Made in Germany

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Technical Information

GEL 244XF

MiniCODER Bearingless Rotary Encoders for Fanuc Inverter Series

Rotational Speed and Position Sensor with Serial Interface for Fanuc αi SP/SP-B/SP-D

D-51T-244xF | Status 2026-08-06

FANUC

LENORD +BAUER

Finding solutions. Founding trust.

Motion sensors and integrated drive technology

Overview

General Information

- Direct connection to Fanuc inverter series
- Non-contact magnetic sensing for maximum service life
- Compact construction type fits into the smallest installation spaces with the harshest environmental conditions
- Fast, error-free parameterization and efficient commissioning with the GEL 211 Mobile Service Unit
- Integrated condition monitoring ensures high process reliability

Features

- Fanuc αi
- Non-contact measurement for wear-free operation
- Resolution: 24-bit
- Integrated operating hours meter
- Maximum permissible rotational speed:
  ≤100,000 min^{-1} [100,000 rpm]
- High positioning accuracy
- Jitter-free position value calculation
- Latency-free transmission
- Degree of protection: IP68
- Operating temperature range:
  -30 °C … +105 °C [-22.0 °F … +221.0 °F]

Advantages

- No signal converter box required
- Maintenance-free electronics and wear-free mechanics
- Reliable operation even under extreme temperature fluctuations
- High immunity to interference
- No mechanical wear
- Easy integration into tight spaces
- Measurement of very high rotational speeds
- High shock and vibration resistance
- Resistant to environmental influences
- Easy commissioning and maintenance thanks to smart programming functions

Applications

- Position and speed measurement in machine tool manufacturing

General Description of the MiniCODER

Product construction

The MiniCODERs are designed for non-contact measurement of rotational or linear motion, primarily in machines, gearboxes, motors, or high-speed spindles. They are manufactured using state-of-the-art microsystem technology and are fully encapsulated, making them particularly resistant to shocks and vibrations.

Measuring system

The measuring system consists of a MiniCODER and a target wheel. The system does not require its own bearings, as the target wheel is mounted directly on the machine shaft.

The measuring system operates non-contact, is wear-free, and requires no electrical maintenance. 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 generates a magnetic field that is altered by the rotating target wheel. The sensors detect the change in the magnetic field, and the integrated electronics convert this into corresponding output signals. An external evaluation unit can read the output signals and determine the direction of rotation, rotational speed, and position of the machine shaft.

A defined air gap between the target wheel and the MiniCODER is required for non-contact measurement. To facilitate installation, a corresponding distance gauge is included with the MiniCODER.

Reference mark

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

Module

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

Explanatory Notes on the Target Wheel

To measure rotational motion, MiniCODERs are used in combination with target wheels. The size of the target wheel —and thus its diameter—depends directly on the module and the number of teeth.

Standard target wheels are available for immediate delivery ex works. For specifications and designs, see “Technical Information ZAx / ZFx (D-51T-ZAx/ZFx)”.

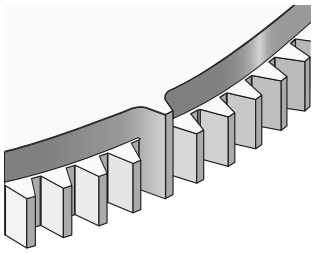
Custom target wheels are manufactured individually upon customer request. Please send us a design drawing of your target wheel (preferably as a PDF file) to info@lenord.de.

Reference mark Z – tooth-to-tooth

The MiniCODER can detect tooth-shaped reference marks. The captured reference signal can be used to establish the reference position. This is required, for example, for the automatic change of a tool on a milling or grinding spindle.

The selection of the reference mark is determined by the size and rotational speed of the target wheel being used, as both factors influence the forces acting on the reference mark.

These target wheels are manufactured from a single piece.



Z = Reference mark – tooth

Module

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

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

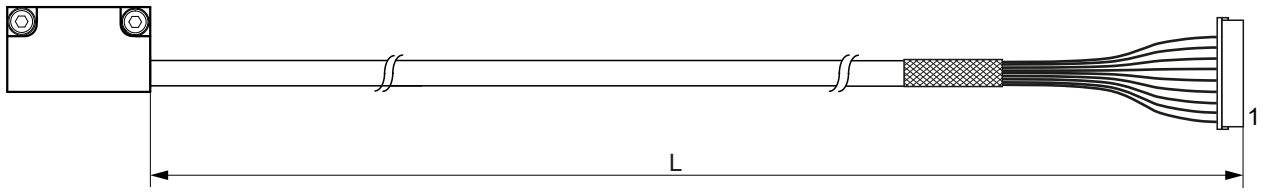
Connection type

L = Cable Length

The shield of the connection cable is connected to the MiniCODER housing.

Connection example with GEL 2449

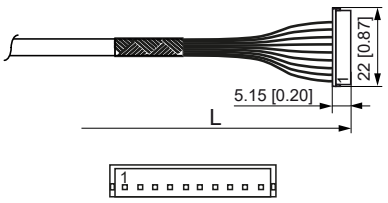
MiniCODER cable outlet	Cable design	Connection type
L (tangential left)	**–** (without temperature sensor cable)	**K** (flying lead)



Pin Assignment

Connection type K

Flying lead (10-pin female connector(1))
(plug-in view)



All dimensions in millimeters [inches]

Pin designation	Wire Color	Signal designation	Function
1	Red	U_B	+5 V supply voltage
2	White	Not used (2)	
3	Brown	Not used (2)	
4	Pink	Data	Positive data
5	Black	/Data	Inverse data
6	Green	Not used (2)	
7	Gray	Not used (2)	
8	Yellow	Not used (2)	
9	Blue	0 V	GND
10	Not used		

(1) The product is shipped with a Lenord+Bauer test connector already attached.
(2) Insulate the wire when connecting your own connector to prevent accidental contact with electrically conductive surfaces or other wires.

If a Mobile Service Unit is to be used for functional testing, the test plug must not be removed!

Instructions for properly assembling your own connector on the MiniCODER connection cable

- The shield of the connection cable must not be connected to the “0 V” signal.
- The cable shield must be connected to the connector even for short cables (< 30 cm [11.81 in]).
- Ensure that no foreign objects or liquids can enter the cable to prevent damage to the MiniCODER.

If the electromagnetic environment requires special shielding concepts, Lenord+Bauer provides extensive knowledge and experience to assist with integrating the MiniCODER into the application’s shielding concept.

General Description of the Fanuc Interface

The MiniCODER GEL 244xF is a digital Built-in Encoder with a reference signal for direct connection to Fanuc machine controls. It transmits data via a digital interface (αi protocol).

The MiniCODER can be connected directly to the following Fanuc drive series:
Spindle Amplifier Model Series:
- αi SP
- αi SP-B
- αi SP-D

Commissioning Note:

To operate the MiniCODER with the corresponding Fanuc inverter series, parameter adjustments are required in the Fanuc system controllers. The necessary parameters and settings are provided by Fanuc and can be found in the corresponding Fanuc documentation.

Functions with the Mobile Service Unit

The MiniCODER can be tested and configured using the GEL 211CST4␣2M Mobile Service Unit.
The following functions are available:
- Functional test of the MiniCODER
- Functional test of the target wheel
- Changing the number of teeth on the target wheel
- Changing the resolution

If the number of teeth stored in the MiniCODER by the manufacturer does not match the number of teeth on the target wheel, the number of teeth in the MiniCODER must be adjusted to match the number of teeth on the target wheel using the Mobile Service Unit.

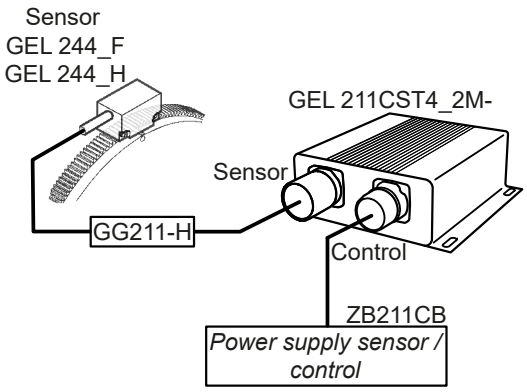
Accessories

GEL 211CST04␣2M Mobile Service Unit

Features
- Compact, portable device
- Data transmission via Wi-Fi or Ethernet
- Browser-based operation on a smartphone, tablet, or PC without software installation
- Plug-and-play connection without removing the sensor
- Analysis, optimization, and parameterization of the MiniCODER via a digital RS-485 interface

Accessories for GEL 244␣F and GEL 244␣H

Item Number:	Description:
GG211-H	1 m [39.37 in] adapter cable for **GEL 244␣F␣␣␣␣K␣␣␣␣** and **GEL 244␣H␣␣␣␣K␣␣␣␣** (connection to Mobile Service Unit)
PK211C-244XM-E	Configuration kit (Ethernet), consisting of: ▪ GEL 211CST4E2M Mobile Service Unit ▪ Universal adapter box, ZB2449M4 ▪ 5 V power supply, ZB211CB ▪ Adapter cable GG211-H ▪ Operating Instructions, D-71B-211C or D-53B-211C ▪ Carrying Case, XW1303
PK211C-244XM-W	Configuration Kit (Wi-Fi), consisting of: ▪ GEL 211CST4W2M Mobile Service Unit ▪ Universal adapter box, ZB2449M4 ▪ 5 V power supply, ZB211CB ▪ Adapter cable GG211-H ▪ Operating Instructions, D-71B-211C or D-53B-211C ▪ Carrying Case, XW1303



GEL 211CST4␣2M: Connection Options

GEL 2444F

Technical Data

GEL 2444F

Electrical Data	
Supply Voltage U_B (reverse-polarity protected, overvoltage protected)	5 V DC ± 5%
Current consumption (no load)	≤ 80 mA
Digital interface	RS-485 with Fanuc αi protocol: bidirectional half-duplex
Data transfer rate	2.73 Mbit/s
Power consumption without load	≤ 0.5 W
Start-up time	< 0.5 s
Mechanical Data	
Housing material	Die-cast zinc
Mass	30 g [1.06 oz]
Maximum permissible rotational speed	≤ 100,000 min^{-1} [100,000 rpm] (1)
Cable Data	
Cable construction (number of conductors × conductor cross-section)	9 × 0.15 mm^2 [25 AWG]
Cable diameter	5 mm [0.20 in]
Minimum bend radius	25 mm [0.98 in]
Maximum allowable cable length	≤ 30 m [1181.10 in] (2)
Ambient Data	
Working temperature range	0 °C … +70 °C [32.0 °F … +158.0 °F]
Operating and storage temperature range	-30 °C … +105 °C [-22.0 °F … +221.0 °F]
Degree of protection at the cable outlet of the MiniCODER housing	IP68
Dielectric strength	500 V AC; in accordance with DIN EN 61439-1
Electromagnetic compatibility	Emission DIN EN 61000-6-4; DIN EN 61000-6-3 Immunity DIN EN 61000-6-2; DIN EN 61000-6-1
Vibration Resistance	200 m/s^2 [656.17 ft/s^2], in accordance with EN 60068-2-6
Shock resistance	2000 m/s^2 [2187.23 yd/s^2], in accordance with EN 60068-2-27
MTTF FIT	4,325,201 h at 55 °C [131.0 °F] 231.203 × 10^{-9} h^{-1} at 55 °C [131.0 °F]
Approvals	
European Economic Area	Compliance with EMC Directive 2014/30/EU CE

(1) Depending on the selected optional features. Mechanically permissible rotational speed depends on the design of the Target wheel (see Technical Information ZAx / ZFx (DS51-ZAx/ZFx or D-51T-ZAx/ZFx)).

(2) Note the voltage drop across the power supply cable; if the connection cable between the MiniCODER and the system controller is longer, we recommend using a cable with larger conductor cross-sections. The signal lines should be twisted-pair cables.

Measuring system

Module	3	4	5
Target wheel			
Material	Ferromagnetic steel		
Width of the target wheel	10.0 mm [0.39 in]		
Reference mark	Tooth (**Z**)		
Module m (1)	0.3	0.4	0.5
Geometric Data			
Nominal air gap	0.15 mm ± 0.02 mm [5.91 mil ± 0.79 mil]	0.20 mm ± 0.02 mm [7.87 mil ± 0.79 mil]	0.20 mm ± 0.03 mm [7.87 mil ± 1.18 mil]

(1) Additional modules available upon request

Optional features H

Configuration

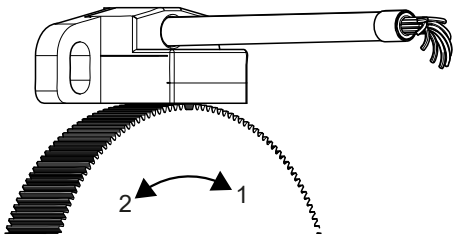
The number of teeth configured in the MiniCODER with Optional features **H** must match the number of teeth on the target wheel. The resolution is independent of the maximum rotational speed. The maximum configurable resolution is 24 bits / 0.0000215° (16,777,216 positions per revolution).

Factory Settings (1)

Designation	Module 3 (m = 0.3)	Module 4 (m = 0.4)	Module 5 (m = 0.5)
Positions per revolution	16777216	16,777,216	16,777,216
Resolution	24-bit / 0.0000215°	24-bit / 0.0000215°	24-bit / 0.0000215°
Number of teeth on the target wheel	256	192	150

(1) Other factory settings are available upon request.

Direction of Rotation

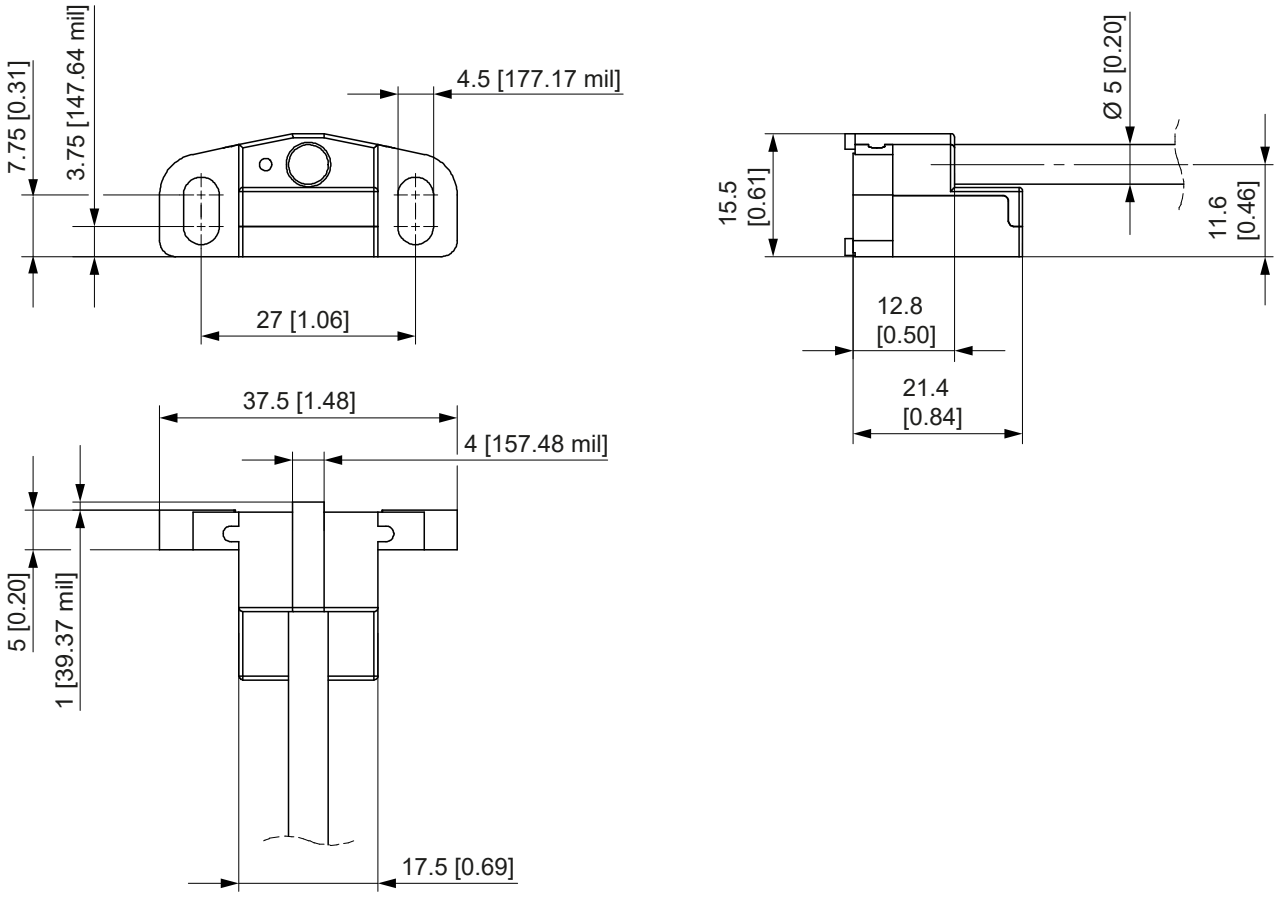


1 Clockwise rotation
→ Counter value increasing
2 Counterclockwise rotation
→ Counter value decreasing

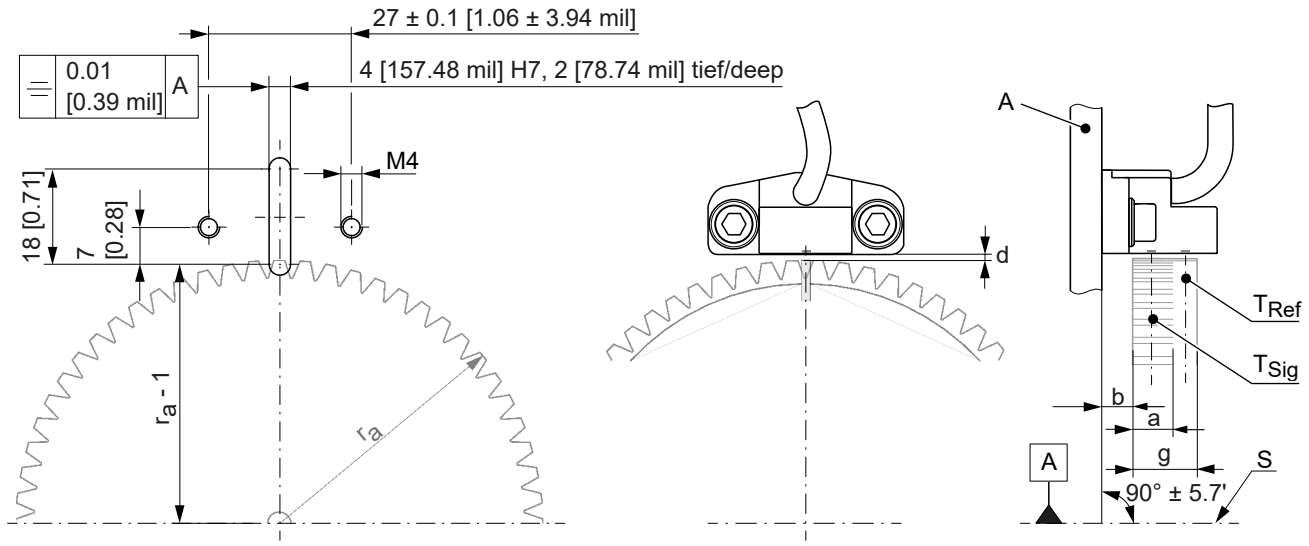
Dimension Drawing

All dimensions in millimeters [inches]; general tolerance DIN ISO 2768 -mK

MiniCODER Cable Outlet: Axial (**G**)



Drilling Pattern and Mounting Dimensions

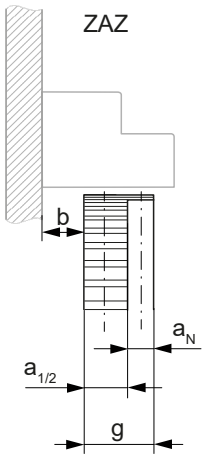


All dimensions in millimeters [inches]

a Width of the signal track (depends on the target wheel)
b Distance from mounting surface to target wheel: depends on the geometry of the target wheel (for example, width of the signal track)
d Air gap: depends on the module (*see „Air Gap Table“, page 12*)
g Width of the target wheel
r_a = $d_a/2$ (where d_a = pitch circle diameter of the target wheel)
A Mounting device
S Centerline of 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 [0.39]
$a_{1/2}$	6 [0.24]
a_N	4 [157.48 mil]
b	7.5 ± 0.5 [0.3 ± 19.69 mil]

General tolerance DIN ISO 2768 -mK



Air Gap Table

Module	Module m	Nominal air gap d
3	0.3	0.15 mm ± 0.02 mm [5.91 mil ± 0.79 mil]
4	0.4	0.20 mm ± 0.02 mm [7.87 mil ± 0.79 mil]
5	0.5	0.20 mm ± 0.03 mm [7.87 mil ± 1.18 mil]

To facilitate installation, the MiniCODER comes with a corresponding distance gauge.

Type Code

2444	**Product type**								
	F	**Signal pattern** Serial Interface for Fanuc Machine Controls							
		Z	**Reference mark** (1) Tooth-to-tooth						
			H	**Optional features** Resolution configurable up to 24 bits					
				G	**MiniCODER cable outlet** (2) Axial				
					3 **4** **5**	**Module m** (3) 0.3 0.4 0.5			
						K	**Connection type** Flying lead (4)		
							030 **050** **100** **150** **200** **250**	**Cable length L** 0.3 m [11.81 in] 0.5 m [19.69 in] 1.0 m [39.37 in] 1.5 m [59.06 in] 2.0 m [78.74 in] 2.5 m [98.43 in]	
								–	**Cable design for temperature sensor, 2 m [78.74 in]** Without temperature sensor cable
▼	▼	▼	▼	▼	▼	▼	▼	▼	
2444	–	–	–	–	–	–	– – –	–	◀ **Product code**

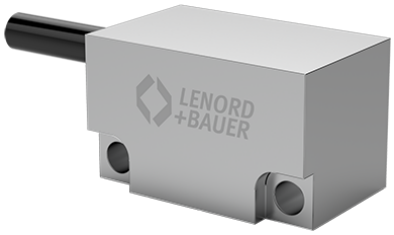
(1) Additional reference marks available upon request
(2) Additional cable outlets available upon request
(3) Additional modules available upon request
(4) The unit is shipped with a Lenord+Bauer test plug already connected.

For MiniCODERs with optional features **H,** the resolution and number of teeth can be configured using the GEL 211CST4␣2M Mobile Service Unit.
The factory settings can be found under *see „“Factory Settings“, page 10.*” Other factory settings are available upon request.

If you have any questions, please contact our support team (support@lenord.de) or one of our company locations (*see „contact information“, page 24*).

Technical information on MiniCODERs with other Signal patterns is available online (*see „contact information“, page 24*).

GEL 2449F



Technical Data

GEL 2449F

Electrical Data	
Supply Voltage U_B (reverse-polarity protected, overvoltage protected)	5 V DC ± 5%
Current consumption (no load)	≤ 80 mA
Digital interface	RS-485 with Fanuc αi protocol: bidirectional half-duplex
Data transfer rate	2.73 Mbit/s
Power consumption without load	≤ 0.5 W
Start-up time	≤ 0.5 s
Mechanical Data	
Housing material	Die-cast zinc
Weight	100 g [3.53 oz]
Maximum permissible rotational speed	≤ 100,000 min^{-1} [100,000 rpm] (1)
Cable Data	
Cable construction (number of conductors × conductor cross-section)	9 × 0.15 mm^2 [25 AWG]
Cable diameter	5 mm [0.20 in]
Minimum bend radius	25 mm [0.98 in]
Maximum allowable cable length	≤ 30 m [1181.10 in] (2)
Ambient Data	
Working temperature range	0 °C … +70 °C [32 °F … 158 °F]
Operating and storage temperature range	-30 °C … +105 °C [-22.0 °F … +221.0 °F]
Degree of protection at the cable outlet of the MiniCODER housing	IP68
Dielectric strength	500 V AC; in accordance with DIN EN 61439-1
Electromagnetic compatibility	Emission DIN EN 61000-6-4; DIN EN 61000-6-3 Immunity DIN EN 61000-6-2; DIN EN 61000-6-1
Vibration Resistance	200 m/s^2 [656.17 ft/s^2], in accordance with EN 60068-2-6
Shock resistance	2000 m/s^2 [2187.23 yd/s^2], in accordance with EN 60068-2-27
MTTF FIT	3,828,120 h at 55 °C [131.0 °F] 261 × 10^{-9} h^{-1} at 55 °C [131.0 °F]
Approvals	
European Economic Area	Compliance with EMC Directive 2014/30/EU CE

(1) Depending on the selected optional features. Mechanically permissible rotational speed depends on the design of the target wheel (see Technical Information ZAx / ZFx (DS51-ZAx/ZFx or D-51T-ZAx/ZFx)).

(2) Note the voltage drop across the power supply cable; if the connection cable between the MiniCODER and the system controller is longer, we recommend using a cable with larger conductor cross-sections. The signal lines should be twisted-pair cables.

Measuring system

Module	1	4
Target wheel		
Material	Ferromagnetic steel	
Width	ZAZ: 10.0 mm [0.39 in]; ZFF: 8.6 mm [0.34 in]	
Reference mark	Tooth (**Z**)	
Module m (1)	1.0	0.4
Nominal air gap	0.50 mm ± 0.03 mm [19.69 mil ± 1.18 mil]	0.20 mm ± 0.02 mm [7.87 mil ± 0.79 mil]

(1) Additional modules available upon request

Optional features H

Configuration

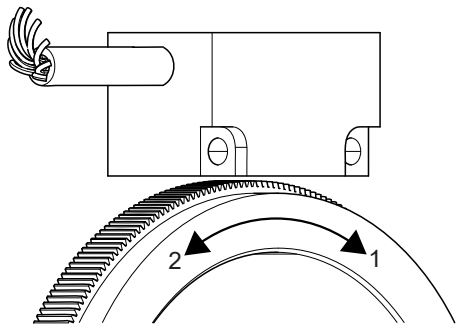
The number of teeth configured in the MiniCODER with Optional features **H** must match the number of teeth on the target wheel. The resolution is independent of the maximum rotational speed. The maximum configurable resolution is 24 bits / 0.0000215° (16,777,216 positions per revolution).

Factory Settings (1)

Designation	Module 4 (m = 0.4)	Module 1 (m = 1.0)
Positions per revolution	16777216	16,777,216
Resolution	24 bits / 0.0000215°	24 bits / 0.0000215°
Number of teeth on the target wheel	192	75

(1) Other factory settings are available upon request.

Direction of rotation

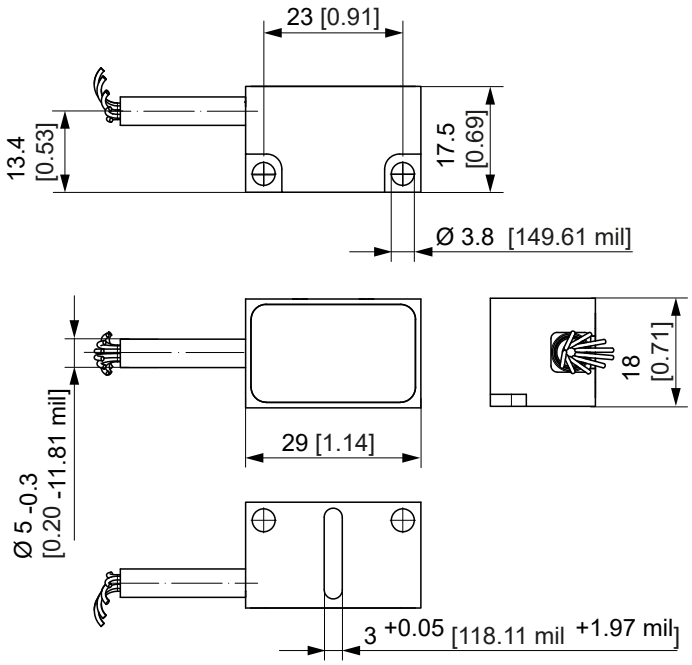


1 Clockwise rotation
→ Counter value increasing
2 Counterclockwise rotation
→ Counter value decreasing

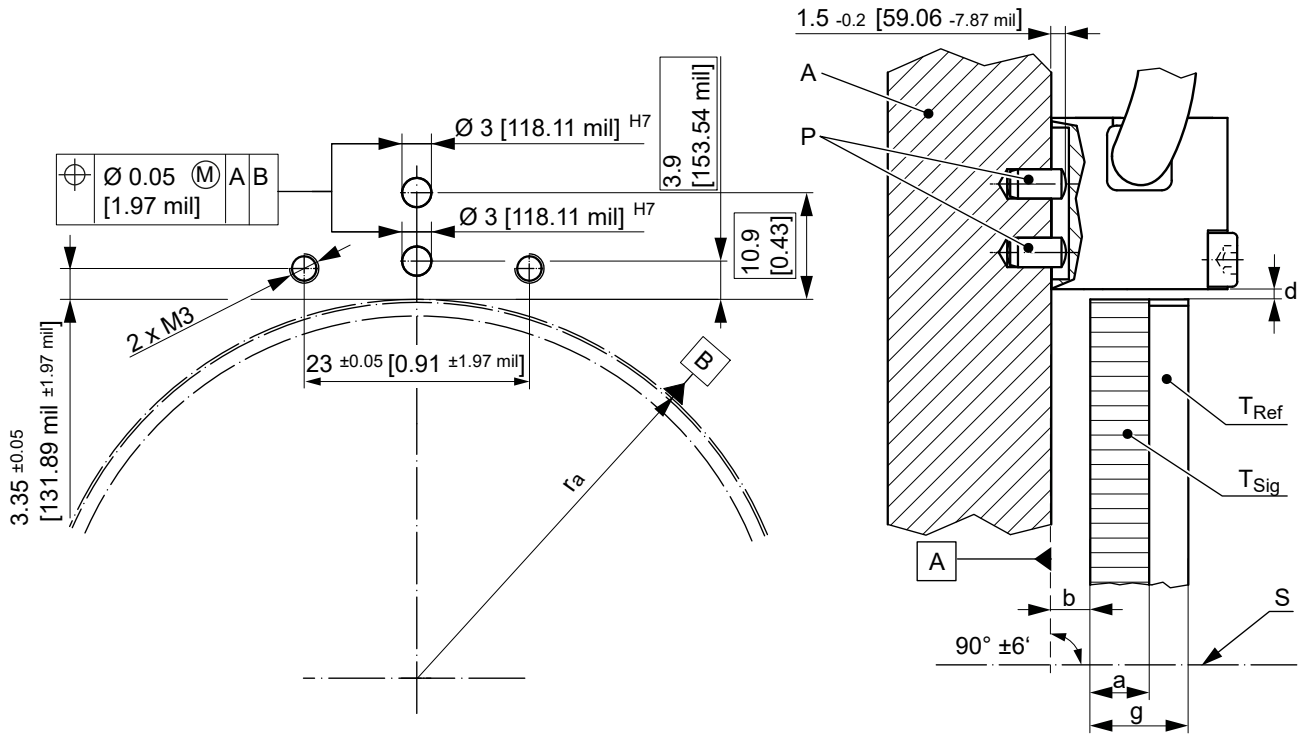
Dimension Drawing

All dimensions in millimeters [inches]; general tolerance DIN ISO 2768 -mK

MiniCODER cable outlet: Tangential Left (**L**)



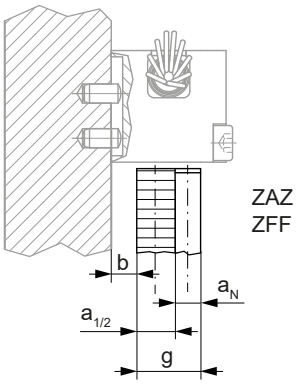
Drilling Pattern and Mounting Dimensions



All dimensions in millimeters [inches]

a Width of the signal track (depends on the target wheel)
b Distance from mounting surface to target wheel: depends on the geometry of the target wheel (for example, width of the signal track)
d Air gap: depends on the module (*see „Air Gap Table", page 20*)
g Width of the target wheel
r_a = $d_a/2$ (where d_a = pitch circle diameter of the target wheel)
A Mounting device
P M3 positioning pins
S Centerline of machine shaft / target wheel
T_{Ref} Reference track (target wheel)
T_{Sig} Signal track (target wheel)

Installation dimensions for standard target wheels		
Di-men-sion	ZAZ	ZFF
g	10 [0.39]	8.6 [0.34]
$a_{1/2}$	6 [0.24]	4.6 [181.10 mil]
a_N	4 [157.48 mil]	4 [157.48 mil]
b	4 ± 0.2 [157.48 mil ± 7.87 mil]	4.7 ± 0.2 [185.04 mil ± 7.87 mil]



Air Gap Table

Module	Module m	Nominal air gap d
1	1.0	0.50 mm ± 0.03 mm [19.69 mil ± 1.18 mil]
4	0.4	0.20 mm ± 0.02 mm [7.87 mil ± 0.79 mil]

To facilitate installation, the MiniCODER comes with a corresponding distance gauge.

Type Code

2449	**Product type**							
	F Signal pattern Serial Interface for Fanuc Machine Controls							
		Z Reference mark Tooth-to-tooth						
			H Optional features Configurable resolution up to 24 bits					
				L MiniCODER cable outlet Tangential, cable outlet on the left				
					1 Module m (1) 1.0 **4** 0.4			
						K Connection type Flying lead (2)		
							030 Cable length L 0.3 m [11.81 in] **050** 0.5 m [19.69 in] **100** 1.0 m [39.37 in] **150** 1.5 m [59.06 in] **200** 2.0 m [78.74 in] **250** 2.5 m [98.43 in]	
								– Cable design for temperature sensor, 2 m [78.74 in] Without temperature sensor cable
▼	▼	▼	▼	▼	▼	▼	▼	▼
2449	–	–	–	–	–	–	– – –	– ◀ **Product code**

(1) Additional modules available upon request

(2) The unit is shipped with a Lenord+Bauer test connector already attached.

For MiniCODERs with optional features **H,** the resolution and number of teeth can be configured using the GEL 211CST4␣2M Mobile Service Unit.
The factory settings can be found under *see „“Factory Settings“, page 17*.” Other factory settings are available upon request.

If you have any questions, please contact our support team (support@lenord.de) or one of our company locations (*see „contact information“, page 24*).

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