HEIDENHAIN

General Catalog

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

September 2014

DR. JOHANNES HEIDENHAIN GmbH develops and manufactures linear and angle encoders, rotary encoders, subsequent electronics, 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.

Contents

Fundamentals and processes

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

Measuring machine for linear scales

Linear scale inspection station in the lithography area

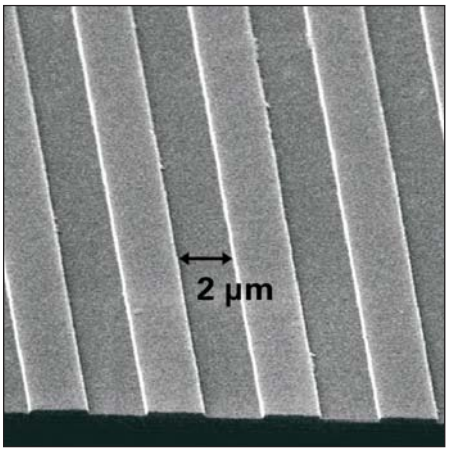
Competence in the area of linear and angular metrology is reflected by a large number of customized solutions for users. Among other implementations, they include the measuring and test equipment developed and built for standard laboratories and the angle encoders for telescopes and satellite receiving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

Angle comparator, measuring step approx. 0.001"

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



Phase grating with approx. 0.25 µm 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.

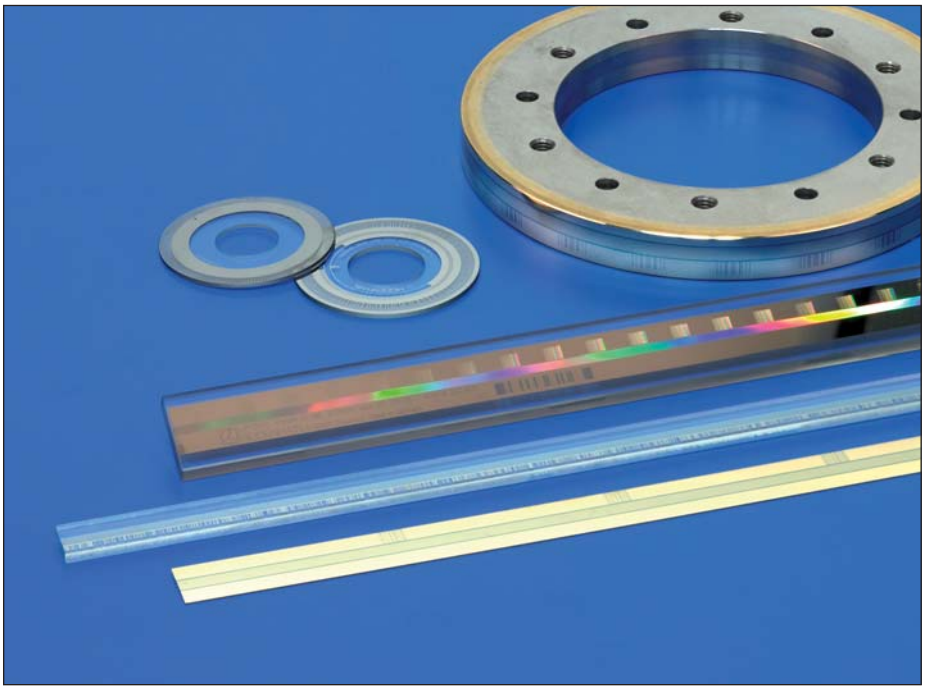
METALLUR
With its special optical composition of reflective gold layers, METALLUR graduations show a virtually planar structure. They are therefore particularly tolerant to contamination.

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

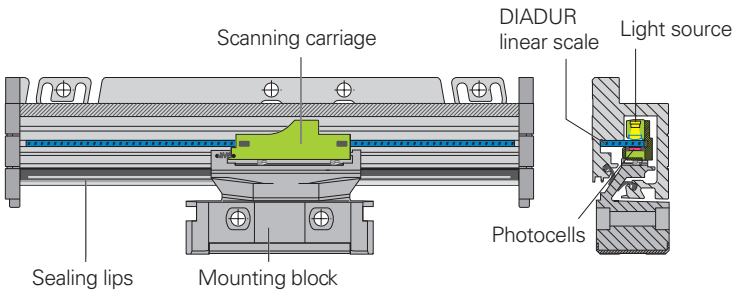
Sealed linear encoders
Sealed linear encoders from HEIDENHAIN are protected from dust, chips and splash fluids and are ideal for operation on **machine tools.**

- Accuracy grades as fine as ± 0.2 µm
- Measuring steps to 0.001 µm
- Measuring lengths up to 30 m (to 72 m upon request)
- Fast and simple installation
- Large mounting tolerances
- High acceleration loading
- Protection against contamination

Sealed linear encoders are available with

- **Full-size scale housing**
  – For high vibration loading
  – Up to 30 m measuring length (72 m upon request)
- **Slimline scale housing**
  – For limited installation space
  – 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 ± 0.5 µm and better
- Measuring steps to 0.001 µm (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 ± 0.1 µm
- Measuring steps to 0.005 µm (5 nm)
- Measuring lengths up to 100 mm
- High measuring accuracy
- Available with automated plunger drive
- Simple mounting

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

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

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

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

Sealed linear encoders		Series	Page
With full-size scale housing	Absolute position measurement	**LC 100**	**8**
	Absolute position measurement and large measuring lengths	**LC 200**	
	Incremental position measurement	**LS 100**	
	Very high repeatability	**LF 100**	
	Typically for manual machines	**LS 600**	
	Large measuring lengths	**LB 300**	
With slimline scale housing	Absolute position measurement	**LC 400**	**10**
	Incremental position measurement	**LS 400**	
	Very high repeatability	**LF 400**	
	Typically for manual machines	**LS 300**	
Exposed linear encoders	Very high accuracy	**LIP, LIF**	**12**
	Two-coordinate encoders	**PP**	**13**
	High traversing speed and large measuring lengths	**LIDA**	**14**
	Absolute position measurement	**LIC**	
Length gauges	For measuring stations and multipoint inspection apparatuses	**AT, CT, MT, ST**	**16**

LC, LF, LS, LB sealed linear encoders
With full-size scale housing

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

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

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

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

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

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

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

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

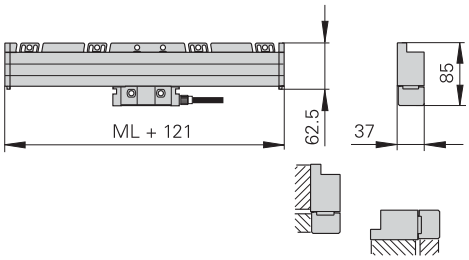
LB 382
- **For large measuring lengths** up to 30 m[3)]
- Defined thermal behavior
- High vibration rating
- Two mounting attitudes
- Single-field scanning

LS 600 series
- **Typically for manual machines**
- Simple installation

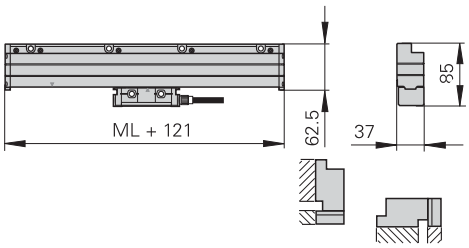
	Absolute **LC 115[1)]/LC 185 LC 195 F/M/S[1)]**	**LC 211/LC 281 LC 291 F/M**
Measuring standard	DIADUR glass scale	METALLUR steel scale
Grating period	20 µm	40 µm
Interface	*LC 115:* EnDat 2.2 *LC 185:* EnDat 2.2 with ~ 1 V_{PP} *LC 195:* Fanuc αi/Mitsubishi/ Siemens DRIVE-CLiQ	*LC 211:* EnDat 2.2 *LC 281:* EnDat 2.2 with ~ 1 V_{PP} *LC 291:* Fanuc αi/Mitsubishi
Signal period	20 µm	40 µm
Accuracy grade	± 5 µm, ± 3 µm[3)]	± 5 µm
Meas. lengths ML	Up to 4240 mm	Up to 28 040 mm
Reference mark	–	

[1)] **Functional safety** upon request

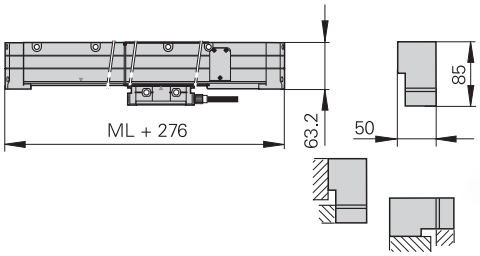
[2)] 5/10-fold integrated interpolation



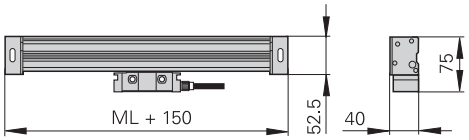
LC 100



LF 185



LC 200



LS 600

	Incremental **LF 185**	**LS 187** **LS 177**	**LS 688C** **LS 628C**	**LB 382**
	SUPRADUR phase grating on steel 8 µm	DIADUR glass scale 20 µm	DIADUR glass scale 20 µm	AURODUR steel scale tape 40 µm
	∿ 1 V_{PP}	***LS 187:*** ∿ 1 V_{PP} ***LS 177:*** ⊓⊔ TTL	***LS 688C:*** ∿ 1 V_{PP} ***LS 628C:*** ⊓⊔ TTL	∿ 1 V_{PP}
	4 µm	***LS 187:*** 20 µm ***LS 177:*** 4 µm/2 µm[2)]	20 µm	40 µm
	± 3 µm, ± 2 µm	± 5 µm; ± 3 µm	± 10 µm	± 5 µm
	Up to 3 040 mm	Up to 3 040 mm		Up to 30 040 mm[4)]
	One or distance-coded; ***LS 6xxC:*** C: distance-coded			

[3)] Up to ML 3040 mm

[4)] Up to ML 72 040 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

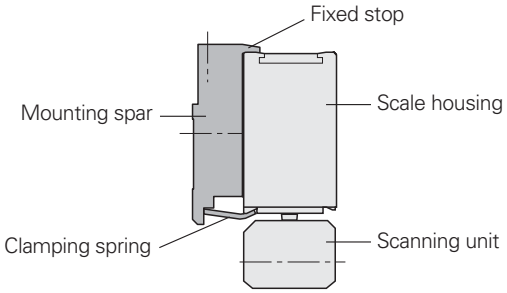
LS 400 series
- **Incremental position measurement**
- Defined thermal behavior
- Single-field scanning

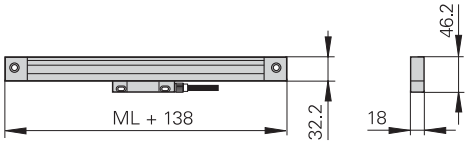
LF 485
- **Very high repeatability**
- Thermal behavior similar to steel or cast iron
- Single-field scanning

LS 300 series
- **Typically for manual machines**

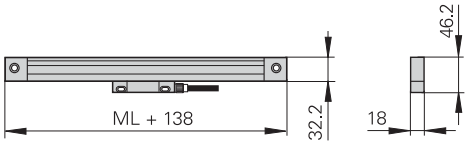
Simple installation with mounting spar
The use of a mounting spar is of great benefit when mounting slimline linear encoders. It can be fastened as part of the machine assembly process. The encoder is then simply clamped on during final mounting. Easy exchange also facilitates servicing.

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

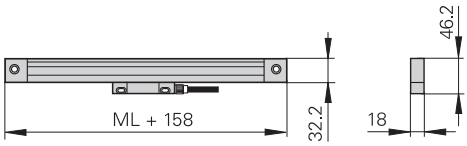




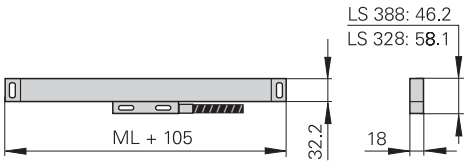
LC 400



LS 400



LF 485



LS 300

	Absolute **LC 415**[1] **/LC 485 LC 495 F/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
Grating period	20 µm	8 µm	20 µm	20 µm
Interface	*LC 415:* EnDat 2.2 *LC 485:* EnDat 2.2 with ∿ 1 V_{PP} *LC 495:* Fanuc αi/Mitsubishi/ Siemens DRIVE-CLiQ	∿ 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[2]	20 µm
Accuracy grade	± 5 µm; ± 3 µm	± 5 µm; ± 3 µm		± 10 µm
Meas. 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] **Functional safety** upon request [2] 5/10-fold integrated interpolation
[3] Over ML 1240 mm only with mounting spar or tensioning elements

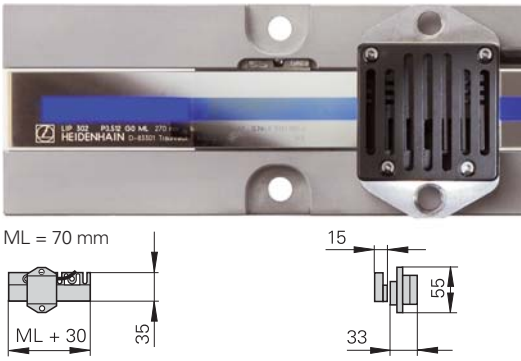
LIP, LIF exposed linear encoders
For very high accuracy

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.

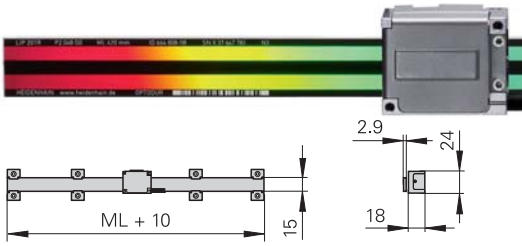
LIP and **LIF** encoders are typically used for:
- Measuring machines and comparators
- Measuring microscopes
- Ultra-precision machines such as diamond lathes for optical components, facing lathes for magnetic storage disks, and grinding machines for ferrite components
- Measuring and production equipment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

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

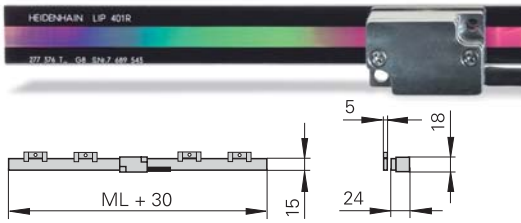
LIP 300 series
- **Very high resolution** with measuring steps to 1 nm
- Very high repeatability through an extremely fine signal period
- Defined thermal behavior thanks to a measuring standard on Zerodur glass ceramic



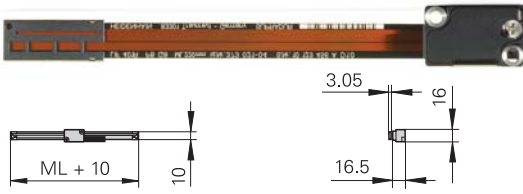
LIP 200 series
- Measuring lengths up to 3040 mm
- Measuring step down to 1 nm
- Very high repeatability with compact dimensions
- Defined thermal behavior thanks to a measuring standard on Zerodur glass ceramic



LIP 400 series
- Small dimensions
- Measuring steps as fine as 0.005 µm
- Scale available with various thermal expansion coefficients



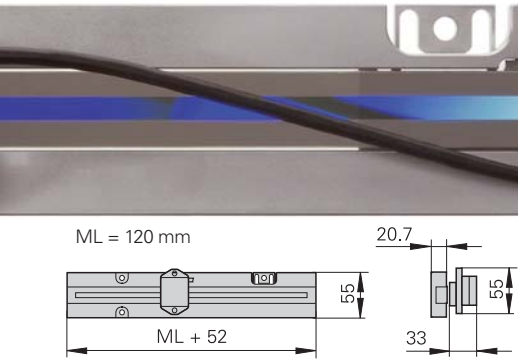
LIF 400 series
- **Fast, simple scale fastening** with PRECIMET adhesive film
- Relatively insensitive to contamination thanks to SUPRADUR graduation
- Position detection through limit switches and homing track



	Incremental		
	LIP 382 **LIP 372**	**LIP 281** **LIP 211**	**LIP 481** **LIP 471**
Measuring standard Grating period Coefficient of linear expansion	DIADUR phase grating on Zerodur glass ceramic 0.512 µm $\alpha_{therm} \approx (0 \pm 0.1) \times 10^{-6}\ K^{-1}$	OPTODUR phase grating on Zerodur glass ceramic 2.048 µm $\alpha_{therm} \approx (0 \pm 0.1) \times 10^{-6}\ K^{-1}$	DIADUR phase grating on glass or Zerodur glass ceramic 4 µm $\alpha_{therm} \approx 8 \times 10^{-6}\ K^{-1}$ (glass) or $\alpha_{therm} \approx (0 \pm 0.1) \times 10^{-6}\ K^{-1}$ (Zerodur)
Interface	*LIP 382:* ∿ 1 V_{PP} *LIP 372:* ⊓⊔ TTL	*LIP 281:* ∿ 1 V_{PP} *LIP 211:* EnDat 2.2[2]	*LIP 481:* ∿ 1 V_{PP} *LIP 471:* ⊓⊔ TTL
Signal period	*LIP 382:* 0.128 µm *LIP 372:* 0.004 µm[1]	*LIP 281:* 0.512 µm *LIP 211:* –	*LIP 481:* 2 µm *LIP 471:* 0.4 µm/0.2 µm[3]
Accuracy grade	± 0.5 µm	± 1 µm / ± 3 µm	± 0.5 µm; ± 1 µm
Position error per signal period typically	± 0.001 µm	± 0.001 µm	± 0.02 µm
Meas. lengths ML	70 mm to 270 mm	20 mm to 1 020 mm / 370 mm to 3 040 mm	70 mm to 420 mm
Reference mark	None	One	One

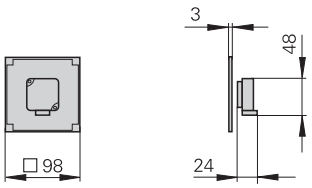
[1] 32-fold integrated interpolation [2] Absolute position value after scanning the reference mark [3] 5/10-fold integrated interpolation

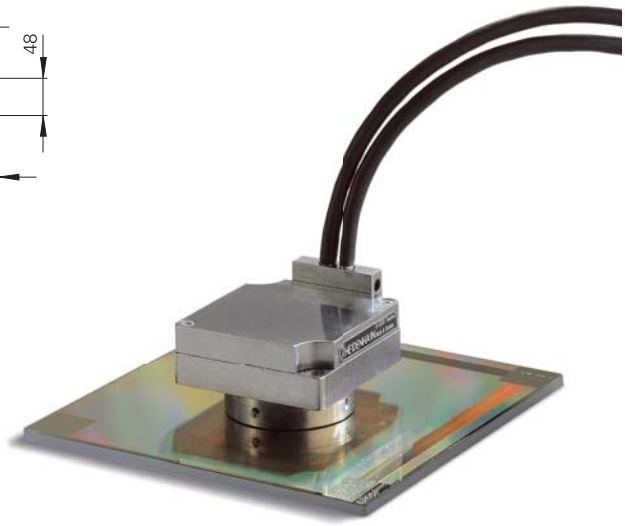
PP exposed linear encoders
Two-coordinate encoders



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

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





	LIF 481 **LIF 471**
	SUPRADUR phase grating on glass or Zerodur glass ceramic 8 µm $\alpha_{therm} \approx 8 \times 10^{-6}\ K^{-1}$ (glass) or $\alpha_{therm} \approx (0 \pm 0.1) \times 10^{-6}\ K^{-1}$ (Zerodur)
	LIF 481: ∿ 1 V_{PP} *LIF 471:* ⊓⊔ TTL
	LIF 481: 4 µm *LIF 471:* 0.8 µm to 0.04 µm[3)]
	± 1 µm (only Zerodur); ± 3 µm
	± 0.04 µm
	70 mm to 1020 mm (up to 3040 mm upon request)
	One

	Incremental **PP 281**
Measuring standard Grating period Coefficient of linear expansion	DIADUR phase grating on glass 8 µm $\alpha_{therm} \approx 8 \times 10^{-6}\ K^{-1}$
Interface	∿ 1 V_{PP}
Signal period	4 µm
Accuracy grade	± 2 µm
Position error per signal period typically	± 0.04 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 **LIC** makes **absolute position measurement** possible over measuring lengths up to 28 m. In their dimensions, they correspond to LIDA 400 and LIDA 200 incremental linear encoders.

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

LIC and LIDA exposed linear encoders are typically used for:
- Coordinate measuring machines
- Inspection machines
- PCB assembly machines
- PCB drilling machines
- Precision handling devices
- Position and velocity measurement on linear motors

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

LIC 41x3, LIDA 4x3
- Scale of glass or glass ceramic is bonded directly onto the mounting surface.

LIC 41x5, LIDA 4x5
- One-piece steel scale tape is drawn into an aluminum extrusion and tensioned at its ends
- The aluminum extrusions can be screwed or bonded onto the mounting surface.

LIC 41x7, LIC 21x7, LIDA 4x7, LIDA 2x7
- One-piece steel scale-tape is drawn into aluminum extrusions and fixed at center.
- The aluminum extrusions are bonded onto the mounting surface.

LIC 41x9, LIC 21x9, LIDA 4x9, LIDA 2x9
- One-piece steel scale tape is bonded directly to the mounting surface.

LIC 4100 series
- **Absolute position acquisition** up to 28 m
- Various mounting options

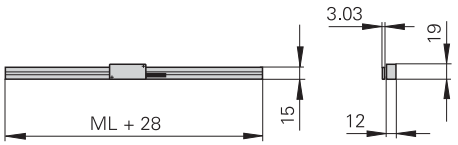
LIP 400 series
- Large **measuring lengths up to 30 m**
- Various mounting options
- Limit switches

LIC 2100 series
- **Absolute position measurement**
- Large mounting tolerances
- For simple applications

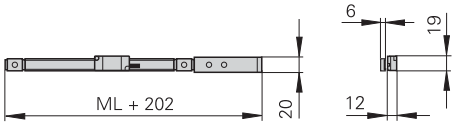
LIP 200 series
- **Scale tape cut from roll**
- Large mounting tolerances
- For simple applications
- Simple installation through integrated function display

	Absolute				***Incremental***
	LIC 4113 LIC 4193 F/M	**LIC 4115 LIC 4195 F/M**	**LIC 4117 LIC 4197 F/M**	**LIC 4119 LIC 4199 F/M**	**LIDA 483 LIDA 473**
Measuring standard Grating period Coefficient of linear expansion	METALLUR graduation on glass ceramic or glass 40 µm $\alpha_{therm} \approx 8 \times 10^{-6}\ K^{-1}$ (glass) $\alpha_{therm} \approx (0 \pm 0.1) \times 10^{-6}\ K^{-1}$ (Zerodur glass ceramic)	METALLUR steel scale tape 40 µm *LIC 4115:* α_{therm} Same as mounting surface *LIC 4117/LIC 4119:* $\alpha_{therm} \approx 10 \times 10^{-6}\ K^{-1}$			METALLUR graduation on glass ceramic or glass 20 µm $\alpha_{therm} \approx 8 \times 10^{-6}\ K^{-1}$ (glass) $\alpha_{therm} \approx (0 \pm 0.1) \times 10^{-6}\ K^{-1}$ (Zerodur glass ceramic)
Interface	*LIC 411x:* EnDat 2.2 *LIC 419x:* Fanuc αi/Mitsubishi				*LIDA 483:* ∿ 1 V_{PP} *LIDA 473:* ⊓⊔ TTL
Signal period	–				*LIDA 483:* 20 µm *LIDA 473:* 4 µm/2 µm/ 0.4 µm/0.2 µm[1]
Accuracy grade	± 5 µm; ± 3 µm	± 5 µm	± 3 µm[3]; ± 5 µm[3]; ± 15 µm	± 15 µm; ± 3 µm	± 1 µm[4]; ± 3 µm; ± 5 µm
Position error per signal period typically	± 0.04 µm				± 0.2 µm
Meas. lengths ML	240 mm to 3040 mm	140 mm to 28440 mm	240 mm to 6040 mm	70 mm to 1020 mm	240 mm to 3040 mm
Reference mark	–				One or distance-coded

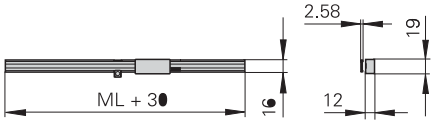
[1] integrated 5/10/50/100-fold interpolation [2] Integrated 5/10/50/100-fold Interpolation [3] Up to measuring length 1020 mm or 1040 mm



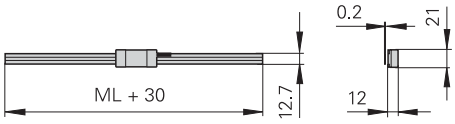
LIC 4113



LIDA 485



LIC 2117



LIDA 279

	LIDA 485 **LIDA 475**	**LIDA 487** **LIDA 477**	**LIDA 489** **LIDA 479**	***Incremental*** **LIDA 287** **LIDA 277**	**LIDA 289** **LIDA 279**	***Absolute*** **LIC 2117** **LIC 2197 F/M/P**	**LIC 2119** **LIC 2199 F/M/P**
	METALLUR steel scale tape 20 µm *LIDA 4x5:* α_{therm} Same as mounting surface *LIDA 4x7/LIDA 4x9:* $\alpha_{therm} \approx 10 \times 10^{-6}\ K^{-1}$			Steel scale tape 200 µm $\alpha_{therm} \approx 10 \times 10^{-6}\ K^{-1}$		Steel scale tape 200 µm $\alpha_{therm} \approx 10 \times 10^{-6}\ K^{-1}$	
	LIDA 48x: ∿ 1 V_{PP} *LIDA 47x:* ⊓⊔ TTL			*LIDA 28x:* ∿ 1 V_{PP} *LIDA 27x:* ⊓⊔ TTL		*LIC 211x:* EnDat 2.2 *LIC 219x:* Fanuc αi/Mitsubishi/ Panasonic	
	LIDA 48x: 20 µm *LIDA 47x:* 4 µm/2 µm/0.4 µm/0.2 µm[1]			*LIDA 28x:* 200 µm *LIDA 27x:* 20 µm/4 µm/2 µm[2]		–	
	± 5 µm	± 3 µm[3]; ± 5 µm[3]; ± 15 µm	± 15 µm; ± 3 µm	± 15 µm		± 15 µm	
	± 0.2 µm			± 2 µm		± 2 µm	
	140 mm to 30040 mm	240 mm to 6040 mm		Scale tape from the roll 3 m/5 m/10 m		120 mm to 3020 mm (larger measuring lengths upon request)	
	One			Selectable every 100 mm		–	

[4] Only for Zerodur glass ceramics up to ML 1640 mm

AT, CT, MT, ST length gauges

For measuring stations and multipoint inspection apparatuses

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

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

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

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

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

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

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

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

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

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

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

HEIDENHAIN-METRO
MT 1200 and MT 2500
- High accuracy
- Measuring range up to 25 mm
- High repeatability

HEIDENHAIN-METRO
MT 60 and MT 101
- Large measuring range up to 100 mm
- High repeatability

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

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

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

MT 101M

CT 6001

MT 2581

AT 3018

ST 3088

	MT 2581 MT 2587	MT 2571	MT 60M MT 60K	MT 101M MT 101K	ST 1288 ST 1287	ST 1278 ST 1277	ST 3088 ST 3087	ST 3078 ST 3077
			DIADUR graduation on glass ceramic scale		DIADUR glass scale			
			10 µm		20 µm			
	~ 1 V_{PP}	⊓⊔ TTL	~ 11 $µA_{PP}$		~ 1 V_{PP}	⊓⊔ TTL	~ 1 V_{PP}	⊓⊔ TTL
	2 µm	0.4 µm/0.2 µm[3]	10 µm		20 µm	4 µm/2 µm[3]	20 µm	4 µm/2 µm[3]
			± 0.5 µm	± 1 µm	± 1 µm			
	25 mm		60 mm	100 mm	12 mm		30 mm	
			MT xxM: With motor *MT xxK:* By coupling		*ST xxx8:* By measured object *ST xxx7:* Pneumatically			
			One		One			

Angle measurement

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

- Line counts typically 9000 to 180000
- Accuracy from ± 5" to ± 0.4"
- Measuring steps as fine as 0.000 01° or 0.036" (incremental) or 29 bits, i.e. approx. 536 million positions per revolution (absolute)

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

- Line counts of typically 50 to 5000
- Accuracy grades to ± 10" (depending on the line count, corresponding to ± 1/20 of the grating period)
- Measuring steps to 0.001°. Particularly with the photoelectric encoders, the high quality of the sinusoidal incremental signals permits high interpolation factors for digital speed control.

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

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

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

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

- Requires little space
- Large hollow-shaft diameters
- High shaft speeds possible
- No additional starting torque

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

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

Absolute angle encoders and rotary encoders require no previous traverse to provide the current position value. **Singleturn encoders** provide the current angular position value within one revolution, while **multiturn encoders** can additionally distinguish between revolutions. The position values are transmitted over an **EnDat, SSI, PROFIBUS-DP, PROFINET or other serial data interface.** The EnDat-Interface, PROFIBUS-DP or PROFINET bidirectional interfaces enable automatic configuration of the higher-level electronics and provide monitoring and diagnostic functions.

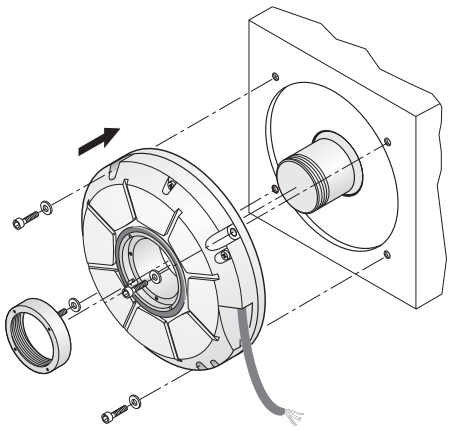
Under the designation **functional safety**, HEIDENHAIN offers encoders with purely serial data transmission as single-encoder systems for safety-related machines and systems. The two measured values are already formed independently of each other in the encoder, and are transmitted to the safe control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

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

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.

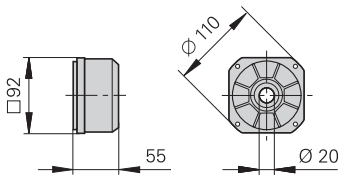


Features of the **RCN 2000, RCN 5000** and **RCN 8000** series angle encoders:

- **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

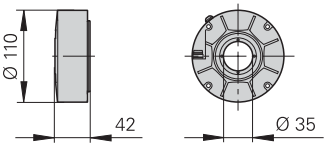
RCN 2000 and RON 200 series

- **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



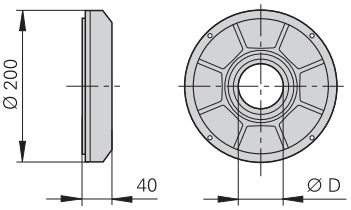
RCN 5000 series

- **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

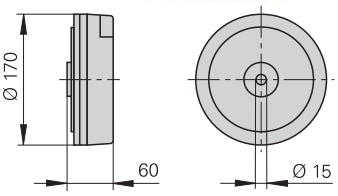
- **Large hollow shaft diameters** up to Ø 100 mm
- System accuracy ± 2" and ± 1"
- Typically used on rotary and angle measuring tables, indexing fixtures, measuring setups, image scanners



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 ± 0.4"
- Used with high-accuracy measuring devices and for the inspection of measuring equipment



	Absolute				*Incremental*	
	RCN 2380 **RCN 2580**	**RCN 2310**[1] **RCN 2510**[1]	**RCN 2390F** **RCN 2590F**	**RCN 2390M** **RCN 2590M**	**RON 225** **RON 275**	**RON 285** **RON 287**
Interface	EnDat 2.2[2] with ~ 1 V_{PP}	EnDat 2.2[2]	Fanuc αi	Mitsubishi	⊓⊔ TTL	~ 1 V_{PP}
Position values/revolution	*RCN 23x0:* 67108864 (26 bits); *RCN 25x0:* 268435456 (28 bits)				–	
Signal periods/rev	16384	–			18000[3] 90000/180000[4]	18000
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**[1] **RCN 5510**[1]	**RCN 5390F** **RCN 5590F**	**RCN 5390M** **RCN 5590M**
Interface	EnDat 2.2[2] with ~ 1 V_{PP}	EnDat 2.2[2]	Fanuc αi	Mitsubishi
Position values/revolution	*RCN 53x0:* 67108864 (26 bits); *RCN 55x0:* 268435456 (28 bits)			
Signal periods/rev	16384	–		
System accuracy	*RCN 53x0:* ± 5"; *RCN 55x0:* ± 2.5"			
Mech. permissible speed	≤ 1500 min^{-1}			

	Absolute				*Incremental*		
	RCN 8380 **RCN 8580**	**RCN 8310**[1] **RCN 8510**[1]	**RCN 8390F** **RCN 8590F**	**RCN 8390M** **RCN 8590M**	**RON 786**	**RON 886**	**RPN 886**
Interface	EnDat 2.2[2] with ~ 1 V_{PP}	EnDat 2.2[2]	Fanuc αi	Mitsubishi	~ 1 V_{PP}		
Position values/revolution	536870912 (29 bits)				–		
Signal periods/rev	32768	–	–		18000, 36000	36000	180000
System accuracy	*RCN 83x0:* ± 2"; *RCN 85x0:* ± 1"				± 2"	± 1"	
Mech. permissible speed	≤ 500 min^{-1}				≤ 1000 min^{-1}		

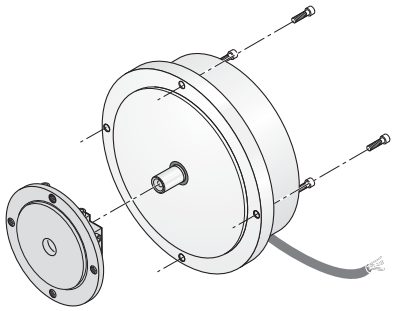
	Incremental
	RON 905
Interface	~ 11 μA_{PP}
Signal periods/rev	36000
System accuracy	± 0.4"
Mech. permissible speed	≤ 100 min^{-1}

1) **Functional safety** upon request
2) DRIVE-CLiQ via EIB; PROFIBUS-DP via gateway
3) Integrated 2-fold interpolation
4) Integrated 5/10-fold interpolation

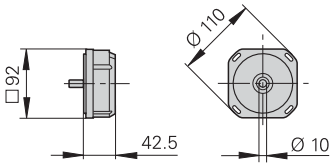
ROD angle encoders
With integral bearing, for separate shaft coupling

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.



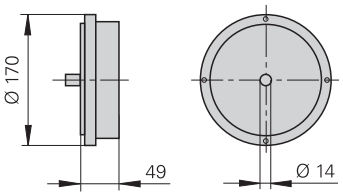
ROD 200 series
- **Compact design**
- Sturdy design
- Typically used with rotary tables, tilting tables, for positioning and synchronization monitoring



	Incremental ROD 220	ROD 270	ROD 280
Interface	⊓⊔TTL	⊓⊔TTL	∿ 1 V_{PP}
Signal periods/rev	18000[2)]	180000[3)]	18000
System accuracy[1)]	± 5″		
Mech. permissible speed	≤ 10000 min^{-1}		

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

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



	Incremental ROD 780	ROD 880
Interface	∿ 1 V_{PP}	
Signal periods/rev	18000, 36000	36000
System accuracy[1)]	± 2″	± 1″
Mech. permissible speed	≤ 1000 min^{-1}	

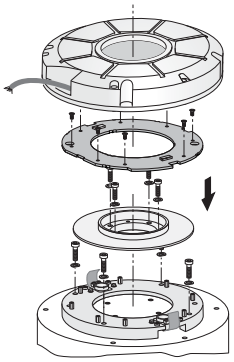
[1)] Without shaft coupling

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.

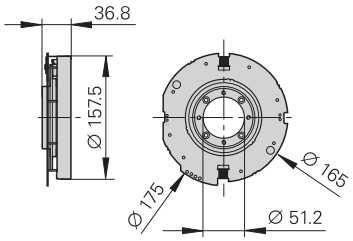
A circular scale with phase grating serves as the basis for the high accuracy of the ERP encoders. The attainable system accuracy depends on the eccentricity of the graduation to the drive shaft bearing, as well as the radial runout and wobble of the bearing.



Mounting the ERP 880

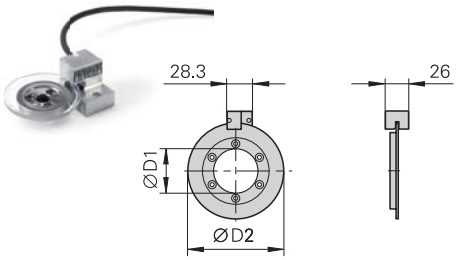
ERP 880
- **Very high accuracy**
- Very fine grating period
- Low error within one signal period thanks to the interferential scanning principle

ERP 880 with housing



	Incremental **ERP 880**
Interface	∿ 1 V_{PP}
Signal periods/rev	180 000
Accuracy of graduation	± 0.9“
Mech. permissible speed	≤ 1000 min^{-1}

ERP 4080 and **ERP 8080**
- **Very high resolution**
- High accuracy
- Very compact dimensions
- Low error within one signal period thanks to the interferential scanning principle



	Incremental **ERP 4080**	**ERP 8080**
Interface	∿ 1 V_{PP}	
Signal periods/rev	131 072	360 000
Accuracy of graduation	± 2“	± 1“
Diameter D1/D2	8 mm/44 mm	50 mm/108 mm
Mech. permissible speed	≤ 300 min^{-1}	≤ 100 min^{-1}

ERO, ERA angle encoders
Without integral bearing

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

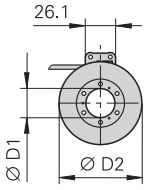
The attainable system accuracy depends on the eccentricity of the graduation to the drive shaft bearing, as well as the radial runout and wobble of the bearing.

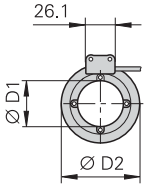
The **ERO** angle encoders use a circular glass scale with hub at the graduation carrier. The EROs are primarily characterized by their low weight and compact dimensions. Applications are to be found in metrology, in compact rotary tables and in precise, highly dynamic applications.

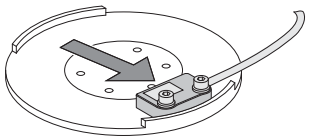
The **ERA** angle encoders feature a sturdy steel scale drum and are suited for high shaft speeds up to 10000 min^{-1}. They are typically found on fast running spindles, on rotary tables and tilting axes.

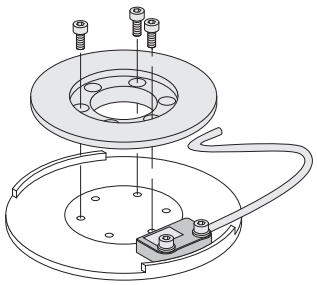
ERO 6000 series
- Very flat design
- High system accuracy
- Simple installation

ERO 6100 series
- For dynamic applications with reduced accuracy requirements
- Application examples include printing machines and handling axes.
- Large inside diameter





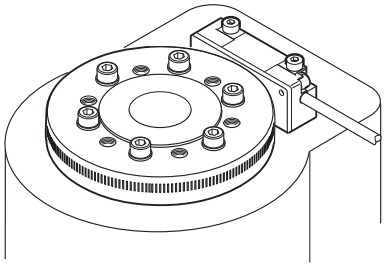




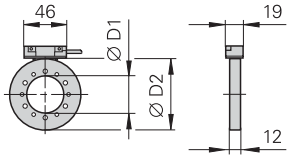
ERO 6000

ERA 4000 series
- **High shaft speeds** up to 10000 min^{-1}
- Sturdy design with steel scale drum and METALLUR graduation
- Axial motion of measured shaft permissible up to ± 0.5 mm
- The ERA 4480C is available 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

Interface	
Inside diameter D1	
Outside diameter D2	
Signal periods/rev	*ERA 4280C* *ERA 4480C* *ERA 4880C*
Accuracy of graduation	
Mech. permissible speed	



ERA 4000



ERA 4000

	Incremental **ERO 6070**		**ERO 6080**		**ERO 6180**
Interface	⊓⊔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
Accuracy of graduation	± 3″	± 2″	± 3″	± 2″	± 10″
Mech. permissible speed	≤ 1600 min^{-1}	≤ 800 min^{-1}	≤ 1600 min^{-1}	≤ 800 min^{-1}	≤ 3500 min^{-1}

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

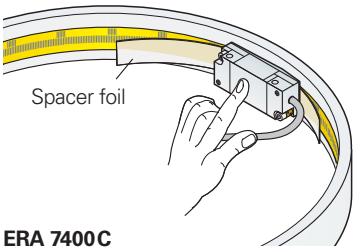
	Incremental **ERA 4280C**[1)] Signal period 20 µm **ERA 4480C** Signal period 40 µm **ERA 4880C** Signal period 80 µm								
	∿ 1 V_{PP}								
	40 mm	70 mm	80 mm	120 mm	150 mm	180 mm	270 mm	425 mm	512 mm
	76.75 mm	104.63 mm	127.64 mm	178.55 mm	208.89 mm	254.93 mm	331.31 mm	484.07 mm	560.46 mm
	12000 6000 3000	16384 8192 4096	20000 10000 5000	28000 14000 7000	32768 16384 8192	40000 20000 10000	52000 26000 13000	– 38000 –	– 44000 –
	± 5″	± 3.7″	± 3″	± 2.5″				± 2″	
	≤ 10000 min^{-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*

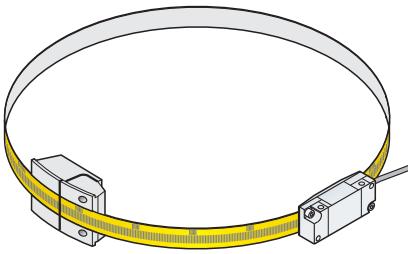
ERA angle encoders
Without integral bearing

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.



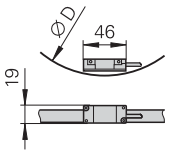
ERA 7400C



ERA 8400C

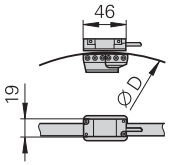
ERA 7000 and ERA 8000 series
- **For very large diameters** up to 10 m
- METALLUR steel scale tape
- High accuracy even at the junction of the scale-tape ends

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 circumference of the machine element
- **ERA 8400C:** Full-circle version
- **ERA 8401C:** Segment version, scale tape secured with tensioning elements
- **ERA 8402C:** Segment version, scale tape secured without tensioning elements



ERA 8480C

	Incremental **ERA 7400C**		
Interface	∿ 1 V_{PP}; signal period 40 µm (on circumference)		
Signal periods/rev	36000	45000	90000
Accuracy of graduation	± 3.9“	± 3.2“	± 1.6“
Accuracy of the scale tape	± 3 µm per meter tape length		
Diameter D1	458.62 mm	573.20 mm	1146.10 mm
Mech. permissible speed	≤ 250 min^{-1}		≤ 220 min^{-1}

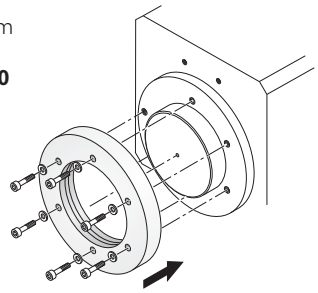
	Incremental **ERA 8400C**		
Interface	∿ 1 V_{PP}; signal period 40 µm (on circumference)		
Signal periods/rev	36000	45000	90000
Accuracy of graduation	± 4.7“	± 3.9“	± 1.9“
Accuracy of the scale tape	± 3 µm per meter tape length		
Diameter D1	458.04 mm	572.63 mm	1145.73 mm
Mech. permissible speed	≤ 50 min^{-1}		≤ 45 min^{-1}

ERM modular encoders
Without integral bearing

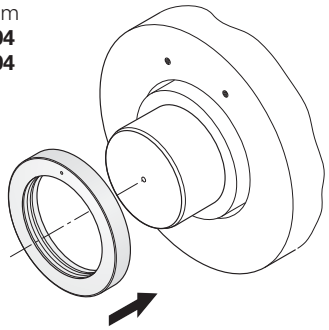
The **ERM** modular encoders from HEIDENHAIN consist of a magnetized scale drum and a scanning unit with magnetoresistive sensor. Their MAGNODUR measuring standard and the magnetoresistive scanning principle make them particularly tolerant to contamination.

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

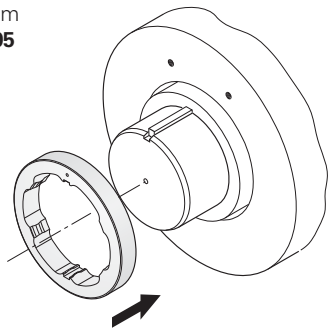
Scale drum
ERM 200
ERM 2200



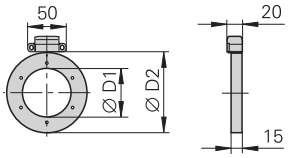
Scale drum
ERM 2404
ERM 2904



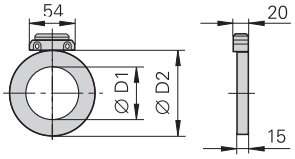
Scale drum
ERM 2405



ERM 2200 series
- High graduation accuracy
- Signal period 200 µm at circumference
- Distance-coded reference marks
- Drum fastening with axial screws

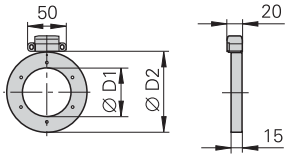


ERM 200 Series
- For large shaft diameters up to 410 mm
- Drum fastening with axial screws

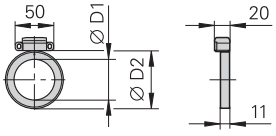


ERM 200

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



ERM 2400 series
- Especially compact dimensions for limited installation space
- High mechanically permissible shaft speeds and therefore particularly well suited for spindles
- **ERM 2484:** Drum fastening by axial clamping
- **ERM 2485:** Drum fastening by axial clamping and feather key as anti-rotation element



ERM 2484

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

	Incremental **ERM 2200**					
Interface	∿ 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/± 7″	2048/± 6″	2800/± 5″	4096/± 3.5″	5200/± 3″	7200/± 2.5″
Shaft speed[1]	≤ 14500 min^{-1}	≤ 13000 min^{-1}	≤ 9000 min^{-1}	≤ 6000 min^{-1}	≤ 4500 min^{-1}	≤ 3000 min^{-1}
Operating temperature	–10 °C to 60 °C					

	Incremental **ERM 220** **ERM 280** **ERM 2410**								
Interface	***ERM 220:*** ⊓⊔TTL; ***ERM 280:*** ∿ 1 V_{PP}; ***ERM 2410:*** EnDat 2.2[2]								
Signal period	Approx. 400 µm (at circumference); ***ERM 2410:*** –								
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/ ± 11″	900/ ± 8″	1024/ ± 7″	1200/ ± 6″	1400/ ± 5.5″	2048/ ± 4″	2048/ ± 5″	2600/ ± 4″	3600/ ± 3.5″
Shaft speed[1]	≤ 19000 min^{-1}	≤ 14500 min^{-1}	≤ 13000 min^{-1}	≤ 10500 min^{-1}	≤ 9000 min^{-1}	≤ 6000 min^{-1}	≤ 6000 min^{-1}	≤ 4500 min^{-1}	≤ 3000 min^{-1}
Operating temperature	–10 °C to 100 °C								

	Incremental **ERM 2484** **ERM 2485**[3]				**ERM 2984**[4]	
Interface	∿ 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/± 17″	600/± 14″	900/± 10″	1024/± 9″	256/± 51″	400/± 33″
Shaft speed[1] *ERM 2484:*	≤ 42000 min^{-1}	≤ 36000 min^{-1}	≤ 22000 min^{-1}	≤ 20000 min^{-1}	≤ 35000 min^{-1}	≤ 16000 min^{-1}
ERM 2485:	≤ 33000 min^{-1}	≤ 27000 min^{-1}	–	–	–	–
Operating temperature	–10 °C to 100 °C					

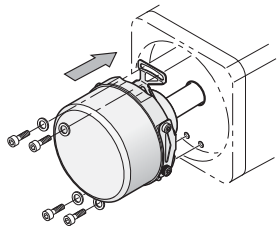
[1] Mech. permissible speed
[2] Through integrated counting function after traverse of two reference marks
[3] Only with outside diameters D2 64.37 mm and 75.44 mm
[4] Additional drum diameters upon request

ECN, EQN, ERN rotary encoders

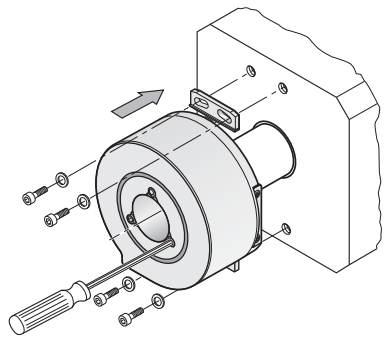
With integral bearing and mounted stator coupling
IP 64 protection

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

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



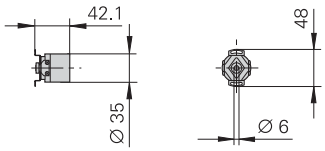
ECN/EQN/ERN 1000
ECN/EQN/ERN 400



ECN/ERN 100

ECN, EQN, ERN 1000 series

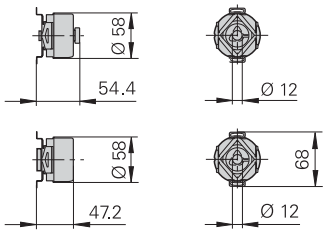
- **Miniaturized version**
- Blind hollow shaft with 6 mm inside diameter
- Housing outside diameter: 35 mm
- Natural frequency of the encoder stator coupling: ≥ 1500 Hz
- Mechanically permissible speed: ≤ 12 000 min^{-1}



Interface	
Position values/revolution	
Revolutions	
Line count	
Voltage supply	

ECN, EQN, ERN 400 series

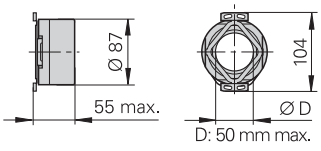
- **Compact design**
- Blind hollow shaft or hollow through shaft with 8 mm or 12 mm inside diameter
- Housing outside diameter: 58 mm
- Degree of protection:
  IP 67 at housing (IP 66 with hollow through shaft)
  IP 64 at shaft inlet (IP 66 upon request)
- Natural frequency of the encoder stator coupling: ≥ 1400 Hz (cable version)
- Mechanically permissible speed: ≤ 12 000 min^{-1}



Interface	
Position values/revolution	
Revolutions	
Line count	
Voltage supply	

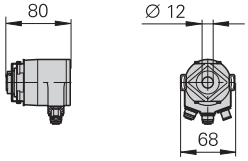
ECN/ERN 100 series

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



	Absolute				*Incremental*			
	ECN 1013	**EQN 1025**	**ECN 1023**	**EQN 1035**	**ERN 1020**	**ERN 1030**	**ERN 1070**	**ERN 1080**
	EnDat 2.2[1] with ∿ 1 V_{PP}		EnDat 2.2[1]		⊓⊔ TTL	⊓⊔ HTL	⊓⊔ TTL[2]	∿ 1 V_{PP}
	8192 (13 bits)		8388608 (23 bits)		–			
	–	4096 (12 bits)	–	4096 (12 bits)	–			
	512		–		100 to 3600		1000/2500/3600	100 to 3600
	3.6 to 14 V				5 V	10 V to 30 V	5 V	

	Absolute						*Incremental*		
	ECN 413[3]		**EQN 425**[3]		**ECN 425**[4] **ECN 425 F** **ECN 425 M** **ECN 424 S**[4]	**EQN 437**[4] **EQN 437 F** **EQN 437 M** **EQN 436 S**[4]	**ERN 420**[3] **ERN 460**	**ERN 430**[3]	**ERN 480**[3]
	EnDat 2.2[1] with ∿ 1 V_{PP}; SSI	PROFIBUS-DP; PROFINET	EnDat 2.2[1] with ∿ 1 V_{PP}; SSI	PROFIBUS-DP; PROFINET	EnDat 2.2[1]; Fanuc αi; Mitsubishi; Siemens DRIVE-CLiQ		⊓⊔ TTL; ⊓⊔ TTL	⊓⊔ HTL	∿ 1 V_{PP}
	8192 (13 bits)		8192 (13 bits)		*ECN 425:* 33554432 (25 bits) *ECN 424:* 16777216 (24 bits)		–		
	–		4096 (12 bits)		–	4096 (12 bits)	–		
	512 or 2048	–	512 or 2048	–	–		250 to 5000		1000 to 5000
	3.6 to 14 V 5 V or 10 V to 30 V	9 V to 36 V; 10 V to 30 V	3.6 to 14 V 5 V or 10 V to 30 V	9 V to 36 V; 10 V to 30 V	3.6 V to 14 V; 3.6 V to 14 V; 10 V to 28.8 V		5 V; 10 V to 30 V	10 V to 30 V	5 V



PROFIBUS-DP/PROFINET

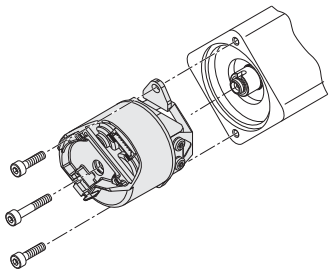
	Absolute		*Incremental*		
	ECN 113	**ECN 125**	**ERN 120**	**ERN 130**	**ERN 180**
Interface	EnDat 2.2[1] with ∿ 1 V_{PP}	EnDat 2.2[1]	⊓⊔ TTL	⊓⊔ HTL	∿ 1 V_{PP}
Position values/revolution	8192 (13 bits)	33554432 (25 bits)	–		
Line count	2048	–	1000 to 5000		
Voltage supply	5 V	3.6 V to 5.25 V	5 V	10 V to 30 V	5 V

[1] Includes EnDat 2.1 command set; PROFIBUS-DP via gateway
[2] Integrated 5/10-fold interpolation
[3] ATEX version available (*ECN 413/EQN 425* with 5 V power supply and EnDat 2.1)
[4] **Functional safety** upon request

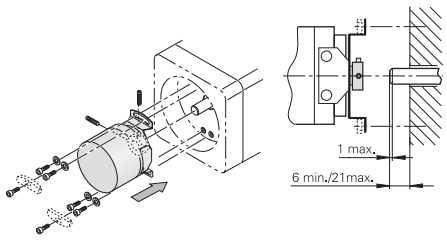
ECN, EQN, ERN rotary encoders

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

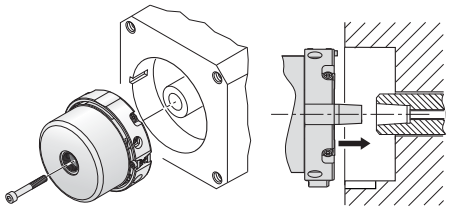
The **ECN, EQN** and **ERN** rotary encoders from HEIDENHAIN with IP 40 degree of protection are specially designed for integration in motors. Bearings and mounted stator coupling are integrated. Absolute rotary encoders and versions with commutation tracks are available for synchronous motors. The taper 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 on a plane surface or a location hole and permits fast, simple mounting.



ECN/EQN 1100



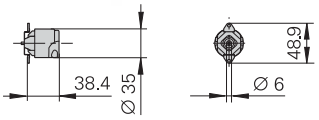
ERN 1123



ERN/ECN/EQN 1300

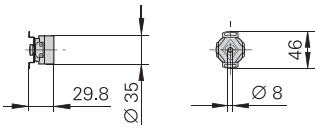
ECN/EQN 1100 series

- **Miniaturized version**
- Blind hollow shaft Ø 6 mm with positive fit element
- Housing outside diameter 35 mm
- Natural frequency of the encoder stator coupling: ≥ 1000 Hz
- Mech. permissible speed 12 000 min^{-1}
- Fault exclusion of the mechanical coupling for functional safety



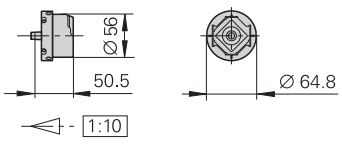
ERN 1123

- Blind hollow shaft Ø 8 mm
- Housing outside diameter 35 mm
- Stator coupling with bolt-hole circle Ø 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 holes with 65 mm inside diameter
- Natural frequency of the encoder stator coupling: ≥ 1800 Hz
- Mech. permissible speed
  ERN/ECN: 15 000 min^{-1}
  EQN: 12 000 min^{-1}
- IP 40 protection when mounted
- Fault exclusion of the mechanical coupling for functional safety



	Absolute				*Incremental*
	ECN 1113	**EQN 1125**	**ECN 1123**[2]	**EQN 1135**[2]	**ERN 1123**
Interface	EnDat 2.2[1] with ~ 1 V_{PP}		EnDat 2.2[1]		⊓⊔ TTL
Position values/revolution	8192 (13 bits)		8388608 (23 bits)		–
Revolutions	–	4096 (12 bits)	–	4096 (12 bits)	–
Line count	512		–		500 to 8192
Commutation signals	–				Block commutation[3]
Voltage 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 1325**[4]	**EQN 1337**[4]	**ERN 1321**	**ERN 1326**	**ERN 1381**	**ERN 1387**
Interface	EnDat 2.2[1] with ~ 1 V_{PP}		EnDat 2.2[1]		⊓⊔ TTL		~ 1 V_{PP}	
Position values/revolution	8192 (13 bits)		33554432 (25 bits)		–			
Revolutions	–	4096 (12 bits)	–	4096 (12 bits)	–			
Line count	512 or 2048		–		1024 2048 4096		512 2048 4096	2048
Commutation signals	–				–	Block commutation[2]	–	Z1 track[3]
Voltage supply	3.6 to 14 V				5 V			
Operating temperature	≤ 115 °C				≤ 120 °C; *4096 lines:* ≤ 100 °C			

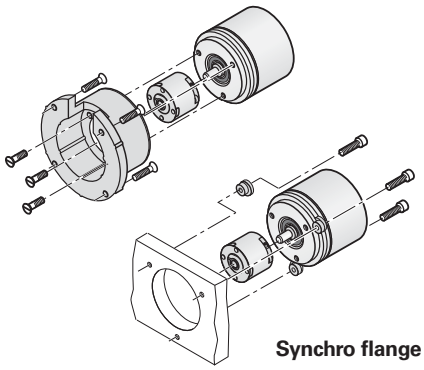
[1] Includes EnDat 2.1 command set; PROFIBUS-DP via gateway
[2] Three block commutation tracks with 90° or 120° mechanical phase shift
[3] One sine and one cosine signal with one period per revolution of the encoder shaft
[4] **Functional Safety** upon request

ROC, ROQ, ROD, RIC, RIQ rotary encoders
With integral bearing, for separate shaft coupling
HR handwheel

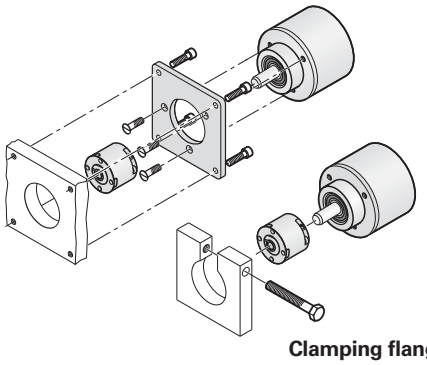
The optical encoders **ROC**, **ROQ** and **ROD**, as well as the inductive **RIC** and **RIQ** from HEIDENHAIN have integrated bearings and are sealed. They provide IP 64 to IP 66 protection, depending on the version. They are robust and compact.

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

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

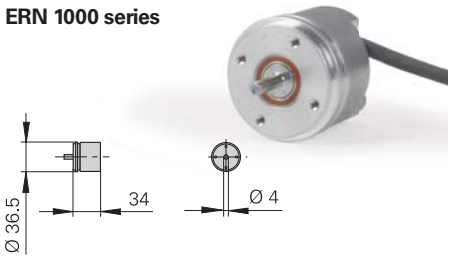
ROC, ROQ, ROD 1000 series
- **Miniaturized dimensions** for installation in small devices or in limited installation space
- Mounting by synchro flange
- Shaft diameter 4 mm

HR handwheel
- Compact dimensions
- Sturdy design
- Mechanical detent

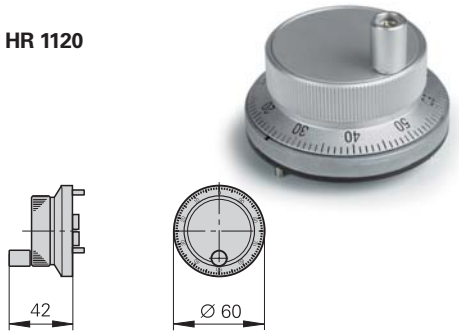
ROC/ROQ/ROD 400 series
- **Industrial standard** for dimensions and output signals
- Degree of protection IP 67 at housing IP 64 at shaft inlet (IP66 available on request)
- Mounting via synchro flange or clamping flange
- Shaft diameters
  6 mm with synchro flange
  10 mm with clamping flange
- Preferred types with fast delivery (see *Rotary Encoders* brochure or ask HEIDENHAIN)
- Fault exclusion of the mechanical coupling for functional safety

RIC/RIQ 400 series
- Inductive scanning principle
- For reduced accuracy requirements up to ± 480"
- Mechanical design same as ROC/ROQ 400

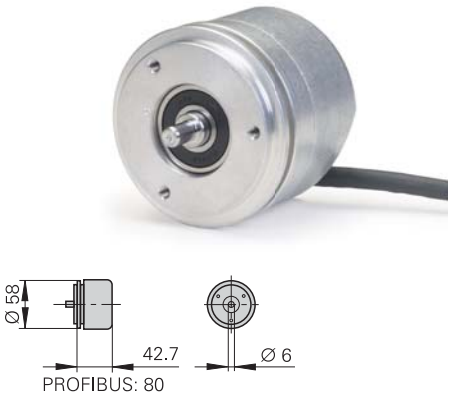
ERN 1000 series



HR 1120



Series 400 with synchro flange



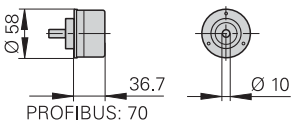
Synchro flange / Clamping flange	*Absolute* RIC 418	RIQ 430	ROC 413	ROQ 425	ROC 413
Interface	EnDat 2.1 with ∿ 1 V_{PP}		EnDat 2.2[4] With ∿ 1 V_{PP}; SSI		PROFIBUS-DP; PROFINET
Position values/ revolution	262 144 (18 bits)		8192 (13 bits)		
Revolutions	–	4096 (12 bits)	–	4096 (12 bits)	–
Line count/ signal periods	16		512		–
Voltage supply	5 V		3.6 V to 14 V; 5 V or 10 V to 30 V		9 V to 36 V; 10 V to 30 V

[1] ATEX version available (*ROC/ROQ* with 5 V voltage supply and EnDat 2.1)
[2] **Functional safety** upon request

	Absolute				*Incremental*				
	ROC 1013	**ROQ 1025**	**ROC 1023**	**ROQ 1035**	**ROD 1020**	**ROD 1030**	**ROD 1070**	**ROD 1080**	**HR 1120**
Interface	EnDat 2.2[1] with ∿ 1 V_{PP}		EnDat 2.2[1]		⊓⊔ TTL	⊓⊔ HTL	⊓⊔ TTL[2]	∿ 1 V_{PP}	⊓⊔ TTL
Position values/ revolution	8192 (13 bits)		8388608 (23 bits)		–				
Revolutions	–	4096 (12 bits)	–	4096 (12 bits)	–				
Line count/ signal periods	512		–		100 to 3600		1000/2500/ 3600	100 to 3600	100
Voltage supply	3.6 to 14 V		3.6 to 14 V		5 V	10 V to 30 V	5 V		

[1] Includes EnDat 2.1 command set; PROFIBUS-DP via gateway
[2] Integrated 5/10-fold interpolation

Series 400
with clamping flange



PROFIBUS-DP/PROFINET

					Incremental			
ROQ 425	**ROC 424 S**	**ROQ 436 S**	**ROC 425[2] ROC 425 F ROC 425 M**	**ROQ 437[2] ROQ 437 F ROQ 437 M**	**ROD 426[1]** / **ROD 420[1]**	**ROD 466[1]** / **–**	**ROD 436[1]** / **ROD 430[1]**	**ROD 486[1]** / **ROD 480[1]**
	Siemens DRIVE-CLiQ		EnDat 2.2[4]; Fanuc αi; Mitsubishi		⊓⊔ TTL	⊓⊔ TTL[1]	⊓⊔ HTL	∿ 1 V_{PP}
	16777216 (24 bits)		33554432 (25 bits)		–			
4096 (12 bits)	–	4096 (12 bits)	–	4096 (12 bits)	–			
					50 to 5000 *ROD 426/466:* Up to 10000[3]			1000 to 5000
	10 V to 28.8 V		3.6 to 14 V		5 V	10 V to 30 V		5 V

[3] Signal periods over 5000 are generated through signal doubling in the encoder
[4] Includes EnDat 2.1 command set; PROFIBUS-DP via gateway

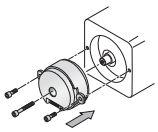
ECI, EQI, EBI, ERO rotary encoders
Without integral bearing

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 fastened in a location hole by several screws.

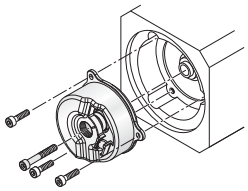
The **ECI/EBI 100** inductive rotary encoders have a particularly small outside diameter with a large shaft opening. It is slid onto the shaft and fastened from behind with axial screws.

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

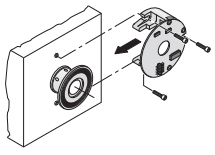
The correct installation of the rotary encoders without integral bearing can be inspected with the HEIDENHAIN PWM 20 measuring and testing device.



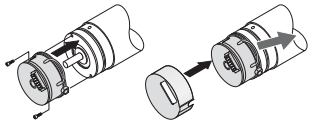
ECI/EQI 1100



ECI/EQI 1300



ERO 1200



ERO 1400

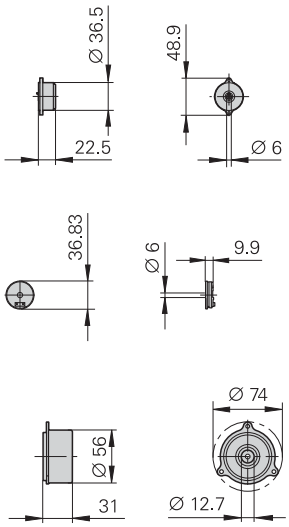
ECI/EQI/EBI 1100 series
- **Miniature size**
- Simple mounting without adjustment
- Blind hollow shaft Ø 6 mm
- *EBI 1135*: Multiturn function via battery-buffered revolution counter
- Version available featuring mounting-compatibility with ECN/EQN 1100
- Fault exclusion of the mechanical coupling for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

ECI/EQI 1300 series
- **Simple mounting** without adjustment
- Blind hollow shaft
- Version featuring mounting-compatibility with ECN/EQN 1300 with tapered shaft or blind hollow shaft available upon request
- Fault exclusion of the mechanical coupling for functional safety

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

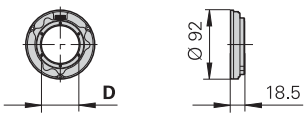
ERO 1200 series
- **Compact design**
- For shaft diameters up to 12 mm

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



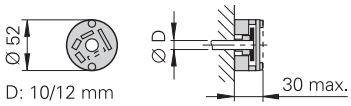
	Absolute **ECI 1119** **ECI 1319**[1]	**EQI 1131** **EQI 1331**[1]	**EBI 1135**
Interface	EnDat 2.2		EnDat 2.2
Position values/revolution	524 288 (19 bits)		262 144 (18 bits)
Revolutions	–	4096 (12 bits)	65 536 (16 bits)[2]
Mech. permissible speed	≤ 15 000 min^{-1}	≤ 12 000 min^{-1}	
Shaft	Blind hollow shaft		

1) **Functional safety** upon request
2) Multiturn function via battery-buffered revolution counter

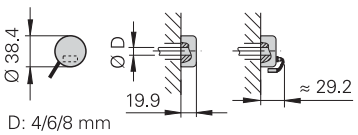


	Absolute **ECI 119**	**EBI 135**
Interface	EnDat 2.1 with ∿ 1 V_{PP}	EnDat 2.2
Position values/revolution	524 288 (19 bits)	
Revolutions	–	65 536 (16 bits)[3]
Line count	32	–
Mech. permissible speed	≤ 6000 min^{-1}	
Shaft	Hollow through shaft Ø 30, 38, 50 mm	

1) Multiturn function via battery-buffered revolution counter



	Incremental **ERO 1225**	**ERO 1285**
Interface	⊓⊔TTL	∿ 1 V_{PP}
Line count	1024 2048	
Mech. permissible speed	≤ 25 000 min^{-1}	
Shaft diameter D	Ø 10, 12 mm	



	Incremental **ERO 1420**	**ERO 1470**	**ERO 1480**
Interface	⊓⊔TTL	⊓⊔TTL[1]	∿ 1 V_{PP}
Line count	512 1000 1024	1000, 1500	512 1000 1024
Mech. permissible 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/turning machines and machining centers
The TNC controls from HEIDENHAIN cover the whole range of applications: From the simple, compact TNC 128 three-axis straight cut control to the TNC 640 (up to 18 axes plus spindle)—there's a TNC control for nearly every application. The TNC 640 is a control for milling machines that are also capable of turning operations.

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

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

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

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

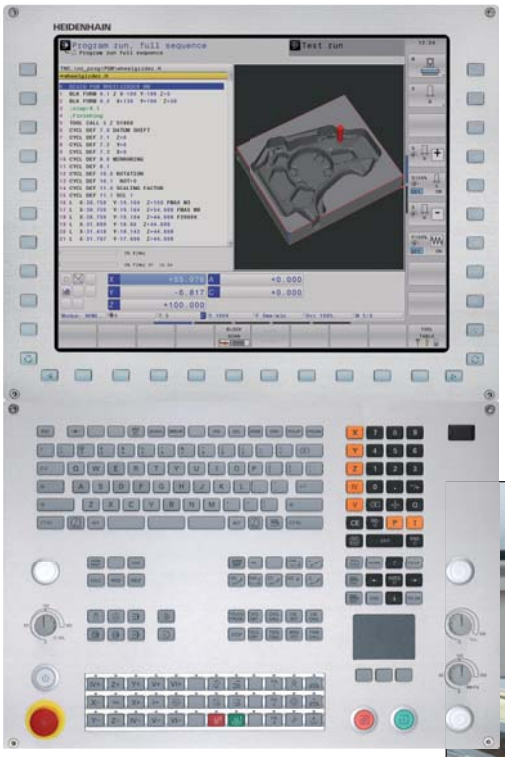
The controls from HEIDENHAIN can be used for almost every task. It offers the right programming capability for any job.

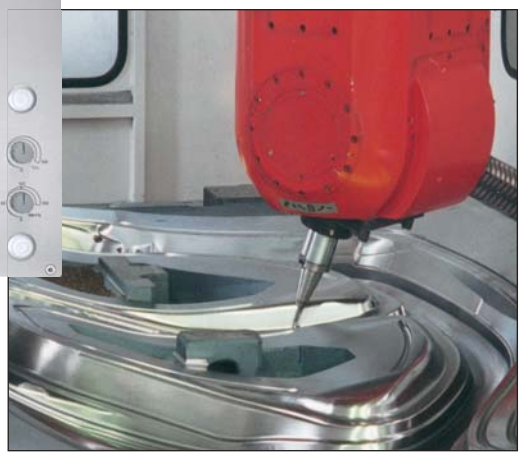
Programming at the machine
Its workshop-oriented design enables the machinist to program directly at the machine.

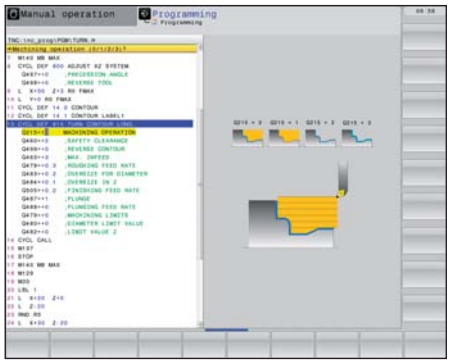
Thanks to its **conversational programming,** the user need not learn G codes or special programming languages. The control "speaks" with him with easily understandable questions and prompts. Ease of use is also promoted by clear, **unambiguous key symbols** and names. Each key has only one function.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

The alternative **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.**

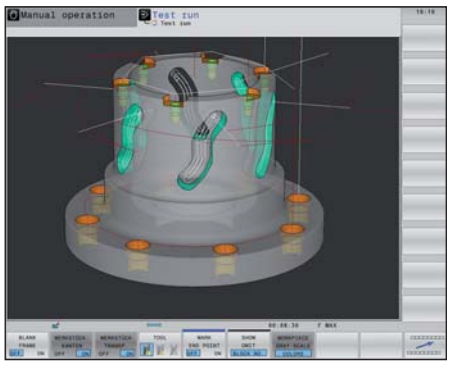






Conversational Programming

Key symbols



Detailed, high-resolution graphics

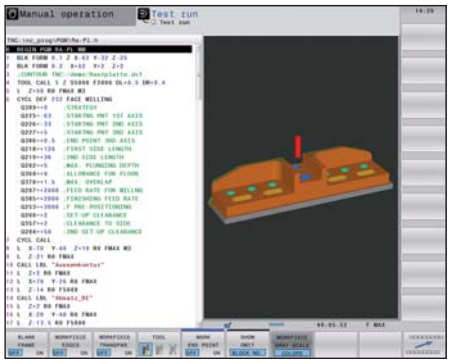
Frequently recurring machining sequences are saved as **fixed cycles. Graphic illustrations** simplify programming and provide valuable aid for verifying the program during test runs.

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

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

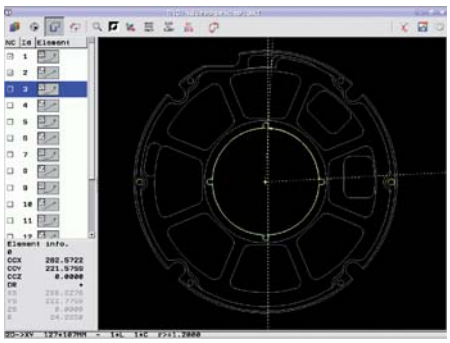
Creating programs offline
The HEIDENHAIN controls can be programmed remotely just as well—for example on a CAD/CAM system or at a HEIDENHAIN programming station. Their **Ethernet interface** guarantees very short transfer times, even of long programs.

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



Test Run

Offline programming



DXF data, processing

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

TNC 640 and iTNC 530 contouring controls

For milling machines, milling/turning machines and machining centers

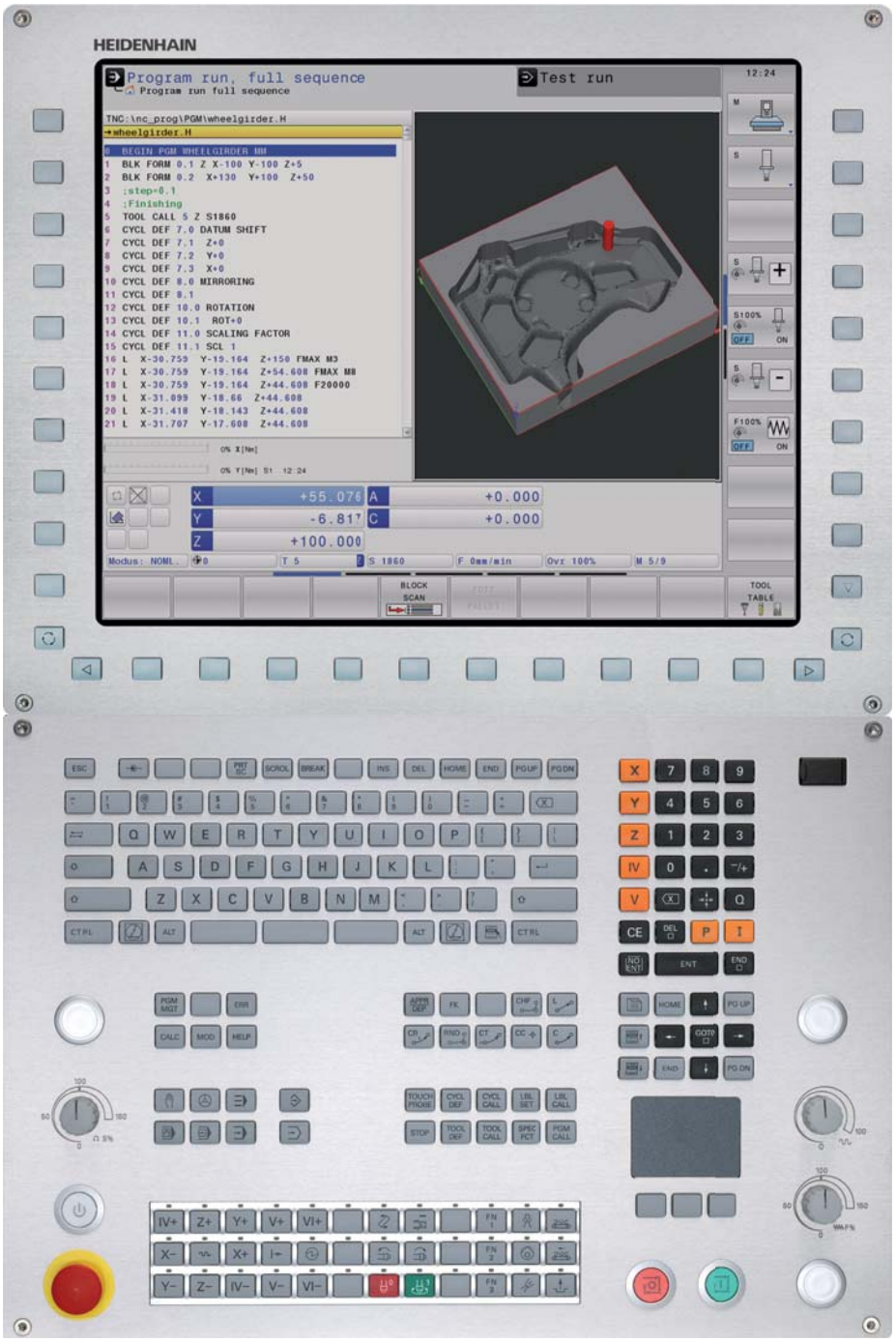
The HEIDENHAIN TNC 640 and iTNC 530 controls have been conceived as versatile and workshop-oriented controls for milling, drilling and boring machines as well as machining centers. The TNC 640 is additionally capable of combined milling and turning operations. TNC 640 and iTNC 530 offer comprehensive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

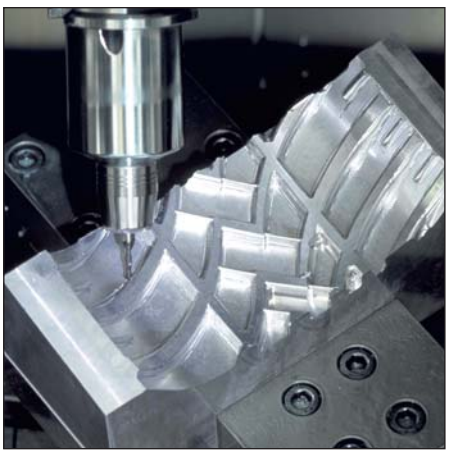
- On universal milling machines
- On combined milling/turning machines (only TNC 640)
- In high speed cutting
- For 5-axis machining with swivel head and rotary table
- For 5-axis machining on very large machines
- On boring mills
- On machining centers and for automated machining

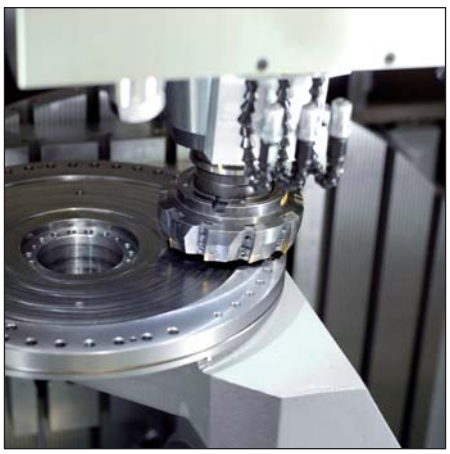
The TNC 640 and iTNC 530 feature **optimized motion control, short block processing times** and special control strategies. Together with its **uniform digital design** and its integrated digital drive control including inverters, it enables you to reach very high machining speeds and the best possible contour accuracy—particularly when machining 3-D contours.

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

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







	TNC 640	iTNC 530
Axes	Up to 18 axes and 2 spindles	
Interpolation	• 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 • Helical • Cylinder surface[1)] • Rigid tapping[1)]	
Program entry	HEIDENHAIN conversational, DIN/ISO	HEIDENHAIN conversational, smarT.NC, DIN/ISO
Programming support	TNCguide presents user information directly on the control	
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	As fine as 0.1 µm or 0.0001°; *TNC 640* optionally as fine as 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	• Turning tool data management • Tool-tip radius compensation • Constant surface speed • Toggling between milling and turning operations	–
High speed cutting	Motion control with minimum jerk	
FK free contour programming	HEIDENHAIN conversational with graphical support	
Coordinate transformation	• Datum shift, rotation, mirror image, scaling factor (axis-specific) • Tilting the working plane, PLANE function (option)	
Fixed cycles	For drilling, milling and turning (only TNC 640, option); data input with graphical support	
Touch probe cycles	For tool measurement, workpiece alignment, workpiece measurement and workpiece presetting	
Graphics	For programming and program verification	
Parallel operation	Program run and programming with graphics	
Data interface	Ethernet 1000BASE-T; USB2.0; RS-232-C/V.24 (max. 115200 baud)	
Remote control and diagnosis	TeleService	
LCD screen	15-inch or 19-inch color flat-panel display (TFT)	
Axis feedback control	• 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)]	
Accessories	• Electronic handwheel • TS workpiece touch probe **and** TT or TL tool touch probe	

[1)] This feature must be implemented by the machine tool builder
For further functions and differences in function, see product documentation

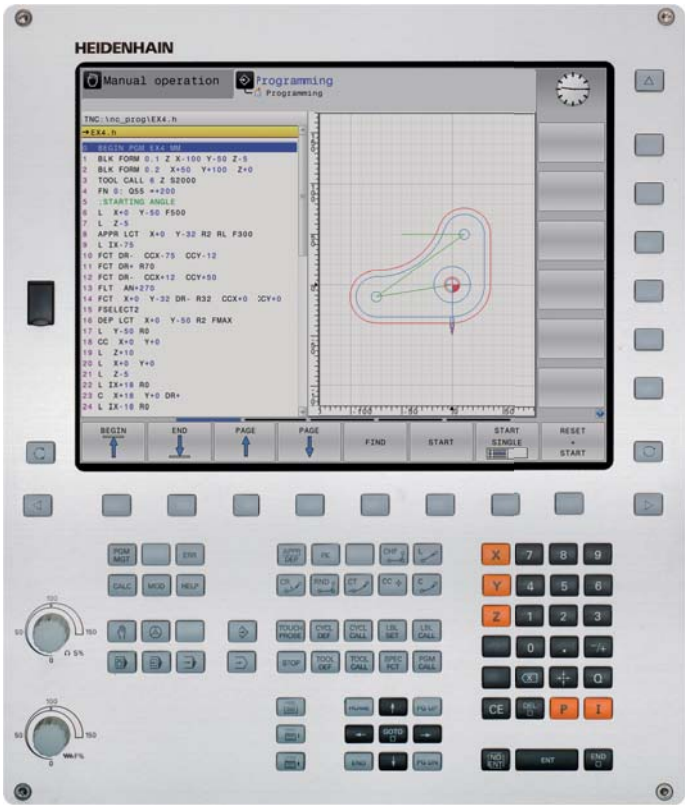
TNC 320, TNC 620 contouring controls
For milling machines

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

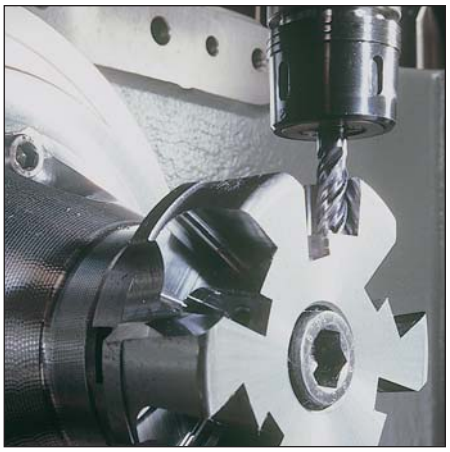
- Series and single-part production
- Tool making
- Machine building
- Research and development
- Prototypes and pilot plants
- Repair departments
- Training and education facilities

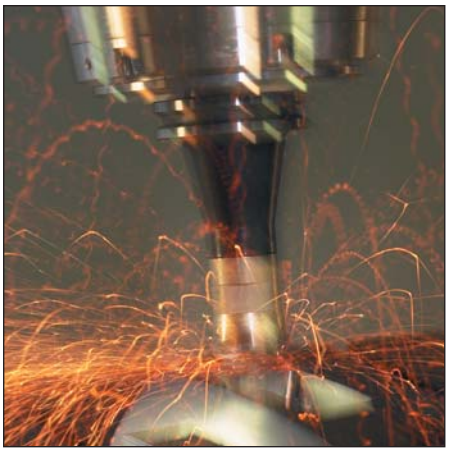
Because of its analog output that also provides nominal speed values, the **TNC 320** is well suited for retrofitting on machine tools.

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



TNC 620





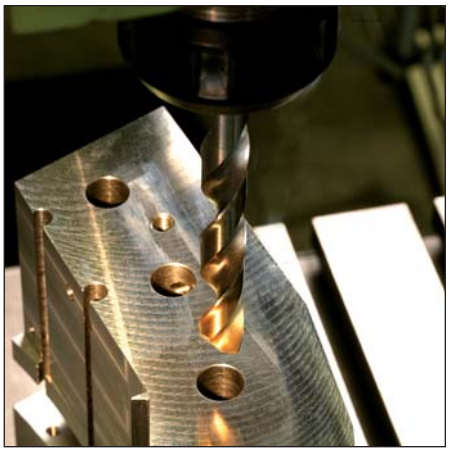
	TNC 620	TNC 320
Axes	3 axes plus spindle Optional 4th and 5th axes	3 axes plus spindle Optional 4th and 5th axis (with noncontrolled spindle)
Interpolation	• Linear: in 4 axes (optionally 5) • Circular: in 2 (optionally 3) axes • Helical, superimposition of circular and straight paths • Cylinder surface (option)	• Linear in 4 axes • Circular in 2 axes • Helical, superimposition of circular and straight paths • Cylinder surface (option)
Program entry	• 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	1.8 GB	
Position entry	• Positions in Cartesian or polar coordinates • Incremental or absolute dimensions • Display and entry in mm or inches • Actual position capture	
Input resolution and display step	Down to 0.1 µm or 0.0001°; optionally to 0.01 µm or 0.00001°	Down to 0.1 µm or 0.0001°
Block processing time	1.5 ms	6 ms
Coordinate transformation	• Datum shift, rotation, mirror image, scaling factor (axis-specific) • Tilting the working plane, PLANE function (option)	
Fixed cycles (some optional with the TNC 620)	• 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 datum setting (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	• Ethernet 1000BASE-T • USB 3.0; USB 2.0 • RS-232-C/V.24 and RS-422/V.11 (max. 115200 baud)	
LCD screen	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 via PL 6000	Inputs/outputs expandable via PL 510
Accessories	• HR panel-mounted electronic handwheels • TS workpiece touch probe **and** TT or TL tool touch probe	

TNC 128 straight cut control
For milling machines

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

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

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



	TNC 128
Axes	3 axes plus spindle Optional 4th and 5th axis (with noncontrolled spindle)
Program entry	HEIDENHAIN conversational
Program memory	1.8 GB
Position entry	• Positions in Cartesian or polar coordinates • Incremental or absolute dimensions • Display and entry in mm or inches
Input resolution and display step	Down to 0.1 µm or 0.0001°
Block processing time	6 ms
Coordinate transformation	Datum shift, rotation, mirror image, scaling factor (axis-specific)
Fixed cycles	• Drilling, tapping, reaming and boring • Cycles for hole patterns, facing of flat surfaces • Pocket, stud and slot milling
Touch probe cycles	Touch probe calibration and datum setting
Graphics	For programming and program verification; graphic support with cycle programming
Parallel operation	Program run and programming, program-run graphics
Data interface	• Ethernet 1000BASE-T • USB 3.0; USB 2.0 • RS-232–C/V.24 (max. 115200 baud)
LCD screen	12.1-inch color flat-panel display (TFT)
Axis feedback control	Feedforward control or operation with following error
Interfacing to the machine	Via integrated programmable logic controller (PLC); inputs/outputs expandable by PL 510
Accessories	• HR panel-mounted electronic handwheels • TS or KT workpiece touch probe **and** TT tool touch probe

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 high 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:

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

TNC 640
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 550 FS 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 550 FS** 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

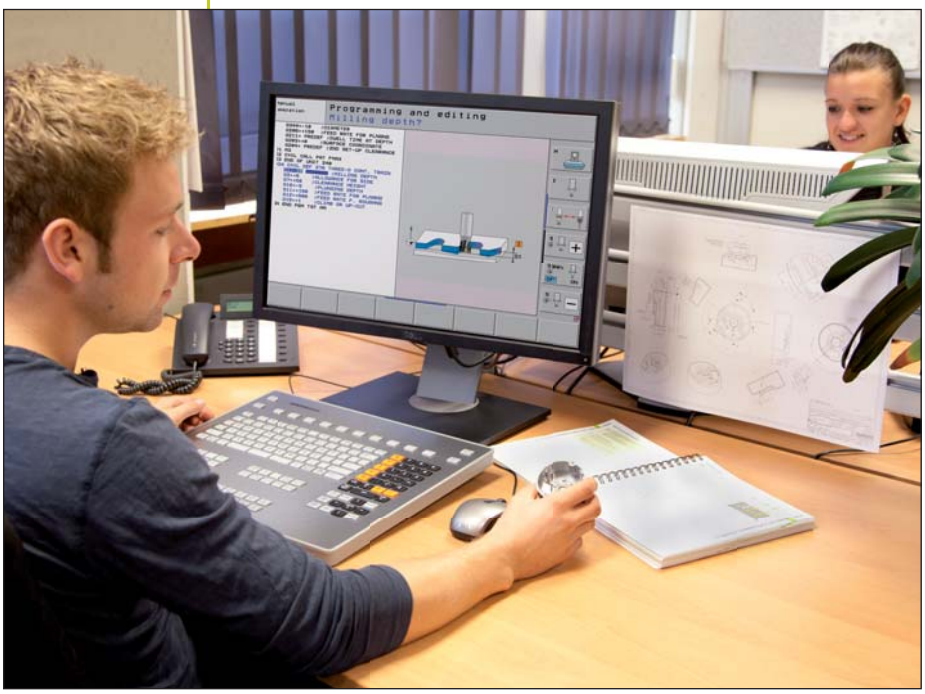
Programming stations

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

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

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

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



Tool and workpiece setup and measurement
Workpiece touch probes

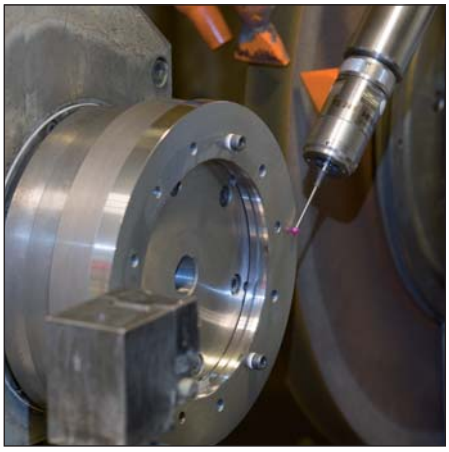
The **TS workpiece touch probes** from HEIDENHAIN help you perform setup, measuring and inspection functions directly on the machine tool.

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

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

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

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



Touch probe with **cable connection for signal transmission** for machines with manual tool change:
- **TS 260**
  Flange socket axial or radial

Touch probe with **radio and infrared transmission** for machines with automatic tool change
- **TS 460**
  Standard touch probe with compact dimensions

Touch probes with **infrared signal transmission** for machines with automatic tool change:
- **TS 444**
  Battery-free voltage supply through integrated air turbine generator over central compressed air supply
- **TS 642**
  Activation by switch in the taper shank
- **TS 740**
  High probing accuracy and repeatability, low probing force

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

TS 460

TS 740

SE 540

SE 660

TS 260

TS 260 with taper shank

	TS 460	TS 444	TS 642	TS 740	TS 260
	CNC machine tools for milling, drilling and boring as well as **CNC grinding machines or lathes**				
	Automatic				**Manual**
	Radio and infrared	Infrared			Via cable
	• *SE 540:* For integration in spindle head; only infrared transmission • *SE 660:* As common SE for TS and TT; radio and infrared transmission				–
	Batteries, rechargeable or nonrechargeable	Air turbine generator	Batteries, rechargeable or nonrechargeable		15 V to 30 V
	For radio or infrared transmission		Switch in taper shank	By infrared signal	–
	HTL via SE transmitter/receiver unit				HTL
	2 σ ≤ 1 µm			2 σ ≤ 0.25 µm	2 σ ≤ 1 µm
	≤ 3 m/min			≤ 0.25 m/min	≤ 3 m/min
	IP 67				

Tool touch probes

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

With their rugged design and high degree of protection, these tool touch probes can be installed directly within the machine tool's work envelope.

Tool measurement is possible at any time: before machining, between two machining steps, or after machining is done.

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

TT 160
- Signal transmission to the NC over **connecting cable**

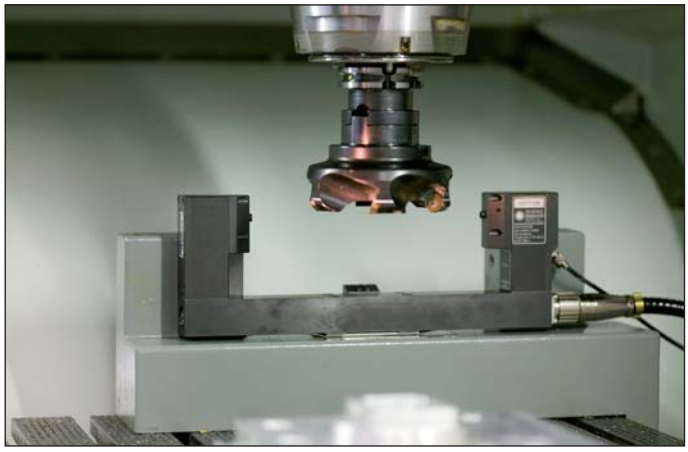
TT 460
- Signal transmission over **radio and infrared beam** to transmitter/receiver unit
- The SE 660 is a common transmitter/receiver unit for tool and workpiece touch probes with radio and infrared transmission

TT 160

TT 460

	TT 160	TT 460
Probing method	Physical probing in three dimensions: ± X, ± Y, +Z	
Probe repeatability	2 σ ≤ 1 µm (probing velocity 1 m/min)	
Permissible deflection of probe contact	Approx. 5 mm in all directions	
Voltage supply	10 V to 30 V from the NC	Batteries, rechargeable or nonrechargeable
Interface to control Signal level	HTL	HTL via SE transmitter/receiver unit
Signal transmission	Via cable	Radio wave and infrared transmission with 360° range
Probe contact	Ø 40 mm or Ø 25 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: ± X (or ±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:
Reproducibility	± 0.2 µm		± 1 µm	
Spindle speed	For individual tooth measurement, optimized to standard spindles or HSC spindles (> 30000 min^{-1})			
Laser	Visible red-light laser with beam focused at center of system; protection class 2 (IEC 825)			
Voltage supply	24 V from the NC			
Interface to control Signal level	HTL			
Protection EN 60529	IP 68 (when connected, with sealing air)			
Tool cleaning	Integral blowing unit			

Measured value acquisition and display

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

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

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

Evaluation electronics for measuring and testing tasks

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

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

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

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

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

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

User-friendly environment
Digital readouts and evaluation electronics with integrated display are specially designed for user friendliness. Typical characteristics:
- Optimally readable, graphic flat panel display
- Simple, logically arranged keypad
- Ergonomically designed push-button keys
- 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.

		Series	Page
Evaluation electronics for metrology applications			
	For 2-D and 3-D measuring tasks	**ND 100 QUADRA-CHEK** **ND 1000 QUADRA-CHEK** **IK 5000 QUADRA-CHEK** **ND 1200T TOOL-CHEK**	**54**
	For measuring and testing tasks	**ND 287** **ND 1100 QUADRA-CHEK** **ND 2100 G GAGE-CHEK** **MSE 1000** **EIB 700** **IK 220**	**56**
Digital readouts for manually operated machine tools			
	For milling machines, lathes and positioning devices	**ND 500** **ND 780** **POSITIP 880**	**58**
Interface electronics	For signal adjustment	**External Interface box (EIB)** **IBV, EXE** **Gateway** **IDP**	**59**

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

The evaluation electronics for 2-D and 3-D measuring tasks feature special functions for measured-value acquisition and evaluation. They serve primarily as
- Profile projectors
- Measuring microscopes
- Video measuring machines
- Coordinate measuring machines (manual or with CNC)
- 2-D measuring machines
- Tool presetters

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

TOOL-CHEK is an evaluation unit for use on tool presetters.

The **ND** evaluation electronics are independently operating devices. They feature an integrated screen and sturdy housing.

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

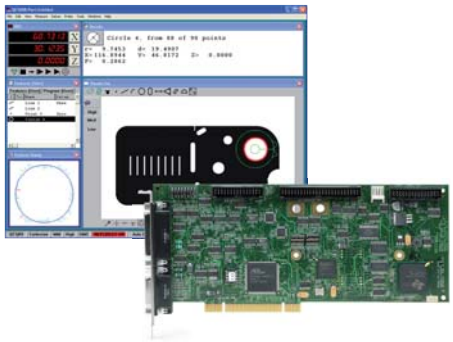
ND 100

ND 1200

	ND 100 QUADRA-CHEK	**ND 1200 QUADRA-CHEK**
Application	• Profile projectors • Measuring microscopes	• Profile projectors • Measuring microscopes • 2-D measuring machines
Axes[1]	2 or 3	XY, XYQ, XYZ or XYZQ
Encoder inputs	⊓⊔TTL	∿ 1 V_{PP} or ⊓⊔TTL (other interfaces upon request)
Display	5.7-inch monochrome flat-panel display	
Function	• Measurement of 2-D features • Point measurement with crosshairs • Entry of tolerances • Graphic display of measurement results	
	–	• Measure Magic function • Programming of features and parts
Optional[2] *or depending on version*	–	Automatic edge sensing via optical edge detector
Data interfaces	USB	USB; RS-232-C

[1] Depending on version [2] Possible combinations depending on version

ND 1300



IK 5000

	ND 1300 QUADRA-CHEK	ND 1400 QUADRA-CHEK	IK 5000 QUADRA-CHEK	ND 1202T TOOL-CHEK
	• Profile projectors • Measuring microscopes • Video measuring machines	• Manual coordinate measuring machines	• Profile projectors • Measuring microscopes • Video measuring machines • Coordinate measuring machines	Tool presetters
		XYZQ	XYQ, XYZ or XYZQ	2 (XZ)
			~ 1 V_{PP} or ⊓⊔ TTL (other interfaces upon request)	
	8.4-inch color flat-panel display (touch screen)		By PC screen	5.7-inch monochrome flat-panel display
		• Measurement of 2-D and 3-D features • Points measured via touch probe, crosshairs or rigid probing element • Entry of tolerances • Graphic display of measurement results • Five coordinate systems can be stored • Touch-probe management	• Measurement of 2-D features • Point measurement with crosshairs • Entry of tolerances • Graphic display of measurement results • Report generator • Import and export functions for CAD and measured data • Nominal-to-actual comparison for 2-D free-form contours from a CAD model	• Point measurement with crosshairs • 99 tool adapters • Memory for 300 tools • Entry of tolerances • Circle and angle measurement • Label printing
				–
	• Automatic edge sensing via optical edge detector • Video edge detection and live image display • Image archiving • Zoom and light control • CNC axis control and autofocus	–	• Measurement of 3-D features • Automatic edge sensing via optical edge detector • Video edge detection and live image display • Image archiving • Point measurement by touch probe (also TP 200) • CNC axis control and autofocus • Zoom and light control	–
			PCI (PC interface)	USB; RS-232-C

Evaluation electronics for metrology applications
Measuring and testing tasks

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

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

The **MSE 1000** is a modular electronics unit for multipoint measuring apparatuses for shop-floor metrology. With its modular design and various interfaces, it can be adapted flexibly to a wide variety of applications. Measured values are evaluated and displayed through a higher-level computer system.

The **EIB 741** is ideal for applications requiring high resolution, fast measured-value acquisition, mobile data acquisition or data storage. The data is transferred over the standard Ethernet interface for evaluation and display in a higher-level computer system.

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

ND 287

ND 2100G

	ND 287	ND 1100 QUADRA-CHEK
Application	• Measurement equipment • Testing devices • SPC inspection stations	• Positioning equipment • Measuring fixtures
Axes[1]	1 (optional: 2)	2, 3 or 4
Encoder inputs	∿ 1 V_{PP}; ∿ 11 μA_{PP} or EnDat 2.2	∿ 1 V_{PP} or ⊓⊔ TTL (other interfaces upon request)
Display	Color flat-panel display	5.7-inch monochrome flat-panel display
Function	• 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 *Optional:* Sum/difference display or thermal compensation	• Measurement series with min/max acquisition • Touch probe connection for a HEIDENHAIN or Renishaw touch probe
Data interfaces	USB; RS-232-C; *optional:* Ethernet	USB; RS-232-C

[1] Depends on version

MSE 1000

EIB 700

IK 220

	ND 2100G GAGE-CHEK	MSE 1000	EIB 700	IK 220
	• Multipoint inspection apparatuses • SPC inspection stations	• Multipoint inspection apparatuses • PLC testing stations	• Testing stations • Multipoint inspection apparatuses • Mobile data acquisition	• Measuring and testing stations
	4 or 8	Up to 250	4	2
	∿ 1 V_{PP} or ⊓⊔ TTL or EnDat 2.2 (other interfaces upon request)		∿ 1 V_{PP}, EnDat 2.1 or EnDat 2.2 (∿ 11 μA_{PP} upon request)	∿ 1 V_{PP}, ∿ 11 μA_{PP}, EnDat 2.1 or SSI
	5.7-inch color flat-panel display	By PC screen		
	• 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 • Programming of up to 100 parts • Entry of any formulas, combinations and variables • Output of measurement results	• Modular design • Configurable as desired • Various interfaces • Fast communication with higher-level computer system • Universal outputs	• Precise position measurement up to 50 kHz updating rate • Programmable measured-value inputs • Internal and external measured-value triggers • Measured-value memory for approx. 250 000 measured values per channel • Connection over standard Ethernet interface to higher-level computer systems	• Programmable measured-value inputs • Internal and external measured-value triggers • Measured-value memory for 8192 measured values per channel
		Ethernet		PCI (PC interface)

Digital readouts for manually operated machine tools

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

The splash-proof front panel and the sturdy cast-metal housing make digital readouts from HEIDENHAIN impervious to the hardest of workshop conditions.

ND 780

ND 500

	POSITIP 880	**ND 780**	**ND 500**
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 or 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	*Milling:* 99; *turning:* 1	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	• 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	• Radius/Diameter display • Separate or sum display for Z and Z_O • Taper calculator • Freezing the tool position for back-off		
	• 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

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

Incremental signals
∿ 1 V_{PP} > ⊓⊔ TTL
∿ 11 μA_{PP} > ⊓⊔ TTL

Incremental signals > position values
∿ 1 V_{PP} > EnDat
∿ 1 V_{PP} > Fanuc Serial Interface
∿ 1 V_{PP} > Mitsubishi high speed Interface

Position values
EnDat > DRIVE-CLiQ
EnDat > Yaskawa Serial Interface
EnDat > PROFIBUS-DP

HEIDENHAIN interface electronics are available in various mechanical designs.

Box design

Plug design

Version for integration

Top-hat rail design

Outputs	Inputs	Design	Interpolation[1] or subdivision	Type
⊓⊔ TTL	∿ 1 V_{PP}	Housing	5/10-fold	**IBV 101**
			20/25/50/100-fold	**IBV 102**
			Without interpolation	**IBV 600**
			25/50/100/200/400-fold	**IBV 660 B**
		Connector	5/10/20/25/50/100-fold	**APE 371**
		Installation	5/10-fold	**IDP 181**
			20/25/50/100-fold	**IDP 182**
	∿ 11 μA_{PP}	Housing	5/10-fold	**EXE 101**
			20/25/50/100-fold	**EXE 102**
			Without/5-fold	**EXE 602 E**
			25/50/100/200/400-fold	**EXE 660 B**
		Installation	5-fold	**IDP 101**
⊓⊔ TTL/ ∿ 1 V_{PP} Adjustable	∿ 1 V_{PP}	Housing	2-fold	**IBV 6072**
			5/10-fold	**IBV 6172**
			5/10-fold and 20/25/50/100-fold	**IBV 6272**
EnDat 2.2	∿ 1 V_{PP}	Housing	≤ 16384-fold	**EIB 192**
		Connector	≤ 16384-fold	**EIB 392**
		Housing	≤ 16384-fold	**EIB 1512**[3]
DRIVE-CLiQ	EnDat 2.2	Housing	–	**EIB 2391 S**
Fanuc Serial Interface	∿ 1 V_{PP}	Housing	≤ 16384-fold	**EIB 192 F**
		Connector	≤ 16384-fold	**EIB 392 F**
		Housing	≤ 16384-fold	**EIB 1592 F**[3]
Mitsubishi high speed interface	∿ 1 V_{PP}	Housing	≤ 16384-fold	**EIB 192 M**
		Connector	≤ 16384-fold	**EIB 392 M**
		Housing	≤ 16384-fold	**EIB 1592 M**[3]
Yaskawa Serial Interface	EnDat 2.2[2]	Connector	–	**EIB 3391 Y**
PROFIBUS-DP	EnDat 2.1; EnDat 2.2	Top hat rail	–	**PROFIBUS Gateway**

[1] Switchable
[2] Only LIC 4100 with 5 nm measuring step, LIC 2100 with 50 nm and 100 nm measuring steps
[3] Connections for two scanning heads for digital calculation

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).

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At our home page on the Internet at www.heidenhain.de you will find these brochures in various languages, but also a great deal of further up-to-date information on the company and its products.

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- Technical articles
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Length measurement

Brochure
Linear Encoders
For Numerically Controlled Machine Tools

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

Brochure
Exposed Linear Encoders

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

Brochure
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HEIDENHAIN-ACANTO
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Angle measurement

Brochure
Rotary encoders

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Absolute rotary encoders
ECN, EQN, ROC, ROQ
Incremental Rotary Encoders
ERN, ROD

Brochure
Angle Encoders With Integral Bearing

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

Brochure
Encoders for Servo Drives

Contents:
Rotary encoders
Angle encoders
Linear encoders

Brochure
Angle Encoders without Integral Bearing

Contents:
Incremental angle encoders
ERA, ERO, ERP

Brochure
Modular Magnetic Encoders

Contents:
Incremental encoders
ERM

Machine tool control

Brochures
iTNC 530 Contouring Control
TNC 640 Contouring Control

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Information for the user

OEM brochures
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Contents:
Information for the machine tool builder

Brochures
TNC 128 Straight Cut Control
TNC 320 Contouring Control
TNC 620 Contouring Control

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Brochure
MANUALplus 620 Contouring Control
CNC Pilot 640 Contouring Control

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Setup and measurement

Brochure
Touch Probes

Contents:
Tool touch probes
TT, TL
Workpiece Touch Probes
TS

Brochure
Measuring Systems For Machine Tool Inspection and Acceptance Testing

Contents:
Incremental linear encoders
KGM, VM

Measured value acquisition and display

Brochure
Evaluation Electronics
For Metrological Applications

Contents:
ND 100, ND 287, ND 1100, ND 1200, ND 1300, ND 1400 ND 1200T, ND 2100G MSE 1000, EIB 700, IK 220, IK 5000

Brochure
Digital Readouts/Linear Encoders
For Manually Operated Machine Tools

Contents:
Digital readouts
ND 280, ND 500, ND 700, POSITIP, ND 1200T
Linear encoders
LS 300, LS 600

Product overview
Interface electronics

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