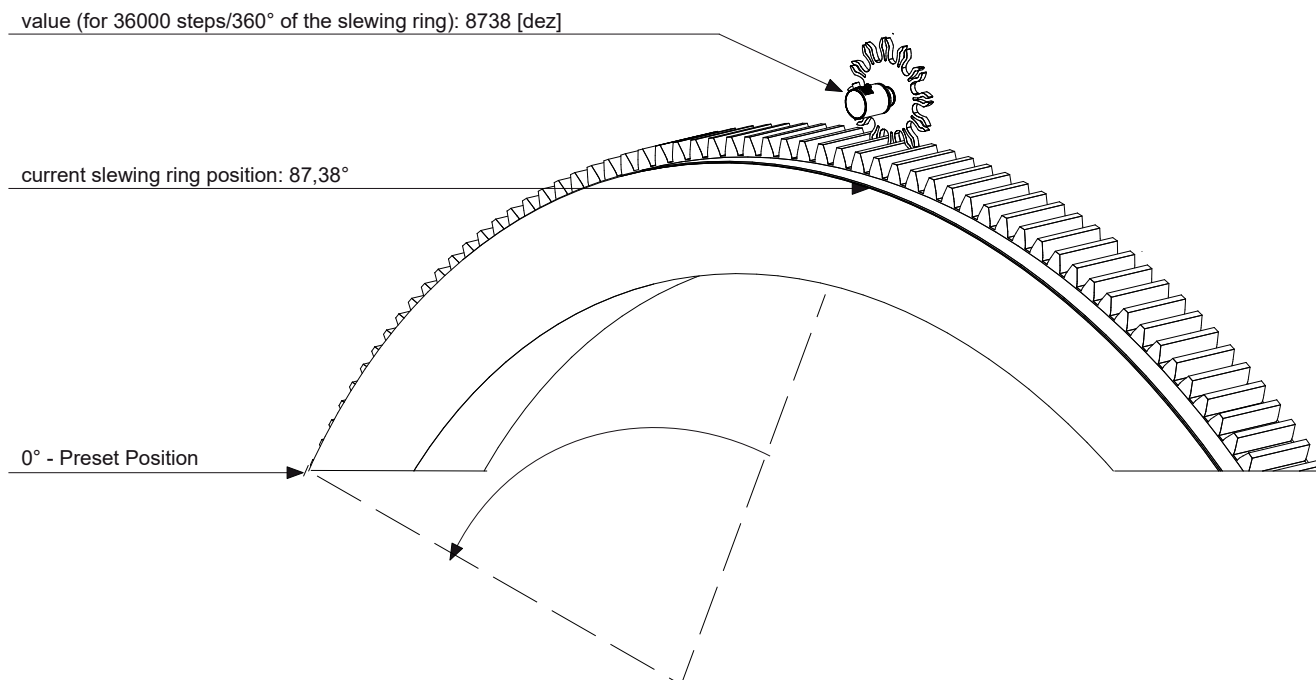
Software version 'S' provides this function. The encoder is located on the fast gear axis (drive wheel) and calculates the position of the slow gear axis (output wheel) via the transmission ratio. The transmission ratio and the resolution of the output axis (digit per revolution) can be freely selected. 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".

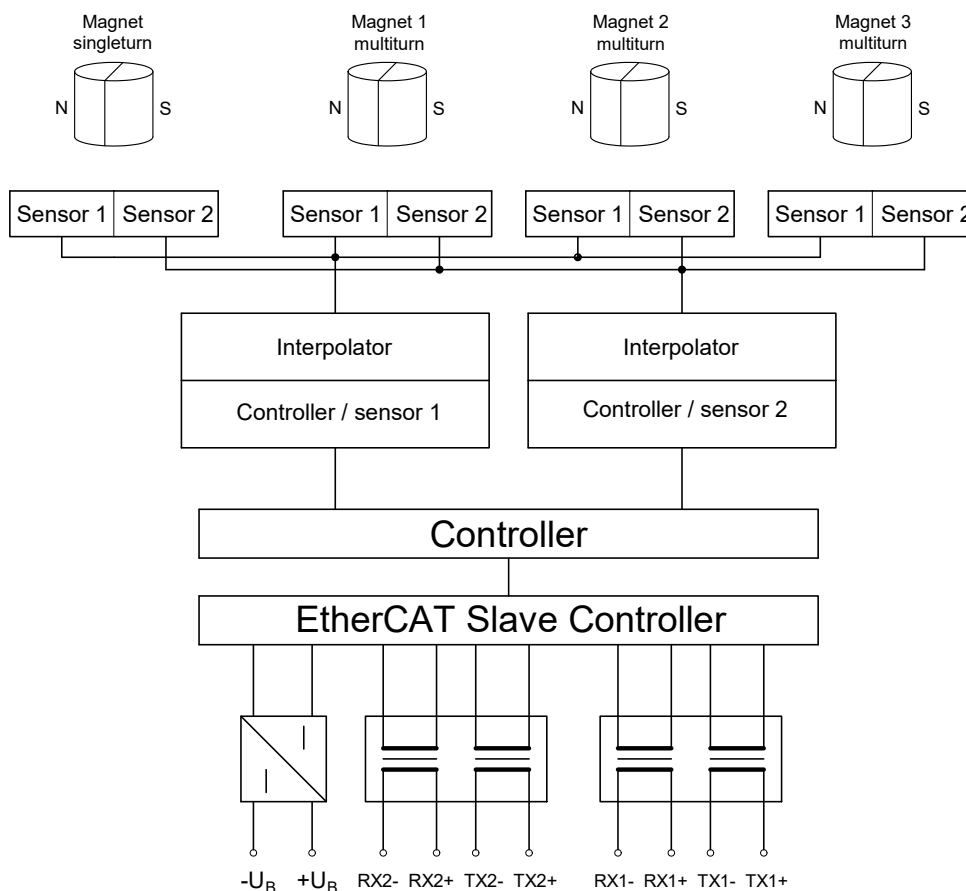
### ENCODER OUTPUT

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.  $1/100^\circ$  (36 000 steps/ $360^\circ$ -slewing ring rotation) or  $1/1\,000^\circ$  (360 000 steps/ $360^\circ$ -slewing ring rotation). For further details please refer to manual [TRK16798](#).



## TECHNICAL DATA

### PRINCIPAL CIRCUIT DIAGRAM



## ELECTRICAL CONNECTION - PINOUT

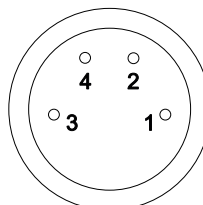
### ELECTRICAL CONNECTION

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

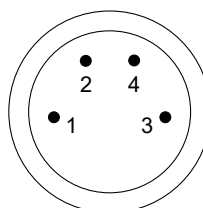
1 ..... TX+  
2 ..... RX+  
3 ..... TX-  
4 ..... RX-



### 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 |                      |                                                                                                                                                                      |
|--------------|-------------------------------------------------------------------------------|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>42</b>    | Design form Ø                                                                 | 42                   | Design form 42 mm                                                                                                                                                    |
| <b>ST</b>    | Flange and shaft                                                              | ST<br>SZ             | Synchro flange, shaft 6 mm with flattened area<br>Synchro flange, shaft for play-compensating toothed gear ZRS                                                       |
| <b>A</b>     | Housing material                                                              | A<br>S<br>V<br>W     | Aluminium 3.2315 (AlMgSi1)<br>Stainless steel 1.4305 (AISI 303)<br>Stainless steel 1.4404 (AISI 316L)<br>Stainless steel 1.4521 for shielding strong magnetic fields |
| <b>65536</b> | Resolution in steps/360°                                                      | 4096<br>...<br>65536 | 12 bit<br>...<br>16 bit                                                                                                                                              |
| <b>R</b>     | Code                                                                          | R<br>S               | Binary code<br>Binary code, slewing ring function                                                                                                                    |
| <b>4096</b>  | Measuring range                                                               | 4096                 | Number of revolutions (Single turn version: leave blank)                                                                                                             |
| <b>S3</b>    | Profile                                                                       | S0<br>S3             | Sample, not certified<br>SIL2/PLd certified according to this data sheet                                                                                             |
| <b>M</b>     | Electrical connection                                                         | M                    | 3 x M8 connector radial                                                                                                                                              |
| <b>K</b>     | Output                                                                        | K                    | EtherCAT 100Base-TX                                                                                                                                                  |
| <b>01</b>    | 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,<br>Datasheet             | Type                   | Design &<br>wire fixing | Housing-<br>material          | Cable ø &<br>wire size                 | Shielding &<br>IP grade |
|----------------------------------------|------------------------|-------------------------|-------------------------------|----------------------------------------|-------------------------|
| <b>STK4GPxxx</b> ,<br>(99 3363 300 04) | M8-A<br>4-pole, male   | Straight,<br>screws     | Brass (CuZn)<br>nickel-plated | 6 – 8 mm<br>0.14 – 0.5 mm <sup>2</sup> | On housing<br>IP67      |
| <b>STK4GPxxx</b> ,<br>(99 3363 00 04)  | M8-A<br>4-pole, male   | Straight,<br>soldering  | Brass (CuZn)<br>nickel-plated | 3.5 – 5 mm<br>0.25 mm <sup>2</sup>     | On housing<br>IP67      |
| <b>STK4GSxxx</b> ,<br>(99 3362 300 04) | M8-A<br>4-pole, female | Straight,<br>screws     | Brass (CuZn)<br>nickel-plated | 6 – 8 mm<br>0.14 – 0.5 mm <sup>2</sup> | On housing<br>IP67      |
| <b>STK4GSxxx</b> ,<br>(99 3362 00 04)  | M8-A<br>4-pole, female | Straight,<br>soldering  | Brass (CuZn)<br>nickel-plated | 3.5 – 5 mm<br>0.25 mm <sup>2</sup>     | On housing<br>IP67      |
| <b>STK4WPxxx</b> ,<br>(99 3367 00 04)  | M8-A<br>4-pole, male   | Angled,<br>soldering    | Brass (CuZn)<br>nickel-plated | 3.5 – 5 mm<br>0.25 mm <sup>2</sup>     | On housing<br>IP67      |
| <b>STK4WSxxx</b> ,<br>(99 3366 00 04)  | M8-A<br>4-pole, female | Angled,<br>soldering    | Brass (CuZn)<br>nickel-plated | 3.5 – 5 mm<br>0.25 mm <sup>2</sup>     | On housing<br>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](http://www.twk.de/en) in the documentation area, model TRK.

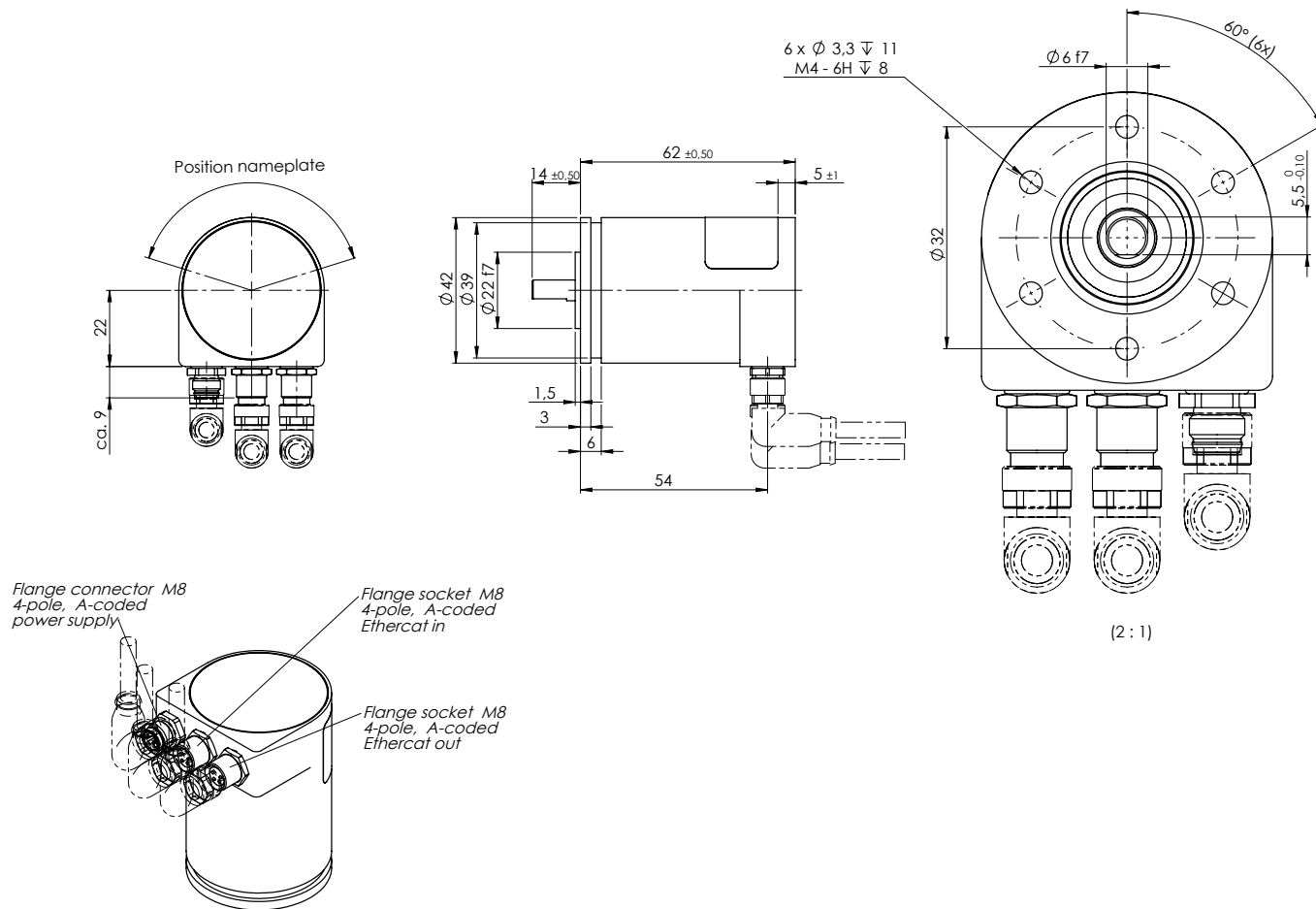
Data sheet . . . . . TRK17023  
Manual . . . . . [TRK13349](#)  
Certificate SIL2/PLd . . . . . TRKxxxxx - in preparation  
EtherCAT conformance test . . . . . TRKxxxxx - in preparation  
FSoE conformance test . . . . . TRKxxxxx - in preparation  
FSoE conformance test (TÜV) . . . . . TRKxxxxx - in preparation  
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](http://www.twk.de/files/CRC-Calculator20.zip)



## INSTALLATION DRAWINGS

### MODEL TRK42-STA65536R4096S3MK01 - MULTITURN

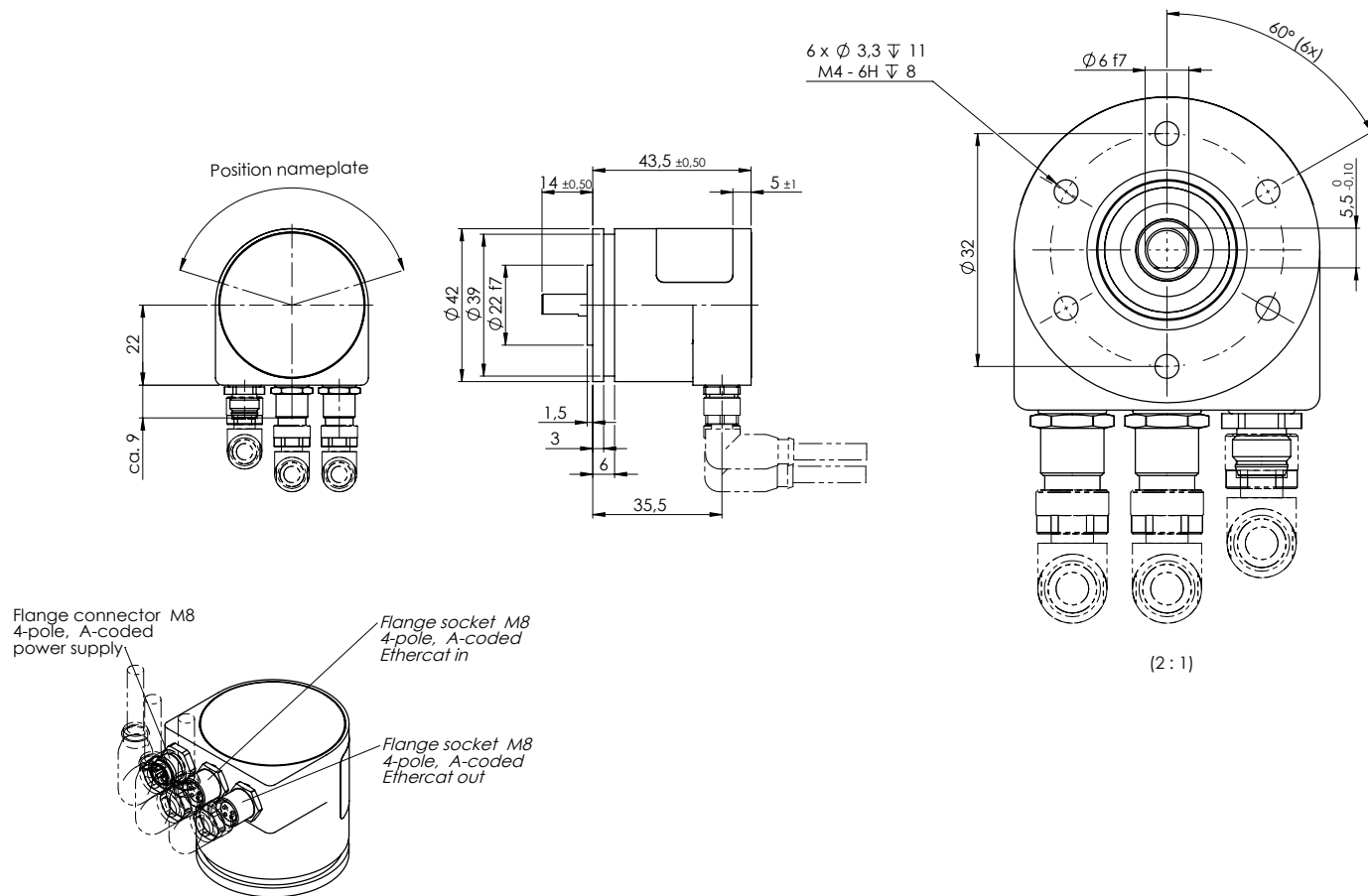
Dimensions in mm



## INSTALLATION DRAWINGS

### MODEL TRK42-STA65536RS3MK01 - SINGLETURN

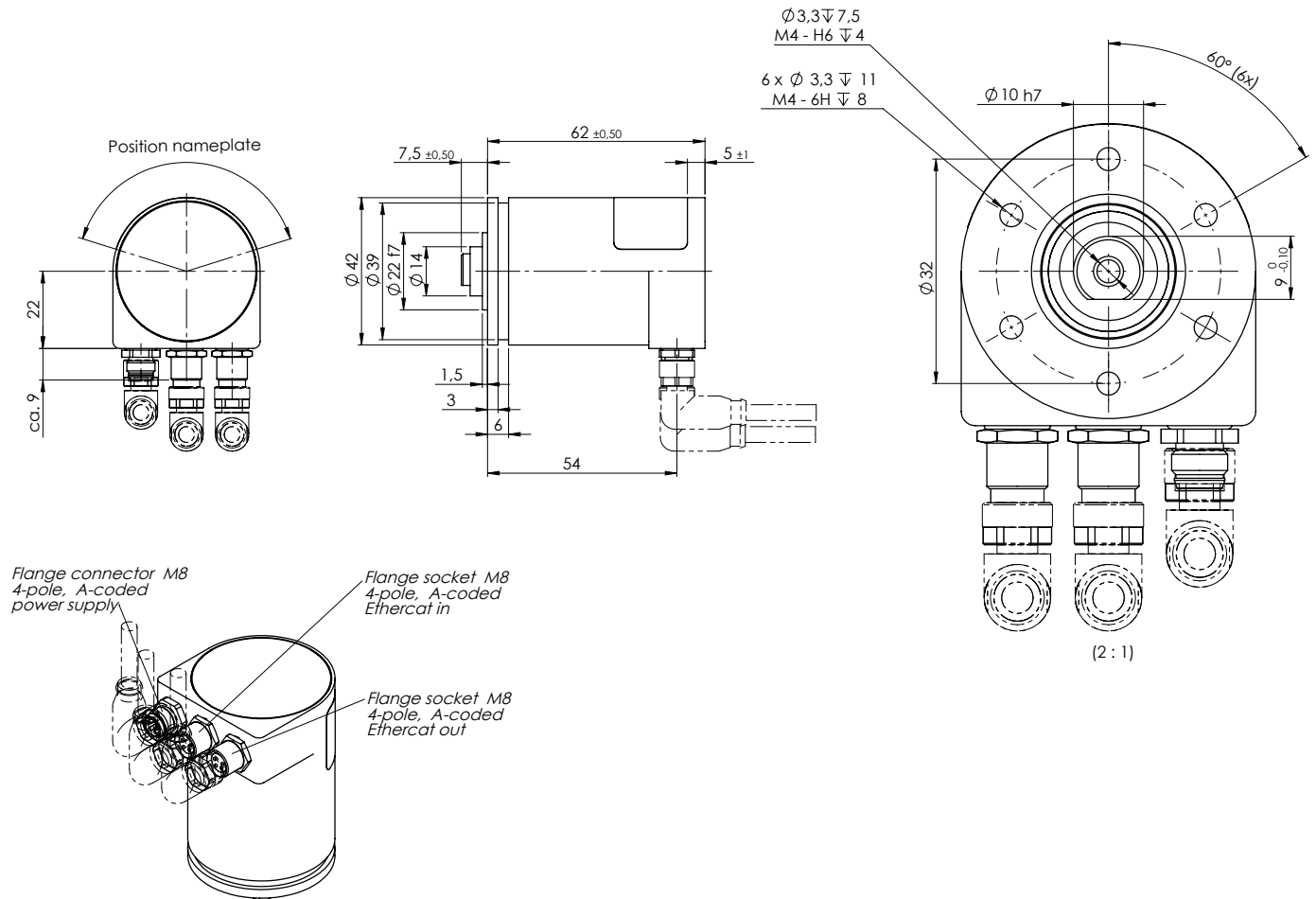
Dimensions in mm



## INSTALLATION DRAWINGS

### MODEL TRK42-SZA65536R4096S3MK01 - MULTITURN

Dimensions in mm



## INSTALLATION DRAWINGS

## MODEL TRK42-SZA65536RS3MK01 - SINGLETURN

Dimensions in mm

