Absolute multiturn rotary encoder
Model TRA redundant analogue

SUPREME SENSORING
TWK

Document no.: **TRA** 12665 NE
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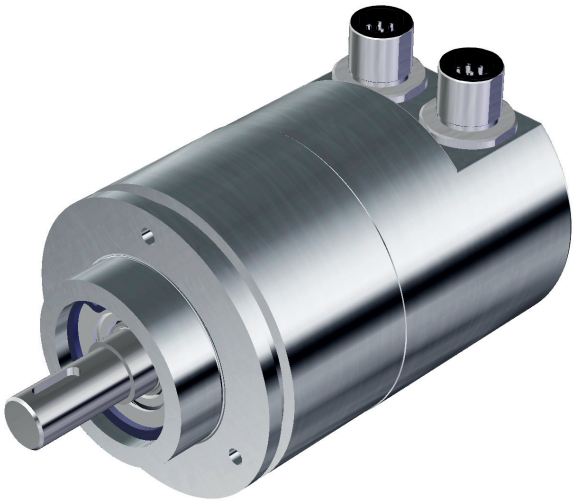

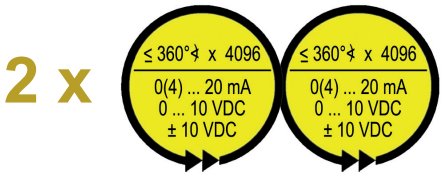

- **Robust design for rough applications, e.g. crane technology and construction machines**
- **Dual-chamber system for separating the rotor and electronics**
- **Measuring ranges of the two redundant sensor units can be selected independently and can be configured by the customer**
- **Maximum measuring range 1,474,560° (4096revolutions)**
- **Protection type IP 67 (higher protection types up to IP 69K possible)**
- **TRA options:**
  TRA draw wire sensor, see pages 9 and 11

Design

- Robust housing (wall thicknesses 5 mm) manufactured from seawater-proof aluminium (AlMgSi1) or stainless steel (material: 1.4305 optionally 1.4404).
- Redundant voltage supply plus sensor system and electronics.
- Common shaft (measurement axis) and ball bearing with shaft seal.
- Transmission and permanent magnets in prechamber.
- Sensor circuit consisting of ASICs with Hall elements and interface electronics in the enclosed main chamber.
- Recording of the revolutions by an absolute multiturn transmission.
- The contactless electromagnetic sensor systems are ex-tended by a 12-bit D/A converter so that the measured variable is available as an analogue signal from 0 (4) to 20 mA, 0 to 10 VDC or ± 10 VDC.
- Electrical connections via connector M12x1.
- SWF draw wire with integrated redundant encoder TRA for compact length measurement available.
  Order code for encoders (example):
  TRA58 - SA 11520 W R1 S A63 for 10m SWF wire rope hoist

Function

A positive mechanical connection between the customer and sensor shaft ensures that the sensor shaft magnet precisely reflects the customer shaft's rotations. With the run-on absolute transmission, the rotary encoder achieves a measuring range of up to 4096 revolutions. Two autonomously operating, redundant sensor units record the position and the revolutions of the customer's shaft. A sensor unit consists of position and revolution sensors, an interpolator, a microcontroller and a D/A converter. The sensor units' redundancy offers the user two analogue output signals which are not influenced by each other. The so-called teach-in functionality enables the execution of functions such as zero point, end value, pre-set value and default value setting and enables the code direction to be changed independently for each channel. The zero point and end value setting functions allow the slope of the output signal to be changed.

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Technical data

Electrical data

■ Sensor system:	ASICs with Hall elements
■ Operating voltage:	9 to 36 VDC, protected against polarity reversal (output: A, B, C****) ± 13 to ± 16 VDC, protected against polarity reversal (output: D****) (Separate power supply for sensor 1,2)
■ Power consumption:	< 2.5 W per channel
■ Measuring range:	4096 revolutions x 360°, default setting 3600°
■ D/A converter:	12-bit
■ Code path:	CW* or CCW** can be set
■ Accuracy:	± 0.25 % (with reference to one revolution)
■ Reproducibility:	± 0.02 % (with reference to one revolution)
■ Temperature drift:	< 0.01 % / °K typ. (with reference to one revolution)
■ System synchronisation:	Static ≤ 1 % (with reference to one revolution) Dynamic ≤ 5 % (with reference to one revolution) at 3000 revolutions per minute

Electrical output data

■ Current output A, B: Burden:	A: 0 to 20 mA; B: 4 to 20 mA 0 ... 500 Ω
■ Voltage output C, D Output current:	C: 0 to 10 VDC; D: ±10 VDC Max. 5 mA corresp. to load resistance ≥ 2 kΩ resistant to short-circuit

Mechanical data

■ Operating speed:	4000 rpm
■ Angular acceleration:	105 rad/s² max.
■ Moment of inertia (rotor):	20 gcm²
■ Operating torque:	≤ 2 Ncm
■ Starting torque:	≤ 3 Ncm
■ Perm. shaft load:	250 N axially, 250 N radially
■ Bearing service life:	≥ 109 revolutions ***
■ Weight:	Aluminium approx. 0.5 kg, stainless steel approx. 0.7 kg

*) CW = increasing signal clockwise viewed looking towards the shaft
**) CCW = increasing signal counter-clockwise viewed looking towards the shaft
***) This value applies at maximum shaft load
****) See page 6

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:	500 m/s²; 10 Hz ... 2000 Hz DIN EN 60068-2-6
■ EMC standards:	DIN EN 61 000 - 6 - 2 Immission (burst/ESD/etc.) * DIN EN 61 000 - 6 - 4 Emission
■ Protection type (DIN EN 60529):	IP 67 (For higher protection types up to IP 69K, please contact our technical staff)

* - Separate power supply, no DC - supply network
- Total cable length ≤ 30 m

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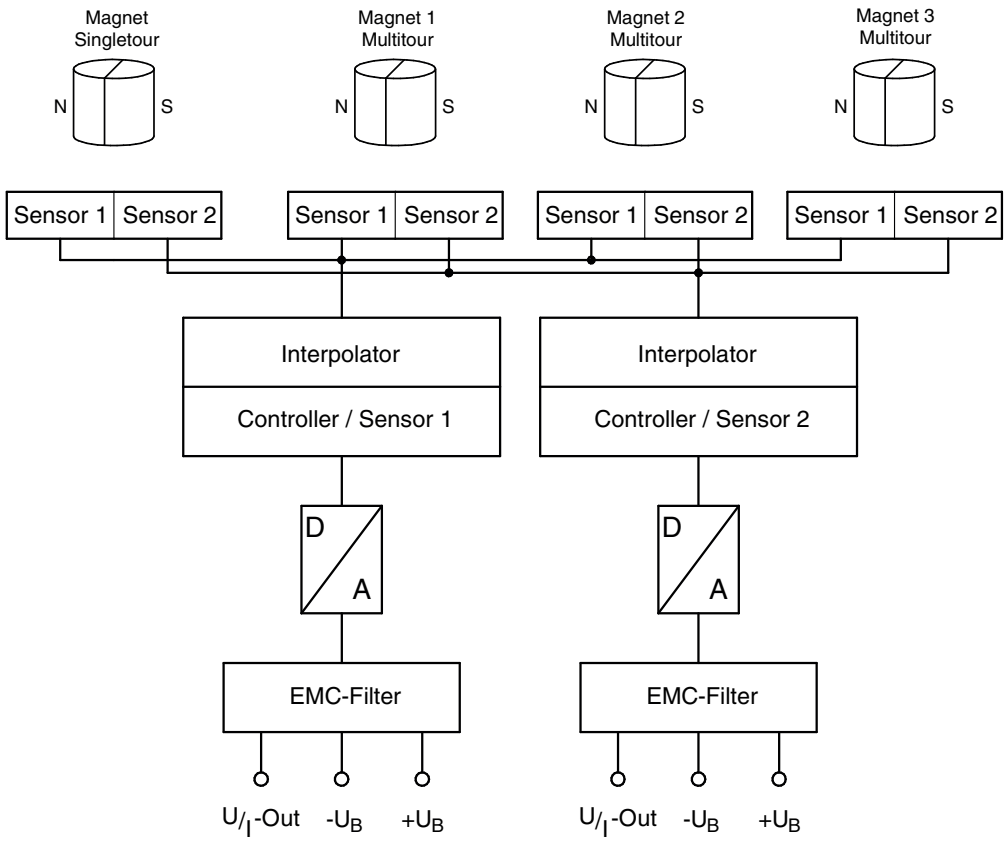
Principle circuit diagram

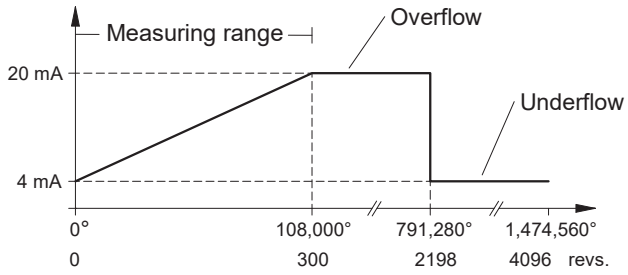


Measuring range setting

Standard measuring range

The rotary encoder has a maximum measuring range of 1,474,560° (4096 revolutions). As standard, both sensor units are set to a measuring range of 3600° (10 revolutions). Pre-set measuring ranges which deviate from the standard can be ordered. To do this, the desired measuring range has to be specified in the order designation. The MFP's* can be used to adapt the pre-set measuring ranges at the customer. Outside of the measuring range, the characteristic curve always contains a symmetrically subdivided overflow and underflow up to the 4096th revolution (see characteristic curve 1).

Characteristic curve 1: measuring range 108,000° or 300 revolutions as an example (output B**)

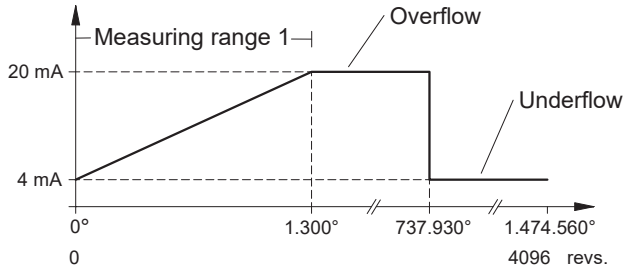


Alternative measuring range

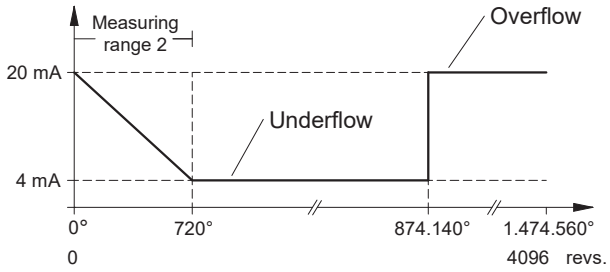
Solutions e.g. without overflow and underflow or any special characteristic curves are possible on request. For example, different measuring ranges can be set for the two sensor units (see characteristic curve 2).

Characteristic curve 3: example of different measuring ranges (output B**)

First sensor unit: measuring range 1300°, ascending



Second sensor unit: measuring range 720°, descending



Note: If the measuring range is not found directly due to sensor shaft rotation (as the sensor system is in the overflow or underflow range), the rotary encoder can be pre-set with the aid of the MFPs*. As a result, the rotary encoder jumps to the middle of the measuring range.

*) See page 5
**) See page 6

Setting option via multifunctional pins

The measuring range, code direction, zero point, end value and pre-set value parameters and default value setting can be set by the user according to the circumstances at the application location. To do this, two multifunctional inputs (MFPs) are planned for each sensor unit. The input circuit for the MFPs is E1 (see next page).

Table for multifunctional inputs (MFP)

Function	MFP 0	MFP 1	
Set zero point	1	0	Set pin MFP 0 to logical one for the duration of 4 s.
Set end value	0	1	Set pin MFP 1 to logical one for the duration of 4 s.
Set default value	1	1	Simultaneously set pins MFP 0 and MFP 1 to logical one for the duration of 4 s. The factory settings are restored
Code direction change	1 0	0 1	**Attention: with the same shaft position** hold pin MFP 0 at logical one for the duration of 4 s. **After a pause of at least 0.5 s** hold pin MFP 1 at logical one for the duration of 4 s.
Set pre-set value (middle of measuring range)	1 1	0 0	**Attention: with the same shaft position** hold pin MFP 0 at logical one for the duration of 4 s. **After a pause of at least 0.5 s** hold pin MFP 0 at logical one for the duration of 4 s.
Normal operation	0	0	

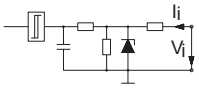
The analogue hand programming device model PMA-05 (see data sheet PMA11443) vorgesehen.

The factory setting of the measurement range is 0 to 3600° (default measuring range: 10 turns) and clockwise (CW). CW means increasing signal when the shaft rotates clockwise with view of the free shaft end. The preset value is set to mid range. Other default settings can be realized by factory.

Input circuit, timing diagrams and output circuits

Input circuit for multifunctional pins (MFP)

Input E1 aktive "high"

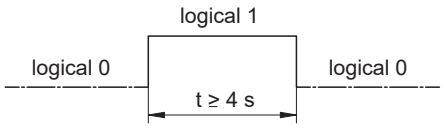


Log 0<5Vor not connected
Log 1 = 11 ... Vs
E1 specifications

Timing diagrams for the MFP settings E1

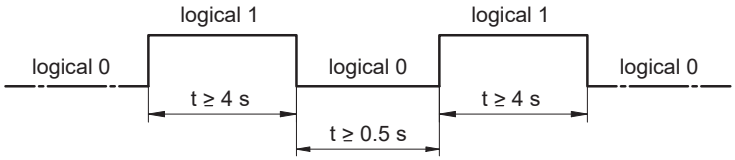
1. Set MFP 0 or MFP 1 once

Set zero point (MFP 0) Set end value (MFP 1)



2. Set MFP 0 and/or MFP 1 twice with the same shaft position

Set pre-set value (MFP 0)
Code direction change (MFP 0 / MFP 1)



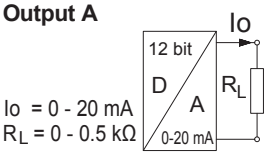
without position changing

3. Set MFP 0 and MFP 1 simultaneously

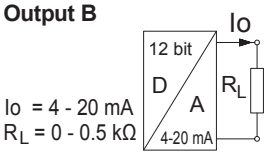
Time difference between MFP 0 and MFP 1 ≤ 0.25 s.

Ausgangsschaltungen

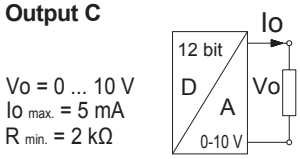
Output A



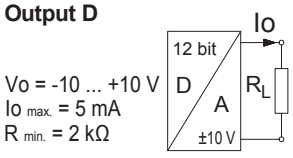
Output B



Output C



Output D



Electrical connection, mating connector, pin diagram, connection assignment

Electrical connection

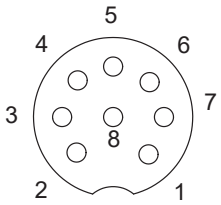
- Two round connectors M12x1, pin, 8-pin
- Refer to the table below for the connection assignment (also supplied along with the devices).

Mating connectors (to be ordered separately)

Order number	STK 8GS54	STK 8WS86	STK 8GS105
Type	M12X1	M12X1	M12X1
Number of pins	8	8	8
Contact design	Socket, A-coded	Socket, A-coded	Socket, A-coded
Connector design	Straight	Angled	Straight
Housing material	Nickel-plated brass	Nickel-plated brass	Stainless steel
Cable ø (mm)	6 - 8	6 - 8	5.5 - 8.6
Connection type	Screws	Screws	Screws
Protection type	IP 67	IP 67	IP 67
Screening	On the housing	On the housing	On the housing
Max. connection cross-section (mm²)	0.5	0.5	0.5

Please note: if angled mating connectors are used, please notify us so that the device connectors can be aligned accordingly.

Pin diagram for mating connector M12x1, 8-pin (view of insertion side)



Socket, 8-pin,
A-coded

Connection assignment

Contact No.	Assigned with
1	$+U_B$ = 9…36 V, Io typ. 80 mA
2	$-U_B$ = 0 V
3	I_A = 4 … 20 mA (4096 steps = 12-bit)
4	0V analogue reference potential
5	Multifunctional input 0 (input circuit E1)
6	Multifunctional input 1 (input circuit E1)
7/8	Not connected

Absolute multiturn rotary encoder
Model TRA redundant

Order number

TRA	58 -	KP	A	3600	W	R1	S	B	01

		Electrical and
	01	mechanical variants*
	63	TRA58 with draw wire, see e.g. SWF 10652
		Output signals: A
	A	0 - 20 mA
	B	4 - 20 mA
	C	0 - 10 VDC
	D	± 10 VDC
		Electrical connections
	Kx	Cable, x = length in m
	S	device connector M12
	R1	Redundant design
		Signal path
	W	CW**
	C	CCW***
		Measuring range:
3600		Measuring range = 3600°
8710-6		Measuring range in degrees and length in meter for draw wire version 6 m **
14516-10		Measuring range in degrees and length in meter for draw wire version 10 m **
		Housing material:
	A	Aluminium
	S	Stainless steel
		Flange type:
58	K	Clamped flange, shaft 10 mm with flattened area
	KF	Clamped flange, shaft 10 mm with disk spring
	KP	Clamped flange, shaft 10 mm with feather key (recommended for safety applications)
	KZ	Clamped flange, shaft for measurement gear ZRS
	ST	Synchro flange, shaft 6 mm with flattened area
	SR	Synchro flange, clamped shaft for 12 mm (torque support, see accessories)
64	NZ	Cam switch flange, shaft for ZRS
65	SP	Synchro flange, shaft 12 mm with feather key
66	K	Clamped flange, shaft 10 mm with flattened area
105	MP	Assembly flange, shaft 12 mm with feather key
125	D	Draw wire version with integrated redundant TRA encoder. Reference datasheet 13794 **
		Design form
		Model:
TRA		Redundant with analogue output

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

** Increasing values clockwise when looking at the shaft

*** Increasing values counterclockwise when looking at the shaft

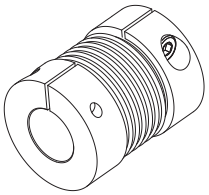
Accessories

hand programming device PMA-05

For programming the encoders TRA/TBA with teach-in functionality

See data sheet PMA11443

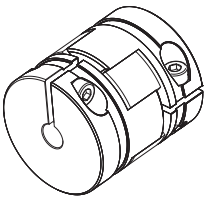
Backlash-free bellows coupling BKK 32 / x - y



x and y: Bore diameter for shaft mounting

See data sheet BKK 11840

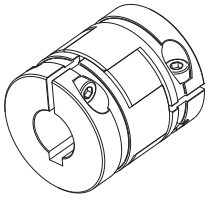
Play-free clamping coupling KK14S / x - y (without groove)



x and y: Bore diameter for shaft mounting

See data sheet KK 12301

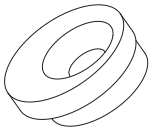
Play-free clamping coupling KK14 / x - y (with groove)



x and y: Bore diameter for shaft mounting

See data sheet KK 12301

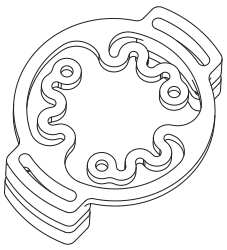
KL 66-2-S



Mounting brackets for encoder mounting

See data sheet MZ 10111

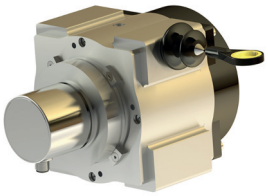
ZMS58



Torque arm/stator clutch. Can be used as encoder mounting for shaft version 'clamping shaft' to compensate for radial and axial play of the drive shaft.

See data sheet ZMS 12939

TRA58 - SA 11520 C S A63/ B63/ C63/ D63 - Draw wire version (example)



Example encoder variant for SWF draw wire, 10m

See data sheet SWF10652

Absolute multiturn rotary encoder
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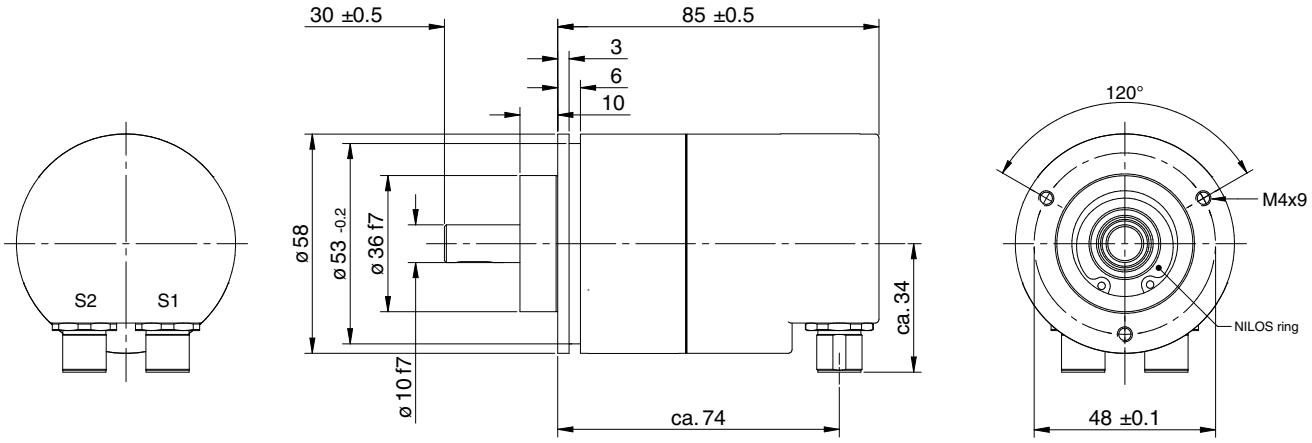
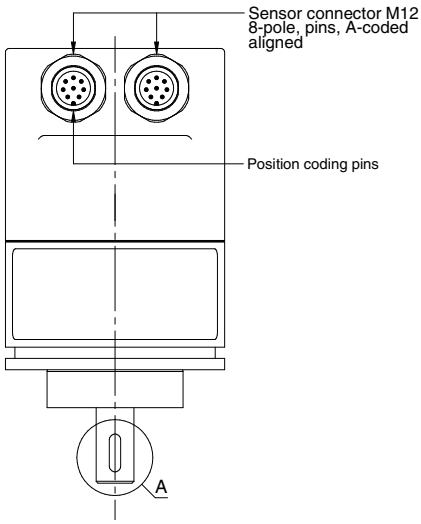
Installation drawing

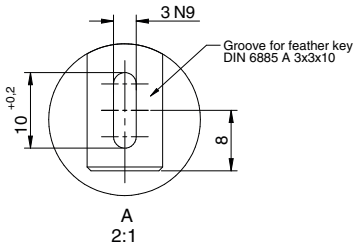
Recommended design form: clamped flange and shaft ø 10 mm with feather key

Order number: **TRA58 - KPA 3600 W R1 S B01**

Dimensions in mm







Absolute multiturn rotary encoder
Model TRA redundant

Installation drawing

Order number: TRA58 - SA 11520 W R1 S A63/ B63/ C63/ D63 - Draw wire version (SWF) for 10m