Absolute single/multi-turn rotary encoder
TBA/TRA redundant analogue

SUPREME SENSORING
TWK

Document No.: TBA/TRA 15241BE
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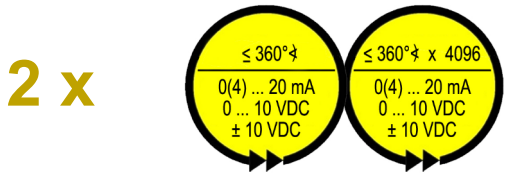

- **Redundant analogue rotary encoder**
- **Robust design for rough applications, e.g. crane technology, construction machines and plant engineering**
- **Dual-chamber system for separating the rotor and electronics**
- **Maximum measuring ranges**
  TBA: 360°
  TRA: 1,474,560°
  (4096 revolutions x 360°)
- **Measuring range of the sensor units can be selected and configured independently and by the customer.**
- **Protection type IP65/IP67 (up to IP69K on customer request)**

Design

- Robust housing (wall thicknesses 5 mm) manufactured from seawater-proof aluminium (AlMgSi1) or stainless steel (material: 1.4305 or 1.4404).
- Design form in Ø 58 or Ø 79 mm diameter (other diameters available for customer specific applications)
- Redundant voltage supply plus sensor system and electronics.
- Shaft (measurement axis) with ball bearing, shaft seal (optional) and permanent magnet in pre-chamber.
- Sensor circuit consisting of ASICs with Hall elements and interface electronics in sealed main chamber.
- The contact-less electromagnetic sensor systems are extended by a 12-bit D/A converter so that the measured variable is available as an analogue signal from 0 (4) to 20 mA or 0 to 10 VDC. Other outputs on request.
- Electrical connections via 2x connectors M12x1.

Function

A form-fit connection between the customer and sensor shaft ensures that the sensor shaft magnet precisely takes over the customer shaft's rotations. Two autonomously operating, redundant sensor units record the position of the magnet. The TRA contains a gear box to achieve a measuring range of up to 4096 revolutions.

Each sensor unit consists of a sensor, an interpolator, a microcontroller and a D/A converter.

The sensor units' redundancy offers the user two analogue output signals which do not influence each other. The so-called teach-in functionality enables the execution of functions such as zero point, end value, preset value and default value setting and can be used to change the code direction independently for each channel. The zero point and end value setting functions can be used to adjust the slope of the output signal.

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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) (5 VDC on request)
■ Power consumption:	TBA: < 1.8 W TRA: < 2.5 W
■ Measuring range:	TBA: 360° TRA: 1,474,560° (4096 revolutions x 360°, Default adjustment 3600°)
■ D/A converter:	12-bit
■ Code path:	CW* or CCW can be set
■ Accuracy:	TBA: ± 0.15 % (with reference to 360°) TRA: ± 0.25 % (with reference to 360°)
■ Reproducibility:	± 0.02 % (with reference to 360°)
■ Temperature drift:	< 0.01 % / K typ. (with reference to 360°)
■ System synchronisation:	Static ≤ 0.5 % (with reference to 360°) Dynamic ≤ 5 % (with reference to 360°) at 3000 rpm

Electrical output data

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

Mechanical data

■ Max. operating speed:	10,000 rpm (Nilos ring, standard), 1000 rpm (shaft sealing ring, optional),
■ Angular acceleration:	10^5 rad/s² max.
■ Moment of inertia (rotor):	20 gcm²
■ Perm. shaft load:	250 N axially, 250 N radially
■ Bearing service life:	≥ 10^9 revolutions **
■ Weight (Ø 58 mm):	Aluminium approx. 0.4 kg, stainless steel approx. 0.6 kg

Environmental data

■ Operating temperature range:	- 40 °C to + 85 °C
■ Storage temperature range:	- 20 °C to + 60 °C (depending on packaging)
■ Resistance	
☐ to shock:	250 m/s², 6 ms, 100 x each in 3 axes (higher values optional, e.g. 5000 m/s²) DIN EN 60068-2-27
☐ to vibration:	100 m/s², 5 Hz ... 2 kHz, 1 h in 3 axes (higher values optional e.g. 1000 m/s²) DIN EN 60068-2-6
■ EMC-standards:	DIN EN 61 000 - 6 - 2 Immission (Burst/ESD/ ...) DIN EN 61 000 - 6 - 4 Emission
■ Protection grade (DIN EN 60529):	Shaft side: IP65 - Nilos ring (standard), IP 66 - Shaft sealing ring (optional) Housing: IP67, Option IP69K (potting) (For higher protection grades and technical questions please contact our technical personal.)

*) CW = increasing signal clockwise viewed looking towards the shaft
**) This value applies at maximum shaft load

Measuring range setting

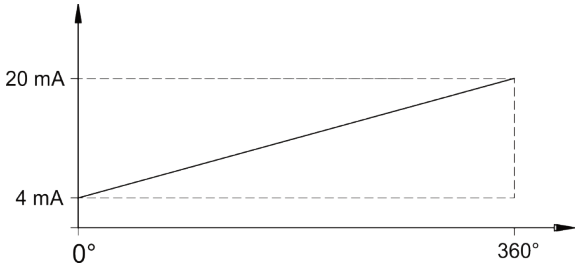
By default both redundant sensor units are set to the same measuring range. If a customer specifies a measuring range in the order number, both sensor units are identically set to this specified measuring range in the factory. Outside of the measuring range, the characteristic curves have a symmetrically divided overflow and underflow.

With the multi-function pins (MFP) the predefined values can be adjusted by the customer. The region outside the measuring range is symmetrically split into an over- and underflow value in the signal output (see characteristic curves below).

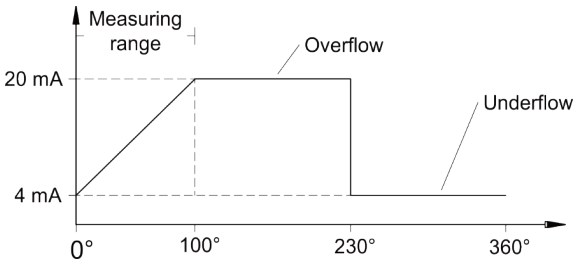
On request, customer specific signal outputs or outputs without over-/underflow can be set in the factory.

Measuring range and characteristic curves for TBA

The encoder TBA has a default measuring range of 360°. The measuring range can be adjusted in the factory and is specified by the customer through the order code (see page 8).



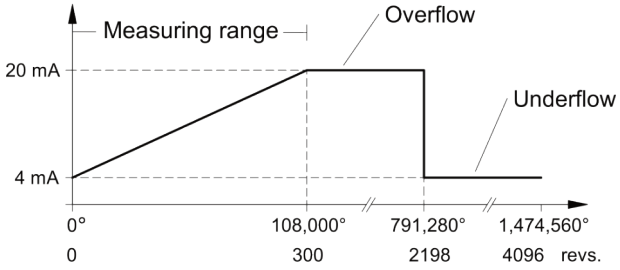
Characteristic curve 1: standard measuring range 360° (output B)



Characteristic curve 2: customer specific measuring range 100° as an example (output B)

Measuring range and characteristic curves for TRA

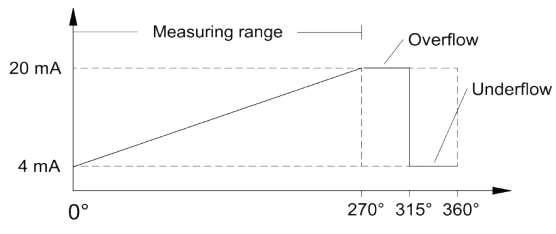
The encoder TRA has a maximum measuring range of 1,474,560° (360° x 4096 revolutions).The standard setting is 3600° (10 revolutions).

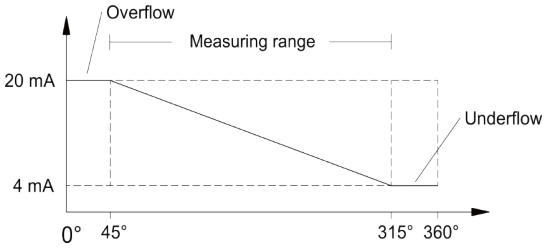


Characteristic curve 3: Measuring range 108,000° or 300 revolutions as an example (Output B)

Alternative measuring range

Different measuring ranges can be set for both redundant sensor units with the aid of the multi-functional pins. These can also be set in the factory on request.





Characteristic curves 3: Different measuring ranges for different sensors. First sensor (left) is set to 270° ascending, second sensor (right) is set to 270° descending, shifted by 45°.

Adjustment via Multi-functional pins

Adjustment via Multi-functional pins

The customer specific parameter zero point, end value, preset value, code sense and the default values can be set via two Multi-functional pins 'MFP0' and 'MFP1'. The input circuit is E1 (see page 5). The logical levels are '0' : 0 VDC or '1' : 24 VDC.

With the functions set zero point and set the end value the gradient of the signal output can be changed

Table for Multi functional pins (MFP)			
Function	**MFP 0**	**MFP 1**	**Remark**
Set zero point	1	0	Set pin MFP 0 to logical 1 for the duration of ~4 s.
Set end value	0	1	Set pin MFP 1 to logical 1 for the duration of ~4 s.
Set default value	1	1	Simultaneously set pins MFP 0 and MFP 1 to logical 1 for the duration of ~2 s. The default setting is restored.
Changing the signal path CW / CCW	1	0	Attention: Shaft must not be moved during this process! Set pin MFP 0 to logical 1 for the duration of ~4 s.
	0	1	After a pause of at least 0.5 s: Set pin MFP 1 to logical 1 for the duration of ~4 s.
Set preset value (middle of measuring range)	1	0	Attention: Shaft must not be moved during this process! Set pin MFP 0 to logical 1 for the duration of ~4 s.
	1	0	After a pause of at least 0.5 s: Set pin MFP 0 to logical 1 for the duration of ~4 s.
Normal operation	0	0	

Notes:

1. **Attention!** On request, the multifunctional inputs (MFP) of the redundant system can be connected in parallel internally. If this is the case and both system sides are supplied with +Vs, the functions of the MFPs are executed in parallel!

2. If you can not find the measuring range by turning the shaft please set preset value via the MFPs. It is possible that the output signal is in the Over/Underflow area. In this case the encoder set the Mid-range of the signal output.

3. The zero point and end value of the measuring range need to separated by at least 2.5 °. It is not possible to program these two values at the same position.

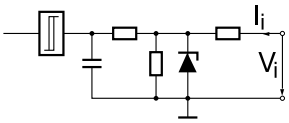
The analogue hand programming device model PMA-05 (see data sheet PMA11443) can be used to simplify TBA/TRA programming.

Basic setting is carried out in the factory with the default values for a measuring range of 360° (TBA) or 3600° (TRA) with a signal path of CW, i.e. the output signal increases on rotating the shaft clockwise when looking at the free end of the shaft. The preset value is set to the middle of the measuring range. Other values can be implemented in the factory.

Input circuit, timing diagrams and output circuits

Input circuit for input E1 (Multi-functional pins MFPs)

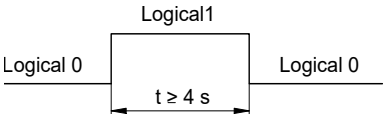
Input E1 active "high"



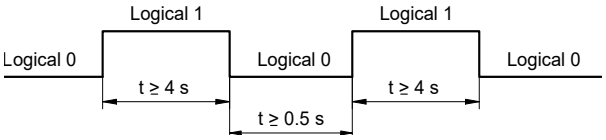
Log 0 < 5 V or not connected
Log 1 = 11 ... Vs
E1 specification

Timing diagrams for the MFP settings

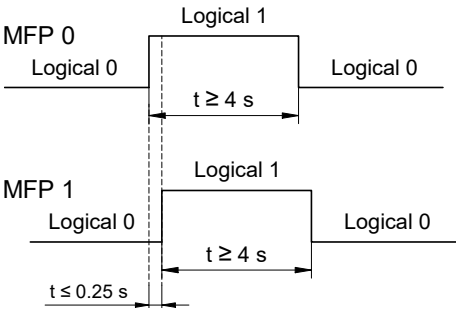
1. Set MFP 0 or MFP 1 once
Set zero point (MFP 0)
Set end value (MFP 1)



2. Set MFP 0 and/or MFP 1 twice with the same shaft position
Set preset value (2 x MFP 0)
Change the signal path (MFP 0 - MFP 1)

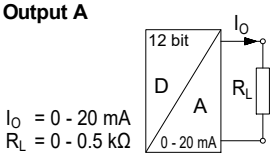


3. Set MFP 0 or MFP 1 simultaneously
Time difference between MFP 0 and MFP 1 ≤ 0.25 s
Restore default values



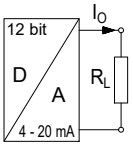
Output circuit

Output A



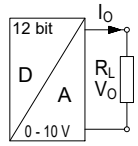
I_O = 0 - 20 mA
R_L = 0 - 0.5 kΩ

Output B



I_O = 4 - 20 mA
R_L = 0 - 0.5 kΩ

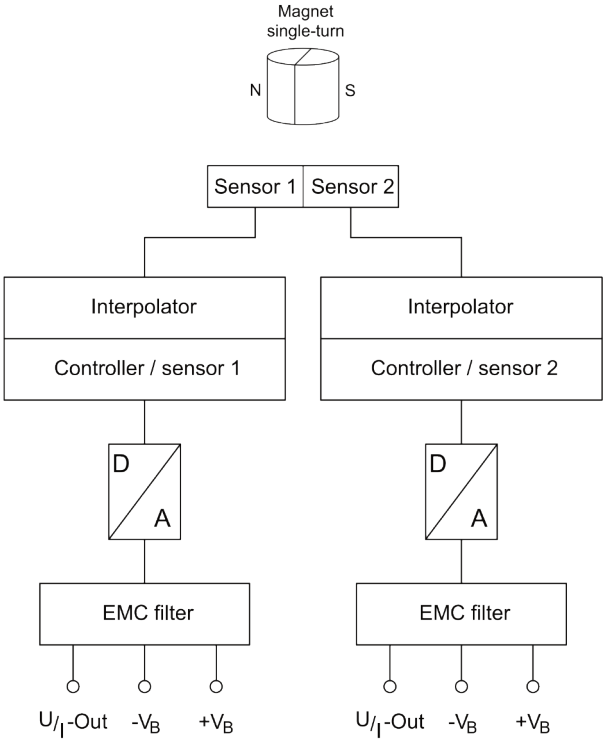
Output C



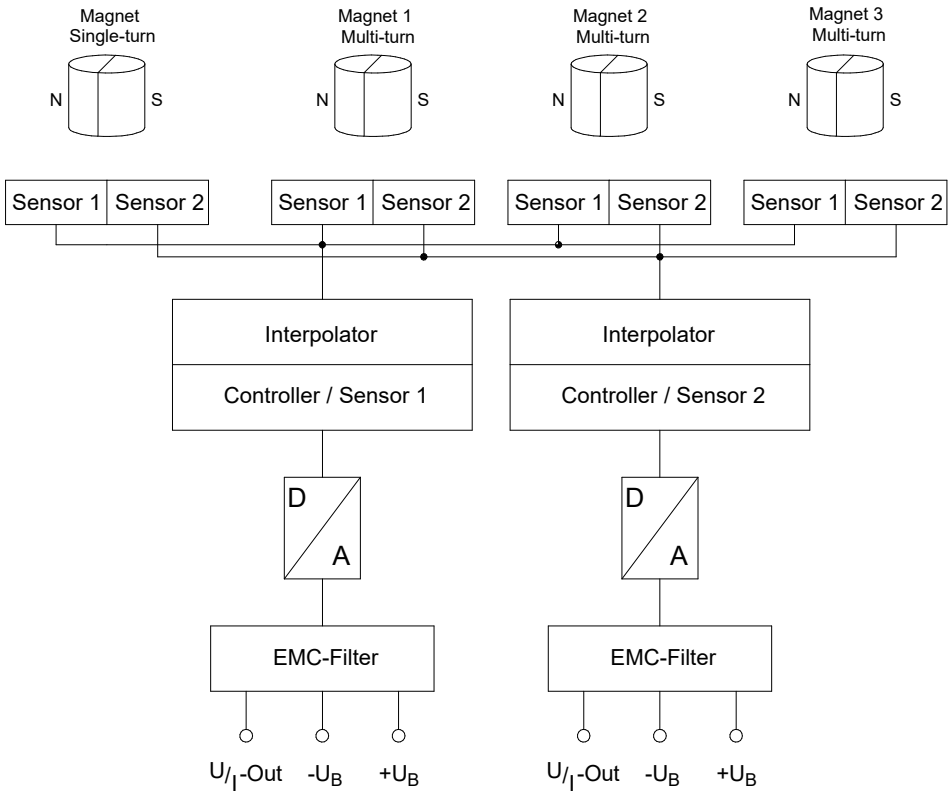
V_O = 0 - 10 V
$I_{O\,max}$ = 5 mA
$R_{L\,min}$ = 5 kΩ

Block diagrams

Block diagram TBA:



Block diagram TRA:

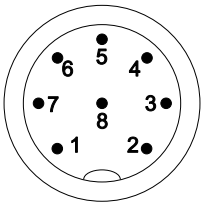


Electrical connection, contact arrangement, connection assignment

Electrical connection

- Two round connectors M12x1, pin, 8-pin
- Refer to the tables below for the connection assignments; these are also enclosed with the devices.

Contact arrangement M12x1



Pins, 8-pole
A-coded

The connection diagram is an integral part of the delivery and is enclosed with every device.

Connection assignment

Contact no.	Assigned to
1	$+V_S$ = 9…36 V, Io typ. 80 mA
2	$-V_S$ = 0 V
3	I_O = 0 (4) … 20 mA (4096 steps = 12 Bit) or V_O = 0 ... 10 Volt (4096 steps = 12 Bit)
4	0V analogue reference potential
5	Multi-functional input 0 (input circuit E1)
6	Multi-functional input 1 (input circuit E1)
7/8	Not connected

Absolute single/multi-turn rotary encoder
TBA/TRA redundant analogue

Order number

TRA	58 -	KP	A	3600	W	R1	S	B	01	→ Standardversion

TRA	TBA Singleturn encoder with analogue output TRA Multiturn encoder with analogue output
58	**Design form*:** 58 Design form Ø 58 mm 79 Design form Ø 79 mm
KP	**Flange type*:** K Clamped flange, shaft with flat area KF Clamped flange, shaft with Woodruff key KP Clamped flange, shaft with feather key KZ Clamped flange, shaft with shaft for measuring gear ZRS (data sheet ZRS 11877) ST Synchro flange, shaft with flattened area SR Synchro flange, clamping shaft (stator coupling ZMS58 according to ZMS 12939) SN Snychro flange, clamping shaft with groove for parallel key SP Synchro flange, shaft with feather key
A	**Housing material:** A Aluminium 3.2315 S Stainless steel 1.4305 V Stainless steel 1.4404
3600	**Measurement rang in degrees:** 360 Measuring range 360° (TBA standard) 3600 Measuring range 3600° (TRA standard)
W	**Code path:** W CW C CCW
R1	**Redundancy** R1 Redundant design
S	**Electrical connection:** S 2 x Device connector M12 K 2 x Cable length 1m Kx 2 x Cable length x m (on request)
B	**Output signals:** A 0 - 20 mA B 4 - 20 mA C 0 - 10 VDC
01	**Electrical and mechanical variants:** 01 Standard according to this data sheet

(*) Standard combinations of design form, flange type and shaft diameter (mm)

		Flange type							
		K	KF	KP	KZ	ST	SR	SP	SN
Design form	58	10	10	10	ZRS	6	12	10	12
	79	10		12	ZRS	10	12	10	12

Other combinations are available on customer request.

Accessories (selection)

Mating connectors

Order number	STK8GS54	STK8WS86	STK8GS105
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	IP67	IP67	IP67
Screening	On the housing	On the housing	On the housing
Max. connection cross-section (mm²)	0.5	0.5	0.5

Please note: The position of the coding groove of the angled connector must be defined by the customer.

Analogue Hand Programming Device Model PMA-05

To program the encoder TRA/TBA with teach-in functionality

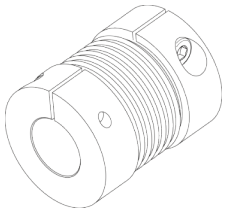
See data sheet PMA 11443

Accessories (selection)

Play-free bellows coupling BKK 32 / x - y

x and y: Bore diameter for shaft support

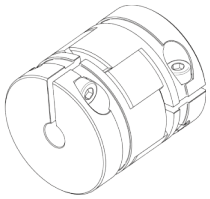
See data sheet BKK 11840



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

x and y: Bore diameter for shaft support

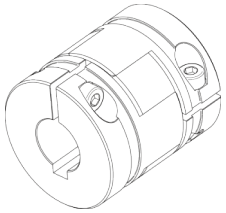
See data sheet KK 12301



Play-free clamp coupling KK14N / x - y (with groove)

x and y: Bore diameter for shaft support

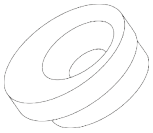
See data sheet KK 12301



Mounting brackets KL 66-2-S

Mounting brackets for shaft encoder assembly.

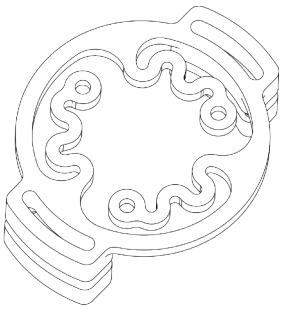
See data sheet MZ 10111



Torque support ZMS58

Torque support/stator coupling. Suitable for use as a shaft encoder bracket for the clamping shaft version, for the offsetting of radial and axial drive shaft play for Ø 58 mm shaft encoders.

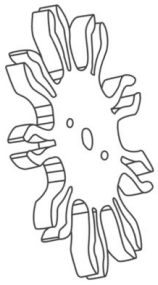
See data sheet ZMS 12939



Play free measuring wheel ZRS

Play-free measuring wheel ZRS for slewing ring applications.

See data sheet ZRS 11877



Documentation

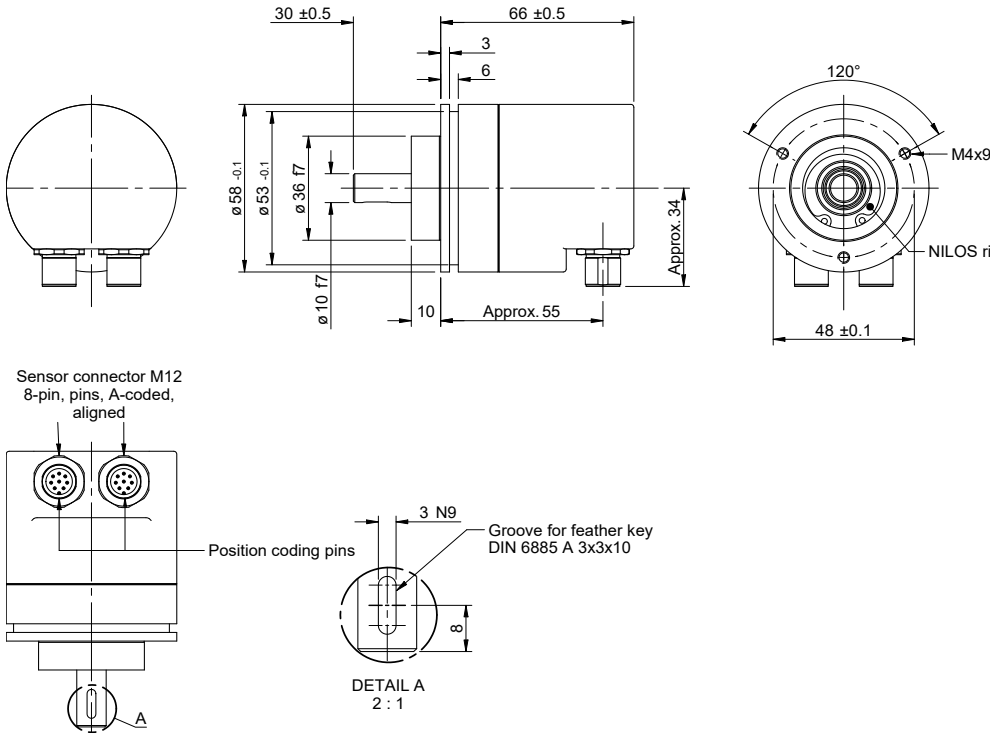
The following documents can be found on the internet under www.twk.de in the documents area.

- This data sheet 15241
- Installation instruction 16169

Installation drawing (Dimensions in mm)

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

Order number: **TBA58 - KPx xxx x R1 S x01**



Order number: **TRA58 - SNx xxxx x R1 K x01**