

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 180000
- Accuracy from $\pm 5''$ to $\pm 0.4''$
- Measuring steps as fine as 0.000005° or $0.018''$ (incremental) or 29 bits, i.e. approx. 536 million positions per revolution (absolute)



Rotary encoders

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

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

- Requires little 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 reference point.

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. **Single-turn 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, 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, RIC ROQ, RIQ ROD	32
Without integral bearing	Absolute (singleturn) Absolute (multiturn) Incremental	ECI EQI ERO	34

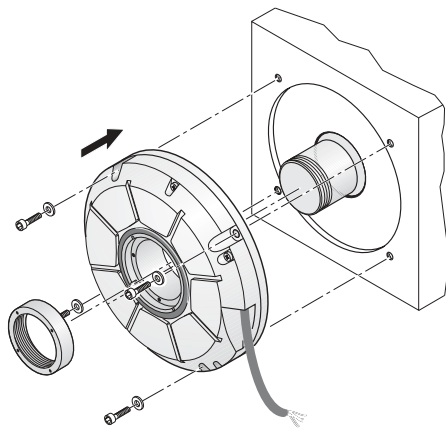
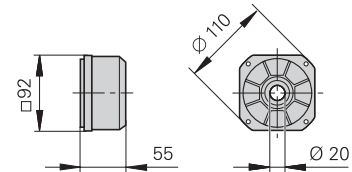
RCN, RON, RPN Angle Encoders

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.

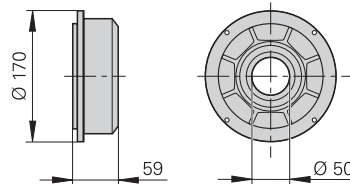
RCN/RON 200 Series

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

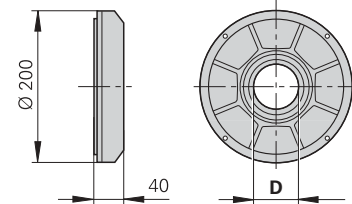


RCN/RON 700 Series and RCN/RON/RPN 800

- **Large hollow shaft diameter** up to Ø 100 mm
- Measuring steps to 0.00001° with system accuracy grades of ± 2" and ± 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



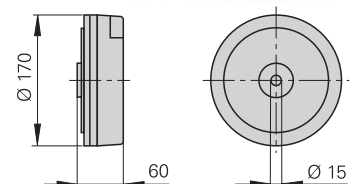
RON 785



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

RON 905

- **Very high-accuracy angle encoder**
- Measuring steps to 0.00001°.
- System accuracy ± 0.4"
- Used with high-accuracy measuring devices and for the inspection of measuring equipment



	Absolute			Incremental			
	RCN 226 RCN 228	RCN 223 F RCN 227 F	RCN 223 M RCN 227 M	RON 225	RON 275	RON 285	RON 287
Incremental signals	$\sim 1 V_{PP}^{3)}$	-		\square TTL x 2	\square TTL x 5 \square TTL x 10	$\sim 1 V_{PP}$	
Line count Signal periods/rev	16384 ³⁾	-		9000 18000	18000 90000 or 180000	18000	
Absolute position values	EnDat 2.2 ¹⁾	Fanuc 02	Mit02-4	-			
Position values per rev	67 108 864 (26 bits) 268 435 456 (28 bits)	8 388 608 (23 bits) 134 217 728 (27 bits)		-			
System accuracy	$\pm 5''$ $\pm 2.5''$			$\pm 5''$			$\pm 2.5''$
Recommended measuring step²⁾	0.0001°			0.005°	0.001° 0.0005°	0.0001°	
Mech. perm. speed	$\leq 3000 \text{ min}^{-1}$			$\leq 3000 \text{ min}^{-1}$			

¹⁾ PROFIBUS-DP via gateway ²⁾ For position measurement ³⁾ Only for EnDat 2.2/02

	Absolute			Incremental		RPN 886
	RCN 729 RCN 829	RCN 727 F RCN 827 F	RCN 727 M RCN 827 M	RON 786 RON 785	RON 886	
Incremental signals	$\sim 1 V_{PP}^{4)}$	-		$\sim 1 V_{PP}$		
Line count Signal periods/rev	32 768 ⁴⁾	-		18000, 36000 ³⁾	36000	90000 180000
Absolute position values	EnDat 2.2 ¹⁾	Fanuc 02	Mit02-4	-		
Position values per rev	536870912 (29 bits)	134217728 (27 bits)		-		
System accuracy	RCN 72x: $\pm 2''$; RCN 82x: $\pm 1''$			$\pm 2''$	$\pm 1''$	
Rec. meas. step²⁾	0.0001°/0.00005°			0.0001°	0.00005°	0.00001°
Mech. perm. speed	$\leq 1000 \text{ min}^{-1}$			$\leq 1000 \text{ min}^{-1}$		

¹⁾ PROFIBUS-DP via gateway ²⁾ For position measurement ³⁾ Only RON 786 ⁴⁾ Only for EnDat 2.2/02

	Incremental RON 905
Incremental signals	$\sim 11 \mu A_{PP}$
Line count	36000
System accuracy	$\pm 0.4''$
Rec. meas. step	0.00001°
Mech. perm. speed	$\leq 100 \text{ min}^{-1}$

ROD Angle Encoders

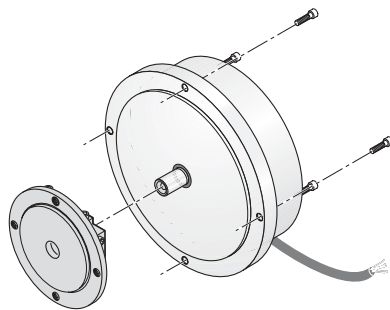
with integral bearing, for separate shaft coupling



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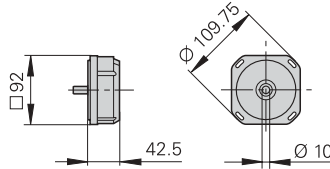
ROD angle encoders with solid shaft for separate shaft coupling are particularly attractive for applications where high shaft speeds and large mounting tolerances are required. The precision shaft couplings allow axis motion up to ± 1 mm.

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 design**
- Sturdy design
- Typically used with rotary tables, tilting tables, for positioning and synchronization monitoring
- Measuring steps to 0.0001° .



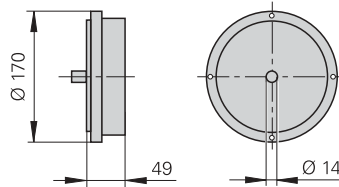
	Incremental ROD 220	ROD 270	ROD 280
Incremental signals	\square TTL x 2	\square TTL x 10	\sim 1 V _{PP}
Line count	9000	18000	18000
Signal periods/rev	18000	180000	
System accuracy¹⁾	$\pm 5''$		
Rec. meas. step²⁾	0.005°	0.0005°	0.0001°
Mech. perm. speed	$\leq 10000 \text{ min}^{-1}$		

¹⁾ Without shaft coupling

²⁾ For position measurement

ROD 780 and ROD 880

- **High accuracy**
 $\pm 2''$ (ROD 780) or
 $\pm 1''$ (ROD 880)
- Measuring steps to 0.00005°
- Ideal for angle measurement on high-precision rotary tables, dividing apparatuses or measuring machines



	Incremental ROD 780	ROD 880
Incremental signals	\sim 1 V _{PP}	
Line count	18000. 36000	36000
System accuracy¹⁾	$\pm 2''$	$\pm 1''$
Rec. meas. step²⁾	0.0001°	0.00005°
Mech. perm. speed	$\leq 1000 \text{ min}^{-1}$	

¹⁾ Without shaft coupling

²⁾ For position measurement

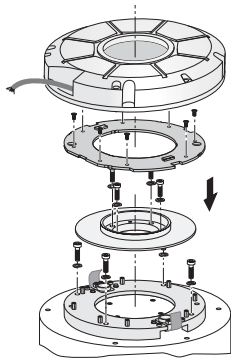
ERP Angle Encoders without integral bearing



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The HEIDENHAIN **ERP** angle encoders without integral bearing are intended for integration in machine elements or components. They operate without friction and permit high accuracy. This makes them particularly attractive for high-precision angle measuring tables and precision devices in angular metrology. The **ERP 4080** and **ERP 8080** angle encoders are designed for applications in the clean room.

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



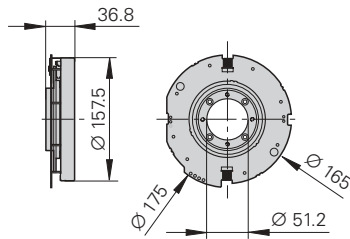
Mounting the ERP 880

ERP 880

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



ERP 880 with housing



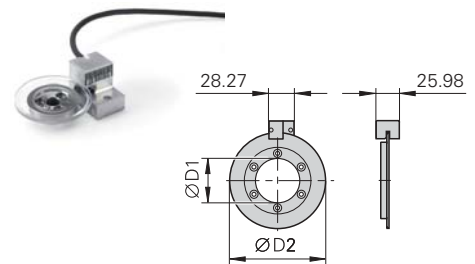
	Incremental ERP 880
Incremental signals	$\sim 1 V_{PP}$
Line count	90000
Signal periods	180000
System accuracy¹⁾	$\pm 1''$
Rec. meas. step²⁾	0.00001°
Mech. perm. speed	$\leq 1000 \text{ min}^{-1}$

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

²⁾ For position measurement

ERP 4080 and ERP 8080

- Very high accuracy
- Very compact dimensions
- Low error within one signal period thanks to the interferential scanning principle



	Incremental ERP 4080	ERP 8080
Incremental signals	$\sim 1 V_{PP}$	
Line count	65536	180000
Signal periods	131072	360000
System accuracy¹⁾	$\pm 5''$	$\pm 2''$
Rec. meas. step²⁾	0.00001°	0.000005°
Diameter D1/D2	8 mm/44 mm	50 mm/108 mm
Mech. perm. speed	$\leq 300 \text{ min}^{-1}$	$\leq 100 \text{ min}^{-1}$

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

²⁾ For position measurement

ERA Angle Encoders without integral bearing

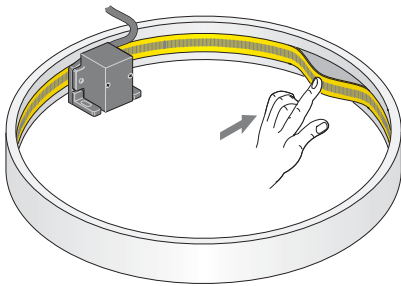


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The HEIDENHAIN **ERA** angle encoders without integral bearing are intended for integration in machine elements or components. They are designed to meet the following requirements:

- Large hollow-shaft diameter (up to 10 m with scale tape)
- High shaft speeds up to 10000 min⁻¹
- No additional starting torque from shaft seals

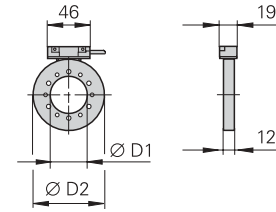
The attainable system accuracy depends on the eccentricity of the graduation to the drive shaft bearing, as well as the radial runout and wobble of the bearing.



ERA 780C

ERA 4000 Series

- **High shaft speeds** up to 10000 min⁻¹
- Sturdy design with steel scale drum
- Axial motion of measured shaft permissible up to ± 0.5 mm
- Typical application on fast spindles and ball screws
- The ERA 4480C is available for larger diameters or versions with protective cover
- Various **drum versions**
 - **ERA 4x80C:** solid version with centering collar for high speeds
 - **ERA 4x81C:** with T-section for 3-point centering with low weight and low moment of inertia
 - **ERA 4282C:** solid version with 3-point centering for high accuracy requirements



ERA 4000

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 version
- **ERA 781C:** circle-segment version

ERA 800 Series

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

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



ERA 880C

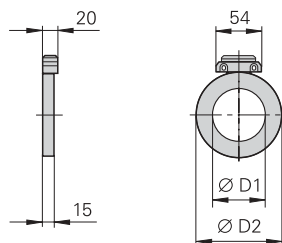
ERM Modular Rotary Encoder without integral bearing

The **ERM** modular encoder from HEIDENHAIN consists of a magnetized scale drum and a scanning unit with magneto-resistive 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

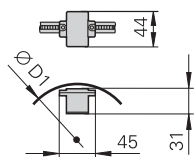
- **For large shaft diameters**
Up to 410 mm
- **High degree of protection** IP 67 through magneto-resistive scanning principle



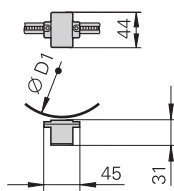
		Incremental						
		ERA 4280C ¹⁾ Signal period 20 μm ERA 4480C ¹⁾ Signal period 40 μm ERA 4880C Signal period 80 μm						
Incremental signals		~ 1 V _{PP}						
Inside diameter D1		40 mm	70 mm	80 mm	120 mm	150 mm	180 mm	270 mm
Outside diameter D2		76.75 mm	104.63 mm	127.64 mm	178.55 mm	208.89 mm	254.93 mm	331.31 mm
Line count/ System accuracy ²⁾		ERA 4280C 12 000/± 6.1" ERA 4480C 6 000/± 7.2" ERA 4880C 3 000/± 9.4"	16 384/± 4.5" 8 192/± 5.3" 4 096/± 6.9"	20 000/± 3.7" 10 000/± 4.3" 5 000/± 5.6"	28 000/± 3.0" 14 000/± 3.5" 7 000/± 4.4"	32 768/± 2.9" 16 384/± 3.3" 8 192/± 4.1"	40 000/± 2.9" 20 000/± 3.2" 10 000/± 3.8"	52 000/± 2.8" 26 000/± 3.0" 13 000/± 3.5"
Shaft speed		10 000 min ⁻¹	8 500 min ⁻¹	6 250 min ⁻¹	4 500 min ⁻¹	4 250 min ⁻¹	3 250 min ⁻¹	2 500 min ⁻¹

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

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



ERA 780



ERA 880

		Incremental				
		ERA 780 C			ERA 880 C	
Incremental signal		~ 1 V _{PP} ; signal period 40 μm (on circumference)				
Line count		36 000	45 000	90 000	36 000	45 000
System accuracy ¹⁾		± 3.5"	± 3.4"	± 3.2"	± 3.5"	± 3.4"
Diameter D1		458.62 mm	573.20 mm	1 146.10 mm	458.04 mm	572.63 mm
Mech. perm. speed		≤ 500 min ⁻¹			≤ 100 min ⁻¹	

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

		Incremental							
		ERM 280							
Incremental signals		~ 1 V _{PP}							
Line count		600	900	1024	1200	1400	2048	2600	2600
Shaft speed		≤ 19 000 min ⁻¹	≤ 14 500 min ⁻¹	≤ 13 000 min ⁻¹	≤ 10 500 min ⁻¹	≤ 9 000 min ⁻¹	≤ 6 000 min ⁻¹	≤ 4 500 min ⁻¹	≤ 3 000 min ⁻¹
Inside diameter D1		40 mm	70 mm	80 mm	120 mm	130 mm	180 mm	295 mm	410 mm
Outside diameter D2		75.44 mm	113.16 mm	128.75 mm	150.88 mm	176.03 mm	257.5 mm	326.9 mm	452.64 mm