# MiniCODER comfort
# ▶ GEL 2444K
Speed and position sensor with metal housing and sin/cos output

**LENORD +BAUER**

*... automates motion.*

## General

▶ The measuring unit comprises a sensor and a precision target wheel for attachment to shafts with a shaft diameter from 8 mm to over 500 mm

▶ Rotational speed and position acquisition by means of contactless scanning of precision target wheels using magnetoresistive sensor elements

▶ Output signals are two sinusoidal signals offset by 90° for the detection of direction (tracks 1 and 2) and their inverse signals, optionally with a reference pulse (track N).

▶ High resolution and accuracy of the incremental hollow shaft measuring system by interpolation of the sensor signals

▶ **Safety integrated** certificate

## Features

▶ Output signal 1 $V_{pp}$ with high signal quality (sin/cos)

▶ Frequency range from 0 to 200 kHz

▶ Speed measurement range from 0 to 100,000 $min^{-1}$

▶ Temperature range -40 to +120°C

▶ Protection class IP 68

## Advantages

▶ Easy mounting due to amplitude regulation (optional)

▶ Extremely robust due to full encapsulation of the MiniCODER

▶ Low temperature drift and high signal quality due to usage of optimised GMR sensors

▶ Highest immunity to interference due to fully screened metal housing

▶ New tangential cable outlets provide new integration options for the sensor

▶ Customer-specific manufacture of precision target wheels for simple implementation

## Field of application

▶ Machine tool engineering
  - Position and speed acquisition in HSC spindles (High Speed Cutting)
  - Electronic synchronisation of screw spindles in vacuum pumps
  - Position and speed acquisition in milling spindles and grinding spindles

▶ Speed and position measurement in test stands, motors (hybrid drives, torque motors)

# Technical data

| Electrical data | |
|---|---|
| Supply voltage $V_S$ | 5 V DC ± 5%, polarity reversal protected, overvoltage protected |
| Output level | 1 $V_{pp}$ Differential signal |
| Output signal | Two sinusoidal signals offset by 90° and their inverse signals, short-circuit-proof; option: reference pulse |
| Output frequency | 0 to 200 kHz [1] |
| Power consumption without load | ≤ 0.3 W |
| Electromagnetic compatibility | EN 61000–6–1 to 4 |
| Insulation strength | 500 V, in accordance with EN 60439–1 |
| **Mechanical data** | |
| Air gap permitted | 0.5 mm ± 0.3 at module 1.0<br>0.20 mm ± 0.03 mm at module 0.5<br>0.15 mm ± 0.02 mm at module 0.3 |
| Target wheel material | Ferromagnetic steel |
| Working temperature range | -30 °C to +85 °C |
| Operating and storage temperature range | -40 °C to +120 °C |
| Protection class | IP 68 |
| Vibration resistance | 200 m/s$^2$, in accordance with DIN EN 60068-2-6 |
| Shock resistance | 2000 m/s$^2$, in accordance with DIN EN 60068-2-27 |
| Weight | 30 g |
| Housing material | Die cast zinc |
| **Electrical connection** | |
| Number of cores x cable cross-section | 9 x 0.15 mm$^2$ |
| Max. permitted cable length | 100 m [2] |
| Cable diameter | 5 mm |
| Min. bending radius | 25 mm |

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[1] At a cable capacitance of 5 nF
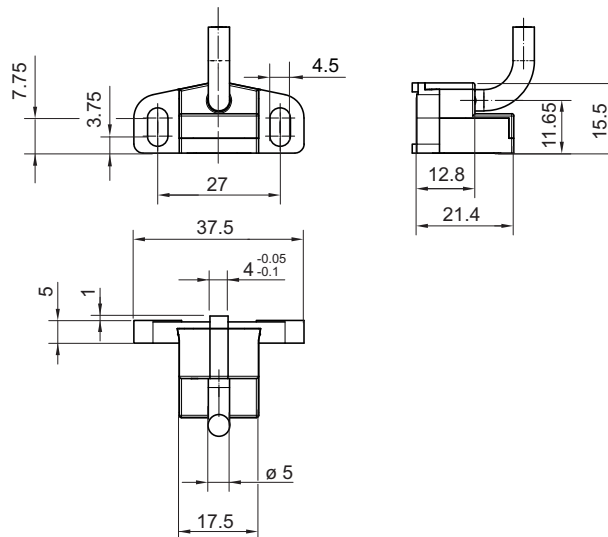[2] Pay attention to the voltage drop on the supply cable
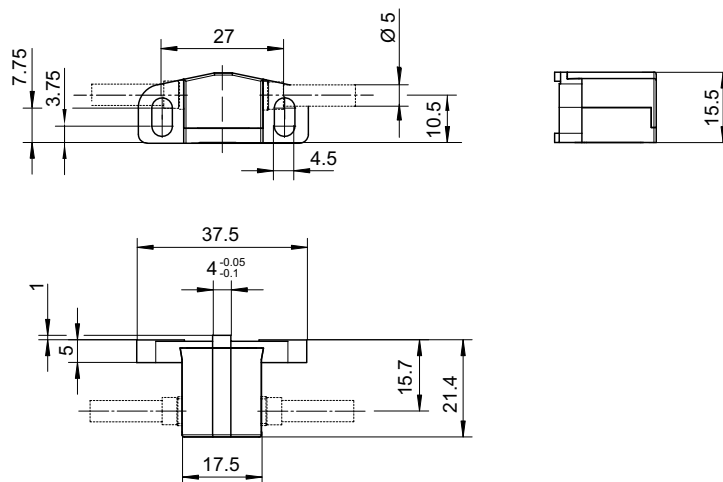
**Dimensional drawing GEL 2444K**

**with radial cable outlet**
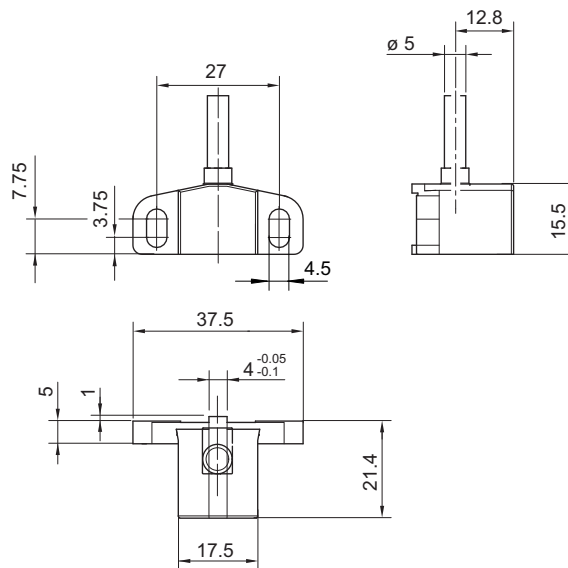
**with axial cable outlet**

**with tangential cable outlet on right or left side**
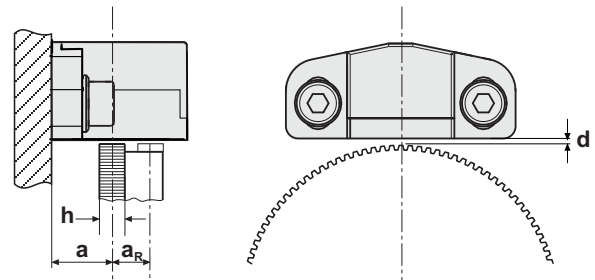
# Dimensional drawing

**Boring and milling sketch**



27±0.1

4 H7 (2 deep)

M 4

18

7

$r_a - 1mm$
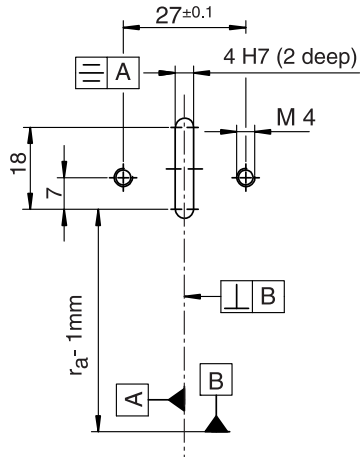
*Dimensions stated in mm*

$= d_a/2$

$r_a$ (with $d_a$ = Outside diameter of the tooth wheel)

**Assembly drawing**



h

a    $a_R$

d

a    Distance (9.5 ±0.5 mm)

$a_R$   Reference mark distance (6 mm)

d    Air gap (see air gap table → page 7)

h    Width of the target wheel (> 4.0 mm)

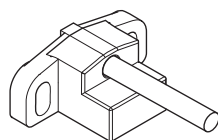## Type code GEL 2444K

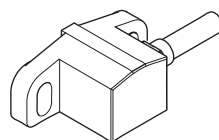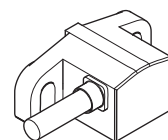| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **Signal pattern** | | | | | | | | |
| | **K** | Sin/cos signals 1 $V_{pp}$ | | | | | | | | |
| | | **Reference mark** | | | | | | | | |
| | | **–** None | | | | | | | | |
| | | **N** Flag (only for module 0.3 or 0.5) | | | | | | | | |
| | | **M** Groove | | | | | | | | |
| | | **Z** Reference tooth (recommended) | | | | | | | | |
| | | | **Internal regulation** | | | | | | | |
| | | | **1** Without internal regulation | | | | | | | |
| | | | **R** With internal amplitude regulation | | | | | | | |
| | | | | **Cable outlet** | | | | | | |
| | | | | **R** Radial | | | | | | |
| | | | | **G** Axial | | | | | | |
| | | | | **T** Tangential, cable outlet right (viewed on the mounting surface) | | | | | | |
| | | | | **L** Tangential, cable outlet left (viewed on the mounting surface) | | | | | | |
| | | | | | **Module** | | | | | |
| | | | | | **1** Scanning of target wheels with module M = 1 (reference mark M or Z only) | | | | | |
| | | | | | **3** Scanning of target wheels with module M = 0.3 | | | | | |
| | | | | | **5** Scanning of target wheels with module M = 0.5 | | | | | |
| | | | | | | **Connection type** | | | | |
| | | | | | | **K** Flying lead (fixed length: 30, 150, 250 or 600 cm) | | | | |
| | | | | | | **N** 17-pin receptacle straight, with EMC screening, strain relief and sealing, IP 67 (connected) [1] | | | | |
| | | | | | | **M** 17-pin receptacle angled, with EMC screening, strain relief and sealing, IP 67 (connected) [1] | | | | |
| | | | | | | | **Cable length L** | | | |
| | | | | | | | Stated in cm: 030, 150, 250 or 600 | | | |
| | | | | | | | | **Cable for temperature sensor (2 m)** | | |
| | | | | | | | | **–** None | | |
| | | | | | | | | **M** With | | |
| **2444** | _ | _ | _ | _ | _ | _ | _ _ _ | _ | | |
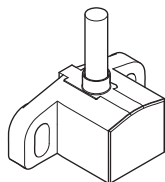


*Radial cable outlet **R***    *Axial cable outlet **G***    *Tangential cable outlet on right **T***    *Tangential cable outlet on left **L***

## Target wheels

For detecting rotary movements, the MiniCODERs and target wheels form a complete unit. The target wheel size and hence , its diameter are directly dependent 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".

### Customised target wheels

On request, customised target wheels are manufactured according to individual specifications. Please send us a dimensional drawing of your target wheel (if possible, as a dxf-file) to **info@lenord.de**.

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[1] (state cable length in cm)

# Description

## General

MiniCODERs and precision target wheels form a unit for the acquisition of rotary movements.

The MiniCODER scans the ferromagnetic target wheel. The magnetic field from the MiniCODER is modulated by the rotating target wheel. The integrated sensors and electronics convert this change into sinusoidal output signals.

## Signal pattern

The output signals are two sine/cosine signals offset by 90° for the detection of direction (tracks 1 and 2) and their inverse signals, signal pattern K.
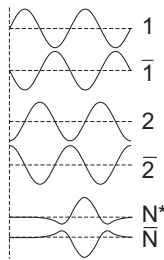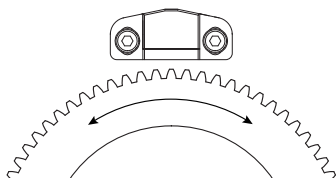


N*     Reference signal (track N) optional

To evaluate a reference signal a reference mark (option) on the target wheel is required. The position of the reference mark defines the phase position of the reference signal in relation to the track signals.

## Reference marks

Reference marks may occur in the form of a groove or a flag or a tooth.

The selection of the reference mark is determined by the size and speed of the used target wheel, as both variables affect the forces acting on the reference mark.

For new designs, we recommend the use of target wheels with reference mark variant "**Z**".

### Reference mark N – Flag

A metal flag integrated in the target wheel is detected when its position is exactly between two teeth. This reference signal can be used as a positon reference. This is required, for instance, for the automatic changing of a tool in a milling or grinding spindle. The flag must be made of ferromagnetic material and may not protrude beyond the gear-wheel of the target wheel.

### Reference mark M – Groove

Depending on size and geometry of the target wheel, the target wheel version with a reference flag can only be used up to certain speeds. For speeds beyond 30.000 $min^{-1}$, a MiniCODER detecting a reference groove integrated in the target wheel is used. For technical reasons, the target wheel is in this case composed of two parts.
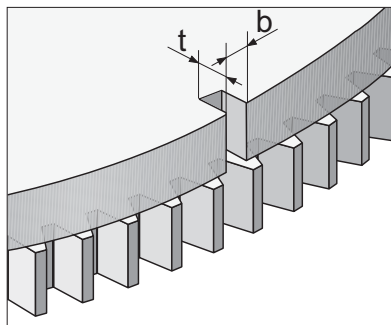
### Reference mark Z – tooth at tooth

This MiniCODER design makes it possible to scan a target wheel manufactured from a single piece. With this system rotational speeds in excess of 100,000 $min^{-1}$ are achievable. For technical reasons the reference mark is flush with a tooth.
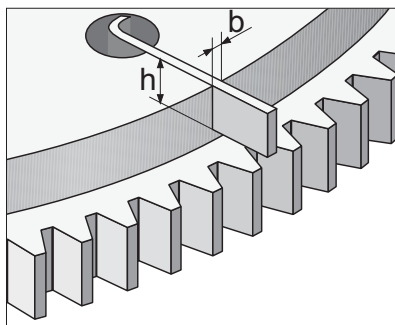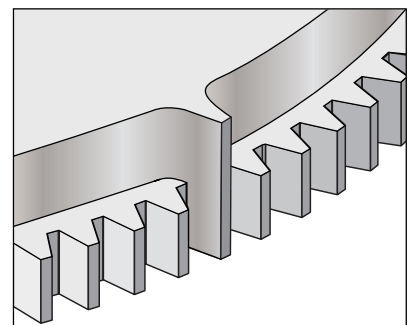


*N = Reference mark – flag*

    h = 4 mm
    b = 0.5 mm

*M = Reference mark – groove*

    t = 1 mm,
    b = 1.2 mm for module 0.3
    b = 1.6 mm for module 0.5
    b = 3.0 mm for module 1.0

*Z = Reference mark – tooth*

## Internal regulation

The MiniCODER can be supplied with or without internal regulation.
The MiniCODER with internal regulation (option R) regulates fluctuations in the sin/cos amplitudes on changes in the air gap and temperature.
As a result mounting is significantly simplified. It is not necessary to re-adjust the MiniCODER to optimise the signals.

## Module

The module describes the relationship between the number of teeth and the outside diameter of a target wheel.

**Air gap table**

| Type | Module | Air gap *d*, adjusting measure | Distance tolerance |
|------|--------|-------------------------------|--------------------|
| 3 | 0.3 | 0.15 mm | ±0.02 mm |
| 5 | 0.5 | 0.20 mm | ±0.03 mm |
| 1 | 1.0 | 0.50 mm | ±0.3 mm |

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

ℹ️ The MiniCODER must be ordered to suit the target wheel.

## Cable length

With the connection type **K** (flying lead) there are 4 cable lengths available: 30, 150, 250, 600 cm. On the fabrication of the connection cable with a receptacle the cable length in cm is to be stated.
Type of cable   PUR cable, screened, 9 x 0.15 mm$^2$
            Outside diameter:     5 mm (- 0.3)
            Min. bending radius:  25 mm

## Cable for temperature sensor (2 m)

Upon request on the delivery of the connection types **M** and **N** the cable for the temperature sensor is connected to the receptacle (see → page 9).
Type of cable   TEFLON cable, 2 x 0.14 mm$^2$
            Outside diameter:     2.8 mm (± 0.1)
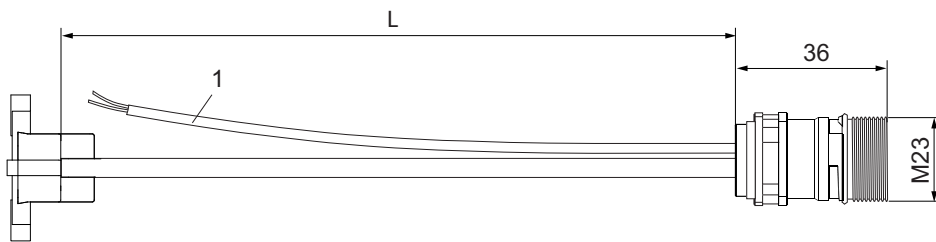            Min. bending radius:  20 mm
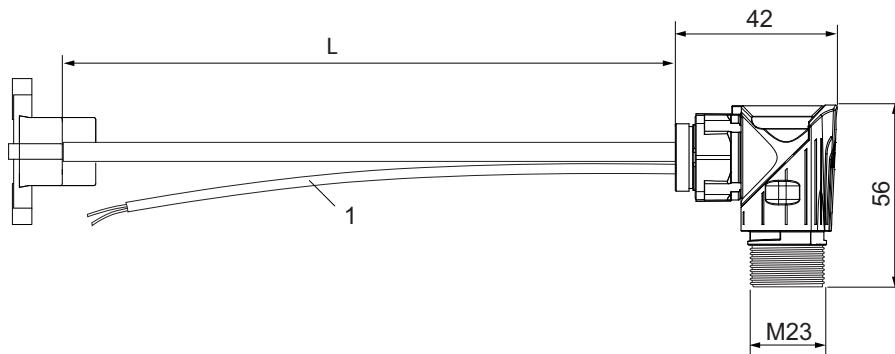
# Description

## Connection type

The MiniCODERs are supplied with a flying lead, type **K**, or with a 17-pin receptacle M23 (male connector), type **N**, or **M**.
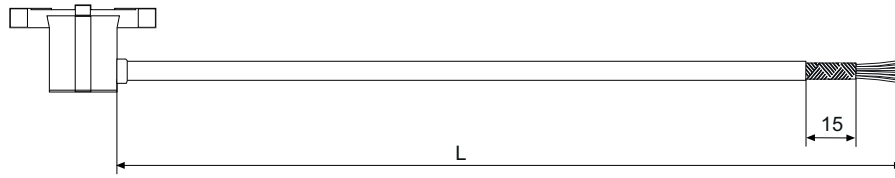
*Connection type **K** – flying lead*

*Connection type **N** 17-pin receptacle, straight*

*Connection type **M** 17-pin receptacle, angled*
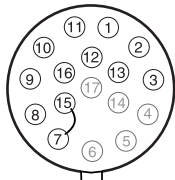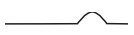
**Key**
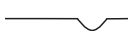1 Cable for temperature sensor option **M** (2-core, length 2 m)
L Cable length (see type code)

**Connection type K**

| Flying lead | Core colour | Signal/ function | | |
|---|---|---|---|---|
| | white | $V_{1+}$ | Track 1 |  |
| | brown | $V_{1-}$ | /Track 1 |  |
| | grey | $V_{N+}$ | Reference track |  |
| | blue | 0 V | GND | |
| | red | $V_S$ | + 5 V supply | |
| | pink | $V_{2+}$ | Track 2 |  |
| | black | $V_{2-}$ | /Track 2 |  |
| | yellow | $V_{N-}$ | /Reference track |  |
| | green | $V_{Sense}$ | 5 V Sense | |

**Connection type N and M**

| 17-pin receptacle | Core colour | Pin | Signal / function | | |
|---|---|---|---|---|---|
| | white | 1 | $V_{1+}$ | Track 1 |  |
| | brown | 2 | $V_{1-}$ | /Track 1 |  |
| | grey | 3 | $V_{N+}$ | Reference track |  |
| | | 4 – 6 | Not used | | |
| | blue | 7 | 0 V | GND | |
| | (brown)[1] | 8 | $\vartheta+$ | Temperature + |  |
| | (blue)[1] | 9 | $\vartheta-$ | Temperature – |  |
| | red | 10 | $V_S$ | + 5 V supply | |
| | pink | 11 | $V_{2+}$ | Track 2 |  |
| | black | 12 | $V_{2-}$ | /Track 2 |  |
| | yellow | 13 | $V_{N-}$ | /Reference track |  |
| | | 14 | Not used | | |
| | – | 15 | 0 V | GND | Jumper pin 7 |
| | green | 16 | $V_{Sense}$ | 5 V Sense | |
| | | 17 | Not used | | |

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[1] Option: temperature sensor cable

# Accessories

**Test device**

For the correct function of the MiniCODER, exact adjustment and compliance with the tolerances is necessary. The sine and cosine signals from the MiniCODER can be checked using the test device GEL 210 to ensure the signal level is correct. On the 3½-digit, backlit LC display the following measured parameters can be displayed:
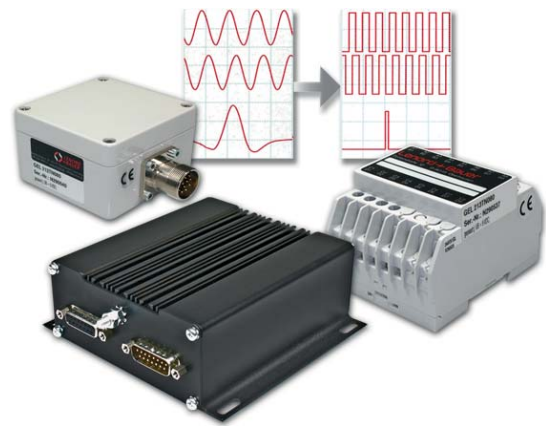
▶ Amplitude values for the sine and cosine track
▶ Offset values for the two signal tracks
▶ Phase offset referred to 90° between the signal tracks
▶ Correct function of the reference signal (amplitude and offset)
▶ Reference signal position detection

The values measured can be compared with the tolerances specified and in this way checked appropriately.

**Interpolation electronics**

On the MiniCODER the interpolation of the 1 Vpp output signals is normally undertaken by the control system used. If the control system cannot perform this task, Lenord + Bauer can supply dedicated interpolation electronics with the series GEL 212 / GEL 213 / GEL 214. These convert the 1 Vpp output signals into TTL square-wave signals (maximum interpolation factor = 512). Please request the related documentation or refer to our web site www.lenord.de . The related documentation is also available for download there.

Your notes:

LENORD
+BAUER
... automates motion.

IRIS Certification   ISO 9001   ISO 14001