



# HEIDENHAIN

## General Catalog

Linear Encoders  
Length Gauges  
Angle Encoders  
Rotary Encoders  
Contouring Controls  
Touch Probes  
Digital Readouts

September 2013

DR. JOHANNES HEIDENHAIN GmbH develops and manufactures linear and angle encoders, rotary encoders, digital readouts, and numerical controls. HEIDENHAIN supplies its products to manufacturers of machine tools and of automated machines and systems, in particular for semiconductor and electronics manufacturing.

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 page 60) or on the Internet at [www.heidenhain.de](http://www.heidenhain.de). Our sales personnel will be glad to help you personally. See page 62 for addresses and telephone numbers.



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## Fundamentals and processes

The high quality of HEIDENHAIN products depends on special production facilities and measuring equipment. Masters and submasters for scale manufacturing are produced in a clean room with special measures for temperature stabilization and vibration insulation. The copying machines and the machines required for the manufacture and measurement of linear and circular graduations are largely developed and built by HEIDENHAIN.

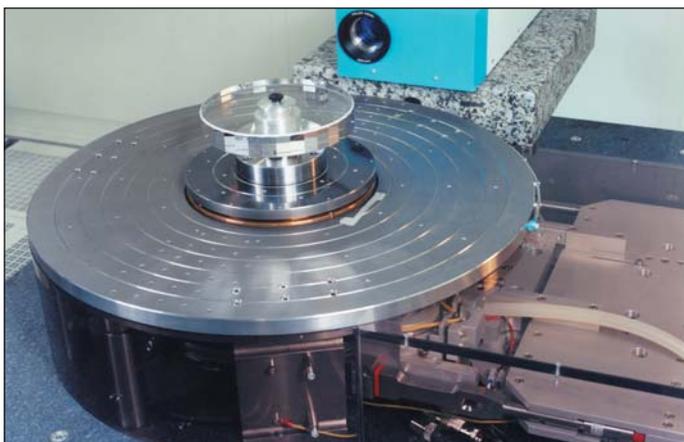


Measuring machine for linear scales



Linear scale inspection station in the lithography area

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 standard laboratories and the angular encoders for telescopes and satellite receiving antennas. Of course the products in the standard HEIDENHAIN product program profit from the knowledge gained.



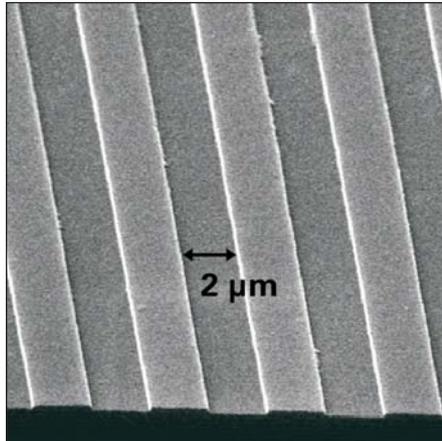
Angle comparator, measuring step approx. 0.001"



Very Large Telescope (VLT), Paranal, Chile (photograph by ESO)

# Precision graduations—the foundation for high accuracy

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

## AURODUR

AURODUR graduations consist of highly reflective gold lines and matte etched gaps. AURODUR graduations are usually on steel carriers.

## 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

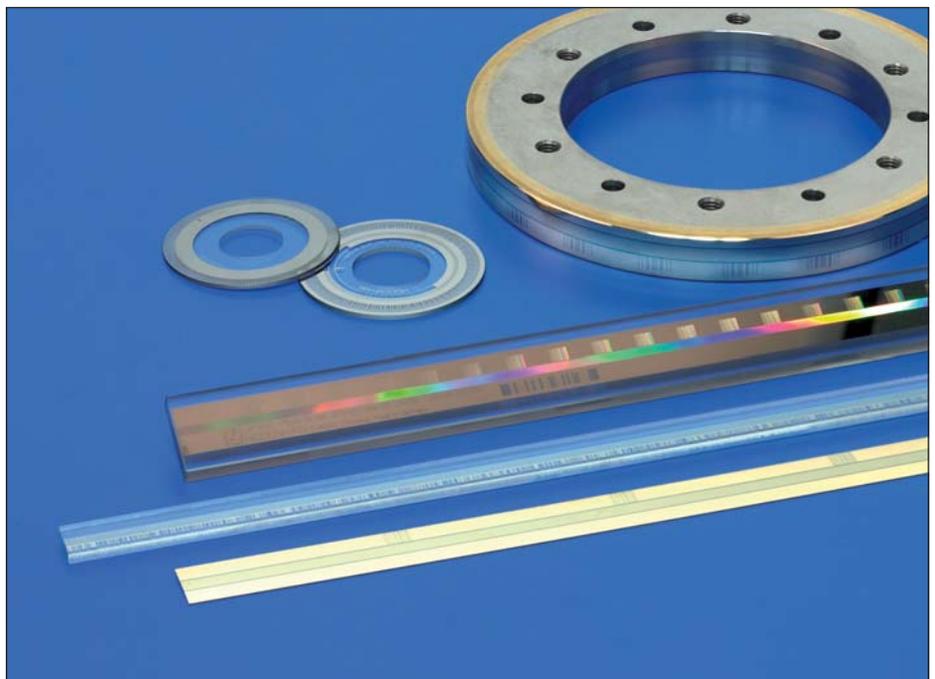
Graduations manufactured with the SUPRADUR process function optically like three-dimensional phase gratings, but they have a planar structure and are therefore particularly insensitive to contamination.

## 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



### 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 to  $0.005 \mu\text{m}$  (5 nm)
- Measuring lengths 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 datum 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		Series	Page
<b>With full-size scale housing</b>	Absolute position measurement	<b>LC 100</b>	<b>8</b>
	Absolute position measurement and large measuring lengths	<b>LC 200</b>	
	Incremental position measurement	<b>LS 100</b>	
	Very high repeatability	<b>LF 100</b>	
	Typically for manual machines	<b>LS 600</b>	
<b>With Slimline Scale Housing</b>	Absolute position measurement	<b>LC 300</b>	<b>10</b>
	Incremental position measurement	<b>LS 400</b>	
	Very high repeatability	<b>LF 400</b>	
	Typically for manual machines	<b>LS 300</b>	
<b>Exposed linear encoders</b>	Very high accuracy	<b>LIP, LIF</b>	<b>12</b>
	Two-coordinate encoders	<b>PP</b>	<b>13</b>
	High traversing speed and large measuring lengths	<b>LIDA</b>	<b>14</b>
	Absolute position measurement	<b>LIC</b>	
<b>Length gauges</b>	For measuring stations and multipoint inspection apparatuses	<b>AT, CT, MT, ST</b>	<b>16</b>

# 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 any previous traverse required. 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 or AURODUR graduation—is delivered as a single piece, and after the housing sections have been mounted, is pulled into the housing, drawn to a defined tension and fixed at both ends to the machine casting.

### LC 100 series

- **Absolute position measurement**
- Defined thermal behavior
- High vibration rating
- Two mounting attitudes
- Single-field scanning

### LC 200 series

- **Absolute position measurement for large measuring lengths** up to 28 m
- Defined thermal behavior
- High vibration rating
- Two mounting attitudes
- Single-field scanning

### LS 100 series

- **Incremental position measurement**
- Defined thermal behavior
- High vibration rating
- Two mounting attitudes
- Single-field scanning

### LF 185

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

### LB 382

- **For large measuring lengths** up to 30 m<sup>3</sup>
- Defined thermal behavior
- High vibration rating
- Two mounting attitudes
- Single-field scanning

### LS 600 series

- **Typically for manual machines**
- Simple installation

#### Measuring standard

Grating period

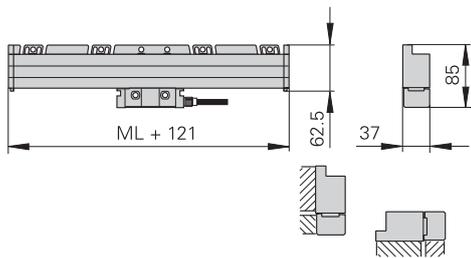
#### Interface

Signal period

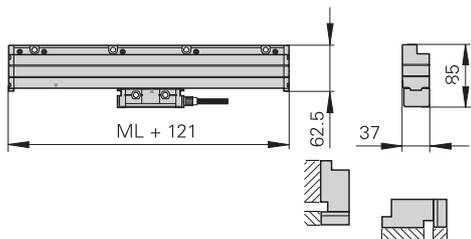
#### Accuracy grade

#### Measuring lengths ML

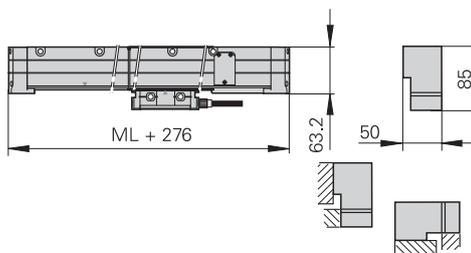
#### Reference mark



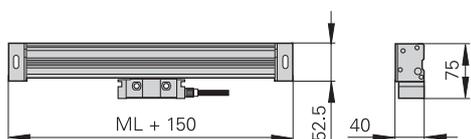
LC 100



LF 185



LC 200



LS 600

<b>Absolute</b> LC 115 LC 195F/M/S <sup>1)</sup>	LC 211/LC 281 LC 291F/M	<b>Incremental</b> LF 185	LS 187 LS 177	LS 688C LS 628C	LB 382
DIADUR glass scale 20 µm	METALLUR steel scale 40 µm	SUPRADUR phase grating on steel 8 µm	DIADUR glass scale 20 µm	DIADUR glass scale 20 µm	AURODUR steel scale tape 40 µm
LC 115: EnDat 2.2 LC 195: Fanuc αi/ Mitsubishi/ Siemens 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	LS 688C: ~ 1 V <sub>PP</sub> LS 628C: □TTL	~ 1 V <sub>PP</sub>
–	40 µm	4 µm	LS 187: 20 µm LS 177: 4 µm/2 µm <sup>2)</sup>	20 µm	40 µm
± 5 µm, ± 3 µm	± 5 µm	± 3 µm, ± 2 µm	± 5 µm, ± 3 µm	± 10 µm	± 5 µm
Up to 4240 mm	Up to 28040 mm	Up to 3040 mm	Up to 3040 mm		Up to 30040 mm <sup>3)</sup>
–		One or distance-coded; LS 6xxC: distance-coded			

<sup>1)</sup> Available upon request

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

<sup>3)</sup> Up to ML 72040 mm upon request

# 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 any previous traverse required. 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**.

### LC 400 series

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

### LS 400 series

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

### LF 485

- **Very high repeatability**
- Thermal behavior similar to steel or cast iron
- Single-field scanning

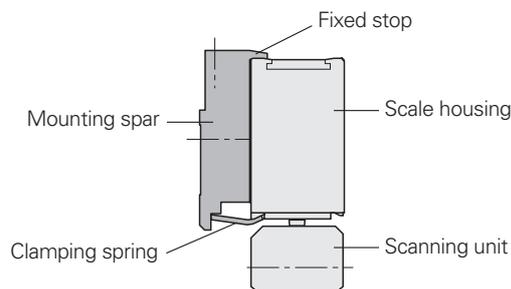
### LS 300 series

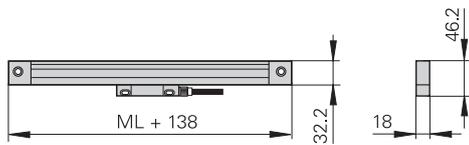
- **Typically for manual machines**

### Simple installation with mounting spar

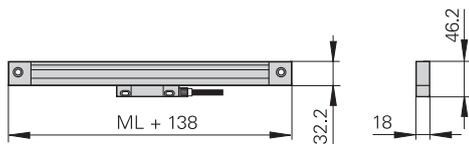
The use of a mounting spar can be of great benefit when mounting slimline linear encoders. It can be fastened as part of the machine assembly process. The encoder is then simply clamped on during final mounting. Easy exchange also facilitates servicing.

Moreover, installation with a mounting spar significantly improves the encoder's acceleration behavior.

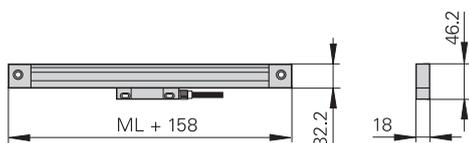




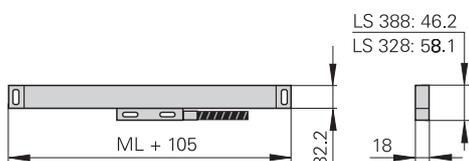
LC 400



LS 400



LF 485



LS 300

	<b>Absolute</b> LC 415 LC 495F/M/S <sup>1)</sup>	<b>Incremental</b> LF 485	LS 487 LS 477	LS 388C LS 328C
<b>Measuring standard</b>	DIADUR glass scale	SUPRADUR phase grating on steel	DIADUR glass scale	DIADUR glass scale
Grating period	20 µm	8 µm	20 µm	20 µm
<b>Interface</b>	LC 415: EnDat 2.2 LC 495: Fancu αi/Mitsubishi/ Siemens DRIVE-CLiQ	~ 1 V <sub>PP</sub>	LS 487: ~ 1 V <sub>PP</sub> LS 477: □□TTL	LS 388C: ~ 1 V <sub>PP</sub> LS 328C: □□TTL
Signal period	–	4 µm	LS 487: 20 µm LS 477: 4 µm/2 µm <sup>2)</sup>	20 µm
<b>Accuracy grade</b>	± 5 µm, ± 3 µm	± 5 µm, ± 3 µm		± 10 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

<sup>1)</sup> Available upon request      <sup>2)</sup> Integrated interpolation 5/10-fold

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

# LIP, LIF exposed linear encoders

For very high accuracy

The exposed linear encoders of the **LIP** and **LIF** types 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

The LIF 481V is suited for special **applications in high vacuum** (to  $10^{-7}$  bar).

## LIP 300 series

- **Very high resolution** with measuring steps to 1 nm
- Very high repeatability through an extremely fine signal period
- Defined thermal behavior thanks to a measuring standard on Zerodur glass ceramic

## LIP 200 series

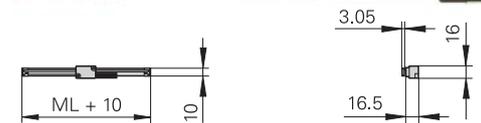
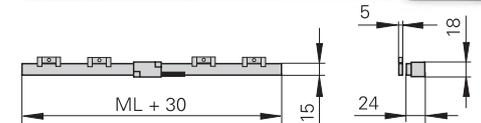
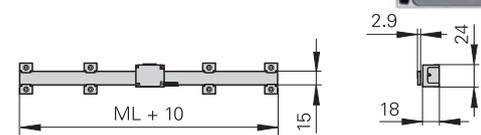
- Measuring lengths up to 3040 mm
- Measuring step down to 1 nm
- Very high repeatability with compact dimensions
- Defined thermal behavior thanks to a measuring standard on Zerodur glass ceramic

## LIP 400 series

- Small dimensions
- Measuring steps as fine as  $0.005 \mu\text{m}$
- Scale available with various thermal expansion coefficients

## LIF 400 series

- **Fast, simple scale fastening** with PRECIMET adhesive film
- Relatively insensitive to contamination thanks to SUPRADUR graduation
- Position detection through limit switches and homing track



	<b>Incremental</b> <b>LIP 382</b> <b>LIP 372</b>	<b>LIP 281</b>	<b>LIP 481</b> <b>LIP 471</b>
<b>Measuring standard</b>	DIADUR phase grating on Zerodur glass ceramic Grating period 0.512 $\mu\text{m}$ Coefficient of linear expansion $\alpha_{\text{therm}} \approx (0 \pm 0.1) \times 10^{-6} \text{K}^{-1}$	OPTODUR phase grating on Zerodur glass ceramic 2.048 $\mu\text{m}$ $\alpha_{\text{therm}} \approx (0 \pm 0.1) \times 10^{-6} \text{K}^{-1}$	DIADUR phase grating on glass or Zerodur glass ceramic 4 $\mu\text{m}$ $\alpha_{\text{therm}} \approx 8 \times 10^{-6} \text{K}^{-1}$ (glass) or $\alpha_{\text{therm}} \approx (0 \pm 0.1) \times 10^{-6} \text{K}^{-1}$ (Zerodur)
<b>Interface</b>	<b>LIP 382:</b> $\sim 1 \text{V}_{\text{PP}}$ <b>LIP 372:</b> $\square$ TTL	$\sim 1 \text{V}_{\text{PP}}$	<b>LIP 481:</b> $\sim 1 \text{V}_{\text{PP}}$ <b>LIP 471:</b> $\square$ TTL
Signal period	<b>LIP 382:</b> 0.128 $\mu\text{m}$ <b>LIP 372:</b> 0.004 $\mu\text{m}$ <sup>1)</sup>	0.512 $\mu\text{m}$	<b>LIP 481:</b> 2 $\mu\text{m}$ <b>LIP 471:</b> 0.4 $\mu\text{m}$ /0.2 $\mu\text{m}$ <sup>2)</sup>
<b>Accuracy grade</b>	$\pm 0.5 \mu\text{m}$	$\pm 1 \mu\text{m}; \pm 3 \mu\text{m}$	$\pm 1 \mu\text{m}; \pm 0.5 \mu\text{m}$
<b>Position error per signal period</b> typically	$\pm 0.001 \mu\text{m}$	$\pm 0.001 \mu\text{m}$	$\pm 0.02 \mu\text{m}$
<b>Measuring lengths ML</b>	70 mm to 270 mm	20 mm to 3040 mm	70 mm to 420 mm
<b>Reference mark</b>	None	One	One

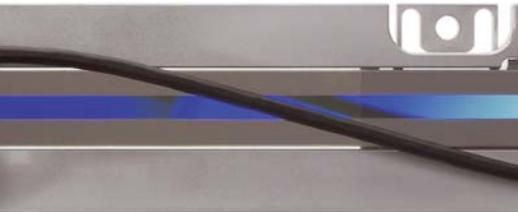
<sup>1)</sup> Integrated 32-fold interpolation

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

<sup>3)</sup> Only for Zerodur glass ceramics

# PP exposed linear encoders

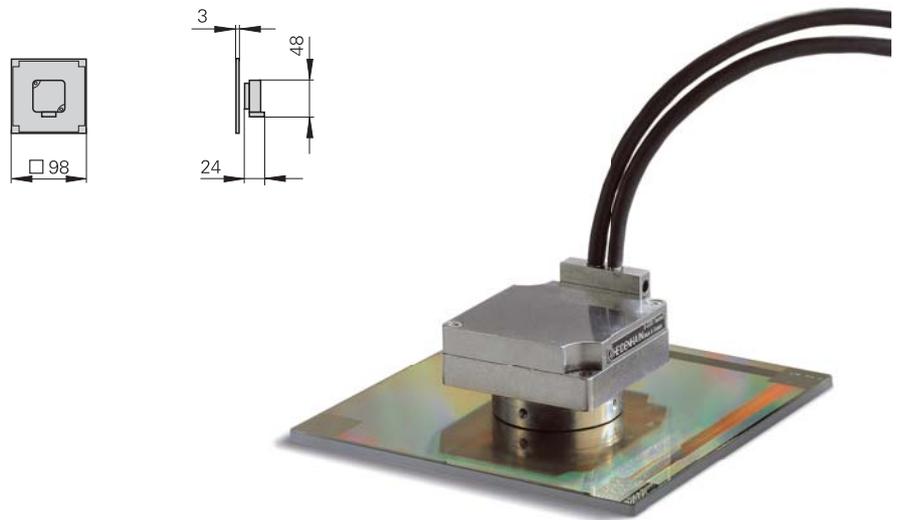
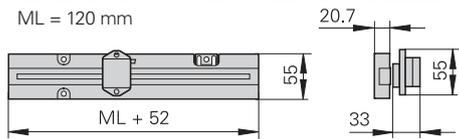
## Two-coordinate encoders



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



LIF 481 LIF 471
SUPRADUR phase grating on glass or Zerodur glass ceramic 8 $\mu\text{m}$ $\alpha_{\text{therm}} \approx 8 \times 10^{-6} \text{ K}^{-1}$ (glass) or $\alpha_{\text{therm}} \approx (0 \pm 0.1) \times 10^{-6} \text{ K}^{-1}$ (Zerodur)
LIF 481: $\sim$ 1 V <sub>PP</sub> LIF 471: $\square$ TTL
LIF 481: 4 $\mu\text{m}$ LIF 471: 0.8 $\mu\text{m}$ to 0.04 $\mu\text{m}^2$
$\pm 1 \mu\text{m}^3$ ; $\pm 3 \mu\text{m}$
$\pm 0.04 \mu\text{m}$
70 mm to 1020 mm (up to 3040 mm on request)
One

	Incremental PP 281
<b>Measuring standard</b> Grating period Coefficient of linear expansion	DIADUR phase grating on glass 8 $\mu\text{m}$ $\alpha_{\text{therm}} \approx 8 \times 10^{-6} \text{ K}^{-1}$
<b>Interface</b>	$\sim$ 1 V <sub>PP</sub>
Signal period	4 $\mu\text{m}$
<b>Accuracy grade</b>	$\pm 2 \mu\text{m}$
<b>Position error per signal period</b> typically	$\pm 0.04 \mu\text{m}$
<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** up to 10 m/s and **large measuring lengths** of up to 30 m.

The **LICs** make **absolute position measurement** possible over measuring lengths up to 27 m. In their dimensions and mounting they correspond to LIDA 400 incremental linear encoders.

On the **LIC** and **LIDA** linear encoders, steel scale tapes typically serve as substrate for METALLUR graduations. With the **LIDA 403**, 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
- Testing machines
- PCB assembly machines
- PCB drilling machines
- Precision handling devices
- Position and velocity measurement on linear motors

LIC and LIDA are particularly easy to mount with **various mounting possibilities**:

## LIDA 403

- Scale of glass or glass ceramic is bonded directly onto the mounting surface.

## LIC 4015, LIDA 4x5

- One-piece steel scale tape is drawn into an aluminum extrusion and tensioned at its ends
- The aluminum extrusions can be screwed or bonded onto the mounting surface.

## LIC 4017, LIDA 4x7, LIDA 2x7

- One-piece steel scale-tape is drawn into aluminum extrusions and fixed at center.
- The aluminum extrusions are bonded onto the mounting surface.

## LIC 4019, LIDA 4x9, LIDA 2x9

- One-piece steel scale tape is bonded directly to the mounting surface.

## LIC 4000 series

- **Absolute position acquisition** up to 27 m
- Compatible in its mounting dimensions to the LIDA 400
- Various mounting options

## LIDA 400 series

- Large **measuring lengths up to 30 m**
- Various mounting options
- Limit switches

## LIDA 200 series

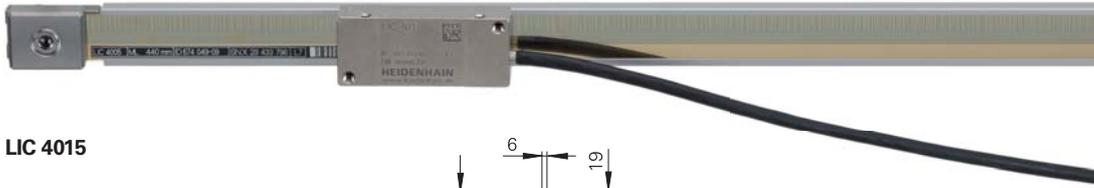
- **Scale tape cut from roll**
- Large mounting tolerances
- For simple applications

	<b>Absolute</b> <b>LIC 4015</b>		<b>LIC 4017</b>	<b>LIC 4019</b>	<b>Incremental</b> <b>LIDA 483</b> <b>LIDA 473</b>	
<b>Measuring standard</b> Grating period Coefficient of linear expansion	METALLUR steel scale tape 20 µm <i>LIC 4015</i> : $\alpha_{\text{therm}}$ Same as mounting surface <i>LIC 4017/LIC 4019</i> : $\alpha_{\text{therm}} \approx 10 \times 10^{-6} \text{ K}^{-1}$				METALLUR graduation on glass ceramic or glass 20 µm $\alpha_{\text{therm}} \approx 8 \times 10^{-6} \text{ K}^{-1}$ (glass) $\alpha_{\text{therm}} \approx 0 \times 10^{-6} \text{ K}^{-1}$ (Robax glass ceramic) $\alpha_{\text{therm}} \approx (0 \pm 0.1) \times 10^{-6} \text{ K}^{-1}$ (Zerodur glass ceramic)	
<b>Interface</b>	EnDat 2.2				<i>LIDA 483</i> : $\sim 1 \text{ V}_{\text{PP}}$ ; <i>LIDA 473</i> : $\square$ TTL	
Signal period	–				<i>LIDA 483</i> : 20 µm; <i>LIDA 473</i> : 4 µm/2 µm/0.4 µm/0.2 µm <sup>1)</sup>	
<b>Accuracy grade</b>	± 5 µm	± 3 µm <sup>3)</sup> ; ± 5 µm; ± 15 µm		± 1 µm <sup>4)</sup> ; ± 3 µm; ± 5 µm		
<b>Position error per signal period</b> typically	± 0.08 µm				± 0.2 µm	
<b>Measuring lengths ML</b>	140 mm to 27040 mm	240 mm to 6040 mm	70 mm to 1020 mm		240 to 3040 mm (Robax glass ceramics to 1640 mm)	
<b>Reference mark</b>	–				One or distance-coded	

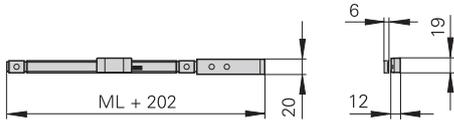
<sup>1)</sup> Integrated 5/10/50/100-fold interpolation

<sup>2)</sup> Integrated 10/50/100-fold interpolation

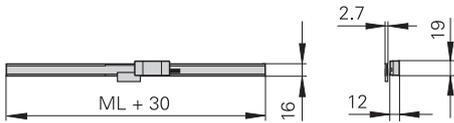
<sup>3)</sup> Up to 1020 mm or 1040 mm measuring length



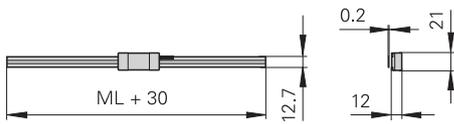
LIC 4015



LIDA 487



LIDA 279



LIDA 485 LIDA 475	LIDA 487 LIDA 477	LIDA 489 LIDA 479	LIDA 287 LIDA 277	LIDA 289 LIDA 279
METALLUR steel scale tape 20 µm <i>LIDA 4x5</i> : $\alpha_{\text{therm}}$ Same as mounting surface <i>LIDA 4x7/LIDA 4x9</i> : $\alpha_{\text{therm}} \approx 10 \times 10^{-6} \text{ K}^{-1}$			Steel scale tape 200 µm $\alpha_{\text{therm}} \approx 10 \times 10^{-6} \text{ K}^{-1}$	
<i>LIDA 48x</i> : $\sim 1 V_{\text{PP}}$ ; <i>LIDA 47x</i> : $\square$ TTL			<i>LIDA 28x</i> : $\sim 1 V_{\text{PP}}$ ; <i>LIDA 27x</i> : $\square$ TTL	
<i>LIDA 48x</i> : 20 µm; <i>LIDA 47x</i> : 4 µm/2 µm/0.4 µm/0.2 µm <sup>1)</sup>			<i>LIDA 28x</i> : 200 µm; <i>LIDA 27x</i> : 20 µm/4 µm/2 µm <sup>2)</sup>	
± 5 µm		± 3 µm <sup>3)</sup> ; ± 5 µm; ± 15 µm	± 15 µm	
± 0.2 µm			± 2 µm	
140 mm to 30040 mm	240 mm to 6040 mm		Scale tape from the roll 3 m/5 m/10 m	
One			Selectable every 100 mm	

<sup>4)</sup> Only for Zerodur glass ceramics up to ML 1640 mm

# 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 up to 100 mm. They feature plungers with integral bearings and therefore serve as compact measuring devices.

The **HEIDENHAIN-CERTO** CT length gauge 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, quality control, but also 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.

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

- Absolute position measurement
- Compact dimensions
- Plug-in cables
- Measuring ranges up to 30 mm

## HEIDENHAIN-CERTO

- Very high accuracy
- Large measuring range up to 60 mm
- Very high thermal stability

## HEIDENHAIN-METRO

MT 1200 and MT 2500

- High accuracy
- Measuring range up to 25 mm
- High repeatability

## HEIDENHAIN-METRO

MT 60 and MT 101

- Large measuring range up to 100 mm
- High repeatability

## HEIDENHAIN-SPECTO

- Very compact dimensions
- Measuring range up to 25 mm
- Ball-bush guided plunger

	<b>Absolute</b> AT 1218 AT 1217		AT 3018 AT 3017	<b>Incremental</b> CT 2501 CT 2502		CT 6001 CT 6002	MT 1281 MT 1287	MT 1271
<b>Measuring standard</b>	DIADUR glass scale			DIADUR phase grating on Zerodur glass ceramic scale Coefficient of linear expansion: $\alpha_{\text{therm}} \approx 0 \pm 0.1 \times 10^{-6} \text{ K}^{-1}$				
Grating period	188.4 $\mu\text{m}$			4 $\mu\text{m}$		4 $\mu\text{m}$		
<b>Interface</b>	EnDat 2.2			$\sim 11 \mu\text{A}_{\text{PP}}$		$\sim 1 \text{V}_{\text{PP}}$		$\square$ TTL
Signal period	–			2 $\mu\text{m}$		2 $\mu\text{m}$		0.4 $\mu\text{m}/0.2 \mu\text{m}^{(3)}$
<b>System accuracy</b>	$\pm 2 \mu\text{m}$			$\pm 0.1 \mu\text{m}^{(1)}$ $\pm 0.03 \mu\text{m}^{(2)}$		$\pm 0.1 \mu\text{m}^{(1)}$ $\pm 0.05 \mu\text{m}^{(2)}$		$\pm 0.2 \mu\text{m}$
<b>Measuring range</b>	12 mm	30 mm		25 mm	60 mm		12 mm	
<b>Plunger actuation</b>	AT xx18: By measured object AT xx17: Pneumatically			CT xx01: With motor CT xx02: By coupling			MT xxx1: Cable-type lifter or free MT xx87: pneumatic	
<b>Reference mark</b>	–			One			One	

<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> Integrated 5/10-fold interpolation



MT 101 M



CT 6001



MT 2581



AT 3018



ST 3088

MT 2581 MT 2587		MT 2571	MT 60M MT 60K	MT 101M MT 101K	ST 1288 ST 1287	ST 1278 ST 1277	ST 3088 ST 3087	ST 3078 ST 3077
			DIADUR graduation on glass ceramic scale		DIADUR glass scale			
			10 µm		20 µm			
~ 1 V <sub>PP</sub>		□TTL	~ 11 µA <sub>PP</sub>		~ 1 V <sub>PP</sub>		~ 1 V <sub>PP</sub>	□TTL
2 µm		0.4 µm/0.2 µm <sup>3)</sup>	10 µm		20 µm		20 µm	4 µm/2 µm <sup>3)</sup>
			± 0.5 µm	± 1 µm	± 1 µm			
25 mm			60 mm	100 mm	12 mm		30 mm	
			<i>MT xxM</i> : With motor <i>MT xxK</i> : By coupling		<i>ST xxx8</i> : By measured object <i>ST xxx7</i> : Pneumatically			
			One		One			

# Angle measurement

## Angle encoders

HEIDENHAIN angle encoders are characterized by high accuracy values in the angular second range and better. These devices are used in applications such as rotary tables, swivel heads of machine tools, dividing apparatuses, 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  $0.00001^\circ$  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 also, 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 and handling devices, as well as various types of measuring, testing, and inspection devices.

- Line counts of typically 50 to 5000
- Accuracy from  $\pm 12''$  (depending on the line count, corresponding to  $\pm 1/20$  of the grating period)
- Measuring steps to 0.001. Particularly with the photoelectric 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. During angular acceleration of the shaft, the stator coupling must absorb only that torque resulting from friction in the bearing, thereby minimizing both static and dynamic measuring error. Moreover, the coupling mounted on the stator compensates axial motion of the measured shaft. Other benefits of the stator coupling are:

- Simple installation
- Short overall length
- High natural frequency of the coupling
- Hollow through shaft is possible

Angle encoders and rotary encoders with integral bearings that are conceived 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:

- Requires little space
- 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 datum 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 transmitted over an **EnDat, SSI, PROFIBUS-DP, PROFINET or other serial data interface**. The EnDat-Interface, PROFIBUS-DP or PROFINET bidirectional interfaces enable automatic configuration of the higher-level electronics and provide monitoring and diagnostic functions.

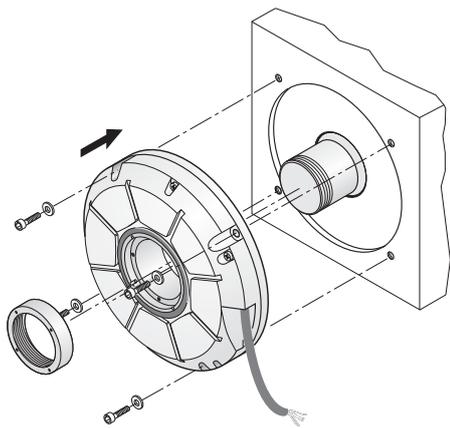
Under the designation **functional safety**, HEIDENHAIN offers encoders with purely serial data transmission as single-encoder systems for safety-related machines and systems. The two measured values are already formed independently of each other in the encoder, and are transmitted to the safe control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

Angle encoders		Series	Page
<b>With integral bearing and integrated stator coupling</b>	Absolute (singleturn) Incremental	<b>RCN</b> <b>RON, RPN</b>	<b>20</b>
<b>With integral bearing, for separate shaft coupling</b>	Incremental	<b>ROD</b>	<b>22</b>
<b>Without integral bearing</b>	Incremental	<b>ERP, ERO, ERA</b>	<b>23 – 27</b>
<b>Modular encoders</b>	Incremental	<b>ERM</b>	<b>28</b>
<b>Rotary encoders</b>			
<b>With integral bearing, for mounting by stator coupling</b>	Absolute (singleturn/multiturn) Incremental	<b>ECN/EQN</b> <b>ERN</b>	<b>30, 32</b>
<b>With integral bearing, for separate shaft coupling</b>	Absolute (singleturn/multiturn) Incremental	<b>ROC/ROQ, RIC/RIQ</b> <b>ROD</b>	<b>34</b>
<b>Without integral bearing</b>	Absolute (singleturn/multiturn) Incremental	<b>ECI/EQI</b> <b>ERO</b>	<b>36</b>

# RCN, RON, RPN 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 units for high-precision applications such as rotary tables and tilting axes. The measuring standard is a circular scale with DIADUR graduation or—with the RPN—a phase grating. For the units 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.



Features of the **RCN 2000, RCN 5000** and **RCN 8000** series angle encoders:

- **Optimized scanning** with large scanning surface for absolute track (serial code structure) and incremental track (single-field scanning and optical filtering)
- **Large mounting tolerances** thanks to optimized stator coupling with improved torsional rigidity and revised shaft seal
- **Plug-in cable with quick disconnect**
- **Scanning and evaluation electronics** for a large power supply range and additional monitoring and diagnostic capabilities

### RCN 2000 and RON 200 series

- **Compact design**
- Sturdy design
- Typically used with rotary tables, tilting tables, for positioning and speed control
- Versions in stainless steel (e.g. for antennas) available on request



### RCN 5000 series

- **Large hollow shaft and small installation space**
- Stator mounting dimensions compatible with RCN 2000 and RON 200



### RCN 8000, RON 700 and RON/RPN 800 series

- **Large hollow shaft diameter** up to  $\varnothing 100$  mm
- System accuracy  $\pm 2''$  and  $\pm 1''$
- Typically used on rotary and angle measuring tables, indexing fixtures, measuring setups, image scanners



**RCN 8000**  
D = 60 mm or 100 mm  
**RON 786/886, RPN 886**  
D = 60 mm

### RON 905

- **Very high-accuracy angle encoder**
- System accuracy  $\pm 0.4''$
- Used with high-accuracy measuring devices and for the inspection of measuring equipment



	<b>Absolute</b> RCN 2380 RCN 2580	RCN 2310 RCN 2510	RCN 2390F RCN 2590F	RCN 2390M <sup>2)</sup> RCN 2590M <sup>2)</sup>	<b>Incremental</b> RON 225 RON 275	RON 285 RON 287
<b>Interface</b>	EnDat 2.2 <sup>1)</sup> with $\sim 1 V_{PP}$	EnDat 2.2 <sup>1)</sup>	Fanuc $\alpha$ i	Mitsubishi	$\square$ TTL	$\sim 1 V_{PP}$
Position values/rev	RCN 23x0: 67 108 864 (26 bits); RCN 25x0: 268 435 456 (28 bits)				–	
Signal periods/rev	16384	–			18000 <sup>3)</sup> 90000/180000 <sup>4)</sup>	18000
<b>System accuracy</b>	RCN 23x0: $\pm 5''$ ; RCN 25x0: $\pm 2.5''$				$\pm 5''$	$\pm 5''$ ; $\pm 2.5''$
<b>Mech. perm. speed</b>	$\leq 1500 \text{ min}^{-1}$				$\leq 3000 \text{ min}^{-1}$	

	<b>Absolute</b> RCN 5380 RCN 5580	RCN 5310 RCN 5510	RCN 5390F RCN 5590F	RCN 5390M <sup>2)</sup> RCN 5590M <sup>2)</sup>
<b>Interface</b>	EnDat 2.2 <sup>1)</sup> with $\sim 1 V_{PP}$	EnDat 2.2 <sup>1)</sup>	Fanuc $\alpha$ i	Mitsubishi
Position values/rev	RCN 53x0: 67 108 864 (26 bits); RCN 55x0: 268 435 456 (28 bits)			
Signal periods/rev	16384	–		
<b>System accuracy</b>	RCN 53x0: $\pm 5''$ ; RCN 55x0: $\pm 2.5''$			
<b>Mech. perm. speed</b>	$\leq 1500 \text{ min}^{-1}$			

	<b>Absolute</b> RCN 8380 RCN 8580	RCN 8310 RCN 8510	RCN 8390F RCN 8590F	RCN 8390M <sup>2)</sup> RCN 8590M <sup>2)</sup>	<b>Incremental</b> RON 786	RON 886	RPN 886
<b>Interface</b>	EnDat 2.2 <sup>1)</sup> with $\sim 1 V_{PP}$	EnDat 2.2 <sup>1)</sup>	Fanuc $\alpha$ i	Mitsubishi	$\sim 1 V_{PP}$		
Position values/rev	536870912 (29 bits)				–		
Signal periods/rev	32 768	–	–		18000, 36000	36000	180000
<b>System accuracy</b>	RCN 83x0: $\pm 2''$ ; RCN 85x0: $\pm 1''$				$\pm 2''$	$\pm 1''$	
<b>Mech. perm. speed</b>	$\leq 500 \text{ min}^{-1}$				$\leq 1000 \text{ min}^{-1}$		

	<b>Incremental</b> RON 905
<b>Interface</b>	$\sim 11 \mu A_{PP}$
Signal periods/revolution	36000
<b>System accuracy</b>	$\pm 0.4''$
<b>Mech. perm. speed</b>	$\leq 100 \text{ min}^{-1}$

1) DRIVE-CLiQ via EIB; PROFIBUS-DP via gateway

2) Available upon request

3) Integrated 2-fold interpolation

4) Integrated 5/10-fold interpolation

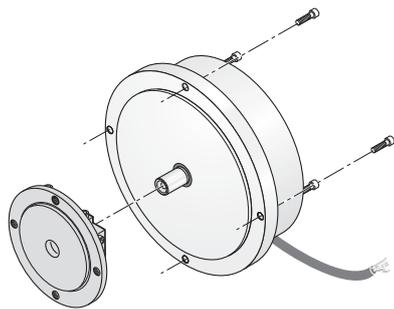
DRIVE-CLiQ is a registered trademark of the Siemens Aktiengesellschaft

# ROD angle encoders

With integral bearing, for separate shaft coupling

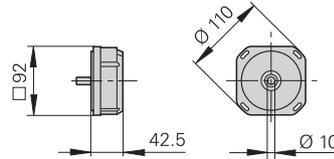
**ROD** angle encoders with solid shaft for separate shaft coupling are particularly attractive for applications where high shaft speeds and large mounting tolerances are required. The precision shaft couplings allow axis motion up to  $\pm 1$  mm.

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 determine the system accuracy.



## ROD 200 series

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

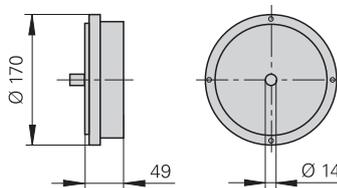


	<b>Incremental ROD 220</b>	<b>ROD 270</b>	<b>ROD 280</b>
<b>Interface</b>	□ TTL	□ TTL	~ 1 V <sub>PP</sub>
Signal periods/rev	18000 <sup>2)</sup>	180000 <sup>3)</sup>	18000
<b>System accuracy<sup>1)</sup></b>	± 5"		
<b>Mech. permissible speed</b>	≤ 10000 min <sup>-1</sup>		

- 1) Without shaft coupling  
 2) Integrated 2-fold interpolation  
 3) Integrated 10-fold interpolation

## ROD 780 and ROD 880

- **High accuracy**  
**ROD 780: ± 2"**  
**ROD 880: ± 1"**
- Ideal for angle measurement on high-precision rotary tables, dividing apparatuses or measuring machines



	<b>Incremental ROD 780</b>	<b>ROD 880</b>
<b>Interface</b>	~ 1 V <sub>PP</sub>	
Signal periods/rev	18000, 36000	36000
<b>System accuracy<sup>1)</sup></b>	± 2"	± 1"
<b>Mech. permissible speed</b>	≤ 1000 min <sup>-1</sup>	

- 1) Without shaft coupling

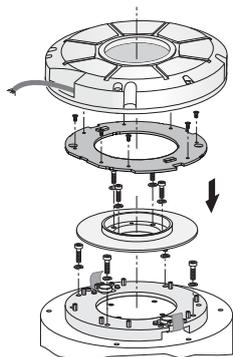
# ERP angle encoders

## Without integral bearing

The HEIDENHAIN **ERP** angle encoders without integral bearing are intended for integration in machine elements or components. They operate without friction and permit high accuracy.

This makes them particularly attractive for high-precision angle measuring tables and precision devices in angular metrology. The **ERP 4080** and **ERP 8080** angle encoders are designed for applications in the clean room.

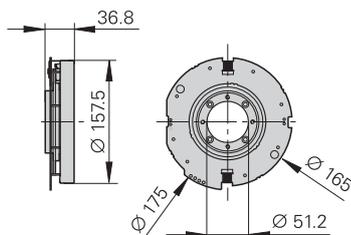
A circular scale with phase grating serves as the basis for the high accuracy of the ERP encoders. The attainable system accuracy depends on the eccentricity of the graduation to the drive shaft bearing, as well as the radial runout and wobble of the bearing.



Mounting the ERP 880

### ERP 880

- **Very high accuracy**
- Very fine grating period
- Low error within one signal period thanks to the interferential scanning principle

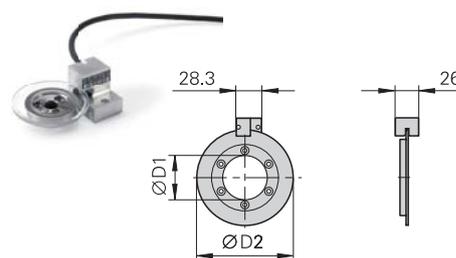


ERP 880 with housing

	<b>Incremental ERP 880</b>
<b>Interface</b>	$\sim 1 V_{PP}$
Signal periods/rev	180000
<b>Accuracy of graduation</b>	$\pm 0.9''$
<b>Mech. permissible speed</b>	$\leq 1000 \text{ min}^{-1}$

### ERP 4080 and ERP 8080

- **Highest resolution**
- High accuracy
- Very compact dimensions
- Low error within one signal period thanks to the interferential scanning principle



	<b>Incremental ERP 4080</b>	<b>ERP 8080</b>
<b>Interface</b>	$\sim 1 V_{PP}$	
Signal periods/rev	131072	360000
<b>Accuracy of graduation</b>	$\pm 2''$	$\pm 1''$
<b>Diameter D1/D2</b>	8 mm/44 mm	50 mm/108 mm
<b>Mech. permissible speed</b>	$\leq 300 \text{ min}^{-1}$	$\leq 100 \text{ min}^{-1}$

# ERO, ERA angle encoders

## Without integral bearing

The **ERO** 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 **ERO** angle encoders use a circular glass scale with hub at the graduation carrier. The EROs are primarily characterized by their low weight and compact dimensions. Applications are to be found in metrology, in compact rotary tables and in precise, highly dynamic applications.

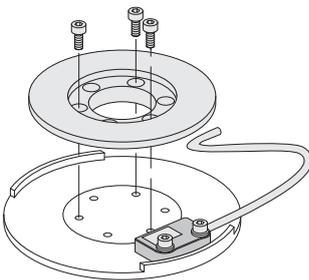
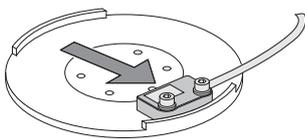
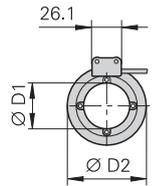
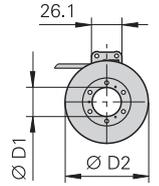
The **ERA** angle encoders feature a sturdy steel scale drum and are suited for high shaft speeds up to  $10000 \text{ min}^{-1}$ . They are typically found on fast running spindles, on rotary tables and tilting axes.

### ERO 6000 Series

- Very flat design
- High system accuracy
- Simple installation

### ERO 6100 Series

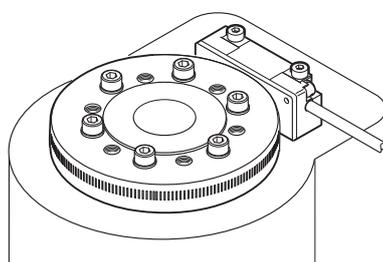
- For dynamic applications with reduced accuracy requirements
- Application examples include printing machines and handling axes.
- Large inside diameter



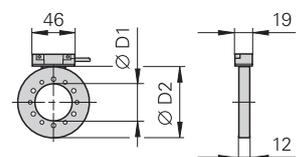
ERO 6000

### ERA 4000 series

- **High shaft speeds** up to  $10000 \text{ min}^{-1}$
- Sturdy design with steel scale drum and METALLUR graduation
- Axial motion of measured shaft permissible up to  $\pm 0.5 \text{ mm}$
- The ERA 4480C is available for larger diameters or in versions with protective cover
- Various **drum versions**  
**ERA 4x80C:** Solid design with centering collar for high shaft speeds  
**ERA 4282C:** Solid design with 3-point centering for higher accuracy requirements



ERA 4000



ERA 4000

<b>Interface</b>	
<b>Inside diameter D1</b>	
<b>Outside diameter D2</b>	
<b>Signal periods/rev</b>	ERA 4280C ERA 4480C ERA 4880C
<b>Accuracy of graduation</b>	
<b>Mechanically permissible speed</b>	

	<b>Incremental ERO 6070</b>		<b>ERO 6080</b>		<b>ERO 6180</b>
<b>Interface</b>	□□TTL		~ 1 V <sub>PP</sub>		~ 1 V <sub>PP</sub>
<b>Inside diameter D1</b>	25 mm	95 mm	25 mm	95 mm	41 mm
<b>Outside diameter D2</b>	71 mm	150 mm	71 mm	150 mm	70 mm
<b>Signal periods/rev</b>	45000 to 450000 <sup>1)</sup>	90000 to 900000 <sup>1)</sup>	9000	18000	4096
<b>Accuracy of graduation</b>	± 3"	± 2"	± 3"	± 2"	± 10"
<b>Mechanically permissible speed</b>	≤ 1600 min <sup>-1</sup>	≤ 800 min <sup>-1</sup>	≤ 1600 min <sup>-1</sup>	≤ 800 min <sup>-1</sup>	≤ 3500 min <sup>-1</sup>

<sup>1)</sup> After integrated 5/10/50-fold interpolation

<b>Incremental ERA 4280C<sup>1)</sup> Signal period 20 μm ERA 4480C Signal period 40 μm ERA 4880C Signal period 80 μm</b>									
~ 1 V <sub>PP</sub>									
40 mm	70 mm	80 mm	120 mm	150 mm	180 mm	270 mm	425 mm	512 mm	
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	
12000 6000 3000	16384 8192 4096	20000 10000 5000	28000 14000 7000	32768 16384 8192	40000 20000 10000	52000 26000 13000	– 38000 –	– 44000 –	
± 5"	± 3.7"	± 3"	± 2.5"				± 2"		
≤ 10000 min <sup>-1</sup>	≤ 8500 min <sup>-1</sup>	≤ 6250 min <sup>-1</sup>	≤ 4500 min <sup>-1</sup>	≤ 4250 min <sup>-1</sup>	≤ 3250 min <sup>-1</sup>	≤ 2500 min <sup>-1</sup>	≤ 1800 min <sup>-1</sup>	≤ 1500 min <sup>-1</sup>	

<sup>1)</sup> For other drum versions, please refer to our catalog *Angle Encoders without Integral Bearings*

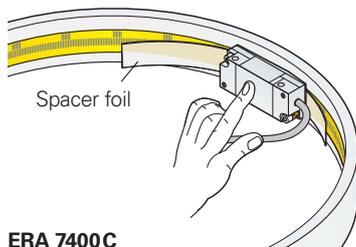
# ERA angle encoders

## Without integral bearing

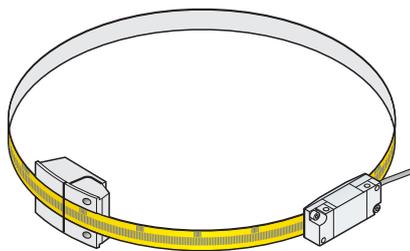
The HEIDENHAIN **ERA** angle encoders with steel scale tape as measuring standard function without integral bearings. They are intended for integration in machine elements or components. They are designed to meet the following requirements:

- Large hollow shaft diameters up to 10 m
- No additional starting torque from 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

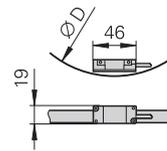
### ERA 7000 and ERA 8000 series

- For very large diameters up to 10 m
- METALLUR steel scale tape
- High accuracy even at the junction of the scale-tape ends

#### 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

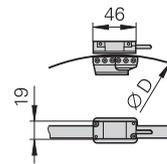


ERA 7481C

#### ERA 8000 series

Scale tape is fastened on the outside 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



ERA 8480C

	<b>Incremental ERA 7400C</b>		
<b>Interface</b>	~ 1 V <sub>PP</sub> ; signal period 40 μm (on circumference)		
Signal periods/revolution	36000	45000	90000
<b>Accuracy of graduation</b>	± 3.9"	± 3.2"	± 1.6"
<b>Accuracy of the scale tape</b>	± 3 μm per meter tape length		
<b>Diameter D1</b>	458.62 mm	573.20 mm	1 146.10 mm
<b>Mech. permissible speed</b>	≤ 250 min <sup>-1</sup>		≤ 220 min <sup>-1</sup>

	<b>Incremental ERA 8400C</b>		
<b>Interface</b>	~ 1 V <sub>PP</sub> ; signal period 40 μm (on circumference)		
Signal periods/revolution	36000	45000	90000
<b>Accuracy of graduation</b>	± 4.7"	± 3.9"	± 1.9"
<b>Accuracy of the scale tape</b>	± 3 μm per meter tape length		
<b>Diameter D1</b>	458.04 mm	572.63 mm	1145.73 mm
<b>Mech. permissible speed</b>	≤ 50 min <sup>-1</sup>		≤ 45 min <sup>-1</sup>

# ERM modular encoders

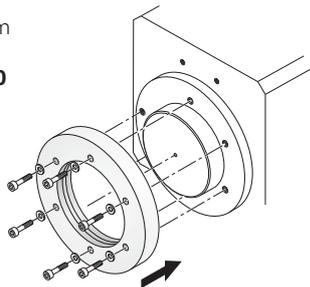
## Without integral bearing

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

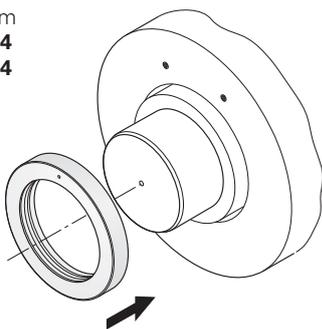
Typical fields of application include machines and equipment with **large hollow shaft diameters** in environments with large amounts of airborne particles and liquids, for example:

- Rotary and tilting axes for ERM 2200
- C axes on lathes for ERM 200 and ERM 2410
- Main spindles on milling machines for ERM 2900 and ERM 2400

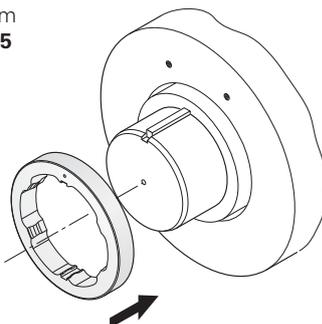
Scale drum  
**ERM 200**  
**ERM 2200**



Scale drum  
**ERM 2404**  
**ERM 2904**

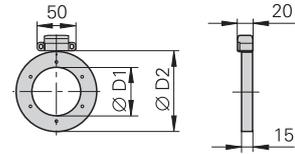


Scale drum  
**ERM 2405**



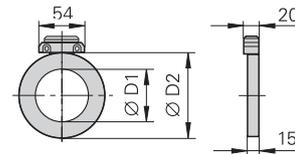
### ERM 2200 series

- High graduation accuracy
- Signal period 200  $\mu\text{m}$  at circumference
- Distance-coded reference marks
- Drum fastening with axial screws



### ERM 200 series

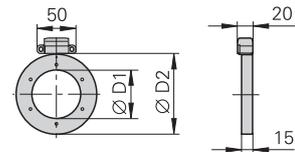
- For large shaft diameters up to 410 mm
- Drum fastening with axial screws



**ERM 200**

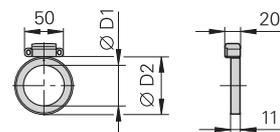
### ERM 2410

- Consists of ERM 2410 scanning head and the ERM 200C scale drum
- Incremental measuring method with distance-coded reference marks
- Integrated counting function for **absolute position-value output**
- Absolute position value after traverse of two reference marks



### ERM 2400 series

- Especially compact dimensions for limited installation space
- High mechanically permissible shaft speeds and therefore particularly well suited for spindles
- **ERM 2484**: Drum fastening by axial clamping
- **ERM 2485**: Drum fastening by axial clamping and feather key as anti-rotation element



**ERM 2484**

### ERM 2984 series

Except for its line count, the ERM 2984 modular encoder shares the same mechanical and electrical features as the ERM 2484.

<b>Incremental ERM 2200</b>						
<b>Interface</b>	~ 1 V <sub>PP</sub>					
Signal period	Approx. 200 µm (at circumference)					
<b>Inside diameter D1</b>	70 mm	80 mm	130 mm	180 mm	260 mm	380 mm
<b>Outside diameter D2</b>	113.16 mm	128.75 mm	176.03 mm	257.50 mm	326.90 mm	452.64 mm
<b>Line count/accuracy of graduation</b>	1800/± 7"	2048/± 6"	2800/± 5"	4096/± 3.5"	5200/± 3"	7200/± 2.5"
<b>Shaft speed<sup>1)</sup></b>	≤ 14500 min <sup>-1</sup>	≤ 13000 min <sup>-1</sup>	≤ 9000 min <sup>-1</sup>	≤ 6000 min <sup>-1</sup>	≤ 4500 min <sup>-1</sup>	≤ 3000 min <sup>-1</sup>
<b>Operating temperature</b>	-10 °C to 60 °C					

<b>Incremental ERM 220 ERM 280 ERM 2410</b>									
<b>Interface</b>	<i>ERM 220</i> : □□TTL; <i>ERM 280</i> : ~ 1 V <sub>PP</sub> ; <i>ERM 2410</i> : EnDat 2.2 <sup>2)</sup>								
Signal period	Approx. 400 µm (at circumference); <i>ERM 2410</i> : –								
<b>Inside diameter D1</b>	40 mm	70 mm	80 mm	120 mm	130 mm	180 mm	220 mm	295 mm	410 mm
<b>Outside diameter D2</b>	75.44 mm	113.16 mm	128.75 mm	150.88 mm	176.03 mm	257.50 mm	257.50 mm	326.90 mm	452.64 mm
<b>Line count/accuracy of graduation</b>	600/± 11"	900/± 8"	1024/± 7"	1200/± 6"	1400/± 5.5"	2048/± 4"	2048/± 5"	2600/± 4"	3600/± 3.5"
<b>Shaft speed<sup>1)</sup></b>	≤ 19000 min <sup>-1</sup>	≤ 14500 min <sup>-1</sup>	≤ 13000 min <sup>-1</sup>	≤ 10500 min <sup>-1</sup>	≤ 9000 min <sup>-1</sup>	≤ 6000 min <sup>-1</sup>	≤ 6000 min <sup>-1</sup>	≤ 4500 min <sup>-1</sup>	≤ 3000 min <sup>-1</sup>
<b>Operating temperature</b>	-10 °C to 100 °C								

<b>Incremental ERM 2484 ERM 2485<sup>3)</sup></b>							<b>ERM 2984<sup>4)</sup></b>
<b>Interface</b>	~ 1 V <sub>PP</sub>						
Signal period	Approx. 400 µm (at circumference)				Approx. 1 mm (at circumference)		
<b>Inside diameter D1</b>	40 mm	55 mm	80 mm	100 mm	55 mm	100 mm	
<b>Outside diameter D2</b>	64.37 mm	75.44 mm	113.16 mm	128.75 mm	77.41 mm	120.96 mm	
<b>Line count/accuracy of graduation</b>	512/± 17"	600/± 14"	900/± 10"	1024/± 9"	256/± 51"	400/± 33"	
<b>Shaft speed<sup>1)</sup></b>	<i>ERM 2484</i> : ≤ 42000 min <sup>-1</sup> <i>ERM 2485</i> : ≤ 33000 min <sup>-1</sup>	≤ 36000 min <sup>-1</sup> ≤ 27000 min <sup>-1</sup>	≤ 22000 min <sup>-1</sup> –	≤ 20000 min <sup>-1</sup> –	≤ 35000 min <sup>-1</sup> –	≤ 16000 min <sup>-1</sup> –	
<b>Operating temperature</b>	-10 °C to 100 °C						

<sup>1)</sup> Mech. permissible speed

<sup>2)</sup> Through integrated counting function after traverse of two reference marks

<sup>3)</sup> Only with outside diameters D2 64.37 mm and 75.44 mm

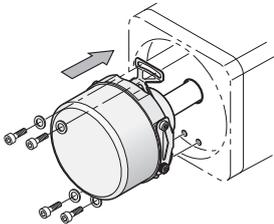
<sup>4)</sup> Additional drum diameters upon request

# ECN, EQN, ERN rotary encoders

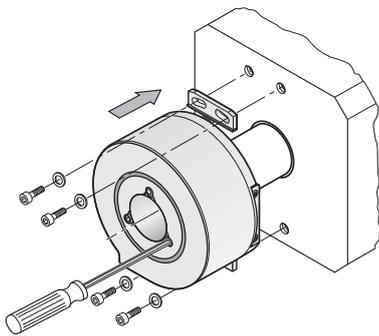
With integral bearing and mounted stator coupling  
IP 64 degree of protection

HEIDENHAIN **ECN, EQN** and **ERN** rotary encoders with integral bearings and stator-mounted couplings 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 caused by friction in the bearing. Rotary encoders with stator coupling therefore provide excellent dynamic performance and a high natural frequency.

Some rotary encoders are suitable in a special version for potentially explosive atmospheres in accordance with Directive 94/9/EG, **(ATEX)**. They comply with Equipment Group II, meet the requirements of Category 2 and can be used for Zones 1 and 21 as well as 2 and 22.



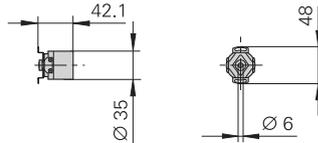
**ECN/EQN/ERN 1000**  
**ECN/EQN/ERN 400**



**ECN/ERN 100**

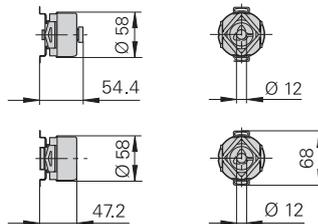
## ECN/EQN/ERN 1000 series

- **Miniaturized version**
- Blind hollow shaft with 6 mm inside diameter
- Housing outside diameter 35 mm
- Natural frequency of the encoder stator coupling:  $\geq 1500$  Hz
- Mechanically permissible speed:  $\leq 12000 \text{ min}^{-1}$



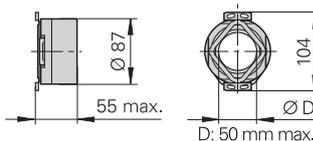
## ECN/EQN/ERN 400 series

- **Compact design**
- Blind hollow shaft or hollow through shaft with 8 mm or 12 mm inside diameter
- Housing outside diameter: 58 mm
- Degree of protection:  
IP 67 at housing (IP 66 with hollow through shaft)  
IP 64 at shaft inlet (IP 66 upon request)
- Natural frequency of the encoder stator coupling:  $\geq 1400$  Hz (cable version)
- Mechanically permissible speed:  $\leq 12000 \text{ min}^{-1}$



## ECN/ERN 100 series

- **For large shaft diameters**
- Hollow through shaft with inside diameters D: D: 20 mm, 25 mm, 38 mm, 50 mm
- Housing outside diameter: 87 mm
- Natural frequency of the encoder stator coupling:  $\geq 1000$  Hz
- Mechanically permissible speed:  
 $D \leq 30 \text{ mm}: \leq 6000 \text{ min}^{-1}$   
 $D > 30 \text{ mm}: \leq 4000 \text{ min}^{-1}$



### Interface

Position values/rev

Distinguishable revolutions

Line count

### Voltage supply

### Interface

Position values/rev

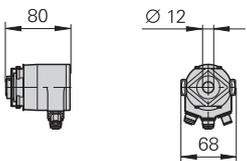
Distinguishable revolutions

Line count

### Voltage supply

<b>Absolute ECN 1013</b>	<b>EQN 1025</b>	<b>ECN 1023</b>	<b>EQN 1035</b>	<b>Incremental ERN 1020</b>	<b>ERN 1030</b>	<b>ERN 1070</b>	<b>ERN 1080</b>
EnDat 2.2 <sup>1)</sup> with $\sim 1 V_{PP}$		EnDat 2.2 <sup>1)</sup>		$\square$ TTL	$\square$ HTL	$\square$ TTL <sup>2)</sup>	$\sim 1 V_{PP}$
8 192 (13 bits)		8388608 (23 bits)		–			
–	4096 (12 bits)	–	4096 (12 bits)	–			
512		–		100 to 3600		1000/2500/ 3600	100 to 3600
3.6 to 14 V				5 V	10 V to 30 V	5 V	

<b>Absolute ECN 413<sup>3)</sup></b>		<b>EQN 425<sup>3)</sup></b>		<b>ECN 425 ECN 425 F ECN 424 S</b>	<b>EQN 437 EQN 437 F EQN 436 S</b>	<b>Incremental ERN 420<sup>3)</sup> ERN 460</b>	<b>ERN 430<sup>3)</sup></b>	<b>ERN 480<sup>3)</sup></b>
EnDat 2.2 <sup>1)</sup> With $\sim 1 V_{PP}$ ; SSI	PROFIBUS- DP; PROFINET	EnDat 2.2 <sup>1)</sup> With $\sim 1 V_{PP}$ ; SSI	PROFIBUS- DP; PROFINET	EnDat 2.2 <sup>1)</sup> ; Fanuc $\alpha$ i Siemens DRIVE-CLiQ		$\square$ TTL; $\square$ TTL	$\square$ HTL	$\sim 1 V_{PP}$
8 192 (13 bits)		8 192 (13 bits)		<i>ECN 425: 33 554 432 (25 bits)</i> <i>ECN 424: 16 777 216 (24 bits)</i>		–		
–		4096 (12 bits)		–	4096 (12 bits)	–		
512 or 2048	–	512 or 2048	–	–		250 to 5000		1 000 to 5000
3.6 to 14 V 5 V or 10 V to 30 V	9 V to 36 V; 10 V to 30 V	3.6 to 14 V 5 V or 10 V to 30 V	9 V to 36 V; 10 V to 30 V	3.6 V to 14 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



PROFIBUS-DP/PROFINET



	<b>Absolute ECN 113</b>	<b>ECN 125</b>	<b>Incremental ERN 120</b>	<b>ERN 130</b>	<b>ERN 180</b>
<b>Interface</b>	EnDat 2.2 <sup>1)</sup> with $\sim 1 V_{PP}$	EnDat 2.2 <sup>1)</sup>	$\square$ TTL	$\square$ HTL	$\sim 1 V_{PP}$
Position values per revolution	8 192 (13 bits)	33 554 432 (25 bits)	–		
Line count	2048	–	1 000 to 5000		
<b>Power supply</b>	5 V	3.6 V to 5.25 V	5 V	10 V to 30 V	5 V

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

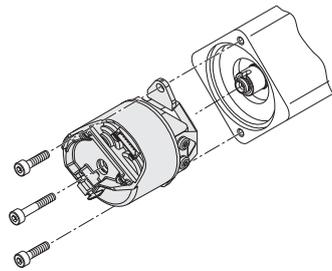
<sup>2)</sup> Integrated 5/10-fold interpolation

<sup>3)</sup> ATEX version available (ECN 413/EQN 425 with 5 V power supply and EnDat 2.1)

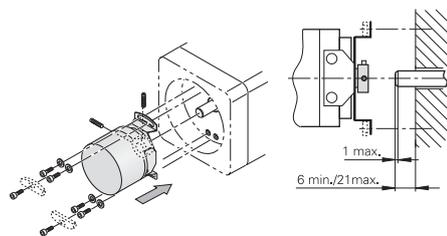
# ECN, EQN, ERN rotary encoders

With integral bearing and mounted stator coupling  
IP 40 degree of protection

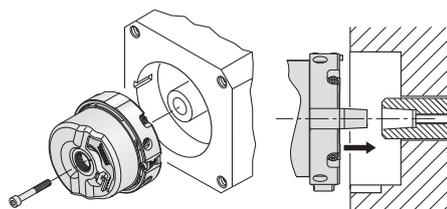
The **ECN, EQN** and **ERN** rotary encoders from HEIDENHAIN with IP 40 degree of protection are specially designed for integration in motors. Bearings and mounted stator coupling are integrated. Absolute rotary encoders and versions with commutation tracks are available for synchronous motors. The taper 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 in a location bore and permits fast, simple mounting while enabling a mechanical fine adjustment of the commutation.



ECN/EQN 1100



ERN 1123



ERN/ECN/EQN 1300

## ECN/EQN 1100 series

- **Miniaturized version**
- Blind hollow shaft  $\varnothing$  6 mm with positive fit element
- Housing outside diameter 35 mm
- Natural frequency of the encoder stator coupling:  $\geq$  1000 Hz
- Mechanically permissible speed 12000  $\text{min}^{-1}$



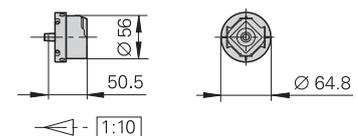
## ERN 1123

- Blind hollow shaft  $\varnothing$  8 mm
- Housing outside diameter 35 mm
- Stator coupling with bolt-hole circle  $\varnothing$  40 mm
- Natural frequency of the stator coupling:  $\geq$  1000 Hz
- Mechanically permissible speed 6000  $\text{min}^{-1}$



## 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 bores with 65 mm inside diameter
- Natural frequency of the encoder stator coupling:  $\geq$  1800 Hz
- Mechanically permissible speed  
**ERN/ECN:** 15000  $\text{min}^{-1}$   
**EQN:** 12000  $\text{min}^{-1}$
- IP 40 protection when mounted



	<b>Absolute</b>				<b>Incremental</b>
	<b>ECN 1113</b>	<b>EQN 1125</b>	<b>ECN 1123<sup>2)</sup></b>	<b>EQN 1135<sup>2)</sup></b>	<b>ERN 1123</b>
<b>Interface</b>	EnDat 2.2 <sup>1)</sup> with $\sim 1 V_{PP}$		EnDat 2.2 <sup>1)</sup>		$\square$ TTL
Position values/revolution	8 192 (13 bits)		8 388 608 (23 bits)		–
Distinguishable revolutions	–	4 096 (12 bits)	–	4 096 (12 bits)	–
Line count	512		–		500 to 8 192
<b>Commutation signals</b>	–				Block commutation <sup>3)</sup>
<b>Voltage supply</b>	3.6 to 14 V				5 V
<b>Operating temperature</b>	$\leq 115\text{ }^{\circ}\text{C}$				$\leq 90\text{ }^{\circ}\text{C}$

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

<sup>2)</sup> **Functional Safety** upon request

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

	<b>Absolute</b>				<b>Incremental</b>				
	<b>ECN 1313</b>	<b>EQN 1325</b>	<b>ECN 1325<sup>4)</sup></b>	<b>EQN 1337<sup>4)</sup></b>	<b>ERN 1321</b>	<b>ERN 1326</b>	<b>ERN 1381</b>	<b>ERN 1387</b>	
<b>Interface</b>	EnDat 2.2 <sup>1)</sup> with $\sim 1 V_{PP}$		EnDat 2.2 <sup>1)</sup>		$\square$ TTL		$\sim 1 V_{PP}$		
Position values/revolution	8 192 (13 bits)		33 554 432 (25 bits)		–				
Distinguishable revolutions	–	4 096 (12 bits)	–	4 096 (12 bits)	–				
Line count	512 or 2 048		–		1 024	2 048	4 096	512 2 048 4 096	2 048
<b>Commutation signals</b>	–				–	Block commutation <sup>2)</sup>	–	Z1 track <sup>3)</sup>	
<b>Voltage supply</b>	3.6 to 14 V				5 V				
<b>Operating temperature</b>	$\leq 115\text{ }^{\circ}\text{C}$				$\leq 120\text{ }^{\circ}\text{C}$ ; 4 096 lines: $\leq 100\text{ }^{\circ}\text{C}$				

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

<sup>2)</sup> Three block commutation tracks with 90° or 120° mechanical phase shift

<sup>3)</sup> One sine and one cosine signal with one period per revolution of the encoder shaft

<sup>4)</sup> **Functional Safety** upon request

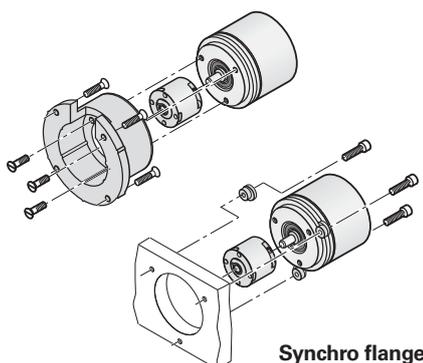
# ROC, ROQ, ROD and RIC, RIQ rotary encoders

With integral bearing, for separate shaft coupling

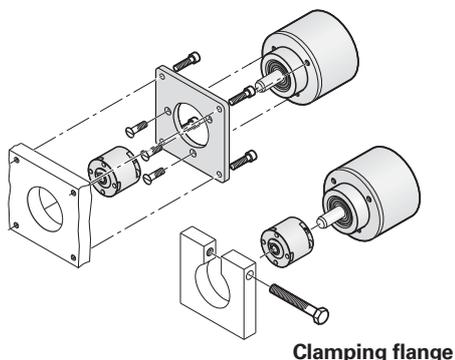
The optical encoders **ROC, ROQ** and **ROD**, as well as the inductive **RIC** and **RIQ** from HEIDENHAIN have integrated bearings and are sealed. They provide IP 64 to IP 67 protection, depending on the version. They are robust and compact.

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.

Some rotary encoders are suitable in a special version for potentially explosive atmospheres in accordance with Directive 94/9/EG, (**ATEX**). They comply with Equipment Group II, meet the requirements of Category 2 and can be used for Zones 1 and 21 as well as 2 and 22.



Synchro flange

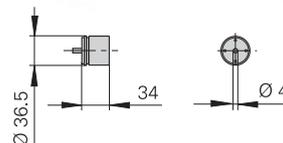


Clamping flange

## 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

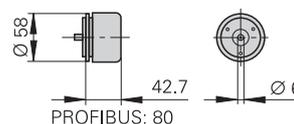
## Series 1000



## ROC/ROQ/ROD 400 series

- **Industrial standard** for dimensions and output signals
- Degree of protection  
IP 67 at housing  
IP 64 at shaft inlet (IP 66 available on request)
- Mounting by synchro flange or clamping flange
- Shaft diameters  
6 mm with synchro flange  
10 mm with clamping flange
- Preferred types with fast delivery (see *Rotary Encoders* brochure or ask HEIDENHAIN)

## ROD 400 series with synchro flange



## RIC/RIQ 400 series

- Inductive scanning principle
- For reduced accuracy requirements up to  $\pm 480''$
- Mechanical design same as ROC/ROQ 400

	Absolute RIC 418	RIQ 430	ROC 413	ROQ 425	ROC 413
<b>Synchro flange</b>					
<b>Clamping flange</b>					
<b>Interface</b>	EnDat 2.1 with $\sim 1 V_{PP}$		EnDat 2.2 <sup>1)</sup> with $\sim 1 V_{PP}$ ; SSI		PROFIBUS-DP; PROFINET
Position values/rev	262 144 (18 bits)		8 192 (13 bits)		
Distinguishable revolutions	–	4 096 (12 bits)	–	4 096 (12 bits)	–
Line count/signal periods	16		512		–
<b>Voltage supply</b>	5 V		3.6 V to 14 V; 5 V or 10 V to 30 V		9 V to 36 V; 10 V to 30 V

<sup>1)</sup> ATEX version available (ROC/ROQ with 5 V voltage supply and EnDat 2.1)

<sup>2)</sup> **Functional Safety** upon request

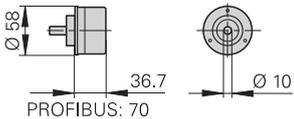
	Absolute				Incremental			
	ROC 1013	ROQ 1025	ROC 1023	ROQ 1035	ROD 1020	ROD 1030	ROD 1070	ROD 1080
<b>Interface</b>	EnDat 2.2 <sup>1)</sup> with ~ 1 V <sub>PP</sub>		EnDat 2.2 <sup>1)</sup>		□ TTL	□ HTL	□ TTL <sup>2)</sup>	~ 1 V <sub>PP</sub>
<b>Position values/revolution</b>	8 192 (13 bits)		8 388 608 (23 bits)		-			
<b>Distinguishable revolutions</b>	-	4 096 (12 bits)	-	4 096 (12 bits)	-			
<b>Line count/signal periods</b>	512		-		100 to 3600		1 000/2 500/3 600	100 to 3600
<b>Voltage supply</b>	3.6 to 14 V		3.6 to 14 V		5 V	10 V to 30 V	5 V	

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

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

**ROD 400 series with clamping flange**

**PROFIBUS-DP/PROFINET**



ROQ 425	ROC 424S	ROQ 436S	ROC 425 <sup>2)</sup> ROC 425F	ROQ 437 <sup>2)</sup> ROQ 437F	Incremental ROD 426 <sup>1)</sup>	ROD 466 <sup>1)</sup>	ROD 436 <sup>1)</sup>	ROD 486 <sup>1)</sup>
					ROD 420 <sup>1)</sup>	-	ROD 430 <sup>1)</sup>	ROD 480 <sup>1)</sup>
	Siemens DRIVE-CLiQ		EnDat 2.2 <sup>4)</sup> ; Fanuc $\alpha$ i		□ TTL	□ TTL <sup>1)</sup>	□ HTL	~ 1 V <sub>PP</sub>
	16 777 216 (24 bits)		33 554 432 (25 bits)		-			
4 096 (12 bits)	-	4 096 (12 bits)	-	4 096 (12 bits)	-			
					50 to 5000 ROD 426/466: Up to 10000 <sup>3)</sup>			1 000 to 5 000
	10 V to 28.8 V		3.6 to 14 V		5 V	10 V to 30 V		5 V

<sup>3)</sup> Signal periods over 5000 are generated through signal doubling in the encoder

<sup>4)</sup> Includes EnDat 2.1 command set; PROFIBUS-DP via gateway

# ECI, EQI, ERO rotary encoders

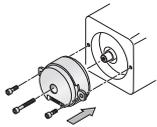
## Without integral bearing

The inductive rotary encoders **ECI/EQI 1100** and **ECI/EQI 1300** are mechanically compatible with the corresponding ExN photoelectric encoders: the shaft is fastened with a central screw. The stator of the encoder is screw fastened in a location hole.

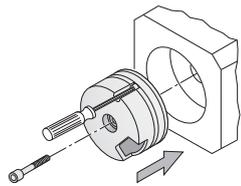
The **ECI 119** inductive rotary encoder has a particularly small outside diameter with a large shaft opening. It is slid onto the shaft and fastened from behind with axial screws.

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 for which there must be **no friction**.

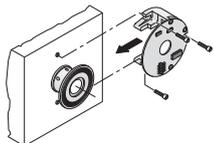
The correct installation of the rotary encoders without integral bearing can be inspected with the HEIDENHAIN PWM 20 measuring and testing device.



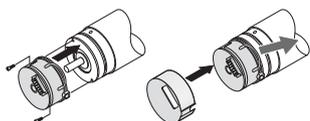
**ECI/EQI 1100**



**ECI/EQI 1300**



**ERO 1200**



**ERO 1400**

### ECI/EQI 1100 series

- **Mounting compatible with ECN/ EQN 1100**
- Simple mounting without adjustment
- Blind hollow shaft  $\varnothing$  6 mm

### ECI/EQI 1300 series

- **Mounting compatible with ECN/ EQN 1300**
- Taper shaft or blind hollow shaft

### Version with functional safety

- Simple mounting without adjustment
- Blind hollow shaft



### ECI 119

- Especially **flat design**
- Hollow through shaft  $\varnothing$  50 mm

### ERO 1200 series

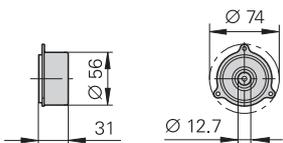
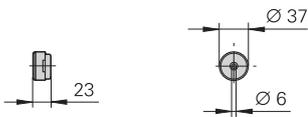
- **Compact design**
- For shaft diameters up to 12 mm



### ERO 1400 series

- **Miniaturized modular rotary encoder** for measured shafts up to  $\varnothing$  8 mm
- Special integral mounting aid
- With cover cap





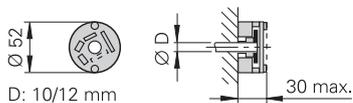
	<b>Absolute</b> ECI 1118	EQI 1130	ECI 1319 <sup>1)</sup>	EQI 1331 <sup>1)</sup>
<b>Interface</b>	EnDat 2.1 with $\sim 1 V_{PP}$		EnDat 2.2 with $\sim 1 V_{PP}$ <sup>2)</sup>	
Position values/revolution	262 144 (18 bits)		524 288 (19 bits)	
Distinguishable revolutions	–	4 096 (12 bits)	–	4 096 (12 bits)
Line count	16		32 <sup>2)</sup>	
<b>Mech. permiss. speed</b>	$\leq 15000 \text{ min}^{-1}$	$\leq 12000 \text{ min}^{-1}$	$\leq 15000 \text{ min}^{-1}$	$\leq 12000 \text{ min}^{-1}$
<b>Shaft</b>	Blind hollow shaft		Taper shaft <sup>2)</sup> or blind hollow shaft	

<sup>1)</sup> **Functional Safety** upon request

<sup>2)</sup> Not in version with functional safety

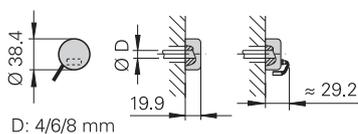


	<b>Absolute</b> ECI 119
<b>Interface</b>	EnDat 2.1 with $\sim 1 V_{PP}$
Position values/revolution	524 288 (19 bits)
Line count	32
<b>Mech. permiss. speed</b>	$\leq 6000 \text{ min}^{-1}$
<b>Shaft</b>	Hollow through shaft $\varnothing 50 \text{ mm}$



D: 10/12 mm

	<b>Incremental</b> ERO 1225	ERO 1285
<b>Interface</b>	$\square$ TTL	$\sim 1 V_{PP}$
Line count	1 024 2 048	
<b>Mech. permiss. speed</b>	$\leq 25000 \text{ min}^{-1}$	
<b>Shaft diameter D</b>	$\varnothing 10, 12 \text{ mm}$	



D: 4/6/8 mm

	<b>Incremental</b> ERO 1420	ERO 1470	ERO 1480
<b>Interface</b>	$\square$ TTL	$\square$ TTL <sup>1)</sup>	$\sim 1 V_{PP}$
Line count	512 1 000 1 024	1 000 1 500	512 1 000 1 024
<b>Mech. permiss. speed</b>	$\leq 30000 \text{ min}^{-1}$		
<b>Shaft diameter D</b>	$\varnothing 4, 6, 8 \text{ mm}$		

<sup>1)</sup> Integrated 5/10/20/25-fold interpolation

## Contouring controls for milling/turning machines and machining centers

The TNC controls from HEIDENHAIN cover the whole range of applications: From the simple, compact TNC 128 three-axis straight cut control to the TNC 640 (up to 18 axes plus spindle)—there's a TNC control for nearly every application. The TNC 640 is a control for milling machines that are also capable of turning operations.

The HEIDENHAIN TNC controls are versatile: They feature both **shop-floor programming**, and **offline programming**, and are therefore ideal for **automated production**. They handle simple milling tasks just as reliably as the TNC 640 and iTNC 530, for example, can handle **high speed cutting**—with especially jerk-free path control—or **5-axis machining** with swivel head and rotary table.

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

## And this is what the future looks like:

The HEIDENHAIN contouring controls are now undergoing a generational change. As the future high-end control, the TNC 640 stands ready as a powerful and modern control platform. It already features almost the complete range of functions provided by the proven iTNC 530. It also offers the following:

- Functions for milling/turning operations with powerful turning cycles
- Improved motion control for even more precise surfaces and high contour accuracy
- High-resolution graphics with 3-D simulation view in sharp detail
- Well-thought-out, structured color user interface

**The controls from HEIDENHAIN can be used for almost every task. It offers the right programming capability for any job.**

## Programming at the machine

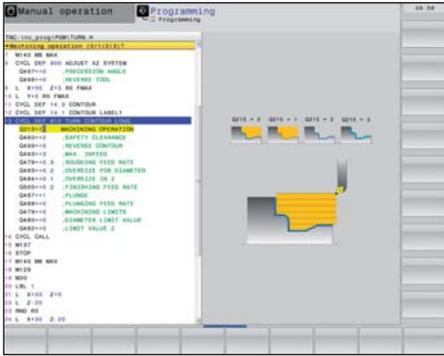
Its workshop-oriented design enables the machinist to program directly at the machine.

Thanks to its **conversational programming**, 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. With the TNC 640, even complex milling and turning operations can be programmed consistently with conversational guidance.

The alternative **smarTNC** operating mode of the iTNC 530 makes programming even easier. Easily understandable program entry in fillable forms, default setting for globally valid values, numerous selections and straightforward graphic support ensure fast and user-friendly operation.

The **easy-to-read screen** displays plain-language information, dialog guidance, programming steps, graphics, and a soft-key row. All texts are available in **numerous languages**.

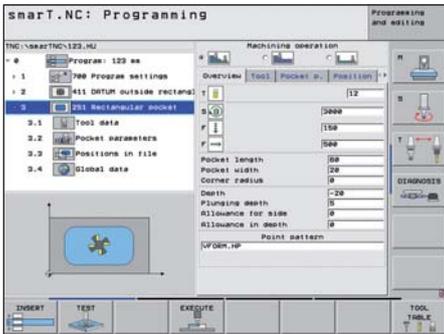




Plain-language programming



Key symbols



smarT.NC:  
Programming with fillable forms

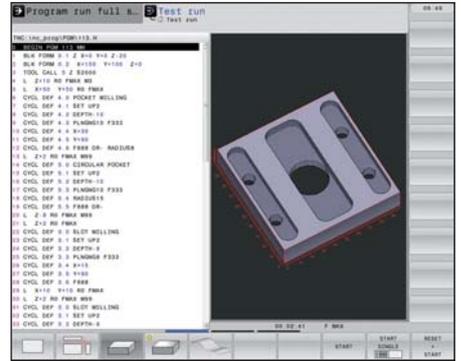
Frequently recurring machining sequences are saved as **fixed cycles**. **Graphic illustrations** simplify programming and provide valuable aid for verifying the program during test runs.

And if you are used to **G-code programming**, then HEIDENHAIN controls are still the right controls for you.

**Positioning with manual data input**  
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.

**Creating programs offline**  
The HEIDENHAIN controls can be programmed remotely just as well—for example on a CAD/CAM system or at a HEIDENHAIN programming station. Their **Ethernet interface** guarantees very short transfer times, even of long programs.

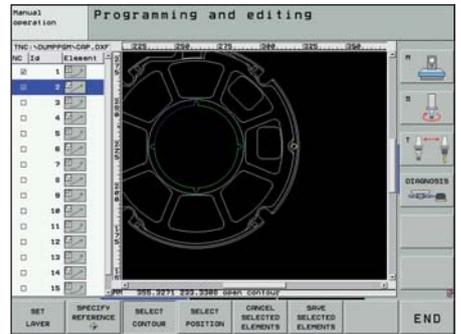
You can open **DXF files** created in a CAD system directly on the TNC 640, TNC 620 and iTNC 530 to extract contours and machining positions. Not only does this save time otherwise spent on programming and testing, but you can also be sure that the transferred data are exactly according to the designer's specifications.



Test Run



Offline programming



Processing DXF data

HEIDENHAIN controls		Series	Page
<b>Contouring controls for milling/turning machines and machining centers</b>	Up to 18 axes and 2 spindles	TNC 640	40
<b>Contouring control for milling machines and machining centers</b>	Up to 18 axes and 2 spindles	iTNC 530	40
<b>Contouring control for simple milling machines</b>	Up to four axes plus spindle	TNC 320	42
	Up to five axes plus spindle	TNC 620	42
<b>Straight-cut control for simple milling machines</b>	Up to four axes plus spindle	TNC 128	44
<b>Accessories</b>	Electronic handwheels	HR	47
	Programming stations	TNC 620 TNC 640 iTNC 530 TNC 320	47

# TNC 640 and iTNC 530 contouring controls

For milling machines, milling/turning machines and machining centers

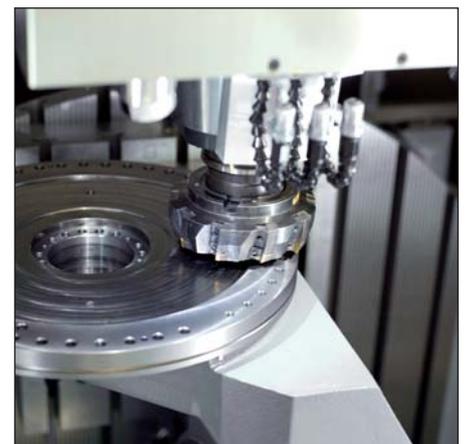
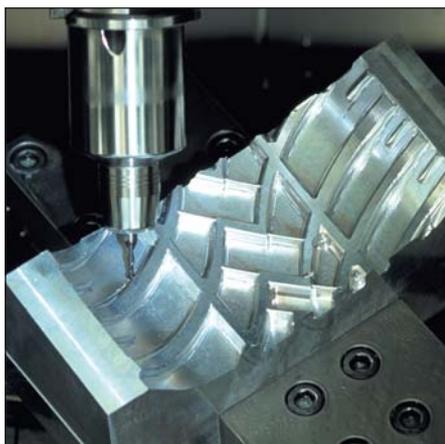
The HEIDENHAIN TNC 640 and iTNC 530 controls have been conceived as versatile and workshop-oriented controls for milling, drilling and boring machines as well as machining centers. The TNC 640 is additionally capable of combined milling and turning operations. TNC 640 and iTNC 530 offer comprehensive functions:

- On universal milling machines
- On combined milling/turning machines (only TNC 640)
- In high speed cutting
- For five-axis machining with swivel head and rotary table
- For 5-axis machining on very large machines
- On boring mills
- On machining centers and for automated machining

The TNC 640 and iTNC 530 feature **optimized motion control, short block processing times** and special 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 3-D contours.

You can program **turning contours** with the TNC 640 in the familiar HEIDENHAIN plain language. 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 coding, standardized table editors and smartSelect—the dialog-guided fast selection of functions—aid you at your work.



	TNC 640	iTNC 530
<b>Axes</b>	Up to 18 axes and 2 spindles	
<b>Interpolation</b>	<ul style="list-style-type: none"> <li>• Linear in max. 5 axes (with Tool Center Point Management)</li> <li>• Circular in max. 3 axes with tilted working plane</li> <li>• Spline interpolation in max. 5 axes</li> <li>• Helix</li> <li>• Cylinder surface<sup>1)</sup></li> <li>• Rigid tapping<sup>1)</sup></li> </ul>	
<b>Programming</b>	HEIDENHAIN conversational, DIN/ISO	HEIDENHAIN conversational, smarT.NC, DIN/ISO
<b>Programming support</b>	TNCguide presents user information directly on the control	
<b>DXF converter</b> option	Download contours and machining positions from DXF files	
<b>Program memory</b>	Hard disk with at least 21 GB	
<b>Position entry</b>	Nominal positions in Cartesian or polar coordinates, dimensions absolute or incremental, in mm or inches; actual position capture	
<b>Input resolution and display step</b>	As fine as 0.1 µm or 0.0001°; <i>TNC 640</i> optionally as fine as 0.01 µm or 0.00001°	
<b>Block processing time</b>	0.5 ms (3-D straight line without radius compensation at 100 % PLC utilization)	
<b>Turning functions</b> option	<ul style="list-style-type: none"> <li>• Turning tool data management</li> <li>• Tool-tip radius compensation</li> <li>• Constant surface 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 conversational with graphical support	
<b>Coordinate transformation</b>	<ul style="list-style-type: none"> <li>• Datum shift, rotation, mirror image, scaling factor (axis-specific)</li> <li>• Tilting the working plane, PLANE function (option)</li> </ul>	
<b>Fixed cycles</b>	For drilling, milling and turning (only TNC 640, option); data input with graphical support	
<b>Touch probe cycles</b>	For tool measurement, workpiece alignment, workpiece measurement and workpiece 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 2.0; RS-232-C/V.24 (max. 115200 baud)	
<b>Remote control and diagnosis</b>	TeleService	
<b>Visual display unit</b>	15-inch or 19-inch color flat-panel display (TFT)	
<b>Axis feedback control</b>	<ul style="list-style-type: none"> <li>• Feedforward control or operation with following error</li> <li>• Integrated <b>digital drive control</b> with integrated inverter</li> </ul>	
<b>Adaptive feed rate control</b> option	AFC adjusts the contouring feed rate to the spindle power <sup>1)</sup>	
<b>DCM collision monitoring</b> option	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>• Electronic handwheel</li> <li>• TS workpiece touch probe <b>and</b> TT or TL tool touch probe</li> </ul>	

<sup>1)</sup> This feature must be implemented by the machine tool builder  
For further functions and differences in function, see product documentation

# TNC 320, TNC 620 contouring controls

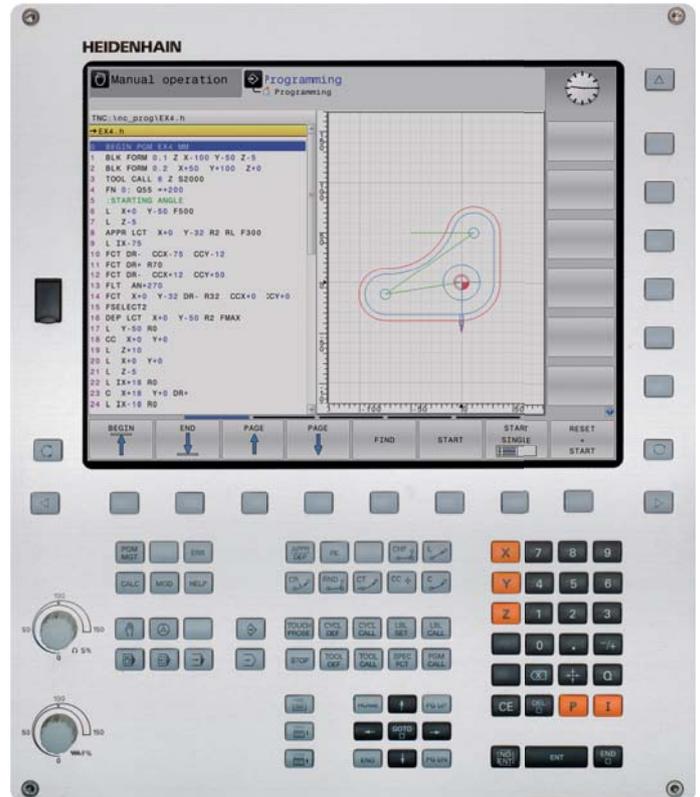
## For milling machines

The HEIDENHAIN **TNC 320** and **TNC 620** controls are compact but versatile contouring controls. Thanks to their flexible operation—workshop-oriented programmability with HEIDENHAIN conversational programming 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

Because of its analog output that also provides nominal speed values, the **TNC 320** is well suited for retrofitting on machine tools.

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.



TNC 620



	TNC 320	TNC 620
<b>Axes</b>	3 axes + spindle Optional 4th and 5th axis (with noncontrolled spindle)	3 axes + spindle Optional 4th and 5th axes
<b>Interpolation</b>	<ul style="list-style-type: none"> <li>• Linear in 4 axes</li> <li>• Circular in 2 axes</li> <li>• Helical, superimposition of circular and straight paths</li> <li>• Cylinder surface (option)</li> </ul>	<ul style="list-style-type: none"> <li>• Linear: in 4 axes (optionally 5)</li> <li>• Circular: in 2 (optionally 3) axes</li> <li>• Helical, superimposition of circular and straight paths</li> <li>• Cylinder surface (option)</li> </ul>
<b>Program entry</b>	<ul style="list-style-type: none"> <li>• HEIDENHAIN conversational</li> <li>• DIN/ISO (program input via soft keys or via external USB keyboard)</li> <li>• FK free contour programming (option on the TNC 620)</li> </ul>	
<b>Programming support</b>	TNCguide presents user information directly on the TNC	
<b>DXF converter</b> option	–	Download contours and machining positions from DXF files
<b>Program memory</b>	300 MB	
<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>	Down to 0.1 µm or 0.0001°	Down to 0.1 µm or 0.0001°; optionally to 0.01 µm or 0.00001°
<b>Block processing time</b>	6 ms	1.5 ms
<b>Coordinate transformation</b>	<ul style="list-style-type: none"> <li>• Datum shift, rotation, mirror image, scaling factor (axis-specific)</li> <li>• Tilting the working plane, PLANE function (option)</li> </ul>	
<b>Fixed cycles</b> (some optional with 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>• Pocket clearance and finishing, slots and studs</li> </ul>	
<b>Touch probe cycles</b>	For tool measurement, workpiece alignment, workpiece measurement and datum setting (option with TNC 620)	
<b>Graphics</b>	For programming and program verification (option with TNC 620); graphic support with cycle programming	
<b>Parallel operation</b>	Programming during program run, program-run graphics (option with TNC 620)	
<b>Data interface</b>	<ul style="list-style-type: none"> <li>• Ethernet 1000BASE-T</li> <li>• USB 2.0</li> <li>• RS-232-C/V.24 and RS-422/V.11 (max. 115200 baud)</li> </ul>	
<b>Visual display unit</b>	15-inch color flat-panel display (TFT)	
<b>Axis feedback control</b>	Feedforward control or operation with following error	
	–	Integrated <b>digital drive control</b> for synchronous and asynchronous motors
<b>Interfacing to the Machine</b>	Via integrated programmable logic controller (PLC)	
	Inputs/outputs expandable via PL 510	Inputs/outputs via PL 6000
<b>Accessories</b>	<ul style="list-style-type: none"> <li>• HR electronic handwheels</li> <li>• TS workpiece touch probe <b>and</b> TT or TL tool touch probe</li> </ul>	

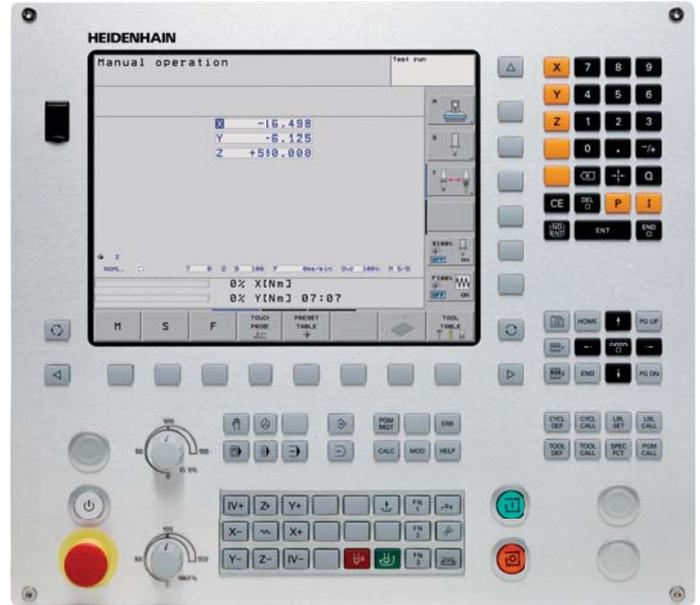
# TNC 128 straight cut control

## 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

- 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.



	<b>TNC 128</b>
<b>Axes</b>	3 axes + spindle Optional 4th and 5th axis (with noncontrolled spindle)
<b>Program entry</b>	HEIDENHAIN conversational
<b>Program memory</b>	300 MB
<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>	Down to 0.1 µm or 0.0001°
<b>Block processing time</b>	6 ms
<b>Coordinate transformation</b>	Datum shift, rotation, mirror image, scaling factor (axis-specific)
<b>Fixed 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 datum setting
<b>Graphics</b>	For programming and program verification; graphic support with 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 2.0</li> <li>• RS-232-C/V.24 and RS-422/V.11 (max. 115200 baud)</li> </ul>
<b>Visual display unit</b>	12.1-inch color flat-panel display (TFT)
<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 by PL 510
<b>Accessories</b>	<ul style="list-style-type: none"> <li>• HR electronic handwheels</li> <li>• TS or KT workpiece touch probe <b>and</b> TT tool touch probe</li> </ul>

# Contouring controls

## Digital control design

In the uniformly digital control design from HEIDENHAIN, all components are connected to each other via purely digital interfaces: The control components are connected via **HSCI** (HEIDENHAIN Serial Controller Interface), the real-time protocol from HEIDENHAIN for Fast Ethernet, and the encoders are connected via **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. These outstanding properties of the uniformly digital design from HEIDENHAIN guarantee not only very high accuracy and surface quality, but rapid traverse speeds as well.

### 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**.

Either compact or modular inverters are available, depending on the type of machine. The **compact inverters** contain the power stage for up to 2 axes, 3 axes, or 4 axes plus spindle with spindle power ratings up to 15 kW. With **modular inverters**, various power modules are available for axes and spindles, and power supply units with 22 kW to 80 kW. The modular inverters are suitable for machines with up to 13 axes and a spindle with maximum power of up to 40 kW.

**Feed motors** of 0.4 Nm to 62.5 and **spindle motors** of 5.5 kW to 40 kW are available for connection to HEIDENHAIN inverters.

The following HEIDENHAIN controls are available with HSCI and digital drive control:

- iTNC 530
- TNC 640
- TNC 620
- MANUALplus 620
- CNC PILOT 640



**iTNC 530**  
With modular inverter and motors

# Accessories

## Electronic handwheels

With the 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 410, HR 520 and HR 550FS portable handwheels

The axis keys and certain functional keys are integrated in the housing. It allows you to switch axes or setup 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 and spindle speed, the operating mode and other functions, as well as an override potentiometer for feed rate and spindle speed. You can enjoy unlimited freedom of movement with the **HR 550FS** with radio transmission. It features correspond to those of the HR 520.



HR 550 FS

HR 410

### 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. Up to three HR 150 electronic handwheels can be connected through an adapter.



HR 130 for integration in the machine operating panel

## Programming stations

The iTNC, TNC 320/TNC 620 and TNC 640 programming stations enable you to program in plain language just as you do at the machine, but away from the noise and distractions of the shop floor.

### Creating programs

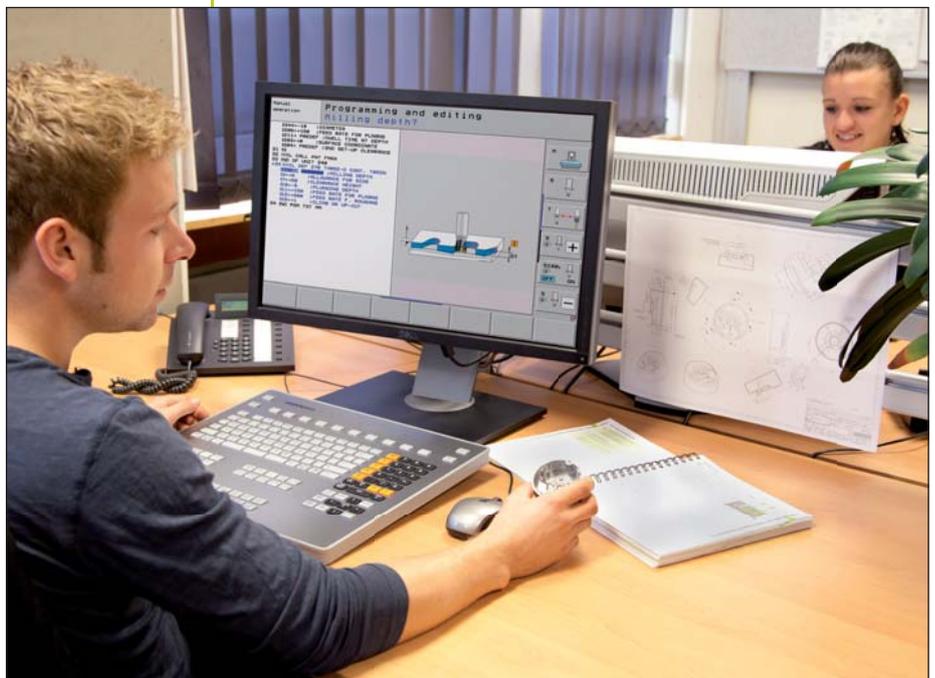
Programming, testing and optimizing HEIDENHAIN conversational or ISO programs with the programming station substantially reduces machine idle times. You do not need to change your way of thinking. At the programming station you program on the same keyboard as at the machine. Of course you can also use the alternative smarT.NC operating mode on the iTNC programming station.

### 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 in ISO as well as in plain language format, the programming stations can also be used in schools for NC programming training.



# Tool and workpiece setup and measurement

## Workpiece touch probes

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

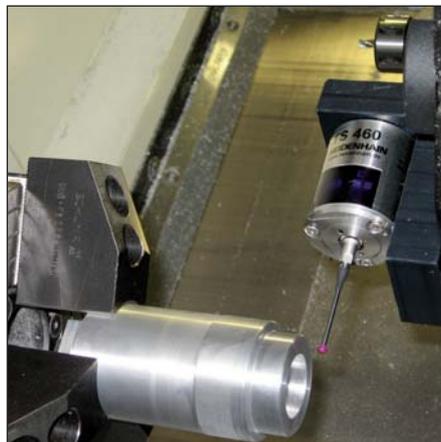
The stylus of a TS touch trigger probe is deflected upon contact with a workpiece surface. At that moment the TS generates a trigger signal that, depending on the model, is transmitted either by cable or over an infrared or radio beam to the control.

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 switch 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 probe repeatability
- High probe velocity
- 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 subsequent electronics; no interface required



Touch probe with **cable connection for signal transmission** for machines with manual tool change:

- **TS 260**  
Flange socket axial or radial

Touch probe with **radio and infrared transmission** for machines with automatic tool change

- **TS 460**  
Standard touch probe with compact dimensions

Touch probes with **infrared signal transmission** for machines with automatic tool change:

- **TS 444**  
Battery-free voltage supply through integrated air turbine generator over central compressed air supply
- **TS 642**  
Activation by switch in the taper shank
- **TS 740**  
High probing accuracy and repeatability, low probing force

<b>Machine type</b>
<b>Tool change</b>
<b>Signal transmission</b>
<b>Transceiver Unit</b>
<b>Voltage supply</b>
<b>Switching on/off</b>
<b>Interface to control</b> signal levels
<b>Probe repeatability</b>
<b>Probe velocity</b>
<b>Protection</b> EN 60529



TS 460	TS 444	TS 642	TS 740	TS 260
<b>CNC machine tools for milling, drilling and boring</b> as well as <b>CNC grinding machines or lathes</b>				
<b>Automatic</b>				<b>Manual</b>
Radio and infrared	Infrared/			Via cable
<ul style="list-style-type: none"> <li>• <b>SE 540:</b> For integration in spindle head; only infrared transmission</li> <li>• <b>SE 660:</b> As common SE for TS and TT; radio and infrared transmission</li> </ul>				–
Batteries, rechargeable or nonrechargeable	Air turbine generator	Batteries, rechargeable or nonrechargeable		15 V to 30 V
For radio or infrared transmission		Switch in taper shank	By infrared signal	–
HTL via SE transmitter/receiver unit				HTL
$2\sigma \leq 1\ \mu\text{m}$			$2\sigma \leq 0.25\ \mu\text{m}$	$2\sigma \leq 1\ \mu\text{m}$
$\leq 3\ \text{m/min}$			$\leq 0.25\ \text{m/min}$	$\leq 3\ \text{m/min}$
IP 67				

# Tool touch probes

Tool measurement on the machine shortens non-productive times, increases machining accuracy and reduces scrapping and reworking of machined parts. With the tactile TT touch probes and the contact-free TL laser systems, HEIDENHAIN offers two completely different possibilities for tool measurement.

With 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 3-D touch trigger probes for tool measurement and inspection. The disk-shaped probe contact of the TT is deflected during physical probing of a tool. At that moment the TT generates a trigger signal that is transmitted to the control, where it is processed further. The trigger signal is generated through a wear-free optical switch that ensures high reliability.

### TT 160

- Signal transmission to the NC over **connecting cable**

### TT 460

- Signal transmission over **radio and infrared beam** to transmitter/receiver unit
- The SE 660 is a common transmitter/receiver 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: $\pm X, \pm Y, +Z$	
<b>Probe repeatability</b>	$2\sigma \leq 1\ \mu\text{m}$ (probing velocity 1 m/min)	
<b>Permissible deflection of probe contact</b>	Approx. 5 mm in all directions	
<b>Power supply</b>	10 V to 30 V from the NC	Batteries, rechargeable or nonrechargeable
<b>Interface to control</b> Signal levels	HTL	HTL via SE transmitter/receiver unit
<b>Signal transmission</b>	Via cable	Radio wave and infrared transmission with 360° range
<b>Probe contact</b>	$\varnothing 40\ \text{mm}$ or $\varnothing 25\ \text{mm}$	
<b>Protection</b> EN 60529	IP 67	

### TL laser systems

The TL Micro and TL Nano laser systems can measure tools at the rated speed without making contact. With the aid of the included measuring cycles you can measure tool lengths and diameters, inspect the form of the individual teeth and check for tool wear or breakage. The control automatically saves the results of measurement in the tool table.



	TL Nano	TL Micro 150	TL Micro 200	TL Micro 350
<b>Probing method</b>	Contact-free with laser beam in two dimensions: $\pm X$ (or $\pm Y$ ), $+Z$			
<b>Tool diameter</b> Central measurement	0.03 to 37 mm	0.03 to 30 mm	0.03 to 80 mm	0.03 to 180 mm
<b>Repeatability</b>	$\pm 0.2 \mu\text{m}$		$\pm 1 \mu\text{m}$	
<b>Spindle speed</b>	Optimized for individual tooth measurement on standard or HSC spindles ( $> 30000 \text{ min}^{-1}$ )			
<b>Lasers</b>	Visible red-light laser with beam focused at center of system; protection class 2 (IEC 825)			
<b>Power supply</b>	24 V from the NC			
<b>Interface to control</b> Signal levels	HTL			
<b>Protection EN 60529</b>	IP 68 (when connected, with sealing air)			
<b>Tool cleaning</b>	Integral blowing unit			

# Measured value acquisition and display

## Digital readouts

Digital readouts serve to visualize the values measured with linear encoders, length gauges, rotary encoders or angle encoders. Areas of application include:

- Measuring and inspection equipment
- Dividing apparatuses
- Monitoring of measuring equipment
- Manual machine tools
- Measuring machines

Digital readouts from HEIDENHAIN are designed to be highly **user-friendly**. Typical characteristics:

- Optimally readable, graphic flat panel display
- Simple, logically arranged keypad
- Ergonomically designed push-button keys
- Splash-protected front panel
- Sturdy die-cast housing
- Conversational user guidance with help and graphic functions
- User-friendly functions for easier operation of manual machines and equipment
- Reference mark evaluation for distance-coded and single reference marks
- Problem-free installation, maintenance-free operation
- Fast payback with economical use

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

## Interface electronics

Interface electronics from HEIDENHAIN adapt the encoder signals to the interface of the subsequent electronics.

**Counter cards** for installation in PCs or subsequent electronics simplify the realization of **customized solutions** such as measuring electronics, controls or automation devices.

The MSE **modular interface electronics** serve as flexible subsequent electronics particularly for use on multipoint inspection apparatuses.

With its integrated counting function, the **external interface box** (EIB) converts the sinusoidal output signals from HEIDENHAIN encoders into position values to simplify connection to various control systems.



## Digital readouts for maximum productivity

**Digital readouts for metrology applications** offer numerous functions for **measured data acquisition** and **statistical evaluation** of measured values.

**QUADRA-CHEK** digital readouts for profile projectors, measuring microscopes, 2-D and video measuring machines as well as CMMs measure points on **2-D contours**, depending on the version either automatically or manually by crosshairs, by optical edge detection or by video camera with real-time display of the live image and integrated image processing. For **3-D contours**, such as planes, cylinders, cones and spheres, the measurement points are saved by probing with a touch probe. In the optional **CNC version**, they also operate as full-fledged controls for axis positioning and can automatically execute measuring programs.

**TOOL-CHEK** is a digital readout with special features for use on tool presetters.

The **GAGE-CHEK** digital readout with its max. eight encoder inputs is predestined for multipoint inspection apparatuses and SPC testing stations.



PC solution for a measuring machine



Position display on a milling machine

**Digital readouts for manual machine tools** increase your productivity. You save time, increase the dimensional accuracy of the finished workpiece and enjoy user-friendly operation.

It plays no role whether you have equipped a new or used machine with a digital readout. HEIDENHAIN digital readouts can easily be retrofitted to any model of machine or type of equipment, whatever the application and number of displayed axes.

**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.

### Digital readouts for metrology applications

For 2-D and 3-D measuring tasks

Series

Page

ND 100 QUADRA-CHEK  
ND 1000 QUADRA-CHEK  
ND 1200T TOOL-CHEK

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For measuring and testing tasks

ND 200  
ND 1100 QUADRA-CHEK  
ND 2100G GAGE-CHEK

55

### Digital readouts for manually operated machine tools

For milling machines, lathes and positioning devices For up to six axes  
For up to three axes

POSITIP 880  
ND 780  
ND 500

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### Interface electronics

For signal adjustment

EIB  
Gateway  
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### Evaluation electronics

For measuring tasks

MSE 1000  
IK 5000

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# Digital readouts

## For metrology applications

For many metrology applications, ranging from simple measuring stations to complex inspection systems with multiple measuring points, HEIDENHAIN supports you with the appropriate digital readouts or solutions for a PC.

Their functionality always orients itself to the specific application. Whether it is an SPC inspection station, a tool presetter, a profile projector, a measuring microscope, or a coordinate measuring machine, the **digital readouts for metrological applications** from HEIDENHAIN are the right choice for measurement tasks. There is even a CNC option for the automation of measurement tasks.



ND 100



ND 1200

	ND 100 QUADRA-CHEK	ND 1200 QUADRA-CHEK	ND 1300 QUADRA-CHEK	ND 1400 QUADRA-CHEK
<b>Application</b>	<ul style="list-style-type: none"> <li>Profile projectors</li> <li>Measuring microscopes</li> </ul>	<ul style="list-style-type: none"> <li>Profile projectors</li> <li>Measuring microscopes</li> <li>2-D measuring machines</li> </ul>	<ul style="list-style-type: none"> <li>Profile projectors</li> <li>Measuring microscopes</li> <li>Video measuring machines</li> </ul>	<ul style="list-style-type: none"> <li>Manual coordinate measuring machines</li> </ul>
<b>Axes<sup>1)</sup></b>	2 or 3	XY, XYQ, XYZ or XYZQ		XYZQ
<b>Encoder inputs</b>	□□TTL	~ 1 V <sub>PP</sub> or □□TTL (other interfaces upon request)		
<b>Display</b>	5.7-inch monochrome flat-panel display		8.4-inch color flat-panel display (touch screen)	
<b>Function</b>	Measurement of 2-D features			Measurement of 2-D and 3-D features
	<ul style="list-style-type: none"> <li>Programming of features and parts</li> <li>Entry of tolerances</li> </ul>	<ul style="list-style-type: none"> <li>Measure Magic function</li> <li>Programming of features and parts</li> <li>Entry of tolerances</li> </ul>		
	Point measurement with crosshairs			<ul style="list-style-type: none"> <li>Points measured via touch probe, crosshairs or rigid probing element</li> <li>Five coordinate systems can be stored</li> <li>Touch-probe management</li> </ul>
	–	<i>Optional:</i> Automatic edge sensing via optical edge detector	<i>Optional<sup>2)</sup>:</i> <ul style="list-style-type: none"> <li>Automatic edge sensing via optical edge detector</li> <li>Video edge detection and live image display</li> <li>Image archiving</li> <li>Zoom and light control, programmable</li> <li>CNC axis control and autofocus</li> </ul>	
<b>Data interfaces</b>	USB	USB; RS-232-C		

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

<sup>2)</sup> Possible combinations depending on version



ND 1300



ND 2100G



ND 287

ND 1202T TOOL-CHEK	ND 280	ND 287	ND 1100 QUADRA-CHEK	ND 2100G GAGE-CHEK
Tool presetters	Measuring and inspection equipment	<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> <li>Manual coordinate measuring machines</li> </ul>	<ul style="list-style-type: none"> <li>Multipoint inspection apparatuses</li> <li>SPC inspection stations</li> </ul>
2 (XZ)	1	1 (optional: 2)	2, 3 or 4	4 or 8
	$\sim 1 V_{PP}$ , $\sim 11 \mu A_{PP}$ or EnDat 2.2		$\sim 1 V_{PP}$ or $\square$ TTL (other interfaces upon request)	$\sim 1 V_{PP}$ or $\square$ TTL or EnDat 2.2 (other interfaces upon request)
5.7-inch monochrome flat-panel display	Monochrome flat-panel display	Color flat-panel display	5.7-inch monochrome flat-panel display	5.7-inch color flat-panel display
<ul style="list-style-type: none"> <li>Point measurement with crosshairs</li> <li>99 tool adapters</li> <li>Memory for 300 tools</li> <li>Entry of tolerances</li> <li>Circle and angle measurement</li> <li>Label printing</li> </ul>	–	<ul style="list-style-type: none"> <li>Sorting and tolerance checking</li> <li>Measurement series with min./max. value storage</li> <li>Functions for statistical process control (SPC)</li> <li>Graphic display of measurement results</li> <li>Storage of measured values</li> </ul>	Measurement series with min./max. acquisition  <i>Optional:</i> Touch-probe connection	<ul style="list-style-type: none"> <li>Sorting and tolerance checking</li> <li>Measurement series with min./max. value storage</li> <li>Functions for statistical process control (SPC)</li> <li>Graphic display of measurement results</li> <li>Storage of measured values</li> </ul>
		<i>Optional:</i> Sum/difference display or thermal compensation		<ul style="list-style-type: none"> <li>Programming of up to 100 parts</li> <li>Entry of any formulas, combinations and variables</li> <li>Output of measurement results</li> </ul>
		USB; RS-232-C <i>Optional:</i> Ethernet	USB; RS-232-C	

# Digital readouts

## For manually operated machine tools

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, measuring and testing equipment, and special machines—in fact all machines where axis slides are moved manually.



ND 780



ND 523

	POSITIP 880	ND 780	ND 522	ND 523
<b>Application</b>	Milling, drilling, boring machines and lathes			
<b>Description</b>	Color flat-panel display, program memory, splash-proof full-travel keyboard	Monochrome flat-panel display, splash-proof full-travel keyboard	Monochrome flat-panel display, membrane keyboard	
<b>Axes</b>	Up to 6 axes	Up to 3 axes	2 axes	3 axes
<b>Encoder inputs</b>	~ 1 V <sub>PP</sub> or EnDat 2.1	~ 1 V <sub>PP</sub>	TTL	
<b>Display step</b>	10 μm, 5 μm, 1 μm or finer		5 μm (with LS 328C/LS 628C)	
<b>Datums</b>	<i>Milling: 99; turning: 1</i>	10		
<b>Tool data</b>	For 99 tools	For 16 tools		
<b>Programming</b>	Max. 999 program blocks per program	–		
<b>Functions</b>	Contour monitoring with magnify function	Contour monitoring		
For milling, drilling and boring machines	<ul style="list-style-type: none"> <li>• Calculation of positions for hole patterns (circular patterns as well as linear patterns)</li> <li>• Cutting data calculator</li> </ul>			
	Probing functions for datum acquisition with the KT edge finder: "Edge," "Centerline" and "Circle center"		–	
	Positioning aids for milling and roughing of rectangular pockets		–	
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>• Taper calculator</li> <li>• Freezing the tool position for back-off</li> </ul>			
	<ul style="list-style-type: none"> <li>• Oversize allowances</li> <li>• Cycle for area clearance</li> </ul>		–	
<b>Interfaces</b>	Edge finder, switching functions (option)		–	
	RS-232-C/V.24, Centronics		RS-232-C/V.24	
			USB	

# Interface electronics

## For signal adjustment

### EIB series

#### External Interface Box

The external interface box subdivides the sinusoidal output signals from HEIDENHAIN encoders and converts them into absolute position values with the aid of the integrated counting function. When the reference mark is crossed, the position value is defined with respect to a fixed reference point.



EIB 392

	EIB 192	EIB 392
<b>Design</b>	Housing	Connector
<b>Protection</b>	IP 65	IP 40
<b>Encoder input</b>	~ 1 V <sub>PP</sub>	
<b>Connection</b>	M23 connector (12-pin, female)	<ul style="list-style-type: none"> <li>D-sub (15-pin, female)</li> <li>M23 connector (12-pin, female)</li> </ul>
<b>Signal subdivision</b>	≤ 16384-fold	
<b>Interface (output)</b>	<i>EIB 192/EIB 392</i> : EnDat 2.2 <i>EIB 192F/EIB 392F</i> : Fanuc Serial Interface <i>EIB 192M/EIB 392M</i> : Mitsubishi high speed interface	
<b>Voltage supply</b>	5 V DC ± 0.25 V	

### EIB 2391 S

#### External interface box

The EIB 2391 S supports the connection of HEIDENHAIN encoders with EnDat 22 interface (with or without functional safety) to the DRIVE-CLiQ interface.



	EIB 2391 S
<b>Encoder input</b>	EnDat 2.2
<b>Connection</b>	M12 connector (female), 8-pin
<b>Interface (output)</b>	DRIVE-CLiQ
<b>Voltage supply</b>	24 V DC (16.0 V to 28.8 V)
<b>Protection</b>	IP 65

DRIVE-CLiQ is a registered trademark of Siemens Aktiengesellschaft

### PROFIBUS Gateway

All absolute encoders from HEIDENHAIN with EnDat interface can be connected through a PROFIBUS gateway to the PROFIBUS-DP. The information available via PROFIBUS is generated on the basis of the EnDat 21 interface regardless of the encoder interface. The position value corresponds to the absolute value transmitted via the EnDat interface without interpolation of the 1 V<sub>PP</sub> signals. The complete interface electronics are integrated in the gateway, as well as a voltage converter for supplying EnDat encoders with 5 V DC.



	PROFIBUS DP Gateway
<b>Encoder input</b>	Absolute encoders with EnDat interface
<b>Connection</b>	M12 flange socket (female) 8-pin or M23 flange socket (female) 17-pin
<b>Output</b>	PROFIBUS DP-V0, classes 1 and 2 PROFIBUS DP-V1, DP-V2, classes 3 and 4 Integrated T-junction and bus termination (can be switched off)
<b>PROFIBUS clock frequency</b>	9.6 kb/s to 12 Mb/s
<b>Cable length</b>	≤ 400 m for 1.5 Mb/s ≤ 100 m for 12 Mb/s
<b>Voltage supply</b>	9 V to 36 V DC
<b>Protection</b>	IP 65
<b>Fastening</b>	Top-hat rail mounting

# Evaluation electronics

## For measuring tasks

### IK 5000

#### PC solution for measuring machines

IK 5000 QUADRA-CHEK, the universal PC package solution for 2-D and 3-D measuring tasks, is equally suitable as initial equipment on a machine as well as for retrofitting. It is available in versions for three or four axes, and the optional expansions make it ready for all coordinate measuring technology applications and for video measuring microscopes. You can measure two- and three-dimensional geometries and their relationships. The IK 5000 QUADRA-CHEK consists of the IK 5000 slot card for the PC as well as the additional necessary slot covers and the corresponding PC software. Once installed on your PC you will have a powerful measuring station.



	IK 5000 QUADRA-CHEK
<b>Application</b>	<ul style="list-style-type: none"> <li>• Profile projectors</li> <li>• Measuring microscopes</li> <li>• Video measuring machines</li> <li>• Coordinate measuring machines</li> </ul>
<b>Axes</b>	XYQ, XYZ or XYZQ (depending on the version)
<b>Encoder inputs</b>	$\sim 1 V_{PP}$ or $\square$ TTL (other interfaces upon request)
<b>Display</b>	By PC screen
<b>Function</b>	Measurement of 2-D features <ul style="list-style-type: none"> <li>• Measure Magic function</li> <li>• Programming of features and parts</li> <li>• Entry of tolerances</li> </ul> Point measurement with crosshairs <i>Depending on version:</i> <ul style="list-style-type: none"> <li>• Measurement of 3-D features</li> <li>• Automatic edge sensing via optical edge detector</li> <li>• Video edge detection and live image display</li> <li>• Point measurement by touch probe (also TP 200)</li> <li>• CNC axis control and autofocus</li> </ul>
<b>Data interfaces</b>	PCI (PC interface)

### MSE 1000

#### Modular electronic unit for multipoint inspection apparatuses

The MSE 1000 is a modular electronics unit for multipoint measuring apparatuses for shop-floor metrology. With its modular design and various interfaces, it can be adapted flexibly to a wide variety of applications. The individual modules permit connection of many different measuring devices with incremental, absolute and analog measurands, the output of switch signals, and communication over diverse interfaces. Fast communication with higher-level computers via Ethernet, outputs for controlling sorting switches, warning lamps, PLCs etc., as well as the capability of issuing measuring results for documentation and further processing are additional characteristics of the MSE 1000.



Modules	Description	Interface
<b>Basic</b>	Basic unit with complete functionality <ul style="list-style-type: none"> <li>• Ethernet 10/100 for connection to the PC</li> <li>• Encoder inputs</li> <li>• Switching inputs <math>\square</math>TTL</li> </ul>	Four EnDat 2.2, $\sim 1 V_{PP}$ or $\square$ TTL encoders
<b>Power supply</b>	Power supply unit	100 V to 240 V AC or 24 V DC
<b>EnDat</b>	Bidirectional encoder interface (purely serial)	4 or 8 EnDat 2.2 encoders
<b>Sinusoidal</b>	Counter module for incremental encoders	4 or 8 $\sim 1 V_{PP}$ encoders
<b>Square wave</b>	Counter module for incremental encoders	5 or 8 $\square$ TTL encoders
<b>Analog</b>	Axis module for analog inputs	Two $\pm 10 V$ or 4 mA to 20 mA inputs
<b>I/O</b>	Floating inputs/outputs	4 relay outputs 4 TTL switching inputs
<b>Compressed air</b>	Air switch for activation of pneumatic length gauges	1 input, 1 output Compressed air

### EIB 741

#### External interface box

The EIB 741 is ideal for applications requiring high resolution, fast measured-value acquisition, mobile data acquisition or data storage.

Up to four incremental or absolute HEIDENHAIN encoders can be connected to the EIB 741. The data is output over a standard Ethernet interface.



EIB 741			
<b>Encoder inputs</b> Switchable	$\sim 1 V_{PP}$ ( $\sim 11 \mu A_{PP}$ )	EnDat 2.1	EnDat 2.2
Connection	Four D-sub connections (15-pin, female)		
Input frequency	$\leq 500$ kHz	–	
<b>Signal subdivision</b>	4096-fold	–	
<b>Internal memory</b>	Typically 250 000 position values per input		
<b>Interface</b>	Ethernet as per IEEE 802.3 ( $\leq 1$ gigabit)		
<b>Driver software and demo program</b>	<b>For Windows, Linux, LabView</b> Example programs, EIB application software		

### IK 220

#### Universal PC counter card

The IK 220 is an expansion board for PCs for recording the measured values of two incremental or absolute HEIDENHAIN encoders. The subdivision and counting electronics subdivide the sinusoidal input signals 4096-fold. A driver software package is included in delivery.



IK 220				
<b>Encoder inputs</b> Switchable	$\sim 1 V_{PP}$	$\sim 11 \mu A_{PP}$	EnDat 2.1	SSI
Connection	Two D-sub connections (15-pin, male)			
Input frequency	$\leq 500$ kHz	$\leq 33$ kHz	–	
<b>Signal subdivision</b>	4096-fold	–		
<b>Internal memory</b>	8 192 position values per input			
<b>Interface</b>	PCI bus (plug and play)			
<b>Driver software and demo program</b>	<b>For Windows 2000/XP/Vista/7</b> in VISUAL C++, VISUAL BASIC and BORLAND DELPHI			

## For more information

### Brochures, data sheets and CD-ROMs

The products shown in this General Catalog 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

Visit our home page at [www.heidenhain.com](http://www.heidenhain.com) for up-to-date information on:

- The company
- The products

Our web site 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**

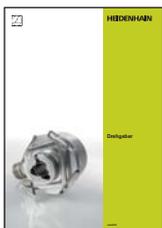
Contents:  
HEIDENHAIN-ACANTO  
HEIDENHAIN-SPECTO  
HEIDENHAIN-METRO  
HEIDENHAIN-CERTO



Brochure  
**Exposed Linear Encoders**

Contents:  
Absolute Linear Encoders  
**LIC**  
Incremental Linear Encoders  
**LIP, PP, LIF, LIDA**

## Angle measurement



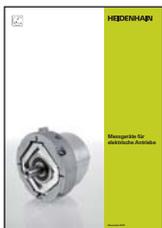
Brochure  
**Rotary Encoders**

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  
**Angle Encoders without Integral Bearing**

Contents:  
Incremental Angle Encoders  
**ERA, ERO, ERP**



Brochure  
**Modular Magnetic Encoders**

Contents:  
Incremental Encoders  
**ERM**

## Machine tool control



Brochures  
***iTNC 530 Contouring Control***  
***TNC 640 Contouring Control***

Contents:  
Information for the user



OEM brochures  
***iTNC 530 Contouring Control***  
***TNC 640 Contouring Control***

Contents:  
Information for the machine tool builder



Brochures  
***TNC 320 Contouring Control***  
***TNC 620 Contouring Control***

Contents:  
Information for the user



OEM brochures  
***TNC 320 Contouring Control***  
***TNC 620 Contouring Control***

Contents:  
Information for the machine tool builder



Brochure  
***MANUALplus 620 Contouring Control***

Contents:  
Information for the user



OEM brochure  
***MANUALplus 620 Contouring Control***

Contents:  
Information for the machine tool builder

## Setup and measurement



Brochure  
***Touch Probes***

Contents:  
Tool Touch Probe  
**TT, TL**  
Workpiece Touch Probe  
**TS**



Product Overview  
***Touch probes***  
***New Generation***

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



Brochure  
***Measuring Systems for Machine Tool***  
***Inspection and Acceptance Testing***

Contents:  
Incremental Linear Encoders  
**KGM, VM**

## Measured value acquisition and display



Brochure  
***Digital Readouts***  
***For Metrology Applications***

Contents:  
Digital Readouts  
**ND 100, ND 200, ND 1100, ND 1200,**  
**ND 1300, ND 1400 ND 1200T, ND 2100G**



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

Contents:  
Digital Readouts  
**ND 200, ND 500, ND 700, POSITIP**  
Linear Encoders  
**LS 300, LS 600**



Product Overview  
***Interface Electronics***

HEIDENHAIN is represented by subsidiaries in all important industrial nations. In addition to the addresses listed here, there are many service agencies located worldwide. For their addresses, please refer to the Internet or contact HEIDENHAIN Traunreut.

## DR. JOHANNES HEIDENHAIN GmbH

Dr.-Johannes-Heidenhain-Straße 5

83301 Traunreut, Germany

☎ +49 8669 31-0

☎ +49 8669 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: tbm@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: tbsvw@heidenhain.de

### HEIDENHAIN Technisches Büro Südost

83301 Traunreut, Deutschland

☎ 08669 31-1345

E-Mail: tbso@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/SA

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 GmbH

ul. Zhilunovicha 11, Office 204

220026 Minsk, Belarus

☎ +375 172954875

www.heidenhain.by

### CH HEIDENHAIN (SCHWEIZ) AG

Vieristrasse 14

8603 Schwerzenbach, Switzerland

☎ +41 44 8062727

www.heidenhain.ch

### CZ HEIDENHAIN s.r.o.

Dolnomecholupska ul. 12b

102 00 Praha 10, Czech Republic

☎ +420 272658131

www.heidenhain.cz

### DK TP TEKNIK A/S

Korskildelund 4

2670 Greve, Denmark

☎ +45 70 100966

www.tp-gruppen.dk

### ES FARRESA ELECTRONICA S.A.

Les Corts, 36 bajos

08028 Barcelona, Spain

☎ +34 934092491

www.farresa.es

### FI HEIDENHAIN Scandinavia AB

Mikkelänkallio 3

02770 Espoo, Finland

☎ +358 9 8676476

www.heidenhain.fi

### FR HEIDENHAIN FRANCE sarl

2 avenue de la Cristallerie

92310 Sèvres, France

☎ +33 0141143000

www.heidenhain.fr

## 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 DIADUR Indústria e Comércio 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

Av. Las Américas 1808

Fracc. Valle Dorado

20235 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.com

### VE Maquinaria Diekmann S.A.

Av. Humbolt (Prol. Leoncio Martinzes)

Urb. Las Acacias Aptdo. 40.112

Caracas, 1040-A, Venezuela

☎ +58 212 6325410

E-mail: purchase@diekmann.com.ve

## Africa

### ZA MAFEMA SALES SERVICES C.C.

107 16th Road, Unit B3

Tillbury Business Park, Randjespark

1685 Midrand, South Africa

☎ +27 11 3144416

www.heidenhain.co.za

## Australia

### AU FCR Motion Technology Pty. Ltd

Automation Place, Unit 6,

38-40 Little Boundary Road

Laverton North 3026, Victoria, Australia

☎ +61 3 93626800

E-mail: vicsales@fcrmotion.com

<b>GB</b>	<b>HEIDENHAIN (G.B.) Limited</b> 200 London Road, Burgess Hill West Sussex RH15 9RD, United Kingdom ☎ +44 1444 247711 www.heidenhain.co.uk	<b>NO</b>	<b>HEIDENHAIN Scandinavia AB</b> Orkdalsveien 15 7300 Orkanger, Norway ☎ +47 72480048 www.heidenhain.no	<b>SE</b>	<b>HEIDENHAIN Scandinavia AB</b> Storsåtragränd 5 12739 Skårholmen, Sweden ☎ +46 8 53193350 www.heidenhain.se
<b>GR</b>	<b>MB Milionis Vassilis</b> 38, Scoufa Str., St. Dimitrios 17341 Athens, Greece ☎ +30 210 9336607 www.heidenhain.gr	<b>PL</b>	<b>APS</b> ul. Włodarzewska 47 02-384 Warszawa, Poland ☎ +48 228639737 www.heidenhain.pl	<b>SK</b>	<b>KOPRETINA TN s.r.o.</b> Suvoz 1660 91101 Trenčín, Slovakia ☎ +421 32 7401700 www.kopretina.sk
<b>HR</b>	Croatia → <b>SL</b>	<b>PT</b>	<b>FARRESA ELECTRÓNICA LDA.</b> Rua do Espido, 74 C 4470 - 177 Maia, Portugal ☎ +351 229478140 www.farresa.pt	<b>SL</b>	<b>NAVO d.o.o.</b> Sokolska ulica 46 2000 Maribor, Slovenia ☎ +386 2 4297216 www.heidenhain.si
<b>HU</b>	<b>HEIDENHAIN Kereskedelmi Képviselet</b> Grassalkovich út 255. 1239 Budapest, Hungary ☎ +36 1 4210952 www.heidenhain.hu	<b>RO</b>	<b>HEIDENHAIN Reprezentantă Romania</b> Str. Zizinului, nr. 110, etaj 2, Braşov, 500407, Romania ☎ +40 726235914 www.heidenhain.ro	<b>TR</b>	<b>T&amp;M Mühendislik San. ve Tic. LTD. ŞTİ.</b> Eski Bostancı Yolu, KEYAP Carsi Sitesi G1 Blok, No. 119 B 34728 Umraniye-Istanbul, Turkey ☎ +90 216 3141111 www.heidenhain.com.tr
<b>IT</b>	<b>HEIDENHAIN ITALIANA S.r.l.</b> Via Asiago, 14 20128 Milano, Italy ☎ +39 02270751 www.heidenhain.it	<b>RS</b>	Serbia → <b>BG</b>	<b>UA</b>	<b>Gertner Service GmbH</b> Büro Kiev 01133 Kiev, Ukraine bul. L. Ukrainki 14a/40 ☎ +38 044 2357574 www.heidenhain.ua
<b>NL</b>	<b>HEIDENHAIN NEDERLAND B.V.</b> Copernicuslaan 34, 6716 BM Ede, Netherlands ☎ +31 318 581800 www.heidenhain.nl	<b>RU</b>	<b>OOO HEIDENHAIN</b> Chasovaya Street 23 A 125315 Moscow, Russia ☎ +7 495 931-9646 www.heidenhain.ru		

## Asia

<b>CN</b>	<b>DR. JOHANNES HEIDENHAIN (CHINA) Co., Ltd.</b> No. 6, TianWeiSanJie, Area A. Beijing Tianzhu Airport Industrial Zone Shunyi District, Beijing 101312, China ☎ +86 10-80420000 www.heidenhain.com.cn	<b>IN</b>	<b>HEIDENHAIN Optics &amp; Electronics India Private Limited</b> Citilights Corporate Centre No. 1, Vivekananda Street, Off Spurtank Road Chetpet, Chennai 600 031, India ☎ +91 44 3023-4000 www.heidenhain.in	<b>PH</b>	<b>Machinebanks` Corporation</b> 482 G. Araneta Avenue, Quezon City, Philippines 1113 ☎ +63 2 7113751 E-mail: info@machinebanks.com
<b>HK</b>	<b>HEIDENHAIN LTD</b> Unit 2007-2010, 20/F, Apec Plaza 49 Hoi Yuen Road, Kwun Tong Kowloon, Hong Kong ☎ +852 27591920 E-mail: sales@heidenhain.com.hk	<b>JP</b>	<b>HEIDENHAIN K.K.</b> Hulic Kojimachi Bldg 9F 3-2 Kojimachi, Chiyoda-ku Tokyo 102-0083, Japan ☎ +81 (0)3-3234-7781 www.heidenhain.co.jp	<b>SG</b>	<b>HEIDENHAIN PACIFIC PTE LTD.</b> 51, Ubi Crescent Singapore 408593 ☎ +65 6749-3238 www.heidenhain.com.sg
<b>ID</b>	<b>PT Servitama Era Toolsindo</b> GTS Building, Jl. Pulo Sidik Block R29 Jakarta Industrial Estate Pulogadung Jakarta 13930, Indonesia ☎ +62 21 46834111 E-mail: ptset@group.gts.co.id	<b>KR</b>	<b>HEIDENHAIN Korea LTD.</b> 2F Namsung Plaza (9th Ace Techno Tower) 345-30, Gasan-Dong, Geumcheon-Gu, Seoul, Korea, 153-782 ☎ +82 2 2028-7430 www.heidenhain.co.kr	<b>TH</b>	<b>HEIDENHAIN (THAILAND) LTD</b> 53/72 Moo 5 Chaloem Phra Kiat Rama 9 Road Nongbon, Pravate, Bangkok 10250, Thailand ☎ +66 2 398-4147-8 www.heidenhain.co.th
<b>IL</b>	<b>NEUMO VARGUS MARKETING LTD.</b> Post Box 57057 34-36, Itzhak Sade St. Tel Aviv 61570, Israel ☎ +972 3 5373275 E-mail: neumo@neumo-vargus.co.il	<b>MY</b>	<b>ISOSERVE SDN. BHD.</b> No. 21, Jalan CJ 3/13-2 Pusat Bandar Cheras Jaya 43200 Balakong, Selangor ☎ +03 9080 3121 E-mail: isoserve@po.jaring.my	<b>TW</b>	<b>HEIDENHAIN Co., Ltd.</b> No. 29, 33rd Road Taichung Industrial Park Taichung 40768, Taiwan R.O.C. ☎ +886 4 23588977 www.heidenhain.com.tw
				<b>VN</b>	<b>AMS Co. Ltd</b> 243/9/10 D To Hien Thanh Street, Ward 13, District 10, HCM City, Vietnam ☎ +84 8 3868 3738 E-mail: davidgoh@amsvn.com

# HEIDENHAIN

## DR. JOHANNES HEIDENHAIN GmbH

Dr.-Johannes-Heidenhain-Straße 5

83301 Traunreut, Germany

☎ +49 8669 31-0

FAX +49 8669 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.de](http://www.heidenhain.de)

<b>DE</b>	<b>HEIDENHAIN Vertrieb Deutschland</b> 83301 Traunreut, Deutschland ☎ 08669 31-3132 FAX 08669 32-3132 E-Mail: hd@heidenhain.de	<b>ES</b>	<b>FARRESA ELECTRONICA S.A.</b> 08028 Barcelona, Spain www.farresa.es	<b>PL</b>	<b>APS</b> 02-384 Warszawa, Poland www.heidenhain.pl
	<b>HEIDENHAIN Technisches Büro Nord</b> 12681 Berlin, Deutschland ☎ 030 54705-240	<b>FI</b>	<b>HEIDENHAIN Scandinavia AB</b> 02770 Espoo, Finland www.heidenhain.fi	<b>PT</b>	<b>FARRESA ELECTRÓNICA, LDA.</b> 4470 - 177 Maia, Portugal www.farresa.pt
	<b>HEIDENHAIN Technisches Büro Mitte</b> 07751 Jena, Deutschland ☎ 03641 4728-250	<b>FR</b>	<b>HEIDENHAIN FRANCE sarl</b> 92310 Sèvres, France www.heidenhain.fr	<b>RO</b>	<b>HEIDENHAIN Reprezentantă Romania</b> Braşov, 500407, Romania www.heidenhain.ro
	<b>HEIDENHAIN Technisches Büro West</b> 44379 Dortmund, Deutschland ☎ 0231 618083-0	<b>GB</b>	<b>HEIDENHAIN (G.B.) Limited</b> Burgess Hill RH15 9RD, United Kingdom www.heidenhain.co.uk	<b>RS</b>	Serbia → <b>BG</b>
	<b>HEIDENHAIN Technisches Büro Südwest</b> 70771 Leinfelden-Echterdingen, Deutschland ☎ 0711 993395-0	<b>GR</b>	<b>MB Milionis Vassilis</b> 17341 Athens, Greece www.heidenhain.gr	<b>RU</b>	<b>OOO HEIDENHAIN</b> 125315 Moscow, Russia www.heidenhain.ru
	<b>HEIDENHAIN Technisches Büro Südost</b> 83301 Traunreut, Deutschland ☎ 08669 31-1345	<b>HK</b>	<b>HEIDENHAIN LTD</b> Kowloon, Hong Kong E-mail: sales@heidenhain.com.hk	<b>SE</b>	<b>HEIDENHAIN Scandinavia AB</b> 12739 Skärholmen, Sweden www.heidenhain.se
		<b>HR</b>	Croatia → <b>SL</b>	<b>SG</b>	<b>HEIDENHAIN PACIFIC PTE LTD.</b> Singapore 408593 www.heidenhain.com.sg
<b>AR</b>	<b>NAKASE SRL.</b> B1653AOX Villa Ballester, Argentina www.heidenhain.com.ar	<b>HU</b>	<b>HEIDENHAIN Kereskedelmi Képviselet</b> 1239 Budapest, Hungary www.heidenhain.hu	<b>SK</b>	<b>KOPRETINA TN s.r.o.</b> 91101 Trenčín, Slovakia www.kopretina.sk
<b>AT</b>	<b>HEIDENHAIN Techn. Büro Österreich</b> 83301 Traunreut, Germany www.heidenhain.de	<b>ID</b>	<b>PT Servitama Era Toolsindo</b> Jakarta 13930, Indonesia E-mail: ptset@group.gts.co.id	<b>SL</b>	<b>NAVO d.o.o.</b> 2000 Maribor, Slovenia www.heidenhain.si
<b>AU</b>	<b>FCR Motion Technology Pty. Ltd</b> Laverton North 3026, Australia E-mail: vicsales@fcrmotion.com	<b>IL</b>	<b>NEUMO VARGUS MARKETING LTD.</b> Tel Aviv 61570, Israel E-mail: neumo@neumo-vargus.co.il	<b>TH</b>	<b>HEIDENHAIN (THAILAND) LTD</b> Bangkok 10250, Thailand www.heidenhain.co.th
<b>BE</b>	<b>HEIDENHAIN NV/SA</b> 1760 Roosdaal, Belgium www.heidenhain.be	<b>IN</b>	<b>HEIDENHAIN Optics &amp; Electronics India Private Limited</b> Chetpet, Chennai 600 031, India www.heidenhain.in	<b>TR</b>	<b>T&amp;M Mühendislik San. ve Tic. LTD. ŞTİ.</b> 34728 Ümraniye-Istanbul, Turkey www.heidenhain.com.tr
<b>BG</b>	<b>ESD Bulgaria Ltd.</b> Sofia 1172, Bulgaria www.esd.bg	<b>IT</b>	<b>HEIDENHAIN ITALIANA S.r.l.</b> 20128 Milano, Italy www.heidenhain.it	<b>TW</b>	<b>HEIDENHAIN Co., Ltd.</b> Taichung 40768, Taiwan R.O.C. www.heidenhain.com.tw
<b>BR</b>	<b>DIADUR Indústria e Comércio Ltda.</b> 04763-070 – São Paulo – SP, Brazil www.heidenhain.com.br	<b>JP</b>	<b>HEIDENHAIN K.K.</b> Tokyo 102-0083, Japan www.heidenhain.co.jp	<b>UA</b>	<b>Gertner Service GmbH Büro Kiev</b> 01133 Kiev, Ukraine www.heidenhain.ua
<b>BY</b>	<b>GERTNER Service GmbH</b> 220026 Minsk, Belarus www.heidenhain.by	<b>KR</b>	<b>HEIDENHAIN Korea LTD.</b> Gasam-Dong, Seoul, Korea 153-782 www.heidenhain.co.kr	<b>US</b>	<b>HEIDENHAIN CORPORATION</b> Schaumburg, IL 60173-5337, USA www.heidenhain.com
<b>CA</b>	<b>HEIDENHAIN CORPORATION</b> Mississauga, Ontario L5T2N2, Canada www.heidenhain.com	<b>MX</b>	<b>HEIDENHAIN CORPORATION MEXICO</b> 20235 Aguascalientes, Ags., Mexico E-mail: info@heidenhain.com	<b>VE</b>	<b>Maquinaria Diekmann S.A.</b> Caracas, 1040-A, Venezuela E-mail: purchase@diekmann.com.ve
<b>CH</b>	<b>HEIDENHAIN (SCHWEIZ) AG</b> 8603 Schwerzenbach, Switzerland www.heidenhain.ch	<b>MY</b>	<b>ISOSERVE SDN. BHD.</b> 43200 Balakong, Selangor E-mail: isoserve@po.jaring.my	<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>NL</b>	<b>HEIDENHAIN NEDERLAND B.V.</b> 6716 BM Ede, Netherlands www.heidenhain.nl	<b>ZA</b>	<b>MAFEMA SALES SERVICES C.C.</b> Midrand 1685, South Africa www.heidenhain.co.za
<b>CZ</b>	<b>HEIDENHAIN s.r.o.</b> 102 00 Praha 10, Czech Republic www.heidenhain.cz	<b>NO</b>	<b>HEIDENHAIN Scandinavia AB</b> 7300 Orkanger, Norway www.heidenhain.no		
<b>DK</b>	<b>TPTEKNIK A/S</b> 2670 Greve, Denmark www.tp-gruppen.dk	<b>PH</b>	<b>Machinebanks Corporation</b> Quezon City, Philippines 1113 E-mail: info@machinebanks.com		

