

# Magnetic incremental encoder

## GEL 260

for harsh industrial environments



GEL 260

### General information

- ▶ High-resolution magnetic incremental encoder with robust mechanical design.
- ▶ Worldwide proven technology in various applications, suitable for harsh industrial environments.
- ▶ Radial or axial plug or cable outlet available.
- ▶ Optionally with explosion-proof housing available, protection class IP 54 and ATEX certification.
- ▶ High reliability and long service life characterizes the magnetic incremental encoders.

### Features

- ▶ High resolution up to 273408 pulses per revolution
- ▶ Interpolation up to 1024-fold
- ▶ Additionally current output  
0 to 20 mA, 4 to 20 mA, -20 to + 20 mA
- ▶ Reference signal
- ▶ High electromagnetic compatibility (EMC)



GEL 260 EEx

### Advantages

- ▶ Absolute operational reliability even in case of high humidity (dewing) and frequent change of ambient temperature
- ▶ Withstands extreme impacts and vibration
- ▶ Resistant to dirt, humidity and oil
- ▶ No ageing of the magnetic sensor technology

### Fields of application

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

# Description

## Construction and design

The magnetic incremental encoder GEL 260 is based on contactless magnetic scanning of the integrated toothed measuring wheel. The resilient encoder housing with a flange size of 90 mm is available with axial or radial plug or cable outlet. The solid encoder shaft is mounted to the driving shaft via a flexible coupling. Diameter and lengths of the encoder shaft are selectable.

Optional designs include a condensate outlet or additional protection measures against moisture and vibration for harsh environmental conditions. Encoders with condensate drain must be mounted so that the condensate outlet points down.

For usage in areas with EEx risk, the GEL 260 is available with ATEX approval. The flameproof housing has a flange size of 115 mm. This variant meets protection class IP 54. Please note the changes in technical data and the restricted type code.

## Sensing principle

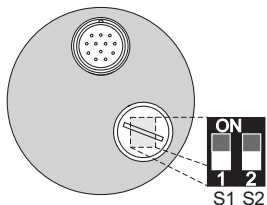
The rotary encoders GEL 260 work with differential, magnetic-field-dependent sensors and a precision target wheel. The sensors scan without contact the tooth structure of the target wheel and output a sine and cosine voltage. The integrated evaluation electronics converts the analog sensor signals into incremental output signals.

## Output signals

Rectangular signals are output with different signal patterns which provide a clear direction detection and a high data reliability. Additionally, an optional reference pulse can be supplied.

For display and control purposes, a measuring current of 0 to 20 mA, 4 to 20 mA or -20 to + 20 mA can be obtained from the pulse frequency. The current depends on the rotational speed and can be direction-dependent if necessary. Therefore the measuring pulses are integrated and converted into a speed dependent output current. There is a strictly linear interrelation between measuring current and pulse frequency (see current outputs).

The polarity of the current can be reversed by DIP switch S2, accessible from the rear-side. For encoders with signal pattern S, by reversing the measuring current the direction-dependent S-signal is also reversed. This can be undone by switching DIP switch S1.



*DIP switches behind screw cap on the rear side of the encoder*

## Possible pulse numbers

The GEL 260 is a high-resolution rotary encoder with pulse numbers of up to 273,408 pulses per revolution and is available in the following standard pulse numbers:

50	60	90	100	120
125	150	180	200	250
256	300	400	500	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	70000
80000	90000	100000	120000	125000
131072	262144			

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

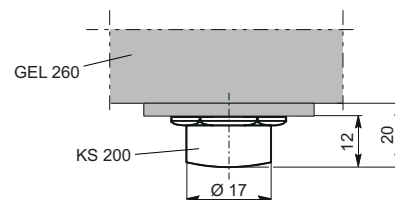
## Additional protection measures

### 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

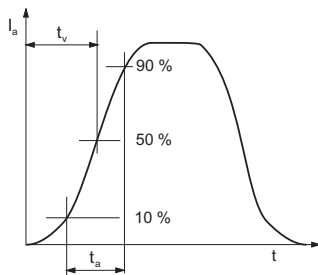
The additional fixing of mechanical parts with special plastic prevents the electronics and the connections inside the encoder from vibrating. Thus, the proper and continuous operation of the encoder even under extreme vibration and shock loading is guaranteed.

## Current output – options

- A:  Direction dependent measuring current  
nominal range: -20 to + 20 mA  
(reversible)
- B:  Direction independent measuring current  
nominal range: 0 to + 20 mA
- C:  Direction independent measuring current  
nominal range: +4 ... +20 mA.

## General information

Due to the high resolution (10 to 273,408 steps direction of rotation dependent pulses per revolution) a DC output current is obtained which shows a low harmonic content even at a very low speed range (e.g. 0 to 0.5 min<sup>-1</sup>). The harmonic content depends on the pulse frequency and the determined attenuation, latter influencing the rising and trailing edge times as well as the delay time in case of erratic changes of the speed.



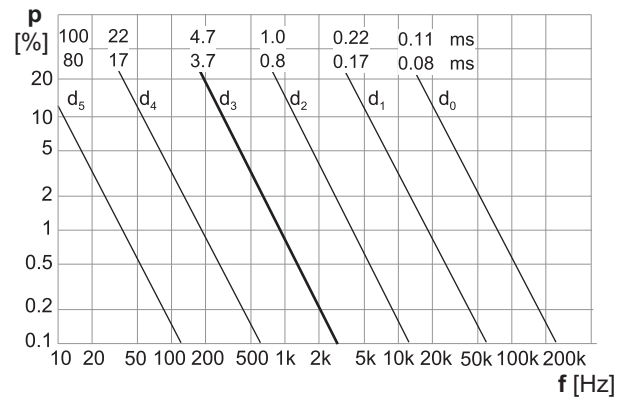
Rise time  $t_a$  and delay time  $t_v$  after a erratic change in speed

$I_a$  Output current

## Attenuation

The attenuation is adjusted according to the diagram below. The desired factory default setting must be specified in the order, default is set to  $d_3$ .

The speed for the maximum current of 20 mA, which was specified in the order is indicated on the ID-plate (eg, “4000 min<sup>-1</sup>”). The attenuation is factory set so that the harmonic content  $p$  at rated speed is  $\leq 1\%$ , it is also indicated on the ID-plate (eg 'd5').



Harmonic content of the output current as a function of the pulse frequency ( $f$ ) and the selectable attenuation ( $d_n$ )

- d attenuation
- f effective pulse frequency
- p harmonic content
- $t_a$  rise time
- $t_v$  delay time

## Technical data

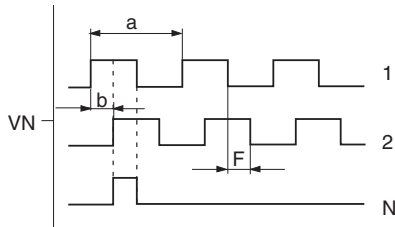
Current output		
Max. apparent ohmic resistance	$R_a$	550 $\Omega$
Measuring device class	K	1
Rated current tolerance		< 1 %
Linearity error		< 1 %
Repeatability	r	100 %
Temperature drift	$\Delta I_{aT}$	< $\pm 3 \mu A/1^\circ K$
Min. RPM (for attenuation $d_5$ )	$n_{min \text{ electrical}}$	$1,5 \times 10^3/i \text{ min}^{-1}$
Max. RPM	$n_{max \text{ electrical}}$	$6 \times 10^6/i \text{ min}^{-1}$

i = rated pulse number

# Output signals

## Signal pattern V, VN

The "V" signal pattern refers to 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.

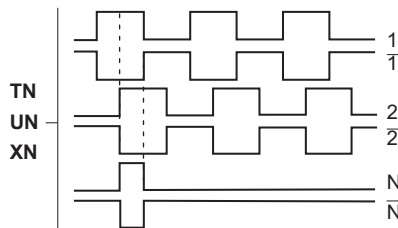


- a 360° electrical
- b 90° phase offset
- F Time between edges<sup>(1)</sup>

	$V_S^{(2)}$	$V_{out}^{(3)}$
<b>V, VN</b>	10 to 30 V DC	HTL

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

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



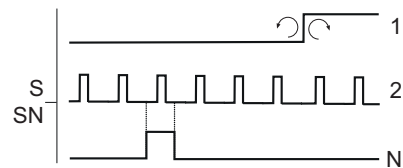
	$V_S^{(2)}$	$V_{out}^{(3)}$
<b>T, TN</b>	+ 5 V DC ± 5 %	TTL
<b>U, UN</b>	10 to 30 V DC	TTL
<b>X, XN</b>	10 to 30 V DC	HTL

## Signal pattern S, SN

Pulses independent of the direction of rotation and of constant duration are derived from the square-wave signals as per signal pattern V and output on the 2nd track. In addition, a signal dependent on the direction of rotation is obtained from the signal pattern (counting direction); it is output on the 1st track. On the third track N (option) a reference signal is output once per turn.

The pulses follow a possible change in the direction of rotation with a short delay so that any downstream counting circuit can be set to the counting direction prior to the pulse.

The signal dependent on the direction of rotation can be inverted using a switch accessible from the exterior (switch 1).



	$V_S^{(2)}$	$V_{out}^{(3)}$
<b>S, SN</b>	10 to 30 V DC	HTL

## Output signal level

The signal patterns S, SN, V, VN, X and XN have HTL levels, the signal patterns T, TN, U and UN have TTL levels (for output voltage see technical data). All outputs have a push-pull power amplifier and have sustained short circuit-protection.

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

## Maximum cable lengths

The following stated data for each signal pattern refer to cable type LiYCY 6 (10) × 0.25 mm<sup>2</sup> between encoder and subsequent electronics.

## Maximum cable lengths

Signal pattern		at output frequency f of						
		5	10	20	50	100	200	[kHz]
T, TN, U, UN	TTL ( $V_B = 5 V$ ) <sup>(4)</sup>	200	200	200	200	145	72	[m]
S, SN, V, VN	HTL (at $V_S = 20 V$ )	200	200	200	80	40	20	[m]
X, XN	HTL (at $V_S = 20 V$ )	200	200	100	40	20	10	[m]

(1) At an output frequency of 200 kHz the time between the edges is  $F > 0.6 \mu s$

(2) Supply voltage

(3) Signal voltage

(4) The given lengths are only valid for a power supply with Sense control.

# Technical data

Signal pattern	T, TN	U, UN	S, SN	V, VN	X, XN
<b>General</b>					
Resolution per revolution	10 to 273,408 steps				
Measuring range	36° to 0.0013°				
Error limit	0.07° <sup>(1)</sup>				
Incremental deviation	0.01° <sup>(1)</sup>				
Accuracy	0.005° <sup>(1)</sup>				
<b>Electrical data</b>					
Power supply	5 V DC ± 5%	10 to 30 V DC			
Power consumption	≤ 1,0 W ≤ 1,40 W <sup>(2)</sup>	≤ 1.3 W ≤ 1.65 W <sup>(2)</sup>			
Output frequency	0 to 200 kHz				
Logic level	TTL		HTL		
Output signal level high	≥ V <sub>S</sub> - 1.00 V at I = 10 mA; ≥ V <sub>S</sub> - 1.20 V at I = 30 mA	4.00 V at I = 10 mA; ≥ 3.85 V at I = 30 mA	≥ V <sub>S</sub> - 1.80 V at I = 10 mA; ≥ V <sub>S</sub> - 2.20 V at I = 30 mA		
Output signal level low	≤ 0.75 V at I = 10 mA; ≤ 1.00 V at I = 30 mA		≤ 1.15 V at I = 10 mA; ≤ 1.55 V at I = 30 mA		
<b>Mechanical data</b>					
Shaft diameter	6, 8, 10, 12 mm				
Housing diameter	90 mm <sup>(3)</sup>				
Weight	700 g <sup>(3)</sup>				
Maximum operating speed	10,000 min <sup>-1</sup> <sup>(4)</sup>				
Moment of inertia of rotor	7 x 10 <sup>-5</sup> kgm <sup>2</sup>				
Operating torque	3 Ncm (< 0.1 Nm <sup>(5)</sup> )				
Starting torque	0.05 Nm (0.1 Nm <sup>(5)</sup> )				
Permissible shaft load (point of impact 15 mm before contact surface of the flange)	200 N axial, 200 N radial				
Bearing life cycle at maximum shaft load at half shaft load	2000 x 10 <sup>6</sup> revolutions 12600 x 10 <sup>6</sup> revolutions				
<b>Ambient data</b>					
Working temperature range	0 ° C to +70 ° C <sup>(4)</sup> -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 <sup>(4)</sup> , IP 64 <sup>(6)</sup>				
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				
EMC	EN 61000-6-1 to 4				
Insulation strength (DIN EN 60439-1)	Ri > 1 MΩ at 500 V AC				

(1) Value at highest resolution, values for lower resolutions on request

(2) with current output

(3) Modified data for EEx variant (see separate table)

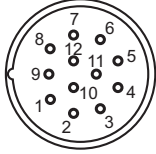
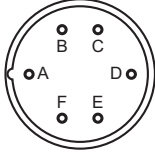
(4) Standard

(5) with ball bearing cover (IP 50)

(6) with condensate outlet

# Connection assignment

## Pin layout – plug outlet

Signal	with plug outlet type		Description
	C / D	A / B	
	12 pin 	6 pin 	
V <sub>S</sub>	12	F	Supply voltage
GND	10	A	Ground
1	5	C	Channel 1
/1	6	–	Channel 1, inverted
2	8	B	Channel 2
/2	1	–	Channel 2, inverted
N	3	D	Reference signal
/N	4	–	Reference signal, inverted
A/B/C	7	E	Current output
V <sub>sense+</sub>	2	–	+ Sense (U <sub>B</sub> ) <sup>(1)</sup>
V <sub>sense-</sub>	11	–	- Sense (GND)

## Connection assignment – cable outlet

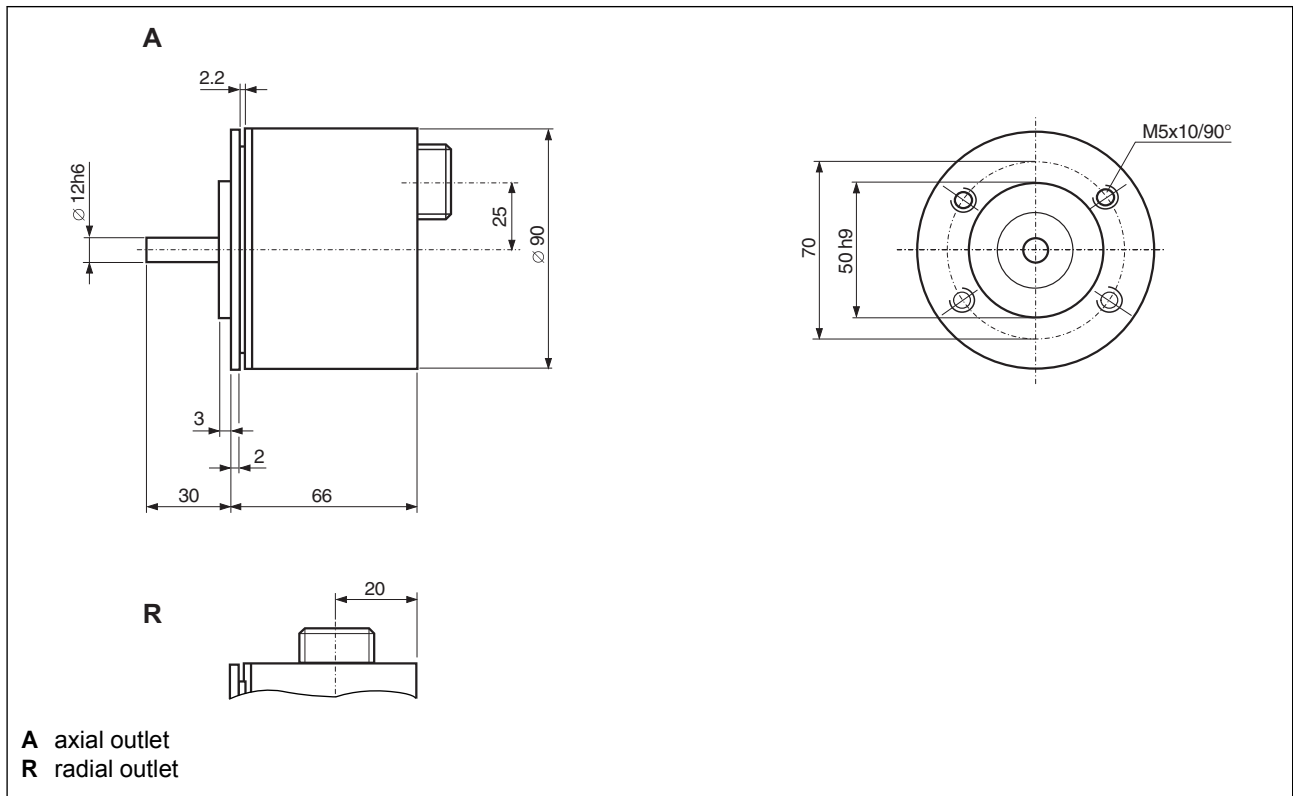
Signal	GEL 260 with outlet type		GEL 260 EEx with outlet type		Description
	F / G	H / I	E	K	
	6-core	10-core	7-core, numbered	12-core, numbered	
V <sub>S</sub>	yellow	red	6	6	Power supply
GND	green	blue	1	1	Ground
1	brown	white	3	3	Channel 1
/1	–	brown	–	8	Channel 1, inverted
2	white	pink	2	2	Channel 2
/2	–	black	–	7	Channel 2, inverted
N	grey	violet	4	4	Reference signal
/N	–	yellow	–	9	Reference signal, inverted
A/B/C	pink	grey	5	5	Current output
		green	7	10, 11, 12	not connected

Cable shield not connected to sensor.

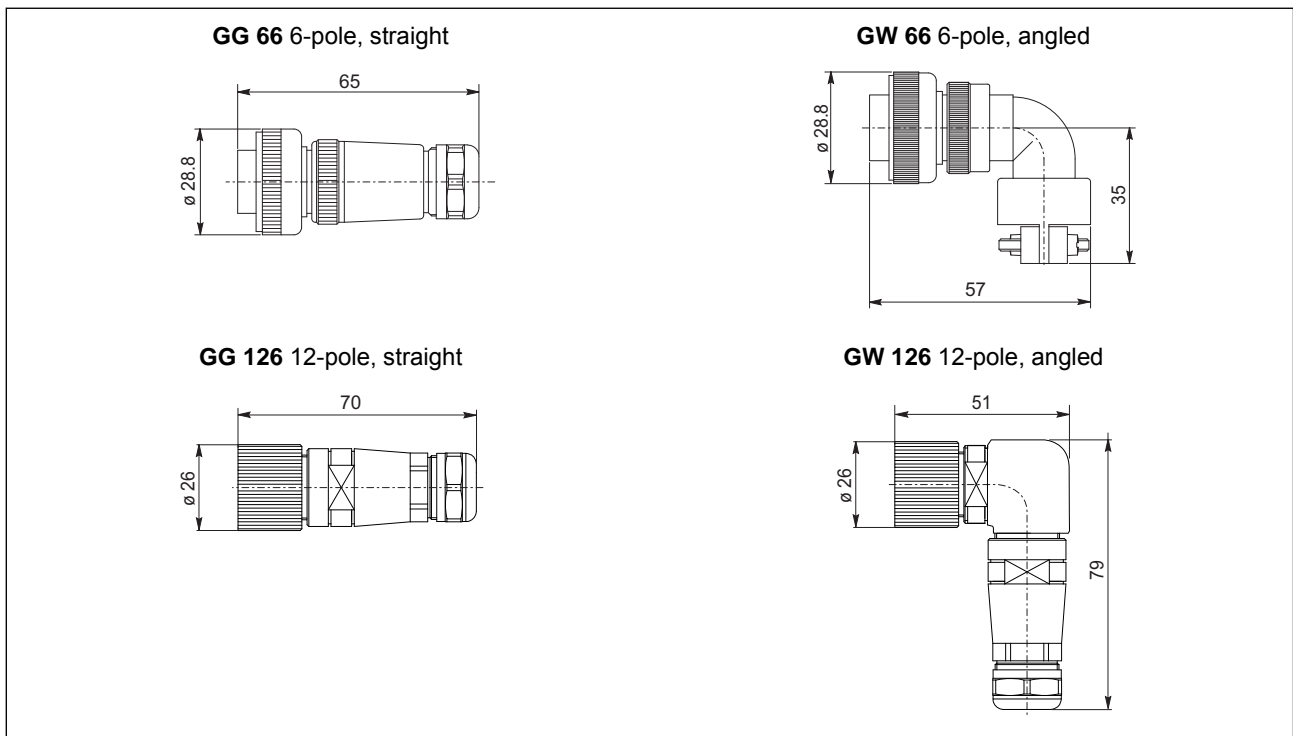
<sup>(1)</sup> If sense function is not used, use the free cores for the power supply, thus halving the voltage drop by the parallel connection.

# Dimensional drawing

## Dimensional drawing GEL 260



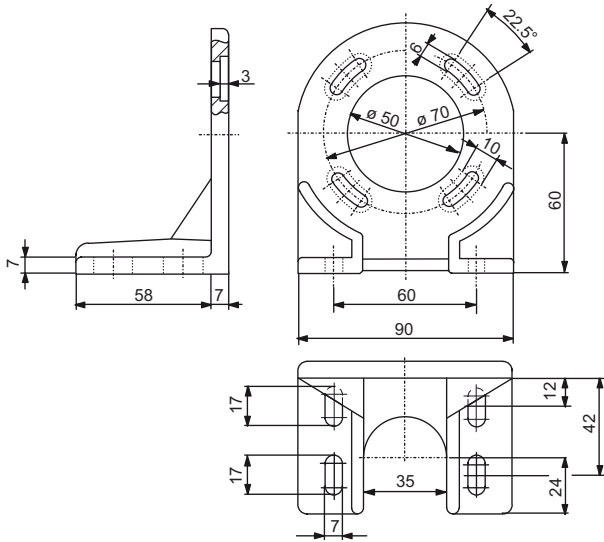
## Dimensional drawings – mating connectors



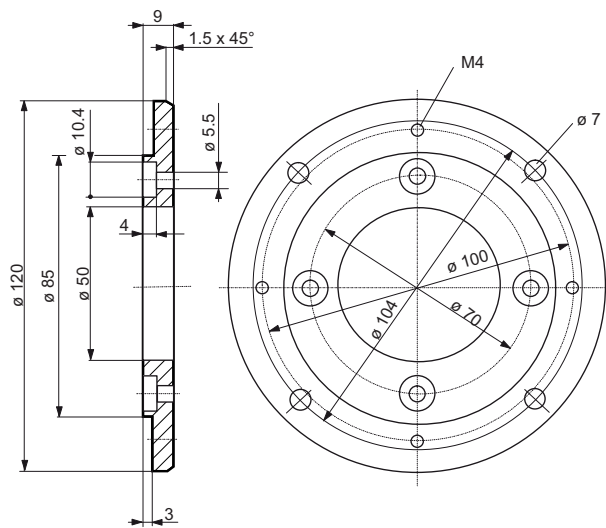
# Dimensional drawing

## Dimensional drawings – mounting accessories

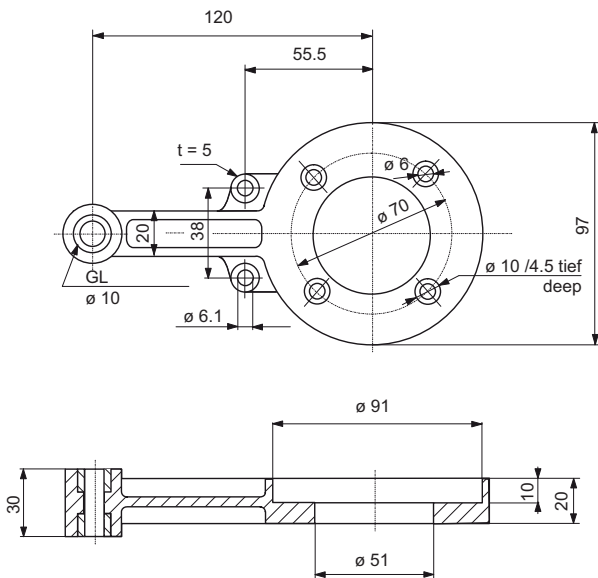
**Mounting bracket MW 92**



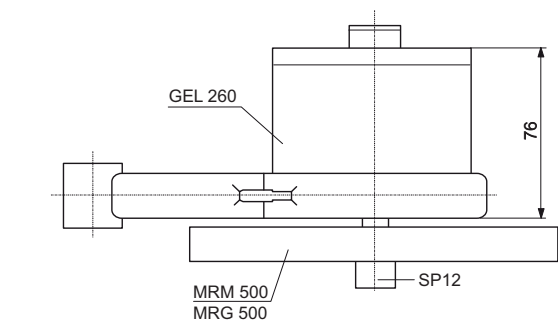
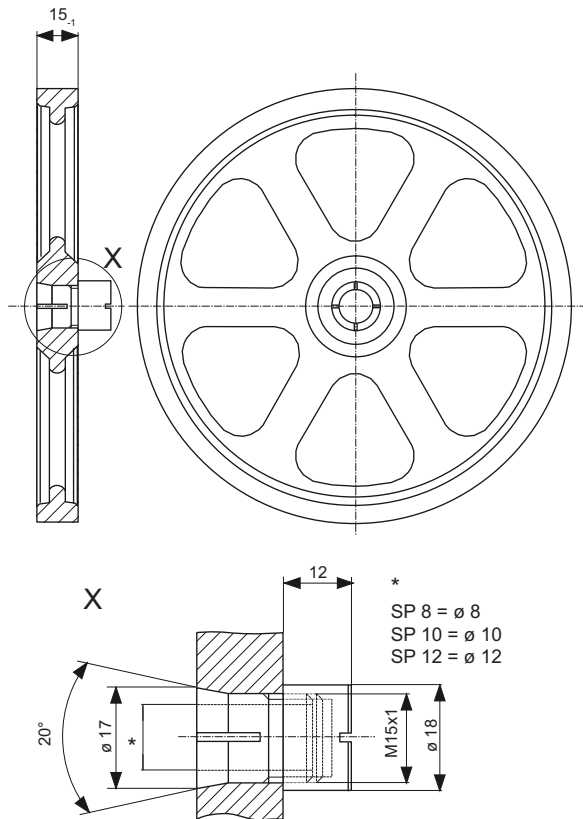
**Mounting flange MF 121**



**Measuring arm MA 262**



**Measuring wheel MRM 500 / MRG 500  
with collet chuck SP 8 / 10 / 12**



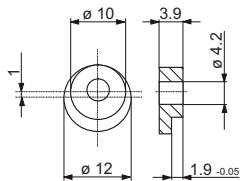
**MRG 500 Operating temperature (rubber)**  
 -30 ° ... +120 °C continuous  
 -40 ° ... +150 °C short term



# Dimensional drawing

## Dimensional drawings – mounting accessories

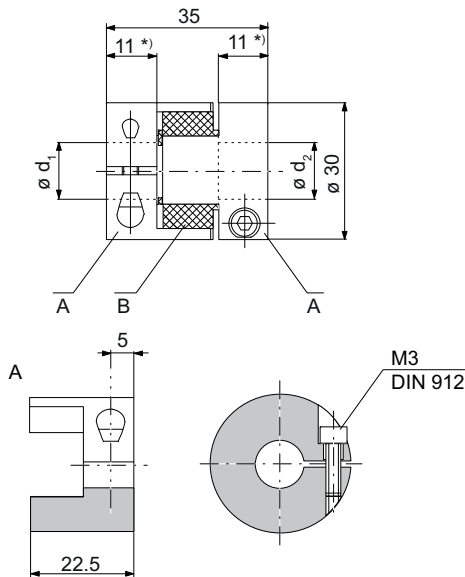
### Clamping elements KL 260 (4 pieces)



## Dimensional drawings – couplings

### Clamp coupling KK 14

(2 identical coupling halves, positive-fit prestressed, backlash-free assembled)

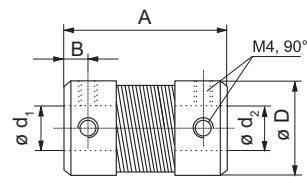


- \*) Maximum dimension for inserted shaft  
 A Coupling half  
 B Involute gear rim

	$d_1^{(1)}$	$d_2^{(1)}$	Standard $d_1 / d_2$
KK 14	6 ... 16	6 ... 16	6/6; 8/8; 10/10; 12/12; 16/16
with different diameters $d_1$ and $d_2$ available			

static torsional stiffness	125 Ncm/°
transmittable torque, backlash-free	100 Ncm
maximum misalignment	
axial	-1 mm
radial	0,2 mm
angular	1°

### Metal coupling MK 8 / MK 12

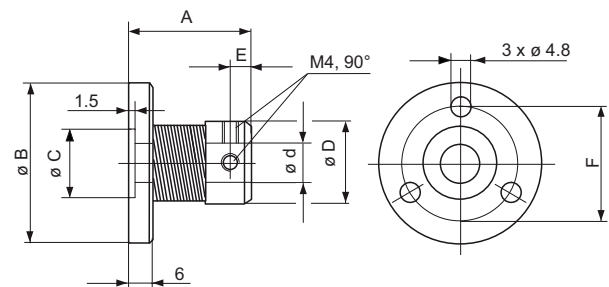


- MK 8 Material: X12CrNi18-8 (V2-A)  
 MK 12 Material: ST

	A	B	D	$d_1^{(1)}$	$d_2^{(1)}$	Standard $d_1 / d_2$
MK 8	35	5	21	5 ... 12	5 ... 12	6/6; 8/8; 10/10; 12/12
MK 12	50	7	26 <sup>(2)</sup>	6 ... 15	6 ... 15	12/12
with different diameters $d_1$ and $d_2$ available						

Permissible offset of the nominal shaft diameter: 3° or 3%

### Screw coupling MKF 8 / MKF 12



	A	B	C <sup>(1)</sup>	D	E	F	$d^{(1)}$	Standard d
MKF 8	30	42	18	21	5	30	6 ... 10	6; 8; 10
MKF 12	40	48	22	26 <sup>(2)</sup>	7	37	8 ... 15	12

Permissible offset of the nominal shaft diameter: 3° or 3%  
 Mount coupling with 1 mm preload.

(1) Tolerance H7

(2) with keyway available

# Encoder with Ex protection

## General information GEL 260 EEx

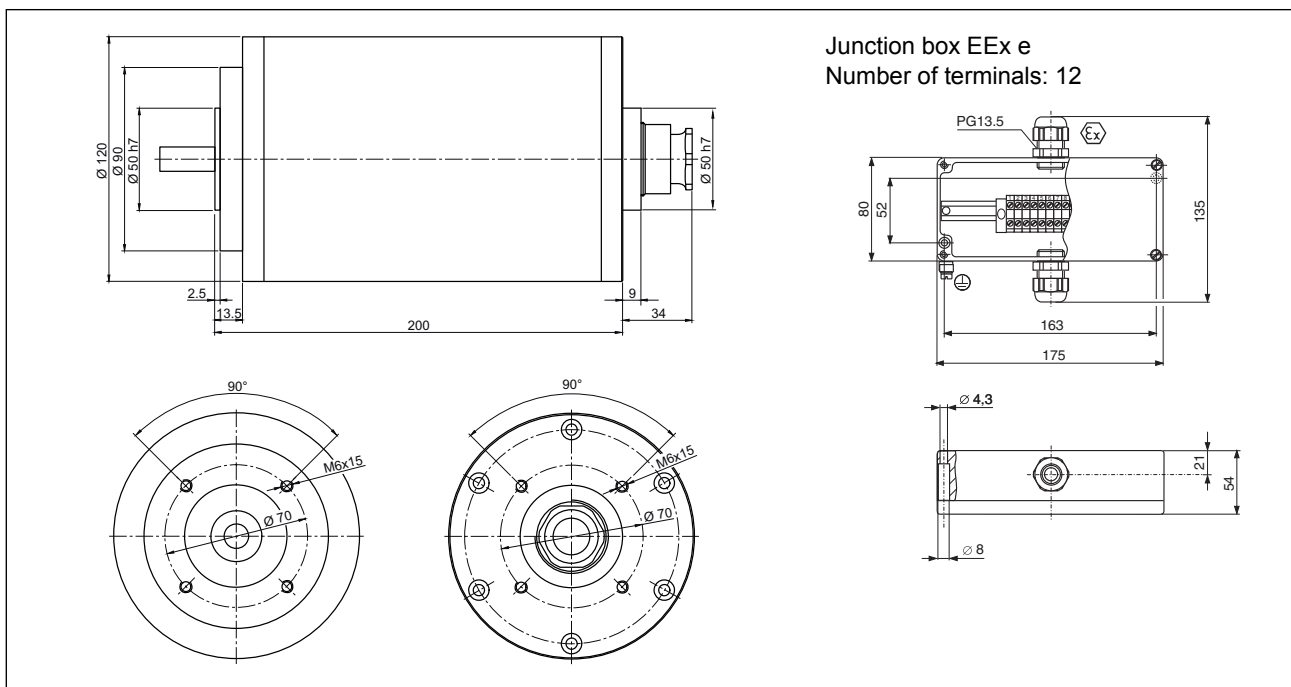
The rotary encoder GEL 260 Ex is only allowed to be operated in zone 1. The mechanical and electrical characteristics as per the operating instructions GEL 260 Ex, e.g. temperature, max. load current, max. supply voltage and mechanical load, are not allowed to be exceeded under any circum-

stances. The GEL 260 Ex is only allowed to be operated with the protection class approved. The company operating the system has the obligation to undertake a risk assessment. For the connection only the variant with cable outlet E or K together with the junction box EEx e is allowed to be used. The type code is restricted.

## Type code for Ex protection

Feature	Possible variant
Current output Signal pattern Reference signal Pulse numbers per revolution	no restrictions
Plug / cable outlet	E, K
Shaft diameter / length	0
Additional protection measures	6, 7, 8, 9
Temperatur range	1

## Dimensional drawing GEL 260 for Ex-hazardous areas



## Modified technical data of GEL 260 EEx

Mechanical data	
Housing diameter	115 mm
Weight	5.1 kg
Maximum operating speed	3000 min <sup>-1</sup>
Starting torque	0.06 Nm
Safety parameters	
Ignition protection type	II 2G EEx [ia/ib] IIC T5-T6
Certification number	PTB03ATEX1051 (former PTB-Nr. Ex-87/1095)
Protection class	IP 54 pressure-proof

<b>260</b>	<b>Current output</b>	
	- without current output	
	<b>A</b> Nominal range -20 mA to +20 mA <sup>(1)</sup>	
	<b>B</b> Nominal range 0 mA to +20 mA <sup>(1)</sup>	
	<b>C</b> Nominal range +4 mA to +20 mA <sup>(1)</sup>	
	<b>Signal pattern</b>	
	- without signal output	
	<b>S</b> Signal pattern S, logic level HTL	
	<b>T</b> Signal pattern T; logic level TTL <sup>(2)</sup>	
	<b>U</b> Signal pattern U; logic level TTL <sup>(2)</sup>	
<b>V</b> Signal pattern VN; logic level HTL		
<b>X</b> Signal pattern XN; logic level HTL <sup>(2)</sup>		
<b>Reference signal</b>		
- without reference signal		
<b>N</b> with Reference signal		
	<b>Pulse number</b>	
	Pulse number per revolution	
	<b>Plug / cable outlet</b>	
	<b>A</b> 6-pole plug, axial <sup>(3)</sup>	
	<b>B</b> 6-pole plug, radial <sup>(3)</sup>	
	<b>C</b> 12-pole plug, axial <sup>(3)</sup>	
	<b>D</b> 12-pole plug, radial <sup>(3)</sup>	
	<b>E</b> 7-core cable <sup>(4)</sup> (only for GEL 260 EEx)	
	<b>F</b> 6-core cable <sup>(4)</sup> , axial	
	<b>G</b> 6-core cable <sup>(4)</sup> , radial	
	<b>H</b> 10-core cable <sup>(4)</sup> , axial	
	<b>I</b> 10-core cable <sup>(4)</sup> , radial	
	<b>K</b> 12-core cable <sup>(4)</sup> (only for GEL 260 EEx)	
	<b>Shaft diameter / length</b>	
	<b>0</b> Standard; d = 12 mm, L = 30 mm for GEL 260 EEx d = 12 mm, L = 27 mm	
	<b>1</b> d = 6 mm, L = 13 mm	
	<b>2</b> d = 8 mm, L = 30 mm	
	<b>3</b> d = 8 mm, L = 30 mm, shaft with Woodruff key to DIN 6888	
	<b>4</b> d = 10 mm, L = 30 mm	
	<b>5</b> d = 10 mm, L = 30 mm, shaft with Woodruff key to DIN 6888	
	<b>7</b> d = 12 mm, L = 30 mm, shaft with Woodruff key to DIN 6888	
	<b>Additional protection measures</b>	
	<b>0</b> without additional protection measures (standard)	
	<b>1</b> Moisture protection	
	<b>2</b> Vibration protection	
	<b>3</b> Moisture and vibration protection	
	<b>4</b> Moisture protection and condensate outlet <sup>(5)</sup>	
	<b>5</b> Moisture and vibration protection with condensate outlet <sup>(5)</sup>	
	<b>6</b> Protection class EEx without additional protection measures	
	<b>7</b> Protection class EEx with moisture protection	
	<b>8</b> Protection class EEx with vibration protection	
	<b>9</b> Protection class EEx with moisture and vibration protection	
	<b>Temperature range</b>	
	<b>1</b> 0°C to +70°C	
	<b>3</b> -20°C to +85°C (extended)	

## Customer-specific designs

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

<sup>(1)</sup> Nominal speed for  $I_{max}$  must be specified upon the order.

<sup>(2)</sup> Only with plug / cable outlet option: C, D, H, I, K

<sup>(3)</sup> Mating connector straight included in the scope of supply (angled mating connector available)

<sup>(4)</sup> Standard cable length 1 m (other cable length must be specified upon the order)

<sup>(5)</sup> Position must be specified upon the order.

# Type code GEL 260

## Accessories

### Mounting accessories

Description	Item number
Screw mount coupling MKF 8: inner diameter 6 to 10 mm (specify shaft diameter, standard: 6, 8, 10 mm)	MKF 8
Screw mount coupling MKF 12: inner diameter 8 to 15 mm (specify shaft diameter, standard: 12 mm)	MKF 12
Clamp coupling KK14, inner diameter: 6 to 16 mm (specify shaft diameter)	KK 14
Clamping element (set with 4 pieces)	KL 260
Metal coupling MK 8, inner diameter: 5 to 12 mm (specify shaft diameter)	MK 8
Metal coupling MK 12, Innendurchmesser: 6 to 15 mm (specify shaft diameter)	MK 12
Mounting bracket for encoder GEL 260, aluminium die casting	MW 92
Mounting flange, aluminium die casting, diameter 120 mm	MF 121
Measuring wheel, aluminium die casting, hard anodic coated surface (approx. 700 HV), circumference 500 mm ± 0.3 mm, collet chuck included	MRM 500
Measuring wheel, aluminium die casting, rubber coated surface (approx. shore 70, coating: Nitrile), circumference 500 mm ± 0.8 mm, collet chuck included	MRG 500
Collet chuck for mounting MRM 500 / MRG 500, shaft diameter 8, 10 or 12 mm	SP 08/SP 10/SP 12
Protective casing with cable glands 5 x PG21	SG 110
Protective casing with cable glands 6 x PG21	SG 111

### Connection accessories

Description	Item number
Mating connector, M23, 12-pole, straight, IP 65	GG 126
Mating connector, M23, 12-pole, angled, IP 65	GW 126
Mating connector, 6-pole, straight, IP 65	GG 66
Mating connector, 6-pole, angled, IP 65	GW 66
Junction box EEx, number of terminals 12	upon request

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

