

- Compact, robust design for mechanical engineering, instrumentation and outdoor application
- With absolute multiturn gearbox
- With digital or analogue interfaces
- Optional potting for positive shock and vibration protection
- Resolution: 4096 positions / 360° (12 Bits) / 13 Bits (optional)
- Measuring range: 4096 revolutions max.
- Case in aluminium or stainless steel
- Two - chamber construction to separate rotating components from electronic circuit
- Protection grades: IP 66 or IP 69K (option)
- Working temperature range: - 40 °C to + 85 °C



### Construction

Robust case either in seawater resistant aluminum or in stainless steel - shaft in stainless steel - rotating components with permanent magnet in front chamber - electronic circuit with ASiC and Hall elements and interface components fitted within main chamber, separated from rotating components by a metallic wall - integrated absolute multiturn gearbox for the acquisition of revolutions - optional potting against water jets (IP 69K) - electrical connections via cable leads with inspection plug.

### Electronic interfaces

- **TRE 42: Synchronous serial interface-SSI** (page 2)
- **TRN 42: CANopen** (page 3)
- **TRA 42: Analogue** (page 4)

### Mechanical data of all models

- Operating speed: 1.000 rpm max. (10.000 rpm / optional)
- Angular acceleration: 10<sup>5</sup> rad/s<sup>2</sup> max.
- Inertial mass (rotor): 20 gcm<sup>2</sup>
- Operating torque: ≤ 8 Ncm at 500 rpm
- Wind-up torque: ≤ 4 Ncm
- Permissible shaft loads: 250 N (axial and radial)
- Bearing life expectancy: 10<sup>9</sup> revolutions
- Mass: 0.2 kg approx. (aluminium)  
0.3 kg approx. (stainless steel)

Dimensions, materials and accessories: Page 6

### Electrical data of all models

- Sensor system: ASiC with Hall elements
- Measuring position deviation: ± 0.5 LSB
- EMC - Standards:
  - Emission: EN 61000-6-4
  - Noise immunity: EN 61000-6-2

### Environmental data of all models

- Operating temperature: - 40 °C to + 85 °C
- Storage temperature: - 20 °C to + 60 °C (dependant on packing materials)
- Resistance to shock: 500 m/s<sup>2</sup> ; 11 ms (DIN EN 60068-2-27)
- Resistance to vibration: 10 Hz ... 2000 Hz ; 500 m/s<sup>2</sup> (DIN EN 60068-2-6)
- Protection grades: IP 66  
IP 69K (with optional potting of main chamber) (DIN EN 60529)

The connection data are supplied with each item.



**Model TRE 42: Synchronous Serial Interface - 12 Bits / 360° and max. 4096 rev.**

**Function**

The absolute angle information derived by the encoder is converted into serial information by an internal parallel-serial converter and then transmitted to a receiving electronic circuit in synchronism with a clock. Important advantages are : Low number of data lines and high reliability.

**Maximum data transmission rate**

The data rate is defined by the following factors:

- Clock frequency 1 MHz max up to 40 meters connection line
- Delay time of the overall electronics (between 40 and 150 meters)

$$t_{GV} = t_C + 2t_K + t_E$$

$t_{GV}$ : Total delay time

$t_C$ : Delay time of the encoder electronics, e. g.  $\leq 300$  ns

$t_K$ : Delay time of lead, depending on type and length, e. g. speed 6.5 ns/m

$t_E$ : Delay time of receiving electronics, e. g. 150 ns

Admitting a security gap of 50 ns between the periods of clock  $t_T$  and the delay time of the overall electronics  $t_{GV}$  the result is shown as follows:

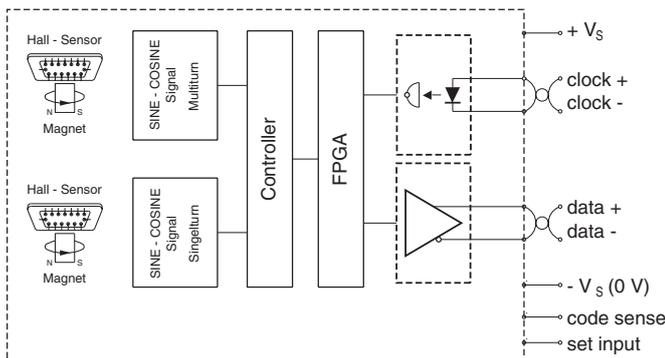
$$t_T = t_{GV} + 50 \text{ ns} = 500 \text{ ns} + 2t_K$$

When calculating the maximum frequency the following function applies:  $f_{max} = 1/t_T$ .

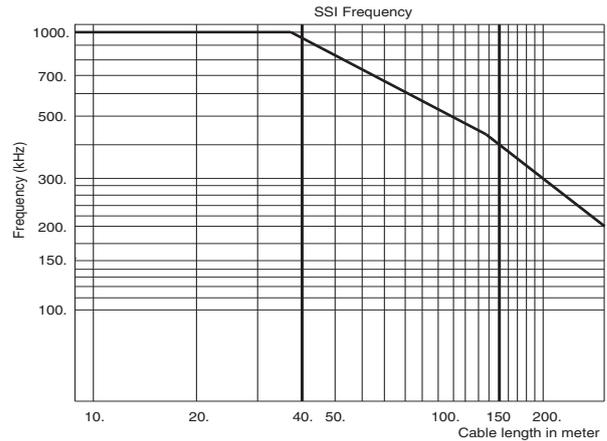
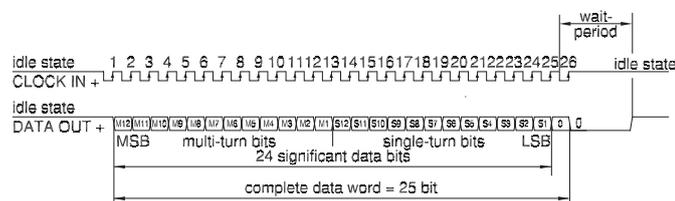
- To RS422 specification starting at 150 m approximately

The opposite diagram is based on the above dat

**Block diagram**



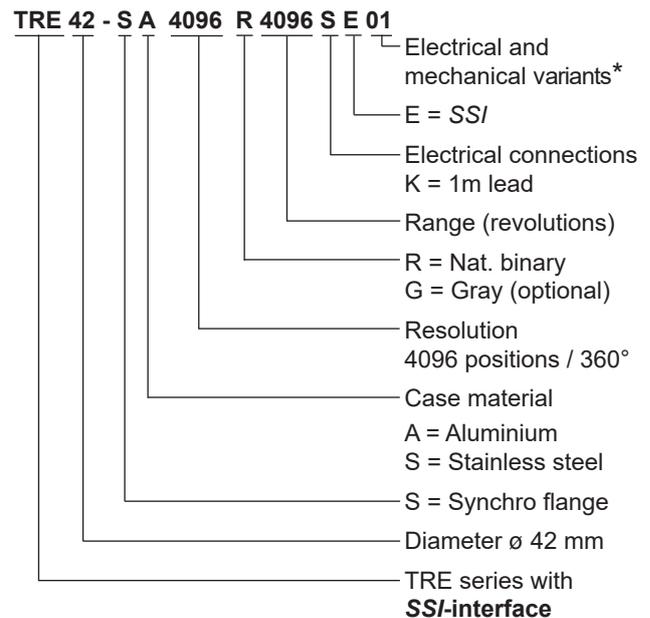
**Interface profile SSI - 25 Bits nat. binary**



**Electrical data**

- Supply voltage range: + 11 VDC to + 28 VDC
- Supply current: 30 mA typ. / 90 mA max.
- Resolution (standard): 4096 positions / 360° (12 Bits) (13 Bits optional)
- Measuring range: max. 4096 rev.
- Output code: Nat. binary (Gray optional)
- Preset value: Set Zero or other values (optional), via input circuit E1, page 5
- Code sense: CW or CCW adjustable via input circuit E1, page 5
- Serial output: Differential data output to RS 422
- Clock input: Differential data input to RS 422
- Monoflop time:  $16 \pm 10 \mu\text{s}$  (standard)
- Clock rate: 1 MHz max.

**Order code format**



\* The basic versions in accordance with the data sheet bear the code number 01. Variations from the basic version are indicated with a consecutive number and are documented in our works.



**Model TRN 42: CANopen - 12 Bits / 360°, up to 4096 revolutions**

**Electrical data**

To CANopen Application Layer and Communication Profile, CiA Draft Standard 301, Version 4.1 and to "Device Profile for Encoders CiA Draft Standard Proposal 406 Version 3.0" and CANopen Layer setting Services and Protocol (LSS), CiA DSP 305.

- Supply voltage range: + 11 VDC to + 28 VDC
- Power consumption: < 1 W
- Inrush current: < 200 mA
- Resolution: 4096 positions / 360° (12Bits) (13 Bits optional)
- Measuring range: 4096 revolutions max. (12 Bit)
- Output code: Nat. binary
- Code sense: CW / CCW
- Reference value: 0 - (total capacity less 1)
- CAN-interface: to ISO/DIS 11898
- Addressing: via SDO / LSS
- Termination resistance: by separate implementation
- Max. transmission length: 200 m\*

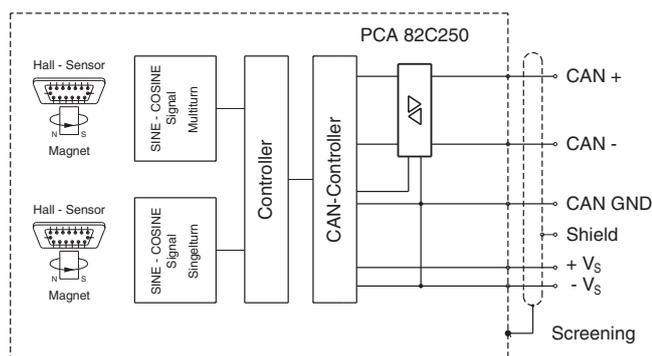
\* No galvanic isolation between power supply and bus (see CiA DS301)

**CANopen features**

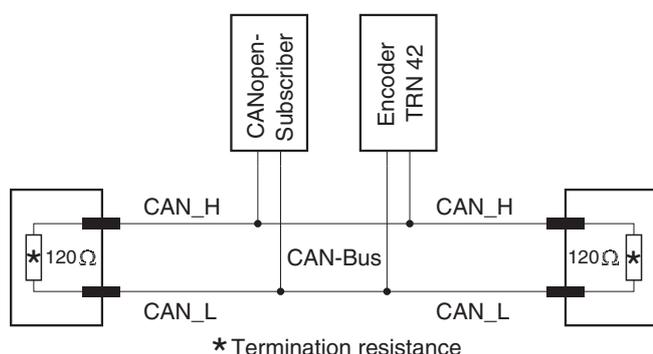
- NMT Master: no
- NMT-Slave: yes
- Maximum Boot up: no
- Minimum Boot up: yes
- COB ID Distribution: Default, SDO
- Node ID Distribution: via Index 2000 or LSS
- No of PDOs: 2 Tx
- PDO-Modes: sync, async, cyclic, acyclic
- Variables PDO-Mapping: no
- Emergency Message: yes
- Heartbeat: yes
- No. of SDOs: 1 Rx / 1 Tx
- Device Profile: CiA DSP 406 Version 3.0

For detailed description of the CANopen profile pl. refer to application manual TXN 11551

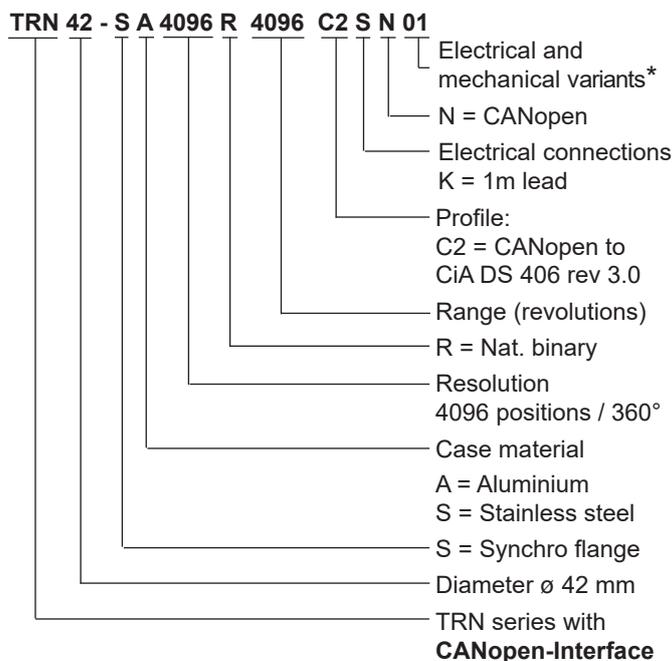
**Block diagram**



**Bus configuration to ISO / DIS 11898**



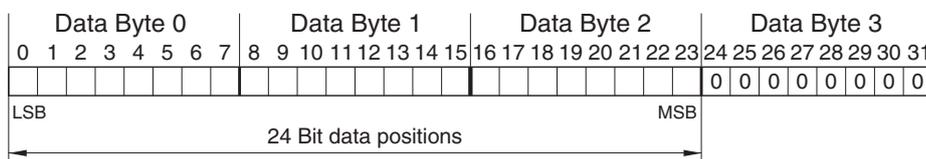
**Order code format**

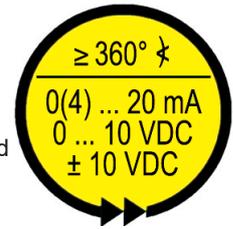


\* The basic versions in accordance with the data sheet bear the code number 01. Variations from the basic version are indicated with a consecutive number and are documented in our works.

**Data profile CANopen**

**PDO 1 / PDO 2**



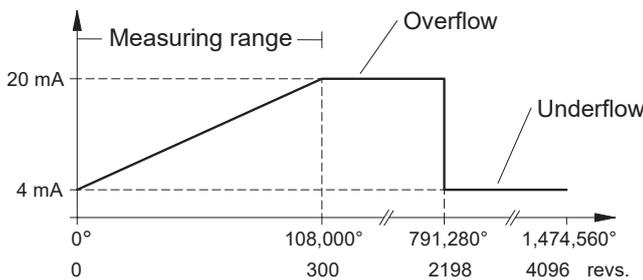
**Model TRA 42: Analogue outputs 0-20 mA, 4-20 mA, 0-10 VDC or ±10 VDC, max. 4096 revolutions**

**Function**

The contactless electromagnetic sensor system is extended with 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 V or ± 10 VDC.

**Measuring range setting**

The rotary encoder has a maximum measuring range of 1,474,560° (4096 revolutions). As standard, the measuring range is set to 3600°, i.e. 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 MFPs (see below) can be used by the customer to adapt the pre-set measuring ranges. Outside of the measuring range, the characteristic curve contains a symmetrically subdivided overflow and underflow up to the 4096th revolution (see characteristic curve). Solutions e.g. without overflow and underflow or any special characteristic curves are possible on request.

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



Note: If the measuring range cannot be 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 centre of the measuring range.

**Electrical data**

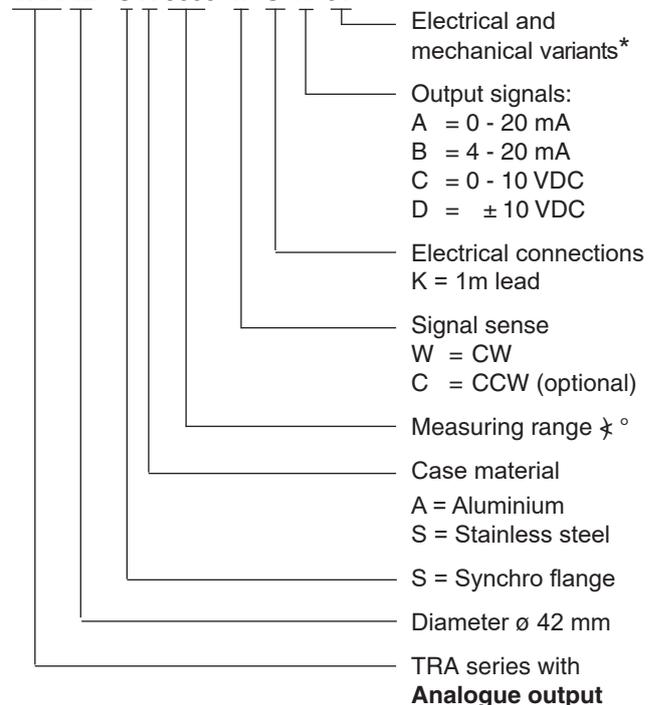
- Supply voltage range: + 18 VDC to + 28 VDC (Output: A, B, C)  
± 13 to ± 16 VDC (Output: D)
- Supply current: 80 mA typ. / 100 mA max.
- Resolution: 4096 steps/ 360° ↻ - 12 Bit to 4096 x 360° ↻
- Measuring range: (Default adjustment: 3600° ↻)
- D/A-Converter: 12 Bit
- Output signals: A: 0 to 20 mA  
B: 4 to 20 mA  
C: 0 to 10 VDC  
D: ± 10 VDC
- Signal sense: CW or CCW adjustable
- Preset value: Centre of the measuring range, other values optional
- Linearity: ≤ 0.25 %, optional ± 0.1%
- Repeatability: ≤ 0.02 %
- Temperature drift: < 0.0025 % / ° K / typ.

**Current output accuracy (Output A, B)**

- at starting point 0 mA: 0 mA ± 50 µA  
4 mA: 4 mA ± 50 µA
- at end point 20 mA: 20 mA ± 50 µA
- Load resistance: to 500 Ω at  $V_s = 18$  to 28 VDC

**Voltage output accuracy (Output C, D)**

- at starting point 0 V: 0 V + 0.1 V (output 0 - 10 V)  
0 V ± 25 mV (output ± 10 V)
- at end point 10 V: 10 V ± 25 mV  
± 10 V: ± 10 V ± 50 mV
- Output current: 5 mA max. when load resistance > 2 kΩ (short circuit proof)

**Order code format**
**TRA 42 - S A 3600 W S A 01**


\* The basic versions in accordance with the data sheet bear the code number 01. Variations from the basic version are indicated with a consecutive number and are documented in our works.

## Functional description and adjustment modes

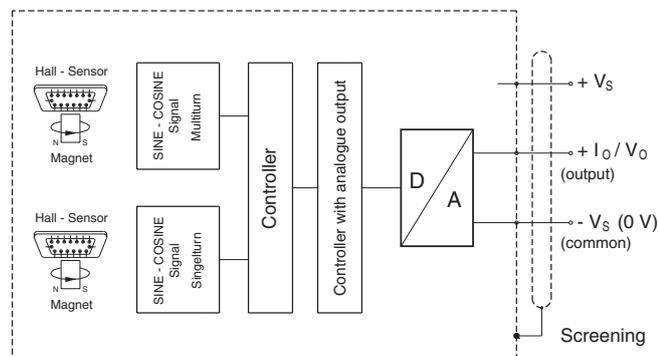
The following parameters can be adjusted by the user in situ: Code sense, zero point, end point, preset value and default values, via the multi-functional entries MFP 0 and 1 (entry circuit E1). Before delivery the measuring range will be set at 0 to 3600 degree and the code sense increasing CW with view to the shaft end.

The default value for the Preset value is the centre of the measuring range. Other values can be realized ex-work. The encoder will be supplied ex work with the default values.

Table for multi-functional inputs (MFP)			
Function	MFP 0	MFP 1	
Preset zero point	1	0	Keep the pin MFP 0 to logical 1 for a period of 1 s.
Preset final value	0	1	Keep the pin MFP 1 to logical 1 for a period of 1 s.
Preset default value	1	1	At the same time (within 1ms) preset pins MFP 0 and MFP 1 to logical 1 for a period of 1 s. Manufacturer adjustment is restored.
Change of code sense	1	0	Attention: at the same shaft position Keep the pin MFP 0 to logical 1 for a period of 1.5 s after a delay of a minimal period of 0,5 s
	0	1	Keep the pin MFP 1 to logical 1 for a period of 1.5 s
Preset value (centre of the measuring range)	1	0	Attention: at the same shaft position Keep the pin MFP 0 to logical 0 for a period of 1.5 s after a delay of a minimal period of 0,5 s
	1	0	Keep the pin MFP 0 to logical 0 for a period of 1.5 s.
End of adjustment, normal transducer function	0	0	

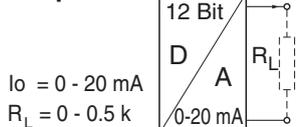
The Analogue Hand Programming device Model PMA-01 (see datasheet PMA 11443) is used for simple teach in adjustment of transducer TRA.

## Block diagram

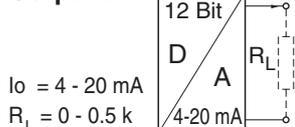


## Output circuits

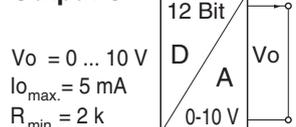
### Output A



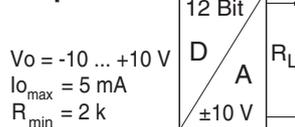
### Output B



### Output C

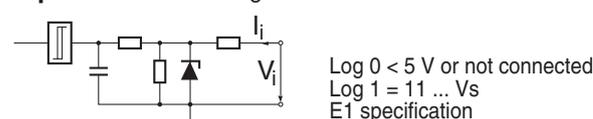


### Output D



## Input circuits of the multifunctional inputs (MFP)

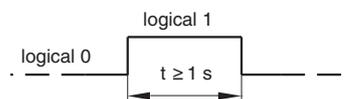
### Input E1 active "high"



## Timing diagram for the MFP- adjustments

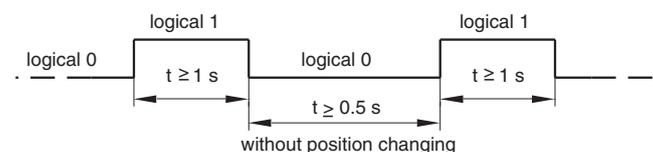
### 1. MFP 0 or MFP 1 once setting

- Preset zero point (MFP 0)
- Preset final value (MFP 1)



### 2. MFP 0 and/ or MFP 1 setting twice at the same shaft position

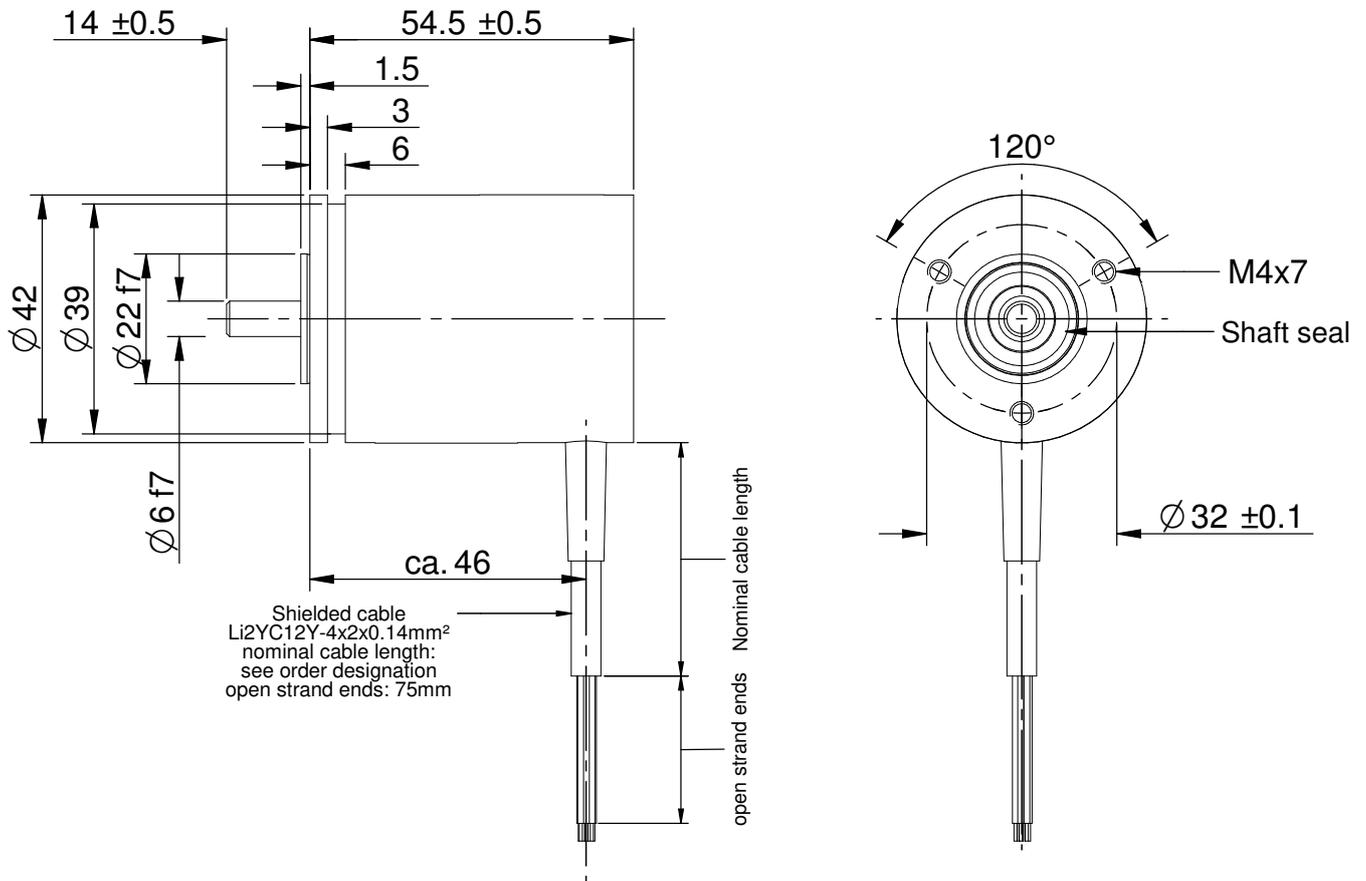
- Preset value (MFP 0)
- Code sense (MFP 1)



### 3. MFP 0 and MFP 1 setting simultaneously

Time difference between MFP 0 und MFP 1 ≤ 0,25 s.

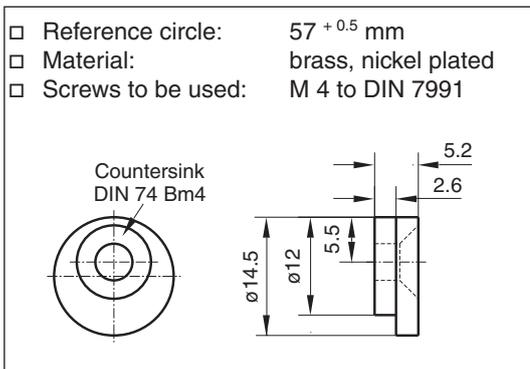
**Dimensions in mm**



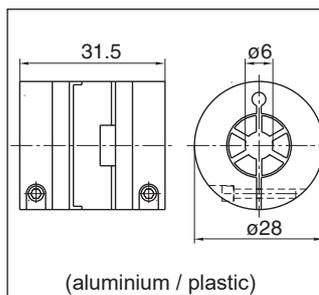
**Materials used**

Case in stainless steel:	1.4305
Case in aluminium:	AlMgSi1
Shaft in stainless steel:	1.4305
Rear cover:	Polyamid
Lead gland:	NBR
Toroidal sealing rings:	NBR

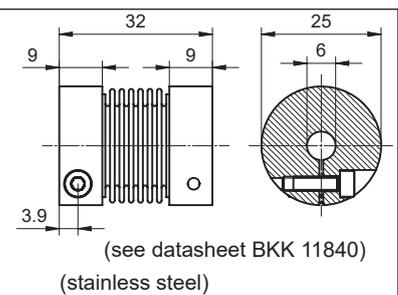
**Mounting clamps KL 66-2**



**Oldham coupling 416/6**



**Bellow coupling BKK 32/6**



Coupling no. 416 is also available with different bores for driving shafts with diameters other than 6 mm.