



HEIDENHAIN



General Catalog

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

April 2006

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

HEIDENHAIN is represented in 49 countries—mostly with wholly owned 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 52) or on the Internet at www.heidenhain.de. Our sales personnel will be glad to help you personally. See page 54 for addresses and telephone numbers.



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Fundamentals and Processes

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

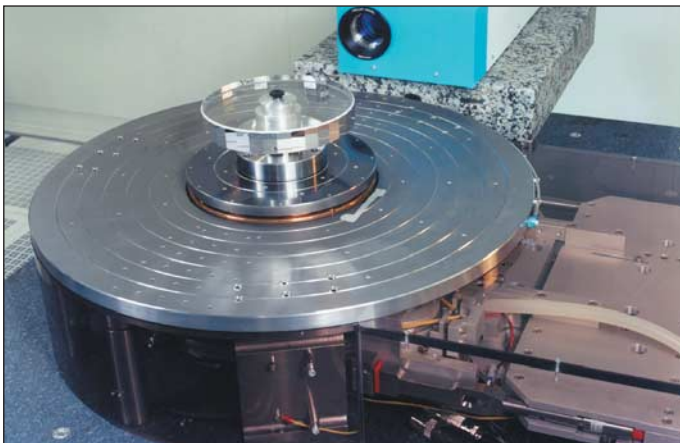


Measuring machine for linear scales



Linear scale inspection station

Our competence in the area of linear and angular metrology is reflected by a large number of customized solutions for users. These include in particular the measuring and inspection devices developed and built for standards laboratories as well as angle encoders for telescope projects and satellite receiving antennas. Of course the products in the standard HEIDENHAIN product program profit from the knowledge gained.



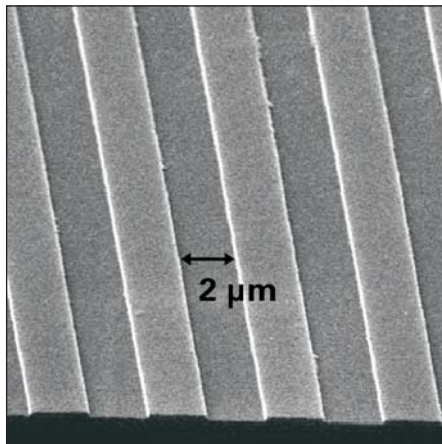
Angle comparator, measuring step approx. 0.001 "



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 AURODUR) 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. They 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.

Phase gratings

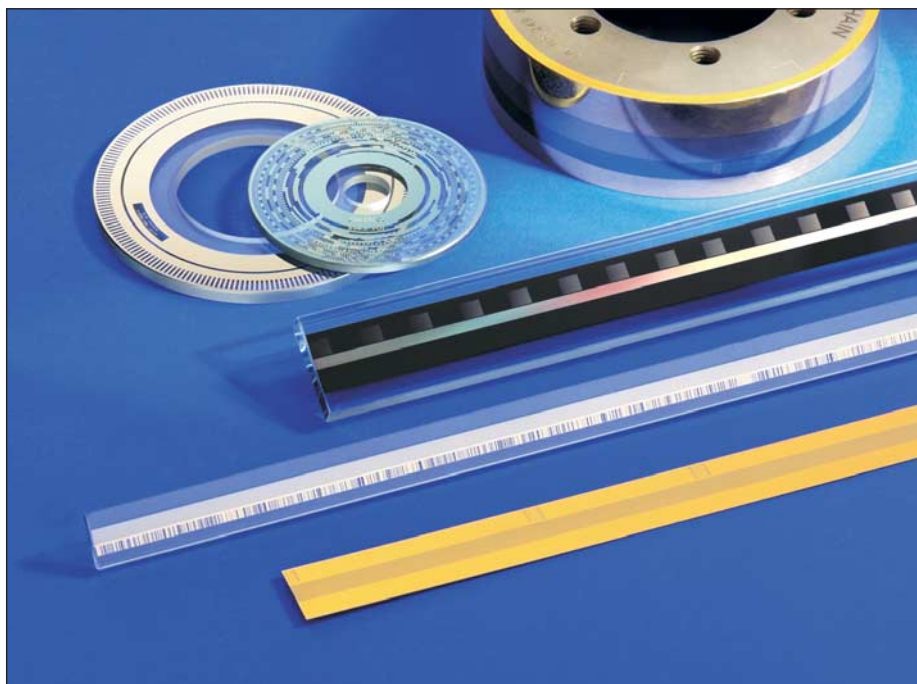
Special manufacturing processes make it possible to produce three-dimensional graduation structures, possessing special optical characteristics. The structure widths are in the range of a few microns down to quarters of a micron.

SUPRADUR

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

MAGNODUR

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



DIADUR and AURODUR graduations on various carrier materials

Length Measurement

Sealed linear encoders

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

machine tools.

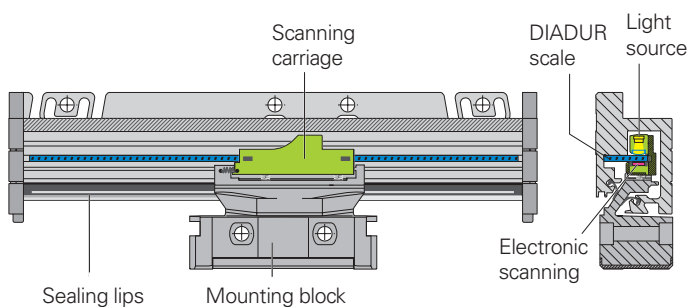
- Accuracy grades as fine as $\pm 2 \mu\text{m}$
- Measuring steps as fine as $0.005 \mu\text{m}$
- Measuring lengths up to 30 m
- Fast and simple mounting
- Large mounting tolerances
- High acceleration load capacity
- Protection against contamination



Sealed linear encoders are available with

- **Full-size scale housing**
 - For high vibration rating
 - Up to 30 m measuring length
- **Slimline scale housing**
 - For limited installation space
 - Up to 1240 mm measuring length, up to 2040 mm with mounting spar or tensioning elements

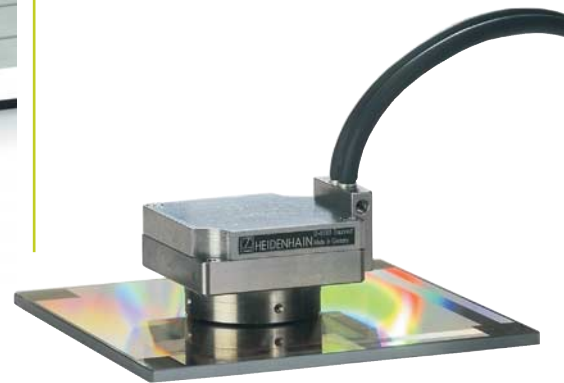
The aluminum housing of a HEIDENHAIN sealed linear encoder protects the scale, scanning carriage, and its guideway from chips, dust, and fluids. Downward-oriented elastic lips seal the housing. The scanning carriage travels in a low-friction guide within the scale unit. It is connected to the external mounting block by a coupling that compensates unavoidable misalignment between the scale and the machine guideways.



Exposed linear encoders

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

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



Length gauges

Length gauges from HEIDENHAIN feature integral guideways for the plunger.

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

- Accuracy grades as fine as $\pm 0.1 \mu\text{m}$
- Measuring steps to $0.005 \mu\text{m}$ (5 nm)
- Measuring lengths up to 100 mm
- High measuring accuracy
- Available with automated plunger drive
- Simple mounting

With **incremental linear encoders**, the current position is determined by starting at a datum and counting measuring steps, or by subdividing and counting signal periods. Incremental encoders from HEIDENHAIN feature reference marks, which must be scanned after switch-on to reestablish the datum. This process is especially simple and fast with distance-coded reference marks. After traverse of no more than 20 mm (LS, LF) or 80 mm (LB), the display value is shown with respect to the datum as it was last defined.

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.

Measuring steps

The recommended measuring steps listed in the table refer primarily to position measurements. Smaller measuring steps are useful in particular for applications in rotational speed control, e.g. on direct drives. The sinusoidal output signals make it possible to attain higher interpolation factors up to 4096.



Sealed Linear Encoders

with full-size scale housing

Absolute position measurement
Incremental position measurement
Very high repeatability
Typically for manual machines
Large measuring lengths

Series

LC 100
LS 100
LF 100
LS 600
LB 300

Page

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with slimline scale housing

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

LC 400
LS 400
LF 400
LS 300

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Exposed Linear Encoders

Accuracy grades better than $\pm 1 \mu\text{m}$
Two-coordinate encoders
Accuracy grades to $\pm 3 \mu\text{m}$

LIP
PP
LIDA, LIF

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Length Gauges

Accuracy $\pm 0.1 \mu\text{m}$
Accuracy $\pm 0.2 \mu\text{m}$
Accuracy to $\pm 0.5 \mu\text{m}$
Accuracy $\pm 1 \mu\text{m}$

HEIDENHAIN-CERTO
HEIDENHAIN-METRO
HEIDENHAIN-METRO
HEIDENHAIN-SPECTO

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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** series provide the **absolute position value** without any previous traverse required. Incremental signals can also be provided. They 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 und LS 100 series linear encoders are especially well suited for use on **NC-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 **LB** type of incremental linear encoders were conceived for very **long measuring lengths up to 30 meters**. Their measuring standard—a steel tape with 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 187

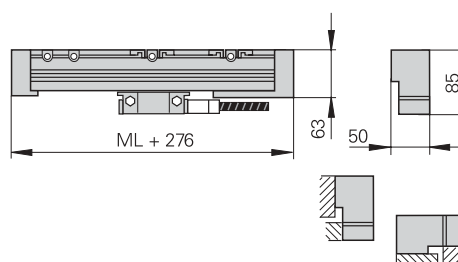
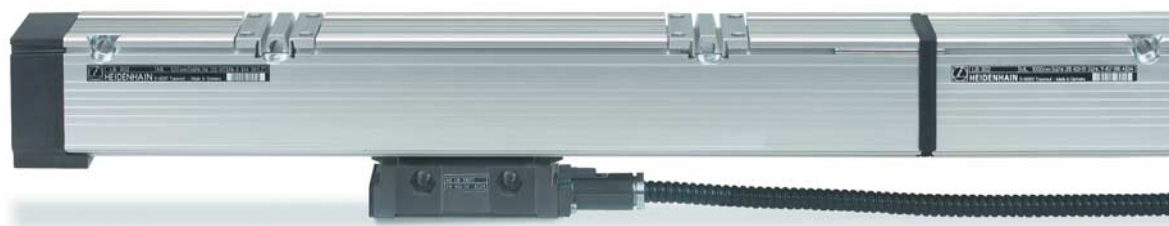
- **Incremental position measurement**
- Defined thermal behavior
- High vibration rating
- Two mounting attitudes
- Single-field scanning

LF 183

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

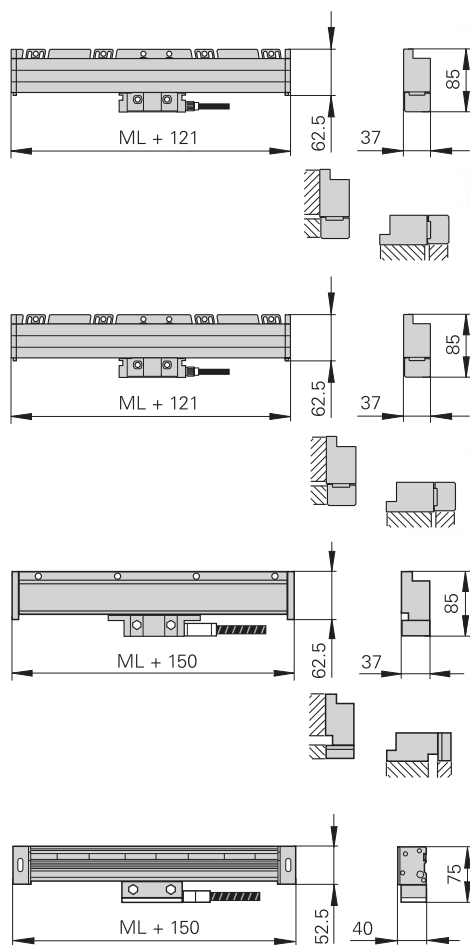
LS 600 series

- **Typical for manual machines**
- Simple installation



LB 382

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



	Absolute	Incremental			
	LC 183 ¹⁾ LC 193 F/M ¹⁾	LF 183	LS 187 ¹⁾ LS 177 ¹⁾	LS 603 LS 623	LB 382
Measuring standard	DIADUR glass scale	DIADUR phase grating on steel	DIADUR glass scale	DIADUR glass scale	AURODUR steel scale tape
Incremental signals	Optional for LC 183	~ 1 V _{PP}	LS 187: ~ 1 V _{PP} LS 177: □□TTL	LS 603: ~ 11 μA _{PP} LS 623: □□TTL	~ 1 V _{PP}
Signal period	20 μm	4 μm	20 μm LS 177: 4 μm/2 μm	20 μm	40 μm
Absolute position values	EnDat 2.2	—			
	Fanuc/Mitsubishi				
Accuracy grade	± 5 μm, ± 3 μm	± 3 μm, ± 2 μm	± 5 μm, ± 3 μm	± 10 μm	± 5 μm
Recommended measuring step	0.05 to 0.005 μm ²⁾	1 to 0.1 μm	1 μm and 0.5 μm	10 μm and 5 μm	10 to 0.1 μm
Measuring lengths (ML)	140 to 4240 mm (± 3 μm up to 3040 mm)	140 to 3040 mm		170 to 3040 mm	440 to 30040 mm
Reference mark	—	One or distance-coded			

¹⁾ Availability planned for mid-2006

²⁾ Absolute position values

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. Incremental signals can also be provided. Like the **LS 400** series incremental linear encoders, their high accuracy and defined thermal behavior make them especially well suited for use on **NC-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 487

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

LF 481

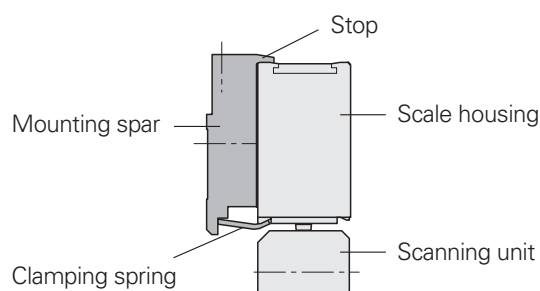
- **Very high repeatability**
- High resolution
- Thermal behavior similar to steel or cast iron
- Single-field scanning

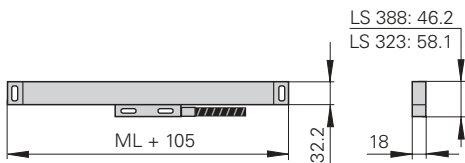
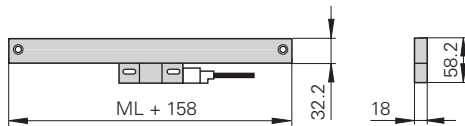
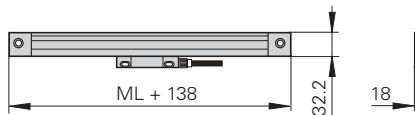
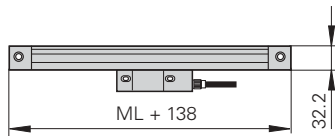
LS 300 series

- **Typically for manual machines**

Simple installation with mounting spar

The use of a mounting spar can be of great benefit when mounting slimline linear encoders. They 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.





	Absolute LC 483 ¹⁾ LC 493 F/M ¹⁾	Incremental LF 481	LS 487 ¹⁾ LS 477 ¹⁾	LS 388C LS 323
Measuring standard	DIADUR glass scale	DIADUR phase grating on steel	DIADUR glass scale	DIADUR glass scale
Incremental signals	Optional for LC 483	~ 1 V _{PP}	LS 487: ~ 1 V _{PP} LS 477: □□ TTL	LS 388C: ~ 1 V _{PP} LS 323: □□ TTL
Signal period	20 µm	4 µm	20 µm LS 477: 4 µm/2 µm	20 µm
Absolute position values	EnDat 2.2 Fanuc/Mitsubishi	—		
Accuracy grade	± 5 µm, ± 3 µm	± 5 µm, ± 3 µm		± 10 µm
Recommended measuring step	0.05 to 0.005 µm ²⁾	1 to 0.1 µm	1 µm and 0.5 µm	10 µm and 5 µm
Meas. lengths (ML)	70 to 2040 mm ³⁾	50 to 1220 mm	70 to 2040 mm ³⁾	70 to 1240 mm
Reference mark	—	One or distance-coded; LS 388C: distance-coded		

¹⁾ Availability planned for mid-2006

²⁾ Absolute position values

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

LIP Exposed Linear Encoders

Accuracy grades better than $\pm 1 \mu\text{m}$

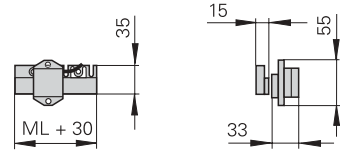
The exposed linear encoders of the **LIP** type are characterized by small measuring steps together with high accuracy. The measuring standard is a phase grating applied to a substrate of glass or glass ceramic.

LIP 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

LIP 300 series

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



ML = 70 mm

LIP 400 series

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



LIP 500 series

- Measuring lengths up to 1440 mm
- Measuring steps to $0.05 \mu\text{m}$

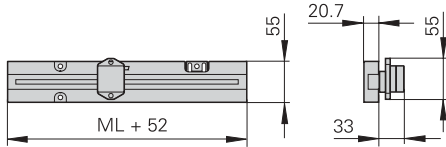
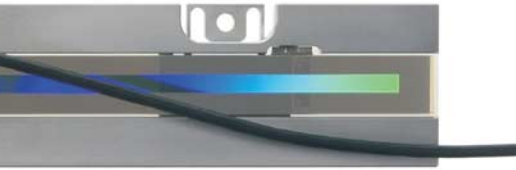


	Incremental	
	LIP 382 LIP 372	LIP 481 LIP 471
Measuring standard Thermal expansion coefficient	DIADUR phase grating on Zerodur® glass ceramic $\alpha_{\text{therm}} \approx 0 \text{ ppm/K}$	DIADUR phase grating on Zerodur® glass ceramic $\alpha_{\text{therm}} \approx 8 \text{ ppm/K (glass) or}$ $\alpha_{\text{therm}} \approx 0 \text{ ppm/K (Zerodur®)}$
Incremental signals	LIP 382: $\sim 1 \text{ V}_{\text{PP}}$ LIP 372: $\square \text{ TTL}$	LIP 481: $\sim 1 \text{ V}_{\text{PP}}$ LIP 471: $\square \text{ TTL}$
Signal period	LIP 382: $0.128 \mu\text{m}$ LIP 372: $0.004 \mu\text{m}$	LIP 481: $2 \mu\text{m}$ LIP 471: $0.4 \mu\text{m}/0.2 \mu\text{m}$
Accuracy grade	$\pm 0.5 \mu\text{m}^{1)}$	$\pm 1 \mu\text{m}; \pm 0.5 \mu\text{m}^{1)}$
Recommended measuring step	1 nm	$1 \mu\text{m}$ to $0.005 \mu\text{m}$
Measuring lengths (ML)	70 to 270 mm	70 to 420 mm
Reference mark	None	One

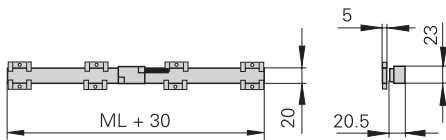
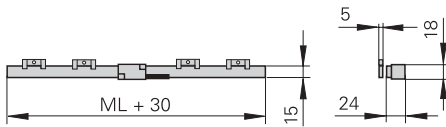
¹⁾ Other accuracy grades available on request

PP Exposed Linear Encoders

Two-coordinate encoders



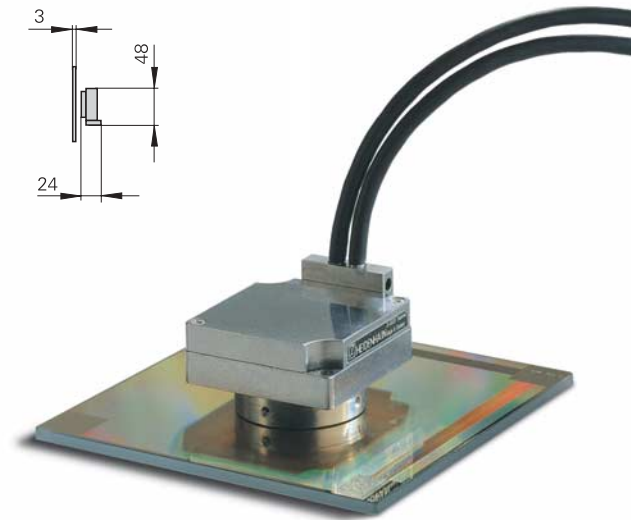
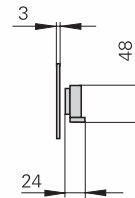
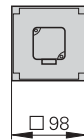
ML = 120 mm



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



LIP 581
LIP 571

DIADUR phase grating on glass
 $\alpha_{\text{therm}} \approx 8 \text{ ppm/K}$

LIP 581: $\sim 1 \text{ V}_{\text{pp}}$
LIP 571: \square TTL

LIP 581: $4 \mu\text{m}$
LIP 571: $0.8 \mu\text{m}/0.4 \mu\text{m}$

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

$1 \mu\text{m}$ to $0.05 \mu\text{m}$

70 to 1440 mm

One or distance-coded

Incremental

PP 281
PP 271

Measuring standard
Thermal expansion
coefficient

DIADUR phase grating on glass
 $\alpha_{\text{therm}} \approx 8 \text{ ppm/K}$

Incremental signals

PP 281: $\sim 1 \text{ V}_{\text{pp}}$
PP 271: \square TTL

Signal period

PP 281: $4 \mu\text{m}$
PP 271: $0.8 \mu\text{m}/0.4 \mu\text{m}$

Accuracy grade

$\pm 2 \mu\text{m}$

Recommnd. meas. step

To $0.01 \mu\text{m}$

Measuring range

$68 \text{ mm} \times 68 \text{ mm}$,
(other measuring ranges upon request)

Reference mark

One per coordinate

LIF, LIDA Exposed Linear Encoders

Accuracy grades to $\pm 3 \mu\text{m}$

The **LIF** and **LIDA** exposed linear encoders are characterized by easy installation. They are typically used in:

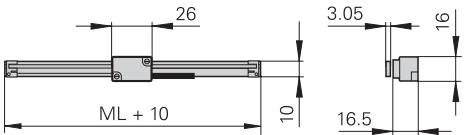
- Coordinate measuring machines
- Inspection machines
- PCB assembly machines
- PCB drilling machines
- Precision handling devices
- Position and velocity measurement on linear motors



A phase grating on glass, manufactured in the SUPRADUR process, serves as measuring standard for **LIF** linear encoders. Its small signal period permits a **high repeatability**.

LIDA linear encoders use AURODUR steel scale tape as measuring standard. They are ideal for **high traversing speeds** up to 8 m/s. Their special scanning method makes them highly tolerant to scale contamination and unevenness of the mounting surface.

LIF 400 series

- **Fast, simple scale fastening** with HEIDENHAIN PRECIMET[®] adhesive film
- Relatively insensitive to contamination thanks to SUPRADUR graduation
- High repeatability
- Defined thermal behavior
- Short mounting times
- Position detection through limit switches and homing



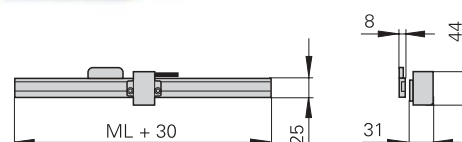
	Incremental LIF 481 LIF 471
Measuring standard Thermal expansion coefficient	SUPRADUR phase grating on glass (from ML 270 mm: DIADUR phase grating) $\alpha_{\text{therm}} \approx 8 \text{ ppm/K}$
Incremental signals	<i>LIF 481</i> :  1 V _{pp} <i>LIF 471</i> :  TTL
Signal period	<i>LIF 481</i> : 4 μm <i>LIF 471</i> : 0.04 μm /0.08 μm /0.2 μm /0.4 μm /0.8 μm
Accuracy grade	$\pm 3 \mu\text{m}$
Recommd. meas. step	1 μm to 0.1 μm
Measuring lengths (ML)	70 to 1020 mm (up to 3040 mm upon request)
Reference mark	One

LIDA 101 series

- One-piece steel scale
- High traversing speed



LIDA 181

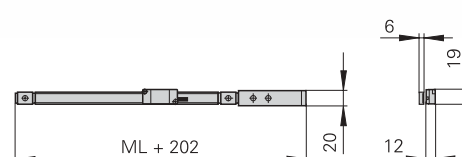


LIDA 405 series

- Large measuring lengths up to 30 m
- High traversing speed
- One-piece AURODUR steel scale tape guided in scale-tape carriers
- Scale is drawn to a defined tension and fixed at both ends to the machine base
- Integral limit switches



LIDA 485

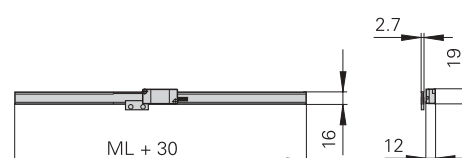


LIDA 407 series

- Fast, simple mounting of the scale tape carrier with HEIDENHAIN PRECIMET[®] adhesive film
- High traversing speed
- One-piece AURODUR steel scale tape guided in scale-tape carriers
- Fastening of scale center guarantees defined thermal behavior
- Integral limit switches



LIDA 487



	Incremental		
	LIDA 181 LIDA 171	LIDA 485 LIDA 475	LIDA 487 LIDA 477
Measuring standard Thermal expansion coefficient	AURODUR steel scale tape $\alpha_{\text{therm}} \approx 10 \text{ ppm/K}$		
Incremental signals	LIDA 181: $\sim 1 V_{PP}$ LIDA 171: \square TTL	LIDA 48x: $\sim 1 V_{PP}$ LIDA 47x: \square TTL	
Signal period	LIDA 181: 40 μm LIDA 171: 4 $\mu\text{m}/8 \mu\text{m}$	LIDA 48x: 20 μm LIDA 47x: 0.2 $\mu\text{m}/0.4 \mu\text{m}/2 \mu\text{m}/4 \mu\text{m}$	
Accuracy grade	$\pm 5 \mu\text{m}, \pm 3 \mu\text{m}$	$\pm 5 \mu\text{m}$	$\pm 15 \mu\text{m}$
Recommnd. meas. step	1 μm to 0.1 μm	1 μm to 0.1 μm	1 μm to 0.1 μm
Measuring lengths (ML)	220 to 2040 mm	140 to 30040 mm	240 to 6040 mm
Reference mark	One; LIDA 1x1: One or distance-coded		

HEIDENHAIN-CERTO Length Gauges

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

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

Accuracy

The total error of HEIDENHAIN-CERTO length gauges lies within $\pm 0.1 \mu\text{m}$. After linear length error compensation in the evaluation electronics of the ND 281 B, for example, HEIDENHAIN guarantees accuracy of $\pm 0.03 \mu\text{m}$ for the CT 2500 and $\pm 0.05 \mu\text{m}$ for the CT 6000. These accuracy grades apply over the entire measuring range at ambient temperatures between 19 and 21 °C and with a temperature variation of $\pm 0.1 \text{ K}$ during measurements using the CS 200 gauge stand for HEIDENHAIN-CERTO.

Plunger actuation

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

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

Mounting

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



	Incremental			
	CT 2501	CT 2502	CT 6001	CT 6002
Measuring standard	DIADUR phase grating on Zerodur® glass ceramic Therm. expansion coefficient: $\alpha_{\text{therm}} \approx 0 \pm 0.1 \text{ ppm/K}$			
Incremental signals	$\sim 11 \text{ }\mu\text{App}$			
Signal period	2 μm			
System accuracy ¹⁾	$\pm 0.1 \text{ }\mu\text{m}$ $\pm 0.03 \text{ }\mu\text{m}^{2)}$		$\pm 0.1 \text{ }\mu\text{m}$ $\pm 0.05 \text{ }\mu\text{m}^{2)}$	
Recommd. meas. step	0.01 μm and 0.005 μm with ND 281 B measured value display unit			
Measuring range	25 mm		60 mm	
Plunger actuation	Motor driven	Via coupling	Motor driven	Via coupling
Reference mark	One			

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

²⁾ With linear length error compensation in the evaluation electronics

HEIDENHAIN-METRO Length Gauges

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

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

Plunger actuation







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

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

Mounting

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



	Incremental					
	MT 1201	MT 1271	MT 1281 MT 1287	MT 2501	MT 2571	MT 2581 MT 2587
Measuring standard	DIADUR phase grating on Zerodur® glass ceramic Therm. expansion coefficient: $\alpha_{\text{therm}} \approx 0 \pm 0.1 \text{ ppm/K}$					
Incremental signals	 11 μA_{PP}	 TTL	 1 V_{PP}	 11 μA_{PP}	 TTL	 1 V_{PP}
Signal period	2 μm	0.4 μm or 0.2 μm	2 μm		0.4 μm or 0.2 μm	2 μm
System accuracy	$\pm 0.2 \mu\text{m}$					
Recommd. meas. step	0.5 μm to 0.05 μm					
Measuring range	12 mm			25 mm		
Plunger actuation	MT 12x1/MT 25x1: by cable-type lifter or freely movable MT 1287/MT 2587: pneumatic					
Reference mark	One					

HEIDENHAIN-METRO Length Gauges

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

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

Plunger actuation

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

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

Mounting

The length gauges are mounted onto a flat surface by two screws. The M versions can also be mounted in the accessory MS 100 and MS 200 gauge stands.



	Incremental			
	MT 60 M	MT 60 K	MT 101 M	MT 101 K
Measuring standard	DIADUR graduation on glass ceramic			
Incremental signals	⌚ 11 μApp			
Signal period	10 μm			
System accuracy	± 0.5 μm		± 1 μm	
Recommd. meas. step	1 μm to 0.1 μm			
Measuring range	60 mm		100 mm	
Plunger actuation	Motor driven	Via coupling	Motor driven	Via coupling
Protection	IP 50			
Reference mark	One			

HEIDENHAIN-SPECTO Length Gauges

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

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

Plunger actuation







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

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

Mounting

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



	Incremental					
	ST 1208 ST 1207	ST 1278 ST 1277	ST 1288 ST 1287	ST 3008 ST 3007	ST 3078 ST 3077	ST 3088 ST 3087
Measuring standard	DIADUR glass scale					
Incremental signals	 11 μA _{PP}	 TTL	 1 V _{PP}	 11 μA _{PP}	 TTL	 1 V _{PP}
Signal period	20 μm	4 μm or 2 μm	20 μm		4 μm or 2 μm	20 μm
System accuracy	± 1 μm					
Recommd. meas. step	1 μm to 0.2 μm					
Measuring range	12 mm			30 mm		
Plunger actuation	ST 12x8/ST 30x8: by measured object ST 12x7/ST 30x7: pneumatic					
Protection	IP 64					
Reference mark	One					

Angle Measurement

Angle encoders

HEIDENHAIN angle encoders are characterized by high accuracy values in the arc 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 90 000
- Accuracy from $\pm 5''$ to $\pm 0.4''$
- Measuring steps as fine as 0.00001° or $0.036''$ (incremental) or 29 bits, i.e. approx. 536 million positions per revolution (absolute)



Rotary encoders

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

- Line counts of typically 50 to 5000
- Accuracy from $\pm 12''$ (depending on the line count, corresponding to $\pm 1/20$ of the grating period)
- Measuring steps as fine as 0.001° . 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 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:

- Little installation space
- Large hollow-shaft diameter
- High shaft speeds
- 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, which must be scanned after switch-on to reestablish the datum.

Incremental rotary encoders with commutation signals supply 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.

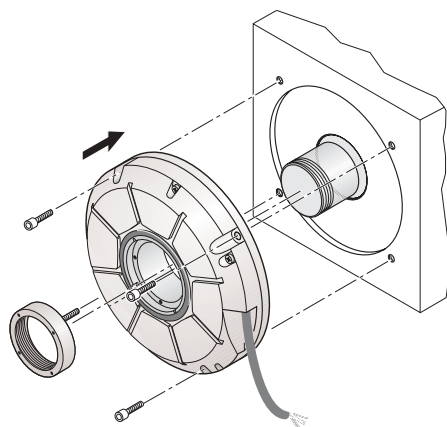
Absolute angle encoders and rotary encoders from HEIDENHAIN provide the position values over an **EnDat, SSI, PROFIBUS-DP or other serial data interface**. The EnDat or PROFIBUS-DP bidirectional interfaces enable automatic configuration of the higher-level electronics and provide monitoring and diagnostic functions.

Angle Encoders		Series	Page
with integral bearing and integrated stator coupling	Absolute (singleturn) Incremental	RCN RON, RPN	22
with integral bearing, for separate shaft coupling	Incremental	ROD	24
without integral bearing	Incremental	ERP, ERO, ERA, ERM	25, 26
Rotary Encoders			
with integral bearing, for mounting by stator coupling	Absolute (singleturn) Absolute (multiturn) Incremental	ECN EQN ERN	28, 30
with integral bearing, for separate shaft coupling	Absolute (singleturn) Absolute (multiturn) Incremental	ROC ROQ ROD	32
without integral bearing	Absolute (singleturn) Absolute (multiturn) Incremental	ECI EQI ERO	34

RCN, RON, RPN Angle Encoders

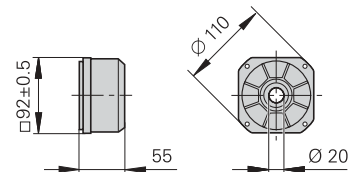
with integral bearing and integrated stator coupling

Because of their high static and dynamic accuracy, the **RCN, RON** and **RPN** angle encoders with integral bearings and stator couplings are the preferred units for high-precision applications such as rotary tables and tilting axes. 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.



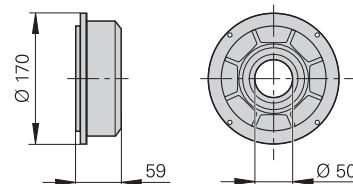
RCN/RON 200 series

- **Compact dimensions**
- Sturdy design
- Typically used with rotary tables, tilting tables, for positioning and speed control
- Measuring steps as fine as 0.0001°
- Versions in stainless steel (e.g. for antennas) available on request

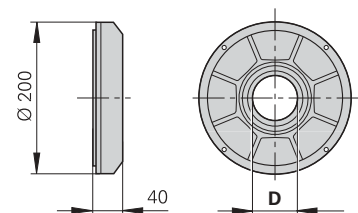


RCN/RON 700 and RCN/RON/RPN 800 series

- **Large hollow-shaft diameter**
up to $\varnothing 100$ mm
- Measuring steps to 0.00001° with system accuracy grades of $\pm 2''$ and $\pm 1''$
- Typically used on rotary and angle measuring tables, indexing fixtures, measuring setups, image scanners
- Versions in stainless steel (e.g. for antennas) available on request



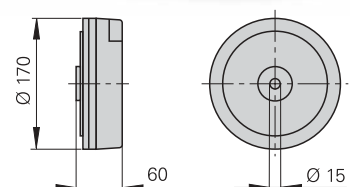
RON 785








RON 786/886, RPN 886 D = 60 mm
RCN 700/800 D = 60 mm or 100 mm

RON 905



- **Very high-accuracy angle encoder**
- Measuring steps as fine as 0.00001°
- System accuracy $\pm 0.4''$
- Used with high-accuracy measuring devices and for the inspection of measuring equipment



	Absolute			Incremental			
	RCN 226	RCN 223 F	RCN 223 M	RON 225	RON 275	RON 285	RON 287
Incremental signals	 1 V _{PP}	–		 TTL x 2	 TTL x 5  TTL x 10	 1 V _{PP}	
Line count Signal periods/rev.	16384	–		9000 18000	18000		
Absolute position values	EnDat 2.1 ¹⁾	Fanuc 01	Mitsubishi 01	–			
Position values/rev.	67 108 864 (26 bits)	8 388 608 (23 bits)		–			
System accuracy	± 5″/± 2.5″			± 5″			± 2.5″
Recommended measuring step ²⁾	0.0001°			0.005°	0.001° 0.0005°	0.0001°	
Mech. perm. speed	≤ 3000 rpm			≤ 3000 rpm			

¹⁾ PROFIBUS-DP via gateway

²⁾ For position measurement


	Absolute			Incremental		
	RCN 729 RCN 829	RCN 727 F RCN 827 F	RCN 723 M RCN 823 M	RON 786 RON 785	RON 886	RPN 886
Incremental signals	 1 V _{PP} ⁴⁾	–		 1 V _{PP}		
Line count Signal periods/rev.	32 768 ⁴⁾	–		18000, 36000 ³⁾	36000	90000 180000
Absolute position values	EnDat 2.2 ¹⁾	Fanuc 02	Mitsubishi 01	–		
Position values/rev.	536 870 912 (29 bits)	134 217 728 (27 bits)	8 388 608 (23 bits)	–		
System accuracy	RCN 72x: ± 2" RCN 82x: ± 1"			± 2"	± 1"	
Recommended measuring step²⁾	0.0001°/0.00005°			0.0001°	0.00005°	0.00001°
Mech. perm. speed	≤ 1000 rpm			≤ 1000 rpm		

¹⁾ PROFIBUS-DP via gateway

²⁾ For position measurement

³⁾ Only for RON 786

⁴⁾ Only for EnDat 2.2/02

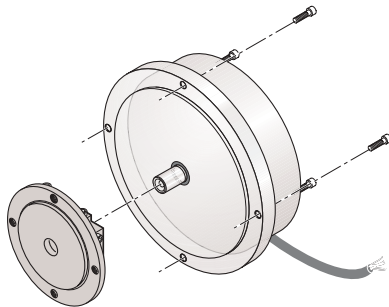
	Incremental
	RON 905
Incremental signals	 11 μA _{PP}
Line count	36 000
System accuracy	± 0.4"
Recommended measuring step	0.00001°
Mech. perm. speed	≤ 100 rpm

ROD Angle Encoders

with integral bearing, for separate shaft coupling

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

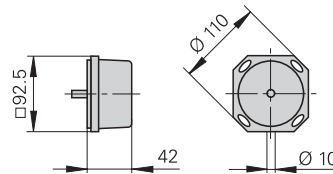
For angle encoders with separate shaft coupling, the angular measuring error caused by the shaft coupling must be added to determine the system accuracy.



ROD 200 series

• Compact dimensions

- Sturdy design
- Typically used with rotary tables, tilting tables, for positioning and synchronization monitoring
- Measuring steps as fine as 0.0001°



	Incremental ROD 260	ROD 270	ROD 280
Incremental signals	□ TTL	□ TTL x 10	~ 1 V _{PP}
Line count	18000		
System accuracy¹⁾	$\pm 5''$		
Recommended measuring step²⁾	0.005°	0.0005°	0.0001°
Mech. perm. speed	$\leq 10\,000$ rpm		

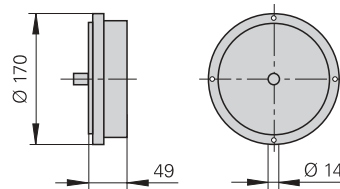
¹⁾ Without coupling

²⁾ For position measurement

ROD 780 and ROD 880

• High accuracy

- $\pm 2''$ (ROD 780) or $\pm 1''$ (ROD 880)
- Measuring steps as fine as $0.000\,05^\circ$
- Ideal for angle measurement on high-precision rotary tables, dividing apparatuses or measuring machines



	Incremental ROD 780	ROD 880
Incremental signals	~ 1 V _{PP}	
Line count	18000, 36000	36000
System accuracy¹⁾	$\pm 2''$	$\pm 1''$
Recommended measuring step²⁾	0.0001°	0.00005°
Mech. perm. speed	≤ 1000 rpm	

¹⁾ Without coupling

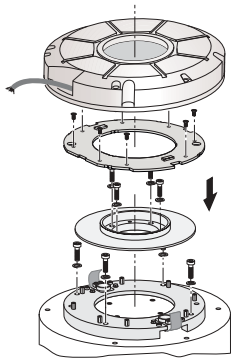
²⁾ For position measurement

ERP, ERO Angle Encoders

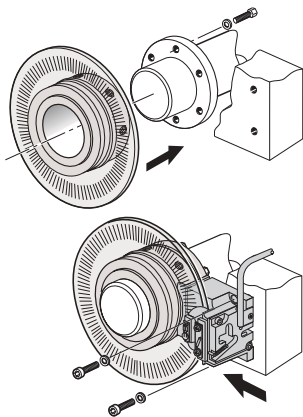
without integral bearing

The HEIDENHAIN **ERP** and **ERO** 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 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.



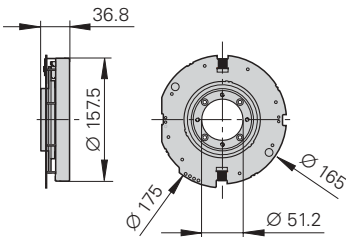
Mounting — ERP



ERO 785

ERP 880

- **Very high accuracy**
- Very fine grating period
- Low error within one signal period thanks to the interferential scanning principle
- Housing with connecting cable as accessory



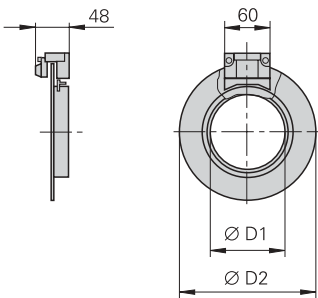
ERP 880 with housing

	Incremental ERP 880
Incremental signals	~ 1 V _{pp}
Line count	90 000 (180 000 signal periods)
System accuracy ¹⁾	± 1"
Recmd. meas. step ²⁾	0.000 01°
Mech. perm. speed	≤ 1000 rpm

¹⁾ Before installation; additional error is caused by imprecise mounting and the bearing
²⁾ For position measurement

ERO 785

- **High accuracy**
- DIADUR graduation on glass disk



	Incremental ERO 785		
Incremental signals	~ 1 V _{pp}		
Line count	36 000		
System accuracy ¹⁾	± 4.2"	± 3"	± 2.2"
Recmd. meas. step ²⁾	0.0001°		
Diameter D1/D2	47.2 mm/129.9 mm	102.2 mm/182 mm	155.1 mm/256.9 mm
Mech. perm. speed	≤ 8000 rpm	≤ 6000 rpm	≤ 4000 rpm

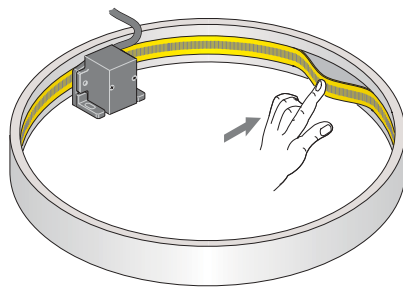
¹⁾ Before installation; additional error is caused by imprecise mounting and the bearing
²⁾ For position measurement

ERA Angle Encoders without integral bearing

The HEIDENHAIN **ERA** angle encoders without integral bearing 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 with scale tape)
- High shaft speeds up to 20 000 rpm
- No additional starting torque from shaft seals

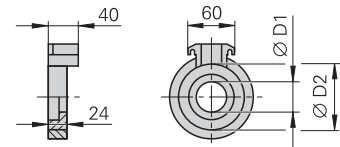
The attainable system accuracy depends on the eccentricity of the graduation to the drive shaft bearing, as well as the radial runout and wobble of the bearing.



ERA 780C

ERA 180

- **High shaft speeds** up to 20 000 rpm
- Sturdy design with solid steel scale drum
- Axial motion of drive shaft permissible up to ± 0.5 mm
- Typically used for direct mounting on high-speed spindles and ball screws



ERA 700 and ERA 800 series

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

ERA 700 series

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

- **ERA 780C:** full circle
- **ERA 781C:** segment

ERA 800 series

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

- **ERA 880C:** full circle
- **ERA 881C:** segment, scale tape secured with tensioning elements
- **ERA 882C:** segment, scale tape secured without tensioning elements



ERA 880C

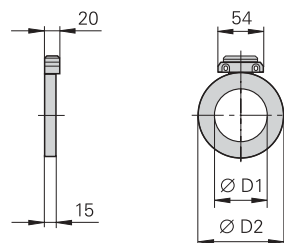
ERA 781 C, ERA 881 C, ERA 882 C:
Segments with 5000, 10 000 or 20 000 grating periods for various diameters and segment angles

ERM Modular Rotary Encoder without integral bearing

The **ERM** modular encoder from HEIDENHAIN consists of a magnetized scale drum and a scanning unit with magnetoresistive sensor. Typical applications include machines and equipment with **large hollow shaft diameters** in environments with large amounts of airborne particles and liquids, for example on the spindles of lathes or milling machines, for reduced accuracy requirements.

ERM 280

- **For large shaft diameters** up to 410 mm
- **High degree of protection** IP 67 through magnetoresistive scanning principle

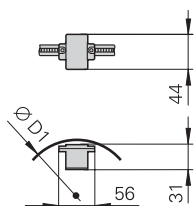


	Incremental						
	ERA 180						
Incremental signals	$\sim 1 V_{PP}$						
Line count	6000	9000	18000	36000			
System accuracy ¹⁾	$\pm 7.5''$	$\pm 5''$	$\pm 4''$	$\pm 2.5''$			
Recommended measuring step ²⁾	0.0015°	0.001°	0.0005°	0.0001°			
Inside diameter D1 Outside diameter D2	40 mm 80 mm	80 mm 130 mm	120 mm 180 mm	180 mm 250 mm	270 mm 330 mm	425 mm 485 mm	512 mm 562 mm
Shaft speed ³⁾	≤ 20000 rpm	≤ 14500 rpm	≤ 11000 rpm	≤ 7500 rpm	≤ 5500 rpm	≤ 3500 rpm	≤ 3000 rpm

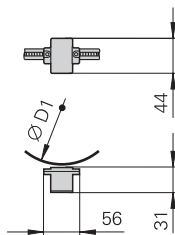
¹⁾ Before installation. Additional error is caused by imprecise mounting and the bearing.

²⁾ For position measurement


³⁾ Fatigue strength (10^7 change of load) according to FKM guidelines



ERA 780



ERA 880

	Incremental				
	ERA 780C			ERA 880C	
Incremental signals/ Signal period	 1 V _{PP} 40 μm (on circumference)				
Line count	36000	45000	90000	36000	45000
System accuracy ¹⁾	± 3.5″	± 3.4″	± 3.2″	± 3.5″	± 3.4″
Recommended measuring step ²⁾	0.0001° to 0.00002°				
Diameter D1	458.62 mm	573.20 mm	1146.10 mm	458.04 mm	572.63 mm
Mech. perm. speed	≤ 500 rpm			≤ 100 rpm	

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

²⁾ For position measurement

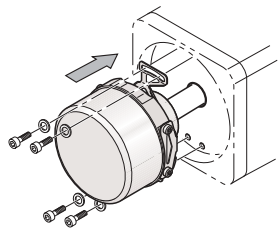
	Incremental							
	ERM 280							
Incremental signals	$\sim 1 V_{PP}$							
Line count	600	900	1024	1200	1400	2048	2600	3600
Shaft speed ¹⁾	≤ 19000 rpm	≤ 14500 rpm	≤ 13000 rpm	≤ 10500 rpm	≤ 9000 rpm	≤ 6000 rpm	≤ 4500 rpm	≤ 3000 rpm
Inside diameter D1 Outside diameter D2	40 mm 75.44 mm	70 mm 113.16 mm	80 mm 128.75 mm	120 mm 150.88 mm	130 mm 176.03 mm	180 mm 257.5 mm	295 mm 326.9 mm	410 mm 452.64 mm

¹⁾ Fatigue strength (10^7 change of load) according to FKM guidelines. Higher speeds with other drum versions on request.

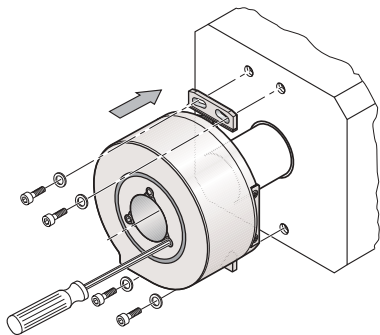
ECN, EQN, ERN Rotary Encoders

with integral bearing and mounted stator coupling
Protection IP 64

HEIDENHAIN **ECN**, **EQN** and **ERN** rotary encoders with integral bearing and mounted stator coupling are characterized by 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.



ERN 1000
ECN/EQN/ERN 400

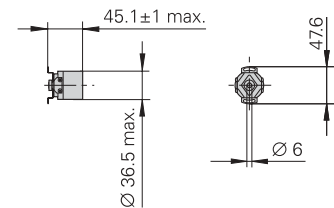


ECN/ERN 100

ERN 1000 series

• Miniaturized version

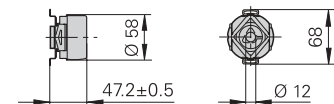
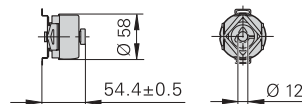
- Blind hollow shaft with 6-mm inside diameter
- Housing outside diameter: 36.5 mm
- Natural frequency of the encoder stator coupling: ≥ 950 Hz
- Mechanically permissible speed: 10 000 rpm



ECN/EQN/ERN 400 series

• Compact dimensions

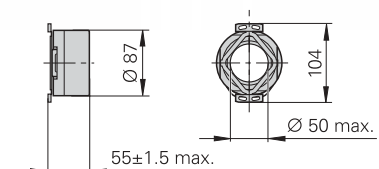
- Blind hollow shaft or hollow through shaft with 12-mm inside diameter
- Housing outside diameter: 58 mm
- Natural frequency of the encoder stator coupling: ≥ 1250 Hz
- Mechanically permissible speed: 12 000 rpm (EQN: 10 000 rpm)








ECN/ERN 100 series

• For large shaft diameters



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



	Incremental			
	ERN 1020	ERN 1030	ERN 1080	ERN 1085
Incremental signals			$\sim 1 V_{PP}$	
Line count	100 to 3600			512 or 2048
Commutation signals	–			1 sine and 1 cosine signal with 1 period per revolution (Z1 track)
Power supply	5 V	10 to 30 V	5 V	
Operating temperature	Max. 100 °C	Max. 70 °C	Max. 100 °C	

	Absolute				Incremental			
	ECN 413	EQN 425	ECN 425	EQN 437	ERN 420	ERN 430	ERN 460	ERN 480
Incremental signals	$\sim 1 V_{PP}$		–					$\sim 1 V_{PP}$
Line count	512 or 2048		–		250 to 5000			1000 to 5000
Absolute position values	EnDat 2.1 ¹⁾ or SSI		EnDat 2.2		–			
Position values/rev.	8192 (13 bits)		33 554 432 (25 bits)		–			
Distinguishable revolutions	–	4096 (12 bits)	–	4096 (12 bits)	–			
Power supply	EnDat: 5 V SSI: 5 V or 10 to 30 V		3.6 to 5.25 V		5 V	10 to 30 V		5 V
Operating temperature	5 V: max. 100 °C 10 to 30 V: max. 85 °C		Max. 100 °C		Max. 100 °C		Max. 70 °C	Max. 100 °C

¹⁾ PROFIBUS-DP via gateway

	Absolute		Incremental		
	ECN 113	ECN 125	ERN 120	ERN 130	ERN 180
Incremental signals	$\sim 1 V_{PP}$	–			$\sim 1 V_{PP}$
Line count	2048	–	1000 to 5000		
Absolute position values	EnDat 2.1 ¹⁾ or SSI	EnDat 2.2	–		
Position values/rev.	8192 (13 bits)	33 554 432 (25 bits)	–		
Power supply	5 V ²⁾	3.6 to 5.25 V	5 V	10 to 30 V	5 V
Operating temperature	Max. 100 °C		Max. 100 °C	Max. 100 °C (U _P ≤ 15 V) Max. 85 °C (U _P ≤ 30 V)	Max. 100 °C

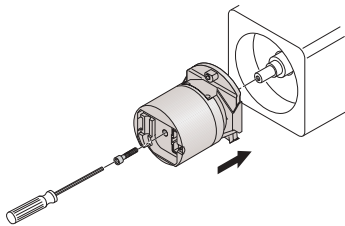
¹⁾ PROFIBUS-DP via gateway

²⁾ 10 to 30 V via connecting cable with voltage converter (only SSI)

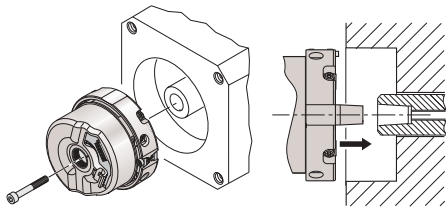
ECN, EQN, ERN Rotary Encoders

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

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



ERN/ECN/EQN 1100



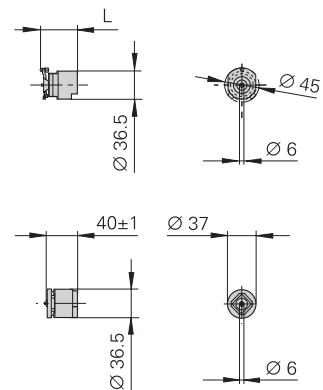
ERN/ECN/EQN 1300

ECN/EQN/ERN 1100 series

- **Miniaturized version**
- Blind hollow shaft $\varnothing 6$ mm
- Housing outside diameter 36.5 mm
- Stator coupling in two versions for location holes with inside diameters
 - of **45 mm**
 - of **37 mm** (only ECN 1113/EQN 1125)
- Natural frequency of the encoder stator coupling: ≥ 1500 Hz
- Mech. permissible speed 12 000 rpm

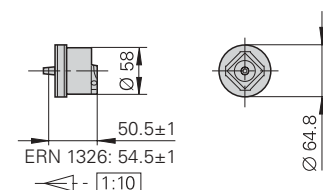





ERN: $L = 52.2 \pm 1$
ECN/EQN: $L = 54.8 \pm 1$






ECN/EQN/ERN 1300 series

- **Compact dimensions**
- 1:10 taper shaft with 9.25 mm functional diameter for extremely stiff connection
- Housing outside diameter: 58 mm
- The stator coupling is suited for location bores with 65-mm inside diameter
- Natural frequency of the encoder stator coupling: ≥ 1750 Hz
- Mech. permissible speed
 - ERN/ECN: 15 000 rpm
 - EQN: 12 000 rpm
- IP 30 protection when not mounted



	Absolute		Incremental		
	ECN 1113	EQN 1125	ERN 1120	ERN 1180	ERN 1185
Incremental signals	 1 V _{PP}			 1 V _{PP}	
Line count	512		1024 2048 3600		512 or 2048
Commutation signals	–		–		1 sine and 1 cosine signal with 1 period per revolution (Z1 track)
Absolute position values	EnDat 2.1 ¹⁾		–		
Position values/rev.	8192 (13 bits)		–		
Distinguishable revolutions	–	4096 (12 bits)	–		
Power supply	5 V		5 V		
Operating temperature	Max. 115 °C		Max. 100 °C		Max. 115 °C

¹⁾ PROFIBUS-DP via gateway

	Absolute				Incremental			
	ECN 1313	EQN 1325	ECN 1325	EQN 1337	ERN 1321	ERN 1326	ERN 1381	ERN 1387
Incremental signals	 1 V _{PP}		–				 1 V _{PP}	
Line count	512 or 2048		–		1024 2048 4096		512 2048 4096	2048
Commutation signals	–		–		–	Block commutation ²⁾	–	Z1 track ³⁾
Absolute position values	EnDat 2.1 ¹⁾		EnDat 2.2		–			
Position values/rev.	8192 (13 bits)		33 554 432 (25 bits)		–			
Distinguishable revolutions	–	4096 (12 bits)	–	4096 (12 bits)	–			
Power supply	5 V		3.6 to 5.25 V		5 V			
Operating temperature	Max. 115 °C		Max. 115 °C		Max. 120 °C			

¹⁾ PROFIBUS-DP via gateway

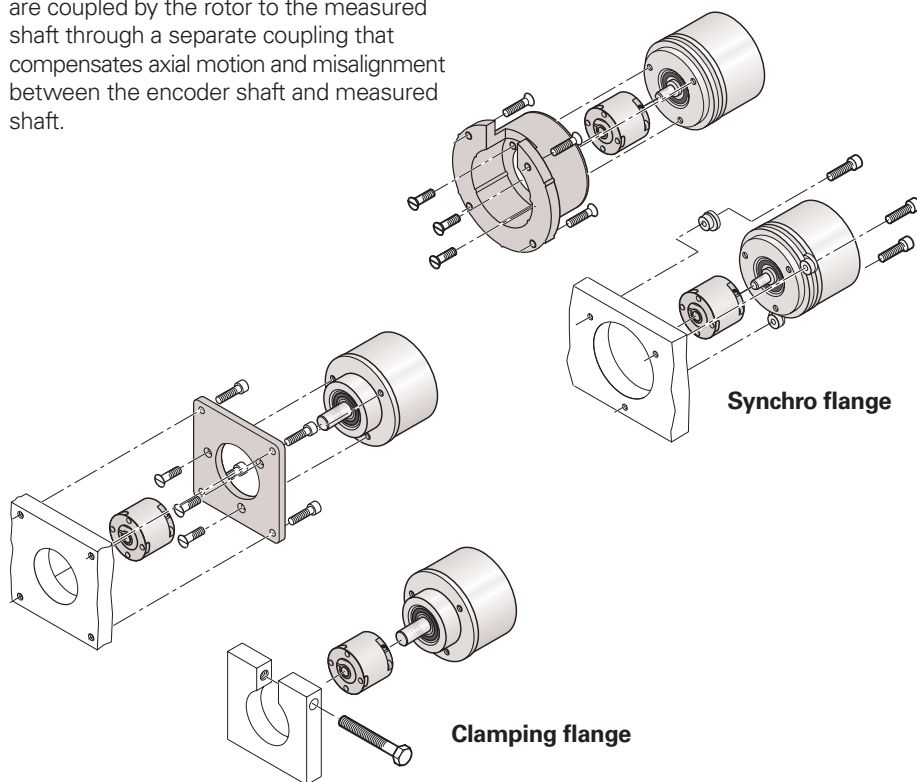
²⁾ 3 block commutation tracks with 90° or 120° mech. phase shift

³⁾ 1 sine and 1 cosine signal with 1 period per revolution

ROC, ROQ, ROD Rotary Encoders

with integral bearing, for separate shaft coupling

ROC, ROQ and ROD rotary encoders from HEIDENHAIN have integrated bearings and are sealed, providing IP 64 to IP 67 protection, depending on the version. They are robust and compact. These encoders are coupled by the rotor to the measured shaft through a separate coupling that compensates axial motion and misalignment between the encoder shaft and measured shaft.






ROD 1000 series

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

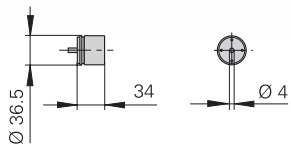
ROC/ROQ/ROD 400 series

- **Industrial standard** for dimensions and output signals
- Degree of protection
IP 67 at housing
IP 64 at shaft end (IP 66 available on request)
- Mounting by synchro flange or clamping flange
- Shaft diameter
6 mm with synchro flange
(except ROC 415/417: Ø 10 mm)
10 mm with clamping flange
- Preferred types with fast delivery (see *Rotary Encoders* brochure or ask HEIDENHAIN)

	Absolute Singleturn							
Synchro flange	ROC 410	ROC 412	ROC 413			ROC 425	ROC 415	ROC 417
Clamping flange	–		ROC 413			ROC 425	–	
Incremental signals	 1 V _{PP}		 1 V _{PP}		–		 1 V _{PP}	
Line counts/ Signal periods	512		512		–		8192	
Absolute position values	SSI		EnDat 2.1 ¹⁾	SSI	PROFIBUS-DP	EnDat 2.2	EnDat 2.1 ¹⁾	
Positions per revolution	1024 (10 bits)	4096 (12 bits)	8192 (13 bits)			33 554 432 (25 bits)	32 768 (15 bits)	131 072 (17 bits)
Distinguishable revolutions	–							
Power supply	5 V or 10 to 30 V		5 V	5 V or 10 to 30 V	10 to 30 V	3.6 to 5.25 V	5 V	
Max. operating temperature	5 V: 100 °C 10 to 30 V: 85 °C		100 °C	5 V: 100 °C 10 to 30 V: 85 °C	60 °C	100 °C	80 °C	

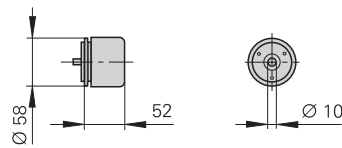
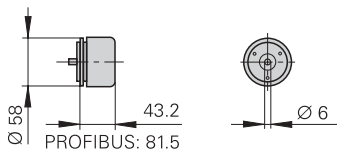
¹⁾ PROFIBUS-DP via Gateway

²⁾ Signal periods over 5000 are generated through signal doubling in the encoder

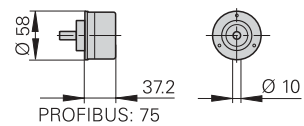


	Incremental		
	ROD 1020	ROD 1030	ROD 1080
Incremental signals			1 V _{PP}
Line count	100 to 3600		
Mech. perm. speed	10 000 rpm		
Power supply	5 V	10 to 30 V	5 V
Operating temperature	Max. 100 °C	Max. 70 °C	Max. 100 °C

With synchro flange



With clamping flange



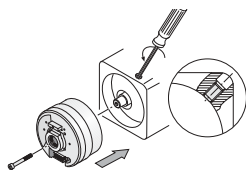
Multiturn				Incremental		
				ROD 426	ROD 466	ROD 436
ROQ 425	ROQ 437	ROD 426	ROD 466	ROD 436	ROD 486	
ROQ 425	ROQ 437	ROD 420	–	ROD 430	ROD 480	
1 V _{PP}	–			1 V _{PP}		
512	–	50 to 5000 ROD 426/466: Up to 10 000 ²⁾		1000 to 5000		
EnDat 2.1 ¹⁾	SSI	PROFIBUS-DP	EnDat 2.2	–		
8192 (13 bits)	33 554 432 (25 bits)	–				
4096 (12 bits)	–					
5 V	5 V or 10 to 30 V	10 to 30 V	3.6 to 5.25 V	5 V	10 to 30 V	5 V
100 °C	5 V: 100 °C 10 to 30 V: 85 °C	60 °C	100 °C	100 °C	70 °C	100 °C

ECI, EQI, ERO Rotary Encoders

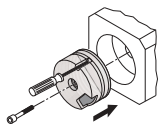
without integral bearing

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

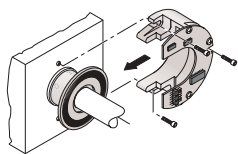
The photoelectric **ERO** modular rotary encoders from HEIDENHAIN consist of a graduated disk with hub and a scanning unit. They are particularly well suited for **limited installation space** or for applications for which there must be **no friction**.



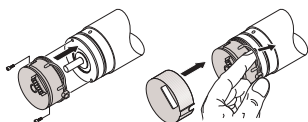
ECI/EQI 1100



ECI/EQI 1300



ERO 1200/1300



ERO 1400

ECI/EQI 1100 series

- Mechanically compatible with ECN/EQN 1100
- Blind hollow shaft Ø 6 mm



ECI/EQI 1300 series

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



ERO 1200 series

- Compact dimensions
- For shaft diameters up to 12 mm



ERO 1300 series

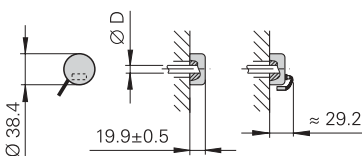
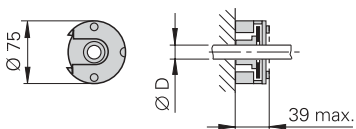
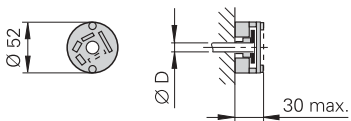
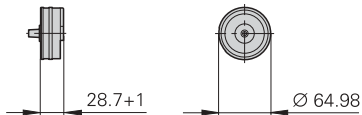
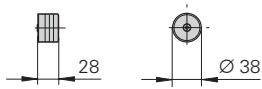
- For **large shaft diameters** up to 30 mm
- Lateral mounting of scanning unit possible with through shaft



ERO 1400 series

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





	Absolute			
	ECI 1116	EQI 1128	ECI 1317	EQI 1329
Incremental signals	–		~ 1 V _{PP} ; 32 lines	
Absolute position values	EnDat			
Position values/rev.	65 536 (16 bits)		131 072 (17 bits)	
Distinguishable revolutions	–	4096 (12 bits)	–	4096 (12 bits)
Mech. perm. speed	12 000 rpm		15 000 rpm	12 000 rpm
Shaft	Blind hollow shaft		Taper shaft or blind hollow shaft	

	Incremental			
	ERO 1225	ERO 1285	ERO 1324	ERO 1384
Incremental signals	□ TTL	~ 1 V _{PP}	□ TTL	~ 1 V _{PP}
Line count	1024 2048		1024 2048 5000	
Mech. perm. speed	25 000 rpm		16 000 rpm	
Shaft diameter D	Ø 10, 12 mm		Ø 20, 30 mm	

	Incremental		
	ERO 1420	ERO 1470	ERO 1480
Incremental signals	□ TTL	□ TTL ¹⁾	~ 1 V _{PP}
Line count	512 1000 1024	1000 1500	512 1000 1024
Mech. perm. speed	30 000 rpm		
Shaft diameter D	Ø 4, 6, 8 mm		

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

Machine Tool Control

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

TNC contouring controls from HEIDENHAIN for milling, drilling, boring machines and machining centers cover the whole range of applications:

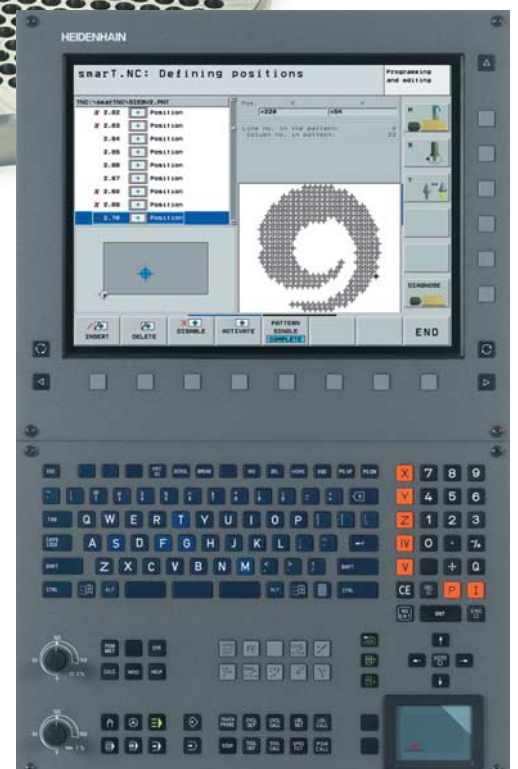
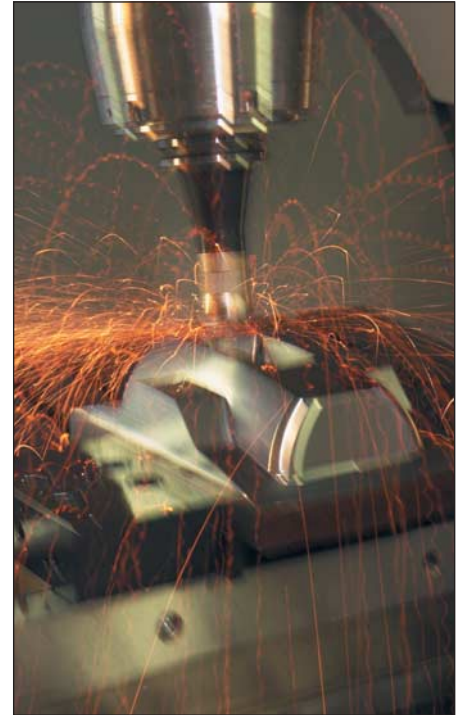
From the simple, compact TNC 320 3-axis control to the iTNC 530 (up to 13 axes plus spindle)—there's a HEIDENHAIN TNC control for nearly every application.

Besides these TNCs, HEIDENHAIN also supplies controls for other areas of application, such as lathes.

HEIDENHAIN TNCs are versatile, featuring both **shop-floor programming**, and **offline programming**, and are therefore ideal for **automated production**.

They handle simple milling tasks just as reliably as the iTNC 530, for example, can perform **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.



Shop-floor programming

HEIDENHAIN controls are workshop oriented, which means that they were conceived to be **programmed** by the machinist **right 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.

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



Frequently recurring machining sequences are saved as **fixed cycles**.

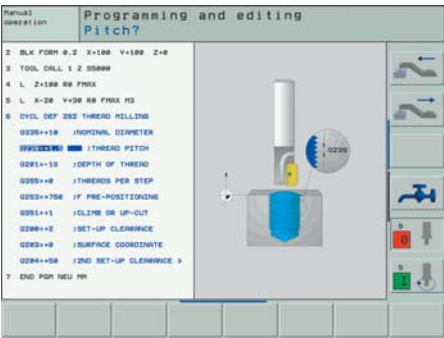
Graphic illustrations simplify programming and provide valuable aid for verifying the program during test runs.

The new **smarT.NC** operating mode makes programming even easier. With the well-thought-out input forms, you can create your NC program even faster. Of course you'll be aided by help graphics. As always, HEIDENHAIN has placed great value on compatibility. At any time, you can switch from smarT.NC to conversational and back. But not only can you write programs with smarT.NC—you can test and run them as well.

HEIDENHAIN controls excel not only through their conversational programming. You can also write programs in ISO 6983 (DIN 66025) or download and run them through the data interface.

DXF import of contours (option)

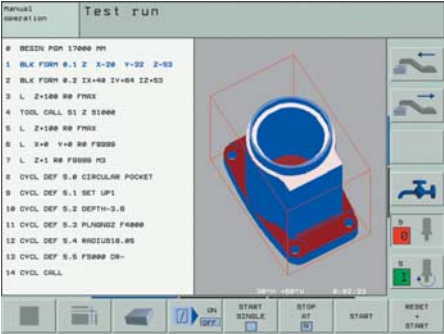
Why program complex contours when your drawing is already in DXF format anyway? You can now open DXF files created in a CAD system directly on the iTNC 530 to extract contours. Not only does this save time otherwise spent on programming and testing, but you can also be sure that the finished contour is exactly according to the designer's specifications.



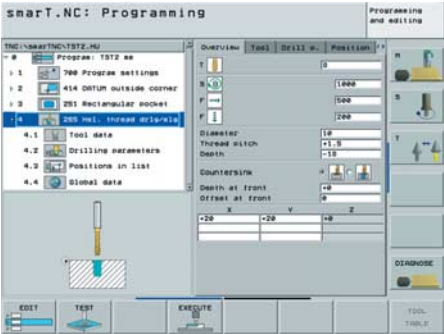
Conversational programming



Key symbols



Graphic support



smarT.NC: Programming made simple

HEIDENHAIN Contouring Controls		Series	Page
for milling, drilling, boring machines and machining centers for simple milling, drilling and boring machines	Up to 11 axes plus spindle	iTNC 530	38
	3 axes plus spindle	TNC 320	42
Accessories	Electronic handwheels	HR	43
	Programming station	iTNC	43

iTNC 530 Contouring Control

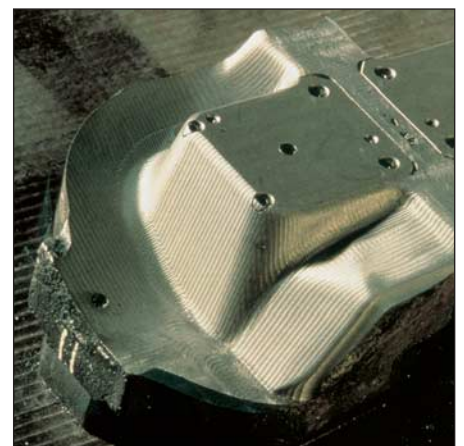
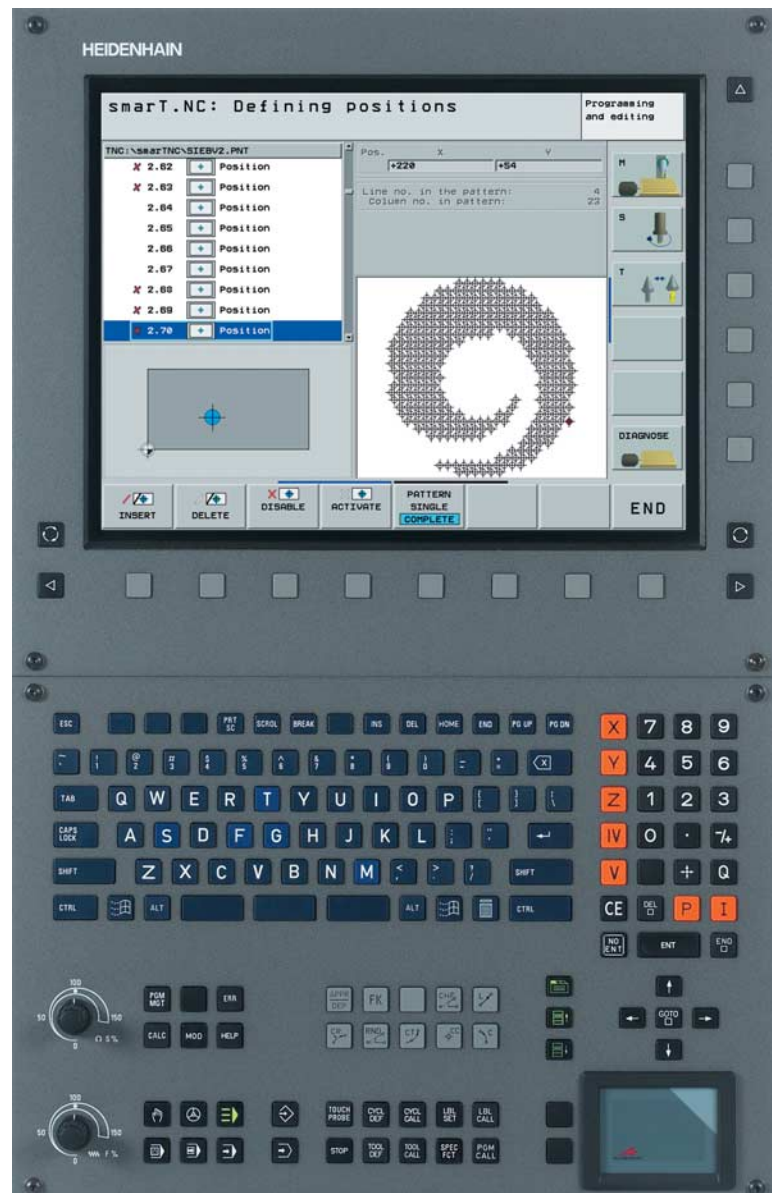
for milling, drilling, boring machines and machining centers

The iTNC 530 from HEIDENHAIN is a versatile, workshop-oriented contouring control for milling, drilling and boring machines as well as machining centers.

It features an integrated digital drive control with integrated inverter, which enables it to produce a highly accurate workpiece contour while machining at high velocity.

The iTNC 530 controls up to 13 axes plus spindle. The block processing time is 0.5 ms. A hard disk serves as program memory medium.

The iTNC 530 hardware option with two processors additionally features the Windows 2000 operating system as a user interface, enabling the use of standard Windows applications.



High speed milling with the iTNC 530

The iTNC 530's special drive strategies enable very high machining speeds with the greatest possible contouring accuracy.

High contour accuracy at high feed rates

The control loop of the iTNC 530 is fast and it "looks ahead." Like all TNC contouring controls from HEIDENHAIN, the iTNC 530 features velocity feedforward control, which means that it can machine with a very small following error of only a few microns.

The integrated motor control has further improved contour accuracy, both through digital control technology and the additional acceleration feedforward capability. This also improves the machine's dynamic performance, with following error approaching zero. The benefit to you is dramatically improved geometrical accuracy, particularly when milling small radii at high speeds.

High speed spindle speeds

High surface-cutting speeds require accordingly high spindle speeds. The iTNC 530 can digitally control rotational speeds up to 40 000 rpm.

Machining 2-D contours or 3-D surfaces at high feed rates

The iTNC 530 provides the following important features for machining contours:

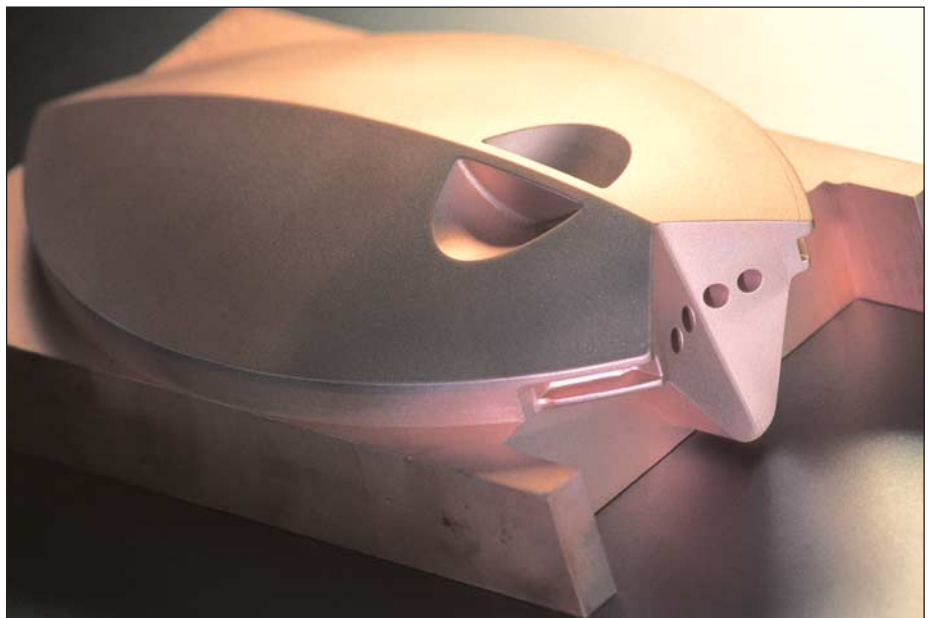
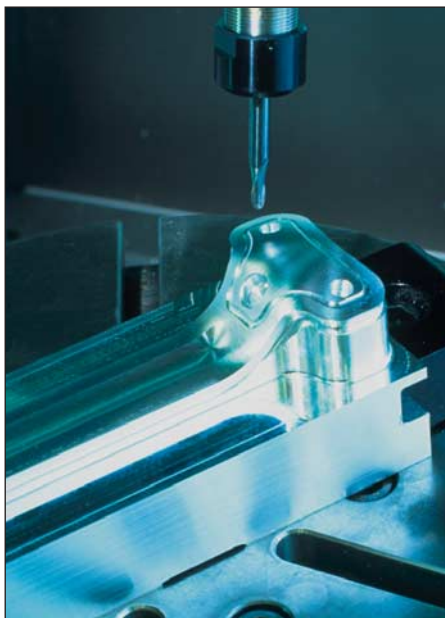
- The iTNC's ability to limit and reduce jerk ensures smoother acceleration and optimum motion control—both during workpiece approach, on the contour, and at corners.
- When running long programs from the hard disk, the iTNC has a short block processing time of only 0.5 ms. This means that the iTNC can even mill contours made of 0.1 mm line segments at feed rates as high as 12 meters per minute.
- The iTNC looks ahead up to 1024 blocks into the part program to ensure a steady traversing speed even over a large number of very short contour elements.
- The iTNC can automatically smoothen discontinuous contour transitions—and you define the desired tolerance range. The iTNC mills smoother surfaces without risking dimensional tolerances.

Dynamic Collision Monitoring Option (DCM)

Since axis movements in 5-axis machining operations are very difficult to predict, and the traverse speeds of NC axes continue to increase, collision monitoring is a useful function for relieving the machine operator and avoiding damage to the machine.

The iTNC 530 cyclically monitors the working space of the machine for possible collisions with machine components. The machine manufacturer defines these machine components within the kinematics description as collision objects.

The control outputs an error message in time before a collision with machine components can occur. The machine operator can then retract the axes.



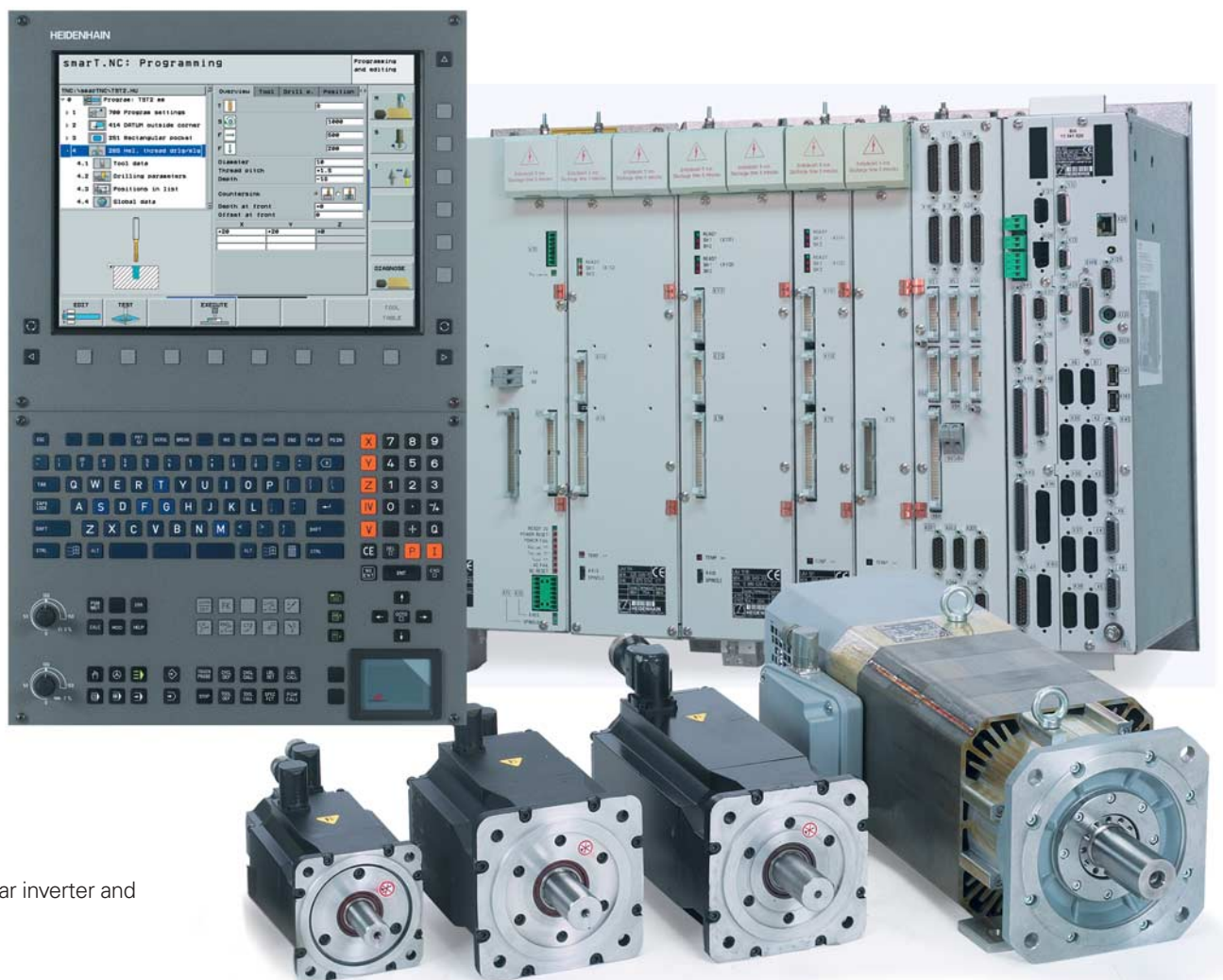
Digital drive control

High surface definition, high contouring accuracy of the finished workpiece, and short machining times—these requirements can be met only with digital drive concepts. For **integrated drive control**, HEIDENHAIN offers the iTNC 530. 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 55 kW. The modular inverters are suitable for machines with up to 13 axes and a spindle with maximum power of 35 kW.

Feed motors of 1.5 Nm to 62.5 Nm and **spindle motors** of 5.5 kW to 32 kW are available for connection to HEIDENHAIN inverters.



iTNC 530
with modular inverter and
motors

TNC contouring controls	iTNC 530
Axes	Up to 13 plus spindle, or 12 plus 2 spindles
Interpolation	<ul style="list-style-type: none"> • Linear in max. 5 axes (with Tool Center Point Management) • Circular in max. 3 axes with tilted working plane • Spline interpolation in max. 5 axes • Helix • Cylinder surface¹⁾ • Rigid tapping¹⁾
Program entry	In HEIDENHAIN conversational format, with smarT.NC and according to ISO
DXF import (option)	Downloading contours from DXF files
Program memory	Hard disk
Position data coordinates	Nominal positions in Cartesian or polar coordinates, dimensions absolute or incremental, in mm or inches; actual position capture
Input resolution and display step	To 0.1 µm or 0.0001°
Block processing time	0.5 ms (3-D straight line without radius compensation at 100% PLC utilization)
High speed cutting	Motion control with minimum jerk
FK free contour programming	HEIDENHAIN conversational with graphical support
Tilting the working plane	With the powerful PLANE function
Fixed cycles	For drilling and milling; data input with graphical support
Touch probe cycles	For tool measurement, workpiece alignment, workpiece measurement and datum setting
Graphics	For programming and program verification
Cutting data tables	Yes
Parallel operation	Program run and programming with graphics
Data interface	<ul style="list-style-type: none"> • RS-232-C/V.24 and RS-422/V.11 (max. 115 200 bauds) • Ethernet 100BaseT
Remote control and diagnosis	TeleService
Visual display unit	15-inch color flat-panel display (TFT)
Axis control	<ul style="list-style-type: none"> • Feedforward control or following error • Integrated digital drive control with integrated inverter
DCM – Dynamic Collision Monitoring (option)	Monitoring the working space for possible collisions with machine components
Integral PLC	Approx. 16 000 logic commands
Accessories	<ul style="list-style-type: none"> • Electronic handwheel • Triggering 3-D touch probes TS 220, TS 440 or TS 640 and TT 130
Dual-processor version (option)	With additional Windows 2000 operating system as user interface

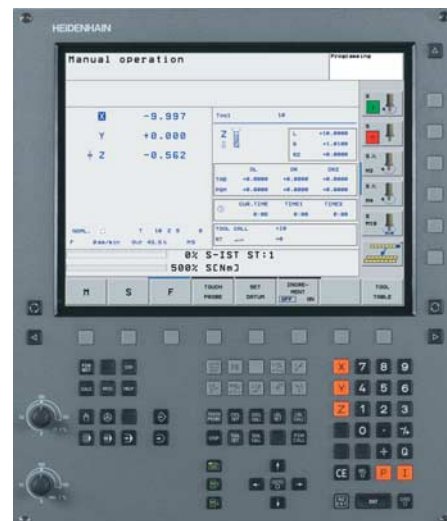
¹⁾ This feature must be implemented by the machine tool builder

TNC 320 Contouring Control

for simple milling, drilling and boring machines

The TNC 320 is a compact workshop-oriented contouring control with TFT color flat-panel display and TNC control keys. The powerful main computer, the display unit and the TNC operating panel are all contained in one unit. A maximum of four (optionally 5) drives can be controlled via the analog speed command interface.

The user programs the control directly at the machine in HEIDENHAIN conversational format, with practice-oriented fixed cycles. Convenient graphical illustrations on the screen provide additional guidance during programming.



	TNC 320
Axes	3 closed-loop axes plus servo-controlled spindle S
Options	4 closed-loop axes plus non-controlled spindle S or (optionally with hardware expansion) 4 closed-loop axes plus servo-controlled spindle S or 5 closed-loop axes plus non-controlled spindle S
Interpolation	<ul style="list-style-type: none"> • Linear in max. 4 axes • Circular in max. 2 axes • Helix, superimposition of circular and straight paths
Program entry	HEIDENHAIN conversational
Program memory	10 MB
Input resolution and display step	To 0.1 µm or 0.0001°
Block processing time	6 ms
Display	15.1-inch TFT color flat-panel display (1024 x 768 pixels)
Fixed cycles	Drilling, tapping, thread milling, reaming and boring, cycles for hole patterns (bolt hole circle and linear hole pattern), multipass milling of plane surfaces, roughing and finishing pockets, slots and studs
Touch probe cycles	For datum setting and workpiece alignment
Graphics	Programming graphics, verification graphics, graphic support for cycle programming
Parallel operation	With graphical support
Data interfaces	<ul style="list-style-type: none"> • Ethernet 100 BaseT • USB 1.1 • RS-232-C/V.24
Integral PLC	10 MB memory for PLC program 52 PLC inputs 31 PLC outputs (expandable by PL 510, max. 4)
	Symbolic operands
Accessories	<ul style="list-style-type: none"> • HR 410 electronic handwheel • TS 220, TS 440 or TS 640 workpiece touch probe



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 and HR 420 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 420 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.



HR 420

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 built-in 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

iTNC Programming Station

With the iTNC programming station 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

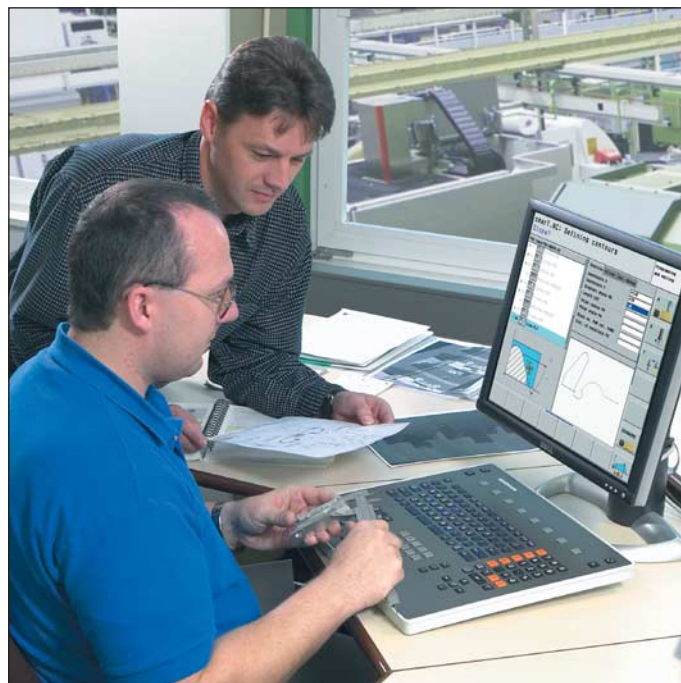
Programming, testing and optimizing HEIDENHAIN conversational or ISO programs for the iTNC 530 with the programming station substantially reduces machine idle times. You do not need to change your way of thinking. At the programming station you program on the same keyboard as at the machine. Of course you can also use the alternative smarT.NC operating mode on the iTNC programming station.

Training with the iTNC programming station

Since the iTNC programming station is based on the software of the iTNC 530, it is ideally suited for apprentice and advanced training.

TNC training in schools

Because it can be programmed in ISO as well as in conversational format, the iTNC programming station can also be used in schools for TNC programming training.



Tool and Workpiece Setup and Measurement

TS workpiece touch probes

The **TS** 3-D touch probes from HEIDENHAIN are used to probe workpieces. They expand the capabilities of your machine tools by enabling them to perform setup, measuring and inspection functions. They can also be used to digitize 3-D surfaces.

The **TS 220/TS 230, TS 440** and **TS 640** 3-D touch probes approach the workpiece until the stylus is deflected. This releases a trigger signal in the TS that is transmitted to the control either through a cable (with TS 220/TS 230) or as an infrared light signal (TS 440/TS 640). Within microseconds, the control saves the actual position value for subsequent use.



TS 220



TS 440



TS 640



SE 540



SE 640



	TS 220/TS 230	TS 440/TS 640
Probe repeatability	2 σ \pm 1 μ m at a probing velocity of 1 m/min	
Perm. stylus deflection (for stylus length 40 mm)	Approx. 5 mm in all directions	
Power supply	TS 220: 5 V \pm 5 % from the NC TS 230: 10 to 30 V from the NC	Two 3.6 V lithium batteries
Interface to NC control	TS 220: TTL signal levels TS 230: HTL signal levels	HTL signal levels over transceiver unit SE
Signal transmission	Via cable	Via infrared beam with omnidirectional transmission to transceiver unit <ul style="list-style-type: none"> • SE 540: Integration in spindle head • SE 640: Integration in the machine's workspace
Probe velocity	Max. 3 m/min	
Styli	Ball-tip styli in various diameters and lengths	
Protection IEC 60529	IP 55	IP 67

TT tool touch probe

The **TT 130** is a 3-D touch trigger probe for tool setting and inspection. The trigger signal is generated through a wear-free optical switch that ensures high reliability.

The standard disk-type probe contact assures protection against collision since the diameter of the touch probe housing is smaller than the disk diameter.

Thanks to its sturdy design and high IP 67 degree of protection, the TT 130 can be installed indefinitely in the working space

of the machine tool. The tool can be measured for length and diameter, and checked for breakage or wear directly on the machine with the tool in the spindle.

The TT 130 is attached to the machine table by a bolt through its mounting base into a T-slot. No adjustment is required, since the probe contact is pre-adjusted to the mounting face.



TT 130

	TT 130
Probe repeatability	< ±1 µm
Perm. deflection of probe contact	Approx. 5 mm in all directions
Power supply	10 to 30 V from the NC
Interface to NC control	HTL signal levels
Probe contact	Hardened steel disk, Ø 40 mm
Protection IEC 60 529	IP 67

Measured Value Acquisition and Display

Digital readouts

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

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

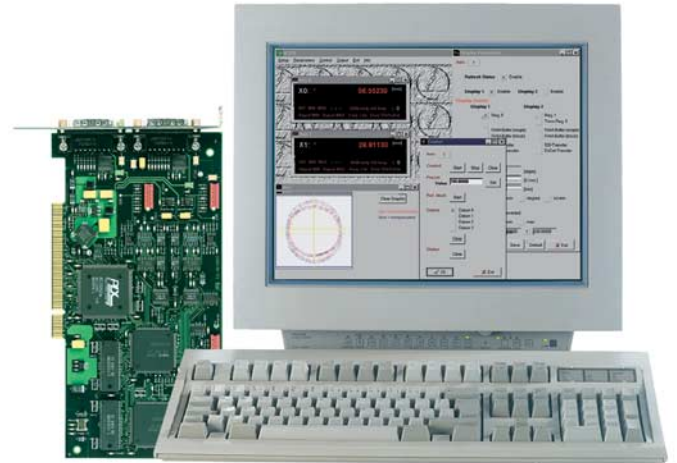
Position displays from HEIDENHAIN are designed to be highly **user-friendly**. Typical characteristics are:

- Highly readable, alphanumeric display
- Simple, logically arranged keypad
- Ergonomically designed push-button keys
- Splash-protected front panel
- Sturdy die-cast housing

Most position display units feature a **data interface** for further processing in the higher-level electronics or simply to print out the measured values.

Counter cards

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

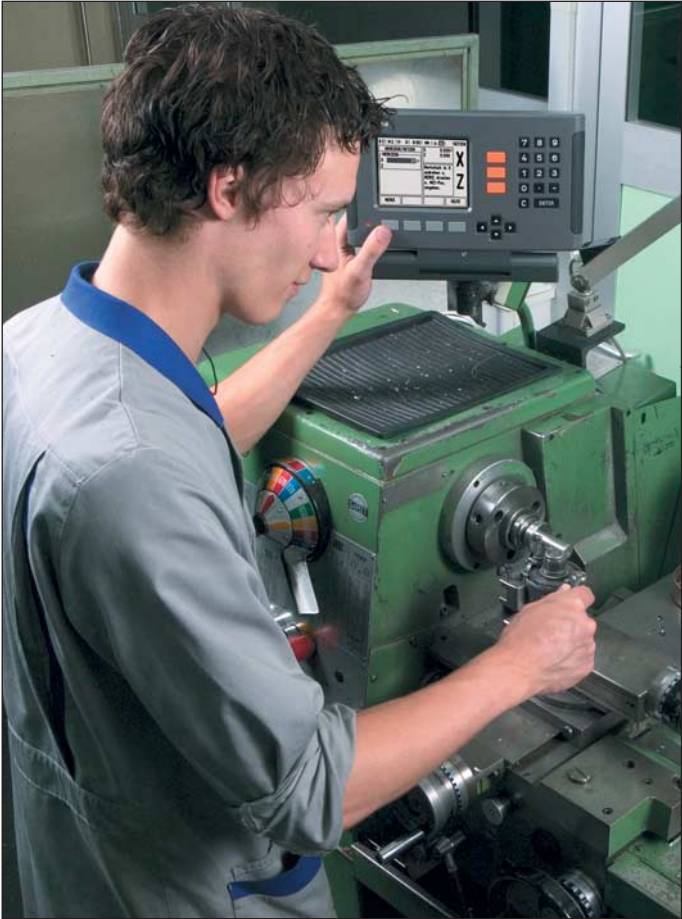


HEIDENHAIN Digital Readouts

for manually operated machine tools

Increased productivity with HEIDENHAIN digital readouts

Digital readouts from HEIDENHAIN increase the productivity of manually operated machine tools or measuring equipment. They save time, increase the dimensional accuracy of machined parts, and enhance operating ease. Regardless of whether they are installed on new equipment or are retrofitted on machines already in operation, HEIDENHAIN **ND** or **POSITIP** display units with the appropriate **LS** or **LB** linear encoders are easily fitted to any model of machine or type of equipment, whatever the application and number of displayed axes.



Fast
HEIDENHAIN's digital readouts save time. The distance-to-go display feature allows the user to approach the next nominal position quickly and reliably, simply by traversing to a display value of zero. Datums can be set wherever needed. This simplifies positioning, especially for workpieces with complicated dimensions. Cycles help the user mill or drill hole patterns and rectangular pockets. The positions are approached directly using the distance-to-go display.

On lathes, the sum display feature for saddle and top slide contributes to more accurate positioning. If taper dimension data are not complete, the display will help the user to calculate the angles.

The POSITIP is ideal for small-batch production, because repetitive machining sequences can be stored as programs and then used as often as required.

Reliable
A highly readable display shows the measured positions with respect to the selected reference point. As a result, the probability of error is reduced and machining becomes more reliable.

POSITIP's graphic positioning aid improves the speed and reliability of the distance-to-go display. Input of geometric data is made easy with the graphic display function.

Accurate
On older machine tools, precise machining in the range of 0.01 mm is a matter of luck. Worn machine elements make exact dial and vernier settings impossible. Linear encoders from HEIDENHAIN sense machine slide movement directly. The backlash caused by mechanical transfer elements such as lead screws, racks and gears therefore has no influence. By determining the slide position directly, you achieve higher machining accuracy and reduce scrap rates.

Position Displays for Manually Operated Machine Tools		Series	Page
for up to six axes	For positioning devices, milling machines, and lathes	POSITIP 880	48
for up to three axes	For positioning devices, milling machines, and lathes	ND 780	49
Measured Value Display Units	For length and angle	ND 200 B	50
Counter Card	For PCs	IK 220	51

ND, POSITIP Position Display Units

for up to 6 axes

A digital readout (DRO) consists of one or more linear encoders for traverse measurement and a display unit for position values. DROs are typically fitted or retrofitted on:

- Machine tools such as milling, drilling and boring machines, lathes, electrical discharge machines, grinding machines
- Measuring machines

Features:

- User-friendly functions for easier operation of manual machines and equipment
- Problem-free installation, maintenance-free operation
- Fast payback with economical use

POSITIP 880



KT edge finder

The 3-D edge finder is a triggering probe. Used together with the HEIDENHAIN display units ND 780 and POSITIP 880, the KT simplifies workpiece locating and speeds datum setting.



	POSITIP 880 Display with dialog-supported user guidance on a color flat-panel display, HELP functions, graphic functions and program memory	
Application	Primarily for milling, drilling and boring machines	Primarily for lathes
Axes	Up to 6 axes from A to Z	Up to 6 axes from A to Z and Z ₀ , Z _S
Display step	10 µm, 5 µm, 1 µm or finer	
Reference points	99	1
Tool data	For 99 tools	
Features	<ul style="list-style-type: none"> REF reference mark evaluation for distance-coded or single reference marks Distance-to-go display with nominal position input in absolute or incremental values Contour monitoring with zoom function 	
	<ul style="list-style-type: none"> Probing functions for reference point determination, primarily with the KT edge finder: "Edge," "Centerline" and "Circle Center" Calculation of positions for hole patterns (circular and linear patterns) Positioning aids for milling and roughing rectangular pockets Cutting data calculator 	<ul style="list-style-type: none"> Radius/diameter display Separate or sum display Z_S for Z and Z₀ Oversize allowance for positioning Multipass turning cycle Freezing the tool position value for retraction Taper calculator
	<ul style="list-style-type: none"> Programming of max. 999 program blocks per program 	
Interfaces	RS-232-C/V.24, Centronics, KT edge finder	

ND 780



ND 780

Display with dialog-supported user guidance on a monochrome flat-panel display, HELP functions, graphic functions

Primarily for milling, drilling and boring machines

Primarily for lathes

Up to 3 axes from A to Z

Up to 3 axes from A to Z and Z₀, Z_S

10 µm, 5 µm, 1 µm or finer

10

For 16 tools

- REF reference mark evaluation for distance-coded and single reference marks
- Distance-to-go display with nominal position input in absolute or incremental values

- Probing function for reference-point acquisition with the KT edge finder: "Edge," "Centerline" and "Circle center"
- Calculation of positions for hole patterns (circular and linear patterns)
- Cutting data calculator

- Radius/diameter display
- Separate or sum display for Z and Z₀
- Freezing the tool position value for retraction
- Taper calculator

RS-232-C/V.24, KT edge finder, edge finder with contact triggering



ND 200B Measured Value Display Units

for length and angle

The **ND 200 B series** serves to display measured values from one length gauge, linear encoder, or angle encoder with sinusoidal output signals (11 μ App).
The **ND 281 B** display unit can also be connected with one linear or angle encoder with 1 Vpp signals.

Display units with serial **RS-232-C** data output or parallel **BCD** data output are available for measuring and inspection stations at which the results of measurement are transmitted to a printer or a PC for further processing.

The **ND 281 B** and **ND 282 B** offer functions for sorting and tolerance checking or finding the minimum and maximum values from a series of measurements. Their switching inputs and outputs suit them also for use in equipment with simple automated tasks.

The **ND 231 B** with sum/difference display allows you to connect two encoders.

The **ND 281 B** can be switched to display angular position in degrees or degrees/minutes/seconds.



ND 281 B





	ND 221 B	ND 281 B	ND 282 B	ND 231 B with 2 signal inputs
Display step				
Length	10 μ m, 5 μ m, 1 μ m and finer			
Angle	–	1° to 0.0001° or 1″	–	
Signal input	\sim 11 μ App	\sim 11 μ App or \sim 1 Vpp (switchable)	\sim 11 μ App	2 x \sim 11 μ App
Interface	RS-232-C/V.24		BCD	RS-232-C/V.24
Features	–	<ul style="list-style-type: none"> • Sorting and tolerance checking • Min./max. evaluation 		<ul style="list-style-type: none"> • Sorting and tolerance checking • Sum/difference display
		Switching inputs, switching outputs		

IK Counter Card

IK 220 Universal PC counter card

The IK 220 is an expansion board for PCs for recording the measured values of **two incremental or absolute linear or angle encoders**. The subdivision and counting electronics **subdivide** the **sinusoidal input signals** to generate up to **4096 measuring steps**. A driver software package is included in delivery.



	IK 220			
Input signals (switchable)	 1 V _{PP}	 11 μA _{PP}	EnDat 2.1	SSI
Encoder inputs	2 D-sub connections (15-pin) male			
Max. input frequency	500 kHz	33 kHz	–	
Max. cable length	60 m		10 m	
Signal transmission (signal period: meas. step)	Up to 4096-fold			
Data register for measured values (per channel)	48 bits (44 bits used)			
Internal memory	For 8192 position values			
Interface	PCI bus (plug and play)			
Driver software and demonstration program	For Windows 98/NT/2000/XP in VISUAL C++, VISUAL BASIC and BORLAND DELPHI			
Dimensions	Approx. 190 mm × 100 mm			

For More Information

Brochures, data sheets and CD-ROMs

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

HEIDENHAIN on the Internet

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

- The company
- The products

Our web site also includes:

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

Length Measurement



Brochure **Linear Encoders** *for NC-Controlled Machine Tools*

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



Brochure **Length Gauges**

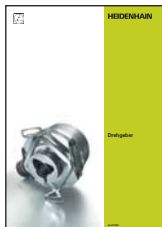
Contents:
HEIDENHAIN-SPECTO
HEIDENHAIN-METRO
HEIDENHAIN-CERTO



Brochure **Exposed Linear Encoders**

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

Angle Measurement



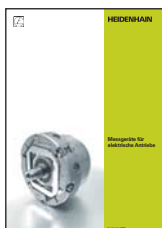
Brochure **Rotary Encoders**

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



Brochure **Angle Encoders**

Contents:
Incremental Angle Encoders
ERA, ERP, ERO, RON, RPN, ROD
Absolute Angle Encoders
RCN



Brochure **Encoders for Servo Drives**

Contents:
Rotary Encoders
Angle Encoders
Linear Encoders

Machine Tool Control



Brochure
iTNC 530 Contouring Control

CD-ROM
iTNC Presentation

Contents:
Information for the user



OEM Brochure
iTNC 530 Contouring Control

Contents:
Information for the machine tool builder



Brochure
TNC 320 Contouring Control

Contents:
Information for the user



OEM Brochure
TNC 320 Contouring Control

Contents:
Information for the machine tool builder



Brochure
MANUALplus 4110 Contouring Control

Contents:
Information for the user



OEM Brochure
MANUALplus 4110 Contouring Control

Contents:
Information for the machine tool builder

Tool and Workpiece Setup and Measurement



Brochure, CD-ROM
3-D Touch Probes

Contents:
Tool Touch Probe
TT
Workpiece Touch Probe
TS



Brochure
Measuring Systems for Machine Tool Inspection and Acceptance Testing

Contents:
Incremental Linear Encoders
KGM, DBB, VM

Measured Value Acquisition and Display



Brochure
Digital Readouts
for Manually Operated Machine Tools

Contents:
Position Display Units
ND 200, ND 700, POSITIP
Linear Encoders
LB, LS, LIM



Brochure
Digital Readouts
Linear Encoders
for Manually Operated Machine Tools

Contents:
Position Display Units
ND 200, ND 700, POSITIP
Linear Encoders
LS 388 C; LS 603

Sales and Service—Worldwide

HEIDENHAIN is represented by subsidiaries in all important industrial nations. In addition to the addresses listed here, there are many service agencies located worldwide. For more information, visit our Internet site or contact HEIDENHAIN in Traunreut, Germany.

DR. JOHANNES HEIDENHAIN GmbH

Dr.-Johannes-Heidenhain-Straße 5

83301 Traunreut, Germany

☎ +49 (8669) 31-0

FAX +49 (8669) 5061

E-Mail: info@heidenhain.de

www.heidenhain.de

Germany

DE HEIDENHAIN Technisches Büro Nord

12681 Berlin, Deutschland

☎ (030) 547 05-240

E-Mail: tbn@heidenhain.de

HEIDENHAIN Technisches Büro Mitte

08468 Heinsdorfergrund, Deutschland

☎ (037 65) 695 44

E-Mail: tbn@heidenhain.de

HEIDENHAIN Technisches Büro West

58093 Hagen, Deutschland

☎ (023 31) 95 79-0

E-Mail: tbw@heidenhain.de

HEIDENHAIN Technisches Büro Südwest

72131 Ofterdingen, Deutschland

☎ (074 73) 227 33

E-Mail: tbsw@heidenhain.de

HEIDENHAIN Technisches Büro Südost

83301 Traunreut, Deutschland

☎ (086 69) 31-1345

E-Mail: tbsso@heidenhain.de

Europe

AT HEIDENHAIN Techn. Büro Österreich

Dr.-Johannes-Heidenhain-Straße 5

83301 Traunreut, Germany

☎ +49 (8669) 31-1337

FAX +49 (8669) 5061

E-Mail: tba@heidenhain.de

BE HEIDENHAIN NV/SA

Pamelse Klei 47

1760 Roosdaal, Belgium

☎ +32 (54) 51 52 10

FAX +32 (54) 34 31 73

E-Mail: sales@heidenhain.be

BG ESD Bulgaria Ltd.

G.M. Dimitrov Blvd.,

bl. 60, entr. G, fl. 1, ap 74

Sofia 1172, Bulgaria

☎ +359 (2) 963 2949

FAX +359 (2) 963 2940

E-Mail: info@esd.bg

BY Belarus → RU

CH HEIDENHAIN (SCHWEIZ) AG

Vierstrasse 14

8603 Schwerzenbach, Switzerland

☎ +41 (44) 806 27 27

FAX +41 (44) 806 27 28

E-Mail: verkauf@heidenhain.ch

CS Serbia and Montenegro → BG

CZ HEIDENHAIN s.r.o.

Stremchová 16

106 00 Praha 10, Czech Republic

☎ +420 2 72 65 81 31

FAX +420 2 72 65 87 24

E-Mail: heidenhain@heidenhain.cz

DK TP TEKNIK A/S

Korskildelund 4

2670 Greve, Denmark

☎ +45 (70) 10 09 66

FAX +45 (70) 10 01 65

E-Mail: tp-gruppen@tp-gruppen.dk

ES FARRESA ELECTRONICA S.A.

Les Corts, 36 bajos

08028 Barcelona, Spain

☎ +34 934 09 24 91

FAX +34 933 39 51 17

E-Mail: farresa@farresa.es

FI HEIDENHAIN Scandinavia AB

Mikkellänkallio 3

02770 Espoo, Finland

☎ +358 (9) 86 76 47 6

FAX +358 (9) 86 76 47 40

E-Mail: info@heidenhain.fi

FR HEIDENHAIN FRANCE sarl

2 avenue de la Cristallerie

92316 Sèvres, France

☎ +33 01 41 14 30 00

FAX +33 01 41 14 30 30

E-Mail: info@heidenhain.fr

America

AR NAKASE SRL

Calle 49 Nr. 5764

B1653AOX Villa Ballester,

Provincia de Buenos Aires, Argentina

☎ +54 (11) 47 68 42 42

FAX +54 (11) 47 68 42 42-111

E-Mail: nakase@nakase.com

BR DIADUR Indústria e Comércio Ltda.

Rua Sérvia, 329 Socorro, Santo Amaro

04763-070 – São Paulo – SP, Brazil

☎ +55 (11) 56 96-67 77

FAX +55 (11) 55 23-14 11

E-Mail: diadur@diadur.com.br

CA HEIDENHAIN CORPORATION

Canadian Regional Office

11-335 Admiral Blvd., Unit 11

Mississauga, Ontario L5T 2N2, Canada

☎ +1 (905) 670-8900

FAX +1 (905) 670-4426

E-Mail: info@heidenhain.com

MX HEIDENHAIN CORPORATION MEXICO

Av. Las Américas 1808

Fracc. Valle Dorado

20235 Aguascalientes, Ags., Mexico

☎ +52 (449) 9 13 08 70

FAX +52 (449) 9 13 08 76

E-Mail: info@heidenhain.com

US HEIDENHAIN CORPORATION

333 East State Parkway

Schaumburg, IL 60173-5337, USA

☎ +1 (847) 490-11 91

FAX +1 (847) 490-39 31

E-Mail: info@heidenhain.com

VE Maquinaria Diekmann S.A.

Av. Humbolt (Prol. Leoncio Martínez)

Urb. Las Acacias Aptdo. 40.112

Caracas, 1040-A, Venezuela

☎ +58 (212) 632 54 10

FAX +58 (212) 632 80 13

E-Mail: purchase@diekmann.com.ve

Africa

ZA MAFEMA SALES SERVICES C.C.

107 – 16th Road, Unit B3

Tillbury Business Park, Randjespark

1685 Midrand, South Africa

☎ +27 (11) 3 14 44 16

FAX +27 (11) 3 14 22 89

E-Mail: mailbox@mafema.co.za

Australia

AU FCR Motion Technology Pty. Ltd

Automation Place, Unit 6,

38-40 Little Boundary Road

Laverton North 3026, Victoria, Australia

☎ +61 (3) 93 62 68 00

FAX +61 (3) 93 14 37 44

E-Mail: vicsales@fcrmotion.com

GB HEIDENHAIN (G.B.) Limited
200 London Road, Burgess Hill
West Sussex RH15 9RD, United Kingdom
☎ +44 (1444) 24 77 11
FAX +44 (1444) 87 00 24
E-Mail: sales@heidenhain.co.uk

GR MB Milionis Vassilis
38, Scoufa Str., St. Dimitrios
17341 Athens, Greece
☎ +30 (2 10) 933 66 07
FAX +30 (2 10) 934 96 60
E-Mail: bmilioni@otenet.gr

HR Croatia → SL

HU HEIDENHAIN Kereskedelmi Képviselet
Grassalkovich út 255.
1239 Budapest, Hungary
☎ +36 (1) 421 09 52
FAX +36 (1) 421 09 53
E-Mail: info@heidenhain.hu

IT HEIDENHAIN ITALIANA S.r.l.
Via Asiago, 14
20128 Milano, Italy
☎ +39 02 27 07 51
FAX +39 02 27 07 52 10
E-Mail: info@heidenhain.it

MK Macedonia → BG

NL HEIDENHAIN NEDERLAND B.V.
Copernicuslaan 34,
6716 BM Ede, Netherlands
☎ +31 (3 18) 58 18 00
FAX +31 (3 18) 58 18 70
E-Mail: verkoop@heidenhain.nl

NO HEIDENHAIN Scandinavia AB
Orkdalsveien 15
7300 Orkanger, Norway
☎ +47 72 48 00 48
FAX +47 72 48 00 49
E-Mail: info@heidenhain.no

PL APS
Popularna 56
02-473 Warszawa, Poland
☎ +48 2 28 63 97 37
FAX +48 2 28 63 97 44
E-Mail: aps@apserwis.com.pl

PT FARRESA ELECTRÓNICA LDA.
Rua do Espido, 74 C
4470 - 177 Maia, Portugal
☎ +351 2 29 47 81 40
FAX +351 2 29 47 81 49
E-Mail: fep@farresa.pt

RO Romania → HU

RU Gertner Service GmbH
113035 Moskau, Russian Federation
☎ +7 (495) 931-9645
E-Mail: heidenhain@gertnergroupp.de

SE HEIDENHAIN Scandinavia AB
Storsåtragränd 5
12739 Skärholmen, Sweden
☎ +46 (8) 53 19 33 50
FAX +46 (8) 53 19 33 77
E-Mail: sales@heidenhain.se

SK Slovakia → CZ

SL Posredništvo HEIDENHAIN SAŠO HÜBL s.p.
Sokolska ulica 46
2000 Maribor, Slovenia
☎ +386 (2) 4 29 72 16
FAX +386 (2) 4 29 72 17
E-Mail: hubl@siol.net

TR T&M Mühendislik Müessillik
Sanayi ve Ticaret Ltd. Pirketi
Zincirlikösk Sok
Doga Apt. No. 11/1
34728 Erenköy-Istanbul, Turkey
☎ +90 (2 16) 3 02 23 45
FAX +90 (2 16) 3 02 43 51
E-Mail: info@tmmuhendislik.com

UA Ukraine → RU

Asia

CN HEIDENHAIN (TIANJIN) OPTICS & ELECTRONICS CO., LTD
No. 6, Tian Wei San jie, Area A,
Beijing Tianzhu Airport Industrial Zone
Shunyi District, Beijing 101312, China
☎ +86 10 - 8042 00 00
FAX +86 10 - 8042 00 10
E-Mail: sales@heidenhain.com.cn

HK HEIDENHAIN LTD
Unit 2, 15/F, Apec Plaza
49 Hoi Yuen Road
Kowloon, Hong Kong
☎ +852 27 59 19 20
FAX +852 27 59 19 61
E-Mail: service@heidenhain.com.hk

ID PT Servitama Era Toolsindo
GTS Building, Jl. Pulo Sidik Block R29
Jakarta Industrial Estate Pulogadung
Jakarta 13930, Indonesia
☎ +62 (21) 46 83 41 11
FAX +62 (21) 46 83 41 13
E-Mail: ptset@group.gts.co.id

IL NEUMO VARGUS MARKETING LTD.
Post Box 57057
34-36, Itzhak Sade St.
Tel Aviv 61570, Israel
☎ +972 (3) 537 32 75
FAX +972 (3) 537 21 90
E-Mail: neumo@neumo-vargus.co.il

IN ASHOK & LAL
Post Box 5422
12 Pulla Reddy Avenue
Chennai - 600 030, India
☎ +91 (44) 26 15 12 89
FAX +91 (44) 26 47 82 24
E-Mail: ashoklal@satyam.net.in

JP HEIDENHAIN K.K.
Kudan Center Bldg. 10th Floor
Kudankita 4-1-7, Chiyoda-ku
Tokyo 102-0073, Japan
☎ +81 (3) 32 34-77 81
FAX +81 (3) 32 62-25 39
E-Mail: sales@heidenhain.co.jp

KR HEIDENHAIN LTD.
Suite 1415, Family Tower Bldg, 958-2
Youngtong-Dong, Youngtong-Gu, Suwon
Kyunggi-Do, Korea, 443-810
☎ +82 (31) 2 01 15 11
FAX +82 (31) 2 01 15 10
E-Mail: info@heidenhain.co.kr

MY ISOSERVE Sdn. Bhd
No. 6 - 1 Jalan 2/96A
Taman Cheras Makmur
56100 Kuala Lumpur, Malaysia
☎ +60 (3) 91 32 06 85
FAX +60 (3) 91 32 06 95
E-Mail: isoserve@po.jaring.my

PH Machinebanks` Corporation
482 G. Araneta Avenue,
Quezon City, Philippines 1113
☎ +63 (2) 7 11 37 51
FAX +63 (2) 7 12 24 84
E-Mail: info@machinebanks.com

SG HEIDENHAIN PACIFIC PTE LTD.
51, Ubi Crescent
Singapore 408593
☎ +65 67 49-32 38
FAX +65 67 49-39 22
E-Mail: info@heidenhain.com.sg

TH HEIDENHAIN (THAILAND) LTD
53/72 Moo 5
Chaloem Phra Kiat Rama 9 Road
Nongbon, Pravate,
Bangkok 10250, Thailand
☎ +66 (2) 3 98-41 47-8
FAX +66 (2) 3 98-41 43
E-Mail: info@heidenhain.co.th

TW HEIDENHAIN Co., Ltd.
No. 12-5, Gong 33rd Road
Taichung Industrial Park
Taichung 407, Taiwan
☎ +886 (4) 23 58 89 77
FAX +886 (4) 23 58 89 78
E-Mail: info@heidenhain.com.tw

VN AMS Advanced Manufacturing Solutions Pte Ltd
310 (12A-13A) Le Hong Phong Street,
District 10, HCM City, Việt Nam
☎ +84 (8) 912 36 58 - 835 24 90
FAX +84 (8) 835 15 30
E-Mail: davidgoh@amsvn.com

HEIDENHAIN

DR. JOHANNES HEIDENHAIN GmbH

Dr.-Johannes-Heidenhain-Straße 5

83301 Traunreut, Germany

☎ +49 (8669) 31-0

FAX +49 (8669) 5061

E-Mail: info@heidenhain.de

www.heidenhain.de

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