

# Absolute encoder TRK/S3 with EtherCAT FSoE interface


**SIL2**  
IEC 61508

 FUNCTIONAL  
SAFETY  
SENSOR

**PLd**  
ISO 13849

 FUNCTIONAL  
SAFETY  
SENSOR

Safety over  
**EtherCAT®**



- Contactless, wear-free sensor system according to the Hall principle
- High vibration and shock resistance thanks to the robust mechanical design
- SIL2 and Performance Level d
- Safe position and safe speed signal
- Resolution: up to 65536 steps / 360° ↻ (16-bit)
- Measuring range: 4096 revolutions (12-bit)
- Protection class: up to IP69K
- Also available as singleturn version
- Optionally in magnetically shielding housing material

## Design and function

Recording of the angular position and revolutions by means of Hall sensors - absolute multiturn transmission for up to 4096 revolutions - data output plus parameterisation and diagnosis via EtherCAT.

Robust housing manufactured from seawater-resistant aluminium or stainless steel - stainless steel shaft - ball bearing with radial shaft seal - sensor circuit consisting of ASIC with Hall elements - electrical connection via M12 connector or cable outlet.

In the model series TRK absolute encoders, the EtherCAT interface is integrated according to IEC 61158-2 to 6 and encoder profile CiA DSP406.

The use of the CANopen over EtherCAT message and the CANopen encoder profile enable parameter and diagnostic data handling as familiar from CANopen. These are contained in an object directory under the same indices as in CANopen.

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.

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](#).

## EtherCAT® features

- 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)

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

# Absolute encoder model TRK/S3

## Technical data

**Note:** All technical data listed in this data sheet apply only to hardware version 2

### Input data \*

- 8 byte 4 byte position data, 2 byte speed data, 2 byte status word

### Output data \*

- 2 byte 2 byte control word

### 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: depending on type: 4096, 8192 or 65536 steps/360 °
- Measuring range: 4096 revolutions
- Total number of steps: depending on type: 24, 25 or 28 bit
- Absolute accuracy of the position value: ± 0.2% (with reference to one revolution), singleturn version: ± 0,05 %
- Absolute accuracy of the speed ± 0.8 % (related to the maximum value of 32767 steps/gate time), singleturn version 0,4%
- Toleranz of the internal position monitoring 1,5 % (with reference to one revolution)
- Internal updating time of the position value: 2 ms
- Output code: Binary
- Code sense: CW / CCW
- Speed signal: 16-bit, with prefix, unit: steps/gate time (gate time adjustable in the 10 ... 1000 ms range, default: 10 ms)
- Internal updating time of the speed signal: 2 ms
- Bootup time 450 ms
- Programmable parameters: Preset, code sense, gate time and scaling of the speed value

### EtherCAT data

- Transfer technology 100 Base-TX
- Transfer rate 100 MBit/s
- Cable length Max. 100 m (between two subscribers)

### Mechanical data

- Operating speed: 1.000 rpm max. (variant 23: 5000 rpm)
- Angular acceleration:  $10^5$  rad/s<sup>2</sup> max.
- Moment of inertia (rotor): 20 gcm<sup>2</sup>
- Operating torque: ≤ 8 Ncm (at 500 rpm)
- Starting torque: ≤ 4 Ncm
- Perm. shaft load: 250 N axial, 250 N radial
- Bearing service life \*\*: > 10<sup>9</sup> revolutions
- Weight: approx. 0.450 kg (stainless steel version approx.. 0.7 kg)

### 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 class: IP 66 / IP 67, with cable outlet IP68, IP69K (optional) (DIN EN 60529)  
Variant 23 (without shaft sealing): IP65
- Salt mist test: Test Kb according to IEC 60068-2-52
- Corrosion resistance: C4 long (EN ISO 12944)
- Altitude: ≤ 2000 m
- Power frequency magnetic field immunity test (EN 6100-4-8): 30 A/m, test criterion A (±8 digit at 13 Bits output resolution)  
100 A/m, test criterion B

\* From the point of view of the control system.

\*\* These values apply at maximum shaft load. Higher values are achievable at lower loads.

# Absolute encoder model TRK/S3

## Technical data

### 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 ( $\pm 16$ digit) 100 A/m, test criterion B
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

### Safety data

All values apply to +70°C

- According to DIN EN 61508:

Singleturn	Multiturn
PFH = 9,95101E-08	PFH = 1,10497E-07
SFF = 92,04%	SFF = 93,20%
HFT = 0	HFT = 0
SIL2	SIL2

- According to DIN EN ISO 13849-1:

Singleturn	Multiturn
MTTF <sub>d</sub> = 100 years (calculated 557,3853 years)	MTTF <sub>d</sub> = 100 years (calculated 577,9868 years)
DC = 95,36%	DC = 93,39
PL d	PL d
Category 2	Category 2

- Maximum service life

20 years (please contact us for longer service lifes)

### Electrical connection

- EtherCAT:

M12 connector D-coded 4-pin for bus in / bus out, socket or cable output via cable glands

- Supply:

M12 connector A-coded 4-pin, pins or cable output via cable glands

### Cable output EtherCAT

- Cable type:
- Cable jacket:
- Temperatur range:
- Outer diameter:
- Min. bend radius:

PROFINET Type-C, 4 x 0,36 mm<sup>2</sup> (AWG22)

PUR, color: green

- 40 °C to + 70 °C

6,5 mm  $\pm$  0,2 mm

5 x d fixed installation, 10 x d freely movable

### Cable output power supply

- Cable type:
- Cable jacket:
- Temperatur range:
- Outer diameter:
- Min. bend radius:

2 x 0,75 mm<sup>2</sup>, shielded

PUR, color: gray

- 40 °C to + 80 °C fixed installation, - 5 °C to + 70 °C freely movable

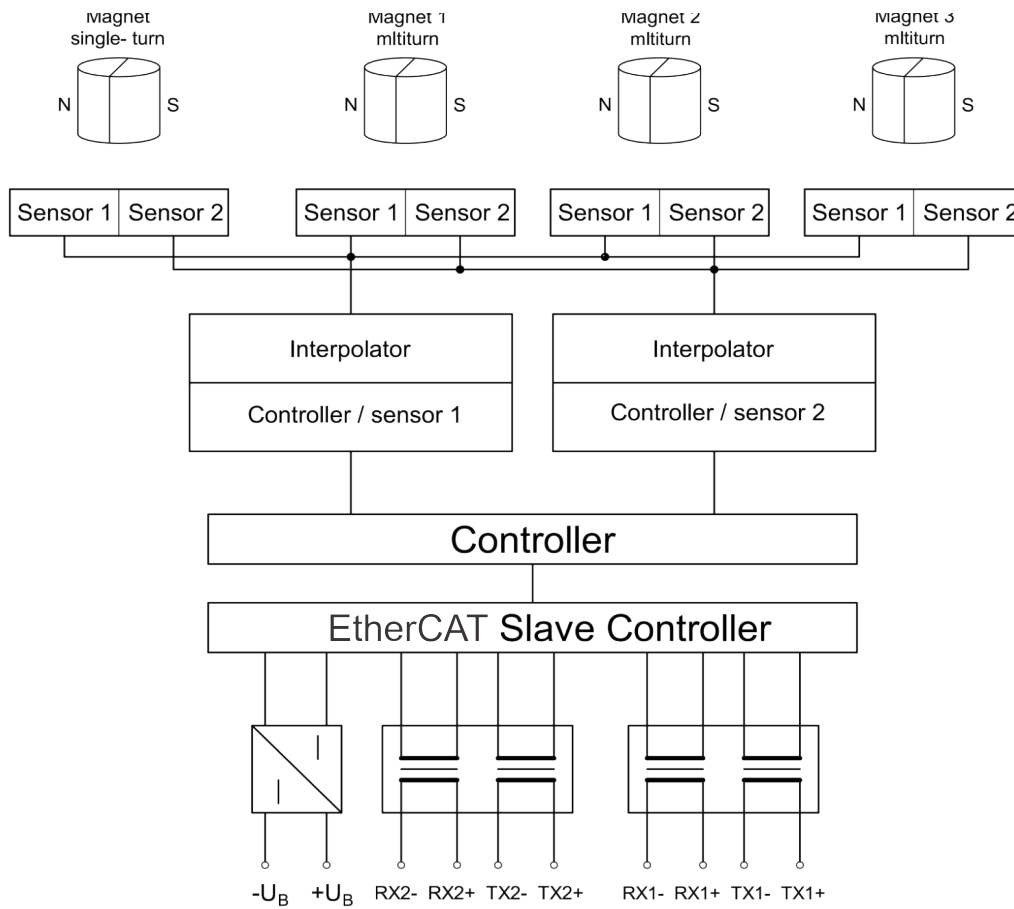
6 mm

6 x d fixed installation, 15 x d freely movable

# Absolute encoder model TRK/S3

## Electrical connection

### Block diagram



### EtherCAT M12 connector connection assignment (Port1 and Port 2)

PIN	1	2	3	4
Signal	TX+	RX+	TX-	RX-
Colour*	yellow	white	orange	blue

### Supply M12 connector connection assignment

PIN	1	2	3	4
Signal	+ UB (+ 24 VDC)	—	- UB (0 VDC)	—

\* Industrial Ethernet cable colours according to ISO / IEC 8802-3.

## Absolute encoder model TRK/S3

### Diagnosis LEDs

#### Diagnosis LEDs:

UB	Link/ Activity (L/A)	Status (ST)		Description
		green	red	
green	green	green	red	
on				Operating voltage available
	on			Network connection established
	flashing			Network active
		off		Initialisation
		1 x flashing		Safe-Operational
		flashing		Pre-Operational
		on		Operational
			off	Normal operating mode
			flickering	Boot error
			flashing	General configuration error
			1x flashing	Change of EtherCAT state due to internal error
			2x flashing	EtherCAT watchdog expired
			on	Critical communication controller error

# Absolute encoder model TRK/S3

## Order number

### Absolut encoder

TRK	58	-	KP	A	65536	R	4096	S3	M	K	01	→ Standard version
<p><b>Electrical and / or mechanical variants*</b></p> <p>01 Standard  02 Protection class IP69K (only with cable output)  23 Without shaft sealing (IP65)</p> <p><b>Output:</b>  K 100Base-TX</p> <p><b>Electrical connection:</b>  M M12 connector  Kx Cable, x = length in m</p> <p><b>Profil:</b>  S1 FSoE, not certified sample devices  S3 FSoE, SIL2 certified</p> <p><b>Measuring range:</b>  <b>Singleturn version: leave blank</b>  4096 Revolutions</p> <p><b>Output code:</b>  R Binary code</p> <p><b>Resolution:</b>  4096 Steps / 360° ↯  8192 Steps / 360° ↯  65536 Steps / 360° ↯ standard (as of hardware version 2)</p> <p><b>Housing material:</b>  A Aluminium  B Burnished steel for shielding strong magnetic fields  S Stainless steel (1.4305)  V Stainless steel (1.4404)</p> <p><b>Flange:</b></p> <p>58 K Clamped flange, shaft 10 mm with flat  KF Clamped flange, shaft 10 mm with woodruff key  KP Clamped flange, shaft 10 mm with parallel key (recommended for safety)  KZ Clamped flange, shaft for play-compensating toothed gear ZRS  SN Synchronizer flange, clamping shaft 12 mm with groove for parallel key  ST Synchro flange, shaft 6 mm with flat</p> <p>64 NZ Cam switch flange, shaft for play-compensating toothed gear ZRS  65 SP Synchro flange, shaft 12 mm with parallel key  66 K Clamped flange, shaft 10 mm with flat  KP Clamped flange, shaft 10 mm with parallel key</p> <p>78 KP Ex housing for zone 1/21, clamped flange, shaft 10 mm with parallel key  SP Ex housing for zone 1/21, synchro flange, shaft 10 mm with parallel key  VP Ex housing for zone 1/21, square flange, shaft 10 mm with parallel key</p> <p>105 MP Mounting flange, shaft 12 mm with parallel key</p> <p><b>Design form</b></p> <p><b>Modell:</b>  TRK T series encoder with EtherCAT interface</p>												

\* The basic versions according to the data sheet have the number 01. Deviations are identified with a variant number and are documented in the factory.

## Absolute encoder model TRK/S3

### Accessories, documentation, EDS file

#### Accessories (to be ordered separately)

- Straight mating connector
  - STK4GP81** for EtherCAT in/out (Zinc die-cast nickel-plated), see data sheet [STK14570](#)
  - STK4GP110** for EtherCAT in/out (stainless steel 1.4404), see data sheet [STK14569](#)
  - STK4GS60** for the supply voltage (Zinc die-cast nickel-plated), see data sheet [STK14572](#)
  - STK4GS104** for the supply voltage (stainless steel 1.4404), see data sheet [STK14571](#)
- Angled mating connector
  - STK4WP82** for EtherCAT in/out, see data sheet [STK14676](#)
  - STK4WP116** for EtherCAT in/out, see data sheet [STK15518](#)
  - STK4WS61** for the supply voltage, see data sheet [STK14675](#)
  - STK4WS117** for the supply voltage, see data sheet [STK16392](#)
- Connecting cable - EtherCAT
  - KABEL-xxx-114** Industrial Ethernet data cable with M12 connectors, D-coded, moulded on at both ends. Standard lengths: 1, 2, 3 and 5 m (xxx = length in metres), see data sheet [KBL14673](#)
  - KABEL-xxx-118** Industrial Ethernet data cable with M12 connector to RJ 45, IP 20 (xxx = length in metres), see data sheet [KBL14655](#)
- Connecting cable - power supply
  - KABEL-5-191** With moulded M12 connector, A-coded, straight, 2. side open, length 5m, see data sheet [KBL13411](#)
- Couplings
  - BKK** Folding bellows coupling, large, see data sheet [BKK11840](#)
  - BKM** Folding bellows coupling, small, see data sheet [BKM11995](#)
  - KK14N** Clamp coupling, see data sheet [KK12301](#)
- Toothed gear
  - ZRS** Play-compensating toothed gear [ZRS11877](#)
- Torque plate
  - ZMS** see data sheet [ZMS12939](#)
- Further installation accessories and securing clamps are available according to data sheet [MZ10111](#).

#### Documentation, EDS file, etc.

The following documents plus the EDS file can be found in the Internet under [www.twk.de](http://www.twk.de) in the documentation area, model TRK.

- Data sheet No. [TRK13348](#)
- Manual No. [TRK13349](#)

# Absolute encoder model TRK/S3

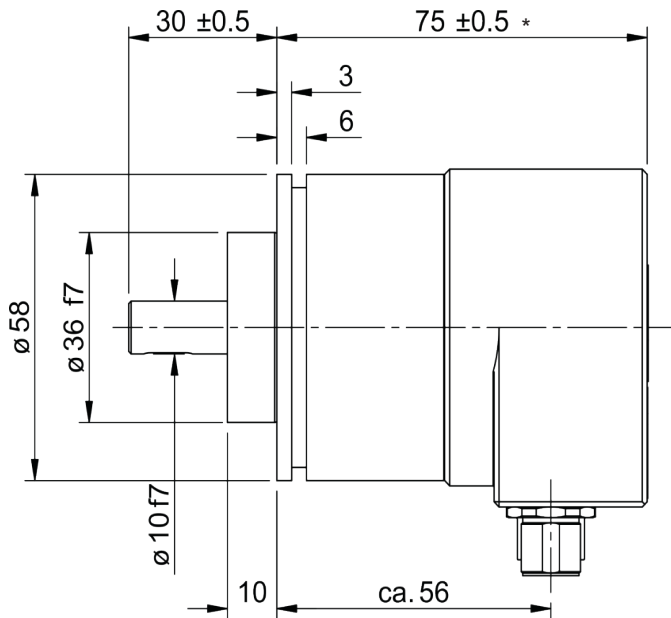
## Installation drawings

### Standard design

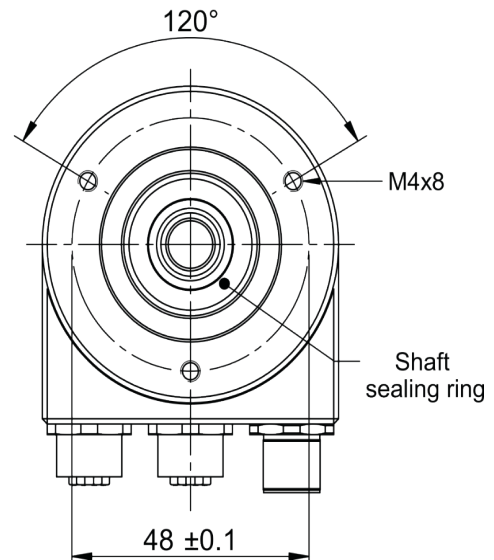
**Design form 58 with clamped flange, order number: TRK58-KPA65536R4096S3MK01**

Shaft  $\varnothing$  10 mm, with parallel key

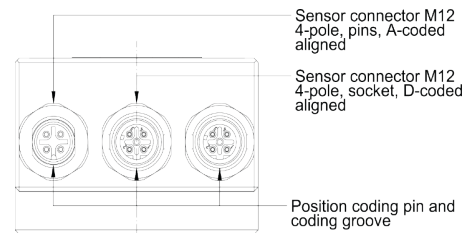
### Dimensions in mm



\* Singleturn version 14 mm shorter



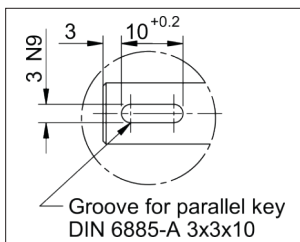
**Connector view with M12-connector**



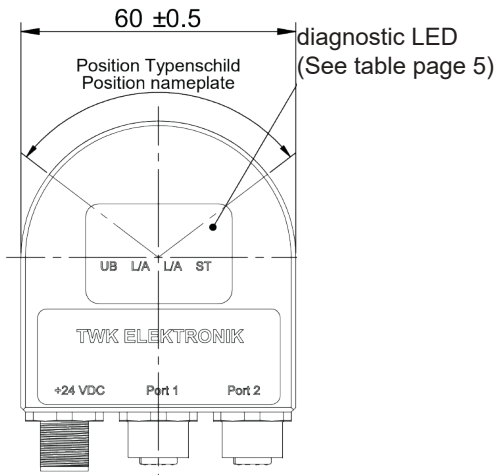
**Note:**

The connectors of the stainless steel version are not aligned.

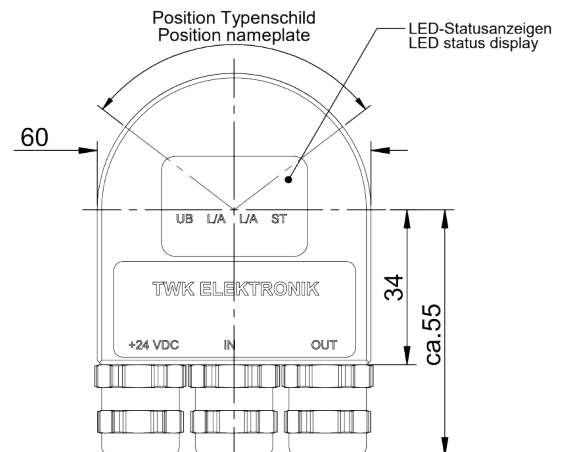
■ Shaft  $\varnothing$  10 mm with groove and parallel key



### Rear view with M12 connectors



### Rear view with cable output





# Absolute encoder model TRK/S3

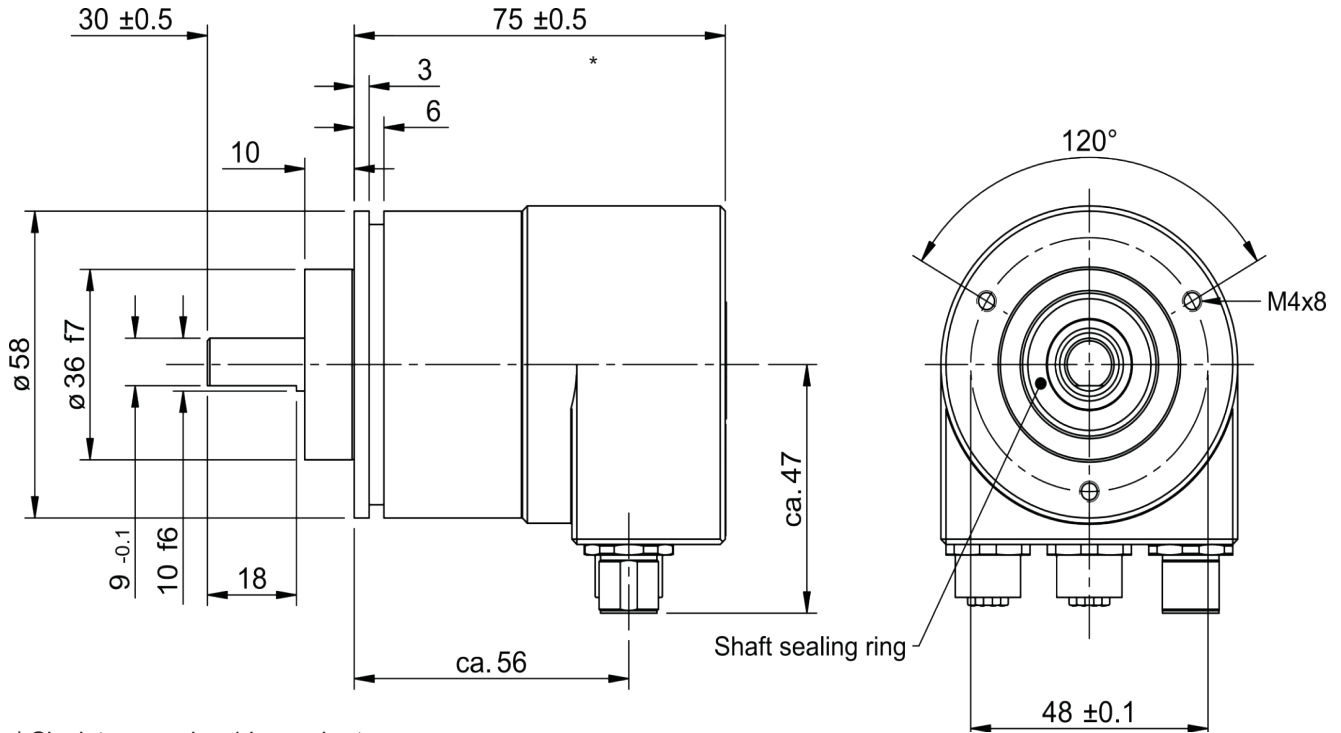
## Installation drawings

### Further possible designs

**Design form 58 with clamped flange, order number: TRK58-KA65536R4096S3MK01**

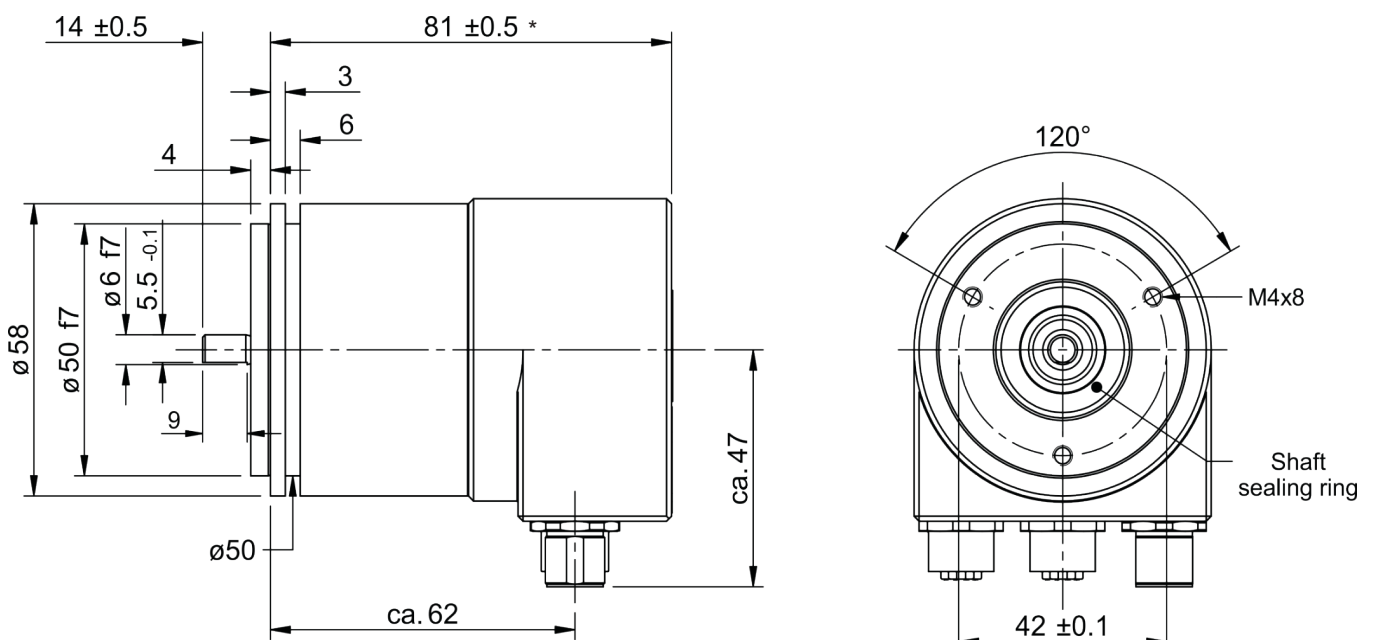
Shaft  $\varnothing$  10 mm with flat

### Dimensions in mm



**Design form 58 with synchroniser flange, order number: TRK58-STA65536R4096S3MK01**

Shaft  $\varnothing$  6 mm with flat



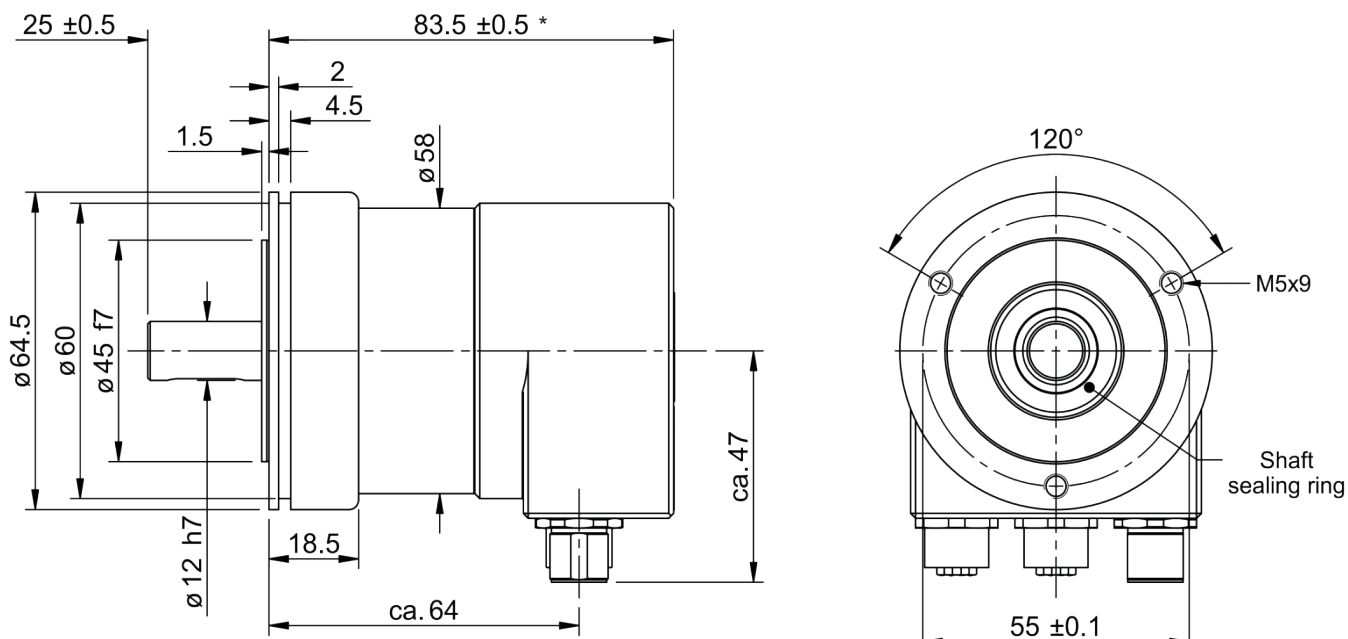
# Absolute encoder model TRK/S3

## Installation drawings

**Design form 65 with synchroniser flange, order number: TRK65-SPA65536R4096S3MK01**

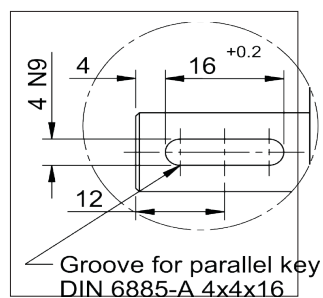
Shaft  $\varnothing$  12 mm, with parallel key

### Dimensions in mm



\* Singleturn version 14 mm shorter

■ Shaft  $\varnothing$  12 mm, with groove and parallel key



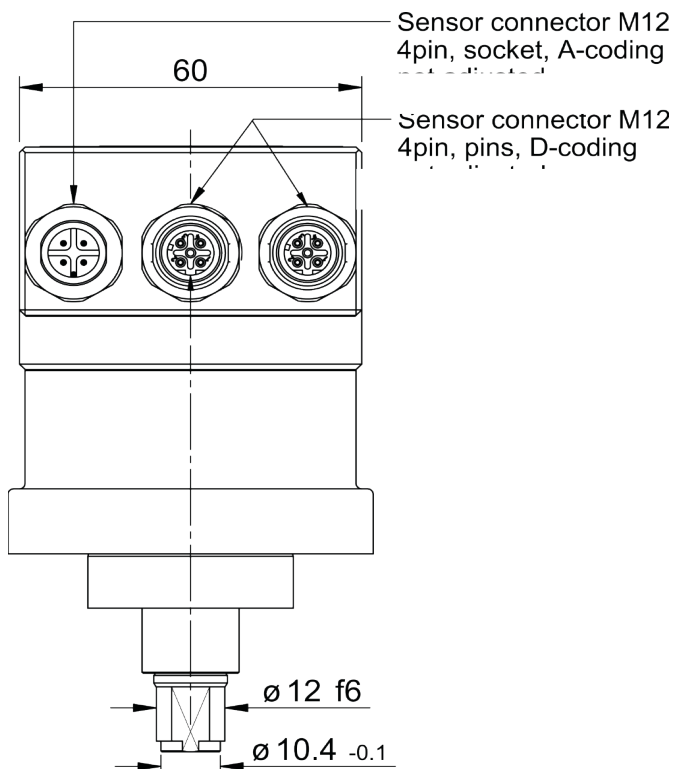
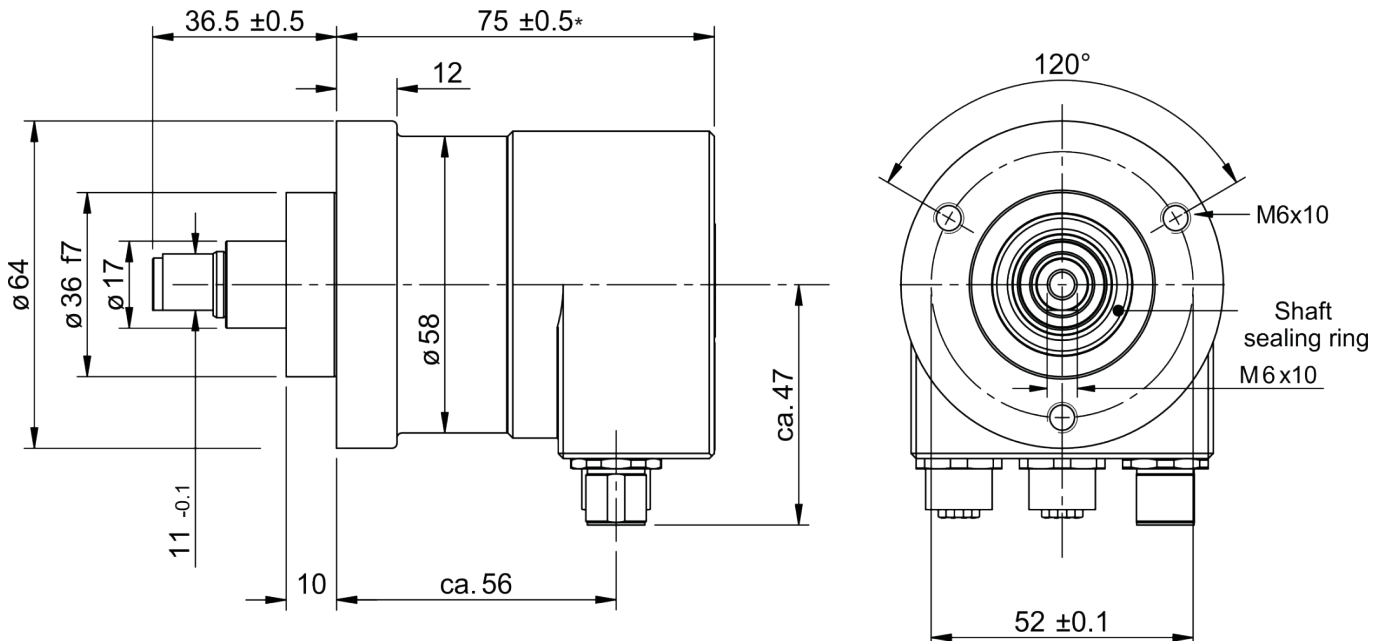
**Absolute encoder model TRK/S3**

**Installation drawings**

**Design form 64 with switching cam encoder flange, order number: TRK64-NZA65536R4096S3MK01**

Shaft  $\varnothing$  12 mm with flattened area, for mounting the toothed gear

**Dimensions in mm**



Note:  
The connectors of the stainless steel version are not aligned.

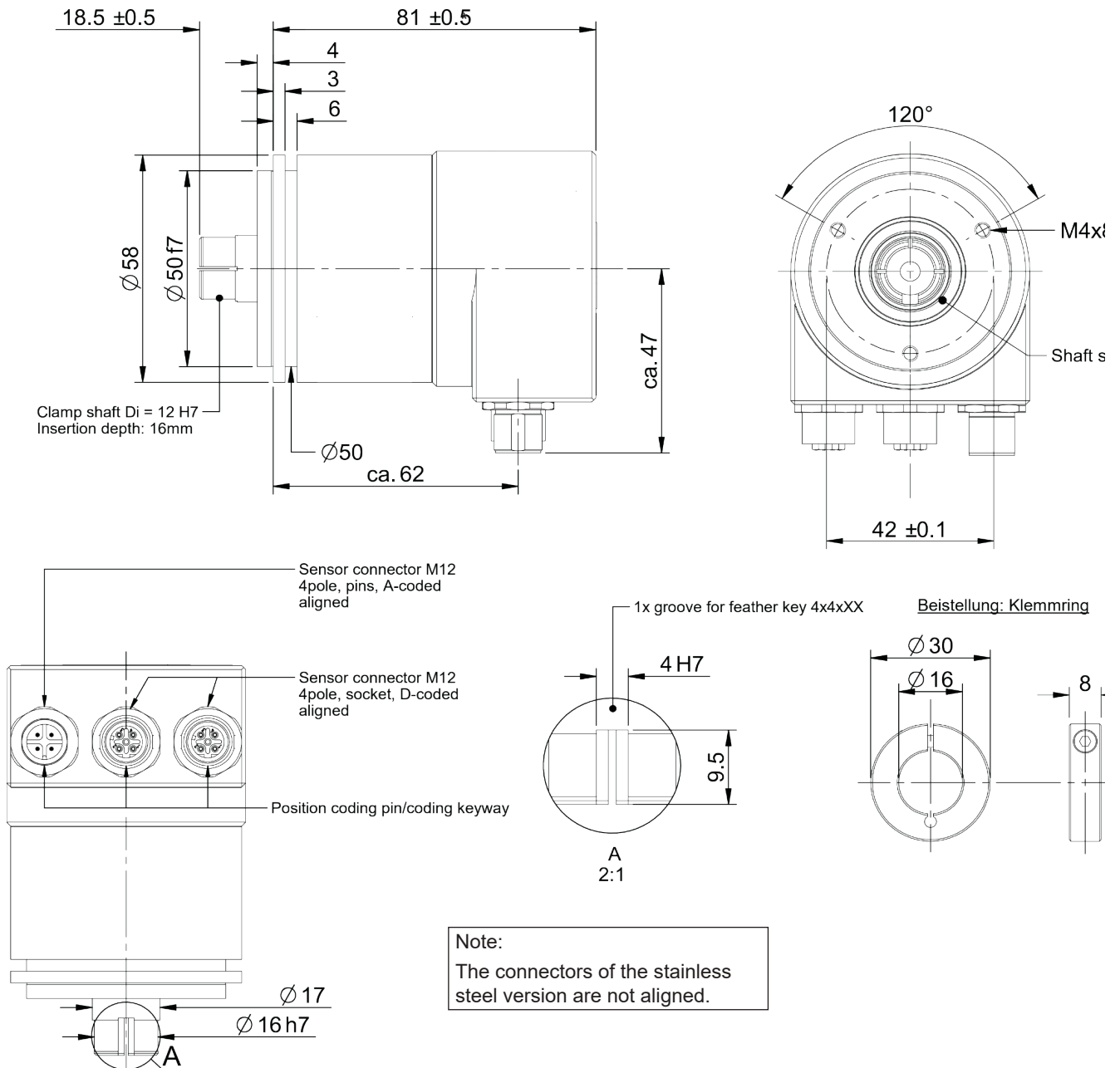
\* Singleturn version 14 mm shorter

**Absolute encoder model TRK/S3**

**Installation drawings**

**Design form 58 with synchroniser flange and clamping shaft, order number: TRK58-SNA65536R4096S3MK01**  
 Shaft  $\varnothing$  12 mm (other diameters on request)

**Dimensions in mm**



\* Singleturn version 14 mm shorter

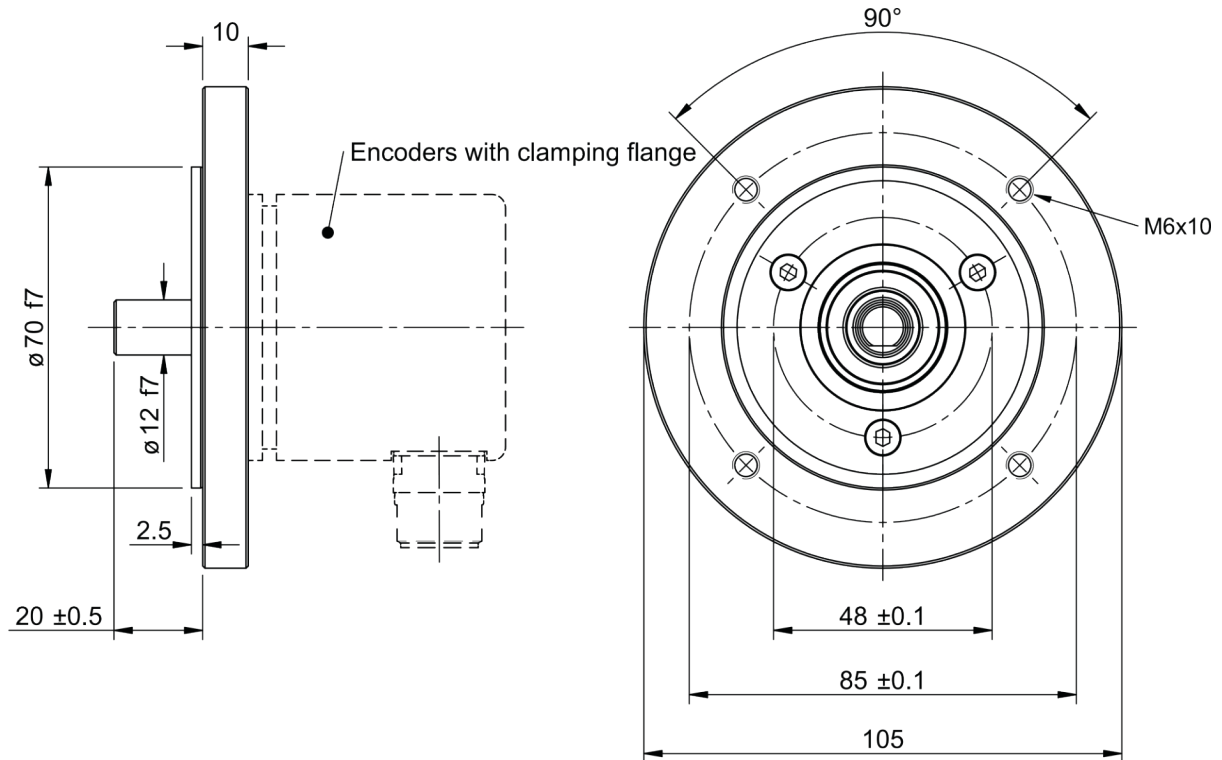
**Absolute encoder model TRK/S3**

**Installation drawings**

**Design form 105, order number: TRK105-MPA65536R4096S3MK01**

Shaft  $\varnothing$  12 mm, with parallel key

**Dimensions in mm**



- Shaft  $\varnothing$  12 mm with groove and parallel key

