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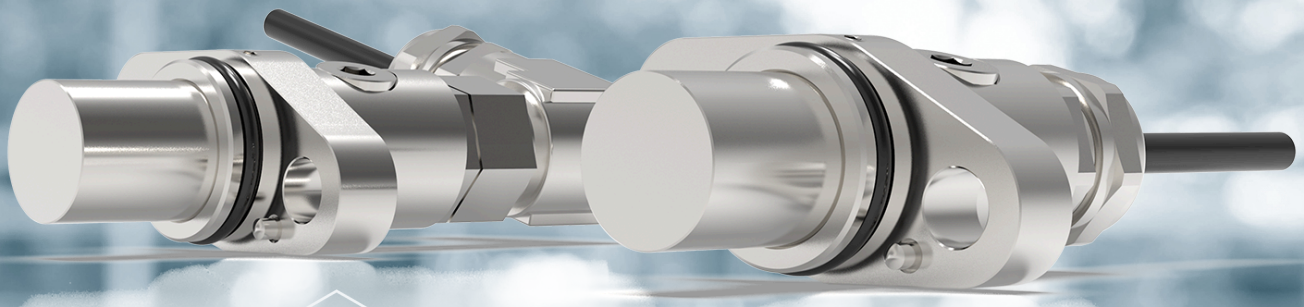


Technical Information

GEL 2475FD

CombiCODER

with integrated flat spot detection

D-51T-2475FD | Date of issue 2025-12-09

LENORD +BAUER

Finding solutions. Founding trust.

Motion sensors and integrated drive technology

General

Description

The**CombiCODER**combines the familiar speed signals based on proven, interference-resistant magnetic scanning with state-of-the-art MEMS technology. The two systems mentioned above operate with independent supply voltages and are completely free of feedback.

The flat spot detector reliably detects flat spots and welds on the wheel and indicates the severity in clear, discrete stages. This ensures that workshop visits can be planned early and efficiently without disrupting operational processes.

When using multiple flat spot detectors, rail joints can also be detected. The temperature is measured using an integrated NTC thermistor.

Thanks to the compatible sensor housing, existing speed sensors can be replaced by the **GEL 2475FD**with minimal effort. The signal output of the flat position detector is an analog PWM signal with HTL output levels and can thus be read with conventional analog input stages.

Do you have special requirements regarding flange shape, shaft length, number of channels, cable protection, cable outlet, connector assembly or EMC concept? Talk to us. Our experts can design the optimal solution for your application from an extensive modular system and will be pleased to advise you how to customize your solution in the most cost-efficient way.

Write to support@lenord.de or call +49 208 9963-215.

Advantages

- Replaces existing speed sensors with compatible housing
- Simple evaluation thanks to analog pulse width modulated signal
- Flat spot detection works regardless of the installation position of the sensor housing on the vehicle.
- When retrofitting existing control systems, they will continue to be supplied with the necessary independent speed signals.
- Insulation coordination and development according to EN50155

Field of application

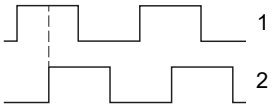
Railroad technology and transportation
Rail vehicle industry: ▪ Traction monitoring, anti-slip protection, motor speed, anti-skid protection, Automatic Train Protection, odometry
Condition monitoring in rail vehicles: ▪ Automatic, objective detection and evaluation of flat spots

Technical data voltage output

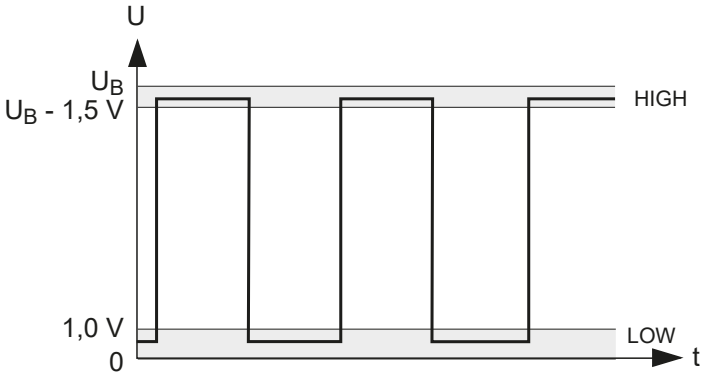
Signal pattern	E-	V-	EM	VM
Electrical data				
Supply voltage U_B(reverse polarity protected)	10 to 30 V DC		10 to 20 V DC	
Current consumption I_B(without load)	≤ 30 mA		≤ 25 mA	
Output signal (short-circuit-proof)	Square-wave signals			
Output signal level High(1)	≥ U_B- 1.5 V		≥ U_B- 1.8 V	
Output signal level Low(2)	≤ 1.0 V		≤ 1.5 V	
Output current per channel	≤ 20 mA		≤ 10 mA	
Frequency range	0 to 20 kHz		0 to 8 kHz	
Duty cycle	50 % ± 20 %(2)			
Phase offset	–	typ. 90°	–	typ. 90°
Electrical data PWM signal				
Supply voltage U_B(reverse polarity protected)	10 to 30 V DC			
Output signal level High(1)	≥ U_B- 1.5 V			
Output signal level Low(1)	≤ 1.0 V			
Output current	≤ 20 mA			
Frequency	1 kHz			
Electrical data NTC thermistor				
Measuring resistor	1 to 100 kOhm at 25 °C			
Measuring range	-55 °C to +70 °C (max. 100 mW) -55 °C to 150 °C (max. 1 mW)			
Measurement tolerance	1 % at 25 °C			
Mechanical data				
Sensor tube material	Stainless steel			
Flange material	Stainless steel			
Sensor weight (incl. 2 m cable)	500 g			
Environmental tests				
Working and operating temperature	-40 °C to +120 °C			
Storage temperature	-40 °C to +120 °C			
Dielectric strength	500 V AC/750 V DC (DIN EN 50155:2022-06)			
Electromagnetic compatibility(3)	DIN EN 50121-3-2:2017-11			
Degree of protection on measuring side(4)	IP 68			
Vibration resistance	DIN EN 61373:2011-04 cat. 3			
Shock resistance	DIN EN 61373-2011-04 cat. 3			
Fire protection	DIN EN 45545-2:2023-12 NFPA 130 upon request			
MTTF value (speed)	2,000,000 h at 55 °C			
MTTF value (flat spot)	950,000 h at 55 °C			

(1) depending on output current and temperature
(2) applies to operation with nominal air gap and toothing as per DIN 867
(3) Observe EMC notes in the mounting/operating instructions
(4) Degree of protection on the cable outlet side depends on cable gland or cable protection

Output signals and connection

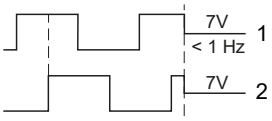
Signal pattern for voltage output (E-, V-)			
Output signals		**Supply voltage**	**Pulse diagram**
E-	1-channel square-wave signal	10 to 30 V DC	
V-	2-channel square-wave signals with 90° phase offset	10 to 30 V DC	

Output signal level – voltage output (E-, V-)

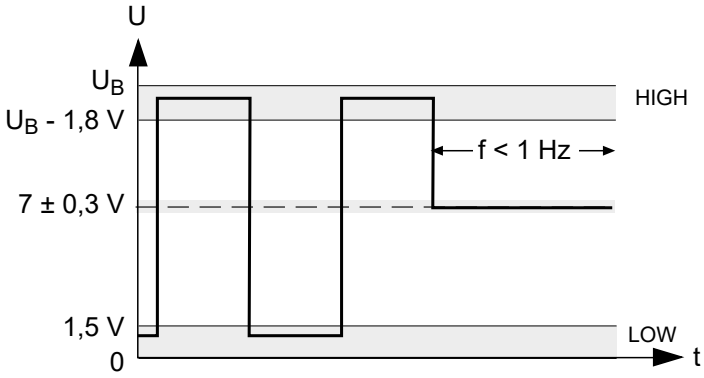


Assignment – voltage output (E-, V-)		
Signal	**E-**	**V-**
Rotational speed channel 1	YE	YE
Rotational speed channel 2	-	WH
GND (0 V)	BU	BU
$+U_B$	RD	RD
PWM U_B	PK	PK
PWM GND	GY	GY
PWM flat spot	BK	BK
PWM rail joint	BN	BN
NTC+	RD-BU	RD-BU
NTC-	PK-BU	PK-BU
Cables/Screens	1/1	1/1
Cable screen is connected directly or, as an option, capacitively in the sensor Core identifier: **BK** black **BN** brown **BU** blue **GY** gray **PK** pink **RD** red **WH** white **YE** yellow		

Output signals and connection

Signal pattern with standstill voltage (EM, VM)			
Output signals		**Supply voltage**	**Pulse diagram**
EM	1-channel square-wave signal and standstill voltage	10 to 20 V DC	
VM	2-channel square-wave signals with 90° phase and standstill voltage	10 to 20 V DC	

Output signal level – voltage output (EM, VM)



Assignment – voltage output (EM, VM)		
Signal	**E-**	**V-**
Rotational speed channel 1	YE	YE
Rotational speed channel 2	-	WH
GND (0 V)	BU	BU
$+U_B$	RD	RD
PWM U_B	PK	PK
PWM GND	GY	GY
PWM flat spot	BK	BK
PWM rail joint	BN	BN
NTC+	RD-BU	RD-BU
NTC-	PK-BU	PK-BU
Cables/Screens	1/1	1/1
Cable screen is connected directly or, as an option, capacitively in the sensor Core identifier: **BK** black **BN** brown **BU** blue **GY** gray **PK** pink **RD** red **WH** white **YE** yellow		

Flat spot detector

Functionality of the flat spot detector	
Periodically occurring shock loads are already evaluated internally and are output at the corresponding sensor output as a pulse width modulated (PWM) signal with a fundamental frequency of 1 kHz. The duty cycle of the PWM signal corresponds to the severity of the flat spot.	
Duty cycle	
10 % (±4 %)	The current vehicle speed does not allow for evaluation, or the measured values are too low to come to a conclusion.
20 % (±4 %)	The current vehicle speed is within the permissible evaluation range. There are no signs of a flat spot.
30 % to 80 % (±4 %)	**The current vehicle speed is within the permissible evaluation range.** **A flat spot is detected:** 30 % lower threshold – slight flat spot to 80 % upper threshold – very marked flat spot The thresholds for ‘slight’ and ‘marked’ can be customized for each customer, as the installation location (sprung/unsprung) has a significant impact on the measured intensity.
90 % (±4 %)	An error status is signaled. The flat spot detector has detected an internal hardware problem.

Rail joint functionality (when using multiple flat spot detectors)	
When using multiple flat spot detectors, impacts that occur not periodically but consecutively over the measuring distance (for example, track joints) can be detected. An additional PWM output is available for this purpose.	
Duty cycle	
below 20 % (±4 %)	The current vehicle speed does not allow for evaluation, or the measured values are too low to come to a conclusion.
20 % to 80 % (±4 %)	**The current vehicle speed is within the permissible evaluation range.** **A rail joint is detected:** 20 % lower threshold – slight rail joint to 80 % upper threshold – very marked rail joint The thresholds for ‘slight’ and ‘marked’ can be customized for each customer, as the installation location (sprung/unsprung) has a significant impact on the measured intensity.
90 % (±4 %)	An error status is signaled. The flat spot detector has detected an internal hardware problem.

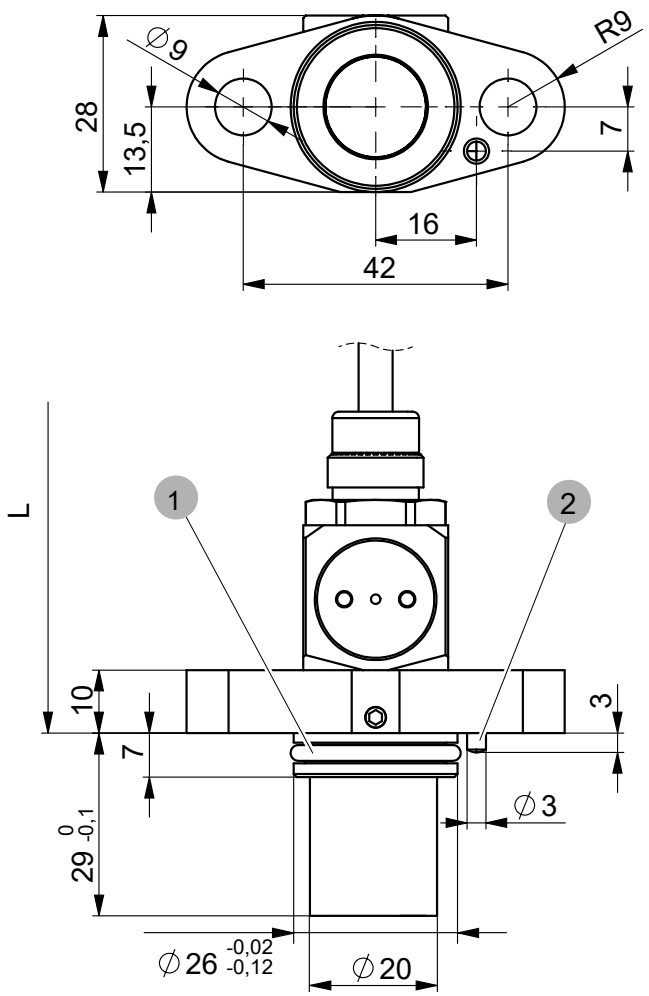
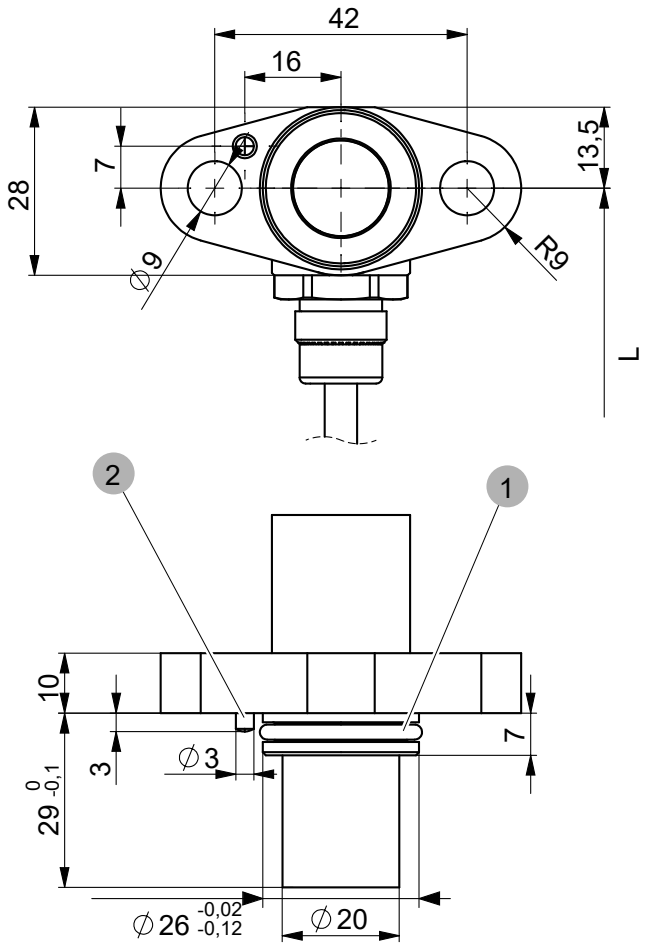
Mechanical properties

Target wheel	
Requirements for the target wheel	
Material	Ferromagnetic steel
Tooth form	▪ Involute gear teeth in accordance with DIN 867 (see type code) ▪ Square gear teeth (see type code)
Width	≥ 15 mm (smaller upon request)
Module m	The selection can be made in 0.25 increments from 1.00 to 3.50 (see type code)
Air gap (nominal air gap)	0.2 to 1.5 mm (0.7 mm)

Screening concept	
Screen connection selection	**Screen connection at encoder housing**
Option **SD** - Connected directly (see type code)	Directly connected to sensor housing
Option **SC** - Connected capacitively (see type code)	Connected capacitively to the sensor housing
Option **SI** - Insulated from the housing (see type code)	Insulated from the housing
Despite the high electromagnetic immunity, integration into a screening concept is required for the sensor to ensure EMC stability.	

Should the electromagnetic environment require special screening concepts, Lenord+Bauer offers support based on extensive knowledge and experience in integrating the sensor into the screening concept of the application.

Observe EMC notes in the relevant documents.

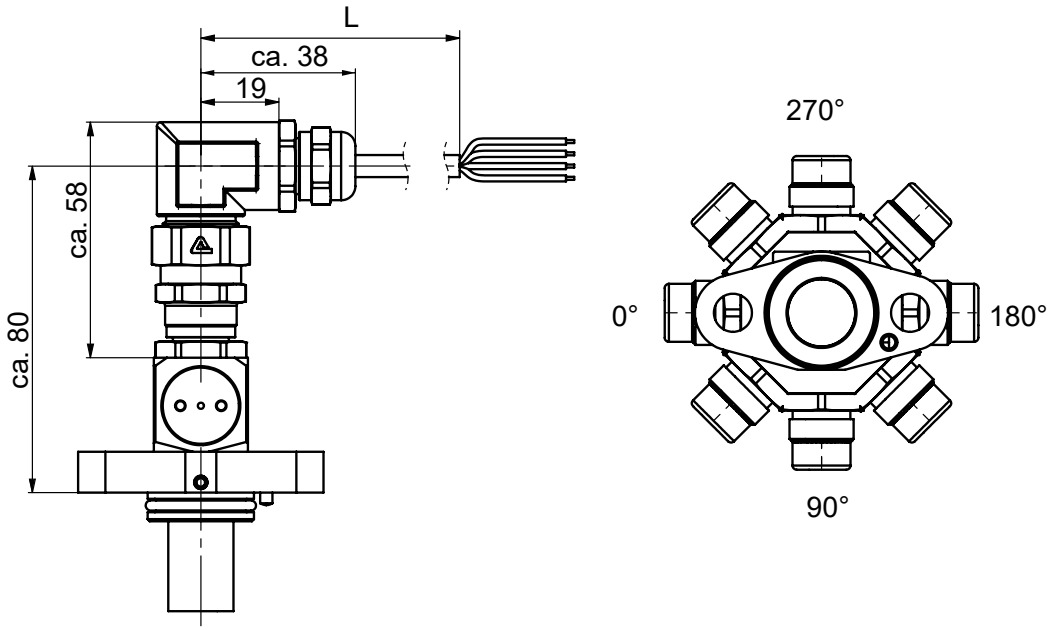
Cable outlet	
Cable outlet straight Option **S** (see type code)	**Cable outlet at side** Option **L** (see type code)
The straight cable outlet can also be connected via an angle: *"**Cable outlet straight with angle**", page 9*	The side cable outlet can also be connected via an angle: *"**Cable outlet at side with angle**", page 9*
	

1	Sealing ring: O-ring 21 x 2.5 mm; NBR
2	Index pin
L	Cable length **L** is determined by type code (Tolerance depends on the preassembled cable length)

Cable outlet straight with angle

Cable outlet straight with angle - If option **S** is selected for cable outlet (see type code)

The selection can be made in 45° increments 000°; 045°; 090°; 135°; 180°; 225°; 270°; 315° (Tolerance ± 10°) (see type code).

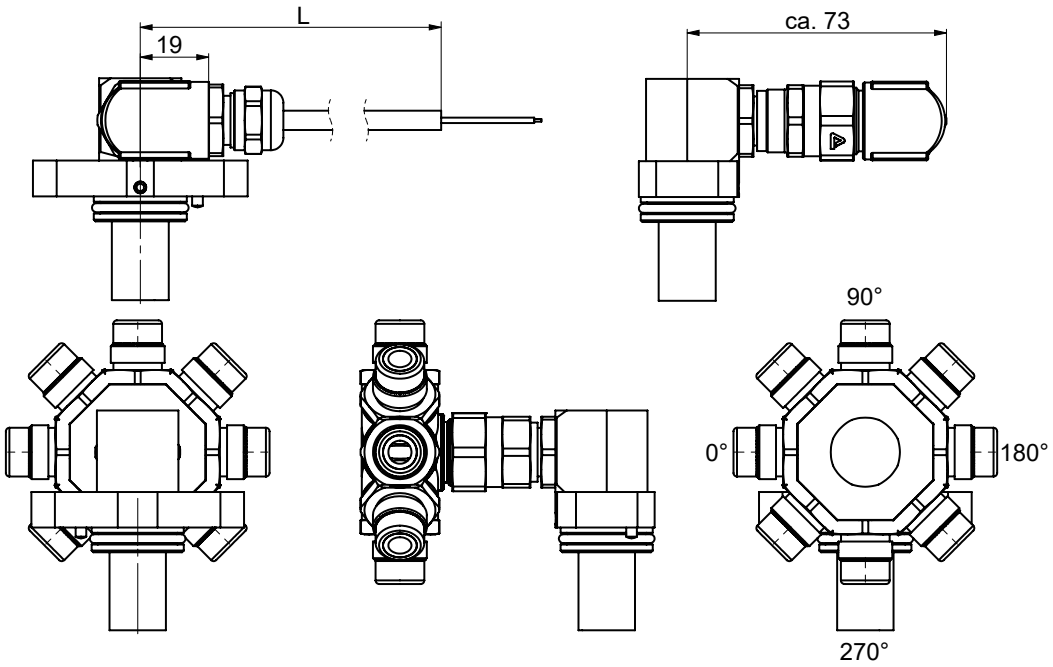


Cable length **L** is determined by type code
(Tolerance depends on the preassembled cable length)

Cable outlet at side with angle

Cable outlet at side with angle - If option **L** is selected for cable outlet (see type code)

The selection can be made in 45° increments 000°; 045°; 090°; 135°; 180°; 225°; 270°; 315° (Tolerance ± 10°) (see type code).



Cable length **L** is determined by type code
(Tolerance depends on the preassembled cable length)

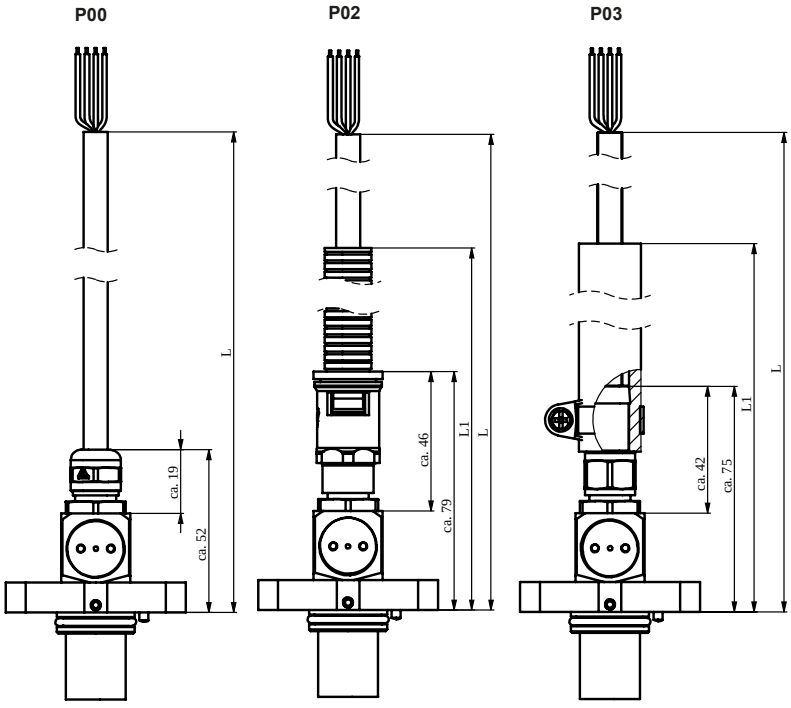
Cable protection at cable outlet	
The GEL 2475FD can be equipped with different types of cable protection at the cable outlet as required.	
▪ Dimensional drawings for straight cable outlet: *"Cable outlet straight", page 10* ▪ Dimensional drawings for cable outlet at side: *"Cable outlet at side", page 11*	
Selection **P00**	Without cable protection
Selection **P02**	Flexible conduit NW12
Selection **P03**	Hydraulic hose DN12

Technical data for cable protection			
Option	**P00**	**P02**	**P03**
Type	12 × 0.34 mm²	Flexible conduit NW12	Hydraulic hose DN12
Material	Halogen-free (specification upon request)	Polyamid, halogen-free	Rubber compound
Outside diameter	8.0 ± 0.3 mm	15.8 mm	20.0 mm
Minimum bending radius	24 mm (static) 40 mm (dynamic)	35 mm (static) 80 mm (dynamic)	70 mm

Cable outlet straight

Cable protection cable outlet straight - If option **S** is selected for cable outlet (see type code)

The design depends on the cable protection option at the cable outlet: *"Cable protection at cable outlet", page 10*

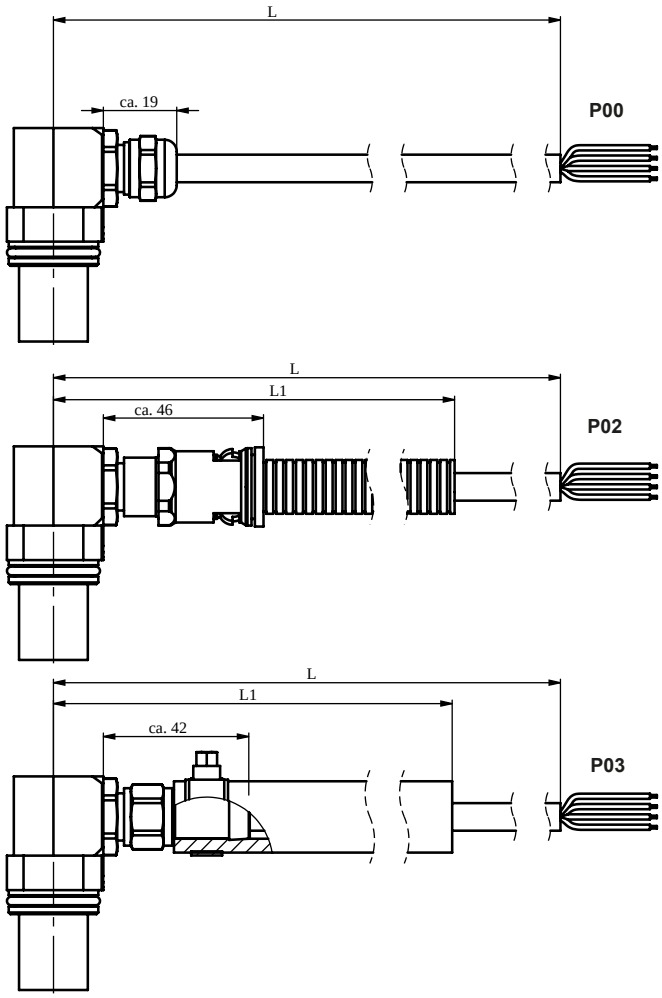


P00	Without cable protection
P02	Flexible conduit NW12
P03	Hydraulic hose DN12
L	Cable length **L** is determined by type code (Tolerance depends on the preassembled cable length)
L1	Protective sleeve length L1; depending on the cable connection and assembly, the protective sleeve length L1 corresponds to thecable length L - 100 mm

Cable outlet at side

Cable protection cable outlet at side - If option **L** is selected for cable outlet (see type code)

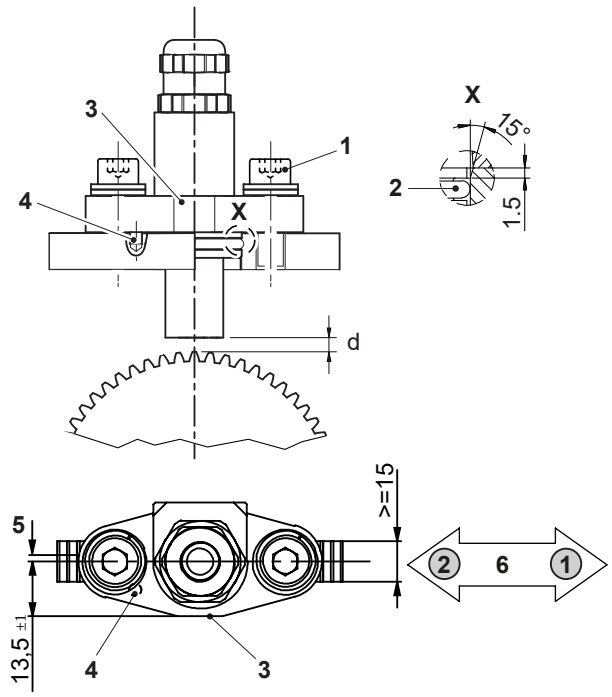
The design depends on the cable protection option at the cable outlet:*"Cable protection at cable outlet", page 10*



P00	Without cable protection
P02	Flexible conduit NW12
P03	Hydraulic hose DN12
L	Cable length **L** is determined by type code (Tolerance depends on the preassembled cable length)
L1	Protective sleeve length L1; depending on the cable connection and assembly, the protective sleeve length L1 corresponds to thecable length L - 100 mm

Assembly drawing

All dimensions in mm, general tolerance DIN ISO 2768 mK

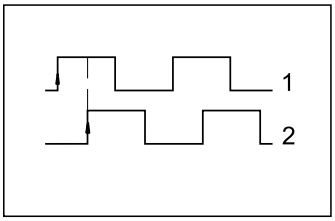


X Insertion chamfer

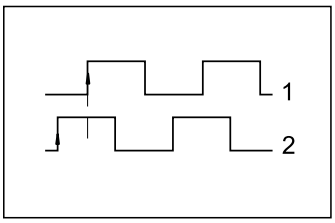
d Air gap: 0.2 to 1.5 mm
Nominal air gap: max. 0.7 mm
Permissible radial runout: ± 0.3 mm

1 Fastening screw (recommended: M8 x 20 DI-N EN ISO 4762)
2 Sealing ring
3 Reference surface
4 Index pin
5 Axial offset
6 Direction of rotation of target wheel

Signal for direction of rotation 1



Signal for direction of rotation 2



The direction of rotation is determined by the reference surface (3) or the index pin (4).

Index pin

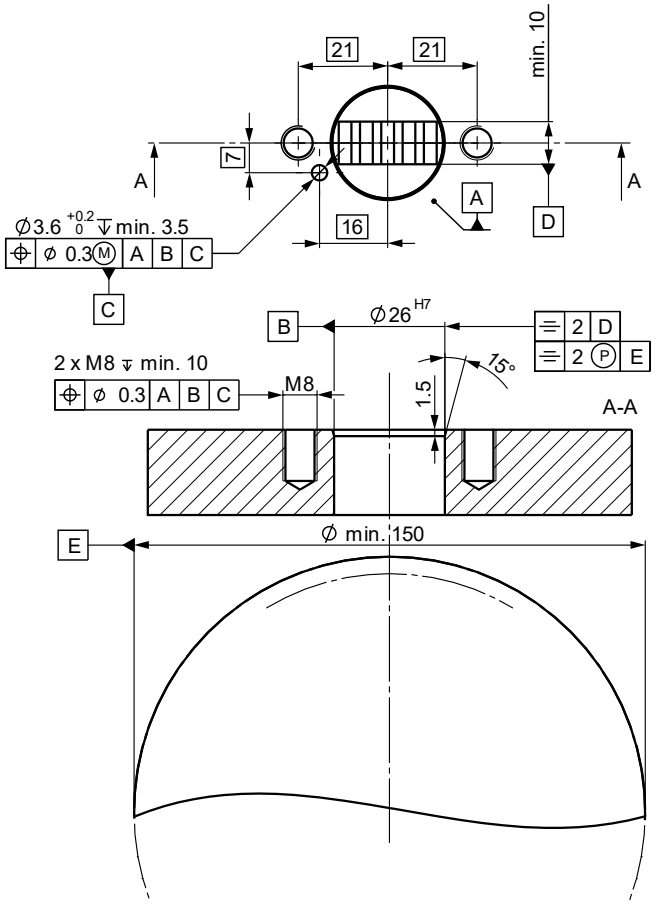
- If the target wheel rotates from the index pin to the center of the sensor, this is **Direction of rotation 1**.
- If the target wheel rotates from the center of the sensor to the index pin, this is **Direction of rotation 2**.

Reference surface

- If the target wheel rotates clockwise with view to the reference surface, this is **Direction of rotation 1**.
- If the target wheel rotates counterclockwise with view to the reference surface, this is **Direction of rotation 2**.

Hole pattern

All dimensions in mm, general tolerance DIN ISO 2768 mK



Type code GEL 2475FD

2475FD	Product type							
	Signal pattern							
	E-	1-channel square-wave signals						
	V-	2-channel square-wave signals with 90° phase offset						
	EM	1-channel square-wave signal and standstill voltage						
	VM	2-channel square-wave signals with 90° phase and standstill voltage						
		Screen connection						
		SD	connected directly					
		SC	connected capacitively					
		SI	insulated from the housing					
			Module		**Module**			
			M01	m = 1.00, steel, involute	**M12**	m = 1.00, steel, rectangular		
			M02	m = 1.25, steel, involute	**M13**	m = 1.25, steel, rectangular		
			M03	m = 1.50, steel, involute	**M14**	m = 1.50, steel, rectangular		
			M04	m = 1.75, steel, involute	**M15**	m = 1.75, steel, rectangular		
			M05	m = 2.00, steel, involute	**M16**	m = 2.00, steel, rectangular		
			M06	m = 2.25, steel, involute	**M17**	m = 2.25, steel, rectangular		
			M07	m = 2.50, steel, involute	**M18**	m = 2.50, steel, rectangular		
			M08	m = 2.75, steel, involute	**M19**	m = 2.75, steel, rectangular		
			M09	m = 3.00, steel, involute	**M20**	m = 3.00, steel, rectangular		
			M10	m = 3.25, steel, involute	**M21**	m = 3.25, steel, rectangular		
			M11	m = 3.50, steel, involute	**M22**	m = 3.50, steel, rectangular		
				Cable outlet				
				S	Cable outlet straight			
				L	Cable outlet at side			
					Angle			
					0	without angle		
					1	with angle, 0 degrees		
					2	with angle, 45 degrees		
					3	with angle, 90 degrees		
					4	with angle, 135 degrees		
					5	with angle, 180 degrees		
					6	with angle, 225 degrees		
					7	with angle, 270 degrees		
					8	with angle, 315 degrees		
						Cable protection		
						P00	without	
						P02	Flexible conduit NW12	
						P03	Hydraulic hose DN12	
							Cable length L	
							L2	2000 mm
							L3	3000 mm
							L4	4000 mm
								Gear wheel
								XXX Number of target wheel teeth
▼	▼	▼	▼	▼	▼	▼	▼	▼
2475FD	__	__	___	_	_	___	__	___

◄ **Product code**

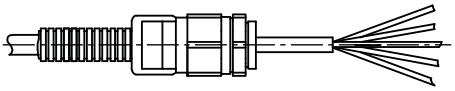
A Y-number is assigned for a customer-specific version. A special version is manufactured according to drawing or application description and may deviate from the standard technical specifications.

Preferred types, examples

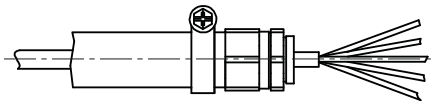
We can manufacture according to your specifications:

In addition to the extensive selection options for the cable outlet and cable protection (see type code), various configurations are also available for the flying lead.

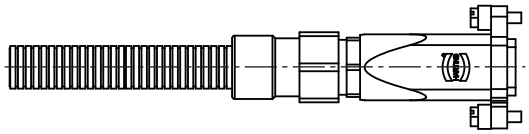
Examples for the flying lead, preferred types



Flexible conduit and flying lead

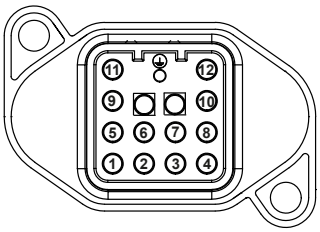


Rubber sleeve and flying lead



Flexible conduit with Harting connector HAN HPR

Assignment Harting connector HAN HPR, preferred type



PIN	E-	V-	EM	VM
1	PWM flat spot	PWM flat spot	PWM flat spot	PWM flat spot
2	PWM GND	PWM GND	PWM GND	PWM GND
3				
4	-	Rotational speed channel 2	-	Rotational speed channel 2
5	GND (0 V)	GND (0 V)	GND (0 V)	GND (0 V)
6	$+U_B$	$+U_B$	$+U_B$	$+U_B$
7				
8	PWM rail joint	PWM rail joint	PWM rail joint	PWM rail joint
9	PWM U_B	PWM U_B	PWM U_B	PWM U_B
10	NTC+	NTC+	NTC+	NTC+
11	Rotational speed channel 1	Rotational speed channel 1	Rotational speed channel 1	Rotational speed channel 1
12	NTC-	NTC-	NTC-	NTC-

If you decide to have our speed sensors assembled with cable protection and connectors, we recommend using the preferred types shown in the figure. The required materials are field-tested in large quantities and are always in stock. This guarantees the fastest delivery times with the best material availability and the lowest prices due to large purchasing volumes. If you need help in finding the product you need, please contact our internal sales team at support@lenord.de or call +49 208 9963-215.

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