HEIDENHAIN

Angle Encoders
With Integral Bearing

Angle encoders with integral bearing and integrated stator coupling

Angle encoders with integral bearing for separate shaft coupling

Information on
• Angle encoders without integral bearing
• Magnetic modular encoders
• Rotary encoders
• Encoders for servo drives
• Exposed linear encoders
• Linear encoders for numerically controlled machine tools
• Interface electronics
• HEIDENHAIN controls
is available upon request as well as on the Internet at *www.heidenhain.de*.

Comprehensive descriptions of all available interfaces as well as general electrical information are included in the *Interfaces for HEIDENHAIN Encoders* catalog.

This catalog supersedes all previous editions, which thereby become invalid. The basis for ordering from HEIDENHAIN is always the catalog edition valid when the contract is made.

Standards (ISO, EN, etc.) apply only where explicitly stated in the catalog.

Contents

Angle encoders from HEIDENHAIN

The term angle encoder is typically used to describe encoders that have an accuracy of better than ± 5″ and a line count above 10 000.

Angle encoders are found in applications requiring precision angular measurement to accuracies within several arc seconds.

Examples:
• Rotary tables on machine tools
• Swivel heads on machine tools
• C-axes of lathes
• Measuring machines for gears
• Printing units of printing machines
• Spectrometer
• Telescopes
etc.

In contrast, rotary encoders are used in applications where accuracy requirements are less stringent, e.g. in automation, electrical drives, and many other applications.
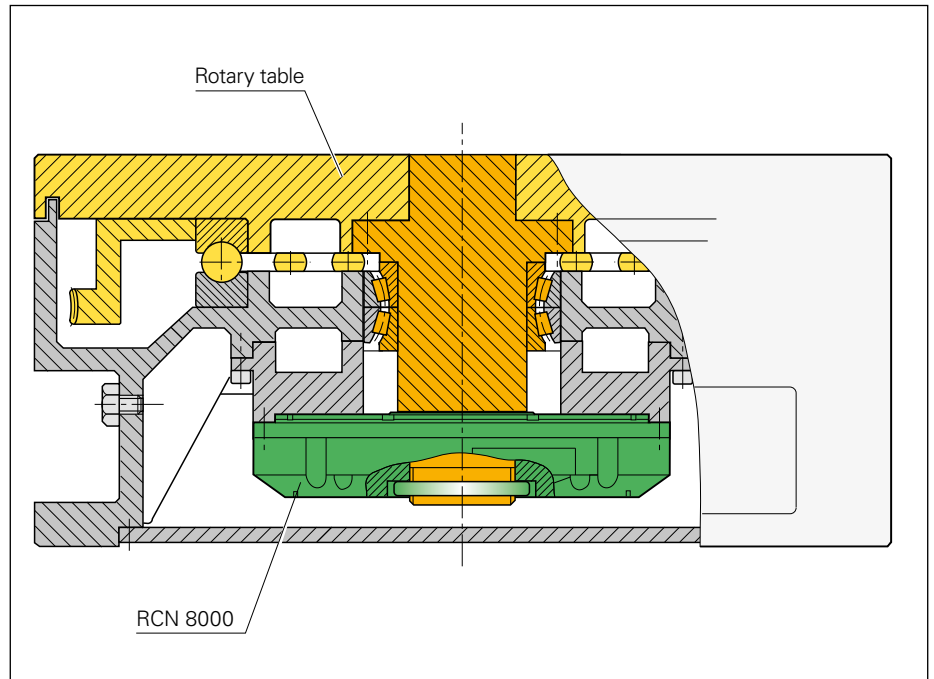
The **RCN 8000** angle encoder mounted on the rotary table of a machine tool

Angle encoders can have one of the following mechanical designs:

Angle encoders with integral bearing, hollow shaft and stator coupling
Because of the design and mounting of the stator coupling, it must absorb only that torque caused by friction in the bearing, particularly during angular acceleration of the shaft. These angle encoders therefore provide excellent dynamic performance. Thanks to the stator coupling, the system accuracy includes the error of the shaft coupling.

The **RCN, RON** and **RPN** angle encoders have an integrated stator coupling, whereas the **ECN** has a stator coupling mounted on the outside.

Other advantages:
• Compact size for limited installation space
• Hollow shaft diameters up to 100 mm to provide space for power lines, etc.
• Simple installation
• Versions with **functional safety** available on request

Selection guide
• *For absolute angle encoders, see page 6/7*
• *For incremental angle encoders, see pages 8/9*

RCN 8580 absolute angle encoder

ROD 880 incremental angle encoder with **K 16** flat coupling

Angle encoders with integral bearing, for separate shaft coupling
ROD angle encoders with solid shaft are particularly suited to applications where higher shaft speeds and/or larger mounting tolerances are required. The shaft couplings allow axial tolerances of up to ± 1 mm.

Selection guide on pages 8/9

ERA 4000 incremental angle encoder

Angle encoders without integral bearing
The **ERP, ERO** and **ERA** angle encoders without integral bearing (modular angle encoders) are intended for integration in machine elements or apparatuses. They are designed to meet the following requirements:
• Large hollow shaft diameters (up to 10 m with a scale tape)
• High shaft speeds up to 20 000 min^{-1}
• No additional starting torque from shaft seals
• Segment versions

Selection guide on pages 10 to 13

Modular magnetic encoders
The robust **ERM** modular magnetic encoders are especially suited for use in production machines. The large inside diameters available, their small dimensions and the compact design of the scanning head predestine them for
• the C axis of lathes,
• simple rotary and tilting axes (e.g. for speed measurement on direct drives or for integration in gear stages),
• spindle orientation on milling machines or auxiliary axes.
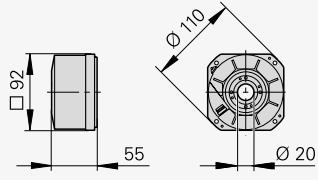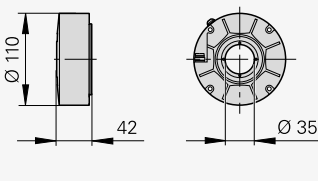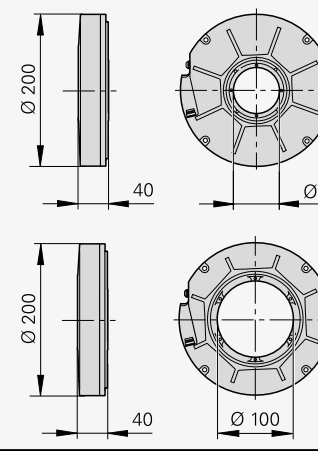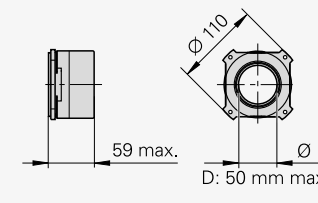
Selection guide on pages 12/13

You can find more detailed information on our modular angle encoders on the Internet at www.heidenhain.de or in the *Angle Encoders without Integral Bearing* and *Modular Magnetic Encoders* catalogs.

5

Selection guide
Absolute angle encoders with integral bearing

Series	Overall dimensions in mm	System accuracy	Mechanically perm. speed	Position values/ Revolution	Interface
With integrated stator coupling					
RCN 2000	□ 92, 55, Ø 110, Ø 20	± 5″	≤ 1500 min^{-1}	67 108 864 ≙ 26 bits	EnDat 2.2
					EnDat 2.2
					Fanuc αi
					Mitsubishi
		± 2.5″		268 435 456 ≙ 28 bits	EnDat 2.2
					EnDat 2.2
					Fanuc αi
					Mitsubishi
RCN 5000	Ø 110, 42, Ø 35	± 5″	≤ 1500 min^{-1}	67 108 864 ≙ 26 bits	EnDat 2.2
					EnDat 2.2
					Fanuc αi
					Mitsubishi
		± 2.5″		268 435 456 ≙ 28 bits	EnDat 2.2
					EnDat 2.2
					Fanuc αi
					Mitsubishi
RCN 8000	Ø 200, 40, Ø 60 / Ø 200, 40, Ø 100	± 2″	≤ 500 min^{-1}	536 870 912 ≙ 29 bits	EnDat 2.2
					EnDat 2.2
					Fanuc αi
					Mitsubishi
		± 1″			EnDat 2.2
					EnDat 2.2
					Fanuc αi
					Mitsubishi
With mounted stator coupling					
ECN 200	Ø 110, 59 max., Ø D, D: 50 mm max.	± 10″	≤ 3000 min^{-1}	33 554 432 ≙ 25 bits	EnDat 2.2
					EnDat 2.2
				8 388 608 ≙ 23 bits	Fanuc α
					Mitsubishi

[1] **Functional safety** upon request

Incremental signals	Signal periods/ revolution	Model	Page
$\sim$ 1 V$_{PP}$	16384	**RCN 2380**	**28**
–	–	**RCN 2310**	
–	–	**RCN 2390F**	
–	–	**RCN 2390M**	
$\sim$ 1 V$_{PP}$	16384	**RCN 2580**	
–	–	**RCN 2510**	
–	–	**RCN 2590F**	
–	–	**RCN 2590M**	
$\sim$ 1 V$_{PP}$	16384	**RCN 5380**	**32**
–	–	**RCN 5310**	
–	–	**RCN 5390F**	
–	–	**RCN 5390M**	
$\sim$ 1 V$_{PP}$	16384	**RCN 5580**	
–	–	**RCN 5510**	
–	–	**RCN 5590F**	
–	–	**RCN 5590M**	
$\sim$ 1 V$_{PP}$	32768	**RCN 8380**	**36**
–	–	**RCN 8310**	
–	–	**RCN 8390F**	
–	–	**RCN 8390M**	
$\sim$ 1 V$_{PP}$	32768	**RCN 8580**	**38**
–	–	**RCN 8510**	
–	–	**RCN 8590F**	
–	–	**RCN 8590M**	
$\sim$ 1 V$_{PP}$	2048	**ECN 225**	**44**
–	–	**ECN 225**	
–	–	**ECN 223F**	
–	–	**ECN 223M**	

RCN 2000

RCN 5000

RCN 8000
Ø 60 mm

RCN 8000
Ø 100 mm

ECN 200
Ø 50 mm

Selection guide
Incremental angle encoders with integral bearing

Series	Overall dimensions in mm	System accuracy	Mechanically permissible speed[1]	Interface
With integrated stator coupling				
RON 200	Ø 110, □ 92, 55, Ø 20	± 5″	≤ 3000 min⁻¹	⊓⊔ TTL
				⊓⊔ TTL
				∿ 1 V$_{PP}$
		± 2.5″		∿ 1 V$_{PP}$
RON 700	Ø 170, 59, Ø 50	± 2″	≤ 1000 min⁻¹	∿ 1 V$_{PP}$
	Ø 200, 40, Ø 60			∿ 1 V$_{PP}$
RON 800 RPN 800	Ø 200, 40, Ø 60	± 1″	≤ 1000 min⁻¹	∿ 1 V$_{PP}$
				∿ 1 V$_{PP}$
RON 900	Ø 170, 60, Ø 15	± 0.4″	≤ 100 min⁻¹	∿ 11 µA$_{PP}$
For separate shaft coupling				
ROD 200	Ø 110, □ 92, 42.5, Ø 10	± 5″	≤ 10000 min⁻¹	⊓⊔ TTL
				⊓⊔ TTL
				∿ 1 V$_{PP}$
ROD 700	Ø 170, 49, Ø 14	± 2″	≤ 1000 min⁻¹	∿ 1 V$_{PP}$
ROD 800		± 1″	≤ 1000 min⁻¹	∿ 1 V$_{PP}$

[1] May be limited in operation by electrically permissible shaft speed
[2] After integrated interpolation

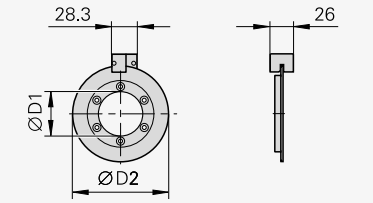| Signal periods/ revolution	Model	Page
18 000 [2]	**RON 225**	**30**
180 000/90 000 [2]	**RON 275**	
18 000	**RON 285**	
18 000	**RON 287**	
18 000	**RON 785**	**34**
18 000/36 000	**RON 786**	**40**
36 000	**RON 886**	**40**
180 000	**RPN 886**	
36 000	**RON 905**	**42**
18 000 [2]	**ROD 220**	**48**
180 000 [2]	**ROD 270**	
18 000	**ROD 280**	
18 000/36 000	**ROD 780**	**50**
36 000	**ROD 880**	

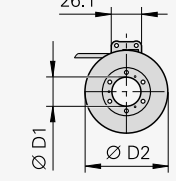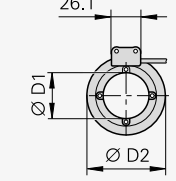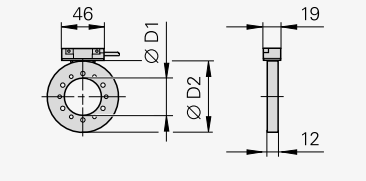RON 285

RON 786

RON 905
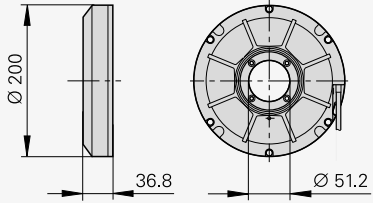
ROD 280

ROD 780

Selection guide
Angle encoders without integral bearing

Series	Version and mounting	Overall dimensions in mm	Diameter D1/D2	Accuracy of graduation	Mechanically permissible speed[1]
Angle encoders with graduation on glass disk					
ERP 880	Phase grating on glass disk with hub; screwed onto front of shaft	Ø 200 36.8 Ø 51.2	–	± 0.9″	≤ 1000 min^{-1}
ERP 4000	Phase grating on glass disk with hub; screwed onto front of shaft	28.3 26 Ø D1 Ø D2	D1: 8 mm D2: 44 mm	± 2″	≤ 300 min^{-1}
ERP 8000			D1: 50 mm D2: 108 mm	± 1″	≤ 100 min^{-1}
ERO 6000	METALLUR graduation on glass disk with hub; screwed onto front of shaft	26.1 Ø D1 Ø D2	D1: 25/95 mm D2: 71/150 mm	± 3″/ ± 2″	≤ 1600 min^{-1} ≤ 800 min^{-1}
ERO 6100	Chrome graduation on glass; screwed onto front of shaft	26.1 Ø D1 Ø D2	D1: 41 mm D2: 70 mm	± 10″	≤ 3500 min^{-1}
Angle encoders with graduation on steel scale drum					
ECA 4000	Scale drum with centering collar; screwed onto front of shaft	46 Ø D1 Ø D2 19	D1: 70 mm to 512 mm D2: 104.3 mm to 560.46 mm	± 3″ to ± 1.5″	≤ 8500 min^{-1} to ≤ 1500 min^{-1}
ERA 4x80		12	D1: 40 mm to 512 mm D2: 76.5 mm to 560.46 mm	± 5″ to ± 2″	≤ 10 000 min^{-1} to ≤ 1500 min^{-1}
ERA 4282	Scale drum for increased accuracy; screwed onto front of shaft		D1: 40 mm to 270 mm D2: 76.5 mm to 331.31 mm	± 4″ to ± 1.7″	≤ 10 000 min^{-1} to ≤ 2500 min^{-1}

[1] May be limited in operation by electrically permissible shaft speed
[2] After integrated interpolation

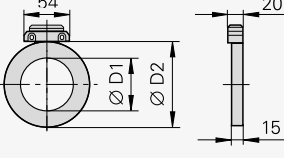| Interface	Signal periods/rev	Reference marks	Model	Further Information
∿ 1 V$_{PP}$	180000	One	**ERP 880**	Catalog: *Angle Encoders Without Integral Bearing*
∿ 1 V$_{PP}$	131072	No	**ERP 4080**	
∿ 1 V$_{PP}$	360000	No	**ERP 8080**	
∿ 1 V$_{PP}$	9000/ 18000	One	**ERO 6080**	
⊓⊔ TTL	45000 to 900000[2]	One	**ERO 6070**	
∿ 1 V$_{PP}$	4096	One	**ERO 6180**	
EnDat 2.2	–	–	**ECA 4410**	Product Info *ECA 4000*
Fanuc			**ECA 4490F**	
Mitsubishi			**ECA 4490M**	
∿ 1 V$_{PP}$	12000 to 52000	Distance-coded	**ERA 4280C**	Catalog: *Angle Encoders Without Integral Bearing*
	6000 to 44000		**ERA 4480C**	
	3000 to 13000		**ERA 4880C**	
∿ 1 V$_{PP}$	12000 to 52000	Distance-coded	**ERA 4282C**	

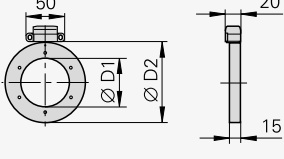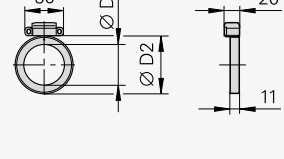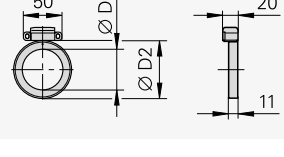**ERP 880**

ERP 4080
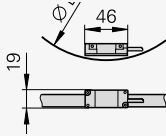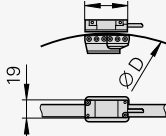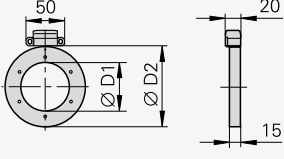
ERO 6080

ERA 4000

Selection guide
Angle encoders without integral bearing and modular encoders

Series	Version and mounting	Overall dimensions in mm	Diameter	Accuracy of graduation	Mechanically permissible speed[2]
Angle encoders with graduation on steel tape					
ERA 7000	Steel scale tape for internal mounting, full circle version[1]; scale tape is tensioned on the inside circumference		458.62 mm to 1 146.10 mm	± 3.9″ to ± 1.6″	≤ 250 min^{-1} to ≤ 220 min^{-1}
ERA 8000	Steel scale tape for external mounting, full circle version; scale tape is tensioned on the outside circumference		458.11 mm to 1 145.73 mm	± 4.7″ to ± 1.9″	≈ ≤ 45 min^{-1}
Modular encoders with magnetic graduation					
ERM 2200	Steel scale drum with MAGNODUR graduation; fastened by axial screws		D1: 70 mm to 380 mm D2: 113.16 mm to 452.64 mm	± 7″ to ± 2.5″	≤ 14 500 min^{-1} to ≤ 3000 min^{-1}
ERM 200	Steel scale drum with MAGNODUR graduation; fastened by axial screws		D1: 40 mm to 410 mm D2: 75.44 mm to 452.64 mm	± 11″ to ± 3.5″	≤ 19 000 min^{-1} to ≤ 3000 min^{-1}
ERM 2410	Steel scale drum with MAGNODUR graduation; fastened by axial screws		D1: 40 mm to 410 mm D2: 75.44 mm to 452.64 mm	± 11″ to ± 3.5″	≤ 19 000 min^{-1} to ≤ 3000 min^{-1}
ERM 2400	Steel scale drum with MAGNODUR graduation; friction-locked fastening by clamping the drum		D1: 40 mm to 100 mm D2: 64.37 mm to 128.75 mm	± 17″ to ± 9″	42 000 min^{-1} to 20 000 min^{-1}
	Steel scale drum with MAGNODUR graduation; friction-locked fastening by clamping the drum; additional slot for feather key as anti-rotation element		D1: 40 mm; 55 mm D2: 64.37 mm; 75.44 mm		≤ 33 000 min^{-1}; ≤ 27 000 min^{-1}
ERM 2900	Steel scale drum with MAGNODUR graduation; friction-locked fastening by clamping the drum		D1: 40 mm to 100 mm D2: 58.06 to 120.96 mm	± 68″ to ± 33″	≤ 47 000 min^{-1} to ≤ 16 000 min^{-1}

[1] Segment versions upon request
[2] May be limited in operation by electrically permissible shaft speed
[3] The position value is generated internally from the incremental signals after traverse over two reference marks.

Interface	Signal periods/rev	Reference marks	Model	Further information
⌒ 1 V$_{PP}$	36000 to 90000	Distance-coded	**ERA 7480 C**	Catalog: *Angle Encoders Without Integral Bearing*
⌒ 1 V$_{PP}$	36000 to 90000	Distance-coded	**ERA 8480 C**	
⌒ 1 V$_{PP}$	1800 to 7200	Distance-coded	**ERM 2280**	Catalog: *Magnetic Modular Encoders*
⊓⊔ TTL	600 to 3600	One or distance-coded	**ERM 220**	
⌒ 1 V$_{PP}$			**ERM 280**	
EnDat 2.2[3]	600 to 3600	Distance-coded	**ERM 2410**	
⌒ 1 V$_{PP}$	512 to 1024	One	**ERM 2484**	
⌒ 1 V$_{PP}$	512; 600		**ERM 2485**	
⌒ 1 V$_{PP}$	192 to 400	One	**ERM 2984**	

ERA 7480

ERA 8480

ERM 2200
ERM 2410

ERM 200

ERM 2400

ERM 2900

Measuring principles
Measuring standard

HEIDENHAIN encoders with optical scanning incorporate measuring standards of periodic structures known as graduations.

These graduations are applied to a carrier substrate of glass or steel. The scale substrate for large measuring lengths is a steel tape.

HEIDENHAIN manufactures the precision graduations in specially developed, photolithographic processes.
- AURODUR: matte-etched lines on gold-plated steel tape with typical graduation period of 40 µm
- METALLUR: contamination-tolerant graduation of metal lines on gold, with typical graduation period of 20 µm
- DIADUR: extremely robust chromium lines on glass (typical graduation period of 20 µm) or three-dimensional chromium structures (typical graduation period of 8 µm) on glass
- SUPRADUR phase grating: optically three dimensional, planar structure; particularly tolerant to contamination; typical graduation period of 8 µm and finer
- OPTODUR phase grating: optically three dimensional, planar structure with particularly high reflectance, typical graduation period of 2 µm and less

Along with these very fine grating periods, these processes permit a high definition and homogeneity of the line edges. Together with the photoelectric scanning method, this high edge definition is a precondition for the high quality of the output signals.

The master graduations are manufactured by HEIDENHAIN on custom-built high-precision dividing engines.
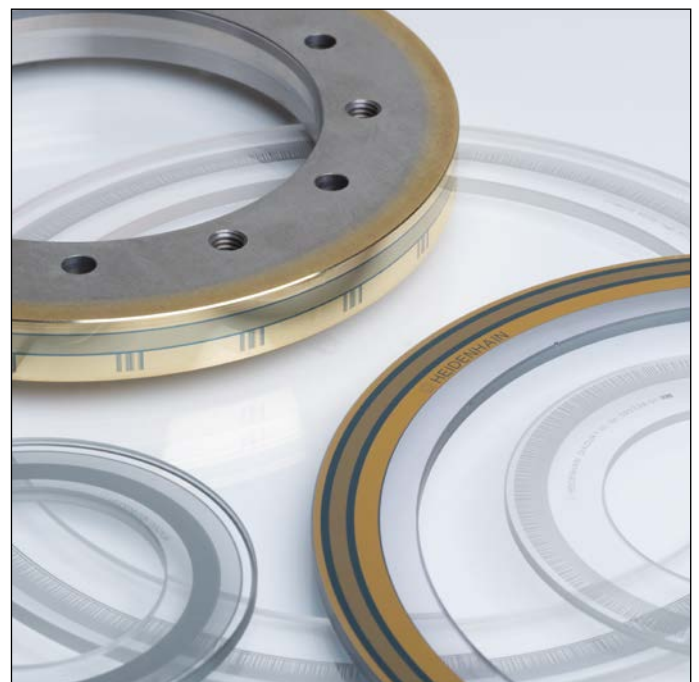
Absolute measuring method

With the absolute measuring method, the position value is available from the encoder immediately upon switch-on and can be called at any time by the subsequent electronics. There is no need to move the axes to find the reference position.

The absolute position information is read from the **graduated disk** which is formed from a serial absolute code structure. The code structure is unique over one revolution. A separate incremental track is read with the single-field scanning principle and interpolated for the position value.
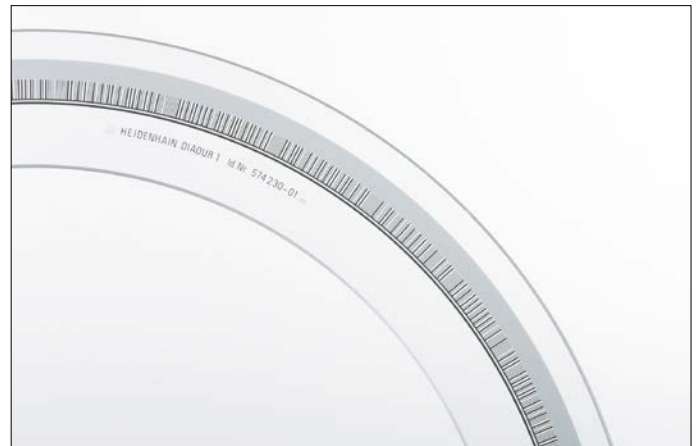
Graduated disk with serial absolute code track and incremental track

Absolute and incremental circular scales and scale drums

Incremental measuring method

With the incremental measuring method, the graduation consists of a periodic grating structure. The position information is obtained **by counting** the individual increments (measuring steps) from some point of origin. Since an absolute reference is required to ascertain positions, the scales or scale tapes are provided with an additional track that bears a **reference mark.** The absolute position on the scale, established by the reference mark, is gated with exactly one measuring step.

The reference mark must therefore be scanned to establish an absolute reference or to find the last selected datum.

In some cases, this may require rotation by up to nearly 360°. To speed and simplify such "reference runs," many HEIDENHAIN encoders feature **distance-coded reference marks**—multiple reference marks that are individually spaced according to a mathematical algorithm. The subsequent electronics find the absolute reference after traversing two successive reference marks—meaning only a few degrees of traverse (see nominal increment I in the table).

Encoders with distance-coded reference marks are identified with a "C" behind the model designation (e.g. RON 786 C).

With distance-coded reference marks, the **absolute reference** is calculated by counting the signal periods between two reference marks and using the following formulas:

$$\alpha_1 = (abs\ A - sgn\ A - 1) \times \frac{G}{2} + (sgn\ A - sgn\ D) \times \frac{abs\ M_{RR}}{2}$$

where:

$$A = \frac{2 \times abs\ M_{RR} - G}{GP}$$

Where:

α_1 = Absolute angular position of the first traversed reference mark to the zero position in degrees

abs = Absolute value

sgn = Sign function ("+1" or "–1")

M_{RR} = Measured distance between the traversed reference marks in degrees

I = Nominal increment between two fixed reference marks (see table)

GP = Grating period ($\frac{360°}{\text{Line count}}$)

D = Direction of rotation (+1 or –1) Rotation to the right (when viewing the mounting side of the angle encoder—see "Mating dimensions") results in "+1"

Line count z	Number of reference marks	Nominal increment I
36000	72	10°
18000	36	20°
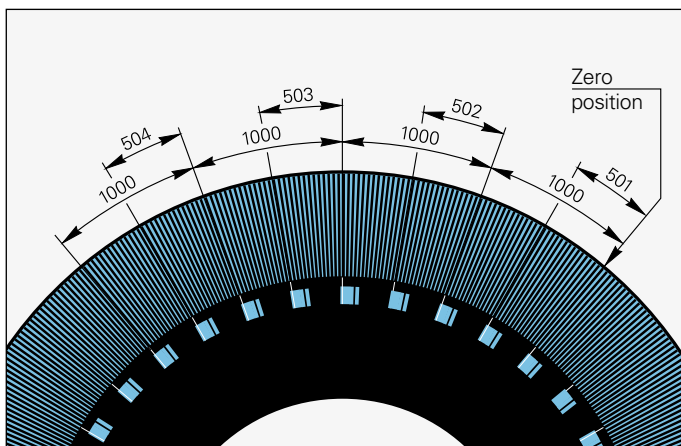
Schematic representation of a circular scale with distance-coded reference marks

Photoelectric scanning

Most HEIDENHAIN encoders operate using the principle of photoelectric scanning. Photoelectric scanning of a measuring standard is contact-free, and as such, free of wear. This method detects even very fine lines, no more than a few micrometers wide, and generates output signals with very small signal periods.

The finer the grating period of a measuring standard is, the greater the effect of diffraction on photoelectric scanning. HEIDENHAIN uses two scanning principles with angle encoders:

- The **imaging scanning principle** for grating periods from 10 µm to approx. 70 µm.
- The **interferential scanning principle** for very fine graduations with grating periods of 4 µm.

Imaging principle
Put simply, the imaging scanning principle functions by means of projected-light signal generation: two graduations with equal grating periods—the circular scale and the scanning reticle—are moved relative to each other. The carrier material of the scanning reticle is transparent, whereas the graduation on the measuring standard may be applied to a transparent or reflective surface.

When parallel light passes through a grating, light and dark surfaces are projected at a certain distance. An index grating with the same grating period is located here. When the two gratings move relative to each other, the incident light is modulated. If the gaps in the gratings are aligned, light passes through. If the lines of one grating coincide with the gaps of the other, no light passes through.

Photovoltaic cells or a large-surface photovoltaic-cell array convert these variations in light intensity into electrical signals. The specially structured grating of the scanning reticle filters the light to generate nearly sinusoidal output signals. The smaller the period of the grating structure is, the closer and more tightly toleranced the gap must be between the scanning reticle and circular scale. Practical mounting tolerances for encoders with the imaging scanning principle are achieved with grating periods of 10 µm and larger.

The RCN, ECN, RON and ROD angle encoders with integral bearing operate according to the imaging scanning principle.

Imaging principle

LED light source

Condenser lens

Scanning reticle

Measuring standard

Photocells

$I_{0°}$ $I_{180°}$

$I_1 = I_{0°} - _{180°}$

$I_{90°}$ and $I_{270°}$ photocells are not shown
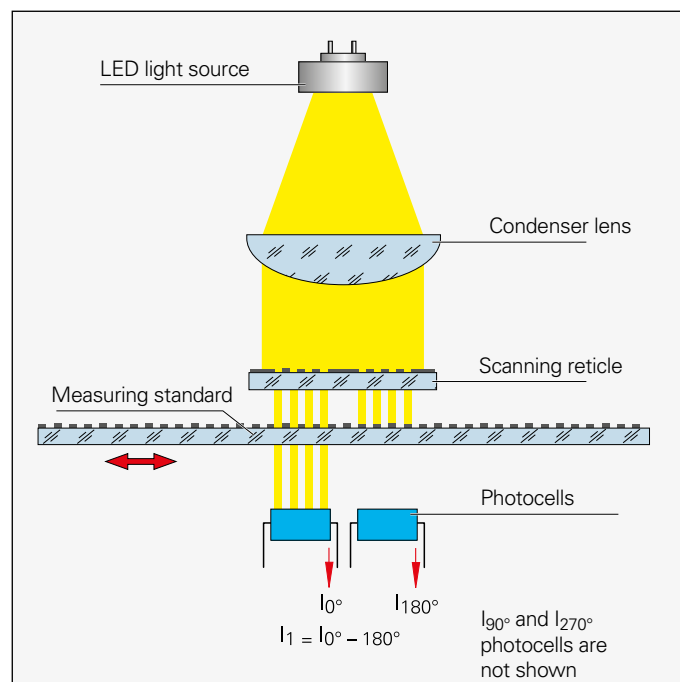
Interferential scanning principle

The interferential scanning principle exploits the diffraction and interference of light on a fine graduation to produce signals used to measure displacement.

A step grating is used as the measuring standard: reflective lines 0.2 µm high are applied to a flat, reflective surface. In front of that is the scanning reticle—a transparent phase grating with the same grating period as the scale.

When a light wave passes through the scanning reticle, it is diffracted into three partial waves of the orders –1, 0, and +1, with approximately equal luminous intensity. The waves are diffracted by the scale such that most of the luminous intensity is found in the reflected diffraction orders +1 and –1. These partial waves meet again at the phase grating of the scanning reticle where they are diffracted again and interfere. This produces essentially three waves that leave the scanning reticle at different angles. Photovoltaic cells convert this alternating light intensity into electrical signals.

A relative motion of the scanning reticle to the scale causes the diffracted wave fronts to undergo a phase shift: when the grating moves by one period, the wave front of the first order is displaced by one wavelength in the positive direction, and the wavelength of diffraction order –1 is displaced by one wavelength in the negative direction. Since the two waves interfere with each other when exiting the grating, the waves are shifted relative to each other by two wavelengths. This results in two signal periods from the relative motion of just one grating period.

Interferential encoders function with average grating periods of 4 µm and finer. Their scanning signals are largely free of harmonics and can be highly interpolated. These encoders are therefore especially suited for high resolution and high accuracy. Even so, their generous mounting tolerances permit installation in a wide range of applications.
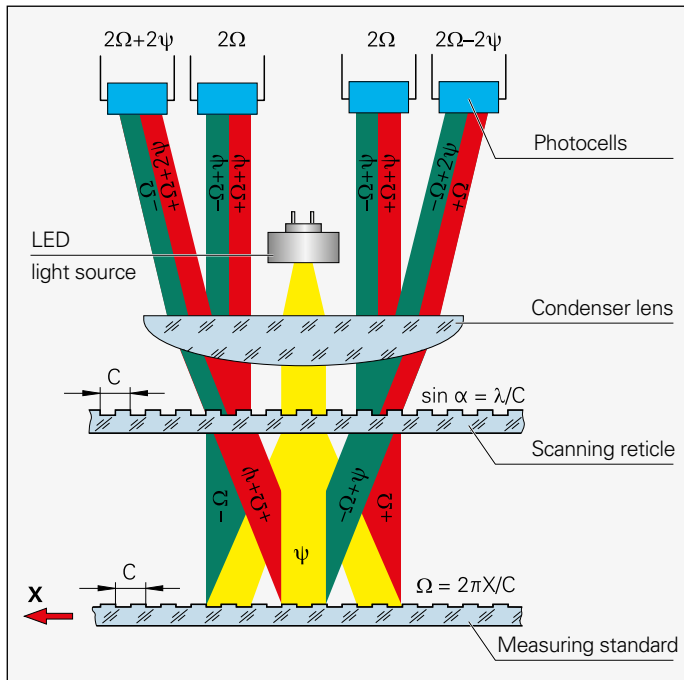
The RPN 886 angle encoder with integral bearing operates according to the interferential scanning principle.

Interferential scanning principle (optics schematics)
C Grating period
Ψ Phase shift of the light wave when passing through the scanning reticle
Ω Phase shift of the light wave due to motion X of the scale

Measuring accuracy

The accuracy of angular measurement is mainly determined by
- the quality of the graduation,
- the quality of the scanning process,
- the quality of the signal processing electronics,
- the eccentricity of the graduation to the bearing,
- the error of the bearing,
- the coupling to the measured shaft, and
- the elasticity of the stator coupling (RCN, ECN, RON, RPN) or shaft coupling (ROD)

These factors of influence are comprised of encoder-specific error and application-dependent issues. All individual factors of influence must be considered in order to assess the attainable **overall accuracy.**

Error specific to the measuring device

For angle encoders with integral bearing, the error that is specific to the measuring device is shown in the Specifications as the **system accuracy.**

The extreme values of the total deviations of a position are—referenced to their mean value—within the system accuracy ± a.

The system accuracy reflects position errors within one revolution as well as those within one signal period and—for angle encoders with stator coupling—the errors of the shaft coupling.

Position error within one signal period
Position errors within one signal period are considered separately, since they already have an effect even in very small angular motions and in repeated measurements. They especially lead to speed ripples in the speed control loop.

The position error within one signal period ± u results from the quality of the scanning and—for encoders with integrated pulse-shaping or counter electronics—the quality of the signal-processing electronics. For encoders with sinusoidal output signals, however, the errors of the signal processing electronics are determined by the subsequent electronics.

The following individual factors influence the result:
- The size of the signal period
- The homogeneity and period definition of the graduation
- The quality of scanning filter structures
- The characteristics of the sensors
- The stability and dynamics of further processing of the analog signals

These errors are considered when specifying the position error within one signal period.

The position error within one signal period ± u is indicated in the specifications of the angle encoders.

As the result of increased reproducibility of a position, much smaller measuring steps are still useful.

Application-dependent error

For **angle encoders with integral bearing** the specified system accuracy already includes the error of the bearing. For angle encoders with separate **shaft coupling** (ROD), the angle error of the coupling must be added (see *Mechanical design types and mounting — ROD*). For angle encoders with **stator coupling** (RCN, ECN, ROP, RPN), the system accuracy already includes the error of the shaft coupling.

In contrast, the mounting and adjustment of the scanning head normally have a significant effect on the accuracy that can be achieved by **encoders without integral bearing.** Of particular importance are the mounting eccentricity of the graduation and the radial runout of the measured shaft. The application-dependent error values must be measured and calculated individually in order to evaluate the **overall accuracy** of such encoders (see the *Angle Encoders without Integral Bearing* catalog).

Position errors within one revolution

Position error within one signal period

18
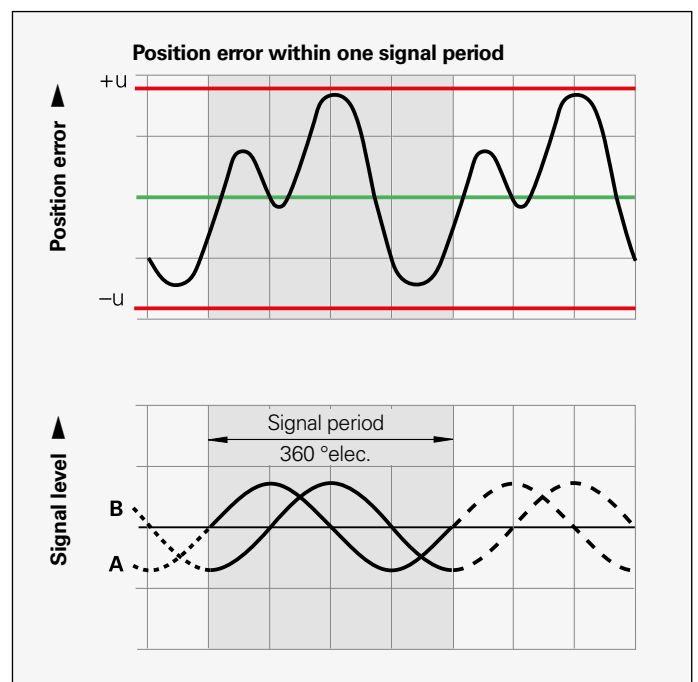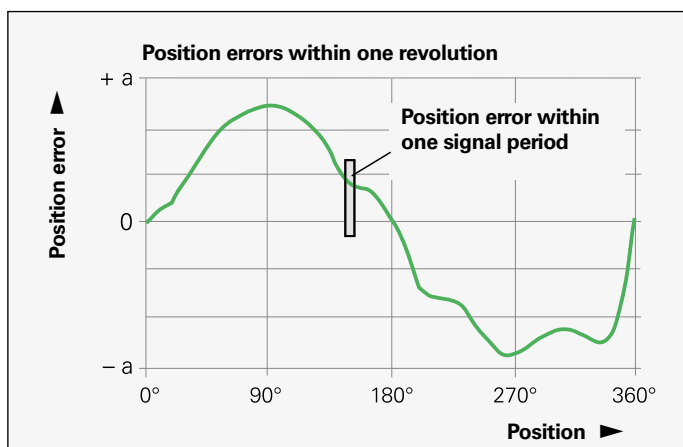
Calibration chart

For its angle encoders with integral bearings, HEIDENHAIN prepares individual Quality Inspection Certificates and ships them with the encoder.

The **Quality Inspection Certificate** documents the system accuracy. It is ascertained through five forward and five backward measurements. The measuring positions per revolution are chosen to determine very exactly not only the long-range error, but also the position error within one signal period.

The **mean value curve** shows the arithmetic mean of the measured values, in which the mechanical hysteresis is not included.

The **mechanical hysteresis** depends on the shaft coupling. On angle encoders with stator coupling—RCN, ECN, RPN and RPN—it is determined at ten measuring positions in forward and backward steps. The maximum value and arithmetic mean are documented on the calibration chart. The following limits apply to the mechanical hysteresis:
RCN 2xxx/RON 2xx: ≤ 0.6″
RCN 5xxx: ≤ 0.6″
ECN 2xx: ≤ 2″
RON 7xx: ≤ 0.4″
RCN 8xxx/RON/RPN 8xx: ≤ 0.4″

The **calibration standard** indicated in the Quality Inspection Certificate documents and guarantees traceability to recognized national and international standards.
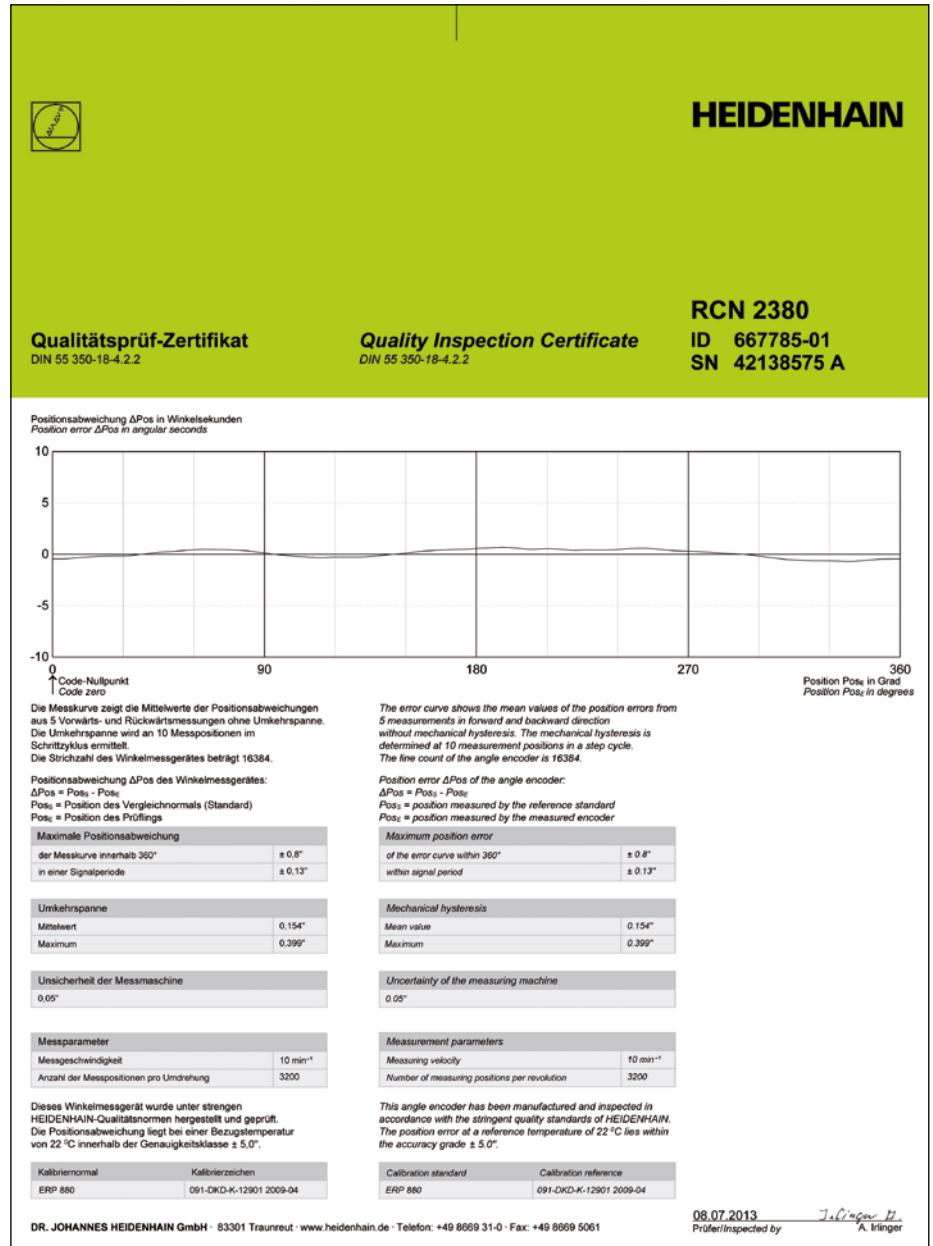
Example

Determination of the reversal error with forward and backward measurements

- ● Measuring point
- ✕ Reference mark
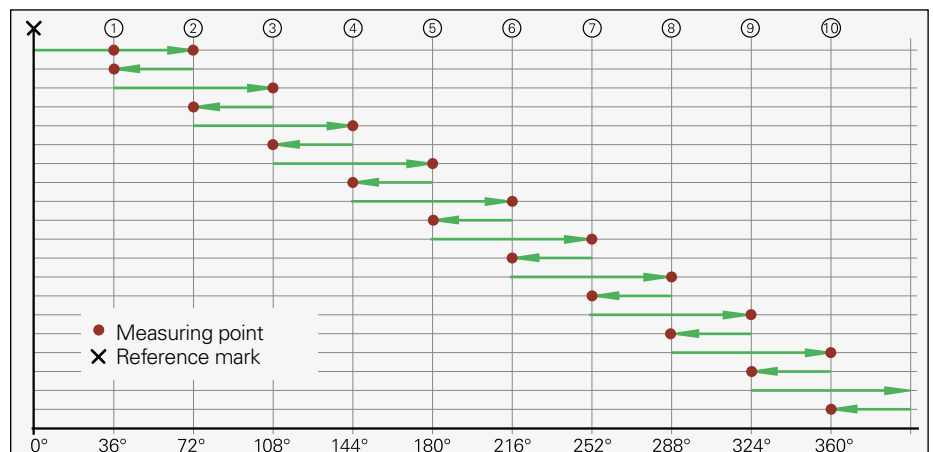
Mechanical design types and mounting
RCN, ECN, RON, RPN

RCN, ECN, RON and RPN angle encoders have an integral bearing, hollow shaft and a coupling on the stator side. The measured shaft is directly connected with the shaft of the angle encoder.

Setup
The graduated disk is rigidly affixed to the hollow shaft. The scanning unit rides on the shaft on ball bearings and is connected to the housing with a coupling on the stator side. The stator coupling and the sealing design greatly compensate axial and radial mounting errors without restricting function or accuracy. This permits relatively large mounting tolerances to facilitate mounting, especially for the RCN. Particularly during angular acceleration of the shaft, the coupling must absorb only that torque caused by friction in the bearing. Angle encoders with stator coupling therefore provide excellent dynamic performance.

Mounting
The housing of the RCN, ECN, RON, and RPN is firmly connected by a integral mounting flange and a centering collar to the stationary machine part.

• **Shaft coupling for RCN, ECN (Ø 20 mm), RON, RPN**

Shaft coupling with ring nut
The shaft is a hollow through shaft. For installation, the hollow through shaft of the angle encoder is placed over the machine shaft, and is fixed with a ring nut from the front of the encoder. The ring nut can easily be tightened with the mounting aid.

Front-end shaft coupling
It is often helpful, especially with rotary tables, to integrate the angle encoder in the table so that it is freely accessible when the rotor is lifted off. The hollow shaft is connected by threaded holes on the front end with the aid of special mounting elements adapted to the respective design (not included in delivery). To comply with radial and axial runout specifications, the internal bore ① and the shoulder surface ② are to be used as mounting surfaces for shaft coupling at the front of the encoder.
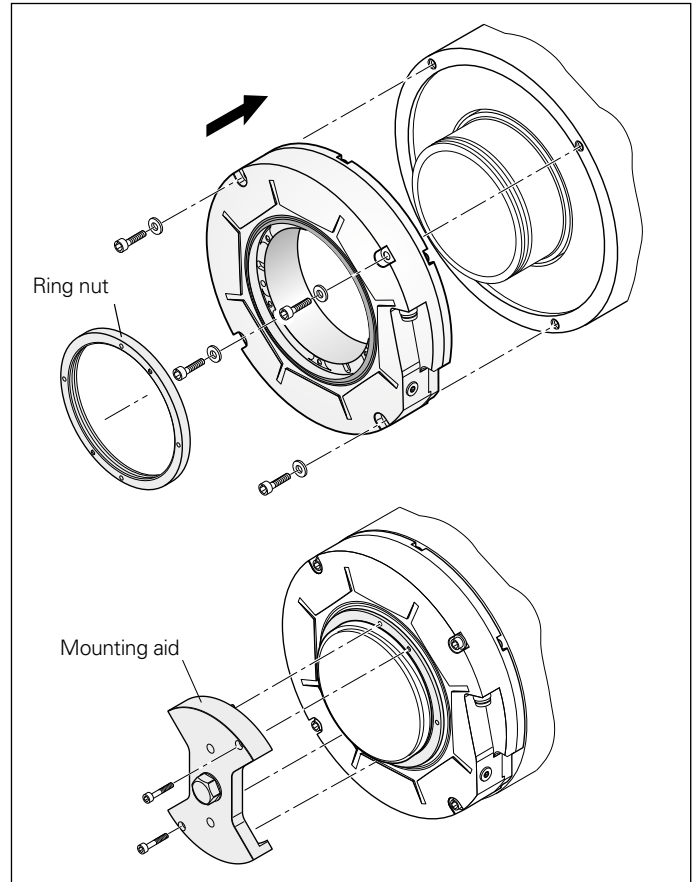

Mounting an angle encoder with a ring nut
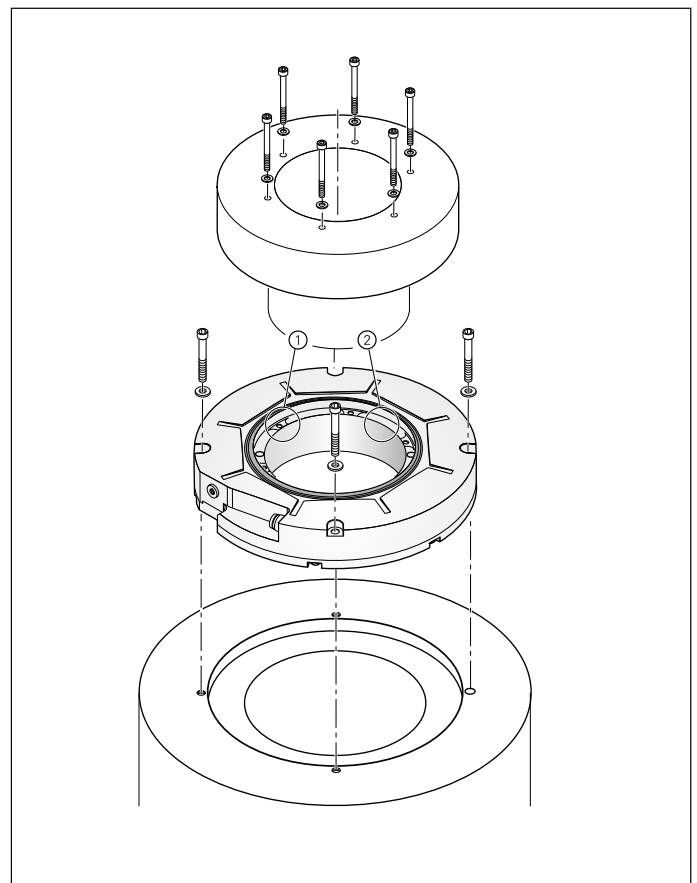
Example of connecting an encoder to the shaft face
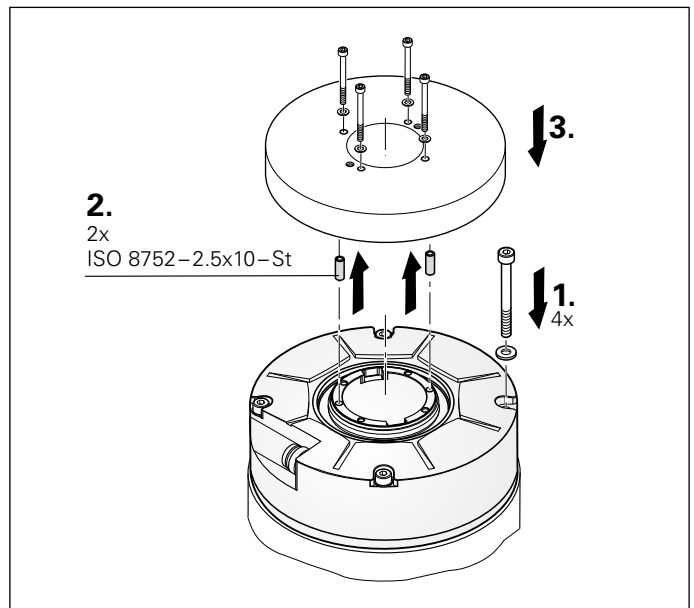
Mechanical fault exclusion

For the RCN 2000, RCN 5000 and RCN 8000, a fault exclusion can be realized for the loosening of the mechanical connection between the encoder and drive. For this purpose, the shaft has to be coupled either through an additional catch or additional spring pins. At the same time there are constraints and changes in

• the maximum permissible shaft speed,
• the operating temperature,
• the permissible angular acceleration, and
• the materials to be used.

For more details, refer to the Product Information documents *"RCN 2000, RCN 5000, RCN 8000 – Absolute Angle Encoders for Safety-Related Applications."*
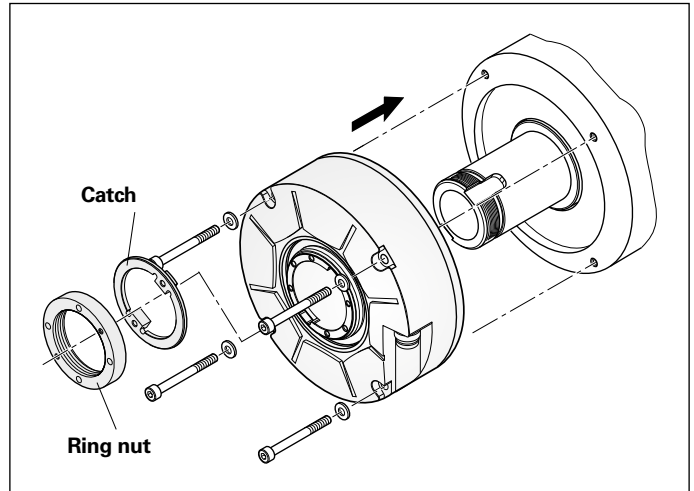
Shaft coupling with ring nut and catch

Front-end shaft coupling with mounting screws and spring pins

Catch for mechanical fault exclusion of the shaft coupling through ring nut on the RCN

Catch for RCN 2000:   ID 817921-01
Catch for RCN 5000:   ID 817921-02
Catch for RCN 8000:
  – Hollow shaft Ø 60 mm: ID 817921-03
  – Hollow shaft Ø 100 mm: ID 817921-04

	Moment of inertia of ring nut and catch
RCN 2000	$4.8 \cdot 10^{-6}$ kgm^2
RCN 5000	$24 \cdot 10^{-6}$ kgm^2
RCN 8000 (Ø 60 mm)	$87 \cdot 10^{-6}$ kgm^2
RCN 8000 (Ø 100 mm)	$550 \cdot 10^{-6}$ kgm^2

|	**D** (mm)
RCN 2000	Ø 29.6
RCN 5000	Ø 45.8
RCN 8000 (Ø 60 mm)	Ø 70
RCN 8000 (Ø 100 mm)	Ø 114
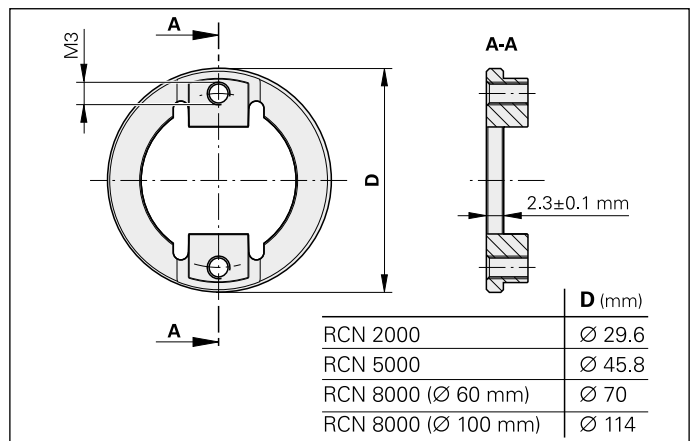
- **Shaft coupling for ECN (Ø 50 mm)**
  The ECN 200 is slid by its hollow shaft onto the measured shaft, and the rotor is fastened by three eccentric clamps.
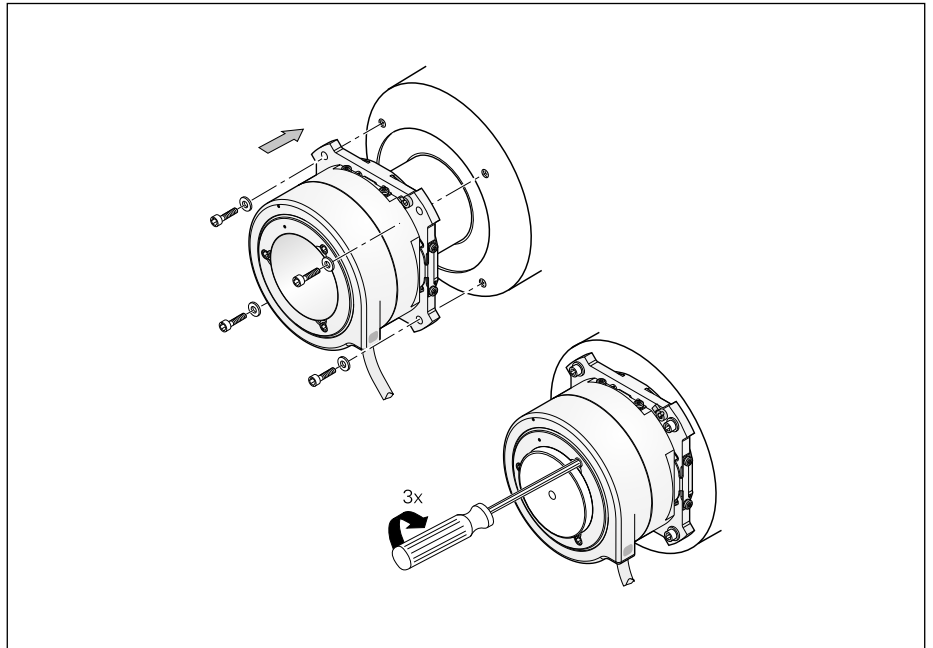
Mounting an ECN 200 with Ø 50 mm hollow shaft

- **Shaft coupling for RON 905**
  The RON 905 has a blind hollow shaft. The shaft is connected by an axial central screw.
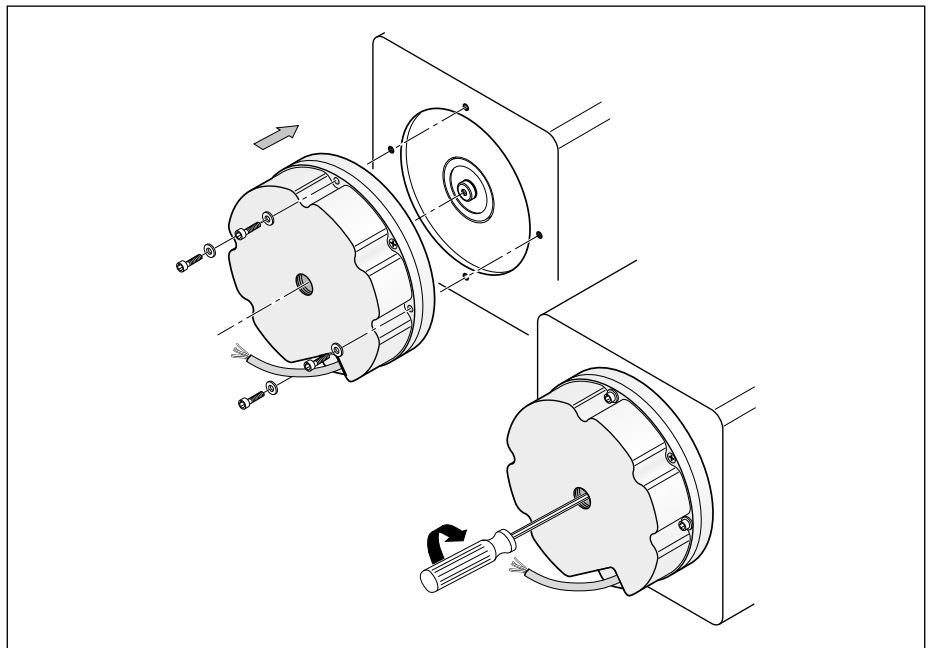
Mounting an RON 905

Materials required for mounting the RCN, ECN, RON and RPN

The machine shaft and the fastening components must be made of steel. The material must have a coefficient of thermal expansion value of
$\alpha = (10 \text{ to } 16) \times 10^{-6} \text{ K}^{-1}$.
Additionally, the material must meet the following specifications:
- For hollow-shaft connection
  $R_m \geq 650 \text{ N/mm}^2$
  $R_{p0.2} \geq 370 \text{ N/mm}^2$ (for mechanical fault exclusion, see page 21)
- For housing connection
  $R_{p0.2} \geq 370 \text{ N/mm}^2$

22

Ring nuts for RCN, ECN (Ø 20 mm), RON and RPN

HEIDENHAIN offers special ring nuts for the RCN, ECN (Ø 20 mm), RON and RPN encoders. Choose the tolerance of the shaft thread such that the ring nut can be tightened easily, with a minor axial play. This guarantees that the load is evenly distributed on the shaft connection, and prevents distortion of the encoder's hollow shaft.

Ring nut for
Hollow shaft Ø 20 mm:	ID 336669-03
Hollow shaft Ø 35 mm:	ID 336669-17
Hollow shaft Ø 50 mm:	ID 336669-15
Hollow shaft Ø 60 mm:	ID 336669-11
Hollow shaft Ø 100 mm:	ID 336669-16

Ring nut for hollow shaft Ø 20 mm

*) Pitch diameter

Ring nut for	L1	L2	D1	D2	D3	B
Hollow shaft Ø 35	Ø 46±0.2	Ø 40	(Ø 34.052 ±0.075)	Ø 34.463 ±0.053	(Ø 35.24)	1
Hollow shaft Ø 50	Ø 62±0.2	Ø 55	(Ø 49.052 ±0.075)	Ø 49.469 ±0.059	(Ø 50.06)	1
Hollow shaft Ø 60	Ø 70±0.2	Ø 65	(Ø 59.052 ±0.075)	Ø 59,469 ±0.059	(Ø 60.06)	1
Hollow shaft Ø 100	Ø 114±0.2	Ø 107	(Ø 98.538 ±0.095)	(Ø 99.163 ±0.07)	(Ø 100.067)	1.5

*) Pitch diameter
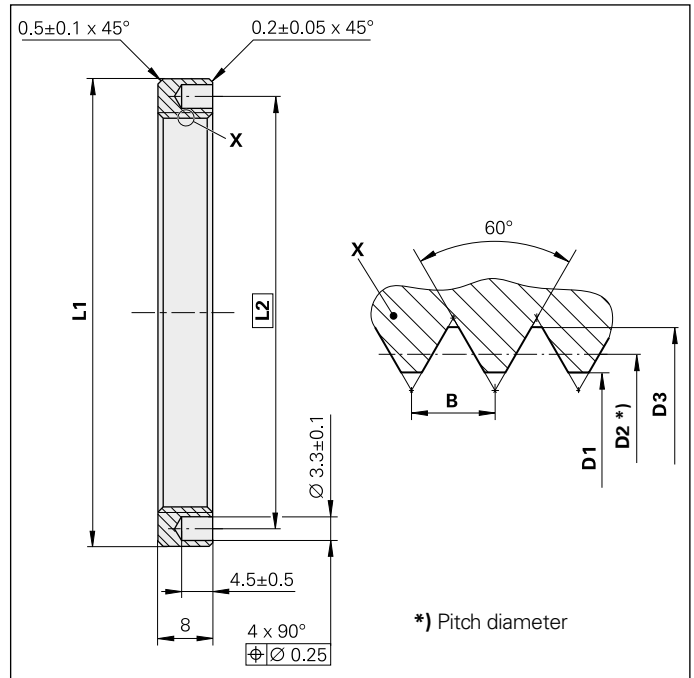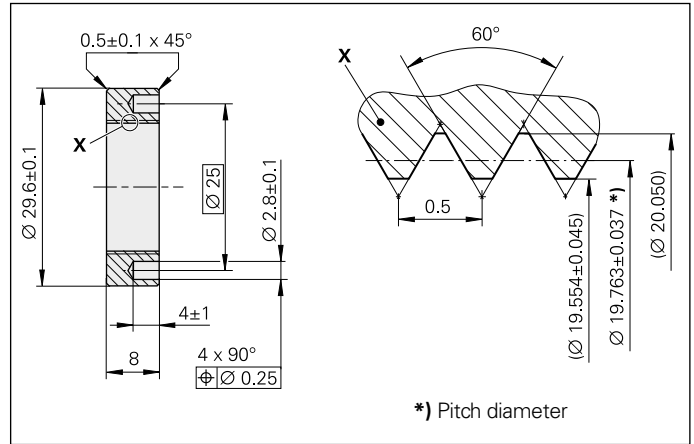
Mounting aid for HEIDENHAIN ring nuts

The mounting aid is used to tighten the ring nut. Its pins lock into the holes in the ring nut. A torque wrench provides the necessary tightening torque.

Mounting aid for ring nuts with
Hollow shaft Ø 20 mm:	ID 530334-03
Hollow shaft Ø 35 mm:	ID 530334-17
Hollow shaft Ø 50 mm:	ID 530334-15
Hollow shaft Ø 60 mm:	ID 530334-11
Hollow shaft Ø 100 mm:	ID 530334-16

PWW inspection tool for RCN/RON/RPN angle encoders

The PWW makes it possible to simply and quickly inspect the most significant mating dimensions. The integrated measuring equipment measures position and radial runout, for example. It is best suited for the shaft coupling with ring nut.

PWW for
Hollow shaft Ø 20 mm:	ID 516211-01
Hollow shaft Ø 35 mm:	ID 516211-06
Hollow shaft Ø 50 mm:	ID 516211-02
Hollow shaft Ø 60 mm:	ID 516211-03
Hollow shaft Ø 100 mm:	ID 516211-05

Inspection tool (PWW)

ROD

Angle encoders of the **ROD** product family require a separate coupling for connection to the drive shaft. The shaft coupling compensates axial movement and misalignment between the shafts, preventing excessive load on the bearing of the angle encoder. It is important that the encoder shaft and the drive shaft be optimally aligned for high measurement accuracies to be realized. The HEIDENHAIN product program includes diaphragm couplings and flat couplings designed for connecting the shaft of the ROD angle encoder to the drive shaft.

Mounting

ROD angle encoders are provided with an integral mounting flange with centering collar. The encoder shaft is connected to the drive shaft by way of a diaphragm coupling or flat coupling.

Shaft couplings

The shaft coupling compensates axial movement and misalignment between the encoder shaft and the drive shaft, preventing excessive load on the encoder bearing of the angle encoder.

Radial offset λ
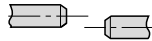
Angular error α

Axial motion δ
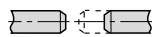
Mounting example
ROD 880
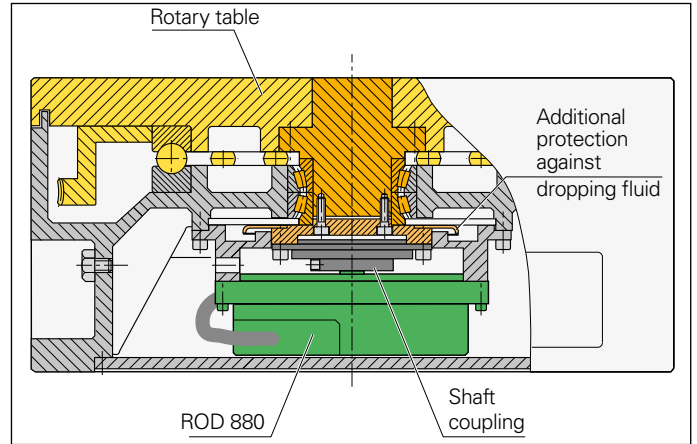
Mounting an ROD
with flat coupling
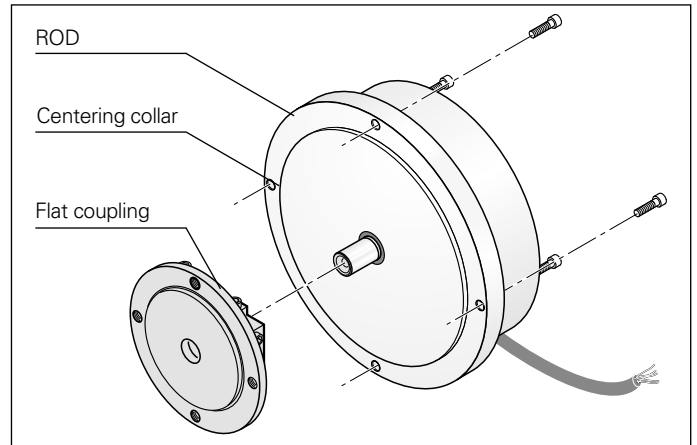
| Shaft coupling	ROD 200 series		ROD 700 series, ROD 800 series		
	K 03 Diaphragm coupling	K 18 Flat coupling	K 01 Diaphragm coupling	K 15 Flat coupling	K 16 Flat coupling
Hub bore	10 mm		14 mm		
Kinematic transfer error	± 2″ At $\lambda \leq 0.1$ mm and $\alpha \leq 0.09°$	± 3″	± 1″	± 0.5″ At $\lambda \leq 0.05$ mm and $\alpha \leq 0.03°$	
Torsional rigidity	1500 Nm/rad	1200 Nm/rad	4000 Nm/rad	6000 Nm/rad	4000 Nm/rad
Permissible torque	0.2 Nm	0.5 Nm			
Perm. radial offset λ	≤ 0.3 mm				
Perm. angular error α	$\leq 0.5°$			$\leq 0.2°$	$\leq 0.5°$
Perm. axial offset δ	≤ 0.2 mm			≤ 0.1 mm	≤ 1 mm
Moment of inertia (approx.)	$20 \cdot 10^{-6}$ kgm^2	$75 \cdot 10^{-6}$ kgm^2	$200 \cdot 10^{-6}$ kgm^2		$400 \cdot 10^{-6}$ kgm^2
Permissible speed	10 000 min^{-1}	1 000 min^{-1}	3 000 min^{-1}	1 000 min^{-1}	
Torque for locking screws (approx.)	1.2 Nm		2.5 Nm	1.2 Nm	
Weight	100 g	117 g	180 g	250 g	410 g

Diaphragm coupling K 03
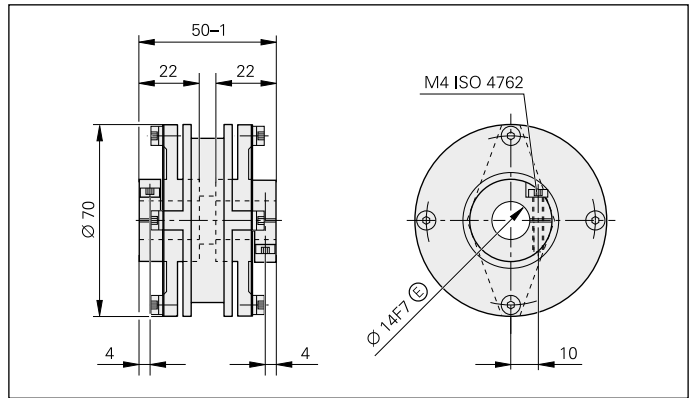ID 200313-04
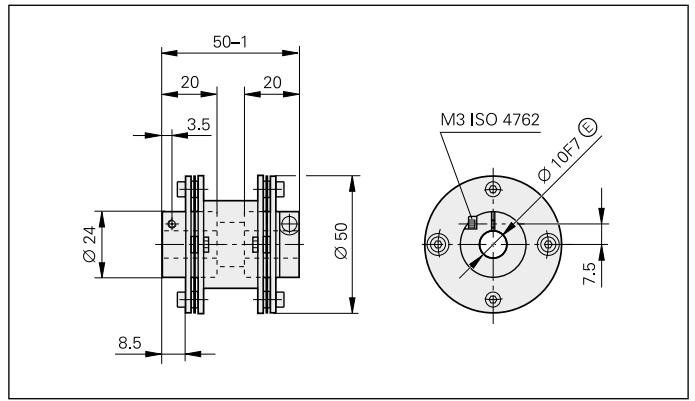
Flat coupling K 18
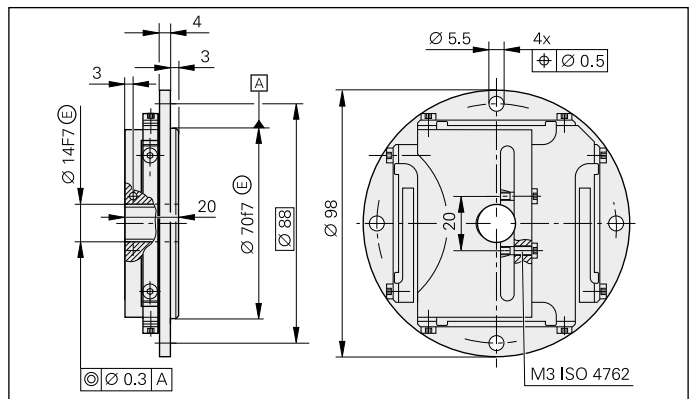ID 202227-01
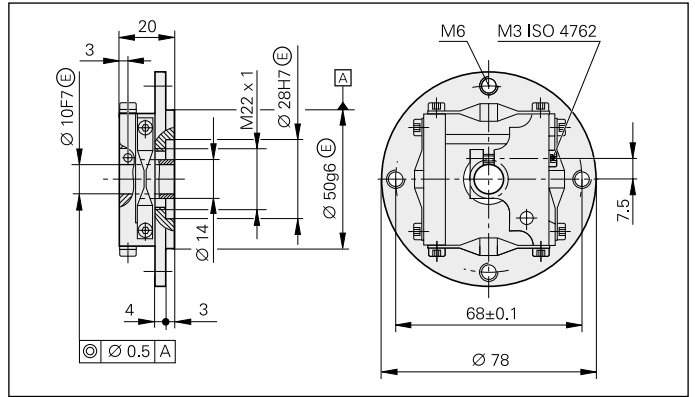
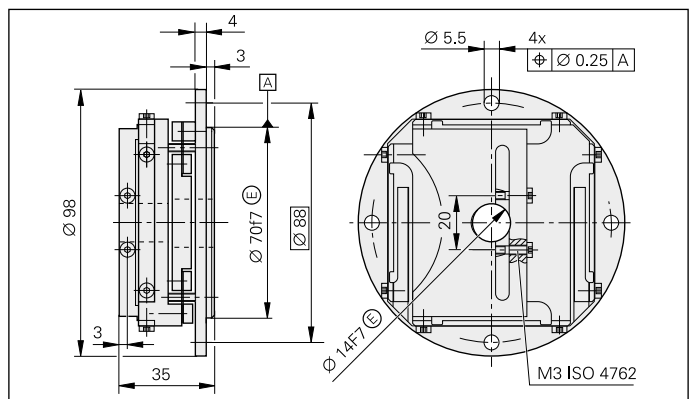**Diaphragm coupling K 01**
ID 200301-02

Flat coupling K 15
ID 255797-01

Flat coupling K 16
ID 258878-01

mm

Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm

General mechanical information

Protection
Unless otherwise indicated, RCN, ECN, RON, RPN and ROD angle encoders meet protection standard IP 64 as per EN 60529 and IEC 60529.

Splash water must not contain any substances that would have harmful effects on the encoder's parts. If the protection to IP 64 is not sufficient, e.g. when the angle encoder is mounted vertically, additional measures such as labyrinth seals should be provided.

RCN, RON, RPN and ROD angle encoders are equipped with a compressed air inlet. Connection to a source of compressed air slightly above atmospheric pressure generates **sealing air** and provides additional protection against contamination.

The compressed air introduced directly onto the encoders must be cleaned by a micro filter, and must comply with the following quality classes as per **ISO 8573-1** (2010 edition):
- Solid contaminants: **Class 1**
  Particle size   No. of particles per m^3

  0.1 µm to 0.5 µm ≤ 20000
  0.5 µm to 1.0 µm ≤ 400
  1.0 µm to 5.0 µm ≤ 10
- Max. pressure dew   **Class 4**
  point: (pressure dew point at 3 °C)
- Total oil content: **Class 1**
  (max. oil concentration: 0.01 mg/m^3)

For optimum supply of sealing air to the angle encoders with integral bearing, the required air flow is 1 to 4 l/min per encoder. Ideally the air flow is regulated by the HEIDENHAIN connecting pieces with integrated throttle (see *Accessories*). At an inlet pressure of $\approx 1 \cdot 10^5$ Pa (1 bar), the throttles ensure the prescribed volume of airflow.

For more information, ask for our *DA 400* Product Information Sheet.

Accessory:
DA 400 compressed air unit
ID 894602-01

DA 400
HEIDENHAIN offers the DA 400 compressed-air filter system for purifying the compressed air. It is designed specifically for the introduction of compressed air into encoders.

The DA 400 consists of three filter stages (prefilter, fine filter and activated carbon filter) and a pressure regulator with pressure gauge. The pressure gauge and the automatic pressure switch (which is available as an accessory) effectively monitor the sealing air.

The compressed air introduced into the DA 400 must fulfill the requirements of the following purity classes as per ISO 8573-1 (2010 edition):

- Solid contaminants: **Class 5**
  Particle size   No. of particles per m^3

  0.1 µm to 0.5 µm   Not specified
  0.5 µm to 1.0 µm   Not specified
  1.0 µm to 5.0 µm ≤ 100000
- Max. pressure   **Class 6**
  dew point: (pressure dew point at 10 °C)
- Total oil content: **Class 4**
  (max. oil concentration: 5 mg/m^3)

Necessary for connection to angle encoders:

Connecting piece
For tubing 6 x 1
With throttle and gasket
For air-flow rate from 1 to 4 l/min
ID 207835-04

Also suitable:

Swiveling screw fitting 90°
With seal
ID 207834-02

DA 400

Temperature range

The angle encoders are inspected at a **reference temperature** of 22 °C. The system accuracy given in the calibration chart applies at this temperature.

The **operating temperature range** indicates the ambient temperature limits between which the angle encoders will function properly.

The **storage temperature range** of –20 °C to 60 °C applies when the unit remains in its packaging. The storage temperature for the RPN 886 and RON 905 must remain between –10 °C and 50 °C.

Protection against contact

After encoder installation, all rotating parts (shaft coupling on ROD, locking ring on RCN, ECN, RON and RPN) must be protected against accidental contact during operation.

Acceleration

Angle encoders are subject to various types of acceleration during operation and mounting.
- The **permissible angular acceleration** of the rotor for the RCN/ECN/RON/RPN angle encoders is 1000 rad/s^2. Higher values can sometimes apply for the RCN with fault exclusion for loosening of the mechanical connection (see *Product Information document for RCN 2000, RCN 5000, RCN 8000 for Safety-Related Applications*). For the ROD angle encoders, the permissible angular acceleration varies depending on the shaft coupling and the mating shaft (details upon request).
- The indicated maximum values for **vibration** apply for frequencies of 55 Hz to 2000 Hz (EN 60068-2-6), except when mechanical resonance arises.
- The maximum permissible acceleration values (semi-sinusoidal shock) for **shock and impact** are valid for 6 ms (EN 60068-2-27). 1000 m/s^2 (ROD 780/880: 300 m/s^2) must not be exceeded during shipping. The corresponding values for operation are listed in the specifications.

Under no circumstances should a hammer or similar implement be used to position the encoder.

Natural frequency f$_N$ of coupling

The rotor and shaft coupling of the ROD angle encoders, as well as the stator and stator coupling of the RCN, ECN, RON and RPN angle encoders, form a single vibrating spring-mass system.

The **natural frequency f$_N$** should be as high as possible. For RCN, ECN, RON and RPN angle encoders, the frequency ranges given in the respective specifications are those where the natural frequencies of the encoders do not cause any significant position deviations in the measuring direction. A prerequisite for the highest possible natural frequency on **ROD angle encoders** is the use of a **shaft coupling** with a high torsional rigidity C.

$$f_N = \frac{1}{2 \cdot \pi} \cdot \sqrt{\frac{C}{I}}$$

f$_N$: Natural frequency in Hz
C: Torsional rigidity of the shaft coupling in Nm/rad
I: Moment of inertia of the rotor in kgm^2

If radial and/or axial acceleration occurs during operation, the effect of the rigidity of the encoder bearing, the encoder stator and the coupling are also significant. If such loads occur in your application, HEIDENHAIN recommends consulting with the main facility in Traunreut.

Conditions for longer storage times

HEIDENHAIN recommends the following in order to make storage times beyond 12 months possible:
- Leave the encoders in the original packaging.
- The storage location should be dry, free of dust, and temperature-regulated. It should also not be subjected to vibrations, mechanical shock or chemical influences.
- For encoders with integral bearing, every 12 months (e.g. as run-in period) the shaft should be turned at low speeds, without axial or radial loads, so that the bearing lubricant redistributes itself evenly again.

Compensating currents

Compensating currents over the encoder bearing can negatively influence function and are therefore not permitted.

Expendable parts

HEIDENHAIN encoders contain components that are subject to wear, depending on the application and handling. These include in particular the following parts:
- LED light source
- Cables with frequent flexing
Additionally for encoders with integral bearing:
- Bearing
- Shaft sealing rings for rotary and angular encoders
- Sealing lips for sealed linear encoders

System tests

Encoders from HEIDENHAIN are usually integrated as components in larger systems. Such applications require **comprehensive tests of the entire system** regardless of the specifications of the encoder.

The specifications shown in this brochure apply to the specific encoder, not to the complete system. Any operation of the encoder outside of the specified range or for any other than the intended applications is at the user's own risk.
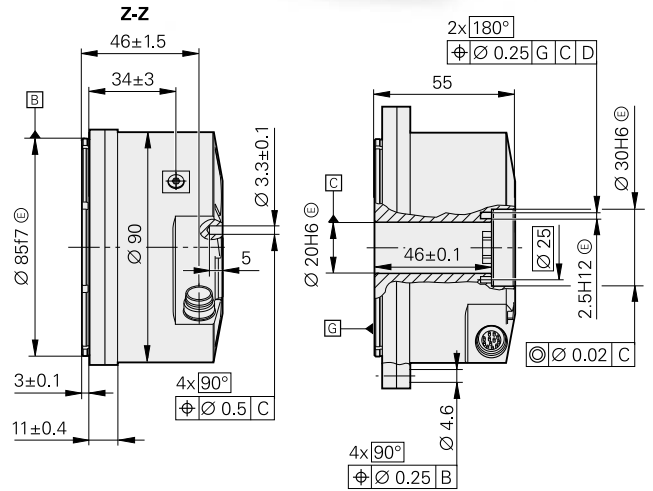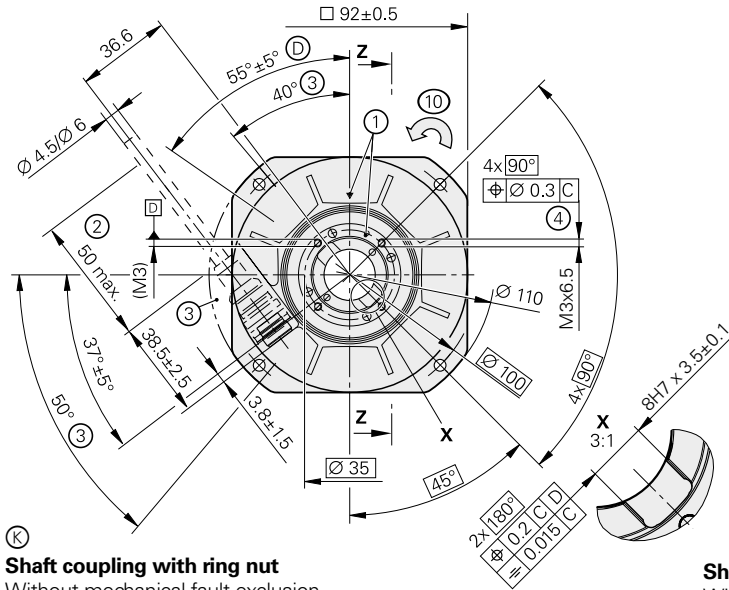
In safety-related systems, the higher-level system must verify the position value of the encoder after switch-on.

Assembly

Work steps to be performed and dimensions to be maintained during mounting are specified solely in the mounting instructions supplied with the unit. All data in this catalog regarding mounting are therefore provisional and not binding; they do not become terms of a contract.
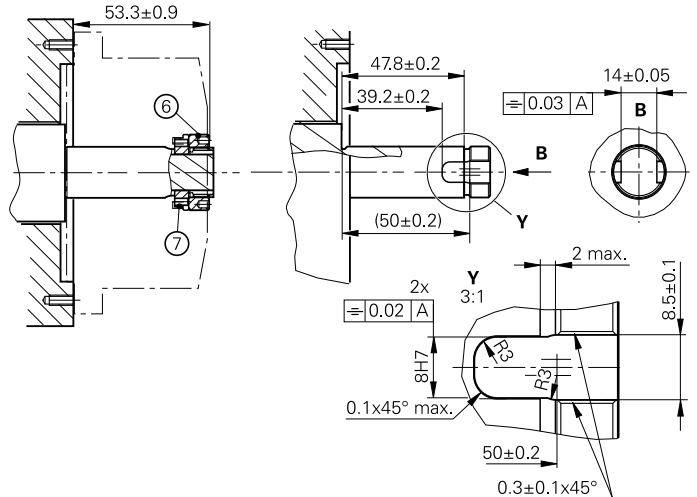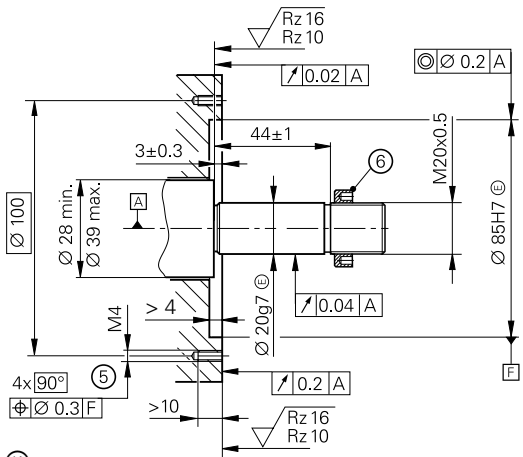
RCN 2000 series

- **Integrated stator coupling**
- **Hollow through shaft Ø 20 mm**
- **System accuracy ± 2.5" and ± 5"**
- **Fault exclusion for loosening of the mechanical connection is possible**
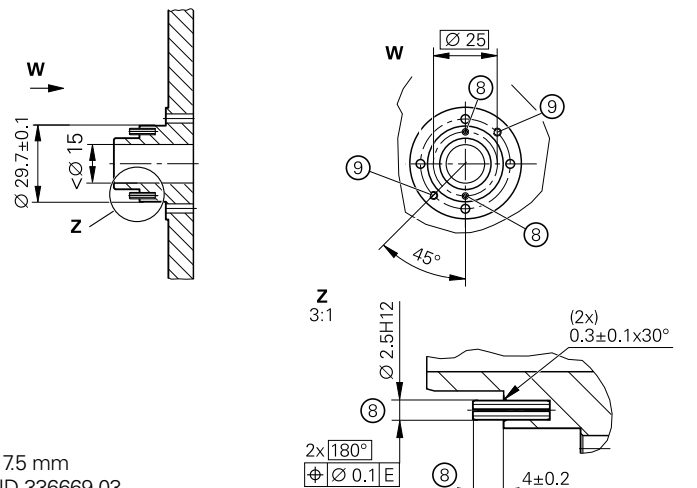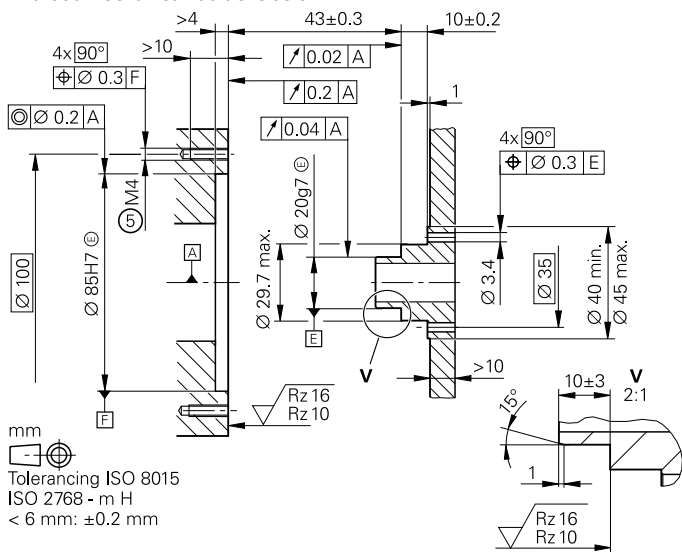

Shaft coupling with ring nut
Without mechanical fault exclusion

Shaft coupling with ring nut and catch
With mechanical fault exclusion
(for further dimensions, see "Without mechanical fault exclusion")

Front end shaft coupling
Without mechanical fault exclusion

Front-end shaft coupling
With mechanical fault exclusion
(for further dimensions, see "Without mechanical fault exclusion")

mm
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm

Ⓐ = Bearing of mating shaft
Ⓓ = Compressed air inlet
Ⓚ = Required mating dimensions
1 = Mark for 0° position ± 5°
2 = Cable support
3 = Free space for customer
4 = Screw penetration 4.5 ± 0.5 mm
5 = Screw penetration > 7.5 mm
6 = Accessory: Ring nut ID 336669-03
7 = Accessory: Ring nut ID 817921-01
8 = 2x spring pins ISO 8752 – 2.5x10 – St
9 = When using spring pins, provide additional back-off threads (M3)
10 = Direction of shaft rotation for output signals as per the interface description

	Absolute RCN 2510 RCN 2310	RCN 2580 RCN 2380	RCN 2590 F RCN 2390 F	RCN 2590 M RCN 2390 M
Measuring standard	DIADUR circular scale with absolute and incremental track (16384 lines)			
System accuracy	*RCN 25x0:* ± 2.5″; *RCN 23x0:* ± 5″			
Position error per signal period	*RCN 25x0:* ≤ ± 0.3″ *RCN 23x0:* ≤ ± 0.4″	*RCN 25x0:* ≤ ± 0.4″ *RCN 23x0:* ≤ ± 0.4″		
Functional safety*	Option[1]	–		
Interface	EnDat 2.2		Fanuc serial interface αi Interface	Mitsubishi high speed interface
Ordering designation	EnDat22	EnDat02	Fanuc05	Mit03-4
Position values/revolution	*RCN 25x0:* 268 435 456 (28 bits); *Fanuc α Interface:* 134 217 728 (27 bits) *RCN 23x0:* 67 108 864 (26 bits); *Fanuc α Interface:* 8 388 608 (23 bits)			
Elec. permissible speed	≤ 3000 min^{-1} for continuous position value	≤ 1500 min^{-1} for continuous position value	≤ 3000 min^{-1} for continuous position value	
Clock frequency Calculation time t_{cal}	≤ 16 MHz ≤ 5 µs	≤ 2 MHz ≤ 5 µs	–	
Incremental signals Cutoff frequency –3 dB	–	$\sim$ 1 V$_{PP}$ ≥ 400 kHz	–	
Electrical connection	Separate adapter cable connectable to encoder via quick disconnect			
Cable length[2]	≤ 150 m		≤ 50 m	≤ 30 m
Voltage supply	3.6 V to 14 V DC			
Power consumption[3] (max.)	*3.6 V:* ≤ 1.1 W; *14 V:* ≤ 1.3 W			
Current consumption (typical)	*5 V:* 140 mA (without load)			
Shaft	Hollow through shaft D= 20 mm			
Mech. permissible speed	≤ 1500 min^{-1}; *temporary:* ≤ 3000 min^{-1} [4] (Speeds over 1500 min^{-1} require consultation)			
Torque (friction)	≤ 3.3 Nm (typical starting torque: ≤ 0.08 Nm at 20 °C)			
Moment of inertia	*Rotor (hollow shaft)*: 180 · 10^{-6} kgm^2; *Stator (housing/flange)*: 670 · 10^{-6} kgm^2			
Permissible axial motion of measured shaft	± 0.3 mm			
Natural frequency	≥ 1000 Hz			
Vibration 55 to 2000 Hz **Shock** 6 ms	≤ 200 m/s^2 (EN 60068-2-6) ≤ 200 m/s^2 (EN 60068-2-27)			
Operating temperature	*RCN 25xx:* 0 °C to 50 °C; *RCN 23xx:* –20 °C to 60 °C[4]			
Protection EN 60 529	IP 64			
Weight	≈ 1.0 kg			

* Please indicate when ordering
[2] With HEIDENHAIN cable; ≤ 8 MHz
[4] For mechanical fault exclusion, see page 21

[1] For dimensions and specifications, see separate Product Information document
[3] See *General electrical information* in the catalog *Interfaces of HEIDENHAIN Encoders*

RON 200 series

- **Integrated stator coupling**
- **Hollow through shaft ∅ 20 mm**
- **System accuracy ± 2.5″ and ± 5″**
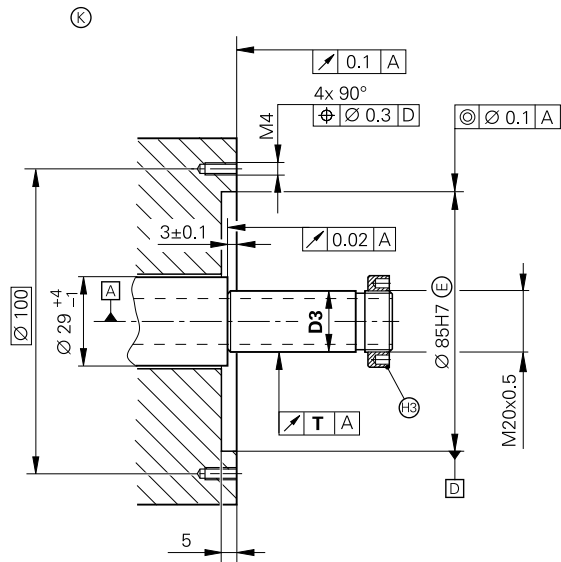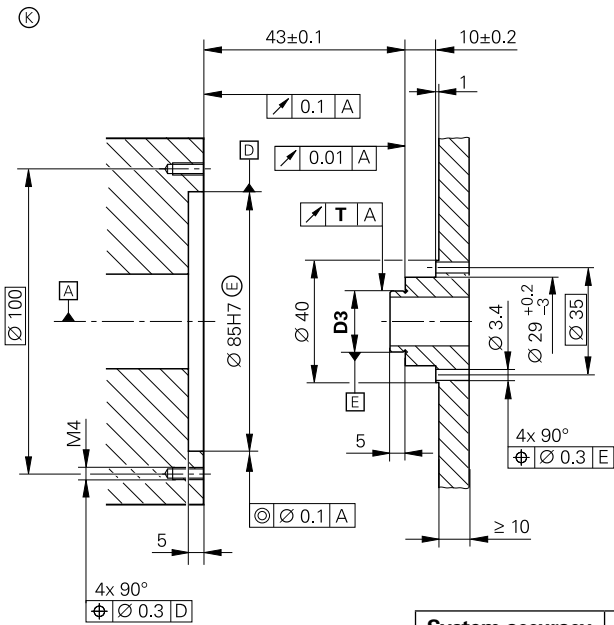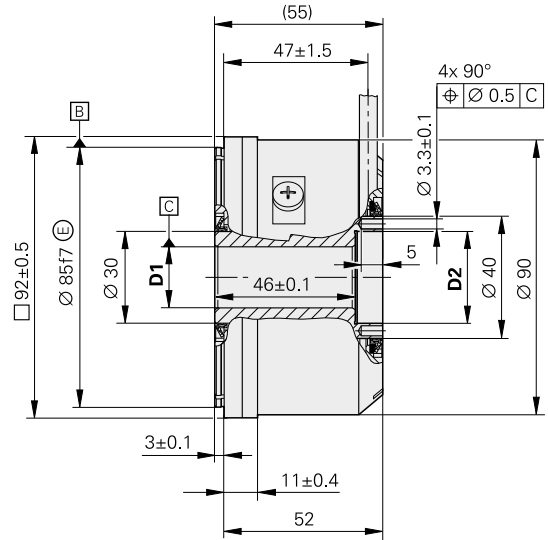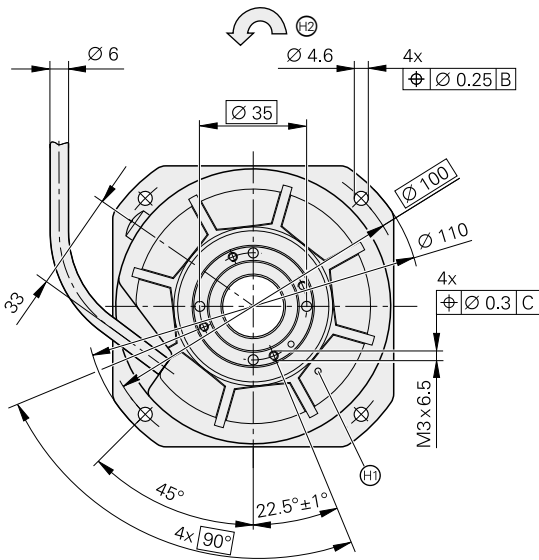
System accuracy	± 2.5″	± 5″
D1	∅ 20H6 Ⓔ	∅ 20H7 Ⓔ
D2	∅ 30H6 Ⓔ	∅ 30H7 Ⓔ
D3	∅ 20g6 Ⓔ	∅ 20g7 Ⓔ
T	0.01	0.02

mm

Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm

Cable radial, also usable axially
Ⓐ = Bearing of mating shaft
Ⓚ = Required mating dimensions
Ⓗ1 = Position of the reference mark signal ± 5°
Ⓗ2 = Direction of shaft rotation for output signals as per the interface description
Ⓗ3 = Accessory: Ring nut ID 336669-03

	Incremental RON 225	RON 275	RON 275	RON 285	RON 287
Measuring standard	DIADUR circular scale with incremental track				
Line count	9000	18000			
System accuracy	± 5″				± 2.5″
Position error per signal period	≤ ± 1.4″	≤ ± 0.7″			
Interface	⌐⌐TTL			$\sim$ 1 V$_{PP}$	
Integrated interpolation* Output signals/rev	2-fold 18000	5-fold 90000	10-fold 180000	–	
Reference mark*	One			*RON 2xx:* One *RON 2xxC:* Distance-coded	
Cutoff frequency –3 dB Output frequency Edge separation a	– ≤ 1 MHz ≥ 0.125 µs	– ≤ 250 kHz ≥ 0.96 µs	– ≤ 1 MHz ≥ 0.22 µs	≥ 180 kHz – –	
Elec. permissible speed	–	≤ 166 min^{-1}	≤ 333 min^{-1}	–	
Electrical connection*	Cable 1 m, with or without M23 coupling (male, 12-pin)				
Cable length[1]	≤ 50 m			≤ 150 m	
Voltage supply	5 V DC ± 0.5 V/≤ 150 mA (without load)				
Shaft	Hollow through shaft D= 20 mm				
Mech. permissible speed	≤ 3000 min^{-1}				
Starting torque	≤ 0.08 Nm at 20 °C				
Moment of inertia of rotor	73.0 · 10^{-6} kgm^2				
Permissible axial motion of measured shaft	± 0.1 mm				
Natural frequency	≥ 1200 Hz				
Vibration 55 to 2000 Hz **Shock** 6 ms	≤ 100 m/s^2 (EN 60068-2-6) ≤ 200 m/s^2 (EN 60068-2-27)				
Operating temperature	*Moving cable:* –10 °C to 70 °C *Stationary cable:* –20 °C to 70 °C				0 °C to +50 °C
Protection EN 60 529	IP 64				
Weight	≈ 0.8 kg				

* Please select when ordering
[1] With HEIDENHAIN cable

RCN 5000 series

- **Integrated stator coupling**
- **Hollow through shaft Ø 35 mm**
- **System accuracy ± 2.5" and ± 5"**
- **Fault exclusion for loosening of the mechanical connection is possible**
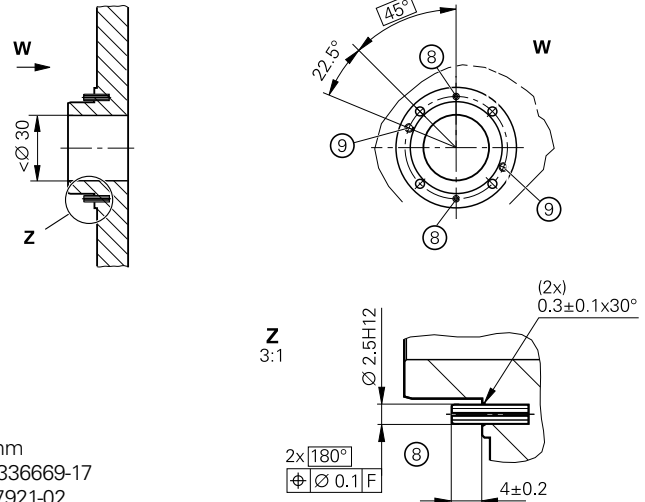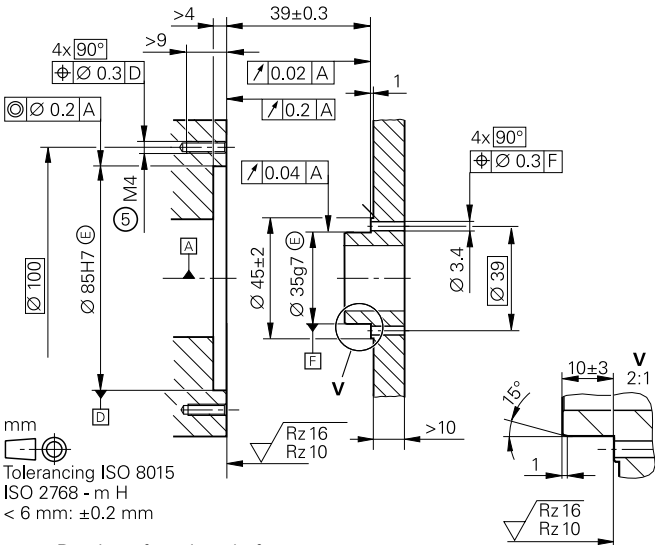

Shaft coupling with ring nut
Without mechanical fault exclusion

Shaft coupling with ring nut and catch
With mechanical fault exclusion
(for further dimensions, see "Without mechanical fault exclusion")

Shown without ring nut and catch

Front end shaft coupling
Without mechanical fault exclusion

Front-end shaft coupling
With mechanical fault exclusion
(for further dimensions, see "Without mechanical fault exclusion")

mm

Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm
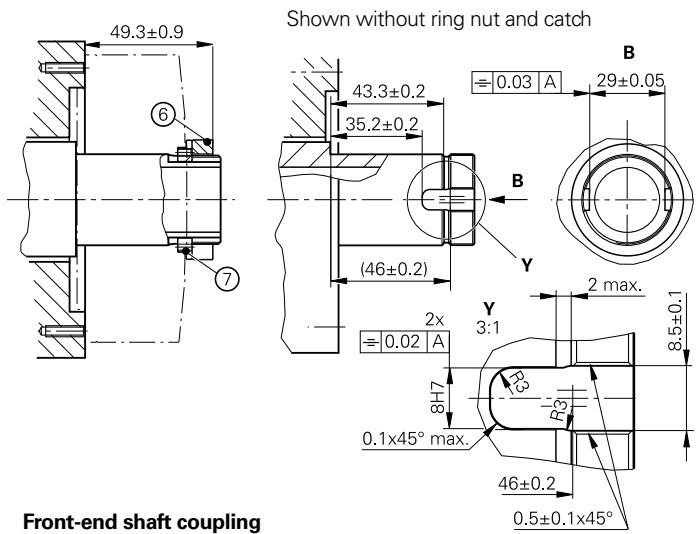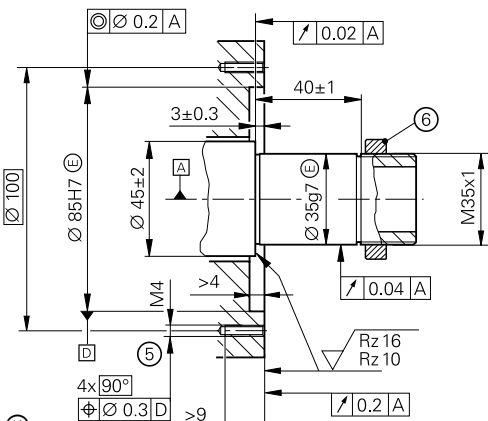
Ⓐ = Bearing of mating shaft
Ⓓ = Compressed air inlet
Ⓚ = Required mating dimensions
1 = Mark for 0° position ± 5°
2 = Cable support
3 = Free space for customer
4 = Screw penetration 4.5 ± 0.5 mm

5 = Screw penetration >7 mm
6 = Accessory: Ring nut ID 336669-17
7 = Accessory: Catch ID 817921-02
8 = 2x spring pins ISO 8752 – 2.5x10 – St
9 = When using spring pins, provide additional back-off threads (M3)
10 = Direction of shaft rotation for output signals as per the interface description

	Absolute **RCN 5510** **RCN 5310**	**RCN 5580** **RCN 5380**	**RCN 5590 F** **RCN 5390 F**	**RCN 5590 M** **RCN 5390 M**
Measuring standard	DIADUR circular scale with absolute and incremental track (16384 lines)			
System accuracy	*RCN 55x0: ± 2.5″; RCN 53x0: ± 5″*			
Position error per signal period	*RCN 55x0: ≤ ± 0.3″* *RCN 53x0: ≤ ± 0.4″*	*RCN 55x0: ≤ ± 0.4″* *RCN 53x0: ≤ ± 0.4″*		
Functional safety*	Option[1]	–		
Interface	EnDat 2.2		Fanuc serial interface αi Interface	Mitsubishi high speed interface
Ordering designation	EnDat22	EnDat02	Fanuc05	Mit03-4
Position values/revolution	*RCN 55x0:* 268 435 456 (28 bits); *Fanuc α Interface:* 134 217 728 (27 bits) *RCN 53x0:* 67 108 864 (26 bits); *Fanuc α Interface:* 8 388 608 (23 bits)			
Elec. permissible speed	≤ 3000 min^{-1} for continuous position value	≤ 1500 min^{-1} for continuous position value	≤ 3000 min^{-1} for continuous position value	
Clock frequency Calculation time t_{cal}	≤ 16 MHz ≤ 5 µs	≤ 2 MHz ≤ 5 µs	–	
Incremental signals Cutoff frequency –3 dB	–	$\sim$ 1 V$_{PP}$ ≥ 400 kHz	–	
Electrical connection	Separate adapter cable connectable to encoder via quick disconnect			
Cable length[2]	≤ 150 m		≤ 50 m	≤ 30 m
Voltage supply	3.6 V to 14 V DC			
Power consumption[3] (max.)	*3.6 V:* ≤ 1.1 W; *14 V:* ≤ 1.3 W			
Current consumption (typical)	*5 V:* 140 mA (without load)			
Shaft	Hollow through shaft D = 35 mm			
Mech. permissible speed	≤ 1500 min^{-1}; *temporary:* ≤ 3000 min^{-1} [4] (Speeds over 1500 min^{-1} require consultation)			
Torque (friction)	≤ 3.38 Nm (typical starting torque: ≤ 0.2 Nm at 20 °C)			
Moment of inertia	*Rotor (hollow shaft)*: 130 · 10^{-6} kgm^2; *Stator (housing/flange)*: 1010 · 10^{-6} kgm^2			
Permissible axial motion of measured shaft	± 0.3 mm			
Natural frequency	≥ 1000 Hz			
Vibration 55 to 2000 Hz **Shock** 6 ms	≤ 200 m/s^2 (EN 60068-2-6) ≤ 200 m/s^2 (EN 60068-2-27)			
Operating temperature	*RCN 55xx:* 0 °C to 50 °C; *RCN 53xx:* –20 °C to 60 °C[4]			
Protection EN 60 529	IP 64			
Weight	≈ 0.9 kg			

* Please indicate when ordering
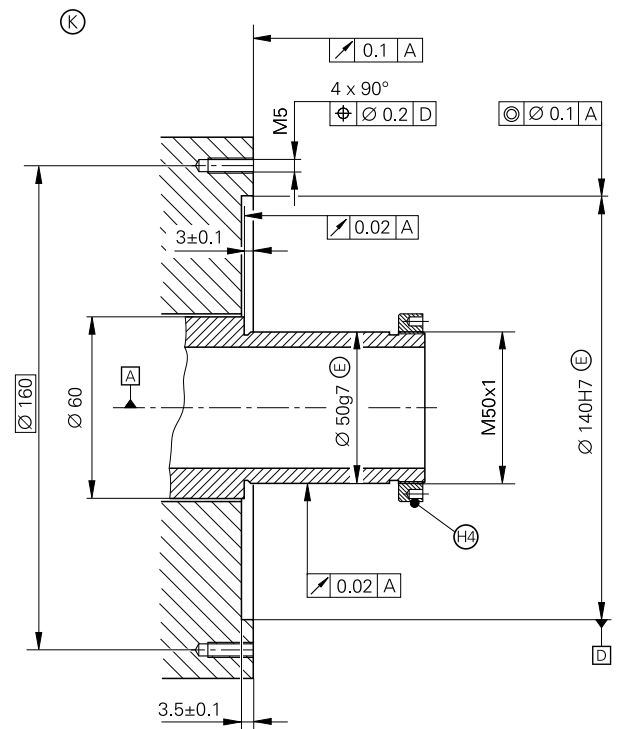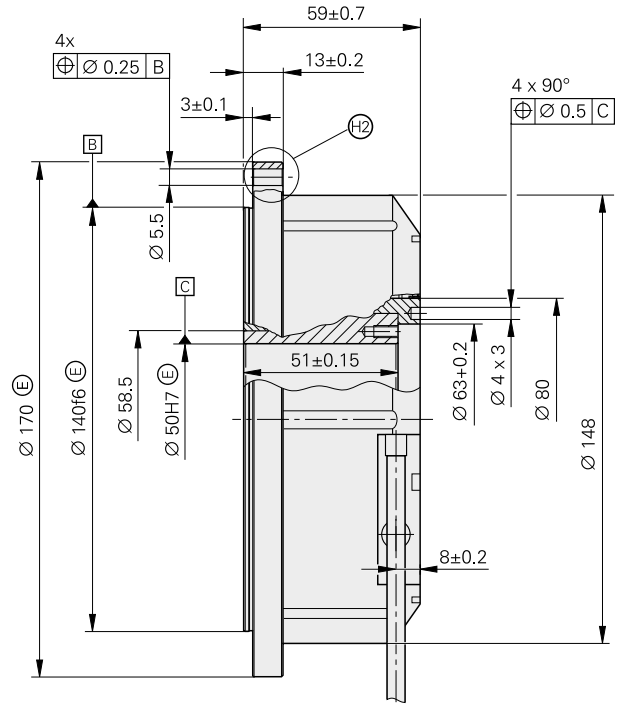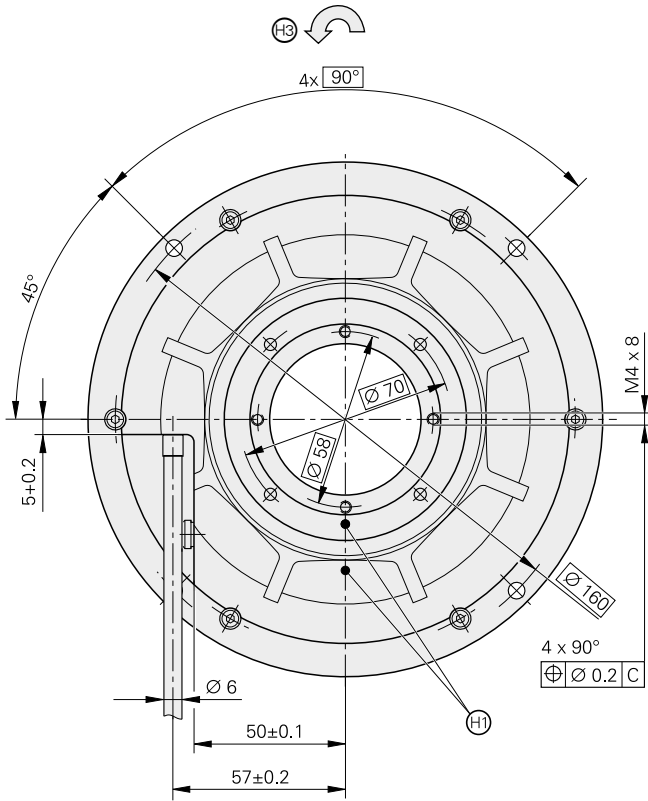[2] With HEIDENHAIN cable; ≤ 8 MHz
[4] For mechanical fault exclusion, see page 21

[1] For dimensions and specifications, see separate Product Information document
[3] See *General electrical information* in the catalog *Interfaces of HEIDENHAIN Encoders*

33

RON 785

- **Integrated stator coupling**
- **Hollow through shaft ⌀ 50 mm**
- **System accuracy ± 2″**

mm

Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm

Cable radial, also usable axially
Ⓐ = Bearing of mating shaft
Ⓚ = Required mating dimensions
H1 = Position of the reference mark signal ± 5°
H2 = Shown rotated by 45°
H3 = Direction of shaft rotation for output signals according to interface description
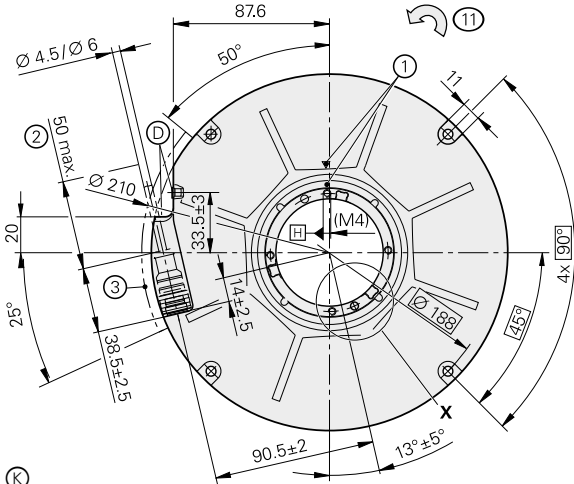H4 = Accessory: Ring nut ID 336669-15

	Incremental RON 785
Measuring standard	DIADUR circular scale with incremental track
Line count	18 000
System accuracy	± 2″
Position error per signal period	≤ ± 0.7″
Interface	⌇ 1 V$_{PP}$
Reference mark*	*RON 785:* One *RON 785 C:* Distance-coded
Cutoff frequency –3 dB	≥ 180 kHz
Electrical connection*	Cable 1 m, with or without M23 coupling (male, 12-pin)
Cable length[1]	≤ 150 m
Voltage supply	5 V DC ± 0.5 V/≤ 150 mA (without load)
Shaft	Hollow through shaft D = 50 mm
Mech. permissible speed	≤ 1000 min^{-1}
Starting torque	≤ 0.5 Nm at 20 °C
Moment of inertia of rotor	$1.05 \cdot 10^{-3}$ kgm^2
Permissible axial motion of measured shaft	± 0.1 mm
Natural frequency	≥ 1000 Hz
Vibration 55 to 2 000 Hz **Shock** 6 ms	≤ 100 m/s^2 (EN 60 068-2-6) ≤ 200 m/s^2 (EN 60 068-2-27)
Operating temperature	0 °C to +50 °C
Protection EN 60 529	IP 64
Weight	≈ 2.5 kg

* Please select when ordering
[1] With HEIDENHAIN cable

RCN 8000 series

- **Integrated stator coupling**
- **Hollow through shaft ⌀ 60 mm**
- **System accuracy ± 1″ and ± 2″**
- **Fault exclusion for loosening of the mechanical connection is possible**
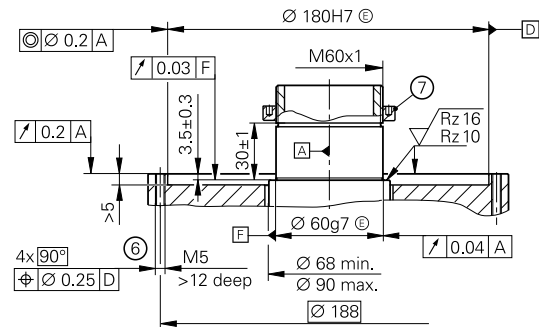
Shaft coupling with ring nut
Without mechanical fault exclusion

Shaft coupling with ring nut and catch
With mechanical fault exclusion
(for further dimensions, see "Without mechanical fault exclusion")

Shown without ring nut and catch
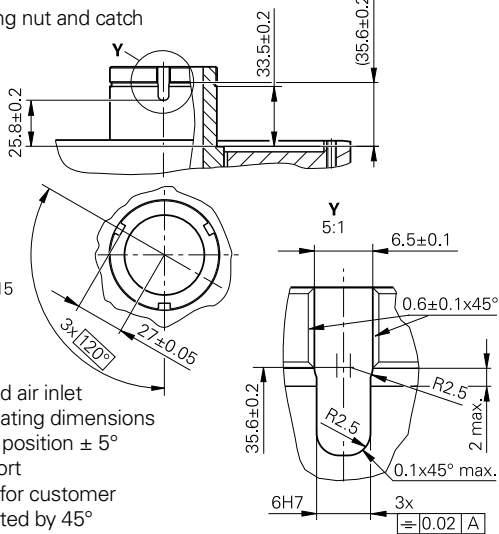
mm
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm

Ⓐ = Bearing
Ⓓ = Compressed air inlet
Ⓚ = Required mating dimensions
1 = Mark for 0° position ± 5°
2 = Cable support
3 = Free space for customer
4 = Shown rotated by 45°
5 = Screw penetration 5.5 ± 0.5 mm
6 = Screw penetration > 10 mm
7 = Accessory: Ring nut ID 336669-11
8 = Accessory: Catch ID 817921-03
9 = 2x spring pins ISO 8752 – 4x10 – St
10 = When using spring pins, provide additional back-off threads (M4)
11 = Direction of shaft rotation for output signals as per the interface description

Front end shaft coupling
Without mechanical fault exclusion

Front-end shaft coupling
With mechanical fault exclusion
(for further dimensions, see "Without mechanical fault exclusion")

	Absolute **RCN 8510** **RCN 8310**	**RCN 8580** **RCN 8380**	**RCN 8590 F** **RCN 8390 F**	**RCN 8590 M** **RCN 8390 M**
Measuring standard	DIADUR circular scale with absolute and incremental track (32 768 lines)			
System accuracy	*RCN 85x0:* $\pm 1''$; *RCN 83x0:* $\pm 2''$			
Position error per signal period	*RCN 85x0:* $\leq \pm 0.15''$ *RCN 83x0:* $\leq \pm 0.2''$	*RCN 85x0:* $\leq \pm 0.2''$ *RCN 83x0:* $\leq \pm 0.2''$		
Functional safety*	Option[1]	–		
Interface	EnDat 2.2		Fanuc serial interface αi Interface	Mitsubishi high speed interface
Ordering designation	EnDat22	EnDat02	Fanuc05	Mit03-4
Position values/revolution	536 870 912 (29 bits); *Fanuc α Interface:* 134 217 728 (27 bits)			
Elec. permissible speed	≤ 1500 min^{-1} for continuous position value	≤ 750 min^{-1} for continuous position value	≤ 1500 min^{-1} for continuous position value	
Clock frequency Calculation time t_{cal}	≤ 16 MHz ≤ 5 µs	≤ 2 MHz ≤ 5 µs	–	
Incremental signals Cutoff frequency –3 dB	–	$\sim$ 1 V$_{PP}$ ≥ 400 kHz	–	
Electrical connection	Separate adapter cable connectable to encoder via quick disconnect			
Cable length[2]	≤ 150 m		≤ 50 m	≤ 30 m
Voltage supply	3.6 V to 14 V DC			
Power consumption[3] (max.)	*3.6 V:* ≤ 1.1 W; *14 V:* ≤ 1.3 W			
Current consumption (typical)	*5 V:* 140 mA (without load)			
Shaft	Hollow through shaft D = 60 mm			
Mech. permissible speed	≤ 500 min^{-1}; *temporary:* ≤ 1500 min^{-1} [4] (Speeds over 500 min^{-1} require consultation)			
Torque (friction)	≤ 4.05 Nm (typical starting torque: ≤ 0.7 Nm at 20 °C)			
Moment of inertia	*Rotor (hollow shaft)*: $1.22 \cdot 10^{-3}$ kgm^2; *Stator (housing/flange)*: $11.0 \cdot 10^{-3}$ kgm^2			
Permissible axial motion of measured shaft	± 0.3 mm			
Natural frequency	≥ 900 Hz			
Vibration 55 to 2000 Hz **Shock** 6 ms	≤ 200 m/s^2 (EN 60068-2-6) ≤ 200 m/s^2 (EN 60068-2-27)			
Operating temperature	0 °C to +50 °C			
Protection EN 60 529	IP 64			
Weight	≈ 2.8 kg			

* Please indicate when ordering
[2] With HEIDENHAIN cable; ≤ 8 MHz
[4] For mechanical fault exclusion, see page 21

[1] For dimensions and specifications, see separate Product Information document
[3] See *General electrical information* in the catalog *Interfaces of HEIDENHAIN Encoders*
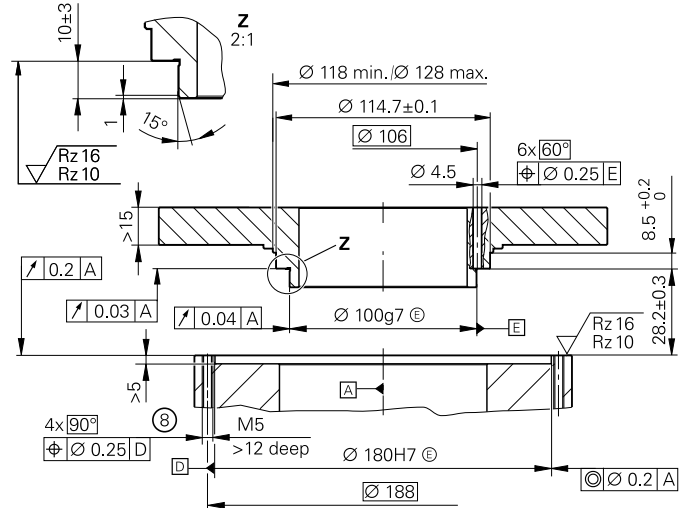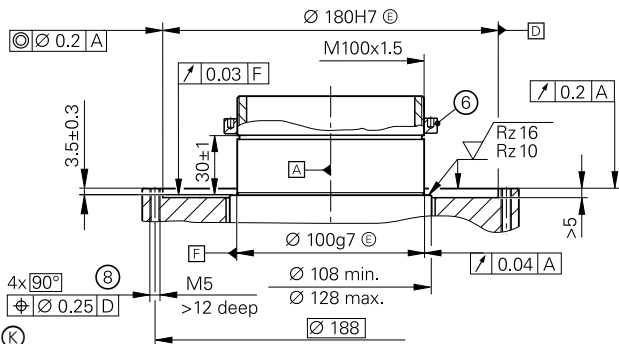
RCN 8000 series

- **Integrated stator coupling**
- **Hollow through shaft Ø 100 mm**
- **System accuracy ± 1″ and ± 2″**
- **Fault exclusion for loosening of the mechanical connection is possible**
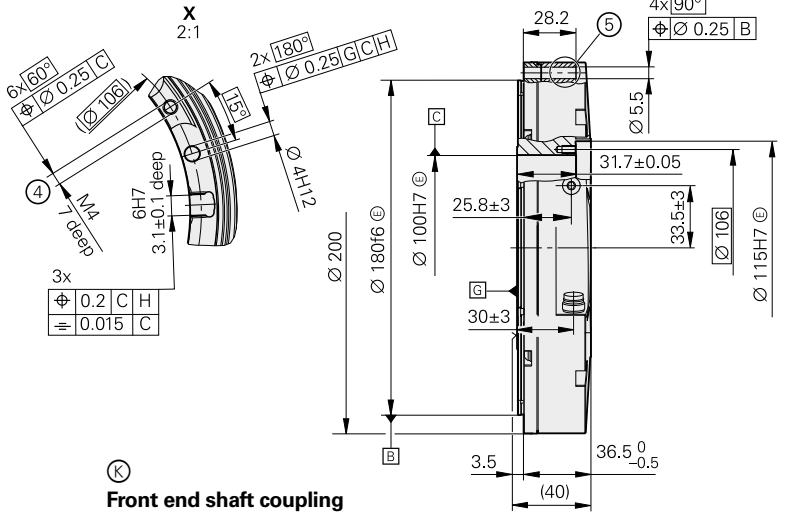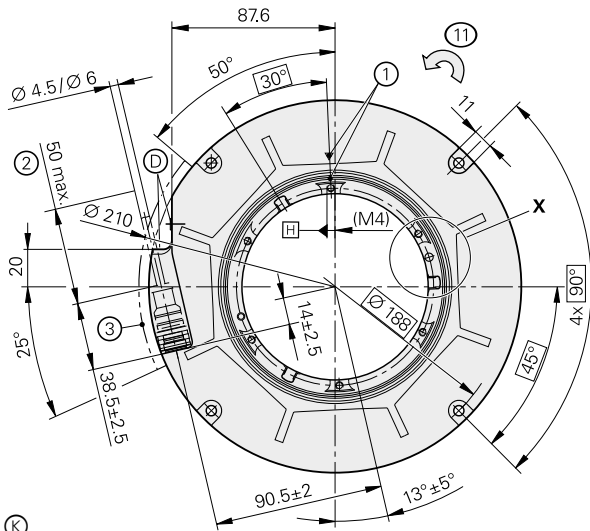
Ⓚ
## Shaft coupling with ring nut
Without mechanical fault exclusion

Ⓚ
Shaft connection with ring nut and catch
With mechanical fault exclusion
(for further dimensions, see "Without mechanical fault exclusion")

Shown without ring nut and catch

mm
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm

Ⓚ
Front end shaft coupling
Without mechanical fault exclusion

Front-end shaft coupling
With mechanical fault exclusion
(for further dimensions, see "Without mechanical fault exclusion")
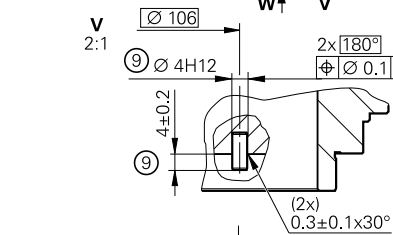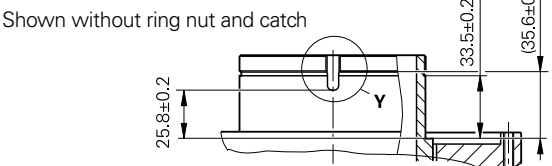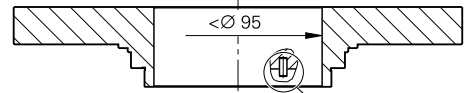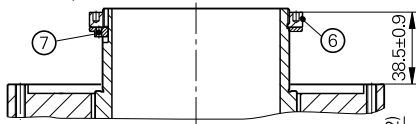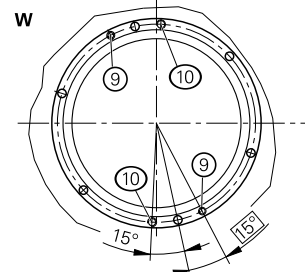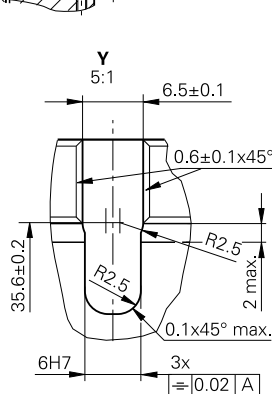
Ⓐ = Bearing
Ⓓ = Compressed air inlet
Ⓚ = Required mating dimensions
1 = Mark for 0° position ± 5°
2 = Cable support
3 = Free space for customer
4 = Screw penetration 5.5 ± 0.5 mm
5 = Shown rotated by 45°
6 = Accessory: Ring nut ID 336669-16
7 = Accessory: Catch ID 817921-04
8 = Screw penetration > 10 mm
9 = 2x spring pins ISO 8752 – 4x10 – St
10 = When using spring pins, provide additional back-off threads (M4)
11 = Direction of shaft rotation for output signals as per the interface description

38

	Absolute **RCN 8510** **RCN 8310**	**RCN 8580** **RCN 8380**	**RCN 8590 F** **RCN 8390 F**	**RCN 8590 M** **RCN 8390 M**
Measuring standard	DIADUR circular scale with absolute and incremental track (32 768 lines)			
System accuracy	*RCN 85x0: ± 1″; RCN 83x0: ± 2″*			
Position error per signal period	*RCN 85x0: ≤ ± 0.15″* *RCN 83x0: ≤ ± 0.2″*	*RCN 85x0: ≤ ± 0.2″* *RCN 83x0: ≤ ± 0.2″*		
Functional safety*	Option[1]	–		
Interface	EnDat 2.2		Fanuc serial interface αi Interface	Mitsubishi high speed interface
Ordering designation	EnDat22	EnDat02	Fanuc05	Mit03-4
Position values/revolution	536 870 912 (29 bits); *Fanuc α Interface:* 134 217 728 (27 bits)			
Elec. permissible speed	≤ 1500 min^{-1} for continuous position value	≤ 750 min^{-1} for continuous position value	≤ 1500 min^{-1} for continuous position value	
Clock frequency Calculation time t_{cal}	≤ 16 MHz ≤ 5 µs	≤ 2 MHz ≤ 5 µs	–	
Incremental signals Cutoff frequency –3 dB	–	$\sim$ 1 V$_{PP}$ ≥ 400 kHz	–	
Electrical connection	Separate adapter cable connectable to encoder via quick disconnect			
Cable length[2]	≤ 150 m		≤ 50 m	≤ 30 m
Voltage supply	3.6 V to 14 V DC			
Power consumption[3] (max.)	*3.6 V:* ≤ 1.1 W; *14 V:* ≤ 1.3 W			
Current consumption (typical)	*5 V:* 140 mA (without load)			
Shaft	Hollow through shaft D = 100 mm			
Mech. permissible speed	≤ 500 min^{-1}; *temporary:* ≤ 1500 min^{-1} [4] (Speeds over 500 min^{-1} require consultation)			
Torque (friction)	≤ 4.5 Nm (typical starting torque: ≤ 1.0 Nm at 20 °C)			
Moment of inertia	*Rotor (hollow shaft)*: 3.20 · 10^{-3} kgm^2; *Stator (housing/flange)*: 10.0 · 10^{-3} kgm^2			
Permissible axial motion of measured shaft	± 0.3 mm			
Natural frequency	≥ 900 Hz			
Vibration 55 to 2000 Hz **Shock** 6 ms	≤ 200 m/s^2 (EN 60068-2-6) ≤ 200 m/s^2 (EN 60068-2-27)			
Operating temperature	0 °C to +50 °C			
Protection EN 60 529	IP 64			
Weight	≈ 2.6 kg			

***** Please indicate when ordering
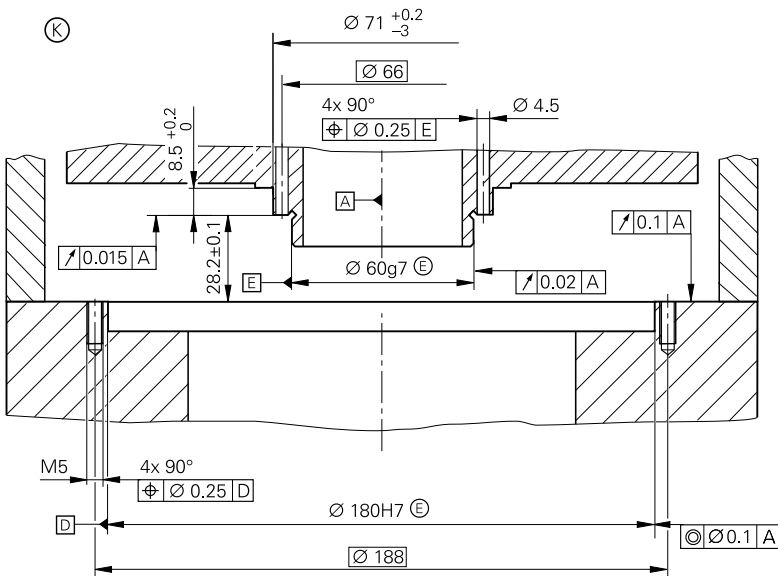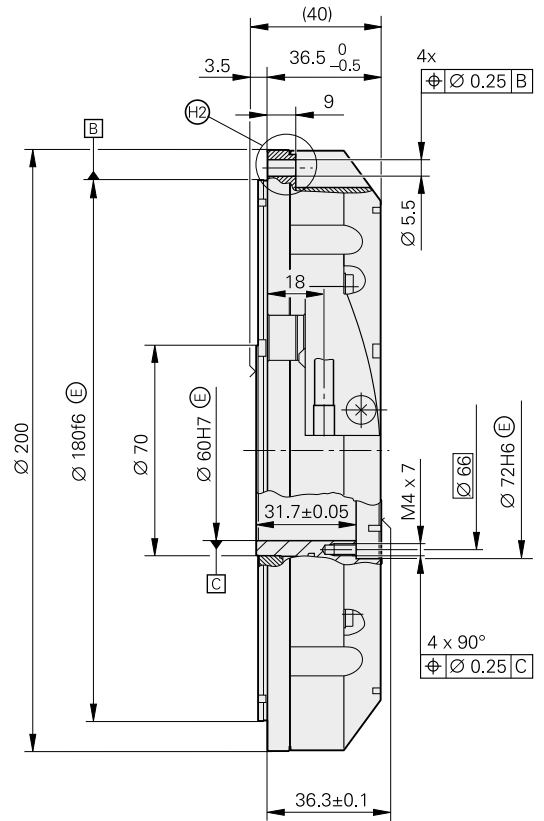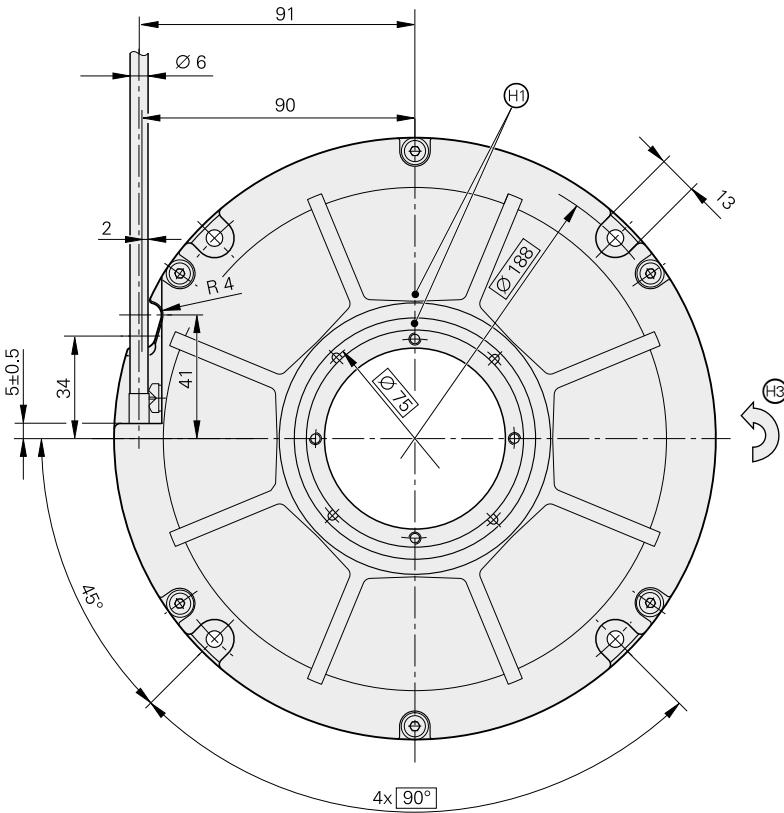[2] With HEIDENHAIN cable; ≤ 8 MHz
[4] For mechanical fault exclusion, see page 21

[1] For dimensions and specifications, see separate Product Information document
[3] See *General electrical information* in the catalog *Interfaces of HEIDENHAIN Encoders*

RON 786/RON 886/RPN 886

- **Integrated stator coupling**
- **Hollow through shaft ∅ 60 mm**
- **System accuracy ± 1″ or ± 2″**
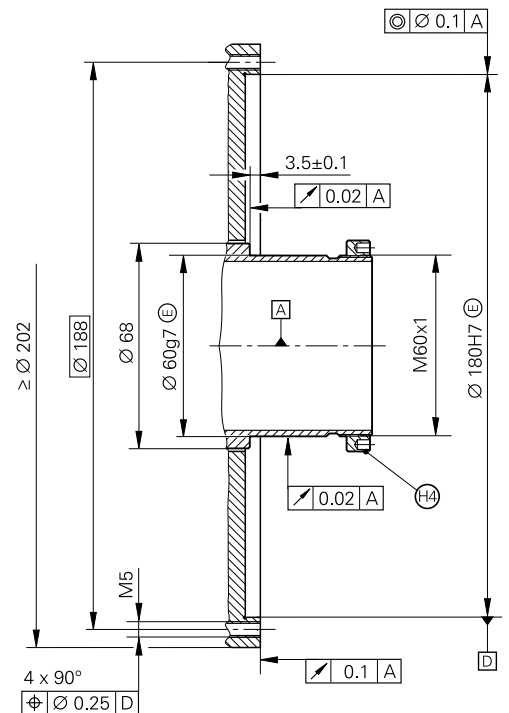
mm

Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm

Cable radial, also usable axially
Ⓐ = Bearing of mating shaft
Ⓚ = Required mating dimensions
⑪ = Position of the reference mark signal ± 5°
⑫ = Shown rotated by 45°
⑬ = Direction of shaft rotation for output signals according to interface description
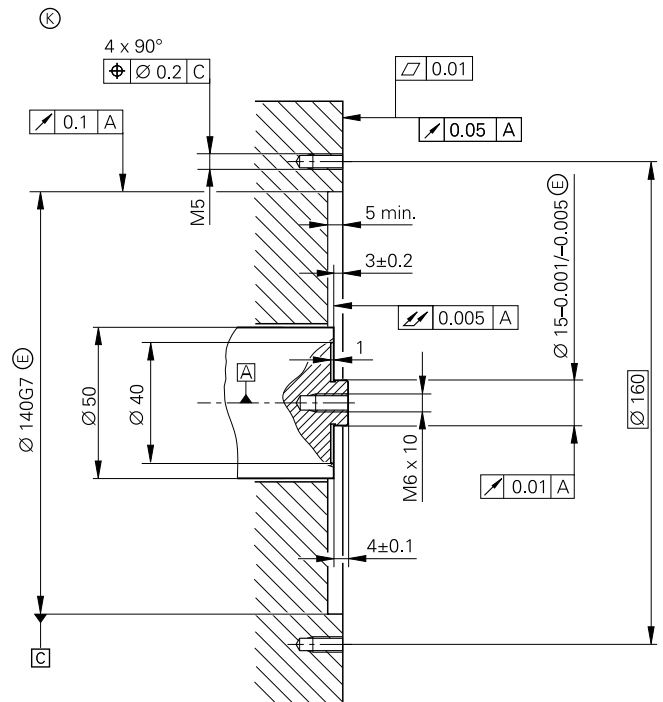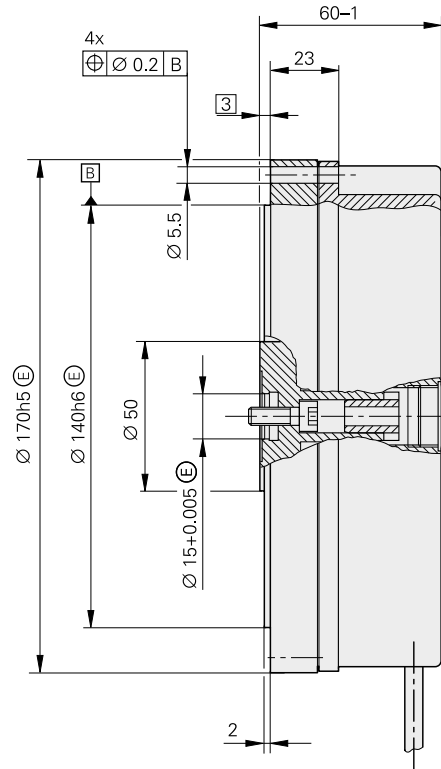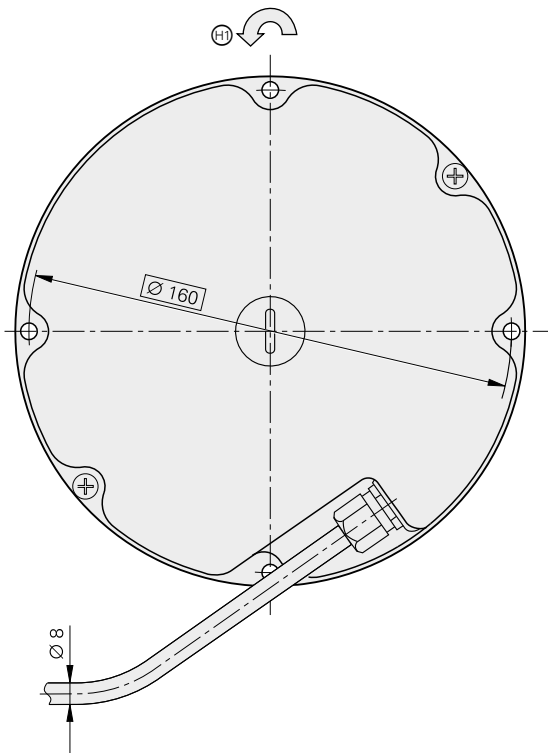⑭ = Accessory: Ring nut ID 336669-11

	Incremental RON 786	RON 886	RPN 886
Measuring standard	DIADUR circular scale with incremental track		
Line count*****	18000 36000	36000	90000 ($\hat{=}$ 180000 signal periods)
System accuracy	± 2″	± 1″	
Position error per signal period	*18000 lines:* ≤ ± 0.7″ *36000 lines:* ≤ ± 0.35″	≤ ± 0.35″	≤ ± 0.1″
Interface	$\sim$ 1 V$_{PP}$		
Reference mark*****	*RON x86:* One *RON x86 C:* Distance-coded		One
Cutoff frequency –3 dB –6 dB	≥ 180 kHz		≥ 800 kHz ≥ 1300 kHz
Electrical connection*	Cable 1 m, with or without M23 coupling (male, 12-pin)		
Cable length[1]	≤ 150 m		
Voltage supply	5 V DC ± 0.5 V/≤ 150 mA (without load)		5 V DC ± 0.5 V/≤ 250 mA (without load)
Shaft	Hollow through shaft D = 60 mm		
Mech. permissible speed	≤ 1000 min^{-1}		
Starting torque	≤ 0.5 Nm at 20 °C		
Moment of inertia of rotor	1.20 · 10^{-3} kgm^2		
Permissible axial motion of measured shaft	≤ ± 0.1 mm		
Natural frequency	≥ 1000 Hz		≥ 500 Hz
Vibration 55 to 2000 Hz **Shock** 6 ms	≤ 100 m/s^2 (EN 60068-2-6) ≤ 200 m/s^2 (EN 60068-2-27)		≤ 50 m/s^2 (EN 60068-2-6) ≤ 200 m/s^2 (EN 60068-2-27)
Operating temperature	0 °C to 50 °C		
Protection EN 60 529	IP 64		
Weight	≈ 2.5 kg		

* Please select when ordering
[1] With HEIDENHAIN cable

RON 905

- **Integrated stator coupling**
- **Blind hollow shaft**
- **System accuracy ± 0.4”**

4x
$\oplus$ | $\varnothing$ 0.2 | B

60−1

23

3

B

$\varnothing$ 5.5

$\varnothing$ 170h5 (E)

$\varnothing$ 140h6 (E)

$\varnothing$ 50

$\varnothing$ 15+0.005 (E)

2

(K)

4 x 90°
$\oplus$ | $\varnothing$ 0.2 | C

$\square$ | 0.01

$\diagup$ | 0.1 | A

$\diagup$ | 0.05 | A

M5

5 min.

3±0.2

$\diagup\diagup$ | 0.005 | A

$\varnothing$ 15−0.001/−0.005 (E)

$\varnothing$ 140G7 (E)

$\varnothing$ 50

$\varnothing$ 40

A

1

M6 x 10

$\varnothing$ 160

$\diagup$ | 0.01 | A

4±0.1

C

mm

Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm

42

Cable radial, also usable axially
$\boxed{A}$ = Bearing
(K) = Required mating dimensions
$\oplus$ = Direction of shaft rotation for output signal I_2 lagging I_1

	Incremental RON 905
Measuring standard	DIADUR circular scale with incremental track
Line count	36 000
System accuracy	± 0.4″
Position error per signal period	≤ ± 0.3″
Interface	⌇ 11 µA$_{PP}$
Reference mark	One
Cutoff frequency –3 dB	≥ 40 kHz
Electrical connection	Cable 1 m, with M23 connector (male, 9 pin)
Voltage supply	5 V DC ± 0.25 V/≤ 250 mA (without load)
Cable length[1]	≤ 15 m
Shaft	Blind hollow shaft
Mech. permissible speed	≤ 100 min^{-1}
Starting torque	≤ 0.05 Nm at 20 °C
Moment of inertia of rotor	$0.345 \cdot 10^{-3}$ kgm^2
Permissible axial motion of measured shaft	≤ ± 0.2 mm
Natural frequency	≥ 350 Hz
Vibration 55 to 2000 Hz **Shock** 6 ms	≤ 50 m/s^2 (EN 60068-2-6) ≤ 200 m/s^2 (EN 60068-2-27)
Operating temperature	10 °C to 30 °C
Protection EN 60 529	IP 64
Weight	≈ 4 kg

[1] With HEIDENHAIN cable

ECN 200 series

- **Mounted stator coupling**
- **Hollow through shaft with Ø 20 mm and Ø 50 mm**
- **System accuracy ± 10″**

ECN 200   Ø 20 mm

ECN 200   Ø 50 mm
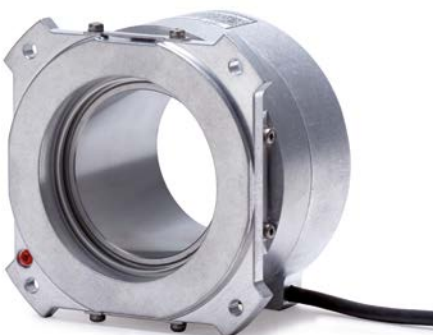
Measuring standard
System accuracy
Position error per signal period
Interface
Ordering designation*
Position values/revolution
Electrically permissible speed
Clock frequency
Calculation time t_{cal}
Incremental signals
Cutoff frequency –3 dB
Electrical connection*
Cable length[1]
Voltage supply
Power consumption[2] (maximum)
Current consumption (typical)
Shaft*
Mechanically permissible speed
Starting torque (at 20 °C)
Moment of inertia of rotor
Permissible axial motion of measured shaft
Natural frequency
Vibration 55 to 2000 Hz **Shock** 6 ms
Operating temperature
Protection EN 60 529
Weight

* Please select when ordering
[1] With HEIDENHAIN cable
[2] See *General electrical information*

Absolute ECN 225		ECN 223 F	ECN 223 M
DIADUR circular scale with absolute and incremental track (2048 lines)			
± 10″			
≤ ± 5″			
EnDat 2.2		Fanuc serial interface α Interface	Mitsubishi high speed interface
EnDat22	EnDat02	Fanuc02	Mit02-4
33 554 432 (25 bits)		8 388 608 (23 bits)	
≤ 3000 min^{-1} for continuous position value			
≤ 8 MHz	≤ 2 MHz	–	
≤ 5 µs		–	
–	$\sim$ 1 V$_{PP}$	–	
–	≥ 200 kHz	–	
Cable 1 m, with M12 coupling (male), 8-pin	Cable 1 m, with M23 coupling (male), 17-pin	Cable 1 m, with or without M12 coupling (male, 8-pin)	
≤ 150 m		≤ 30 m	
3.6 to 5.25 V DC			
3.6 V: ≤ 0.7 W *5.25 V:* ≤ 1.0 W			
5 V: 200 mA (without load)			
Hollow-through shaft D = 20 mm or 50 mm			
≤ 3000 min^{-1}			
D = 20 mm: ≤ 0.15 Nm *D = 50 mm:* ≤ 0.2 Nm			
D = 20 mm: 0.138 · 10^{-3} kgm^2 *D = 50 mm:* 0.215 · 10^{-3} kgm^2			
± 0.1 mm			
≥ 1000 Hz			
≤ 100 m/s^2 (EN 60068-2-6) ≤ 200 m/s^2 (EN 60068-2-27)			
Moving cable: −10 °C to 70 °C *Stationary cable:* −20 °C to 70 °C			
IP 64			
D = 20 mm: ≈ 0.8 kg; *D = 50 mm:* ≈ 0.7 kg			

Hollow shaft D = 20 mm

mm
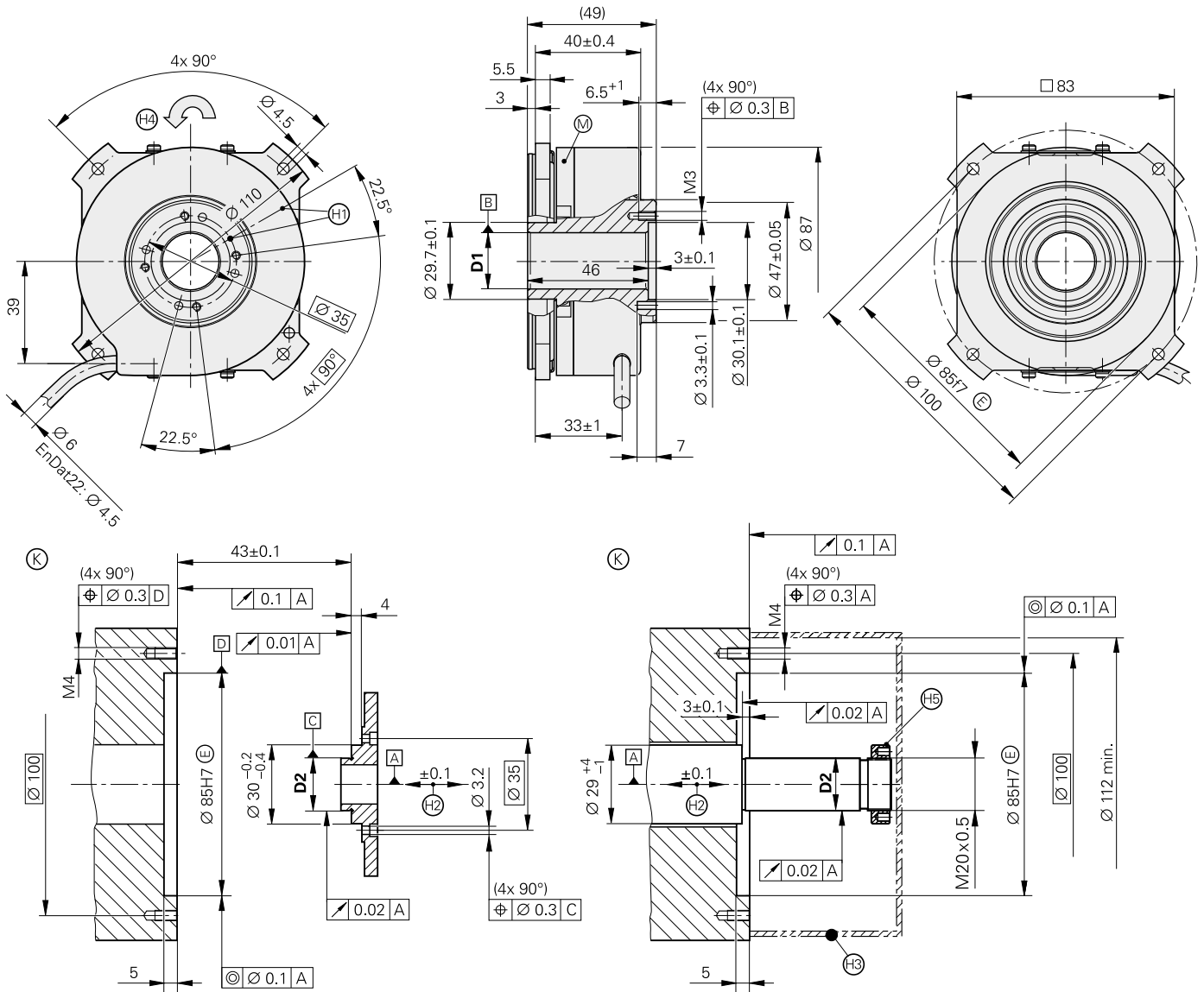
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm

D1	D2
Ø 20H7 Ⓔ	Ø 20g7 Ⓔ

Ⓐ = Bearing of mating shaft
Ⓑ = Bearing of encoder
Ⓚ = Required mating dimensions
Ⓜ = Measuring point for operating temperature
⑪ = Zero position ± 15°
⑫ = Maximum permissible motion of motor shaft
⑬ = Protection against contact as per EN 60529
⑭ = Direction of shaft rotation for output signals as per the interface description
⑮ = Accessory: Ring nut ID 336669-03

Hollow shaft D = 50 mm
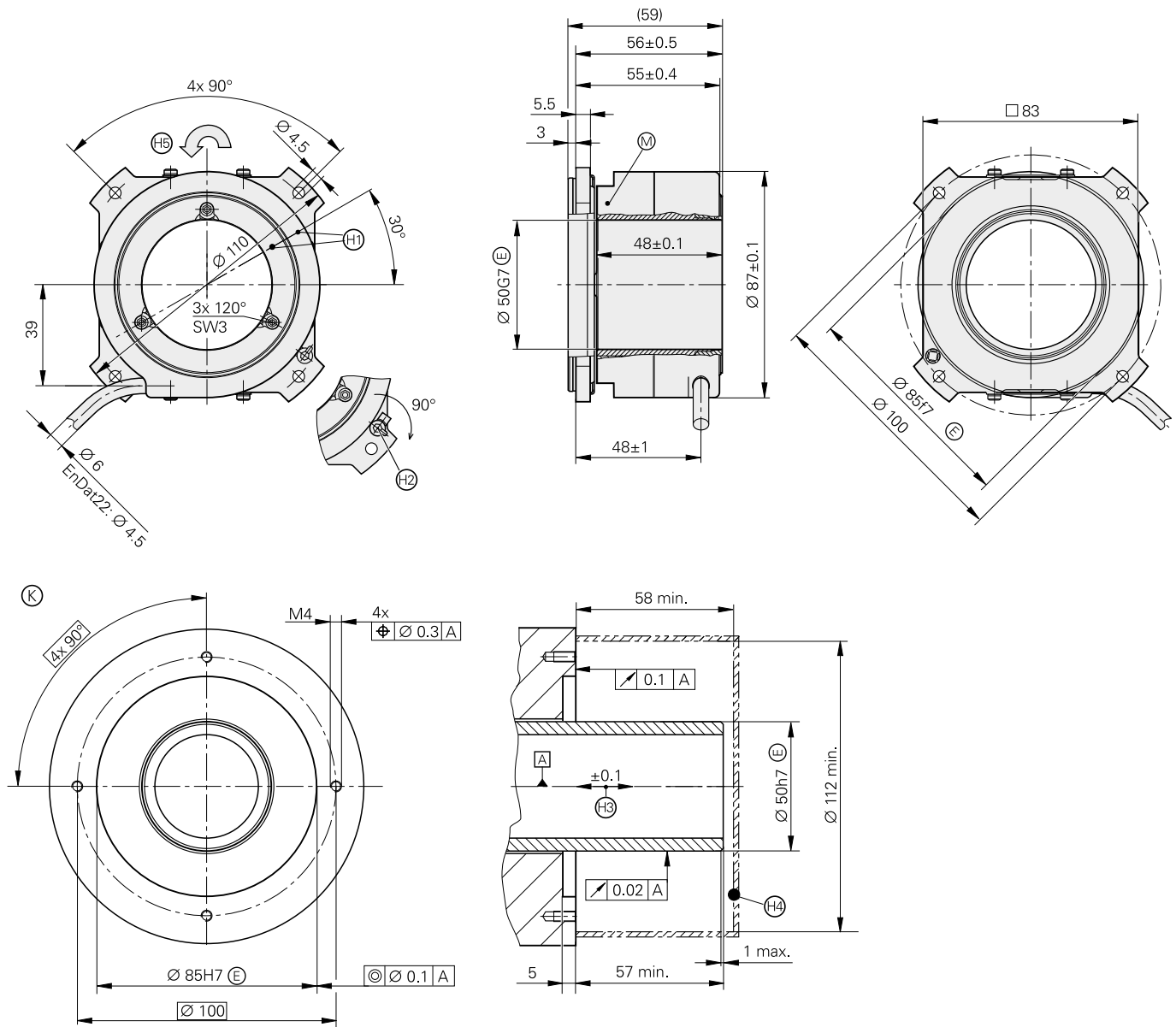
(59)

56±0.5

55±0.4

5.5

3

M

4x 90°

H5

Ø 4.5

30°

H1

Ø 110

3x 120°
SW3

39

90°

H2

Ø 6

EnDat22: Ø 4.5

Ø 50G7 (E)

48±0.1

Ø 87±0.1

48±1

□ 83

Ø 85f7 (E)

Ø 100

K

4x 90°

M4

4x

⊕ Ø 0.3 A

58 min.

0.1 A

A

±0.1

H3

Ø 50h7 (E)

Ø 112 min.

0.02 A

H4

1 max.

5

57 min.

Ø 85H7 (E)

Ø 100

⊚ Ø 0.1 A

mm

Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm

Ⓐ = Bearing of mating shaft
Ⓚ = Required mating dimensions
Ⓜ = Measuring point for operating temperature
⑪ = Zero position ± 15°
⑫ = Remove mounting aid before putting into operation. Width A/F 3
⑬ = Maximum permissible motion of motor shaft
⑭ = Protection against contact as per EN 60529
⑮ = Direction of shaft rotation for output signals as per the interface description

ROD 200 series

- **For separate shaft coupling**
- **System accuracy ± 5″**
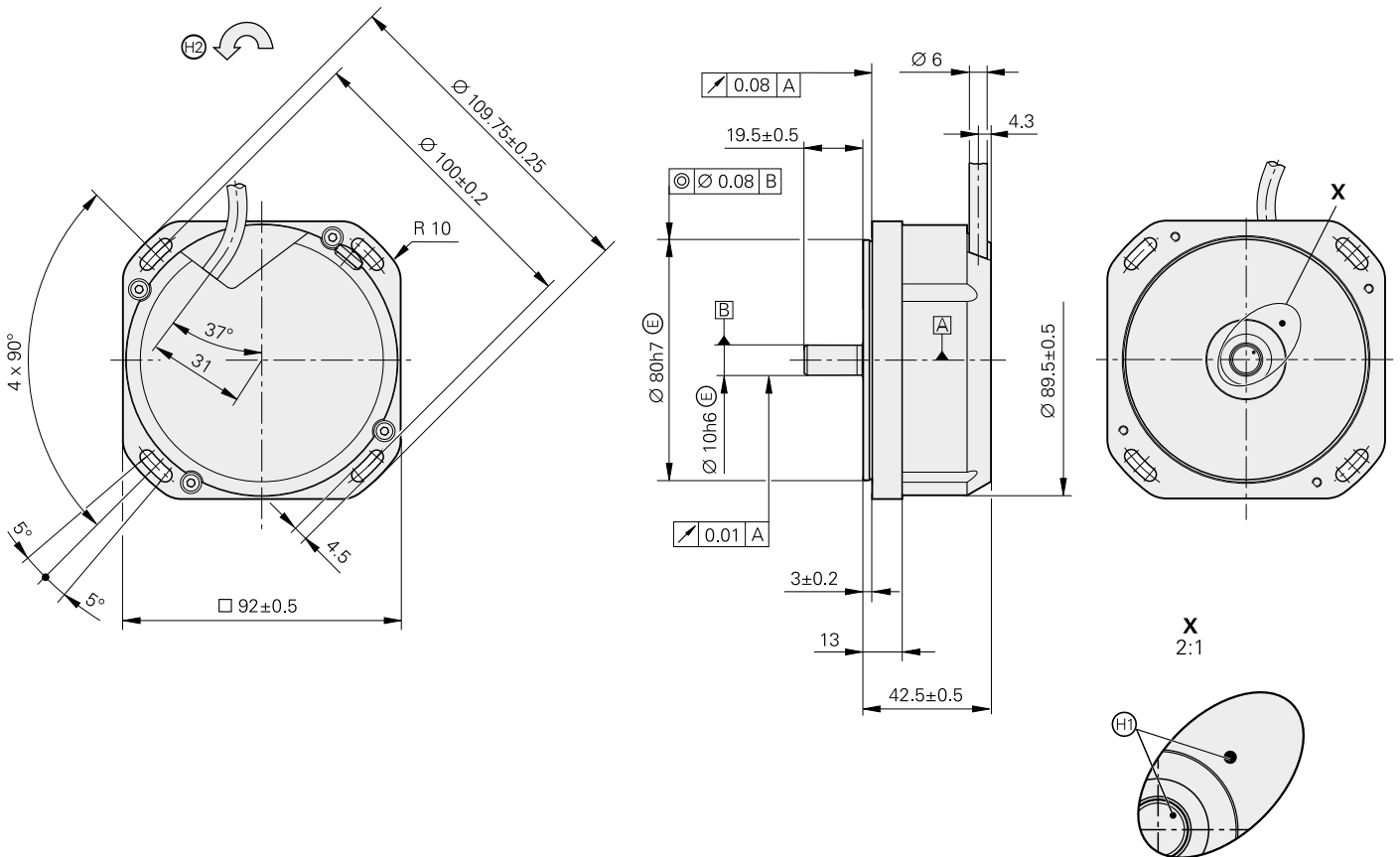
Ø 109.75±0.25
Ø 100±0.2
R 10
4 × 90°
37°
31
4.5
5°
5°
□ 92±0.5

Ø 6
0.08 A
19.5±0.5
4.3
Ø 0.08 B
B
Ø 80h7 Ⓔ
Ø 10h6 Ⓔ
A
Ø 89.5±0.5
0.01 A
3±0.2
13
42.5±0.5

X
X
2:1
H1

mm

Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm

Cable radial, also usable axially
Ⓐ = Bearing
⑪ = Position of the reference mark signal ±5°
⑫ = Direction of shaft rotation for output signals as per the interface description

	Incremental ROD 220	ROD 270	ROD 280
Measuring standard	DIADUR circular scale with incremental track		
Line count	9000	18000	18000
System accuracy	± 5″		
Position error per signal period	≤ ± 1.4″	≤ ± 0.7″	
Interface	⊓⊔ TTL		$\sim$ 1 V$_{PP}$
Integrated interpolation Output signals/rev	2-fold 18000	10-fold 180000	– 18000
Reference mark*	One		ROD 280: One ROD 280 C: Distance-coded
Cutoff frequency –3 dB Output frequency Edge separation a	– ≤ 1 MHz ≥ 0.125 µs	– ≤ 1 MHz ≥ 0.22 µs	≥ 180 kHz – –
Electrically permissible speed	≤ 3333 min^{-1}	≤ 333 min^{-1}	–
Electrical connection*	Cable 1 m, with or without M23 coupling (male, 12-pin)		
Cable length[1]	≤ 100 m		≤ 150 m
Voltage supply	5 V DC ± 0.5 V/≤ 150 mA (without load)		
Shaft	Solid shaft D = 10 mm		
Mech. permissible speed	≤ 10000 min^{-1}		
Starting torque	≤ 0.01 Nm at 20 °C		
Moment of inertia of rotor	20 · 10^{-6} kgm^2		
Shaft load	Axial: 10 N Radial: 10 N at shaft end		
Vibration 55 to 2000 Hz **Shock** 6 ms	≤ 100 m/s^2 (EN 60068-2-6) ≤ 200 m/s^2 (EN 60068-2-27)		
Operating temperature	Moving cable: –10 °C to 70 °C Stationary cable: –20 °C to 70 °C		
Protection EN 60 529	IP 64		
Weight	≈ 0.7 kg		

* Please select when ordering
[1] With HEIDENHAIN cable

ROD 780/ROD 880

- **For separate shaft coupling**
- **System accuracy ± 1″ or ± 2″**
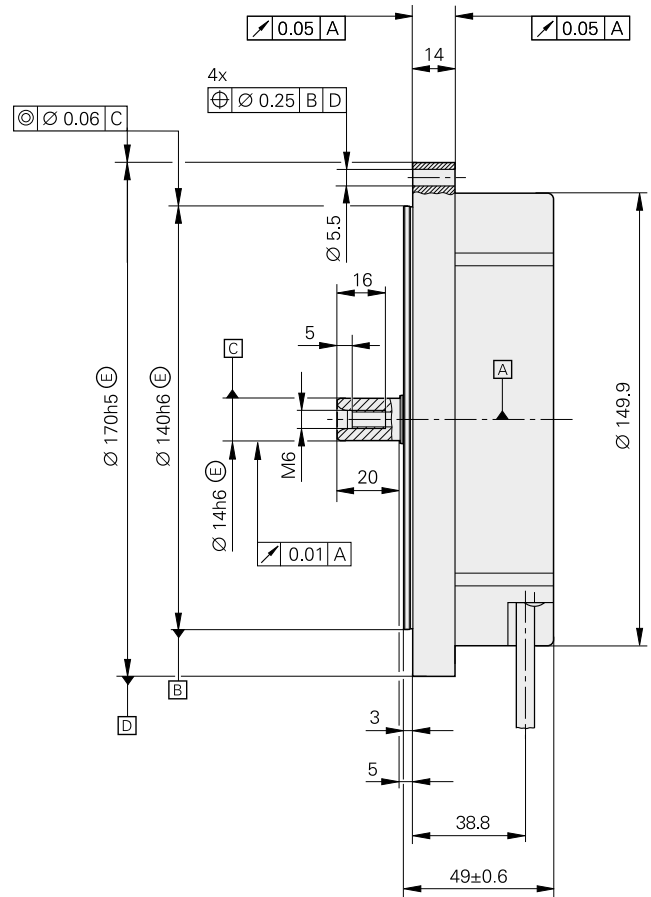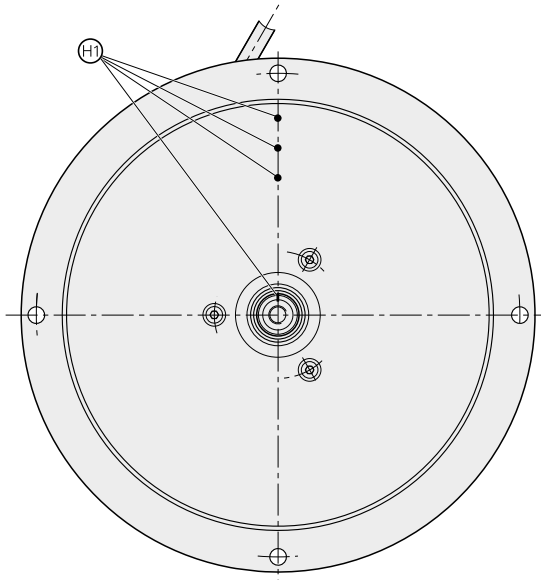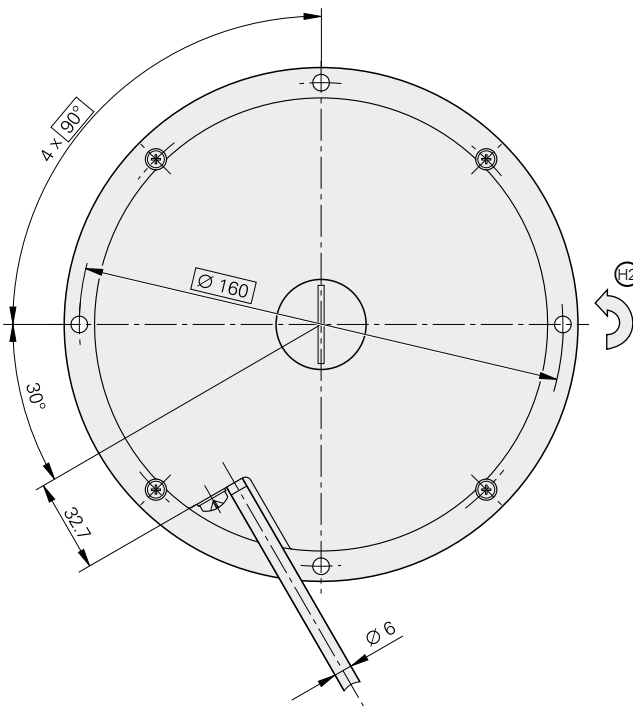
mm

Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm

Cable radial, also usable axially
Ⓐ = Bearing
Ⓗ1 = Position of the reference mark signal ± 5°
Ⓗ2 = Direction of shaft rotation for output signals as per the interface description

	Incremental ROD 780	ROD 880
Measuring standard	DIADUR circular scale with incremental track	
Line count*	18000 36000	36000
System accuracy	± 2″	± 1″
Position error per signal period	*18000 lines:* ≤ ± 0.7″ *36000 lines:* ≤ ± 0.35″	≤ ± 0.35″
Interface	$\sim$ 1 V_{PP}	
Reference mark*	*ROD x80:* One *ROD x80 C:* Distance-coded	
Cutoff frequency –3 dB	≥ 180 kHz	
Electrical connection*	Cable 1 m, with or without M23 coupling (male, 12-pin)	
Cable length[1]	≤ 150 m	
Voltage supply	5 V DC ± 0.5 V/≤ 150 mA (without load)	
Shaft	Solid shaft D = 14 mm	
Mech. permissible speed	≤ 1000 min^{-1}	
Starting torque	≤ 0.012 Nm at 20 °C	
Moment of inertia of rotor	$0.36 \cdot 10^{-3}$ kgm^2	
Shaft load	*Axial:* 30 N *Radial:* 30 N at shaft end	
Vibration 55 to 2000 Hz **Shock** 6 ms	≤ 100 m/s^2 (EN 60068-2-6) ≤ 200 m/s^2 (EN 60068-2-27)	
Operating temperature	0 °C to 50 °C	
Protection EN 60 529	IP 64	
Weight	≈ 2.4 kg	

* Please select when ordering
[1] With HEIDENHAIN cable

Interfaces
Incremental signals $\sim$ 1 V$_{PP}$

HEIDENHAIN encoders with $\sim$ 1 V$_{PP}$ interface provide voltage signals that can be highly interpolated.

The sinusoidal **incremental signals** A and B are phase-shifted by 90° elec. and have amplitudes of typically 1 V$_{PP}$. The illustrated sequence of output signals—with B lagging A—applies for the direction of motion shown in the dimension drawing.

The **reference mark signal** R has an unambiguous assignment to the incremental signals. The output signal might be somewhat lower next to the reference mark.

Comprehensive descriptions of all available interfaces as well as general electrical information are included in the *Interfaces for HEIDENHAIN Encoders* catalog.


A, B, R measured with oscilloscope in differential mode
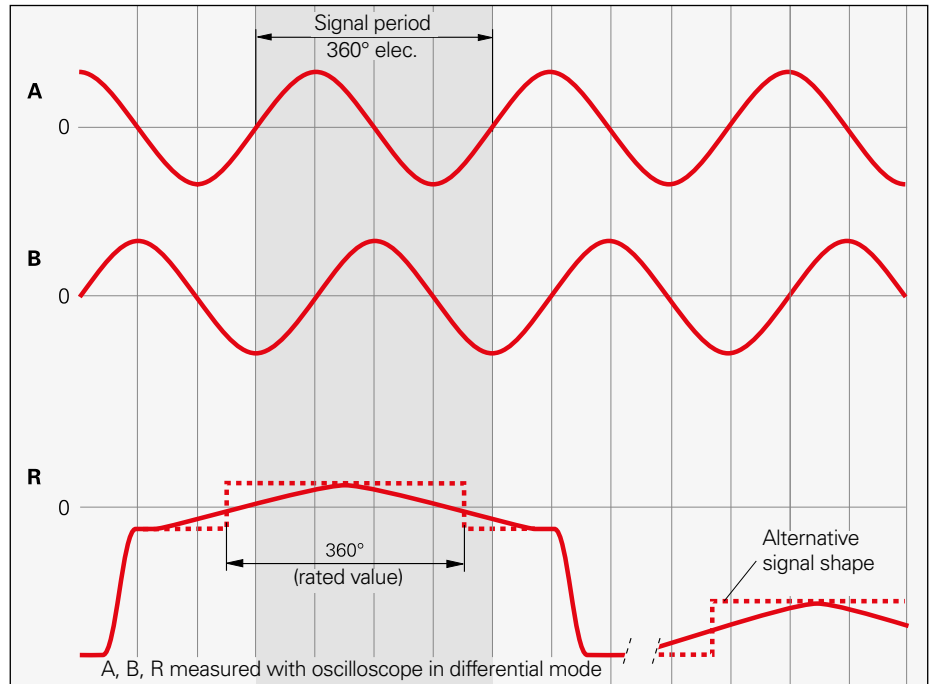
Pin layout

	12-pin coupling, M23							**12-pin connector,** M23					

	15-pin D-sub connector For HEIDENHAIN controls and IK 220							**15-pin D-sub connector** For encoder or PWM 20					

	Power supply				Incremental signals						Other signals		
	12	2	10	11	5	6	8	1	3	4	9	7	/
	1	9	2	11	3	4	6	7	10	12	5/8/13/15	14	/
	4	12	2	10	1	9	3	11	14	7	5/6/8/15	13	/
	U$_P$	Sensor[1] U$_P$	0 V	Sensor[1] 0 V	A+	A–	B+	B–	R+	R–	**Vacant**	**Vacant**	**Vacant**
	Brown/Green	Blue	White/Green	White	Brown	Green	Gray	Pink	Red	Black	/	Violet	Yellow

Cable shield connected to housing; **U$_P$** = Power supply voltage
Sensor: The sensor line is connected in the encoder with the corresponding power line.
Vacant pins or wires must not be used!
[1] **LIDA 2xx:** Vacant

Incremental signals ⊓⊔TTL

HEIDENHAIN encoders with ⊓⊔TTL interface incorporate electronics that digitize sinusoidal scanning signals with or without interpolation.

The **incremental signals** are transmitted as the square-wave pulse trains U_{a1} and U_{a2}, phase-shifted by 90° elec. The **reference mark signal** consists of one or more reference pulses U_{a0}, which are gated with the incremental signals. In addition, the integrated electronics produce their **inverted signals** $\overline{U_{a1}}$, $\overline{U_{a2}}$ and $\overline{U_{a0}}$ for noise-proof transmission. The illustrated sequence of output signals—with U_{a2} lagging U_{a1}—applies to the direction of motion shown in the dimension drawing.

The **fault detection signal** $\overline{U_{aS}}$ indicates fault conditions such as an interruption in the supply lines, failure of the light source, etc.

The distance between two successive edges of the incremental signals U_{a1} and U_{a2} through 1-fold, 2-fold or 4-fold evaluation is one **measuring step**.

Inverse signals $\overline{U_{a1}}$, $\overline{U_{a2}}$, $\overline{U_{a0}}$ are not shown

Comprehensive descriptions of all available interfaces as well as general electrical information are included in the *Interfaces for HEIDENHAIN Encoders* catalog.

Pin layout

	Power supply				Incremental signals						Other signals		
⊟ ⊞	12	2	10	11	5	6	8	1	3	4	7	/	9[3]
⊢	1	9	2	11	3	4	6	7	10	12	14	8/13/15	5
⊢	4	12	2	10	1	9	3	11	14	7	13	5/6/8	15[3]
	U_P	Sensor[1] U_P	0 V	Sensor[1] 0 V	U_{a1}	$\overline{U_{a1}}$	U_{a2}	$\overline{U_{a2}}$	U_{a0}	$\overline{U_{a0}}$	$\overline{U_{aS}}$[2]	Vacant	Vacant
—◄	Brown/Green	Blue	White/Green	White	Brown	Green	Gray	Pink	Red	Black	Violet	/	Yellow

Cable shield connected to housing; U_P = Power supply voltage
Sensor: The sensor line is connected in the encoder with the corresponding power line.
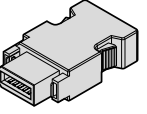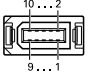Vacant pins or wires must not be used!
[1] **LIDA 2xx:** Vacant / [2] **ERO 14xx:** Vacant
[3] **Exposed linear encoders:** Switchover TTL/11 µApp for PWT, otherwise vacant

Interfaces
Position values EnDat →

The EnDat interface is a digital, **bidirectional** interface for encoders. It is capable both of transmitting **position values** as well as transmitting or updating information stored in the encoder, or saving new information. Thanks to the **serial transmission method**, only **four signal lines** are required. The DATA data is transmitted in **synchronism** with the CLOCK signal from the subsequent electronics. The type of transmission (position values, parameters, diagnostics, etc.) is selected through mode commands that the subsequent electronics send to the encoder. Some functions are available only with EnDat 2.2 mode commands.

Comprehensive descriptions of all available interfaces as well as general electrical information are included in the *Interfaces for HEIDENHAIN Encoders* catalog.

Ordering designation	Command set	Incremental signals
EnDat01	EnDat 2.1 or EnDat 2.2	With
EnDat21		Without
EnDat02	EnDat 2.2	With
EnDat22	EnDat 2.2	Without

Versions of the EnDat interface
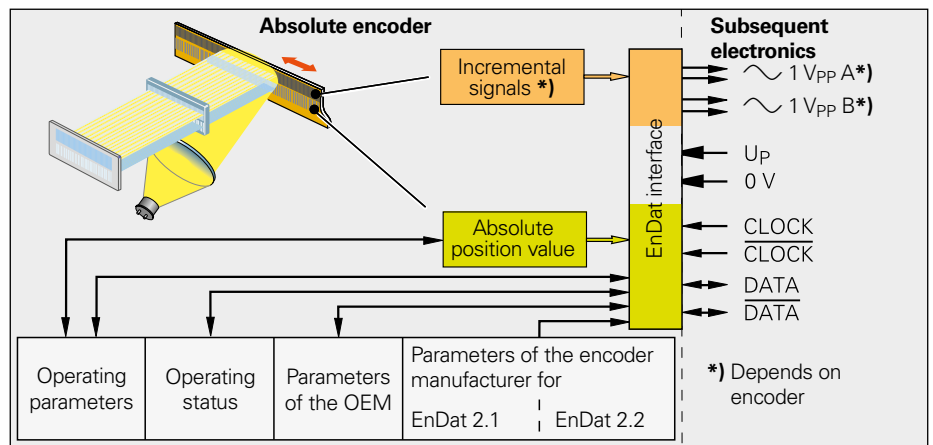
Pin layout

8-pin coupling, M12								

	Voltage supply				Absolute position values			
	8	**2**	**5**	**1**	**3**	**4**	**7**	**6**
	U_P	**Sensor** U_P	**0 V**	**Sensor** 0 V	**DATA**	$\overline{\text{DATA}}$	**CLOCK**	$\overline{\text{CLOCK}}$
	Brown/Green	Blue	White/Green	White	Gray	Pink	Violet	Yellow

17-pin coupling, M23	**15-pin D-sub connector**
	For HEIDENHAIN controls and IK 220

	Power supply					Incremental signals[1]				Absolute position values			
	7	**1**	**10**	**4**	**11**	**15**	**16**	**12**	**13**	**14**	**17**	**8**	**9**
	1	**9**	**2**	**11**	**13**	**3**	**4**	**6**	**7**	**5**	**8**	**14**	**15**
	U_P	**Sensor** U_P	**0 V**	**Sensor** 0 V	**Internal shield**	**A+**	**A–**	**B+**	**B–**	**DATA**	$\overline{\text{DATA}}$	**CLOCK**	$\overline{\text{CLOCK}}$
	Brown/ Green	Blue	White/ Green	White	/	Green/ Black	Yellow/ Black	Blue/ Black	Red/ Black	Gray	Pink	Violet	Yellow

Cable shield connected to housing; **U_P** = Power supply voltage
Sensor: The sensor line is connected in the encoder with the corresponding power line.
Vacant pins or wires must not be used!
[1] Only with order designations EnDat01 and EnDat02
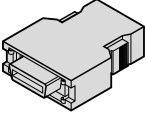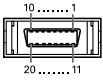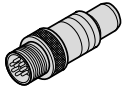
Interfaces
Fanuc and Mitsubishi pin layouts

Fanuc

HEIDENHAIN encoders with the code letter F after the model designation are suited for connection to Fanuc controls with

- **Fanuc Serial Interface – α Interface**
  Ordering designation: Fanuc02
  Normal and high speed, two-pair transmission

- **Fanuc Serial Interface – αi interface**
  Ordering designation: Fanuc05
  High speed, one-pair transmission
  Includes α interface (normal and high speed, two-pair transmission)

20-pin Fanuc connector						8-pin M12 coupling			
	Voltage supply					Absolute position values			
⊐	9	18/20	12	14	16	1	2	5	6
▪	8	2	5	1	–	3	4	7	6
	U_P	Sensor U_P	0 V	Sensor 0 V	Shield	Serial Data	$\overline{\text{Serial Data}}$	Request	$\overline{\text{Request}}$
⊏	Brown/Green	Blue	White/Green	White	–	Gray	Pink	Violet	Yellow

Cable shield connected to housing; **U_P** = Power supply voltage
Sensor: The sensor line is connected in the encoder with the corresponding power line.
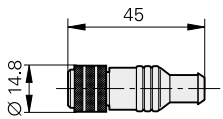Vacant pins or wires must not be used!
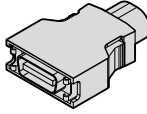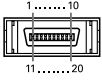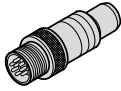
Mitsubishi

HEIDENHAIN encoders with the code letter M after the model designation are suited for connection to Mitsubishi controls with
Mitsubishi high speed interface
- Ordering designation: Mitsu01
  Two-pair transmission

- Ordering designation: Mit02-4
  Generation 1, two-pair transmission
- Ordering designation: Mit02-2
  Generation 1, one-pair transmission
- Ordering designation: Mit03-4
  Generation 2, two-pair transmission

10-pin Mitsubishi connector					20-pin Mitsubishi connector			8-pin M12 coupling	
	Voltage supply					Absolute position values			
⊐ 10-pin	1	–	2	–	7	8	3	4
⊐ 20-pin	20	19	1	11	6	16	7	17
▪	8	2	5	1	3	4	7	6
	U_P	Sensor U_P	0 V	Sensor 0 V	Serial Data	$\overline{\text{Serial Data}}$	Request Frame	$\overline{\text{Request Frame}}$
⊏	Brown/Green	Blue	White/Green	White	Gray	Pink	Violet	Yellow

Cable shield connected to housing; **U_P** = Power supply voltage
Sensor: The sensor line is connected in the encoder with the corresponding power line.
Vacant pins or wires must not be used!

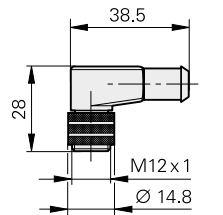# Connecting elements and cables
General information

Connector (insulated): Connecting element with coupling ring; available with male or female contacts (see symbols).
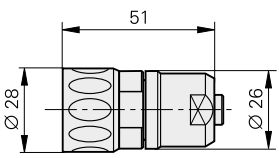
Symbols

M12

45

$\varnothing$ 14.8

M12 right-angle connector

38.5

28

M12 x 1

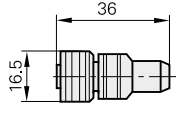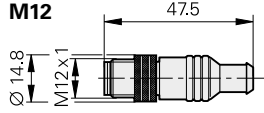$\varnothing$ 14.8

M23

51

$\varnothing$ 28

$\varnothing$ 26

Coupling (insulated): Connecting element with external thread; available with male or female contacts (see symbols).
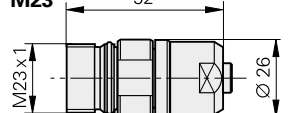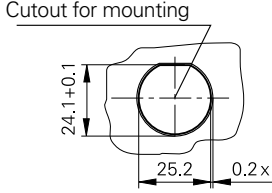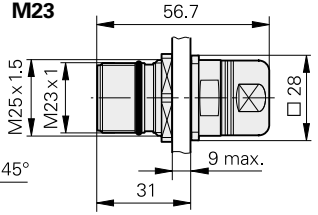
On the adapter cable

36

16.5

Symbols

M12

47.5

$\varnothing$ 14.8

M12 x 1

M23

52

M23 x 1

$\varnothing$ 26

Mounted coupling with central fastening

Cutout for mounting

24.1 +0.1

25.2

0.2 x 45°

M23

56.7

M25 x 1.5

M23 x 1

$\square$ 28

9 max.

31
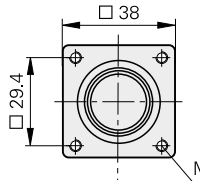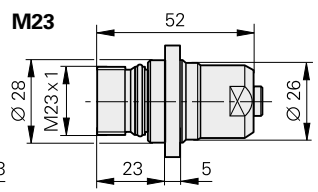
Mounted coupling with flange

$\square$ 38

$\square$ 29.4

M3

M23

52

$\varnothing$ 28

M23 x 1

$\varnothing$ 26

23

5
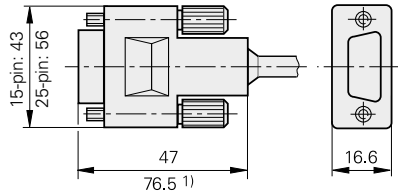
D-sub connector for HEIDENHAIN controls, counters and IK absolute value cards.
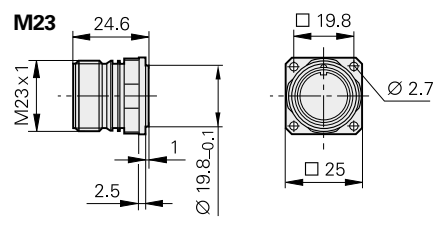
Symbols

15-pin: 43
25-pin: 56

47

76.5 [1]

16.6

[1] With integrated interface electronics

Flange socket with external thread; permanently mounted on a housing, available with male or female contacts.

Symbols

M23

24.6

M23 x 1

1

$\varnothing$ 19.8 −0.1

2.5

$\square$ 19.8

$\varnothing$ 2.7

$\square$ 25

The pins on connectors are **numbered** in the direction opposite to those on couplings or flange sockets, regardless of whether the connecting elements have

male contacts or

female contacts.

When engaged, the connections are **protected** to IP 67 (D-sub connector: IP 50; EN 60 529). When not engaged, there is no protection.

Accessories for flange sockets and M23 mounted couplings

Threaded metal dust cap
ID 219926-01

Accessory for M12 connecting element Insulation spacer
ID 596495-01

Connecting elements $\sim$ 1 V$_{PP}$
$\sqcap\sqcup$ TTL
EnDat
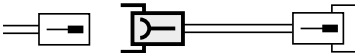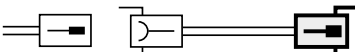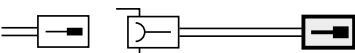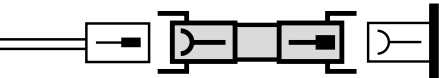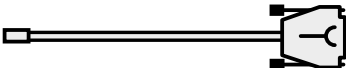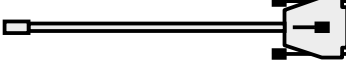
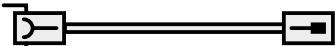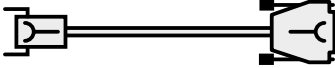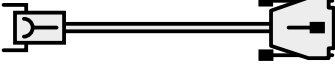|			12-pin M23	17-pin M23	8-pin M12
Mating element on connecting cable to connector on encoder cable	**Connector (female)** for cable	Ø 8 mm	291697-05	291697-26	–
Connector on connecting cable for connection to subsequent electronics	**Connector (male)** for cable	Ø 4.5 mm Ø 8 mm Ø 6 mm	291697-06 291697-08 291697-07	– 291697-27 –	– – –
Coupling on connecting cable	**Coupling (male)** for cable	Ø 4.5 mm Ø 6 mm Ø 8 mm	291698-14 291698-03 291698-04	291698-25 291698-26 291698-27	– – –
Flange socket for mounting on subsequent electronics	**Flange socket (female)**		315892-08	315892-10	–
Mounted couplings	**With flange (female)**	Ø 6 mm Ø 8 mm	291698-17 291698-07	291698-35 –	– –
	With flange (male)	Ø 6 mm Ø 8 mm	291698-08 291698-31	291698-41 291698-29	– –
	With central fastener (male)	Ø 6 mm to 10 mm	741045-01	741045-02	–
Adapter $\sim$ **1 V$_{PP}$/11 µA$_{PP}$** For converting the 1 V$_{PP}$ signals to 11 µA$_{PP}$; M23 connector (female, 12-pin) and M23 connector (male, 9-pin)			364914-01	–	–
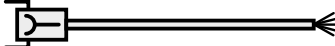
Connecting cables $\sim$ 1 V_{PP}
$\sqcap\sqcup$ TTL
EnDat

			12-pin M23	17-pin M23	8-pin M12
			$\sim$ **1 V_{PP}** $\sqcap\sqcup$ **TTL**	**EnDat** with incremental signals	**EnDat** without incremental signals
PUR adapter cable	**8-pin:** **17-pin:**	$\varnothing$ **4.5 mm;** [$4 \times 2 \times 0.14$ mm^2] $\varnothing$ **6 mm;** [$6 \times 2 \times 0.19$ mm^2]	$A_P = 0.14$ mm^2 $A_P = 0.19$ mm^2		
Complete with • M12 coupling (male), 8-pin • M23 coupling (male), 17-pin			–	– 643450-xx	679671-xx –
Complete with M23 coupling (male), 17-pin with central fastening (M23 SpeedTEC)			–	1072523-xx	–
Complete with D-sub connector (female), 15-pin			–	727658-xx	735987-xx
Complete with D-sub connector (female), 25-pin			–	735961-xx	735994-xx
Complete with D-sub connector (male), 15-pin			–	–	735993-xx
With one connector			–	681186-xx	680856-xx
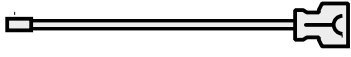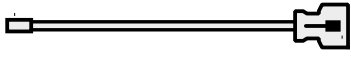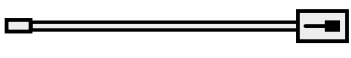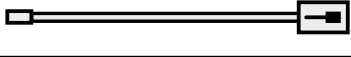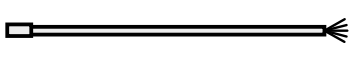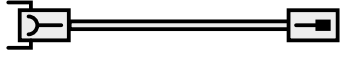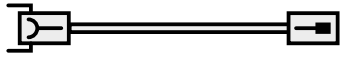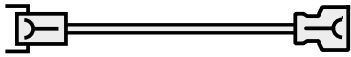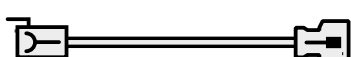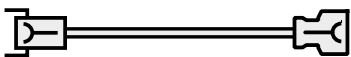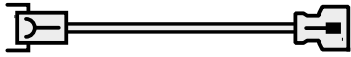
PUR connecting cable	**8-pin:** **17-pin:** **12-pin:**	$\varnothing$ **6 mm;** [4×0.14 mm^2 + 4×0.34 mm^2] $\varnothing$ **8 mm;** [$4 \times 2 \times 0.14$ mm^2 + 4×0.5 mm^2 + 4×0.14 mm^2] $\varnothing$ **8 mm;** [$4 \times 2 \times 0.14$ mm^2 + 4×0.5 mm^2]	$A_P = 0.34$ mm^2 $A_P = 0.5$ mm^2 $A_P = 0.5$ mm^2		
Complete with connector (female) and coupling (male)			298401-xx	323897-xx	368330-xx
Complete with connectors (female and male)			298399-xx	–	–
Complete with connector (female) and D-sub connector (female), 15-pin			310199-xx	332115-xx	533627-xx
Complete with connector (female) and D-sub connector (female), 25-pin			–	509667-xx	641926-xx
Complete with connector (female) and D-sub connector (male), 15-pin			310196-xx	324544-xx	524599-xx
With one connector (female)			309777-xx	309778-xx	634265-xx
Cable only			816317-xx	816322-xx	816329-xx

A_P: Cross section of power supply lines
$\varnothing$: Cable diameter (for bend radii, see catalog *Interfaces of HEIDENHAIN Encoders*)

Connecting cables Fanuc
Mitsubishi

PUR adapter cable	Ø 4.5 mm; [4 × 2 × 0.14 mm^2] $A_P = 0.14$ mm^2	Fanuc	Mitsubishi
Complete with • Fanuc connector (female) or • Mitsubishi connector (female), 10-pin		770967-xx	770968-xx
Complete with Mitsubishi connector (male), 20-pin		–	770966-xx
Complete with M12 coupling (male), 8-pin		679671-xx	
Complete with M23 coupling (male), 17-pin		827607-xx	
Complete with M23 coupling (male), 17-pin with central fastening (M23 SpeedTEC)		1034884-xx	
With one connector		680856-xx	

PUR connecting cable	① Ø 6 mm; [4 × 0.14 mm^2 + 4 × 0.34 mm^2] $A_P = 0.34$ mm^2 ② Ø 8 mm; [2 × 2 × 0.14 mm^2 + 4 × 1 mm^2] $A_P = 1$ mm^2 ③ Ø 6 mm; [2 × 2 × 0.14 mm^2 + 4 × 0.5 mm^2] $A_P = 0.5$ mm^2	Cable	Fanuc	Mitsubishi
Complete with M12 connector (female), 8-pin, and M12 coupling (male), 8-pin		①	368330-xx	
Complete with M12 connector (female), 8-pin and M23 coupling (male), 17-pin		①	582333-xx	
Complete with M12 connector (female), 8-pin, and • Fanuc connector (female) or • Mitsubishi connector (female), 10-pin		①	646807-xx	647314-xx
Complete with M12 connector (female), 8-pin, and Mitsubishi connector (male), 20-pin		①	–	646806-xx
Complete with M23 connector (female), 17-pin, and • Fanuc connector (female) or • Mitsubishi connector (female), 10-pin		②	534855-xx	573661-xx
Complete with M23 connector (female), 17-pin, and Mitsubishi connector (male), 20-pin		③	–	367958-xx
Cable only		②	816327-xx	

A_P: Cross section of power supply lines
Ø: Cable diameter (for bend radii, see catalog *Interfaces of HEIDENHAIN Encoders*)

Diagnostic and testing equipment

HEIDENHAIN encoders are provided with all information necessary for commissioning, monitoring and diagnostics. The type of available information depends on whether the encoder is incremental or absolute and which interface is used.

Incremental encoders mainly have 1 V_{PP}, TTL or HTL interfaces. TTL and HTL encoders monitor their signal amplitudes internally and generate a simple fault detection signal. With 1 V_{PP} signals, the analysis of output signals is possible only in external test devices or through computation in the subsequent electronics (**analog diagnostics interface**).

Absolute encoders operate with serial data transfer. Depending on the interface, additional 1 V_{PP} incremental signals can be output. The signals are monitored comprehensively within the encoder. The monitoring result (especially with valuation numbers) can be transferred along with the position value through the serial interface to the subsequent electronics (**digital diagnostics interface**). The following information is available:
- Error message: Position value not reliable
- Warning: An internal functional limit of the encoder has been reached
- Valuation numbers:
  – Detailed information on the encoder's functional reserve
  – Identical scaling for all HEIDENHAIN encoders
  – Cyclic output is possible

This enables the subsequent electronics to evaluate the current status of the encoder at little cost even in closed-loop mode.

HEIDENHAIN offers the appropriate PWM inspection devices and PWT test devices for encoder analysis. There are two types of diagnostics, depending on how they are integrated:
- Encoder diagnostics: The encoder is connected directly to the test or inspection device. This makes a comprehensive analysis of encoder functions possible.
- Diagnostics in the control loop: The PWM phase meter is looped into the closed control loop (e.g. through a suitable testing adapter). This makes a real-time diagnosis of the machine or system possible during operation. The functions depend on the interface.
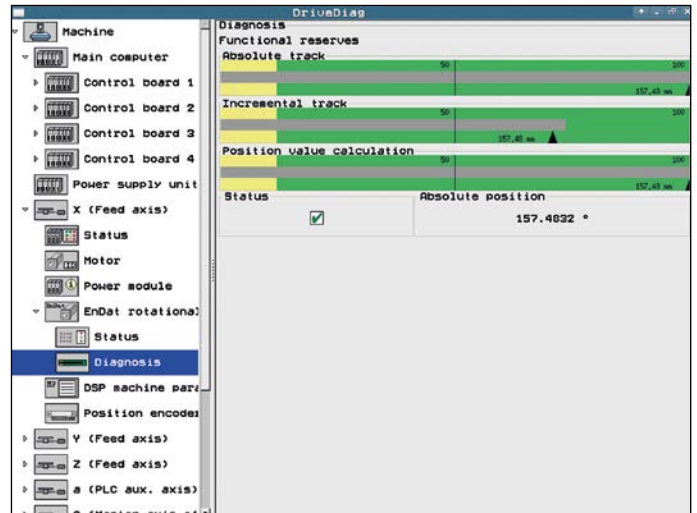
Diagnostics in the control loop on HEIDENHAIN controls with display of the valuation number or the analog encoder signals
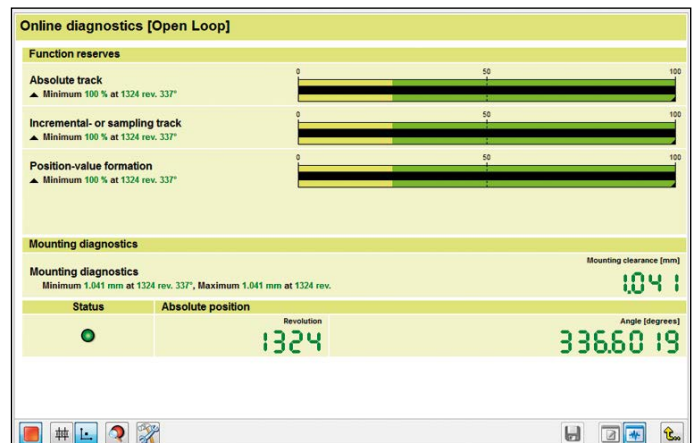
Diagnostics using PWM 20 and ATS software

Commissioning using PWM 20 and ATS software

PWM 20

Together with the ATS adjusting and testing software, the PWM 20 phase angle measuring unit serves for diagnosis and adjustment of HEIDENHAIN encoders.

For more information, refer to the Product Information document *PWM 20/ATS Software*.

	PWM 20
Encoder input	• EnDat 2.1 or EnDat 2.2 (absolute value with/without incremental signals) • DRIVE-CLiQ • Fanuc Serial Interface • Mitsubishi high speed interface • Yaskawa Serial Interface • Panasonic serial interface • SSI • 1 V_{PP}/TTL/11 μA_{PP} • HTL (via signal adapter)
Interface	USB 2.0
Voltage supply	100 V to 240 V AC or 24 V DC
Dimensions	258 mm x 154 mm x 55 mm

	ATS
Languages	Choice between English and German
Functions	• Position display • Connection dialog • Diagnostics • Mounting wizard for EBI/ECI/EQI, LIP 200, LIC 4000 and others • Additional functions (if supported by the encoder) • Memory contents
System requirements and recommendations	PC (dual-core processor, > 2 GHz) RAM > 2 GB Windows operating systems XP, Vista, 7 (32-bit/64-bit), 8 200 MB free space on hard disk

DRIVE-CLiQ is a registered trademark of Siemens Aktiengesellschaft

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The **PWM 9** is a universal measuring device for checking and adjusting HEIDENHAIN incremental encoders. Expansion modules are available for checking the various types of encoder signals. The values can be read on an LCD monitor. Soft keys provide ease of operation.

	PWM 9
Inputs	Expansion modules (interface boards) for 11 μA_{PP}; 1 V_{PP}; TTL; HTL; EnDat*/SSI*/commutation signals *No display of position values or parameters
Functions	• **Measures** signal amplitudes, current consumption, operating voltage, scanning frequency • **Graphically displays** incremental signals (amplitudes, phase angle and on-off ratio) and the reference-mark signal (width and position) • **Displays symbols** for the reference mark, fault-detection signal, counting direction • **Universal counter,** interpolation selectable from single to 1024-fold • **Adjustment support** for exposed linear encoders
Outputs	• Inputs are connected through to the subsequent electronics • BNC sockets for connection to an oscilloscope
Voltage supply	10 V to 30 V DC, max. 15 W
Dimensions	150 mm × 205 mm × 96 mm

Interface electronics

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

Input signals of the interface electronics
Interface electronics from HEIDENHAIN can be connected to encoders with sinusoidal signals of 1 V_{PP} (voltage signals) or 11 μA_{PP} (current signals). Encoders with the serial interfaces EnDat or SSI can also be connected to various interface electronics.

Output signals of the interface electronics
Interface electronics with the following interfaces to the subsequent electronics are available:
• TTL square-wave pulse trains
• EnDat 2.2
• DRIVE-CLiQ
• Fanuc Serial Interface
• Mitsubishi high speed interface
• Yaskawa Serial Interface
• Profibus

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

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

Box design

Plug design

Version for integration

Top-hat rail design

Outputs		Inputs		Design – Protection class	Interpolation[1] or subdivision	Model
Interface	Qty.	Interface	Qty.			
⎍ TTL	1	∿ 1 V$_{PP}$	1	Box design – IP 65	5/10-fold	**IBV 101**
					20/25/50/100-fold	**IBV 102**
					Without interpolation	**IBV 600**
					25/50/100/200/400-fold	**IBV 660 B**
				Plug design – IP 40	5/10/20/25/50/100-fold	**APE 371**
				Version for integration – IP 00	5/10-fold	**IDP 181**
					20/25/50/100-fold	**IDP 182**
		∿ 11 µA$_{PP}$	1	Box design – IP 65	5/10-fold	**EXE 101**
					20/25/50/100-fold	**EXE 102**
					Without/5-fold	**EXE 602 E**
					25/50/100/200/400-fold	**EXE 660 B**
				Version for integration – IP 00	5-fold	**IDP 101**
⎍ TTL/ ∿ 1 V$_{PP}$ Adjustable	2	∿ 1 V$_{PP}$	1	Box design – IP 65	2-fold	**IBV 6072**
					5/10-fold	**IBV 6172**
					5/10-fold and 20/25/50/100-fold	**IBV 6272**
EnDat 2.2	1	∿ 1 V$_{PP}$	1	Box design – IP 65	≤ 16384-fold subdivision	**EIB 192**
				Plug design – IP 40	≤ 16384-fold subdivision	**EIB 392**
			2	Box design – IP 65	≤ 16384-fold subdivision	**EIB 1512**
DRIVE-CLiQ	1	EnDat 2.2	1	Box design – IP 65	–	**EIB 2391 S**
Fanuc serial interface	1	∿ 1 V$_{PP}$	1	Box design – IP 65	≤ 16384-fold subdivision	**EIB 192 F**
				Plug design – IP 40	≤ 16384-fold subdivision	**EIB 392 F**
			2	Box design – IP 65	≤ 16384-fold subdivision	**EIB 1592 F**
Mitsubishi high speed interface	1	∿ 1 V$_{PP}$	1	Box design – IP 65	≤ 16384-fold subdivision	**EIB 192 M**
				Plug design – IP 40	≤ 16384-fold subdivision	**EIB 392 M**
			2	Box design – IP 65	≤ 16384-fold subdivision	**EIB 1592 M**
Yaskawa serial interface	1	EnDat 2.2[2]	1	Plug design – IP 40	–	**EIB 3391 Y**
PROFIBUS-DP	1	EnDat 2.1; EnDat 2.2	1	Top-hat rail design	–	**PROFIBUS Gateway**

[1] Switchable   [2] Only LIC 4100 with 5 nm measuring step, LIC 2100 with 50 nm and 100 nm measuring steps

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