Absolute multiturn encoder TRT/S3 with PROFIsafe on PROFINET interface

- 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 certified
- Safe position and safe speed signal
- Resolution: up to 8192 steps / 360° (13-bit)
- Measuring range: 4096 revolutions (12-bit)
- Protection type: up to IP69K
- Programmable via PROFINET
- Option: Draw wire version with integrated encoder: TRT125-D

**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 PROFINET.

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.

The Profinet interface according to IEC 61158 / 61784 or PNO specifications order No. 2.712 and 2.722, version 2.2, is integrated into the model series TRT absolute encoders.

Real time classes 1 and 3 are supported, i.e. Real Time (RT) and Isochronous Real Time (IRT) plus the requirements of conformance class C.

To achieve the SIL2 level, the TRT/S3 contains additional internal monitoring mechanisms as well as safe communication via PROFIsafe. The PROFIsafe protocol is implemented according to the PROFIsafe Profile for Safety Technologie version 2.4 (PNO Order No. 3.192)

The draw wire version with integrated encoder offers a very compact solution for length measurement up to 10 m. See datasheet 125-D13794 for mechanical design.

Setting the address, baud rate or terminating resistances is not necessary. A name, which is stored in the absolute encoder's non-volatile memory, is assigned via the PROFINET controller to address the device.

The integrated 2-fold switch enables the TWK PROFINET absolute encoders to be used in star, tree and line network topologies.

An exhaustive description of integration into a PROFINET network can be found in the TRT 12886 manual.

**PROFINET properties**

- Real Time (RT) and Isochronous Real Time (IRT)
- Device exchange without interchangeable medium or programming device
- Prioritised start-up (Fast Start Up)
- Media redundancy possible
- Firmware update via Profinet
- Programming via Profinet
Absolute multiturn encoder model TRT/S3

Technical data

Input data *
- 2-byte status word
- 4-byte position data
- 2-byte speed data

Output data *
- 2-byte control word
- 4-byte reference value

Electrical data
- Sensor system: ASIC with Hall elements
- Operating voltage: + 9 VDC to + 36 VDC (reverse voltage protection)
- Power consumption: < 3 W, switch-on current < 500 mA
- Resolution: 4096 steps / 360° (12-bit) or 8192 steps / 360° (13-bit)
- Measuring range: 4096 revolutions
- Total number of steps: 24-bit or 25-bit
- Absolute accuracy of the position value: ± 0.2% (with reference to one revolution)
- Tolerance of the internal position monitoring: 1.5 % (with reference to one revolution)
- Internal updating time of the position value: 1 ms
- Output code: Binary
- Code path: 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: 1 ms

PROFINET data
- MAC address: 00:0E:CF:XX:XX:XX
  The relevant, current MAC address is located on the model plate.
- Transfer technology: 100 Base-TX
- Transfer rate: 10 / 100 MBit/s
- Line length: Max. 100 m (between two subscribers)
- Minimum transmission cycle: 250 µs

Mechanical data
- Operating speed: 1.000 rpm max. (2.000 rpm optional)
- Angular acceleration: 10° rad/s² max.
- Moment of inertia (rotor): 20 gcm²
- Operating torque: ≤ 8 Ncm (at 500 rpm)
- Starting torque: ≤ 4 Ncm
- Perm. shaft load: 250 N axial, 250 N radial
- Bearing service life **: > 10⁹ revolutions
- Weight: ca. 0.450 kg (stainless steel version ca. 0.7 kg)

Environmental data
- Operating temperature range: - 40°C to + 85°C
- Storage temperature range: - 40°C to + 100 °C (without packaging)
- Resistance:
  - To shock: 500 m/s²; 11 ms, DIN EN 60068-2-27
  - To vibration: 250 m/s²; 10 ... 2000 Hz, DIN EN 60068-2-6
- EMC standards:
  - EN 61000-6-4 (interference emission)
  - EN 61000 6-2 (interference immunity)
- Protection type: IP 66 / IP 67, with cable outlet IP68, IP69K (optional) (DIN EN 60529)
- Salt mist test: Test Kb according to IEC 60068-2-52

* From the point of view of the control system.
** These values apply at maximum shaft load. Higher values are achievable at lower loads.
Absolute multiturn encoder model TRT/S3

Technical data

Safety data
- Certificate: TÜV No. 44 799 13172902
- According to EN 61508:2010: PFH = 9,889·10^{-8} 1/h
  SFF = 92,2%
  HFT = 0
  SIL2
- According to EN ISO 13849-1:2015: MTTFd = 162 years
  DC = 86,1 %
  Categorie 2
  Performance Level D
- Maximum service life: 20 years

Electrical connection
- PROFINET: 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

PROFINET mating connector
- Connection type: M12 connector D-coded 4-pin
- Housing: Die-cast zinc, nickel-plated
- Contacts: Pins, gold
- Wire connection: Cage clamp
- Connection cross-section: Max. 0.75 mm²
- Cable diameter: 6 - 8 mm
- Protection type: IP 67

Supply mating connector
- Connection type: M12 connector A-coded 4-pin
- Housing: Die-cast zinc, nickel-plated
- Contacts: Socket, gold
- Wire connection: Screw connection
- Connection cross-section: Max. 0.75 mm²
- Cable diameter: 4-6 mm
- Protection type: IP 67

Pre-assembled Industrial Ethernet data cable
- Connection type: M12 connector D-coded 4-pin
- Contacts: Pins, gold
- Cable type: PUR, halogen-free, Profinet type C
- Cable cross-section: 4 x 0.38 mm² (AWG 22)
- Cable diameter: 6.2 mm
- Protection type: IP 67

Cable output PROFINET
- Cable type: PROFINET Type-C, 4 x 0.36 mm² (AWG22)
- Cable jacket: PUR, color: green
- Temperatur range: - 40 °C to + 70 °C
- Outer diameter: 6.5 mm ± 0.2 mm
- Min. bend radius: 5 x d fixed installation, 10 x d freely movable

Cable output power supply
- Cable type: 2 x 0.75 mm², shielded
- Cable jacket: PUR, color: gray
- Temperatur range: - 40 °C to + 80 °C fixed installation, - 5 °C to + 70 °C freely movable
- Outer diameter: 6 mm
- Min. bend radius: 6 x d fixed installation, 15 x d freely movable
## Programmable parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value range</th>
<th>Parameter description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scaling</td>
<td>off / on</td>
<td></td>
</tr>
<tr>
<td>Code path</td>
<td>CW / CCW</td>
<td>CW (clockwise): ascending values on rotation clockwise</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CCW (counter clockwise): descending values on rotation clockwise (viewed looking at the shaft)</td>
</tr>
<tr>
<td>Resolution [steps/360°]</td>
<td>1 ... 4096 (8192) 4096 (with coding W)</td>
<td>Steps per revolution (360°)</td>
</tr>
<tr>
<td>Total number of steps</td>
<td>1 ... 16,777,216 (33,554,432)</td>
<td>Overall measuring range</td>
</tr>
<tr>
<td>Reference value</td>
<td>0 ... total number of steps -1</td>
<td>For adaptation to the application, the position value can be set to any value within the measuring range. Once programmed, a reference value can be set via bit 0 in the control word (output data).</td>
</tr>
<tr>
<td>Gate time</td>
<td>10 ... 1000 ms</td>
<td>Time basis for speed registration</td>
</tr>
</tbody>
</table>

(The values in brackets apply to the TRTxx-xxx8192x4096S3xTxx)
Absolute multiturn encoder model TRT/S3

Electrical connection

Block diagram

PROFINET M12 connection assignment connector / cable output
(Port1 and Port 2)

<table>
<thead>
<tr>
<th>PIN</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signal</td>
<td>TX+</td>
<td>RX+</td>
<td>TX-</td>
<td>RX-</td>
</tr>
<tr>
<td>Colour*</td>
<td>yellow</td>
<td>white</td>
<td>orange</td>
<td>blue</td>
</tr>
</tbody>
</table>

Supply M12 connection assignment connector / cable output

<table>
<thead>
<tr>
<th>PIN</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signal</td>
<td>+ UB (+ 24 VDC)</td>
<td>—</td>
<td>- UB (0 VDC)</td>
<td>—</td>
</tr>
<tr>
<td>Colour</td>
<td>white</td>
<td>—</td>
<td>brown</td>
<td>—</td>
</tr>
</tbody>
</table>

* Industrial Ethernet cable colours according to ISO / IEC 8802-3.
### Diagnosis-LEDs

<table>
<thead>
<tr>
<th>UB (VS)</th>
<th>Link 1 (L1)</th>
<th>Link 2 (L2)</th>
<th>Status (NS)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>green</td>
<td>green</td>
<td>green</td>
<td>green/red</td>
<td>Operating voltage available</td>
</tr>
<tr>
<td>on</td>
<td></td>
<td></td>
<td></td>
<td>Network connection established</td>
</tr>
<tr>
<td>on</td>
<td></td>
<td></td>
<td>green</td>
<td>Network connection established</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>green flashing</td>
<td>Data exchange, device in operation and OK</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>green flashing</td>
<td>Network connection o.k. but no connection to a PROFINET controller</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>red, slow flashing</td>
<td>Firmware download mode</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>red flashing</td>
<td>Impermissible parameter or preset value, velocity to high or wrong modul</td>
</tr>
<tr>
<td></td>
<td>Fast red flashing</td>
<td></td>
<td></td>
<td>Device error</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>red</td>
<td>Connection to the PROFINET controller disrupted</td>
</tr>
</tbody>
</table>
## Absolut encoder

<table>
<thead>
<tr>
<th>TRT</th>
<th>58</th>
<th>KP</th>
<th>A</th>
<th>8192</th>
<th>R</th>
<th>4096</th>
<th>S3</th>
<th>M</th>
<th>T</th>
<th>01</th>
</tr>
</thead>
</table>

### Order number

- **TRT/S3**

**Absolut encoder**

### Electrical and/or mechanical variants

- **01**: Electrical and/or mechanical variants
  - Standard
  - Aligned device connectors, customer specification
  - Same as variant 02 but with gear wheel ZRS-12-12-A13
  - Stainless steel 1.4404

### Number of outputs:

- **1** = Hybrid
- **2** = 1x power supply, 1x PROFINET
- **3** = 1x power supply, 2x PROFINET

### Output:

- **T**: 100Base-TX

#### Electrical connection:

- **M**: Standard, 3 connectors radial
- **Mx**: Connector output radial (x = number of outputs)
- **Ky**: Cable output radial (y = cable length)

#### Profile:

- **S3**: PROFIsafe, SIL2 certified

#### Measuring range:

- **4096** Revolutions
- **10** Length in meter for draw wire version. Possible values: 6 and 10

#### Output code:

- **R**: Binary code, position value divided into two words
- **W**: Binary code, position value divided into two words, 1. word multiturn data, 2. word singleturn data, resolution not adjustable
- **D**: Binary code, position as double word (e.g. for Simatic TIA Portal with Safety Advance)

#### Resolution:

- **4096** steps / 360° or at draw wire: steps / drum circumference (248 mm)
- **8192**

#### Housing material:

- **A**: Aluminium housing
- **S**: Stainless steel housing 1.4305
- **V**: Stainless steel housing 1.4404

### Flanschart:

- **58**: Clamped flange, shaft 10 mm with flat
- **KP**: Clamped flange, shaft 10 mm with woodruff key
- **KF**: Clamped flange, shaft 10 mm with parallel key (recommended for safety)
- **KZ**: Clamped flange, shaft for play-compensating toothed gear ZRS
- **SN**: Synchro flange, clamping shaft 12 mm with groove for parallel key
- **ST**: Synchro flange, shaft 6 mm with flat
- **64**: Cam switch flange, shaft for play-compensating toothed gear ZRS
- **SP**: Synchro flange, shaft 12 mm with parallel key
- **66**: Clamped flange, shaft 10 mm with flat
- **KP**: Clamped flange, shaft 10 mm with parallel key
- **90**: Mounting flange, shaft 12 mm with parallel key
- **105**: Mounting flange, shaft 12 mm with parallel key
- **125**: Draw wire version with integrated TRT/S3 rotary encoder, see datasheet [125-D13794](#)

See remaque at page 8.

### Design form

- **TRT T series multiturn with PROFINET interface**

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

** Number of outputs:
1 = Hybrid
2 = 1x power supply, 1x PROFINET
3 = 1x power supply, 2x PROFINET
Absolute multiturn encoder model TRT/S3

Accessories, documentation, EDS file

Accessories (to be ordered separately)
- Documentation on CD
  TWK-CD-01 CD-ROM with documentation, device description file, bitmap and example programme
- Straight mating connector
  STK4GP81 for PROFINET in/out
  STK4GS60 for the supply voltage
  STK4GP110 for PROFINET in/out (stainless steel 1.4404)
  STK4GS104 for the supply voltage (stainless steel 1.4404)
- Angled mating connector (can only be used with aligned device connectors (option))
  STK4WP82 for PROFINET in/out
  STK4WS61 for the supply voltage
- Connecting cable
  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)
  KABEL-xxx-118 Industrial Ethernet data cable with M12 connector to RJ 45, IP 20 (xxx = length in metres)
- 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, GSD file, etc.
The following documents plus the GSD file, a bitmap and example programmes can be found in the Internet under www.twk.de in the documentation area, model TRT.
- Data sheet TRT12845
- Manual No. TRT12846

Optionally, a CD-ROM can be supplied. (Please specify article No. TWK-CD-01 on ordering.)

Remark for draw wire version with integrated encoder

Notification

The safety certificate is only valid for the integrated rotary encoder. The validity of the certificate ends at the shaft of the rotary encoder. A safe length measurement is therefore only possible in combination with monitoring measures in a safe control unit. Please contact us for further information.
Absolute multiturn encoder model TRT/S3

Installation drawings

Standard design
Design form 58 with clamped flange, order number: TRT58-KPA8192R4096S3MT01
Shaft ø 10 mm, with parallel key

Dimensions in mm

![Diagram showing dimensions and symbols]

- Shaft ø 10 mm with groove and parallel key
- Groove for parallel key
  DIN 6885-A 3x3x10

Rear view with M12 connectors
- Diagnostic LED
  (See table page 6)
- Connector M12, D-coded, not adjusted
- Connector M12, A-coded, not adjusted

Rear view with cable output
- 60° orientation
- 34 mm height
- Ca. 55 mm width
- 60° M4x8 screws
Absolute multiturn encoder model TRT/S3

Installation drawings

Further possible designs

Design form 58 with clamped flange, order number: TRT58-KA8192R4096S3MT01
Shaft ø 10 mm with flat

Dimensions in mm

Design form 58 with synchroniser flange, order number: TRT58-STA8192R4096S3MT01
Shaft ø 6 mm with flat
Absolute multiturn encoder model TRT/S3

Installation drawings

Design form 65 with synchroniser flange, order number: TRT65-SPA8192R4096S3MT01
Shaft ø 12 mm, with parallel key

Dimensions in mm

- Shaft ø 12 mm, with groove and parallel key

Groove for parallel key
DIN 6885-A 4x4x16
Absolute multiturn encoder model TRT/S3

Installation drawings

Design form 64 with switching cam encoder flange, order number: TRT64-NZA8192R4096C4MT01
Shaft ø 12 mm with flattened area, for mounting the toothed gear

Dimensions in mm
Absolute multiturn encoder model TRT/S3

Installation drawings

Design form 58 with synchroniser flange and clamping shaft, order number: TRT58-SNA8192R4096S3MT01
Shaft ø 12 mm (Other shaft diameters on request)

Dimensions in mm

Clamped shaft
Di = 12 H7
Insertion depth: 16mm

Sensor connector M12
4-pin, pins, A-coding, not adjustable

Sensor connector M12
4-pin, socket, D-coding, not adjustable

1x Groove for feather key
4x4xXX

Radial shaft seal

Clamping ring
(in scope of delivery)

Date: 11.05.2017
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Absolute multiturn encoder model TRT/S3

Installation drawings

Design form 105, order number: TRT105-MPA8192R4096S3MT01
Shaft ø 12 mm, with parallel key

Dimensions in mm

- Shaft ø 12 mm with groove and parallel key

Groove for parallel key
DIN 6885-A 4x4x16