

# Incremental rotary encoder

## GEL 207 / 208 / 209 / 219

for extreme applications



Rotary encoder for shaft load up to 200 N  
Clamping flange GEL 208 or synchro flange GEL 207



Rotary encoder for shaft load up to 500 N  
Bearing pedestal GEL 209 or square flange GEL 219

### General

- ▶ High-resolution magnetic-incremental rotary encoder with robust mechanical design.
- ▶ Technology proven worldwide in a very wide range of applications, suitable for the harshest industrial environments.
- ▶ All types available with radial and axial connector or cable outlet.
- ▶ High reliability and a long service life characterise the magnetic-incremental rotary encoders.

For extreme applications

GEL 207 with synchro flange, range of shaft diameters and lengths

GEL 208 with clamping flange, range of shaft diameters and lengths

For shaft load up to 500 N

GEL 209 with bearing pedestal, shaft diameter 16 mm with Woodruff key in accordance with DIN 6888

GEL 219 with square flange, shaft diameter 16 mm with Woodruff key in accordance with DIN 6888

### Features

- ▶ High resolution up to 136192 pulses per turn
- ▶ Reference signal
- ▶ High shaft load up to 500 N (GEL 209 and 219)
- ▶ Cable or plug outlet, axial or radial
- ▶ Various shaft diameters from 6 mm to 16 mm
- ▶ High electromagnetic compatibility

### Advantages

- ▶ Absolute reliability even in high atmospheric humidity (condensation) and frequent temperature changes
- ▶ Withstands high shock and vibration loads
- ▶ Not affected by dirt or oil mist
- ▶ Temperature behaviour stable over the long-term
- ▶ No ageing of the magnetic sensor technology

### Field of application

- ▶ Heavy industry
- ▶ Paper and packaging machines
- ▶ Transport and storage systems
- ▶ Machines for processing steel, wood, stone, plastics etc.
- ▶ Bottling plants

# Description

## Construction and design

The magnetic-incremental rotary encoders in the series GEL 207, GEL 208, GEL 209 and GEL 219 are based on the contactless magnetic scanning of a target wheel integrated into the encoder. The robust steel housing with a diameter of 58 mm is electrogalvanised and black chromatised. The rotary encoders are available with a radial or axial connector or cable outlet.

The maximum angular acceleration is extremely high, as the encoder shaft and the target wheel have interlocking shapes and are pressed together to form a mechanical unit. The encoder shaft should be connected to the drive shaft via a flexible coupling so that the permissible shaft load is not exceeded.

Optionally the rotary encoders can be equipped with a condensed water outlet or additional protection for the electronics against humidity and vibration for operation in a harsh environment.

A wide range of accessories is available for connecting the rotary encoder.

## Sensing principle

The differential, magnetic field-dependent sensors contactlessly scan the tooth structure on the target wheel and output a sine and a cosine voltage. The integrated evaluation electronics in ASIC and SMD technology convert the analogue sensor signals into incremental output signals.

Square-wave signals are output with various signal patterns that allow the unambiguous detection of the direction of rotation and ensure high data reliability. In addition it is possible to output a reference pulse.

## Pulse numbers available

The incremental encoders in the series GEL 207, 208, 209 and 219 are high-resolution rotary encoders with pulse numbers from 10 to 136,192 pulses per turn. The following standard pulse numbers are available:

50	60	90	100	120
125	180	200	250	256
300	360	400	500	512
600	720	750	800	900
1000	1024	1200	1250	1500
1800	2000	2048	2500	3000
3600	4000	4096	5000	6000
7000	7200	8000	8192	9000
10000	12000	12500	15000	16384
18000	20000	25000	30000	32768
36000	40000	50000	60000	65536
131072				

Other pulse numbers can be checked on the Internet at [www.lenord.com](http://www.lenord.com) or are available upon request.

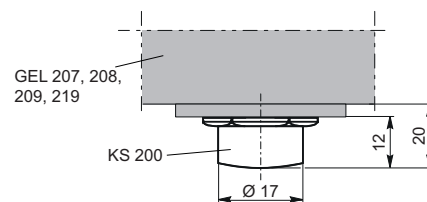
## Additional protection measures

### Moisture protection

The encoder electronics is coated with a highly effective protection against humidity, salt-water atmosphere and corrosive vapours. During years, proper functioning even in harsh environments is ensured.

### Condensate outlet

By multiple dewing condensed water may gather in the encoder housing. This water can drain through the condensate outlet. When mounting the encoder make sure that the outlet points down. The protection class drops to IP 64.



The position of the condensate outlet must be specified upon the order.

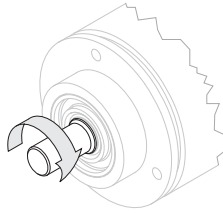
### Vibration protection

The additional fixing of mechanical parts with special plastic prevents the electronics and the connections inside the encoder from vibrating. Thus, the proper and continuous operation of the encoder even under extreme vibration and shock loading is guaranteed.

# Output signals

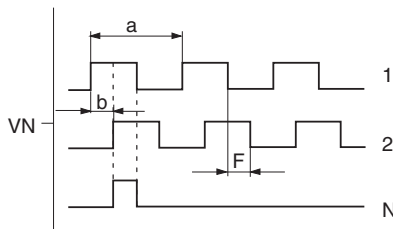
## Signal pattern

The signal patterns are shown for clockwise rotation, this means the shaft is rotating clockwise on looking at the encoder shaft.



## Signal pattern V, VN

Signal pattern "V" has two tracks with square-wave signals offset by 90°. On the third track N a reference signal of defined length is output once per turn. Reference signals with other lengths are available upon request.



- a 360° electrical
- b 90° phase offset
- F Time between edges (at an output frequency of 200 kHz the time between the edges is  $F > 0.6 \mu\text{s}$ )

	$U_B^{(1)}$	$U_{out}^{(2)}$
V, VN	10 to 30 V DC	HTL

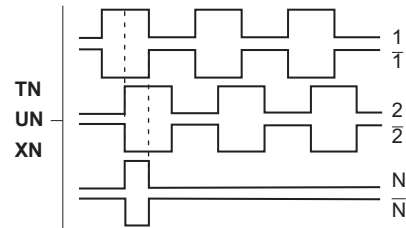
## Maximum cable lengths

Signal pattern		with an output frequency f of						
		5	10	20	50	100	200	[kHz]
T, TN, U, UN	TTL ( $U_B = 5 \text{ V}$ ) <sup>(3)</sup>	200	200	200	200	145	72	[m]
V, VN	HTL (at $U_B = 20 \text{ V}$ )	200	200	200	80	40	20	[m]
X, XN	HTL (at $U_B = 20 \text{ V}$ )	200	200	100	40	20	10	[m]

The information represents standard values and relates to cables of type LIYCY 6 (10) × 0.25 mm<sup>2</sup> between the rotary encoder and downstream electronics.

## Signal pattern T, TN, U, UN, X, XN

The two pulse outputs and the reference signal are also output as inverse signals.



	$U_B^{(1)}$	$U_{out}^{(2)}$
T, TN	+ 5 V DC ± 5 %	TTL
U, UN	10 to 30 V DC	TTL
X, XN	10 to 30 V DC	HTL

## Output signal level

The signal patterns V, VN, X and XN have HTL levels, the signal patterns T, TN, U and UN have TTL levels. All outputs have a push-pull power amplifier and are sustained short circuit-proof.

The peak output current for discharging the cable capacitance is 100 mA.

(1) Operating voltage  
 (2) Signal voltage  
 (3) The lengths stated apply on the usage of a power supply unit with sense regulation.

# Technical data

The electrical data will vary depending on the signal pattern selected. The mechanical data are defined by the encoder type and are listed separately.

	T, TN	U, UN	V, VN	X, XN
<b>General</b>				
Resolution (pulses per revolution)	10 to 136,192			
Measuring range	36° to 0.003°			
Error limit	0.14°			
<b>Electrical data</b>				
Supply voltage $V_S$	5 V DC $\pm$ 5%	10 to 30 V DC		
Power consumption	$\leq$ 1.0 W	$\leq$ 1.3 W		
Output frequency max.	0 to 200 kHz			
Logic level	TTL		HTL	
Output level high	$\geq V_S - 1.00$ V at $I = 10$ mA; $\geq V_S - 1.20$ V at $I = 30$ mA	$\geq 4.00$ V at $I = 10$ mA; $\geq 3.85$ V at $I = 30$ mA	$\geq V_S - 1.80$ V at $I = 10$ mA; $\geq V_S - 2.20$ V at $I = 30$ mA	
Output level low	$\leq 0.75$ V at $I = 10$ mA; $\leq 1.00$ V at $I = 30$ mA		$\leq 1.15$ V at $I = 10$ mA; $\leq 1.55$ V at $I = 30$ mA	
<b>Ambient data</b>				
Working temperature range	0 °C to +70 °C (standard) -20 °C to +85 °C (option)			
Operating temperature range	-20 °C to +85 °C			
Storage temperature range	-40 °C to +105 °C			
Protection class (EN 60529)	IP 65			
Vibration protection (DIN EN 60068-2-6)	100 m/s <sup>2</sup> , 10 to 2000 Hz			
Shock protection (DIN EN 60068-2-27)	1000 m/s <sup>2</sup> , 11 ms			
Electromagnetic compatibility (EMC)	EN 61000-6-1 to 4			
Insulation strength (DIN EN 60439-1)	$R_i > 1$ M $\Omega$ at 500 V AC testing voltage			

<b>Mechanical data of GEL 207 and GEL 208</b>	
Shaft diameter	see type code
Weight	500 g
Max. operating speed (r.p.m.)	1,000 min <sup>-1</sup>
Moment of inertia of rotor	$7 \times 10^{-5}$ kgm <sup>2</sup>
Operating torque	0,03 Nm (< 0.1 Nm <sup>(1)</sup> )
Starting torque	0.05 Nm (0.1 Nm <sup>(1)</sup> )
Permissible shaft load (point of application 15 mm in front of flange hub)	200 N axial, 200 N radial
Bearing life cycle at maximum shaft load at half shaft load	2,000 x 10 <sup>6</sup> revolutions 12,600 x 10 <sup>6</sup> revolutions

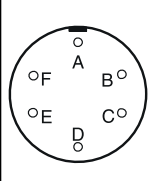
(1) with option ball bearing cover (IP 50)

# Technical data, pin layout

Mechanical data of GEL 209 and GEL 219	
Shaft diameter	16 mm
Weight	700 g
Max. operating speed (r.p.m.)	8,000 min <sup>-1</sup>
Moment of inertia of rotor	7 × 10 <sup>-5</sup> kgm <sup>2</sup>
Operating torque	0,03 Nm (< 0.1 Nm <sup>(1)</sup> )
Starting torque	0.05 Nm (0.1 Nm <sup>(1)</sup> )
Permissible shaft load (point of application 15 mm in front of flange hub)	400 N axial, 500 N radial
Bearing life cycle at maximum shaft load at half shaft load	840 × 10 <sup>6</sup> revolutions 6600 × 10 <sup>6</sup> revolutions

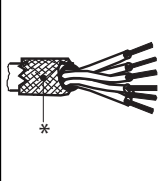
## Pin layout for signal pattern V, VN

### Plug outlet – option A or B

6-pin plug	Signal	Explanation
	F	U <sub>B</sub> Operating voltage
	A	GND Earth
	D	N Reference signal
	B	2 Track 2
	C	1 Track 1

Mating connector GG 66 included in the scope of supply.

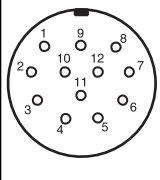
### Cable outlet – option F or G

6-core cable	Signal	Explanation
	yellow	U <sub>B</sub> Operating voltage
	green	GND Earth
	grey	N Reference signal
	white	2 Track 2
	brown	1 Track 1

\* Screen not connected at the encoder end.

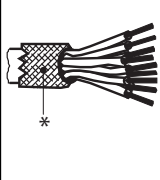
## Pin layout for signal pattern T, TN, U, UN, X, XN

### Plug outlet – option C or D

12-pin plug	Signal	Explanation
	12	U <sub>B</sub> Operating voltage
	10	GND Earth
	3	N Reference signal
	4	/N Reference signal, inverted
	8	2 Track 2
	1	/2 Track 2, inverted
	5	1 Track 1
	6	/1 Track 1, inverted

Mating connector GG 126 included in the scope of supply.

### Cable outlet – option H or I

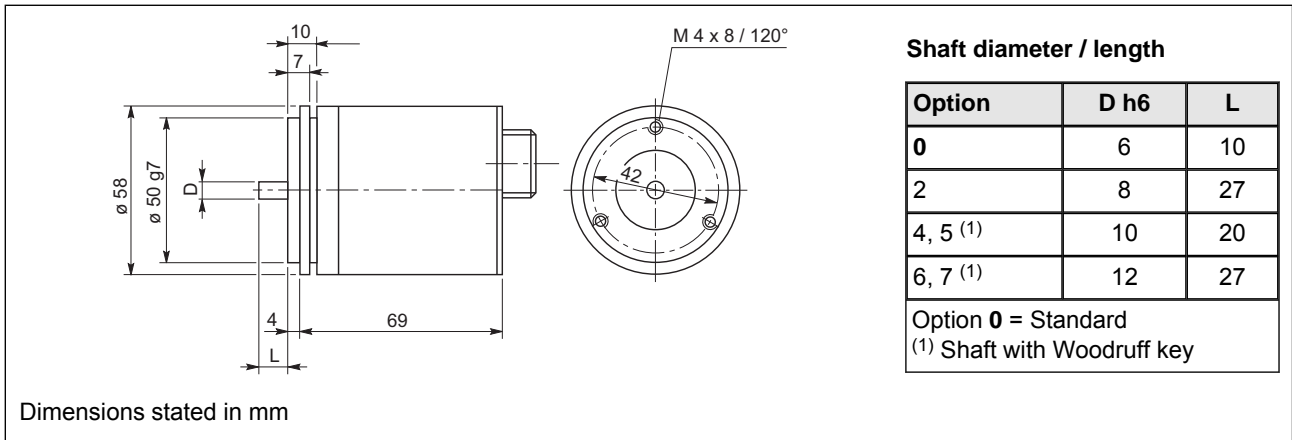
10-core cable	Signal	Explanation
	red	U <sub>B</sub> Operating voltage
	blue	GND Earth
	violet	N Reference signal
	yellow	/N Reference signal, inverted
	pink	2 Track 2
	black	/2 Track 2, inverted
	white	1 Track 1
	brown	/1 Track 1, inverted

\* Screen not connected at the encoder end.

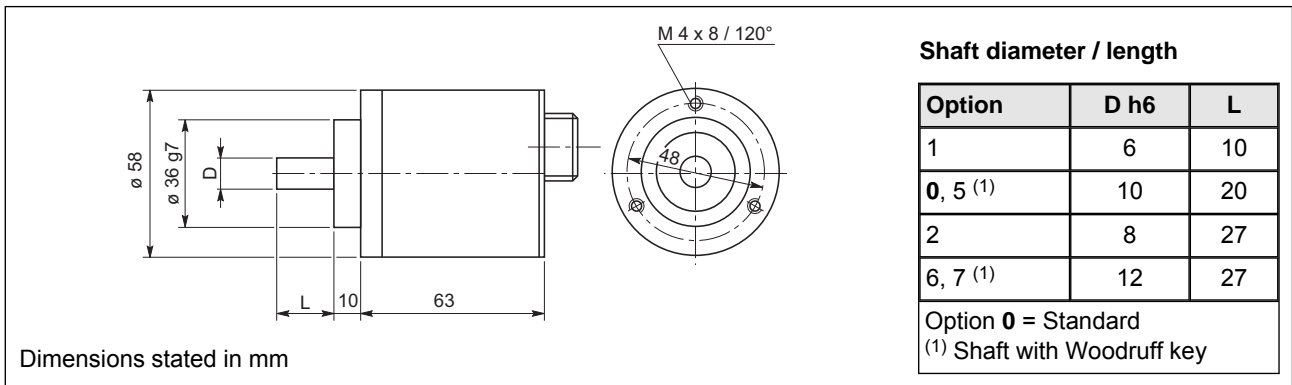
(1) with option ball bearing cover (IP 50)

# Dimensional drawings

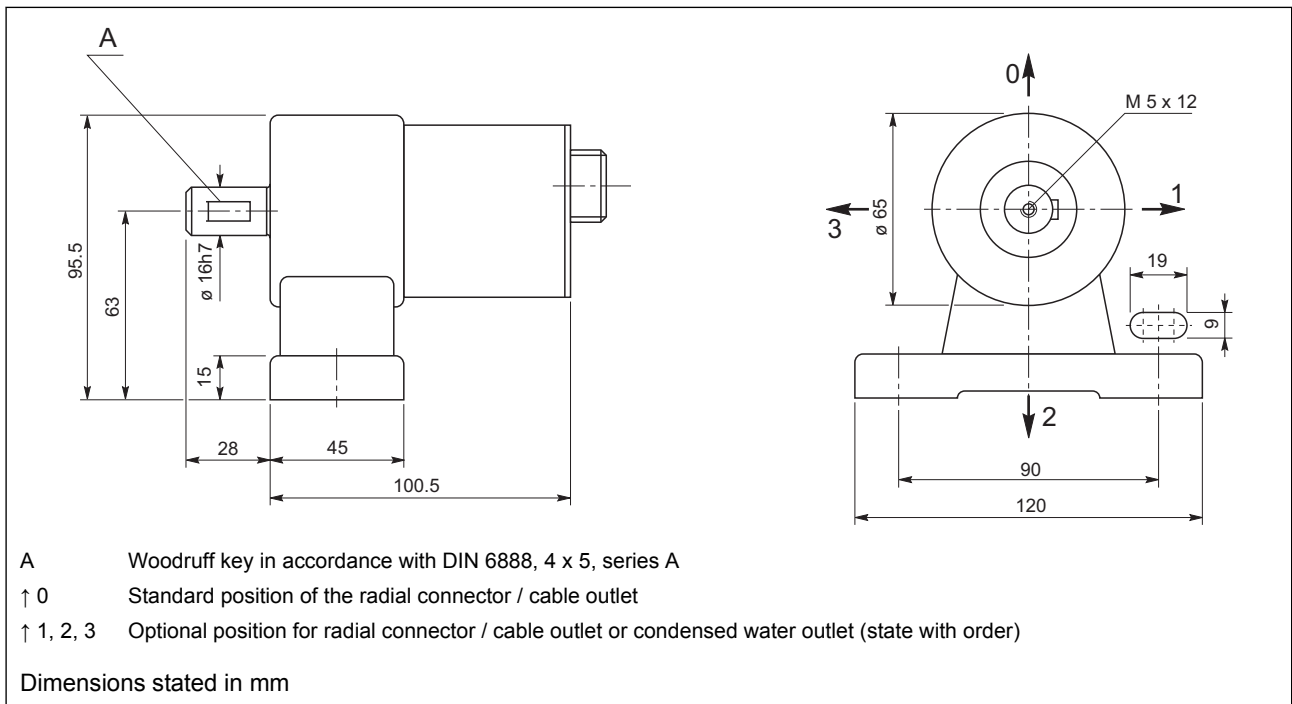
**Dimensional drawing GEL 207 – rotary encoder with synchro flange, plug outlet axial**



**Dimensional drawing GEL 208 – rotary encoder with clamping flange, plug outlet axial**

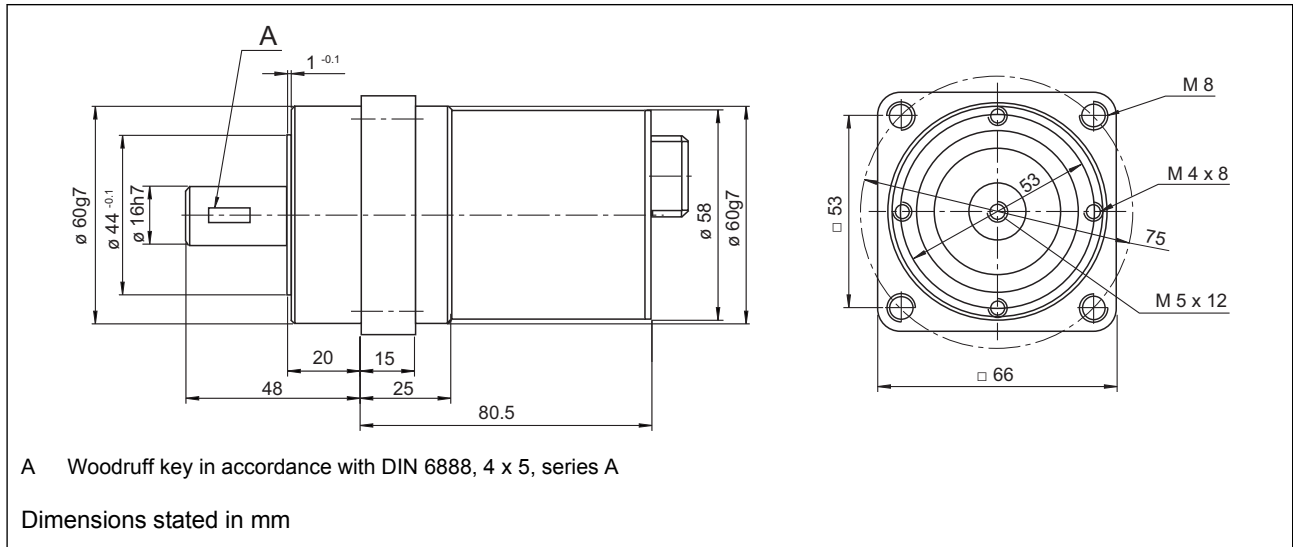


**Dimensional drawing GEL 209 – rotary encoder with bearing pedestal, plug outlet axial**

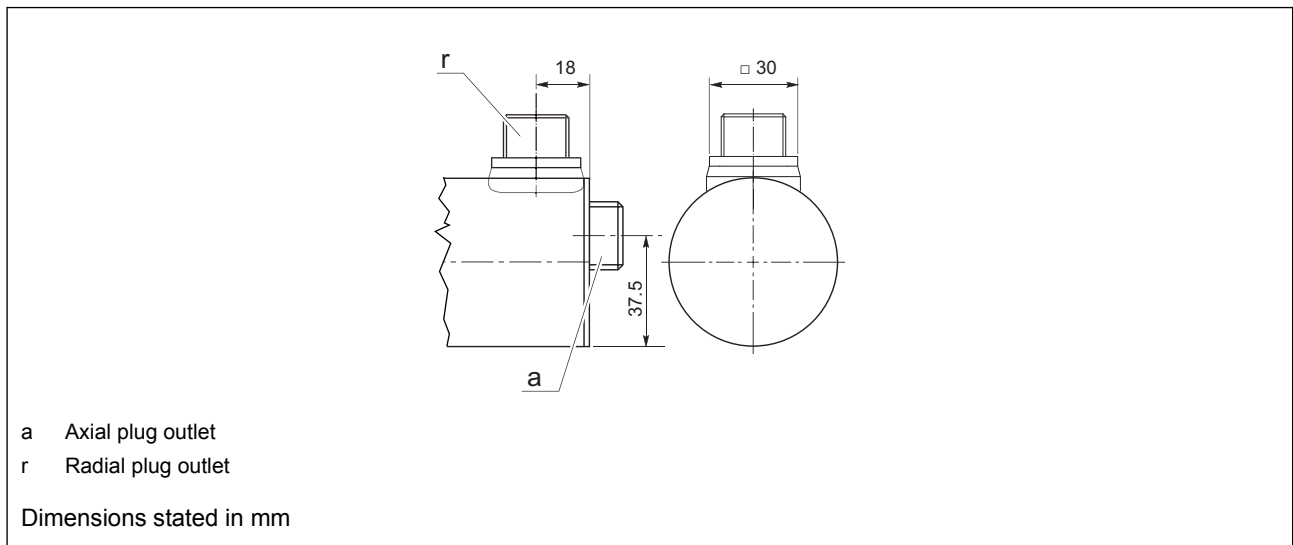


# Dimensional drawings

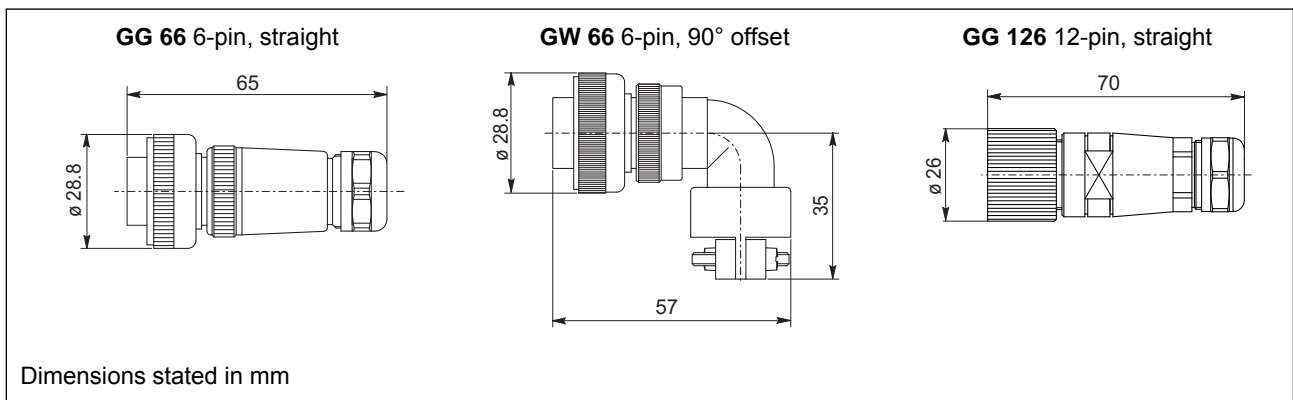
## Dimensional drawing GEL 219 – rotary encoder with square flange, plug outlet axial



## Dimensional drawing plug outlet axial or radial



## Dimensional drawings mating connector



# Type code

## Type code GEL 207 / 208 / 209 / 219

<b>2</b>	<b>Type</b>
	<b>07</b> with synchroflange
	<b>08</b> with clamping flange
	<b>09</b> with bearing pedestal for shaft load up to 500 N
	<b>19</b> with square flange for shaft load up to 500 N
	<b>Signal pattern</b>
	<b>T</b> 2 square-wave signals shifted by 90° and their inversed signals (TTL)
	<b>U</b> 2 square-wave signals shifted by 90° and their inversed signals (TTL)
	<b>V</b> 2 square-wave signals shifted by 90° (HTL)
	<b>X</b> 2 square-wave signals shifted by 90° and their inversed signals (HTL)
<b>Reference signal</b>	
- without	
<b>N</b> with reference signal	
<b>Pulse numbers per revolution</b>	
00010 ... 136192	
<b>Connector / cable outlet</b>	
<b>A</b> 6-pole connector, axial	
<b>B</b> 6-pole connector, radial	
<b>C</b> 12-pole connector, axial	
<b>D</b> 12-pole connector, radial	
<b>F</b> 6-core cable, axial	
<b>G</b> 6-core cable, radial	
<b>H</b> 10-core cable, axial	
<b>I</b> 10-core cable, radial	
<b>Shaft diameter and length</b>	
<b>0</b> Standard GEL 207: d = 6 mm, L = 10 mm GEL 208: d = 10 mm, L = 20 mm GEL 209/219: d = 16 mm, L = 28 mm	
<b>1</b> d = 6 mm, L = 10 mm (GEL 208 only)	
<b>2</b> d = 8 mm, L = 27 mm (GEL 207/208 only)	
<b>4</b> d = 10 mm, L = 20 mm (GEL 207 only)	
<b>5</b> d = 10 mm, L = 20 mm Woodruff key (GEL 207/208 only)	
<b>6</b> d = 12 mm, L = 27 mm (GEL 207/208 only)	
<b>7</b> d = 12 mm, L = 27 mm Woodruff key (GEL 207/208 only)	
<b>Protection of electronics</b>	
<b>0</b> no additional protection	
<b>1</b> moisture protection	
<b>2</b> vibration protection	
<b>3</b> moisture and vibration protection	
<b>4</b> moisture protection with condensate outlet	
<b>5</b> moisture and vibration protection with condensate outlet	
<b>Temperature range</b>	
<b>1</b> 0 °C to +70 °C	
<b>3</b> -20 °C to +85 °C	

### Ordering information

Standard cable length is 1 m. Please state other cable lengths with order.

Mating connectors GG 66 or GG 126 are included in the scope of supply, for optional GW 66 please state with order.

### Customer-specific designs

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

Subject to technical modifications and typographical errors.  
The latest version can be downloaded at [www.lenord.de](http://www.lenord.de).

