

# MiniCODER

Configurable speed  
and position sensor

**GEL 244x**  
*digital interfaces*

## Technical information

Version 2019-10

### General

- The measuring system comprises a MiniCODER and a precision target wheel for attachment to shafts
- Precision target wheels are to be ordered separately
- The MiniCODER contactlessly scans the precision target wheel using magnetoresistive sensors and acquires the direction of rotation, rotational speed and position
- Data is transmitted via a digital interface
- The MiniCODER can be tested and configured using the testing and programming unit

### Interfaces available

#### MHSSI

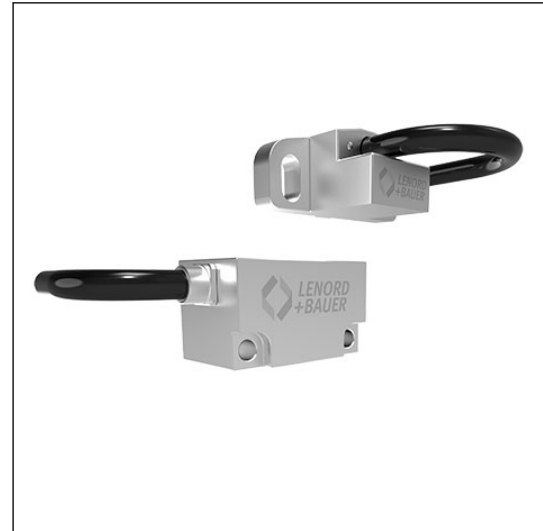
- MHSSI (Mitsubishi High Speed Serial Interface)  
2.5 Mbit (RS 422-compliant)
- CNC series M800/M80/E80/C80

### Advantages

- Maintenance and wear-free
- Low temperature drift and high signal quality
- Highest immunity to interference due to fully screened metal housing
- Resistant to typical oils
- Quick commissioning of the configurable MiniCODER in the assembled state using the testing and programming unit without the need to open the spindle
- High design flexibility due to custom manufacture of precision target wheels

### Field of application

- Position and rotational speed acquisition in machine tool engineering



MiniCODER GEL 2449 / GEL 2444

*Right to technical changes and errors reserved.*

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 **LENORD  
+BAUER**

# General description

## Construction

The MiniCODERs are intended to be used for the contactless measurement of rotary and linear movements predominantly in machines, gears, motors or high-speed spindles. They are manufactured using the latest micro system technology and are fully encapsulated, as such they are particularly resistant to shocks and vibration.

## Measuring system

The measuring system comprises a MiniCODER and a precision target wheel. The system does not need dedicated bearings for this task, as the precision target wheel is mounted directly on the shaft.

The measuring system operates contactlessly and is maintenance and wear-free. It acquires the direction of rotation, rotational speed and position of the rotating shaft.

The precision target wheel is made of ferromagnetic material and is to be ordered separately.

The MiniCODER has a magnetic field that is changed by the rotating precision target wheel. The sensor acquires the change in the magnetic field and the integrated electronics convert this information into appropriate output signals.

External electronics can read the output signals and determine the direction of rotation, rotational speed and position of the shaft.

A defined air gap between the precision target wheel and MiniCODER is required for the contactless measurement.

To make assembly easier, a corresponding distance gauge is included with the MiniCODER.

## Reference mark

The MiniCODER can determine the position of a shaft by acquiring a reference mark.

## Module

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

## Explanations about the target wheel

### Target wheels

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

### Standard target wheels

Standard target wheels are available on short delivery times from stock. For specifications and designs see "Technical information ZAx / ZFx".

### Custom target wheels

Custom target wheels are manufactured individually to customer requirements. Please send us a design drawing of your target wheel (if possible as a dxf file) to [info@lenord.de](mailto:info@lenord.de).

### Reference marks

The MiniCODER can detect reference marks in the form of a slot, lug or tooth. The pulse detected can be used for referencing the position. This feature is necessary, for example, to change automatically a tool in a milling spindle or grinding spindle.

The selection of the reference mark is defined by the size and rotational speed of the target wheel used, as both parameters have an effect on the forces acting on the reference mark. In case of new designs we recommend the usage of a target wheel with reference mark variant "Z".

### Reference mark N – lug

A metal lug integrated into the target wheel and that is positioned exactly between two teeth is detected. The lug must be made of ferromagnetic material and must not protrude beyond the outside diameter of the target wheel. Due to the forces acting on the reference lug, this variant is only allowed to be used in a very limited speed range.

### Reference mark M – slot

The MiniCODER detects a reference slot between two teeth. This target wheel is made up of two pieces for technical reasons.

### Reference mark Z – tooth on tooth

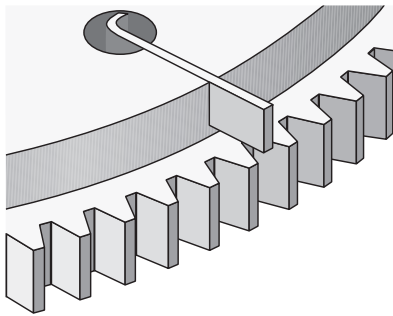
These target wheels are made from one piece.

### Module

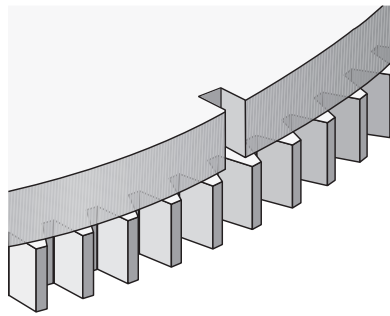
The module is a tooth parameter for tooth wheels and describes the relationship between the number of teeth and the diameter of the tooth wheel. Given the same number of teeth, the smaller the module, the smaller the outside diameter.



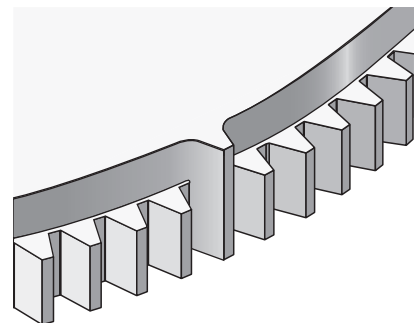
The MiniCODER must be ordered to suit the design of the reference mark and to suit the module of the target wheel.



**N** = Reference mark – lug



**M** = Reference mark – slot



**Z** = Reference mark – tooth

# General description

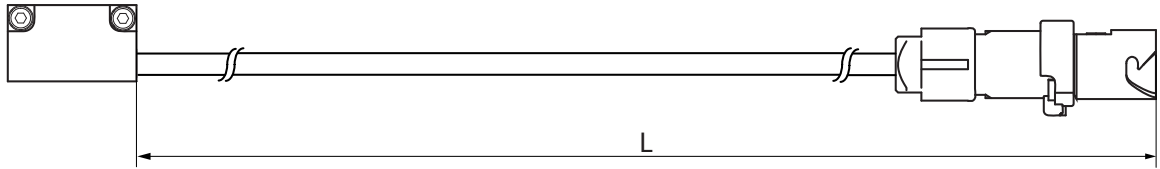
## Connection types

L = cable length

## Connection example

### GEL 2449M

Cable outlet MiniCODER	Cable version	Connection type
L (tangential left)	— (without temperature sensor cable)	Z (10-pin plug)

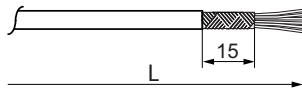


## Pin layouts

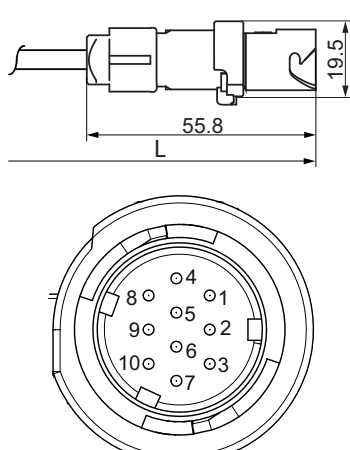


The screen on the connection cable is connected electrically to the MiniCODER housing.

## Connection type K

Flying lead	Core colour	Signal / function	
	white	RQ+	Positive request signal
	brown	RQ-	Inverse request signal
	grey	n.c.	Not used
	blue	0 V	GND
	red	U <sub>B</sub>	+ 5 V power supply
	pink	Data+	Positive data
	black	Data-	Inverse data
	yellow	n.c.	Not used
	green	n.c.	Not used

## Connection type Z

10-pin plug	Pin	Signal / function	
	1	n.c.	Not used
	2	n.c.	Not used
	3	RQ+	Positive request signal
	4	RQ-	Inverse request signal
	5	Data+	Positive data
	6	Data-	Inverse data
	7	U <sub>B</sub>	+ 5 V power supply
	8	0 V	GND
	9	screen	Screen
	10	n.c.	Not used

# Description of MHSSI interface

## Signal pattern M

The MiniCODER GEL 244xM is an incremental rotary encoder with reference signal. It transmits data via a digital serial interface (Mitsubishi High Speed Serial Interface).

Data is only transmitted upon request. The MiniCODER decodes requests (RQ+/RQ-) received from a control system and then sends the data requested (Data+/Data-) to the control system.

The MiniCODER can be connected directly to Mitsubishi CNC series M800/M80/E80/C80.

Application possibilities M800/M80/E80/C80	
Spindle drive	Servo drive
Models <ul style="list-style-type: none"> <li>▪ MDS-E-SP series</li> <li>▪ MDS-EH-SP series</li> <li>▪ MDS-EJ-SP series</li> <li>▪ MDS-EM-SP series</li> <li>▪ MDS-EMH-SP series</li> </ul>	Models <ul style="list-style-type: none"> <li>▪ MDS-E-Vx series</li> <li>▪ MDS-EH-Vx series</li> <li>▪ MDS-EJ-Vx series</li> <li>▪ MDS-EHG-Vx series</li> <li>▪ MDS-EM-Vx series</li> <li>▪ MDS-EMH-Vx series</li> </ul>
Firmware number: BND-1501W202	Firmware number: BND-1501W201
Firmware version: B2 or later	Firmware version: B2 or later



### Plug and Play

Any tooth wheel diameter is possible so the number of teeth can be selected as required. The application can be connected directly to Mitsubishi control systems by configuring the measuring system using the testing and programming unit.

## Alarm and warning table

Alarm number (MiniCODER connected to CN2)	2B	2C	2D	2E	48	49	4A	4B
Alarm number (MiniCODER connected to CN3)	1B	1C	1D	1E	27	28	29	2A
GEL 244xM... (ID: 9F)	Signal fault	Amplitude warning	EEPROM fault	Under-voltage	Hardware fault	Overspeed warning	Counter fault	Temperature fault

## Optional extras P (configurable)

The MiniCODER can be tested and configured using the testing and programming unit GEL 211CST4\_2M-.

The following functions are available:

- MiniCODER function test
- Target wheel function test
- Changing the resolution

# Accessories MHSSI interface

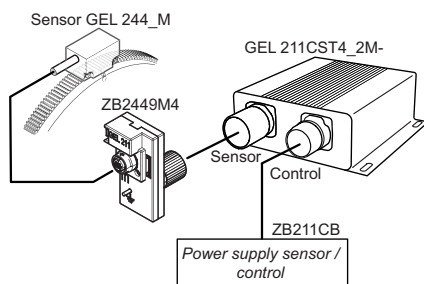
## GEL 211CST4\_2M-



- Testing sensors from Lenord+Bauer, e.g. MiniCODER GEL 244\_M
- Transmission of the data via Ethernet or WLAN
- Display of the data in a web browser, independent of the operating system
- Quick commissioning in the assembled state without the need to open the spindle
- Configuration of the resolution
- Function test on the MiniCODER and the target wheel

### Accessories 244\_M

Item no.:	Identifier:
ZB2449M1	Adapter cable 3.0 m for <b>GEL 244_M</b> ... <b>Z</b> ... (connection to Mitsubishi control system)
ZB2449M3	Adapter cable 2.0 m for <b>GEL 244_M</b> ... <b>Z</b> ... (connection to Mitsubishi control system)
ZB2449M2	Adapter cable for <b>GEL 244_M</b> ... <b>Z</b> ... (connection to GEL 211CST4_2M-)
GEL 211CST4E2M-	Testing and programming unit with Ethernet interface
GEL 211CST4W2M-	Testing and programming unit with WLAN interface
ZB211CB	Power supply unit 211C 5V (connection of sensor voltage to GEL 211CST4_2M-)
ZB2449M4	Universal adapter box (connection of GEL 244_M to GEL 211CST4_2M-)
PK211C-244XM-E	Configuration kit, consisting of: <ul style="list-style-type: none"> <li>▪ GEL 211CST4E2M-</li> <li>▪ Universal adapter box, ZB2449M4</li> <li>▪ Power supply unit 211C 5 V, ZB211CB</li> <li>▪ Operating instructions, D-71B-211C</li> <li>▪ Case, XW1303</li> </ul>
PK211C-244XM-W	Configuration kit, consisting of: <ul style="list-style-type: none"> <li>▪ GEL 211CST4W2M-</li> <li>▪ Universal adapter box, ZB2449M4</li> <li>▪ Power supply unit 211C 5 V, ZB211CB</li> <li>▪ Operating instructions, D-71B-211C</li> <li>▪ Case, XW1303</li> </ul>



### GEL 211CST4\_2M-: connections

# GEL 2444 with MHSSI interface

## Technical data

	GEL 2444M_...3	GEL 2444M_...4	GEL 2444M_...5
<b>Target wheel</b>			
Module <sup>(1)</sup>	0.3	0.4	0.5
Width of the signal track	≥ 4.0 mm		
Material	Ferromagnetic steel		
Reference mark	Lug ( <b>N</b> ), tooth ( <b>Z</b> )		
<b>Geometric data</b>			
Centre distance between sensor elements (1/2 and N) $c_2$	6 mm		
Distance mounting surface to sensor element (1/2) $c_1$	9.5 mm		
Air gap permitted	0.15 mm ± 0.02 mm	0.20 mm ± 0.02 mm	0.20 mm ± 0.03 mm
<b>Electrical data</b>			
Supply voltage $U_B$	5 V DC ± 5%, polarity reversal protected, overvoltage protected		
Current consumption (without load)	≤ 80 mA		
Digital interface	MHSSI (Mitsubishi High Speed Serial Interface) 2.5 Mbit (RS 422-compliant)		
Signal identifiers	Request: Data request signal from the control system Data: Data output from the MiniCODER as response to the data request signal		
Data transmission rate	2.5 Mbit/s		
Power consumption without load	≤ 0.5 W		
Switch-on time	< 0.5 s		
Electromagnetic compatibility	Electromagnetic emissions DIN EN 61000-6-4:2011-09; DIN EN 61000-6-3:2011-09 Electromagnetic immunity DIN EN 61000-6-2:2006-03; DIN EN 61000-6-1:2007-10		
Dielectric strength	500 V AC; as per DIN EN 61439-1:2012-06		
<b>Mechanical data</b>			
Weight	30 g		
Housing material	Die cast zinc		
Rotational speed	≤ 40,000 min <sup>-1</sup> <sup>(2)</sup>		
Operating temperature range	0 °C to +70 °C		
Operating and storage temperature range	-30 °C to +105 °C		
Degree of protection	IP 68		
Vibration resistance	200 m/s <sup>2</sup> (EN 60068-2-6:2008-10)		
Shock resistance	2000 m/s <sup>2</sup> (EN 60068-2-27:2010-02)		
MTTF	4,325,201 h at 55 °C		
FIT	231.203 10 <sup>-9</sup> h <sup>-1</sup> at 55 °C		
<b>Electrical connection</b>			
Number of cores x core cross-section	9 x 0.15 mm <sup>2</sup>		
Max. permitted cable length	≤ 30 m <sup>(3)</sup> <sup>(4)</sup>		
Cable diameter	5 mm		
Min. bending radius	25 mm		

(1) Further modules upon request

(2) Depending on the number of teeth and resolution

(3) In operation

(4) Pay attention to voltage drop on the supply cable; recommended cable length: max. 2.5 m (no twisted pair)

# GEL 2444 with MHSSI interface

## Standard target wheels <sup>(1)</sup> <sup>(2)</sup>

Application	Standard		Rotational speed					Positioning (high resolution)
			256					
Interpolation	512		256					1024
Number of teeth	128	192	160	204	256	384	512	512
Maximum rotational speed (min <sup>-1</sup> ) <sup>(3)</sup>	41199	27466	65918	51700	41199	27466	20599	5150
Resolution	65536	131072	32768	65536	65536	131072	131072	524288
Step width (in degrees)	0.0055	0.0027	0.0110	0.0055	0.0055	0.0027	0.0027	0.0007

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

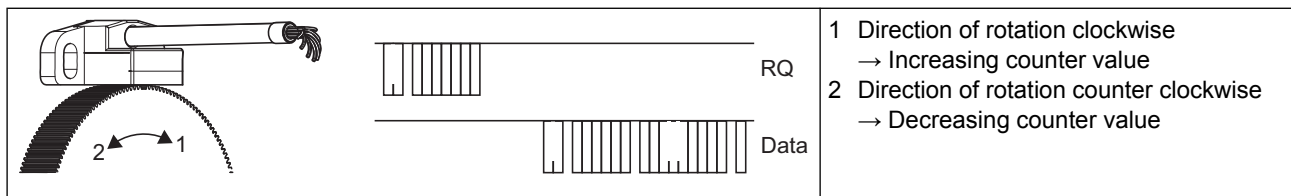
## Factory settings (Factory default)

Designation	Module 0.3	Module 0.4	Module 0.5
Application	Standard	Standard	Standard
Interpolation	512	512	512
Number of teeth	250	192	150
Maximum rotational speed (min <sup>-1</sup> )	21094	27466	35156
Resolution	131072	131072	65536
Step width (in degrees)	0.0027	0.0027	0.0055



If you have any questions, please contact our Support department.  
Simply send an e-mail to: [support@lenord.de](mailto:support@lenord.de).

## Assignment of direction of rotation



<sup>(1)</sup> In operation

<sup>(2)</sup> additional upon request

<sup>(3)</sup> The maximum rotational speed is limited by the internal electronics. The maximum mechanical rotational speed is dependent on the target wheel selected.

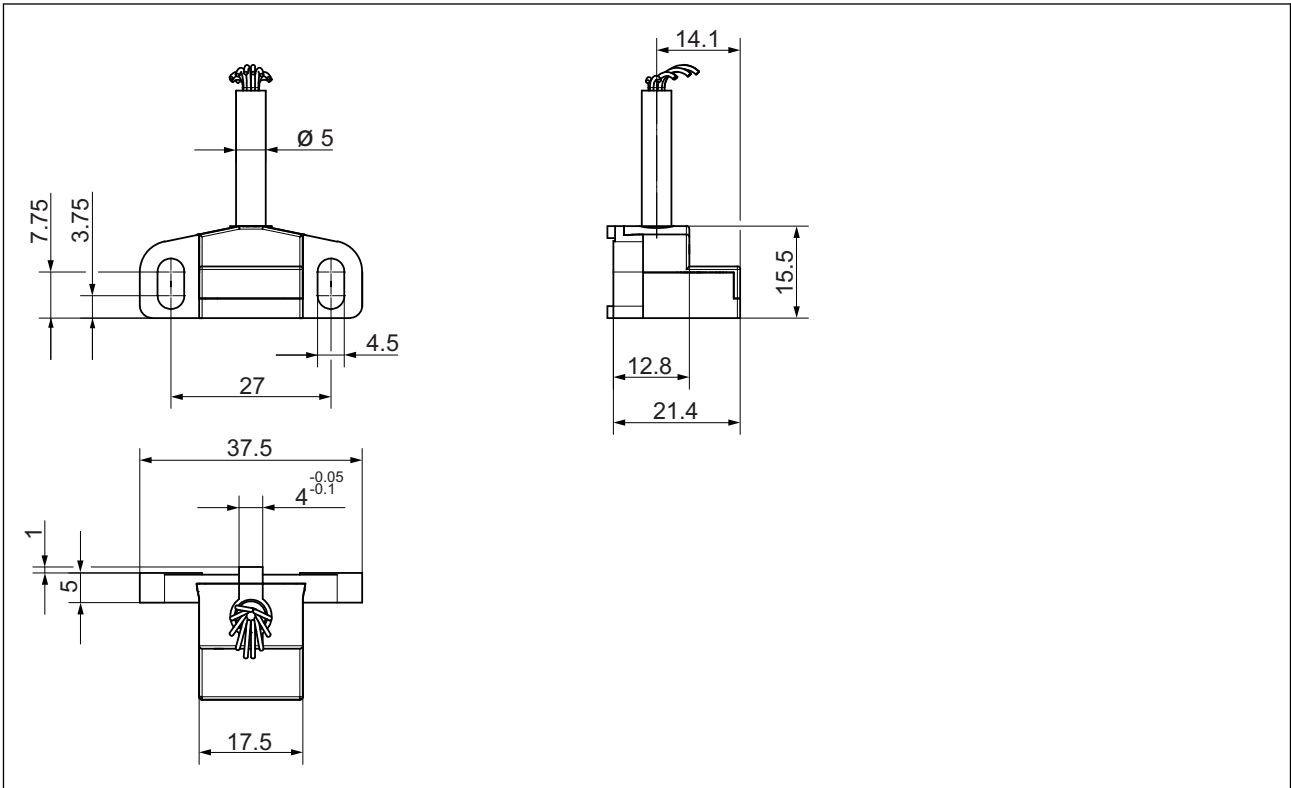


# GEL 2444 with MHSSI interface

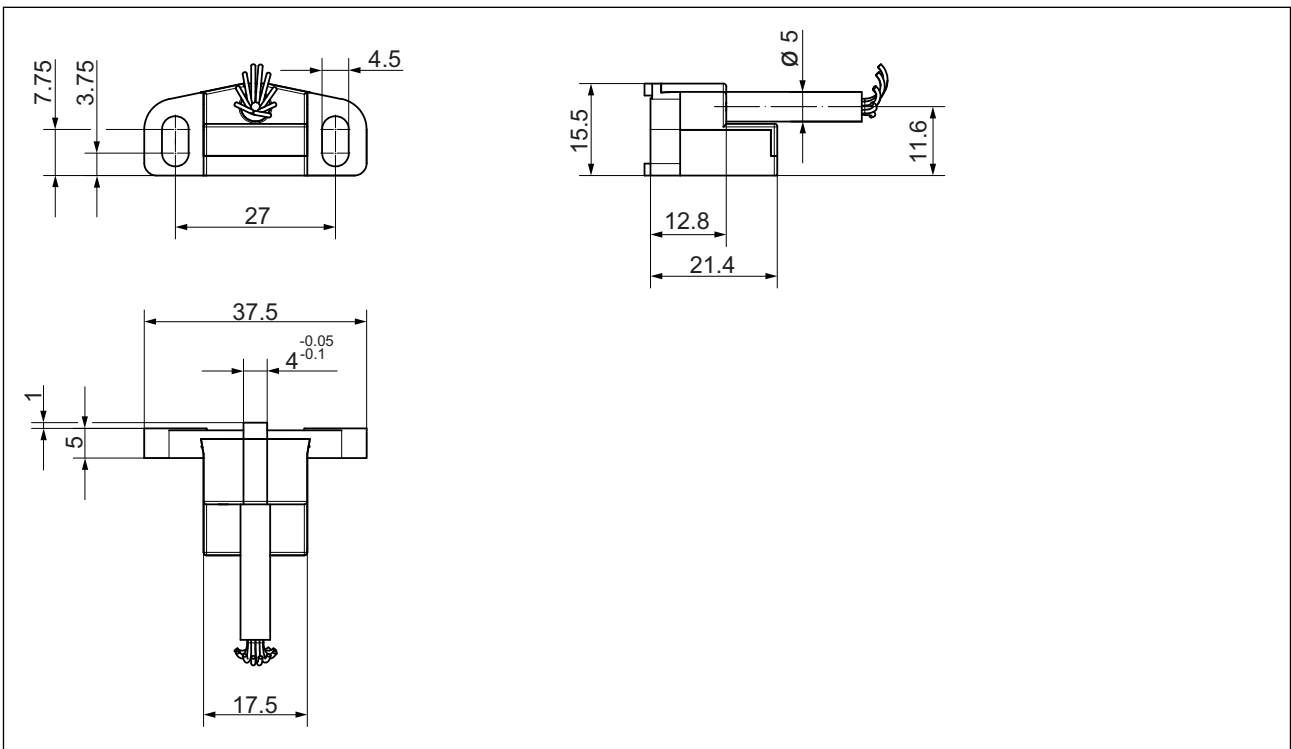
## Dimensional drawings

All dimensions stated in mm; general tolerance ISO 2768-m

### Dimensional drawing GEL 2444 with radial cable outlet

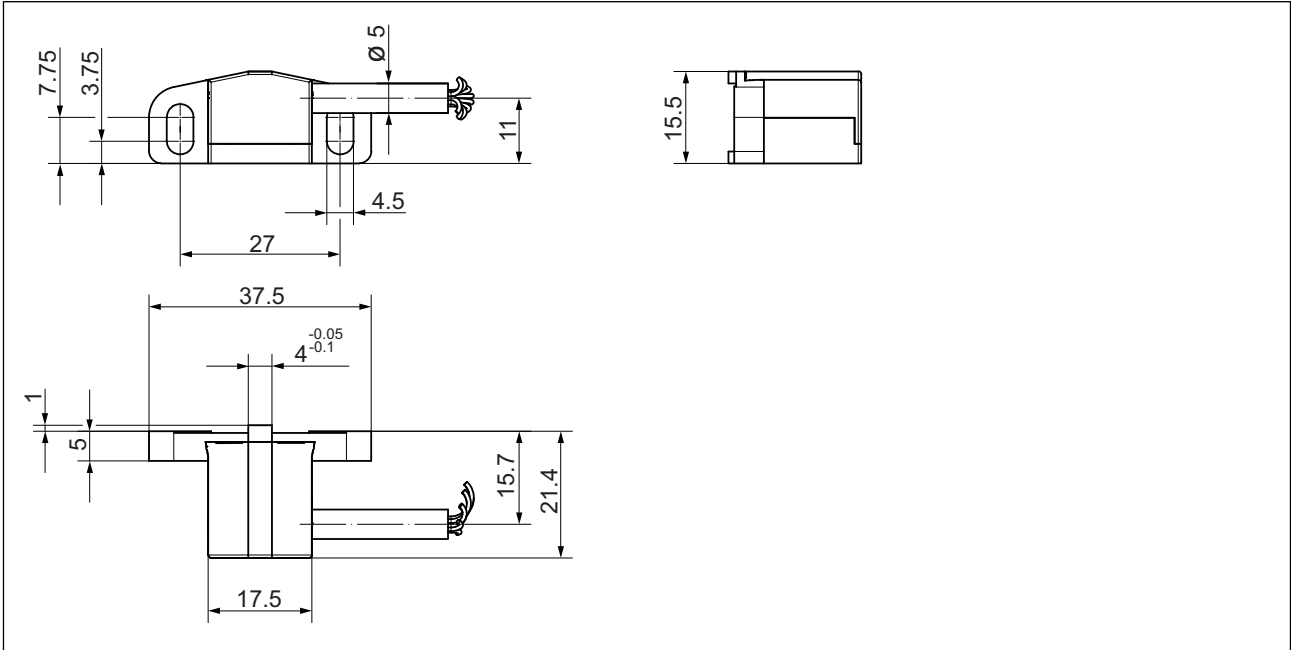


### Dimensional drawing GEL 2444 with axial cable outlet

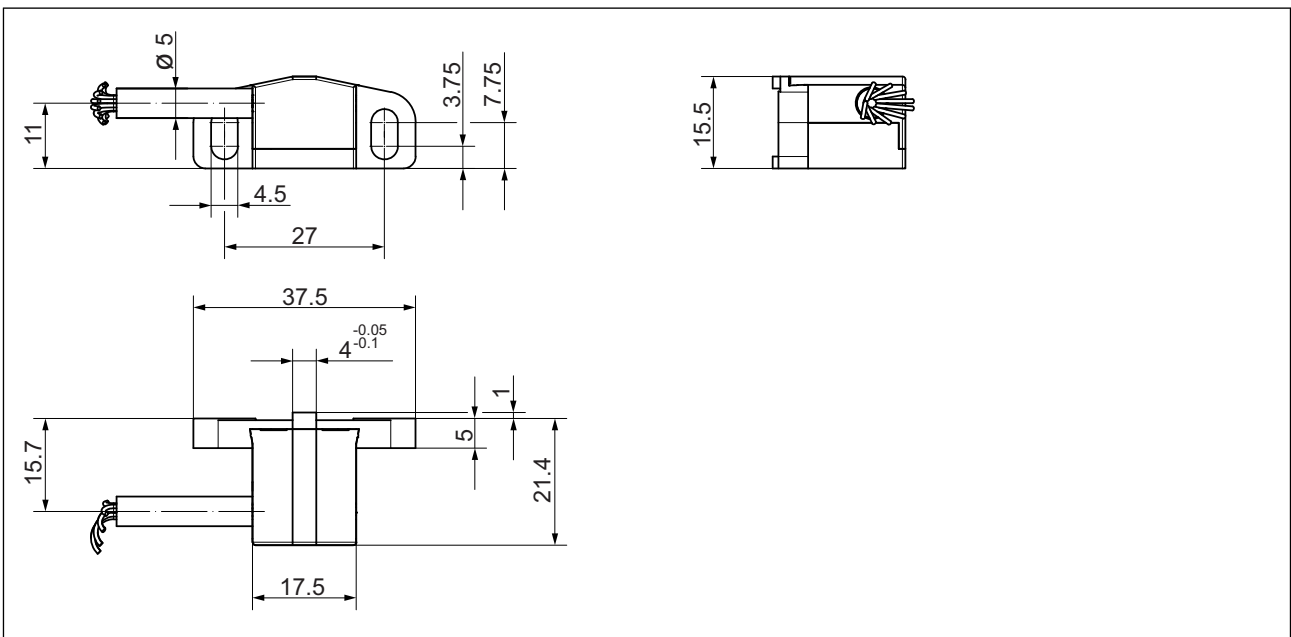


# GEL 2444 with MHSSI interface

Dimensional drawing GEL 2444 with tangential cable outlet right

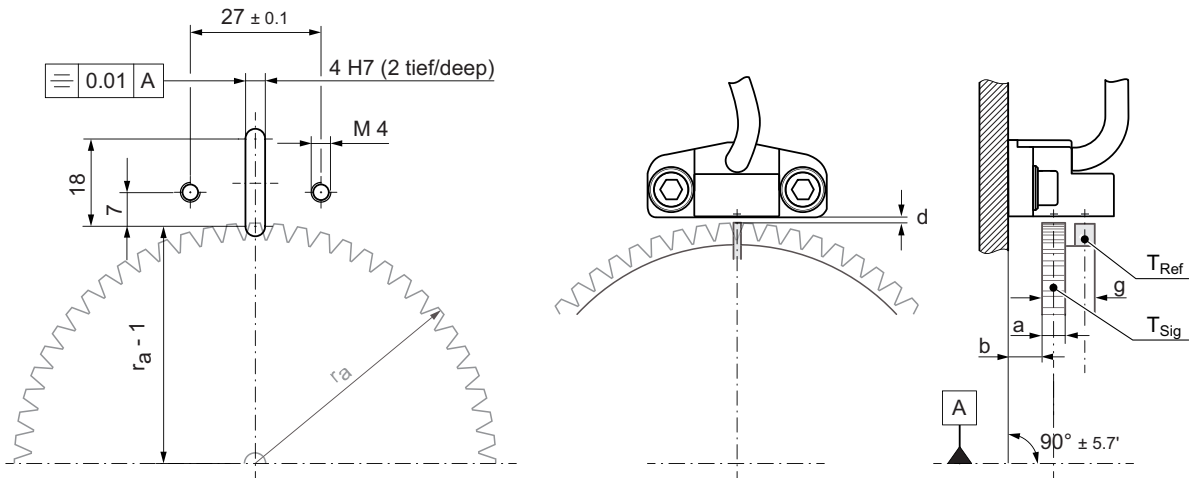


Dimensional drawing GEL 2444 with tangential cable outlet left



# GEL 2444 with MHSSI interface

## Hole pattern and installation dimensions

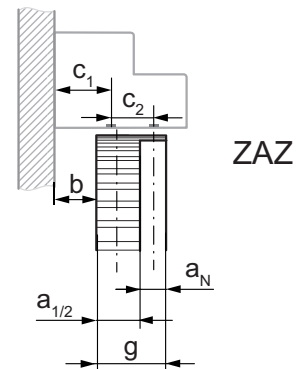


All dimensions stated in mm

- a Width of the signal track:  $\geq 4.0$  mm
- b Mounting surface to tooth wheel distance: dependent on the geometry of the target wheel (e.g. width of the signal track)
- d Air gap: depending on target wheel module
- g Width of the target wheel
- $r_a = d_a/2$  (with  $d_a$  = Outside diameter of the tooth wheel)
- $T_{Ref}$  Reference track
- $T_{Sig}$  Signal track

### Installation dimensions for standard target wheels

Dimension	ZAZ
g	10
$a_{1/2}$	6
$a_N$	4
b	$7.5 \pm 0.5$
Position of the sensor elements: $c_1 = 9.5$ mm; $c_2 = 6$ mm	



# GEL 2444 with MHSSI interface

## Type code

<b>Signal pattern</b>	
<b>M</b>	MHSSI (Mitsubishi High Speed Serial Interface) 2.5 Mbit
<b>Reference mark</b>	
<b>N</b>	Lug
<b>Z</b>	Tooth on tooth
<b>Optional extras</b>	
<b>P</b>	Configurable (with digital reference signal)
<b>Cable outlet MiniCODER</b>	
<b>R</b>	Radial
<b>G</b>	Axial
<b>T</b>	Tangential, cable outlet right
<b>L</b>	Tangential, cable outlet left
<b>Module <sup>(1)</sup></b>	
<b>3</b>	0.3
<b>4</b>	0.4
<b>5</b>	0.5
<b>Connection type</b>	
<b>K</b>	Flying lead
<b>Z</b>	10-pin male connector (only cable lengths 100 / 120 / 200 / 250 available)
<b>Cable length L</b>	
<b>030</b>	0.3 m
<b>050</b>	0.5 m
<b>100</b>	1.0 m
<b>120</b>	1.2 m
<b>150</b>	1.5 m
<b>200</b>	2.0 m
<b>250</b>	2.5 m
<b>Cable version for temperature sensor (2 m)</b>	
<b>-</b>	Without cable for temperature sensor
<b>2444</b>	- - - - -



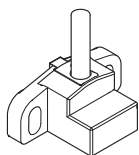
The optional extra **P** makes it possible to configure the resolution. You will find the factory settings on → [page 8](#). Other factory settings are available upon request.



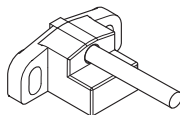
You will find MiniCODERs with different waveforms in the Technical information GEL 2444 (DS22-2444).

## Cable outlet MiniCODER

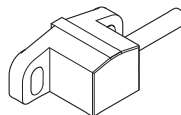
### Kabelausgang



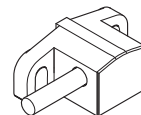
radial **R**



axial **G**



tangential rechts **T**



tangential links **L**

<sup>(1)</sup> Further modules upon request

# GEL 2449 with MHSSI interface

## Technical data

	GEL 2449M_...1	GEL 2449M_...4
<b>Target wheel</b>		
Module <sup>(1)</sup>	1.0	0.4
Width of the measuring track	≥ 8.6 mm	
Material	Ferromagnetic steel	
Reference mark	Tooth (Z)	
<b>Geometric data</b>		
Air gap permitted	0.50 mm ± 0.03 mm	0.20 mm ± 0.02 mm
<b>Electrical data</b>		
Supply voltage U <sub>B</sub>	5 V DC ± 5%, polarity reversal protected, overvoltage protected	
Current consumption (without load)	≤ 80 mA	
Digital interface	MHSSI (Mitsubishi High Speed Serial Interface) 2.5 Mbit (RS 422-compliant)	
Signal identifiers	Request: Data request signal from the control system Data: Data output from the MiniCODER as response to the data request signal	
Data transmission rate	2.5 Mbit/s	
Power consumption without load	≤ 0.5 W	
Switch-on time	< 0.5 s	
Electromagnetic compatibility	Electromagnetic emissions DIN EN 61000-6-4:2011-09; DIN EN 61000-6-3:2011-09 Electromagnetic immunity DIN EN 61000-6-2:2006-03; DIN EN 61000-6-1:2007-10	
Dielectric strength	500 V AC; as per DIN EN 61439-1:2012-06	
<b>Mechanical data</b>		
Weight	100 g	
Housing material	Die cast zinc	
Rotational speed	≤ 40,000 min <sup>-1</sup> <sup>(2)</sup>	
Operating temperature range	0 °C to +70 °C	
Operating and storage temperature range	-30 °C to +105 °C	
Degree of protection	IP 68	
Vibration resistance	200 m/s <sup>2</sup> (EN 60068-2-6:2008-10)	
Shock resistance	2000 m/s <sup>2</sup> (EN 60068-2-27:2010-02)	
MTTF	3,828,120 h at 55 °C	
FIT	261 10 <sup>-9</sup> h <sup>-1</sup> at 55 °C	
<b>Electrical connection</b>		
Number of cores x core cross-section	9 x 0.15 mm <sup>2</sup>	
Max. permitted cable length	≤ 30 m <sup>(3)</sup> <sup>(4)</sup>	
Cable diameter	5 mm	
Min. bending radius	25 mm	

<sup>(1)</sup> Further modules upon request

<sup>(2)</sup> Depending on the number of teeth and resolution

<sup>(3)</sup> In operation

<sup>(4)</sup> Pay attention to voltage drop on the supply cable; recommended cable length: max. 2.5 m (no twisted pair)

# GEL 2449 with MHSSI interface

## Standard target wheels <sup>(1)</sup> <sup>(2)</sup>

Application	Standard		Rotational speed					Positioning (high resolution)
			256					
Interpolation	512							1024
Number of teeth	128	192	160	204	256	384	512	512
Maximum rotational speed (min <sup>-1</sup> ) <sup>(3)</sup>	41199	27466	65918	51700	41199	27466	20599	5150
Resolution	65536	131072	32768	65536	65536	131072	131072	524288
Step width (in degrees)	0.0055	0.0027	0.0110	0.0055	0.0055	0.0027	0.0027	0.0007

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

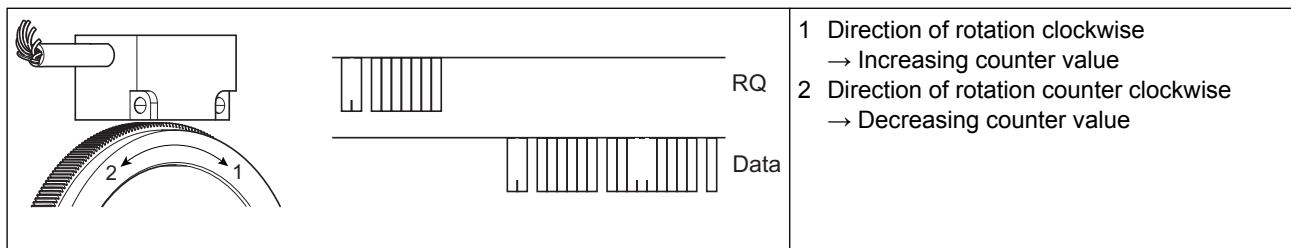
## Factory settings (Factory default)

Name	Module 0.4	Module 1
Application	Standard	Standard
Interpolation	512	512
Number of teeth	192	75
Maximum rotational speed (min <sup>-1</sup> )	27466	70313
Resolution	131072	32758
Step width (in degrees)	0.0027	0.011



If you have any questions, please contact our Support department.  
Simply send an e-mail to: [support@lenord.de](mailto:support@lenord.de).

## Assignment of direction of rotation



<sup>(1)</sup> In operation

<sup>(2)</sup> additional upon request

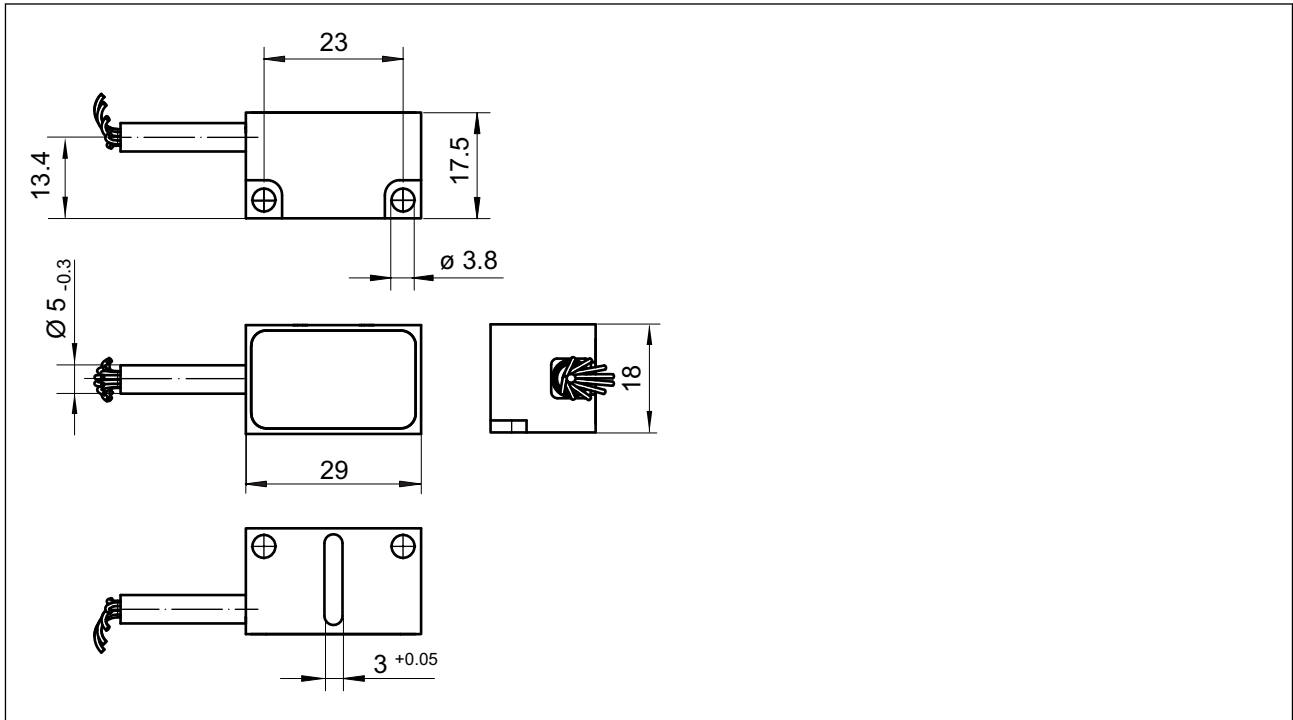
<sup>(3)</sup> The maximum rotational speed is limited by the internal electronics. The maximum mechanical rotational speed is dependent on the target wheel selected.

# GEL 2449 with MHSSI interface

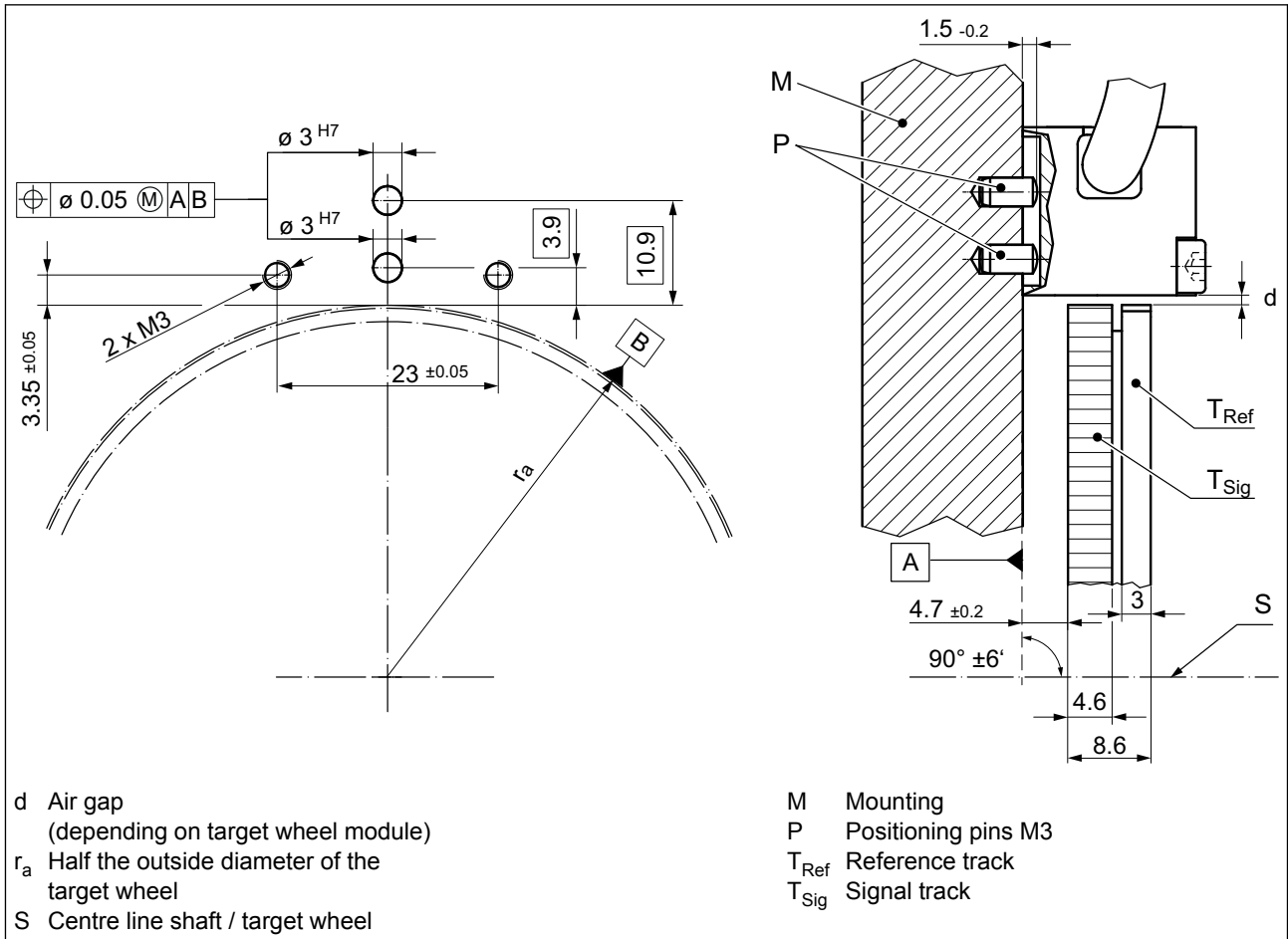
## Mechanical data

All dimensions stated in mm; general tolerance ISO 2768-m

### Dimensional drawing – cable outlet tangential left (L)



### Hole pattern and installation dimensions



# GEL 2449 with MHSSI interface

## Type code

<b>Signal pattern</b>	
<b>M</b>	MHSSI (Mitsubishi High Speed Serial Interface) 2.5 Mbit
<b>Reference mark</b>	
<b>Z</b>	Reference tooth (tooth on tooth)
<b>Optional extras</b>	
<b>P</b>	Configurable MiniCODER plus
<b>Cable outlet MiniCODER</b>	
<b>L</b>	Tangential, cable outlet left
<b>Module <sup>(1)</sup></b>	
<b>1</b>	Scanning of target wheels with module M = 1.0
<b>4</b>	Scanning of target wheels with module M = 0.4
<b>Connection type</b>	
<b>K</b>	Flying lead
<b>Z</b>	10-pin connector (only cable length 100 / 120 / 200 / 250 available)
<b>Cable length L</b>	
<b>030</b>	0.3 m
<b>050</b>	0.5 m
<b>100</b>	1.0 m
<b>120</b>	1.2 m
<b>150</b>	1.5 m
<b>200</b>	2.0 m
<b>250</b>	2.5 m
<b>Cable version for temperature sensor (2 m)</b>	
<b>-</b>	Without cable for temperature sensor
<b>2449</b>	— — — — — — — — — —



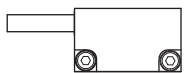
The optional extra **P** makes it possible to configure the resolution. You will find the factory settings on → [page 14](#). Other factory settings are available upon request.



You will find MiniCODERs with 1 V<sub>pp</sub> differential signal in the Technical information GEL 2449 (DS22-2449).

### Cable outlet MiniCODER

The MiniCODER is available with the following cable outlet:



Tangential left (L)

<sup>(1)</sup> Further modules upon request