



# HEIDENHAIN



## General Catalog

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

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

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

This General Catalog offers you an overview of the HEIDENHAIN product program. You will find more products and further information in the documentation for specific products (see *For more information* on page Page 68 *For more information*) or the Internet at [www.heidenhain.de](http://www.heidenhain.de). Our sales personnel will be glad to help you personally. See *Sales and service—worldwide* on pPage 70 *Sales and service—worldwide* for addresses and telephone numbers.

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



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# Fundamentals and processes

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



30 m long measuring machine for scale tapes



Vacuum machine for application of chromium layers

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



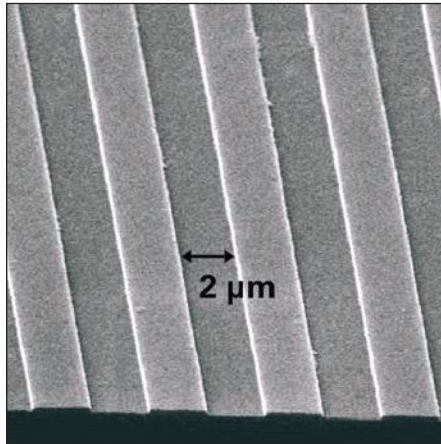
Angle comparator, measuring step approx. 0.001°



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

# 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  $0.25\text{ }\mu\text{m}$  to  $10\text{ }\mu\text{m}$ . These precision graduations are manufactured in a process invented by HEIDENHAIN (e.g. DIADUR or METALLUR) and are a decisive factor in the function and accuracy of encoders. The graduations consist of lines and gaps at defined intervals with very little deviation, forming structures with very high edge definition. These graduations are resistant to mechanical and chemical influences and can tolerate vibration and shock. All measuring standards have a defined thermal behavior.



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

## AUODUR

AUODUR graduations consist of highly reflective gold lines and matte etched gaps. AUODUR 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 micrometers down to quarters of a micrometer.

## SUPRADUR

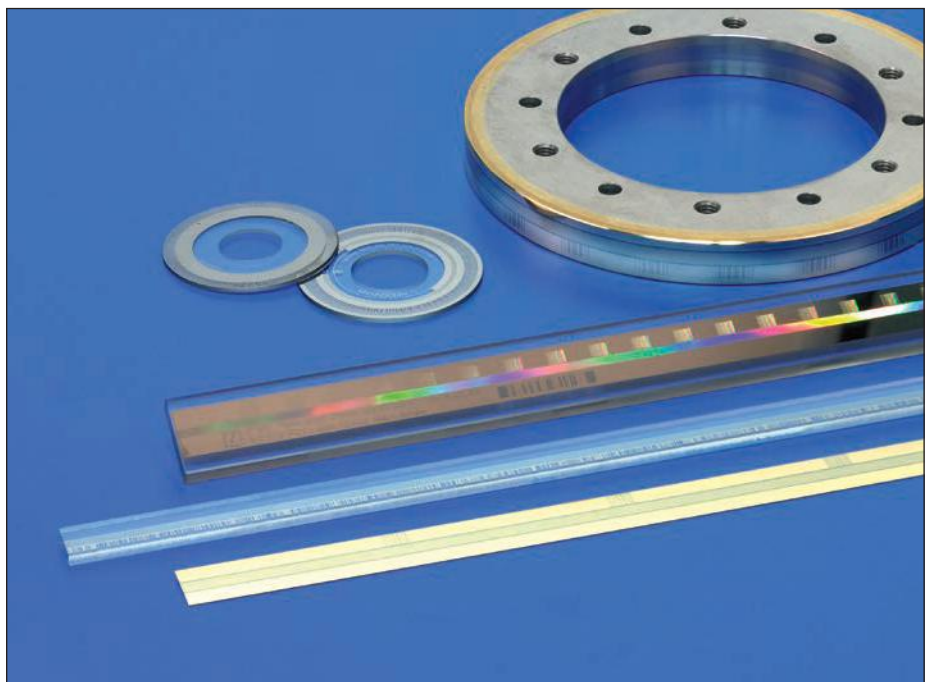
Graduations manufactured with the SUPRADUR process function optically like three-dimensional phase gratings, but they have a planar structure and are therefore particularly insensitive to contamination.

## 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 measurement

## Sealed linear encoders

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

### machine tools.

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

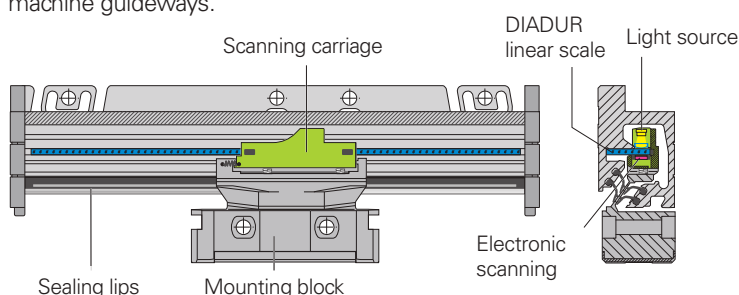


Sealed linear encoders are available with

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

The aluminum housing of a HEIDENHAIN sealed linear encoder protects the scale, scanning carriage, and its guideway from chips, dust, and fluids. Downward-oriented elastic lips seal the housing.

The scanning carriage travels along the scale on a low-friction guide. It is connected to the external mounting block by a coupling that compensates unavoidable misalignment between the scale and the machine guideways.



## Exposed linear encoders

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

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



### Length gauges

Length gauges from HEIDENHAIN feature integral guideways for the plunger.

They are used to monitor measuring equipment, in industrial metrology, and as position encoders.

- Accuracy grades as fine as  $\pm 0.1 \mu\text{m}$
- For measuring steps 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
With full-size scale housing	Absolute position measurement	LC 100	8
	Absolute position measurement and large measuring lengths	LC 200	
	Incremental position measurement	LS 100	
	Very high repeatability	LF 100	
	Typically for manual machines	LS 600	
	Large measuring lengths	LB 300	
With slimline scale housing	Absolute position measurement	LC 400	10
	Incremental position measurement	LS 400	
	Very high repeatability	LF 400	
	Typically for manual machines	LS 300	
Exposed linear encoders	Very high accuracy	LIP	12
	Two-coordinate encoders	LIF, PP	13
	For high accuracy and large measuring lengths	LIDA	14
	Absolute position measurement	LIC	
Length gauges	For measuring stations and multipoint inspection apparatuses	AT, CT, MT, ST	16



# LC, LF, LS, LB sealed linear encoders

## With full-size scale housing

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

Absolute linear encoders of the **LC 100** and **LC 200** series provide the **absolute position value** without 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 of incremental linear encoders is 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 resistance
- Two mounting attitudes
- Single-field scanning

### LC 200 series

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

### LS 100 series

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

### LF 185

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

### LB 382

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

### LS 600 series

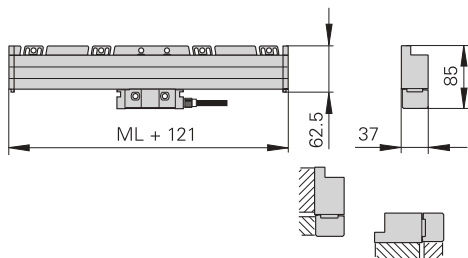
- Incremental position measurement
- Typically for manual machines
- Simple mounting

	<b>Absolute</b> <b>LC 115<sup>1)</sup>/LC 185</b> <b>LC 195 F/M/P/S<sup>1)</sup></b>	<b>LC 211/LC 281</b> <b>LC 291 F/M</b>
<b>Measuring standard</b>	DIADUR glass scale	METALLUR steel scale tape
Grating period	20 µm	40 µm
<b>Interface</b>	<i>LC 115:</i> EnDat 2.2 <i>LC 185:</i> EnDat 2.2 with ~ 1 V <sub>PP</sub> <i>LC 195:</i> Fanuc αi/Mitsubishi/ Panasonic/DRIVE-CLiQ	<i>LC 211:</i> EnDat 2.2 <i>LC 281:</i> EnDat 2.2 with ~ 1 V <sub>PP</sub> <i>LC 291:</i> Fanuc αi/Mitsubishi
Signal period	<i>LC 185:</i> 20 µm	<i>LC 281:</i> 40 µm
<b>Accuracy grade</b>	±5 µm, ±3 µm <sup>3)</sup>	±5 µm
<b>Measuring lengths ML</b>	Up to 4240 mm	Up to 28 040 mm <sup>5)</sup>
<b>Reference mark</b>	—	

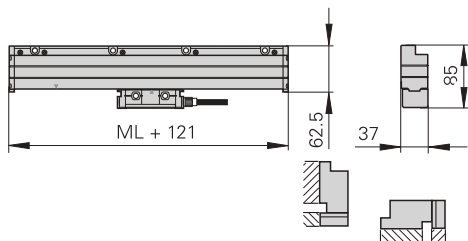
<sup>1)</sup> Also available with functional safety

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

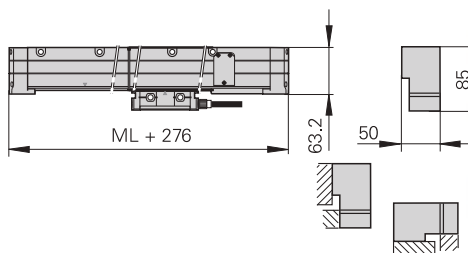




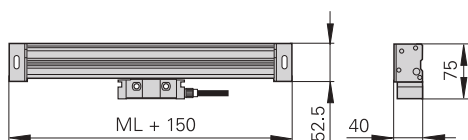
LC 100



LF 185



LC 200



LS 600



	<i>Incremental</i> LF 185	LS 187 LS 177	LS 688C LS 628C	LB 382
	SUPRADUR phase grating on steel 8 µm	DIADUR glass scale  20 µm	DIADUR glass scale  20 µm	AUODUR steel scale tape  40 µm
	~ 1 V <sub>PP</sub>	LS 187: ~ 1 V <sub>PP</sub> LS 177: □□TTL <sup>2)</sup>	LS 688C: ~ 1 V <sub>PP</sub> LS 628C: □□TTL	~ 1 V <sub>PP</sub>
	4 µm	LS 187: 20 µm	LS 688C: 20 µm	40 µm
	±3 µm, ±2 µm	±5 µm, ±3 µm	±10 µm	±5 µm
	Up to 3040 mm	Up to 3040 mm		Up to 30 040 mm <sup>4)</sup>
	One or distance-coded; <b>LS 6xxC</b> : distance-coded			

<sup>3)</sup> Up to ML 3040 mm

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

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

# LC, LF, LS sealed linear encoders

## With slimline scale housing

Sealed linear encoders with **slimline scale housing** are primarily used where installation space is limited.

Absolute linear encoders of the **LC 400** series provide the **absolute position value** without requiring any previous traverse. Like the **LS 400** series of 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 of incremental linear encoders is 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

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

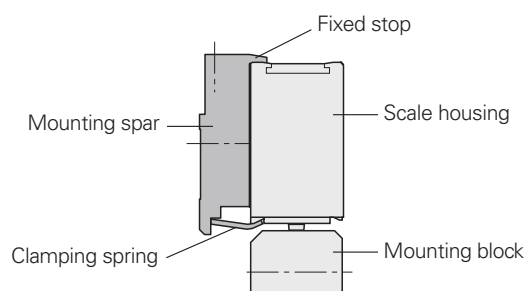
### LS 300 series

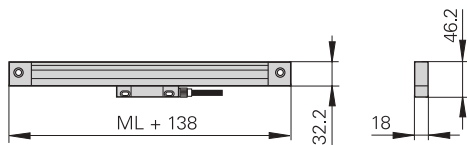
- Incremental position measurement
- Typically for manual machines

### Simple installation with mounting spar

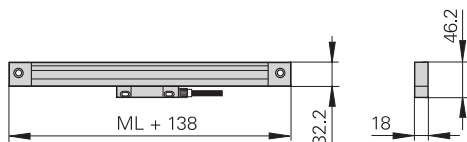
The use of a mounting spar is of great benefit when mounting slimline linear encoders. It can be fastened as part of the machine assembly process. The encoder is then simply clamped on during final mounting. Easy exchange also facilitates servicing.

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

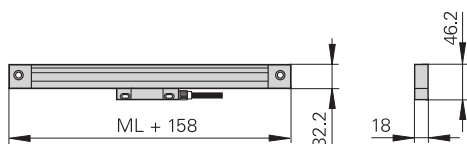




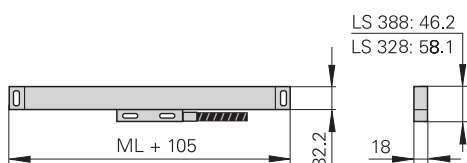
LC 400



LS 400



LF 485



LS 300

	<b>Absolute</b> LC 415 <sup>1)</sup> /LC 485 LC 495 F/M/P/S <sup>1)</sup>	<b>Incremental</b> LF 485	LS 487 LS 477	LS 388 C LS 328 C
<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 485: EnDat 2.2 with ~ 1 V <sub>PP</sub> LC 495: Fanuc αi/ Mitsubishi/ Panasonic/ DRIVE-CLiQ	~ 1 V <sub>PP</sub>	LS 487: ~ 1 V <sub>PP</sub> LS 477: □ TTL <sup>2)</sup>	LS 388 C: ~ 1 V <sub>PP</sub> LS 328 C: □ TTL
Signal period	LC 485: 20 µm	4 µm	LS 487: 20 µm	LS 388 C: 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> Also available with functional safety

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

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

# LIP, LIF exposed linear encoders

## For very high accuracy

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

**LIP** and **LIF** encoders are typically used for:

- Measuring machines and comparators
- Measuring microscopes
- Ultra-precision machines such as diamond lathes for optical components, facing lathes for magnetic storage disks, and grinding machines for ferrite components
- Measuring and production equipment in the semiconductor industry
- Measuring and production equipment in the electronics industry

Special **vacuum applications in high vacuum** are served by LIF 481 V and LIP 481 V (for high vacuum, down to  $10^{-7}$  bar) and LIP 481 U (for ultrahigh vacuum, down to  $10^{-11}$  bar).

### LIP 300 series

- Highest resolutions 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

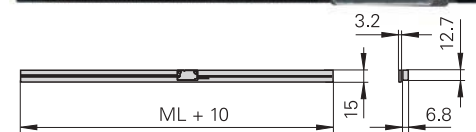
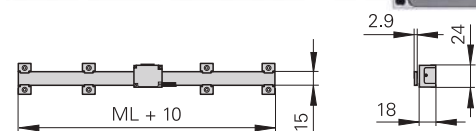
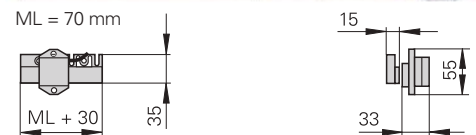
- Very high repeatability with compact dimensions
- Measuring lengths up to 3040 mm
- Measuring step down to 1 nm
- Defined thermal behavior thanks to a measuring standard on Zerodur glass ceramic

### LIP 6000 series

- For highly dynamic applications
- For limited installation space
- Measuring step down to 2 nm
- Position detection through limit switches and homing track

### LIF 400 series

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



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

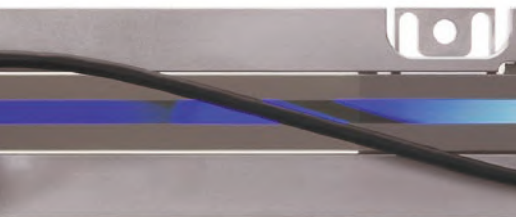
<sup>1)</sup> Absolute position value after scanning the reference mark

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



# PP exposed linear encoders

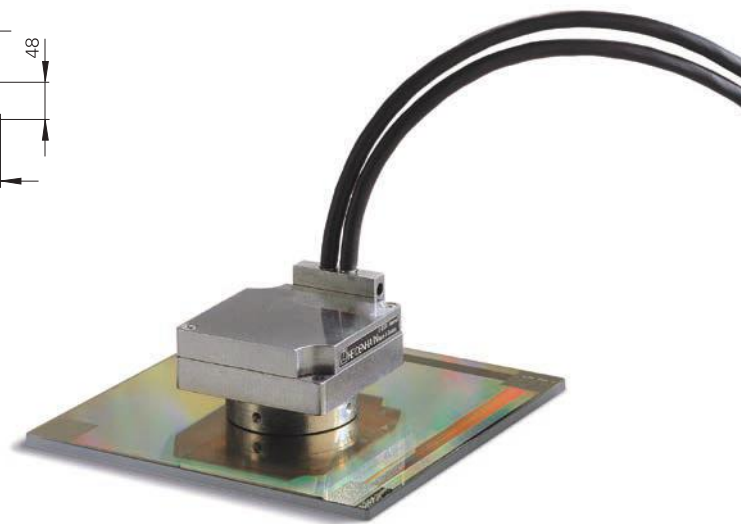
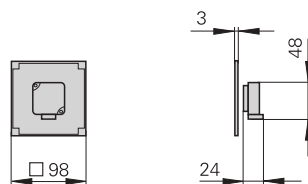
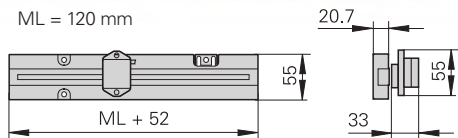
## Two-coordinate encoders





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 μm		
LIF 481:  1 V <sub>PP</sub> LIF 471:  TTL		
LIF 481: 4 μm		
±1 μm (only for Zerodur)	±3 μm	
≤ ±0.225 μm/5 mm		
±12 nm		
70 mm to 1020 mm	70 mm to 1640 mm	
One		

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

# LIC, LIDA exposed linear encoders

For high accuracy and large measuring lengths

The **LIC** and **LIDA** exposed linear encoders are designed for **high traversing speeds** up to 10 m/s and **large measuring lengths** of up to 30 m.

The **LIC** encoders make **absolute position measurement** possible over measuring lengths up to 28 m. In their dimensions, they correspond to LIDA 400 and LIDA 200 incremental linear encoders.

On the **LIC** and **LIDA** linear encoders, steel scale tapes typically serve as substrate for METALLUR graduations. With the LIC 41x3 and LIDA 4x3, graduation carriers of glass or glass ceramics permit **thermal adaptation** thanks to their different coefficients of linear expansion.

LIC and LIDA exposed linear encoders are typically used for:

- Coordinate measuring machines
- Inspection machines
- PCB assembly machines
- PCB drilling machines
- Precision handling devices
- Position and velocity measurement on linear motors

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

## LIC 41x3, LIDA 4x3

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

## LIC 41x5, LIDA 4x5

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

## LIC 41x7, LIC 21x7, 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 41x9, LIC 21x9, LIDA 4x9, LIDA 2x9

- One-piece steel scale tape is bonded directly to the mounting surface
- Also available with functional safety

## LIC 4100 series

- Absolute position acquisition up to 28 m
- Various mounting options

## LIP 400 series



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

## LIC 2100 series

- Absolute position measurement
- Large mounting tolerance
- For simple applications

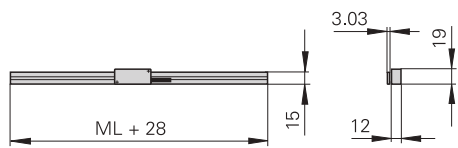
## LIP 200 series

- Scale tape cut from roll
- Large mounting tolerance
- For simple applications
- Simple installation through integrated function display

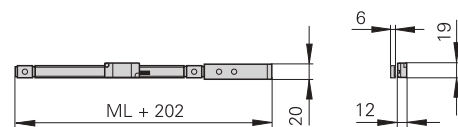
	<b>Absolute</b> <b>LIC 4113</b> <b>LIC 4193</b>	<b>LIC 4115</b> <b>LIC 4195</b>	<b>LIC 4117</b> <b>LIC 4197</b>	<b>LIC 4119<sup>1)</sup></b> <b>LIC 4199</b>	<b>Incremental</b> <b>LIDA 483</b> <b>LIDA 473</b>
<b>Measuring standard</b>	METALLUR graduation on glass ceramic or glass	METALLUR steel scale tape			METALLUR graduation on glass ceramic or glass
Grating period	40 μm	40 μm			20 μm
<b>Interface</b>	<i>LIC 411x</i> : EnDat 2.2 <i>LIC 419x</i> : Fanuc αi/Mitsubishi/Panasonic/Yaskawa				<i>LIDA 48x</i> :  1 V <sub>PP</sub> <i>LIDA 47x</i> :  TTL <sup>2)</sup>
Signal period	—				<i>LIDA 48x</i> : 20 μm
<b>Accuracy grade</b>	±3 μm; ±5 μm	±5 μm	±3 μm <sup>3)</sup> , ±5 μm <sup>3)</sup> ; ±15 μm	±3 μm; ±15 μm	±1 μm <sup>4)</sup> ; ±3 μm; ±5 μm
<b>Baseline error</b>	≤ ±0.275 μm/10 mm	≤ ±0.750 μm/50 mm			≤ ±0.275 μm/10 mm
<b>Interpolation error<sup>5)</sup></b>	±20 nm	±20 nm			±45 nm
<b>Measuring lengths ML</b>	240 mm to 3040 mm	140 mm to 28440 mm	240 mm to 6040 mm	70 mm to 1020 mm	240 mm to 3040 mm
<b>Reference mark</b>	—				One or distance-coded

<sup>1)</sup> Also available with functional safety <sup>2)</sup> Up to 100-fold integrated interpolation ( LIDA 47x also 5-fold)

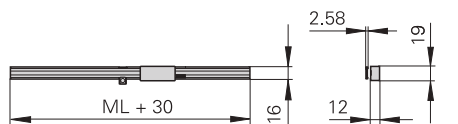
<sup>3)</sup> Up to measuring length 1020 mm or 1040 mm



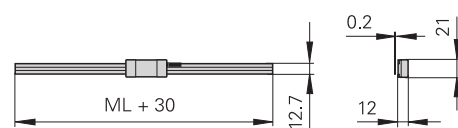
LIC 4113



LIDA 485



LIC 2117



LIDA 279

	LIDA 485 LIDA 475	LIDA 487 LIDA 477	LIDA 489 LIDA 479	Incremental LIDA 287 LIDA 277	LIDA 289 LIDA 279	Absolute LIC 2117 LIC 2197	LIC 2119 LIC 2199
	METALLUR steel scale tape			Steel scale tape		Steel scale tape	
	20 μm			200 μm		220 μm	
				<i>LIDA 28x</i> : $\sim 1 V_{PP}$ <i>LIDA 27x</i> : $\square\square TTL^{2)}$		<i>LIC 211x</i> : EnDat 2.2 <i>LIC 219x</i> : Fanuc $\alpha$ /Mitsubishi/ Panasonic/Yaskawa	
				<i>LIDA 28x</i> : 200 μm		—	
	±5 μm	±3 μm <sup>3)</sup> ; ±5 μm <sup>3)</sup> ; ±15 μm	±3 μm; ±15 μm	±15 μm		±15 μm	
	≤ ±0.750 μm/50 mm (typical)			—		—	
	±45 nm			±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		120 mm to 3020 mm (larger measuring lengths upon request)	
	One			Selectable every 100 mm		—	

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

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

# AT, CT, MT, ST length gauges

For measuring stations and multipoint inspection apparatuses

HEIDENHAIN length gauges are characterized by high accuracy together with large strokes of up to 100 mm. They feature plungers with integral bearings and therefore serve as compact measuring devices.

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

The **HEIDENHAIN-METRO** MT 1200 and MT 2500 length gauges are ideal for precision measuring stations and testing equipment. The ball-bush guided plunger tolerates high radial forces. The primary applications for the MT 60 and MT 101 are incoming inspection, production monitoring, and quality control. They are also used as high-accuracy position encoders, for example on linear slides or X-Y tables.

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

## Plunger actuation

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

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

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

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

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

## HEIDENHAIN-ACANTO

- Online diagnostics
- Protection up to IP67
- Absolute scanning

## HEIDENHAIN-CERTO

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

## HEIDENHAIN-METRO

MT 1200 and MT 2500

- High repeatability
- Various gauging force variants
- Various possibilities for plunger actuation


## HEIDENHAIN-METRO

MT 60 and MT 101

- Large measuring ranges
- Plunger actuation by motor or coupling
- Ball-bush guided plunger

## HEIDENHAIN-SPECTO

- Exceptionally compact dimensions
- Protection up to IP67
- Especially durable ball-bush guide
- Variant for harsh ambient conditions

	<i>Absolute</i> AT 1218 AT 1217		AT 3018 AT 3017	<i>Incremental</i> CT 2501 CT 2502		CT 6001 CT 6002	MT 1281 MT 1287	MT 1271
Measuring standard	DIADUR glass scale			DIADUR phase grating on Zerodur glass ceramic scale Coefficient of linear expansion: $\alpha_{\text{therm}} = (0\pm 0.1) \times 10^{-6} \text{ K}^{-1}$				
Grating period	188.4 $\mu\text{m}$			4 $\mu\text{m}$			4 $\mu\text{m}$	
Interface	EnDat 2.2			$\sim 11 \text{ }\mu\text{A}_{\text{PP}}$			$\sim 1 \text{ V}_{\text{PP}}$	 TTL <sup>3)</sup>
Signal period	–			2 $\mu\text{m}$				–
System accuracy	$\pm 1 \text{ }\mu\text{m}$	$\pm 2 \text{ }\mu\text{m}$		$\pm 0.1 \text{ }\mu\text{m}^{1)}$ $\pm 0.03 \text{ }\mu\text{m}^{2)}$	$\pm 0.1 \text{ }\mu\text{m}^{1)}$ $\pm 0.05 \text{ }\mu\text{m}^{2)}$	$\pm 0.2 \text{ }\mu\text{m}$		
Repeatability	0.4 $\mu\text{m}$	0.8 $\mu\text{m}$		0.02 $\mu\text{m}$	0.03 $\mu\text{m}$			
Measuring range	12 mm	30 mm		25 mm	60 mm		12 mm	
Plunger actuation	AT xx18: by measured object AT xx17: pneumatic			CT xx01: with motor CT xx02: by coupling			MT xxx1: cable-type lifter or free MT xx87: pneumatic	

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

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

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





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 <sup>3)</sup>	~ 11 µA <sub>PP</sub>		~ 1 V <sub>PP</sub>	□TTL <sup>3)</sup>	~ 1 V <sub>PP</sub>	□TTL <sup>3)</sup>
	2 µm	–	10 µm		20 µm	–	20 µm	–
			±0.5 µm	±1 µm	±1 µm			
	0.09 µm		0.06 µm	0.04 µm	0.25 µm		0.7 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> : pneumatic			

## Angle encoders

HEIDENHAIN angle encoders are characterized by high accuracy values in the range of angular seconds and better. These devices are used in applications such as rotary tables and swivel heads of machine tools, indexing heads, high-precision angle measuring tables, precision devices in angular metrology, antennas, and telescopes.

- Line counts typically 9000 to 180 000
- Accuracy from  $\pm 5''$  to  $\pm 0.4''$
- Measuring steps as fine as  $0.000\,01^\circ$  or  $0.036''$  (incremental) or 29 bits, i.e. approx. 536 million positions per revolution (absolute)



## Rotary encoders

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

- Line counts of typically 16 to 5000
- Accuracy grades to  $\pm 10''$  (depending on the line count, corresponding to  $\pm 1/20$  of the grating period)
- Measuring steps to  $0.001^\circ$ .  
Particularly for photoelectric rotary encoders, the high quality of the sinusoidal incremental signals permits high interpolation factors for digital speed control.



### Mounting variants

In angle encoders and rotary encoders with integral bearing and **stator coupling**, the graduated disk of the encoder is connected directly to the shaft to be measured. The scanning unit is guided on the shaft via ball bearings, supported by the stator coupling. As a result, during angular acceleration of the shaft, the stator coupling must absorb only that torque resulting from friction in the bearing. These angle encoders therefore provide excellent dynamic performance. Thanks to the stator coupling, the system accuracy includes the error of the shaft coupling.

Other benefits of the stator coupling are:

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

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

Angle encoders and rotary encoders **without integral bearing** operate without friction. The two components—the scanning head and the scale disk, drum, or tape—are adjusted to each other during assembly. The benefits are:

- 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 bidirectional EnDat interface, PROFIBUS-DP, and PROFINET enable automatic configuration of the higher-level electronics and provide monitoring and diagnostic functions.

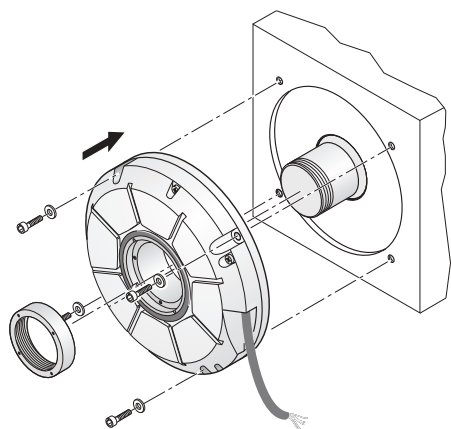
Under the designation **functional safety**, HEIDENHAIN offers encoders with purely serial data transmission as single-encoder systems for safety-related machines and systems. The two measured values are already formed independently of each other in the encoder, and are transmitted to the safe control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

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

# RCN, RON, RPN sealed angle encoders

## With integral bearing and integrated stator coupling

Because of their high static and dynamic accuracy, the **RCN, RON, and RPN** angle encoders with integral bearings and integral stator couplings are the preferred units for high-precision applications such as rotary tables and tilting axes. The measuring standard is a circular scale with DIADUR graduation. 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.

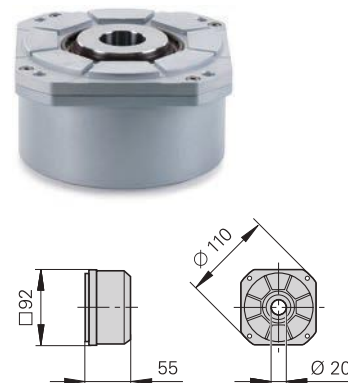


Features of the **RCN 2000, RCN 5000, RCN 6000, and RCN 8000** series of angle encoders:

- **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
- Possibility of mechanical fault exclusion against loosening of the encoder-to-drive connection

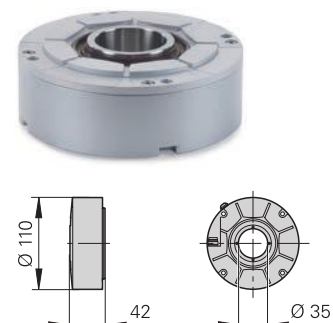
### RCN 2000 and RON 200 series

- Compact dimensions
- Sturdy design
- Typically used with rotary tables, tilting tables, for positioning and speed control
- Stainless steel versions (e.g. for antennas) upon 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

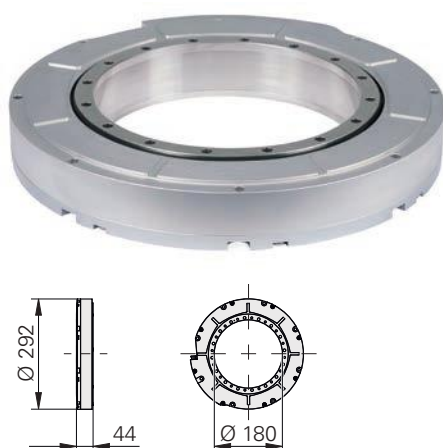
- Large hollow shaft diameters up to Ø 100 mm
- System accuracy  $\pm 2''$  and  $\pm 1''$
- Typically used on rotary and angle measuring tables, indexing heads, measuring setups, image scanners, etc.




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

### RCN 6000 series

- Very large hollow shaft
- System accuracies  $\pm 2''$
- Typically used with rotary tables, tilting tables, and direct drives






	<b>Absolute</b> RCN 2380 RCN 2580	RCN 2310 <sup>1)</sup> RCN 2510 <sup>1)</sup>	RCN 2390 F RCN 2590 F	RCN 2390 M RCN 2590 M	<b>Incremental</b> RON 225 RON 275	RON 285 RON 287
<b>Interface</b>	EnDat 2.2 <sup>2)</sup> with ~ 1 V <sub>PP</sub>	EnDat 2.2 <sup>2)</sup>	Fanuc αi	Mitsubishi	 TTL	~ 1 V <sub>PP</sub>
Position values/revolution	RCN 23x0: 67 108 864 (26 bits); RCN 25x0: 268 435 456 (28 bits)				–	
Signal periods/revolution	16384	–			18000 <sup>3)</sup> 90000/180000 <sup>4)</sup>	18000
<b>System accuracy</b>	RCN 23x0: ±5"; RCN 25x0: ±2.5"				±5"	±5"; ±2.5"
<b>Mech. permissible speed</b>	≤ 1500 rpm				≤ 3000 rpm	

	<b>Absolute</b> <b>RCN 5380</b> <b>RCN 5580</b>	<b>RCN 5310</b> <sup>1)</sup> <b>RCN 5510</b> <sup>1)</sup>	<b>RCN 5390 F</b> <b>RCN 5590 F</b>	<b>RCN 5390 M</b> <b>RCN 5590 M</b>
<b>Interface</b>	EnDat 2.2 <sup>2)</sup> with ~ 1 V <sub>PP</sub>	EnDat 2.2 <sup>2)</sup>	Fanuc αi	Mitsubishi
Position values/revolution	RCN 53x0: 67 108 864 (26 bits); RCN 55x0: 268 435 456 (28 bits)			
Signal periods/revolution	16384	–		
<b>System accuracy</b>	RCN 53x0: ±5"; RCN 55x0: ±2.5"			
<b>Mech. permissible speed</b>	≤ 1500 rpm			

	<b>Absolute</b> RCN 8380 RCN 8580	RCN 8310 <sup>1)</sup> RCN 8510 <sup>1)</sup>	RCN 8390 F RCN 8590 F	RCN 8390 M RCN 8590 M	<b>Incremental</b> RON 786	RON 886	RPN 886
<b>Interface</b>	EnDat 2.2 <sup>2)</sup> with ~ 1 V <sub>PP</sub>	EnDat 2.2 <sup>2)</sup>	Fanuc αi	Mitsubishi	~ 1 V <sub>PP</sub>		
Position values/revolution	536870912 (29 bits)				–		
Signal periods/revolution	32 768	–	–		18000, 36000	36000	180000
<b>System accuracy</b>	RCN 83x0: ±2"; RCN 85x0: ±1"				±2"	±1"	
<b>Mech. permissible speed</b>	≤ 500 rpm				≤ 1000 rpm		

	<b>Absolute</b> RCN 6310		RCN 6390 F	RCN 6390 M
<b>Interface</b>	EnDat 2.2		Fanuc Serial Interface $\alpha$ i interface	Mitsubishi high speed interface
Position values/revolution	268 435 456 (28 bits); Fanuc $\alpha$ interface: 134 217 728 (27 bits)			
<b>System accuracy</b>	$\pm 2.0''$			
<b>Mech. permissible speed</b>	$\leq 200$ rpm <sup>5)</sup>			

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

<sup>2)</sup> DRIVE-CLiQ via EIB; PROFIBUS-DP via Gateway

<sup>3)</sup> Integrated 2-fold interpolation

<sup>4)</sup> Integrated 5/10-fold interpolation

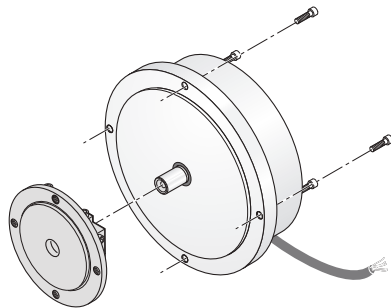
<sup>5)</sup> Higher speeds possible depending on the operating temperature  
DRIVE-CLiQ is a registered trademark of Siemens AG.

# ROC, ROD, RON sealed angle encoders

## With integral bearing

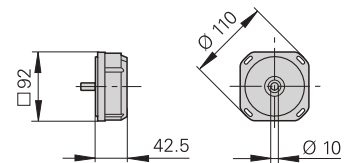
**ROC** and **ROD** angle encoders with solid shaft for separate shaft coupling are particularly suited to applications where higher shaft speeds and larger mounting tolerances are required. The precision shaft couplings allow axial motion up to  $\pm 1$  mm.

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



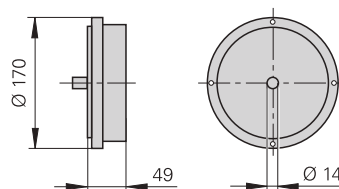
### For separate shaft coupling ROC 2000 and ROD 200

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

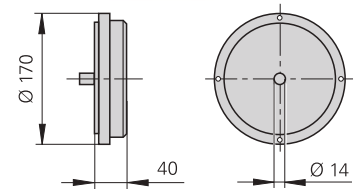


### For separate shaft coupling ROC 7000, ROD 780, and ROD 880

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



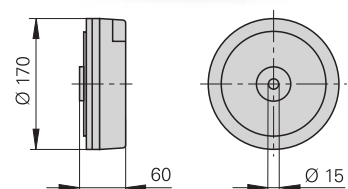
ROD 780, ROD 880





ROC 7000

### For highly accurate applications RON 905

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



	<b>Absolute ROC 2310</b>	<b>ROC 2380</b>	<b>ROC 2390F</b>	<b>ROC 2390M</b>	<b>Incremental ROD 220</b>	<b>ROD 270</b>	<b>ROD 280</b>
<b>Interface</b>	EnDat 2.2 <sup>4)</sup>	EnDat 2.2 <sup>4)</sup> ~ 1 V <sub>PP</sub>	Fanuc $\alpha$ i	Mitsubishi	 TTL	 TTL	~ 1 V <sub>PP</sub>
Signal periods/revolution	16384				18000 <sup>2)</sup>	180000 <sup>3)</sup>	18000
<b>System accuracy</b> <sup>1)</sup>	±5"						
<b>Mech. permissible speed</b>	≤ 3000 rpm				≤ 10000 rpm		

<sup>1)</sup> Without shaft coupling

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

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

<sup>4)</sup> DRIVE-CLiQ via EIB; PROFIBUS via Gateway

	<b>Absolute ROC 7310</b>	<b>ROC 7380</b>	<b>ROC 7390F</b>	<b>ROC 7390M</b>	<b>Incremental ROD 780</b>	<b>ROD 880</b>
<b>Interface</b>	EnDat 2.2 <sup>2)</sup>	EnDat 2.2 <sup>2)</sup> ~ 1 V <sub>PP</sub>	Fanuc $\alpha$ i	Mitsubishi	~ 1 V <sub>PP</sub>	
Signal periods/revolution	16384				18000, 36000	36000
<b>System accuracy</b> <sup>1)</sup>	±2"				±2"	±1"
<b>Mech. permissible speed</b>	≤ 3000 rpm				≤ 1000 rpm	

<sup>1)</sup> Without shaft coupling

<sup>2)</sup> DRIVE-CLiQ via EIB; PROFIBUS via Gateway

DRIVE-CLiQ is a registered trademark of Siemens AG.

	<b>Incremental RON 905</b>
<b>Interface</b>	~ 11 $\mu$ A <sub>PP</sub>
Signal periods/revolution	36000
<b>System accuracy</b>	±0.4"
<b>Mech. permissible speed</b>	≤ 100 rpm

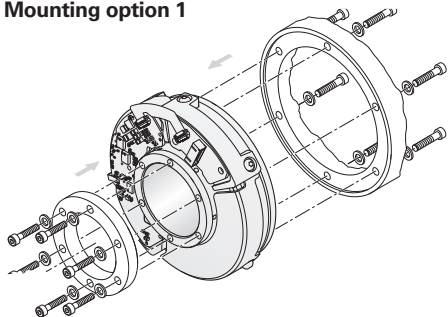
# MRP, SRP angle encoder modules

## Assemblies for high-precision rotary axes

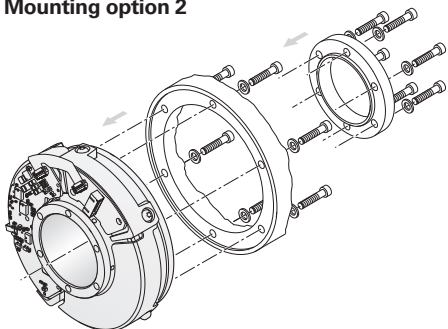
### MRP angle encoder module: combination of angle encoder and bearing

Angle encoder modules from HEIDENHAIN consist of optimally harmonized combinations of angle encoders and high-precision bearings. These assemblies feature high measuring and bearing accuracy, very high resolution, and exceptional repeatability, as well as smooth motion thanks to their low starting torque. Their design as specified and tested complete assemblies makes handling and installation easier.

#### Mounting option 1



#### Mounting option 2



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

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

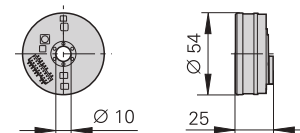
### MRP 2000 series

Angle encoder modules with integrated encoder and bearing

- Particularly compact dimensions
- High measuring and bearing accuracy
- Hollow shaft  $\varnothing$  10 mm



MRP 2010



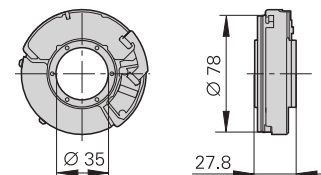
### MRP 5000 series

Angle encoder modules with integrated encoder and bearing

- Compact dimensions
- High measuring and bearing accuracy
- Hollow shaft  $\varnothing$  35 mm



MRP 5010



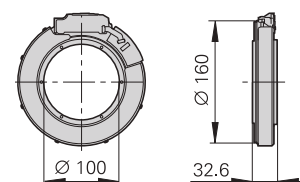
### MRP 8000 series

Angle encoder modules with integrated encoder and bearing

- Compact dimensions
- High measuring and bearing accuracy
- Hollow shaft  $\varnothing$  100 mm



MRP 8010



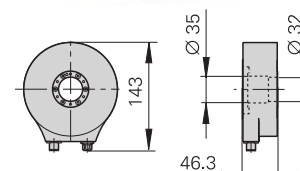
### SRP 5000 series

Angle encoder modules with integrated encoder, bearing, and torque motor

- Compact dimensions
- Torque motor with low cogging torque
- Peak torque: 2.70 Nm
- Rated torque: 0.385 Nm



SRP 5000





	<b>Incremental MRP 2080</b>	<b>Absolute MRP 2010</b>
<b>Interface</b>	$\sim 1 V_{PP}$	EnDat 2.2
Signal periods/revolution	2048	
<b>System accuracy</b>	$\pm 7''$	
Maximum permissible axial load	50 N (centered load, purely static, without additional vibrations or shock loading)	
Radial guideway accuracy	Measured at distance $h = 52$ mm from the ball race: $\leq 0.60 \mu\text{m}$	
Wobble of the axis	$2.5''$	

	<b>Incremental MRP 5080</b>	<b>Absolute MRP 5010</b>
<b>Interface</b>	$\sim 1 V_{PP}$	EnDat 2.2
Signal periods/revolution	30000	16384
<b>System accuracy</b>	$\pm 2.5''$ or $\pm 5''$	
Maximum permissible axial load	200 N (centered load, purely static, without additional vibrations or shock loading)	
Radial guideway accuracy	Measured at distance $h = 55$ mm: $\leq 0.20 \mu\text{m}$ (without load)	
Wobble of the axis	$0.7''$	

	<b>Incremental MRP 8080</b>	<b>Absolute MRP 8010</b>
<b>Interface</b>	$\sim 1 V_{PP}$	EnDat 2.2
Signal periods/revolution	63000	32768
<b>System accuracy</b>	$\pm 1''$ or $\pm 2''$	
Maximum permissible axial load	300 N (centered load, purely static, without additional vibrations or shock loading)	
Radial guideway accuracy	Measured at distance $h = 124$ mm: $\leq 0.15 \mu\text{m}$	
Wobble of the axis	$0.5''$	

	<b>Incremental SRP 5080</b>	<b>Absolute SRP 5010</b>
<b>Interface</b>	$\sim 1 V_{PP}$	EnDat 2.2
Signal periods/revolution	30000	16384
<b>System accuracy</b>	$\pm 2.5''$ or $\pm 5''$	
Maximum permissible axial load	200 N (centered load, purely static, without additional vibrations or shock loading)	
Radial guideway accuracy	Measured at distance $h = 55$ mm: $\leq 0.20 \mu\text{m}$ (without load)	
Wobble of the axis	$0.7''$	

# ERP, ERO modular angle encoders

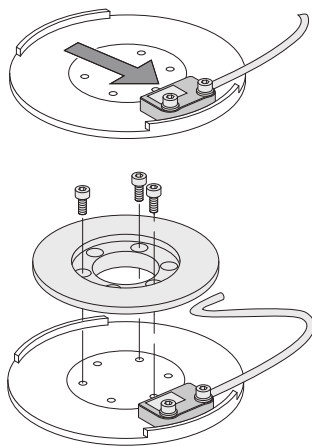
## Without integral bearing, with optical scanning

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

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

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

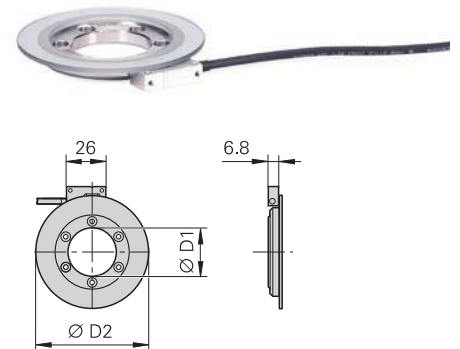
Applications for the **ERO** are found in metrology, in compact rotary tables, and in precise, highly dynamic drives.



**ERO 6000**

### ERP 1000 series

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



### ERO 2000 series

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



### ERO 6000 series

- Very flat design
- High system accuracy
- Simple mounting



### ERO 6100 series

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



	<b>Incremental</b> <b>ERP 1070</b> <b>ERP 1080</b>			
<b>Interface</b>	<i>ERP 1070:</i> □ □ TTL; <i>ERP 1080:</i> ∼ 1 V <sub>PP</sub>			
Signal periods/revolution	23 000	30 000	50 000	63 000
<b>Accuracy of graduation</b>	±4"	±3"	±1.8"	±1.5"; ±0.9"
<b>Inside diameter D1</b>	13 mm	32 mm	62 mm	104 mm
<b>Outside diameter D2</b>	57 mm	75 mm	109 mm	151 mm
<b>Mech. permissible speed</b>	≤ 2600 rpm	≤ 2000 rpm	≤ 1200 rpm	≤ 950 rpm

	<b>Incremental</b> <b>ERO 2080</b>	<b>ERO 6070</b> <b>ERO 6080</b>		<b>ERO 6180</b>
<b>Interface</b>	∼ 1 V <sub>PP</sub>	<i>ERO 6070:</i> □ □ TTL; <i>ERO 6080:</i> ∼ 1 V <sub>PP</sub>		∼ 1 V <sub>PP</sub>
Signal periods/revolution	4096	9000	18 000	4096
<b>Accuracy of graduation</b>	±8"	±3"	±2"	±10"
<b>Inside diameter D1</b>	5 mm	25 mm	95 mm	41 mm
<b>Outside diameter D2</b>	30 mm	71 mm	150 mm	70 mm
<b>Mech. permissible speed</b>	≤ 14000 rpm	≤ 1600 rpm	≤ 800 rpm	≤ 3500 rpm

# ECA, ERA modular angle encoders

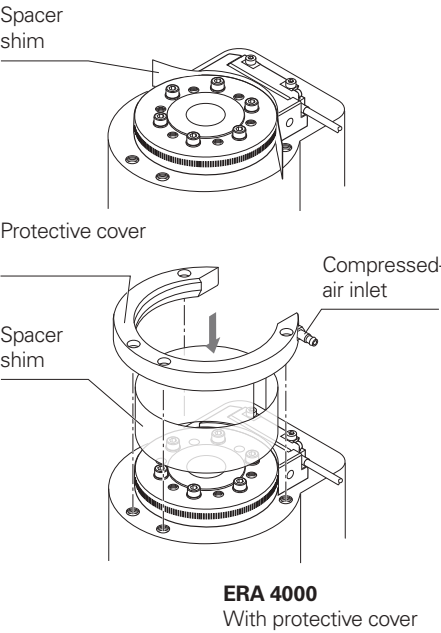
## Without integral bearing, with optical scanning

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

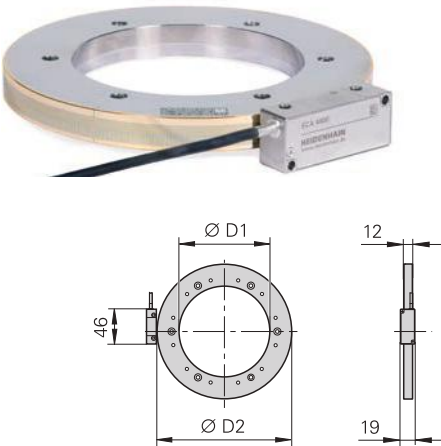
The attainable system accuracy depends on the eccentricity of the graduation to the drive shaft bearing, as well as the radial runout and wobble of the bearing.

The angle encoders **ECA** and **ERA** feature a sturdy steel scale drum and are suited for high shaft speeds up to 10000 rpm. They are typically found on fast running spindles, rotary tables, and tilting axes.

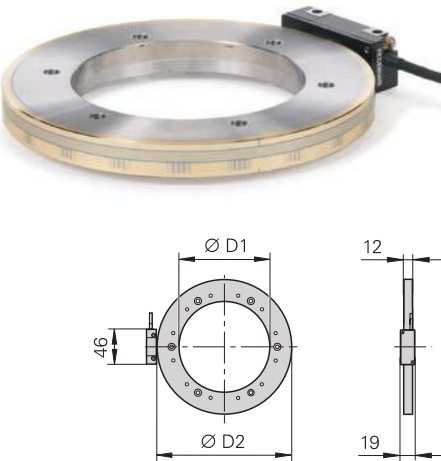
The ECA 4000 V angle encoders are suitable for vacuum applications in high vacuum (down to 10<sup>-7</sup> bar).



- ECA 4400 series**
- High accuracy
  - Sturdy design with steel scale drum and METALLUR graduation
  - Various drum versions  
*ECA 4xx0:* with centering collar  
*ECA 4xx2:* with 3-point centering



- ERA 4000 series**
- High shaft speeds up to 10000 rpm
  - Sturdy design with steel scale drum and METALLUR graduation
  - Axial motion of measured shaft permissible up to ±0.5 mm
  - The ERA 4480C is available with larger diameters or as versions with protective cover
  - Various drum versions  
*ERA 4xx0:* with centering collar  
*ERA 4xx2:* with 3-point centering



Interface	
Signal periods/revolution	
Accuracy of graduation	
Inside diameter D1	
Outside diameter D2	
Mechanically permissible speed	

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

<b>Absolute</b> <b>ECA 4412<sup>1)</sup></b> <b>ECA 4492F</b> <b>ECA 4492M</b> <b>ECA 4492P</b>									
<i>ECA 4412:</i> EnDat 2.2; <i>ECA 4492F:</i> Fanuc $\alpha$ i; <i>ECA 4492M:</i> Mitsubishi; <i>ECA 4492P:</i> Panasonic									
8195	10010	11 616	14 003	16 379	19 998	25 993	37 994	44 000	
±3"	±2.5"	±2.8"	±2"	±1.9"	±1.8"	±1.7"	±1.5"	±1.5"	
70 mm	80 mm	120 mm	120 mm	150/185 mm	180/210 mm	270 mm	425 mm	512 mm	
104.63 mm	127.64 mm	148.2 mm	178.55 mm	208.89 mm	254.93 mm	331.31 mm	484.07 mm	560.46 mm	
≤ 8500 rpm	≤ 6250 rpm	≤ 5250 rpm	≤ 4500 rpm	≤ 4250 rpm	≤ 3250 rpm	≤ 2500 rpm	≤ 1800 rpm	≤ 1500 rpm	

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

<b>Incremental</b> <b>ERA 4280C<sup>1)</sup></b> Signal period 20 $\mu$ m <b>ERA 4480C</b> Signal period 40 $\mu$ m <b>ERA 4880C</b> Signal period 80 $\mu$ m									
$\sim$ 1 V <sub>PP</sub>									
12 000 6 000 3 000	16 384 8 192 4 096	20 000 10 000 5 000	28 000 14 000 7 000	32 768 16 384 8 192	40 000 20 000 10 000	52 000 26 000 13 000	– 38 000 –	– 44 000 –	
±5"	±3.7"	±3"	±2.5"				±2"		
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	
≤ 10 000 rpm	≤ 8500 rpm	≤ 6250 rpm	≤ 4500 rpm	≤ 4250 rpm	≤ 3250 rpm	≤ 2500 rpm	≤ 1800 rpm	≤ 1500 rpm	

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



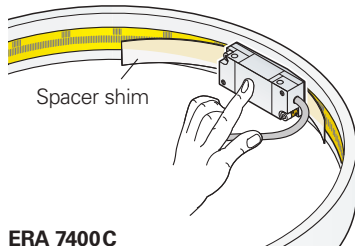
# ERA modular angle encoders

## Without integral bearing, with optical scanning

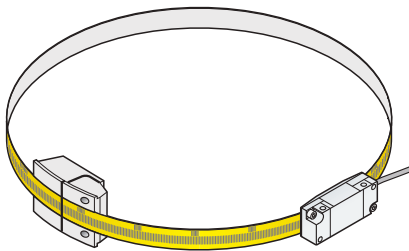
The HEIDENHAIN **ERA** angle encoders with steel scale tape as measuring standard function without integral bearings. They are intended for integration in machine elements or components. They are designed to meet the following requirements:

- Large hollow shaft diameters up to 10 m
- No additional starting torque caused by rotary shaft seals

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



**ERA 7400C**



**ERA 8400C**

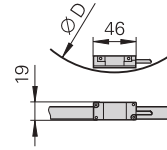
### ERA 7000 and ERA 8000 series

- For very large diameters up to 10 m
- METALLUR steel scale tape

#### ERA 7000 series

Scale tape is placed in a slot on the inside circumference of the machine element

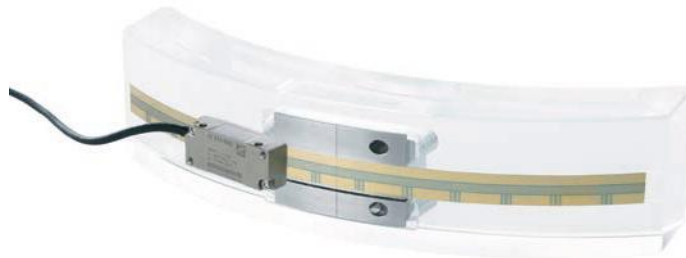
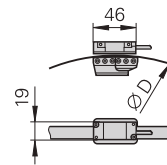
- **ERA 7400C**: full-circle version
- **ERA 7401C**: segment version



#### ERA 8000 series

Scale tape is fastened on the circumference of the machine element

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



	<b>Incremental ERA 7400C</b>		
<b>Interface</b>	$\sim 1 V_{PP}$ ; signal period 40 $\mu m$ (on circumference)		
Signal periods/revolution	36000	45000	90000
<b>Accuracy of graduation</b>	$\pm 3.9''$	$\pm 3.2''$	$\pm 1.6''$
<b>Accuracy of the scale tape</b>	$\pm 3 \mu m$ per meter tape length		
<b>Diameter D1</b>	458.62 mm	573.20 mm	1146.10 mm
<b>Mech. permissible speed</b>	$\leq 250$ rpm		$\leq 220$ rpm

	<b>Incremental ERA 8400C</b>		
<b>Interface</b>	$\sim 1 V_{PP}$ ; signal period 40 $\mu m$ (on circumference)		
Signal periods/revolution	36000	45000	90000
<b>Accuracy of graduation</b>	$\pm 4.7''$	$\pm 3.9''$	$\pm 1.9''$
<b>Accuracy of the scale tape</b>	$\pm 3 \mu m$ per meter tape length		
<b>Diameter D1</b>	458.04 mm	572.63 mm	1145.73 mm
<b>Mech. permissible speed</b>	$\leq 50$ rpm		$\leq 45$ rpm

# ERM modular angle encoders

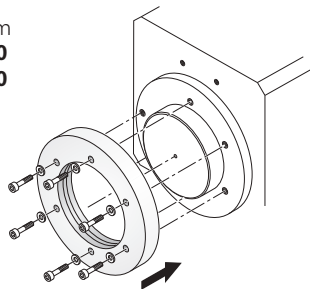
## Without integral bearing, with magnetic scanning

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

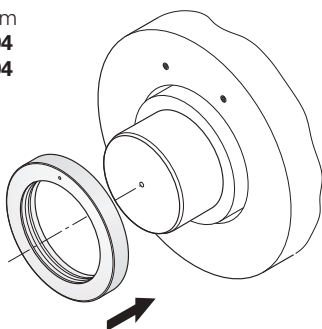
Typical fields of application include machines and equipment with **large hollow shaft diameters** in environments with large amounts of airborne particles and liquids, for example:

- Rotary and tilting axes for ERM 2280
- C axes on lathes for ERM 2410, ERM 2420, and ERM 2480
- Main spindles on milling machines for ERM 2484, ERM 2485, and ERM 2984

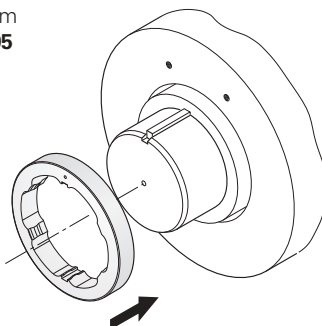
Scale drum  
**ERM 2200**  
**ERM 2400**



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

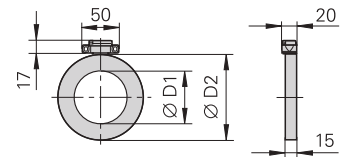


Scale drum  
**ERM 2405**



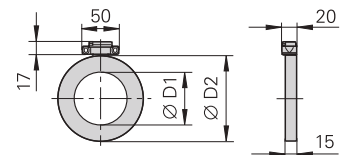
### ERM 2280 series

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



### ERM 2420 and ERM 2480 series

- For large shaft diameters up to 410 mm
- Drum fastening with axial screws
- Distance-coded reference marks are possible

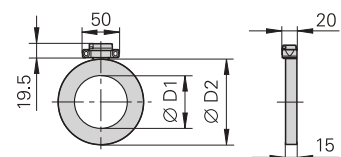


**ERM 2480**



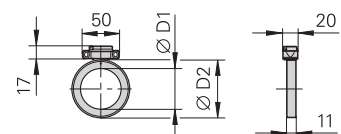
### ERM 2410

- Consists of ERM 2410 scanning head and the ERM 2400C 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 2484 and ERM 2485 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 2280</b>					
<b>Interface</b>	~ 1 V <sub>PP</sub>					
Signal period	≈ 200 μm (at circumference)					
<b>Line count/accuracy of graduation</b>	1800/±7"	2048/±6"	2800/±5"	4096/±3.5"	5200/±3"	7200/±2.5"
<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>Speed<sup>1)</sup></b>	≤ 14500 rpm	≤ 13000 rpm	≤ 9000 rpm	≤ 6000 rpm	≤ 4500 rpm	≤ 3000 rpm
<b>Operating temperature</b>	-10 °C to 60 °C					

	<b>Incremental ERM 2420 ERM 2480 ERM 2410</b>								
<b>Interface</b>	<i>ERM 2420</i> : □□TTL; <i>ERM 2480</i> : ~ 1 V <sub>PP</sub> ; <i>ERM 2410</i> : EnDat 2.2 <sup>2)</sup>								
Signal period	≈ 400 μm (at circumference); <i>ERM 2410</i> : –								
<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>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>Speed<sup>1)</sup></b>	≤ 19000 rpm	≤ 14500 rpm	≤ 13000 rpm	≤ 10500 rpm	≤ 9000 rpm	≤ 6000 rpm	≤ 6000 rpm	≤ 4500 rpm	≤ 3000 rpm
<b>Operating temperature</b>	-10 °C to 100 °C								

	Incremental ERM 2484 ERM 2485 <sup>3)</sup>				ERM 2984 <sup>4)</sup>			
Interface	 1 V <sub>PP</sub>							
Signal period	≈ 400 μm (at circumference)				≈ 1 mm (at circumference)			
Line count/accuracy of graduation	512/±17"	600/±14"	900/±10"	1024/±9"	192/±68"	256/±51"	300/±44"	400/±33"
Inside diameter D1	40 mm	55 mm	80 mm	100 mm	40 mm	55 mm	60 mm	100 mm
Outside diameter D2	64.37 mm	75.44 mm	113.16 mm	128.75 mm	58.06 mm	77.41 mm	90.72 mm	120.96 mm
Speed <sup>1)</sup>	<div>ERM 2484: ERM 2485:</div> <div>≤ 42 000 rpm ≤ 33 000 rpm</div> <div>≤ 36 000 rpm ≤ 27 000 rpm</div> <div>≤ 22 000 rpm –</div> <div>≤ 20 000 rpm –</div> <div>≤ 47 000 rpm –</div> <div>≤ 35 000 rpm –</div> <div>≤ 29 000 rpm –</div> <div>≤ 16 000 rpm –</div>							
Operating temperature	–10 °C to 100 °C							

<sup>1)</sup> Mechanically 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

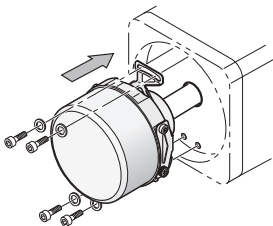
<sup>4)</sup> Additional drum diameters upon request

# ECN, EQN, ERN rotary encoders

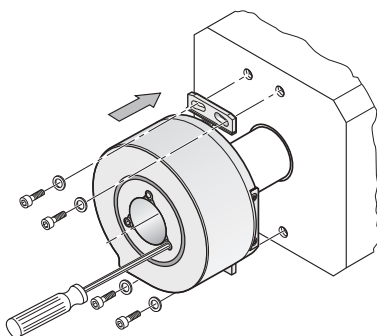
With integral bearing and mounted stator coupling  
IP64 protection

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

Some rotary encoders are suitable in a special version for potentially explosive atmospheres in accordance with Directive 2014/34/EU, (**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.



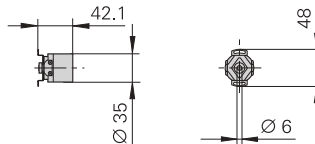
**ECN/EQN/ERN 1000**  
**ECN/EQN/ERN 400**



**ECN/ERN 100**

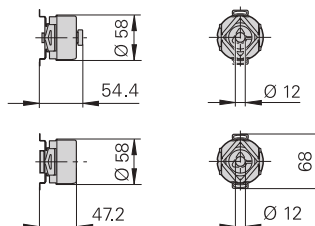
## ECN/EQN/ERN 1000 series

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



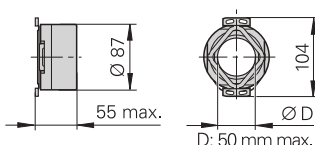
## ECN/EQN/ERN 400 series

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



## ECN/ERN 100 series

- For large shaft diameters
- Hollow through shaft with inside diameters D: 20, 25, 38, 50 mm
- Housing outside diameter: 87 mm
- Typical natural frequency of the encoder stator coupling: 1000 Hz
- Mechanically permissible speed:  $D \leq 30$  mm:  $\leq 6000$  rpm  $D > 30$  mm:  $\leq 4000$  rpm



### Interface

Position values/revolution

Revolutions

Line count

### Supply voltage

### Interface

Position values/revolution

Revolutions

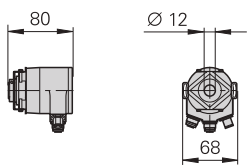
Line count

### Supply voltage



<b>Absolute</b> ECN 1013	EQN 1025	ECN 1023	EQN 1035	<b>Incremental</b> ERN 1020	ERN 1030	ERN 1070	ERN 1080
EnDat 2.2 <sup>1)</sup> with $\sim 1 V_{PP}$ ; SSI		EnDat 2.2 <sup>1)</sup>		$\square$ TTL	$\square$ HTL	$\square$ TTL <sup>2)</sup>	$\sim 1 V_{PP}$
8192 (13 bits)		8388608 (23 bits)		–			
–	4096 (12 bits)	–	4096 (12 bits)	–			
512		–		100 to 3600		1000/2500/3600	100 to 3600
DC 3.6 V to 14 V; DC 4.75 V to 30 V				DC 5 V	DC 10 V to 30 V	DC 5 V	

<b>Absolute</b> ECN 413 <sup>3)</sup>		<b>EQN 425<sup>3)</sup></b>		<b>ECN 425<sup>4)</sup></b> <b>ECN 425 F</b> <b>ECN 425 M</b> <b>ECN 424 S<sup>4)</sup></b>	<b>EQN 437<sup>4)</sup></b> <b>EQN 437 F</b> <b>EQN 435 M</b> <b>EQN 436 S<sup>4)</sup></b>	<b>Incremental</b> ERN 420 <sup>3)</sup> ERN 460	ERN 430 <sup>3)</sup>	ERN 480 <sup>3)</sup>
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; Mitsubishi; Siemens DRIVE-CLiQ		$\square$ TTL; $\square$ TTL	$\square$ HTL	$\sim 1 V_{PP}$
8192 (13 bits)		8192 (13 bits)		<b>ECN 425, EQN 437:</b> 33554432 (25 bits) <b>ECN 424, EQN 436:</b> 16777216 (24 bits) <b>EQN 435:</b> 8388608 (23 bits)		–		
–		4096 (12 bits)		–	4096 (12 bits)	–		
512 or 2048	–	512 or 2048	–	–		250 to 5000		1000 to 5000
3.6 V to 14 V; 4.75 V to 30 V	9 V to 36 V; 10 V to 30 V	3.6 V to 14 V; 4.75 V to 30 V	9 V to 36 V; 10 V to 30 V	3.6 V to 14 V; 10 V to 28.8 V		5 V; 10 V to 30 V	10 V to 30 V	5 V



PROFIBUS-DP/PROFINET



	<b>Absolute</b> ECN 113	ECN 125	<b>Incremental</b> ERN 120	ERN 130	ERN 180
<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/revolution	8192 (13 bits)	33554432 (25 bits)	–		
Line count	2048	–	1000 to 5000		
<b>Supply voltage</b>	DC 3.6 V to 14 V	DC 3.6 V to 14 V	DC 5 V	DC 10 V to 30 V	DC 5 V

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

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

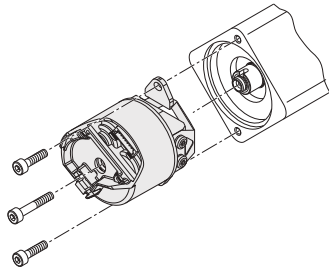
<sup>3)</sup> ATEX version available

<sup>4)</sup> Also available with functional safety

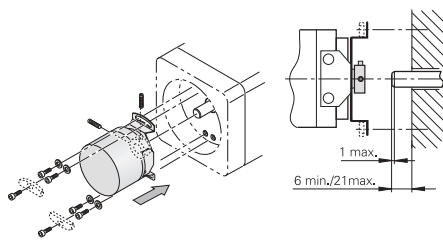
# ECN, EQN, ERN rotary encoders

With integral bearing and mounted stator coupling  
IP40 protection

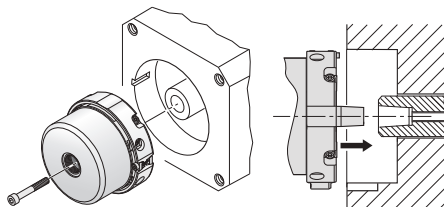
The **ECN, EQN**, and **ERN** photoelectric rotary encoders from HEIDENHAIN with IP40 protection are specially designed for integration in motors. Bearings and mounted stator coupling are integrated. Absolute rotary encoders and versions with commutation tracks are available for synchronous motors. The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



**ECN/EQN 1100**



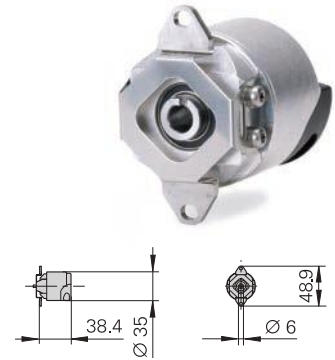
**ERN 1123**



**ECN/EQN/ERN 1300**

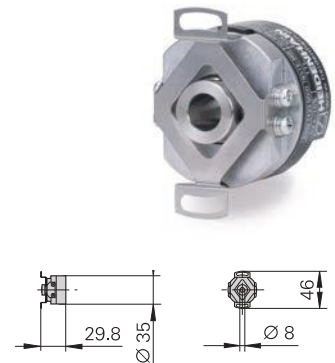
## ECN/EQN 1100 series

- Miniaturized version
- Blind hollow shaft  $\varnothing$  6 mm with positive-fit element
- Housing outside diameter 35 mm
- Typical natural frequency of the encoder stator coupling: 1000 Hz
- Mech. permissible speed 12000 rpm
- Fault exclusion of the mechanical coupling for functional safety available



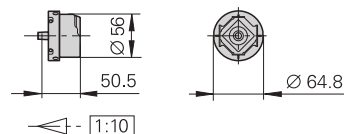
## ERN 1123

- Blind hollow shaft  $\varnothing$  8 mm
- Housing outside diameter 35 mm
- Stator coupling with bolt-hole circle  $\varnothing$  40 mm
- Typical natural frequency of the stator coupling: 1000 Hz
- Mech. permissible speed 6000 rpm
- IP00 protection



## ECN/EQN/ERN 1300 series

- Compact dimensions
- 1:10 taper shaft with 9.25 mm functional diameter for extremely stiff connection
- Housing outside diameter 56 mm. The stator coupling is suited for location holes with 65 mm inside diameter
- Typical natural frequency of the encoder stator coupling: 1800 Hz
- Mech. permissible speed  
**ERN/ECN:** 15000 rpm  
**EQN:** 12000 rpm
- IP40 protection when mounted
- Fault exclusion of the mechanical coupling for functional safety available



### Interface

Position values/  
revolution


Revolutions

Line count

### Commutation signals

### Supply voltage

### Operating temperature

	<i>Absolute</i>				<i>Incremental</i>
	ECN 1113	EQN 1125	ECN 1123 <sup>2)</sup>	EQN 1135 <sup>2)</sup>	ERN 1123
Interface	EnDat 2.2 <sup>1)</sup> with $\sim 1\text{ V}_{\text{PP}}$		EnDat 2.2 <sup>1)</sup>		 TTL
Position values/revolution	8192 (13 bits)		8388608 (23 bits)		–
Revolutions	–	4096 (12 bits)	–	4096 (12 bits)	–
Line count	512		–		500 to 8192
Commutation signals	–				Block commutation <sup>3)</sup>
Supply voltage	DC 3.6 V to 14 V				DC 5 V
Operating temperature	$\leq 115\text{ }^{\circ}\text{C}$				$\leq 90\text{ }^{\circ}\text{C}$

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

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

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

	Absolute						Incremental			
	ECN 1313	EQN 1325	ECN 1325 <sup>4)</sup>	EQN 1337 <sup>4)</sup>	ECN 1324 S <sup>4)</sup>	EQN 1336 S <sup>4)</sup>	ERN 1321	ERN 1326	ERN 1381	ERN 1387
	EnDat 2.2 <sup>1)</sup> with $\sim 1\text{ V}_{\text{PP}}$		EnDat 2.2 <sup>1)</sup>		Siemens DRIVE-CLiQ		$\square\square$ TTL		$\sim 1\text{ V}_{\text{PP}}$	
	8192 (13 bits)		33554432 (25 bits)		16777216 (24 bits)		–			
	–	4096 (12 bits)	–	4096 (12 bits)	–	4096 (12 bits)	–			
	512 or 2048		–				1024 2048 4096		512 2048 4096	2048
	–						–	Block com- mutation <sup>2)</sup>	–	Z1 track <sup>3)</sup>
	DC 3.6 V to 14 V				DC 10 V to 28.8 V		DC 5 V			
	$\leq 115\text{ }^{\circ}\text{C}$				$\leq 100\text{ }^{\circ}\text{C}$		$\leq 120\text{ }^{\circ}\text{C}$ ; <b>4096 lines</b> : $\leq 100\text{ }^{\circ}\text{C}$			

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

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

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

<sup>4)</sup> Also available with functional safety

DRIVE-CLiQ is a registered trademark of SIEMENS AG.

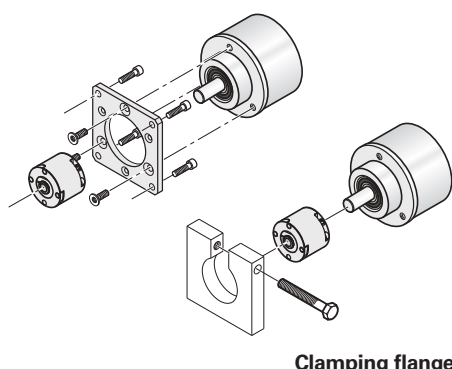
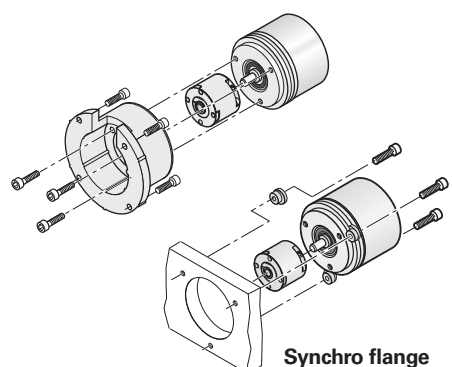
# ROC, ROQ, ROD rotary encoders

## With integral bearing, for separate shaft coupling HR handwheel

The **ROC, ROQ, and ROD** photoelectric rotary encoders from HEIDENHAIN have integrated bearings and are sealed. The degree of protection is IP64 to IP66, depending on the version. They are robust and compact.

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

Some rotary encoders are suitable in a special version for potentially explosive atmospheres in accordance with Directive 2014/34/EU, **(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.

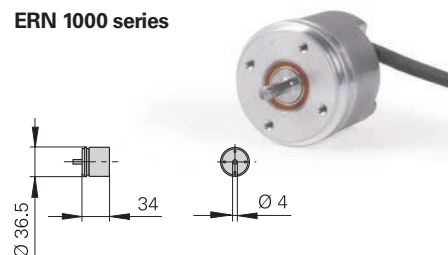


The **HR** electronic handwheel features an integral bearing and mechanical detent. It was conceived for use in portable or stationary housings, e.g. for positioning units or automation applications.

### 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

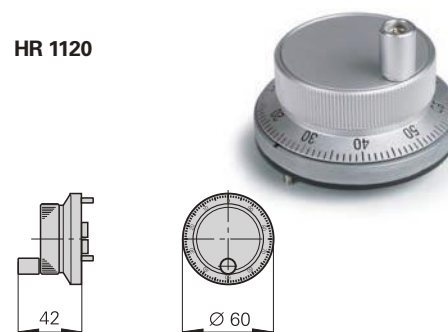
### ERN 1000 series



### HR handwheel

- Compact dimensions
- Sturdy design
- Mechanical detent

### HR 1120



### ROC/ROQ/ROD 400 series

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

### The 400 series with synchro flange



Synchro flange	Absolute ROC 413 <sup>1)</sup>	ROQ 425 <sup>1)</sup>	ROC 413	ROQ 425
Clamping flange				
Interface	EnDat 2.2 <sup>4)</sup> with $\sim 1\text{ V}_{\text{PP}}$ ; SSI		PROFIBUS-DP; PROFINET	
Position values/ revolution	8192 (13 bits)			
Revolutions	–	4096 (12 bits)	–	4096 (12 bits)
Line count/ signal periods	512		–	
Supply voltage	DC 3.6 V to 14 V; DC 4.75 V to 30 V		DC 9 V to 36 V; DC 10 V to 30 V	

<sup>1)</sup> ATEX version available

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

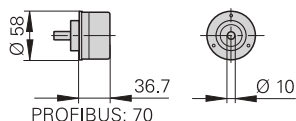
	<b>Absolute</b>				<b>Incremental</b>				
	<b>ROC 1013</b>	<b>ROQ 1025</b>	<b>ROC 1023</b>	<b>ROQ 1035</b>	<b>ROD 1020</b>	<b>ROD 1030</b>	<b>ROD 1070</b>	<b>ROD 1080</b>	<b>HR 1120</b>
<b>Interface</b>	EnDat 2.2 <sup>1)</sup> with $\sim 1 V_{PP}$ ; SSI		EnDat 2.2 <sup>1)</sup>					$\sim 1 V_{PP}$	
Position values/ revolution	8192 (13 bits)		8388608 (23 bits)		–				
Revolutions	–	4096 (12 bits)	–	4096 (12 bits)	–				
Line count/ signal periods	512		–		100 to 3600		1000/2500/ 3600	100 to 3600	100
<b>Supply voltage</b>	DC 3.6 V to 14 V; DC 4.75 V to 30 V		DC 3.6 V to 14 V		DC 5 V	DC 10 V to 30 V	DC 5 V		

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

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

#### The 400 series with clamping flange

#### PROFIBUS-DP/PROFINET



<b>ROC 424S<sup>2)</sup></b>	<b>ROQ 436S<sup>2)</sup></b>	<b>ROC 425<sup>2)</sup> ROC 425F ROC 425M</b>	<b>ROQ 437<sup>2)</sup> ROQ 437F ROQ 435M</b>	<b>Incremental ROD 426<sup>1)</sup></b>	<b>ROD 466<sup>1)</sup></b>	<b>ROD 436<sup>1)</sup></b>	<b>ROD 486<sup>1)</sup></b>
				<b>ROD 420<sup>1)</sup></b>	–	<b>ROD 430<sup>1)</sup></b>	<b>ROD 480<sup>1)</sup></b>
Siemens DRIVE-CLiQ		EnDat 2.2 <sup>4)</sup> ; Fanuc $\alpha$ i; Mitsubishi					$\sim 1 V_{PP}$
16777216 (24 bits)		33554432 (25 bits) <b>ROQ 435:</b> 8388608 (23 bits)		–			
–	4096 (12 bits)	–	4096 (12 bits)	–			
				50 to 5000 <b>ROD 426/466:</b> up to 10000 <sup>3)</sup>			1000 to 5000
DC 10 V to 28.8 V		DC 3.6 V to 14 V		DC 5 V	DC 10 V to 30 V		DC 5 V

<sup>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, EBI, ERO rotary encoders

## Without integral bearing

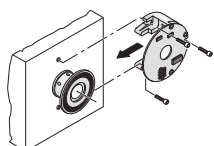
The photoelectric **ERO** modular rotary encoders from HEIDENHAIN consist of a graduated disk with hub and a scanning unit. They are particularly well suited for **limited installation space** or for applications where there must be **no friction**

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

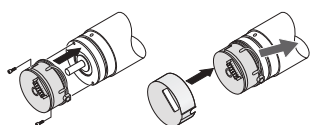
The inductive rotary encoders **ECI/EQI/EBI 1100** and **ECI/EQI 1300** are mechanically compatible with the corresponding ExN photoelectric encoders: the shaft is fastened with a central screw. The stator of the encoder is fastened by several screws.

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

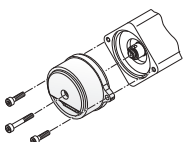
The correct installation of the rotary encoders without integral bearing can be inspected with the HEIDENHAIN PWM 21 or PWT 101 measuring and testing devices.



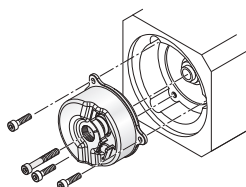
**ERO 1200**



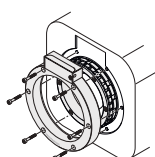
**ERO 1400**



**ECI/EQI/EBI 1100**



**ECI/EQI/EBI 1300**



**ECI/EBI 4000**

### ERO 1200 series

- Compact dimensions
- For shaft diameters up to 12 mm



### ERO 1400 series

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



### ECI/EQI/EBI 1100 series

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



### ECI/EQI/EBI 1300 series

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



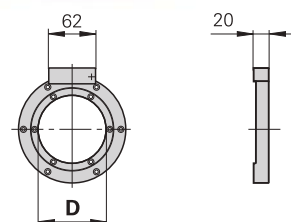
### ECI/EBI 100 series

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

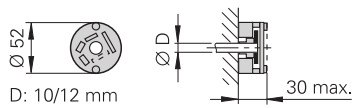


### ECI/EBI 4000 series

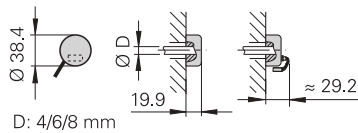
- Flat design
- Hollow through shaft Ø 90, 180 mm
- **EBI 4010**: multiturn function via battery-buffered revolution counter



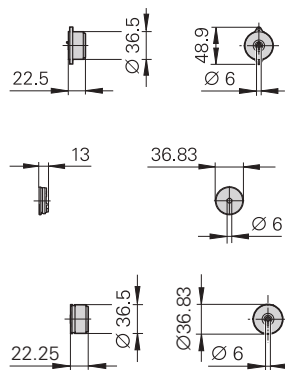
### ERO 1200 series



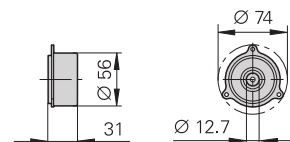
### ERO 1400 series



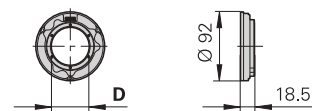
### ECI/EQI/EBI 1100 series



### ECI/EQI/EBI 1300 series



### ECI/EBI 100 series



	Incremental ERO 1225	ERO 1285
Interface	□ TTL	~ 1 V <sub>PP</sub>
Line count	1024 2048	
Mech. permissible speed	≤ 25000 rpm	
Shaft diameter D	Ø 10, 12 mm	

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

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

	Absolute ECI 1119 <sup>1)</sup> ECI 1319 <sup>1) 3)</sup> ECI 1118	EQI 1131 <sup>1)</sup> EQI 1331 <sup>1) 3)</sup>	EBI 1135 EBI 1335
Interface	EnDat 2.2		EnDat 2.2
Position values/revolution	524 288 (19 bits) ECI 1118: 262 144 (18 bits)		262 144 (18 bits)
Revolutions	–	4096 (12 bits)	65 536 (16 bits) <sup>2)</sup>
Mech. permissible speed	≤ 15000 rpm	≤ 12000 rpm	≤ 12000 rpm
Shaft	Blind hollow shaft		

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

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

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

	Absolute ECI 119	EBI 135	ECI 4010 <sup>1)</sup>	EBI 4010 <sup>1)</sup>	ECI 4090 S <sup>1)</sup>
Interface	EnDat 2.1 with ~ 1 V <sub>PP</sub>	EnDat 2.2			Siemens DRIVE-CLiQ
Position values/revolution	524 288 (19 bits)		1 048 576 (20 bits)		
Revolutions	–	65 536 (16 bits) <sup>2)</sup>	–	65 536 (16 bits) <sup>2)</sup>	–
Line count	32	–			
Mech. permissible speed	≤ 6000 rpm				
Shaft	Hollow through shaft Ø 30, 38, 50 mm		Hollow through shaft Ø 90, 180 mm		

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

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

DRIVE-CLiQ is a registered trademark of Siemens AG.

## Controls for milling machines

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

- Simple milling, drilling, and boring operations
- Machining in a tilted working plane
- Complex 5-axis operations
- HSC operations
- Milling-turning operations

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

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

## Controls for lathes

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

Many shop-compatible functions support you optimally during:

- Conventional lathe operations
- Operations with driven tools
- Machining with the C and Y axes
- Full-surface machining with dual spindles
- Machining with the B axis

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

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

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

## Quickly and easily to the finished part

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

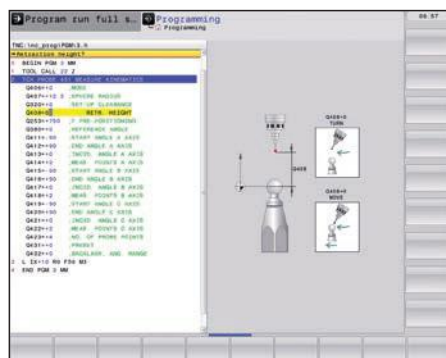
The HEIDENHAIN controls can be **programmed remotely** just as well—for example on a CAD/CAM system or at a HEIDENHAIN programming station.

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

## User-friendly and practical

Thanks to the robust design optimized for the application, HEIDENHAIN controls are ideally suited for a harsh work-day environment. The clear-cut screen displays informational notes, questions, prompts, program steps, graphics, and soft-key rows. All texts are available in numerous languages. **Graphic illustrations** simplify programming and provide valuable aid for verifying the program during simulation.





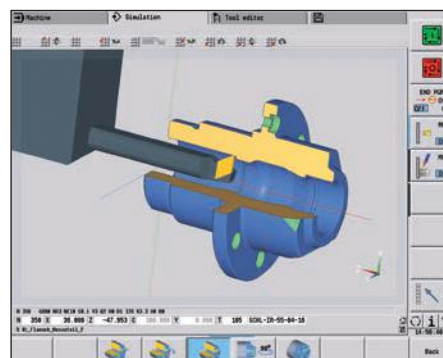
Klartext conversational input on a TNC

## High quality and productivity

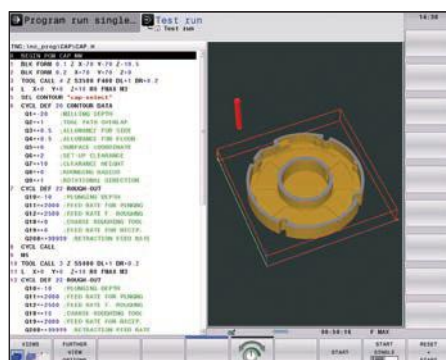
Thanks to intelligent motion control, HEIDENHAIN controls enable short machining times with perfect workpiece surfaces and very high workpiece accuracy. The bottom line is an increase in productivity: unit costs are reduced without affecting accuracy and surface quality.

## Automating manual operations

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



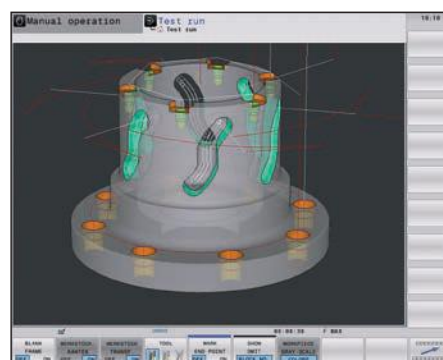
High-resolution graphics of lathe controls



NC program simulation

## Manufacturing complex components precisely

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



High-resolution graphics of milling controls

HEIDENHAIN controls		Series	Page
Controls for milling machines	Contouring control for up to 24 control loops	<b>TNC 640</b>	<b>44</b>
	Contouring control for up to 8 control loops	<b>TNC 620</b>	<b>46</b>
	Contouring control for up to 5 control loops	<b>TNC 320</b>	<b>46</b>
	Straight cut control for up to 5 control loops	<b>TNC 128</b>	<b>48</b>
Controls for lathes	Contouring control for up to 24 control loops	<b>CNC PILOT 640</b>	<b>50</b>
	Contouring control for up to 10 control loops	<b>MANUALplus 620</b>	<b>52</b>
Accessories	Electronic handwheels	<b>HR</b>	<b>55</b>
	Programming stations	<b>TNC 640/TNC 620/TNC 320 DataPilot MP 620/CP 640</b>	<b>55</b>
Tool and workpiece setup and measurement	Workpiece touch probes	<b>TS</b>	<b>56</b>
	Tool touch probes	<b>TT</b>	<b>58</b>
	Transceivers	<b>SE</b>	<b>59</b>



# TNC 640 contouring control

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

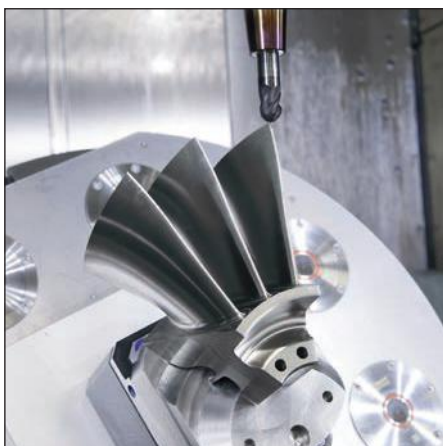
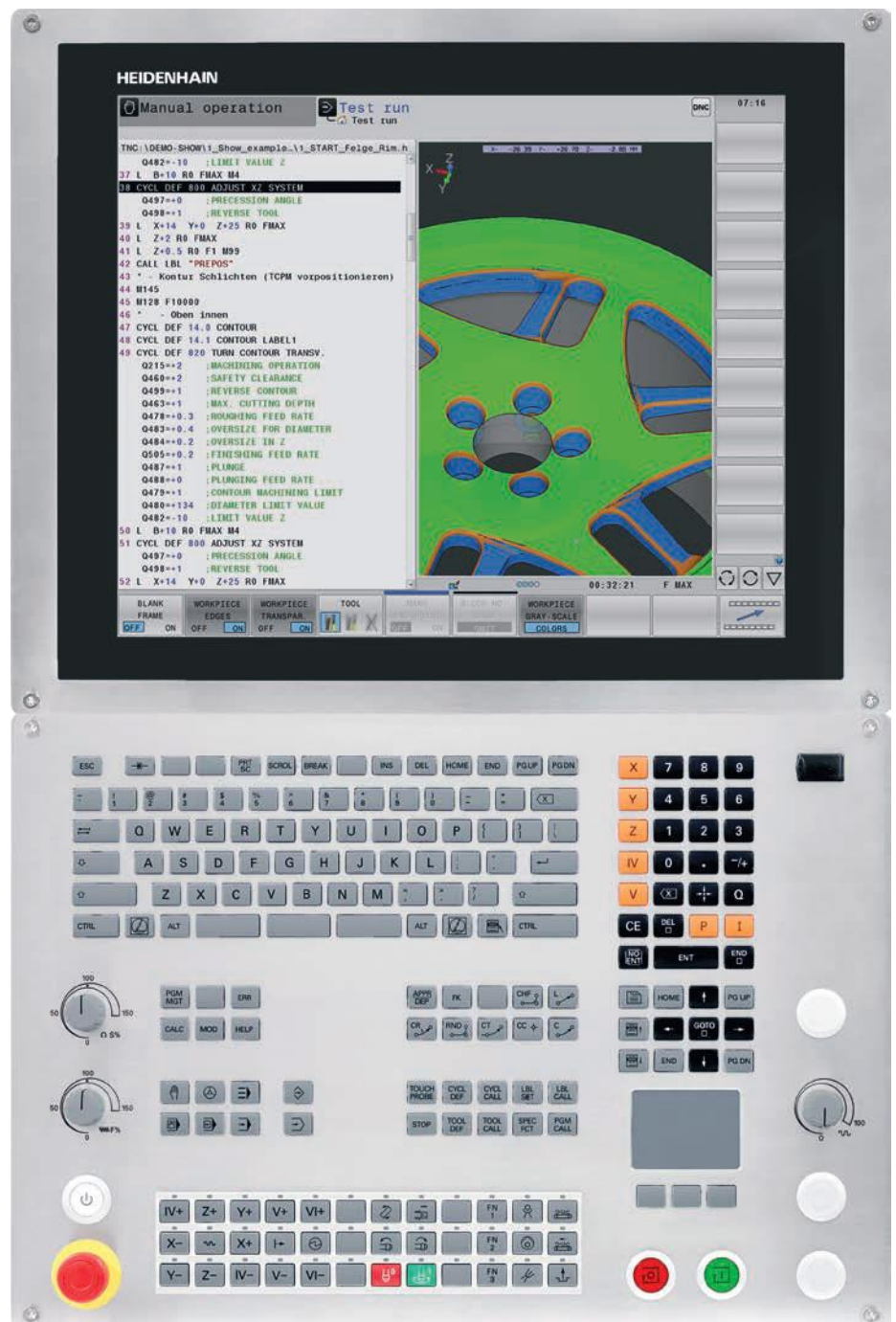
Besides milling, the **TNC 640** from HEIDENHAIN is also capable of combined milling and turning operations. It is particularly well suited for milling, turning, HSC machining, and 5-axis machining. The shop-oriented and versatile control features numerous functions. It is especially attractive for the following areas of application:

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

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

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

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





	<b>TNC 640</b>
<b>Axes</b>	24 control loops (22 with functional safety), of which up to 4 can be configured as spindles
<b>Interpolation</b>	<ul style="list-style-type: none"> <li>• Linear in max. 5 axes with Tool Center Point Management (<b>TCPM</b>)</li> <li>• Circular in max. 3 axes with tilted working plane</li> <li>• Helical</li> <li>• Cylinder surface<sup>1)</sup></li> <li>• Rigid tapping<sup>1)</sup></li> </ul>
<b>Program entry</b>	HEIDENHAIN Klartext conversational format, ISO (G codes)
<b>Programming support</b>	TNCguide presents user information directly on the control
<b>CAD import</b> option	Loading of contours from 3-D models
<b>Program memory</b>	HDR or SSDR hard disk, 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>	To 0.1 µm or 0.0001°; optionally to 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 cutting speed</li> <li>• Toggling between milling and turning operations</li> </ul>
<b>High-speed cutting</b>	Motion control with minimum jerk
<b>FK free contour programming</b>	HEIDENHAIN Klartext conversational format with graphical support
<b>Coordinate transformation</b>	<ul style="list-style-type: none"> <li>• Shifting, rotating, mirroring, scaling (axis specific)</li> <li>• Tilting the working plane, PLANE function (option)</li> </ul>
<b>Fixed cycles</b>	For drilling, milling, turning (option), interpolation turning (option), hobbing (option), and for cylinder surface machining (option); data input with graphical support
<b>Touch probe cycles</b>	For tool measurement, workpiece alignment, workpiece measurement, and presetting
<b>Graphics</b>	For programming and program verification
<b>Parallel operation</b>	Program run and programming with graphics
<b>Data interface</b>	Ethernet 1000BASE-T; USB 3.0; USB 2.0; RS-232-C/V.24 (max. 115200 bauds)
<b>Remote control and diagnosis</b>	TeleService
<b>Screen</b>	15-inch or 19-inch screen with operating keys; 19-inch screen for multitouch operation
<b>Axis feedback control</b>	<ul style="list-style-type: none"> <li>• Feedforward control or operation with following error</li> <li>• Integrated digital drive control including inverter</li> </ul>
<b>Adaptive feed rate control</b> option	AFC adjusts the contouring feed rate to the spindle power
<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>• HR electronic handwheels</li> <li>• TS workpiece touch probe and TT tool touch probe</li> </ul>

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

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

# TNC 620, TNC 320 contouring controls

## For milling machines

The HEIDENHAIN **TNC 620** and **TNC 320** controls are compact but versatile contouring controls. Thanks to their flexible operation—shop-oriented programmability with the HEIDENHAIN Klartext format or offline programming—and their scope of features, they are especially suited for use on universal milling, drilling, and boring machines for the following:

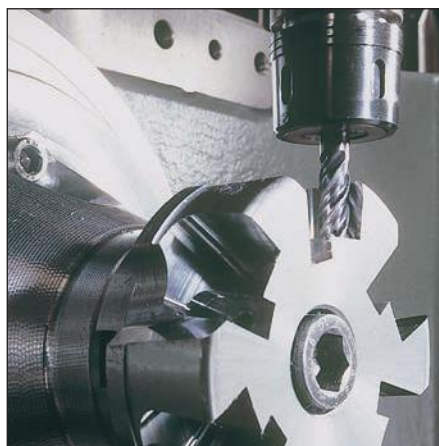
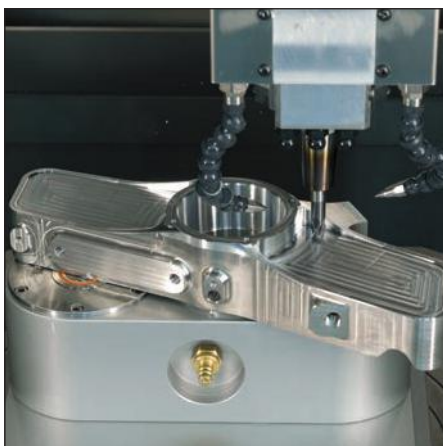
- Series and single-part production
- Tool making
- Machine building
- Research and development
- Prototypes and pilot plants
- Repair departments
- Training and education facilities

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

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



TNC 620 touch screen version (only for TNC 620)



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

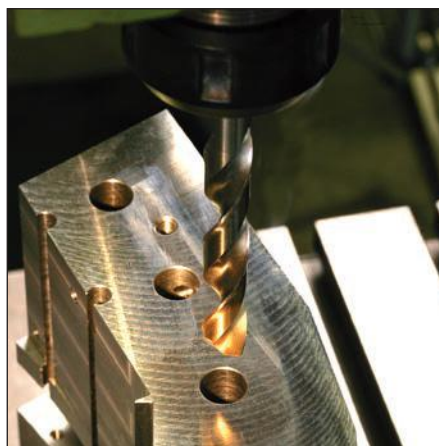
# TNC 128 straight-cut control

## 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 closed-loop axis is an option. Thanks to its simple operation and scope of features, it is especially well suited for use on universal milling, drilling, and boring machines for the following possibilities:

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

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





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

# CNC PILOT 640 contouring control

## For lathes and turning-milling machines

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

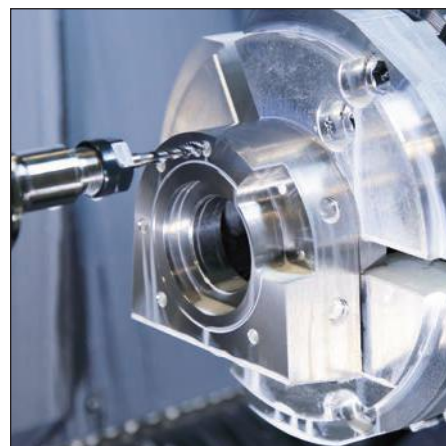
The CNC PILOT 640 was designed for CNC lathes and is ideal for both horizontal and vertical lathes as well as for vertical boring and turning mills.

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

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

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

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





	CNC PILOT 640
<b>Axes</b>	Up to 24 control loops (22 with functional safety)
<b>Interpolation</b>	<ul style="list-style-type: none"> <li>• Straight line: in 2 principal axes, optional in 3 principal axes</li> <li>• Circle: in 2 axes, optional additional linear interpolation in the third axis</li> <li>• C1/C2 axis: interpolation of X and Z linear axes with the C1/C2 axis (option)</li> <li>• B axis: 5-axis interpolation between X, Z, Y, B, and C axes (option)</li> </ul>
<b>Program entry</b>	smart.Turn, DIN PLUS, Teach-In mode (option)
<b>Programming aids</b>	TURNguide presents user information directly on the control
<b>DXF import</b> option	Loading DXF contours
<b>Program memory</b>	1.8 GB CFR memory card
<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>	X axis: 0.5 $\mu\text{m}$ , diameter: 1 $\mu\text{m}$ U, V, W, Y, Z axes: 1 $\mu\text{m}$ B, C1/C2 axes: 0.001°
<b>Block processing time</b>	1.5 ms (3-D straight line without radius compensation at 100% PLC utilization)
<b>Setup functions</b>	<ul style="list-style-type: none"> <li>• Setting the workpiece datum</li> <li>• Defining the tool change point</li> <li>• Defining the protection zone</li> </ul>
<b>Interactive Contour Programming ICP</b>	Contour definition with graphic support
<b>Fixed cycles</b>	Stock removal, recessing, recess turning, engraving, thread cutting, helical slot milling, boring, drilling, tapping, deburring, trochoidal milling, hobbing, eccentric and non-circular turning
<b>Touch probe cycles</b> option	For tool and workpiece measurement as well as presetting
<b>Graphics</b>	For programming and program verification
<b>Parallel operation</b>	Program run and programming with graphics
<b>Data interface</b>	Ethernet 1000BASE-T; USB 3.0; USB 2.0; RS-232-C/V.24 (max. 115200 bauds)
<b>Remote control and diagnosis</b>	TeleService
<b>Screen</b>	15.6-inch or 19-inch screen for multitouch operation
<b>Axis feedback control</b>	<ul style="list-style-type: none"> <li>• Feedforward control or operation with following error</li> <li>• Integrated digital drive control including inverter</li> </ul>
<b>Multi-channel capability</b>	<ul style="list-style-type: none"> <li>• Up to three channels for asynchronous multi-slide machining</li> </ul>
<b>Accessory</b>	<ul style="list-style-type: none"> <li>• HR electronic handwheels</li> <li>• TS workpiece touch probe and TT tool touch probe</li> </ul>

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

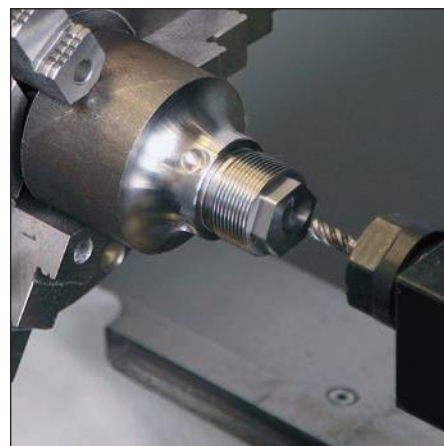
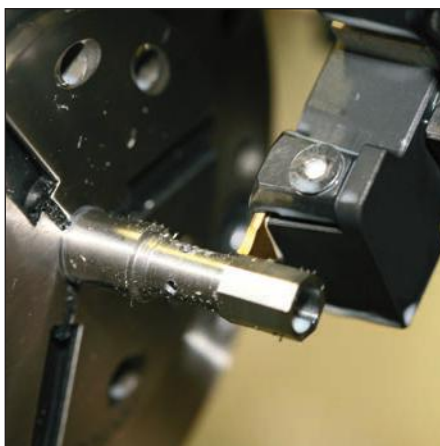
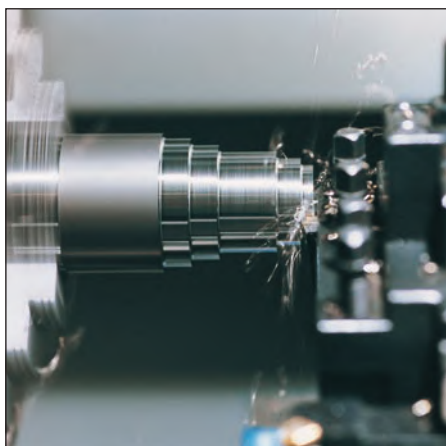
# MANUALplus 620 contouring control

For CNC and cycle lathes

The **MANUALplus 620** is a compact and versatile contouring control that is particularly well suited for cycle-controlled lathes. The MANUALplus 620 optimally combines the ease of use of conventional lathes with the advantages of CNC-controlled machines.

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

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



	MANUALplus 620
<b>Axes</b>	10 control loops
<b>Interpolation</b>	<ul style="list-style-type: none"> <li>• Straight line: in 2 principal axes, optional in 3 principal axes</li> <li>• Circle: in 2 axes, optional additional linear interpolation in the third axis</li> <li>• C1/C2 axis: interpolation of X and Z linear axes with the C1/C2 axis (option)</li> </ul>
<b>Program entry</b>	Teach-In mode, smart.Turn (option), DIN PLUS
<b>Programming aids</b>	TURNguide presents user information directly on the control
<b>DXF import option</b>	Loading DXF contours
<b>Program memory</b>	1.8 GB CFR memory card
<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>	X axis: 0.5 $\mu\text{m}$ , diameter: 1 $\mu\text{m}$ U, V, W, Y, Z axes: 1 $\mu\text{m}$ B, C1/C2 axes: 0.001°
<b>Block processing time</b>	3 ms
<b>Setup functions</b>	<ul style="list-style-type: none"> <li>• Setting the workpiece datum</li> <li>• Defining the tool change point</li> <li>• Defining the protection zone</li> </ul>
<b>Interactive Contour Programming ICP</b>	Contour definition with graphic support
<b>Fixed cycles</b>	Stock removal, recessing, recess turning, engraving, thread cutting, helical slot milling, boring, drilling, tapping, deburring, trochoidal milling, hobbing, eccentric and non-circular turning
<b>Touch probe cycles option</b>	For tool and workpiece measurement as well as presetting
<b>Graphics</b>	For programming and program verification
<b>Parallel operation</b>	Program run and programming with graphics
<b>Data interface</b>	Ethernet 1000BASE-T; USB 3.0; USB 2.0; RS-232-C/V.24 (max. 115200 bauds)
<b>Remote control and diagnosis</b>	TeleService
<b>Screen</b>	15.6-inch screen for multitouch operation (with displayed operating panel)
<b>Axis feedback control</b>	<ul style="list-style-type: none"> <li>• Feedforward control or operation with following error</li> <li>• Integrated digital drive control including inverter</li> </ul>
<b>Accessory</b>	<ul style="list-style-type: none"> <li>• HR electronic handwheels</li> <li>• TS workpiece touch probe and TT tool touch probe</li> </ul>

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

# Contouring controls

## Digital control design

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

### Digital drive control

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

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

**Feed motors** with a stall torque of 1.5 Nm to 120 Nm and **spindle motors** with a power rating 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:

- TNC 640
- TNC 620
- CNC PILOT 640
- MANUALplus 620



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



# Accessory

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

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



HR 550 FS

HR 510

### HR 130 and HR 150 panel-mounted handwheels

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



HR 130 for integration in the machine operating panel

## Programming stations

With the TNC 640 and TNC 620/TNC 320 programming stations, you have the capability to program in Klartext conversational format just as you do at the machine, but away from the noise and distractions of the shop floor.

### Creating programs

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

### Training with the programming station

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

### TNC training in schools

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



# Tool and workpiece setup and measurement

## TS workpiece touch probes

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

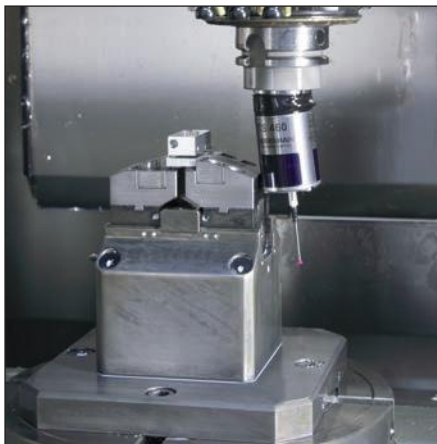
The stylus of a TS touch trigger probe is deflected upon contact with a workpiece surface. At that moment the TS generates a trigger signal that, depending on the model, is transmitted either by cable or over an infrared or radio beam to the control.

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

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

### Benefits of HEIDENHAIN touch probes

- High probing repeatability
- High probing 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 **radio and infrared transmission** for machines with automatic tool change:

- **TS 460** – standard touch probe  
Compact dimensions, energy-saving mode, optional collision protection and thermal decoupling

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

- **TS 642** – touch probe for retrofitting  
Activation by switch in the taper shank
- **TS 740** – highly accurate touch probe  
High probing accuracy and repeatability, low probing force

Probe system with **cable-bound signal transmission** for machines with manual tool change, e.g. grinding, turning, and milling machines:

- **TS 150** – cable-bound touch probe  
Radial or axial cable connection
- **TS 260** – cable-bound touch probe  
Radial or axial cable connection
- **TS 248** – cable-bound touch probe  
Radial cable connection, with reduced deflection forces





	TS 460	TS 642	TS 740	TS 260 TS 248	TS 150
Machine type	CNC machine tools for milling, drilling, and boring as well as lathes			CNC grinding machine or lathes	
Signal transmission	Radio and infrared	Infrared		Via cable	
Transceiver unit	SE 540: infrared SE 642: infrared SE 660: radio/infrared SE 661: radio/infrared	SE 540: infrared SE 642: infrared		–	
Power supply	Rechargeable or nonrechargeable batteries			DC 15 V to 30 V	Via UTI 150 interface electronics
Switching on/off	Radio or infrared transmission	Switch in taper shank	By infrared signal	–	
Interface to control Signal level	HTL via SE transceiver unit			HTL	
Probe repeatability	2 σ ≤ 1 μm		2 σ ≤ 0.25 μm	2 σ ≤ 1 μm	
Probe velocity	≤ 3 m/min		≤ 0.25 m/min	≤ 3 m/min	
Protection EN 60529	IP68				

# TT tool touch probes

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

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

## Touch probes

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

### TT 160

Signal transmission to the NC over connecting cable

### TT 460

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



TT 160



TT 460

	TT 160	TT 460
<b>Probing method</b>	Physical probing in three dimensions: ±X, ±Y, ±Z	
<b>Probe repeatability</b>	2 σ ≤ 1 μm (probing velocity 1 m/min)	
<b>Permissible deflection of probe contact</b>	≈ 5 mm in all directions	
<b>Supply voltage</b>	DC 10 V to 30 V via NC	Rechargeable or nonrechargeable batteries
<b>Interface to control</b> Signal level	HTL	<i>SE 642:</i> infrared <i>SE 660:</i> radio/infrared <i>SE 661:</i> radio/infrared
<b>Signal transmission</b>	Via cable	Radio wave and infrared transmission with 360° range
<b>Probe contact</b>	Ø 40 mm or Ø 25 mm	
<b>Protection</b> EN 60529	IP67	

# SE transceiver units

The following transceiver units are available for **wireless signal transmission**:

- **SE 540**: for integration in spindle head; only infrared transmission
- **SE 642**: shared SE for TS and TT; only infrared transmission
- **SE 660**: shared SE for TS and TT; radio and infrared transmission
- **SE 661**: shared SE for TS and TT; radio and infrared transmission, EnDat interface for touch probes

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

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



SE 660



SE 661



SE 540



SE 642

	SE 660	SE 661	SE 540	SE 642
TS 460	Radio/infrared		Infrared	
TS 642	Infrared	–	Infrared	
TS 740	–		Infrared	
TT 460	Radio/infrared		Infrared	

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

## Evaluation electronics units

Evaluation electronics for metrology applications from HEIDENHAIN serve to visualize and process the values measured with linear encoders, length gauges, rotary encoders, or angle encoders. They combine measured value acquisition with intelligent, application-specific further processing. They are used in many metrological applications, ranging from simple measuring stations to complex inspection systems with multiple measuring points.

The evaluation electronics include units with integrated display—which can be used independently—and units that require a PC for operation. They feature interfaces for various encoder signals.



Evaluation electronics for 2-D and 3-D measuring tasks

## Digital readouts

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

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

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

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



Evaluation electronics for measuring and testing tasks

**Interface electronics**

HEIDENHAIN interface electronics adapt the encoder signals to the interface of the subsequent electronics. They are used when the subsequent electronics cannot directly process the output signals from HEIDENHAIN encoders, or if additional interpolation of the signals is necessary.



**User-friendly environment**

Digital readouts and evaluation electronics with integrated display are specially designed for user friendliness. Typical characteristics:

- Optimally readable, graphic flat panel display
- Intuitive operation using touchscreen or keyboard (depending on the product)
- All-in-one device with compact outside dimensions
- Sturdy aluminum housing
- Reference mark evaluation for distance-coded and single reference marks
- Problem-free installation, maintenance-free operation
- Fast payback with economical use

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

Evaluation electronics for metrology applications		Series	Page
For 2-D and 3-D measuring tasks		QUADRA-CHEK 2000 QUADRA-CHEK 3000 IK 5000 QUADRA-CHEK	62
	For measuring and testing tasks	ND 287 GAGE-CHEK 2000 ND 2100 G GAGE-CHEK EIB 700 IK 220	64
Digital readouts for manually operated machine tools			
For milling machines, lathes, and positioning devices		POSITIP 8000 ND 7000 ND 5000	66
Interface electronics, inspection and test equipment			67

# Evaluation electronics for metrology applications

## 2-D and 3-D measuring tasks

The evaluation electronics for 2-D and 3-D measuring tasks feature special functions for measured-value acquisition and evaluation. They serve primarily as

- Profile projectors
- Measuring microscopes
- Video measuring machines
- Coordinate measuring machines (manual or with CNC)
- 2-D measuring machines

**QUADRA-CHEK** evaluation electronics for profile projectors, measuring microscopes, 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 you can measure points using a triggering touch probe. In the optional **CNC version** they also operate as full-fledged controls for axis positioning and can automatically execute measuring programs.

The **QUADRA-CHEK 2000** and **QUADRA-CHEK 3000** are independently operating devices. They feature an integrated screen and sturdy housing.

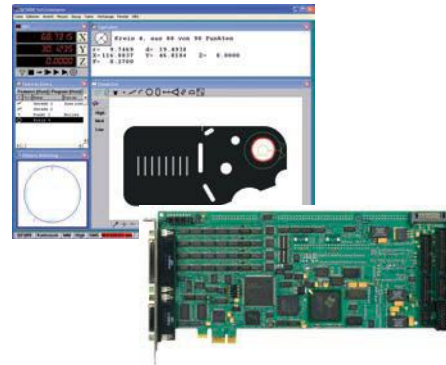
The **IK 5000 QUADRA-CHEK** universal PC package solution consists of a PC card and the associated software. Together with a PC, they make for a powerful measuring station.



	QUADRA-CHEK 2000
Application	<ul style="list-style-type: none"> <li>• Profile projectors</li> <li>• Measuring microscopes</li> <li>• 2-D measuring machines</li> </ul>
Axes	Three (XYZ or XYQ), one of which can be enabled via software option
Encoder inputs	$\sim 1 V_{PP}$ $\sim 11 \mu A_{PP}$ EnDat 2.2, or $\square$ TTL (other
Display	7-inch screen for multitouch operation
Function	<ul style="list-style-type: none"> <li>• Measurement of 2-D features</li> <li>• Measuring point acquisition via crosshairs</li> <li>• Entry of tolerances</li> <li>• Graphic display of measurement results</li> <li>• User administration</li> <li>• Creation of measuring programs (teach-in)</li> <li>• Creation and output of measurement reports</li> <li>• Measure Magic function</li> </ul>
Optional or depending on the version	<p><b>OED software option</b> Automatic edge sensing via optical edge detector</p> <p><b>AEI1 software option</b> Additional encoder input</p>
Data interfaces	Ethernet, USB

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





	QUADRA-CHEK 3000	IK 5000 QUADRA-CHEK
	<ul style="list-style-type: none"> <li>• Profile projectors</li> <li>• Measuring microscopes</li> <li>• 2-D and 3-D measuring machines</li> <li>• Video measuring machines</li> <li>• Coordinate measuring machines</li> </ul>	<ul style="list-style-type: none"> <li>• Profile projectors</li> <li>• Measuring microscopes</li> <li>• Video measuring machines</li> <li>• Coordinate measuring machines</li> <li>• Multi-sensor measuring machines</li> </ul>
	Four (XYZQ), two of which can be enabled via software option	XYQ, XYZ, or XYZQ <sup>1)</sup>
interfaces upon request)		
	12.1-inch screen for multitouch operation	On a PC screen
		<ul style="list-style-type: none"> <li>• Measurement of 2-D features</li> <li>• Measuring point acquisition via crosshairs</li> <li>• Entry of tolerances</li> <li>• Graphic display of measurement results</li> <li>• Creation of measuring programs (teach-in)</li> <li>• Report generator</li> <li>• Import and export functions for CAD and measured data</li> <li>• Nominal-to-actual comparison for 2-D free-form contours from a CAD model</li> </ul>
	<p><b>AEI1 software option</b> Additional encoder input</p> <p><b>VED software option</b></p> <ul style="list-style-type: none"> <li>• Video edge detection and live image display</li> <li>• Image archiving</li> <li>• Light control</li> </ul> <p><b>OED software option</b> Automatic edge sensing via optical edge detector</p> <p><b>AF software option</b> Assisted focusing of the camera on the object of measurement</p> <p><b>3D software option</b> Point measurement via touch probe for 3-D contours</p>	<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>• Image archiving</li> <li>• Point measurement by touch probe (also TP 200)</li> <li>• CNC axis control and autofocus</li> <li>• Zoom and light control</li> </ul>
		PCIe (PC interface)

# Evaluation electronics for metrology applications

## Measuring and testing tasks

Evaluation electronics for measuring and testing tasks are ideal for

- Measurement equipment
- Adjustment and inspection equipment
- SPC inspection stations
- Multipoint inspection apparatuses
- Mobile data acquisition
- Positioning equipment

The **ND** evaluation units are independently operating devices with integrated screen and sturdy housing. They feature special functions for measuring and statistical evaluation of measured values such as sorting and tolerance check mode, minimum/maximum value storage, and measurement series storage. These data make it possible to calculate mean values and standard deviations, and graphically display them in histograms or control charts. With the ND 2100G, even complex properties like flatness and volume can be ascertained: its inputs can be assigned and combined as desired with mathematical, trigonometric, or statistical formulas.

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

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



	ND 287	GAGE-CHEK 2000
<b>Application</b>	<ul style="list-style-type: none"> <li>• Measurement equipment</li> <li>• Testing devices</li> <li>• SPC inspection stations</li> </ul>	<ul style="list-style-type: none"> <li>• Positioning equipment</li> <li>• Measuring fixtures</li> </ul>
<b>Axes<sup>1)</sup></b>	1 (optional 2)	3, two of which can be enabled with a software option
<b>Encoder inputs</b>	$\sim 1 V_{PP}$ , $\sim 11 \mu A_{PP}$ , or EnDat 2.2	$\sim 1 V_{PP}$ , $\sim 11 \mu A_{PP}$ , EnDat 2.2, or $\square$ TTL (other interfaces upon request)
<b>Display</b>	Screen	7-inch screen for multitouch operation
<b>Function</b>	<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> <p><i>Optional:</i> Sum/difference display or thermal compensation</p>	<ul style="list-style-type: none"> <li>• Measurement series with min./max. value storage</li> <li>• Touch probe connection for a HEIDENHAIN or Renishaw touch probe</li> <li>• Manual, continuous, or touch-probe-triggered data transfer</li> <li>• User administration</li> </ul>
<b>Data interfaces</b>	USB; RS-232-C; <i>optional:</i> Ethernet	Ethernet, USB <sup>2)</sup>

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

<sup>2)</sup> Possible with RS-232 adapter connection over USB port



ND 2100 G GAGE-CHEK	EIB 700	IK 220
<ul style="list-style-type: none"> <li>• Multipoint inspection apparatuses</li> <li>• SPC inspection stations</li> </ul>	<ul style="list-style-type: none"> <li>• Testing stations</li> <li>• Multipoint inspection apparatuses</li> <li>• Mobile data acquisition</li> </ul>	<ul style="list-style-type: none"> <li>• Measuring and testing stations</li> </ul>
4 or 8	4	2
$\sim 1 V_{PP}$ , $\square$ TTL, EnDat 2.2, LVDT, or HBT (other interfaces upon request)	$\sim 1 V_{PP}$ , EnDat 2.1, or EnDat 2.2 ( $\sim 11 \mu A_{PP}$ upon request)	$\sim 1 V_{PP}$ , $\sim 11 \mu A_{PP}$ , EnDat 2.1, or SSI
5.7-inch screen	By PC screen	
<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> <li>• Programming of up to 100 parts</li> <li>• Entry of any formulas, combinations, and variables</li> <li>• Output of measurement results</li> </ul>	<ul style="list-style-type: none"> <li>• Precise position measurement, up to 50 kHz updating rate</li> <li>• Programmable measured-value inputs</li> <li>• Internal and external measured-value triggers</li> <li>• Measured-value memory for approx. 250 000 measured values per channel</li> <li>• Connection over standard Ethernet interface to higher-level computer systems</li> </ul>	<ul style="list-style-type: none"> <li>• Programmable measured-value inputs</li> <li>• Internal and external measured-value triggers</li> <li>• Measured-value memory for 8192 measured values per channel</li> </ul>
USB; RS-232-C	Ethernet	PCI (PC interface)

# Digital readouts for manually operated machine tools

Applications for digital readouts are on manually operated machine tools, e.g.

- Milling machines
- Drilling and boring machines
- Lathes
- Radial drilling machines
- Grinding machines
- Electrical discharge machines

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



ND 7013



ND 5023

	POSITIP 8016	ND 7013	ND 5023
Application	Milling, drilling, and boring machines and lathes		
Description	12.1-inch screen for multitouch operation, program memory, switching inputs and outputs (digital and analog)	7-inch screen for multitouch operation, switching inputs and outputs (digital and analog, depending on the version)	7-inch screen with operating keys
Axes	6, two of which can be enabled with a software option	3	3
Encoder inputs	$\sim 1 V_{PP}$ , $\sim 11 \mu A_{PP}$ , or EnDat 2.2	$\sim 1 V_{PP}$ , $\sim 11 \mu A_{PP}$	TTL
Display step	10 $\mu m$ , 5 $\mu m$ , 1 $\mu m$ or finer		5 $\mu m$ (with LS 328 C/628 C), 1 $\mu m$ (with LS 378 C)
Presets	100		10
Tool data	For 100 tools		For 16 tools
Programming	Yes	No	
Functions	<ul style="list-style-type: none"><li>• Manual and MDI operation, graphical positioning aid, variable size for display of position values</li><li>• User administration and data management</li></ul>		
	<ul style="list-style-type: none"><li>• Touch probe connection</li><li>• ACTIVE version: NC control of up to three axes (point to point), can be enabled as software option</li></ul>	Touch probe connection	–
For milling or boring operation	<ul style="list-style-type: none"><li>• Hole patterns (circular and linear patterns)</li><li>• Roughing of rectangular pockets</li><li>• Probing functions for reference-point acquisition</li></ul>		<ul style="list-style-type: none"><li>• Circle pattern, linear pattern</li><li>• Diagonal and arc milling</li></ul>
	Controlling the spindle speed, switching functions	I/O version: controlling the spindle speed, switching functions	–
For turning	<ul style="list-style-type: none"><li>• Radius/diameter display</li><li>• Separate or sum display for Z and Z<sub>0</sub></li><li>• Freezing tool position for back-off/taper calculator</li></ul>		
	Constant cutting speed	I/O version: Constant cutting speed	–
Data interfaces	Ethernet, USB		USB

# Interface electronics, inspection and test equipment

## Interface electronics

Interface electronics from HEIDENHAIN adapt the encoder signals to the interface of the subsequent electronics, for example:

Incremental signals

~ 1 V<sub>PP</sub> > TTL

~ 11 μA<sub>PP</sub> > TTL

Incremental signals > position values

~ 1 V<sub>PP</sub> > EnDat

~ 1 V<sub>PP</sub> > Fanuc Serial Interface

~ 1 V<sub>PP</sub> > Mitsubishi high speed Interface

Position values

EnDat > DRIVE-CLiQ

EnDat > Yaskawa Serial Interface

EnDat > PROFIBUS-DP

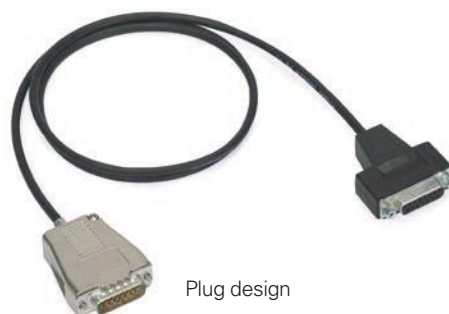
EnDat > PROFINET

In addition to being converted, the sinusoidal encoder signals are also interpolated in the interface electronics. This permits finer measuring steps and, as a result, higher control quality and better positioning behavior.

Some interface electronics have an integrated counting function. Starting from the last set reference point, an absolute position value is generated and output to the subsequent electronics when the reference mark is traversed.

HEIDENHAIN interface electronics are available in various mechanical designs:

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



## Inspection and testing devices from HEIDENHAIN

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

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

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

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

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



PWM 21 inspection device with included ATS adjusting and testing software



PWT 101 test device for mobile application

DRIVE-CLiQ is a registered trademark of Siemens AG.



## 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

At [www.heidenhain.de](http://www.heidenhain.de) you will find not only these brochures in various languages, but also a great deal of further up-to-date information on the company and its products.

Our website also includes:

- Technical articles
- Press releases
- Addresses
- TNC training programs

## Length measurement



Brochure  
**Linear Encoders**  
*For Numerically Controlled Machine Tools*

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



Brochure  
**Length Gauges**

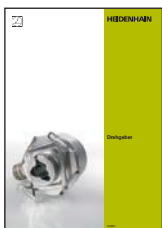
Contents:  
HEIDENHAIN-ACANTO  
HEIDENHAIN-SPECTO  
HEIDENHAIN-METRO  
HEIDENHAIN-CERTO



Brochure  
**Exposed Linear Encoders**

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

## Angle measurement



Brochure  
**Rotary Encoders**

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



Brochure  
**Angle Encoders with Integral Bearing**

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



Brochure  
**Encoders for Servo Drives**

Contents:  
Rotary encoders  
Angle encoders  
Linear encoders



Brochure  
**Modular Angle Encoders**  
*With Optical Scanning*

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



Brochure  
**Modular Angle Encoders**  
*With Magnetic Scanning*

Contents:  
Incremental encoders  
**ERM**

Brochure  
**Angle Encoder Modules**

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

## Machine tool control



Brochures

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

Contents:  
 Information for the user



OEM brochures

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

Contents:  
 Information for the machine tool builder



Brochures

**MANUALplus 620 Contouring Control**  
**CNC PLIOT 640 Contouring Control**

Contents:  
 Information for the user



OEM brochures

**MANUALplus 620 Contouring Control**  
**CNC PLIOT 640 Contouring Control**

Contents:  
 Information for the machine tool builder

## Measured value acquisition and display



Brochure

**Evaluation Electronics**  
*For Metrology Applications*

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



Product Overview  
**Interface Electronics**



Brochure

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

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

## Setup and measurement



Brochure

**Touch Probes**

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



Brochure

**Cables and Connectors**

Contents:  
 Technical properties, cable overviews, and  
 cable lists



Brochure

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

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

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

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