General Catalog
Linear Encoders
Length Gauges
Angle Encoders
Rotary Encoders
Contouring Controls
Software Solutions
Touch Probes
Evaluation Electronics
Digital Readouts
This General Catalog offers you an overview of the HEIDENHAIN product program. You will find more products and further information in the documentation for specific products (see Further information on page 72) or on the Internet at www.heidenhain.com. Our sales personnel will be glad to help you personally. See Sales and service—worldwide on page 74 for addresses and telephone numbers.

The image on the title page shows a milled part with curved surfaces that was milled with diagonal, alternating face-milling movements. The workpiece was machined with a TNC control from HEIDENHAIN on an HSC machining center. Despite the direction reversal during face milling, a very high surface quality was attained thanks to the highly dynamic motion control.
Fundamentals and processes

The high quality of HEIDENHAIN products depends on special production facilities and measuring equipment. Masters and submasters for scale manufacturing are produced in a clean room with special measures for temperature stabilization and vibration insulation. HEIDENHAIN develops and builds most of the machines it needs for the production and measurement of linear and circular scales, including the necessary copying equipment.

Competence in the area of linear and angular metrology is reflected by a large number of customized solutions for users. Among other implementations, they include the measuring and test equipment developed and built for standards laboratories and the angle encoders for telescopes and satellite receiving antennas. Of course, the products in the standard HEIDENHAIN product program profit from the knowledge gained.

Precision graduations: the foundation for high accuracy

The heart of a HEIDENHAIN encoder is its measuring standard, usually in the form of a grating with typical line widths of 0.25 µm to 10 µm. These precision graduations are manufactured in a process invented by HEIDENHAIN (e.g. DIADUR or METALLUR) and are a decisive factor in the function and accuracy of encoders. The graduations consist of lines and gaps at defined intervals with very little deviation, forming structures with very high edge definition. These graduations are resistant to mechanical and chemical influences and can tolerate vibration and shock. All measuring standards have a defined thermal behavior.

DIADUR
DIADUR precision graduations are composed of an extremely thin layer of chromium on a substrate—usually of glass or glass ceramic. The accuracy of the graduation structure lies within the micron and submicron range.

METALLUR
With its special optical composition of reflective gold layers, METALLUR graduations show a virtually planar structure. They are therefore particularly tolerant to contamination.

SUPRADUR
Graduations manufactured with the SUPRADUR process function optically like three-dimensional phase gratings, but they have a planar structure and are therefore particularly insensitive to contamination.

OPTODUR
The OPTODUR process produces graduation structures with particularly high reflectance. Its composition as an optically three-dimensional, planar structure is similar to the SUPRADUR graduation.

MAGNODUR
Thin magnetically active layers in the micron range are structured for very fine, magnetized graduations.

DIADUR and METALLUR graduations on various carrier materials

Angle comparator, measuring step approx. 0.001”
ALMA radio telescope in Chajnantor, Chile (photo courtesy of ESO)
Length measurement

Sealed linear encoders

Sealed linear encoders from HEIDENHAIN are protected from dust, chips, and splash fluids and are ideal for operation on machine tools.

- Accuracy grades as fine as ±2 µm
- Measuring steps of down to 0.001 µm
- Measuring lengths of up to 30 m (72 m upon request)
- Fast and simple installation
- Large mounting tolerances
- High acceleration loading
- Protection against contamination

Exposed linear encoders

Exposed linear encoders from HEIDENHAIN operate with no mechanical contact between the scanning head and the scale or scale tape. Typical areas of application for these encoders include measuring machines, comparators, and other precision devices, as well as production and measuring equipment, for example in the semiconductor industry.

- Accuracy grades of ±0.5 µm and better
- Measuring lengths of up to 30 m
- No friction between scanning head and scale
- Small dimensions and low mass
- High traversing speeds

Sealed linear encoders are available with

- Full-size scale housing
  - For high vibration loading
  - Up to 30 m measuring length
  (72 m upon request)
- Slimline scale housing
  - For limited installation space
  - Measuring lengths of up to 2040 mm
  (for measuring lengths starting from
  1240 mm, mounting via mounting spar
  or tensioning elements)

The aluminum housing of a HEIDENHAIN sealed linear encoder protects the scale, scanning carriage, and its guideway from chips, dust, and fluids. Downward-oriented elastic lips seal the housing. The scanning carriage travels along the scale on a low-friction guide. It is connected to the external mounting block by a coupling that compensates unavoidable misalignment between the scale and the machine guideways.

Exposed linear encoders

Exposed linear encoders from HEIDENHAIN are available with

- Full-size scale housing
  - For high vibration loading
  - Up to 30 m measuring length
  (72 m upon request)
- Slimline scale housing
  - For limited installation space
  - Measuring lengths of up to 2040 mm
  (for measuring lengths starting from
  1240 mm, mounting via mounting spar
  or tensioning elements)

Length gauges

Length gauges from HEIDENHAIN feature integral guideways for the plunger. They are used to monitor measuring equipment, in industrial metrology, and as position encoders.

- Accuracy grades as fine as ±0.1 µm
- For measuring steps of down to 0.005 µm (5 nm)
- Measuring lengths of up to 100 mm
- High measuring accuracy
- Available with automated plunger drive
- Simple mounting

With incremental linear encoders, the current position is determined by starting at a reference point and counting measuring steps, or by subdividing and counting signal periods. Incremental encoders from HEIDENHAIN feature reference marks, which must be scanned after switch-on to reestablish the reference point. This process is especially simple and fast with distance-coded reference marks.

Absolute linear encoders from HEIDENHAIN require no previous traverse to provide the current position value. The encoder transmits the absolute value through the EnDat interface or another serial interface.

The recommended measuring steps listed in the table refer primarily to position measurements. Smaller measuring steps, which are attained through higher interpolation factors of sinusoidal output signals, are useful in particular for applications in rotational speed control, e.g. on direct drives.

Under the designation functional safety, HEIDENHAIN offers encoders with purely serial data transmission as single-encoder systems for safety-related machines and systems. The two measured values are already formed independently of each other in the encoder, and are transmitted to the safe control via the EnDat interface.

Sealed linear encoders

<table>
<thead>
<tr>
<th>Series</th>
<th>Page</th>
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</thead>
<tbody>
<tr>
<td>LC 100</td>
<td>8</td>
</tr>
<tr>
<td>LC 200</td>
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<tr>
<td>LS 100</td>
<td></td>
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<tr>
<td>LF 100</td>
<td></td>
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<tr>
<td>LS 600</td>
<td></td>
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<tr>
<td>LB 300</td>
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</tbody>
</table>

With full-size scale housing

- Absolute position measurement
- Absolute position measurement and large measuring lengths
- Incremental position measurement
- Very high repeatability
- Typically for manual machines
- Large measuring lengths

With slimline scale housing

- Absolute position measurement
- Incremental position measurement
- Very high repeatability
- Typically for manual machines

Exposed linear encoders

- Very high accuracy
- Two-coordinate encoders
- For high accuracy and large measuring lengths
- Absolute position measurement

Length gauges

For measuring stations and multipoint inspection apparatuses

- AT, CT, MT, ST

Series | Page |
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>UP</td>
<td>12</td>
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<tr>
<td>UP, PP</td>
<td>13</td>
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<tr>
<td>LIDA</td>
<td>14</td>
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<tr>
<td>LIC</td>
<td></td>
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</tbody>
</table>
LC, LF, LS, LB sealed linear encoders
With full-size scale housing

Linear encoders with full-size scale housing are characterized particularly by high tolerance to vibration.

Absolute linear encoders of the LC 100 and LC 200 series provide the absolute position value without requiring any previous traverse. Depending on the version, incremental signals can be output additionally. The LC 100 can be mounted to the same mating dimensions as the incremental linear encoders of the LS 100 series and feature the same mechanical design. Because of their high accuracy and defined thermal behavior, LC 100 and LS 100 series linear encoders are especially well suited for use on numerically controlled machine tools.

The incremental encoders of the LF type feature measuring standards with relatively fine grating periods. This makes them particularly attractive for applications requiring very high repeatability.

The LS 600 series incremental linear encoders are used for simple positioning tasks, for example on manual machine tools.

The LC 200 (absolute) and LB (incremental) linear encoders were conceived for very long measuring lengths. Their measuring standard—a steel tape with METALLUR graduation—is delivered as a single piece, and after the housing sections have been mounted, is pulled through the sections, drawn to a defined tension and fixed at both ends to the machine base.

### Absolute position measurement

**LC 100 series**
- Absolute position measurement
- Defined thermal behavior
- High vibration resistance
- Two mounting attitudes
- Single-field scanning

**LC 200 series**
- Absolute position measurement
- For large measuring lengths of up to 28 m
- Defined thermal behavior
- High vibration resistance
- Two mounting attitudes
- Single-field scanning

### Incremental position measurement

**LS 100 series**
- Incremental position measurement
- Defined thermal behavior
- High vibration resistance
- Two mounting attitudes
- Single-field scanning

**LF 185**
- Incremental position measurement
- Very high repeatability
- Thermal behavior similar to steel or cast iron
- High vibration resistance
- Two mounting attitudes
- Single-field scanning

**LB 382**
- Incremental position measurement
- For large measuring lengths of up to 72 m
- Defined thermal behavior
- High vibration resistance
- Two mounting attitudes
- Single-field scanning

**LS 600 series**
- Incremental position measurement
- Typically for manual machines
- Simple mounting

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### Measuring standard

<table>
<thead>
<tr>
<th>Absolute</th>
<th>Incremental</th>
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<tbody>
<tr>
<td>LC 115/LC 185/LC 195/F/M/P</td>
<td>LF 185</td>
</tr>
<tr>
<td>LC 211/LC 281/LC 281/F/M</td>
<td>LS 187/LS 177</td>
</tr>
<tr>
<td>LC 185</td>
<td>LS 688C/LS 628C</td>
</tr>
<tr>
<td>LC 211/LC 281</td>
<td>LB 382</td>
</tr>
</tbody>
</table>

### Interface

<table>
<thead>
<tr>
<th>LC 115</th>
<th>LF 185</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC 115: EnDat 2.2</td>
<td>LC 211: EnDat 2.2</td>
</tr>
<tr>
<td>LC 186: EnDat 2.2 with Rev. 1</td>
<td>LC 281: EnDat 2.2 with Rev. 1</td>
</tr>
<tr>
<td>LC 196: Fanuc/a0i/Mitsubishi/Panasonic/DRIVE-CLIQ</td>
<td>LC 291: Fanuc/a0i/Mitsubishi</td>
</tr>
</tbody>
</table>

### Accuracy grade

<table>
<thead>
<tr>
<th>LC 185</th>
<th>LC 281:</th>
<th>LS 187:</th>
<th>LS 688C:</th>
<th>LB 382</th>
</tr>
</thead>
<tbody>
<tr>
<td>±5 µm, ±3 µm</td>
<td>±5 µm, ±3 µm</td>
<td>±5 µm, ±3 µm</td>
<td>±10 µm</td>
<td>±5 µm</td>
</tr>
</tbody>
</table>

### Measuring lengths ML

<table>
<thead>
<tr>
<th>LC 281:</th>
<th>LS 187:</th>
<th>LS 688C:</th>
<th>LB 382</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 4240 mm</td>
<td>Up to 28040 mm</td>
<td>Up to 3040 mm</td>
<td>Up to 3040 mm</td>
</tr>
</tbody>
</table>

### Signal period

<table>
<thead>
<tr>
<th>LC 281:</th>
<th>LS 187:</th>
<th>LS 688C:</th>
<th>LB 382</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 µm</td>
<td>20 µm</td>
<td>20 µm</td>
<td>40 µm</td>
</tr>
</tbody>
</table>

### Measuring lengths ML

| Up to 4240 mm | Up to 28040 mm | Up to 3040 mm | Up to 3040 mm |

### Reference mark

- One or distance-coded; LS 688C: distance-coded

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1) Also available with functional safety
2) 5/10/20-fold integrated interpolation
3) Up to ML 3040 mm
4) Up to ML 72040 mm upon request
5) Larger measuring lengths with TNC 640 upon request

DRIVE-CLIQ is a registered trademark of SIEMENS AG.
LC, LF, LS sealed linear encoders
With slimline scale housing

Sealed linear encoders with slimline scale housing are primarily used where installation space is limited. Absolute linear encoders of the LC 400 series provide the absolute position value without requiring any previous traverse. Like the LS 400 series incremental linear encoders, their high accuracy and defined thermal behavior make them especially well suited for use on numerically controlled machine tools.

The incremental encoders of the LF type feature measuring standards with relatively fine grating periods. This makes them particularly attractive for applications requiring very high repeatability. The LS 300 series incremental linear encoders are used for simple positioning tasks, for example on manual machine tools.

Simple installation with mounting spar
The use of a mounting spar is of great benefit when mounting slimline linear encoders. It can be fastened as part of the machine assembly process. The encoder is then simply clamped on during final mounting. Easy exchange also facilitates servicing. Moreover, installation with a mounting spar significantly improves the encoder’s acceleration behavior.

Absolute position measurement
LC 400 series
- Absolute position measurement
- Defined thermal behavior
- Single-field scanning

Incremental position measurement
LS 400 series
- Incremental position measurement
- Defined thermal behavior
- Single-field scanning

LF 485
- Incremental position measurement
- Very high repeatability
- Thermal behavior similar to steel or cast iron
- Single-field scanning

LS 300 series
- Incremental position measurement
- Typically for manual machines

Simple installation with mounting spar
The use of a mounting spar is of great benefit when mounting slimline linear encoders. It can be fastened as part of the machine assembly process. The encoder is then simply clamped on during final mounting. Easy exchange also facilitates servicing. Moreover, installation with a mounting spar significantly improves the encoder’s acceleration behavior.

<table>
<thead>
<tr>
<th>Measuring standard</th>
<th>Grating period</th>
<th>Interface</th>
<th>Signal period</th>
<th>Accuracy grade</th>
<th>Measuring lengths ML</th>
<th>Reference mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absolute LC 415 /LC 485, LC 495 F/M/P/S</td>
<td>20 µm</td>
<td>LC 418 EnDat 2.2</td>
<td>4 µm</td>
<td>±5 µm, ±3 µm</td>
<td>Up to 2040 mm 1)</td>
<td>One or distance-coded</td>
</tr>
<tr>
<td>Incremental LF 485</td>
<td>20 µm, 4 µm</td>
<td>LC 418 EnDat 2.2 with 1 Vpp</td>
<td>LS 477: ±1 Vpp</td>
<td>±10 µm</td>
<td>Up to 1240 mm 2)</td>
<td>Distance-coded</td>
</tr>
<tr>
<td>LS 487</td>
<td>DIADUR glass scale</td>
<td>SUPRADUR phase grating on steel</td>
<td>LS 477: ±1 Vpp</td>
<td>±5 µm</td>
<td>Over ML 1240 mm with mounting spar or clamping elements</td>
<td>One or distance-coded</td>
</tr>
<tr>
<td>LS 477</td>
<td>DIADUR glass scale</td>
<td>DIADUR glass scale</td>
<td>LS 477: ±1 Vpp</td>
<td>±5 µm</td>
<td>Over ML 1240 mm with mounting spar or clamping elements</td>
<td>One or distance-coded</td>
</tr>
<tr>
<td>LS 483 C</td>
<td>DIADUR glass scale</td>
<td>Glass scale</td>
<td>LS 477: ±1 Vpp</td>
<td>±5 µm</td>
<td>Over ML 1240 mm with mounting spar or clamping elements</td>
<td>One or distance-coded</td>
</tr>
<tr>
<td>LS 383 C</td>
<td>DIADUR glass scale</td>
<td>DIADUR glass scale</td>
<td>LS 477: ±1 Vpp</td>
<td>±5 µm</td>
<td>Over ML 1240 mm with mounting spar or clamping elements</td>
<td>One or distance-coded</td>
</tr>
<tr>
<td>LS 373 C</td>
<td>DIADUR glass scale</td>
<td>DIADUR glass scale</td>
<td>LS 477: ±1 Vpp</td>
<td>±5 µm</td>
<td>Over ML 1240 mm with mounting spar or clamping elements</td>
<td>One or distance-coded</td>
</tr>
</tbody>
</table>

1) Also available with functional safety
2) 5/10/20-fold integrated interpolation
3) Over ML 1240 mm with mounting spar or clamping elements
LIP, LIF exposed linear encoders
For very high accuracy

The exposed linear encoders of the LIP and LIF design are characterized by small measuring steps together with high accuracy. The measuring standard is a phase grating applied to a substrate of glass or glass ceramic.

LIP and LIF encoders are typically used for:
• Measuring machines and comparators
• Measuring microscopes
• Ultra-precision machines such as diamond lathes for optical components, facing lathes for magnetic storage disks, and grinding machines for ferrite components
• Measuring and production equipment in the semiconductor industry
• Measuring and production equipment in the electronics industry

Special vacuum applications in high vacuum are served by LIF 481 V and LIP 481 V (for high vacuum, down to 10–7 bar) and LIP 481 U (for ultrahigh vacuum, down to 10–11 bar).

Incremental position measurement

LIP 300 series
• Highest resolutions, with measuring steps of down to < 1 nm
• Very high repeatability through an extremely fine signal period
• Defined thermal behavior thanks to a measuring standard on Zerodur glass ceramic scale

LIP 200 series
• Very high repeatability with compact dimensions
• Measuring lengths of up to 3040 mm
• Measuring steps of down to < 1 nm
• Defined thermal behavior thanks to a measuring standard on Zerodur glass ceramic scale

LIP 6000 series
• For highly dynamic applications
• For limited installation space
• Measuring steps of down to 1 nm
• Position detection through limit switches and homing track

LIF 400 series
• Fast, simple scale fastening with PRECIMET adhesive film
• Insensitive to contamination thanks to SUPRADUR graduation
• Position detection through limit switches and homing track

PP exposed linear encoders
Two-coordinate encoders

The PP two-coordinate encoders feature as measuring standard a planar phase-grating structure on a glass substrate. This makes it possible to measure positions in a plane.

Applications include:
• Measuring and production equipment in the semiconductor industry
• Measuring and production equipment in the electronics industry
• Extremely fast X-Y tables
• Measuring machines and comparators
• Measuring microscopes

**Incremental position measurement**

### LIP 300 series
- Highest resolutions, with measuring steps of down to < 1 nm
- Very high repeatability through an extremely fine signal period
- Defined thermal behavior thanks to a measuring standard on Zerodur glass ceramic scale

### LIP 200 series
- Very high repeatability with compact dimensions
- Measuring lengths of up to 3040 mm
- Measuring steps of down to < 1 nm
- Defined thermal behavior thanks to a measuring standard on Zerodur glass ceramic scale

### LIP 6000 series
- For highly dynamic applications
- For limited installation space
- Measuring steps of down to 1 nm
- Position detection through limit switches and homing track

### LIF 400 series
- Fast, simple scale fastening with PRECIMET adhesive film
- Insensitive to contamination thanks to SUPRADUR graduation
- Position detection through limit switches and homing track

<table>
<thead>
<tr>
<th>Measuring length ML</th>
<th>70 mm to 270 mm</th>
<th>20 mm to 1020 mm</th>
<th>20 mm to 3040 mm</th>
<th>20 mm to 1020 mm</th>
<th>20 mm to 3040 mm</th>
<th>70 mm to 270 mm</th>
<th>70 mm to 1640 mm</th>
</tr>
</thead>
</table>

**Reference mark**
- None
- One

**Interface**
- 1 VPP
- LIP 281: 1 VPP, LIP 211: EnDat 2.2
- LIP 6081: 1 VPP, LIP 6071: TTL, LIP 481: 1 VPP, LIP 471: TTL

**Accuracy grade**
- ±0.5 µm
- ±1 µm
- ±3 µm
- ±1 µm (only for Zerodur)
- ±3 µm (only for Zerodur)
- ±3 µm

**Baseline error**
- ≤ ±0.075 µm/5 mm
- ≤ ±0.125 µm/5 mm
- ≤ ±0.175 µm/5 mm
- ≤ ±0.225 µm/5 mm

**Interpolation error**
- ±0.01 mm
- ±0.4 mm
- ±4 mm
- ±12 nm

**Reference mark**
- One per coordinate

1) Absolute position value after scanning the reference mark
2) Only with encoders with 1 VPP or EnDat 2.2 interface
LIC, LIDA exposed linear encoders
For high accuracy and large measuring lengths

There are various possibilities for easy mounting of the LIC and LIDA encoders:
LIC 41x3, LIDA 4x3
• Scale of glass or glass ceramic is bonded directly onto the mounting surface
LIC 41x5, LIDA 4x5
• One-piece steel scale tape pulled through aluminum extrusions and tensioned at its ends
The aluminum extrusions can be screwed or bonded onto the mounting surface
LIC 41x7, LIC 31x7, LIC 21x7, LIDA 4x7, LIDA 2x7
• One-piece steel scale-tape pulled through aluminum extrusions and fastened at center
The aluminum extrusions are bonded onto the mounting surface
LIC 41x9, LIC 31x9, LIC 21x9, LIDA 4x9, LIDA 2x9
• One-piece steel scale tape is bonded directly to the mounting surface
Also available with functional safety (LIC 4119)

Absolute position measurement
LIC 4100 series
• Very high accuracy and long measuring lengths
• Various mounting options
• Grating on steel scale tape, glass, or glass ceramic
• Also available with functional safety
LIC 3100 series
• High accuracy and large measuring lengths
• Various mounting options
• Scale tape cut from roll
LIC 2100 series
• Large mounting tolerance
• For simple applications

Incremental position measurement
LIP 400 series
• Large measuring lengths of up to 30 m
• Various mounting options
• Limit switches
LIP 200 series
• Scale tape cut from roll
• Large mounting tolerance
• For simple applications
• Simple installation through integrated function display

<table>
<thead>
<tr>
<th>Measuring standard</th>
<th>LIC 4113</th>
<th>LIC 4115</th>
<th>LIC 4117</th>
<th>LIC 4119</th>
<th>LIC 3117</th>
<th>LIC 3119</th>
<th>LIC 2117</th>
<th>LIC 2119</th>
<th>LIC 4100</th>
<th>LIC 4110</th>
<th>LIC 4111</th>
<th>LIC 3100</th>
<th>LIC 2100</th>
<th>LIC 4100</th>
<th>LIC 2100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grating period</td>
<td>METALLUR graduation on glass ceramic or glass</td>
<td>METALLUR steel scale tape</td>
<td>Steel scale tape with absolute track and incremental track</td>
<td>Steel scale tape</td>
<td>METALLUR graduation on glass ceramic or glass</td>
<td>Steel scale tape</td>
<td>Steel scale tape</td>
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<tr>
<td>Interface</td>
<td>LIC 411x: EnDat 2.2</td>
<td>LIC 419x: Fanuc a/ Mitsubishi/ Panasonic/Yaskawa</td>
<td>LIC 311x: EnDat 2.2</td>
<td>LIC 211x: Fanuc a/ Mitsubishi/ Panasonic/Yaskawa</td>
<td>LIC 211x: Fanuc a/ Mitsubishi/ Panasonic/Yaskawa</td>
<td>LIC 419x: Fanuc a/ Mitsubishi/ Panasonic/Yaskawa</td>
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</tbody>
</table>

1) Also available with functional safety
2) Up to 100-fold integrated interpolation (LIDA 47x also 5-fold)
3) Up to measuring length of 1020 mm or 1040 mm
4) Only with enoders with 1 Vpp or EnDat 2.2 interface
5) ±5 µm after linear length error compensation in the subsequent electronics

On the LIC and LIDA linear encoders, steel scale tapes typically serve as substrate for METALLUR graduations. With the LIC 41x3 and LIDA 4x3, graduation carriers of glass or glass ceramics permit thermal adaptation thanks to their different coefficients of linear expansion.
LIC and LIDA exposed linear encoders are typically used for:
• Coordinate measuring machines
• Inspection machines
• PCB assembly machines
• PCB drilling machines
• Precision handling devices
• Position and velocity measurement on linear motors

The LIC and LIDA exposed linear encoders are designed for high traversing speeds of up to 10 m/s and large measuring lengths of up to 30 m.
The LIC encoders make absolute position measurement possible over measuring lengths of up to 28 m. In their dimensions, they correspond to LIDA 400 and LIDA 200 incremental linear encoders.
The LIC 4113V and LIDA 4193V encoders are suitable for special high-vacuum applications (down to 10⁻⁷ bar).

For high accuracy and large measuring lengths up to 28 m, LIC 41x3 and LIDA 4x3 encoders are designed. These encoders feature a Grating on steel scale tape, glass, or glass ceramic and permit thermal adaptation thanks to their different coefficients of linear expansion.
LIC and LIDA exposed linear encoders are typically used for:
• Coordinate measuring machines
• Inspection machines
• PCB assembly machines
• PCB drilling machines
• Precision handling devices
• Position and velocity measurement on linear motors

For high accuracy and large measuring lengths up to 30 m, LIC 419x and LIDA 4x9 encoders are available.

The LIC 4113 V and LIC 4193 V encoders are designed for high accuracy and large measuring lengths of up to 28 m. In their dimensions, they correspond to LIDA 400 and LIDA 200 incremental linear encoders.
The LIC 4113 V and LIDA 4193 V encoders are suitable for special high-vacuum applications (down to 10⁻⁷ bar).

On the LIC and LIDA linear encoders, steel scale tapes typically serve as substrate for METALLUR graduations. With the LIC 41x3 and LIDA 4x3, graduation carriers of glass or glass ceramics permit thermal adaptation thanks to their different coefficients of linear expansion.
LIC and LIDA exposed linear encoders are typically used for:
• Coordinate measuring machines
• Inspection machines
• PCB assembly machines
• PCB drilling machines
• Precision handling devices
• Position and velocity measurement on linear motors
HEIDENHAIN length gauges are characterized by high accuracy together with large strokes of up to 100 mm. They feature plungers with integral bearings and therefore serve as compact measuring devices.

The HEIDENHAIN-CERTO CT length gauges are used predominantly for production quality control of high-precision parts and for the monitoring and calibration of reference standards.

The HEIDENHAIN-METRO MT 1200 and MT 2500 length gauges are ideal for precision measuring stations and testing equipment. The ball-bush guided plunger tolerates high radial forces.

The primary applications for the MT 60 and MT 101 are incoming inspection, production monitoring, and quality control. They are also used as high-accuracy position encoders, for example on linear slides or X/Y tables.

Thanks to their very small dimensions, the HEIDENHAIN-ACANTO AT and HEIDENHAIN-SPECTO ST series length gauges are the product of choice for multipoint inspection apparatus and testing equipment.

### Plunger actuation

The plungers of the length gauges with motorized plunger actuation are extended and retracted by an integral motor. They are operated through the associated switch box.

Length gauges with plunger actuation by coupling have no plunger drive. The freely movable plunger is connected by a separate coupling with the moving machine element.

The length gauges with plunger actuation by the measured object or with cable-type lifter feature a spring-loaded plunger that is extended in its resting position.

The MT 1281 and ST 1288 length gauges are available with various gauging forces. Particularly for fragile materials this makes it possible to measure without deformation.

On the length gauges with pneumatic plunger actuation, the plunger is retracted by the integral spring at its rest position. It is extended to the measuring position by application of compressed air.

### Measuring standard

- **Absolute AT 1218 AT 1217**
- **Incremental AT 3018 AT 3017**
- **CT 2501 CT 2502**
- **CT 6001 CT 6002**
- **MT 1281 MT 1287**
- **MT 1271**
- **MT 2581 MT 2587**
- **MT 2571**
- **MT 60 M MT 60 K**
- **MT 101 M MT 101 K**
- **ST 1288 ST 1287**
- **ST 1278 ST 3087**
- **ST 3078 ST 3077**

### Diagrams

- **MT 101 M**
- **CT 6001**
- **MT 2581**
- **AT 3018**
- **ST 3088**

### Table

<table>
<thead>
<tr>
<th>Measuring standard</th>
<th>AT 1218 AT 1217</th>
<th>AT 3018 AT 3017</th>
<th>Incremental</th>
<th>CT 2501 CT 2502</th>
<th>CT 6001 CT 6002</th>
<th>MT 1281 MT 1287</th>
<th>MT 1271</th>
<th>MT 2581 MT 2587</th>
<th>MT 2571</th>
<th>MT 60 M MT 60 K</th>
<th>MT 101 M MT 101 K</th>
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<td>~1 Vpp</td>
<td>TTL3</td>
<td>~11 µAPP</td>
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<td>~11 µAPP</td>
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<td>0.25 µm</td>
<td>0.7 µm</td>
<td>12 mm</td>
<td>100 mm</td>
<td>12 mm</td>
<td>30 mm</td>
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### Plunger actuation

- **AT xx18**: measured object
- **AT xx17**: pneumatic
- **CT xx01**: with motor
- **MT xx01**: cable-type lifter or free
- **MT xx02**: by coupling
- **MT xxM**: with motor
- **MT xxK**: by coupling
- **ST xx01**: measured object
- **ST xx02**: pneumatic

1) At 19 °C to 21 °C; permissible temperature fluctuation during measurement: ±0.1 K
2) With linear length-error compensation in the evaluation electronics
3) 5/10-fold integrated interpolation

---

**HEIDENHAIN-ACANTO**

- Online diagnostics
- Protection up to IP67
- Absolute scanning

**HEIDENHAIN-CERTO**

- For highest accuracy
- Low thermal expansion through thermally invariant materials
- High-precision ball bearing guide

**HEIDENHAIN-METRO**

- MT 1200 and MT 2500
  - High repeatability
  - Various gauging force variants
  - Various possibilities for plunger actuation
- MT 60 and MT 101
  - Large measuring ranges
  - Plunger actuation by motor or coupling
  - Ball-bush guided plunger

**HEIDENHAIN-SPECTO**

- Exceptionally compact dimensions
- Protection up to IP67
- Especially durable ball-bush guide
- Variant for harsh ambient conditions
Angle encoders
HEIDENHAIN angle encoders are characterized by high accuracy values in the range of angular seconds and better. These devices are used in applications such as rotary tables and swivel heads of machine tools, indexing heads, high-precision angle measuring tables, precision devices in angular metrology, antennas, and telescopes.

- Line counts: typically 9000 to 180,000
- Accuracy: from ±4" to ±0.4"
- Measuring steps: as fine as 0.000 01° Incremental
- Accuracy grades: to ±10" (depending on the line count, corresponding to ±1/20 of the grating period)
- Line counts: typically 16 to 5000
- Accuracy: from ±5" to ±0.4"
- Measuring steps: as fine as 0.000 01°

Angle encoders
HEIDENHAIN angle encoders serve as measuring sensors for rotary motion, angular velocity, and when used in conjunction with mechanical measuring standards such as lead screws, for linear motion. Application areas include electrical motors, machine tools, printing machines, woodworking machines, textile machines, robots, elevators, and handling devices, as well as various types of measuring, testing, and inspection devices.

- Line counts: typically 16 to 5000
- Accuracy: from ±5" to ±0.4"
- Measuring steps: as fine as 0.000 01°

Rotary encoders
Rotary encoders from HEIDENHAIN serve as measuring sensors for rotary motion, angular velocity, and when used in conjunction with mechanical measuring standards such as lead screws, for linear motion. Application areas include electrical motors, machine tools, printing machines, woodworking machines, textile machines, robots, elevators, and handling devices, as well as various types of measuring, testing, and inspection devices.

- Line counts: typically 9000 to 180,000
- Accuracy: from ±4" to ±0.4"
- Measuring steps: as fine as 0.000 01° Incremental
- Accuracy grades: to ±10" (depending on the line count, corresponding to ±1/20 of the grating period)
- Measuring steps: as fine as 0.000 01°

Mounting variants
In angle encoders and rotary encoders with integral bearing and stator coupling, the graduated disk of the encoder is connected directly to the shaft to be measured. The scanning unit is guided on the shaft via ball bearings, supported by the stator coupling. As a result, during angular acceleration of the shaft, the stator coupling must absorb only that torque resulting from friction in the bearing. These angle encoders therefore provide excellent dynamic performance. Thanks to the stator coupling, the system accuracy includes the error of the shaft coupling. Other benefits of the stator coupling are:
- Simple mounting
- Short overall length
- High natural frequency of the coupling
- Hollow through shaft is possible

Angle encoders and rotary encoders with integral bearings for a separate shaft coupling are designed with a solid shaft. The recommended coupling to the measured shaft compensates radial and axial tolerances. Angle encoders for separate shaft couplings permit higher shaft speeds.

Angle encoders and rotary encoders without integral bearing operate without friction. The two components—the scanning head and the scale disk, drum, or tape—are adjusted to each other during assembly. The benefits are:
- Little space required
- Large hollow-shaft diameters
- High shaft speeds possible
- No additional starting torque

With incremental angle encoders and rotary encoders, the current position is determined by starting at a reference point and counting measuring steps, or by subdividing and counting signal periods. Incremental encoders from HEIDENHAIN feature reference marks to reestablish the reference point.

Incremental rotary encoders with commutation signals provide the angular shaft position value—without requiring previous traverse—with sufficient accuracy to correctly control the phases of the rotating field of a permanent-magnet three-phase motor.

Absolute angle encoders and rotary encoders require no previous traverse to provide the current position value. Singleturn encoders provide the current angular position value within one revolution, while multturn encoders can additionally distinguish between revolutions. The position values are output, for example, over the purely serial, bidirectional EnDat interface. It enables automatic configuration of the higher-level electronics and provides monitoring and diagnostic functions.

Under the designation functional safety, HEIDENHAIN offers encoders with purely serial data transmission as single-encoder systems for safety-related machines and systems. The two measured values are already formed independently of each other in the encoder, and are transmitted to the safe control via the EnDat interface.
RCN, RON, RPN sealed angle encoders
With integral bearing and integrated stator coupling

Because of their high static and dynamic accuracy, the RCN, RON, and RPN angle encoders with integral bearings and integral stator couplings are the preferred encoders for high-precision applications such as rotary tables and tilting axes. The measuring standard is usually a circular scale with DIADUR graduation. For the encoders with stator coupling, the specified accuracy includes the error caused by the coupling. For angle encoders with separate shaft coupling, the coupling error must be added to find the system accuracy.

RCN 2001 and RON 200 series
• Compact dimensions
• Sturdy design
• Typically used with rotary tables, tilting tables, for positioning and speed control

RCN 5001 series
• Large hollow shaft and small installation space
• Stator mounting dimensions compatible with RCN 2001 and RON 200

RCN 8001, RON 700, and RON/RPN 800 series
• Large hollow shaft diameters of up to 100 mm
• System accuracies: ±2" and ±1"
• Typically used on rotary and angle measuring tables, indexing heads, measuring setups, image scanners, etc.

RCN 6000 series
• Very large hollow shaft
• System accuracy: ±2°
• Typically used with rotary tables, tilting tables, and direct drive motors

Features of the RCN 2001, RCN 5001, RCN 6000, and RCN 8001 series of angle encoders:
• High system accuracies of ±2° and ±4" account for position error within one revolution and within one signal period, as well as errors arising from the coupling, while maintaining wide mounting tolerances.
• Optimized scanning technology, so that even liquid contamination or condensation droplets barely affect the scanning signal quality and therefore the motor control.
• Simple acquisition of temperature values of direct drive motors through evaluation of the winding temperatures in the direct drive motors.
• High permissible speeds with purely serial interface: up to 3000 rpm.
• Possibility of mechanical fault exclusion against loosening of the encoder-to-drive connection.

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<th>Absolute</th>
<th>RCN 2511</th>
<th>RCN 2311</th>
<th>RCN 2581</th>
<th>RCN 2381</th>
<th>RCN 2591F</th>
<th>RCN 2391F</th>
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<td>Mitsubishi</td>
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<td>±6°; ±2.5&quot;</td>
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<tr>
<td>Mech. permissible speed</td>
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<td>±6°; ±2.5&quot;</td>
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<th>RCN 8391M</th>
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<td></td>
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</tr>
<tr>
<td>Signal periods/revolution</td>
<td>32768</td>
<td>36000</td>
<td>36000</td>
<td>18000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>System accuracy</td>
<td>RCN 86xT: ±1°; RCN 83xT: ±2°</td>
<td>±2°</td>
<td>±1°</td>
<td></td>
<td></td>
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<tr>
<td>Mech. permissible speed</td>
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<td>≤ 750 rpm</td>
<td>≤ 1500 rpm</td>
<td>≤ 1000 rpm</td>
<td></td>
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<table>
<thead>
<tr>
<th>Incremental</th>
<th>RON 786</th>
<th>RON 886</th>
<th>RPN 886</th>
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<tr>
<td>Interface</td>
<td>EnDat 2.2</td>
<td>Fanuc ai</td>
<td>Mitsubishi</td>
</tr>
<tr>
<td>Position values/revolution</td>
<td>RCN 86xT: 268435-456 (28 bits)</td>
<td>RCN 83xT: 67108864 (26 bits)</td>
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<td>Signal periods/revolution</td>
<td>32768</td>
<td>36000</td>
<td>36000</td>
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<tr>
<td>System accuracy</td>
<td>RCN 86xT: ±1°; RCN 83xT: ±2°</td>
<td>±2°</td>
<td>±1°</td>
</tr>
<tr>
<td>Mech. permissible speed</td>
<td>≤ 2000 rpm</td>
<td>≤ 1500 rpm</td>
<td>operating temperature ≤ 50 °C</td>
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<table>
<thead>
<tr>
<th>Absolute</th>
<th>RCN 6310</th>
<th>RCN 6390F</th>
<th>RCN 6390M</th>
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<tbody>
<tr>
<td>Interface</td>
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<td>Fanuc Serial Interface</td>
<td>Mitsubishi high speed interface</td>
</tr>
<tr>
<td>Position values/revolution</td>
<td>268435-456 (28 bits)</td>
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<td></td>
</tr>
<tr>
<td>System accuracy</td>
<td>±2°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mech. permissible speed</td>
<td>≤ 200 rpm</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1) Also available with functional safety
2) Integrated 2-fold interpolation
3) 5/10-fold integrated interpolation
4) See Speeds in the Angle Encoders with Integral Bearing brochure
5) For 60 mm hollow shaft diameter: ± 1200 rpm
6) Higher speeds possible depending on the operating temperature
ROC, ROD, RON sealed angle encoders
With integral bearing

For separate shaft coupling
ROC 2000 and ROD 200
- Compact dimensions
- Study design
- Typically used with rotary tables, tilting tables, for positioning and synchronization monitoring.

ROC 2000, ROD 200
• Compact dimensions
• Sturdy design
• Typically used with rotary tables, tilting tables, for positioning and synchronization monitoring.

For highly accurate applications
RON 905
- Very high system accuracy of ±0.4°
- Used with high-accuracy measuring devices and for the inspection of measuring equipment.

RON 905
• Very high system accuracy of ±0.4°
• Used with high-accuracy measuring devices and for the inspection of measuring equipment.

For separate shaft coupling
ROC 7000, ROD 780, and ROD 880
• High accuracy
  - ROC 7000, ROD 780: ±2°
  - ROD 880: ±1°
• Ideal for angle measurement on high-precision rotary tables, indexing heads, or measuring machines.

ROC 7000, ROD 780, ROD 880
• High accuracy
  - ROC 7000, ROD 780: ±2°
  - ROD 880: ±1°
• Ideal for angle measurement on high-precision rotary tables, indexing heads, or measuring machines.

ROC, ROD, RON sealed angle encoders
With integral bearing

ROC and ROD angle encoders with solid shaft for separate shaft coupling are particularly suited to applications where higher shaft speeds and larger mounting tolerances are required. The precision shaft couplings allow up to ±1 mm of axial motion.

ROC and ROD angle encoders feature a DIADUR circular scale as measuring standard. For angle encoders with separate shaft coupling, the angular measuring error caused by the shaft coupling must be added to find the system accuracy.

For separate shaft coupling
ROC 2310, ROD 220
• Compact dimensions
• Sturdy design
• Typically used with rotary tables, tilting tables, for positioning and synchronization monitoring.

ROC 2310, ROD 220
• Compact dimensions
• Sturdy design
• Typically used with rotary tables, tilting tables, for positioning and synchronization monitoring.

For separate shaft coupling
ROC 2380, ROD 270
• High accuracy
  - ROC 2380: ±2°
  - ROD 270: ±1°
• Ideal for angle measurement on high-precision rotary tables, indexing heads, or measuring machines.

ROC 2380, ROD 270
• High accuracy
  - ROC 2380: ±2°
  - ROD 270: ±1°
• Ideal for angle measurement on high-precision rotary tables, indexing heads, or measuring machines.

For separate shaft coupling
ROC 2390, ROD 280
• High accuracy
  - ROC 2390: ±2°
  - ROD 280: ±1°
• Ideal for angle measurement on high-precision rotary tables, indexing heads, or measuring machines.

ROC 2390, ROD 280
• High accuracy
  - ROC 2390: ±2°
  - ROD 280: ±1°
• Ideal for angle measurement on high-precision rotary tables, indexing heads, or measuring machines.

For separate shaft coupling
ROC 7310, ROD 780, ROD 880
• High accuracy
  - ROC 7310: ±2°
  - ROD 780: ±1°
• Ideal for angle measurement on high-precision rotary tables, indexing heads, or measuring machines.

ROC 7310, ROD 780, ROD 880
• High accuracy
  - ROC 7310: ±2°
  - ROD 780: ±1°
• Ideal for angle measurement on high-precision rotary tables, indexing heads, or measuring machines.

For highly accurate applications
RON 905
• Very high system accuracy of ±0.4°
• Used with high-accuracy measuring devices and for the inspection of measuring equipment.

RON 905
• Very high system accuracy of ±0.4°
• Used with high-accuracy measuring devices and for the inspection of measuring equipment.

Absolute
ROC 2310
ROD 220
ROC 2380
ROD 270
ROC 2390
ROD 280
ROC 7310
ROD 780
ROD 880
Incremental
ROC 2310
ROD 220
ROC 2380
ROD 270
ROC 2390
ROD 280
 ROC 7310
ROD 780
ROD 880

<table>
<thead>
<tr>
<th>Interface</th>
<th>ROC 2310</th>
<th>ROC 2380</th>
<th>ROC 2390</th>
<th>ROC 2310</th>
<th>ROC 2380</th>
<th>ROC 2390</th>
<th>ROC 2310</th>
<th>ROC 2380</th>
<th>ROC 2390</th>
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<tbody>
<tr>
<td>EnDat 2.21)</td>
<td></td>
<td>EnDat 2.21)</td>
<td>Fanuc ai</td>
<td>Mitsubishi</td>
<td>TTL</td>
<td>TTL</td>
<td>1 Vpp</td>
<td>1 Vpp</td>
<td></td>
</tr>
<tr>
<td>Signal periods/revolution</td>
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<td>16000</td>
<td>18000</td>
<td>18000</td>
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<tr>
<td>System accuracy 1)</td>
<td>±5°</td>
<td>±2°</td>
<td>±2°</td>
<td>±1°</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Mech. permissible speed</td>
<td>≤ 3000 rpm</td>
<td>≤ 10000 rpm</td>
<td>≤ 10000 rpm</td>
<td>≤ 1000 rpm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1) Without shaft coupling
2) 2-fold integrated interpolation
3) 10-fold integrated interpolation
4) DRIVE-CLIQ via EIB, PROFIBUS via Gateway

**Note:** DRIVE-CLIQ is a registered trademark of Siemens AG.

**Note:** DRIVE-CLIQ is a registered trademark of Siemens AG.
### MRP angle encoder modules

Assemblies for high-precision rotary axes

**MRP angle encoder module:** combination of angle encoder and bearing

Angle encoder modules from HEIDENHAIN are optimally matched combinations of angle encoders and high-precision bearings. They boast high measuring and bearing accuracy, very high resolution, exceptional repeatability, and low starting torque for smooth motion. Their design as specified and tested complete assemblies makes handling and installation easier.

**MRP 8000 / MRP 8100 series**
- Angle encoder modules with integrated encoder and bearing
  - Compact dimensions
  - High measuring and bearing accuracy
  - Hollow shaft diameter: 50 mm

**MRP 8000:**
- 100 mm hollow shaft

**MRP 8100:**
- Axial load of up to 1500 N

**MRP 5000 series**
- Angle encoder modules with integrated encoder and bearing
  - Compact dimensions
  - High measuring and bearing accuracy
  - Hollow shaft diameter: 35 mm

**SRP 5000 series**
- Angle encoder modules with integrated encoder, bearing, and torque motor
  - Compact dimensions
  - Torque motor with low cogging torque
  - Peak torque: 2.70 Nm
  - Rated torque: 0.385 Nm

**SRP 5000**
- Measured at distance h = 55 mm: ± 0.20 µm (without load)
- Wobble of the axis: 0.7°

### MRP, SRP angle encoder modules

Assemblies for high-precision rotary axes

**MRP angle encoder module:** combination of angle encoder and bearing

Angle encoder modules from HEIDENHAIN are optimally matched combinations of angle encoders and high-precision bearings. They boast high measuring and bearing accuracy, very high resolution, exceptional repeatability, and low starting torque for smooth motion. Their design as specified and tested complete assemblies makes handling and installation easier.

**SRP angle encoder module:** combination of angle encoder, bearing and motor

SRP angle encoder modules are additionally equipped with an integrated torque motor. They combine a motor, precision bearing, and encoder with very high accuracy in one compact system. The torque motor with its very low cogging torque enables extraordinarily smooth motion control. Neither disruptive cogging torques nor radial forces impair the high guideway accuracy of the bearing.

**SRP 5000**
- Measured at distance h = 55 mm: ± 0.20 µm (without load)
- Wobble of the axis: 0.7°

### MRP, SRP angle encoder modules specifications

<table>
<thead>
<tr>
<th>Interface</th>
<th>Incremental MRP 2080</th>
<th>Absolute MRP 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signal periods/revolution</td>
<td>2048</td>
<td>EnDat 2.2</td>
</tr>
<tr>
<td>System accuracy</td>
<td>±7°</td>
<td></td>
</tr>
<tr>
<td>Maximum permissible axial load</td>
<td>500 N (centered load, purely static, without additional vibrations or shock loading)</td>
<td></td>
</tr>
<tr>
<td>Radial guideway accuracy</td>
<td>Measured at distance h = 52 mm from the ball race: ± 0.60 µm</td>
<td></td>
</tr>
<tr>
<td>Wobble of the axis</td>
<td>2.5°</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Interface</th>
<th>Incremental MRP 5080</th>
<th>Absolute MRP 5010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signal periods/revolution</td>
<td>30000</td>
<td>EnDat 2.2</td>
</tr>
<tr>
<td>System accuracy</td>
<td>±2.5° or ±5°</td>
<td></td>
</tr>
<tr>
<td>Maximum permissible axial load</td>
<td>200 N (centered load, purely static, without additional vibrations or shock loading)</td>
<td></td>
</tr>
<tr>
<td>Radial guideway accuracy</td>
<td>Measured at distance h = 55 mm: ± 0.20 µm (without load)</td>
<td></td>
</tr>
<tr>
<td>Wobble of the axis</td>
<td>0.7°</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Interface</th>
<th>Incremental MRP 8080</th>
<th>MRP 8180</th>
<th>Absolute MRP 8010</th>
<th>MRP 8110</th>
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<tbody>
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<td>32 768</td>
<td>63000</td>
<td>32 768</td>
</tr>
<tr>
<td>System accuracy</td>
<td>±2°</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum permissible axial load</td>
<td>300 N</td>
<td>1500 N</td>
<td>300 N</td>
<td>1500 N</td>
</tr>
<tr>
<td>Radial guideway accuracy</td>
<td>≤ 0.15 µm</td>
<td>≤ 0.25 µm</td>
<td>≤ 0.15 µm</td>
<td>≤ 0.25 µm</td>
</tr>
<tr>
<td>Wobble of the axis</td>
<td>0.5°</td>
<td>0.7°</td>
<td>0.5°</td>
<td>0.7°</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Interface</th>
<th>Incremental SRP 5080</th>
<th>Absolute SRP 5010</th>
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</thead>
<tbody>
<tr>
<td>Signal periods/revolution</td>
<td>30000</td>
<td>EnDat 2.2</td>
</tr>
<tr>
<td>System accuracy</td>
<td>±2.5° or ±5°</td>
<td></td>
</tr>
<tr>
<td>Maximum permissible axial load</td>
<td>200 N (centered load, purely static, without additional vibrations or shock loading)</td>
<td></td>
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<tr>
<td>Radial guideway accuracy</td>
<td>Measured at distance h = 55 mm: ± 0.20 µm (without load)</td>
<td></td>
</tr>
<tr>
<td>Wobble of the axis</td>
<td>0.7°</td>
<td></td>
</tr>
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</table>
ERP, ERO modular angle encoders
Without integral bearing, with optical scanning

The HEIDENHAIN ERP and ERO angle encoders without integral bearing operate without friction and use a circular glass scale with hub as the graduation carrier. They are characterized by their low weight and compact dimensions. They thus permit high accuracies and are designed for integration in machine elements or components.

The attainable system accuracy depends on the eccentricity of the graduation to the drive shaft bearing, as well as the radial runout and wobble of the bearing.

The interferential scanning principle serves as the basis for the high accuracy of the ERP encoders. This makes them particularly attractive for high-precision angle measuring tables and precision devices in angular metrology. Additionally, the HSP 1.0 signal stabilization feature makes the encoders highly resistant to environmental factors.

Applications for the ERO are found in metrology, in compact rotary tables, and in precise, highly dynamic drives.

ERP 1000 series
- Very high resolution and accuracy
- Small mass, low mass moment of inertia
- Very flat design
- Circular scale available as full circle or segment

ERP 1070: TTL
ERP 1080: 1 VPP
ERP 1010: EnDat 2.2

Signal periods/revolution: 23000, 30000, 50000, 63000
Accuracy of graduation: ±4", ±3", ±1.8", ±1.5", ±0.9"
Inside diameter D1: 13 mm, 32 mm, 62 mm, 104 mm
Outside diameter D2: 57 mm, 75 mm, 109 mm, 151 mm
Mech. permissible speed: ≤ 2600 rpm, ≤ 2000 rpm, ≤ 1200 rpm, ≤ 950 rpm

ERO 2000 series
- Very compact dimensions
- Small mass, low mass moment of inertia
- For highly dynamic applications

ERO 2080
Interface: 1 VPP
Signal periods/revolution: 4096
Accuracy of graduation: ±8"
Inside diameter D1: 5 mm
Outside diameter D2: 30 mm
Mech. permissible speed: ≤ 14000 rpm
ECA, ERA modular angle encoders
Without integral bearing, with optical scanning

The ECA and ERA HEIDENHAIN angle encoders with solid graduation carrier function without integral bearings. They are intended for integration in machine elements or components.

The attainable system accuracy depends on the eccentricity of the graduation to the drive shaft bearing, as well as the radial runout and wobble of the bearing.

The ECA and ERA angle encoders feature a sturdy steel scale drum and are suited for high shaft speeds of up to 20,000 rpm. They are typically found on fast running spindles, rotary tables, and tilting axes.

The ECA 4000 V angle encoders are suitable for vacuum applications in high vacuum (down to 10⁻⁷ bar).

ERA 4000 series
- High shaft speeds of up to 20,000 rpm
- Sturdy design with steel scale drum and METALLUR graduation
- Axial motion of measured shaft permissible up to ±0.5 mm
- The ERA 4480 C is available with larger diameters or as versions with protective cover
- Various drum versions
  - ERA 4xx0: with centering collar
  - ERA 4xx2: with 3-point centering

Absolute
- ECA 4410
- ECA 4490 F
- ECA 4490 P
- ECA 4490 Y

Interface
- ECA 4410: EnDat 2.2
- ECA 4490 F: Fanuc
- ECA 4490 P: Panasonic
- ECA 4490 Y: Yaskawa

Signal periods/revolution
- ECA 4410: 8195, 10 010, 11 616, 14 003, 16 379, 19 998, 25 993, 37 994, 44 000
- ECA 4490 F: 6 022, 10 010, 11 616, 14 003, 16 379, 19 998, 25 993, 37 994, 44 000
- ECA 4490 P: 6 022, 10 010, 11 616, 14 003, 16 379, 19 998, 25 993, 37 994, 44 000
- ECA 4490 Y: 6 022, 10 010, 11 616, 14 003, 16 379, 19 998, 25 993, 37 994, 44 000

Accuracy of graduation
- ECA 4410: ±3”, ±2.5”, ±2”, ±1.9”, ±1.8”, ±1.7”, ±1.5”, ±1.5”
- ECA 4490 F: ±3”, ±2.5”, ±2”, ±1.9”, ±1.8”, ±1.7”, ±1.5”, ±1.5”
- ECA 4490 P: ±3”, ±2.5”, ±2”, ±1.9”, ±1.8”, ±1.7”, ±1.5”, ±1.5”
- ECA 4490 Y: ±3”, ±2.5”, ±2”, ±1.9”, ±1.8”, ±1.7”, ±1.5”, ±1.5”

Inside diameter D1
- ECA 4410: 70 mm, 80 mm, 120 mm, 120 mm, 150/185 mm, 180/210 mm, 270 mm, 425 mm, 512 mm
- ECA 4490 F: 70 mm, 80 mm, 120 mm, 120 mm, 150/185 mm, 180/210 mm, 270 mm, 425 mm, 512 mm
- ECA 4490 P: 70 mm, 80 mm, 120 mm, 120 mm, 150/185 mm, 180/210 mm, 270 mm, 425 mm, 512 mm
- ECA 4490 Y: 70 mm, 80 mm, 120 mm, 120 mm, 150/185 mm, 180/210 mm, 270 mm, 425 mm, 512 mm

Outside diameter D2
- ECA 4410: 104.63 mm, 127.64 mm, 148.2 mm, 178.55 mm, 208.89 mm, 254.93 mm, 331.31 mm, 484.07 mm, 560.46 mm
- ECA 4490 F: 104.63 mm, 127.64 mm, 148.2 mm, 178.55 mm, 208.89 mm, 254.93 mm, 331.31 mm, 484.07 mm, 560.46 mm
- ECA 4490 P: 104.63 mm, 127.64 mm, 148.2 mm, 178.55 mm, 208.89 mm, 254.93 mm, 331.31 mm, 484.07 mm, 560.46 mm
- ECA 4490 Y: 104.63 mm, 127.64 mm, 148.2 mm, 178.55 mm, 208.89 mm, 254.93 mm, 331.31 mm, 484.07 mm, 560.46 mm

Mech. permissible speed
- ECA 4410: ≤8 500 rpm, ≤6 250 rpm, ≤5 250 rpm, ≤4 500 rpm, ≤4 250 rpm, ≤3 250 rpm, ≤2 500 rpm, ≤1 800 rpm, ≤1 500 rpm
- ECA 4490 F: ≤8 500 rpm, ≤6 250 rpm, ≤5 250 rpm, ≤4 500 rpm, ≤4 250 rpm, ≤3 250 rpm, ≤2 500 rpm, ≤1 800 rpm, ≤1 500 rpm
- ECA 4490 P: ≤8 500 rpm, ≤6 250 rpm, ≤5 250 rpm, ≤4 500 rpm, ≤4 250 rpm, ≤3 250 rpm, ≤2 500 rpm, ≤1 800 rpm, ≤1 500 rpm
- ECA 4490 Y: ≤8 500 rpm, ≤6 250 rpm, ≤5 250 rpm, ≤4 500 rpm, ≤4 250 rpm, ≤3 250 rpm, ≤2 500 rpm, ≤1 800 rpm, ≤1 500 rpm

1) Also available with functional safety

For other drum versions, please refer to the Modular Angle Encoders with Magnetic Scanning brochure.
ERA modular angle encoders  
Without integral bearing, with optical scanning

The HEIDENHAIN ERA angle encoders with steel scale tape as measuring standard function without integral bearings. They are intended for integration in machine elements or components. They are designed to meet the following requirements:
- Large hollow shaft diameters of up to 10 m
- No additional starting torque caused by rotary shaft seals

The attainable system accuracy depends on the machining accuracy of the scale tape carrier diameter, on its radial runout and wobble.

### ERA 7000 and ERA 8000 series
- For very large diameters of up to 10 m
- METALLUR steel scale tape

**ERA 7000 series**
- Scale tape is placed in a slot on the inside circumference of the machine element
- **ERA 7400 C**: full-circle version
- **ERA 7401 C**: segment version

The attainable system accuracy depends on the machining accuracy of the scale tape carrier diameter, on its radial runout and wobble.

### ERA 8000 series
- Scale tape is fastened on the circumference of the machine element
- **ERA 8400 C**: full-circle version
- **ERA 8401 C**: segment version, scale tape secured with tensioning elements
- **ERA 8402 C**: segment version, scale tape secured without tensioning elements

### ERA 8400 C Interface
- 1 Vpp; signal period 40 µm (on circumference)
- Signal periods/revolution: 36 000, 45 000, 90 000
- Accuracy of graduation: ±4.7”, ±3.9”, ±1.9”
- Accuracy of the scale tape: ±3 µm per meter of tape
- Diameter D1: 458.04 mm, 572.63 mm, 1145.73 mm
- Mech. permissible speed: ≤ 50 rpm, ≤ 45 rpm

### ERA 7400 C Interface
- 1 Vpp; signal period 40 µm (on circumference)
- Signal periods/revolution: 36 000, 45 000, 90 000
- Accuracy of graduation: ±3.9”, ±3.2”, ±1.6”
- Accuracy of the scale tape: ±3 µm per meter of tape
- Diameter D1: 458.62 mm, 573.20 mm, 1146.10 mm
- Mech. permissible speed: ≤ 250 rpm, ≤ 220 rpm
ECM, ERM modular angle encoders
Without integral bearing, with magnetic scanning

The ECM and ERM modular angle encoders from HEIDENHAIN with magnetic scanning consist of a magnetized scale drum and a scanning unit. Their MAGNODUR measuring standard and the magnetoresistive scanning principle make them particularly tolerant to contamination.

The attainable system accuracy depends on the eccentricity of the graduation to the drive shaft bearing, as well as the radial runout and wobble of the bearing.

Typical fields of application include machines and equipment with large hollow shaft diameters in environments with large amounts of airborne particles and liquids, for example:
- Rotary and tilting axes for ERM 2280 and ECM 2400
- C axes on lathes for ERM 2410, ERM 2420, and ERM 2480
- Main spindles on milling machines for ERM 2484, ERM 2485, and ERM 2984

**Absolute position measurement**

**ECM 2400 series**
- Drum fastening with axial screws
- Functional safety with ECM 2410

**ERM 2200 series**
- High graduation accuracy
- Distance-coded reference marks
- Drum fastening with axial screws
- ERM 2283: small interpolation error, no reversal error

**ERM 2400 series**
- Distance-coded reference marks
- Drum fastening with axial screws
- Large selection of drum diameters

**ERM 2484 and ERM 2984 series**
- Especially compact dimensions for limited installation space
- High mechanically permissible shaft speeds and therefore particularly well suited for spindles
- Drum fastening by axial clamping

**Scanning head**

<table>
<thead>
<tr>
<th></th>
<th>AK ECM 2410</th>
<th>AK ECM 2490F</th>
<th>AK ECM 2490M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface</td>
<td>EnDat 2.2</td>
<td>Fanuc Serial Interface; ai Interface</td>
<td>Mitsubishi high speed interface</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scale drum</th>
<th>TTR ECM 2400</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Grating period = 400 µm</td>
</tr>
<tr>
<td>Signal periods</td>
<td>900 1024 1200 1400 1696 2048 2600</td>
</tr>
<tr>
<td>Drum inside diameter</td>
<td>70 mm 80 mm 95 mm 105 mm 130 mm 160 mm 180 mm 260 mm</td>
</tr>
<tr>
<td>Scale drum outside diameter</td>
<td>113.16 mm 128.75 mm 150.88 mm 176.03 mm 213.24 mm 257.55 mm 326.9 mm</td>
</tr>
<tr>
<td>Accuracy of graduation</td>
<td>±8&quot; ±7&quot; ±6&quot; ±5.5&quot; ±4.5&quot; ±4&quot; ±3.5&quot; ±3&quot;</td>
</tr>
<tr>
<td>Mech. permissible speed</td>
<td>≤ 14 500 rpm ≤ 13 000 rpm/12 500 rpm ≤ 10 500 rpm ≤ 9 500 rpm ≤ 7 000 rpm ≤ 6 000 rpm ≤ 4 500 rpm</td>
</tr>
</tbody>
</table>

**Incremental**

**ERM 2410** (grating period = 400 µm)
- EnDat 2.2

**ERM 2420**

**ERM 2480**
- Mitsubishi high speed interface

<table>
<thead>
<tr>
<th>Signal periods/revolution</th>
<th>600 720 900 1024 1200 1400 2048 2600 3600</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy of graduation</td>
<td>±11&quot; ±10&quot; ±8&quot; ±7&quot; ±6&quot; ±5.5&quot; ±4&quot; ±3.5&quot; ±3&quot;</td>
</tr>
<tr>
<td>Inside diameter D1</td>
<td>40 mm 55 mm 70 mm 90 mm 105 mm 130 mm 180 mm 260 mm</td>
</tr>
<tr>
<td>Outside diameter D2</td>
<td>75.44 mm 90.53 mm 113.16 mm 128.75 mm 150.88 mm 176.03 mm 213.24 mm 257.55 mm 326.9 mm</td>
</tr>
<tr>
<td>Mech. permissible speed</td>
<td>≤ 19 000 rpm ≤ 18 500 rpm ≤ 14 900 rpm ≤ 13 000 rpm ≤ 10 500 rpm ≤ 9 000 rpm ≤ 8 000 rpm ≤ 6 000 rpm ≤ 4 500 rpm ≤ 3 000 rpm</td>
</tr>
</tbody>
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**Incremental**

**ERM 2484** (grating period = 400 µm)
- 1 Vpp

**ERM 2984** (grating period = 1000 µm)
- 1 Vpp

<table>
<thead>
<tr>
<th>Signal periods/revolution</th>
<th>512 600 900 1024 192 256 300 400</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy of graduation</td>
<td>±17&quot; ±14&quot; ±10&quot; ±9&quot; ±68&quot; ±51&quot; ±44&quot; ±33&quot;</td>
</tr>
<tr>
<td>Inside diameter D1</td>
<td>40 mm 55 mm 80 mm 100 mm 40 mm 55 mm 60 mm 100 mm</td>
</tr>
<tr>
<td>Outside diameter D2</td>
<td>64.37 mm 75.44 mm 113.16 mm 128.75 mm 58.06 mm 77.41 mm 90.72 mm 120.96 mm</td>
</tr>
<tr>
<td>Mech. permissible speed</td>
<td>≤ 42 000 rpm ≤ 36 000 rpm ≤ 22 000 rpm ≤ 20 000 rpm ≤ 17 000 rpm ≤ 10 500 rpm ≤ 8 000 rpm ≤ 5 000 rpm ≤ 29 000 rpm ≤ 16 000 rpm</td>
</tr>
</tbody>
</table>

1) Also available with functional safety
2) Through integrated counting function after traverse of two reference marks

For other drum versions, please refer to our brochure Modular Angle Encoders with Magnetic Scanning
ECN, EQN, ERN rotary encoders
With integral bearing and mounted stator coupling
IP64 protection

**ECN/EQN/ERN 1000 series**
- Miniaturized version
- Blind hollow shaft with 6 mm inside diameter
- Housing outside diameter: 35 mm
- Typical natural frequency \( f_N \) of the encoder coupling: 1500 Hz
- **ERN 1023**:
  - Position values/revolution: 8192 (13 bits)
  - Revolutions: 4096 (12 bits)
  - Line count: 512
  - Supply voltage: DC 3.6 V to 14 V
- **ERN 1020**:
  - Position values/revolution: 8192 (13 bits)
  - Revolutions: 4096 (12 bits)
  - Supply voltage: DC 5 V

**ECN/EQN/ERN 400 series**
- Compact dimensions
- Blind hollow shaft or hollow through shaft with 8 mm, 10 mm, or 12 mm inside diameter
- Housing outside diameter: 58 mm
- Protection: IP67 at housing (IP66 with hollow through shaft)
- IP64 at shaft inlet (IP66 upon request)
- Typical natural frequency \( f_N \) of the encoder coupling: 1400 Hz (cable version)
- **ERN 424 S, EQN 436 S**: 16 777 216 (24 bits)
- **ERN 425 F, EQN 437 F**: 33 554 432 (25 bits)
- **ERN 420**, **ERN 460**:
  - Position values/revolution: 8192 (13 bits)
  - Revolutions: 4096 (12 bits)
  - Line count: 512 or 2048
  - Supply voltage: DC 3.6 V to 14 V

**ECN/EQN/ERN 100 series**
- For large shaft diameters
- Hollow through shaft with inside diameters D: 20, 25, 38, 50 mm
- Housing outside diameter: 87 mm
- Typical natural frequency \( f_N \) of the encoder coupling: 1000 Hz
- **ERN 1024 S**: 16 777 216 (24 bits)
- **ERN 1020**:
  - Position values/revolution: 8192 (13 bits)
  - Revolutions: 4096 (12 bits)
  - Line count: 2048
  - Supply voltage: DC 3.6 V to 14 V

---

1) Includes EnDat 2.1 command set; PROFIBUS DP via gateway
2) 5/10-fold integrated interpolation
3) Also available with functional safety

DRIVE-CLIQ is a registered trademark of SIEMENS AG.
**ECN, EQN, ERN rotary encoders**

With integral bearing and mounted stator coupling

IP40 protection

The ECN, EQN, and ERN photoelectric rotary encoders from HEIDENHAIN with IP40 protection are specially designed for integration in motors. Bearings and mounted stator coupling are integrated. Absolute rotary encoders and versions with commutation tracks are available for synchronous motors. The taper shaft or the blind hollow shaft is fastened directly to the shaft to be measured. This ensures an extremely stiff coupling that permits exceptionally high dynamic performance of the drive. The stator coupling is designed to be fastened on a plane surface or a location hole and permits fast, simple mounting.

**ECN/EQN 1100 series**
- Miniaturized version
- Blind hollow shaft, 6 mm inside diameter with positive-fit element
- Housing outside diameter: 35 mm
- Typical natural frequency $f_N$ of the encoder coupling: 1000 Hz
- Mechanically permissible speed: 12,000 rpm
- Fault exclusion of the mechanical coupling for functional safety available

**ERN 1123**
- Blind hollow shaft diameter: 8 mm
- Housing outside diameter: 35 mm
- Stator coupling with bolt-hole circle $\varnothing 40$ mm
- Typical natural frequency $f_N$ of the encoder coupling: 1000 Hz
- Mechanically permissible speed: 6000 rpm
- IP00 protection

**ECN/EQN/ERN 1300 series**
- Compact dimensions
- 1:10 taper shaft with 0.25 mm functional diameter for extremely stiff connection
- Housing outside diameter 56 mm.
- The stator coupling is suited for location holes with 65 mm inside diameter
- Typical natural frequency $f_N$ of the encoder coupling: 1800 Hz
- Mechanically permissible speed: $ERNEC1300$: 15,000 rpm
- $EQN1300$: 12,000 rpm
- IP40 protection when mounted
- Fault exclusion of the mechanical coupling for functional safety available

## Specifications

<table>
<thead>
<tr>
<th>Series</th>
<th>Absolute</th>
<th>Incremental</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Absolute</strong></td>
<td><strong>Incremental</strong></td>
<td></td>
</tr>
<tr>
<td><strong>ECN 1113</strong></td>
<td><strong>ECN 1125</strong></td>
<td><strong>ECN 1123</strong></td>
</tr>
<tr>
<td><strong>Interface</strong></td>
<td>EnDat 2.21</td>
<td>EnDat 2.21</td>
</tr>
<tr>
<td><strong>Position values/revolution</strong></td>
<td>8192 (13 bits)</td>
<td>8388608 (23 bits)</td>
</tr>
<tr>
<td><strong>Revolutions</strong></td>
<td>–</td>
<td>4096 (12 bits)</td>
</tr>
<tr>
<td><strong>Line count</strong></td>
<td>612</td>
<td>500 to 8192</td>
</tr>
<tr>
<td><strong>Commutation signals</strong></td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td><strong>Supply voltage</strong></td>
<td>DC 3.6 V to 14 V</td>
<td>DC 10 V to 28.8 V</td>
</tr>
<tr>
<td><strong>Operating temperature</strong></td>
<td>≤ 115 °C</td>
<td>≤ 115 °C</td>
</tr>
</tbody>
</table>

<sup>1</sup> Includes EnDat 2.1 command set; PROFIBUS DP via gateway

<sup>2</sup> Also available with functional safety

<sup>3</sup> Three block commutation tracks with 90°, 120°, or 180° mech. phase shift

**DRIVE-CLiq** is a registered trademark of Siemens AG.
ROD, ROQ, ROD rotary encoders
With integral bearing, for separate shaft coupling

HR handwheel

The ROC, ROQ, and ROD photoelectric rotary encoders from HEIDENHAIN have integrated bearings and are sealed. The degree of protection is IP64 to IP68, depending on the version. They are robust and compact.

These encoders are coupled by the rotor to the measured shaft through a separate coupling that compensates axial motion and misalignment between the encoder shaft and measured shaft.

<table>
<thead>
<tr>
<th>ROC/ROQ/ROD 1000 series</th>
<th>ROC/ROQ/ROD 400 series</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Miniaturized dimensions for installation in small devices or in limited installation space</td>
<td>• Industrial standard regarding dimensions and output signals</td>
</tr>
<tr>
<td>• Mounting by synchro flange</td>
<td>• IP67 protection at housing, IP64 at shaft inlet (IP66 upon request)</td>
</tr>
<tr>
<td>• Shaft diameter: 4 mm</td>
<td>• Mounting via synchro flange or clamping flange</td>
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<tr>
<td>HR handwheel</td>
<td>• Shaft diameter: 6 mm with synchro flange 10 mm with clamping flange</td>
</tr>
<tr>
<td>• Compact dimensions</td>
<td>• Preferred types with fast delivery (see Rotary Encoders brochure or ask HEIDENHAIN)</td>
</tr>
<tr>
<td>• Study design</td>
<td>• Fault exclusion of the mechanical coupling for functional safety available</td>
</tr>
<tr>
<td>• Mechanical detent</td>
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</tbody>
</table>
ECI, EQI, EBI rotary encoders
Without integral bearing

Compared with optical rotary encoders without integral bearings, inductive rotary encoders are particularly robust and have large mounting tolerances.

The ECI, EQI, and EBI 1100 inductive rotary encoders as well as the ECI, EQI, and EBI 1300 are mechanically compatible with the corresponding ExN photoelectric encoders: the shaft is fastened with a central screw. The stator of the encoder is fastened by several screws.

The correct installation of the rotary encoders without integral bearing can be inspected with the HEIDENHAIN PWM 21 or PWT 101 measuring and testing devices.

ECI/EQI/EBI 1100 series
- Miniature size
- Simple mounting without adjustment
- Blind hollow shaft diameter: 6 mm
- EBI 1135: multiturn function via battery-buffered revolution counter
- Version available featuring mounting-compatibility with ECN/EQN 1100
- Fault exclusion of the mechanical coupling for functional safety
- Synchro flange for variable mounting

ECI/EQI/EBI 1300 series
- Simple mounting without adjustment
- Blind hollow shaft
- EBI 1335: multiturn function via battery-buffered revolution counter
- Version featuring mounting-compatibility with ECN/EQN 1300 with tapered shaft or blind hollow shaft available upon request
- Fault exclusion of the mechanical coupling for functional safety

---

### Specifications

<table>
<thead>
<tr>
<th>Feature</th>
<th>Absolute ECI 1119</th>
<th>ECI 1319</th>
<th>ECI 1118</th>
<th>EBT 1135</th>
<th>EBI 1335</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface</td>
<td>EnDat 2.2, EnDat 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Position values/revolution</td>
<td>524,288 (19 bits)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Revolutions</td>
<td>4096 (12 bits)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mechanical permissible speed</td>
<td>≤ 15,000 rpm</td>
<td>≤ 12,000 rpm</td>
<td>≤ 12,000 rpm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shaft</td>
<td>Blind hollow shaft</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Also available with functional safety
2. Multiturn function via battery-buffered revolution counter
3. Also available with DRIVE-CLIQ interface
ERO, ECI, EBI rotary encoders
Without integral bearing

The photoelectric ERO modular rotary encoders from HEIDENHAIN consist of a graduated disk with hub and a scanning unit. They are particularly well suited for limited installation space or for applications where there must be no friction.

The ECI/EBI 100 and ECI/EBI 4000 inductive rotary encoders have a particularly small outside diameter with a large shaft opening. The encoders were conceived for simple axial mounting.

The correct installation of the rotary encoders without integral bearing can be inspected with the HEIDENHAIN PWM 21 or PWT 101 measuring and testing devices.

**ERO 1200 series**
- Compact dimensions
- For shaft diameters of up to 12 mm

**ERO 1400 series**
- Miniaturized modular rotary encoders for measured shafts of up to 8 mm diameter
- Special integral mounting aid
- With cover cap

**ECI/EBI 100 series**
- Especially flat design
- Hollow through shaft Ø: 30, 38, 50 mm
- EBI 135: multiturn function via battery-buffered revolution counter

**ECI/EBI 4000 series**
- Flat design
- Hollow through shaft Ø: 90, 180 mm
- EBI 4010: multiturn function via battery-buffered revolution counter

---

### Incremental

**ERO 1225**
- Interface: TTL
- Line count: 1024, 2048
- Mech. permissible speed: ≤ 25600 rpm
- Shaft diameter D: 10 mm, 12 mm

**ERO 1285**
- Interface: TTL
- Line count: 1 Vpp

**ERO 1420**
- Interface: TTL
- Line count: 512, 1024, 1000
- Mech. permissible speed: ≤ 30000 rpm
- Shaft diameter D: 4 mm, 6 mm, 8 mm

1) 5/10/20/24-fold integrated interpolation

---

### Absolute

<table>
<thead>
<tr>
<th>ECI 119</th>
<th>EBI 135</th>
<th>ECI 4010(1)</th>
<th>EBI 4010(1)</th>
<th>ECI 4090 S(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface</td>
<td>EnDat 2.1 with ~ 1 Vpp</td>
<td>EnDat 2.2</td>
<td>Drive-CLiQ</td>
<td>DRIVE-CLiQ</td>
</tr>
<tr>
<td>Position values/revolution</td>
<td>524288 (19 bits)</td>
<td>1048576 (20 bits)</td>
<td>65536 (16 bits)</td>
<td>65536 (16 bits)</td>
</tr>
<tr>
<td>Revolutions</td>
<td>~</td>
<td>65536 (16 bits)</td>
<td>~</td>
<td>~</td>
</tr>
<tr>
<td>Line count</td>
<td>52</td>
<td>~</td>
<td>~</td>
<td>~</td>
</tr>
<tr>
<td>Mech. permissible speed</td>
<td>≤ 6000 rpm</td>
<td>~</td>
<td>~</td>
<td>~</td>
</tr>
</tbody>
</table>

1) Also available with functional safety
2) Multiturn function via battery-buffered revolution counter

DRIVE-CLiQ is a registered trademark of Siemens AG.
Machine tool control

Controls for milling machines
With its TNC controls, HEIDENHAIN offers a complete product line for all common types of machines in the area of milling: from a simple three-axis CNC milling machine to a highly complex machine with up to 23 axes—a TNC control is always the right choice. Thanks to their flexible operational design and practical functions, the TNCs are particularly suitable for the following applications:
- Simple milling, drilling, and boring operations
- Machining in a tilted working plane
- Complex 5-axis operations
- HSC operations
- Mill-turning operations

TNC controls are versatile and offer the right programming function for any task. Thanks to its HEIDENHAIN Klartext format, the user need not learn G codes or special programming languages. The control “speaks” with him with easily understandable questions and prompts. Ease of use is also promoted by clear, unambiguous key symbols and names. Each key has only one function. Even if you are used to G-code programming, however, the TNC is still the right control—you can enter G-code address letters simply over soft keys.

TNC part programs have long lives because they are upwardly compatible. Programs from older TNCs can usually also run on the new models. When moving up to a more advanced TNC, the user merely builds on what he already knows.

Controls for lathes
Lathe controls from HEIDENHAIN have been proving themselves for years both on standard and complex lathes as well as on turning centers.

Many shop-compatible functions support you optimally during:
- Conventional lathe operations
- Operations with driven tools
- Machining with the C and Y axes
- Full-surface machining with dual spindles
- Machining with the B axis

HEIDENHAIN lathe controls are extremely flexible: whether you need only single cycles, short program sequences, or complete NC programs—you only need to select the appropriate operating mode.

Program creation with smartTurn is particularly easy and convenient. The straightforward fillable-form input provides graphical support, meaningful dialogue, and a logical check of entries.

You can also reuse NC programs of older HEIDENHAIN lathe controls, such as the CNC PILOT 4290, on the CNC PILOT 640. With a convenient import filter you can simply load the programs into the new control, and then continue using them on the CNC PILOT 640.

Quickly and easily to the finished part
The operational design of the milling and lathe controls is tailored to the needs of the user and therefore offers you the greatest possible flexibility in program creation. When programming at the machine, all required inputs are guided by practice-oriented prompts and questions while highly expressive help images support you. Standard operations and even complex applications are on call as a large variety of cycles for real-world machining, coordinate transformations, or for setup.

The HEIDENHAIN controls can be programmed remotely just as well—for example on a CAD/CAM system or at a HEIDENHAIN programming station.

You can also open DXF files that were created on a separate CAD system directly on the control and extract contours and machining positions from them. This not only saves time otherwise spent on programming and testing, but you can also be sure that the adopted data is exactly in accordance with the design engineer’s specifications.

User-friendly and practical
Thanks to the robust design optimized for the application, HEIDENHAIN controls are ideally suited for a harsh workday environment. The clearcut screen displays informational notes, questions, prompts, and soft-key rows. All texts are available in numerous languages. Graphic illustrations simplify programming and provide valuable aid for verifying the program during simulation.

High quality and productivity
Thanks to intelligent motion control, HEIDENHAIN controls enable short machining times with perfect workpiece surfaces and very high workpiece accuracy. The bottom line is an increase in productivity: unit costs are reduced without affecting accuracy and surface quality.

Automating manual operations
You can start working with the HEIDENHAIN controls even before writing a complete part program. Simply machine a part step by step—switching as you want between manual operation and automatic positioning.

Manufacturing complex components precisely
Regardless of whether the workpieces are simple or complex—HEIDENHAIN controls offer the appropriate functions. With them, neither are operations in a tilted plane a challenge, nor are multi-side or full-surface machining. Simultaneous machining with up to five axes is an especially strong point of HEIDENHAIN controls. With special control strategies, functions for process monitoring, and compensation of production-induced disturbances, you can also manufacture components with complex geometries exactly, with process reliability, and efficiently.

HEIDENHAIN controls

<table>
<thead>
<tr>
<th>Controls for milling machines</th>
<th>Series</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contouring control for up to 24 control loops</td>
<td>TNC 640</td>
<td>46</td>
</tr>
<tr>
<td>Contouring control for up to 8 control loops</td>
<td>TNC 620</td>
<td>48</td>
</tr>
<tr>
<td>Contouring control for up to 6 control loops</td>
<td>TNC 320</td>
<td>48</td>
</tr>
<tr>
<td>Straight cut control for up to 5 control loops</td>
<td>TNC 128</td>
<td>50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Controls for lathes</th>
<th>Series</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contouring control for up to 24 control loops</td>
<td>CNC PILOT 640</td>
<td>52</td>
</tr>
<tr>
<td>Contouring control for up to 10 control loops</td>
<td>MANUALplus 620</td>
<td>54</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Contouring controls</th>
<th>Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital control design</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Accessories</th>
<th>Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electronic handwheels</td>
<td>HR 58</td>
</tr>
<tr>
<td>Programming stations</td>
<td>TNC 640/TNC 620/TNC 320 DataPilot MP 620/CP 640 58</td>
</tr>
<tr>
<td>V121 camera system</td>
<td>59</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Tool and workpiece setup and measurement</th>
<th>Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workpiece touch probes</td>
<td>TS 62</td>
</tr>
<tr>
<td>Tool touch probes</td>
<td>TT 64</td>
</tr>
<tr>
<td>Transceivers</td>
<td>SE 65</td>
</tr>
</tbody>
</table>
Besides milling, the TNC 640 from HEIDENHAIN is also capable of combined milling and turning operations. It is particularly well suited for milling, turning, HSC machining, and 5-axis machining. The shop-oriented and versatile control features numerous functions. It is especially attractive for the following areas of application:

- Universal milling machines
- Combined milling-turning machines
- High speed milling
- Five-axis machining with swivel head and rotary table
- Five-axis machining on very large machines
- Boring mills
- Machining centers and automated machining

The TNC 640 features optimized motion control, short block processing times, and special closed-loop control strategies. Together with its uniform digital design and its integrated digital drive control including inverters, it enables you to reach very high machining speeds and the best possible contour accuracy—particularly when machining 3D contours.

You can program turning contours with the TNC 640 in the familiar HEIDENHAIN Klartext format. Beyond this, you have typical contour elements for turning (recesses, undercuts, thread undercuts) as well as cycles for complex turning operations.

The optimized user interface of the TNC 640 gives you a fast overview: various color codes, standardized table editors, and smartSelect—the dialog-guided fast selection of functions—assist you while you work.

### TNC 640 contouring control

For milling machines, milling-turning machines, and machining centers

<table>
<thead>
<tr>
<th>Axes</th>
<th>24 control loops (22 with functional safety), of which up to 4 can be configured as spindles</th>
</tr>
</thead>
</table>
| Interpolation | • Linear in up to 5 axes with Tool Center Point Management (TCPM)<sup>1)</sup>  
• Circular in up to 3 axes with tilted working plane  
• Helical  
• Cylinder surface<sup>1)</sup>  
• Rigid tapping<sup>2)</sup> |
| Program entry | HEIDENHAIN Klartext conversational format, ISO (G codes) |
| CAD import<sup>2)</sup> | Loading of contours from 3D models |
| Program memory | HDR hard disk or SSDR solid state disk, at least 21 GB |
| Position entry | Nominal positions in Cartesian or polar coordinates, absolute or incremental dimensions, in mm or inches; actual position capture |
| Input resolution and display step | To 0.1 µm or 0.0001", optionally to 0.01 µm or 0.00001" |
| Block-processing time | 0.5 ms (3D straight line without radius compensation at 100 % PLC utilization) |
| Turning functions<sup>1)</sup> | • Turning tool data management  
• Tool-tip radius compensation  
• Constant cutting speed  
• Toggling between milling and turning operations |
| High-speed cutting | Motion control with minimum jerk |
| FK free contour programming | HEIDENHAIN Klartext conversational format with graphical support |
| Coordinate transformation | • Shifting, rotating, mirroring, scaling (axis specific)  
• Tilting the working plane, PLANE function<sup>2)</sup> |
| Machining cycles | For drilling, milling, turning<sup>1)</sup>, interpolation turning<sup>1)</sup>, grinding<sup>3)</sup>, hobbing<sup>4)</sup>, and for cylinder surface machining<sup>5)</sup>; data input with graphical support |
| Touch probe cycles | For tool measurement, workpiece alignment, workpiece measurement, and presetting |
| Graphics | For programming and program verification |
| Parallel operation | Program run and programming with graphics |
| Data interface | Ethernet 1000BASE-T; USB 3.0; USB 2.0; RS-232-C/V.24 (max. 115 200 bauds) |
| Remote control and diagnosis | TeleService |
| Screen | 15-inch or 19-inch screen with operating keys, 19-inch or 24-inch screen for multitouch operation |
| Axis feedback control | • Feedforward control or operation with following error  
• Integrated digital drive control including inverter |
| Adaptive feed control<sup>2)</sup> | AFC adjusts the contouring feed rate to the spindle power |
| Dynamic Collision Monitoring (DCM)<sup>2)</sup> | Dynamic monitoring of the working space for possible collisions with machine components<sup>2)</sup> |
| Accessories | • HR electronic handwheels  
• TS workpiece touch probe and TT tool touch probe |

1) This function requires adaptation by the machine manufacturer  
2) Software option  
For further functions and differences in function, see the product documentation
TNC 620, TNC 320 contouring controls
For milling machines

The HEIDENHAIN TNC 620 and TNC 320 controls are compact but versatile contouring controls. Thanks to their flexible operation—shop-oriented programmability with the HEIDENHAIN Klartext format or offline programming—and their scope of features, they are especially suited for use on universal milling, drilling, and boring machines for the following:
• Series and single-part production
• Tool making
• Machine building
• Research and development
• Prototypes and pilot plants
• Repair departments
• Training and education facilities

Thanks to its digital design, the TNC 620 has control over the machine’s entire drive system. Not only does the field-proven digital drive technology from HEIDENHAIN make high contour fidelity and rapid machining at high speeds possible, but also all control components of the TNC 620 are connected via digital interfaces. The TNC 620 is available in a touch-screen version as well as in a screen and keyboard version.

Because of its analog outputs (which also provide nominal speed values), the TNC 320 is well suited for retrofitting on machine tools.

### TNC 620

- Axes: 8 control loops, of which up to 2 are configurable as spindles
- Interpolation:
  - Linear in 4 (optionally 5) main axes
  - Circular in 4 main axes
  - Helical, superimposition of circular and straight paths
  - Cylinder surface
- Program entry:
  - HEIDENHAIN Klartext conversational format
  - ISO (G codes: input via soft keys or via external USB keyboard)
  - FK free programming of contours (software option on the TNC 620)
- CAD import:
  - Loading of contours from 3D models
- Program memory: 1.8 GB CF card
- Position entry:
  - Positions in Cartesian or polar coordinates
  - Incremental or absolute dimensions
  - Display and entry in mm or inches
  - Actual position capture
- Input resolution and display step: To 0.1 µm or 0.0001° (optionally to 0.01 µm or 0.00001°)
- Block processing time: 1.5 ms
- Coordinate transformation:
  - Shifting, rotating, mirroring, scaling (axis specific)
  - Tilting the working plane, PLANE function
- Machining cycles:
  - Drilling, tapping, thread cutting, reaming, and boring
  - Cycles for hole patterns, facing of flat surfaces
  - Clearance and finishing of pockets, slots, and studs
- Touch probe cycles:
  - For tool measurement, workpiece alignment, workpiece measurement, and workpiece presetting (software option on the TNC 620)
- Graphics:
  - For programming and program verification (software option on the TNC 620; graphic support with cycle programming
- Parallel operation:
  - Programming during program run, program-run graphics (software option on the TNC 620)
- Data interface:
  - Ethernet 1000BASE-T
  - USB 3.0
  - USB 2.0
  - RS-232C/V.24, and RS-422/V.11 (max. 115 200 bauds)
- Screen:
  - 15-inch touch screen with operating keys or 19-inch screen for multitouch operation (portrait)
- Axis feedback control:
  - Feedforward control or operation with following error
  - Integrated digital drive control for synchronous and asynchronous motors
- Interfacing to the machine:
  - Via integrated programmable logic controller (PLC)
  - Inputs/outputs with PL 6000
- Accessories:
  - HR electronic handwheels
  - TS workpiece touch probe and TT tool touch probe

### TNC 320

- Axes: 6 control loops, of which up to 2 are configurable as spindles
- Interpolation:
  - Linear in 4 main axes
  - Circular in 2 axes
  - Helical, superimposition of circular and straight paths
  - Cylinder surface
- Program entry:
  - HEIDENHAIN Klartext conversational format
  - ISO (G codes: input via soft keys or via external USB keyboard)
  - FK free programming of contours (software option on the TNC 620)
- Loading of contours from 3D models
- Program memory: 1.8 GB CF card
- Position entry:
  - Positions in Cartesian or polar coordinates
  - Incremental or absolute dimensions
  - Display and entry in mm or inches
  - Actual position capture
- Input resolution and display step: To 0.1 µm or 0.0001°
- Block processing time: 6 ms
- Coordinate transformation:
  - Shifting, rotating, mirroring, scaling (axis specific)
  - Tilting the working plane, PLANE function
- Machining cycles:
  - Drilling, tapping, thread cutting, reaming, and boring
  - Cycles for hole patterns, facing of flat surfaces
  - Clearance and finishing of pockets, slots, and studs
- Touch probe cycles:
  - For tool measurement, workpiece alignment, workpiece measurement, and workpiece presetting (software option on the TNC 620)
- Graphics:
  - For programming and program verification (software option on the TNC 620; graphic support with cycle programming
- Parallel operation:
  - Programming during program run, program-run graphics (software option on the TNC 620)
- Data interface:
  - Ethernet 1000BASE-T
  - USB 3.0
  - USB 2.0
  - RS-232C/V.24, and RS-422/V.11 (max. 115 200 bauds)
- Screen:
  - 15-inch touch screen with operating keys or 19-inch screen for multitouch operation (portrait)
- Axis feedback control:
  - Feedforward control or operation with following error
  - Integrated digital drive control for synchronous and asynchronous motors
- Interfacing to the machine:
  - Via integrated programmable logic controller (PLC)
  - Inputs/outputs with PL 6000
- Accessories:
  - HR electronic handwheels
  - TS workpiece touch probe and TT tool touch probe

1) Software option
TNC 128 straight-cut control
For milling machines

The TNC 128 from HEIDENHAIN is a compact but versatile straight-cut control for three servo axes and servo spindle. A further servo axis is an option. Thanks to its simple operation and scope of features, it is especially well suited for use on universal milling, drilling, and boring machines for the following possibilities:

- Series and single-part production
- Machine building
- Prototypes and pilot plants
- Repair departments
- Training and education facilities

Because of its analog output that also provides nominal speed values, the TNC 128 is well suited for retrofitting on machine tools.

<table>
<thead>
<tr>
<th>TNC 128</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axes</td>
</tr>
<tr>
<td>Program entry</td>
</tr>
<tr>
<td>Program memory</td>
</tr>
<tr>
<td>Position entry</td>
</tr>
<tr>
<td>Input resolution and display step</td>
</tr>
<tr>
<td>Block processing time</td>
</tr>
<tr>
<td>Coordinate transformation</td>
</tr>
<tr>
<td>Machining cycles</td>
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<tr>
<td>Touch probe cycles</td>
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<tr>
<td>Graphics</td>
</tr>
<tr>
<td>Parallel operation</td>
</tr>
<tr>
<td>Data interface</td>
</tr>
<tr>
<td>Screen</td>
</tr>
<tr>
<td>Axis feedback control</td>
</tr>
<tr>
<td>Interfacing to the machine</td>
</tr>
<tr>
<td>Accessories</td>
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<td></td>
</tr>
</tbody>
</table>
CNC PILOT 640 contouring control
For lathes and turning-milling machines

The CNC PILOT 640 offers you the right support thanks to its flexible design and versatile programming capabilities — regardless of whether you are manufacturing single parts or batches, simple or complex workpieces. The CNC PILOT 640 is characterized by its simple operation and programming. It is quickly learned and requires minimum training time.

The CNC PILOT 640 was designed for CNC lathes and is ideal for both horizontal and vertical lathes as well as for vertical boring and turning mills.

The CNC PILOT 640 supports lathes with main and counter spindle, one slide (X and Z axis), C axis or positionable spindle, driven tools, and machines with Y and B axes.

Regardless of whether you are turning simple parts or complex workpieces, the CNC PILOT 640 provides you with the benefits of graphical contour input and convenient programming with smart.Turn. With the TURN PLUS software option, you can even create an NC program at the touch of a button. You only need to describe the contour, the material, and the clamping fixtures beforehand. TURN PLUS does everything else automatically.

If you program with variables, control special machine components, or use externally created programs, etc., simply switch to DIN PLUS. With DIN PLUS you’ll find the fitting solution for your special tasks.

The CNC PILOT 640 also supports multi-channel machining. Different machining steps can then be performed simultaneously using multiple slides.

---

### CNC PILOT 640

<table>
<thead>
<tr>
<th><strong>Axes</strong></th>
<th>Up to 24 control loops (22 with functional safety)</th>
</tr>
</thead>
</table>
| **Interpolation** | • Straight line: in 2 principal axes, optional in 3 principal axes  
| | • Circle: in 2 axes, optional additional linear interpolation in the third axis  
| | • C1/C2 axis: interpolation of X and Z linear axes with the C1/C2 axis  
| | • B axis: 5-axis interpolation between X, Z, Y, B, and C axes  
| **Program entry** | smart.Turn, DIN PLUS, Teach-In mode |
| **Programming aids** | TURNguide presents user information directly on the control |
| **DXF import** | Loading of DXF contours |
| **Program memory** | 1.8 GB CFR memory card |
| **Position entry** | Nominal positions in Cartesian or polar coordinates, absolute or incremental dimensions, in mm or inches; actual position capture |
| **Input resolution and display step** | X axis: 0.5 µm, diameter: 1 µm  
| | U, V, W, Y, Z axes: 1 µm  
| | B, C1/C2 axes: 0.001° |
| **Block processing time** | 1.5 ms (3D straight line without radius compensation at 100 % PLC utilization) |
| **Setup functions** | • Setting the workpiece datum  
| | • Defining the tool change point  
| | • Defining the protection zone |
| **Interactive contour programming (ICP)** | Contour definition with graphic support |
| **Machining cycles** | Stock removal, recessing, recess turning, engraving, thread cutting, helical slot milling, boring, drilling, tapping, deburring, trochoidal milling, hobbing, eccentric and non-circular turning |
| **Touch-probe cycles** | For tool and workpiece measurement as well as presetting |
| **Graphics** | For programming and program verification |
| **Parallel operation** | Program run and programming with graphics |
| **Data interface** | Ethernet 1000BASE-T; USB 3.0; USB 2.0; RS-232-C/U.24 (max. 115200 bauds) |
| **Remote control and diagnosis** | TeleService |
| **Screen** | 15.6-inch or 24-inch screen for multitouch operation |
| **Axis feedback control** | • Feedforward control or operation with following error  
| | • Integrated digital drive control including inverter |
| **Multi-channel capability** | • Up to three channels for asynchronous multi-slide machining |
| **Accessories** | • HR electronic handwheels  
| | • TS workpiece touch probe and TT tool touch probe |

1 Software option

For further functions and differences in function, see the product documentation.
The MANUALplus 620 is a compact and versatile contouring control that is particularly well suited for cycle-controlled lathes. The MANUALplus 620 optimally combines the ease of use of conventional lathes with the advantages of CNC-controlled machines.

Regardless of whether you are manufacturing single parts or batches or whether your workpieces are simple or complex, the control adapts to the needs of your company. The MANUALplus 620 is characterized by its simple operation and programming. It is quickly learned and requires minimum training time.

The MANUALplus 620 supports lathes with main and counter spindle, one slide (X and Z axis), C axis or positionable spindle, and driven tools, as well as machines with Y and B axes.

### MANUALplus 620

<table>
<thead>
<tr>
<th>Axes</th>
<th>10 control loops</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interpolation</td>
<td>• Straight line: in 2 principal axes, optional in 3 principal axes&lt;br&gt;• Circle: in 2 axes, optional additional linear interpolation in the third axis&lt;br&gt;• C1/C2 axis: interpolation of X and Z linear axes with the C1/C2 axis 1)</td>
</tr>
<tr>
<td>Program entry</td>
<td>Teach-In mode, smart.Turn 1), DIN PLUS</td>
</tr>
<tr>
<td>Programming aids</td>
<td>TURNguide presents user information directly on the control</td>
</tr>
<tr>
<td>DXF import 1)</td>
<td>Loading of DXF contours</td>
</tr>
<tr>
<td>Program memory</td>
<td>1.8 GB CFR memory card</td>
</tr>
<tr>
<td>Position entry</td>
<td>Nominal positions in Cartesian or polar coordinates, absolute or incremental dimensions, in mm or inches; actual position capture</td>
</tr>
<tr>
<td>Input resolution and display step</td>
<td>X axis: 0.5 µm, diameter: 1 µm&lt;br&gt;U, V, W, Y, Z axes: 1 µm&lt;br&gt;B, C1/C2 axes: 0.001° 1)</td>
</tr>
<tr>
<td>Block processing time</td>
<td>3 ms</td>
</tr>
<tr>
<td>Setup functions</td>
<td>• Setting the workpiece datum&lt;br&gt;• Defining the tool change point&lt;br&gt;• Defining the protection zone</td>
</tr>
<tr>
<td>Interactive contour programming (ICP)</td>
<td>Contour definition with graphic support</td>
</tr>
<tr>
<td>Machining cycles</td>
<td>Stock removal, recessing, recess turning, engraving, thread cutting, helical slot milling, boring, drilling, tapping, deburring, trochoidal milling, hobbing, eccentric and non-circular turning</td>
</tr>
<tr>
<td>Touch-probe cycles 1)</td>
<td>For tool and workpiece measurement as well as presetting</td>
</tr>
<tr>
<td>Graphics</td>
<td>For programming and program verification</td>
</tr>
<tr>
<td>Parallel operation</td>
<td>Program run and programming with graphics</td>
</tr>
<tr>
<td>Data interface</td>
<td>Ethernet 1000BASE-T; USB 3.0; USB 2.0; RS-232-C/V.24 (max. 115 200 bauds)</td>
</tr>
<tr>
<td>Remote control and diagnosis</td>
<td>TeleService</td>
</tr>
<tr>
<td>Screen</td>
<td>15.6-inch screen for multitouch operation (with virtual operating panel)</td>
</tr>
<tr>
<td>Axis feedback control</td>
<td>• Feedforward control or operation with following error&lt;br&gt;• Integrated digital drive control including inverter</td>
</tr>
<tr>
<td>Accessories</td>
<td>• HR electronic handwheels&lt;br&gt;• TS workpiece touch probe and TT tool touch probe</td>
</tr>
</tbody>
</table>

1) Software option

For further functions and differences in function, see the product documentation.
Control packages from HEIDENHAIN are perfectly matched systems consisting of the following components:

- Software
- Control hardware and real-time hardware
- Drive electronics
- Motors
- Encoders

In this uniformly digital control solution, all components are connected over purely digital interfaces: the control components over HSCI (HEIDENHAIN Serial Controller Interface), which is the HEIDENHAIN real-time protocol for Fast Ethernet, and the encoders over EnDat 2.2, the bidirectional interface from HEIDENHAIN. This achieves a high degree of availability for the entire system. It can be diagnosed and is immune to noise—from the main computer to the encoder. The outstanding characteristics of the uniform digital solution from HEIDENHAIN guarantee very high accuracy and surface definition together with high traversing speeds.

Digital drive control
High surface definition, high contouring accuracy of the finished workpiece, and short machining times—these requirements can be met only with digital control techniques. Here HEIDENHAIN offers NC products with integrated digital drive control.

The following HEIDENHAIN controls are available with HSCI and digital drive control:
- TNC 640
- TNC 620
- CNC PILOT 640
- MANUALplus 620

Motors for axis and spindle drives
HEIDENHAIN offers various motors for axis and spindle drives as accessories to its controls with integrated inverters:
- Feed motors with a stall torque of 1.5 Nm to 120 Nm and a power rating ranging from 0.5 kW to 14.4 kW.
- Spindle motors with a power rating ranging from 5.5 kW to 40 kW.

Inverter systems
Either compact or modular inverters are available, depending on the type of machine. The compact inverters include power electronics for up to five axes plus spindle with a rated output of the total system up to 22 kW. For the modular inverters, supply units from 22 kW to 125 kW as well as various power modules for axes and spindles are available. Modular inverters are suited for machines with up to 24 axes, of which up to four can be configured as spindles.

Gen 3 drives
With the new Gen 3 components, HEIDENHAIN offers a complete system that is based on highly innovative and future-oriented technologies. You profit from state-of-the-art interface technology, improved performance data, and increased controller performance. This makes the Gen 3 drive technology an important key component for machines that must fulfill stringent requirements regarding availability, surface quality, and machining time.
Accessories

Electronic handwheels and programming stations

With an electronic handwheel from HEIDENHAIN, you can use the feed drive to make very precise movements in the axis slides in proportion to the rotation of the handwheel. As an option, the handwheels are available with mechanical detent.

HR 510, HR 520, and HR 550 FS portable handwheels

The axis keys and certain functional keys are integrated in the housing. This way you can switch axes or set up the machine at any time—regardless of where you happen to be standing. The HR 520 also features a display for the position value, the feed rate, the spindle speed, the operating mode, and other functions, as well as override potentiometers for the feed rate and spindle speed. You can enjoy unlimited freedom of movement with the HR 550 FS with radio transmission. Its features correspond to those of the HR 520.

HR 130 and HR 150 panel-mounted handwheels

Panel-mounted handwheels from HEIDENHAIN can be integrated in the machine operating panel or be installed at another location on the machine. An adapter permits connection of up to three HR 150 electronic panel-mounted handwheels.

With the TNC 640 and TNC 620/TNC 320 programming stations, you have the capability to program in Klartext conversational format just as you do at the machine, but away from the noise and distractions of the shop floor. With the DataPilot CP 640 and the DataPilot MP 620 you can also use SmartTurn, G codes, and cycles to create programs for your HEIDENHAIN lathe controls.

Creating programs

The programming, testing, and optimizing of HEIDENHAIN Klartext or G-code programs with the programming station substantially reduces machine idle times. You do not need to change your way of thinking. At the programming station you program on the same keyboard as at the machine.

Training with the programming station

Because the programming stations are based on the respective control software, they are ideally suited for apprentice and advanced training.

TNC training in schools

Since they can be programmed with G codes as well as in Klartext conversational format, the programming stations can also be used in schools for TNC programming training.

VT 121 camera system for tool inspection

A system for always keeping an eye on the working space of the machine and the tool: the VT 121 camera systems from HEIDENHAIN monitor the cutting edges of tools during machining, thus providing for quick detection of worn tools. The camera system for tool inspection consists of the following two components:

- Camera with two objectives (VT 121)
- Software with touch operation (VTC)

Applications:

- Tool inspection before critical machining steps
- Documentation of tool condition and wear
- Optimization of cutting parameters
- Optimization of NC programs
- Breakage check
- Tool inspection after expiration of tool life

Your benefits:

- Automated imaging during machining
- Time savings, since the tool stays in the machine
- Compact system, even usable with very large tools
- Sturdy design
- Selective use of compressed air
- Software for configuration and evaluation directly on the TNC

VT 121 camera system for tool inspection
The Digital Shop Floor software products from HEIDENHAIN are ideal for manufacturing companies that use CNC machine tools. The software provides support along the entire manufacturing process chain, from job planning to production preparation, monitoring, and inspection.

Software solutions for your manufacturing operations

- **HEIDENHAIN**
  - StateMonitor
    - Machine inventory visualization
    - Messenger with real-time notifications
    - Connection of up to five machines
    - Easy access via web browser

- **HEIDENHAIN**
  - JobTerminal
    - Software option
    - Acquire job data
    - Create and assign production jobs and work steps

- **HEIDENHAIN**
  - MaintenanceManager
    - Software option
    - Create, organize, and document maintenance jobs
    - Display maintenance status of machines
    - Identify faults and report them

- **HEIDENHAIN**
  - Machine inventory visualization
  - Job assignment, booking, and feedback
  - Organization and logging of scheduled maintenance and identified faults
  - Enhanced capturing and recording of equipment-specific signals
  - Machines connected over the HEIDENHAIN DNC, OPC UA, MTConnect, and Modbus TCP interfaces
  - Relaying to an external SQL database for processing of machine data in an MES or ERP system
  - Comprehensive evaluation of all StateMonitor modules

**StateMonitor: all machines at your fingertips**

StateMonitor gives you insight into the production processes of machine tools in real time. Thanks to this innovative software from HEIDENHAIN, your machines are intuitively visualized on a dashboard on your PC, laptop, tablet, or smartphone. The status view gives you a current overview of each machine, such as its productivity and readiness statuses. The Messenger function notifies the appropriate employees if freely definable events occur (such as an emergency stop).

Your benefits:
- Keep sight of machine statuses and derive optimization potential
- Monitor production processes with mobile devices even when away from the office

Interfaces:
- HEIDENHAIN DNC
- OPC UA
- MTConnect
- Modbus TCP

Comprehensive software options give you the possibility of enhancing StateMonitor according to your needs.
The TS workpiece touch probes from HEIDENHAIN help you perform setup, measuring, and inspection functions directly on the machine tool.

The stylus of a TS touch trigger probe is deflected upon contact with a workpiece surface. At that moment the TS generates a trigger signal that, depending on the model, is transmitted either by cable or over an infrared or radio beam to the control.

The control simultaneously saves the actual position values as measured by the machine axis encoders, and uses this information for further processing. The trigger signal is generated through a wear-free optical sensor that ensures high reliability.

HEIDENHAIN offers probe styli with various ball-tip diameters and stylus lengths. On the TS 260, asymmetric probing elements can also be attached through an adapter and exactly aligned with the aid of the screw connection.

**Benefits of HEIDENHAIN touch probes**

- High probing repeatability
- High probing speed
- No wear thanks to contact-free optical switch and high-accuracy pressure sensor
- High repeatability over a long period
- Noise-free signal transmission by cable, radio, or infrared beam
- Optical status indicator
- Integrated flusher/blower on infrared touch probes
- Effective energy-saving mode
- With TS 460: collision protection adapter (optional) prevents damage and reduces heating of the TS through the spindle
- With TS 260: direct connection with any higher-level electronics; no interface required

**Touch probe with radio and infrared transmission** for machines with automatic tool change:
- TS 460: standard touch probe
  Compact dimensions, energy-saving mode, optional collision protection and thermal decoupling

**Touch probes with infrared signal transmission** for machines with automatic tool change:
- TS 642: touch probe for retrofitting
  Activation by switch in the taper shank
- TS 740: highly accurate touch probe
  High probing accuracy and repeatability, low probing force

Probe system with **cable-bound signal transmission** for machines with manual tool change, e.g. grinding, turning and milling machines:
- TS 150: cable-bound touch probe
  Radial or axillary cable connection
- TS 260: cable-bound touch probe
  Radial or axially cable connection
- TS 248: cable-bound touch probe
  Radial cable connection, with reduced deflection forces

---

### Machine Types

<table>
<thead>
<tr>
<th>Machine Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TS 460</td>
<td>CNC machine tools for milling, drilling, and boring as well as lathes</td>
</tr>
<tr>
<td>TS 642</td>
<td>TS 740</td>
</tr>
<tr>
<td>TS 260</td>
<td>TS 150</td>
</tr>
<tr>
<td>TS 750</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Signal Transmission</th>
<th>TS 460</th>
<th>TS 642</th>
<th>TS 260</th>
<th>TS 150</th>
<th>TS 750</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radio and infrared</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infrared</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Transceiver Unit</th>
<th>TS 460</th>
<th>TS 642</th>
<th>TS 260</th>
<th>TS 150</th>
<th>TS 750</th>
</tr>
</thead>
<tbody>
<tr>
<td>SE 540 infrared</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SE 640 infrared</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SE 660 radio/infrared</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SE 661 radio/infrared</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Supply Voltage</th>
<th>TS 460</th>
<th>TS 642</th>
<th>TS 260</th>
<th>TS 150</th>
<th>TS 750</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC 15 V to 30 V</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DC 15 V to 40 V</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Switching on/off</th>
<th>TS 460</th>
<th>TS 642</th>
<th>TS 260</th>
<th>TS 150</th>
<th>TS 750</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radio or infrared transmission</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Switch in taper shank</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infrared transmission</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Interface to Control Signal Level</th>
<th>TS 460</th>
<th>TS 642</th>
<th>TS 260</th>
<th>TS 150</th>
<th>TS 750</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTL via SE transceiver unit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HTL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Probe Repeatability</th>
<th>TS 460</th>
<th>TS 642</th>
<th>TS 260</th>
<th>TS 150</th>
<th>TS 750</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 s ± 0.1 µm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 s ± 0.025 µm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Probe Velocity</th>
<th>TS 460</th>
<th>TS 642</th>
<th>TS 260</th>
<th>TS 150</th>
<th>TS 750</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 3 m/min</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 0.25 m/min</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Protection EN 60529</th>
<th>TS 460</th>
<th>TS 642</th>
<th>TS 260</th>
<th>TS 150</th>
<th>TS 750</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP68</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

1) Via U150
TT tool touch probes

Touch probes
The TT 160 and TT 460 are 3D touch trigger probes for tool measurement and inspection. The disk-shaped probe contact of the TT is deflected during the tactile probing of a tool. In that instant, the TT generates a trigger signal that is transmitted to the control, where it is then processed further. The trigger signal is generated through a wear-free optical sensor that ensures high reliability.

TT 160 Signal transmission to the NC over connecting cable

TT 460
- Signal transmission over radio and infrared beam to transceiver unit
- The SE 660 is a shared transceiver unit for tool and workpiece touch probes with radio and infrared transmission

TT 160
- Probing method
  - Physical probing in three dimensions: ±X, ±Y, ±Z
- Probe repeatability
  - 2 ± 1 µm (probing speed 1 m/min)
- Permissible deflection of probe contact
  - ± 5 mm in all directions
- Supply voltage
  - DC 10 V to 30 V via NC
  - Rechargeable or nonrechargeable batteries
- Interface to control
  - Signal level: HTL
  - SE 640: infrared
  - SE 660: radio/infrared
  - SE 661: radio/infrared
- Signal transmission
  - Via cable
  - Radio wave and infrared transmission with 360° range
- Probe contact
  - Ø 40 mm or Ø 25 mm
- Protection
  - EN 60529: IP67

TT 460
- Probing method
  - Physical probing in three dimensions: ±X, ±Y, ±Z
- Probe repeatability
  - 2 ± 1 µm (probing speed 1 m/min)
- Permissible deflection of probe contact
  - ± 5 mm in all directions
- Supply voltage
  - DC 10 V to 30 V via NC
  - Rechargeable or nonrechargeable batteries
- Interface to control
  - Signal level: HTL
  - SE 640: infrared
  - SE 660: radio/infrared
  - SE 661: radio/infrared
- Signal transmission
  - Via cable
  - Radio wave and infrared transmission with 360° range
- Probe contact
  - Ø 40 mm or Ø 25 mm
- Protection
  - EN 60529: IP67

SE transceiver units

The following transceiver units are available for wireless signal transmission:
- SE 540: for integration in spindle head; only infrared transmission
- SE 640: infrared transmission
- SE 660: shared SE for TS and TT, radio and infrared transmission
- SE 661: shared SE for TS and TT, radio and infrared transmission, EnDat interface for touch probes

With wireless signal transmission these touch probes are also suited for use on machines with automatic tool changer.

The SE 661 transceiver unit and the TS 460 and TT 460 touch probes are available with the EnDat interface. The EnDat interface from HEIDENHAIN is a digital, bidirectional interface that transmits the trigger status as well as diagnostic information and additional data from the touch probe. Thanks to the interface’s serial transmission method, multiple items of data can be transmitted simultaneously.
Measured value acquisition and display

Digital readouts
HEIDENHAIN digital readouts for manually operated machine tools have universal application: in addition to standard tasks on milling, drilling, and boring machines and lathes, they also offer ideal solutions for many applications on machine tools and special machines—in fact all machines where axis slides are moved manually. This includes radial drilling machines and rapid radial drilling machines.

Digital readouts for manual machine tools increase your productivity. They save time and increase the dimensional accuracy of the finished workpiece while offering very user-friendly operation.

Practice-oriented functions and cycles are available for various applications. The distance-to-go display feature with graphic positioning aid allows you to approach the next nominal position quickly and reliably simply by traversing to a display value of zero. And POSITIP speeds up small-batch production—repetitive machining sequences can be saved as a program.

Precise manufacturing made easy: Together with linear encoders from HEIDENHAIN, the digital readouts measure the axis movements directly. The backlash caused by mechanical transfer elements such as lead screws, racks, and gears therefore has no influence.

Evaluation electronics units
HEIDENHAIN provides the appropriate evaluation electronics units for each type of application. They offer numerous functions for measured data acquisition and statistical evaluation of measured values. For automation solutions the results of the measured-data evaluation can be processed further by integrated switching functions. The splash-proof front panel and the sturdy cast-metal housing make evaluation electronics units from HEIDENHAIN impervious to the harshest of everyday shop conditions.

Signal converters
Signal converters from HEIDENHAIN enable the flexible adaptation of interfaces for encoder signals to the requirements of your application. Depending on the application, additional signals (such as from temperature sensors) are processed and transmitted to the higher-level electronics.

User-friendly environment
Digital readouts and evaluation electronics with integrated display are specially designed for user friendliness. Typical characteristics:
- Optimally readable, graphic flat panel display
- Intuitive operation using touchscreen or keyboard (depending on the product)
- All-in-one device with compact outside dimensions
- Sturdy aluminum housing
- Reference mark evaluation for distance-coded and single reference marks
- Problem-free installation, maintenance-free operation
- Fast payback with economical use

Evaluation units and digital readouts from HEIDENHAIN feature a data interface for further processing in the higher-level electronics or simply to print out the measured values.

---

**Evaluation units for metrology applications**

<table>
<thead>
<tr>
<th>Series</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ND 287</td>
<td>68</td>
</tr>
<tr>
<td>GAGE-CHEK 2000</td>
<td></td>
</tr>
<tr>
<td>EIB 700</td>
<td></td>
</tr>
<tr>
<td>IK 220</td>
<td></td>
</tr>
</tbody>
</table>

**Digital readouts for manually operated machine tools**

<table>
<thead>
<tr>
<th>Series</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>POSITIP 8000</td>
<td>70</td>
</tr>
<tr>
<td>ND 7000</td>
<td></td>
</tr>
<tr>
<td>ND 5000</td>
<td></td>
</tr>
</tbody>
</table>

**Signal converters, inspection and testing devices**

<table>
<thead>
<tr>
<th>Series</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>POSITIP 8000</td>
<td>71</td>
</tr>
<tr>
<td>ND 7000</td>
<td></td>
</tr>
<tr>
<td>ND 5000</td>
<td></td>
</tr>
</tbody>
</table>
Evaluation units for metrology applications
Measuring and testing tasks

Evaluation units for measuring and testing tasks are ideal for:
• Measurement equipment
• Adjustment and inspection equipment
• SPC inspection stations
• Multipoint inspection apparatuses
• Mobile data acquisition
• Positioning equipment

The evaluation units are independently operating devices with integrated screen and sturdy housing. They feature special functions for measuring and statistical evaluation of measured values such as sorting and tolerance check mode, minimum/maximum value storage, and measurement series storage. These data make it possible to calculate mean values and standard deviations, and graphically display them in histograms or control charts.

The EIB 700 is ideal for applications requiring high resolution, fast measured-value acquisition, mobile data acquisition, or data storage. The data is transferred over the standard Ethernet interface for evaluation and display in a higher-level computer system.

The IK 220 is an expansion board for PCs for recording the measured values of two incremental or absolute HEIDENHAIN encoders.

<table>
<thead>
<tr>
<th>ND 287</th>
<th>GAGE-CHEK 2000</th>
<th>EIB 700</th>
<th>IK 220</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Application</strong></td>
<td>• Measurement equipment</td>
<td>• Positioning equipment</td>
<td>• Inspection stations</td>
</tr>
<tr>
<td></td>
<td>• Testing devices</td>
<td>• Measuring fixtures</td>
<td>• Multi-gauging fixtures</td>
</tr>
<tr>
<td></td>
<td>• SPC inspection stations</td>
<td></td>
<td>• Mobile data acquisition</td>
</tr>
<tr>
<td><strong>Axes</strong></td>
<td>1 (optional 2)</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td><strong>Encoder inputs</strong></td>
<td>• 1 Vpp or 11 µAPP</td>
<td>• 1 Vpp or 11 µAPP, EnDat 2.2, or TTL</td>
<td>• 1 Vpp or EnDat 2.1, EnDat 2.2, or 11 µAPP</td>
</tr>
<tr>
<td><strong>Display</strong></td>
<td>Screen</td>
<td>7-inch screen for multitouch operation</td>
<td>By PC screen</td>
</tr>
<tr>
<td><strong>Function</strong></td>
<td>• Sorting and tolerance checking</td>
<td>• Measurement series with minimum and maximum value recording</td>
<td>• Precise position measurement; updating rate of up to 50 kHz</td>
</tr>
<tr>
<td></td>
<td>• Measurement series with minimum and maximum value recording</td>
<td>• Functions for statistical process control (SPC)</td>
<td>• Programmed measured-value inputs</td>
</tr>
<tr>
<td></td>
<td>• Graphic display of measurement results</td>
<td>• Data transfer</td>
<td>• Measured-value memory for typically 250 000 measured values per channel</td>
</tr>
<tr>
<td></td>
<td>• Storage of measured values</td>
<td>• Manual or touch probe triggered</td>
<td>• Standard Ethernet interface connection to higher-level computer systems</td>
</tr>
<tr>
<td></td>
<td>Optional: Sum/difference display or thermal compensation</td>
<td>• Continuous or triggered by switching function</td>
<td>• Precise position measurement; updating rate of up to 50 kHz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• User administration</td>
<td>• Internal and external measured-value triggers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Measurement with reference parts</td>
<td>• Measured-value memory for typically 250 000 measured values per channel</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Management of parts</td>
<td>• Standard Ethernet interface connection to higher-level computer systems</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Dial gage for a graph of the measured value</td>
<td>• Programmable measured-value inputs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Diameter/radius display</td>
<td>• Internal and external measured-value triggers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Relative measurement</td>
<td>• Measured-value memory for typically 250 000 measured values per channel</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Probing functions</td>
<td></td>
</tr>
<tr>
<td><strong>Data interfaces</strong></td>
<td>USB, RS-232-C, Ethernet</td>
<td>Ethernet, USB, RS-232-C</td>
<td>Ethernet</td>
</tr>
</tbody>
</table>

1) Depending on version
2) Possible with RS-232 adapter connection over USB port
Digital readouts for manually operated machine tools

Applications for digital readouts are on manually operated machine tools, e.g.:
- Milling machines
- Drilling and boring machines
- Lathes
- Radial drilling machines
- Grinding machines

HEIDENHAIN offers the appropriate digital readout for each of these machine types. The splash-proof front panel and the sturdy aluminum housing make digital readouts from HEIDENHAIN impervious to the harshest of everyday shop conditions.

### POSITIP 8000
- 12.1-inch screen for multitouch operation, program memory, switching inputs and outputs (digital and analog)
- 7-inch screen for multitouch operation, switching inputs and outputs (digital and analog, depending on the version)
- 7-inch screen with operating keys
- 6, two of them as software option
- 1 VPP (with LS 378 C)
- Display step: 10 µm, 5 µm, 1 µm, or finer
- Presets: 100
- Tool data: For 100 tools
- Programming: Manual and MDI operation, graphical positioning aid, variable font size for display of position values
- Functions: Touch probe connection
- Material: ABS plastic

### ND 7000
- 7-inch screen for multitouch operation, switching inputs and outputs (digital and analog)
- 7-inch screen with operating keys
- 6, two of them as software option
- 1 VPP (with LS 378 C)
- Display step: 10 µm, 5 µm, 1 µm, or finer
- Presets: 100
- Tool data: For 100 tools
- Programming: Manual and MDI operation, graphical positioning aid, variable font size for display of position values
- Functions: Touch probe connection
- Material: ABS plastic

### ND 5000
- 7-inch screen with operating keys
- 3
- TTL
- 6 µm
- 3
- No

### Signal converters, inspection and testing devices

#### Signal converters
Signal converters from HEIDENHAIN adapt the encoder signals to the interface of the subsequent electronics, for example:

- Incremental signals
  - 1 Vpp > TTL
  - 11 µAPP > TTL
- Incremental signals > position values
  - 1 Vpp > EnDat
  - 1 Vpp > Fanuc Serial Interface
  - 1 Vpp > Mitsubishi high speed Interface

#### Inspection and testing devices from HEIDENHAIN
HEIDENHAIN encoders provide all of the information needed for commissioning, monitoring, and diagnostics. HEIDENHAIN offers the appropriate PWM inspection devices and PWT testing devices for encoder adjustment and analysis. The PWM inspection devices can be used universally. They have low measuring tolerances and can be calibrated.

Testing devices have larger measuring tolerances, fewer available functions, and cannot be calibrated.

HEIDENHAIN encoders can usually be connected directly or via signal converters to a number of different subsequent electronics.

HEIDENHAIN therefore offers encoders and signal converters with various interfaces. The testing and inspection devices from HEIDENHAIN also support various interfaces, which makes their application more flexible (see overview for the PWM 21 and PWT 101).

#### Encoder input

<table>
<thead>
<tr>
<th>Interface</th>
<th>PWM 21</th>
<th>PWT 101</th>
</tr>
</thead>
<tbody>
<tr>
<td>EnDat 2.1</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>EnDat 2.2</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Drive-CLiQ</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Fanuc Serial Interface</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Mitsubishi high speed interface</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Yaskawa Serial Interface</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Panasonic Serial Interface</td>
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<tr>
<td>SSI</td>
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<tr>
<td>1 Vpp/TTL/11 µAPP</td>
<td>✓</td>
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<tr>
<td>1 Vpp with Z1 track</td>
<td>✓</td>
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<tr>
<td>TTL (via signal adapter)</td>
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#### Signal converters from HEIDENHAIN are available in various designs:
- Box design
- Plug design
- Version for integration
- Top-hat rail design
Brochures, data sheets, and CD-ROMs

The products shown here are described in more detail in separate documentation, including complete specifications, signal descriptions, and dimension drawings in English and German (other languages available upon request).

HEIDENHAIN on the Internet

At www.heidenhain.com you will find not only these brochures in various languages, but also a great deal of further up-to-date information on the company and its products.

Our website also includes:
- Technical articles
- Press releases
- Addresses
- TNC training programs

Length measurement

| Brochure | Linear Encoders
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>For Numerically Controlled Machine Tools</td>
<td></td>
</tr>
<tr>
<td>Contents: Absolute linear encoders, LC, Incremental linear encoders, LB, LF, LS</td>
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<thead>
<tr>
<th>Brochure</th>
<th>Exposed Linear Encoders</th>
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<tr>
<td>Contents: Absolute linear encoders, LIC, Incremental linear encoders, LIP, PF, LIF, LIDA</td>
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| Brochure | Angle measurement
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<tr>
<td>Rotary Encoders</td>
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<td>Contents: Absolute rotary encoders, ECN, EQN, ROC, ROQ, Incremental rotary encoders, ERN, ROD</td>
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<tr>
<th>Brochure</th>
<th>Encoders for Servo Drives</th>
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<td>Rotary encoders, Angle encoders, Linear encoders</td>
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| Brochure | Modular Angle Encoders
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<tr>
<td>With Magnetic Scanning</td>
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<tr>
<td>Contents: Incremental encoders, ERM</td>
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<tr>
<th>Brochure</th>
<th>Angle Encoder Modules</th>
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<td>Contents: Angle encoder modules, MRP 2000/5000/8000, Angle encoder modules with integrated torque motor, SRP 5000, AccurET</td>
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<td>Contents: HEIDENHAIN-ACANTO, HEIDENHAIN-SPECTO, HEIDENHAIN-METRO, HEIDENHAIN-CERTO</td>
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Machine tool control

| Brochure | Machine tool control
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<tbody>
<tr>
<td>TNC 128 Straight-Cut Control</td>
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<tr>
<td>TNC 320 Contouring Control</td>
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<tr>
<td>iTNC 530 Contouring Control</td>
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<td>TNC 620 Contouring Control</td>
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<td>TNC 640 Contouring Control</td>
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<tr>
<td>Contents: Information for end users</td>
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<tr>
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<th>PhD 640 Contouring Control</th>
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<tr>
<td>Contents: Information for machine manufacturers</td>
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| Brochure | Measured value acquisition and display
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<tr>
<td>Evaluation Electronics</td>
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<tr>
<td>For Metrology Applications</td>
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<td>Contents: ND, QUADRA-CHEK, EIB, IK</td>
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<td>Digital Readouts/Linear Encoders</td>
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<tr>
<td>For Manually Operated Machine Tools</td>
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<td>Contents: Digital readouts, ND, POSITIP, Linear encoders, LS</td>
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<th>Brochure</th>
<th>Signal Converters</th>
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<tr>
<td>Product Overview</td>
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<tr>
<th>Brochure</th>
<th>Signal Converters</th>
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<td>Contents: Absolute angle encoders, RCN, ECN, Incremental angle encoders, RON, RPN, ROD</td>
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Setup and measurement

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<td>Touch Probes</td>
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<tr>
<td>Contents: Tool touch probes, TT, Workpiece touch probes, TS</td>
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<td>Cables and Connectors</td>
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<tr>
<td>Contents: Technical properties, cable overviews, and cable lists</td>
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| Brochure | Connecting encoders and touch probes
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<tr>
<td>Measuring Devices For Machine Tool Inspection and Acceptance Testing</td>
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<tr>
<td>Contents: Incremental linear encoders, KGM, VM</td>
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