Magnetic incremental encoder
for harsh industrial environments

GEL 260

Technical information

Version 2024-06-03

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 avaiable.
- Optionally with explosion-proof housing available, protection class IP 54, ATEX certification and IECEx certification.
- High reliability and long service life characterizes the magnetic incremental encoders.



GEL 260

Features

- High resolution up to 273.408 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)

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



GEL 260 Ex

Fields of application

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

Right to technical changes and errors reserved.

Internet: www.lenord.com
E-Mail: info@lenord.de
Phone: +49 208 9963–0

Lenord, Bauer & Co. GmbH
Dohlenstraße 32
46145 Oberhausen, Germany

Description

Construction and design

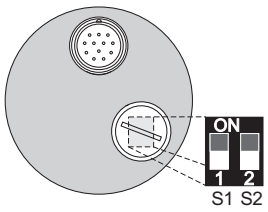
The magnetic incremental encoder GEL 260 is based on contactless magnetic scanning of the integrated toothed measuring wheel. The resilent encoder housing with a flange size of 90 mm is available with axial or radial plug or cable outlet. The solid encoder shaft is mounted to the driving shaft via a 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 condesate outlet points down.
For usage in areas with Ex risk, the GEL 260 is available with ATEX and IECEx certification. 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 incremental encoders GEL 260 is a high-resolution rotary encoder with pulse numbers of 60 up to 273,408 pulses per revolution.
The realizable pulse numbers can be found online at www.lenord.de and are available upon request.

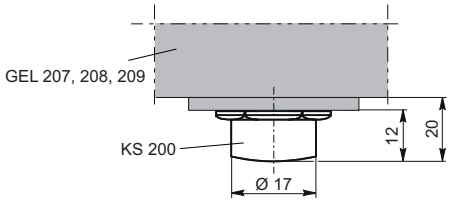
Additional protection measures

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.

Current output – options

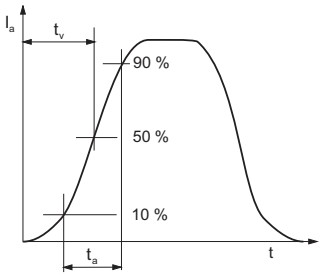
A:  Direction dependent measuring current nominal range: -20 to + 20 mA (reversible)

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 (60 to 273,408 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^{-1}). 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.

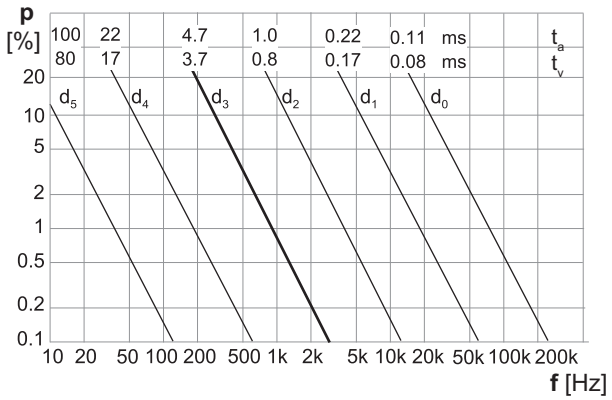


Rise time t_a and delay time t_v after a erratic change in speed

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^{-1}"). The attenuation is factory set so that the harmonic content p at rated speed is ≤ 1%, it is also indicated on the ID-plate (eg 'd5').



Harmonic content of the output current as a function of on 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

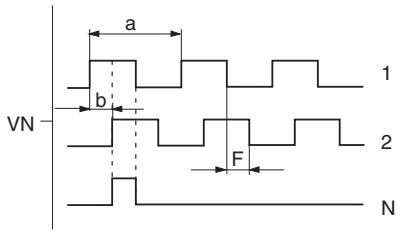
Current output		
Max. apparent ohmic resistance	R_a	550 Ω
Measuring device class	K	1
Rated current tolerance		< 1 %
Linearity error		< 1 %
Repeatability	r	100 %
Temperature drift	ΔI_{aT}	< ±3 µA/1 °K
Min. RPM (for attenuation d_5)	$n_{min\ electrical}$	1,5 x 10^3/i min^{-1}
Max. RPM	$n_{max\ electrical}$	6 x 10^6/i 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

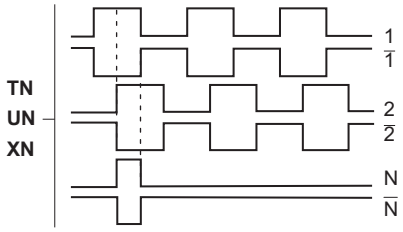
b 90° phase offset

F Time between edges[1]

	U_B[2]	U_{out}[3]
V, VN	10 to 30 V DC	HTL

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

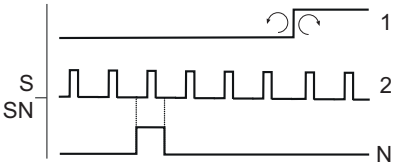
The two pulse outputs and the reference signal are output as inverse signals.



	U_B[2]	U_{out}[3]
T, TN	+ 5 V DC ± 5 %	TTL
U, UN	10 to 30 V DC	TTL
X, XN	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).



	U_B[2]	U_{out}[3]
S, SN	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. 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^2 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 (U_{out} = 5 V) [4]	200	200	200	200	145	72	[m]
S, SN, V, VN	HTL (at U_{out} = 20 V)	200	200	200	80	40	20	[m]
X, XN	HTL (at U_{out} = 20 V)	200	200	100	40	20	10	[m]

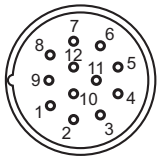
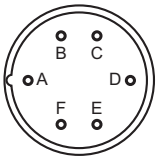
(1) At an output frequency of 200 kHz the time between the edges is F > 0.6 µs
(2) Supply voltage
(3) Signal voltage
(4) The given lengths are only valid for a power supply with Sense control.

Signal pattern	T, TN	U, UN	S, SN	V, VN	X, XN
General					
Resolution (pulses per revolution)	60 to 273,408				
Measuring range	36° to 0.0013°				
Error limit	0.07°(1)				
Incremental deviation	0.01°(1)				
Accuracy	0.005°(1)				
Electrical data					
Supply voltage U_B	5 V DC ± 5%	10 to 30 V DC			
Power consumption	≤ 1.0 W ≤ 1.40 W(2)	≤ 1.3 W ≤ 1.65 W(2)			
Output frequency	≤ 200 kHz (3)				
Logic level	TTL		HTL		
Output signal level high	≥ U_B - 1.00 V at I = 10 mA; ≥ U_B - 1.20 V at I = 30 mA	4.00 V at I = 10 mA; ≥ 3.85 V at I = 30 mA	≥ U_B - 1.80 V at I = 10 mA; ≥ U_B - 2.20 V at I = 30 mA		
Output singal 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		
Mechanical data					
Shaft diameter	6, 8, 10, 12 mm				
Housing diameter	90 mm (4)				
Weight	700 g(4)				
Maximum operating speed	10,000 min^{-1} (5)				
Moment of inertia of rotor	7,5 x 10^{-5} kgm^2				
Operating torque	3 Ncm (< 0.1 Nm(6))				
Starting torque	0.05 Nm (0.1 Nm(6))				
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 10^6 revolutions 12600 x 10^6 revolutions				
Ambient data					
Working temperature range	0 ° C to +70 °C(5) / -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(5), IP 64 (7)				
Vibration protection (DIN EN 60068-2-6)	100 m/s^2, 10 to 2000 Hz				
Shock protection (DIN EN 60068-2-27)	1000 m/s^2, 11 ms				
EMC	EN 61000-6-1 to 4				
Insulation resistance	500 V DC, > 1 MΩ				
Voltage sustaining capability	500 V AC, 1 minute				

(1) Value at highest resolution, values for lower resolutions on request
(2) with current output
(3) detailed information on request
(4) Modified data for Ex variant (see separate table)
(5) Standard
(6) with ball bearing cover (IP 50)
(7) with condensate outlet

Connection assignment

Pin layout – plug outlet

Signal	with plug outlet type		Description
	C / D	A / B	
	12-pole 	6-pole 	
U_B	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
U_{sense+}	2	–	+ Sense (U_B)(1)
U_{sense-}	11	–	- Sense (GND)

Connection assignment – cable outlet

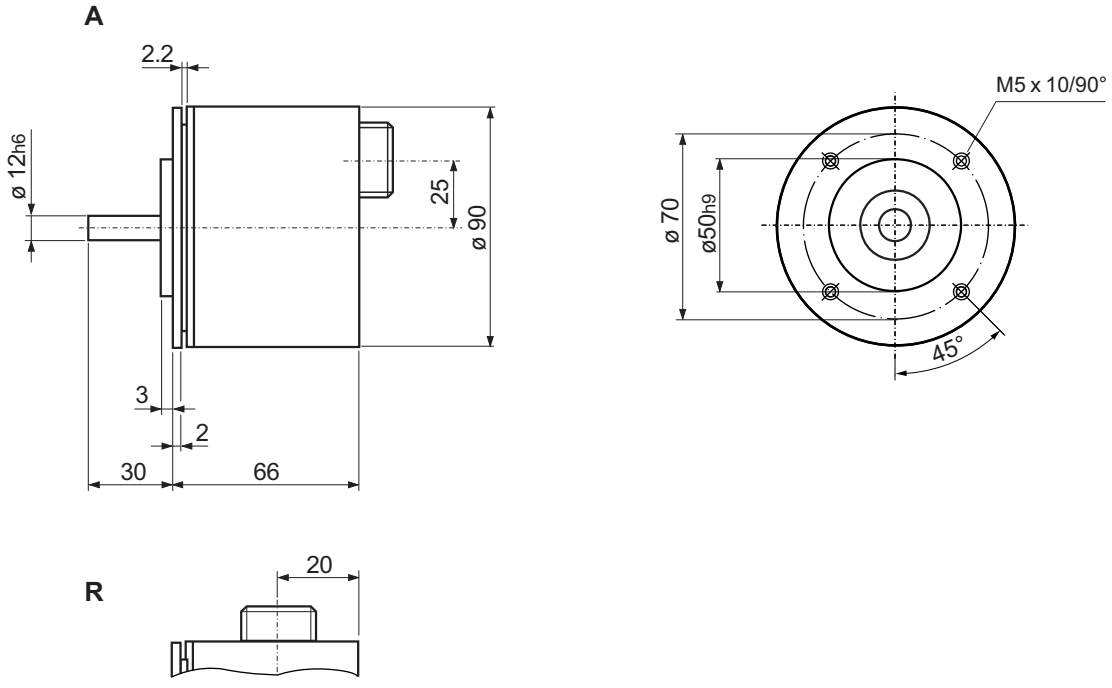
Signal	GEL 260 with outlet type		GEL 260 Ex with outlet type		Description
	F / G	H / I	E	K	
	6-core	10-core	7-core, numbered	12-core, numbered	
U_B	yellow	red	6	6	Supply voltage
GND	green	blue	1	1	Ground
1	brown	white	3	3	Channel 1
/1	–	brown	–	8	Channel 1, inverted
2	white	pink	2	2	Channel 2
/2	–	black	–	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.

(1) 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

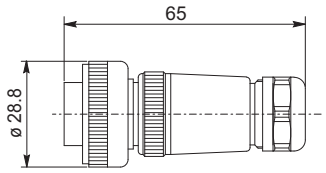
Dimensional drawing GEL 260



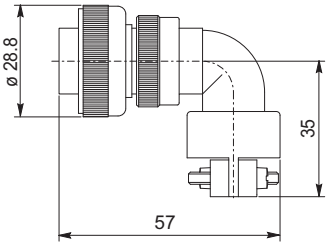
A axial outlet
R radial outlet

Dimensional drawings – mating connectors

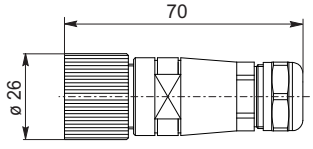
BS1111 = GG 66 6-pole, straight



BS1113 = GW66 6-pole, angled



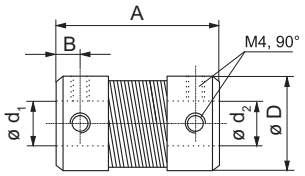
FS1139 = GG 126 12-pole, straight



Dimensional drawing

Dimensional drawing – Coupling

Metal coupling MK 8 / MK 12



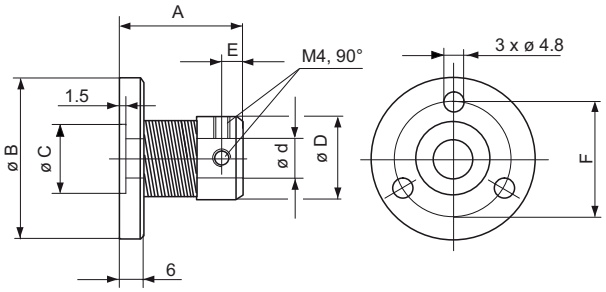
MK 8 Material: X12CrNi18-8 (V2-A)

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(2)	6 … 15	6 … 15	12/12
with different diameters d_1 and d_2 available						

Permissible offset of nominal shaft diameter: 3° or 3%
zulässige Fluchtungenauigkeit des Nennwellen-durchmessers: 3° oder 3%

Screw coupling MKF 8 / MKF 12



	A	B	C(1)	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(2)	7	37	8 … 15	12

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

(1) Tolerance H7
(2) with keyway avaialbe

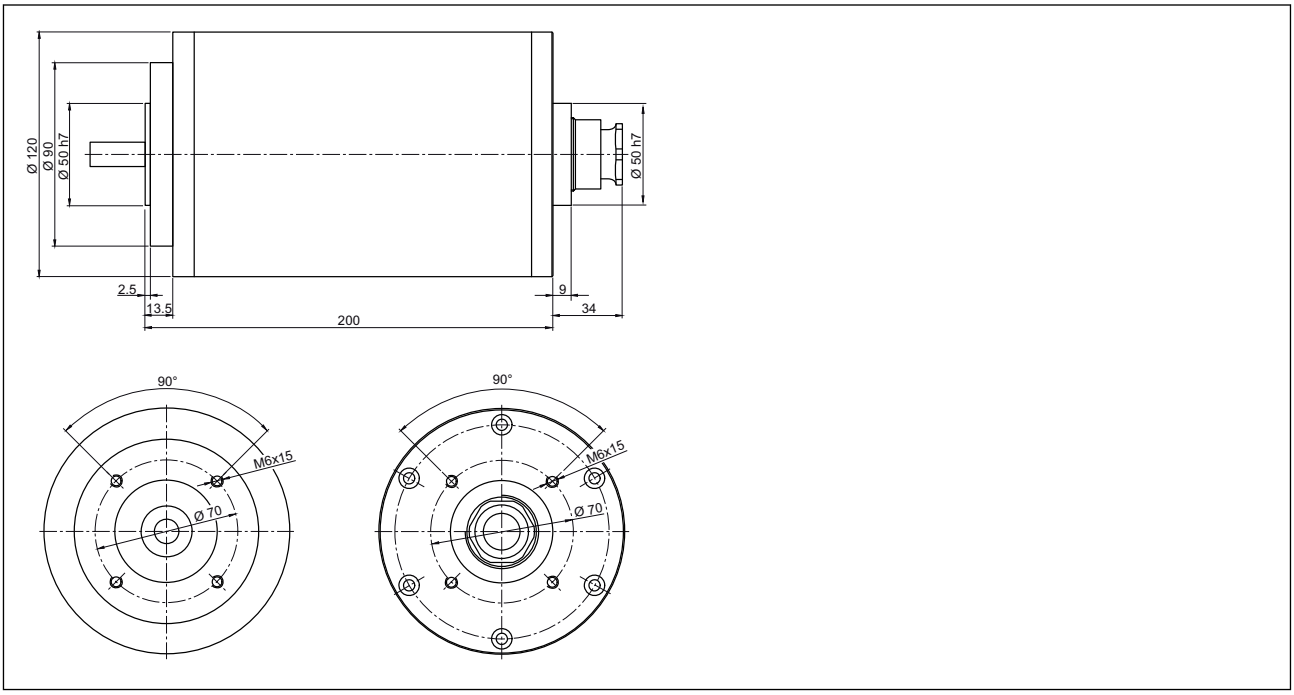
General information GEL 260 Ex

The rotary encoder GEL 260 Ex with ATEX certification and IECEx certification 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 circumstances. 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 an Ex junction box 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 (company BARTEC)



Modified technical data of GEL 260 Ex

Mechanical data	
Housing diameter	115 mm
Weight	5.1 kg
Maximum operating speed	3000 min^{-1}
Starting torque	0.06 Nm
Safety parameters	
Ignition protection type	II 2G Ex db IIC T6 Gb
Certification number	EPS 14 ATEX 1 696 X IECEx EPS 14.0042X
Protection class	IP 54 pressure-proof

Type code GEL 260

	Current output									
	- without current output									
	A Nominal range -20 mA to +20 mA (1)									
	B Nominal range 0 mA to +20 mA (1)									
	C Nominal range +4 mA to +20 mA (1)									
		Signal pattern								
		- without signal output								
		S Signal pattern S, logic level HTL								
		T Signal pattern T; logic level TTL (2)								
		U Signal pattern U; logic level TTL (2)								
		V Signal pattern VN; logic level HTL								
		X Signal pattern XN; logic level HTL (2)								
			Reference signal							
			– without reference signal							
			N with Reference signal							
				Pulse number						
				_ _ _ _ _ _ Pulse number per revolution (60 ... 273.408)						
					Plug / cable outlet					
					A 6-pole plug, axial(3)					
					B 6-pole plug, radial(3)					
					C 12-pole plug, axial(3)					
					D 12-pole plug, radial(3)					
					E 7-core cable(4) (only for GEL 260 Ex)					
					F 6-core cable(4) , axial					
					G 6-core cable(4), radial					
					H 10-core cable(4) , axial					
					I 10-core cable(4), radial					
					K 12-core cable(4)(only for GEL 260 Ex)					
						Shaft diameter / length				
						0 Standard; d = 12 mm, L = 30 mm for GEL 260 Ex d = 12 mm, L = 27 mm				
						1 d = 6 mm, L = 13 mm				
						2 d = 8 mm, L = 30 mm				
						3 d = 8 mm, L = 30 mm, shaft with Woodruff key to DIN 6888				
						4 d = 10 mm, L = 30 mm				
						5 d = 10 mm, L = 30 mm, shaft with Woodruff key to DIN 6888				
						7 d = 12 mm, L = 30 mm, shaft with Woodruff key to DIN 6888				
							Additional protection measures			
							0 without additional protection measures (standard)			
							1 Moisture protection			
							2 Vibration protection			
							3 Moisture and vibration protection			
							4 Moisture protection and condensate outlet (5)			
							5 Moisture and vibration protection with condensate outlet (5)			
							6 Protection class Ex without additional protection measures			
							7 Protection class Ex with moisture protection			
							8 Protection class Ex with vibration protection			
							9 Protection class Ex with moisture and vibration protection			
								Temperature range		
								1 0°C to +70°C		
								3 -20°C to +85°C (extended)		
260	_	_	_	_ _ _ _ _ _		_	_	_	_	

(1) Nominal speed for I_{max} must be specified upon the order.
(2) Only with plug / cable outlet option: C, D, H, I, K
(3) Mating connector straight included in the scope of supply (angled mating connector available)
(4) Standard cable length 1 m (other cable length must be specified upon the order)
(5) Position must be specified upon the order.

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
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

Connection accessories

Description	Item number
Mating connector GG 126, M23, 12-pole, straight, IP 65	GG 126
Mating connector GG 66, 6-pole, straight, IP 65	GG 66
Mating connector GW 66, 6-pole, angled, IP 65	GW 66

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Lenord, Bauer & Co. GmbH
Dohlenstraße 32
46145 Oberhausen
Germany
Phone +49 (0)208 9963-0
www.lenord.de

Lenord+Bauer Italia S.r.l.
Via Gustavo Fara, 26
20124 Milano
Italy
Phone +39 340 1047184
www.lenord.com

Lenord+Bauer USA Inc.
32000 Northwestern Highway
Suite 150
Farmington Hills, MI 48334
USA
Phone +1 248 446 7003
www.lenord.com

Lenord+Bauer
Automation Technology (Shanghai) Co.,Ltd.
Block 42, Room 302, No.1000, Jinhai Road
201206 Shanghai
China
Phone +86 21 50398270
www.lenord.cn