HEIDENHAIN

Product Information

ERM 200 Series

Modular Magnetic Encoders

August 2007

Range of Applications

The robust ERM modular magnetic encoders are especially suited for use in production machines.
Their large possible inside diameters as well as the small dimensions and compact design of the scanning head predestine them for:

- The C axis of lathes
- Spindle orientation on milling machines
- Auxiliary axes
- Integration in gear stages

The signal period of approx. 400 µm and the special MAGNODUR procedure for applying the grating achieve the accuracies and shaft speeds required by these applications.

Accuracy
The typical application for ERM 200 encoders is on the C axis of lathes, especially for the machining of bar-stock material. Here the graduation of the ERM modular encoder is usually on a diameter that is approximately twice as large as the workpiece to be machined. The accuracy and reproducibility of the ERM also achieve sufficient workpiece accuracies for milling operations with lathes (classical C-axis machining).

Example:
Accuracy of a workpiece from bar-stock material, 100-mm diameter;
ERM 280 encoder on C axis with

- Accuracy: ± 12" with 2048 lines
- Drum outside diameter: 257.50 mm

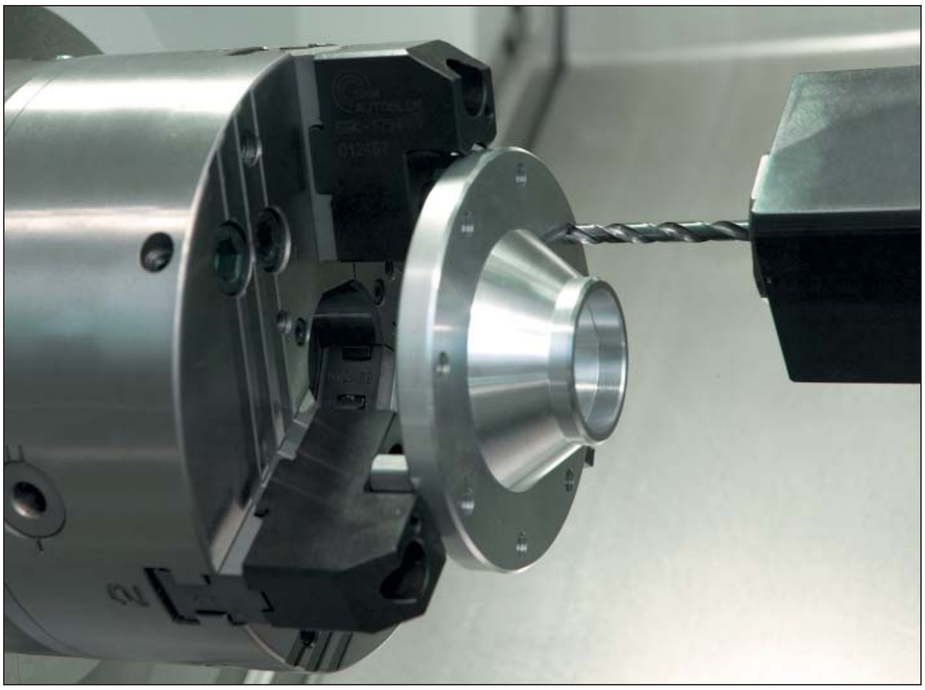
$\Delta\varphi = \pm \tan 12'' \times \text{radius}$
$\Delta\varphi = \pm 2.9\ \mu m$

Calculated position error: ± 2.9 µm

Conclusion:
For bar-stock material with a diameter of 100 mm, the maximum position error that can result from the encoder is less than ± 3 µm. Eccentricity errors must also be considered, but these can be reduced through accurate mounting.

Shaft speeds
The ERM circumferential-scale drums can operate at high shaft speeds. Ancillary noises, such as from gear-tooth systems, do not occur. The maximum shaft speeds listed in the specifications (up to 19000 min^{-1}) suffice for most applications.

C-axis machining



Measuring Principle

Measuring standard
HEIDENHAIN encoders incorporate measuring standards of periodic structures known as graduations.
Magnetic encoders use a graduation carrier of magnetizable steel alloy. A write head applies strong local magnetic fields in different directions, so that a graduation consisting of north poles and south poles is formed with a signal period of 400 µm (MAGNODUR process). Due to the short distance of effect of electromagnetic interaction, and the very narrow scanning gaps required, finer magnetic graduations are not practical.

Magnetic scanning
The permanently magnetic MAGNODUR graduation is scanned by magnetoresistive sensors, whose resistances change in response to a magnetic field. When a voltage is applied to the sensor and the scale drum moves relative to the scanning head, the flowing current is modulated according to the magnetic field.

The special geometric arrangement of the resistive sensors and the manufacture of the sensors on glass substrates ensure a high signal quality. In addition, the large scanning surface allows the signals to be filtered for harmonic waves. These are prerequisites for minimizing position errors within one signal period.

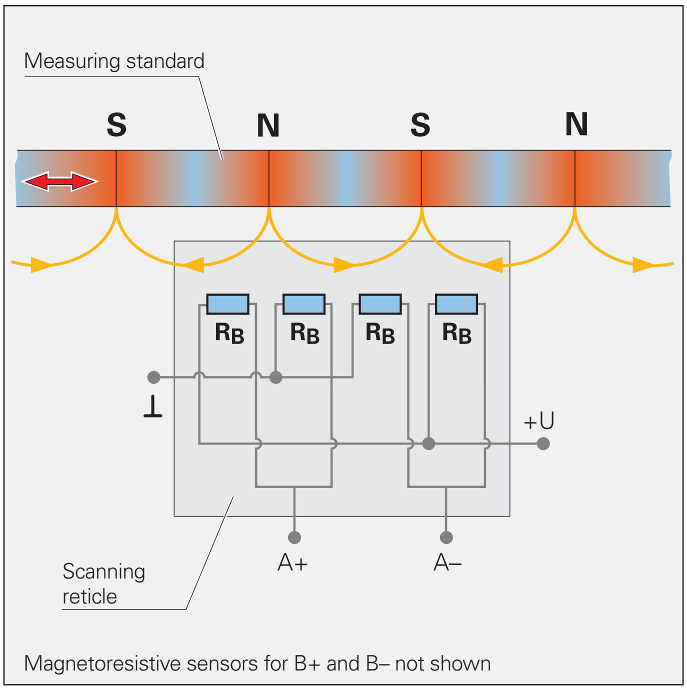
A structure on a separate track produces a reference mark signal. This makes it possible to assign this absolute position value to exactly one measuring step.

Magnetoresistive scanning is used primarily for comparatively low-accuracy applications, or for applications where the machined parts are relatively small compared to the scale drum.

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. The shaft speed is determined through mathematic derivation of the change in position over time.

Since an absolute reference is required to ascertain positions, the scale drums 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.

Magnetoresistive scanning principle



Magnetoresistive sensors for B+ and B– not shown

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

The **system accuracy** given in the *Specifications* is defined as follows:

The system accuracy reflects position error within one revolution as well as that within one signal period. The extreme values of the total deviations of a position are within the system accuracy ± a.

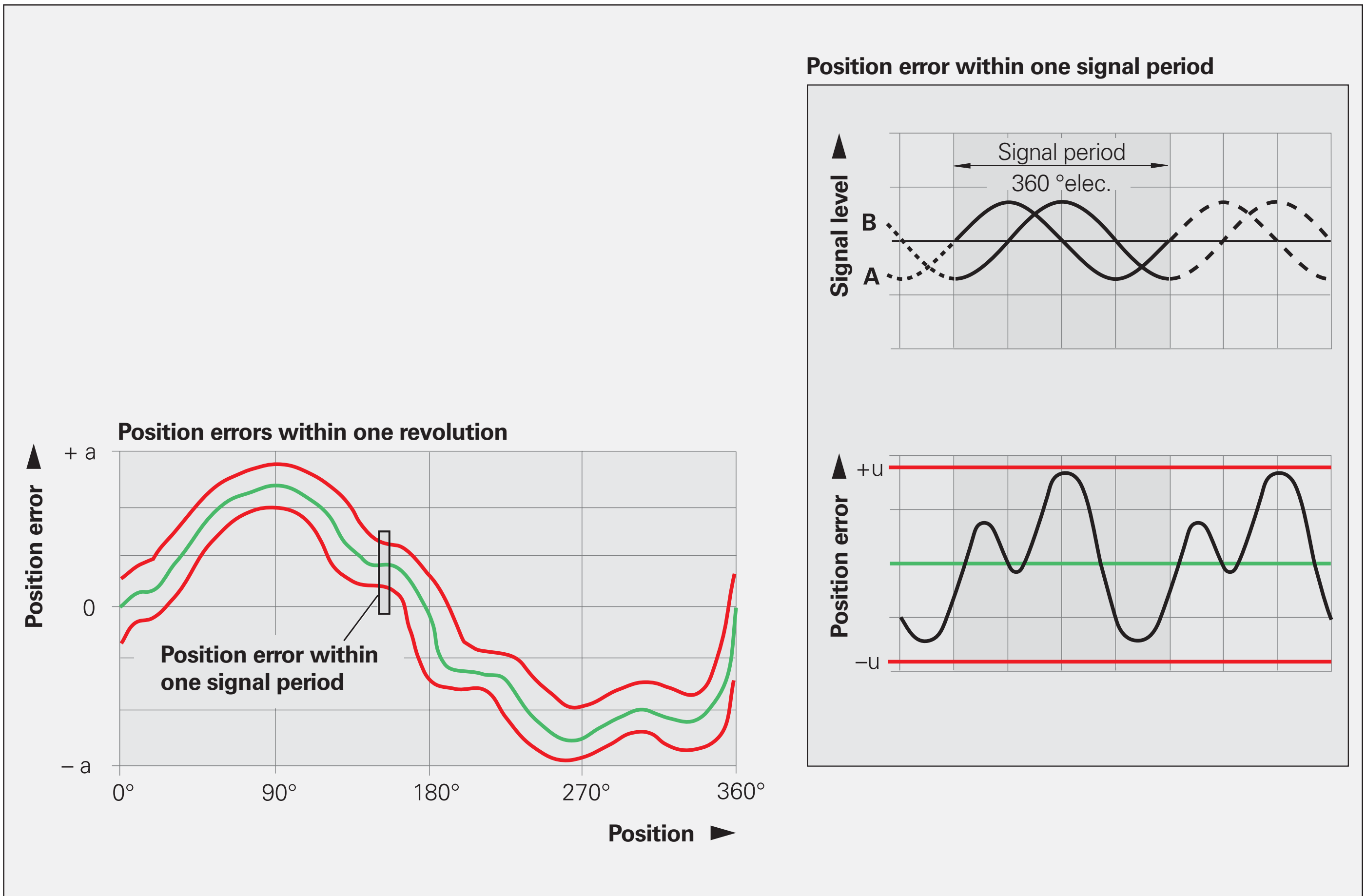
For **encoders without integral bearing,** additional deviations resulting from mounting, errors in the bearing of the drive shaft, and adjustment of the scanning head must be expected. These deviations are not reflected in the system accuracy.

Position errors within one revolution become apparent in larger angular motions.

Position errors within one signal period already become apparent in very small angular motions and in repeated measurements. They especially lead to speed ripples in the speed control loop. These deviations within one signal period are caused by the quality of the sinusoidal scanning signals and their subdivision. The following 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 detectors, and
- The stability and dynamics during the further processing of the analog signals.

HEIDENHAIN encoders take these factors of influence into account, and permit interpolation of the sinusoidal output signal with typical subdivision accuracies of better than ± 1% of the signal period.

However, the 400-µm signal periods of ERM modular magnetic encoders are relatively large. Angle encoders using the photoelectric scanning principle are better suited for higher accuracy requirements: Along with their better system accuracy, they also feature significantly smaller signal periods (typically 20 µm), and therefore have correspondingly smaller position errors within one signal period.



In addition to the system accuracy, the mounting and adjustment of the scanning head and of the scale drum normally have a significant effect on the accuracy that can be achieved with encoders without integral bearings. Of special importance are the mounting eccentricity and radial runout of the drive shaft.

In order to evaluate the **total accuracy,** each of the significant errors must be considered individually.

1. Directional deviations of the graduation

The extreme values of the directional deviation with respect to their mean value are shown in the *Specifications* as the graduation accuracy. The graduation accuracy and the position error within a signal period comprise the system accuracy.

2. Error due to eccentricity of the graduation to the bearing

Under normal circumstances, the graduation will have a certain eccentricity relative to the bearing once the ERM's scale drum is mounted. In addition, dimensional and form deviations of the shaft can result in added eccentricity.

The following relationship exists between the eccentricity *e,* the graduation diameter *D* and the measuring error Δφ (see illustration below):

$$\Delta\varphi = \pm 412 \cdot \frac{e}{D}$$

Δφ = Measuring error in ″ (angular seconds)
e = Eccentricity of the radial grating to the bearing in µm (1/2 the radial deviation)
D = Scale-drum diameter (= drum outside diameter) in mm
M = Center of graduation
φ = "True" angle
φ′ = Scanned angle

Graduation diameter *D*	Error per 1 µm of eccentricity
D = 75 mm	± 5.5″
D = 113 mm	± 3.6″
D = 130 mm	± 3.2″
D = 150 mm	± 2.7″
D = 176 mm	± 2.3″
D = 260 mm	± 1.6″
D = 327 mm	± 1.3″
D = 453 mm	± 0.9″

3. Error due to radial deviation of the bearing

The equation for the measuring error Δφ is also valid for radial deviation of the bearing if the value *e* is replaced with the eccentricity value, i.e. half of the radial deviation (half of the displayed value).

Bearing compliance to radial shaft loading causes similar errors.

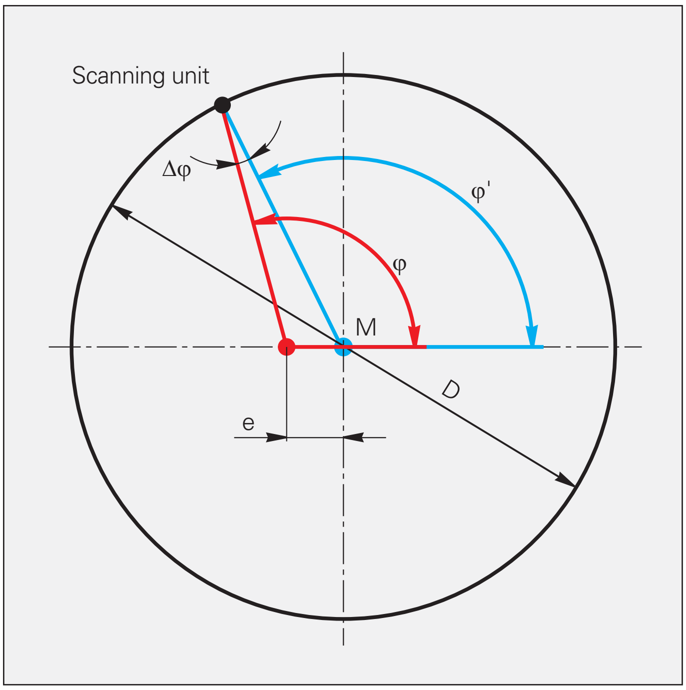
4. Position error within one signal period $\Delta\varphi_u$

The scanning units of all HEIDENHAIN encoders are adjusted so that the maximum position error values within one signal period will not exceed the values listed below, with no further electrical adjusting required at mounting.

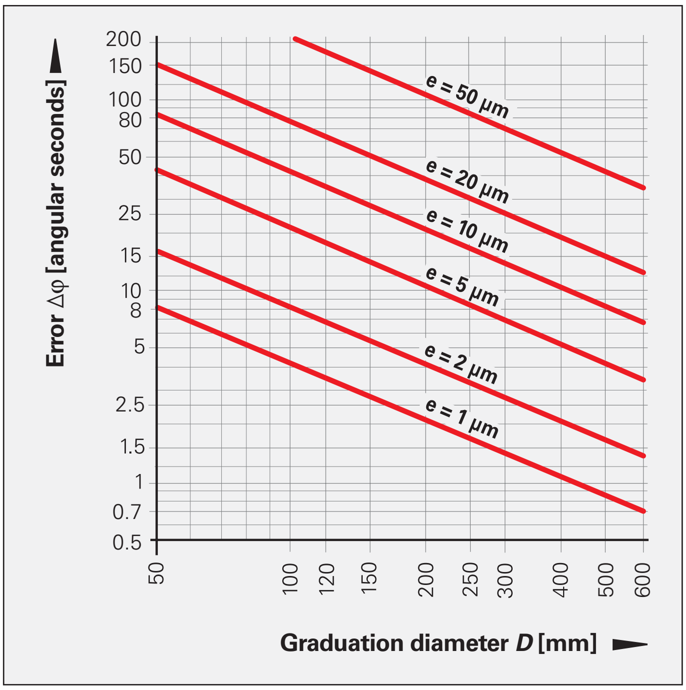
Line count	Position error within one signal period $\Delta\varphi_u$
3600	≤ ± 5″
2600	≤ ± 6″
2048	≤ ± 7″
1400	≤ ± 11″
1200	≤ ± 12″
1024	≤ ± 13″
900	≤ ± 15″
600	≤ ± 22″

The values for the position errors within one signal period are already included in the system accuracy. Larger errors can occur if the mounting tolerances are exceeded.

Eccentricity of the graduation to the bearing



Resultant measured deviations Δφ for various eccentricity values *e* as a function of graduation diameter *D*



Mounting Instructions

Mounting
The ERM modular encoders consist of a circumferential scale drum and the corresponding scanning head. Special design features assure comparatively fast mounting and easy adjustment.

The circumferential scale drum is slid onto the drive shaft and fastened with screws. The scale drum is centered via the centering collar on its inner circumference. HEIDENHAIN recommends using a slight oversize on the shaft for mounting the scale drum. Only if this is done do the rotational velocities listed in the *Specifications* apply. For easier mounting, the scale drum may be slowly warmed on a heating plate over a period of approx. 10 minutes to a temperature of at most 100 °C. In order to check the radial runout and assess the resulting deviations, testing of the rotational accuracy is recommended. For mounting the scanning head, the spacer foil is applied to the surface of the circumferential scale drum. The scanning head is pressed against the foil, fastened, and the foil is removed.

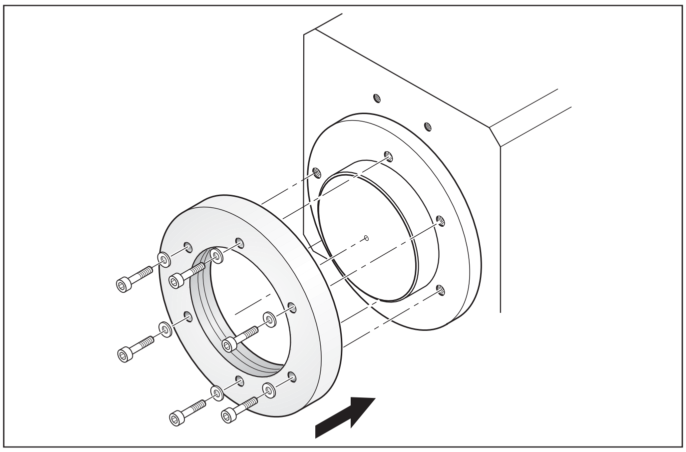
Back-off threads are used for dismounting the scale drums.

Mounting
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.

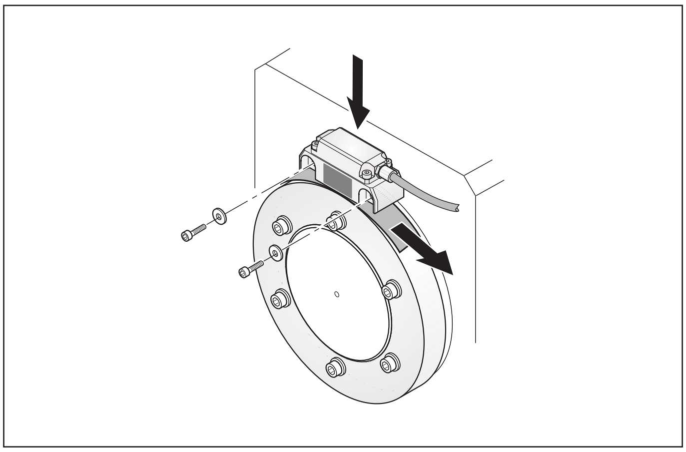
System tests
Encoders from HEIDENHAIN are usually integrated as components in larger systems. Such applications require **comprehensive tests of the entire system** regardless of the specifications of the encoder.

The specifications given in the 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-oriented systems, the higher-level system must verify the position value of the encoder after switch-on.



Mounting the scale drum



Mounting the scanning head with the aid of the spacer foil

Protection against contact
After encoder installation, all rotating parts must be protected against accidental contact during operation.

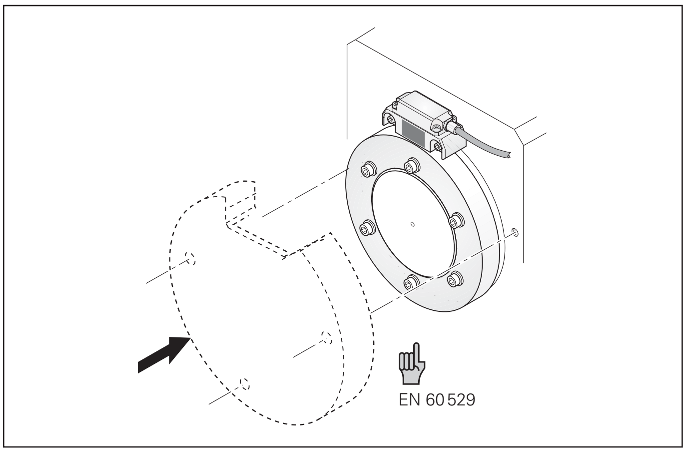
Acceleration
Encoders are subject to various types of acceleration during operation and mounting.

- The indicated maximum values for **vibration** are valid according to IEC 60 068-2-6.
- The maximum permissible acceleration values (semi-sinusoidal shock) for **shock and impact** are valid for 6 ms (IEC 60 068-2-27).
  Under no circumstances should a hammer or similar implement be used to adjust or position the encoder.

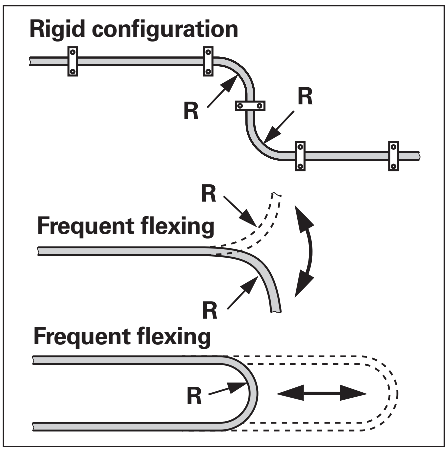
Temperature range
The **operating temperature range** indicates the ambient temperature limits between which the encoders will function properly. The **storage temperature range** of –30 °C to 80 °C is valid when the unit remains in its packaging.

Rotational velocity
The maximum permissible shaft speeds were determined according to FKM guidelines. This guideline serves as mathematical attestation of component strength with regard to all relevant influences and it reflects the latest state of the art. The requirements for fatigue strength (10^7 changes of load) were considered in the calculation of the permissible shaft speeds. Because installation has significant influence, all requirements and instructions in the *Specifications* and mounting instructions must be followed for the rotational velocity data to be valid.

Parts subject to wear
HEIDENHAIN encoders contain components that are subject to wear, depending on the application and manipulation. These include in particular moving cables. Pay attention to the smallest permissible bending radii.



Protection against contact



Smallest permissible bending radii

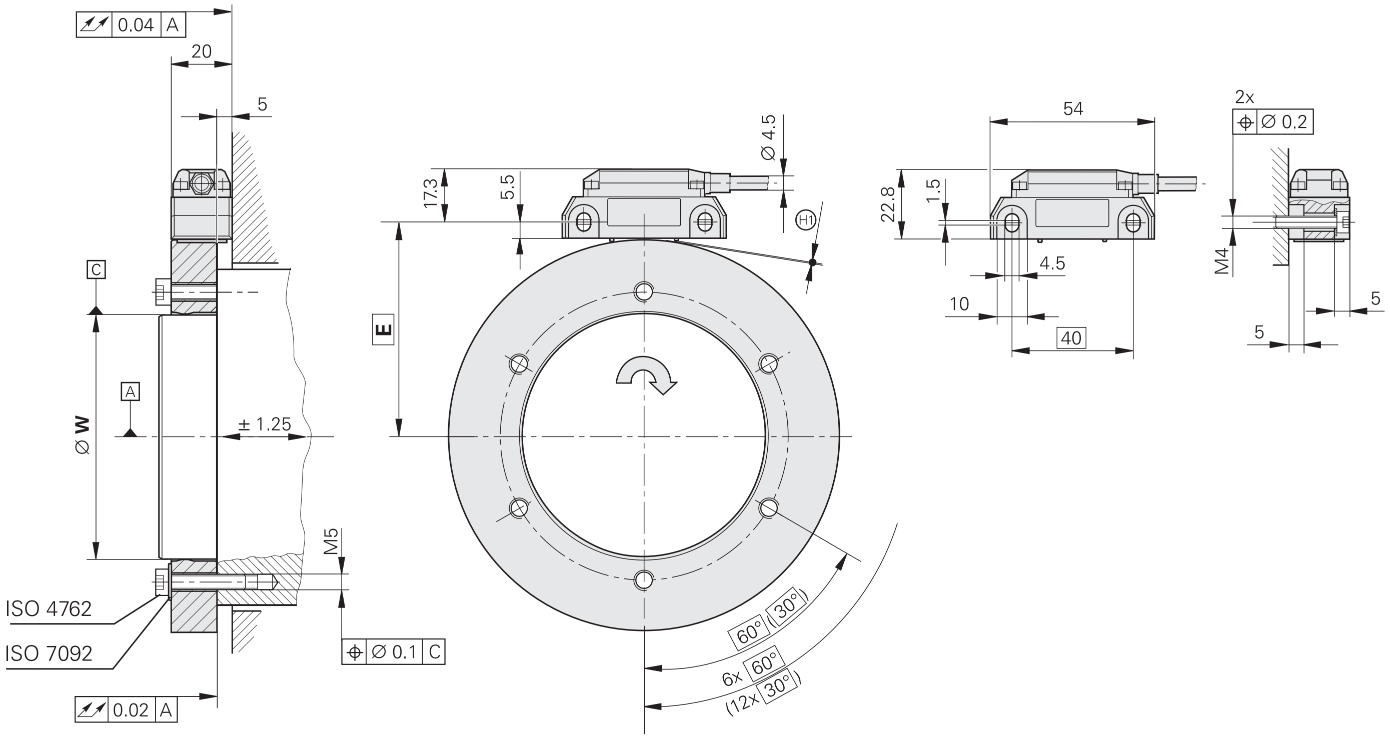
HEIDENHAIN cables	Rigid configuration	Frequent flexing
Ø 4.5 mm	R ≥ 10 mm	R ≥ 50 mm
Ø 8 mm	R ≥ 40 mm	R ≥ 100 mm

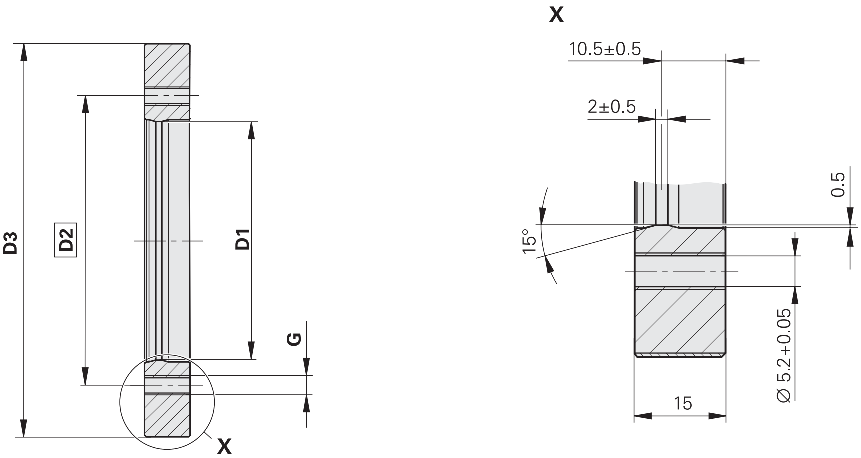
ERM 200 Series

- **Modular rotary encoders**
- **Magnetic scanning principle**

Dimensions in mm

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





D1	W		D2	D3	E	G
Ø 40 –0.007	Ø 40	+0.009/+0.002	Ø 50	Ø 75.44	43.4	6x M6
Ø 70 –0.008	Ø 70	+0.010/+0.002	Ø 85	Ø 113.16	62.3	6x M6
Ø 80 –0.008	Ø 80	+0.010/+0.002	Ø 95	Ø 128.75	70.1	6x M6
Ø 120 –0.010	Ø 120	+0.013/+0.003	Ø 135	Ø 150.88	81.2	6x M6
Ø 130 –0.012	Ø 130	+0.015/+0.003	Ø 145	Ø 176.03	93.7	6x M6
Ø 180 –0.012	Ø 180	+0.015/+0.003	Ø 195	Ø 257.50	134.5	6x M6
Ø 220 –0.014	Ø 220	+0.018/+0.004	Ø 235	Ø 257.50	134.5	6x M6
Ø 295 –0.016	Ø 295	+0.020/+0.004	Ø 310	Ø 326.90	169.2	6x M6
Ø 410 –0.018	Ø 410	+0.025/+0.005	Ø 425	Ø 452.64	232.0	12x M6

A = Bearing
H1 = Mounting distance of 0.15 mm set with spacer foil

	ERM 220 ERM 280								
Incremental signals	*ERM 220:* ⊓⊔ TTL *ERM 280:* ∼ 1 V_{PP}								
Reference mark	One								
Cutoff frequency –3dB Scanning frequency	*ERM 280:* ≥ 300 kHz *ERM 220:* ≤ 350 kHz								
Power supply	5 V ± 10%								
Power consumption	≤ 150 mA (without load)								
Electrical connection	Cable 1 m, with or without coupling								
Cable length with HEIDENHAIN cable	*ERM 220:* ≤ 100 m *ERM 280:* ≤ 150 m								
Drum inside diameter*	40 mm	70 mm	80 mm	120 mm	130 mm	180 mm	220 mm	295 mm	410 mm
Drum outside diameter*	75.44 mm	113.16 mm	128.75 mm	150.88 mm	176.03 mm	257.50 mm	257.50 mm	326.90 mm	452.64 mm
Line count	600	900	1024	1200	1400	2048	2048	2600	3600
System accuracy[1]	± 36″	± 25″	± 22″	± 20″	± 18″	± 12″	± 12″	± 10″	± 9″
Accuracy of the graduation[2]	± 14″	± 10″	± 9″	± 8″	± 7″	± 5″	± 5″	± 4″	± 4″
Shaft speed	≤ 19000 min^{-1}	≤ 14500 min^{-1}	≤ 13000 min^{-1}	≤ 10500 min^{-1}	≤ 9000 min^{-1}	≤ 6000 min^{-1}	≤ 6000 min^{-1}	≤ 4500 min^{-1}	≤ 3000 min^{-1}
Moment of inertia of rotor	$0.34 \cdot 10^{-3}$ kgm^2	$1.6 \cdot 10^{-3}$ kgm^2	$2.7 \cdot 10^{-3}$ kgm^2	$3.5 \cdot 10^{-3}$ kgm^2	$7.7 \cdot 10^{-3}$ kgm^2	$38 \cdot 10^{-3}$ kgm^2	$23 \cdot 10^{-3}$ kgm^2	$44 \cdot 10^{-3}$ kgm^2	$156 \cdot 10^{-3}$ kgm^2
Perm. axial movement	± 1.25 mm								
Vibration 55 to 2000 Hz **Shock** 6 ms	≤ 400 m/s^2 (IEC 60068-2-6) ≤ 1000 m/s^2 (IEC 60068-2-27)								
Max. operating temperature	100 °C								
Min. operating temperature	–10 °C								
Protection IEC 60529	IP 67								
Weight in kg (approx.)									
Scale drum	0.35	0.69	0.89	0.72	1.2	3.0	1.6	1.7	3.2
Scanning head with cable	0.15								

***** Please indicate when ordering; other versions available upon request
[1] Before installation. Additional errors caused by mounting inaccuracy and inaccuracy from the bearing of the drive shaft are not included.
[2] For other errors, see *Measuring Accuracy*

Interfaces

Incremental Signals ∿ 1 V_{PP}

HEIDENHAIN encoders with ∿ 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 an amplitude 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 a usable component G of approx. 0.5 V. Next to the reference mark, the output signal can be reduced by up to 1.7 V to a quiescent value H. This must not cause the subsequent electronics to overdrive. Even at the lowered signal level, signal peaks with the amplitude G can also appear.

The data on **signal amplitude** apply when the power supply given in the specifications is connected to the encoder. They refer to a differential measurement at the 120-ohm terminating resistor between the associated outputs. The signal amplitude decreases with increasing frequency. The **cutoff frequency** indicates the scanning frequency at which a certain percentage of the original signal amplitude is maintained:

- –3 dB cutoff frequency:
  70% of the signal amplitude
- –6 dB cutoff frequency:
  50% of the signal amplitude

Interpolation/resolution/measuring step
The output signals of the 1 V_{PP} interface are usually interpolated in the subsequent electronics in order to attain sufficiently high resolutions. For **velocity control,** interpolation factors are commonly over 1000 in order to receive usable velocity information even at low speeds.

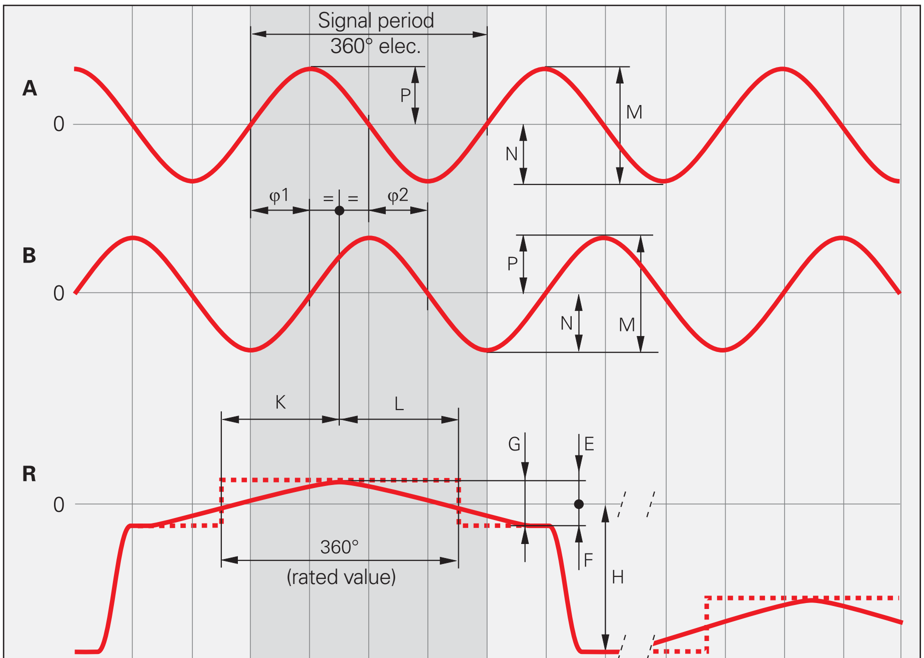
Measuring steps for **position measurement** are recommended in the specifications. For special applications, other resolutions are also possible.

Short circuit stability
A temporary short circuit of an output to 0 V or U_P does not cause encoder failure, but it is not a permissible operating condition.

Short circuit at	20 °C	125 °C
One output	< 3 min	< 1 min
All outputs	< 20 s	< 5 s

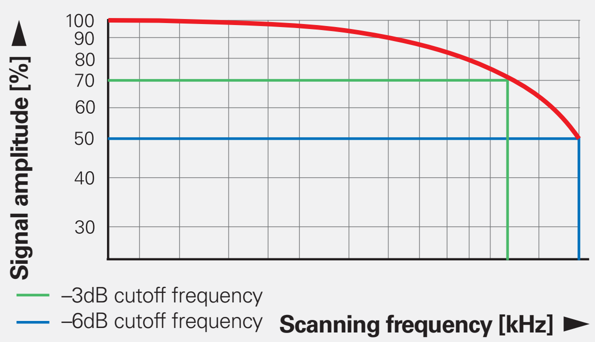
Interface	Sinusoidal voltage signals ∿ **1 V_{PP}**
Incremental signals	**2 nearly sinusoidal signals A and B** Signal amplitude M: 0.6 to 1.2 V_{PP}; typically 1 V_{PP} Asymmetry $\|P – N\|/2M$: ≤ 0.065 Signal ratio M_A/M_B: 0.8 to 1.25 Phase angle $\|\varphi 1 + \varphi 2\|/2$: 90° ± 10° elec.
Reference-mark signal	**One or several signal peaks R** Usable component G: 0.2 to 0.85 V Quiescent value H: 0.04 V to 1.7 V Signal-to-noise ratio E, F: ≥ 40 mV Zero crossovers K, L: 180° ± 90° elec.
Connecting cable Cable length Propagation time	Shielded HEIDENHAIN cable PUR [4(2 x 0.14 mm^2) + (4 x 0.5 mm^2)] max. 150 m with 90 pF/m distributed capacitance 6 ns/m

Any limited tolerances in the encoders are listed in the specifications.



A, B, R measured with oscilloscope in differential mode

Cutoff frequency
Typical signal amplitude curve with respect to the scanning frequency



Input circuitry of the subsequent electronics

Dimensioning
Operational amplifier MC 34074
Z_0 = 120 Ω
R_1 = 10 kΩ and C_1 = 100 pF
R_2 = 34.8 kΩ and C_2 = 10 pF
U_B = ± 15 V
U_1 approx. U_0

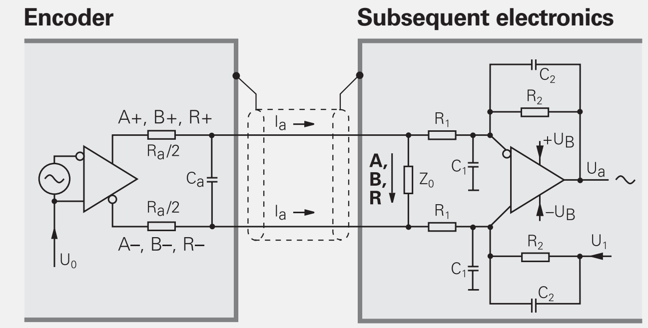
–3dB cutoff frequency of circuitry
approx. 450 kHz
Approx. 50 kHz and C_1 = 1000 pF
and C_2 = 82 pF
This variant admittedly reduces the band width of the circuit, but on the other hand improves its noise immunity.

Circuit output signals
U_a = 3.48 V_{PP} typical
Gain 3.48

Signal monitoring
A threshold sensitivity of 250 mV_{PP} is to be provided for monitoring the 1-V_{PP} incremental signals.

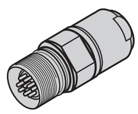
Incremental signals
Reference-mark signal

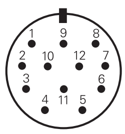
R_a < 100 Ω, typ. 24 Ω
C_a < 50 pF
ΣI_a < 1 mA
U_0 = 2.5 V ± 0.5 V
(relative to 0 V of the power supply)



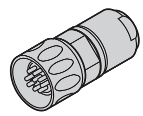
Pin layout

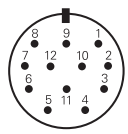
12-pin M23 coupling





12-pin M23 connector





	Power supply				Incremental signals						Other signals		
	12	**2**	**10**	**11**	**5**	**6**	**8**	**1**	**3**	**4**	**7/9**	**/**	**/**
	U_P	**Sensor** U_P	**0 V**	**Sensor** 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

Shield on housing; **U_P** = power supply voltage
Sensor: The sensor line is connected internally with the corresponding power line
Vacant pins or wires must not be used!

Incremental Signals ⊓⊔TTL

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

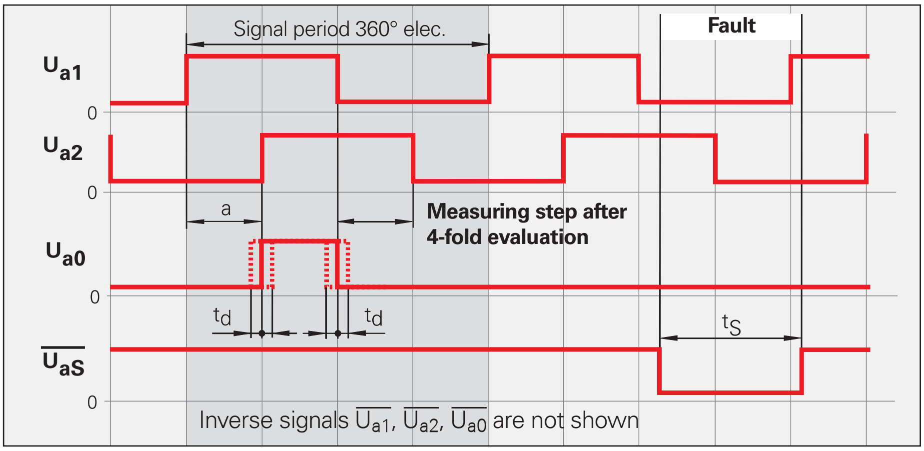
The **incremental signals** are transmitted as the square-wave pulse trains U_{a1} and U_{a2}, phase-shifted by 90° elec. The **reference mark signal** consists of one or more reference pulses U_{a0}, which are gated with the incremental signals. In addition, the integrated electronics produce their **inverse 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 for the direction of motion shown in the dimension drawing.

The **fault-detection signal** $\overline{U_{aS}}$ indicates fault conditions such as breakage of the power line or failure of the light source. It can be used for such purposes as machine shut-off during automated production.

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.**

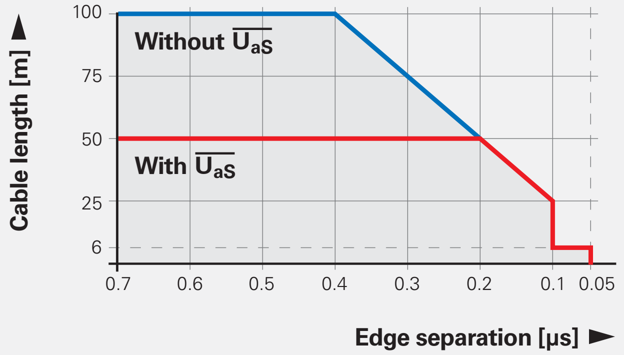
The subsequent electronics must be designed to detect each edge of the square-wave pulse. The minimum **edge separation *a*** listed in the *Specifications* applies for the illustrated input circuitry with a cable length of 1 m, and refers to a measurement at the output of the differential line receiver. Propagation-time differences in cables additionally reduce the edge separation by 0.2 ns per meter of cable length. To prevent counting error, design the subsequent electronics to process as little as 90% of the resulting edge separation. The max. permissible **shaft speed** or **traversing velocity** must never be exceeded.

Interface	Square-wave signals ⊓⊔ **TTL**
Incremental signals	**2 TTL square-wave signals U_{a1}, U_{a2}** and their inverted signals **$\overline{U_{a1}}$, $\overline{U_{a2}}$**
Reference-mark signal Pulse width Delay time	**1 or more TTL square-wave pulses U_{a0}** and their inverted pulses **$\overline{U_{a0}}$** 90° elec. (other widths available on request); *LS 323:* ungated $\lvert t_d \rvert \le 50$ ns
Fault-detection signal Pulse width	**1 TTL square-wave pulse $\overline{U_{aS}}$** Improper function: LOW (upon request: U_{a1}/U_{a2} high impedance) Proper function: HIGH $t_S \ge 20$ ms
Signal level	Differential line driver as per EIA standard RS 422 $U_H \ge 2.5$ V at $-I_H = 20$ mA $U_L \le 0.5$ V at $I_L = 20$ mA
Permissible load	$Z_0 \ge 100\ \Omega$ between associated outputs $\lvert I_L \rvert \le 20$ mA max. load per output $C_{load} \le 1000$ pF with respect to 0 V Outputs protected against short circuit to 0 V
Switching times (10% to 90%)	$t_+ / t_- \le 30$ ns (typically 10 ns) with 1 m cable and recommended input circuitry
Connecting cable Cable length Propagation time	Shielded HEIDENHAIN cable PUR [4(2 × 0.14 mm^2) + (4 × 0.5 mm^2)] Max. 100 m ($\overline{U_{aS}}$ max. 50 m) with 90 pF/m distributed capacitance 6 ns/m



The permissible **cable length** for transmission of the TTL square-wave signals to the subsequent electronics depends on the edge separation *a*. It is max. 100 m, or 50 m for the fault detection signal. This requires, however, that the power supply (see *Specifications*) be ensured at the encoder. The sensor lines can be used to measure the voltage at the encoder and, if required, correct it with an automatic system (remote sense power supply).

Permissible cable length
with respect to the edge separation

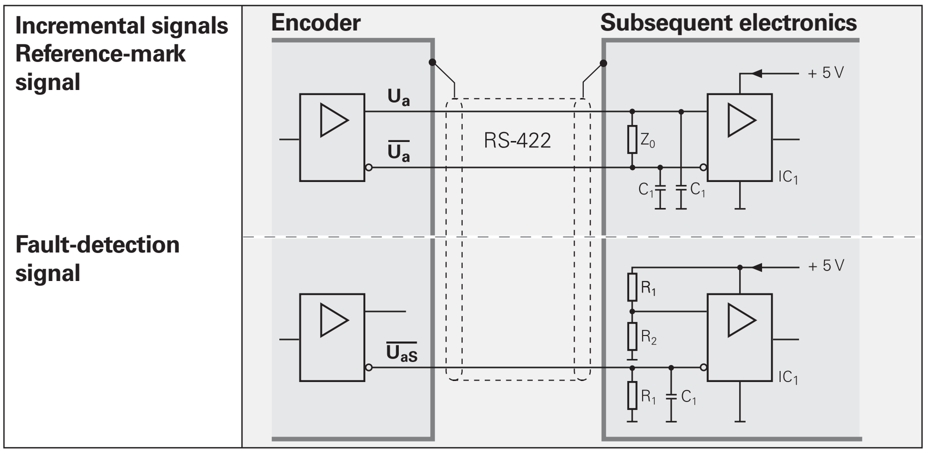


Input circuitry of the subsequent electronics

Dimensioning

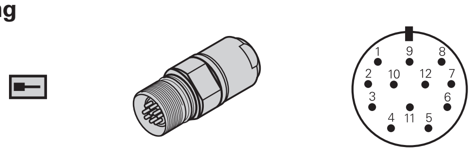
IC_1 = Recommended differential line receivers
DS 26 C 32 AT
Only for a > 0.1 µs:
AM 26 LS 32
MC 3486
SN 75 ALS 193

R_1 = 4.7 kΩ
R_2 = 1.8 kΩ
Z_0 = 120 Ω
C_1 = 220 pF (serves to improve noise immunity)

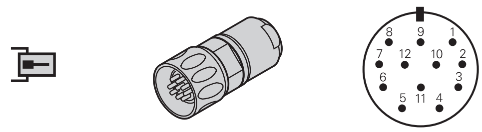


Pin layout

12-pin flange socket or M23 coupling



12-pin M23 connector



	Power supply				Incremental signals						Other signals		
	12	2	10	11	5	6	8	1	3	4	7	/	9
	U_P	Sensor U_P	0 V	Sensor 0 V	U_{a1}	$\overline{U_{a1}}$	U_{a2}	$\overline{U_{a2}}$	U_{a0}	$\overline{U_{a0}}$	$\overline{U_{aS}}$ 1)	Vacant	Vacant 2)
	Brown/ Green	Blue	White/ Green	White	Brown	Green	Gray	Pink	Red	Black	Violet	–	Yellow

Shield on housing; $\mathbf{U_P}$ = power supply voltage
Sensor: The sensor line is connected internally with the corresponding power line
1) **LS 323/ERO 14xx:** Vacant
2) **Exposed linear encoders:** Switchover TTL/11 µA$_{PP}$ for PWT
Vacant pins or wires must not be used!

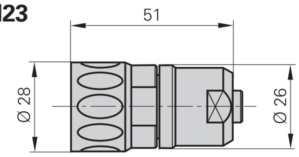
Connecting Elements and Cables

General Information

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

Symbols

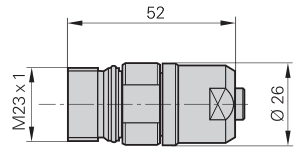
M23



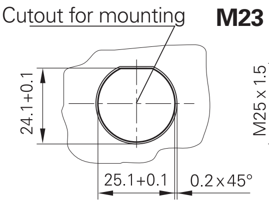
Coupling (insulated): Connecting element with external thread; available with male or female contacts.

Symbols

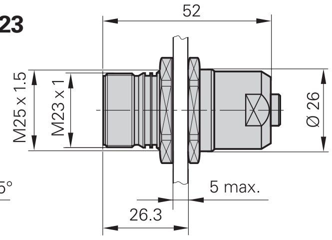
M23



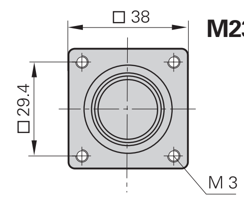
Mounted coupling with central fastening



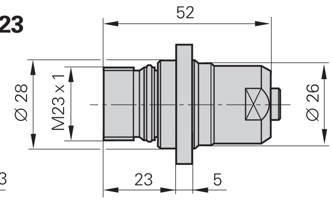
M23



Mounted coupling with flange



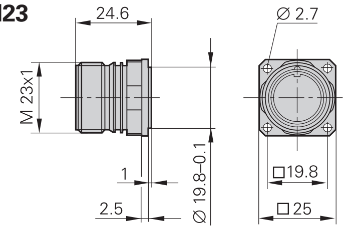
M23



Flange socket: Permanently mounted on the encoder or a housing, with external thread (like the coupling), and available with male or female contacts.

Symbols

M23



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

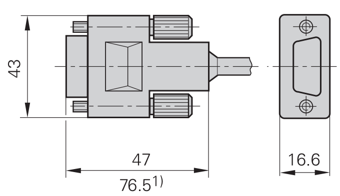
male contacts or

female contacts

When engaged, the connections provide **protection** to IP 67 (D-sub connector: IP 50; IEC 60529). When not engaged, there is no protection.

D-sub connector: For HEIDENHAIN controls, counters and IK absolute value cards.

Symbols

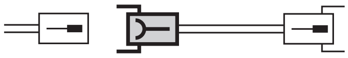
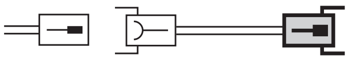
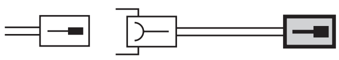
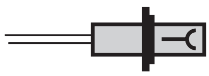
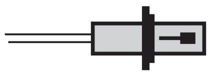
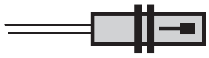


1) with integrated interpolation electronics

Accessories for flange sockets and M23 mounted couplings

Bell seal
ID 266526-01

Threaded metal dust cap
ID 219926-01

		for ∿ 1 V_{PP} ⊓⊔ TTL
PUR connecting cables **12-pin:** [4(2 × 0.14 mm^2) + (4 × 0.5 mm^2)] **Ø 8 mm**		
Complete with connector (female) and coupling (male)		298401-xx
Complete with connector (female) and connector (male)		298399-xx
Complete with connector (female) and D-sub connector (female), 15-pin, for IK 220		310199-xx
With one connector (female)		309777-xx
Cable without connectors, Ø 8 mm		244957-01
Mating element on connecting cable to connector on encoder cable	**Connector (female)** for cable Ø 8 mm 	291697-05
Connector on cable for connection to subsequent electronics	**Connector (male)** for cable Ø 8 mm Ø 6 mm 	291697-08 291697-07
Coupling on connecting cable	**Coupling (male)** for cable Ø 4.5 mm Ø 6 mm Ø 8 mm 	291698-14 291698-03 291698-04
Flange socket for mounting on the subsequent electronics	**Flange socket (female)** 	315892-08
Mounted couplings	**With flange (female)** Ø 6 mm Ø 8 mm 	291698-17 291698-07
	With flange (male) Ø 6 mm Ø 8 mm 	291698-08 291698-31
	With central fastening (male) Ø 6 mm 	291698-33

HEIDENHAIN Measuring Equipment

With modular encoders the scanning head moves over the graduation without mechanical contact. Thus, to ensure highest quality output signals, the scanning head needs to be aligned very accurately during mounting. HEIDENHAIN offers various measuring and testing equipment for checking the quality of the output signals.

The **PWM 9** is a universal measuring device for checking and adjusting HEIDENHAIN incremental encoders. There are different expansion modules available for checking the different 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
Power supply	10 to 30 V, max. 15 W
Dimensions	150 mm × 205 mm × 96 mm

The **PWT 18** is a simple adjusting aid for HEIDENHAIN incremental encoders. In a small LCD window the signals are shown as bar charts with reference to their tolerance limits.

	PWT 18
Encoder input	1 V_{PP}
Functions	Measurement of signal amplitude Wave-form tolerance Amplitude and position of the reference mark signal
Power supply	Via power supply unit (included)
Dimensions	114 mm x 64 mm x 29 mm

HEIDENHAIN

DR. JOHANNES HEIDENHAIN GmbH
Dr.-Johannes-Heidenhain-Straße 5
83301 Traunreut, Germany
☎ +49 (8669) 31-0
FAX +49 (8669) 5061
E-Mail: info@heidenhain.de

www.heidenhain.de

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