

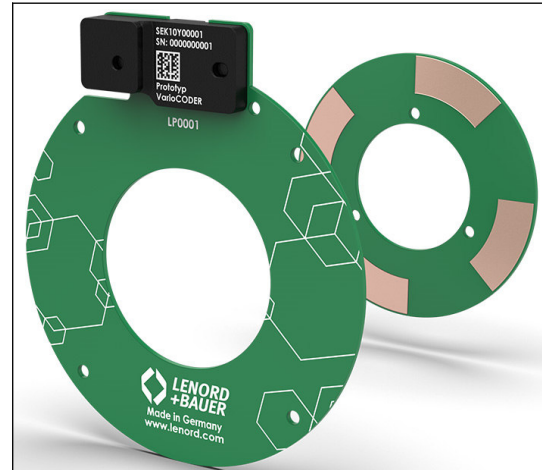
### General

- Mechanically individually configurable encoder kit for convenient integration in electric drives
- Ideal for detection of pole position, angle and rotational speed
- Contactless measurement by inductive scanning
- sin/cos output signals, single-ended or differential

### Properties

- Material: Conductive material  $\geq 35 \mu\text{m}$
- Rotational speed:  $\leq 40,000 \text{ min}^{-1}$
- Accuracy:  $< 0.5^\circ$  electrical
- Latency:  $< 5 \mu\text{s}$
- Operating temperature range:  $-40^\circ\text{C}$  to  $+125^\circ\text{C}$ , short-time up to  $+150^\circ\text{C}$
- Integrated signal processing
- Performance driver for cable lengths up to 30 m
- Prepared for ASIL C and ASIL D (internal self-diagnosis)
- **Configurable parameters:**

Number of pole pairs	1 to 64
Outside diameter stator	52 mm to 200 mm
Shaft diameter rotor	2 mm to 138 mm
Fastening stator	2 to 32 bores or slotted holes
Fastening rotor	2 to 32 screws/gluing/clamping possible
Connector outlet	Tangential/axial
Output signal (sin/cos)	Single-ended/differential



### Advantages

- Can be integrated into all motor designs in minimum space with high mounting tolerances
- Immediate angle output after switching on without any reference search routine
- High accuracy without calibration
- High reliability with regard to mechanical loads
- Function samples and prototypes available within four weeks
- Price/performance similar to mass-produced encoders
- Magnet-free and not sensitive to magnetic fields
- Absence of hysteresis leads to high energy efficiency
- Small dimensions, low moment of inertia
- Large axial and radial mounting tolerances
- Maintenance and wear-free
- Assembly and material cost savings are possible due to direct scanning of structures on a rotor shaft

### Field of application

- E-mobility on-road, off-road, marine, industrial
- Motor commutation, position and rotational speed acquisition
- Applications with large rotor diameters and hollow shafts

*Right to technical changes and errors reserved.*

# Technical data

<b>Electrical data</b>	
Supply voltage $U_B$ (short-circuit-proof)	5 V DC
Current consumption $I_B$ (without load)	< 30 mA
Output signals (short-circuit-proof)	sin/cos Single ended: Two sinusoidal signals phase-shifted by 90° Differential: Two sinusoidal signals phase-shifted by 90° and their inverse signals
Output signal level <sup>(1)</sup>	2 V <sub>pp</sub>
Accuracy per period	< 0.5° electrical
Latency	< 5 µs
Number of periods per mechanical revolution	1 to 64
Frequency range	0 kHz to 10 kHz
<b>Mechanical data encoder kit</b>	
Weight	< 100 g <sup>(2)</sup>
Air gap (nominal)	2.0 mm
<b>Mechanical data stator</b>	
Material	Plastic; electronics in plastic housing
Outside diameter $D_{OS}$	52 mm to 200 mm
Housing material	Plastics
Mounting types	M3 screw mounting, bonding, clamping
Axial overall height	minimum 10.6 mm
<b>Mechanical data rotor</b>	
Material	Conductive material ≥ 35 µm
Rotational speed <sup>(3)</sup>	≤ 40,000 min <sup>-1</sup>
Shaft diameter $D_{IR}$	2 mm to 138 mm
<b>Environmental testing</b>	
Operating temperature range	-40 °C to +125 °C in accordance with ISO 16750-4:2010, for short periods up to +150 °C <sup>(4)</sup>
Storage temperature range	-40 °C to +125 °C
Degree of protection	IP 30
Dielectric strength	ISO 16750-1 to ISO 16750-5
Electromagnetic compatibility <sup>(5)</sup>	DIN EN 61000-4-4; DIN EN 61000-4-2 ISO 10605 ECE-R10
Vibration resistance	DIN EN 60068-2- 64; DIN EN 60068- 2-6 ISO 16750-3
Shock resistance	DIN EN 60068-2-27 ISO 16750-3
Chemical loads	ISO 16750-5
MTTF value	≥ 3,000,000 h at 55 °C



The technical data depends on the configured variant. Other parameters are available upon request.

<sup>(1)</sup> depending on output current and temperature

<sup>(2)</sup> depending on configuration (especially of diameter and of rotor material)

<sup>(3)</sup> depending on the number of pole pairs, mounting type, diameter and material

<sup>(4)</sup> depending on availability of safety function, operating temperature range and service life (MTTF value)

<sup>(5)</sup> Observe EMC notes in the mounting/operating instructions

# Mechanical product construction

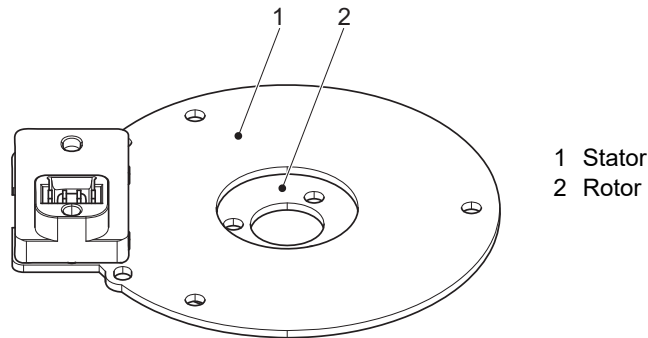
## Encoder kit construction

The inductive rotor position encoder consists of a stator and a rotor. This compact system is particularly well suited for integration in electric drives with high electromagnetic compatibility requirements. The encoder kit can be integrated in almost any environment due to the configuration of diameter, number of periods and the slim design.

The contactless and wear-free system requires no bearings or couplings. The complete scanning over mechanical 360° leads to a high mounting tolerance without affecting function and accuracy significantly.

Internal signal evaluation and processing provide signals which can be directly processed in standard inputs without any additional effort. The sin/cos signals are almost offset free and amplitude stable even with high mounting tolerances.

Stable signals are output even at high speeds and extreme temperatures and allow precise and reliable determination of pole position and speed over the entire operating area.

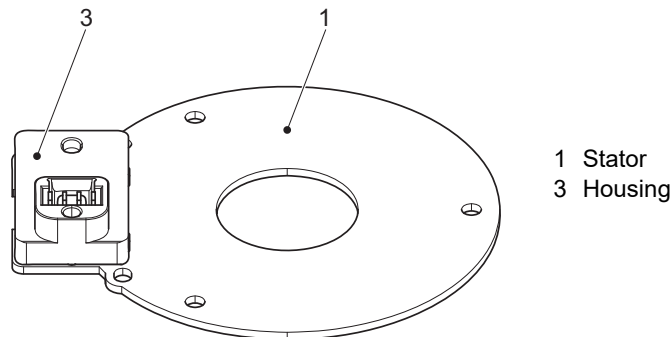


## Stator

The stator consists of a printed circuit board with attached cover to protect the electronic components.

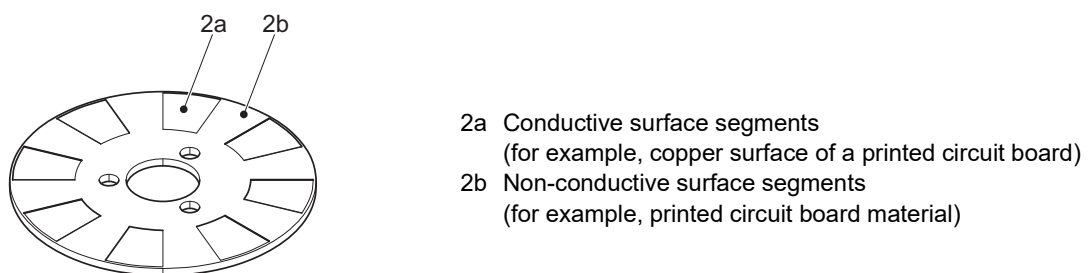
The large bore allows shafts with large diameters to pass. The stator is attached to the drive housing, for example, by a number of screws adapted to the size of the printed circuit board. The stator electrical connection is via a plug connector (axial or tangential connector outlet).

A safety distance to the electronics and the encoder system must only be maintained in a defined circuit and in a defined area of the connection technology.



## Rotor

The rotor is a thin plate with alternating conductive and non-conductive surface segments. The number of segment pairs must match the number of pole pairs on the stator. In the simplest case, a printed circuit board can be used where copper surfaces allow the rotor position to be detected. The rotor can also be made entirely of conductive material such as aluminum or steel. In principle, surface structures of existing rotor components can also be scanned. This can reduce costs and increase reliability.

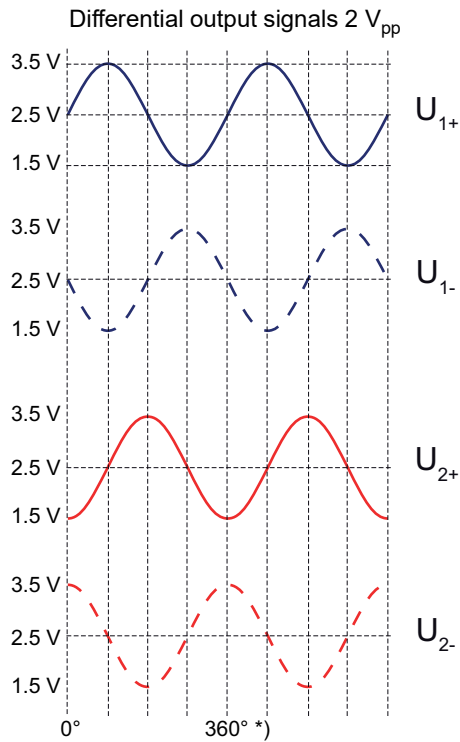


*Example rotor with 8 pole pairs*

# Output signals

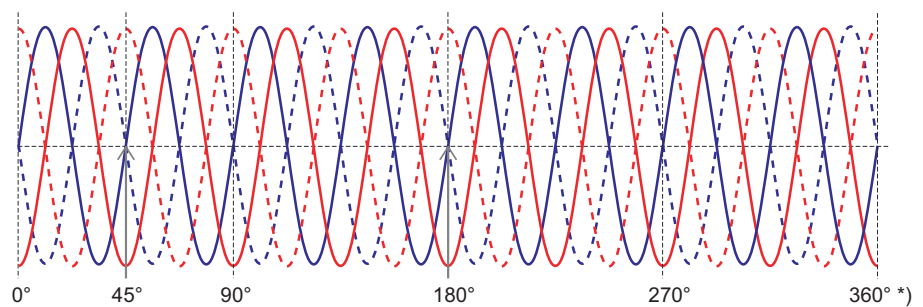
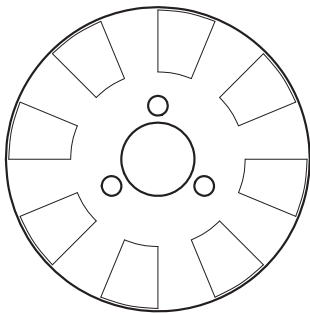
The number of pole pairs on the encoder kit matches the number of sine/cosine periods.

## Output signals for application with one pole pair



If single ended output signals (i.e. not differential but only  $U_1$  and  $U_2$ ) are used, then make sure, that the connections for signals  $U_1$  and  $U_2$  are not connected.

## Application example: Rotor with eight pole pairs



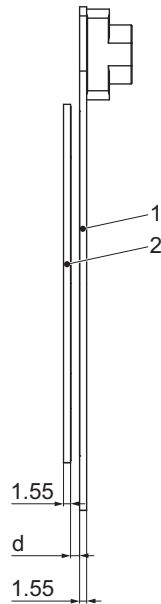
\*)  $360^\circ \triangleq 1$  mechanical revolution

# Assembly and installation

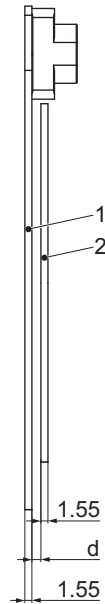
## Installation

The rotor can move in front of or behind the stator depending on mounting requirements.

Rotor behind the stator (standard)



Rotor in front of the stator



- 1 Stator
- 2 Rotor
- d Air gap



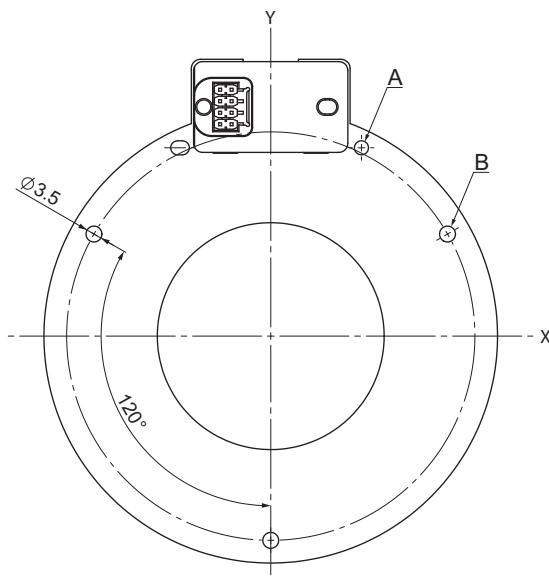
The encoder kit is delivered with a nominal air gap of 2 mm. Deviating from this dimension changes the amplitudes of the output signals. Air gap changes of 0.5 mm influence the interpolation capability only slightly.

## Stator assembly

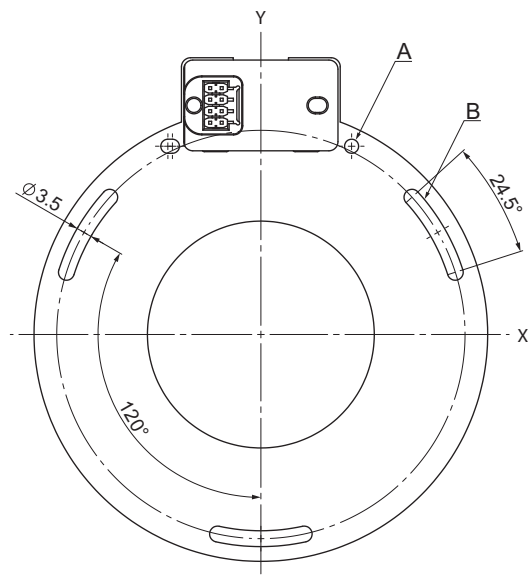
The stator is mounted using the freely selectable number of screw mountings. The fastening bores are designed for M3 screws by default. A distinction is made between whether the zero position of the stator is coordinated electrically (variant 1) or mechanically (variant 2) with the rotor pole position of the drive system.

### Assembly example with 3 fastening bores (spacing 120° each)

Variant 1



Variant 2



- A Internal center holes (2×)
- B Fastening bores



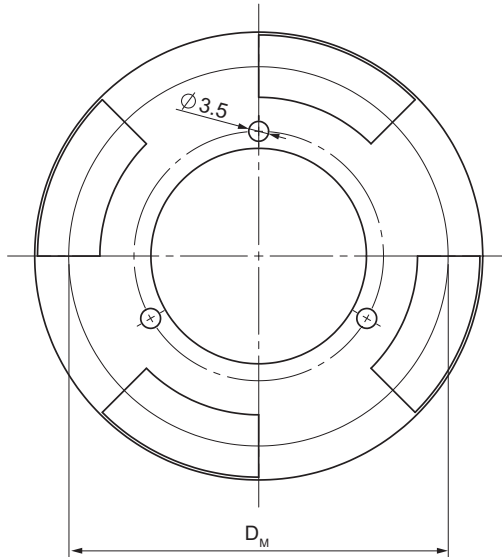
Deviations of 0.5 mm in the X or Y direction do not (coaxially) have a major effect on system accuracy.

# Assembly and installation

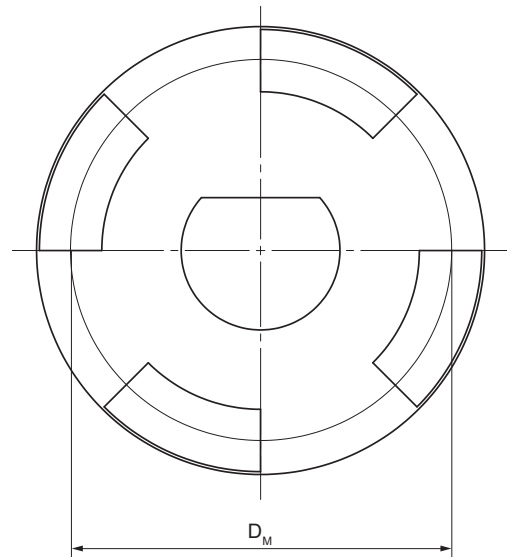
## Rotor assembly

In variant 1 the rotor is mounted via the configurable number of screw mountings. The fastening bores are designed for M3 screws. Variant 2 shows the option of clamping and bonding the rotor. It is possible to integrate the rotor directly into the application.

Example variant 1



Example variant 2

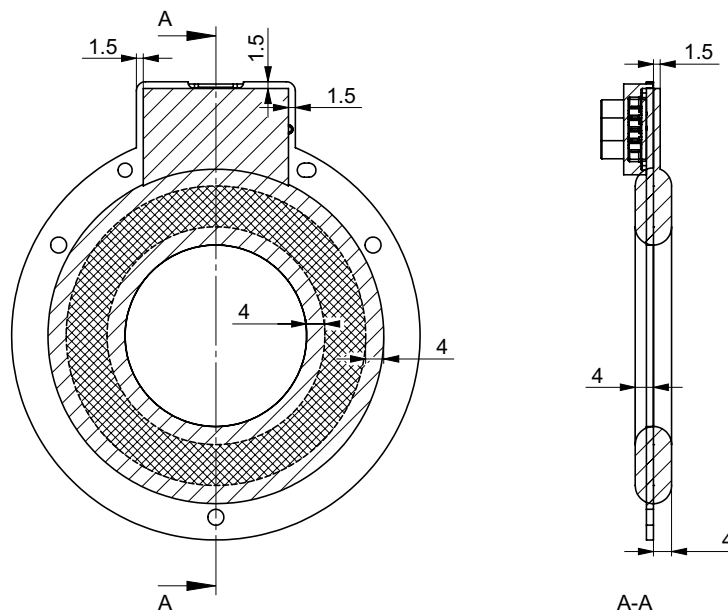


$D_M$  Center diameter rotor

## Safety distance stator



No conductive contours are allowed at a distance of 4 mm around the stator coil system. The distance at the stator housing and electrically conductive materials must be  $> 1.5$  mm.



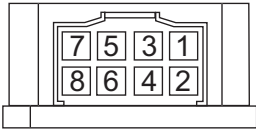

## Assembly notes

- Recommended cable fixation: 80 mm from the connector
- Tightening torque for M3 screws: 1.3 Nm
- **Screening concept:** During configuration of the encoder kit and also following it, Lenord+Bauer offers support based on extensive knowledge and experience in integrating the encoder kit into the screening concept of the application.

# Assignment and accessories

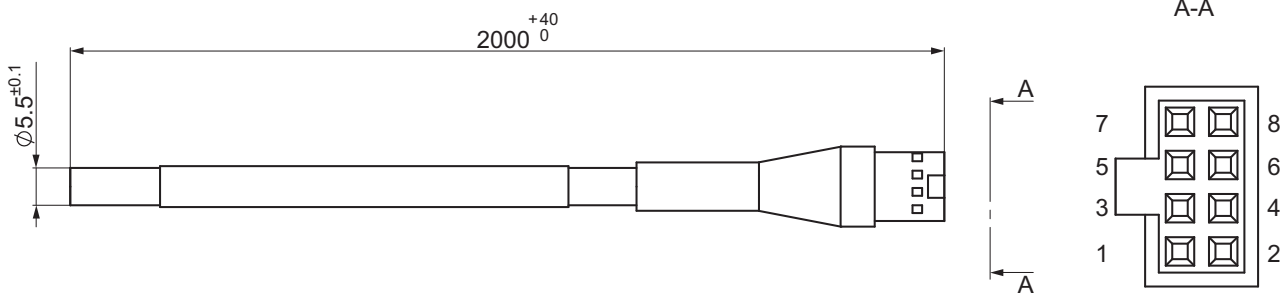
## Connector at stator

### Assignment

8-pole, male (plug-in view)		Pin assign- ment	Signal identifier
Tangential connector outlet		1	unallocated
		2	unallocated
		3	U <sub>1+</sub>
		4	U <sub>1-</sub>
Axial connector outlet		5	U <sub>2+</sub>
		6	U <sub>2-</sub>
		7	GND
		8	U <sub>B</sub>

## Accessories

### GGPOSE001 starter kit



### Assignment

8-pole, female (plug-in view)	Pin assignment	Signal identifier	Core color
Type: AMPMODU MODU IV/V, order number: 104483-1, manufacturer: TE Connectivity	1	unallocated	-
	2	unallocated	-
	3	U <sub>1+</sub>	white
	4	U <sub>1-</sub>	brown
	5	U <sub>2+</sub>	yellow
	6	U <sub>2-</sub>	black
	7	GND	blue
	8	U <sub>B</sub>	red

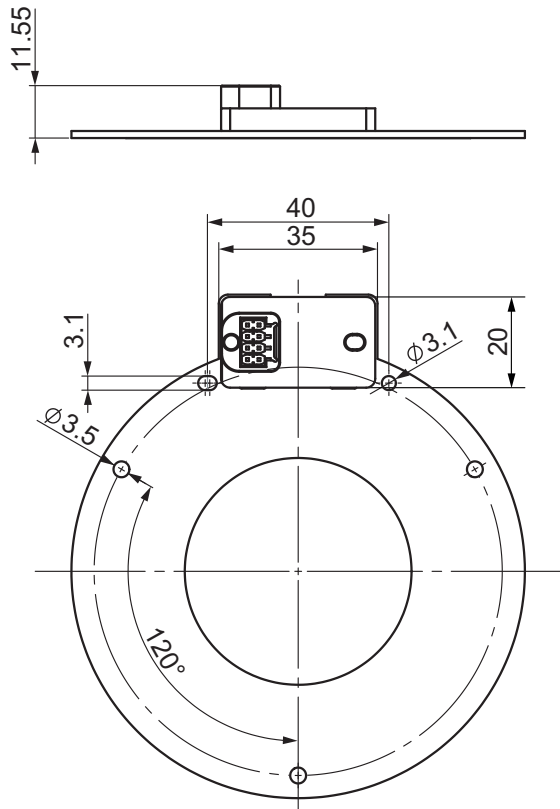
# Dimensional drawings

All dimensions in millimeters, general tolerance DIN ISO 2768 mK

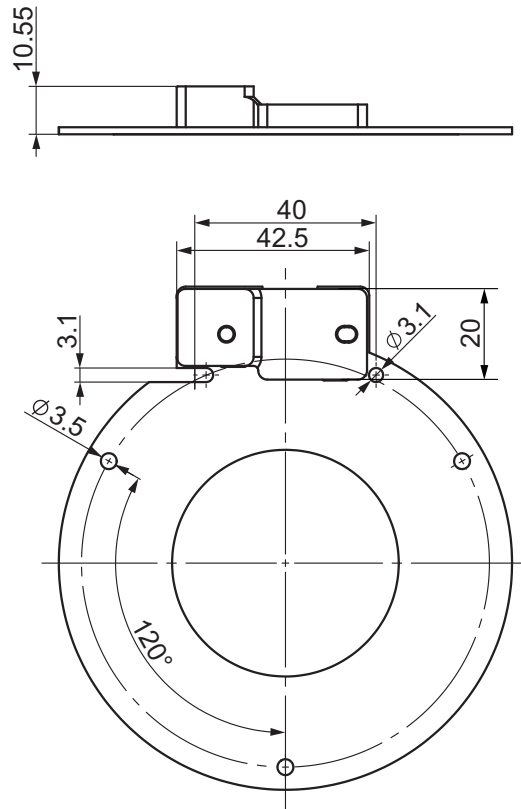
## Stator

Example with 3 fastening bores (spacing 120° each)

Axial connector outlet

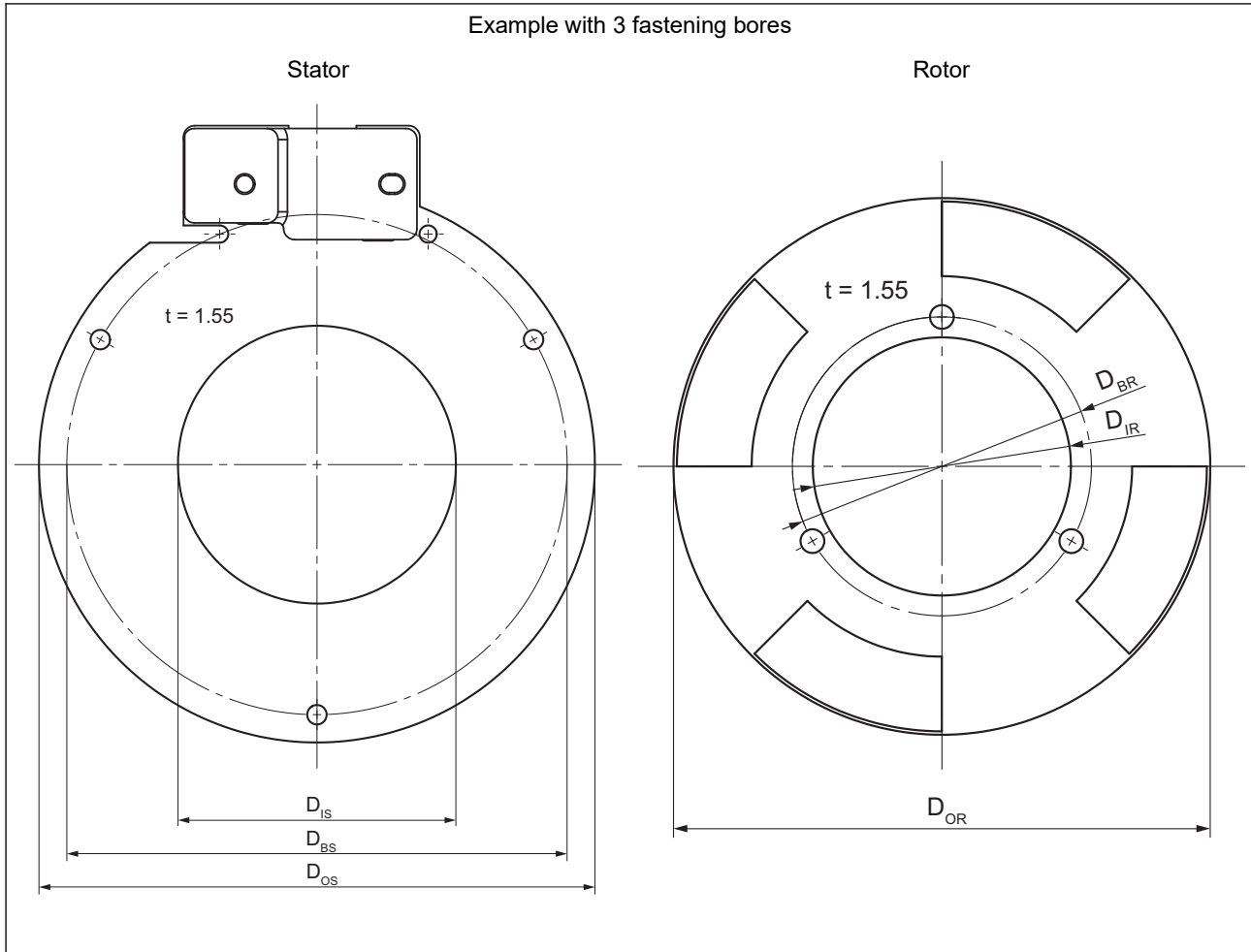


Tangential connector outlet





# Configurable diameters



## Dimensions

Stator		Rotor	
$D_{OS}$	52 mm to 200 mm	$D_{OR}$	31 mm to 179 mm
$D_{BS}$	42 mm to 190 mm	$D_{BR}$	8 mm to 144 mm
$D_{IS}$	6 mm to 176 mm	$D_{IR}$	2 mm to 140 mm



Do you have special requirements regarding shaft diameters, mounting solutions, encoder shape, number of pole pairs, cable protection, cable outlet, connector assembly or scanning of conductive structures on a rotor shaft?

Talk to us. We can work together to design the optimal solution for your application and will advise you how to customize your solution in the most cost-efficient way.

Write to: [support@lenord.de](mailto:support@lenord.de) or call: +49 208 9963-215.

# Your notes



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Lenord, Bauer & Co. GmbH	Lenord+Bauer Italia S.r.l.	Lenord+Bauer USA Inc.	Lenord+Bauer
Dohlenstraße 32	Via Gustavo Fara, 26	32000 Northwestern Highway	Automation Technology (Shanghai) Co.,Ltd.
46145 Oberhausen	20124 Milano	Suite 150	Block 42, Room 302, No.1000, Jinhai Road
Germany	Italy	Farmington Hills, MI 48334	201206 Shanghai
Phone +49 (0)208 9963-0	Phone +39 340 1047184	USA	China
www.lenord.de	www.lenord.com	Phone +1 248 446 7003	Phone +86 21 50398270
		www.lenord.com	www.lenord.cn

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