



MiniCODER with axial cable outlet

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
- ▶ The configurable MiniCODER records the minimum temperature, maximum temperature and rotational speed histogram; it can be calibrated automatically using the testing and programming unit
- ▶ **Safety integrated** certificate

Features

- ▶ Output signal 1 V_{pp} Differential signal (sin/cos)
- ▶ Digital reference pulse
- ▶ Frequency range from 0 to 200 kHz ⁽¹⁾
- ▶ Temperature range -30 °C to +120 °C
- ▶ Protection class IP 68

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

⁽¹⁾ At a cable capacitance of 5 nF

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.

The position is output as a digital differential pulse (track N).

The MiniCODER evaluates the following reference marks: Tooth (Z), Fanuc (F).



MiniCODERs with reference mark **F** can be connected directly to a Fanuc control system.

Module

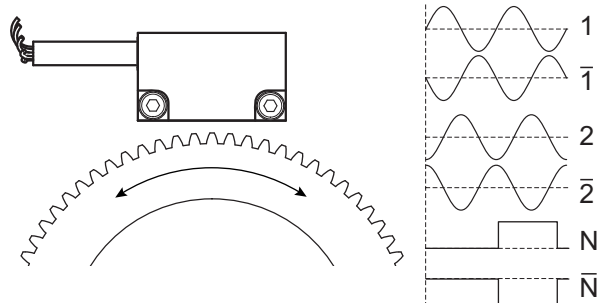
Possible modules: 1.0 and 0.4 .



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

Signal pattern K

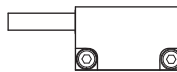
The output signals are two sinusoidal signals offset by 90° for the detection of direction (tracks 1 and 2) and their inverse signals.



N* Reference pulse (track N)

Cable outlet MiniCODER

The MiniCODER is available with the following cable outlet:



Tangential left

Optional extras

Configurable (P)

Configuration of the MiniCODER via the connector

- ▶ Setting the sin/cos amplitudes without mechanical re-adjustment of the air gap
- ▶ Elimination of the offset and amplitude error for compensating mounting tolerances
- ▶ Definition of 7 rotational speed ranges for the activation of the rotational speed histogram in the MiniCODER
- ▶ Entry of a spindle serial number (allocation of the drive)

In addition, various data is saved in the MiniCODER and can be read using the GEL 211:

- ▶ Rotational speed histogram for the analysis of the drive's operating conditions
- ▶ Number of startups
- ▶ Min. / max. temperature in the MiniCODER
- ▶ Item number and serial number of the MiniCODER
- ▶ Total operating time and time since the last configuration



The MiniCODER can be adjusted, analysed and configured using the testing and programming unit GEL 211.

Technical data

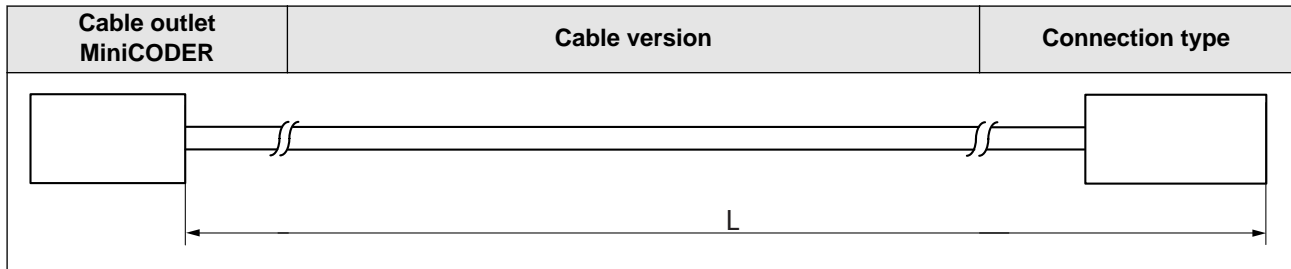
	GEL 2449_...1	GEL 2449_...4
Target wheel		
Module ⁽¹⁾	1.0	0.4
Width of the measuring track	≥ 8.6 mm	
Material	Ferromagnetic steel	
Reference mark	Tooth (Z), Fanuc (F)	
Geometric data		
Air gap permitted	0.50 mm ± 0.02 mm	0.20 mm ± 0.01 mm
Electrical data		
Supply voltage U _B	5 V DC ± 5%, polarity reversal protected, overvoltage protected	
Current consumption (without load)	≤ 50 mA	
Output level	1 V _{pp} Differential signal	
Output signal	Two sinusoidal signals offset by 90° and their inverse signals, short-circuit-proof; digital reference pulse	
Output frequency	0 to 200 kHz ⁽²⁾	
Power consumption without load	≤ 0.3 W	
Electromagnetic compatibility Electromagnetic emissions Electromagnetic immunity	DIN EN 61000-6-4:2011-09; DIN EN 61000-6-3:2011-09 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	
Mechanical data		
Weight	100 g	
Housing material	Die cast zinc	
Assured operating temperature range	0 °C to +70 °C	
Operating and storage temperature range	-30 °C to +120 °C	
Protection class	IP 68	
Vibration resistance	200 m/s ² (EN 60068-2-6:2008-10)	
Shock resistance	2000 m/s ² (EN 60068-2-27:2010-02)	
MTTF FIT	4,405,286 h at 55 °C 227 10 ⁻⁹ h ⁻¹ at 55 °C	
Electrical connection		
Number of cores x core cross-section	9 x 0.15 mm ²	
Max. permitted cable length	100 m ⁽³⁾	
Cable diameter	5 mm	
Min. bending radius	25 mm	

(1) Further modules upon request

(2) At a cable capacitance of 5 nF

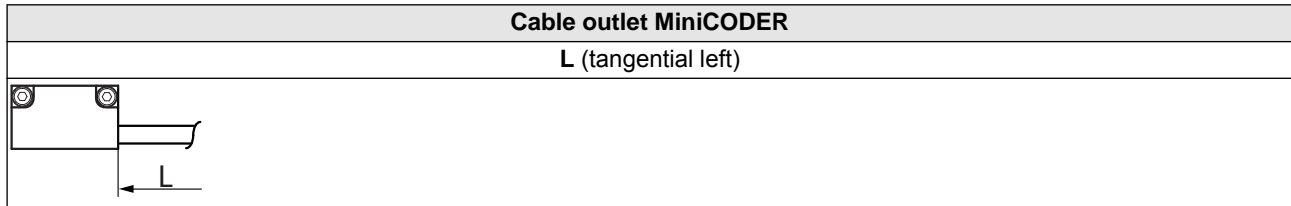
(3) Pay attention to voltage drop on the supply cable

Connection



L = cable length

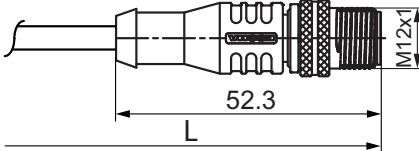
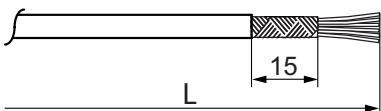
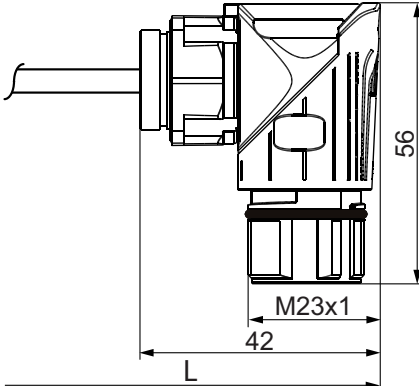
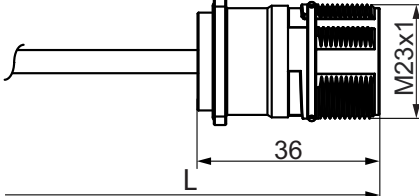
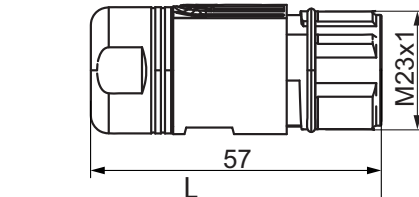
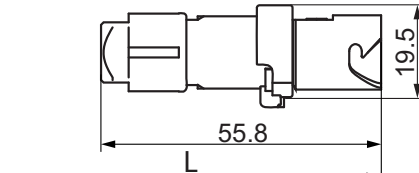
Cable outlet MiniCODER



Cable versions for temperature sensor

Cable version	
— (without temperature sensor cable)	
M (2-core temperature sensor cable, 2 m long) Cable data — TEFLON cable $2 \times 0.14 \text{ mm}^2$ — Outside diameter: 2.8 mm (± 0.1) — Min. bending radius: 20 mm	
N (4-core temperature sensor cable, 2 m long) Cable data — ETFE cable $4 \times 0.14 \text{ mm}^2$ — Outside diameter: 3.5 mm (± 0.2) — Min. bending radius: 7 mm	
P (6-core temperature sensor cable, 2 m long) Cable data — ETFE cable $6 \times 0.14 \text{ mm}^2$ — Outside diameter: 3.5 mm (± 0.2) — Min. bending radius: 7 mm	

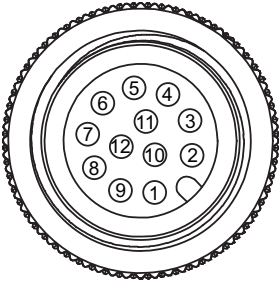
Connection types

Connection type		Notes
J (12-pin plug)		Not available with temperature sensor cable! Cable lengths available: 030 / 050 / 600
K (flying lead)		Cable lengths available: 030 / 050 / 150 / 250 / 600
M (17-pin panel-mounting socket, angled)		EMC screening, strain relief and sealing, IP 67 (connected)
N (17-pin panel-mounting socket)		EMC screening, strain relief and sealing, IP 67 (connected)
U (12-pin panel-mounting socket)		Not available with temperature sensor cable!
Z (10-pin plug)		Not available with temperature sensor cable! Cable lengths available: 120 / 200 / 250

Connection

Pin assignments

Connection type J

12-pin plug	Pin	Signal / function	
	1	U_{1+}	Signal track 1
	2	U_{1-}	Inverse signal track 1
	3	U_{N+}	Signal reference track N
	4	0 V	GND
	5	U_B	+ 5 V supply voltage
	6	U_{2+}	Signal track 2
	7	U_{2-}	Inverse signal track 2
	8	U_{N-}	Inverse signal reference track N
	9	Not used	
	10	U_{Sense}	5 V Sense
	11	Not used	
	12	Not used	

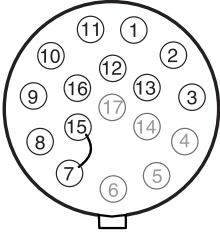


External sense regulation is required with long power supply cables!

Connection type K

Flying lead	Core colour	Signal / function	
	white	U_{1+}	Signal track 1
	brown	U_{1-}	Inverse signal track 1
	grey	U_{N+}	Signal reference track N
	blue	0 V	GND
	red	U_B	+ 5 V supply voltage
	pink	U_{2+}	Signal track 2
	black	U_{2-}	Inverse signal track 2
	yellow	U_{N-}	Inverse signal reference track N
	green	U_{Sense}	5 V Sense

Connection type M and N

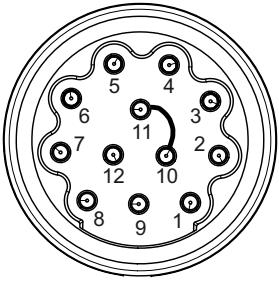
17-pin panel-mounting socket	Pin	Signal / function	
	1	U_{1+}	Signal track 1
	2	U_{1-}	Inverse signal track 1
	3	U_{N+}	Signal reference track N
	4 – 6	Not used	
	7	0 V	GND
	8	Not used	
	9	Not used	
	10	U_B	+ 5 V supply voltage
	11	U_{2+}	Signal track 2
	12	U_{2-}	Inverse signal track 2
	13	U_{N-}	Inverse signal reference track N
	14	Not used	
	15	0 V	GND (jumper pin 7)
	16	U_{Sense}	5 V Sense
	17	Not used	

Connection type M and N: Additional assignments on connection of a temperature sensor cable

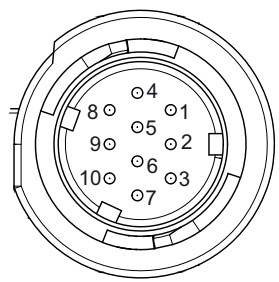
17-pin panel-mounting socket	Core colour	Pin	Signal / function
2-core temperature sensor cable (Cable version M)	brown	8	Temp +
	blue	9	Temp –
4-core temperature sensor cable (Cable version N)	brown	8	Temp1 +
	white	9	Temp1 –
	green	4	Temp2 +
	pink	14	Temp2 –
6-core temperature sensor cable (Cable version P)	brown	8	Temp1 +
	white	9	Temp1 –
	grey	6	Temp2 +
	yellow	5	Temp2 –
	green	4	Temp3 +
	pink	14	Temp3 –

Connection

Connection type U

12-pin panel-mounting socket	Pin	Signal / function	
	1	U_{2-}	Inverse signal track 2
	2	U_{Sense}	5 V Sense
	3	U_{N+}	Signal reference track N
	4	U_{N-}	Inverse signal reference track N
	5	U_{1+}	Signal track 1
	6	U_{1-}	Inverse signal track 1
	7	Not used	
	8	U_{2+}	Signal track 2
	9	Not used	
	10	0 V	GND
	11	0 V	GND (jumper pin 10)
	12	U_B	+ 5 V supply voltage

Connection type Z

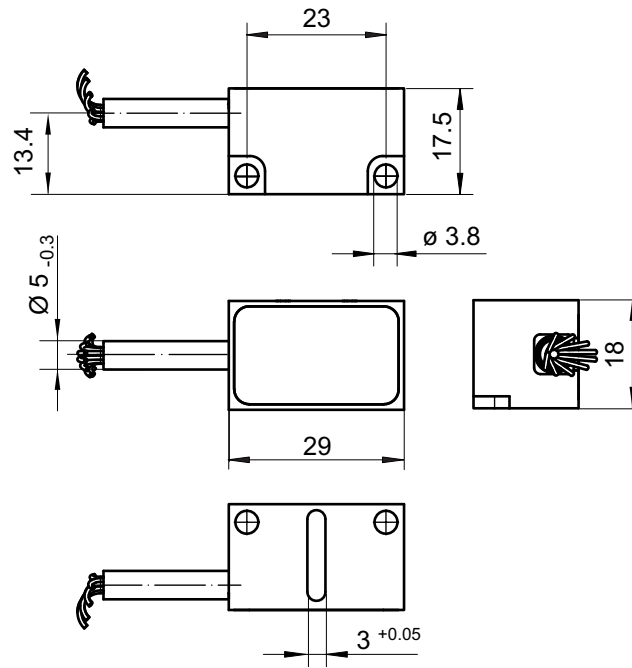
10-pin plug	Pin	Signal / function	
	1	U_{2+}	Signal track 2
	2	U_{2-}	Inverse signal track 2
	3	Screen	
	4	U_B	+ 5 V supply voltage
	5	U_{1+}	Signal track 1
	6	U_{1-}	Inverse signal track 1
	7	0 V	GND
	8	U_{N+}	Signal reference track N
	9	U_{N-}	Inverse signal reference track N
	10	Not used	



Sense regulation not possible!

Dimensional drawing

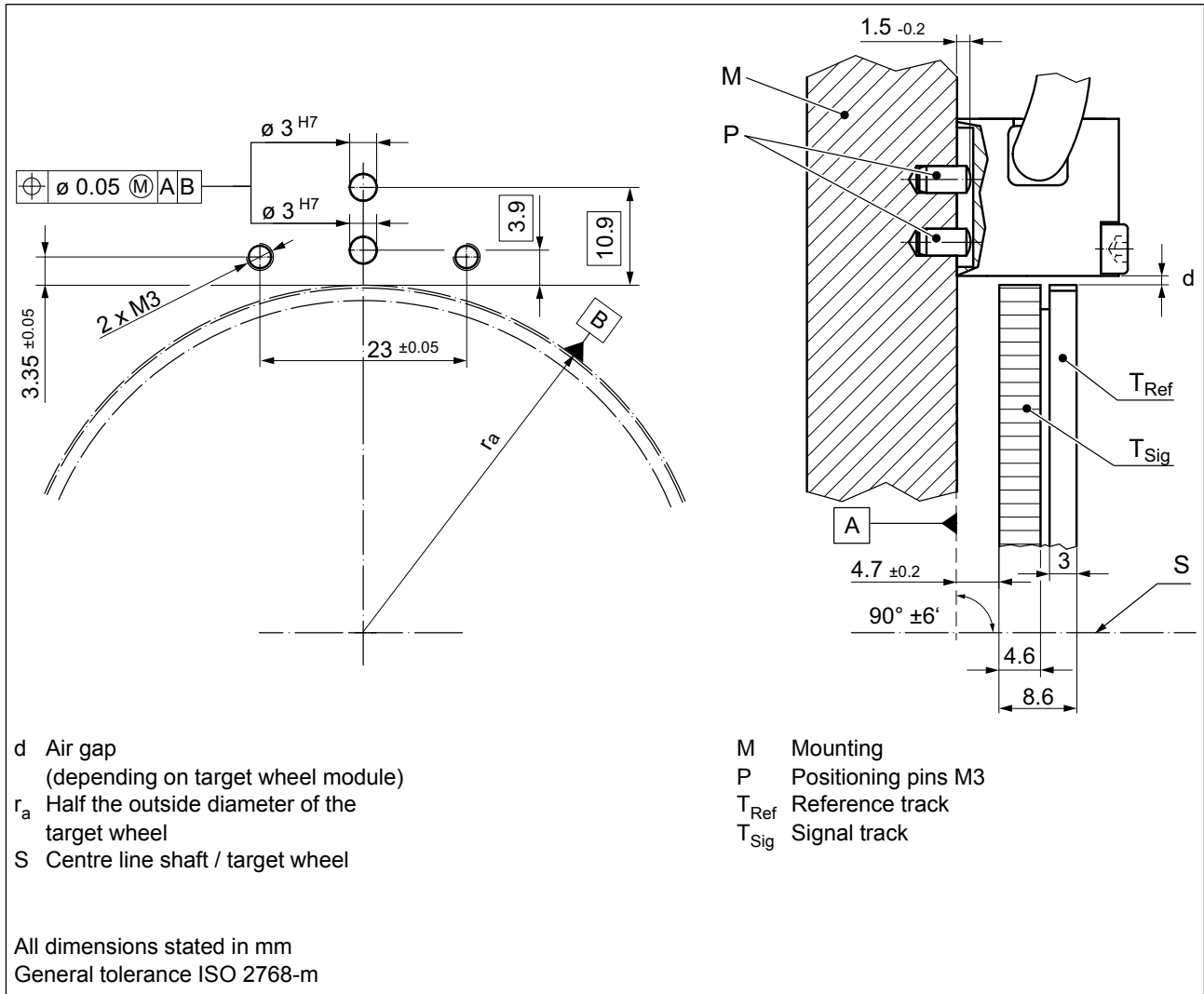
Dimensional drawing GEL 2449 – cable outlet tangential left



All dimensions stated in mm
General tolerance ISO 2768-m

Hole pattern and installation dimensions, air gap table

Hole pattern and installation dimensions



Air gap table

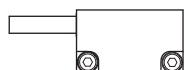
Type	Module	Air gap d , preset measure \pm distance tolerance
1	1.0	0.50 mm \pm 0.02 mm
4	0.4	0.20 mm \pm 0.01 mm

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

Type code GEL 2449

2449	Signal pattern	
	K	Sin/cos signals 1 V _{pp}
	M	MHSSI (Mitsubishi High Speed Serial Interface): IN PREPARATION ⁽¹⁾
	Reference mark	
	F	Plug and play for Fanuc control system
	Z	Reference tooth (tooth on tooth)
	Optional extras	
	P	Configurable (with digital reference signal)
	Cable outlet MiniCODER	
	L	Tangential, cable outlet left
Module ⁽²⁾		
1	Scanning of target wheels with module M = 1.0	
4	Scanning of target wheels with module M = 0.4	
Connection type		
J	12-pin plug (only cable lengths 030 / 050 / 600 available)	
K	Flying lead (only cable length 030 / 050 / 150 / 250 / 600 available)	
M	17-pin panel-mounting socket, angled	
N	17-pin panel-mounting socket	
U	12-pin panel-mounting socket	
Z	10-pin plug (only cable lengths 120 / 200 / 250 available)	
Cable length L		
030	0.3 m	
050	0.5 m	
120	1.2 m	
150	1.5 m	
200	2.0 m	
250	2.5 m	
600	6.0 m	
Cable version for temperature sensor (2 m)		
– Without cable for temperature sensor		
M	With 2-core temperature sensor cable (not for connection type J, U, Z)	
N	With 4-core temperature sensor cable (not for connection type J, U, Z)	
P	With 6-core temperature sensor cable (not for connection type J, U, Z)	

Cable outlet MiniCODER



Tangential left (L)

⁽¹⁾ Other serial protocols upon request

⁽²⁾ Further modules upon request

Use in safety applications

Fault detection has a major influence on the availability of safety functions. This task must be realised by the control system, as fault detection is not integrated into the sensor.



Safety of the overall system

The assessment of the safety of the drive train and the machine can only be undertaken by the machine manufacturer taking account the relevant directives, standards and safety regulations.

MTTF_d⁽¹⁾

For simplicity it is assumed that only 50 % of the hardware failures on electronic components are hazardous failures. For MTTF_d figures it is therefore typically possible to assume twice the MTTF figure⁽²⁾ (sources: EN ISO 13849-1:2008 (D); Annex C, section 5.2 Semiconductors; EN 61800-5-2:2007, Annex B, section 3.1.3 Anteil sicherer Ausfälle (Portion of safe failures)). The expected operating temperature must be taken into account in this assumption.

PFH_d⁽³⁾

The performance level and SIL level do not relate to the reliability of sub-components but to the availability of safety functions. The MTTF_d figures for the sensors are used in these calculations.

Characteristics

Operating temperature [°C]	FIT [10 ⁻⁹ h ⁻¹] ⁽⁴⁾	MTTF [h] ⁽²⁾
55	227	4,405,286

Safety Integrated

MiniCODERs with sin/cos signals (signal pattern **K**) have been checked according to Safety Integrated by the IFA in conjunction with Siemens Sinumerik control systems.

IFA assessment

(IFA test report no. 2013 23874):

"The sensor is suitable for providing two independent items of speed information. Due to the fault detection in the Sinumerik control systems, it is only necessary to use one sensor for safety applications."

Control systems from other manufacturers

For control systems from other manufacturers with a safety function, fault detection must be undertaken in the control system as in the Sinumerik:

- ▶ Faults in the sensor function are detected in the downstream control system by monitoring the differential sin/cos signals. For this purpose the amplitudes, the frequency, the offset or the phase on the sin/cos signals should be checked for plausibility.
- ▶ Mechanical slip or detachment of the target wheel from the shaft in operation or at standstill should, e.g., be excluded by a connection with a shaped fit.

Some measures for fault detection by control systems on the usage of sinusoidal sensor signals are listed in DIN EN 61800-5-2 Table 16 for electrical power drive systems with adjustable rotational speed.

(1) Mean time to failure "dangerous"

(2) Mean time to failure

(3) Probability of dangerous failure per hour

(4) Failure in time; i.e. failures per 10⁹ hours

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

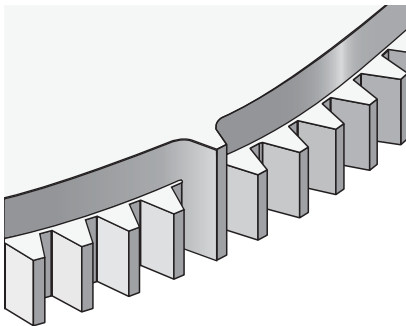
Standard target wheels are available on short delivery times from stock. For specifications and designs see "Technical information ZAx / ZFx".

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.com.

Reference mark

The MiniCODER can detect the reference mark in the form of a tooth. The pulse detected can be used for referencing the position. This feature is necessary, for example, to



Z = Reference mark – tooth

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.

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.

Accessories

Testing and programming unit



- ▶ Testing Lenord+Bauer sensors with sin/cos output 1 V_{pp}, e.g. MiniCODER
- ▶ Transmitting the data via WLAN to mobile terminal devices (tablet, PC etc.)
- ▶ Display of the data in a web browser, independent of the operating system

- ▶ Used for checking the signals for compliance with adjustable tolerance limits
 - sin/cos signals (amplitude, offset, phase offset)
 - Reference pulse (amplitude, offset, position and width)
 - Target wheel (damage, concentricity, quality of the teeth)
- ▶ Defining and saving different tolerance limits

- ▶ Used for the configuration of the MiniCODER
 - Automatic calibration of the sin/cos signals
 - Configuring/reading the operating hours counter (rotational speed histogram)
 - Saving the 7 configured speed ranges of the operating hours counter in one recordPossible to save several records in the GEL 211

Accessories

Item no.:	Identifier:
PK211BS0	Configuration kit, consisting of: <ul style="list-style-type: none">▶ MiniCODER testing and programming unit GEL211BS0▶ Sensor connection cable GG211▶ USB power supply unit AC/DC▶ USB 2.0 charging cable with micro USB connector▶ Case with foam insert
GG211-JAE	Adapter cable GEL 211 for MiniCODER with connection type Z
GG211-12POL-M23	Adapter cable GEL 211 for MiniCODER with connection type U

Evaluation aid for reference signals

Machine tool control systems can evaluate different types of reference signals on the 1 V_{pp} interface. Depending on the manufacturer and product, the reference signal is a digital signal or an analogue signal.

In the following the differences between an analogue reference signal and a digital reference signal from encoder kits with 1 V_{pp} interface are explained so that the interaction of control system and MiniCODER can be evaluated.

Parameters for the evaluation of reference signals

Parameter	Analogue reference signal	Digital reference signal
Zero transition on the rising edge	×	×
Zero transition on the falling edge	×	×
Amplitude	×	Fixed
Quiescent voltage offset level	×	Fixed
× The parameters are dependent on — Width and shape of the reference mark — Position of the reference mark in relation to the teeth on the signal track — Size of the air gap between MiniCODER and tooth wheel		

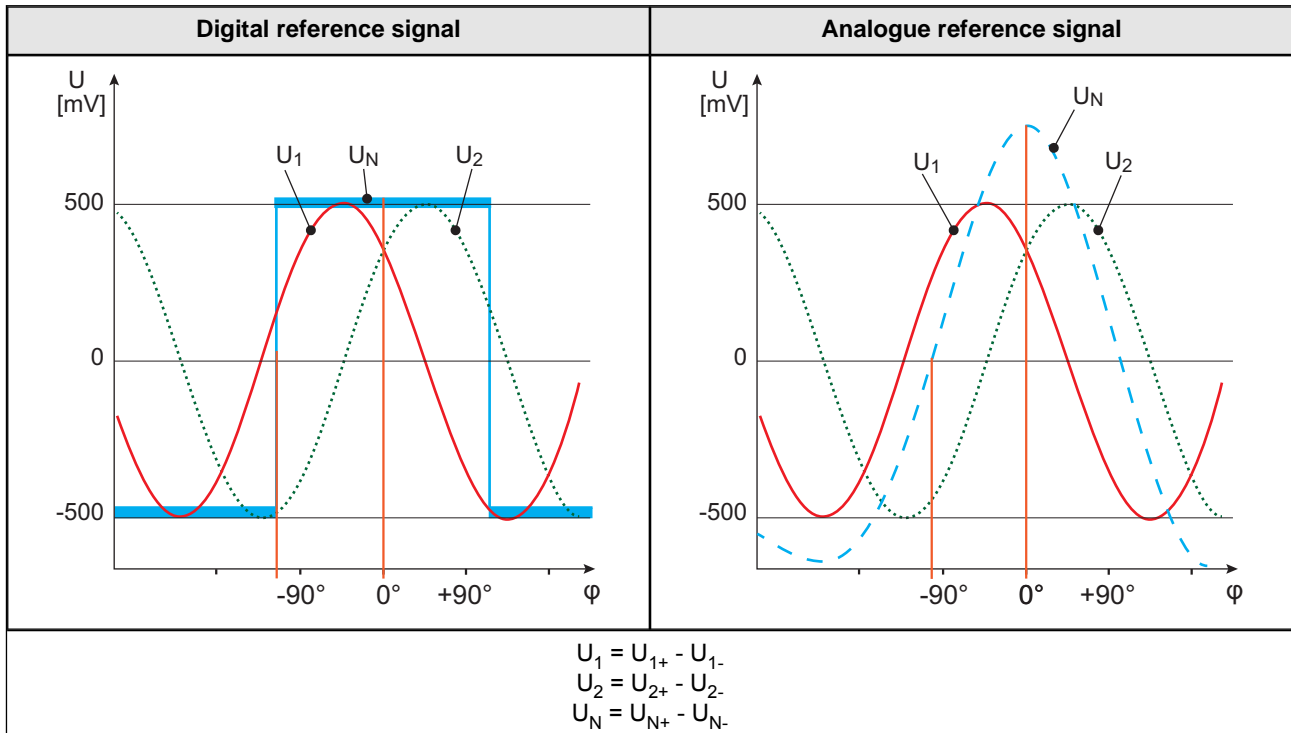
The control system evaluates the zero transitions on the rising and falling edge of the reference signal to determine the width and position of the reference signal. Square-wave and sinusoidal wave forms are allowed if the levels are within the limits specified. For example, on the usage of a Siemens control system the following parameters apply:

Parameter	Limit ranges
Zero transition on the rising edge	-270° to -90°
Zero transition on the falling edge	+270° to +90°
Amplitude	175 mV to 825 mV
Quiescent voltage offset level	150 mV to 600 mV

Evaluation aid for reference signals

Advantages of the digital reference signal

Wave forms



The following applies for the digital reference signal:

- ▶ The amplitude of the reference signal is independent of the air gap and in the ideal case set to +500 mV.
- ▶ The offset level in relation to the quiescent voltage is fixed at -500 mV to provide a large signal to noise ratio.

Summary

Both waveforms correspond to the common specifications for reference signals on the usage of 1 V_{pp} interface.



If you have any questions, please contact our Service department.
You will find information on our Service department on our homepage www.lenord.com.