Magnetic absolute rotary encoder
▶ GEL 2035
with SSI or CANopen interface

LENORD +BAUER

... automates motion.
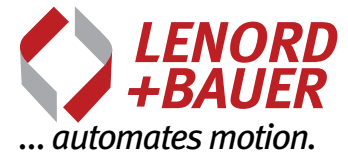
Synchronous serial interface with heavy-duty clamping flange and clamping flange

CANopen interface with semi hollow shaft

General

▶ Magnetic absolute rotary encoder with a maximum total resolution of 24 bits in a compact design

▶ Wear-free electronic gear with a high-performance li-ion buffer battery

▶ Magneto-resistive scanning supplies unambiguous position values for every angular position via a synchronous serial interface or CANopen interface

Features

▶ Total resolution 24 bits
▶ Reset function via push-button or pin
▶ Interfaces:
   - SSI or SSI and resolver
   - CANopen
▶ Flange variants: heavy-duty clamping flange, clamping flange with tooth wheel adapter, semi hollow shaft
▶ Protection class up to IP 69K

Advantages

▶ IP 69K variant also withstands aggressive media or high-pressure cleaner applications due to stainless steel housing with two-chamber system
▶ Heavy-duty clamping flange for high bearing loads
▶ Appropriate for all standard applications and also for real heavy-duty applications

Field of application

▶ General mechanical engineering
▶ Regenerative energies
▶ Mobile machines

Description

Construction and design

The resilient encoder housing has a flange dimension of 58 mm and comprises anodised aluminium. The absolute rotary encoders in the series GEL 2035 are available with a clamping flange, heavy-duty clamping flange or clamping flange with tooth wheel adapter.

A very compact redundant system is realised by combination with a resolver. The complete electrical isolation of the resolver from the magnetic absolute rotary encoder ensures true redundancy of the absolute position values.

For integration into a CANopen network, the absolute rotary encoder GEL 2035 is available with a CANopen interface. This version is available in stainless steel as standard and is equipped with a semi hollow shaft.

For use in extremely dusty, dirty or aggressive environments, the absolute rotary encoder GEL 2035 is available in an IP 69K variant. Compliance with protection class IP 69K is ensured by the robust stainless steel housing with radial cable gland and the two-chamber system.

Battery saving mode

In order to preserve the battery power, the encoder is delivered in battery saving mode. In this mode, the encoder is not active. Applying the power supply, activates the encoder which provides postion values.

To extend battery life, this mode can be re-activated. In the following cases, activation of the saving mode is useful to save battery power:

▶ Long-term shutdown of the plant without voltage supply.
▶ Storage as spare part.
▶ Disassembly of the encoder, followed by long-term storage.
▶ In case of a faulty encoder, before returning it to the factory.

You have two alternatives to activate the battery saving mode:

1. Using the PRESET push-button
   In de-energized state, push the PRESET push-button for at least 0.1 s.
2. Using the PRESET input
   In de-energized state, apply between PRESET input and GND a voltage of 3 V to 30 V for at least 0.1 s.

In battery saving mode the encoder is disabled. After switching on the power supply, the encoder provides the adjusted PRESET value independent of the position of the encoder shaft (→ page 6). Electronic adjustment of the encoder is required. For this reason, battery saving mode is recommended only in the cases mentioned above.

Sensing principle

The multiturn absolute rotary encoders in the series GEL 2035 provide an unambiguous position value for each angular position with a resolution of up to 24 bits. The single turn and multiturn stage each operate with a resolution of 12 bit. The multiturn stage is based on an electronic gear. A buffer battery ensures the function of the absolute rotary encoder also in case of power failure. Even if the rotary encoder moves in de-energised state, the current position value is accurately output immediately after power is switched on.

Interfaces

The absolute rotary encoder supplies the position values either in binary or gray code via a fast synchronous serial interface (SSI) or as per encoder profile DS406 via a CANopen interface.

Temperature ranges

High precision SMD components are used in the absolute rotary encoder. Despite careful selection, thermal ageing of these components cannot be excluded. For this reason the encoder should be stored at a temperature from -40 °C to +85 °C.

Operating temperatures of -40 °C to +85 °C are allowed, an installed absolute rotary encoder is not allowed to exceed this temperature range. The function of the absolute rotary encoder is ensured within the operating temperature range allowed, (DIN 32878); here it is the temperature at the encoder housing that applies.

The temperature of the absolute rotary encoder is affected by the installation situation (thermal conductance, thermal radiation), the heating caused by the absolute rotary encoder (bearing friction, electrical power loss) and the ambient temperature. The operating temperature may be higher than the ambient temperature depending on the operation of the absolute rotary encoder.

Depending on the supply voltage the heating caused by the encoder can be up to 10 °C. At high operating speeds > 5,000 min^{-1} the heating caused by the encoder can be up to 20 °C due to the bearing friction.

If the absolute rotary encoder is operated close to the limits of the specifications allowed, the ambient temperature must be reduced by suitable means (cooling) such that the operating temperature range allowed is not exceeded.

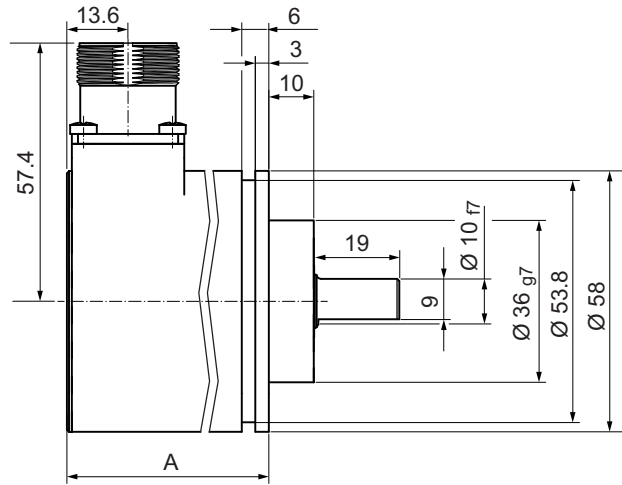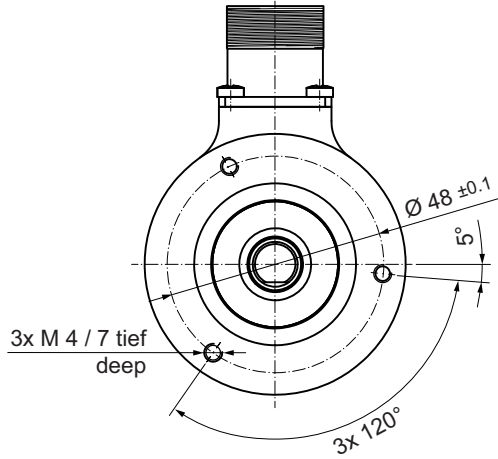| General	
Absolute accurary (DIN 32876)	0.8°
Repeatability	< 0.01°
Step number per revolution	4096 steps per revolution (12 Bit)
Numbers per revolution	4096 revolution(12 Bit)
Electrical data	
Operating voltage	10 to 30 V DC with reverse voltage protection
Power consumption	< 0,3 W, without load
Resolution single turn	12 Bit
Resolution multiturn	12 Bit (electronic gear)
Digital interfaces	SSI (Gray / binary) CANopen Encoder Profil DS406
Analogue interface	Resolver signal
Mechanical data	
Moment of inertia of rotor	611.8×10^{-6} kgm^2
Material	Aluminium anodised, stainless steel
Weight single turn	Stainless steel: 450 g[1]
Weight multiturn	Aluminium: 300 g (SSI), 450 g (SSI+resolver) stainless steel: 600 g [2]
Operating speed (limit value) single turn	12,000 min^{-1}
Operating speed (limit value) multiturn	10,000 min^{-1}, 12,000 min^{-1} (short-term)
Operating torque	< 3 Ncm
Bearing life cycle	> 10^5 h at 1000 min^{-1}
Shaft sealing ring (optional)	Material: Viton, protections class IP 67 / IP 69K
Environmental data	
Working temperature range	-40 °C to +85 °C
Operating temperature range	-40 °C to +85 °C
Storage temperature range	-40 °C to +85 °C
Protection class according to DIN 60529	IP 67, IP 69K
Vibration resistance (DIN EN 60068-2-6)	200 m/s^2, 10 to 2,000 Hz
Shock protection (DIN EN 60068-2-27)	2000 m/s^2, 11 ms
EMC	EN 61000-6-1 to 4
Insulation strength	Ri > 1 MΩ, at a testing voltage of 500 V AC
Relative humidity max.	99 %
Condensation permissible	yes
Clamping flange	
Shaft load (radial/axial)	120 N / 90 N at 1000 min^{-1}
Heavy–duty flange	
Shaft load (radial/axial)	210 N / 90 N at 1000 min^{-1}
Semi hollow shaft	
Shaft load (radial/axial)	75 N / 70 N at 1000 min^{-1}

[1] Absolute rotary encoder with CANopen interface and semi hollow shaft
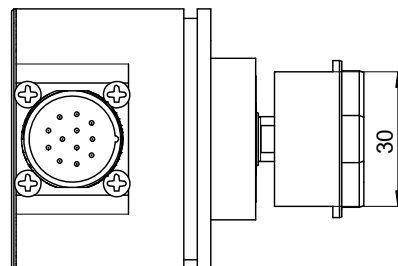[2] IP 69K version

Dimensional drawings

Dimensional drawing GEL 2035 SSI

Clamping flange / heavy-duty flange

Dimension A	Type
44.9	Clamping flange
63.1	Clamping flange with resolver
69.7	Heavy-duty clamping flange

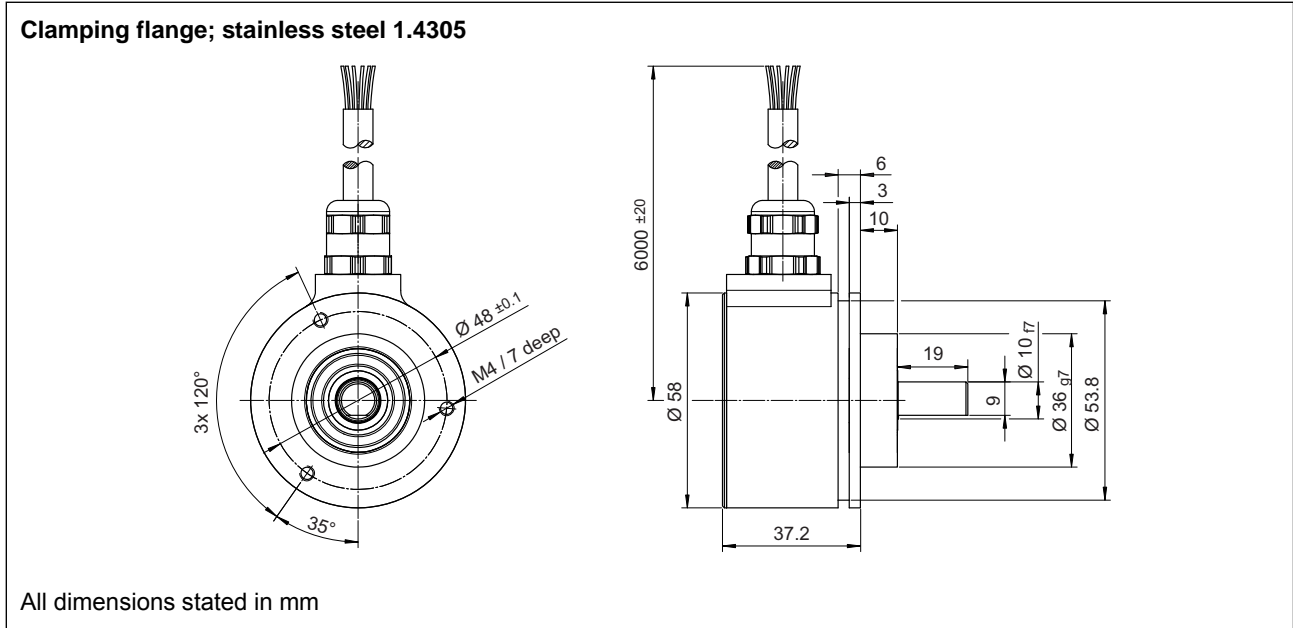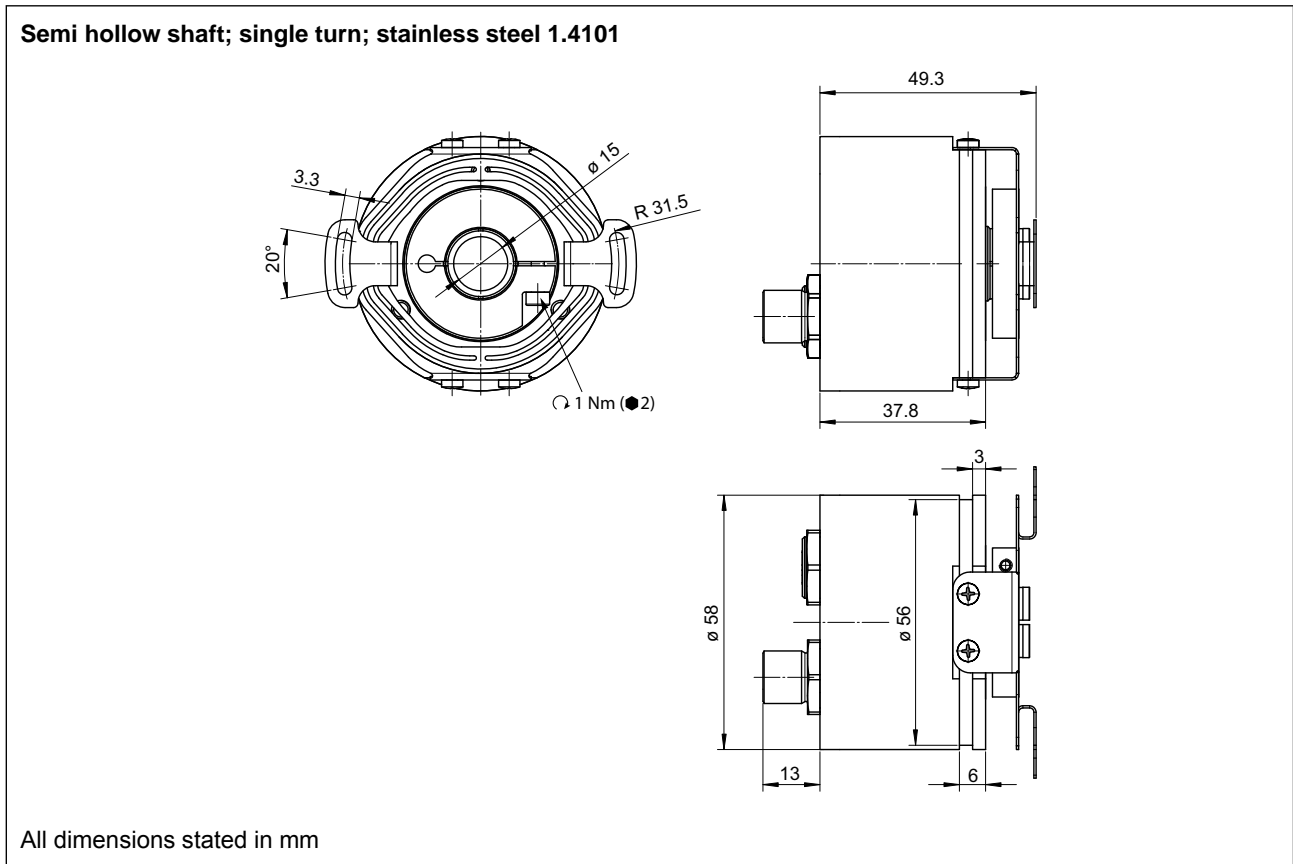**Clamping flange with tooth wheel adapter**

All dimensions stated in mm

Dimensional drawing GEL 2035 SSI – with protection class IP 69K

**Clamping flange; stainless steel 1.4305**

All dimensions stated in mm

Dimensional drawings GEL 2035 – CANopen

Semi hollow shaft; single turn; stainless steel 1.4101

All dimensions stated in mm

Synchronous serial interface

The synchronous serial interface transfers the position data at a clock frequency of up to 2 MHz. Prior to further position sampling, a minimum clock pulse space of 25 µs must be met.
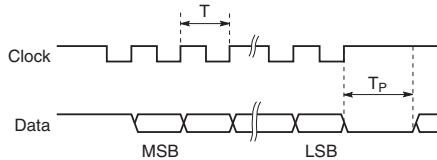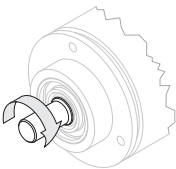

Principle of the serial data transmission [gray code (25 bits), RS 422 / RS 485 standard]

f   > 40 kHz
T   Length of the clock signal period (= 1/clock frequency)
T_p Clock pulse space,
         between the clock sequences T_P At least 25 µs

Direction of rotation

The encoder can output increasing position values on the clockwise or counter clockwise rotation of the shaft. The direction of rotation can be selected by using the CW/CCW input (counting direction).

Position values on the clockwise rotation of the shaft

Standard:
GND on CW/CCW
or not connected: Increasing pos. ↑

Inverse:
V_S on CW/CCW: Reducing pos. ↓

Cable length

With the synchronous serial interface protocol the transmission rate allowed drops with increasing cable length. A screened, twisted pair cable is recommended for the signal cables (± CLOCK and ± DATA).

Cable length [m]	< 50	< 100	< 200	< 400
Clock frequency [kHz]	< 400	< 300	< 200	< 100

PRESET function
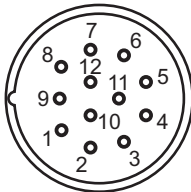
The output signals can be set to a PRESET value from any position value. As supplied the encoder is set to half the maximum resolution. The PRESET is set electronically if the supply voltage U_B is briefly t > 100 ms applied to the PRESET input (do NOT apply continuously). Other PRESET values are available upon request.
As an alternative there is a PRESET push-button recessed into the base of the housing (IP 67). The PRESET push-button can be operated using a pin (t > 100 ms).

P   PRESET push-button (IP67)
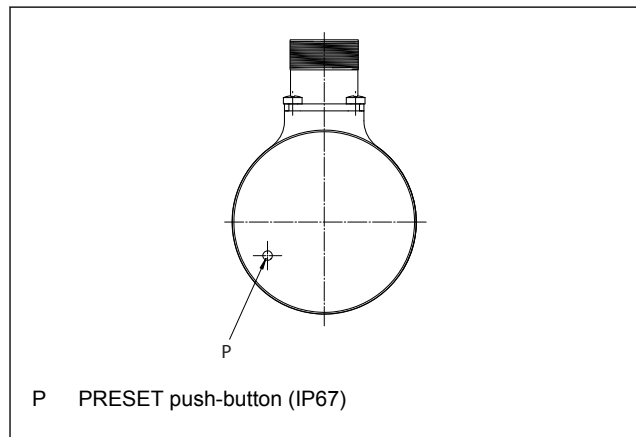
Pin layout – SSI (SD)

M23 connector, 12-pin		

Pin	Signal	Description
1	GND	Earth
2	DATA+	Output: Differential data signal in accordance with RS 485
3	CLOCK+	Input: Differential clock signal in accordance with RS 485
4 – 6	–	Not used
7	CW/CCW	Direction of rotation
8	U_B	Operating voltage
9	Preset	Electronic adjustment U_B, t > 100 ms
10	DATA–	Output: Differential data signal in accordance with RS 485
11	CLOCK–	Input: Differential clock signal in accordance with RS 485

Pin layout – cable gland with IP69K

Flying lead

Core colour	Signal	Description
blue	GND	Earth
brown	DATA+	Output: Differential data signal in accordance with RS 485
grey/pink	CLOCK+	Input: Differential clock signal in accordance with RS 485
grey	CW/CCW	Direction of rotation
red	U_B	Operating voltage
pink	Preset	Electronic adjustment U_B, t > 100 ms
white	DATA–	Output: Differential data signal in accordance with RS 485
red/blue	CLOCK–	Input: Differential clock signal in accordance with RS 485

Synchronous serial interface

Resolver

A resolver is integrated into the rotary encoder GEL 2035 SR. This supplies a redundant position signal within a turn.
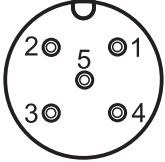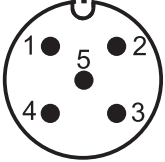
Resolver configuration

R1, R2   Primary (rotor)

S1 to S4   Secondary (stator)
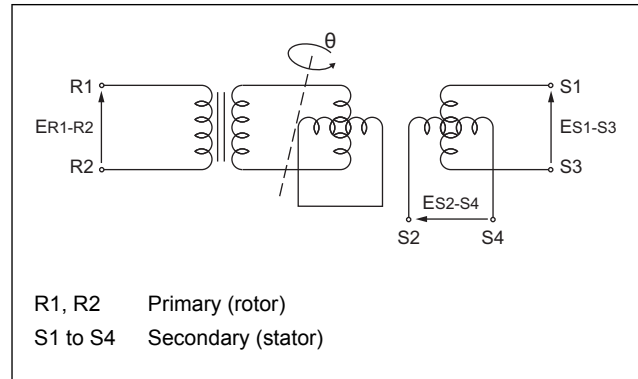
Technical data of resolver	
Input voltage	7 V rms
Primary	$E_{R1-R2}= E\sin \omega t$
Secondary	$E_{S1-S3}= KE_{R1-R2}\cos \Theta$, K = conversion ratio $E_{S2-S4}= KE_{R1-R2}\sin \Theta$
Input frequency	10 kHz (max. permissible deviation ± 5 %)
Conversion ratio	0.5 ± 5 %
Precision (measurement errors)	± 10'
Zero potential	max. 20 mV rms
Phase separation	Nominally 0°
Speed ripple	max. 1.5 % at 1,500 min^{-1}
Insulation resistance	100 M Ω at 500 V DC
Input current	max. 80 mA

Pin layout – synchronous serial interface with resolver (SR)

Connector M23, 17–pin

PIN	Signal	Description
1	R1	Resolver signal
2	R2	Resolver signal
3	S4	Resolver signal
4	S3	Resolver signal
5	CW/CCW	Direction of rotation
6–7	–	Not used
8	Clock-	Differential clock signal in accordance with RS 485
9	Data-	Differential data signal in accordance with RS 485
10	GND	Earth
11	U_B	Operating voltage,
12	PRESET	Electronic adjustment U_B, t > 100 ms
13	S2	Resolver signal
14	S1	Resolver signal
15	Clock+	Differential clock signal in accordance with RS 485
16	Data+	Differential data signal in accordance with RS 485
17	–	Not used

CANopen interface

Pin layout – CANopen

M12 connector

M 2 : 1

A-coded

Bus IN   Bus OUT

Pin/socket layout

Pin	Bus IN	Bus OUT
1	CAN_GND	CAN_GND
2	+V$_S$ IN	+V$_S$ OUT
3	GND	GND
4	CAN_H	CAN_H
5	CAN_L	CAN_L

Technical data CANopen

Device profile	CANopen DS406 with additional function
Cable diameter	8 mm
Programmable parameters	Resolution, PRESET, offset, counting direction, speed, acceleration and rotational speed output, range output referred to pre-defined values, scalable number of steps (decimal/binary)
Output code	Binary
Baud rate	50 kbit/s … 1 Mbit/s can be set via bus master
Sensor ID	0 … 99, can be set via bus master
Terminating resistor	To be provided externally
Operating temperature	-40 … +85 °C (shorttime 100 °C)

Type code

Type code GEL 2035

	Interface									
	SD SSI									
	SR SSI and resolver									
	CO CANopen									
		Code								
		B Binary code								
		G Gray code								
			Resolution per revolution							
			12 12 Bit, 4096 steps per revolution							
				Number of revolutions						
				00 Single turn						
				12 12 Bit, 4096 revolutions						
					Flange / Shaft					
					B Clamping flange D = 10 mm / L = 20 mm					
					E Semi hollow shaft D = 10 mm / L = 25 mm (only CANopen)					
					G Heavy-duty flange D = 10 mm / L = 20 mm					
					H Clamping flange D = 10 mm / L = 20 mm with tooth wheel adapter					
						Outlet				
						C Cable gland, radial (SSI with IP 69K)				
						B 5 pole connector plug M12 [1] + 5 pole connector socket M12[1], axial (für CANopen)				
						E 12-pole connector outlet[1], type M 23, radial (SSI)				
						F 17-pole connector outlet[1], type M 23, radial (only SSI+Resolver)				
							Connector / cable			
							B 1 m cable length			
							C 3 m cable length			
							D 5 m cable length			
							E 10 m cable length			
							S connector			
								IP		
								1 IP 65		
								4 IP 67 (with PRESET push button)		
								5 IP 69K (stainless steel housing, cable gland, withour PRESET push button)		
									Option	
									0 without option	
2035	_ _	_	_ _	_ _	_	_	_	_	_	_

Type code restrictions

SSI (interface: SD)

Feature	Possible variant
Number of revolutions	12
Flange/shaft	B, G, H
Outlet	R
Connector/cable	S

SSI and resolver (interface: SR)

Feature	Possible variant
Number of revolutions	12
Flange/shaft	B
Outlet	F
Connector/cable	S

CANopen (interface: CO)

Feature	Possible variant
Number of revolutions	00 (single turn only)
Flange/shaft	R
Outlet	B
Connector/cable	S

Protection class IP 69K (IP: 5)

Feature	Possible variant
Interface	SD
Number of revolutions	12
Flange/shaft	B
Outlet	C
Connector/cable	B, C, D, E

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[1] Mating connector not included in the scope of delivery

Torque support FB23504
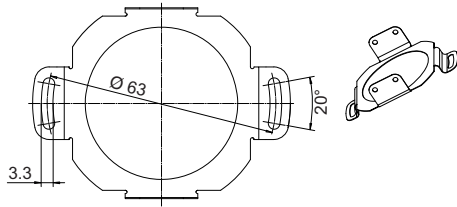
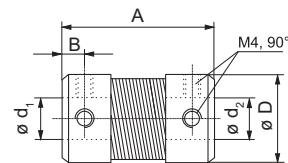**Torque support** FB23505
(standard with semi hollow shaft)
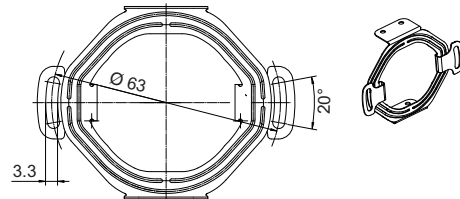
Bushing
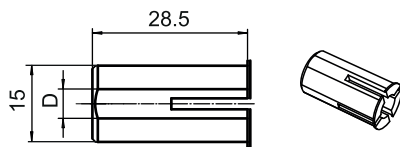
Order no.		D
POM	Brass	
RH 23501	RH 23504	8 mm
RH 23502	RH 23505	10 mm
RH 23503	RH 23506	12 mm

Metal coupling MK 8 / MK 12

MK 8   Material: X12CrNi18-8 (V2-A)
MK 12   Material: ST

	A	B	D	d_1[1]	d_2[1]	d_1 / d_2
MK 8	35	5	21	5 … 12	5 … 12	6/6; 8/8; 10/10;12/12
MK 12	50	7	26	6 … 15	6 … 15	12/12

Clamp coupling KK 14
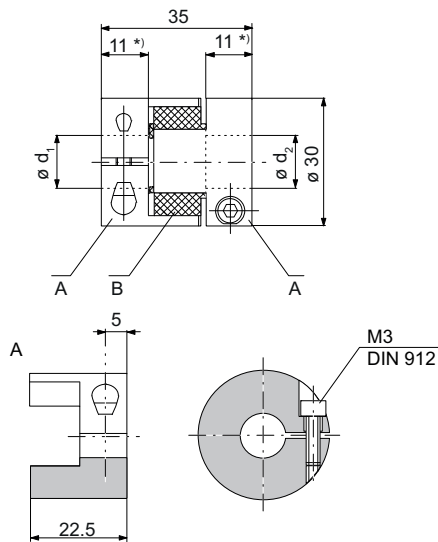
A   Coupling half
B   Involute annular gear

	d_1[1]	d_2[1]	d_1 / d_2
KK 14	6 … 16	6 … 16	6/6; 8/8; 10/10;12/12; 16/16

Clamping elements KL200
(3 pieces)

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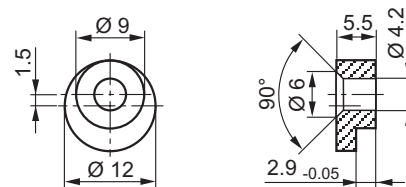
[1] Tolerance H7

Accessories

Ordering overview for mounting accessories

Description	Item number
Torque support, hard(*)	FB 23504
Torque support, soft(*)	FB 23505
Bushing, 8 mm, POM (polyoxymethylene)	RH 23501
Bushing, 10 mm, POM (polyoxymethylene)	RH 23502
Bushing, 12 mm, POM (polyoxymethylene)	RH 23503
Bushing, 8 mm, brass	RH 23504
Bushing, 10 mm, brass	RH 23505
Bushing, 12 mm, brass	RH 23506
Clamping elements (3 pieces)	KL 200
Metal coupling, inside diameter: 5 to 12 mm (state shaft diameter)	MK 8
Metal coupling, inside diameter: 6 to 15 mm (state shaft diameter)	MK 12
Clamp coupling KK14, inside diameter: 6 to 16 mm (state shaft diameter)	KK 14

(*) The GEL 2035 with semi hollow shaft is supplied as standard with a soft torque support FB 23505 mounted. If the alternative torque support FB 23504 is to be mounted, it must be stated on the order.

Ordering overview for connection accessories

Description	Item number
M23 mating connector, 12-pin straight	GG 126
M23 mating connector, 17-pin straight	FS 11311
CANopen mating connector, M12, 5-pin socket , A-coded	FS 3020
CANopen, mating connector, M12, 5-pin plug, A-coded	FS 3021
CANopen connection cable 10 m, 5-pin plug / flying lead with ferrules	BK 2100
CANopen connection cable 2 m, 5-pin plug / flying lead with ferrules	BK 2101
CANopen connection cable 10 m, 5-pin socket / flying lead with ferrules	BK 2102
CANopen connection cable 2 m, 5-pin plug / flying lead with ferrules	BK 2103
CANopen connecting cable 10 m, 5-pin socket/plug	BK 2104
CANopen connecting cable 10 m, 5-pin socket/plug	BK 2105
CANopen terminating resistor M12	FS 3040

Subject to technical modifications and typographical errors.
The latest version can be downloaded at **www.lenord.de**.