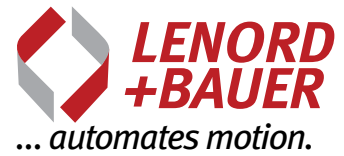


# Single turn absolute rotary encoder

## GEL 2351

with current or voltage interface



Technical information

Version 2014-11



### General

- ▶ Single turn absolute rotary encoder with a resolution of 16 bits
- ▶ Magneto-resistive scanning of a ferromagnetic steel disc provides unambiguous position values at every angular position via analogue interfaces
- ▶ Evaluation based on Vernier principle
- ▶ Available with stainless steel or aluminium housing
- ▶ Magnetic scanning is not subject to ageing and is resistant to temperature fluctuations, contamination or condensation

### Features

- ▶ 16 bit resolution
- ▶ High accuracy  $\pm 0,08^\circ$
- ▶ Analogue interface
  - Current output: 4 ... 20 mA
  - Voltage output: 0 ... 10 V
- ▶ Operating temperature  $-40^\circ\text{C}$  to  $105^\circ\text{C}$
- ▶ Protection class up to IP 67

### Advantages

- ▶ Suitable for all standard applications and also for real heavy-duty applications
- ▶ Full function in case of condensation:  
**dew-point resistant!**
- ▶ Extremely resilient housing made of anodised aluminium, stainless steel variant available
- ▶ Not affected by dirt or oil mist
- ▶ Withstands very high shock and vibration loads as well as acceleration forces
- ▶ Straightforward commissioning using PRESET or teach-in function

### Field of application

- ▶ Construction machines
- ▶ Agricultural machines
- ▶ Food industry
- ▶ Wind power
- ▶ Offshore technology

# Description

## Construction and design

The resilient encoder housing with a standard flange size of 58 mm is made of anodised aluminium and can be supplied alternatively in stainless steel. The housing is extremely compact and has a housing length of approx. 30 mm.

The device provides a high level of protection against vibration and humidity. For this purpose the electronics are encapsulated. With the shaft sealing ring option the protection class IP 67 is achieved.

The double-bearing encoder shaft forms a robust mechanical unit with the metal code disc.

A uniform temperature coefficient on all rotating components ensures the temperature behaviour of the absolute rotary encoder is stable over the long-term.

## Sensing principle

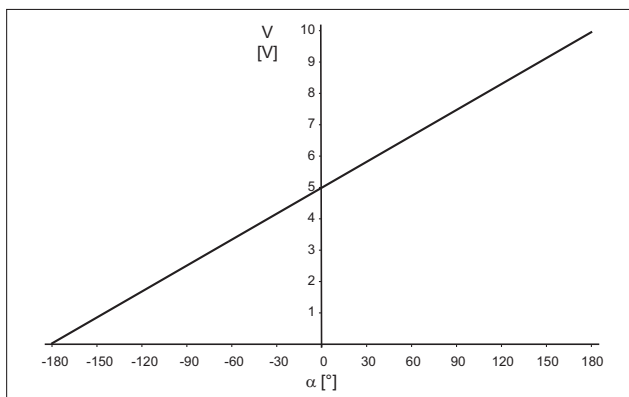
The GEL 2351 is based on contactless magnetic scanning of a ferromagnetic steel code disc, the so-called contour disc. Magnetoresistive (MR) sensors scan three tracks, delivering corresponding sinusoidal signals. The phase position of the three sinusoidal signals is unambiguous within a single turn. The phase position is evaluated on the Vernier principle, providing the absolute position with high resolution and accuracy.

Even if the rotary encoder moves in the de-energised state, the current position value is detected immediately after power is switched on.

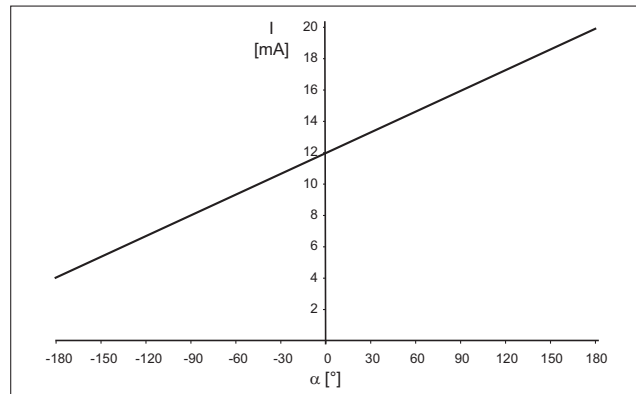
## Interfaces

The single turn absolute rotary encoders in the GEL 2351 series provide unambiguous angular position values via an analogue interface.

A voltage interface from 0 to 10 V DC and a current interface with an output range from 4 to 20 mA are available. By using highly accurate converter blocks the high resolution of the contour disc can also be provided on the analogue interface.



Voltage output signal 0 to 10 V DC



Current output signal 4 to 20 mA

The measuring range, position of the zero point (PRESET) and direction of rotation of the absolute rotary encoder can be adjusted (see → [page 5](#)).

## 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 105 °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<sup>-1</sup> 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.

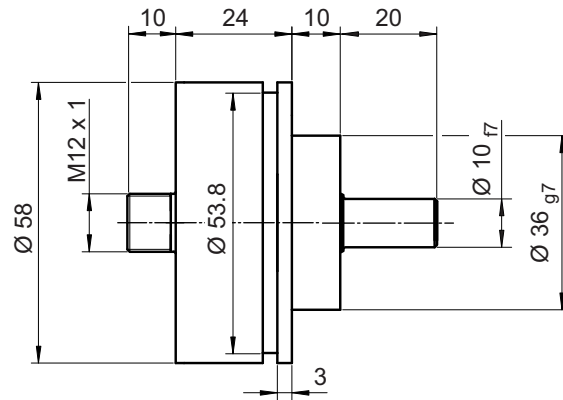
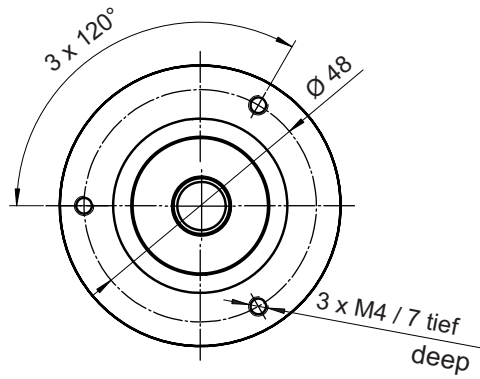
# Technical data

	GEL 2351A	GEL 2351C
General		
Repeatability	< 0,01°	
Accuracy	± 0,08°	
Electrical data		
Operating voltage V <sub>S</sub>	15 to 30 V DC with reverse voltage protection	
Power consumption	< 1 W (without load)	
Output load R <sub>L</sub>	≥ 1 kΩ	≤ (V <sub>S</sub> – 4 V) / 20 mA
Resolution single turn	16 Bit (0.153 mV)	16 Bit (0.244 µA)
Analogue Interfaces	0 to 10 V	0 to 20 mA
Linearity	± 2,44 mV	± 4,8 µA
Temperature drift	Typ. ± 0,34 mV/K	Typ. ± 24µA/K
Offset	Max. ± 9 mV	Max. ± 24µA
Mechanical Data		
Moment of inertia of rotor	611.8 x 10 <sup>-6</sup> kgm <sup>2</sup>	
Material	anodised aluminium, stainless steel 1.4104	
Weight	aluminium: 250 g; stainless steel: 390 g	
Shaft load (radial/axial)	at 1000 min <sup>-1</sup> = 90 N / 70 N,	
Operating speed (limit value)	6,000 min <sup>-1</sup>	
Operating torque	< 3 Ncm	
Bearing life	10 <sup>5</sup> h at 1,000 min <sup>-1</sup>	
Shaft sealing ring (optional)	Material: Viton, protection class IP 67	
Ambient data		
Working temperature range	-40 °C to 80 °C	
Operating temperature range	-40 °C to 105 °C	
Storage temperature range	-40 °C to 85 °C	
Protection	IP 64, IP 67	
Vibration protection (DIN EN 60068-2-6)	200 m/s <sup>2</sup> , 10 to 2000 Hz	
Shock protection (DIN EN 60068-2-27)	2000 m/s <sup>2</sup> , 11 ms	
EMC	EN 61000-6-1 to 4	
Insulation strength (DIN EN 60439-1)	Ri > 1 MΩ, at a testing voltage of 500 V AC	
Relative humidity of air max.	99 %	
Condensation	permissible, according to DIN EN 60068-2-30 Part 2 of 1999	

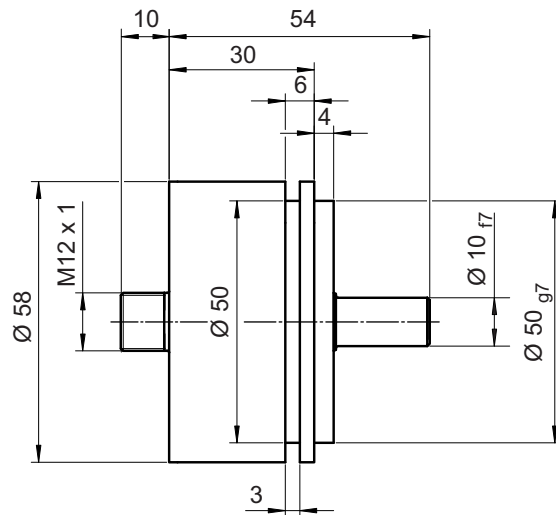
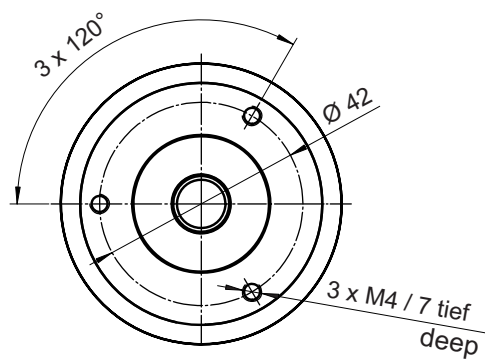
# Dimensional drawings

## Dimensional drawing GEL 2351

### Clamping flange



### Synchro flange



All dimensions stated in mm

## 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

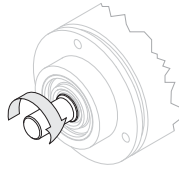
Standard:

GND on CW/CCW

or not connected: Increasing pos. ↑

Inverse:

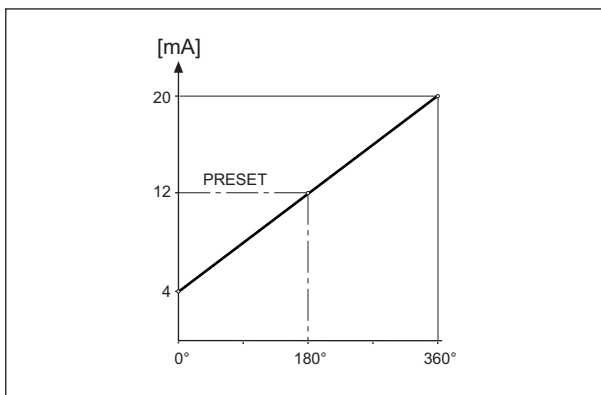
$V_S$  on CW/CCW: Reducing pos. ↓



## PRESET function

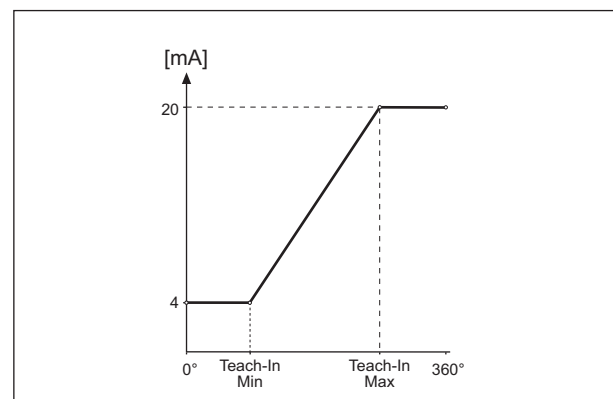
With the aid of the PRESET function the measuring range can be adapted to suit the application and the zero point adjusted.

By applying  $V_S$  for more than 100 ms the middle of the measuring range is set to the actual position of the rotary encoder. This value is saved in the rotary encoder in non-volatile memory. During commissioning the PRESET function should be used for optimal adjustment of the measuring range.



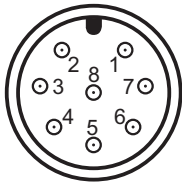
## Teach-in function

The teach-in function is an optional commissioning function of the GEL 2351 with current output. Using this function the operating range of the absolute rotary encoder can be restricted to the required range to obtain the full resolution and accuracy in this range. For this purpose the minimum value (Teach-In Min) and the maximum value (Teach-In Max) must be defined. Outside this range the related end value for the measuring range is output. To define the signal, a high signal is applied to the related signal inputs for at least 100 ms on reaching the Teach-In Min and Teach-In Max positions. The range defined is saved in the absolute rotary encoder in non-volatile memory.



# Pin layout

## Pin assignment

	Pin	Signal	Explanation
Plug M12, 8-pin    View on the connection side	1	GND	Earth
	2	Preset <sup>(1)</sup>	Electronic adjustment $U_B$ , $t > 100$ ms Set measuring range zero point or centre
	3	T_Low <sup>(2)</sup>	Teach-In Min: lower measuring range limit
	4	T_High <sup>(2)</sup>	Teach-In Max: upper measuring range limit
	5	AOUT	Analogue output (current/voltage)
	6	GND A	Analogue output earth
	7	$U_B$	Operating voltage
	8	CW/CCW	Direction of rotation: Default = GND; Inverse = $V_S$

Unused inputs must be connected to GND.

<sup>(1)</sup> Only on absolute rotary encoders without teach-in

<sup>(2)</sup> Only on absolute rotary encoder with teach-in function

# Type code GEL 2351

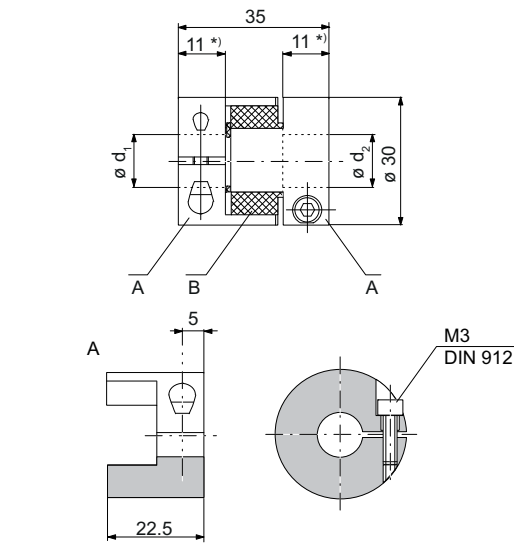
2351	<b>Output</b>						
	<b>A</b> Voltage output 0 to 10 V						
	<b>C</b> Current output 4 to 20 mA						
	<b>Programming</b>						
	<b>0</b> None						
	<b>T</b> Teach-In function (current output only)						
	<b>Measuring range</b>						
	<b>360</b> 360°						
	<b>Flange, shaft</b>						
	<b>B</b> Clamping flange, D = 10 / L = 20 mm						
	<b>D</b> Synchro flange, D = 10 / L = 20 mm						
	<b>Electrical interface</b>						
	<b>1</b> M12 connector, 8-pole, axial						
	<b>Material</b>						
	<b>1</b> Aluminum						
	<b>2</b> Stainless steel 1.4104						
	<b>Option</b>						
	<b>0</b> None						
	<b>1</b> Shaft sealing						

## Customer-specific designs

Customer-specific modifications to mechanical and electrical features are in principle possible.

# Accessories

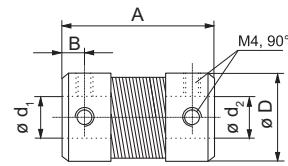
## Clamp coupling KK 14



- 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

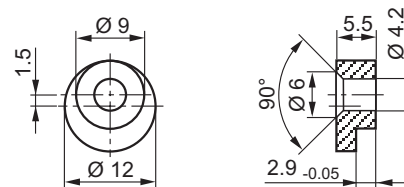
## Metal coupling MK 8 / MK 12



- 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

## Clamping elements KL200 (3 pieces)



## Ordering overview for mounting accessories

Description	Item number
Metal coupling MK 8, inside diameter: 5 to 12 mm (state shaft diameter)	MK 8
Metal coupling MK 12, 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
Clamping elements (3 pieces)	KL 200
8-pin M12 mating connector for analogue interface	FS 1352
Connection cable 10 m, 8-pin M12 socket, angled / flying lead	FS 1095

(1) Tolerance H7