MiniCoders for High-Speed Spindle applications

- Incremental MiniCoders:
  - MiniCoder GEL 2440 - square wave output
  - MiniCoder GEL 2443 – sin/cos output,
  - MiniCoder GEL 2444K, sin/cos output, programmable with GEL 211 tester
  - MiniCoder GEL 2444T, square wave output,
  - MiniCoder GEL 2448 – tested on Fanuc and Siemens, 0.4 module
- Absolute Minicoder GEL 2800 – SSI, BISS, A+B, A+B inverted signals, for shaft DIA up to 500 mm (19.69“)
MiniCoder application - Spindle

GEL 244 in HSC-Spindeln
MiniCoder in a spindle - 2
MiniCoders – how do they work?

ferro-magnetic Modulators

- in principle Lenord + Bauer uses modulators made of ferro-magnetic steel
- geared-tooth-wheels: milling / turning (>> 1000 types in the market)
- nonius structure: expose / etching
- self-centring modulators enables highly reproducible assembly
MiniCoders
GEL 2432, 2440, 2443, 2444K, 2444T, 2448, 2800

- Leading sensors in spindle applications
- Customers world-wide
- Detection of ferromagnetic measuring wheels
- Incremental Measuring system for hollow-shafts
- Successful application in:
  - Spindles
  - Drilling Machines
  - Grinding machines
  - Milling machines
  - Vacuum pumps
  - Specialty machines
Technical Data:

- **Technical features:** Contactless, high resolution, Sin/Cos signal output 1 V pp, speed up to 70,000 rpm
- **Motion detection:** Rotary
- **Max. air gap:** Depending on module 0.15 mm or 0.20 mm
- **Frequency range:** 0...200 kHz
- **Measuring scale:** Measuring target-wheel
- **Temperature range:** -40 °C ... +120 °C
- **Protection class:** IP 68
- **Supply voltage:** 5 V DC
- **Output signals:** incremental – square wave or sin/cos, absolute – SSI, BISS
- **GEL2443, 2444K with optional Amplitude stabilization**
Option: cable out, radial or axial

G = Axial cable outlet

R = Radial cable outlet

3 = Module 0.3

5 = Module 0.5
Option: straight connector
Option: right-angled connector
Option – Amplitude stabilization (GEL 2443, 2444K)

The GEL 2443 MiniCoder offers facilities for stabilizing fluctuations in the sin/cos amplitudes resulting from changes to the measuring distance and temperature. This greatly reduces the effort needed to install the unit: there is no longer any need to readjust the MiniCoder to optimize the signals.

\[ R = \text{Amplitude control} \]
Option – Reference Mark (Zero signal)

N = reference mark (flag)
M = reference mark (groove)
Z = Reference mark (flag over groove)
(blue line on the scope picture)
Measuring wheels

- Norms
- Materials
- Tolerances
- Installation
Measuring wheels - Tolerances
In-house Manufacturing:

- Production tolerances of internal and external production under control of our QS- system.
- Quality of teeth and other relevant tolerances are controlled by our own precision measuring devices
- In-house testing of all measuring wheels
**Flag (for rpm up to 30.000 rpm depending on size of measuring wheel)**

**N = reference mark (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 position reference. This is required, for instance, for the automatic changing of a tool in a milling or grinding spindle.

\[ h = 4 \text{ mm} \]
\[ b = 0.5 \text{ mm} \]
Measuring wheels – Reference Mark Groove

Reference Groove between 2 teeth for speeds above 30,000 rpm

$M = \text{reference mark (groove)}$

Depending on size and geometry of the target wheel, the target wheel version with a reference tab 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.

$h = 1 \text{ mm}$

<table>
<thead>
<tr>
<th>Module</th>
<th>b</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3</td>
<td>1.2 mm</td>
</tr>
<tr>
<td>0.5</td>
<td>1.6 mm</td>
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</tbody>
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Measuring wheels
- Reference Mark Flag over Groove

Reference Flag for speeds above 70,000 rpm, congruent to signal teeth

► Disadvantage: More costly to produce

\[ Z = \text{Reference mark (flag over groove)} \]

This MiniCoder version can be used for scanning a target wheel manufactured in one piece. The system permits reaching speeds of more than 70,000 min\(^{-1}\). The reference flag is in alignment with a tooth of the pulse track.
Assembly drawing

<table>
<thead>
<tr>
<th>module</th>
<th>air gap d adjustment dimension</th>
<th>distance tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3</td>
<td>0.10</td>
<td>± 0.02 mm</td>
</tr>
<tr>
<td>0.5</td>
<td>0.15</td>
<td>± 0.03 mm</td>
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</table>
Install and program MiniCoders with GEL 211

- Test and programming device
- Service tool to complement the MiniCODER family
- Simple data analysis with recording and report generation
- Setting and full diagnosis of MiniCODER Plus
- Universal WLAN connection
- Independent of operating system