



HEIDENHAIN

General Catalog

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

September 2012

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

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

This General Catalog offers you an overview of the HEIDENHAIN product program. You will find more products and further information in the documentation for specific products (see page 60) or on the Internet at www.heidenhain.de. Our sales personnel will be glad to help you personally. See page 62 for addresses and telephone numbers.



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Fundamentals and processes

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



Measuring machine for linear scales

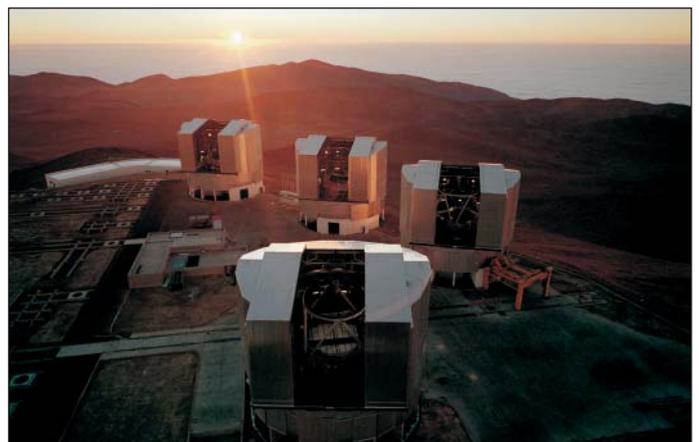


Linear scale inspection station

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



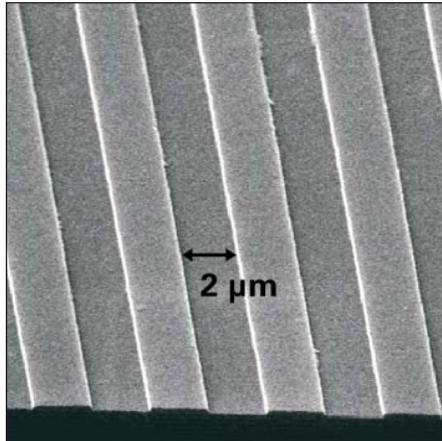
Angle comparator, measuring step approx. 0.001"



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

Precision graduations—the foundation for high accuracy

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



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

DIADUR

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

AURODUR

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

METALLUR

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

Phase gratings

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

SUPRADUR

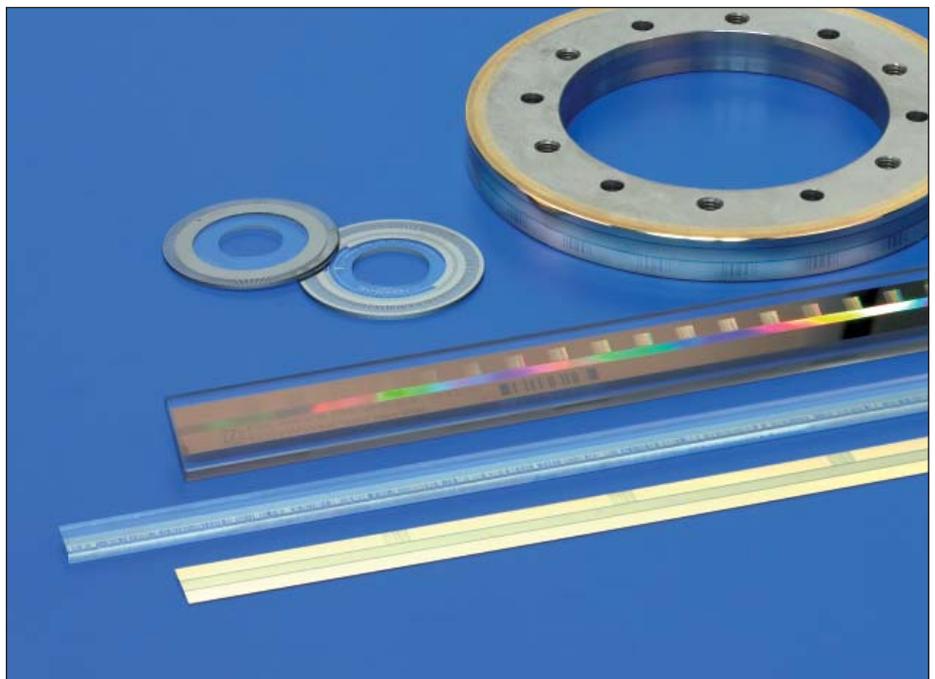
Graduations manufactured with the SUPRADUR process function optically like three-dimensional phase gratings, but they have a planar structure and are therefore particularly insensitive to contamination.

OPTODUR

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

MAGNODUR

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



DIADUR and METALLUR graduations on various carrier materials

Length 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 as fine as $0.005 \mu\text{m}$
- Measuring lengths up to 30 m
- Fast and simple installation
- Large mounting tolerances
- High acceleration loading
- Protection against contamination

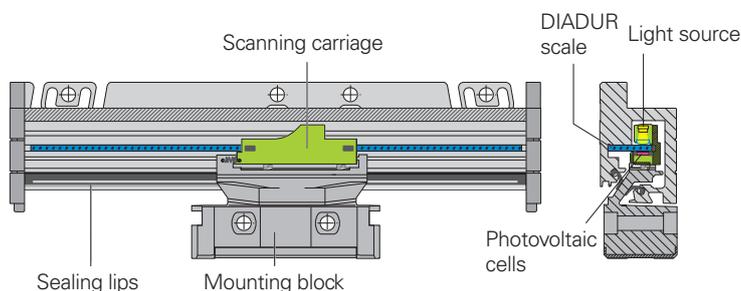


Sealed linear encoders are available with

- **Full-size scale housing**
 - For high vibration loading
 - Up to 30 m measuring length
- **Slimline scale housing**
 - For limited installation space
 - Up to 1240 mm measuring length, up to 2040 mm with 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.

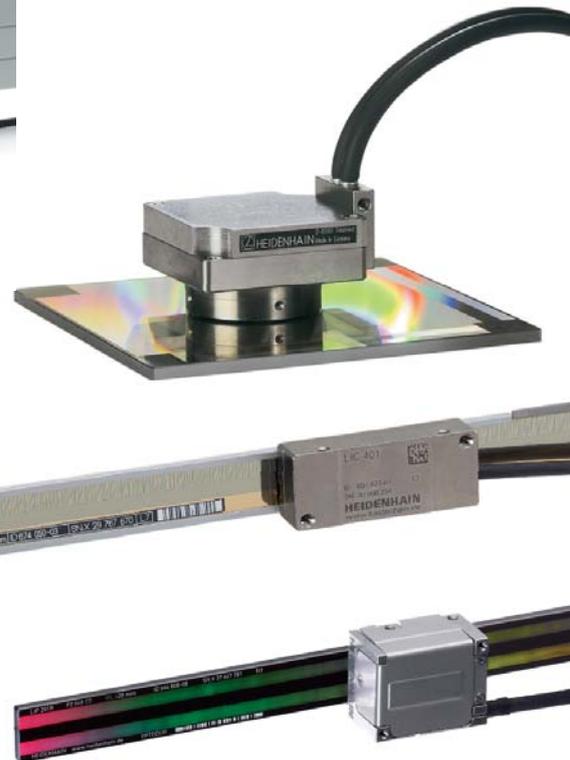
The scanning carriage travels along the scale on a low-friction guide. It is connected to the external mounting block by a coupling that compensates unavoidable misalignment between the scale and the machine guideways.



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** in linear metrology, as well as **production and measuring equipment**, for example in the semiconductor industry.

- Accuracy grades of $\pm 0.5 \mu\text{m}$ and better
- 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 weight
- 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 $\pm 0.1 \mu\text{m}$
- 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 are useful in particular for applications in rotational speed control, e.g. on direct drives. The sinusoidal output signals make it possible to attain higher interpolation factors.

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, LIF	12
	Two-coordinate encoders	PP	13
	High traversing speed and large measuring lengths	LIDA	14
	Absolute position measurement	LIC	
Length gauges	Accuracy $\pm 0.1 \mu\text{m}$	HEIDENHAIN-CERTO	16
	Accuracy $\pm 0.2 \mu\text{m}$	HEIDENHAIN-METRO	17
	Accuracy to $\pm 0.5 \mu\text{m}$	HEIDENHAIN-METRO	18
	Accuracy $\pm 1 \mu\text{m}$	HEIDENHAIN-SPECTO	19
	Accuracy $\pm 2 \mu\text{m}$, absolute position measurement	ACANTO	

LC, LF, LS, LB sealed linear encoders

With full-size scale housing

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

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

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

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

The **LC 200** (absolute) and **LB** (incremental) linear encoders were conceived for very **long measuring lengths up to 30 meters**. Their measuring standard—a steel tape with METALLUR or AURODUR graduation—is delivered as a single piece, and after the housing sections have been mounted, is pulled into the housing, drawn to a defined tension and fixed at both ends to the machine casting.

LC 100 series

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

LC 200 series

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

LS 100 series

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

LF 185

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

LB 382

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

LS 600 series

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

Measuring standard

Incremental signals

Signal period

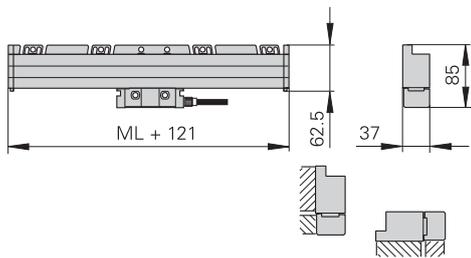
Absolute position values

Accuracy grade

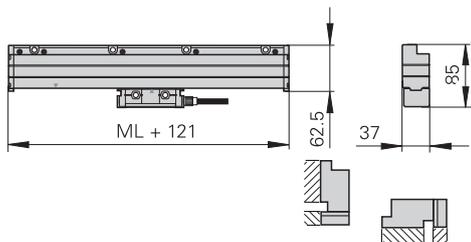
Recommended measuring step

Measuring lengths ML

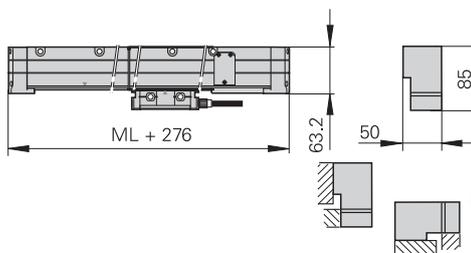
Reference mark



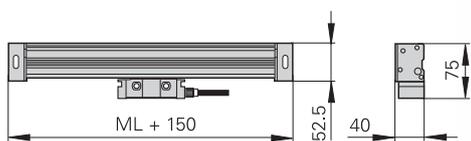
LC 100



LF 185



LC 200



LS 600

Absolute LC 115 LC 195F/M/S ¹⁾	LC 211 LC 281	Incremental LF 185	LS 187 LS 177	LS 688C LS 628C	LB 382
DIADUR glass scale	METALLUR steel scale	SUPRADUR phase grating on steel	DIADUR glass scale	DIADUR glass scale	AURODUR steel scale tape
–	LC 211: – LC 281: $\sim 1 V_{PP}$	$\sim 1 V_{PP}$	LS 187: $\sim 1 V_{PP}$ LS 177: \square TTL	LS 688C: $\sim 1 V_{PP}$ LS 628C: \square TTL	$\sim 1 V_{PP}$
–	40 μm	4 μm	LS 187: 20 μm LS 177: 4 $\mu m/2 \mu m$	20 μm	40 μm
LC 115/LC 2x1: EnDat 2.2 LC 195: Fanuc/Mitsubishi/Siemens		–			
$\pm 5 \mu m, \pm 3 \mu m$	$\pm 5 \mu m$	$\pm 3 \mu m, \pm 2 \mu m$	$\pm 5 \mu m, \pm 3 \mu m$	$\pm 10 \mu m$	$\pm 5 \mu m$
$\pm 5 \mu m$: to 0.01 μm ²⁾ $\pm 3 \mu m$: to 0.001 μm ²⁾	To 0.01 μm ²⁾	To 0.1 μm	To 0.1 μm	LS 688C: to 1 μm LS 628C: 5 μm	To 0.1 μm
Up to 4240 mm	Up to 28040 mm	Up to 1240 mm	Up to 3040 mm		Up to 30040 mm ³⁾
–		One or distance-coded; LS 6xxC: distance-coded			

¹⁾ Available upon request

²⁾ Resolution of the absolute position values

³⁾ Up to ML 72040 mm upon request

LC, LF, LS sealed linear encoders

With slimline scale housing

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

Absolute linear encoders of the **LC 400** series provide the **absolute position value** without any previous traverse required. Like the **LS 400** series incremental linear encoders, their high accuracy and defined thermal behavior make them especially well suited for use on **numerically controlled machine tools**.

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

The **LS 300** series incremental linear encoders are used for simple positioning tasks, for example on **manual machine tools**.

LC 400 series

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

LS 400 series

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

LF 485

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

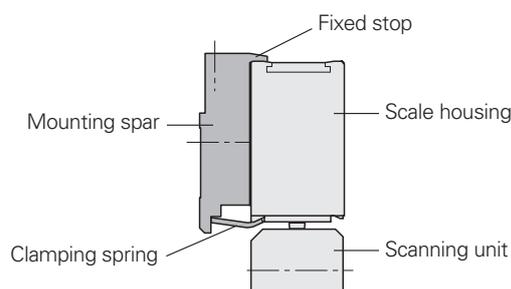
LS 300 series

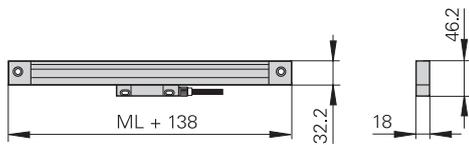
- **Typically for manual machines**

Simple installation with mounting spar

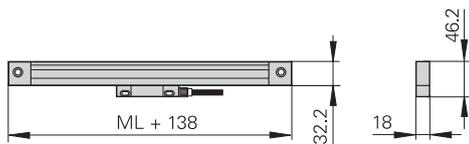
The use of a mounting spar can be of great benefit when mounting slimline linear encoders. It can be fastened as part of the machine assembly process. The encoder is then simply clamped on during final mounting. Easy exchange also facilitates servicing.

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

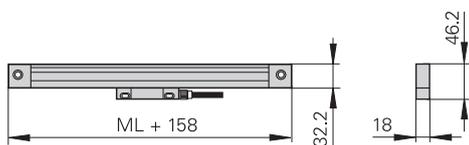




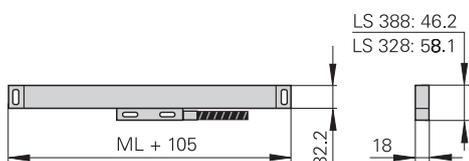
LC 400



LS 400



LF 485



LS 300

	Absolute LC 415 LC 495F/M/S ¹⁾	Incremental LF 485	LS 487 LS 477	LS 388C LS 328C
Measuring standard	DIADUR glass scale	SUPRADUR phase grating on steel	DIADUR glass scale	DIADUR glass scale
Incremental signals	–	~ 1 V _{PP}	LS 487: ~ 1 V _{PP} LS 477: □□TTL	LS 388C: ~ 1 V _{PP} LS 328C: □□TTL
Signal period	–	4 μm	LS 487: 20 μm LS 477: 4 μm/2 μm	20 μm
Absolute position values	LC 415: EnDat 2.2 LC 495: Fanuc/Mitsubishi/ Siemens	–		
Accuracy grade	± 5 μm, ± 3 μm	± 5 μm, ± 3 μm		± 10 μm
Recommended measuring step	± 5 μm: to 0.01 μm ²⁾ ± 3 μm: to 0.001 μm ²⁾	To 0.1 μm	0.1 μm	LS 388C: to 1 μm LS 328C: 5 μm
Measuring lengths ML	Up to 2040 mm ³⁾	Up to 1220 mm	Up to 2040 mm ³⁾	Up to 1240 mm
Reference mark	–	One or distance-coded		Distance-coded

¹⁾ Available upon request

²⁾ Resolution of the absolute position values

³⁾ Over ML 1240 mm only with mounting spar or tensioning elements

LIP, LIF exposed linear encoders

For very high accuracy

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

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

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

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

LIP 300 series

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

LIP 200 series

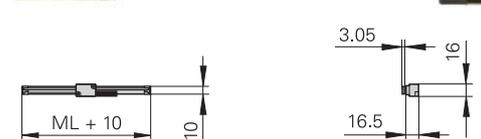
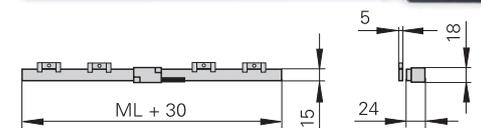
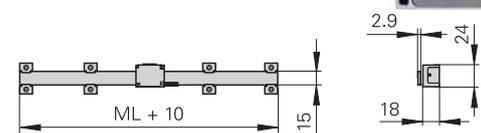
- Measuring lengths up to 3040 mm
- Measuring step down to 1 nm
- Very high repeatability with compact dimensions
- Defined thermal behavior thanks to a measuring standard on Zerodur® glass ceramic

LIP 400 series

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

LIF 400 series

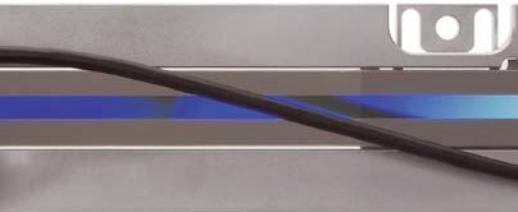
- **Fast, simple scale fastening** with PRECIMET adhesive film
- Relatively insensitive to contamination thanks to SUPRADUR graduation
- Position detection through limit switches and homing track



	Incremental LIP 382 LIP 372	LIP 281	LIP 481 LIP 471
Measuring standard	DIADUR phase grating on Zerodur glass ceramic	OPTODUR phase grating on Zerodur glass ceramic	DIADUR phase grating on glass or Zerodur® glass ceramic
Coefficient of linear expansion	$\alpha_{\text{therm}} \approx (0 \pm 0.1) \times 10^{-6} \text{ K}^{-1}$	$\alpha_{\text{therm}} \approx (0 \pm 0.1) \times 10^{-6} \text{ K}^{-1}$	$\alpha_{\text{therm}} \approx 8 \times 10^{-6} \text{ K}^{-1}$ (glass) or $\alpha_{\text{therm}} \approx (0 \pm 0.1) \times 10^{-6} \text{ K}^{-1}$ (Zerodur)
Incremental signals	LIP 382: $\sim 1 \text{ V}_{\text{PP}}$ LIP 372: \square TTL	$\sim 1 \text{ V}_{\text{PP}}$	LIP 481: $\sim 1 \text{ V}_{\text{PP}}$ LIP 471: \square TTL
Signal period	LIP 382: $0.128 \mu\text{m}$ LIP 372: $0.004 \mu\text{m}$	$0.512 \mu\text{m}$	LIP 481: $2 \mu\text{m}$ LIP 471: $0.4 \mu\text{m}/0.2 \mu\text{m}$
Accuracy grade	$\pm 0.5 \mu\text{m}$	$\pm 1 \mu\text{m}; \pm 3 \mu\text{m}$	$\pm 1 \mu\text{m}; \pm 0.5 \mu\text{m}$
Position error per signal period typically	$\pm 0.001 \mu\text{m}$	$\pm 0.001 \mu\text{m}$	$\pm 0.02 \mu\text{m}$
Recommd. measuring step	1 nm		1 μm to 0.005 μm
Measuring lengths (ML)	70 to 270 mm	20 to 3040 mm	70 to 420 mm
Reference mark	None	One	One

PP exposed linear encoders

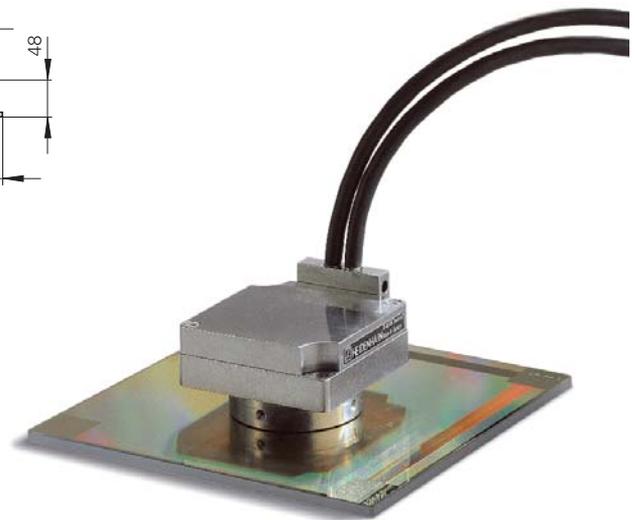
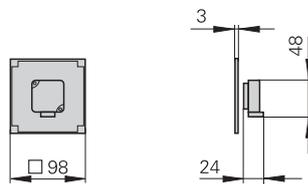
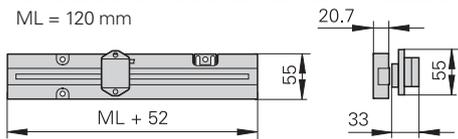
Two-coordinate encoders



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

	Incremental PP 281
Measuring standard Coefficient of linear expansion	DIADUR phase grating on glass $\alpha_{\text{therm}} \approx 8 \times 10^{-6} \text{ K}^{-1}$
Incremental signals	$\sim 1 \text{ V}_{\text{PP}}$
Signal period	4 μm
Accuracy grade	$\pm 2 \mu\text{m}$
Position error per signal period typically	$\pm 0.04 \mu\text{m}$
Recommended measuring step	To 0.01 μm
Measuring range	68 mm x 68 mm (other measuring ranges upon request)
Reference mark	One per coordinate

LIC, LIDA exposed linear encoders

For high accuracy and large measuring lengths

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

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

On the **LIC** and **LIDA** linear encoders, steel scale tapes typically serve as substrate for METALLUR graduations. With the **LIDA 403**, graduation carriers of glass or glass ceramics permit **thermal adaptation** thanks to their different coefficients of linear expansion.

LIC and LIDA exposed linear encoders are typically used for:

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

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

LIDA 403

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

LIC 4015, LIDA 4x5

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

LIC 4017, LIDA 4x7, LIDA 2x7

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

LIC 4019, LIDA 4x9, LIDA 2x9

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

LIC 4000 series

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

LIDA 400 series

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

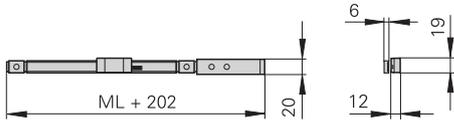
LIDA 200 series

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

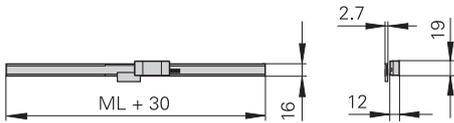
	Absolute LIC 4015	LIC 4017	LIC 4019	Incremental LIDA 483 LIDA 473
Measuring standard Coefficient of linear expansion	METALLUR steel scale tape <i>LIC 4015</i> : α_{therm} Same as mounting surface <i>LIC 4017/LIC 4019</i> : $\alpha_{\text{therm}} \approx 10 \times 10^{-6} \text{ K}^{-1}$			METALLUR graduation on glass ceramic or glass $\alpha_{\text{therm}} \approx 8 \times 10^{-6} \text{ K}^{-1}$ (glass) $\alpha_{\text{therm}} \approx 0 \times 10^{-6} \text{ K}^{-1}$ (Robax glass ceramic) $\alpha_{\text{therm}} \approx (0 \pm 0.1) \times 10^{-6} \text{ K}^{-1}$ (Zerodur glass ceramic)
Incremental signals	–			<i>LIDA 483</i> : $\sim 1 \text{ V}_{\text{pp}}$; <i>LIDA 473</i> : \square TTL
Signal period	–			<i>LIDA 483</i> : 20 μm ; <i>LIDA 473</i> : 4 μm /2 μm /0.4 μm /0.2 μm
Absolute position values	EnDat 2.2			–
Accuracy grade	$\pm 5 \mu\text{m}$	$\pm 15 \mu\text{m}$		$\pm 3 \mu\text{m}$; $\pm 5 \mu\text{m}$
Position error per signal period typically	$\pm 0.08 \mu\text{m}$			$\pm 0.2 \mu\text{m}$
Recommd. measuring step	To 0.01 μm (absolute position values)			1 μm to 0.1 μm
Measuring lengths ML	140 to 27040 mm	240 to 6040 mm	70 to 1040 mm	240 to 3040 mm (Robax glass ceramic to 1640 mm)
Reference mark	–			One or distance-coded



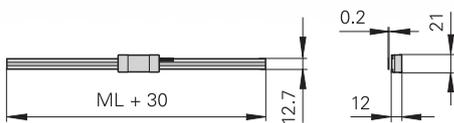
LIC 4015



LIDA 487



LIDA 279



LIDA 485 LIDA 475	LIDA 487 LIDA 477	LIDA 489 LIDA 479	LIDA 287 LIDA 277	LIDA 289 LIDA 279
METALLUR steel scale tape <i>LIDA 4x5</i> : α_{therm} Same as mounting surface <i>LIDA 4x7/LIDA 4x9</i> : $\alpha_{\text{therm}} \approx 10 \times 10^{-6} \text{ K}^{-1}$			Steel scale tape $\alpha_{\text{therm}} \approx 10 \times 10^{-6} \text{ K}^{-1}$	
<i>LIDA 48x</i> : $\sim 1 V_{\text{pp}}$; <i>LIDA 47x</i> : \square TTL			<i>LIDA 28x</i> : $\sim 1 V_{\text{pp}}$; <i>LIDA 27x</i> : \square TTL	
<i>LIDA 48x</i> : 20 μm ; <i>LIDA 47x</i> : 4 μm /2 μm /0.4 μm /0.2 μm			<i>LIDA 28x</i> : 200 μm ; <i>LIDA 27x</i> : 20 μm /4 μm /2 μm	
-			-	
$\pm 5 \mu\text{m}$		$\pm 15 \mu\text{m}$	$\pm 30 \mu\text{m}$	
$\pm 0.2 \mu\text{m}$			$\pm 2 \mu\text{m}$	
1 μm to 0.1 μm			5 μm to 0.5 μm	
140 to 30040 mm		240 to 6040 mm	Scale tape from the roll 3 m/5 m/10 m	
One			Selectable every 100 mm	

HEIDENHAIN-CERTO length gauges

Accuracy $\pm 0.1 \mu\text{m}$

HEIDENHAIN-CERTO length gauges feature a large measuring range, provide high linear accuracy and offer resolution in the nanometer range. They are used predominantly for production quality control of high-precision parts and for the monitoring and calibration of reference standards. Length gauges reduce the number of working standards required to calibrate gauge blocks.

Accuracy

The total error of HEIDENHAIN-CERTO length gauges lies within $\pm 0.1 \mu\text{m}$. After linear length error compensation in the evaluation electronics of the ND 28x, for example, HEIDENHAIN guarantees accuracy of $\pm 0.03 \mu\text{m}$ for the CT 2500 and $\pm 0.05 \mu\text{m}$ for the CT 6000. These accuracy grades apply over the entire measuring range at ambient temperatures between 19 °C and 21 °C and with a temperature variation of $\pm 0.1 \text{ K}$ during measurements using the CS 200 gauge stand for the HEIDENHAIN-CERTO.

Plunger actuation

The plunger of the **CT 2501** and **CT 6001** is extended and retracted by an integral motor. It can be actuated by the associated switch box, which can also be controlled by external signal.

The **CT 2502** and **CT 6002** have no plunger drive. The freely movable plunger is connected by a separate coupling with the moving machine element.

Mounting

The CT 2500 length gauge is fastened by its 16 mm diameter clamping shank. The CT 6000 is fastened with two screws on a plane surface.



	Incremental CT 2501	CT 2502	CT 6001	CT 6002
Measuring standard	DIADUR phase grating on Zerodur glass ceramic Coefficient of linear expansion: $\alpha_{\text{therm}} \approx 0 \pm 0.1 \times 10^{-6} \text{ K}^{-1}$			
Incremental signals	$\sim 11 \mu\text{A}_{\text{PP}}$			
Signal period	2 μs			
System accuracy¹⁾	$\pm 0.1 \mu\text{m}$ $\pm 0.03 \mu\text{m}^2$		$\pm 0.1 \mu\text{m}$ $\pm 0.05 \mu\text{m}^2$	
Recommd. measuring step	0.01 μm and 0.005 μm with the ND 28x measured value display units			
Measuring range	25 mm		60 mm	
Plunger actuation	Motor driven	Via coupling	Motor driven	Via coupling
Reference mark	One			

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

²⁾ With linear length-error compensation in the evaluation electronics

HEIDENHAIN-METRO length gauges

Accuracy $\pm 0.2 \mu\text{m}$

With their high system accuracy and small signal period, the HEIDENHAIN-METRO MT 1200 and MT 2500 length gauges are ideal for precision measuring stations and testing equipment. They feature ball-bush guided plungers and therefore permit high radial forces.

Plunger actuation

The length gauges of the **MT 12x1** and **MT 25x1** series feature a spring-tensioned plunger that is extended at rest. In a special version without spring it exercises particularly low force on the measured object.

In the pneumatic length gauges **MT 1287** and **MT 2587**, the plunger is retracted to its rest position by the integral spring. It is extended to the measuring position by application of compressed air.

Mounting

The MT 1200 and MT 2500 length gauges are fastened by their 8h6 standard clamping shank. A mounting bracket is available as an accessory to mount the length gauges to plane surfaces or to the MS 200 from HEIDENHAIN.



	Incremental MT 1281 MT 1287	MT 1271	MT 2581 MT 2587	MT 2571
Measuring standard	DIADUR phase grating on Zerodur glass ceramic Coefficient of linear expansion: $\alpha_{\text{therm}} \approx 0 \pm 0.1 \times 10^{-6} \text{ K}^{-1}$			
Incremental signals	$\sim 1 \text{ V}_{\text{PP}}$	\square TTL	$\sim 1 \text{ V}_{\text{PP}}$	\square TTL
Signal period	2 μm	0.4 μm , or 0.2 μm	2 μm	0.4 μm , or 0.2 μm
System accuracy	$\pm 0.2 \mu\text{m}$			
Recommd. measuring step	0.5 μm to 0.05 μm			
Measuring range	12 mm		25 mm	
Plunger actuation	MT 12x1/MT 25x1: by cable-type lifter or freely movable MT 1287/MT 2587: pneumatic			
Reference mark	One			

HEIDENHAIN-METRO length gauge

Accuracy to $\pm 0.5 \mu\text{m}$

Large measuring ranges together with their high accuracy make the MT 60 and MT 101 HEIDENHAIN-METRO length gauges attractive for incoming inspection, production monitoring, quality control, or anywhere parts with very different dimensions are measured. But they are also easy to mount as highly accurate position encoders, for example on sliding devices or X-Y tables.

Plunger actuation

M version length gauges feature an integral motor that retracts and extends the plunger. While the MT 101 M operates at a constant gauging force, the MT 60 M allows you to select from three gauging force levels.

K version gauges have no integral plunger actuation. The plunger is freely movable. It can be connected to moving elements such as linear slides and X-Y table by a coupling.

Mounting

The length gauges are mounted onto a flat surface by two screws. HEIDENHAIN offers the M versions for mounting in the accessory MS 100 and MS 200 gauge stands.



	Incremental MT 60M	MT 60K	MT 101 M	MT 101 K
Measuring standard	DIADUR graduation on glass ceramic			
Incremental signals	~ 11 μA_{pp}			
Signal period	10 μm			
System accuracy	$\pm 0.5 \mu\text{m}$		$\pm 1 \mu\text{m}$	
Recommd. measuring step	1 μm to 0.1 μm			
Measuring range	60 mm		100 mm	
Plunger actuation	Motor driven	Via coupling	Motor driven	Via coupling
Degree of protection	IP 50			
Reference mark	One			

ACANTO, HEIDENHAIN-SPECTO length gauges

Accuracy to $\pm 1 \mu\text{m}$

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

The absolute position measurement of the ACANTO length gauge is particularly well suited for measuring stations with very many measuring points: as the measured value is already generated in the length gauge there is no need for the counting electronics for each measuring point that would otherwise be necessary.

Plunger actuation

The length gauges of the **AT 1218**, **ST 12x8** and **ST 30x8** series feature a spring-tensioned plunger that is extended at rest.

In the **AT 1217**, **ST 12x7** and **ST 30x7** pneumatic length gauges, the plunger is retracted to its rest position by the integral spring. It is extended to the measuring position by application of compressed air.

Mounting

The HEIDENHAIN-SPECTO length gauges are fastened by their 8h6 standard clamping shank.



	Absolute AT 1218 AT 1217	Incremental ST 1288 ST 1287	ST 1278 ST 1277	ST 3088 ST 3087	ST 3078 ST 3077
Measuring standard	DIADUR glass scale				
Incremental signals	–	$\sim 1 V_{PP}$	\square TTL	$\sim 1 V_{PP}$	\square TTL
Signal period	–	20 μm	4 $\mu\text{m}/2 \mu\text{m}$	20 μm	4 $\mu\text{m}/2 \mu\text{m}$
Absolute position values	EnDat 2.2	–			
System accuracy	$\pm 2 \mu\text{m}$	$\pm 1 \mu\text{m}$			
Recommd. measuring step	1 μm to 0.1 μm				
Measuring range	12 mm	12 mm		30 mm	
Plunger actuation	AT 1218/ST 12x8/ST 30x8: by measured object AT 1217/ST 12x7/ST 30x7: pneumatic				
Degree of protection	IP 64				
Reference mark	–	One			

Angle encoders

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

- Line counts typically 9000 to 180000
- Accuracy from $\pm 5''$ to $\pm 0.4''$
- Measuring steps as fine as 0.000005° or $0.018''$ (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 and handling devices, as well as various types of measuring, testing, and inspection devices.

- Line counts of typically 50 to 5000
- Accuracy grades to $\pm 12''$ (depending on the line count, corresponding to $\pm 1/20$ of the grating period)
- Measuring steps to 0.001. Particularly with the photoelectric encoders, the high quality of the sinusoidal incremental signals permits high interpolation factors for digital speed control.



Mounting variants

In angle encoders and rotary encoders with integral bearing and **stator coupling**, the graduated disk of the encoder is connected directly to the shaft to be measured. The scanning unit is guided on the shaft via ball bearings, supported by the stator coupling. During angular acceleration of the shaft, the stator coupling must absorb only that torque resulting from friction in the bearing, thereby minimizing both static and dynamic measuring error. Moreover, the coupling mounted on the stator compensates axial motion of the measured shaft. Other benefits of the stator coupling are:

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

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

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

- Requires little space
- Large hollow-shaft diameter
- 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. **Single-turn encoders** provide the current angular position value within one revolution, while **multiturn encoders** can additionally distinguish between revolutions. The position values are transmitted over an **EnDat, SSI, PROFIBUS-DP, PROFINET or other serial data interface**. The EnDat-Interface, PROFIBUS-DP or PROFINET bidirectional interfaces enable automatic configuration of the higher-level electronics and provide monitoring and diagnostic functions.

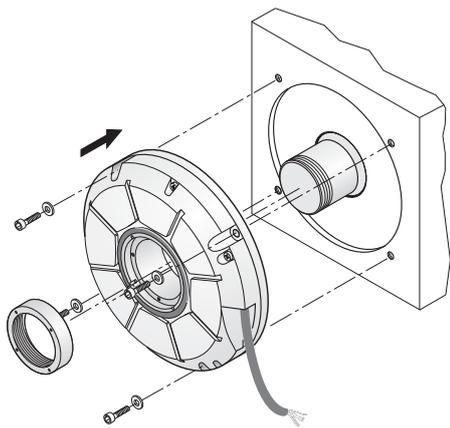
Under the designation **functional safety**, HEIDENHAIN offers encoders with purely serial data transmission as single-encoder systems for safety-related machines and systems. The two measured values are already formed independently of each other in the encoder, and are transmitted to the safe control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

Angle encoders		Series	Page
With integral bearing and integrated stator coupling	Absolute (singleturn) Incremental	RCN RON, RPN	22
With integral bearing, for separate shaft coupling	Incremental	ROD	24
Without integral bearing	Incremental	ERP, ERO, ERA	25 – 28
Modular encoders	Incremental	ERM	30
Rotary encoders			
With integral bearing, for mounting by stator coupling	Absolute (singleturn/multiturn) Incremental	ECN/EQN ERN	32, 34
With integral bearing, for separate shaft coupling	Absolute (singleturn/multiturn) Incremental	ROC/ROQ, RIC/RIQ ROD	36
Without integral bearing	Absolute (singleturn/multiturn) Incremental	ECI/EQI ERO	38

RCN, RON, RPN angle encoders

With integral bearing and integrated stator coupling

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



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

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

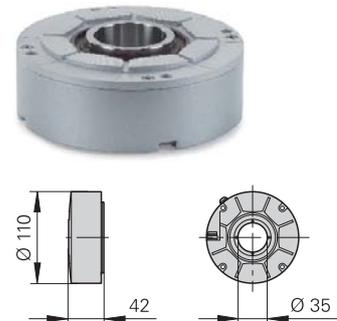
RCN 2000 and RON 200 series

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



RCN 5000 series

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



RCN 8000, RON 700 and RON/RPN 800 series

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



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

RON 905

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



	Absolute RCN 2380 RCN 2580	RCN 2310 RCN 2510	RCN 2390 F RCN 2590 F	RCN 2390 M ²⁾ RCN 2590 M ²⁾	Incremental RON 225 RON 275	RON 285 RON 287
Incremental signals	~ 1 V _{PP}	-			□ TTL	~ 1 V _{PP}
Signal periods/revolution	16384	-			18000 ³⁾ 90000/180000 ⁴⁾	18000
Absolute position values	EnDat 2.2/02 ¹⁾	EnDat 2.2/22 ¹⁾	Fanuc 05	Mit 03-4	-	
Position values/revolution	RCN 23x0: 67 108 864 (26 bits); RCN 25x0: 268 435 456 (28 bits)				-	
System accuracy	RCN 23x0: ± 5"; RCN 25x0: ± 2.5"				± 5"	± 5"; ± 2.5"
Mech. permissible speed	≤ 1500 min ⁻¹				≤ 3000 min ⁻¹	

	Absolute RCN 5380 RCN 5580	RCN 5310 RCN 5510	RCN 5390 F RCN 5590 F	RCN 5390 M ²⁾ RCN 5590 M ²⁾
Incremental signals	~ 1 V _{PP}	-		
Signal periods/revolution	16384	-		
Absolute position values	EnDat 2.2/02 ¹⁾	EnDat 2.2/22 ¹⁾	Fanuc 05	Mit 03-4
Position values/revolution	RCN 53x0: 67 108 864 (26 bits); RCN 55x0: 268 435 456 (28 bits)			
System accuracy	RCN 53x0: ± 5"; RCN 55x0: ± 2.5"			
Mech. permissible speed	≤ 1500 min ⁻¹			

	Absolute RCN 8380 RCN 8580	RCN 8310 RCN 8510	RCN 8390 F RCN 8590 F	RCN 8390 M ²⁾ RCN 8590 M ²⁾	Incremental RON 786	RON 886	RPN 886
Incremental signals	~ 1 V _{PP}	-		-	~ 1 V _{PP}		
Signal periods/revolution	32 768	-		-	18000, 36000	36000	180000
Absolute position values	EnDat 2.2/02 ¹⁾	EnDat 2.2/22 ¹⁾	Fanuc 05	Mit 03-4	-		
Position values/revolution	536870912 (29 bits)				-		
System accuracy	RCN 83x0: ± 2"; RCN 85x0: ± 1"				± 2"	± 1"	
Mech. permissible speed	≤ 500 min ⁻¹				≤ 1000 min ⁻¹		

	Incremental RON 905
Incremental signals	~ 11 μA _{PP}
Signal periods/revolution	36000
System accuracy	± 0.4"
Mech. permissible speed	≤ 100 min ⁻¹

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

²⁾ Available upon request

³⁾ After integrated 3-fold interpolation

⁴⁾ After integrated 5-fold and 10-fold interpolation

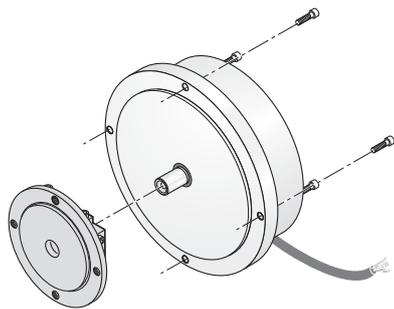
DRIVE-CLiQ is a registered trademark of the Siemens Aktiengesellschaft

ROD angle encoders

With integral bearing, for separate shaft coupling

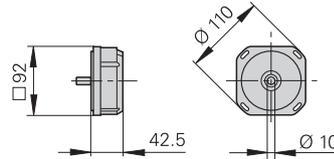
ROD angle encoders with solid shaft for separate shaft coupling are particularly attractive for applications where high shaft speeds and large mounting tolerances are required. The precision shaft couplings allow axial motion up to ± 1 mm.

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



ROD 200 series

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

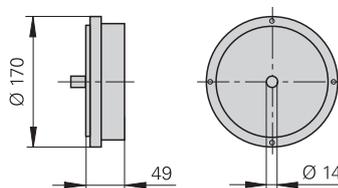


	Incremental ROD 220	ROD 270	ROD 280
Incremental signals	□ TTL x 2	□ TTL x 10	~ 1 V _{PP}
Signal periods/rev	18000	180000	18000
System accuracy¹⁾	± 5"		
Mech. permissible speed	≤ 10000 min ⁻¹		

¹⁾ Without shaft coupling

ROD 780 and ROD 880

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



	Incremental ROD 780	ROD 880
Incremental signals	~ 1 V _{PP}	
Signal periods/rev	18000, 36000	36000
System accuracy¹⁾	± 2"	± 1"
Mech. permissible speed	≤ 1000 min ⁻¹	

¹⁾ Without shaft coupling

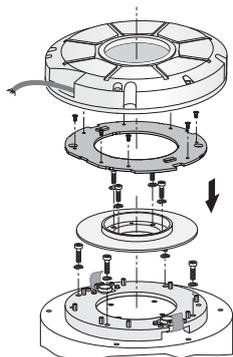
ERP angle encoders

Without integral bearing

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

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

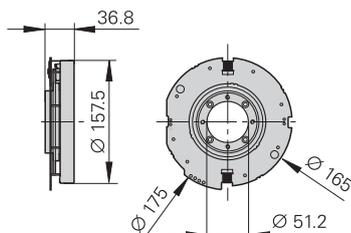
A circular scale with phase grating serves as the basis for the high accuracy of the ERP encoders. The attainable system accuracy depends on the eccentricity of the graduation to the drive shaft bearing, as well as the radial runout and wobble of the bearing.



Mounting the ERP 880

ERP 880

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



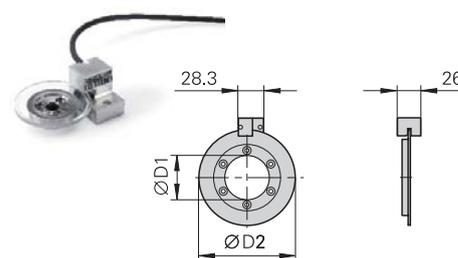
ERP 880 with housing

	Incremental ERP 880
Incremental signals	$\sim 1 V_{PP}$
Signal periods/rev	180000
System accuracy¹⁾	$\pm 1''$
Mech. permissible speed	$\leq 1000 \text{ min}^{-1}$

¹⁾ Before installation. Additional error is caused by imprecise mounting and the bearing.

ERP 4080 and ERP 8080

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



	Incremental ERP 4080	ERP 8080
Incremental signals	$\sim 1 V_{PP}$	
Signal periods/rev	131072	360000
System accuracy¹⁾	$\pm 5''$	$\pm 2''$
Diameter D1/D2	8 mm/44 mm	50 mm/108 mm
Mech. permissible speed	$\leq 300 \text{ min}^{-1}$	$\leq 100 \text{ min}^{-1}$

¹⁾ Before installation. Additional error is caused by imprecise mounting and the bearing.

ERO, ERA angle encoders

Without integral bearing

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

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

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

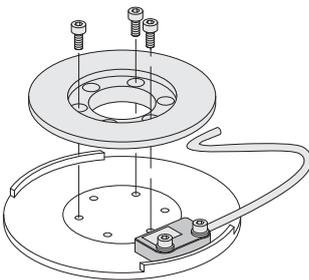
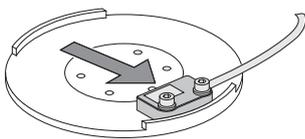
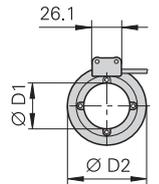
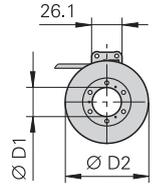
The **ERA** angle encoders feature a sturdy steel scale drum and are suited for high shaft speeds up to 10000 min^{-1} . They are typically found on fast running spindles, on rotary tables and tilting axes.

ERO 6000 series

- Very flat design
- High system accuracy
- Simple installation

ERO 6100 series

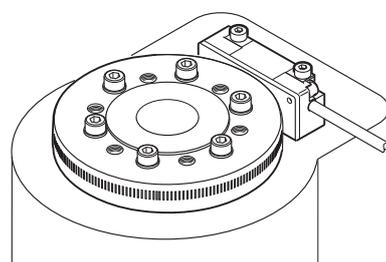
- For dynamic applications with reduced accuracy requirements
- Application examples include printing machines and handling axes.
- Large inside diameter



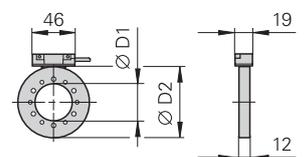
ERA 6000

ERA 4000 series

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



ERA 4000



ERA 4000

Incremental signals	
Inside diameter D1	
Outside diameter D2	
Signal periods/revolution	ERA 4280 C
System accuracy²⁾	ERA 4480 C
	ERA 4880 C
Mechanically permissible speed	

	Incremental ERO 6070		ERO 6080		ERO 6180
Incremental signals	□□TTL		~ 1 V _{PP}		~ 1 V _{PP}
Inside diameter D1	25 mm	95 mm	25 mm	95 mm	41 mm
Outside diameter D2	71 mm	150 mm	71 mm	150 mm	70 mm
Signal periods/rev	45000 to 450000 ¹⁾	90000 to 900000 ¹⁾	9000	18000	4096
System accuracy²⁾	± 5"	± 3"	± 5"	± 3"	± 15"
Mechanically permissible speed	≤ 1 600 min ⁻¹	≤ 800 min ⁻¹	≤ 1 600 min ⁻¹	≤ 800 min ⁻¹	≤ 3 500 min ⁻¹

¹⁾ After integrated 5/10/50-fold interpolation

²⁾ Before installation. Additional error is caused by imprecise mounting and the bearing.

Incremental ERA 4280 C¹⁾ Signal period 20 μm ERA 4480 C Signal period 40 μm ERA 4880 C Signal period 80 μm									
~ 1 V _{PP}									
40 mm	70 mm	80 mm	120 mm	150 mm	180 mm	270 mm	425 mm	512 mm	
76.75 mm	104.63 mm	127.64 mm	178.55 mm	208.89 mm	254.93 mm	331.31 mm	484.07 mm	560.46 mm	
12000/± 6.1" 6000/± 7.2" 3000/± 9.4"	16384/± 4.5" 8192/± 5.3" 4096/± 6.9"	20000/± 3.7" 10000/± 4.3" 5000/± 5.6"	28000/± 3.0" 14000/± 3.5" 7000/± 4.4"	32768/± 2.9" 16384/± 3.3" 8192/± 4.1"	40000/± 2.9" 20000/± 3.2" 10000/± 3.8"	52000/± 2.8" 26000/± 3.0" 13000/± 3.5"	– 38000/± 2.4" –	– 44000/± 2.3" –	
≤ 10000 min ⁻¹	≤ 8500 min ⁻¹	≤ 6250 min ⁻¹	≤ 4500 min ⁻¹	≤ 4250 min ⁻¹	≤ 3250 min ⁻¹	≤ 2500 min ⁻¹	≤ 1800 min ⁻¹	≤ 1500 min ⁻¹	

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

²⁾ Before installation. Additional error is caused by imprecise mounting and the bearing.

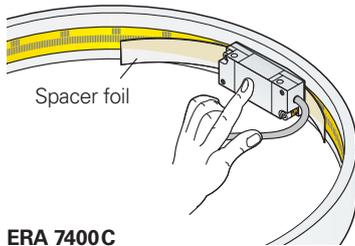
ERA angle encoders

Without integral bearing

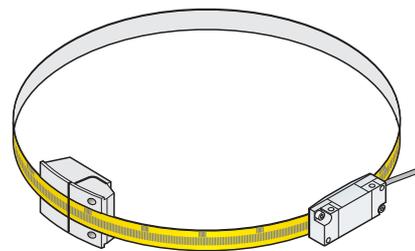
The HEIDENHAIN **ERA** angle encoders with steel scale tape as measuring standard function without integral bearings. They are intended for integration in machine elements or components. They are designed to meet the following requirements:

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

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



ERA 7400C



ERA 8400C

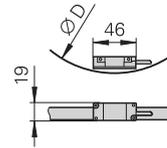
ERA 7000 and ERA 8000 series

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

ERA 7000 series

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

- ERA 7400C: Full-circle version
- ERA 7401C: Segment version

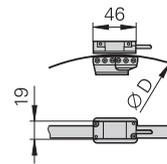


ERA 7481C

ERA 8000 series

Scale tape is fastened on the outside circumference of the machine element

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



ERA 8480C

	Incremental ERA 7400C		
Incremental signals	~ 1 V _{PP} ; signal period 40 μm (on circumference)		
Signal periods/revolution	36000	45000	90000
System accuracy ¹⁾	± 4.0"	± 3.2"	± 1.6"
Accuracy of graduation	± 3 μm per meter tape length		
Diameter D1	458.62 mm	573.20 mm	1 146.10 mm
Mech. permissible speed	≤ 250 min ⁻¹		≤ 220 min ⁻¹

¹⁾ Before installation. Additional error is caused by imprecise mounting and the bearing.

	Incremental ERA 8400C		
Incremental signals	~ 1 V _{PP} ; signal period 40 μm (on circumference)		
Signal periods/revolution	36000	45000	90000
System accuracy ¹⁾	± 4.8"	± 3.9"	± 1.9"
Accuracy of graduation	± 3 μm per meter tape length		
Diameter D1	458.04 mm	572.63 mm	1145.73 mm
Mech. permissible speed	≤ 50 min ⁻¹		≤ 45 min ⁻¹

¹⁾ Before installation. Additional error is caused by imprecise mounting and the bearing.

ERM modular encoders

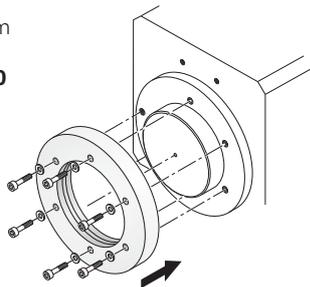
Without integral bearing

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

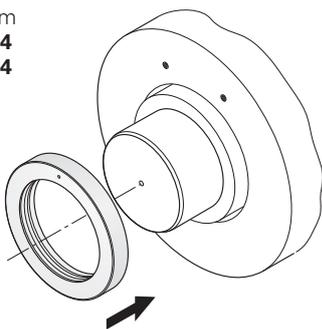
Typical fields of application include machines and equipment with **large hollow shaft diameters** in environments with large amounts of airborne particles and liquids, for example:

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

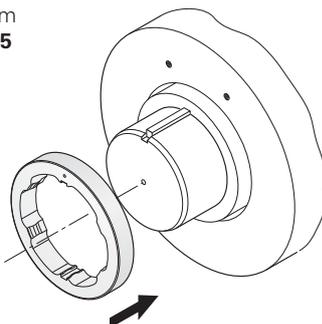
Scale drum
ERM 200
ERM 2200



Scale drum
ERM 2404
ERM 2904

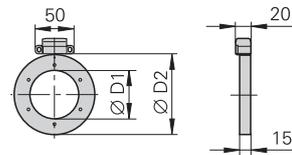


Scale drum
ERM 2405



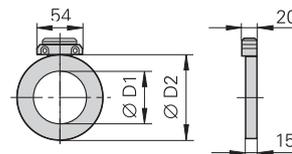
ERM 2200 series

- High graduation accuracy
- Signal period 200 μm at circumference
- Distance-coded reference marks



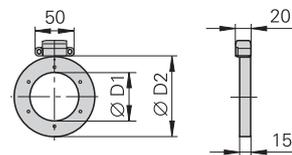
ERM 200 series

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



ERM 2410

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

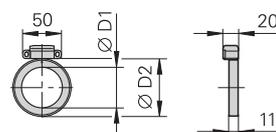


ERM 200



ERM 2400 series

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



ERM 2484



ERM 2984 series

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

Incremental ERM 2200						
Incremental signals	ERM 2200: $\sim 1 V_{PP}$					
Signal period	Approx. 200 μm (at circumference)					
Inside diameter D1	70 mm	80 mm	130 mm	180 mm	260 mm	380 mm
Outside diameter D2	113.16 mm	128.75 mm	176.03 mm	257.50 mm	326.90 mm	452.64 mm
Line count/accuracy of graduation	1800/ $\pm 7''$	2048/ $\pm 6''$	2800/ $\pm 5''$	4096/ $\pm 3.5''$	5200/ $\pm 3''$	7200/ $\pm 2.5''$
Shaft speed¹⁾	$\leq 14500 \text{ min}^{-1}$	$\leq 13000 \text{ min}^{-1}$	$\leq 9000 \text{ min}^{-1}$	$\leq 6000 \text{ min}^{-1}$	$\leq 4500 \text{ min}^{-1}$	$\leq 3000 \text{ min}^{-1}$
Operating temperature	-10 °C to 100 °C					

Incremental ERM 220 ERM 280 ERM 2410									
Incremental signals	ERM 220: \square TTL; ERM 280: $\sim 1 V_{PP}$; ERM 2410: –								
Signal period	Approx. 400 μm (at circumference)								
Absolute position values²⁾	ERM 2410: EnDat 2.2								
Inside diameter D1	40 mm	70 mm	80 mm	120 mm	130 mm	180 mm	220 mm	295 mm	410 mm
Outside diameter D2	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
Line count/accuracy of graduation	600/ $\pm 11''$	900/ $\pm 8''$	1024/ $\pm 7''$	1200/ $\pm 6''$	1400/ $\pm 5.5''$	2048/ $\pm 4''$	2048/ $\pm 5''$	2600/ $\pm 4''$	3600/ $\pm 3.5''$
Shaft speed¹⁾	$\leq 19000 \text{ min}^{-1}$	$\leq 14500 \text{ min}^{-1}$	$\leq 13000 \text{ min}^{-1}$	$\leq 10500 \text{ min}^{-1}$	$\leq 9000 \text{ min}^{-1}$	$\leq 6000 \text{ min}^{-1}$	$\leq 6000 \text{ min}^{-1}$	$\leq 4500 \text{ min}^{-1}$	$\leq 3000 \text{ min}^{-1}$
Operating temperature	-10 °C to 100 °C								

Incremental ERM 2484 ERM 2485³⁾						ERM 2984	
Incremental signals	$\sim 1 V_{PP}$						
Signal period	Approx. 400 μm (at circumference)				Approx. 1 mm (at circumference)		
Inside diameter D1	40 mm	55 mm	80 mm	100 mm	55 mm	100 mm	
Outside diameter D2	64.37 mm	75.44 mm	113.16 mm	128.75 mm	77.41 mm	120.96 mm	
Line count/accuracy of graduation	512/ $\pm 17''$	600/ $\pm 14''$	900/ $\pm 10''$	1024/ $\pm 9''$	256/ $\pm 51''$	400/ $\pm 33''$	
Shaft speed¹⁾	ERM 2484: $\leq 42000 \text{ min}^{-1}$ ERM 2485: $\leq 33000 \text{ min}^{-1}$	$\leq 36000 \text{ min}^{-1}$ $\leq 27000 \text{ min}^{-1}$	$\leq 22000 \text{ min}^{-1}$ –	$\leq 20000 \text{ min}^{-1}$ –	$\leq 35000 \text{ min}^{-1}$ –	$\leq 16000 \text{ min}^{-1}$ –	
Operating temperature	-10 °C to 100 °C						

¹⁾ Mechanically permissible speed

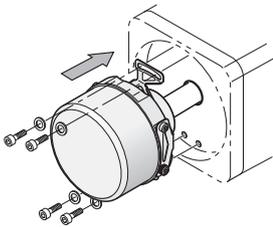
²⁾ Through integrated counting function after traverse of two reference marks

³⁾ Only with outside diameters D2 64.37 mm and 75.44 mm

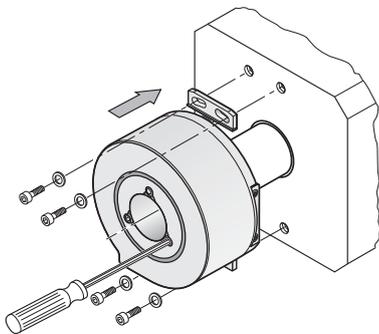
ECN, EQN, ERN rotary encoders

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

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



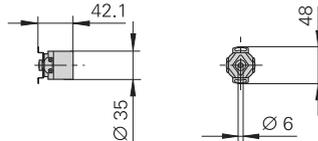
ECN/EQN/ERN 1000
ECN/EQN/ERN 400



ECN/ERN 100

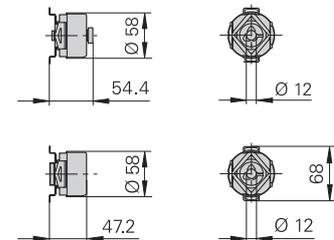
ECN/EQN/ERN 1000 series

- **Miniaturized version**
- Blind hollow shaft with 6 mm inside diameter
- Housing outside diameter: 35 mm
- Natural frequency of the encoder stator coupling: ≥ 1500 Hz
- Mechanically permissible speed: ≤ 12000 min⁻¹



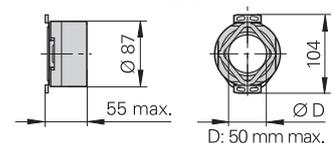
ECN/EQN/ERN 400 series

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



ECN/ERN 100 series

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



Incremental signals

Line count

Absolute position values

Position values/rev

Distinguishable revolutions

Power supply

Operating temperature

Absolute ECN 1013		EQN 1025	ECN 1023	EQN 1035	Incremental ERN 1020		ERN 1030	ERN 1070	ERN 1080
~ 1 V _{PP}			–		□ TTL	□ HTL	□ TTL ²⁾		~ 1 V _{PP}
512			–		100 to 3600			1000/2500/ 3600	100 to 3600
EnDat 2.2 ¹⁾					–				
8192 (13 bits)			8388608 (23 bits)		–				
–	4096 (12 bits)		–	4096 (12 bits)		–			
3.6 to 14 V					5 V	10 to 30 V	5 V		
≤ 100 °C					≤ 100 °C	≤ 70 °C			≤ 100 °C

¹⁾ Includes command set for EnDat 2.1; PROFIBUS-DP via gateway

²⁾ Integrated interpolation 5/10-fold

	Absolute ECN 413		EQN 425	ECN 425	EQN 437	Incremental ERN 420		ERN 430	ERN 460	ERN 480
Incremental signals	~ 1 V _{PP}			–		□ TTL	□ HTL	□ TTTL		~ 1 V _{PP}
Line count	512 or 2048			–		250 to 5000				1000 to 5000
Absolute position values	EnDat 2.2 ¹⁾ or SSI		EnDat 2.2 ¹⁾		–					
Position values/rev	8192 (13 bits)		33554432 (25 bits)		–					
Distinguishable revolutions	–	4096 (12 bits)		–	4096 (12 bits)		–			
Power supply	<i>EnDat</i> : 3.6 to 14 V <i>SSI</i> : 5 V or 10 to 30 V		3.6 to 14 V			5 V	10 to 30 V			5 V
Operating temperature	5 V: ≤ 100 °C 10 to 30 V: ≤ 85 °C		≤ 100 °C			≤ 100 °C			≤ 70 °C	≤ 100 °C

¹⁾ Includes EnDat 2.1 command set; PROFIBUS-DP via gateway

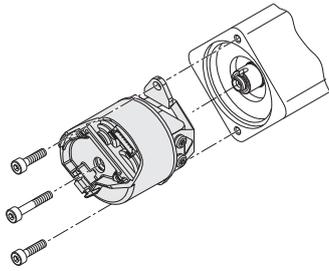
	Absolute ECN 113	ECN 125	Incremental ERN 120		ERN 130	ERN 180
Incremental signals	~ 1 V _{PP}	–	□ TTTL		□ HTL	~ 1 V _{PP}
Line count	2048	–	1000 to 5000			
Absolute position values	EnDat 2.2 ¹⁾	EnDat 2.2 ¹⁾	–			
Position values/rev	8192 (13 bits)	33554432 (25 bits)	–			
Power supply	5 V	3.6 to 5.25 V	5 V		10 to 30 V	5 V
Operating temperature	≤ 100 °C		≤ 100 °C		<i>U_P</i> ≤ 15 V: ≤ 100 °C <i>U_P</i> ≤ 30 V: ≤ 85 °C	

¹⁾ Includes EnDat 2.1 command set; PROFIBUS-DP via gateway

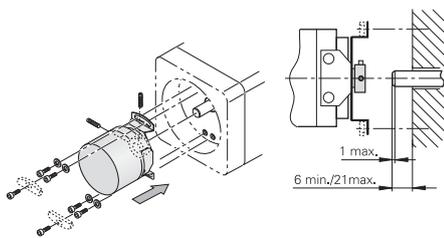
ECN, EQN, ERN rotary encoders

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

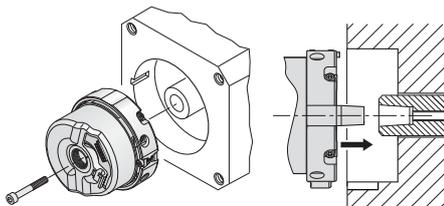
The **ECN, EQN** and **ERN** rotary encoders from HEIDENHAIN with IP 40 degree of protection are specially designed for integration in motors. Bearings and mounted stator coupling are integrated. Absolute rotary encoders and versions with commutation tracks are available for synchronous motors. The taper shaft or the blind hollow shaft is fastened directly to the shaft to be measured. This ensures an extremely stiff coupling that permits exceptionally high dynamic performance of the drive. The stator coupling is designed to be fastened in a location bore and permits fast, simple mounting while enabling a mechanical fine adjustment of the commutation.



ECN/EQN 1100



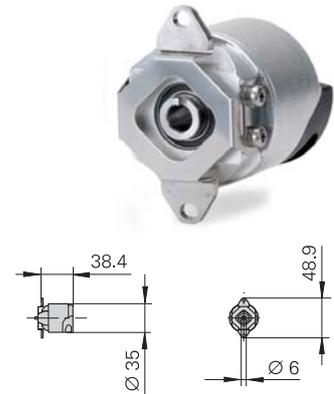
ERN 1123



ERN/ECN/EQN 1300

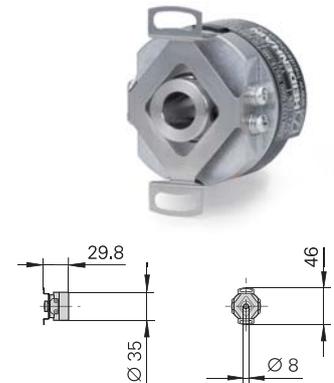
ECN/EQN 1100 series

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



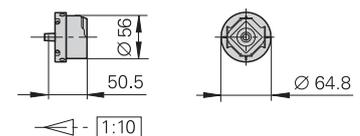
ERN 1123

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



ECN/EQN/ERN 1300 series

- **Compact dimensions**
- 1:10 taper shaft with 9.25 mm functional diameter for extremely stiff connection
- Housing outside diameter: 56 mm. The stator coupling is suited for location bores with 65 mm inside diameter
- Natural frequency of the encoder stator coupling: ≥ 1800 Hz
- Mech. permissible speed
ERN/ECN: 15000 min^{-1}
EQN: 12000 min^{-1}
- IP 40 protection when mounted



	Absolute				Incremental
	ECN 1113	EQN 1125	ECN 1123²⁾	EQN 1135²⁾	ERN 1123
Incremental signals	~ 1 V _{PP}		-		□TTL
Line count	512		-		500 to 8 192
Commutation signals	-		-		Block commutation ³⁾
Absolute position values	EnDat 2.2 ¹⁾				-
Position values/rev	8 192 (13 bits)		8 388 608 (23 bits)		-
Distinguishable revolutions	-	4 096 (12 bits)	-	4 096 (12 bits)	-
Power supply	3.6 to 14 V				5 V
Operating temperature	≤ 115 °C				≤ 90 °C

¹⁾ Includes EnDat 2.1 command set; PROFIBUS-DP via gateway

²⁾ **Functional Safety** upon request

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

	Absolute				Incremental			
	ECN 1313	EQN 1325	ECN 1325⁴⁾	EQN 1337⁴⁾	ERN 1321	ERN 1326	ERN 1381	ERN 1387
Incremental signals	~ 1 V _{PP}		-		□TTL		~ 1 V _{PP}	
Line count	512 or 2 048		-		1 024	2 048	4 096	512 2 048 4 096
Commutation signals	-		-		-	Block commutation ²⁾	-	Z1 track ³⁾
Absolute position values	EnDat 2.2 ¹⁾		EnDat 2.2 ¹⁾		-			
Position values/rev	8 192 (13 bits)		33 554 432 (25 bits)		-			
Distinguishable revolutions	-	4 096 (12 bits)	-	4 096 (12 bits)	-			
Power supply	3.6 to 14 V				5 V			
Operating temperature	≤ 115 °C		≤ 115 °C		≤ 120 °C; 4 096 lines: ≤ 100 °C			

¹⁾ Includes EnDat 2.1 command set; PROFIBUS-DP via gateway

²⁾ Three block commutation tracks with 90° or 120° mechanical phase shift

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

⁴⁾ **Functional Safety** upon request

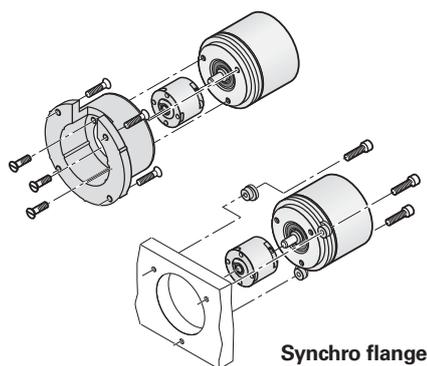
ROC, ROQ, ROD and RIC, RIQ rotary encoders

With integral bearing, for separate shaft coupling

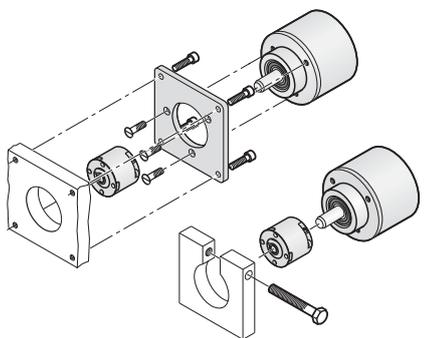
The optical encoders **ROC, ROQ and ROD**, as well as the inductive **RIC** and **RIQ** from HEIDENHAIN have integrated bearings and are sealed. They provide IP 64 to IP 67 protection, depending on the version. They are robust and compact.

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

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



Synchro flange

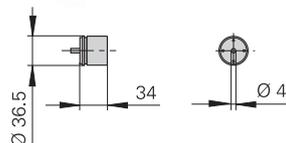


Clamping flange

ROC, ROQ, ROD 1000 series

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

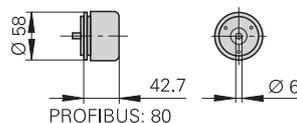
Series 1000



ROC/ROQ/ROD 400 series

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

ROD 400 series with synchro flange



RIC/RIQ 400 series

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

	Absolute Singleturn				
Synchro flange	RIC 418	ROC 413 ¹⁾			ROC 425 ²⁾
Clamping flange	RIC 418	ROC 413 ¹⁾			ROC 425 ²⁾
Incremental signals	$\sim 1 V_{PP}$			-	
Line count/ Signal periods	16	512	-		
Absolute position values	EnDat 2.1	EnDat 2.2 ⁴⁾	SSI 39r1	PROFIBUS DP PROFINET	EnDat 2.2 ⁴⁾
Positions per rev	262 144 (18 bits)	8 192 (13 bits)			33 554 432 (25 bits)
Distinguishable revolutions	-				
Power supply	5 V	3.6 to 14 V	5 V or 10 to 30 V	9 to 36 V 10 to 30 V	3.6 to 14 V
Operating temperature	$\leq 100\text{ }^{\circ}\text{C}$		$\leq 100\text{ }^{\circ}\text{C}$	$\leq 70\text{ }^{\circ}\text{C}$	$\leq 100\text{ }^{\circ}\text{C}$

¹⁾ ATEX version available with 5 V power supply and EnDat 2.1

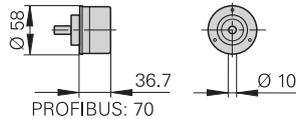
³⁾ Signal periods over 5000 are generated through signal doubling in the encoder

	Absolute Singletum		Multitum		Incremental			
	ROC 1013	ROC 1023	ROQ 1025	ROQ 1035	ROD 1020	ROD 1030	ROD 1070	ROD 1080
Incremental signals	~ 1 V _{PP}	–	~ 1 V _{PP}	–	□ TTL	□ HTL	□ TTL ²⁾	~ 1 V _{PP}
Line count	512	–	512	–	100 to 3600		1 000/2 500 3 600	100 to 3 600
Absolute position values	EnDat 2.2 ¹⁾				–			
Position values/rev	8 192	8 388 608 (23 bits)	8 192 (13 bits)	8 388 608 (23 bits)	–			
Distinguishable revolutions	–		4 096 (12 bits)		–			
Power supply	3.6 to 14 V				5 V	10 to 30 V	5 V	
Operating temperature	≤ 100 °C				≤ 100 °C	≤ 70 °C		≤ 100 °C

¹⁾ Includes command set for EnDat 2.1; PROFIBUS-DP via gateway

²⁾ Integrated interpolation 5/10-fold

ROD 400 series with clamping flange



PROFIBUS-DP/PROFINET



Multitum					Incremental			
RIQ 430	ROQ 425¹⁾		ROQ 437²⁾		ROD 426¹⁾	ROD 466¹⁾	ROD 436¹⁾	ROD 486¹⁾
RIQ 430	ROQ 425¹⁾		ROQ 437²⁾		ROD 420¹⁾	–	ROD 430¹⁾	ROD 480¹⁾
–	~ 1 V _{PP}		–		□ TTL		□ HTL	~ 1 V _{PP}
–	512		–		50 to 5000 <i>ROD 426/466: Up to 10000³⁾</i>			1 000 to 5 000
EnDat 2.1	EnDat 2.2 ⁴⁾	SSI 41r1	PROFIBUS DP PROFINET	EnDat 2.2 ⁴⁾	–			
262 144 (18 bits)	8 192 (13 bits)			33 554 432 (25 bits)	–			
4 096 (12 bits)					–			
5 V	3.6 to 14 V	5 V or 10 to 30 V	9 to 36 V 10 to 30 V	3.6 to 14 V	5 V	10 to 30 V		5 V
≤ 100 °C		≤ 100 °C	≤ 70 °C	≤ 100 °C	≤ 100 °C	≤ 70 °C	≤ 100 °C	

²⁾ **Functional safety** upon request

⁴⁾ Includes EnDat 2.1 command set; PROFIBUS-DP via gateway

ECI, EQI, ERO rotary encoders

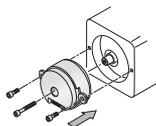
Without integral bearing

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

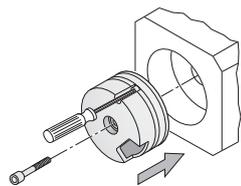
The **ECI 119** inductive rotary encoder has a particularly small outside diameter with a large shaft opening. It is slid onto the shaft and fastened from behind with axial screws.

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

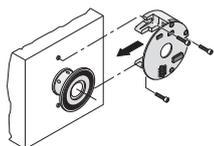
The correct installation of the rotary encoders without integral bearing can be inspected with the HEIDENHAIN measuring and testing device PWM 20.



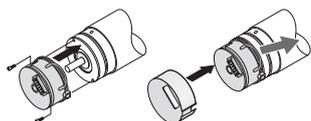
ECI/EQI 1100



ECI/EQI 1300



ERO 1200



ERO 1400

ECI/EQI 1100 series

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



ECI/EQI 1300 series

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



ECI 119

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



ERO 1200 series

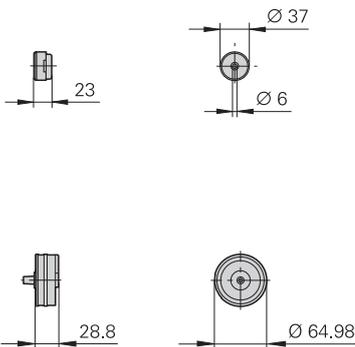
- **Compact design**
- For shaft diameters up to 12 mm



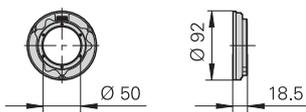
ERO 1400 series

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

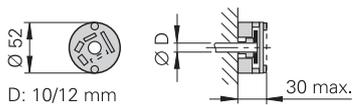




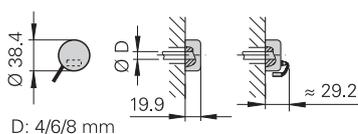
	Absolute ECI 1118	EQI 1130	ECI 1319	EQI 1331
Incremental signals	~ 1 V _{PP} ; 16 lines		~ 1 V _{PP} ; 32 lines	
Absolute position values	EnDat 2.1			
Position values/rev	262 144 (18 bits)		524 288 (19 bits)	
Distinguishable revolutions	–	4 096 (12 bits)	–	4 096 (12 bits)
Mech. permiss. speed	≤ 15 000 min ⁻¹	≤ 12 000 min ⁻¹	≤ 15 000 min ⁻¹	≤ 12 000 min ⁻¹
Shaft	Blind hollow shaft		Taper shaft or blind hollow shaft	



	Absolute ECI 119
Incremental signals	~ 1 V _{PP} ; 32 lines
Absolute position values	EnDat 2.1
Position values/rev	524 288 (19 bits)
Mech. permiss. speed	≤ 6 000 min ⁻¹
Shaft	Hollow through shaft Ø 50 mm



	Incremental ERO 1225	ERO 1285
Incremental signals	□TTL	~ 1 V _{PP}
Line count	1 024 2 048	
Mech. permiss. speed	≤ 25 000 min ⁻¹	
Shaft diameter D	Ø 10, 12 mm	



	Incremental ERO 1420	ERO 1470	ERO 1480
Incremental signals	□TTL	□TTL ¹⁾	~ 1 V _{PP}
Line count	512 1 000 1 024	1 000 1 500	512 1 000 1 024
Mech. permiss. speed	≤ 30 000 min ⁻¹		
Shaft diameter D	Ø 4, 6, 8 mm		

¹⁾ Integrated 5/10/20/25-fold interpolation

Machine tool control

Contouring controls for milling, drilling, boring machines and machining centers

TNC contouring controls from HEIDENHAIN for milling, drilling, boring machines and machining centers cover an entire range of applications: From the simple, compact TNC 320 3-axis control to the iTNC 530 (up to 18 axes plus spindle)—there's a HEIDENHAIN TNC control for nearly every application. The TNC 640 is a control for milling machines that are also capable of turning operations.

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

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

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

Programming at the machine

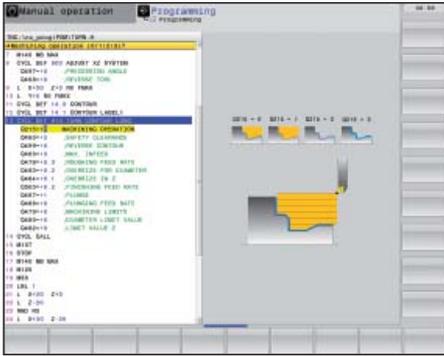
Its workshop-oriented design enables the machinist to program directly at the machine.

Thanks to its **conversational programming**, the user need not learn G codes or special programming languages. The control “speaks” with him with easily understandable questions and prompts. Ease of use is also promoted by clear, **unambiguous key symbols** and names. Each key has only one function. With the TNC 640, even complex milling and turning operations can be programmed consistently with conversational guidance.

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

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





Conversational programming

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

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

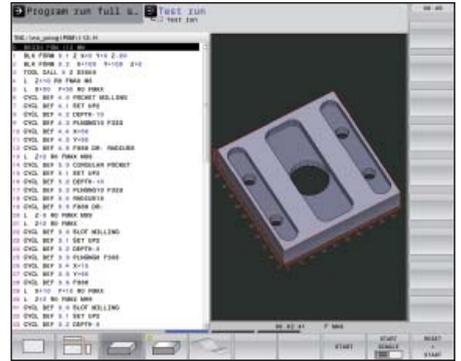
Positioning with manual data input
You can start working with the HEIDENHAIN controls even before writing a complete part program. Simply machine a part step by step—switching as you want between manual operation and automatic positioning.

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

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



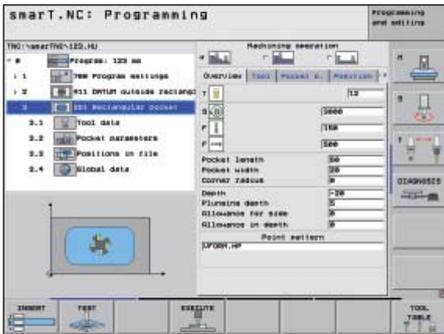
Key symbols



Test Run



Offline programming



smarT.NC:
Programming with fillable forms



Processing DXF data

HEIDENHAIN contouring controls		Series	Page
For simple milling, drilling and boring machines	Up to four axes plus spindle	TNC 320	42
	Up to five axes plus spindle	TNC 620	42
For milling/turning machines	Up to 18 axes and 2 spindles	TNC 640	44
For milling, drilling, boring machines and machining centers	Up to 18 axes and 2 spindles	iTNC 530	46
Accessories	Electronic handwheels	HR	49
	Programming stations	TNC 320/TNC 620 TNC 640 iTNC 530	49

TNC 320, TNC 620 contouring controls

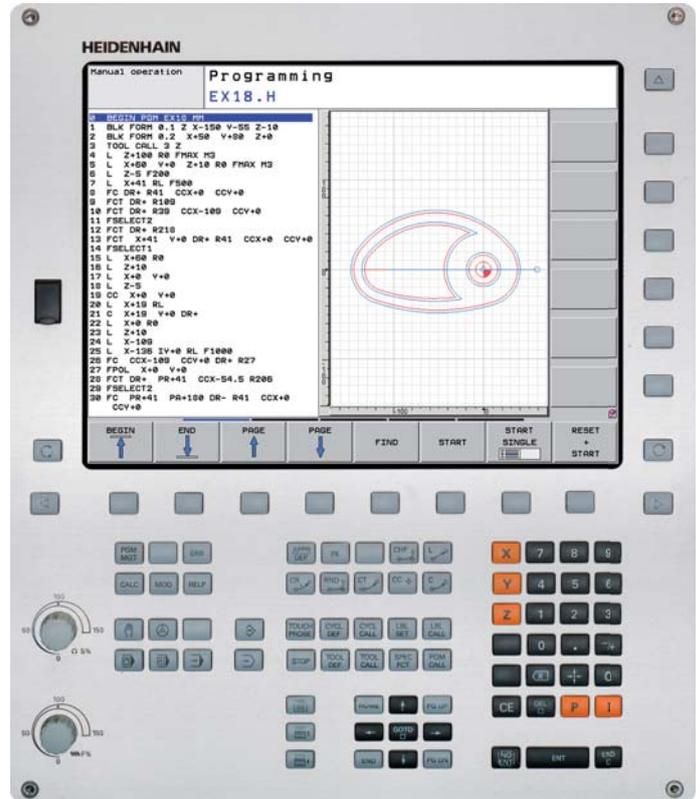
For milling, drilling and boring machines

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

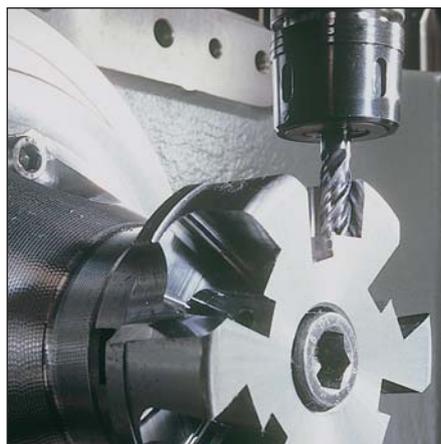
- Series and single-part production
- Tool making
- Machine building
- Research and development
- Prototypes and pilot plants
- Repair departments
- Training and education facilities

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

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



TNC 620



	TNC 320	TNC 620
Axes	3 axes + spindle Optional 4th and 5th axis (with noncontrolled spindle)	3 axes + spindle Optional 4th and 5th axes
Interpolation	<ul style="list-style-type: none"> • Linear in 4 axes • Circular in 2 axes • Helical, superimposition of circular and straight paths • Cylinder surface (option) 	<ul style="list-style-type: none"> • Linear: in 4 axes (optionally 5) • Circular: in 2 (optionally 3) axes • Helical, superimposition of circular and straight paths • Cylinder surface (option)
Program entry	<ul style="list-style-type: none"> • HEIDENHAIN conversational • DIN/ISO (program input via soft keys or via external USB keyboard) • FK free contour programming (option on the TNC 620) 	
Programming support	TNCguide presents user information directly on the TNC	
DXF converter option	–	Download contours and machining positions from DXF files
Program memory	300 MB	
Position entry	<ul style="list-style-type: none"> • Positions in Cartesian or polar coordinates • Incremental or absolute dimensions • Display and entry in mm or inches • Actual position capture 	
Input resolution and display step	Down to 0.1 µm or 0.0001°	Down to 0.1 µm or 0.0001°; optionally to 0.01 µm or 0.00001°
Block processing time	6 ms	1.5 ms
Coordinate transformation	<ul style="list-style-type: none"> • Datum shift, rotation, mirror image, scaling factor (axis-specific) • Tilting the working plane, PLANE function (option) 	
Fixed cycles (some optional with the TNC 620)	<ul style="list-style-type: none"> • Drilling, tapping, thread cutting, reaming and boring • Cycles for hole patterns, facing of flat surfaces • Pocket clearance and finishing, slots and studs 	
Touch probe cycles	For tool measurement, workpiece alignment, workpiece measurement and presetting (option with TNC 620)	
Graphics	For programming and program verification (option with TNC 620); graphic support with cycle programming	
Parallel operation	Programming during program run, program-run graphics (option with TNC 620)	
Data interface	<ul style="list-style-type: none"> • Ethernet 100BaseT • USB 2.0 • RS-232-C/V.24 and RS-422/V.11 (max. 115200 baud) 	
Visual display unit	15-inch color flat-panel display (TFT)	
Axis feedback control	Feedforward control or operation with following error	
	–	Integrated digital drive control for synchronous and asynchronous motors
Interfacing to the Machine	Via integrated programmable logic controller (PLC)	
	Inputs/outputs expandable via PL 510	Inputs/outputs via PL 6000
Accessories	<ul style="list-style-type: none"> • HR electronic handwheels • TS workpiece touch probe and TT or TL tool touch probe 	

TNC 640 contouring control

For milling/turning machines

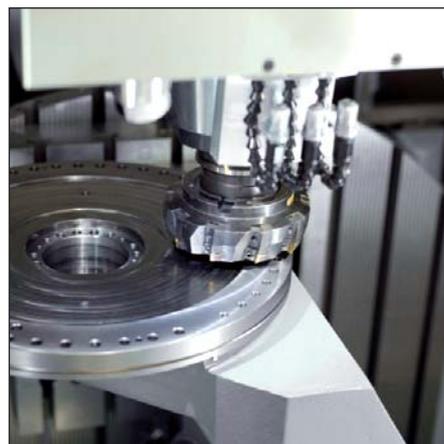
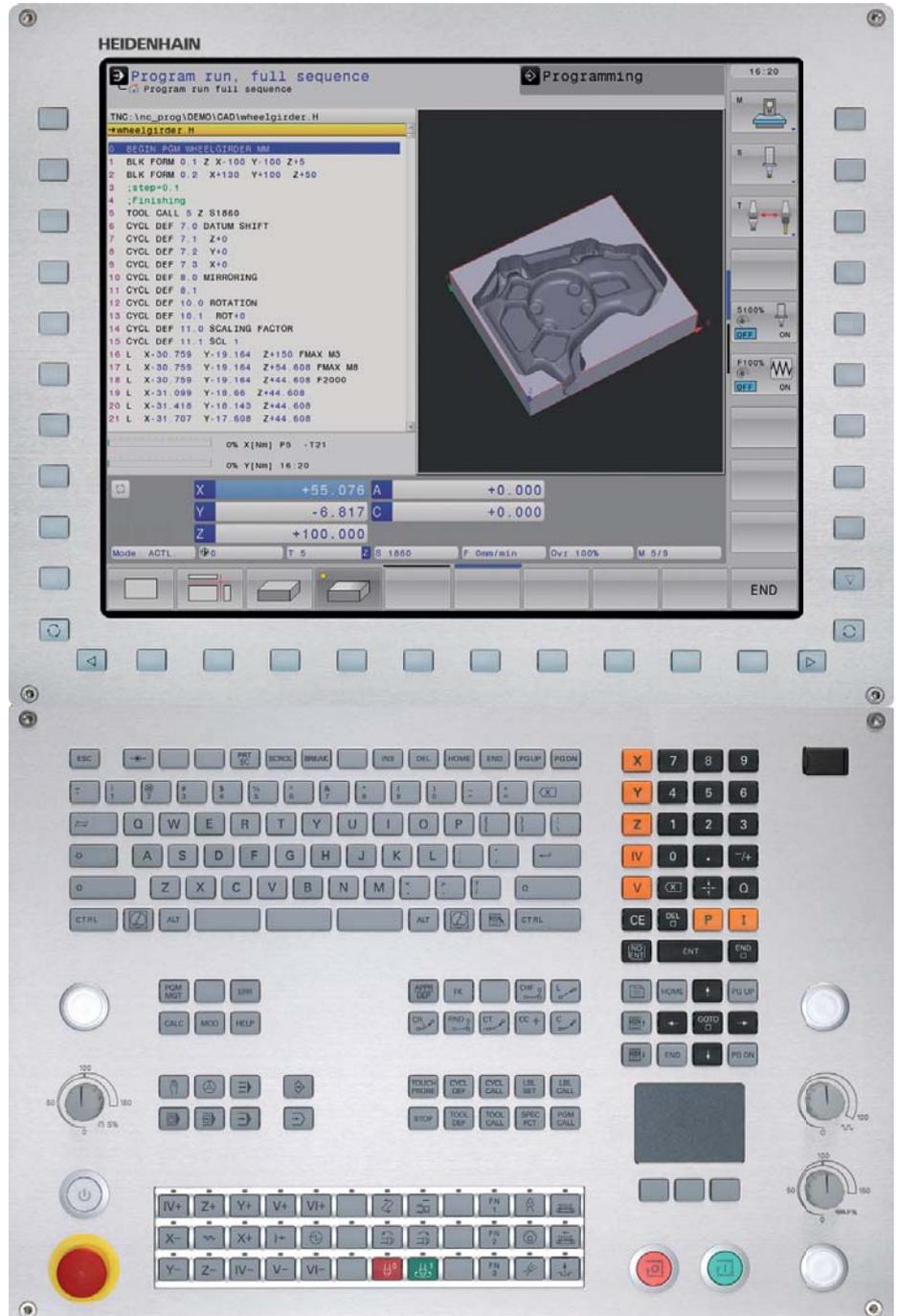
The TNC 640 has been conceived for machines that are capable of performing combined milling and turning operations. It offers powerful functions that enable you to switch between milling and turning mode in the NC program.

You can create turning contours as usual in the HEIDENHAIN plain-language dialog for subsequent machining. Beyond this, you have typical contour elements for turning (recesses, undercuts, thread undercuts). With the aid of **turning cycles**, you can very easily program even complex turning operations at the machine. TNC programmers do not need to relearn, but simply add to what they already know.

The **optimized user interface** of the TNC 640 gives you a fast overview: various color coding, standardized table editors and smartSelect—the dialog-guided fast selection of functions—aid you at your work.

In addition, the TNC 640 has all characteristics typical of the TNC controls from HEIDENHAIN, such as shop-floor programming in **plain-language dialog** with comprehensive cycle packages or off-line programming.

The TNC 640 controls up to 18 axes and 2 spindles. Thanks to its **uniformly digital design** with integrated digital drive control, you can realize high machining speeds and high contour fidelity.



	TNC 640
Axes	Up to 18 axes and 2 spindles
Interpolation	<ul style="list-style-type: none"> • Linear in max. 5 axes (with Tool Center Point Management) • Circular in max. 3 axes with tilted working plane • Spline interpolation in max. 5 axes • Helix • Cylinder surface¹⁾ • Rigid tapping¹⁾
Programming	HEIDENHAIN conversational and according to DIN/ISO
Programming support	TNCguide presents user information directly on the TNC 640
DXF converter option	Download contours and machining positions from DXF files
Program memory	Hard disk with at least 21 GB
Position entry	Nominal positions in Cartesian or polar coordinates, dimensions absolute or incremental, in mm or inches; actual position capture
Input resolution and display step	To 0.1 µm or 0.0001°; optionally to 0.01 µm or 0.00001°
Block processing time	0.5 ms (3-D straight line without radius compensation at 100 % PLC utilization)
Turning functions option	Management of turning tool data, cutter-radius compensation, constant surface speed, switchover between milling and turning mode
High speed cutting	Motion control with minimum jerk
FK free contour programming	HEIDENHAIN conversational with graphical support
Coordinate transformation	<ul style="list-style-type: none"> • Datum shift, rotation, mirror image, scaling factor (axis-specific) • Tilting the working plane, PLANE function (option)
Fixed cycles	For drilling, milling and turning (option); data input with graphical support
Touch probe cycles	For tool measurement, workpiece alignment, workpiece measurement and workpiece presetting
Graphics	<ul style="list-style-type: none"> • For programming milling and turning operations • For testing of milling operations
Parallel operation	Program run and programming with graphics
Data interface	<ul style="list-style-type: none"> • Ethernet 100BaseT • USB 2.0 • RS-232-C/V.24 (max. 115200 baud)
Remote control and diagnosis	TeleService
Visual display unit	19-inch color flat-panel display (TFT)
Axis feedback control	<ul style="list-style-type: none"> • Feedforward control or operation with following error • Integrated digital drive control with integrated inverter
Adaptive feed rate control option	AFC adjusts the contouring feed rate to the spindle power ¹⁾
DCM collision monitoring option	Dynamic monitoring of the working space for possible collisions with machine components ¹⁾
Integrated PLC	Approx. 16000 logic commands
Accessories	<ul style="list-style-type: none"> • Electronic handwheel • TS workpiece touch probe and TT or TL tool touch probe

¹⁾This feature must be implemented by the machine tool builder

iTNC 530 contouring control

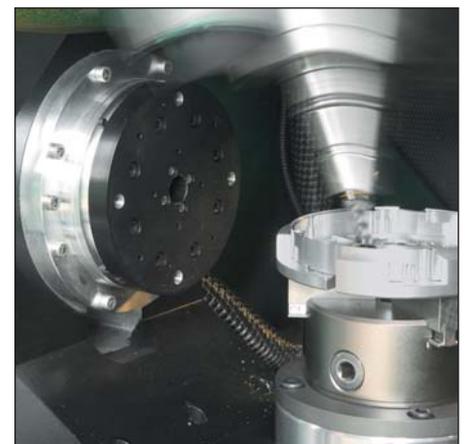
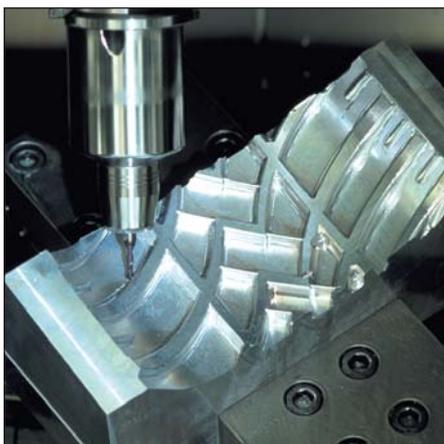
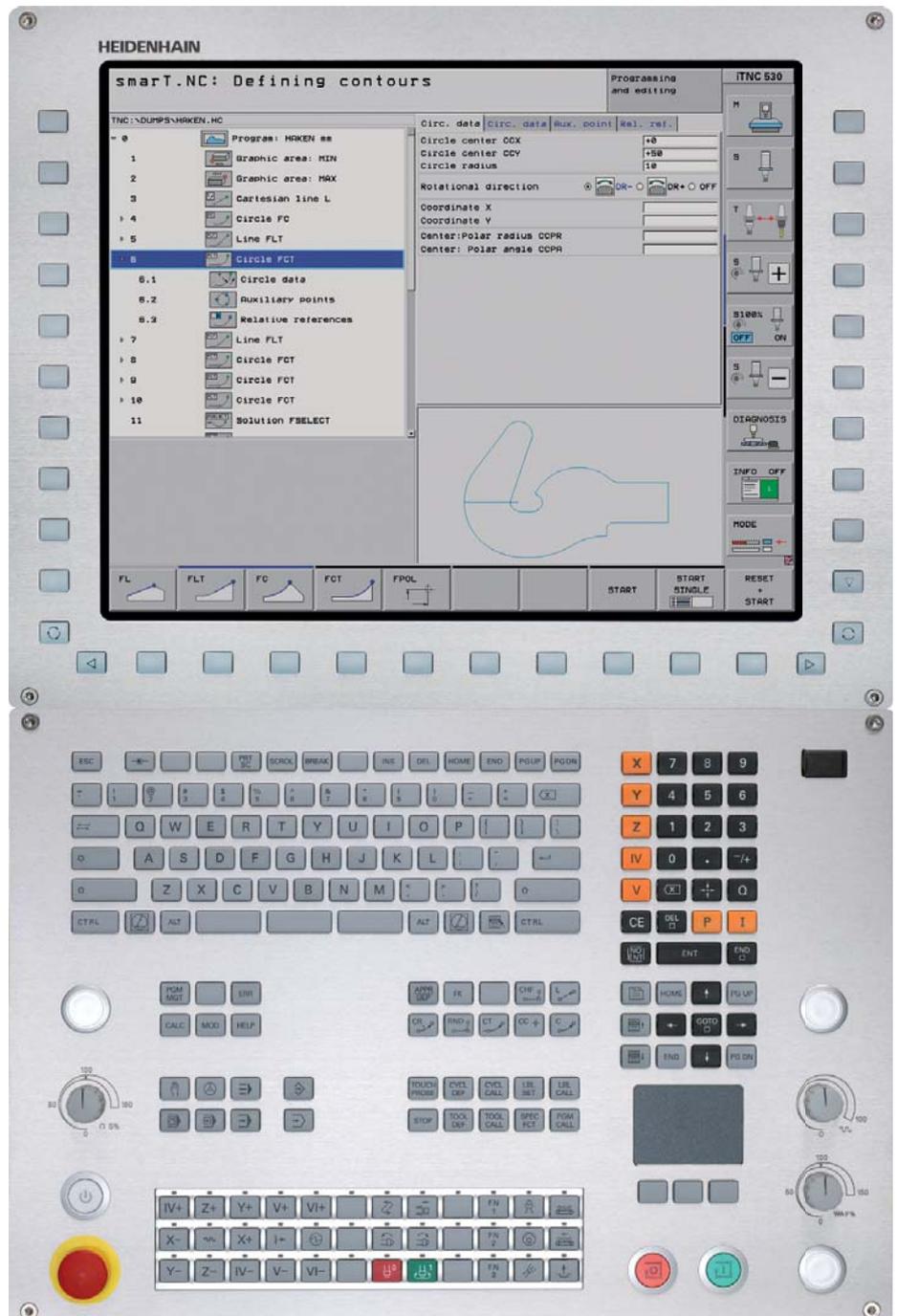
For milling, drilling, boring machines and machining centers

The iTNC 530 from HEIDENHAIN is a versatile, workshop-oriented contouring control for milling, drilling and boring machines as well as machining centers. The iTNC 530 is universal, and its broad and complex range of applications proves it.

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

The iTNC 530 features **optimized motion control, short block processing times** and special control strategies. Together with its **uniform digital design** and its integrated digital drive control including inverters, it enables you to reach very high machining speeds and the best possible contour accuracy—particularly when machining 2-D contours or 3-D shapes. The **DCM dynamic collision monitoring** (option) of the iTNC 530 cyclically monitors the working space of the machine for possible collisions with machine components and fixtures. With the **AFC adaptive feed control** (option), the iTNC regulates the feed rate automatically—depending only on the respective spindle power consumption and other process data. This optimizes the machining time, supports tool monitoring and reduces machine wear.

The iTNC 530 controls up to 18 axes and 2 spindles. The block processing time is 0.5 ms. A hard disk serves as program memory medium.



	iTNC 530
Axes	Up to 18 axes and 2 spindles
Interpolation	<ul style="list-style-type: none"> • Linear in max. 5 axes (with Tool Center Point Management) • Circular in max. 3 axes with tilted working plane • Spline interpolation in max. 5 axes • Helix • Cylinder surface¹⁾ • Rigid tapping¹⁾
Program entry	HEIDENHAIN conversational, with smarT.NC and according to ISO
Programming support	TNCguide presents user information directly on the iTNC 530
DXF converter option	Download contours and machining positions from DXF files
Program memory	Hard disk with at least 21 GB program memory
Position entry	Nominal positions in Cartesian or polar coordinates, dimensions absolute or incremental, in mm or inches; actual position capture
Input resolution and display step	Down to 0.1 µm or 0.0001°
Block processing time	0.5 ms (3-D straight line without radius compensation at 100 % PLC utilization)
High speed cutting	Motion control with minimum jerk
FK free contour programming	HEIDENHAIN conversational with graphical support
Coordinate transformation	<ul style="list-style-type: none"> • Datum shift, rotation, mirror image, scaling factor (axis-specific) • Tilting the working plane, PLANE function (option)
Fixed cycles	For drilling and milling; data input with graphical support
Touch probe cycles	For tool measurement, workpiece alignment, workpiece measurement and workpiece presetting
Graphics	For programming and program verification
Cutting-data tables	Yes
Parallel operation	Program run and programming with graphics
Data interface	<ul style="list-style-type: none"> • Ethernet 100BaseT • USB 2.0 • RS-232-C/V.24 and RS-422/V.11 (max. 115200 baud)
Remote control and diagnosis	TeleService
Visual display unit	15-inch or 19-inch color flat-panel display (TFT)
Axis feedback control	<ul style="list-style-type: none"> • Feedforward control or operation with following error • Integrated digital drive control with integrated inverter
Adaptive feed rate control option	AFC adjusts the contouring feed rate to the spindle power ¹⁾
DCM collision monitoring option	Dynamic monitoring of the working space for possible collisions with machine components ¹⁾
Integrated PLC	Approx. 16000 logic commands
Accessories	<ul style="list-style-type: none"> • Electronic handwheel • TS workpiece touch probe and TT or TL tool touch probe
Windows applications option	Additional Windows 7 operating system as user interface ¹⁾

¹⁾This feature must be implemented by the machine tool builder

Contouring controls

Digital control design

In the uniformly digital control design from HEIDENHAIN, all components are connected to each other via purely digital interfaces: The control components are connected via **HSCI** (HEIDENHAIN Serial Controller Interface), the real-time protocol from HEIDENHAIN for Fast Ethernet, and the encoders are connected via **EnDat 2.2**, the bidirectional interface from HEIDENHAIN. This achieves a high degree of availability for the entire system. It can be diagnosed and is immune to noise—from the main computer to the encoder. These outstanding properties of the uniformly digital design from HEIDENHAIN guarantee not only very high accuracy and surface quality, but rapid traverse speeds as well.

Digital drive control

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

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

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

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

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



iTNC 530
With modular inverter
and motors

Accessories

Electronic handwheels

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

HR 410, HR 520 and HR 550FS portable handwheels

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



HR 550 FS

HR 410

HR 130 and HR 150 panel-mounted handwheels

Panel-mounted handwheels from HEIDENHAIN can be integrated in the machine operating panel or be installed at another location on the machine. Up to three HR 150 electronic handwheels can be connected through an adapter.



HR 130 for integration in the machine operating panel

Programming stations

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

Creating programs

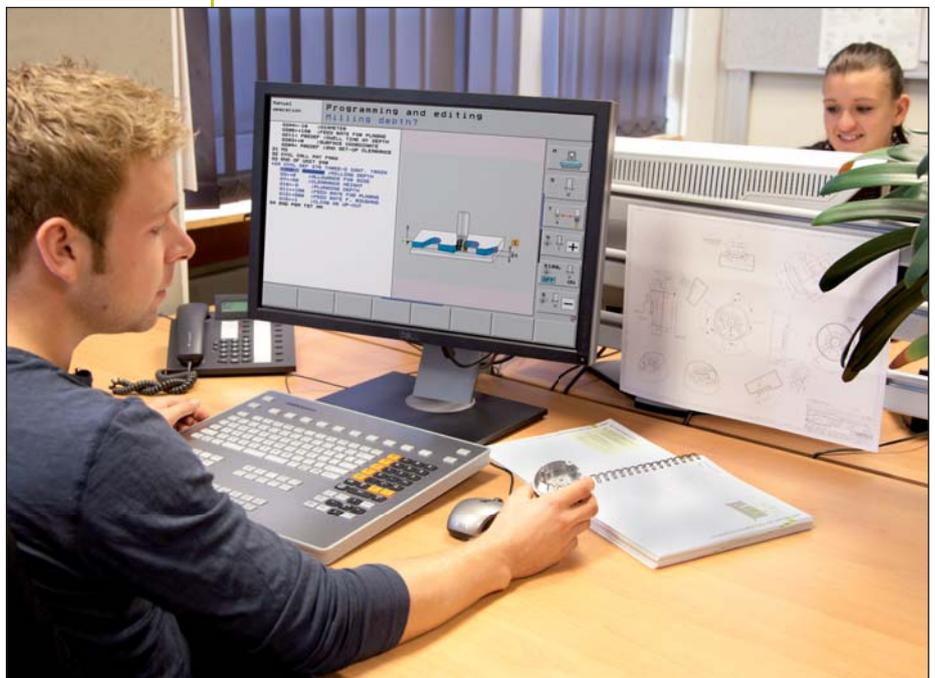
Programming, testing and optimizing HEIDENHAIN conversational or ISO programs with the programming station substantially reduces machine idle times. You do not need to change your way of thinking. At the programming station you program on the same keyboard as at the machine. Of course you can also use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

Training with the programming station

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

TNC training in schools

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



Tool and workpiece setup and measurement

Workpiece touch probes

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

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

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

HEIDENHAIN offers probe styli with various ball-tip diameters and stylus lengths. On the **TS 249**, asymmetric probing elements can also be attached through an adapter and exactly aligned with the aid of the screw connection.

Benefits of HEIDENHAIN touch probes

- High probe repeatability
- High probe velocity
- No wear thanks to contact-free optical switch and high-accuracy pressure sensor.
- High repeatability over a long period
- Noise-free signal transmission by cable or infrared beam
- Optical status indicator
- Integrated flusher/blower on infrared touch probes
- On **TS 249**: Direct connection with any subsequent electronics; no interface required

Touch probes for milling, drilling, boring machines and machining centers



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

- TS 220** – TTL version
- TS 230** – HTL version

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

- TS 440**
Compact dimensions

- TS 444**
Compact dimensions, battery-free power supply through integrated air turbine generator over central compressed air supply

- TS 640**
Standard touch probe with wide-range infrared transmission

- TS 642**
Same as TS 640, but activated by switch in taper shank

- TS 740**
High probing accuracy and repeatability, low probing force

Touch probes for grinding machines and lathes



Touch probe with **signal transmission by cable**

- TS 249**
Particularly compact dimensions, easy to fasten and align through a screw connection to a swivel mechanism

- TS 248**
Same as the TS 249, but with especially low deflection forces for delicate measuring tasks.

Machine type
Tool change
Signal transmission
Power supply
Switching on/off
Interface to control signal levels
Probe repeatability
Probe velocity
Protection EN 60529



TS 440	TS 444	TS 640	TS 642	TS 740	TS 220	TS 230	TS 248/TS 249
CNC machine tool for milling, drilling and boring							CNC grinding machine or lathe
Automatic					Manual		
Infrared beam with 360° range transmission to SE transceiver unit <ul style="list-style-type: none"> • SE 540 for integration in spindle head • SE 640 for integration in the machine's workspace • SE 642 as common SE for TS and TT 449 					Via cable		
Batteries, rechargeable or nonrechargeable	Air turbine generator	Batteries, rechargeable or nonrechargeable			5 V	15 to 30 V	
By infrared signal			Switch in taper shank	By infrared signal	–		
HTL via SE transmitter/receiver unit					TTL	HTL	
$2 \sigma \leq 1 \mu\text{m}$				$2 \sigma \leq 0.25 \mu\text{m}$	$2 \sigma \leq 1 \mu\text{m}$		
$\leq 3 \text{ m/min}$				$\leq 0.25 \text{ m/min}$	$\leq 3 \text{ m/min}$		
IP 67					IP 55		IP 67

Tool touch probes

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

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

Touch probes

The TT 140 and TT 449 are 3-D touch trigger probes for tool measurement and inspection. The disk-shaped probe contact of the TT is deflected during physical probing of a tool. At that moment the TT generates a trigger signal that is transmitted to the control, where it is processed further. The trigger signal is generated through a wear-free optical switch that ensures high reliability.

TT 140

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

TT 449

- Signal transmission over **infrared beam** to transmitter/receiver unit
- The SE 642 is a common transmitter/receiver unit for tool and workpiece touch probes with infrared transmission



TT 140



TT 449

	TT 140	TT 449
Probing method	Physical probing in three dimensions: $\pm X, \pm Y, +Z$	
Probe repeatability	$2 \sigma \leq 1 \mu\text{m}$ (probing velocity 1 m/min)	
Permissible deflection of probe contact	Approx. 5 mm in all directions	
Power supply	10 to 30 V from the NC	
Interface to control Signal levels	HTL	HTL via SE transmitter/receiver unit
Signal transmission	Via cable	Via infrared beam with 360° range transmission to SE 642 transceiver unit
Probe contact	$\varnothing 40 \text{ mm}$ or $\varnothing 25 \text{ mm}$	
Protection EN 60529	IP 67	

TL laser systems

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



	TL Nano	TL Micro 150	TL Micro 200	TL Micro 350
Probing method	Contact-free with laser beam in two dimensions: $\pm X$ (or $\pm Y$), $+Z$			
Tool diameter Central measurement	0.03 to 37 mm	0.03 to 30 mm	0.03 to 80 mm	0.03 to 180 mm
Repeatability	$\pm 0.2 \mu\text{m}$		$\pm 1 \mu\text{m}$	
Spindle speed	Optimized for individual tooth measurement on standard or HSC spindles ($> 30\,000 \text{ min}^{-1}$)			
Lasers	Visible red-light laser with beam focused at center of system; protection class 2 (IEC 825)			
Power supply	24 V from the NC			
Interface to control Signal levels	HTL			
Protection EN 60529	IP 68 (when connected, with sealing air)			
Tool cleaning	Integral blowing unit			

Measured value acquisition and display

Digital readouts

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

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

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

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

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

Interface electronics

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

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

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



Digital readouts for maximum productivity

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

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

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

In the optional **CNC version**, they also operate as full-fledged controls for axis positioning and can automatically execute measuring programs.



PC solution for a measuring machine



Position display on a milling machine

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

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

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

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

Digital readouts for metrology applications		Series	Page
For measuring and positioning equipment	For one axis	ND 200	56
For multipoint inspection apparatuses and SPC	For up to eight axes	ND 2100G GAGE-CHEK	56
For tool presetters	For two axes	ND 1200T TOOL-CHEK	56
For profile projectors, measuring microscopes, 2-D and video measuring machines as well as CMMs	For up to four axes	ND 100 QUADRA-CHEK ND 1000 QUADRA-CHEK IK 5000 QUADRA-CHEK	57
Digital readouts for manually operated machine tools			
For milling machines, lathes and positioning devices	For up to six axes For up to three axes	POSITIP 880 ND 780 ND 500	58
Interface electronics	Counter card for PCs External Interface Box	IK 220 EIB	59

Digital readouts

For metrology applications

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

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



ND 287



ND 100

	ND 280	ND 287	ND 2100G GAGE-CHEK	ND 1202T TOOL-CHEK	ND 1100 QUADRA-CHEK
Application	Measuring and inspection equipment	<ul style="list-style-type: none"> Measurement equipment Testing devices SPC inspection stations 	<ul style="list-style-type: none"> Multipoint inspection apparatuses SPC inspection stations 	Tool presetters	<ul style="list-style-type: none"> Positioning equipment Measuring fixtures Manual coordinate measuring machines
Axes¹⁾	1	1 (optional: 2)	4 or 8	2 (XZ)	2, 3 or 4
Encoder inputs	$\sim 1 V_{PP}$, $\sim 11 \mu A_{PP}$ or EnDat 2.2		$\sim 1 V_{PP}$ or \square TTL (other interfaces upon request)		
Display	Monochrome flat-panel display	Color flat-panel display	5.7-inch color flat-panel display	5.7-inch monochrome flat-panel display	
Function	–	<ul style="list-style-type: none"> Sorting and tolerance checking Measurement series with min./max. value storage Functions for statistical process control (SPC) Graphic display of measurement results Storage of measured values <p><i>Optional:</i> Sum/difference display or thermal compensation</p>	<ul style="list-style-type: none"> Programming of up to 100 parts Entry of any formulas, combinations and variables Output of measurement results 	<ul style="list-style-type: none"> Point measurement with crosshairs 99 tool adapters Memory for 300 tools Entry of tolerances Circle and angle measurement Label printing 	Measurement series with MIN/MAX display <i>Optional:</i> Touch-probe connection
Data interfaces	USB; RS-232-C	USB; RS-232-C <i>Optional:</i> Ethernet	USB; RS-232-C		

¹⁾ Depending on version

²⁾ Possible combinations depending on version



ND 2100G



ND 1300



IK 5000

ND 100 QUADRA-CHEK	ND 1200 QUADRA-CHEK	ND 1300 QUADRA-CHEK	ND 1400 QUADRA-CHEK	IK 5000 QUADRA-CHEK
<ul style="list-style-type: none"> Profile projectors Measuring microscopes 	<ul style="list-style-type: none"> Profile projectors Measuring microscopes 2-D measuring machines 	<ul style="list-style-type: none"> Profile projectors Measuring microscopes Video measuring machines 	<ul style="list-style-type: none"> Manual coordinate measuring machines 	<ul style="list-style-type: none"> Profile projectors Measuring microscopes Video measuring machines Coordinate measuring machines
2 or 3	XY, XYQ or XYZ	XY, XYQ, XYZ or XYZQ	XYZQ	XYQ, XYZ or XYZQ
□ TTL	~ 1 V _{PP} or □ TTL (other interfaces upon request)			
5.7-inch monochrome flat-panel display		8.4-inch color flat-panel display (touch screen)		Via PC screen
Measurement of 2-D features			Measurement of 2-D and 3-D features	Measurement of 2-D features
<ul style="list-style-type: none"> Programming of features and parts Entry of tolerances 	<ul style="list-style-type: none"> Measure Magic function Programming of features and parts Entry of tolerances 			
Point measurement with crosshairs			<ul style="list-style-type: none"> Points measured via touch probe, crosshairs or rigid probing element Five coordinate systems can be stored Touch-probe management 	Point measurement with crosshairs <i>Depending on version:</i> <ul style="list-style-type: none"> Measurement of 3-D features Automatic edge sensing via optical edge detector Video edge detection and live image display Point measurement by touch probe (also TP 200) CNC axis control and autofocus
–	<i>Optional:</i> Automatic edge sensing via optical edge detector	<i>Optional²⁾:</i> <ul style="list-style-type: none"> Automatic edge sensing via optical edge detector Video edge detection and live image display Image archiving Zoom and light control, programmable CNC axis control and autofocus 		
USB	USB; RS-232-C			PCI (PC interface)

Digital readouts

For manually operated machine tools

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



ND 780



ND 523

	POSITIP 880	ND 780	ND 522	ND 523
Application	Milling, drilling, boring machines and lathes			
Description	Color flat-panel display, program memory, splash-proof full-travel keyboard	Monochrome flat-panel display, splash-proof full-travel keyboard	Monochrome flat-panel display, membrane keyboard	
Axes	Up to 6 axes	Up to 3 axes	2 axes	3 axes
Encoder inputs	~ 1 V _{PP} or EnDat 2.1	~ 1 V _{PP}	□TTL	
Display step	10 μm, 5 μm, 1 μm or finer		5 μm (with LS 328C/LS 628C)	
Datums	<i>Milling: 99; turning: 1</i>	10		
Tool data	For 99 tools	For 16 tools		
Programming	Max. 999 program blocks per program	—		
Functions	Contour monitoring with magnify function	Contour monitoring		
For milling, drilling and boring machines	<ul style="list-style-type: none"> • Calculation of positions for hole patterns (circular patterns as well as linear patterns) • Cutting data calculator 			
	Probing functions for reference-point acquisition with the KT edge finder: "Edge," "Centerline" and "Circle center"		—	
	Positioning aids for milling and roughing of rectangular pockets	—		
For turning	<ul style="list-style-type: none"> • Radius/diameter display • Separate or sum display for Z and Z₀ • Taper calculator • Freezing the tool position for back-off 			
	<ul style="list-style-type: none"> • Oversize allowances • Cycle for area clearance 	—		
Interfaces	Edge finder, switching functions (option)		—	
	RS-232-C/V.24, Centronics	RS-232-C/V.24	USB	

Interface electronics

IK 220 – universal counter card for PCs

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



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

EIB 741 – External Interface Box

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

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



	EIB 741		
Encoder inputs Switchable	~ 1 V _{PP} (~ 11 μA _{PP} upon request)	EnDat 2.1	EnDat 2.2
Connection	Four D-sub connections (15-pin, female)		
Input frequency	≤ 500 kHz	–	
Signal subdivision	4096-fold		–
Internal memory	Typically 250 000 position values per input		
Interface	Ethernet as per IEEE 802.3 (≤ 1 gigabit)		
Driver software and demo program	For Windows, Linux, LabView Example programs, application software		

EIB series – External Interface Box

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



EIB 392

	EIB 192	EIB 392
Design	Housing	Connector
Protection	IP 65	IP 40
Encoder input	~ 1 V _{PP}	
Connection	M23 connector (12-pin), female	<ul style="list-style-type: none"> • D-sub connector (15-pin) • M23 connector (12-pin), female
Signal subdivision	≤ 16384-fold	
Interface (output)	<i>EIB 192/EIB 392</i> : EnDat 2.2 <i>EIB 192 F/EIB 392 F</i> : Fanuc Serial Interface <i>EIB 192 M/EIB 392 M</i> : Mitsubishi High Speed Serial Interface	
Power supply	5 V ± 5 %	

For more information

Brochures, data sheets and CD-ROMs

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

HEIDENHAIN on the Internet

Visit our home page at www.heidenhain.com for up-to-date information on:

- The company
- The products

Our web site also includes:

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

Length measurement



Brochure
Linear Encoders
For Numerically Controlled Machine Tools

Contents:
Absolute Linear Encoders
LC
Incremental Linear Encoders
LB, LF, LS



Brochure
Length Gauges

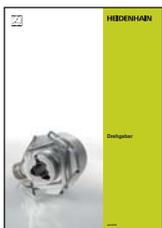
Contents:
HEIDENHAIN-SPECTO
HEIDENHAIN-METRO
HEIDENHAIN-CERTO



Brochure
Exposed Linear Encoders

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

Angle measurement



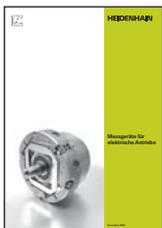
Brochure
Rotary Encoders

Contents:
Absolute Rotary Encoders
ECN, EQN, ROC, ROQ
Incremental Rotary Encoders
ERN, ROD



Brochure
Absolute Angle Encoders
With Optimized Scanning

Contents:
Absolute Angle Encoders
RCN 2000, RCN 5000, RCN 8000



Brochure
Encoders for Servo Drives

Contents:
Rotary Encoders
Angle Encoders
Linear Encoders



Brochure
Angle Encoders with Integral Bearing

Contents:
Absolute Angle Encoders
RCN
Incremental Angle Encoders
RON, RPN, ROD



Brochure
Modular Magnetic Encoders

Contents:
Incremental Encoders
ERM



Brochure
Angle Encoders without Integral Bearing

Contents:
Incremental Angle Encoders
ERA, ERP

Machine tool control



Brochures
iTNC 530 Contouring Control
TNC 640 Contouring Control
 CD-ROM
iTNC Presentation

Contents:
 Information for the user



OEM brochures
iTNC 530 Contouring Control
TNC 640 Contouring Control

Contents:
 Information for the machine tool builder



Brochures
TNC 320 Contouring Control
TNC 620 Contouring Control

Contents:
 Information for the user



OEM brochures
TNC 320 Contouring Control
TNC 620 Contouring Control

Contents:
 Information for the machine tool builder



Brochure
MANUALplus 620 Contouring Control

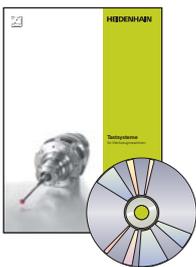
Contents:
 Information for the user



OEM brochure
MANUALplus 620 Contouring Control

Contents:
 Information for the machine tool builder

Setup and measurement



Brochure, CD-ROM
Touch Probes

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



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

Contents:
 Incremental Linear Encoders
KGM, VM

Measured value acquisition and display



Brochure
Digital Readouts
 For Metrology Applications

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



Brochure, CD-ROM
Digital Readouts
Linear Encoders
 For Manually Operated Machine Tools

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

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