



# HEIDENHAIN



## **General Catalog**

Linear Encoders  
Length Gauges  
Angle Encoders  
Rotary Encoders  
Contouring Controls  
Software Solutions  
Touch Probes  
Evaluation Electronics  
Digital Readouts

DR. JOHANNES HEIDENHAIN GmbH develops and manufactures linear and angle encoders, rotary encoders, evaluation units, and numerical controls. HEIDENHAIN supplies its products to manufacturers of machine tools as well as automated machines and systems, especially in the semiconductor and electronics manufacturing industries.

HEIDENHAIN is represented in over 50 countries—mainly through its own subsidiaries. Sales engineers and service technicians support the user on-site with technical information and servicing.

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](http://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.



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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.



30 m long measuring machine for scale tapes



Vacuum machine for application of chromium layers

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.

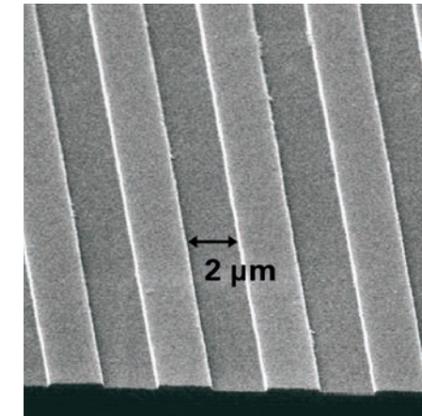


Angle comparator, measuring step approx. 0.001"



ALMA radio telescope in Chajnantor, Chile (photo courtesy of ESO)

The heart of a HEIDENHAIN encoder is its measuring standard, usually in the form of a grating with typical line widths of 0.25  $\mu\text{m}$  to 10  $\mu\text{m}$ . 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.



Phase grating with approx. 0.25  $\mu\text{m}$  grating height

### 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.

### Phase gratings

Special manufacturing processes make it possible to produce three-dimensional graduation structures, possessing certain optical characteristics. The structure widths are in the range of a few microns down to quarters of a micron.

### SUPRADUR

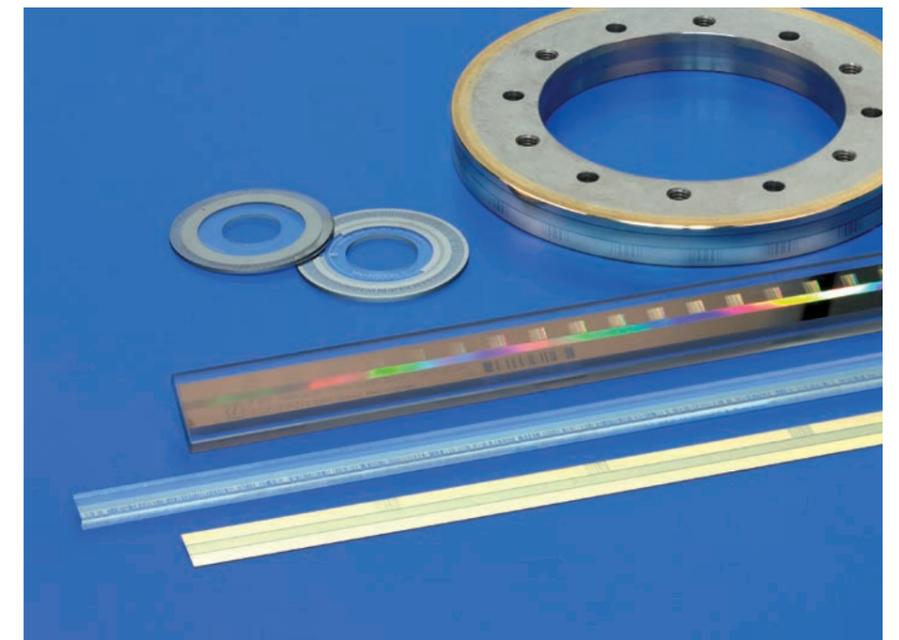
Graduations manufactured with the SUPRADUR process function optically like three-dimensional phase gratings, but they have a planar structure and are therefore particularly insensitive to contamination.

### 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

## Sealed linear encoders

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

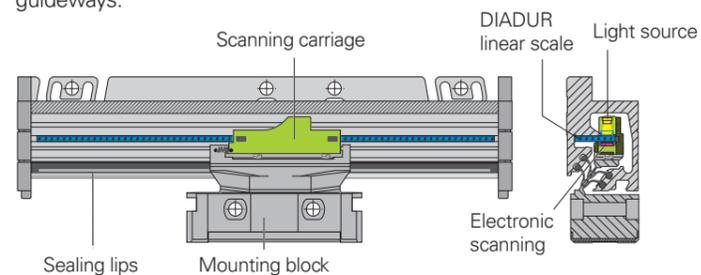
- Accuracy grades as fine as  $\pm 2 \mu\text{m}$
- Measuring steps of down to  $0.001 \mu\text{m}$
- Measuring lengths of up to 30 m (72 m upon request)
- Fast and simple installation
- Large mounting tolerances
- High acceleration loading
- Protection against contamination



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 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  $\pm 0.5 \mu\text{m}$  and better
- For measuring steps of down to  $0.001 \mu\text{m}$  (1 nm)
- Measuring lengths of up to 30 m
- No friction between scanning head and scale
- Small dimensions and low mass
- High traversing speeds



## 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  $\pm 0.1 \mu\text{m}$
- For measuring steps of down to  $0.005 \mu\text{m}$  (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

### 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

Series	Page
LC 100	8
LC 200	
LS 100	
LF 100	
LS 600	
LB 300	

### With slimline scale housing

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

Series	Page
LC 400	10
LS 400	
LF 400	
LS 300	

## Exposed linear encoders

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

Series	Page
LIP	12
LIF, PP	13
LIDA	14
LIC	

## Length gauges

For measuring stations and multipoint inspection apparatuses

Series	Page
AT, CT, MT, ST	16

# 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

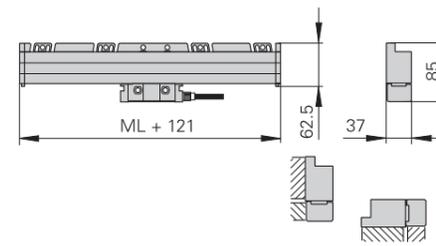
- Incremental position measurement
- Very high repeatability
- Thermal behavior similar to steel or cast iron
- High vibration rating
- Two mounting attitudes
- Single-field scanning

#### LB 382

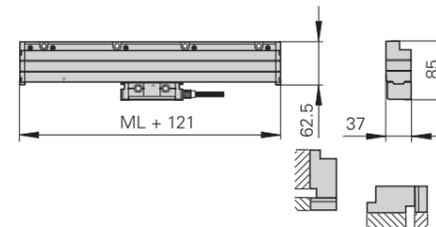
- Incremental position measurement
- For large measuring lengths of up to 30 m<sup>4)</sup>
- Defined thermal behavior
- High vibration resistance
- Two mounting attitudes
- Single-field scanning

#### LS 600 series

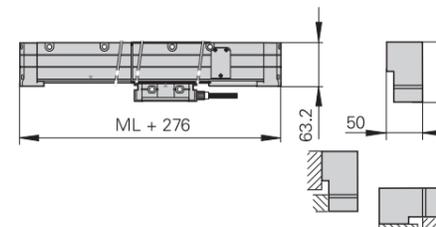
- Incremental position measurement
- Typically for manual machines
- Simple mounting



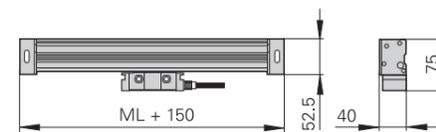
LC 100



LF 185



LC 200



LS 600

	<b>Absolute</b> LC 115 <sup>1)</sup> /LC 185 LC 195 F/M/P/S <sup>1)</sup>	LC 211/LC 281 LC 291 F/M	<b>Incremental</b> LF 185	LS 187 LS 177	LS 688C LS 628C	LB 382
<b>Measuring standard</b>	DIADUR glass scale	METALLUR steel scale tape	SUPRADUR phase grating on steel	DIADUR glass scale	DIADUR glass scale	METALLUR steel scale tape
Grating period	20 µm	40 µm	8 µm	20 µm	20 µm	40 µm
<b>Interface</b>	LC 115: EnDat 2.2 LC 185: EnDat 2.2 with ~ 1 V <sub>PP</sub> LC 195: Fanuc αi/Mitsubishi/ Panasonic/ DRIVE-CLiQ	LC 211: EnDat 2.2 LC 281: EnDat 2.2 with ~ 1 V <sub>PP</sub> LC 291: Fanuc αi/Mitsubishi	~ 1 V <sub>PP</sub>	LS 187: ~ 1 V <sub>PP</sub> LS 177: □TTL <sup>2)</sup>	LS 688C: ~ 1 V <sub>PP</sub> LS 628C: □TTL	~ 1 V <sub>PP</sub>
Signal period	LC 185: 20 µm	LC 281: 40 µm	4 µm	LS 187: 20 µm	LS 688C: 20 µm	40 µm
<b>Accuracy grade</b>	±5 µm, ±3 µm <sup>3)</sup>	±5 µm	±3 µm, ±2 µm	±5 µm, ±3 µm	±10 µm	±5 µm
<b>Measuring lengths ML</b>	Up to 4240 mm	Up to 28 040 mm <sup>5)</sup>	Up to 3040 mm	Up to 3040 mm		Up to 30 040 mm <sup>4)</sup>
<b>Reference mark</b>	–		One or distance-coded; <b>LS 6xx C</b> : distance-coded			

<sup>1)</sup> Also available with functional safety  
<sup>2)</sup> 5/10/20-fold integrated interpolation

<sup>3)</sup> Up to ML 3040 mm  
<sup>4)</sup> Up to ML 72 040 mm upon request

<sup>5)</sup> Larger measuring lengths with TNC 640 upon request

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# 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**.

### Absolute position measurement

#### LC 400 series

- Absolute position measurement
- Defined thermal behavior
- Single-field scanning

### Incremental position measurement

#### LS 400 series

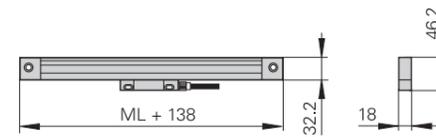
- Incremental position measurement
- Defined thermal behavior
- Single-field scanning

#### LF 485

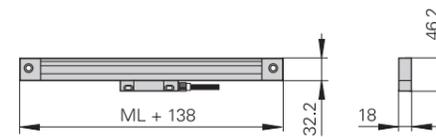
- Incremental position measurement
- Very high repeatability
- Thermal behavior similar to steel or cast iron
- Single-field scanning

#### LS 300 series

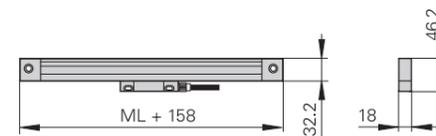
- Incremental position measurement
- Typically for manual machines



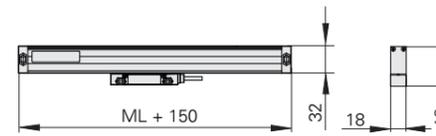
LC 400



LS 400



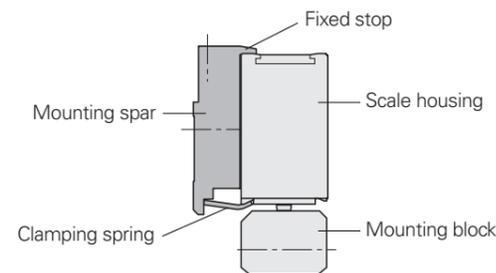
LF 485



LS 300

### 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.



	<b>Absolute</b> LC 415 <sup>1)</sup> /LC 485 LC 495 F/M/P/S <sup>1)</sup>	<b>Incremental</b> LF 485	LS 487 LS 477	LS 388C LS 328C	LS 383C LS 373C
<b>Measuring standard</b>	DIADUR glass scale	SUPRADUR phase grating on steel	DIADUR glass scale	DIADUR glass scale	Glass scale
Grating period	20 µm	8 µm	20 µm	20 µm	20 µm
<b>Interface</b>	LC 415: EnDat 2.2 LC 485: EnDat 2.2 with ~ 1 V <sub>PP</sub> LC 495: Fanuc αi/ Mitsubishi/ Panasonic/ DRIVE-CLiQ	~ 1 V <sub>PP</sub>	LS 487: ~ 1 V <sub>PP</sub> LS 477: □TTL <sup>2)</sup>	LS 388C: ~ 1 V <sub>PP</sub> LS 328C: □TTL	LS 383C: ~ 1 V <sub>PP</sub> LS 373C: □TTL
Signal period	LC 485: 20 µm	4 µm	LS 487: 20 µm	LS 388C: 20 µm	20 µm
<b>Accuracy grade</b>	±5 µm, ±3 µm	±5 µm, ±3 µm		±10 µm	±5 µm
<b>Measuring lengths ML</b>	Up to 2040 mm <sup>3)</sup>	Up to 1220 mm	Up to 2040 mm <sup>3)</sup>	Up to 1240 mm	
<b>Reference mark</b>	–	One or distance-coded		Distance-coded	One or distance-coded

<sup>1)</sup> Also available with functional safety

<sup>2)</sup> 5/10/20-fold integrated interpolation

<sup>3)</sup> Over ML 1240 mm with mounting spar or clamping elements

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# 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

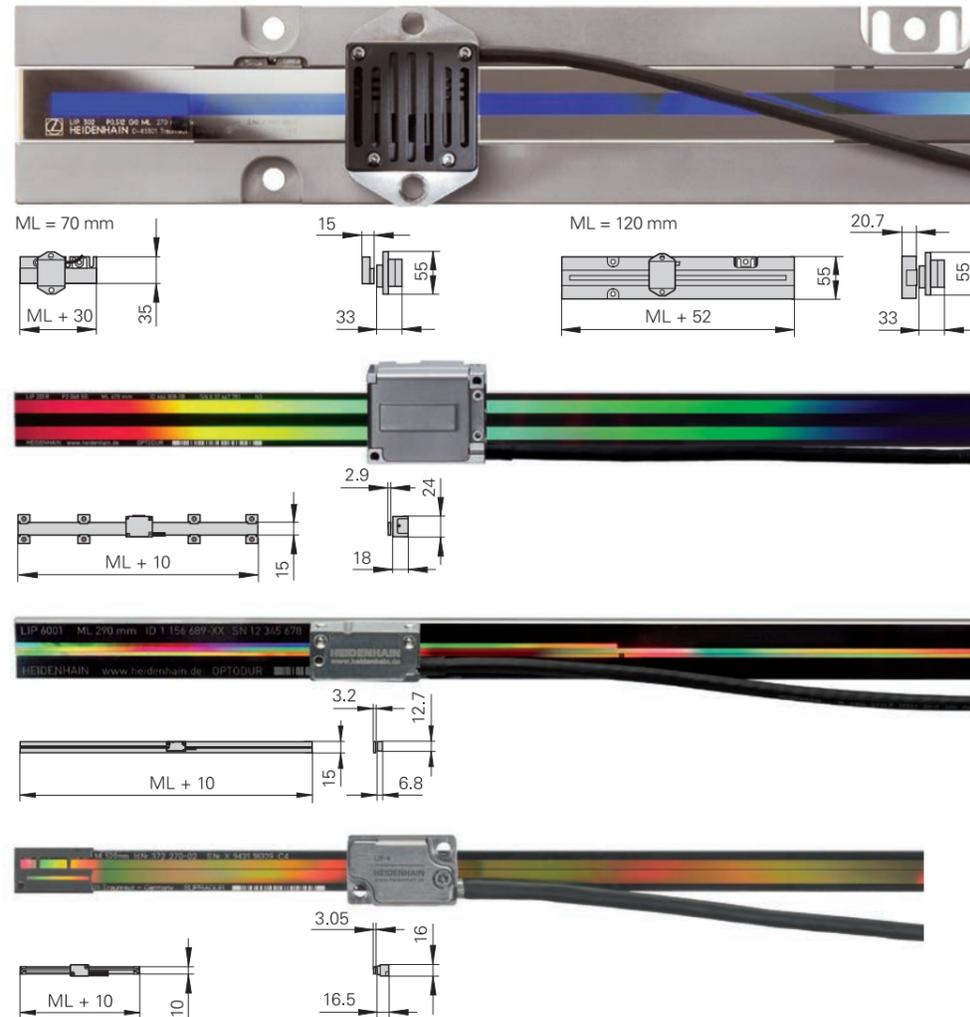
- Very high repeatability with compact dimensions
- Measuring lengths of up to 3040 mm
- Measuring steps of down to < 1 nm
- Defined thermal behavior thanks to a measuring standard on Zerodur glass ceramic scale

### 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



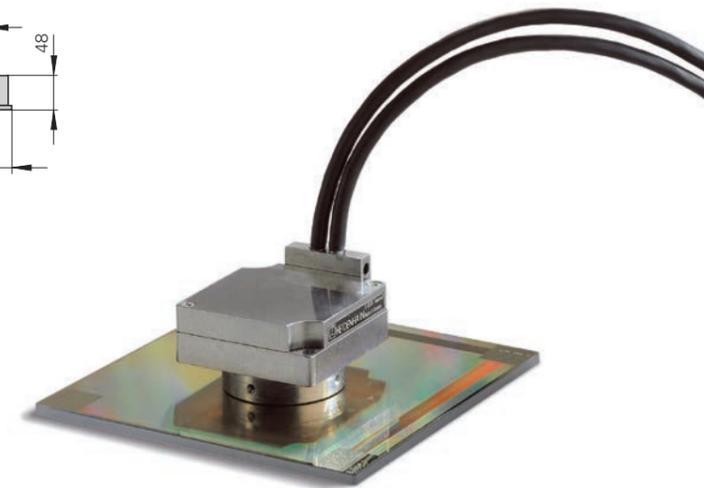
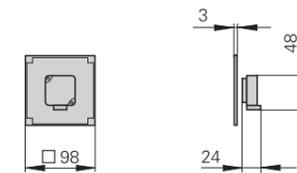
# PP exposed linear encoders

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



	<b>Incremental LIP 382</b>	<b>LIP 281 LIP 211</b>	<b>LIP 6081 LIP 6071</b>	<b>LIF 481 LIF 471</b>
<b>Measuring standard</b>	DIADUR phase grating on Zerodur glass ceramic	OPTODUR phase grating on Zerodur glass ceramic	OPTODUR phase grating on glass or Zerodur glass ceramic	SUPRADUR phase grating on glass or Zerodur glass ceramic
Grating period	0.512 μm	2.048 μm	8 μm	8 μm
<b>Interface</b>	~ 1 V <sub>PP</sub>	LIP 281: ~ 1 V <sub>PP</sub> LIP 211: EnDat 2.2 <sup>1)</sup>	LIP 6081: ~ 1 V <sub>PP</sub> LIP 6071: TTL	LIF 481: ~ 1 V <sub>PP</sub> LIF 471: TTL
Signal period	0.128 μm	LIP 281: 0.512 μm	LIP 6081: 4 μm	LIF 481: 4 μm
<b>Accuracy grade</b>	±0.5 μm	±1 μm    ±3 μm	±1 μm (only for Zerodur)    ±3 μm	±1 μm (only for Zerodur)    ±3 μm
<b>Baseline error</b>	≤ ±0.075 μm/5 mm	≤ ±0.125 μm/5 mm	≤ ±0.175 μm/5 mm	≤ ±0.225 μm/5 mm
<b>Interpolation error<sup>2)</sup></b>	±0.01 nm	±0.4 nm	±4 nm	±12 nm
<b>Measuring lengths ML</b>	70 mm to 270 mm	20 mm to 1020 mm    370 mm to 3040 mm	20 mm to 1020 mm    20 mm to 3040 mm	70 mm to 1020 mm    70 mm to 1640 mm
<b>Reference mark</b>	None	One	One	One

<sup>1)</sup> Absolute position value after scanning the reference mark

<sup>2)</sup> Only with encoders with 1 V<sub>PP</sub> or EnDat 2.2 interface

	<b>Incremental PP 281</b>
<b>Measuring standard</b>	DIADUR phase grating on glass
Grating period	8 μm
<b>Interface</b>	~ 1 V <sub>PP</sub>
Signal period	4 μm
<b>Accuracy grade</b>	±2 μm
<b>Interpolation error</b>	±12 nm
<b>Measuring range</b>	68 mm x 68 mm, other measuring ranges upon request
<b>Reference mark</b>	One per coordinate

# LIC, LIDA exposed linear encoders

For high accuracy and large measuring lengths

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 LIC 4193V 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

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

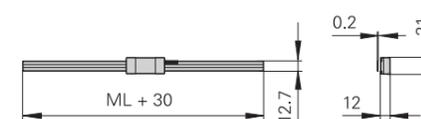
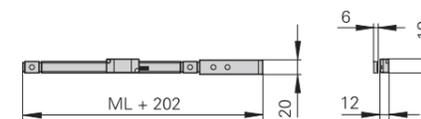
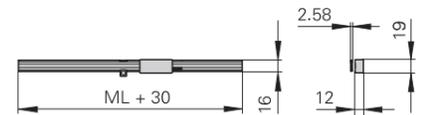
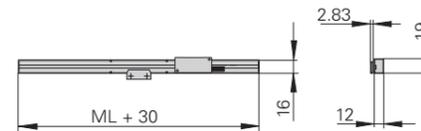
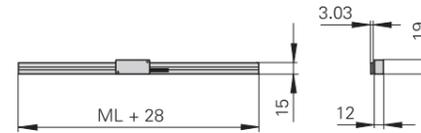
## Incremental position measurement

### 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



LIC 4113



LIC 3100



LIC 2117



LIDA 485



LIDA 279

	<b>Absolute</b> LIC 4113 LIC 4193	LIC 4115 LIC 4195	LIC 4117 LIC 4197	LIC 4119 <sup>1)</sup> LIC 4199	LIC 3117 LIC 3197	LIC 3119 LIC 3199	LIC 2117 LIC 2197	LIC 2119 LIC 2199	<b>Incremental</b> LIDA 483 LIDA 473	LIDA 485 LIDA 475	LIDA 487 LIDA 477	LIDA 489 LIDA 479	LIDA 287 LIDA 277	LIDA 289 LIDA 279
<b>Measuring standard</b>	METALLUR graduation on glass ceramic or glass 40 µm	METALLUR steel scale tape 40 µm			Steel scale tape with absolute track and incremental track 80 µm		Steel scale tape 220 µm		METALLUR graduation on glass ceramic or glass 20 µm	METALLUR steel scale tape 20 µm			Steel scale tape 200 µm	
<b>Interface</b>	LIC 411x: EnDat 2.2 LIC 419x: Fanuc $\alpha$ i/ Mitsubishi/ Panasonic/Yaskawa				LIC 311x: EnDat 2.2 LIC 319x: Fanuc $\alpha$ i/ Mitsubishi/ Panasonic/Yaskawa		LIC 211x: EnDat 2.2 LIC 219x: Fanuc $\alpha$ i/ Mitsubishi/ Panasonic/Yaskawa		LIDA 48x: $\sim 1 V_{PP}$ LIDA 47x: $\square$ TTL <sup>2)</sup>				LIDA 28x: $\sim 1 V_{PP}$ LIDA 27x: $\square$ TTL <sup>2)</sup>	
<b>Signal period</b>	–				–		–		LIDA 48x: 20 µm				LIDA 28x: 200 µm	
<b>Accuracy grade</b>	$\pm 3 \mu\text{m}$ ; $\pm 5 \mu\text{m}$	$\pm 5 \mu\text{m}$	$\pm 3 \mu\text{m}$ <sup>3)</sup> ; $\pm 5 \mu\text{m}$ <sup>3)</sup> ; $\pm 15 \mu\text{m}$	$\pm 3 \mu\text{m}$ ; $\pm 15 \mu\text{m}$	$\pm 15 \mu\text{m}$ <sup>6)</sup>		$\pm 15 \mu\text{m}$		$\pm 1 \mu\text{m}$ <sup>4)</sup> ; $\pm 3 \mu\text{m}$ ; $\pm 5 \mu\text{m}$	$\pm 5 \mu\text{m}$	$\pm 3 \mu\text{m}$ <sup>3)</sup> ; $\pm 5 \mu\text{m}$ <sup>3)</sup> ; $\pm 15 \mu\text{m}$	$\pm 3 \mu\text{m}$ ; $\pm 15 \mu\text{m}$	$\pm 15 \mu\text{m}$	
<b>Baseline error</b>	$\leq \pm 0.275 \mu\text{m}/10 \text{ mm}$	$\leq \pm 0.750 \mu\text{m}/50 \text{ mm}$			$\leq \pm 0.750 \mu\text{m}/50 \text{ mm}$ (typical)		–		$\leq \pm 0.275 \mu\text{m}/10 \text{ mm}$	$\leq \pm 0.750 \mu\text{m}/50 \text{ mm}$ (typical)			–	
<b>Interpolation error</b> <sup>5)</sup>	$\pm 20 \text{ nm}$	$\pm 20 \text{ nm}$			$\pm 100 \text{ nm}$		$\pm 2 \mu\text{m}$		$\pm 45 \text{ nm}$	$\pm 45 \text{ nm}$			$\pm 2 \mu\text{m}$	
<b>Measuring lengths ML</b>	240 mm to 3040 mm	140 mm to 28440 mm	240 mm to 6040 mm	70 mm to 1020 mm	Scale tape from the roll 3 m/5 m/10 m		120 mm to 3020 mm (longer measuring lengths upon request)		240 mm to 3040 mm	140 mm to 30040 mm	240 mm to 6040 mm		Scale tape from the roll 3 m/5 m/10 m	
<b>Reference mark</b>	–				–		–		One or distance-coded	One			Selectable every 100 mm	

<sup>1)</sup> Also available with functional safety

<sup>2)</sup> Up to 100-fold integrated interpolation ( LIDA 47x also 5-fold)

<sup>3)</sup> Up to measuring length of 1020 mm or 1040 mm

<sup>4)</sup> Only for Robax glass ceramic up to ML 1640 mm

<sup>5)</sup> Only with encoders with 1 V<sub>PP</sub> or EnDat 2.2 interface

<sup>6)</sup>  $\pm 5 \mu\text{m}$  after linear length-error compensation in the subsequent electronics

# AT, CT, MT, ST length gauges

For measuring stations and multipoint inspection apparatuses

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.

## 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

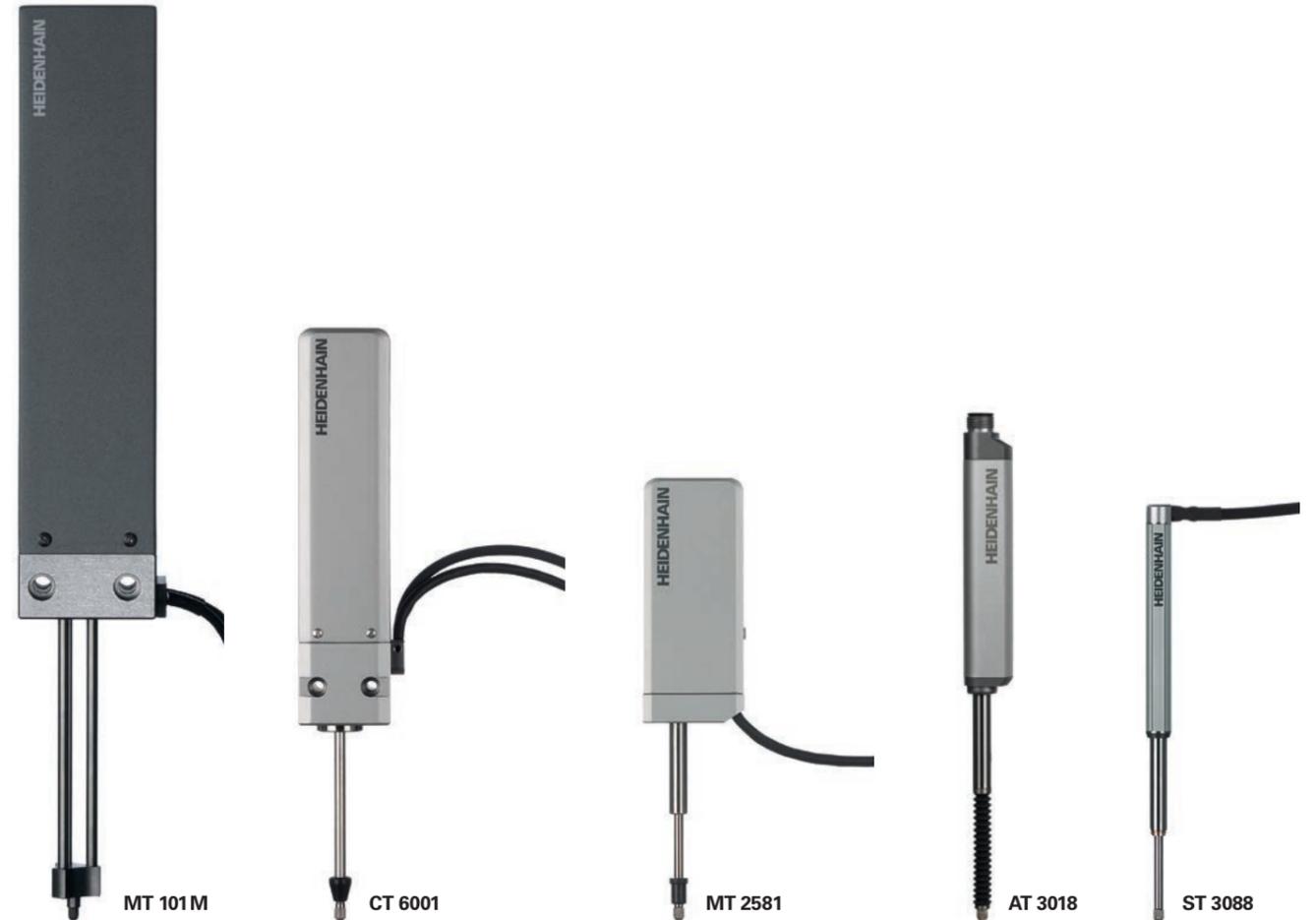
- MT 1200 and MT 2500
- High repeatability
  - Various gauging force variants
  - Various possibilities for plunger actuation

## HEIDENHAIN-METRO

- 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



	<i>Absolute</i> AT 1218 AT 1217	AT 3018 AT 3017	<i>Incremental</i> CT 2501 CT 2502	CT 6001 CT 6002	MT 1281 MT 1287	MT 1271	MT 2581 MT 2587	MT 2571	MT 60M MT 60K	MT 101 M MT 101 K	ST 1288 ST 1287	ST 1278 ST 1277	ST 3088 ST 3087	ST 3078 ST 3077
<b>Measuring standard</b>	DIADUR glass scale		DIADUR phase grating on Zerodur glass ceramic Coefficient of linear expansion: $\alpha_{\text{therm}} = (0 \pm 0.1) \cdot 10^{-6} \text{ K}^{-1}$				DIADUR graduation on glass ceramic		DIADUR glass scale					
Grating period	188.4 $\mu\text{m}$		4 $\mu\text{m}$		4 $\mu\text{m}$		10 $\mu\text{m}$		20 $\mu\text{m}$					
<b>Interface</b>	EnDat 2.2		$\sim 11 \mu\text{A}_{\text{PP}}$		$\sim 1 \text{V}_{\text{PP}}$		$\sim 1 \text{V}_{\text{PP}}$		$\sim 11 \mu\text{A}_{\text{PP}}$		$\sim 1 \text{V}_{\text{PP}}$		$\sim 1 \text{V}_{\text{PP}}$	
Signal period	-		2 $\mu\text{m}$		-		2 $\mu\text{m}$		10 $\mu\text{m}$		20 $\mu\text{m}$		20 $\mu\text{m}$	
<b>System accuracy</b>	$\pm 1 \mu\text{m}$	$\pm 2 \mu\text{m}$	$\pm 0.1 \mu\text{m}^1$ $\pm 0.03 \mu\text{m}^2$	$\pm 0.1 \mu\text{m}^1$ $\pm 0.05 \mu\text{m}^2$	$\pm 0.2 \mu\text{m}$		$\pm 0.5 \mu\text{m}$		$\pm 1 \mu\text{m}$		$\pm 1 \mu\text{m}$		$\pm 1 \mu\text{m}$	
<b>Repeatability</b>	0.4 $\mu\text{m}$	0.8 $\mu\text{m}$	0.02 $\mu\text{m}$		0.03 $\mu\text{m}$		0.09 $\mu\text{m}$		0.06 $\mu\text{m}$	0.04 $\mu\text{m}$	0.25 $\mu\text{m}$		0.7 $\mu\text{m}$	
<b>Measuring range</b>	12 mm	30 mm	25 mm	60 mm	12 mm		25 mm		60 mm	100 mm	12 mm		30 mm	
<b>Plunger actuation</b>	AT xx18: by measured object AT xx17: pneumatic		CT xx01: with motor CT xx02: by coupling		MT xxx1: cable-type lifter or free MT xx87: pneumatic		MT xxM: with motor MT xxK: by coupling		ST xxx8: by measured object ST xxx7: pneumatic					

<sup>1)</sup> At 19 °C to 21 °C; permissible temperature fluctuation during measurement:  $\pm 0.1 \text{ K}$

<sup>2)</sup> With linear length-error compensation in the evaluation electronics

<sup>3)</sup> 5/10-fold integrated interpolation

## 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 180000
- Accuracy: from  $\pm 5''$  to  $\pm 0.4''$
- Measuring steps: as fine as  $0.000\ 01^\circ$  or  $0.036''$  (incremental) or 29 bits, i.e. approx. 536 million positions per revolution (absolute)



## 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 16 to 5000
- Accuracy grades: to  $\pm 10''$  (depending on the line count, corresponding to  $\pm 1/20$  of the grating period)
- Measuring steps: as fine as  $0.000\ 01^\circ$ . Particularly for photoelectric rotary encoders, the high quality of the sinusoidal incremental signals permits high interpolation factors for digital speed control.

## 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 **multiturn 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.

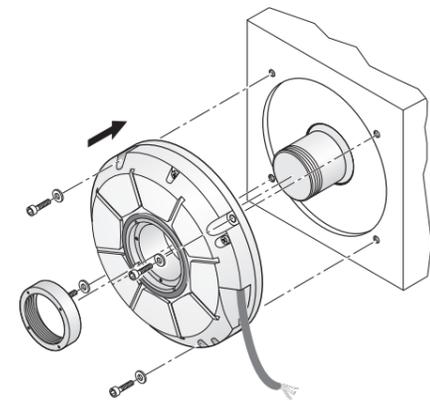
Under the designation **functional safety**, HEIDENHAIN offers encoders with purely serial data transmission as single-encoder systems for safety-related machines and systems. The two measured values are already formed independently of each other in the encoder, and are transmitted to the safe control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

Sealed angle encoders		Series	Page
With integral bearing and integrated stator coupling	Absolute (singleturn)/Incremental	RCN, RON, RPN	20
With integral bearing	Absolute (singleturn)/Incremental	ROC, ROD, RON	22
Angle encoder modules	With precision bearings	MRP, SRP	24
Modular angle encoders			
Without integral bearing, with optical scanning	Absolute (singleturn)/Incremental	ECA, ERA, ERO, ERP	26
Without integral bearing, with magnetic scanning	Absolute (singleturn)/Incremental	ECM, ERM	32
Rotary encoders			
With integral bearing, for mounting by stator coupling	Absolute (singleturn/multiturn) Incremental	ECN, EQN ERN	34
With integral bearing, for separate shaft coupling	Absolute (singleturn/multiturn) Incremental	ROC, ROQ ROD	38
Without integral bearing	Absolute (singleturn/multiturn) Incremental	ECI, EQI, EBI ERO	40

# 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:  $\pm 2''$  and  $\pm 1''$
- Typically used on rotary and angle measuring tables, indexing heads, measuring setups, image scanners, etc.



**RCN 8001**  
D = 60 mm or 100 mm  
**RON 786/886, RPN 886**  
D = 60 mm

### RCN 6000 series

- Very large hollow shaft
- System accuracy:  $\pm 2''$
- 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  $\pm 2''$  and  $\pm 4''$  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

	<b>Absolute</b> RCN 2511 <sup>1)</sup> RCN 2311 <sup>1)</sup>	RCN 2581 RCN 2381	RCN 2591 F RCN 2391 F	RCN 2591 M RCN 2391 M	<b>Incremental</b> RON 225 RON 275	RON 285 RON 287
<b>Interface</b>	EnDat 2.2		Fanuc $\alpha$ i	Mitsubishi	$\square$ TTL	$\sim$ 1 V <sub>pp</sub>
Position values/revolution	RCN 25x1: 268 435 456 (28 bits); RCN 23x1: 67 108 864 (26 bits)				-	
Signal periods/revolution	16384				18000 <sup>2)</sup> 90 000/180 000 <sup>3)</sup>	18000
<b>System accuracy</b>	RCN 25x1: $\pm 2''$ ; RCN 23x1: $\pm 4''$				$\pm 5''$	$\pm 5''$ ; $\pm 2.5''$
<b>Mech. permissible speed</b> <sup>4)</sup>	$\leq 3000$ rpm	$\leq 1500$ rpm	$\leq 3000$ rpm		$\leq 3000$ rpm	

	<b>Absolute</b> RCN 5511 <sup>1)</sup> RCN 5311 <sup>1)</sup>	RCN 5581 RCN 5381	RCN 5591 F RCN 5391 F	RCN 5591 M RCN 5391 M	
<b>Interface</b>	EnDat 2.2			Fanuc $\alpha$ i	Mitsubishi
Position values/revolution	RCN 55x1: 268 435 456 (28 bits); RCN 53x1: 67 108 864 (26 bits)				
Signal periods/revolution	16384				
<b>System accuracy</b>	RCN 55x1: $\pm 2''$ ; RCN 53x1: $\pm 4''$				
<b>Mech. permissible speed</b> <sup>4)</sup>	$\leq 2000$ rpm	$\leq 1500$ rpm (operating temperature $\leq 50$ °C) $\leq 1200$ rpm (operating temperature $> 50$ °C)	$\leq 2000$ rpm		

	<b>Absolute</b> RCN 8511 <sup>1)</sup> RCN 8311 <sup>1)</sup>	RCN 8581 RCN 8381	RCN 8591 F RCN 8391 F	RCN 8591 M RCN 8391 M	<b>Incremental</b> RON 786 RON 886	RPN 886
<b>Interface</b>	EnDat 2.2		Fanuc $\alpha$ i	Mitsubishi	$\sim$ 1 V <sub>pp</sub>	
Position values/revolution	536 870 912 (29 bits)				-	
Signal periods/revolution	32 768				18000, 36000	180000
<b>System accuracy</b>	RCN 85x1: $\pm 1''$ ; RCN 83x1: $\pm 2''$				$\pm 2''$	$\pm 1''$
<b>Mech. permissible speed</b> <sup>4)</sup>	$\leq 1500$ rpm <sup>5)</sup>	$\leq 750$ rpm	$\leq 1500$ rpm <sup>5)</sup>		$\leq 1000$ rpm	

	<b>Absolute</b> RCN 6310 <sup>1)</sup>	RCN 6390 F	RCN 6390 M
<b>Interface</b>	EnDat 2.2	Fanuc Serial Interface $\alpha$ i interface	Mitsubishi high speed interface
Position values/revolution	268 435 456 (28 bits)		
<b>System accuracy</b>	$\pm 2.0''$		
<b>Mech. permissible speed</b>	$\leq 200$ rpm <sup>6)</sup>		

1) Also available with functional safety  
2) Integrated 2-fold interpolation  
3) 5/10-fold integrated interpolation

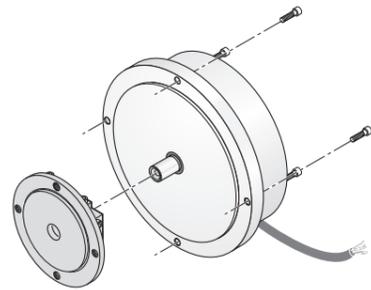
4) See *Speeds* in the *Angle Encoders with Integral Bearing* brochure  
5) For 60 mm hollow shaft diameter;  
for 100 mm hollow shaft diameter:  $\leq 1200$  rpm  
6) Higher speeds possible depending on the operating temperature

# ROC, ROD, RON sealed angle encoders

## With integral bearing

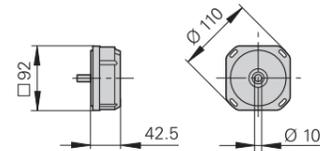
ROC and ROD angle encoders with solid shaft for separate shaft coupling are particularly suited to applications where higher shaft speeds and larger mounting tolerances are required. The precision shaft couplings allow up to  $\pm 1$  mm of axial motion.

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.



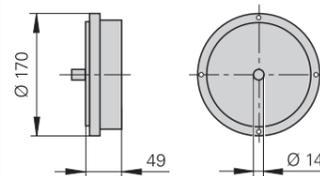
### For separate shaft coupling ROC 2000 and ROD 200

- Compact dimensions
- Sturdy design
- Typically used with rotary tables, tilting tables, for positioning and synchronization monitoring

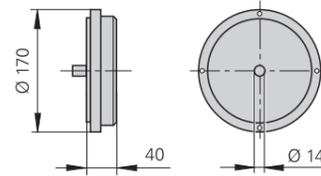


### For separate shaft coupling ROC 7000, ROD 780, and ROD 880

- High accuracy  
ROC 7000, ROD 780:  $\pm 2''$   
ROD 880:  $\pm 1''$
- Ideal for angle measurement on high-precision rotary tables, indexing heads, or measuring machines



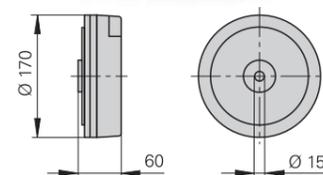
ROD 780, ROD 880



ROC 7000

### For highly accurate applications RON 905

- Very high system accuracy of  $\pm 0.4''$
- Used with high-accuracy measuring devices and for the inspection of measuring equipment



	Absolute				Incremental		
	ROC 2310	ROC 2380	ROC 2390F	ROC 2390M	ROD 220	ROD 270	ROD 280
<b>Interface</b>	EnDat 2.2 <sup>4)</sup>	EnDat 2.2 <sup>4)</sup> $\sim 1 V_{PP}$	Fanuc $\alpha i$	Mitsubishi	$\square$ TTL	$\square$ TTL	$\sim 1 V_{PP}$
Signal periods/revolution	16384				18000 <sup>2)</sup>	180000 <sup>3)</sup>	18000
<b>System accuracy</b> <sup>1)</sup>	$\pm 5''$						
<b>Mech. permissible speed</b>	$\leq 3000$ rpm				$\leq 10000$ rpm		

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

	Absolute				Incremental	
	ROC 7310	ROC 7380	ROC 7390F	ROC 7390M	ROD 780	ROD 880
<b>Interface</b>	EnDat 2.2 <sup>2)</sup>	EnDat 2.2 <sup>2)</sup> $\sim 1 V_{PP}$	Fanuc $\alpha i$	Mitsubishi	$\sim 1 V_{PP}$	
Signal periods/revolution	16384				18000, 36000	36000
<b>System accuracy</b> <sup>1)</sup>	$\pm 2''$				$\pm 2''$	$\pm 1''$
<b>Mech. permissible speed</b>	$\leq 3000$ rpm				$\leq 1000$ rpm	

- 1) Without shaft coupling  
 2) DRIVE-CLiQ via EIB; PROFIBUS via Gateway

	Incremental
	RON 905
<b>Interface</b>	$\sim 11 \mu A_{PP}$
Signal periods/revolution	36000
<b>System accuracy</b>	$\pm 0.4''$
<b>Mech. permissible speed</b>	$\leq 100$ rpm

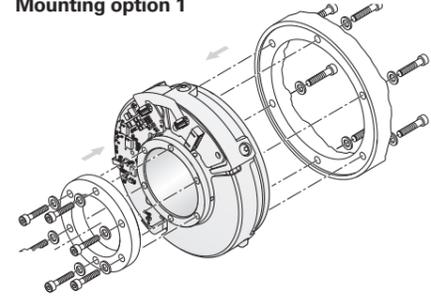
# MRP, SRP angle encoder modules

## Assemblies for high-precision rotary axes

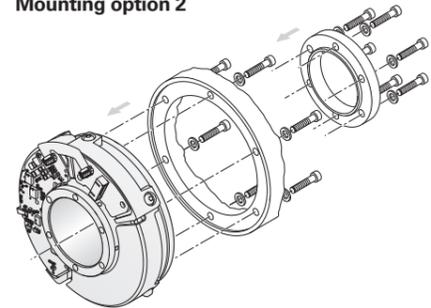
### MRP angle encoder module: combination of angle encoder and bearing

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.

#### Mounting option 1



#### Mounting option 2



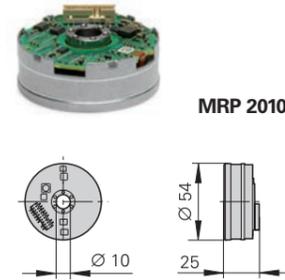
### SRP angle encoder module: combination of angle encoder, bearing and motor

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.

### MRP 2000 series

Angle encoder modules with integrated encoder and bearing

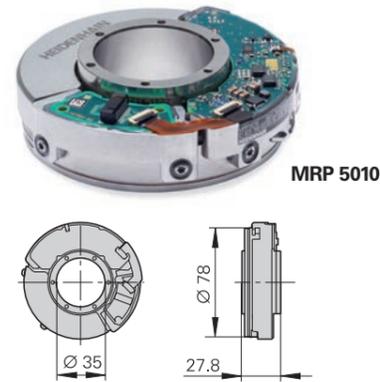
- Particularly compact dimensions
- High measuring and bearing accuracy
- Hollow shaft diameter: 10 mm



### MRP 5000 series

Angle encoder modules with integrated encoder and bearing

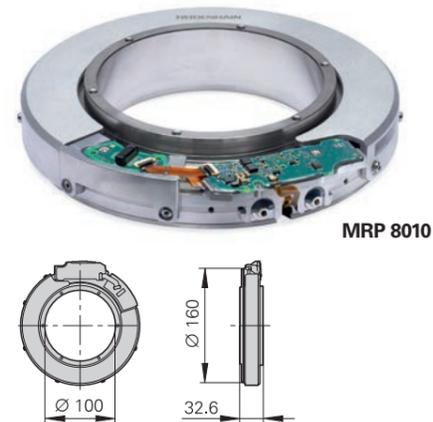
- Compact dimensions
- High measuring and bearing accuracy
- Hollow shaft diameter: 35 mm



### MRP 8000 / MRP 8100 series

Angle encoder modules with integrated encoder and bearing

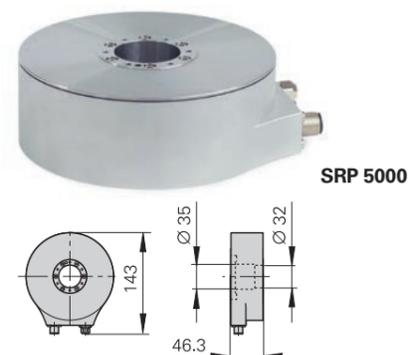
- Compact dimensions
- High measuring and bearing accuracy
- **MRP 8000:** 100 mm hollow shaft Ø
- **MRP 8100:** 80 mm hollow shaft Ø
- **MRP 8100:** axial load of up to 1500 N



### 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



	Incremental MRP 2080	Absolute MRP 2010
<b>Interface</b>	~ 1 V <sub>PP</sub>	EnDat 2.2
Signal periods/revolution	2048	
<b>System accuracy</b>	±7"	
Maximum permissible axial load	50 N (centered load, purely static, without additional vibrations or shock loading)	
Radial guideway accuracy	Measured at distance h = 52 mm from the ball race: ≤ 0.60 µm	
Wobble of the axis	2.5"	

	Incremental MRP 5080	Absolute MRP 5010
<b>Interface</b>	~ 1 V <sub>PP</sub>	EnDat 2.2
Signal periods/revolution	30000	16384
<b>System accuracy</b>	±2.5" or ±5"	
Maximum permissible axial load	200 N (centered load, purely static, without additional vibrations or shock loading)	
Radial guideway accuracy	Measured at distance h = 55 mm: ≤ 0.20 µm (without load)	
Wobble of the axis	0.7"	

	Incremental MRP 8080	MRP 8180	Absolute MRP 8010	MRP 8110
<b>Interface</b>	~ 1 V <sub>PP</sub>		EnDat 2.2	
Signal periods/revolution	63000		32768	
<b>System accuracy</b>	±1" or ±2"			
Maximum permissible axial load	300 N	1500 N	300 N	1500 N
Radial guideway accuracy	≤ 0.15 µm	≤ 0.25 µm	≤ 0.15 µm	≤ 0.25 µm
Wobble of the axis	0.5"	0.7"	0.5"	0.7"

	Incremental SRP 5080	Absolute SRP 5010
<b>Interface</b>	~ 1 V <sub>PP</sub>	EnDat 2.2
Signal periods/revolution	30000	16384
<b>System accuracy</b>	±2.5" or ±5"	
Maximum permissible axial load	200 N (centered load, purely static, without additional vibrations or shock loading)	
Radial guideway accuracy	Measured at distance h = 55 mm: ≤ 0.20 µm (without load)	
Wobble of the axis	0.7"	

# 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.

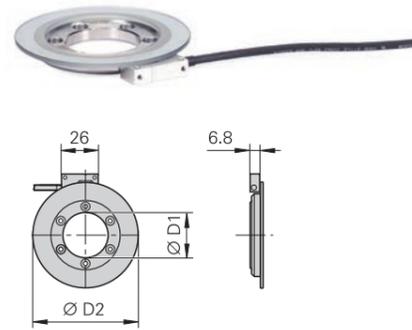
The attainable system accuracy depends on the eccentricity of the graduation to the drive shaft bearing, as well as the radial runout and wobble of the bearing.

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.

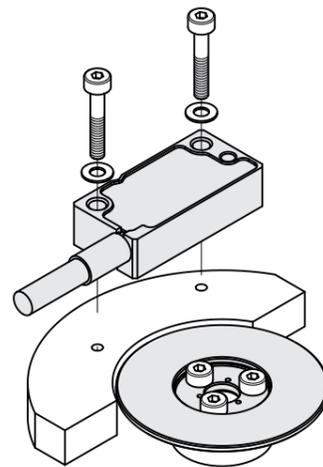
## ERP 1000 series

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

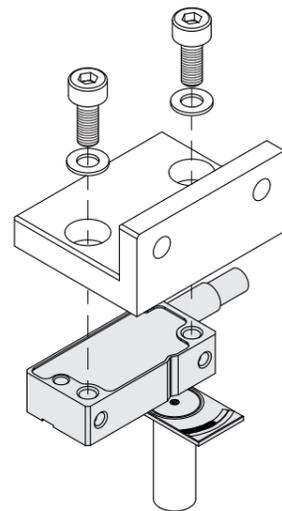


## ERO 2000 series

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



TKN ERO 2000 (full circle)



TKN ERO 2002 (segment)

	<b>Incremental</b> <b>ERP 1070</b> <b>ERP 1080</b> <b>ERP 1010</b>			
<b>Interface</b>	ERP 1070: □ TTL; ERP 1080: ~ 1 V <sub>PP</sub> ; ERP 1010: EnDat 2.2			
Signal periods/revolution	23000	30000	50000	63000
<b>Accuracy of graduation</b>	±4"	±3"	±1.8"	±1.5"; ±0.9"
<b>Inside diameter D1</b>	13 mm	32 mm	62 mm	104 mm
<b>Outside diameter D2</b>	57 mm	75 mm	109 mm	151 mm
<b>Mech. permissible speed</b>	≤ 2600 rpm	≤ 2000 rpm	≤ 1200 rpm	≤ 950 rpm

	<b>Incremental</b> <b>ERO 2080</b>
<b>Interface</b>	~ 1 V <sub>PP</sub>
Signal periods/revolution	4096
<b>Accuracy of graduation</b>	±8"
<b>Inside diameter D1</b>	5 mm
<b>Outside diameter D2</b>	30 mm
<b>Mech. permissible speed</b>	≤ 14000 rpm

# ECA, ERA modular angle encoders

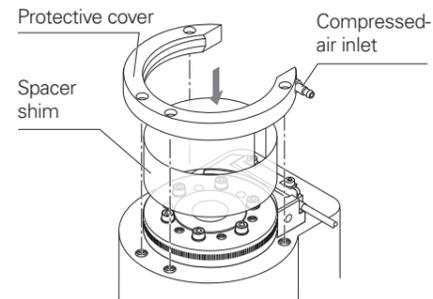
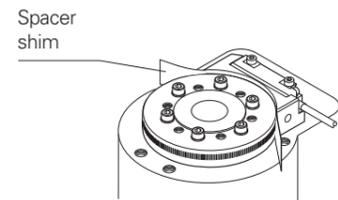
Without integral bearing, with optical scanning

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.

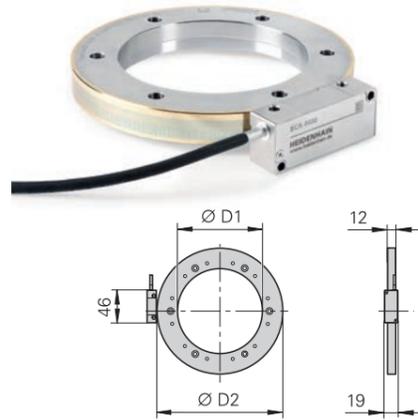
The ECA 4000 V angle encoders are suitable for vacuum applications in high vacuum (down to  $10^{-7}$  bar).



**ERA 4000**  
With protective cover

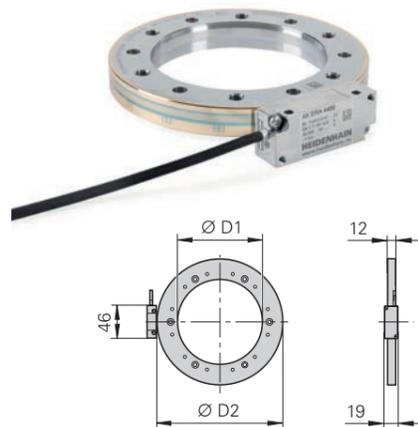
## ECA 4000 series

- High accuracy
- Sturdy design with steel scale drum and METALLUR graduation
- Various drum versions  
*ECA 4xx0*: with centering collar  
*ECA 4xx2*: with 3-point centering



## ERA 4000 series

- High shaft speeds of up to 20000 rpm
- Sturdy design with steel scale drum and METALLUR graduation
- Axial motion of measured shaft permissible up to  $\pm 0.5$  mm
- The ERA 4480C 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



	<b>Absolute</b> <b>ECA 4410</b> <sup>1)</sup> <b>ECA 4490F</b> <b>ECA 4490M</b> <b>ECA 4490P</b> <b>ECA 4490Y</b>								
<b>Interface</b>	<i>ECA 4410</i> : EnDat 2.2; <i>ECA 4490F</i> : Fanuc $\alpha$ i; <i>ECA 4490M</i> : Mitsubishi; <i>ECA 4490P</i> : Panasonic; <i>ECA 4490Y</i> : Yaskawa								
Signal periods/revolution	8195	10010	11 616	14003	16379	19998	25993	37994	44000
<b>Accuracy of graduation</b>	$\pm 3''$	$\pm 2.5''$	$\pm 2.8''$	$\pm 2''$	$\pm 1.9''$	$\pm 1.8''$	$\pm 1.7''$	$\pm 1.5''$	$\pm 1.5''$
<b>Inside diameter D1</b>	70 mm	80 mm	120 mm	120 mm	150/185 mm	180/210 mm	270 mm	425 mm	512 mm
<b>Outside diameter D2</b>	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
<b>Mech. permissible speed</b>	$\leq 8500$ rpm	$\leq 6250$ rpm	$\leq 5250$ rpm	$\leq 4500$ rpm	$\leq 4250$ rpm	$\leq 3250$ rpm	$\leq 2500$ rpm	$\leq 1800$ rpm	$\leq 1500$ rpm

<sup>1)</sup> Also available with functional safety

	<b>Incremental</b> <b>ERA 4280C</b> <sup>1)</sup> Signal period: 20 $\mu$ m <b>ERA 4480C</b> Signal period: 40 $\mu$ m <b>ERA 4880C</b> Signal period: 80 $\mu$ m								
<b>Interface</b>	$\sim 1$ V <sub>PP</sub>								
Signal periods/revolution <i>ERA 4280C</i> <i>ERA 4480C</i> <i>ERA 4880C</i>	12000 6000 3000	16384 8192 4096	20000 10000 5000	28000 14000 7000	32768 16384 8192	40000 20000 10000	52000 26000 13000	– 38000 –	– 44000 –
<b>Accuracy of graduation</b>	$\pm 5''$	$\pm 3.7''$	$\pm 3''$	$\pm 2.5''$					$\pm 2''$
<b>Inside diameter D1</b>	40 mm	70 mm	80 mm	120 mm	150 mm	180 mm	270 mm	425 mm	512 mm
<b>Outside diameter D2</b>	76.75 mm	104.63 mm	127.64 mm	178.55 mm	208.89 mm	254.93 mm	331.31 mm	484.07 mm	560.46 mm
<b>Mech. permissible speed</b>	$\leq 20000$ rpm	$\leq 15000$ rpm	$\leq 12250$ rpm	$\leq 8750$ rpm	$\leq 7500$ rpm	$\leq 6250$ rpm	$\leq 4750$ rpm	$\leq 3250$ rpm	$\leq 2750$ rpm

<sup>1)</sup> For other drum versions, please refer to the *Modular Angle Encoders with Magnetic Scanning* brochure

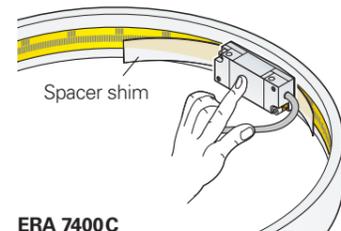
# ERA modular angle encoders

## Without integral bearing, with optical scanning

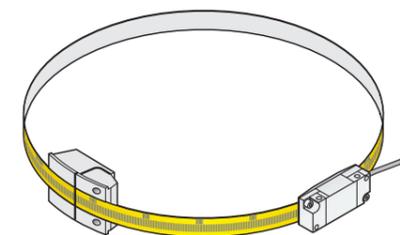
The HEIDENHAIN **ERA** angle encoders with steel scale tape as measuring standard function without integral bearings. They are intended for integration in machine elements or components. They are designed to meet the following requirements:

- 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 7400C



ERA 8400C

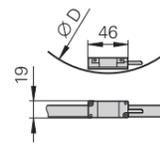
### ERA 7000 and ERA 8000 series

- 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

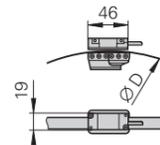
- ERA 7400C: full-circle version
- ERA 7401C: segment version



#### ERA 8000 series

Scale tape is fastened on the circumference of the machine element

- ERA 8400C: full-circle version
- ERA 8401C: segment version, scale tape secured with tensioning elements
- ERA 8402C: segment version, scale tape secured without tensioning elements



	Incremental ERA 7400C		
<b>Interface</b>	~ 1 V <sub>PP</sub> ; signal period 40 μm (on circumference)		
Signal periods/revolution	36 000	45 000	90 000
<b>Accuracy of graduation</b>	±3.9"	±3.2"	±1.6"
<b>Accuracy of the scale tape</b>	±3 μm per meter of tape		
<b>Diameter D1</b>	458.62 mm	573.20 mm	1146.10 mm
<b>Mech. permissible speed</b>	≤ 250 rpm		≤ 220 rpm

	Incremental ERA 8400C		
<b>Interface</b>	~ 1 V <sub>PP</sub> ; signal period 40 μm (on circumference)		
Signal periods/revolution	36 000	45 000	90 000
<b>Accuracy of graduation</b>	±4.7"	±3.9"	±1.9"
<b>Accuracy of the scale tape</b>	±3 μm per meter of tape		
<b>Diameter D1</b>	458.04 mm	572.63 mm	1145.73 mm
<b>Mech. permissible speed</b>	≤ 50 rpm		≤ 45 rpm

# ECM, ERM modular angle encoders

Without integral bearing, with magnetic scanning

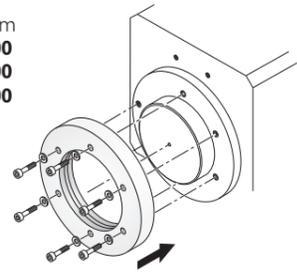
The **ECM** and **ERM** modular angle encoders from HEIDENHAIN with magnetic scanning consist of a magnetized scale drum and a scanning unit. Their MAGNODUR measuring standard and the magnetoresistive scanning principle make them particularly tolerant to contamination.

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.

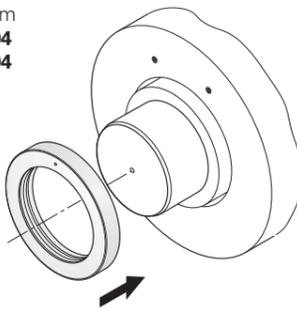
Typical fields of application include machines and equipment with **large hollow shaft diameters** in environments with large amounts of airborne particles and liquids, for example:

- 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

Scale drum  
ERM 2200  
ERM 2400  
ECM 2400



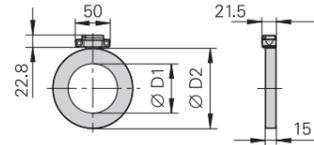
Scale drum  
ERM 2404  
ERM 2904



## Absolute position measurement

### ECM 2400 series

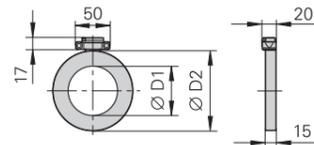
- Drum fastening with axial screws
- Functional safety with ECM 2410



## Incremental position measurement

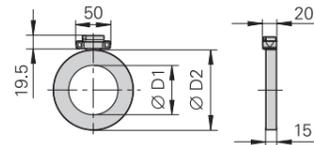
### ERM 2200 series

- 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

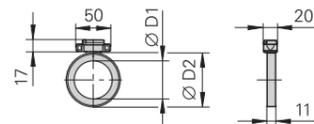


ERM 2480



### 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	AK ECM 2410 <sup>1)</sup>	AK ECM 2490F	AK ECM 2490M
Interface	EnDat 2.2	Fanuc Serial Interface; αi Interface	Mitsubishi high speed interface

Scale drum	TTR ECM 2400 Grating period ≈ 400 μm						
Signal periods	900	1024	1200	1400	1696	2048	2600
Drum inside diameter	70 mm	80 mm/95 mm	105 mm	130 mm	160 mm	180 mm	260 mm
Scale drum outside diameter	113.16 mm	128.75 mm	150.88 mm	176.03 mm	213.24 mm	257.5 mm	326.9 mm
Accuracy of graduation	±8"	±7"	±6"	±5.5"	±4.5"	±4"	±3.5"
Mech. permissible speed	≤ 14500 rpm	≤ 13000 rpm/ 12500 rpm	≤ 10500 rpm	≤ 9000 rpm	≤ 7000 rpm	≤ 6000 rpm	≤ 4500 rpm

	Incremental ERM 2410 (grating period ≈ 400 μm) ERM 2420 ERM 2480								
Interface	ERM 2410: EnDat 2.2 <sup>2)</sup> ; ERM 2420: □TTL; ERM 2480: ~ 1 V <sub>PP</sub>								
Signal periods/revolution	600	720	900	1024	1200	1400	2048	2600	3600
Accuracy of graduation	±11"	±10"	±8"	±7"	±6"	±5.5"	±4"	±3.5"	±3"
Inside diameter D1	40 mm	55 mm	70 mm	80 mm	105 mm	130 mm	180 mm	260 mm	380 mm
Outside diameter D2	75.44 mm	90.53 mm	113.16 mm	128.75 mm	150.88 mm	176.03 mm	257.5 mm	326.9 mm	452.64 mm
Mech. permissible speed	≤ 19000 rpm	≤ 18500 rpm	≤ 14500 rpm	≤ 13000 rpm	≤ 10500 rpm	≤ 9000 rpm	≤ 6000 rpm	≤ 4500 rpm	≤ 3000 rpm

	Incremental ERM 2484 (grating period ≈ 400 μm)				ERM 2984 (grating period ≈ 1000 μm)			
Interface	~ 1 V <sub>PP</sub>							
Signal periods/revolution	512	600	900	1024	192	256	300	400
Accuracy of graduation	±17"	±14"	±10"	±9"	±68"	±51"	±44"	±33"
Inside diameter D1	40 mm	55 mm	80 mm	100 mm	40 mm	55 mm	60 mm	100 mm
Outside diameter D2	64.37 mm	75.44 mm	113.16 mm	128.75 mm	58.06 mm	77.41 mm	90.72 mm	120.96 mm
Mech. permissible speed	≤ 42000 rpm	≤ 36000 rpm	≤ 22000 rpm	≤ 20000 rpm	≤ 47000 rpm	≤ 35000 rpm	≤ 29000 rpm	≤ 16000 rpm

<sup>1)</sup> Also available with functional safety

<sup>2)</sup> 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*

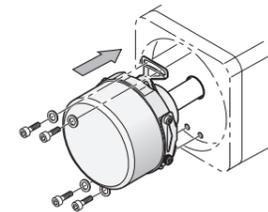
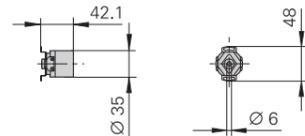
# ECN, EQN, ERN rotary encoders

With integral bearing and mounted stator coupling  
IP64 protection

HEIDENHAIN **ECN, EQN,** and **ERN** rotary encoders with integral bearing and stator-mounted coupling operate by photoelectric scanning. They are characterized by their simple mounting and short overall length. Possible applications range from simple measuring tasks to position and speed control on servo drives. The hollow shaft of these encoders is slid directly onto and fastened to the shaft to be measured. During angular acceleration of the shaft, the stator coupling must absorb only that torque resulting from friction in the bearing. Rotary encoders with stator coupling therefore provide excellent dynamic performance and a high natural frequency.

## ECN/EQN/ERN 1000 series

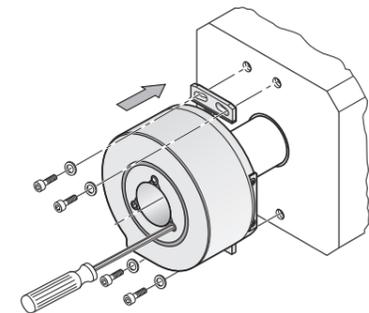
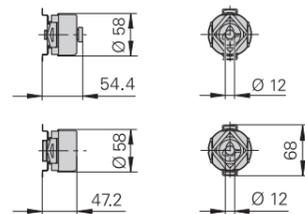
- Miniaturized version
- Blind hollow shaft with 6 mm inside diameter
- Housing outside diameter: 35 mm
- Typical natural frequency  $f_N$  of the encoder coupling: 1500 Hz
- **ERN 1023:** 1000 Hz
- Mechanically permissible speed:  $\leq 12000$  rpm



ECN/EQN/ERN 1000  
ECN/EQN/ERN 400

## ECN/EQN/ERN 400 series

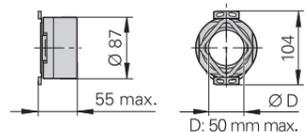
- Compact dimensions
- Blind hollow shaft or hollow through shaft with 8 mm, 10 mm, or 12 mm inside diameter
- Housing outside diameter: 58 mm
- Protection: IP67 at housing (IP66 with hollow through shaft) IP64 at shaft inlet (IP66 upon request)
- Typical natural frequency  $f_N$  of the encoder coupling: 1400 Hz (cable version)
- Mechanically permissible speed:  $\leq 12000$  rpm
- Fault exclusion of the mechanical coupling for functional safety available



ECN/ERN 100

## ECN/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
- Mechanically permissible speed: D  $\leq 30$  mm:  $\leq 6000$  rpm; D > 30 mm:  $\leq 4000$  rpm



	Absolute ECN 1013	EQN 1025	ECN 1023 ECN 1023S	EQN 1035 EQN 1035S	Incremental ERN 1020	ERN 1030	ERN 1070	ERN 1080
<b>Interface</b>	EnDat 2.2 <sup>1)</sup> with $\sim 1$ V <sub>PP</sub>		EnDat 2.2 <sup>1)</sup> ; DRIVE-CLiQ		TTL	HTL	TTL <sup>2)</sup>	$\sim 1$ V <sub>PP</sub>
Position values/revolution	8192 (13 bits)		8388608 (23 bits)		-			
Revolutions	-	4096 (12 bits)	-	4096 (12 bits)	-			
Line count	512		-		100 to 3600		1000/2500/3600	100 to 3600
<b>Supply voltage</b>	DC 3.6 V to 14 V		DC 3.6 V to 14 V; DC 10 V to 28.8 V		DC 5 V	DC 10 V to 30 V	DC 5 V	

	Absolute ECN 413	EQN 425	ECN 425 <sup>3)</sup> ECN 425F ECN 424S <sup>3)</sup>	EQN 437 <sup>3)</sup> EQN 437F EQN 436S <sup>3)</sup>	Incremental ERN 420 ERN 460	ERN 430	ERN 480
<b>Interface</b>	EnDat 2.2 <sup>1)</sup> with $\sim 1$ V <sub>PP</sub> ; SSI	EnDat 2.2 <sup>1)</sup> with $\sim 1$ V <sub>PP</sub> ; SSI	EnDat 2.2 <sup>1)</sup> ; Fanuc $\alpha$ i; DRIVE-CLiQ		TTL; TTL	HTL	$\sim 1$ V <sub>PP</sub>
Position values/revolution	8192 (13 bits)	8192 (13 bits)	ECN 425, EQN 437: 33554432 (25 bits) ECN 424S, EQN 436S: 16777216 (24 bits)		-		
Revolutions	-	4096 (12 bits)	-	4096 (12 bits)	-		
Line count	512 or 2048	512 or 2048	-		250 to 5000		1000 to 5000
<b>Supply voltage</b>	3.6 V to 14 V; 4.75 V to 30 V	3.6 V to 14 V; 4.75 V to 30 V	3.6 V to 14 V; 10 V to 28.8 V		5 V; 10 V to 30 V	10 V to 30 V	5 V

	Absolute ECN 113	ECN 125	Incremental ERN 120	ERN 130	ERN 180
<b>Interface</b>	EnDat 2.2 <sup>1)</sup> with $\sim 1$ V <sub>PP</sub>	EnDat 2.2 <sup>1)</sup>	TTL	HTL	$\sim 1$ V <sub>PP</sub>
Position values/revolution	8192 (13 bits)	33554432 (25 bits)	-		
Line count	2048	-	1000 to 5000		
<b>Supply voltage</b>	DC 3.6 V to 14 V	DC 3.6 V to 14 V	DC 5 V	DC 10 V to 30 V	DC 5 V

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

<sup>2)</sup> 5/10-fold integrated interpolation

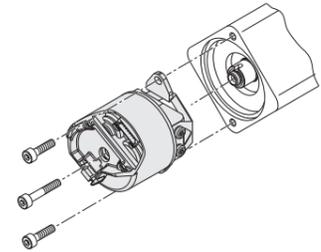
<sup>3)</sup> Also available with functional safety

DRIVE-CLiQ is a registered trademark of SIEMENS AG.

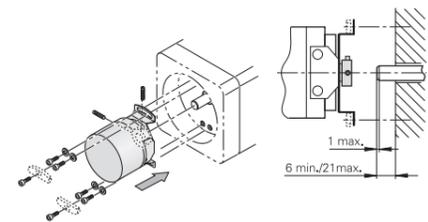
# ECN, EQN, ERN rotary encoders

With integral bearing and mounted stator coupling  
IP40 protection

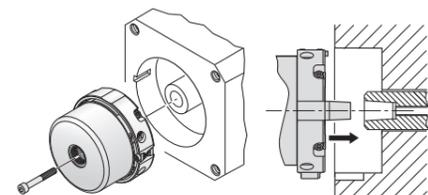
The **ECN, EQN**, and **ERN** photoelectric rotary encoders from HEIDENHAIN with IP40 protection are specially designed for integration in motors. Bearings and mounted stator coupling are integrated. Absolute rotary encoders and versions with commutation tracks are available for synchronous motors. The 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



ERN 1123



ECN/EQN/ERN 1300

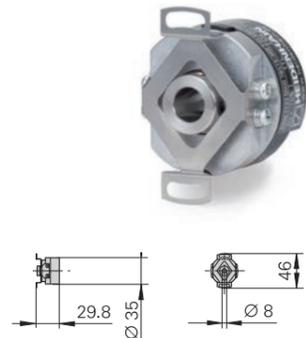
## ECN/EQN 1100 series

- 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: 12000 rpm
- Fault exclusion of the mechanical coupling for functional safety available



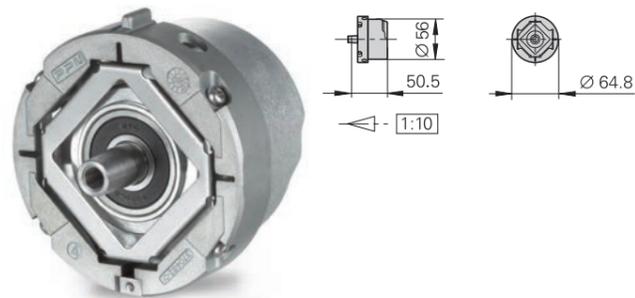
## ERN 1123

- 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 9.25 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:  
**ERN/ECN:** 15000 rpm  
**EQN:** 12000 rpm
- IP40 protection when mounted
- Fault exclusion of the mechanical coupling for functional safety available



	Absolute ECN 1113	EQN 1125	ECN 1123 <sup>2)</sup> ECN 1123 S <sup>2)</sup>	EQN 1135 <sup>2)</sup> EQN 1135 S <sup>2)</sup>	Incremental ERN 1123
<b>Interface</b>	EnDat 2.2 <sup>1)</sup> with $\sim 1$ V <sub>PP</sub>		EnDat 2.2 <sup>1)</sup> ; DRIVE-CLiQ		$\square$ TTL
Position values/revolution	8192 (13 bits)		8388608 (23 bits)		–
Revolutions	–	4096 (12 bits)	–	4096 (12 bits)	–
Line count	512		–		500 to 8192
<b>Commutation signals</b>	–				Block commutation <sup>3)</sup>
<b>Supply voltage</b>	DC 3.6 V to 14 V		ECN 1123, EQN 1135: DC 3.6 V to 14 V; ECN 1123 S, EQN 1135 S: DC 10 V to 28.8 V		DC 5 V
<b>Operating temperature</b>	$\leq 115$ °C		ECN 1123, EQN 1135: $\leq 115$ °C; ECN 1123 S, EQN 1135 S: $\leq 95$ °C		$\leq 90$ °C

- 1) Includes EnDat 2.1 command set; PROFIBUS DP via gateway
- 2) Also available with functional safety
- 3) Three block commutation tracks with 90°, 120°, or 180° mech. phase shift

	Absolute ECN 1313	EQN 1325	ECN 1325 <sup>4)</sup>	EQN 1337 <sup>4)</sup>	ECN 1324 S <sup>4)</sup>	EQN 1336 S <sup>4)</sup>	Incremental ERN 1321	ERN 1326	ERN 1381	ERN 1387	
<b>Interface</b>	EnDat 2.2 <sup>1)</sup> with $\sim 1$ V <sub>PP</sub>		EnDat 2.2 <sup>1)</sup> , EnDat 3		DRIVE-CLiQ		$\square$ TTL	$\sim 1$ V <sub>PP</sub>			
Position values/revolution	8192 (13 bits)		33554432 (25 bits)		16777216 (24 bits)		–				
Revolutions	–	4096 (12 bits)	–	4096 (12 bits)	–	4096 (12 bits)	–				
Line count	512 or 2048		–		–		1024	2048	4096	512 2048 4096	2048
<b>Commutation signals</b>	–						–	Block commutation <sup>2)</sup>	–	Z1 track <sup>3)</sup>	
<b>Supply voltage</b>	DC 3.6 V to 14 V				DC 10 V to 28.8 V		DC 5 V				
<b>Operating temperature</b>	$\leq 115$ °C				$\leq 100$ °C		$\leq 120$ °C; 4096 lines: $\leq 100$ °C				

- 1) Includes EnDat 2.1 command set; PROFIBUS DP via gateway
- 2) Three block commutation tracks with 90° or 120° mech. phase shift
- 3) One sine and one cosine signal with one period per revolution of the encoder shaft
- 4) Also available with functional safety

DRIVE-CLiQ is a registered trademark of Siemens AG.

# ROC, 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 IP66, 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.

### ROC/ROQ/ROD 1000 series

- Miniaturized dimensions for installation in small devices or in limited installation space
- Mounting by synchro flange
- Shaft diameter: 4 mm

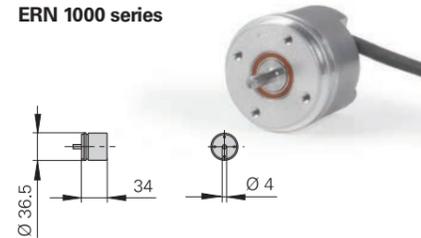
### HR handwheel

- Compact dimensions
- Sturdy design
- Mechanical detent

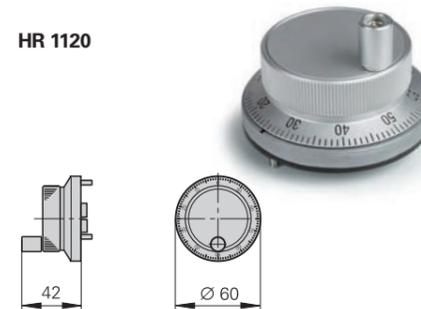
### ROC/ROQ/ROD 400 series

- Industrial standard regarding dimensions and output signals
- IP67 protection at housing, IP64 at shaft inlet (IP66 upon request)
- Mounting via synchro flange or clamping flange
- Shaft diameter: 6 mm with synchro flange, 10 mm with clamping flange
- Preferred types with fast delivery (see *Rotary Encoders* brochure or ask HEIDENHAIN)
- Fault exclusion of the mechanical coupling for functional safety available

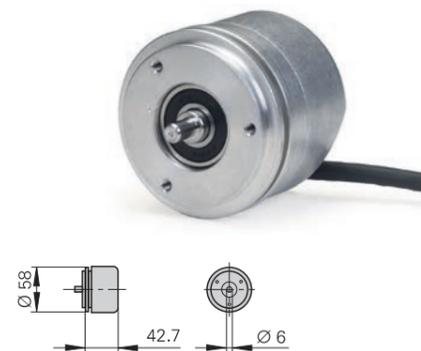
### ERN 1000 series



### HR 1120



### The 400 series with synchro flange

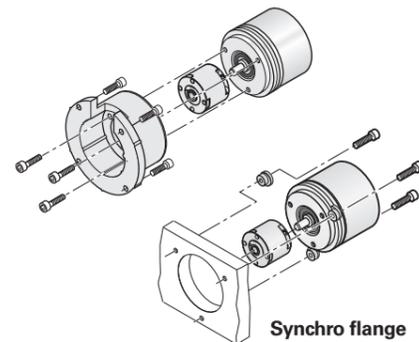
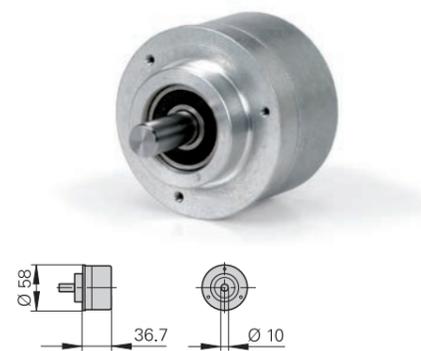


	Absolute				Incremental				
	ROC 1013	ROQ 1025	ROC 1023 ROC 1023 S	ROQ 1035 ROQ 1035 S	ROD 1020	ROD 1030	ROD 1070	ROD 1080	HR 1120
<b>Interface</b>	EnDat 2.2 <sup>1)</sup> with $\sim 1$ V <sub>PP</sub>		EnDat 2.2 <sup>1)</sup> ; DRIVE-CLiQ					$\sim 1$ V <sub>PP</sub>	
Position values/revolution	8192 (13 bits)		8388608 (23 bits)		-				
Revolutions	-	4096 (12 bits)	-	4096 (12 bits)	-				
Line count/signal periods	512		-		100 to 3600		1000/2500/3600	100 to 3600	100
<b>Supply voltage</b>	DC 3.6 V to 14 V		DC 3.6 V to 14 V; DC 10 V to 28.8 V		DC 5 V	DC 10 V to 30 V	DC 5 V		

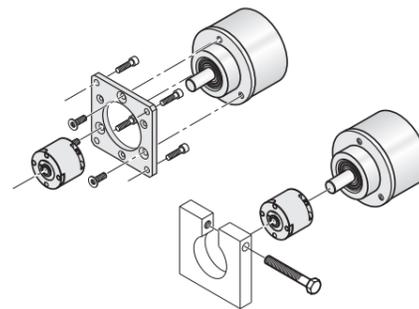
<sup>1)</sup> Includes EnDat 2.1 command set; PROFIBUS DP via gateway  
<sup>2)</sup> 5/10-fold integrated interpolation

DRIVE-CLiQ is a registered trademark of Siemens AG.

### The 400 series with clamping flange



Synchro flange



Clamping flange

	Absolute				Incremental		Incremental			
	ROC 413	ROQ 425	ROC 424S <sup>1)</sup>	ROQ 436S <sup>1)</sup>	ROC 425 <sup>1)</sup> ROC 425F	ROQ 437 <sup>1)</sup> ROQ 437F	ROD 426	ROD 466	ROD 436	ROD 486
<b>Synchro flange</b>										
<b>Clamping flange</b>							ROD 420	-	ROD 430	ROD 480
<b>Interface</b>	EnDat 2.2 <sup>2)</sup> with $\sim 1$ V <sub>PP</sub> ; SSI			DRIVE-CLiQ	EnDat 2.2 <sup>2)</sup> ; Fanuc $\alpha$ i					$\sim 1$ V <sub>PP</sub>
Position values/revolution	8192 (13 bits)		16777216 (24 bits)		33554432 (25 bits)		-			
Revolutions	-	4096 (12 bits)	-	4096 (12 bits)	-	4096 (12 bits)	-			
Line count/signal periods	512		2048		-		50 to 5000 ROD 426/466: up to 10000 <sup>3)</sup>			1000 to 5000
<b>Supply voltage</b>	DC 3.6 V to 14 V; DC 4.75 V to 30 V		DC 10 V to 28.8 V		DC 3.6 V to 14 V		DC 5 V	DC 10 V to 30 V		DC 5 V

<sup>1)</sup> Also available with functional safety  
<sup>2)</sup> Includes EnDat 2.1 command set; PROFIBUS DP via gateway  
<sup>3)</sup> Signal periods over 5000 are generated through signal doubling in the encoder

DRIVE-CLiQ is a registered trademark of Siemens AG.

The **HR** electronic handwheel features an integral bearing and mechanical detent. It was conceived for use in portable or stationary housings, e.g. for positioning units or automation applications.

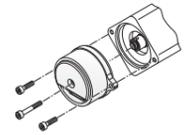
# ECI, EQI, EBI rotary encoders

## Without integral bearing

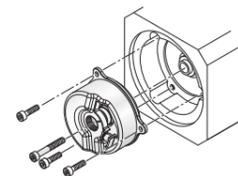
Compared with optical rotary encoders without integral bearings, inductive rotary encoders are particularly robust and have large mounting tolerances.

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



ECI/EQI/EBI 1300

### 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



	<b>Absolute</b> ECI 1119 <sup>1)</sup> ECI 1319 <sup>1) 3)</sup> ECI 1118	EQI 1131 <sup>1)</sup> EQI 1331 <sup>1) 3)</sup>	EBI 1135 EBI 1335
<b>Interface</b>	EnDat 2.2, EnDat 3		EnDat 2.2
Position values/revolution	524 288 (19 bits) <i>ECI 1118</i> : 262 144 (18 bits)		524 288 (19 bits) <i>EBI 1135</i> : 262 144 (18 bits)
Revolutions	–	4096 (12 bits)	65 536 (16 bits) <sup>2)</sup>
<b>Mech. permissible speed</b>	≤ 15 000 rpm	≤ 12 000 rpm	≤ 12 000 rpm
<b>Shaft</b>	Blind hollow shaft		

<sup>1)</sup> Also available with functional safety

<sup>2)</sup> Multiturn function via battery-buffered revolution counter

<sup>3)</sup> Also available with DRIVE-CLiQ interface

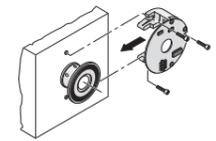
# ERO, ECI, EBI rotary encoders

## Without integral bearing

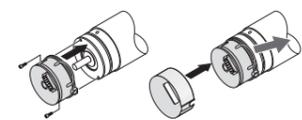
The photoelectric **ERO** modular rotary encoders from HEIDENHAIN consist of a graduated disk with hub and a scanning unit. They are particularly well suited for **limited installation space** or for applications where there must be **no friction**.

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.



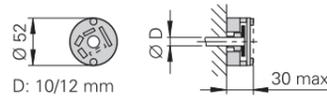
ERO 1200



ERO 1400

### ERO 1200 series

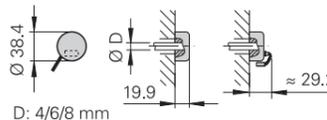
- Compact dimensions
- For shaft diameters of up to 12 mm



D: 10/12 mm

### ERO 1400 series

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



D: 4/6/8 mm

### ECI/EBI 100 series

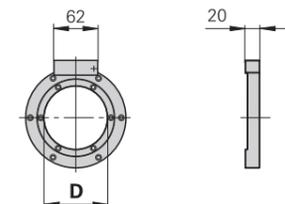
- Especially flat design
- Hollow through shaft Ø: 30, 38, 50 mm
- **EBI 135**: multiturn function via battery-buffered revolution counter



ECI/EBI 4000

### 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	ERO 1285
<b>Interface</b>	□TTL	~ 1 V <sub>PP</sub>
Line count	1024 2048	
<b>Mech. permissible speed</b>	≤ 25000 rpm	
<b>Shaft diameter D</b>	10 mm, 12 mm	

	Incremental ERO 1420	ERO 1470	ERO 1480
<b>Interface</b>	□TTL	□TTL <sup>1)</sup>	~ 1 V <sub>PP</sub>
Line count	512 1000 1024	1000 1500	512 1000 1024
<b>Mech. permissible speed</b>	≤ 30000 rpm		
<b>Shaft diameter D</b>	4 mm, 6 mm, 8 mm		

<sup>1)</sup> 5/10/20/24-fold integrated interpolation

	Absolute ECI 119	EBI 135	ECI 4010 <sup>1)</sup>	EBI 4010 <sup>1)</sup>	ECI 4090 S <sup>1)</sup>
<b>Interface</b>	EnDat 2.1 with ~ 1 V <sub>PP</sub>	EnDat 2.2			DRIVE-CLiQ
Position values/revolution	524288 (19 bits)		1048576 (20 bits)		
Revolutions	-		65536 (16 bits) <sup>2)</sup>	65536 (16 bits) <sup>2)</sup>	-
Line count	32	-			
<b>Mech. permissible speed</b>	≤ 6000 rpm				
<b>Shaft</b>	Hollow through shaft Ø: 30, 38, 50 mm			Hollow through shaft Ø: 90, 180 mm	

<sup>1)</sup> Also available with functional safety

<sup>2)</sup> Multiturn function via battery-buffered revolution counter

DRIVE-CLiQ is a registered trademark of Siemens AG.

## 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
- Milling-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.



TNC 640

## 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 **smart.Turn** is particularly easy and convenient. The straightforward fillable-form input provides graphical support, meaningful dialogs, 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.



CNC PILOT 640

## Quickly and easily to the finished part

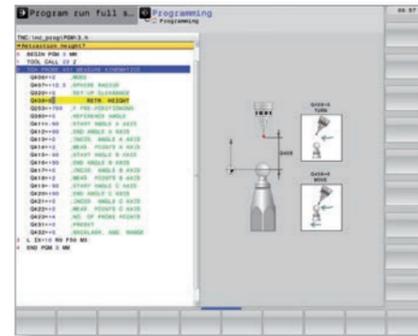
The operational design of the milling and lathe controls is tailored to the needs of the user and therefore offers you the greatest possible flexibility in program creation. When **programming at the machine**, all required inputs are guided by practice-oriented prompts and questions while highly expressive 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.

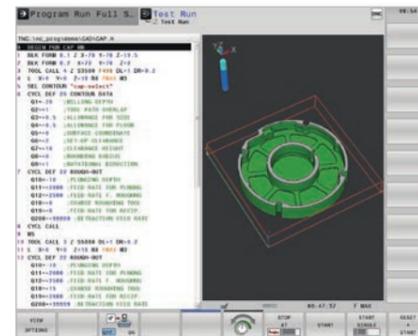
You can also open **DXF files** that were created on a separate CAD system directly on the control and extract contours and machining positions from them. This not only saves time otherwise spent on programming and testing, but you can also be sure that the adopted data is exactly in accordance with 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 work-day environment. The clear-cut screen displays informational notes, questions, prompts, program steps, graphics, 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.



Klartext conversational input on a TNC



NC program simulation

## High quality and productivity

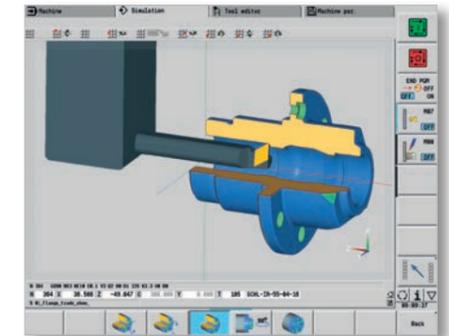
Thanks to intelligent motion control, HEIDENHAIN controls enable short machining times with perfect workpiece surfaces and very high workpiece accuracy. The bottom line is an increase in productivity: unit costs are reduced without affecting accuracy and surface quality.

## Automating manual operations

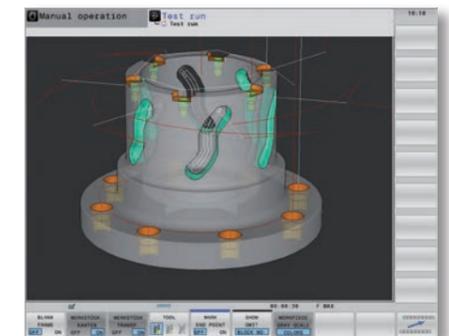
You can start working with the HEIDENHAIN controls even before writing a complete part program. Simply machine a part step by step—switching as you want between manual operation and automatic positioning.

## 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.



High-resolution graphics of lathe controls



High-resolution graphics of milling controls

HEIDENHAIN controls		Series	Page
<b>Controls for milling machines</b>	Contouring control for up to 24 control loops	<b>TNC 640</b>	<b>46</b>
	Contouring control for up to 8 control loops	<b>TNC 620</b>	<b>48</b>
	Contouring control for up to 6 control loops	<b>TNC 320</b>	<b>48</b>
	Straight cut control for up to 5 control loops	<b>TNC 128</b>	<b>50</b>
<b>Controls for lathes</b>	Contouring control for up to 24 control loops	<b>CNC PILOT 640</b>	<b>52</b>
	Contouring control for up to 10 control loops	<b>MANUALplus 620</b>	<b>54</b>
<b>Contouring controls</b>	Digital control design		<b>56</b>
<b>Accessories</b>	Electronic handwheels	<b>HR</b>	<b>58</b>
	Programming stations	<b>TNC 640/TNC 620/TNC 320 DataPilot MP 620/CP 640</b>	<b>58</b>
	VT 121 camera system		<b>59</b>
<b>Tool and workpiece setup and measurement</b>	Workpiece touch probes	<b>TS</b>	<b>62</b>
	Tool touch probes	<b>TT</b>	<b>64</b>
	Transceivers	<b>SE</b>	<b>65</b>

# TNC 640 contouring control

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

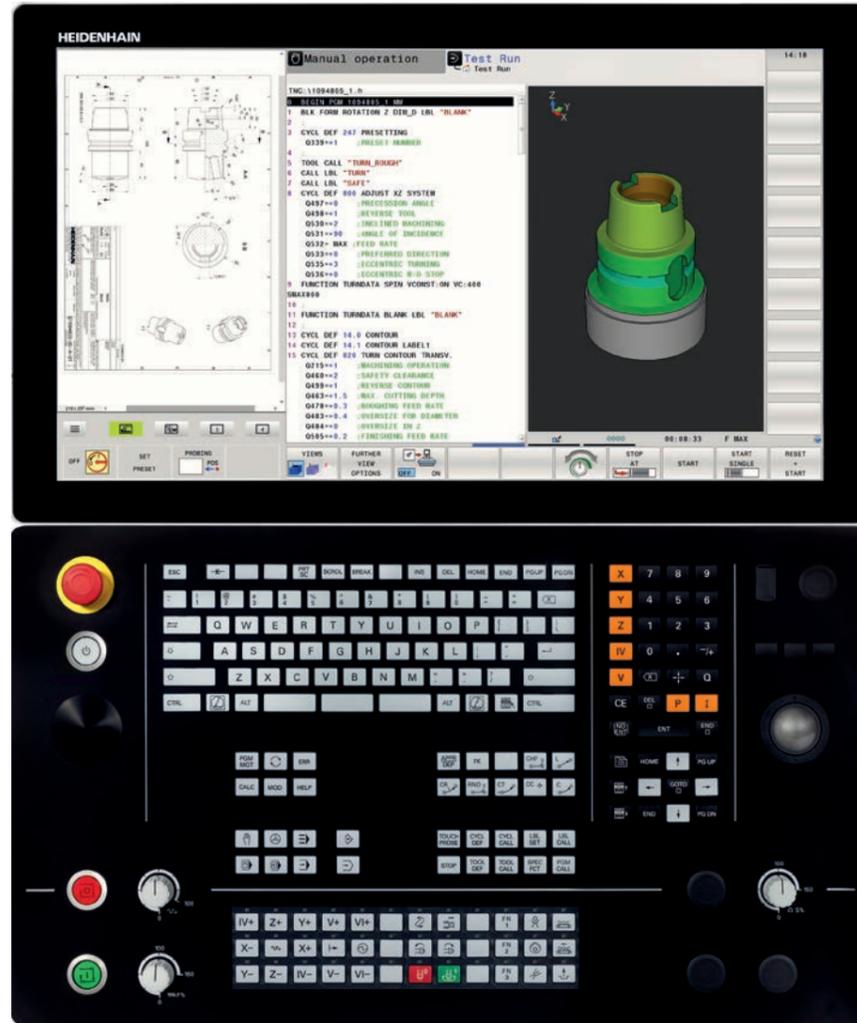
Besides milling, the **TNC 640** from HEIDENHAIN is also capable of combined milling and turning operations. It is particularly well suited for milling, turning, HSC machining, and 5-axis machining. The shop-oriented and versatile control features numerous functions. It is especially attractive for the 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
<b>Axes</b>	24 control loops (22 with functional safety), of which up to 4 can be configured as spindles
<b>Interpolation</b>	<ul style="list-style-type: none"> <li>• Linear in up to 5 axes with Tool Center Point Management (TCPM)</li> <li>• Circular in up to 3 axes with tilted working plane</li> <li>• Helical</li> <li>• Cylinder surface<sup>1)</sup></li> <li>• Rigid tapping<sup>1)</sup></li> </ul>
<b>Program entry</b>	HEIDENHAIN Klartext conversational format, ISO (G codes)
<b>Programming support</b>	TNCguide presents user information directly on the control
<b>CAD import<sup>2)</sup></b>	Loading of contours from 3D models
<b>Program memory</b>	HDR hard disk or SSDR solid state disk, at least 21 GB
<b>Position entry</b>	Nominal positions in Cartesian or polar coordinates, absolute or incremental dimensions, in mm or inches; actual position capture
<b>Input resolution and display step</b>	To 0.1 µm or 0.0001°; optionally to 0.01 µm or 0.00001°
<b>Block-processing time</b>	0.5 ms (3D straight line without radius compensation at 100 % PLC utilization)
<b>Turning functions<sup>2)</sup></b>	<ul style="list-style-type: none"> <li>• Turning tool data management</li> <li>• Tool-tip radius compensation</li> <li>• Constant cutting speed</li> <li>• Toggling between milling and turning operations</li> </ul>
<b>High-speed cutting</b>	Motion control with minimum jerk
<b>FK free contour programming</b>	HEIDENHAIN Klartext conversational format with graphical support
<b>Coordinate transformation</b>	<ul style="list-style-type: none"> <li>• Shifting, rotating, mirroring, scaling (axis specific)</li> <li>• Tilting the working plane, PLANE function<sup>2)</sup></li> </ul>
<b>Machining cycles</b>	For drilling, milling, turning <sup>2)</sup> , interpolation turning <sup>2)</sup> , grinding <sup>2)</sup> , hobbing <sup>2)</sup> , and for cylinder surface machining <sup>2)</sup> ; data input with graphical support
<b>Touch probe cycles</b>	For tool measurement, workpiece alignment, workpiece measurement, and presetting
<b>Graphics</b>	For programming and program verification
<b>Parallel operation</b>	Program run and programming with graphics
<b>Data interface</b>	Ethernet 1000BASE-T; USB 3.0; USB 2.0; RS-232-C/V.24 (max. 115200 bauds)
<b>Remote control and diagnosis</b>	TeleService
<b>Screen</b>	15-inch or 19-inch screen with operating keys; 19-inch or 24-inch screen for multitouch operation
<b>Axis feedback control</b>	<ul style="list-style-type: none"> <li>• Feedforward control or operation with following error</li> <li>• Integrated digital drive control including inverter</li> </ul>
<b>Adaptive feed control<sup>2)</sup></b>	AFC adjusts the contouring feed rate to the spindle power
<b>Dynamic Collision Monitoring (DCM)<sup>2)</sup></b>	Dynamic monitoring of the working space for possible collisions with machine components <sup>1)</sup>
<b>Accessories</b>	<ul style="list-style-type: none"> <li>• HR electronic handwheels</li> <li>• TS workpiece touch probe and TT tool touch probe</li> </ul>

<sup>1)</sup> This function requires adaptation by the machine manufacturer

<sup>2)</sup> 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:

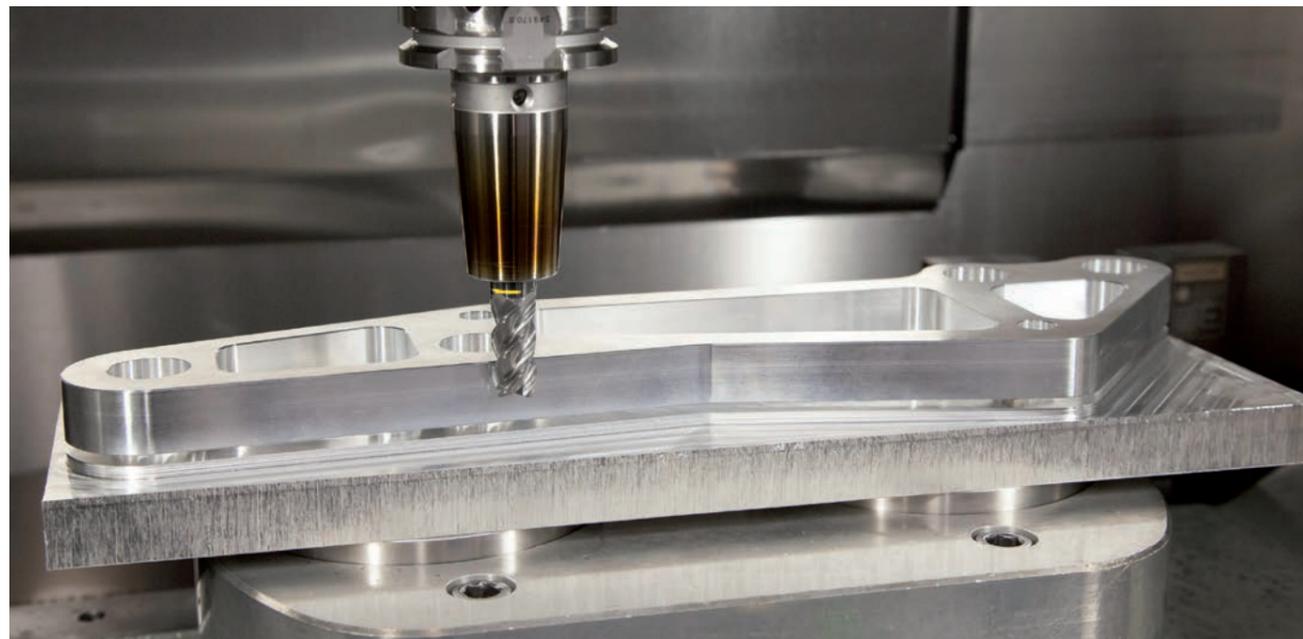
- Series and single-part production
- Tool making
- Machine building
- Research and development
- Prototypes and pilot plants
- Repair departments
- Training and education facilities

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 touch screen version (only for TNC 620)



	TNC 620	TNC 320
<b>Axes</b>	8 control loops, of which up to 2 are configurable as spindles	6 control loops, of which up to 2 are configurable as spindles
<b>Interpolation</b>	<ul style="list-style-type: none"> <li>• Linear in 4 (optionally 5) main axes</li> <li>• Circular in 2 (optionally 3) axes</li> <li>• Helical, superimposition of circular and straight paths</li> <li>• Cylinder surface<sup>1)</sup></li> </ul>	<ul style="list-style-type: none"> <li>• Linear in 4 main axes</li> <li>• Circular in 2 axes</li> <li>• Helical, superimposition of circular and straight paths</li> <li>• Cylinder surface<sup>1)</sup></li> </ul>
<b>Program entry</b>	<ul style="list-style-type: none"> <li>• HEIDENHAIN Klartext conversational format</li> <li>• ISO (G codes: input via soft keys or via external USB keyboard)</li> <li>• FK free programming of contours (software option on the TNC 620)</li> </ul>	
<b>Programming support</b>	TNCguide presents user information directly on the TNC	
<b>CAD import<sup>1)</sup></b>	Loading of contours from 3D models	
<b>Program memory</b>	1.8 GB CFR memory card	
<b>Position entry</b>	<ul style="list-style-type: none"> <li>• Positions in Cartesian or polar coordinates</li> <li>• Incremental or absolute dimensions</li> <li>• Display and entry in mm or inches</li> <li>• Actual position capture</li> </ul>	
<b>Input resolution and display step</b>	To 0.1 µm or 0.0001° (optionally to 0.01 µm or 0.00001°)	To 0.1 µm or 0.0001°
<b>Block processing time</b>	1.5 ms	6 ms
<b>Coordinate transformation</b>	<ul style="list-style-type: none"> <li>• Shifting, rotating, mirroring, scaling (axis specific)</li> <li>• Tilting the working plane, PLANE function<sup>1)</sup></li> </ul>	
<b>Machining cycles</b> (some are software options on the TNC 620)	<ul style="list-style-type: none"> <li>• Drilling, tapping, thread cutting, reaming, and boring</li> <li>• Cycles for hole patterns, facing of flat surfaces</li> <li>• Clearance and finishing of pockets, slots, and studs</li> </ul>	
<b>Touch probe cycles</b>	For tool measurement, workpiece alignment, workpiece measurement, and workpiece presetting (software option on the TNC 620)	
<b>Graphics</b>	For programming and program verification (software option on the TNC 620); graphic support with cycle programming	
<b>Parallel operation</b>	Programming during program run, program-run graphics (software option on the TNC 620)	
<b>Data interface</b>	Ethernet 1000BASE-T; USB 3.0; USB 2.0; RS-232-C/V.24, and RS-422/V.11 (max. 115200 bauds)	
<b>Screen</b>	15-inch screen with operating keys or 19-inch screen for multitouch operation (portrait)	15-inch screen with operating keys
<b>Axis feedback control</b>	Feedforward control or operation with following error	
	Integrated digital drive control for synchronous and asynchronous motors	–
<b>Interfacing to the machine</b>	Via integrated programmable logic controller (PLC)	
	Inputs/outputs with PL 6000	Inputs/outputs expandable with PL 510
<b>Accessories</b>	<ul style="list-style-type: none"> <li>• HR electronic handwheels</li> <li>• TS workpiece touch probe and TT tool touch probe</li> </ul>	

<sup>1)</sup> 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.



	TNC 128
<b>Axes</b>	5 control loops, of which up to 2 are configurable as spindles
<b>Program entry</b>	HEIDENHAIN Klartext conversational format
<b>Program memory</b>	1.8 GB CFR memory card
<b>Position entry</b>	<ul style="list-style-type: none"> <li>• Positions in Cartesian or polar coordinates</li> <li>• Incremental or absolute dimensions</li> <li>• Display and entry in mm or inches</li> </ul>
<b>Input resolution and display step</b>	To 0.1 $\mu\text{m}$ or 0.0001°
<b>Block processing time</b>	6 ms
<b>Coordinate transformation</b>	Shifting, rotating, mirroring, scaling (axis specific)
<b>Machining cycles</b>	<ul style="list-style-type: none"> <li>• Drilling, tapping, reaming, and boring</li> <li>• Cycles for hole patterns, facing of flat surfaces</li> <li>• Pocket, stud, and slot milling</li> </ul>
<b>Touch probe cycles</b>	Touch probe calibration and presetting
<b>Graphics</b>	For programming and program verification; graphic support for cycle programming
<b>Parallel operation</b>	Program run and programming, program-run graphics
<b>Data interface</b>	<ul style="list-style-type: none"> <li>• Ethernet 1000BASE-T</li> <li>• USB 3.0; USB 2.0</li> <li>• RS-232-C/V.24; max. 115200 bauds</li> </ul>
<b>Screen</b>	12.1-inch screen with operating keys
<b>Axis feedback control</b>	Feedforward control or operation with following error
<b>Interfacing to the machine</b>	Via integrated programmable logic controller (PLC); inputs/outputs expandable with PL 510
<b>Accessories</b>	<ul style="list-style-type: none"> <li>• HR electronic handwheels</li> <li>• TS or KT workpiece touch probe and TT tool touch probe</li> </ul>



# 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
<b>Axes</b>	Up to 24 control loops (22 with functional safety)
<b>Interpolation</b>	<ul style="list-style-type: none"> <li>• Straight line: in 2 principal axes, optional in 3 principal axes</li> <li>• Circle: in 2 axes, optional additional linear interpolation in the third axis</li> <li>• C1/C2 axis: interpolation of X and Z linear axes with the C1/C2 axis<sup>1)</sup></li> <li>• B axis: 5-axis interpolation between X, Z, Y, B, and C axes<sup>1)</sup></li> </ul>
<b>Program entry</b>	smart.Turn, DIN PLUS, Teach-In mode
<b>Programming aids</b>	TURNguide presents user information directly on the control
<b>DXF import<sup>1)</sup></b>	Loading of DXF contours
<b>Program memory</b>	1.8 GB CFR memory card
<b>Position entry</b>	Nominal positions in Cartesian or polar coordinates, absolute or incremental dimensions, in mm or inches; actual position capture
<b>Input resolution and display step</b>	X axis: 0.5 µm, diameter: 1 µm U, V, W, Y, Z axes: 1 µm B, C1/C2 axes: 0.001°
<b>Block processing time</b>	1.5 ms (3D straight line without radius compensation at 100 % PLC utilization)
<b>Setup functions</b>	<ul style="list-style-type: none"> <li>• Setting the workpiece datum</li> <li>• Defining the tool change point</li> <li>• Defining the protection zone</li> </ul>
<b>Interactive contour programming (ICP)</b>	Contour definition with graphic support
<b>Machining cycles</b>	Stock removal, recessing, recess turning, engraving, thread cutting, helical slot milling, boring, drilling, tapping, deburring, trochoidal milling, hobbing, eccentric and non-circular turning
<b>Touch-probe cycles<sup>1)</sup></b>	For tool and workpiece measurement as well as presetting
<b>Graphics</b>	For programming and program verification
<b>Parallel operation</b>	Program run and programming with graphics
<b>Data interface</b>	Ethernet 1000BASE-T; USB 3.0; USB 2.0; RS-232-C/V.24 (max. 115200 bauds)
<b>Remote control and diagnosis</b>	TeleService
<b>Screen</b>	15.6-inch or 24-inch screen for multitouch operation
<b>Axis feedback control</b>	<ul style="list-style-type: none"> <li>• Feedforward control or operation with following error</li> <li>• Integrated digital drive control including inverter</li> </ul>
<b>Multi-channel capability</b>	<ul style="list-style-type: none"> <li>• Up to three channels for asynchronous multi-slide machining</li> </ul>
<b>Accessories</b>	<ul style="list-style-type: none"> <li>• HR electronic handwheels</li> <li>• TS workpiece touch probe and TT tool touch probe</li> </ul>

<sup>1)</sup> Software option

For further functions and differences in function, see the product documentation

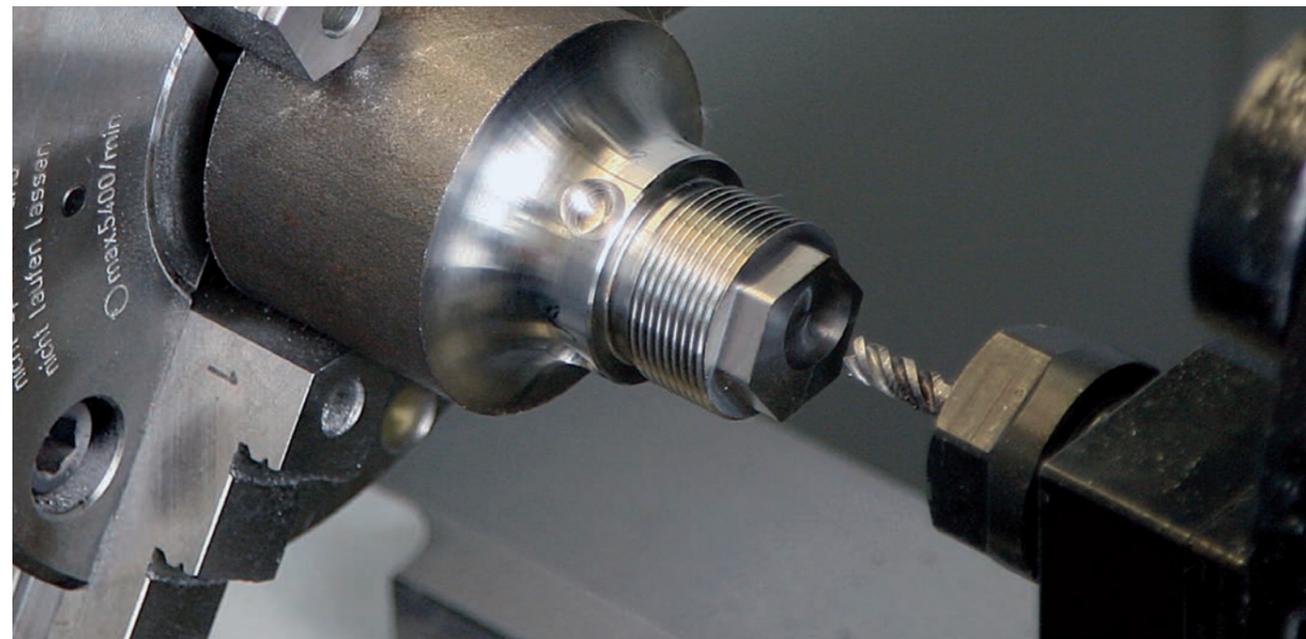
# MANUALplus 620 contouring control

For CNC and cycle lathes

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
<b>Axes</b>	10 control loops
<b>Interpolation</b>	<ul style="list-style-type: none"> <li>• Straight line: in 2 principal axes, optional in 3 principal axes</li> <li>• Circle: in 2 axes, optional additional linear interpolation in the third axis</li> <li>• C1/C2 axis: interpolation of X and Z linear axes with the C1/C2 axis<sup>1)</sup></li> </ul>
<b>Program entry</b>	Teach-In mode, smart.Turn <sup>1)</sup> , DIN PLUS
<b>Programming aids</b>	TURNguide presents user information directly on the control
<b>DXF import<sup>1)</sup></b>	Loading of DXF contours
<b>Program memory</b>	1.8 GB CFR memory card
<b>Position entry</b>	Nominal positions in Cartesian or polar coordinates, absolute or incremental dimensions, in mm or inches; actual position capture
<b>Input resolution and display step</b>	X axis: 0.5 µm, diameter: 1 µm U, V, W, Y, Z axes: 1 µm B, C1/C2 axes: 0.001°
<b>Block processing time</b>	3 ms
<b>Setup functions</b>	<ul style="list-style-type: none"> <li>• Setting the workpiece datum</li> <li>• Defining the tool change point</li> <li>• Defining the protection zone</li> </ul>
<b>Interactive contour programming (ICP)</b>	Contour definition with graphic support
<b>Machining cycles</b>	Stock removal, recessing, recess turning, engraving, thread cutting, helical slot milling, boring, drilling, tapping, deburring, trochoidal milling, hobbing, eccentric and non-circular turning
<b>Touch-probe cycles<sup>1)</sup></b>	For tool and workpiece measurement as well as presetting
<b>Graphics</b>	For programming and program verification
<b>Parallel operation</b>	Program run and programming with graphics
<b>Data interface</b>	Ethernet 1000BASE-T; USB 3.0; USB 2.0; RS-232-C/V.24 (max. 115200 bauds)
<b>Remote control and diagnosis</b>	TeleService
<b>Screen</b>	15.6-inch screen for multitouch operation (with virtual operating panel)
<b>Axis feedback control</b>	<ul style="list-style-type: none"> <li>• Feedforward control or operation with following error</li> <li>• Integrated digital drive control including inverter</li> </ul>
<b>Accessories</b>	<ul style="list-style-type: none"> <li>• HR electronic handwheels</li> <li>• TS workpiece touch probe and TT tool touch probe</li> </ul>

<sup>1)</sup> Software option

For further functions and differences in function, see the product documentation

# Contouring controls

## Digital control design

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.

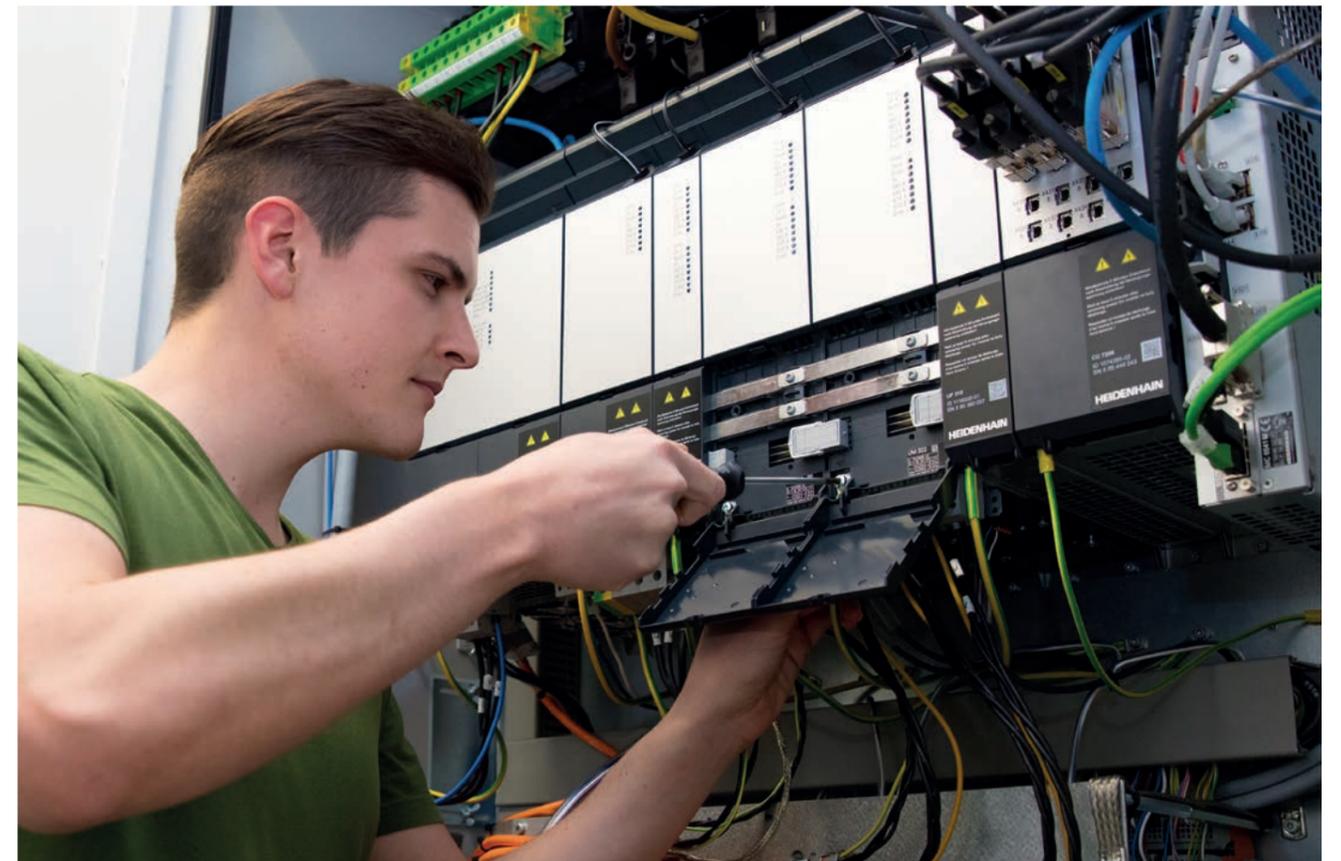
### Gen 3 drives

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.

Gen<sup>3</sup>



**TNC 640**  
With modular inverters, motors, and position encoders



## 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—and 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 550 FS HR 510

#### 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.



HR 130 for integration in the machine operating panel

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 smart.Turn, 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:

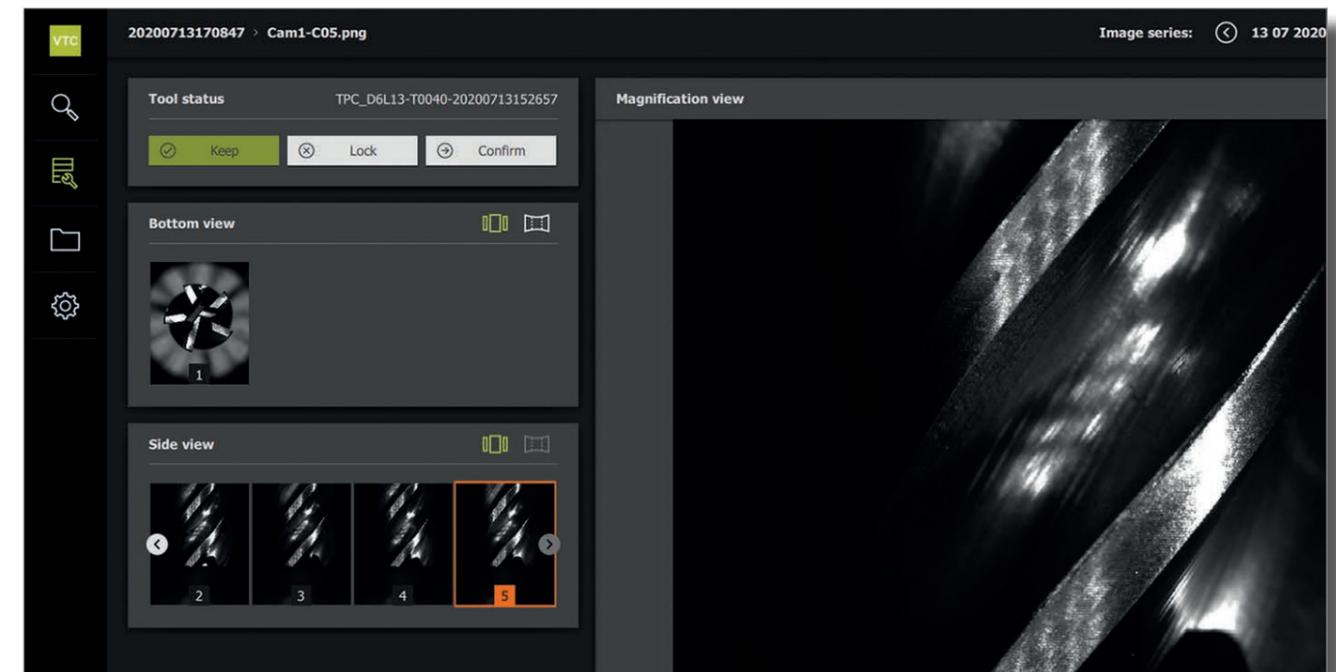
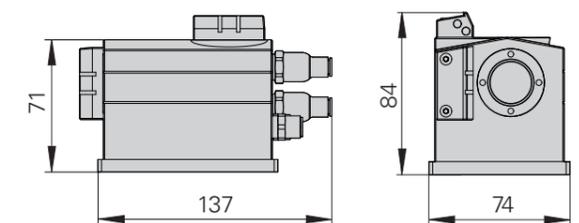
- Camera with two objectives (VT 121)
- Software with touch operation (VTC)

#### 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



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 5 Signals

- Software option
- Acquire and record five additional system-specific PLC signals
- Provide data for additional evaluation methods

### HEIDENHAIN MaintenanceManager

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

### HEIDENHAIN 5 Machines

- Software option
- Connect five additional machines



## 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).

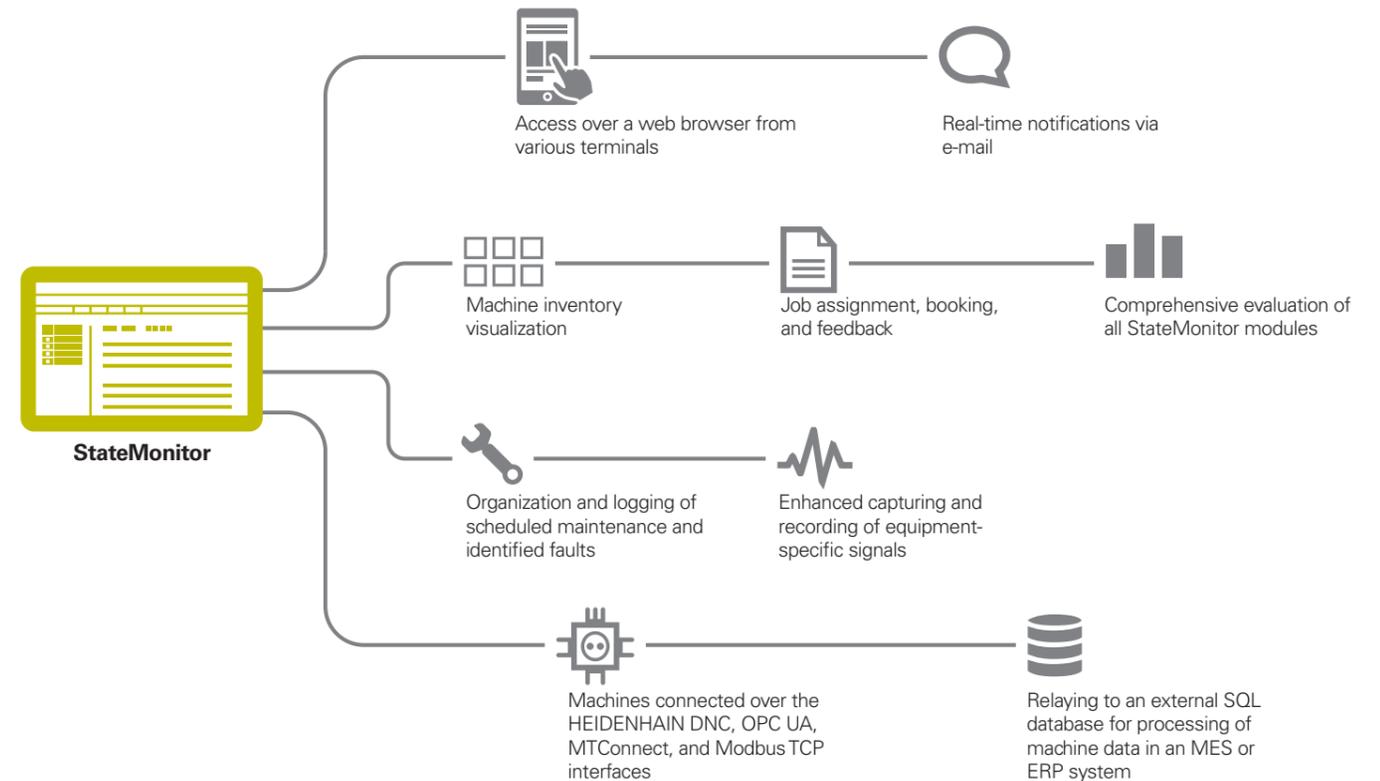
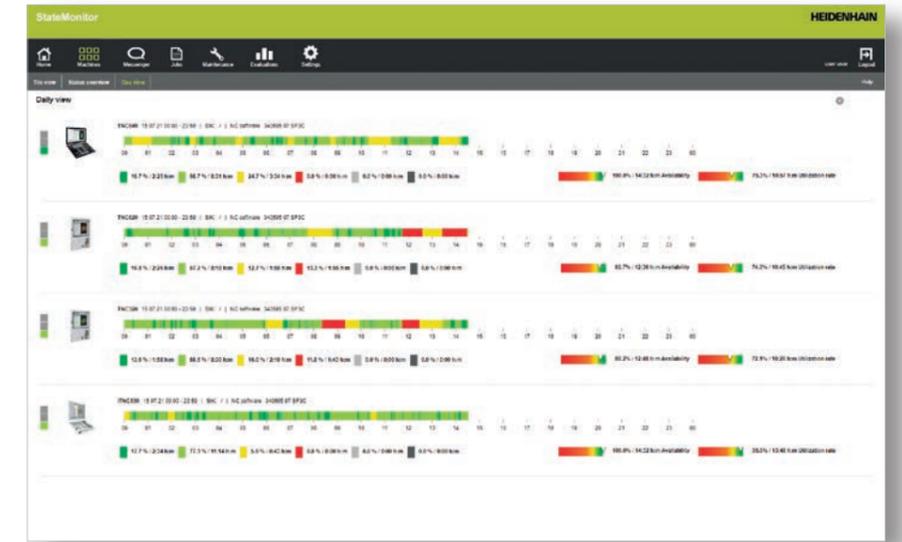
Your benefits:

- 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.



# Tool and workpiece setup and measurement

## TS workpiece touch probes

The **TS workpiece touch probes** from HEIDENHAIN help you perform setup, measuring, and inspection functions directly on the machine tool.

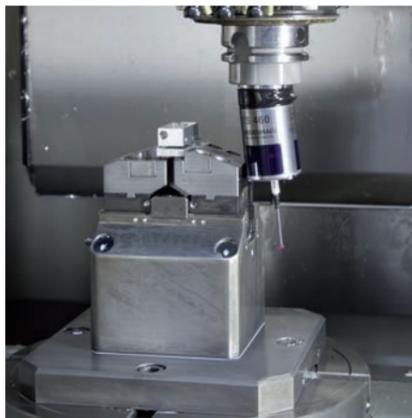
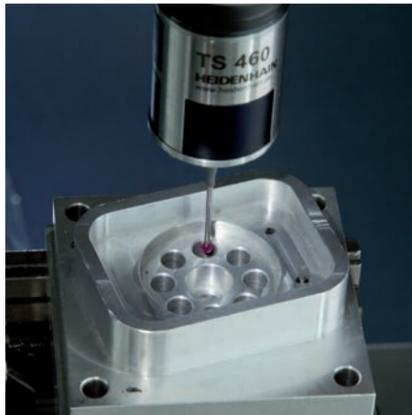
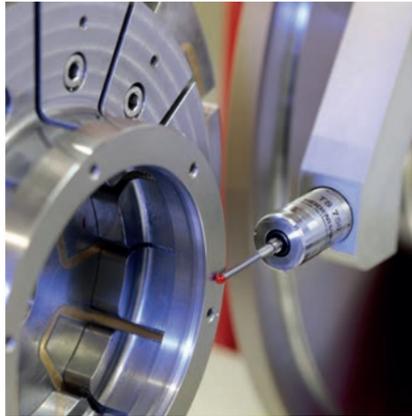
The stylus of a TS touch trigger probe is deflected upon contact with a workpiece surface. At that moment the TS generates a trigger signal that, depending on the model, is transmitted either by cable or over an infrared or radio beam to the control.

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 axial cable connection
- **TS 260**: cable-bound touch probe  
Radial or axial cable connection
- **TS 248**: cable-bound touch probe  
Radial cable connection, with reduced deflection forces



	TS 460	TS 642	TS 740	TS 260	TS 150	TS 750
<b>Machine type</b>	CNC machine tools for milling, drilling, and boring as well as lathes			CNC grinding machine or lathes		
<b>Signal transmission</b>	Radio and infrared	Infrared		Cable		
<b>Transceiver unit</b>	SE 540: infrared SE 640: infrared SE 660: radio/infrared SE 661: radio/infrared	SE 540: infrared SE 640: infrared		-		
<b>Supply voltage</b>	Rechargeable or nonrechargeable batteries			DC 15 V to 30 V		DC 15 V to 40 V <sup>1)</sup>
<b>Switching on/off</b>	Radio or infrared transmission	Switch in taper shank	Infrared transmission	-		
<b>Interface to control</b> Signal level	HTL via SE transceiver unit			HTL		
<b>Probe repeatability</b>	2 $\sigma \leq 1 \mu\text{m}$		2 $\sigma \leq 0.25 \mu\text{m}$	2 $\sigma \leq 1 \mu\text{m}$		2 $\sigma \leq 0.25 \mu\text{m}$
<b>Probe velocity</b>	$\leq 3 \text{ m/min}$		$\leq 0.25 \text{ m/min}$	$\leq 3 \text{ m/min}$		
<b>Protection EN 60529</b>	IP68					

<sup>1)</sup> Via UTI 150

## TT tool touch probes

Tool measurement on the machine shortens non-productive times, increases machining accuracy, and reduces the scrapping and reworking of machined parts. The tactile TT touch probes allow you to measure your tools efficiently and reliably.

Due to their rugged design and high degree of protection, these tool touch probes can be installed directly within the machine tool's work envelope. Tool measurement is possible at any time: before machining, between two machining steps, or after machining is done.

### 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



TT 460

	TT 160	TT 460
<b>Probing method</b>	Physical probing in three dimensions: ±X, ±Y, +Z	
<b>Probe repeatability</b>	2 σ ≤ 1 μm (probing speed 1 m/min)	
<b>Permissible deflection of probe contact</b>	≈ 5 mm in all directions	
<b>Supply voltage</b>	DC 10 V to 30 V via NC	Rechargeable or nonrechargeable batteries
<b>Interface to control</b> Signal level	HTL	SE 640: infrared SE 660: radio/infrared SE 661: radio/infrared
<b>Signal transmission</b>	Via cable	Radio wave and infrared transmission with 360° range
<b>Probe contact</b>	Ø 40 mm or Ø 25 mm	
<b>Protection EN 60529</b>	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.



	SE 660	SE 661	SE 540	SE 640
<b>TS 460</b>	Radio/infrared		Infrared	
<b>TS 642</b>	Infrared	–	Infrared	
<b>TS 740</b>	–		Infrared	
<b>TT 460</b>	Radio/infrared		Infrared	

Signal transmission types and combinations of TS, TT, and SE

## 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

For measuring and testing tasks

#### Series

ND 287  
GAGE-CHEK 2000  
EIB 700  
IK 220

#### Page

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### Digital readouts for manually operated machine tools

For milling machines, lathes, and positioning devices

POSITIP 8000  
ND 7000  
ND 5000

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### Signal converters, inspection and testing devices

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# 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.



	ND 287	GAGE-CHEK 2000	EIB 700	IK 220
<b>Application</b>	<ul style="list-style-type: none"> <li>• Measurement equipment</li> <li>• Testing devices</li> <li>• SPC inspection stations</li> </ul>	<ul style="list-style-type: none"> <li>• Positioning equipment</li> <li>• Measuring fixtures</li> </ul>	<ul style="list-style-type: none"> <li>• Inspection stations</li> <li>• Multi-gauging fixtures</li> <li>• Mobile data acquisition</li> </ul>	<ul style="list-style-type: none"> <li>• Measuring and inspection stations</li> </ul>
<b>Axes<sup>1)</sup></b>	1 (optional 2)	3	4	2
<b>Encoder inputs</b>	$\sim 1 V_{PP}$ , $\sim 11 \mu A_{PP}$ , or EnDat 2.2	$\sim 1 V_{PP}$ , $\sim 11 \mu A_{PP}$ , EnDat 2.2, or $\square$ TTL	$\sim 1 V_{PP}$ , EnDat 2.1, EnDat 2.2, or $\sim 11 \mu A_{PP}$	$\sim 1 V_{PP}$ , $\sim 11 \mu A_{PP}$ , EnDat 2.1, or SSI
<b>Display</b>	Screen	7-inch screen for multitouch operation	By PC screen	
<b>Function</b>	<ul style="list-style-type: none"> <li>• Sorting and tolerance checking</li> <li>• Measurement series with minimum and maximum value recording</li> <li>• Functions for statistical process control (SPC)</li> <li>• Graphic display of measurement results</li> <li>• Storage of measured values</li> </ul> <p><i>Optional:</i> Sum/difference display or thermal compensation</p>	<ul style="list-style-type: none"> <li>• Measurement series with minimum and maximum value recording</li> <li>• Touch probe connection for a HEIDENHAIN or Renishaw touch probe</li> <li>• Data transfer                             <ul style="list-style-type: none"> <li>Manually</li> <li>Touch-probe triggered</li> <li>Continuous</li> <li>Triggered by switching function</li> </ul> </li> <li>• User administration</li> <li>• Measurement with reference parts</li> <li>• Management of parts</li> <li>• Dial gage for a graph of the measured value</li> <li>• Diameter/radius display</li> <li>• Relative measurement</li> <li>• Probing functions</li> </ul>	<ul style="list-style-type: none"> <li>• Precise position measurement; updating rate of up to 50 kHz</li> <li>• Programmable measured-value inputs</li> <li>• Internal and external measured-value triggers</li> <li>• Measured-value memory for typically 250 000 measured values per channel</li> <li>• Standard Ethernet interface connection to higher-level computer systems</li> </ul>	<ul style="list-style-type: none"> <li>• Programmable measured-value inputs</li> <li>• Internal and external measured-value triggers</li> <li>• Measured-value memory for 8192 measured values per channel</li> </ul>
<b>Data interfaces</b>	USB; RS-232-C; <i>optional:</i> Ethernet	Ethernet, USB, RS-232-C <sup>2)</sup>	Ethernet	PCI (PC interface)

<sup>1)</sup> Depending on version

<sup>2)</sup> 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



ND 7000

	POSITIP 8000	ND 7000	ND 5000
<b>Application</b>	Milling, drilling, and boring machines and lathes		
<b>Description</b>	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
<b>Axes</b>	6, two of them as software option	3	3
<b>Encoder inputs</b>	$\sim 1 V_{PP}$ , $\sim 11 \mu A_{PP}$ , or EnDat 2.2	$\sim 1 V_{PP}$ , $\sim 11 \mu A_{PP}$ , or EnDat 2.2	TTL
<b>Display step</b>	10 $\mu m$ , 5 $\mu m$ , 1 $\mu m$ , or finer		5 $\mu m$ (with LS 328C/628C), 1 $\mu m$ (with LS 378C)
<b>Presets</b>	100		10
<b>Tool data</b>	For 100 tools		For 16 tools
<b>Programming</b>	Yes	Software option	No
<b>Functions</b>	<ul style="list-style-type: none"> <li>• Manual and MDI operation, graphical positioning aid, variable font size for display of position values</li> <li>• User administration and data management</li> </ul>		
	<ul style="list-style-type: none"> <li>• Touch probe connection</li> <li>• ACTIVE version: NC control of up to three axes (point to point), as software option</li> </ul>	Touch probe connection	–
For milling or boring operation	<ul style="list-style-type: none"> <li>• Hole patterns (circular and linear patterns)</li> <li>• Roughing of rectangular pockets</li> <li>• Probing functions for reference-point acquisition</li> <li>• Switching functions</li> </ul>		<ul style="list-style-type: none"> <li>• Circle pattern, linear pattern</li> <li>• Diagonal and arc milling</li> </ul>
	ACTIVE version: controlling the spindle speed	I/O version: controlling the spindle speed	–
For turning	<ul style="list-style-type: none"> <li>• Radius/diameter display</li> <li>• Separate or sum display for Z and Z<sub>0</sub></li> <li>• Freezing tool position for back-off/taper calculator</li> <li>• Switching functions</li> </ul>		
	ACTIVE version: constant cutting speed	I/O version: constant cutting speed	–
<b>Data interfaces</b>	Ethernet, USB		USB

## 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

$\sim 1 V_{PP}$  > TTL

$\sim 11 \mu A_{PP}$  > TTL

Incremental signals > position values

$\sim 1 V_{PP}$  > EnDat

$\sim 1 V_{PP}$  > Fanuc Serial Interface

$\sim 1 V_{PP}$  > Mitsubishi high speed Interface

Position values

EnDat > DRIVE-CLiQ

EnDat > Yaskawa Serial Interface

EnDat > PROFIBUS DP

EnDat > PROFINET

In addition to performing signal conversion, the signal converters also interpolate the sinusoidal encoder signals. This permits finer measuring steps, resulting in higher control quality and superior positioning behavior.

Various signal converters feature an integrated counter function. Starting from the last set reference point, an absolute position value is generated and output to the subsequent electronics when the reference mark is crossed.

Signal converters from HEIDENHAIN are available in various designs:

- Box design
- Plug design
- Version for integration
- Top-hat rail design



Plug design

### 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	PWM 21	PWT 101
EnDat 2.1	✓	✓
EnDat 2.2	✓	✓
DRIVE-CLiQ	✓	–
Fanuc Serial Interface	✓	✓
Mitsubishi high speed interface	✓	✓
Yaskawa Serial Interface	✓	✓
Panasonic Serial Interface	✓	✓
SSI	✓	–
1 V <sub>PP</sub> /TTL/11 $\mu$ A <sub>PP</sub>	✓	✓
1 V <sub>PP</sub> with Z1 track	✓	✓
HTL (via signal adapter)	✓	–



PWM 21 inspection device with included ATS adjusting and testing software



PWT 101 testing device for mobile application

DRIVE-CLiQ is a registered trademark of SIEMENS AG.

## 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](http://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**  
*For Numerically Controlled Machine Tools*

Contents:  
Absolute linear encoders  
**LC**  
Incremental linear encoders  
**LB, LF, LS**



Brochure  
**Length Gauges**

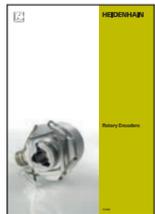
Contents:  
**HEIDENHAIN-ACANTO**  
**HEIDENHAIN-SPECTO**  
**HEIDENHAIN-METRO**  
**HEIDENHAIN-CERTO**



Brochure  
**Exposed Linear Encoders**

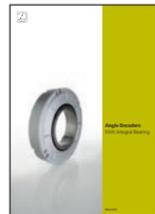
Contents:  
Absolute linear encoders  
**LIC**  
Incremental linear encoders  
**LIP, PP, LIF, LIDA**

## Angle measurement



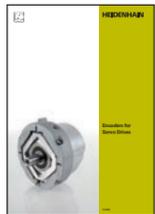
Brochure  
**Rotary Encoders**

Contents:  
Absolute rotary encoders  
**ECN, EQN, ROC, ROQ**  
Incremental rotary encoders  
**ERN, ROD**



Brochure  
**Angle Encoders with Integral Bearing**

Contents:  
Absolute angle encoders  
**RCN, ECN**  
Incremental angle encoders  
**RON, RPN, ROD**



Brochure  
**Encoders for Servo Drives**

Contents:  
Rotary encoders  
Angle encoders  
Linear encoders



Brochure  
**Modular Angle Encoders With Optical Scanning**

Contents:  
Incremental angle encoders  
**ERP, ERO, ERA**



Brochure  
**Modular Angle Encoders With Magnetic Scanning**

Contents:  
Incremental encoders  
**ERM**



Brochure  
**Angle Encoder Modules**

Contents:  
Angle encoder modules  
**MRP 2000/MRP 5000/MRP 8000**  
Angle encoder modules with integrated torque motor  
**SRP 5000, AccurET**

## Machine tool control



Brochures  
**TNC 128 Straight-Cut Control**  
**TNC 320 Contouring Control**  
**iTNC 530 Contouring Control**  
**TNC 620 Contouring Control**  
**TNC 640 Contouring Control**

Contents:  
Information for end users



OEM brochures  
**TNC 128 Straight-Cut Control**  
**TNC 320 Contouring Control**  
**iTNC 530 Contouring Control**  
**TNC 620 Contouring Control**  
**TNC 640 Contouring Control**

Contents:  
Information for machine manufacturers



Brochures  
**MANUALplus 620 Contouring Control**  
**CNC PILOT 640 Contouring Control**

Contents:  
Information for end users



OEM brochures  
**MANUALplus 620 Contouring Control**  
**CNC PILOT 640 Contouring Control**

Contents:  
Information for machine manufacturers

## Measured value acquisition and display



Brochure  
**Evaluation Electronics**  
*For Metrology Applications*

Contents:  
**ND, QUADRA-CHEK, EIB, IK**



Product Overview  
**Signal Converters**



Brochure  
**Digital Readouts/Linear Encoders**  
*For Manually Operated Machine Tools*

Contents:  
Digital readouts  
**ND, POSITIP**  
Linear encoders  
**LS**

## Setup and measurement



Brochure  
**Touch Probes**

Contents:  
Tool touch probes  
**TT**  
Workpiece touch probes  
**TS**



Brochure  
**Measuring Devices For Machine Tool Inspection and Acceptance Testing**

Contents:  
Incremental linear encoders  
**KGM, VM**

## Connecting encoders and touch probes



Brochure  
**Cables and Connectors**

Contents:  
Technical properties, cable overviews, and cable lists

HEIDENHAIN is represented by subsidiaries in all important industrial nations. In addition to the addresses listed here, there are many service agencies located worldwide. Information is available on the Internet or from HEIDENHAIN in Traunreut.

## DR. JOHANNES HEIDENHAIN GmbH

Dr.-Johannes-Heidenhain-Straße 5  
**83301 Traunreut, Germany**  
 ☎ +49 8669 31-0  
 ☎ +49 8669 32-5061  
 E-mail: info@heidenhain.de

www.heidenhain.de

## Germany

### HEIDENHAIN Vertrieb Deutschland

83301 Traunreut, Deutschland  
 ☎ 08669 31-3132  
 ☎ 08669 32-3132  
 E-Mail: hd@heidenhain.de

### HEIDENHAIN Technisches Büro Nord

12681 Berlin, Deutschland  
 ☎ 030 54705-240  
 E-Mail: tbn@heidenhain.de

### HEIDENHAIN Technisches Büro Mitte

07751 Jena, Deutschland  
 ☎ 03641 4728-250  
 E-Mail: tbn@heidenhain.de

### HEIDENHAIN Technisches Büro West

44379 Dortmund, Deutschland  
 ☎ 0231 618083-0  
 E-Mail: tbw@heidenhain.de

### HEIDENHAIN Technisches Büro Südwest

70771 Leinfelden-Echterdingen, Deutschland  
 ☎ 0711 993395-0  
 E-Mail: tbsw@heidenhain.de

### HEIDENHAIN Technisches Büro Südost

83301 Traunreut, Deutschland  
 ☎ 08669 31-1337  
 E-Mail: tbs@heidenhain.de

## Europe

### AT HEIDENHAIN Techn. Büro Österreich

Dr.-Johannes-Heidenhain-Straße 5  
 83301 Traunreut, Germany  
 ☎ +49 8669 31-1337  
 www.heidenhain.de

### BE HEIDENHAIN NV

Pamelse Klei 47  
 1760 Roosdaal, Belgium  
 ☎ +32 54 343158  
 www.heidenhain.be

### BG ESD Bulgaria Ltd.

G.M. Dimitrov Blvd.,  
 bl. 60, entr. G, fl. 1, ap 74  
 Sofia 1172, Bulgaria  
 ☎ +359 2 9632949  
 www.esd.bg

### BY GERTNER Service

ul. Zhilunovicha 11, office 204  
 220026 Minsk, Belarus  
 ☎ +375 17 390 24 30  
 www.heidenhain.by

### CH HEIDENHAIN (SCHWEIZ) AG

Vieristrasse 14  
 8603 Schwerzenbach, Switzerland  
 ☎ +41 44 8062727  
 www.heidenhain.ch

### CZ HEIDENHAIN s.r.o.

Dolnometecholupska ul. 12b  
 102 00 Praha 10, Czech Republic  
 ☎ +420 272658131  
 www.heidenhain.cz

### DK Denmark → SE

### ES FARRESA ELECTRONICA S.A.

Les Corts, 36 bajos  
 08028 Barcelona, Spain  
 ☎ +34 934092491  
 www.farresa.es

### FI HEIDENHAIN Scandinavia AB

Nuolitie 2 a 10  
 01740 Vantaa, Finland  
 ☎ +358 9 8676476  
 www.heidenhain.fi

### FR HEIDENHAIN FRANCE sarl

2 avenue de la Cristallerie  
 92310 Sèvres, France  
 ☎ +33 1 41 14 30 00  
 www.heidenhain.fr

### GB HEIDENHAIN (G.B.) Limited

200 London Road, Burgess Hill  
 West Sussex RH15 9RD, United Kingdom  
 ☎ +44 1444 247711  
 www.heidenhain.co.uk

### GR MB Milionis Vassilis

38, Scoufa Str., St. Dimitrios  
 17341 Athens, Greece  
 ☎ +30 210 9336607  
 www.heidenhain.gr

### HR Croatia → SL

### HU HEIDENHAIN Kereskedelmi Képviselet

Grassalkovich út 255.  
 1239 Budapest, Hungary  
 ☎ +36 1 4210952  
 www.heidenhain.hu

### IT HEIDENHAIN ITALIANA S.r.l.

Via Asiago, 14  
 20128 Milano, Italy  
 ☎ +39 02 27075-1  
 www.heidenhain.it

### NL HEIDENHAIN NEDERLAND B.V.

Copernicuslaan 34,  
 6716 BM Ede, Netherlands  
 ☎ +31 318 581800  
 www.heidenhain.nl

### NO HEIDENHAIN Scandinavia AB

Orkdalsveien 15  
 7300 Orkanger, Norway  
 ☎ +47 72480048  
 www.heidenhain.no

### PL APS

ul. Włodarzewska 47  
 02-384 Warszawa, Poland  
 ☎ +48 228639737  
 www.heidenhain.pl

### PT FARRESA ELECTRÓNICA LDA.

Rua do Espido, 74 C  
 4470 - 177 Maia, Portugal  
 ☎ +351 229478140  
 www.farresa.pt

### RO HEIDENHAIN Reprezentantă Romania

Str. Zizinului, nr. 110, etaj 2,  
 Braşov, 500407, Romania  
 ☎ +40 268 318476  
 www.heidenhain.ro

### RS Serbia → BG

### RU GERTNER Service

Glazovskiy Pereulok, 7, office 12  
 119002 Moscow, Russian Federation  
 ☎ +7 495 0555 100  
 www.heidenhain.ru

### SE HEIDENHAIN Scandinavia AB

Storsåtragränd 5  
 12739 Skärholmen, Sweden  
 ☎ +46 8 53193350  
 www.heidenhain.se

### SK KOPRETINA TN s.r.o.

Suvoz 1660  
 91101 Trencin, Slovakia  
 ☎ +421 32 7401700  
 www.kopretina.sk

### SL NAVO d.o.o.

Sokolska ulica 46  
 2000 Maribor, Slovenia  
 ☎ +386 2 4297216  
 www.heidenhain.si

### TR T&M Mühendislik San. ve Tic. LTD. ŞTİ.

Necip Fazıl Bulvarı, KEYAP Çarşı Sitesi  
 G1 Blok, No. 119/B  
 34775 Y. Dudullu – Ümraniye-Istanbul,  
 Turkey  
 ☎ +90 216 3141111  
 www.heidenhain.com.tr

### UA GERTNER Service

Büro Kiev  
 ul. Magnitogorskaya 1, office 203  
 FIM-Center  
 02094 Kiev, Ukraine  
 ☎ +380 44 2357574  
 www.heidenhain.ua

## The Americas

### AR NAKASE SRL.

Calle 49 Nr. 5764  
 B1653AOX Villa Ballester,  
 Provincia de Buenos Aires, Argentina  
 ☎ +54 11 47684242  
 www.heidenhain.com.ar

### BR HEIDENHAIN Brasil Ltda.

Rua Sérvia, 329 Socorro, Santo Amaro  
 04763-070 – São Paulo – SP, Brazil  
 ☎ +55 11 5696-6777  
 www.heidenhain.com.br

### CA HEIDENHAIN CORPORATION

Canadian Regional Office  
 11-335 Admiral Blvd., Unit 11  
 Mississauga, Ontario L5T2N2, Canada  
 ☎ +1 905 670-8900  
 www.heidenhain.com

### MX HEIDENHAIN CORPORATION MEXICO

Carolina Villanueva de García No. 206  
 Ciudad Industrial  
 20290 Aguascalientes, AGS., Mexico  
 ☎ +52 449 9130870  
 E-mail: info@heidenhain.com

### US HEIDENHAIN CORPORATION

333 East State Parkway  
 Schaumburg, IL 60173-5337, USA  
 ☎ +1 847 490-1191  
 www.heidenhain.us

## Asia

### CN DR. JOHANNES HEIDENHAIN (CHINA) Co., Ltd.

No. 6, TianVeiSanJie, Area A.  
 Beijing Tianzhu Airport Industrial Zone  
 Shunyi District, Beijing 101312, China  
 ☎ +86 10-80420000  
 www.heidenhain.com.cn

### ID PT SERVITAMA ERA TOOLSINDO GTS

GTS Building, Jl. Pulo Sidik Block R29  
 Jakarta Industrial Estate Pulogadung  
 Jakarta 13930, Indonesia  
 ☎ +62 21 46834111  
 E-mail: ptset@group.gts.co.id

### IL NEUMO VARGUS MARKETING LTD.

26 Hamashbir St.  
 Holon 5885948, Israel  
 ☎ +972 3 5373275  
 E-mail: neumo@neumo-vargus.co.il

### IN HEIDENHAIN Optics & Electronics India Private Limited

Citilights Corporate Centre  
 No. 1, Vivekanandan Street,  
 Off Mayor Ramanathan Road  
 Chetpet, Chennai 600 031, India  
 ☎ +91 44 4023-4300  
 www.heidenhain.in

### JP HEIDENHAIN K.K.

Hulic Kojimachi Bldg 9F  
 3-2 Kojimachi, Chiyoda-ku  
 Tokyo 102-0083, Japan  
 ☎ +81 (0)3-3234-7781  
 www.heidenhain.co.jp

### KR HEIDENHAIN Korea Ltd.

75, Jeonpa-ro 24beon-gil, Manan-gu,  
 Anyang-si, Gyeonggi-do, 14087  
 South Korea  
 ☎ +82-31-380-5200  
 www.heidenhain.co.kr

### MY ISOSERVE SDN. BHD.

No. 21, Jalan CJ 3/13-2  
 Pusat Bandar Cheras Jaya  
 43200 Balakong, Selangor  
 ☎ +03 9080 3121  
 E-mail: sales@isoserve.com.my

### NZ Llama ENGINEERING Ltd

8 Hautonga St, Petone, Lower Hutt  
 5012 Wellington, New Zealand  
 ☎ +64 4 650 3772  
 E-mail: info@llamaengineering.co.nz

### PH MACHINEBANKS' CORPORATION

482 G. Araneta Avenue,  
 Quezon City, 1113  
 Metro Manila, Philippines  
 ☎ +63 2 7113751  
 E-mail: info@machinebanks.com

### SG HEIDENHAIN PACIFIC PTE LTD

51, Ubi Crescent  
 Singapore 408593  
 ☎ +65 6749-3238  
 www.heidenhain.com.sg

### TH HEIDENHAIN (THAILAND) LTD

88, 90, 4th Floor Anek-Vunnee Building  
 Chaloeam Phra Kiat Rama 9 Road  
 Nongbon, Pravate,  
 Bangkok 10250, Thailand  
 ☎ +66 2747 2146-7  
 www.heidenhain.co.th

### TW HEIDENHAIN CO., LTD.

No. 29, 33rd Road  
 Taichung Industrial Park  
 Taichung 40768, Taiwan  
 ☎ +886 4 23588977  
 www.heidenhain.com.tw

### VN AMS Co. Ltd

243/9/10 D To Hien Thanh Street, Ward 13,  
 District 10, HCM City, Vietnam  
 ☎ +84 28 3868 3738  
 E-mail: davidgoh@amsvn.com

## Africa

### ZA MAFEMA SALES SERVICES C.C.

28 Monte Carlo Crescent  
 Ground Floor, Suite B  
 Kyalami Business Park, Main Road  
 1684 Kyalami, South Africa  
 ☎ +27 11 3144416  
 www.heidenhain.co.za

## Australia

### AU FCR MOTIONTECHNOLOGY PTY LTD

Unit 6, Automation Place,  
 38-40 Little Boundary Road  
 Laverton North Victoria 3026, Australia  
 ☎ +61 3 93626800  
 E-mail: sales@fcrmotion.com

# HEIDENHAIN

## DR. JOHANNES HEIDENHAIN GmbH

Dr.-Johannes-Heidenhain-Straße 5

83301 Traunreut, Germany

☎ +49 8669 31-0

FAX +49 8669 32-5061

E-mail: info@heidenhain.de

www.heidenhain.de

Vollständige und weitere Adressen siehe [www.heidenhain.de](http://www.heidenhain.de)  
For complete and further addresses see [www.heidenhain.com](http://www.heidenhain.com)

<b>DE</b>	<b>HEIDENHAIN Vertrieb Deutschland</b> 83301 Traunreut, Deutschland ☎ 08669 31-3132 FAX 08669 32-3132 E-Mail: hd@heidenhain.de	<b>DK</b>	Denmark → SE	<b>NZ</b>	<b>Llama ENGINEERING Ltd</b> 5012 Wellington, New Zealand E-mail: info@llamaengineering.co.nz
	<b>HEIDENHAIN Technisches Büro Nord</b> 12681 Berlin, Deutschland ☎ 030 54705-240	<b>ES</b>	<b>FARRESA ELECTRONICA S.A.</b> 08028 Barcelona, Spain www.farresa.es	<b>PH</b>	<b>MACHINEBANKS' CORPORATION</b> Quezon City, Philippines 1113 E-mail: info@machinebanks.com
	<b>HEIDENHAIN Technisches Büro Mitte</b> 07751 Jena, Deutschland ☎ 03641 4728-250	<b>FI</b>	<b>HEIDENHAIN Scandinavia AB</b> 01740 Vantaa, Finland www.heidenhain.fi	<b>PL</b>	<b>APS</b> 02-384 Warszawa, Poland www.heidenhain.pl
	<b>HEIDENHAIN Technisches Büro West</b> 44379 Dortmund, Deutschland ☎ 0231 618083-0	<b>FR</b>	<b>HEIDENHAIN FRANCE sarl</b> 92310 Sèvres, France www.heidenhain.fr	<b>PT</b>	<b>FARRESA ELECTRÓNICA, LDA.</b> 4470 - 177 Maia, Portugal www.farresa.pt
	<b>HEIDENHAIN Technisches Büro Südwest</b> 70771 Leinfelden-Echterdingen, Deutschland ☎ 0711 993395-0	<b>GB</b>	<b>HEIDENHAIN (G.B.) Limited</b> Burgess Hill RH15 9RD, United Kingdom www.heidenhain.co.uk	<b>RO</b>	<b>HEIDENHAIN Reprezentantă Romania</b> Braşov, 500407, Romania www.heidenhain.ro
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<b>AU</b>	<b>FCR MOTION TECHNOLOGY PTY LTD</b> Ravenhall Victoria 3023, Australia E-mail: sales@fcrmotion.com	<b>IN</b>	<b>HEIDENHAIN Optics &amp; Electronics India Private Limited</b> Chetpet, Chennai 600 031, India www.heidenhain.in	<b>SL</b>	<b>NAVO d.o.o.</b> 2000 Maribor, Slovenia www.heidenhain.si
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<b>BY</b>	<b>GERTNER Service</b> 220026 Minsk, Belarus www.heidenhain.by	<b>MX</b>	<b>HEIDENHAIN CORPORATION MEXICO</b> 20290 Aguascalientes, AGS., Mexico E-mail: info@heidenhain.com	<b>UA</b>	<b>GERTNER Service</b> 02094 Kiev, Ukraine www.heidenhain.ua
<b>CA</b>	<b>HEIDENHAIN CORPORATION</b> Mississauga, Ontario L5T2N2, Canada www.heidenhain.com	<b>MY</b>	<b>ISOSERVE SDN. BHD.</b> 43200 Balakong, Selangor E-mail: sales@isoserve.com.my	<b>US</b>	<b>HEIDENHAIN CORPORATION</b> Schaumburg, IL 60173-5337, USA www.heidenhain.us
<b>CH</b>	<b>HEIDENHAIN (SCHWEIZ) AG</b> 8603 Schwerzenbach, Switzerland www.heidenhain.ch	<b>NL</b>	<b>HEIDENHAIN NEDERLAND B.V.</b> 6716 BM Ede, Netherlands www.heidenhain.nl	<b>VN</b>	<b>AMS Co. Ltd</b> HCM City, Vietnam E-mail: davidgoh@amsvn.com
<b>CN</b>	<b>DR. JOHANNES HEIDENHAIN (CHINA) Co., Ltd.</b> Beijing 101312, China www.heidenhain.com.cn	<b>NO</b>	<b>HEIDENHAIN Scandinavia AB</b> 7300 Orkanger, Norway www.heidenhain.no	<b>ZA</b>	<b>MAFEMA SALES SERVICES C.C.</b> Kyalami 1684, South Africa www.heidenhain.co.za
<b>CZ</b>	<b>HEIDENHAIN s.r.o.</b> 102 00 Praha 10, Czech Republic www.heidenhain.cz				