MiniCODER

Configurable speed and position sensor with Mitsubishi interface

GEL 244xM

Technical information

Version 2024-06-26

General

- The measuring system comprises a MiniCODER and a target wheel for attachment to machine shafts.
- The MiniCODER scans the target wheel with magnetoresistive sensors without contact and detects the direction of rotation, speed and position.
- The MiniCODER can be adjusted and configured with the GEL 211CST4_2M mobile service unit.



MiniCODER GEL 2449M/GEL 2444M

Properties

- MHSSI (Mitsubishi High Speed Serial Interface)
- Maximum permissible rotational speed:
  Up to 100,000 min^{-1} (1)
- Resolution: Up to 26 bits
- Operating temperature range: -30 °C to +105 °C
- Degree of protection: IP 68
- Position determination by reference mark detection

Advantages

- Maintenance-free electronics
- Wear-free mechanics
- Low temperature drift and high signal quality
- Highest interference immunity due to completely screened metal housing
- Fast commissioning of the configurable MiniCODER in the assembled state without opening the spindle with mobile service unit
- High design flexibility due to customized manufacture of target wheels

Field of application

- Position and rotational speed measurement in machine tool manufacturing

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Protected trademarks/brands are not marked as such in this document.

(1) Depending on the selected optional extras Mechanically permissible speed depending on the design of the target wheel (see Technical Information ZAx/ZFx (DS51–ZAx/ZFx).

Right to technical changes and errors reserved.

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46145 Oberhausen, Germany

General description

Product construction

MiniCODERs are intended for contactless measurement of rotational or linear movements mainly in machines, gear units, motors or high-speed spindles. They are manufactured using the latest micro system technology and are fully encapsulated, making them particularly insensitive to shocks and vibrations.

Measuring system

The measuring system comprises a MiniCODER and a target wheel. The system does not require dedicated bearings, as the target wheel is mounted directly on the machine shaft.
The measuring system works without contact and is wear-free with maintenance-free electrical parts. It detects the direction of rotation, rotational speed and position of a rotating machine shaft.
The target wheel is made of ferromagnetic material and must be ordered separately.
The MiniCODER has a magnetic field that is changed by the rotating target wheel. The sensor detects the magnetic field change and the integrated electronics convert this into corresponding output signals.
External evaluation electronics can read in the output signals and determine the direction of rotation, rotational speed and position of the machine shaft.
A defined air gap between target wheel and MiniCODER is required for contactless measurement. To facilitate assembly, a corresponding distance gauge is included with the MiniCODER.

Reference mark

The MiniCODER can determine the machine shaft position by detecting a reference mark.

Module

The MiniCODER must be ordered to match the design of the reference mark and to match the module of the target wheel.

Explanations about the target wheel

Target wheels

For the detection of rotatory movements, MiniCODERs form a unit together with target wheels. The target wheel size and thus the diameter depend directly on the module and the number of teeth.

Standard target wheels

Standard target wheels are available at short notice ex factory. Specifications and designs see “Technical information ZAx/ZFx (DS51-ZAx/ZFx)”.

Customized target wheels

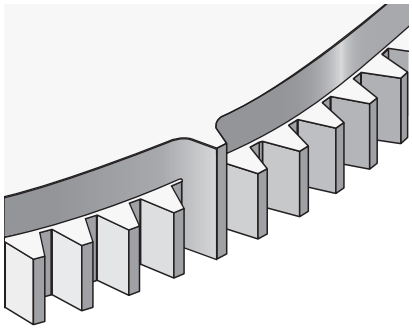
Customized target wheels are manufactured individually according to customer requirements. Please send a design drawing of your target wheel to **info@lenord.de**.

Reference marks

The MiniCODER can detect reference marks of the tooth form. The detected reference signal can be used to reference the position. This is required, for example, for automatic changing of a tool on a milling or grinding spindle. Selection of the reference mark is determined by the size and rotational speed of the target wheel used, as both affect the forces acting on the reference mark.

Reference mark Z – tooth on tooth

These target wheels are made from a single piece.



Z = reference mark – tooth
Standard target wheel

Module

The module is a toothing dimension for target wheels and describes the relationship between the number of teeth and the pitch diameter of the target wheel. For the same number of teeth, the smaller the module, the smaller the outside diameter.

The MiniCODER must be ordered to match the design of the reference mark and to match the module of the target wheel.

General description

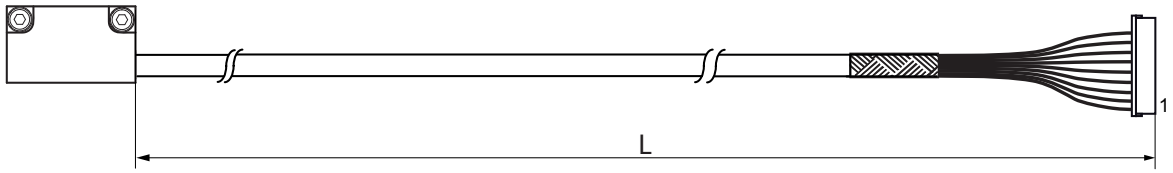
Connection types

L = Cable length

The connection cable screen is electroconductively connected to the MiniCODER housing.

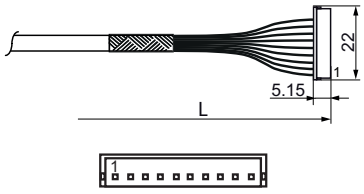
Connection example with GEL 2449M

Cable outlet MiniCODER	Cable design	Connection type
L (tangential left)	**—** (without temperature sensor cable)	**K** (Flying lead)



Assignments

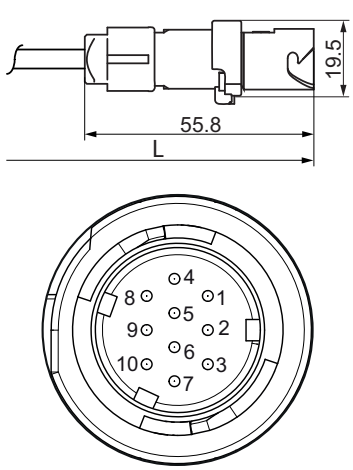
Connection type K

Flying lead (10-pin female connector[1]) (plug-in view)	Pin	Core color	Signal/Function	
	1	red	U_B	+5 V supply voltage
	2	white	RQ+	Positive request signal
	3	brown	RQ-	Inverse request signal
	4	pink	Data+	Positive data
	5	black	Data-	Inverse data
	6	green	n.c.	unallocated
	7	gray	n.c.	unallocated
	8	yellow	n.c.	unallocated
	9	blue	0 V	GND
	10	unallocated		

[1] The delivery takes place with connected test connector from Lenord+Bauer.

If a mobile service unit is to be used for the function test, the test plug must not be removed!

Connection type Z

10-pin male connector (plug-in view)	Pin	Signal/Function	
	1	n.c.	unallocated
	2	n.c.	unallocated
	3	RQ+	Positive request signal
	4	RQ-	Inverse request signal
	5	Data+	Positive data
	6	Data-	Inverse data
	7	U_B	+ 5 V power supply
	8	0 V	GND
	9	Screen	Screen
	10	n.c.	unallocated

General description of the MHSSI interface

Signal pattern M

The MiniCODER GEL 244xM is a digital encoder kit with reference signal. It transmits data via a digital interface (Mitsubishi High Speed Serial Interface).
Data transmission only takes place upon request. The MiniCODER decodes incoming requests (RQ+/RQ-) from a higher level control system and then sends the requested data (Data+/Data-) to the higher level control system.

The MiniCODER can be connected directly to the following Mitsubishi higher level control systems:

Possible applications

Mitsubishi CNC series M800/M80/E80/C80	
Spindle drive	**Servo drive**
Model ▪ MDS-E-SP series ▪ MDS-EH-SP series ▪ MDS-EJ-SP series ▪ MDS-EM-SP series ▪ MDS-EMH-SP series	Model ▪ MDS-E-Vx series ▪ MDS-EH-Vx series ▪ MDS-EJ-Vx series ▪ MDS-EJH-Vx series ▪ MDS-EM-Vx series ▪ MDS-EMH-Vx series
Firmware number: BND-1501W202	Firmware number: BND-1501W201
Firmware version: B2 or higher	Firmware version: B2 or higher

Plug and Play
Any target wheel diameters are possible for freely selectable teeth numbers. The application can be connected directly to Mitsubishi higher level control systems by configuring the measuring system with mobile service unit.

Alarm and warning table

Alarm number (MiniCODER connected with CN2)	2B	2C	2D	2E	48	49	4 A	4B
Alarm number (MiniCODER connected with CN3)	1B	1C	1D	1E	27	28	29	2 A
GEL 244xM… (ID: 9F)	Signal error	Amplitude warning	EEPROM error	Under voltage	Hardware error	Warning overspeed	Counter error	Temperature warning

Optional extras H, P

The MiniCODER can be tested and configured with the GEL 211CST4␣2M mobile service unit.
The following functions are available:
- MiniCODER functional test
- Target wheel functional test
- Changing the resolution and the number of target wheel teeth
- Determining the parameters to be set on the higher level control system

If the number of teeth set in the MiniCODER in the factory does not match the number of teeth of the target wheel, the number of teeth in the MiniCODER must be adjusted to the number of teeth of the target wheel using the mobile service unit.

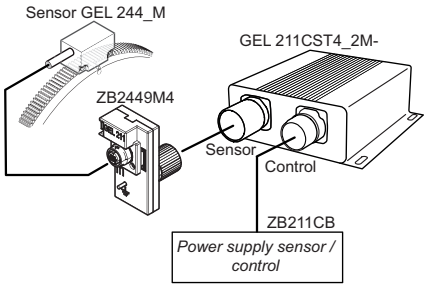
Mobile service unit GEL 211CST4␣2M



- Analysis, optimization and parameterization of the MiniCODERs with digital RS-422/ RS-485 interface, for example, GEL 244xM
- Compact and mobile
- Plug and play: Connection to the MiniCODER via the external connector; no disassembly required
- Menu-driven adjustment to optimize the signal quality in the installed state
- Checking the quality and installation situation of the target wheel
- Easy operation via SensorDEVICE^{UI} in web browser on any end device such as smartphone, tablet or PC; no software installation necessary
- Communication via LAN or WLAN

Accessories GEL 244␣M

Item no.:	Designation:
ZB2449M1	Adapter cable 3.0 m for **GEL 244␣M␣␣␣␣Z␣␣␣␣** (connection to Mitsubishi higher level control systems)
ZB2449M3	Adapter cable 2.0 m for **GEL 244␣M␣␣␣␣Z␣␣␣␣** (connection to Mitsubishi higher level control systems)
PK211C-244XM-E	PK211C-244XM-E (Ethernet), comprising: ▪ Mobile service unit GEL 211CST4E2M ▪ Universal adapter box, ZB2449M4 ▪ Power supply unit 5 V, ZB211CB ▪ Operating instructions, D-71B-211C or D-53B-211C ▪ Case, XW1303
PK211C-244XM-W	PK211C-244XM-W (WLAN), comprising: ▪ Mobile service unit GEL 211CST4W2M ▪ Universal adapter box, ZB2449M4 ▪ Power supply unit 5 V, ZB211CB ▪ Operating instructions, D-71B-211C or D-53B-211C ▪ Case, XW1303



GEL 211CST4␣2M: Connectivity

Technical data measuring system

	GEL 2444M␣␣␣3	GEL 2444M␣␣␣4	GEL 2444M␣␣␣5
Target wheel			
Material	Ferromagnetic steel		
Target wheel width	10.0 mm		
Reference mark	Tooth (**Z**)		
Module m[1]	0.3	0.4	0.5
Geometric data			
Nominal air gap	0.15 mm ± 0.02 mm	0.20 mm ± 0.02 mm	0.20 mm ± 0.03 mm

(1) Other modules upon request

Technical data GEL 2444M

Electrical data	
Supply voltage U_B (polarity reversal protected, overvoltage protected)	5 V DC ± 5 %
Current consumption (without load)	≤ 80 mA
Digital interface	RS-485 with Mitsubishi protocol: MHSSI (Mitsubishi High Speed Serial Interface) 2.5 Mbit (RS-422/RS-485 compliant)
Signal identifiers of the interface	Request (RQ): Data request signal from the higher level control system Data (data): Data output from the MiniCODER as a response to the data request signal
Data transmission rate	2.5 Mbit/s
Power consumption without load	≤ 0.5 W
Power-on time	< 0.5 s
Mechanical data	
Housing material	Zinc die casting
Weight	30 g
Maximum permissible rotational speed	≤ 100,000 min^{-1} (1)
Cable data	
Cable structure (number of cores x core cross-section)	9 x 0.15 mm^2 [25 AWG]
Cable diameter	5 mm
Minimum bending radius	25 mm
Maximum permissible cable length	≤ 30 m (2)
Ambient data	
Working temperature range	0 °C to +70 °C
Operating and storage temperature range	-30 °C to +105 °C
Degree of protection	IP 68
Dielectric strength	500 V AC; as per DIN EN 61439-1
Electromagnetic compatibility	Electromagnetic emission DIN EN 61000-6-4; DIN EN 61000-6-3 Electromagnetic immunity DIN EN 61000-6-2; DIN EN 61000-6-1
Vibration resistance	200 m/s^2 (EN 60068-2-6)
Shock resistance	2000 m/s^2 (EN 60068-2-27)
MTTF FIT	4,325,201 h at 55 °C 231.203 10^{-9} h^{-1} at 55 °C
Approvals	
European Economic Area	Conformity in accordance with EMC Directive 2014/30/EU CE

(1) Depending on the selected optional extras Mechanically permissible speed depending on the design of the target wheel (see Technical Information ZAx/ZFx (DS51–ZAx/ZFx).

(2) Connsider voltage drop on the power supply cable; recommended cable length: maximum 2.5 m (no twisted pair)

Optional extras H

Configuration

The number of teeth configured in the MiniCODER with optional extras H must match the number of teeth of the target wheel. The resolution is dependent of the maximum speed. The maximum configurable resolution is 26 bits/0.0000054° (67,108,864 positions per revolution).

Factory settings(1)

Designation	Module 3 (m= 0.3)	Module 4 (m= 0.4)	Module 5 (m= 0.5)
Positions per revolution	16777216	16777216	16777216
Resolution	24 bit/0.0000215°	24 bit/0.0000215°	24 bit/0.0000215°
Target wheel tooth number	256	192	150

Optional extras P

Configuration

The number of teeth configured in the MiniCODER with optional extras P must match the number of teeth of the target wheel. The resolution is dependent of the number of teeth of the target wheel and the maximum speed. The maximum configurable resolution is 19 bits/0.00068° (524288 positions per revolution).

Resolution for various applications(2)

Application	Standard		Rotational speed					Positioning
Interpolation per tooth cycle	512		256					1024
Target wheel tooth number	128	192	160	204	256	384	512	512
Maximum rotational speed (min^{-1}) (3)	41199	27466	65918	51700	41199	27466	20599	5150
Positions per revolution	65536	65536	32768	32768	65536	65536	131072	524288
Resolution	16 bit/ 0.00549°	16 bit/ 0.00549°	15 bit/ 0.0110°	15 bit/ 0.0110°	16 bit/ 0.00549°	16 bit/ 0.00549°	17 bit/ 0.00274°	19 bit/ 0.00068°

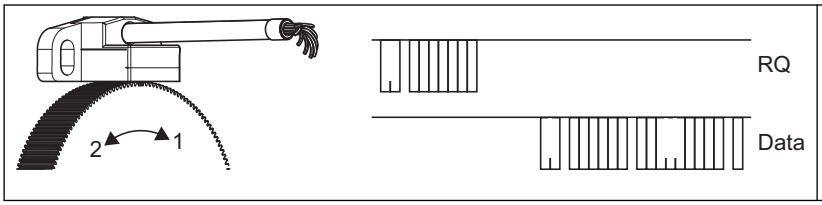
Calculation of the maximum rotational speed

$$\text{Maximum rotational speed} = \frac{2.7 \cdot 10^9}{\text{Number of teeth} \cdot \text{Interpolation}}\ \text{min}^{-1}$$

Factory settings(1)

Designation	Module 3 (m= 0.3)	Module 4 (m= 0.4)	Module 5 (m= 0.5)
Interpolation per tooth cycle	512	512	512
Target wheel tooth number	256	192	150

Assignment direction of rotation



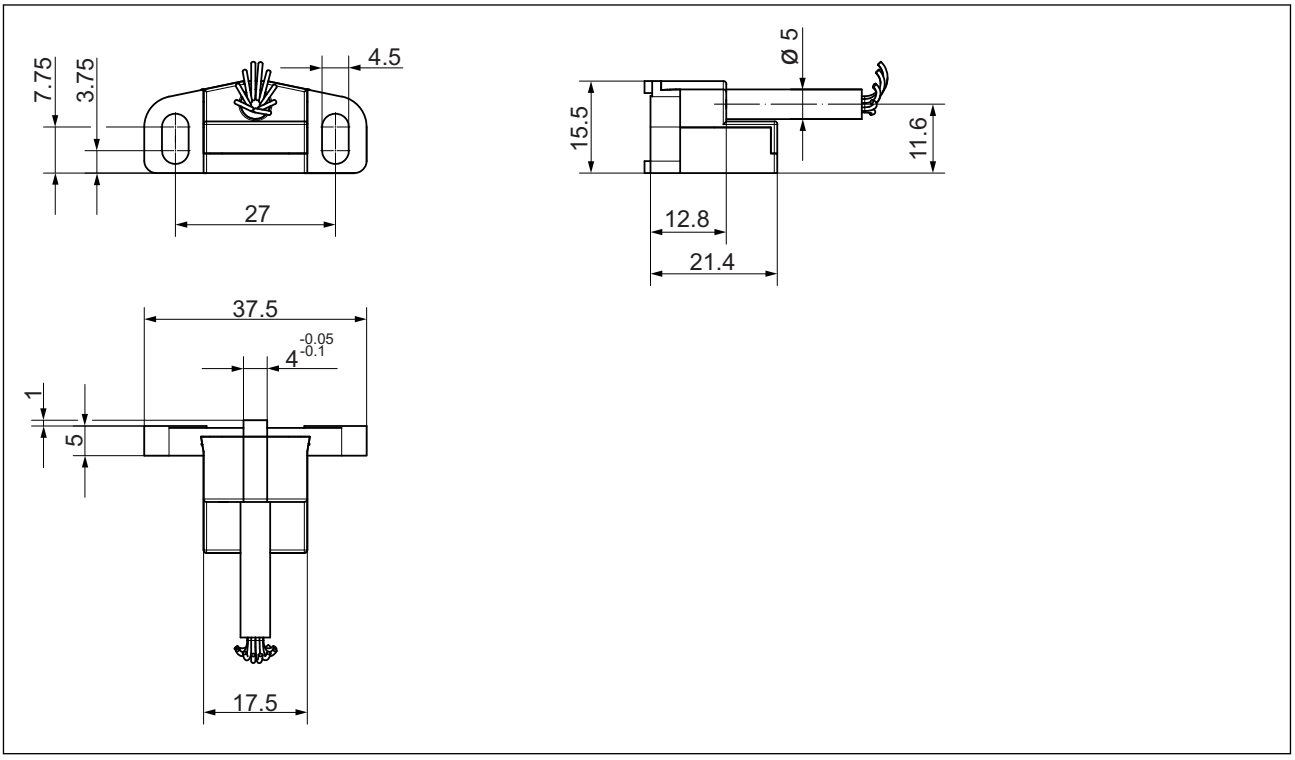
1 Clockwise direction of rotation
→ Counter value increasing
2 Counterclockwise direction of rotation
→ Counter value decreasing

(1) Other factory settings are available upon request.
(2) Configuration with the mobile service unit GEL 211CST
(3) The maximum speed is limited by the internal electronics. The maximum mechanical speed depends on the selection of the target wheel.

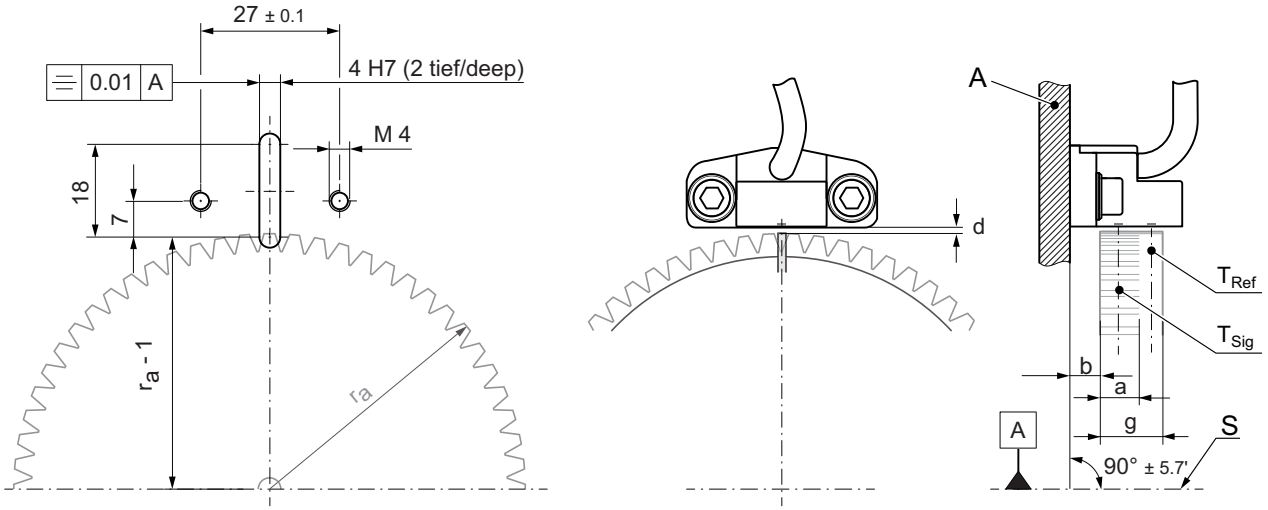
Dimensional drawings

All dimensions in millimeters; general tolerance DIN ISO 2768 – mK

Dimensional drawing cable outlet MiniCODER: Axial (G)



Hole pattern and installation dimensions

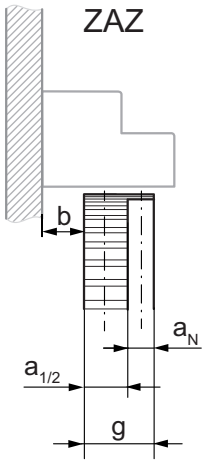


All dimensions in millimeters

a Width of the signal track (depending on the target wheel)
b Distance from mounting surface to target wheel: depending on the target wheel geometry (for example, width of signal track)
d Air gap: depending on the module (→ page 8)
g Target wheel width
r_a = $d_a/2$ (with d_a = target wheel tip circle diameter)
A Mounting device
S Center line machine shaft/target wheel
T_{Ref} Reference track (target wheel)
T_{Sig} Signal track (target wheel)

Installation dimensions for standard target wheels

Dimension	ZAZ
g	10
$a_{1/2}$	6
a_N	4
b	7.5 ± 0.5



Type code

	Signal pattern							
	M MHSSI (Mitsubishi High Speed Serial Interface) 2.5 Mbit							
		Reference mark[1]						
		Z Tooth on tooth						
			Optional extras					
			H Resolution configurable up to 26 bits, independent of the maximum speed.					
			P Resolution configurable up to 19 bits, depending on the maximum speed.					
				Cable outlet MiniCODER[2]				
				G Axial				
					Module [3]			
					3 m= 0.3			
					4 m= 0.4			
					5 m= 0.5			
						Connection type		
						K Flying lead[4]		
						Z 10-pin male connector (only available as cable length 100/120/200/250)		
							Cable length L	
							030 0.3 m	
							050 0.5 m	
							100 1.0 m	
							120 1.2 m	
							150 1.5 m	
							200 2.0 m	
							250 2.5 m	
								Cable design for temperature sensor (2 m)
								– Without temperature sensor cable
2444	_	_	_	_	_	_	_ _ _	_

For MiniCODERs with optional extras **H** or **P** the resolution and the number of teeth can be configured with the mobile service unit GEL 211CST4␣2M. You can find the factory settings on → page 10. Other factory settings are available upon request.
If you have any questions, please contact our Customer Support team (e-mail: support@lenord.de) or one of our company locations (→ page 20).

Technical information on MiniCODERs with other signal patterns is available online at www.lenord.com or can be requested from our support team (support@lenord.de).

(1) Other reference marks upon request
(2) Other cable outlets upon request
(3) Other modules upon request
(4) The delivery takes place with connected test connector from Lenord+Bauer.

Technical data measuring system

	GEL 2449M␣␣␣1	GEL 2449M␣␣␣4
Target wheel		
Material	Ferromagnetic steel	
Target wheel width	ZAZ: 10.0 mm; ZFF: 8.6 mm	
Reference mark	Tooth (**Z**)	
Module m[1]	1.0	0.4
Geometric data		
Nominal air gap	0.50 mm ± 0.03 mm	0.20 mm ± 0.02 mm

(1) Other modules upon request

Technical data GEL 2449M

Electrical data	
Supply voltage U_B (polarity reversal protected, overvoltage protected)	5 V DC ± 5 %
Current consumption (without load)	≤ 80 mA
Digital interface	RS-485 with Mitsubishi protocol: MHSSI (Mitsubishi High Speed Serial Interface) 2.5 Mbit (RS-422/RS-485 compliant)
Signal identifiers of the interface	Request (RQ): Data request signal from the higher level control system Data (data): Data output from the MiniCODER as a response to the data request signal
Data transmission rate	2.5 Mbit/s
Power consumption without load	≤ 0.5 W
Power-on time	< 0.5 s
Mechanical data	
Housing material	Zinc die casting
Weight	100 g
Maximum permissible rotational speed	≤ 100,000 min^{-1} (1)
Cable data	
Cable structure (number of cores x core cross-section)	9 x 0.15 mm^2 [25 AWG]
Cable diameter	5 mm
Minimum bending radius	25 mm
Maximum permissible cable length	≤ 30 m (2)
Ambient data	
Working temperature range	0 °C to +70 °C
Operating and storage temperature range	-30 °C to +105 °C
Degree of protection	IP 68
Dielectric strength	500 V AC; as per DIN EN 61439-1
Electromagnetic compatibility	Electromagnetic emission DIN EN 61000-6-4; DIN EN 61000-6-3 Electromagnetic immunity DIN EN 61000-6-2; DIN EN 61000-6-1
Vibration resistance	200 m/s^2 (EN 60068-2-6)
Shock resistance	2000 m/s^2 (EN 60068-2-27)
MTTF FIT	3,828,120 h at 55 °C 261 10^{-9} h^{-1} at 55 °C
Approvals	
European Economic Area	Conformity in accordance with EMC Directive 2014/30/EU CE

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(2) Connsider voltage drop on the power supply cable; recommended cable length: maximum 2.5 m (no twisted pair)

Optional extras H

Configuration

The number of teeth configured in the MiniCODER with optional extras H must match the number of teeth of the target wheel. The resolution is dependent of the maximum speed. The maximum configurable resolution is 26 bits/0.0000054° (67,108,864 positions per revolution).

Factory settings(1)

Designation	Module 4 (m= 0.4)	Module 1 (m= 1.0)
Positions per revolution	16777216	16777216
Resolution	24 bit/0.0000215°	24 bit/0.0000215°
Target wheel tooth number	192	75

Optional extras P

Configuration

The number of teeth configured in the MiniCODER with optional extras P must match the number of teeth of the target wheel. The resolution is dependent of the number of teeth of the target wheel and the maximum speed. The maximum configurable resolution is 19 bits/0.00068° (524288 positions per revolution).

Resolution for various applications(2)

Application	Standard		Rotational speed					Positioning
Interpolation per tooth cycle	512		256					1024
Target wheel tooth number	128	192	160	204	256	384	512	512
Maximum rotational speed (min^{-1}) (3)	41199	27466	65918	51700	41199	27466	20599	5150
Positions per revolution	65536	65536	32768	32768	65536	65536	131072	524288
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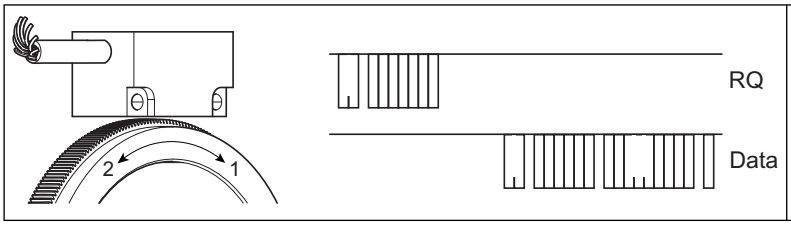
Calculation of the maximum rotational speed

$$\text{Maximum rotational speed} = \frac{2.7 \cdot 10^9}{\text{Number of teeth} \cdot \text{Interpolation}}\ \text{min}^{-1}$$

Factory settings(1)

Designation	Module 4 (m= 0.4)	Module 1 (m= 1.0)
Interpolation per tooth cycle	512	512
Target wheel tooth number	192	75

Assignment direction of rotation



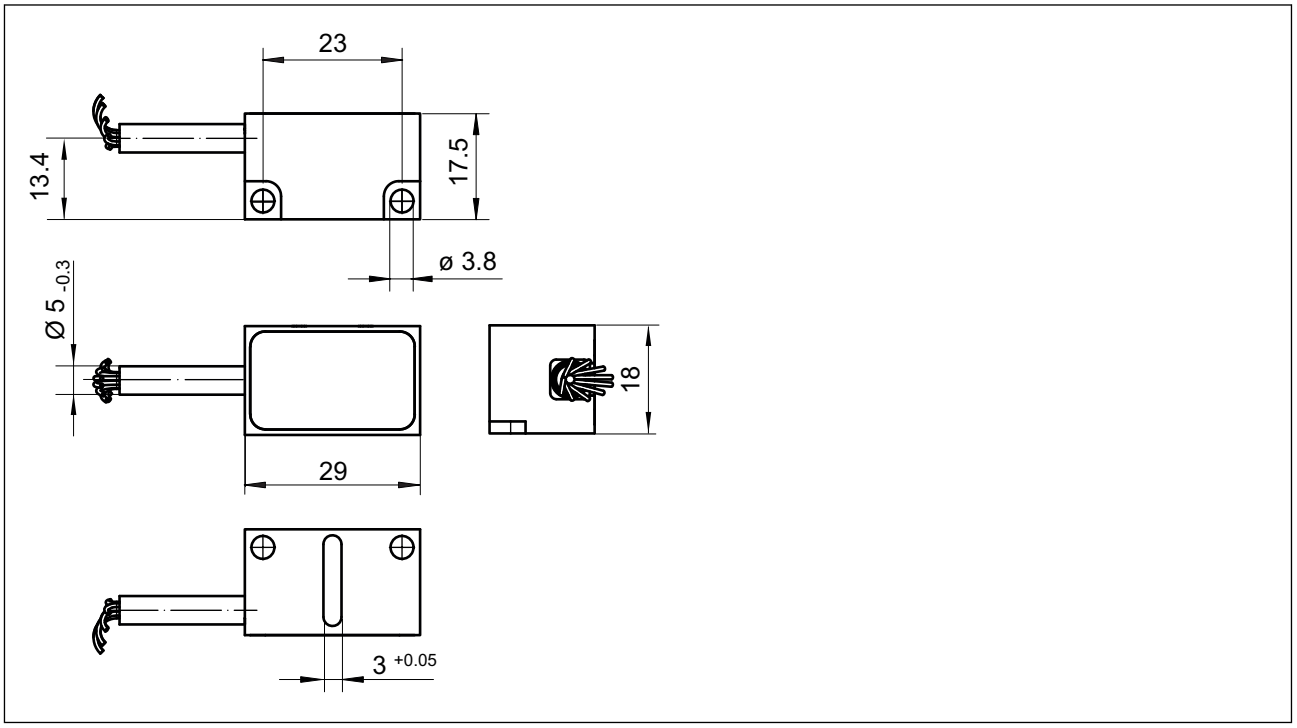
1 Clockwise direction of rotation
→ Counter value increasing
2 Counterclockwise direction of rotation
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(2) Configuration with the mobile service unit GEL 211CST
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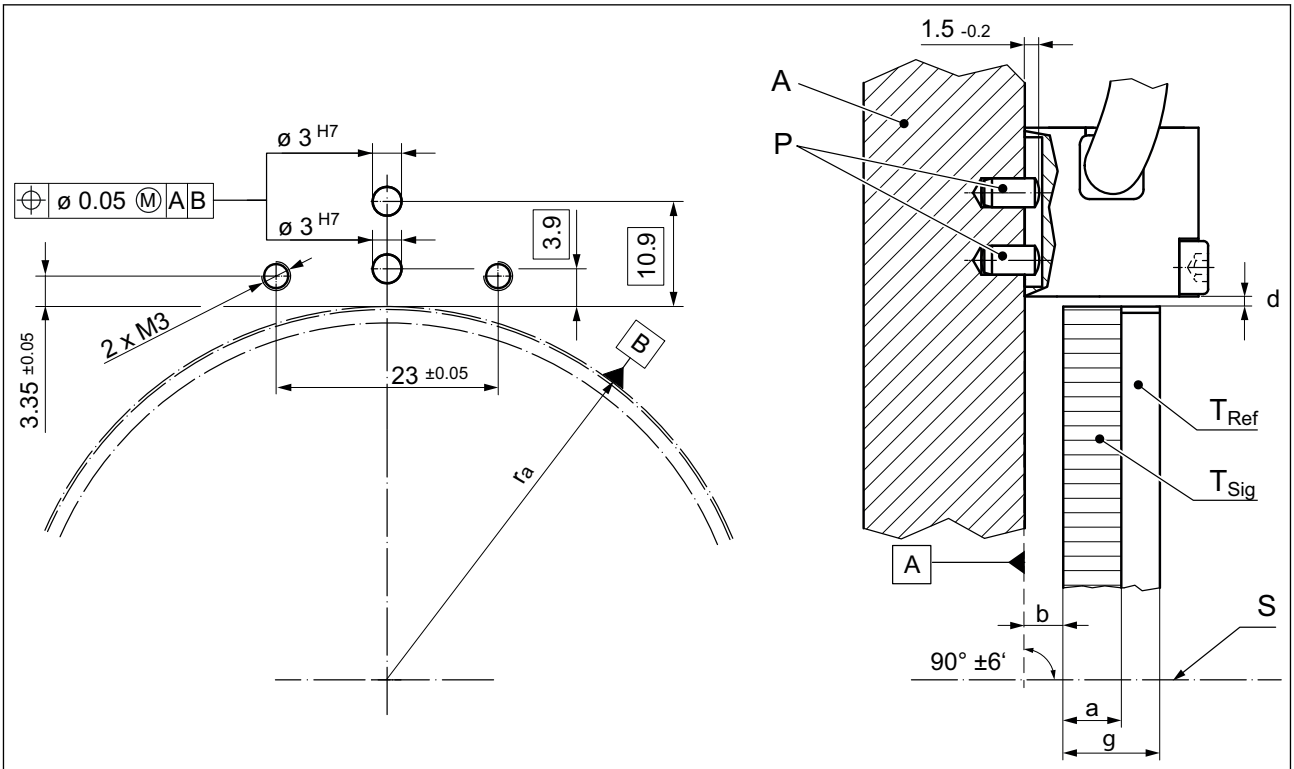
Dimensional drawings

All dimensions in millimeters; general tolerance DIN ISO 2768 – mK

Dimensional drawing – cable outlet MiniCODER: Tangential left (L)



Hole pattern and installation dimensions

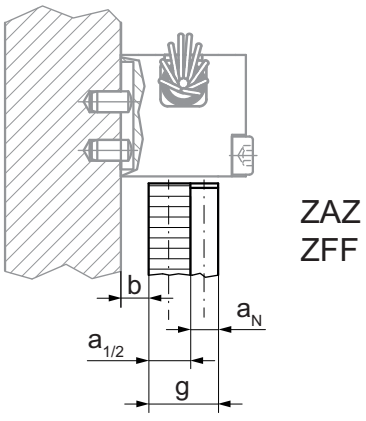


All dimensions in millimeters

a Width of signal track
b Distance from mounting surface to target wheel: depending on the target wheel geometry (for example, width of signal track)
d Air gap: depending on the module (→ page 14)
g Target wheel width
r_a = $d_a/2$ (with d_a = target wheel tip circle diameter)
A Mounting device
P Positioning pins M3
S Center line machine shaft/target wheel
T_{Ref} Reference track (target wheel)
T_{Sig} Signal track (target wheel)

Installation dimensions for standard target wheels

Dimension	ZAZ	ZFF
g	10	8.6
$a_{1/2}$	6	4.6
a_N	4	4
b	4 ± 0.2	4.7 ± 0.2



Type code

	Signal pattern								
	M MHSSI (Mitsubishi High Speed Serial Interface) 2.5 Mbit								
		Reference mark							
		Z Tooth on tooth							
			Optional extras						
			H Resolution configurable up to 26 bits, independent of the maximum speed.						
			P Resolution configurable up to 19 bits, depending on the maximum speed.						
				Cable outlet MiniCODER					
				L Tangential, cable outlet left					
					Module (1)				
					1 m= 1.0				
					4 m= 0.4				
						Connection type			
						K Flying lead(2)			
						Z 10-pin male connector (only available as cable length 100/120/200/250)			
							Cable length L		
							030 0.3 m		
							050 0.5 m		
							100 1.0 m		
							120 1.2 m		
							150 1.5 m		
							200 2.0 m		
							250 2.5 m		
								Cable design for temperature sensor (2 m)	
								– Without temperature sensor cable	
2449	_	_	_	_	_	_	_ _ _	_	

For MiniCODERs with optional extras **H** or **P** the resolution and the number of teeth can be configured with the mobile service unit GEL 211CST4␣2M. You can find the factory settings on → page 16. Other factory settings are available upon request.
If you have any questions, please contact our Customer Support team (e-mail: support@lenord.de) or one of our company locations (→ page 20).

Technical information on MiniCODERs with other signal patterns is available online at www.lenord.com or can be requested from our support team (support@lenord.de).

(1) Other modules upon request
(2) The delivery takes place with connected test connector from Lenord+Bauer.

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