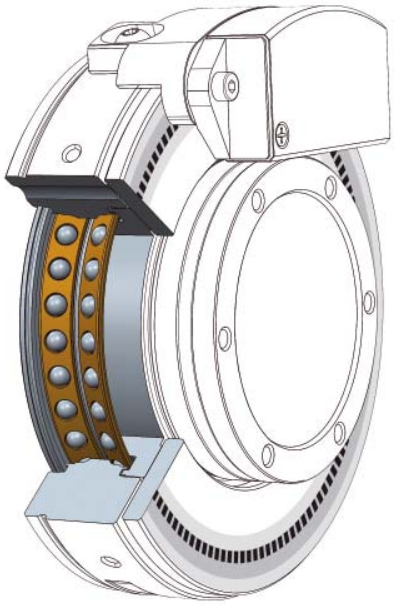
HEIDENHAIN

Angle Encoder Modules

March 2016

Design and applications

Angle encoder modules from HEIDENHAIN are combinations of angle encoders and high-precision bearings that are optimally adjusted to each other. They are characterized by their high degree of measuring and bearing accuracy, their very high resolution, and the highest degree of repeatability. The low starting torque permits smooth motions. Due to their design as completely specified and tested composite components, handling and installation is very simple.



Information on
- Angle encoders with integral bearing
- HEIDENHAIN interface electronics

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 of HEIDENHAIN Encoders* brochure, ID 1078628-xx.

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

Design and applications

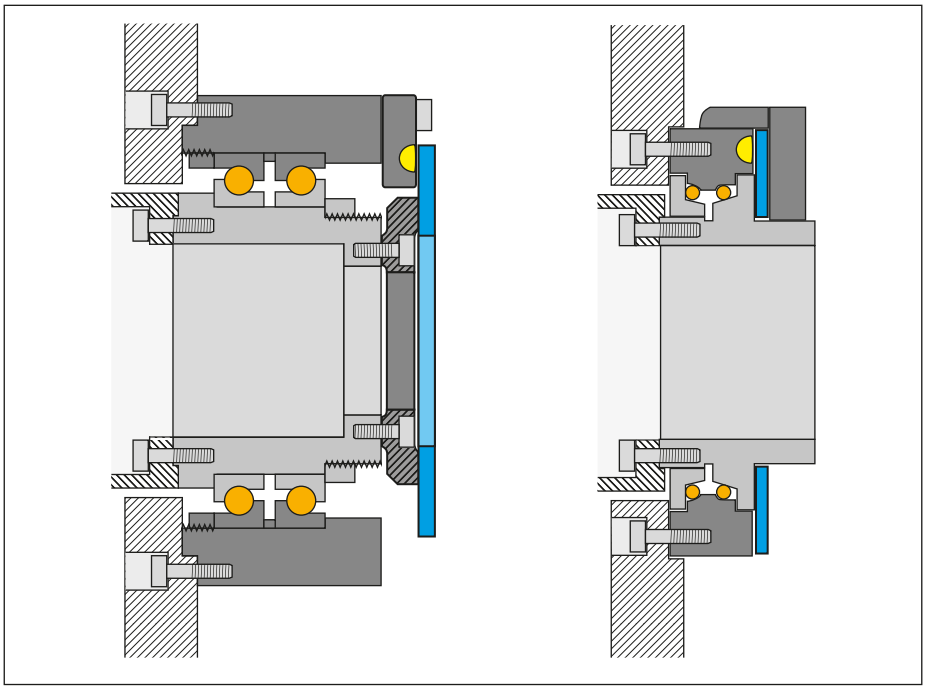
Setup
Since HEIDENHAIN manufactures the bearings as well as the encoders, the two functional assemblies are highly integrated. Fewer components are necessary than in conventional solutions, resulting in fewer joints. This permits a very compact and rigid design, with particularly low overall heights. Currently, angle encoder modules are available with hollow shafts of 10 mm, 35 mm and 100 mm.

Properties
The **rolling bearings** used are specifically adapted to the requirements of high-precision rotary axes. Distinguishing features are very high guideway accuracies, high rigidities, low starting torques, and constant continuous torques. At the same time, value was placed on compact dimensions and low mass where possible. High speeds and a high load rating are not of primary importance.

The **encoders** fulfill the requirements for metrological applications. Their most important features are very high resolution, excellent signal quality and best repeatability, even when operating temperatures vary. Incremental or absolute encoders can be used as required.

Advantages
Angle encoder modules are a combination of a bearing and an encoder. HEIDENHAIN has already completed the necessary assembly and adjustments. This means that the properties of the angle encoder modules have already been defined and tested according to the customer's specifications.

Simple mechanical interfaces eliminate all critical mounting processes. Not only does this significantly ease the installation, but it also ensures that the specified accuracy is attained in the application. The elaborate matching of all individual components to each other as well as to the machine environment is not necessary, nor is time-consuming testing.

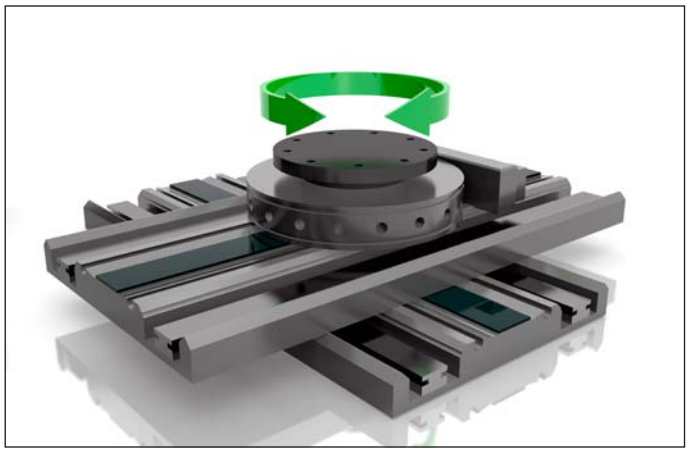


Comparison of the "conventional" setup of a precision axis
and a solution with an angle encoder module from HEIDENHAIN

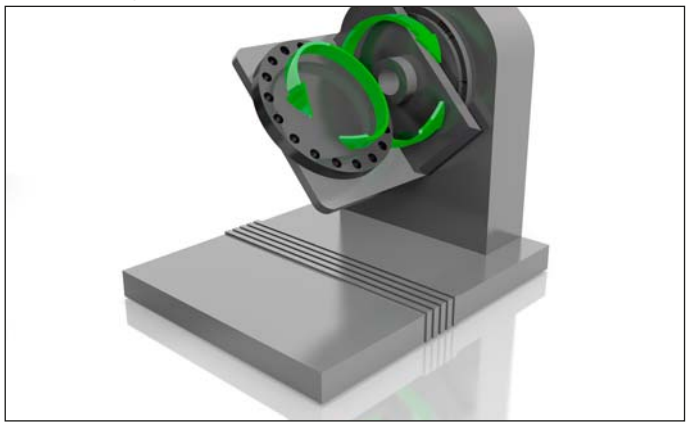
Reproducible guideway accuracy: a decisive property of the bearing
The absolute guideway accuracy of an unloaded air bearing is frequently better than that of a rolling bearing. However, in many applications the highest possible reproducible guideway accuracy of the bearing is decisive. Under this aspect, angle encoder modules from HEIDENHAIN can represent a realistic alternative to air-bearing axes. Because on the one hand, HEIDENHAIN rolling bearings feature an outstanding repeatability; on the other hand their rigidity exceeds that of comparably sized air bearings by a factor of 10. This means that they are the more exact solution for axes under load. In addition, rolling bearings are in general less sensitive to shock loads and do not require a regulated air supply—so they are more robust and simpler to handle.

Areas of application
The angle encoder modules are designed for low to medium shaft speeds and medium loads, with high to very high bearing accuracies as well as very high repeatability. They are suited to the specific requirements of metrology applications. Typical applications therefore include laser trackers for metrology, high-precision rotary tables in measuring machines, and wafer-handling machines in the electronics industry. Angle encoder modules can even be used on machine tools with small loads, such as electrical discharge machines or in laser machining.

Practical solutions
HEIDENHAIN offers custom-specific adaptation of is angle encoder modules. Preload, lubrication, pressure angle and materials can be individually adapted as needed for the specific requirements. If you would like more information, please get in touch with your HEIDENHAIN contact person.


Wafer handling


High-precision rotary tables


Compact tilting units


Laser trackers

Measuring and bearing accuracy

The accuracy of angle encoder modules from HEIDENHAIN as composite components results from the measuring accuracy of the integrated angle encoders and the bearing accuracy of the rolling bearings.

HEIDENHAIN considers the following measuring and bearing accuracies when evaluating the quality of an angle encoder module:

Measuring accuracies
The measuring accuracies of the integrated angle encoder that are most decisive for the specification of the angle encoder module are its system accuracy and repeatability.

The **system accuracy** of the angle encoder indicates the position error within one revolution. It applies to the entire range of the specified centered load.

A distinction is made between one-sided and double-sided repeatability. **One-sided repeatability** applies to any number of revolutions in which the direction is not changed while measuring. Specific points are approached multiple times, and the maximum deviation of the measured points from each other is determined. This evaluation is performed by using a reference encoder for comparison.

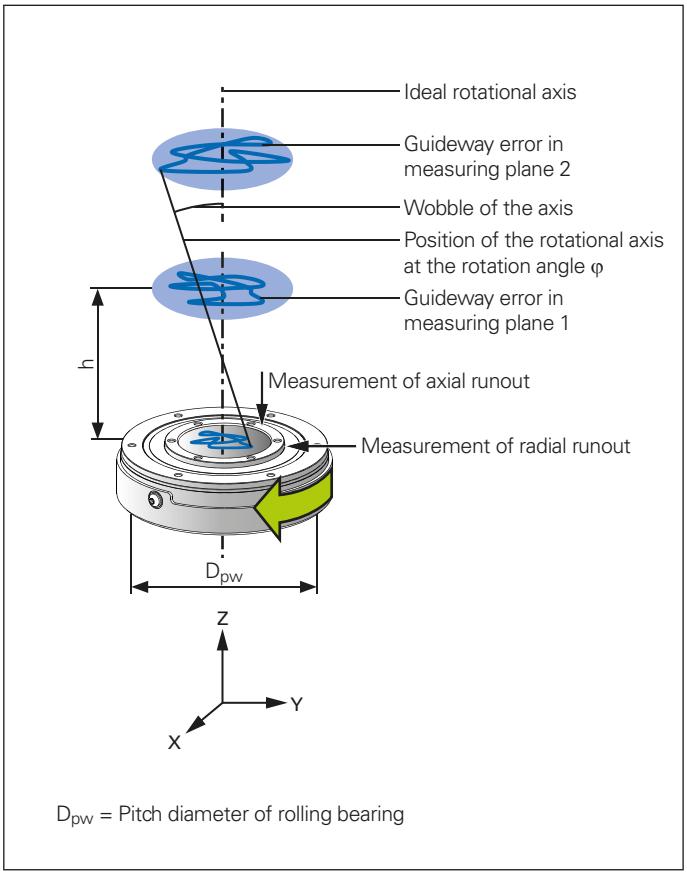
In order to determine the **double-sided repeatability** the direction of measurement is switched while measuring. The points are then each approached alternately from one side and then the other. The maximum deviation of the measured points from each other is thus determined. A reference encoder is used for positioning.

For neither specification is the absolute deviation from the reference of importance, nor is it the goal of the measurement.

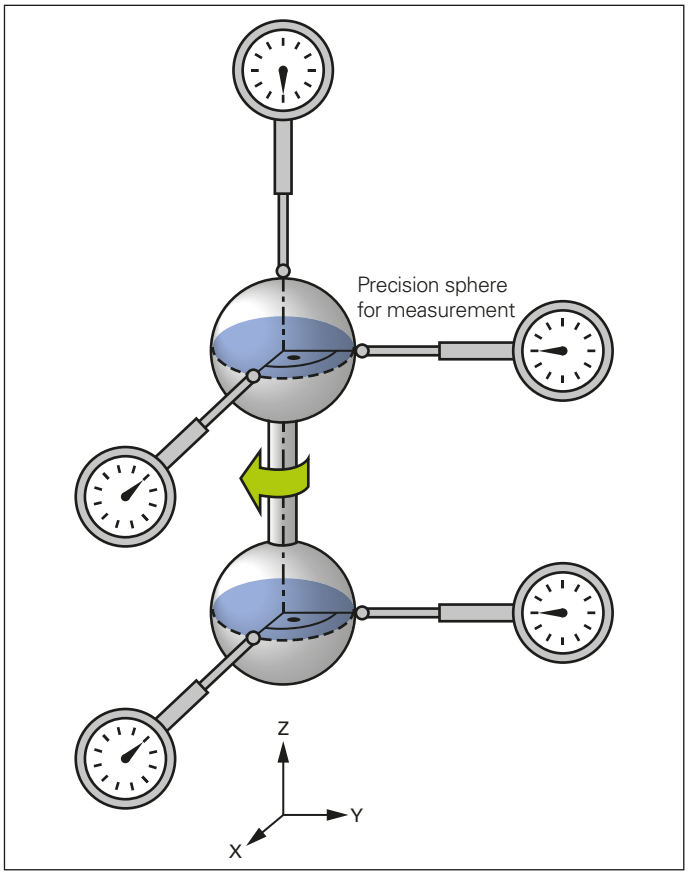
Bearing accuracies
When evaluating the bearing accuracy, the often-mentioned radial runout is not as important as the guideway accuracy of the bearing. It indicates the deviation of the actual rotational axis of the bearing from the nominal rotational axis. The radial and axial guideway accuracy of the bearing are determined, and also the wobble.

The **guideway accuracy** is measured with a calibration standard, such as a ceramic sphere with a known roundness. The center point of the sphere is positioned at a defined distance vertically above the center of the bearing raceway. This distance usually equals the pitch diameter D_{pw} of the bearing, so that the measurement can be standardized.

Two length gauges are used to measure the **radial guideway accuracy**. They are positioned at the height of the sphere center, at a 90° angle to each other. When the bearing is rotated, they measure the respective radial deviations of the sphere in the X and Y directions.

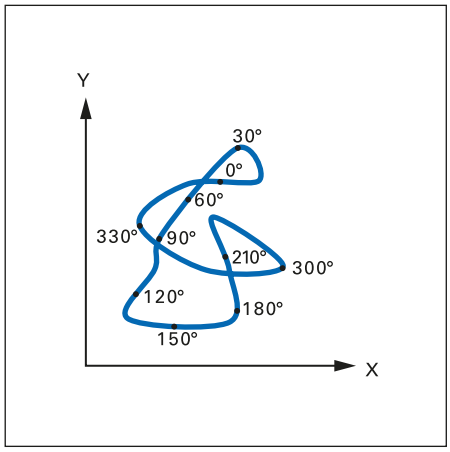


Measured variables and measuring points on a rolling bearing (schematic)

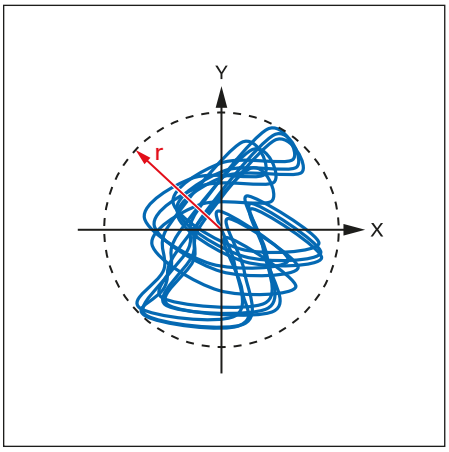


Measurement of the axial and radial guideway accuracy with five length gauges

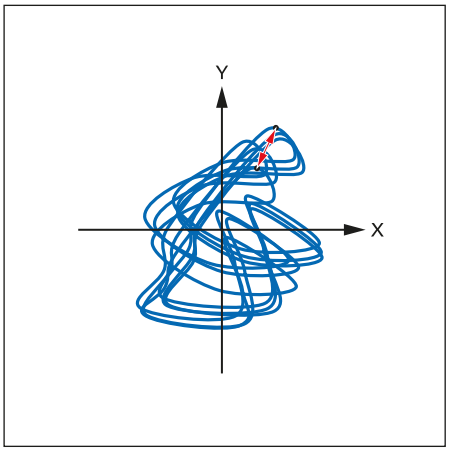
The radial guideway accuracy depends on the distance to the bearing plane. For this reason it is advisable to perform the measurement at various distances to the bearing plane. A defined number of revolutions is used for the measurements. The result is a measure of the deviation of the actual rotational axis from the nominal rotational axis for every rotation angle of the bearing. Misalignment of the sphere to the ideal bearing axis as well as inaccuracies of the sphere itself are removed from the result mathematically.
This analysis supplies values that contain repeated (reproducible) errors as well as random (non-reproducible) errors. Since these measurements are always performed with multiple revolutions, the reproducible errors can be separated from the non-reproducible errors. This permits a qualified statement regarding both components of the guideway accuracy as well as clear information, free of external influences, about the actual quality of the bearing.



The **radial deviation** in the X and Y directions depends on the bearing's angle of rotation. To illustrate the position-dependent deviations, the radial deviation can be shown in a curve.



The radius r of the smallest possible circle enclosing all curves is the **radial guideway accuracy.** The radius results from the maximum deviations of the actual rotary axis from the nominal rotary axis over six revolutions of the bearing.



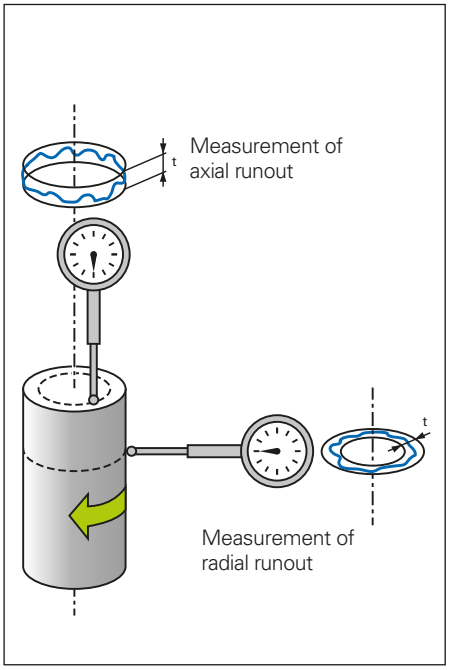
To ascertain the **non-reproducible radial guideway accuracy,** the deviation at the same angle of rotation is measured in six revolutions. The non-reproducible radial guideway accuracy equals the maximum deviation of the ascertained values.

A length gauge is centered above the sphere in order to measure the **axial guideway accuracy**. The gauge records any up and down motions of the sphere in the Z direction while the bearing rotates.

The **wobble** describes the tilt angle of the rotor axis relative to the bearing axis while the bearing rotates. The maximum value of the measurement is indicated. One possibility of determining the wobble is to measure the radial guideway accuracy in two planes.

As opposed to the guideway accuracy, the **radial runout** is the value measured by a length gauge perpendicular to a surface. The value indicated thus contains both the guideway accuracy of the bearing as well as form errors in the roundness and coaxiality of the surface being measured.

This principle also applies to the **axial runout.** It is the value measured by a length gauge perpendicular to a surface, in the axis of the object. The axial runout also contains both the guideway accuracy of the bearing as well as form errors of the surface.



Measurement of axial and radial runout

Information on bearing load

Specifications
All specifications of the bearing characteristics refer to use without additional loads. In addition, they assume that all mounting parts are dimensioned according to the dimension drawings and are manufactured of steel.

Maximum permissible loads
Two factors essentially play a role for the specifications of the maximum permissible axial, radial, and tilting load.

One important aspect is the position of the axial load. While a purely axial load (Figure 1) has no influence on system accuracy, a small influence is detected from a tilting load (Figure 2). In both cases, reproducibility is not influenced.

The other role is played by the limit values required to reach the fatigue strength. To be able to attain reliable fatigue strength, the contact stress (Hertzian contact stress on the rolling-element contact) as per DIN ISO 281 must not exceed 1500 MPa. The loads listed in the specifications are defined so that this value is not exceeded. An superimposition of the individual loads is not considered here. Also, the specified values are for a purely static load.

It is possible in many cases to exceed the specified loads. The constraints in such cases should be discussed with HEIDENHAIN in order to more closely define possible applications.

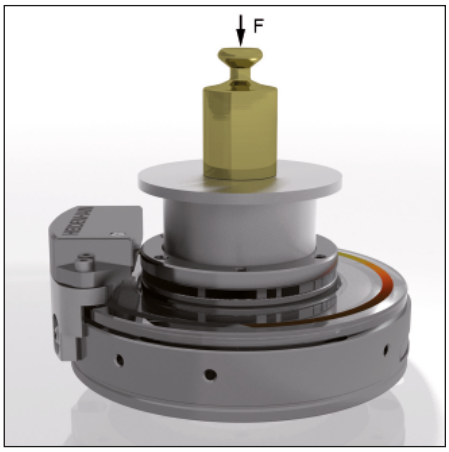


Figure 1: Axial loading at center

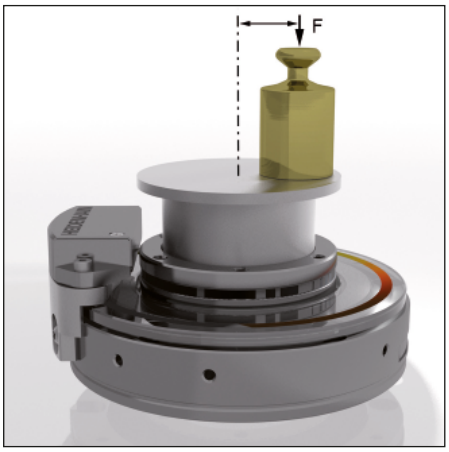
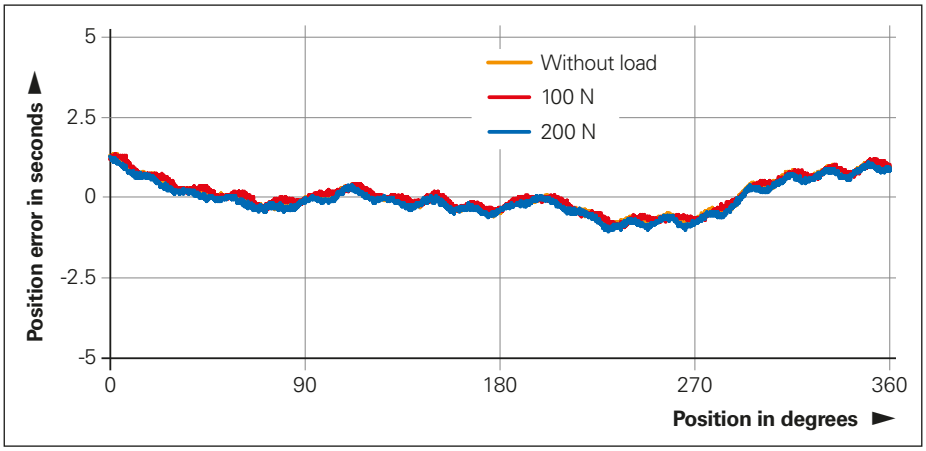
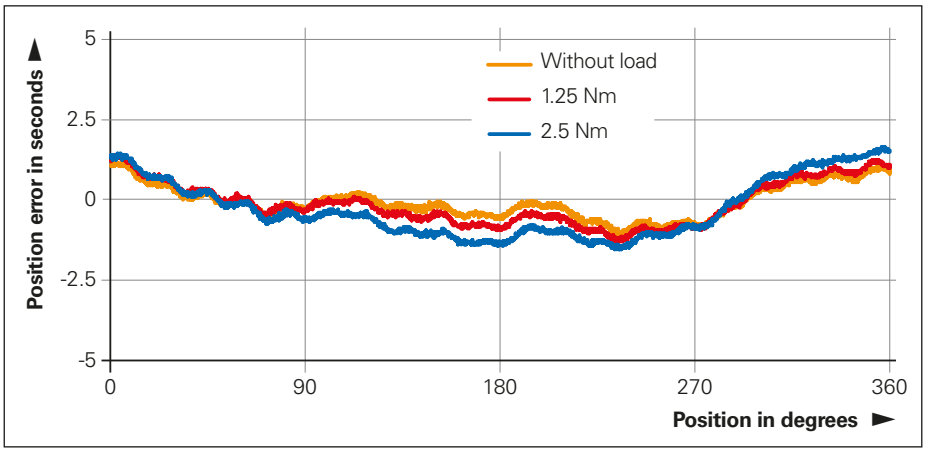


Figure 2: Tilt loading away from center



Position error from axial loading of the MRP 5080



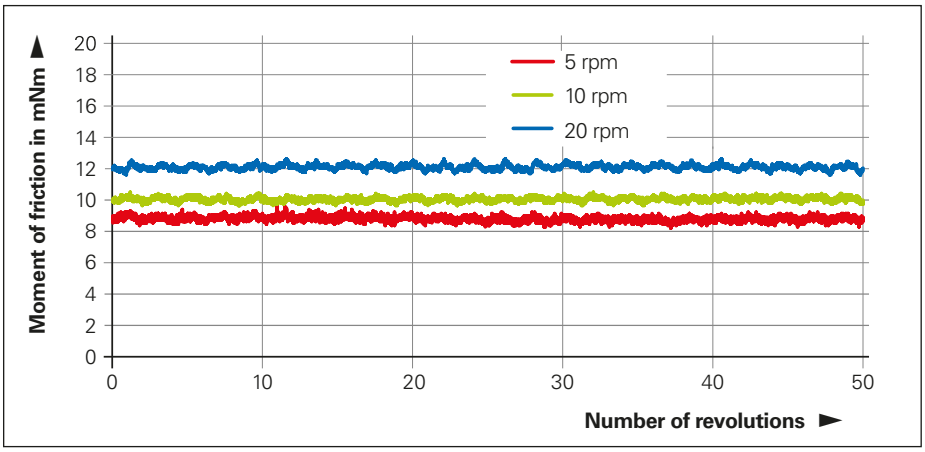
Position error from tilt loading of the MRP 5080

Information on moment of friction and lubrication

Moment of friction
Angle encoder modules from HEIDENHAIN are characterized by a constant moment of friction and low breakaway torque. All angle encoder modules are subjected after production to a run-in process. This ensures that the moment of friction remains constant over a long period. In principle, the moment of friction is always dependent on the rotational speed.

The specifications for moment of friction were measured in the ≤ 300 rpm range.

Lubrication
Lubrication of the HEIDENHAIN angle encoder modules is designed for their entire service life, so no maintenance is required. Only high-quality lubricants are used.



Speed-dependent moment of friction for the MRP 5000

Mechanical design types and mounting

The angle encoder modules comprise a finished, preloaded bearing unit with a mounted angle encoder. Proper mounting is decisive for ensuring good bearing-guideway accuracy.

Please ensure the following during installation:
- The flatness of the mounting parts
- Compliance with the specified screw torque values
- The screw tightening sequence
- The specified load direction
- The transferable torque of the respective joints

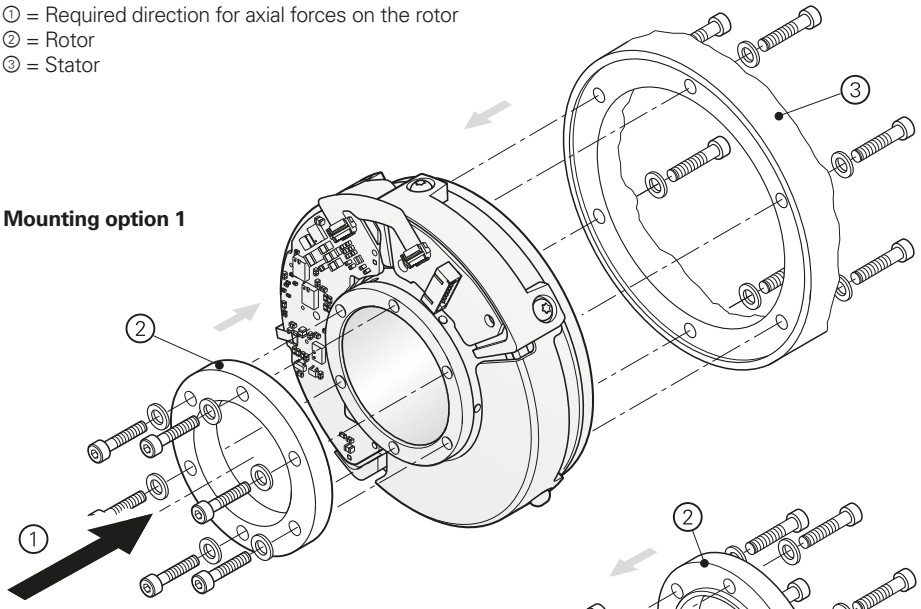
Exact alignment of the angle encoder modules is not required because the angle encoder and bearing are already ideally aligned to each other. Centering collars on the mounting parts, however, can facilitate mounting.

Angle encoder modules must not be combined or stressed with a second fixed bearing. If another support bearing is required, it must be designed as a floating bearing.

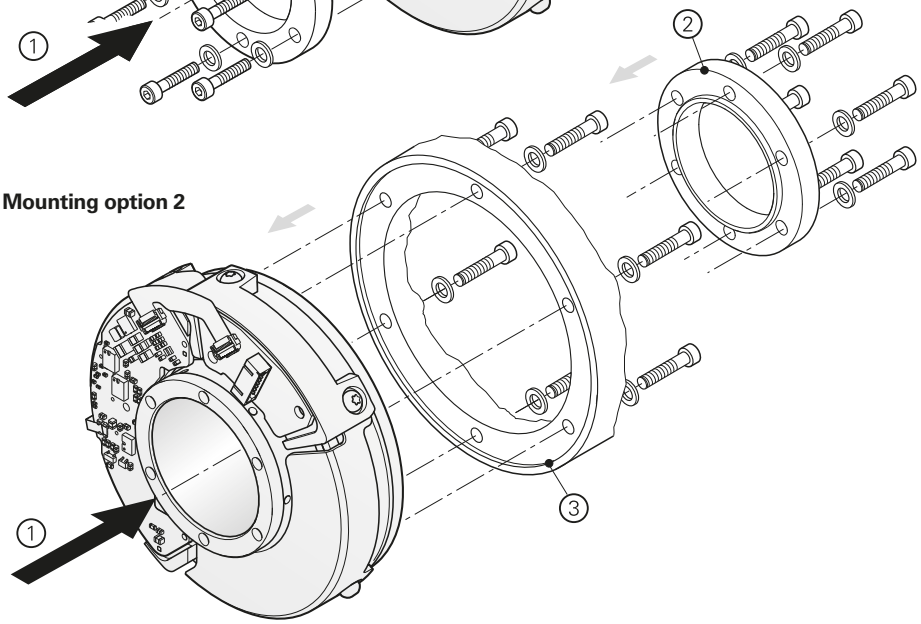
Materials for mounting
The mounting parts must be made of steel. The material must have a coefficient of thermal expansion value of α = (10 to 16) x $10^{-6}K^{-1}$. Additionally, the material must meet the following specifications:
- $R_e \geq 235$ N/mm^2
- $R_m \geq 400$ N/mm^2

① = Required direction for axial forces on the rotor
② = Rotor
③ = Stator

Mounting option 1

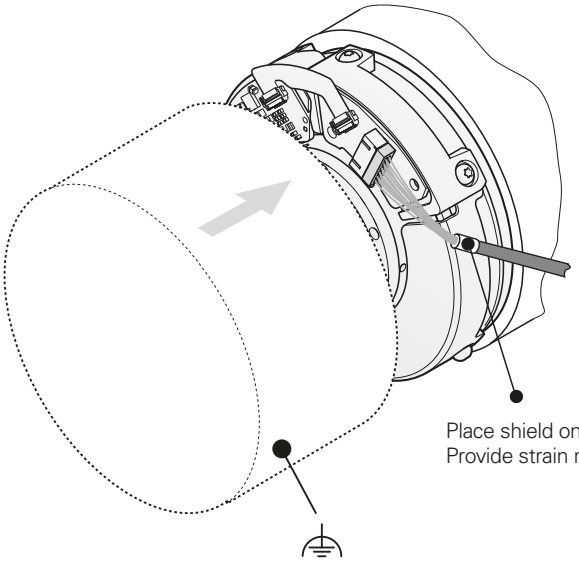


Mounting option 2



Mounting options of the MRP 5010 modules

CE compliance
The modules with the IP00 degree of protection have no CE marking. CE conformity must be ensured by the customer through a suitable protective cap and shield connection.



Place shield on the crimp sleeve.
Provide strain relief for the cable!

Calibration charts

Before shipping, HEIDENHAIN tests the function of each angle encoder module and measures its accuracy.

A Quality Inspection Certificate documents the **system accuracy**. It is ascertained through six forward and six 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.

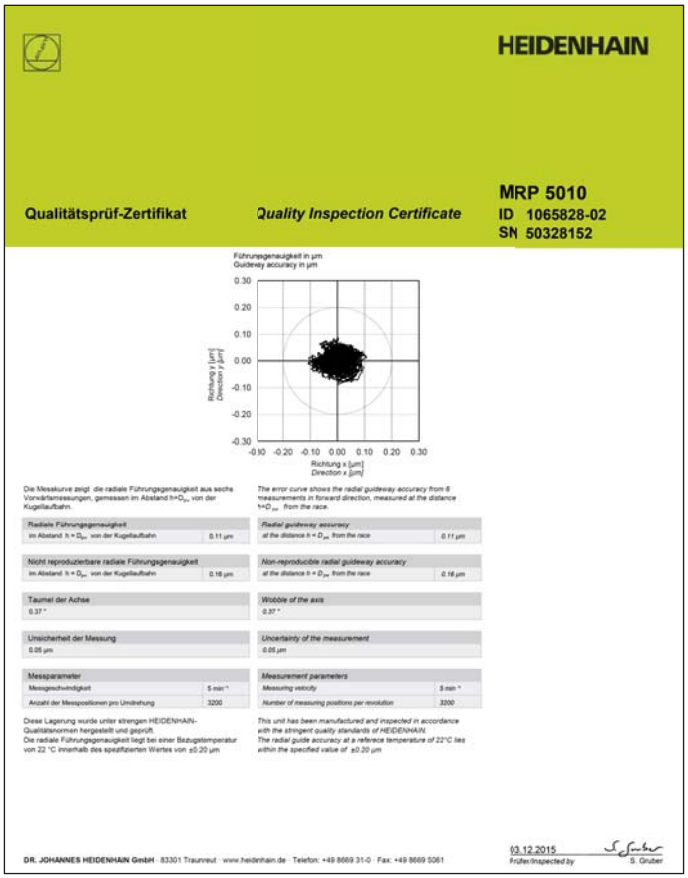
The **calibration standard** indicated in the Quality Inspection Certificate documents and guarantees traceability to recognized national and international standards.

The Quality Inspection Certificate documents the system accuracy.

An additional Quality Inspection Certificate documents the **radial guideway accuracy**. The measurement is made through six forward movements at a defined distance vertically above the bearing raceway's center.

The measurement curve shows the deviation from the actual to the ideal nominal rotary axis with respect to the bearing's angle of rotation.

The **non-reproducible radial guideway accuracy** is the maximum deviation among all measuring points at the same angular position.



The Quality Inspection Certificate documents radial guideway accuracy

MRP 2000 series

Angle encoder modules with integrated encoder and bearing

- **Very small dimensions**
- **High measuring and bearing accuracy**
- **Hollow shaft Ø 10 mm**

	Incremental **MRP 2080**	***Absolute*** **MRP 2010**
Measuring standard	DIADUR circular scale	
Signal periods	2048	
System accuracy*	±7″	
Position error per signal period	±1.5″	
Repeatability	*From both directions:* 3″	
Position noise RMS	Typically ± 0.07″	Typically ± 0.01″
Interface	∿ 1 V_{PP}	EnDat 2.2
Ordering designation	–	EnDat22
Position values/revolution	–	25 bits
Clock frequency Calculation time t_{cal}	–	≤ 16 MHz ≤ 7 µs
Reference marks	1	–
Cutoff frequency –3 dB	≥ 210 kHz	–
Electrical connection	14-pin plug connector; adapter cable with quick disconnect as accessory	12-pin
Cable length	≤ 30 m (with HEIDENHAIN cable)	
Voltage supply	DC 5 V ± 0.25 V	DC 3.6 V to 14 V
Power consumption (max.)	*5.25 V:* ≤ 950 mW	*3.6 V:* ≤ 0.6 W *14 V:* ≤ 0.7 W
Current consumption (typical)	120 mA (without load)	*5 V:* 85 mA (without load)

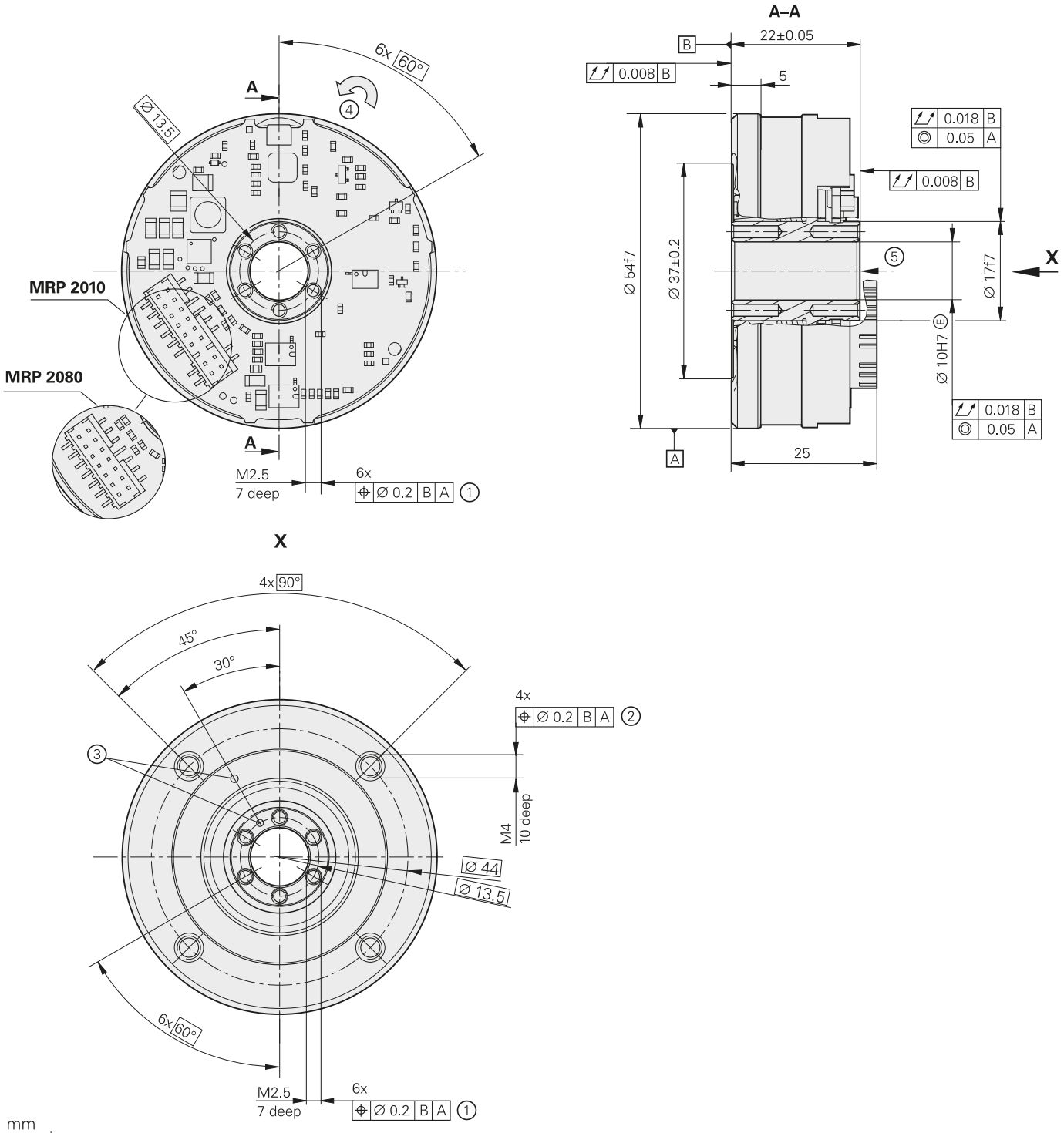
MRP 2010

MRP 2080

	Incremental **MRP 2080**	***Absolute*** **MRP 2010**
Shaft	Hollow through shaft D = 10 mm	
Max. permissible axial load[3)]	50 N (load at center)	
Max. permissible radial load[3)]	45 N	
Max. permissible tilting moment[3)]	0.8 Nm	
Contact stiffness	*Axial:* 54 N/µm *Radial:* 153 N/µm (calculated values)	
Resistance to tilt	2.16 Nm/mrad (calculated values)	
Mech. permissible speed	2000 rpm	
Moment of friction	≤ 0.020 Nm	
Starting torque	≤ 0.010 Nm	
Max. transferable shaft torque[3)]	0.3 Nm	
Moment of inertia of rotor	$3.5 \cdot 10^{-6}$ kgm^2	
Radial guideway accuracy	Measured at distance h = 52 mm from the ball race: ≤ 0.60 µm	
Non-reproducible radial guideway accuracy	Measured at distance h = 52 mm from the ball race: ≤ 0.70 µm	
Axial guideway accuracy	≤ ±0.3 µm	
Axial runout of the surface	≤ 8 µm	
Wobble of the axis	2.5″	
Vibration 55 to 2000 Hz **Shock** 6 ms	≤ 200 m/s^2 (EN 60 068-2-6) ≤ 100 m/s^2 (EN 60 068-2-27)	
Protection EN 60529[2)]	IP00[1)]	
Operating temperature **Storage temperature**	0 °C to 50 °C 0 °C to 50 °C	
Relative air humidity	≤ 75 % without condensation	
Mass	0.12 kg (without cable or connector)	

* Please select when ordering
[1)] CE compliance of the complete system must be ensured by taking the correct measures during installation
[2)] In the mounted condition
[3)] Purely static load, without additional vibration or shock load

MRP 2000 series
MRP 2010, MRP 2080

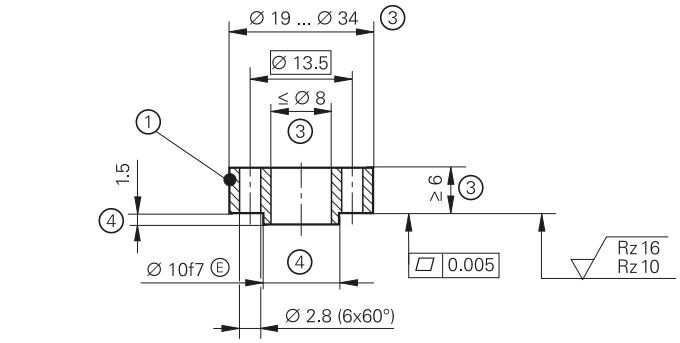


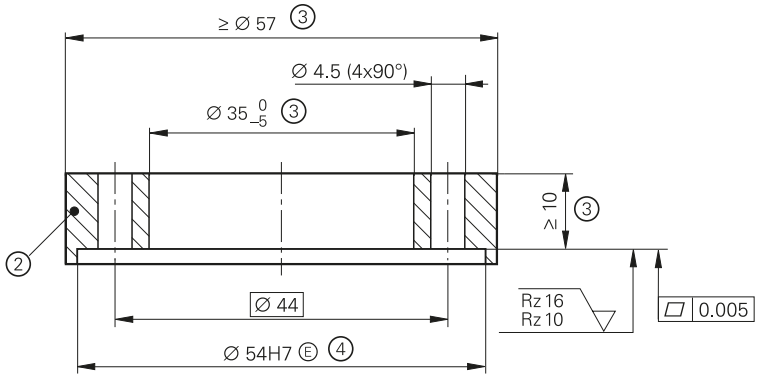
mm

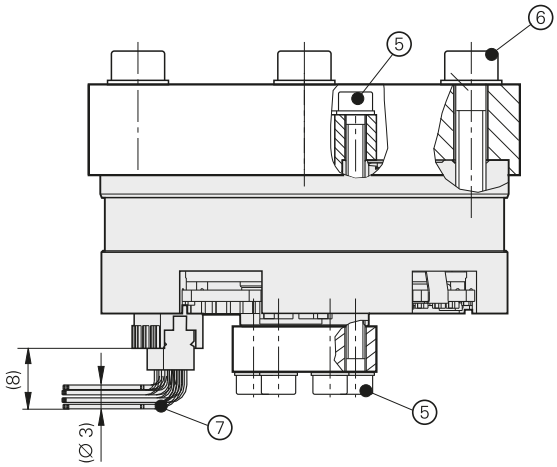
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm

① = Tightening torque values of the M2.5 – 8.8 cylinder head screws: 0.6 ±0.03 Nm
② = Tightening torque values of the M4 – 8.8 cylinder head screws: 2.5 ±0.13 Nm
③ = Mark for 0° position ±5°
④ = Direction of shaft rotation for output signals as per the interface description
⑤ = Required direction for axial forces

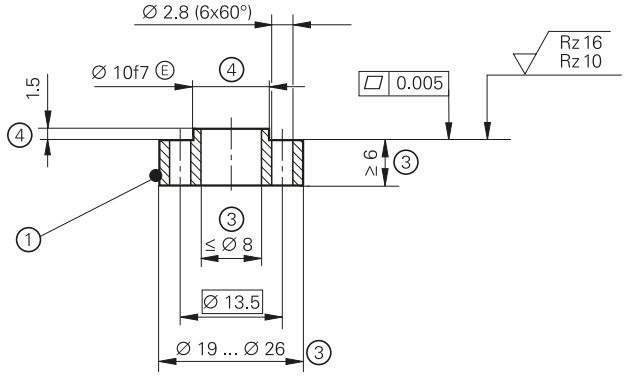
Dimensions of mounting parts







Note the information on mechanical design types and mounting.



① = Rotor
② = Stator (do not use as rotor)
③ = Required mating dimensions for transfer of maximum permissible loads as per specifications
④ = Optional recommended mating dimensions
⑤ = Screw, ISO 4762 – M2.5 – 8.8. Materially bonding threadlocker required. Washer, ISO 7092 – 2.5 – 200HV
Tightening torque 0.6±0.03 Nm
⑥ = Screw, ISO 4762 – M4 – 8.8. Materially bonding threadlocker required. Washer, ISO 7092 – 3 – 200HV
Tightening torque 2.5±0.13 Nm
⑦ = Customer is responsible for electrical shielding and connecting cable

MRP 5000 series

Angle encoder modules with integrated encoder and bearing

- **Compact dimensions**
- **High measuring and bearing accuracy**
- **Hollow shaft Ø 35 mm**

	Incremental **MRP 5080**	***Absolute*** **MRP 5010**
Measuring standard	OPTODUR circular scale	DIADUR circular scale
Signal periods	30 000	16 384
System accuracy*	±2.5″ or ±5″	
Position error per signal period	±0.23″	±0.40″
Repeatability	*From both directions:* 0.3″	*From both directions:* 0.9″
Position noise RMS	Typically ± 0.007″	Typically ± 0.020″
Interface	∿ 1 V_{PP}	EnDat 2.2
Ordering designation	–	EnDat22
Position values/revolution	–	28 bits
Clock frequency Calculation time t_{cal}	–	≤ 16 MHz ≤ 5 µs
Reference marks	80 (distance-coded)	–
Cutoff frequency –3 dB	≥ 500 kHz	–
Electrical connection	Cable 1.5 m with D-sub connector (15-pin), interface electronics integrated in the connector	15-pin plug connector; adapter cable with quick disconnect as accessory
Cable length	≤ 30 m (with HEIDENHAIN cable)	
Voltage supply	DC 5 V ± 0.25 V	DC 3.6 V to 14 V
Power consumption (max.)	*5.25 V:* ≤ 950 mW	*3.6 V:* ≤ 1.1 W *14 V:* ≤ 1.3 W
Current consumption (typical)	175 mA (without load)	*5 V:* 140 mA (without load)

MRP 5080

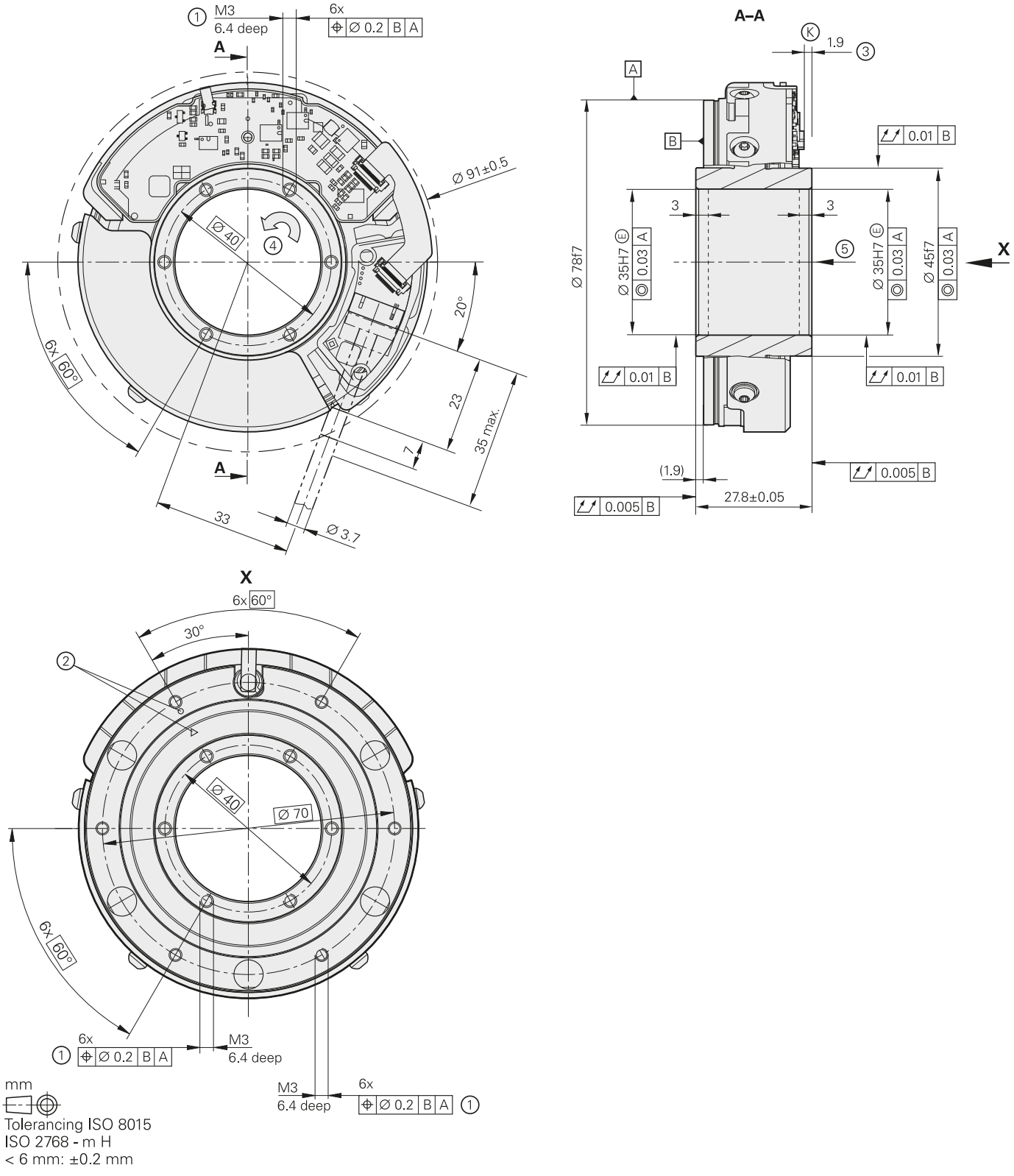
MRP 5010

	Incremental **MRP 5080**	*Absolute* **MRP 5010**
Shaft	Hollow through shaft D = 35 mm	
Max. perm. axial load[3)]	200 N (load at center)	
Max. perm. radial load[3)]	60 N	
Max. permissible tilting moment[3)]	2.5 Nm	
Contact stiffness	*Axial:* 303 N/µm *Radial:* 181 N/µm (calculated values)	
Resistance to tilt	102 Nm/mrad (calculated values)	
Mechanically perm. speed	300 rpm	
Moment of friction	≤ 0.025 Nm	
Starting torque	≤ 0.015 Nm	
Max. transferable shaft torque[3)]	2 Nm	
Moment of inertia of rotor	$0.13 \cdot 10^{-3}$ kgm^2	
Radial guideway accuracy	Measured at distance h = 55 mm: ≤ 0.20 µm (without load)	
Non-reproducible radial guideway accuracy	Measured at distance h = 55 mm: ≤ 0.35 µm (without load)	
Axial guideway accuracy	≤ ±0.2 µm	
Axial shaft runout	≤ 5 µm	
Wobble of the axis	0.7″	
Vibration 55 to 2000 Hz **Shock** 6 ms	≤ 200 m/s^2 (EN 60 068-2-6) ≤ 100 m/s^2 (EN 60 068-2-27) (without load)	
Protection EN 60529[2)]	IP20	IP00[1)] or IP40
Operating temperature **Storage temperature**	0 °C to 50 °C 0 °C to 50 °C	
Relative air humidity	≤ 75 % without condensation	
Mass	0.5 kg (without cable or connector)	

* Please select when ordering
[1)] CE compliance of the complete system must be ensured by taking the correct measures during installation
[2)] In the mounted condition
[3)] Purely static load, without additional vibration or shock load

MRP 5010
with cover

MRP 5000 series
MRP 5010

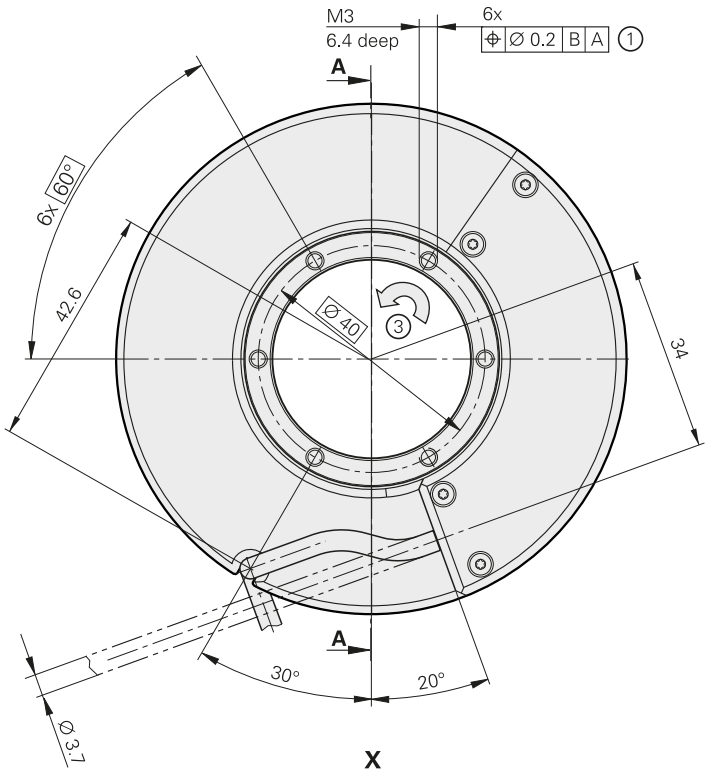


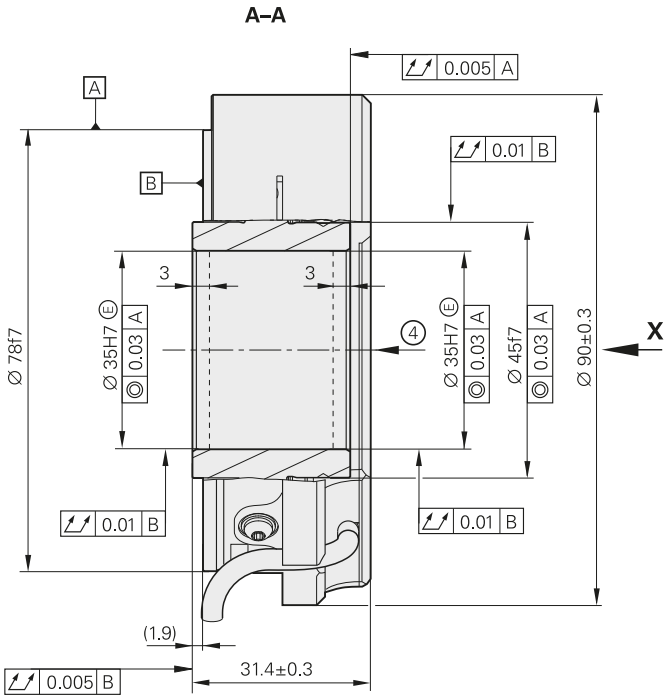
mm

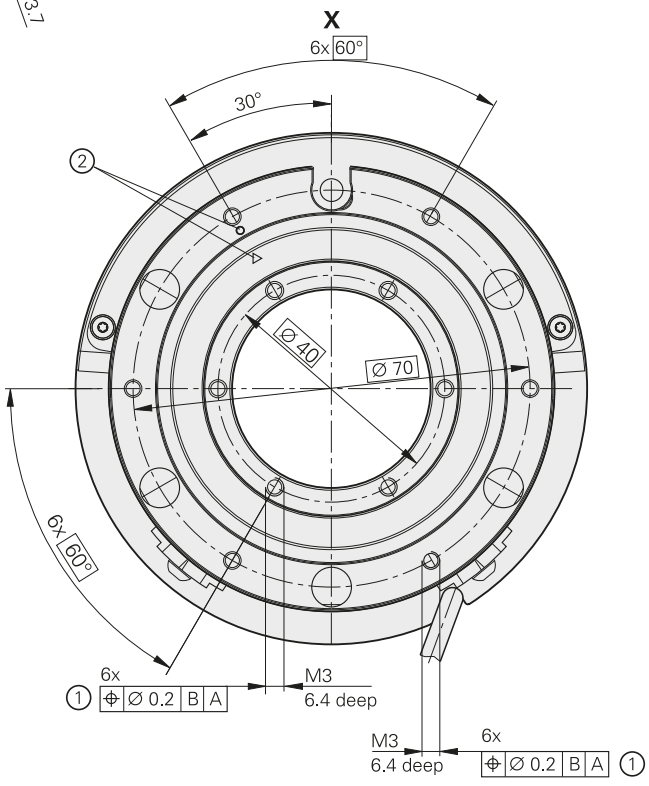
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm

K = Required mating dimensions
① = Tightening torque values of the M3 – 8.8 cylinder head screws: 1.1 ±0.05 Nm
② = Mark for 0° position ±5°
③ = Ensure distance from cover
④ = Direction of shaft rotation for output signals as per the interface description
⑤ = Required direction for axial forces

MRP 5010 with cover





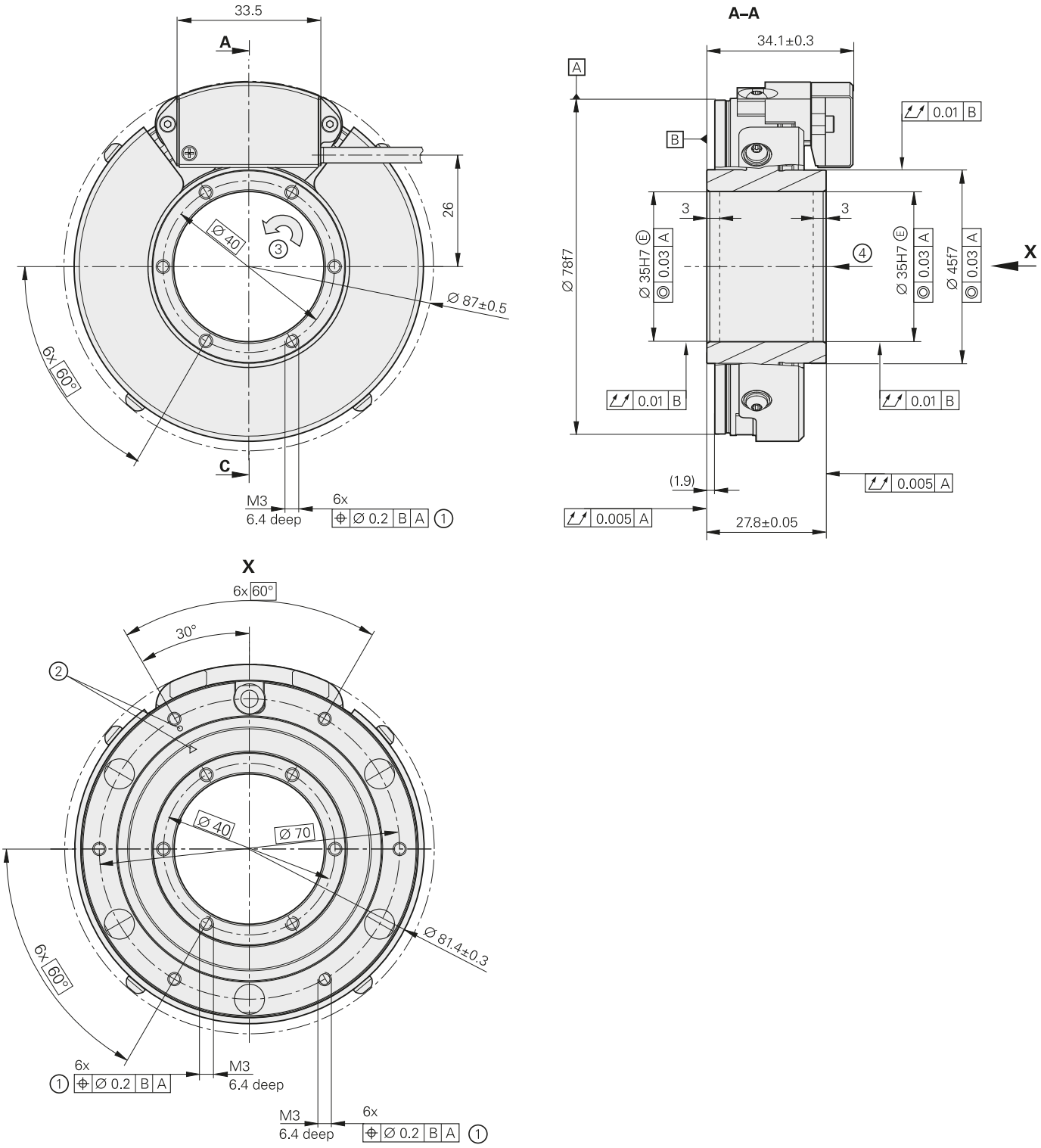


mm

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

① = Tightening torque values of the M3 – 8.8 cylinder head screws: 1.1 ±0.05 Nm
② = Mark for 0° position ±5°
③ = Direction of shaft rotation for output signals as per the interface description
④ = Required direction for axial forces

MRP 5080



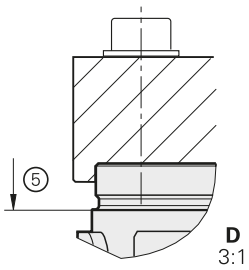
mm

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

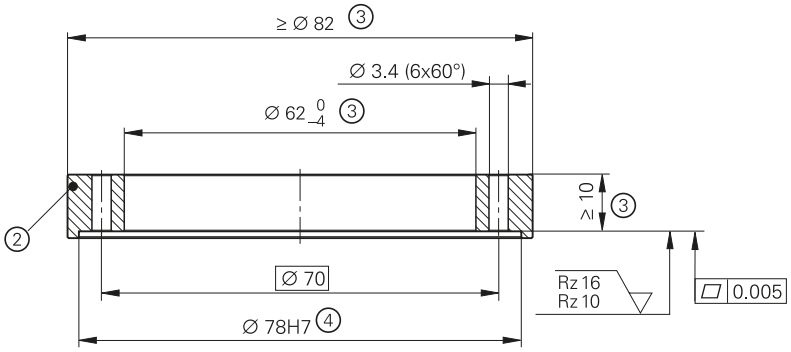
① = Tightening torque values of the M3 – 8.8 cylinder head screws: 1.1 ±0.05 Nm
② = Mark for 0° position ±5°
③ = Direction of shaft rotation for output signals as per the interface description
④ = Required direction for axial forces

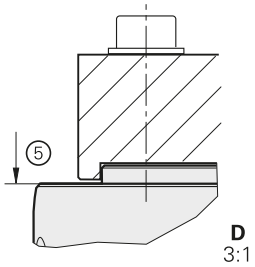
Dimensions of mounting parts

Note the information on mechanical design types and mounting.

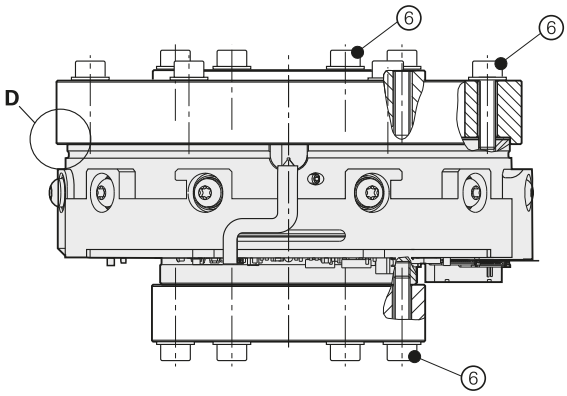


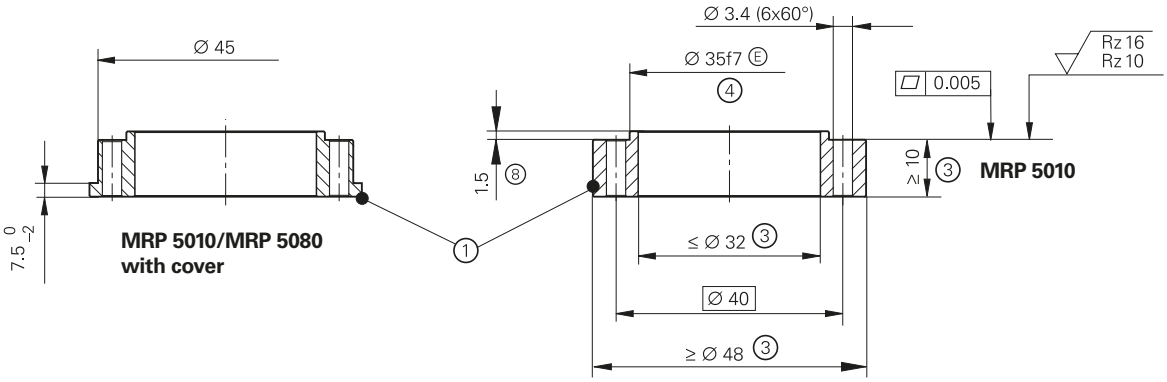
MRP 5010/MRP 5080





MRP 5010 with cover





① = Rotor
② = Stator (do not use as rotor)
③ = Required mating dimensions for transfer of maximum permissible loads as per specifications
④ = Optional recommended mating dimensions
⑤ = Do not use edge as dead stop!
⑥ = Screw, ISO 4762 – M3 – 8.8. Materially bonding threadlocker required. Washer, ISO 7092 – 3 – 200HV
Tightening torque 1.1±0.05 Nm

MRP 8000 series

Angle encoder modules with integrated encoder and bearing

- **Compact dimensions**
- **High measuring and bearing accuracy**
- **Hollow shaft Ø 100 mm**

	Incremental **MRP 8080**	***Absolute*** **MRP 8010**
Measuring standard	OPTODUR circular scale	DIADUR circular scale
Signal periods	63 000	32 768
System accuracy*	±1″ or ±2″	
Position error per signal period	±0.10″	±0.20″
Repeatability	*From both directions:* 0.2″	*From both directions:* 0.5″
Position noise RMS	Typically ± 0.003″	Typically ± 0.010″
Interface	∿ 1 V_{PP}	EnDat 2.2
Ordering designation	–	EnDat22
Position values/revolution	–	29 bits
Clock frequency Calculation time t_{cal}	–	≤ 16 MHz ≤ 5 µs
Reference marks	150 (distance-coded)	–
Cutoff frequency –3 dB	≥ 500 kHz	–
Electrical connection	Cable 1.5 m with D-sub connector (15-pin), interface electronics integrated in the connector	15-pin plug connector; adapter cable with quick disconnect as accessory
Cable length	≤ 30 m (with HEIDENHAIN cable)	
Voltage supply	DC 5 V ± 0.25 V	DC 3.6 V to 14 V
Power consumption (max.)	*5.25 V:* ≤ 950 mW	*3.6 V:* ≤ 1.1 W *14 V:* ≤ 1.3 W
Current consumption (typical)	175 mA (without load)	*5 V:* 140 mA (without load)

MRP 8080

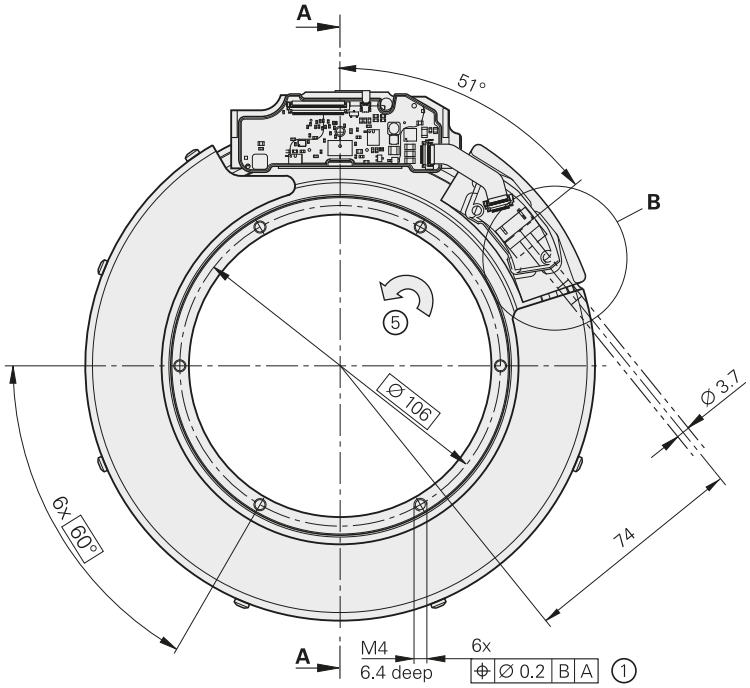
MRP 8010

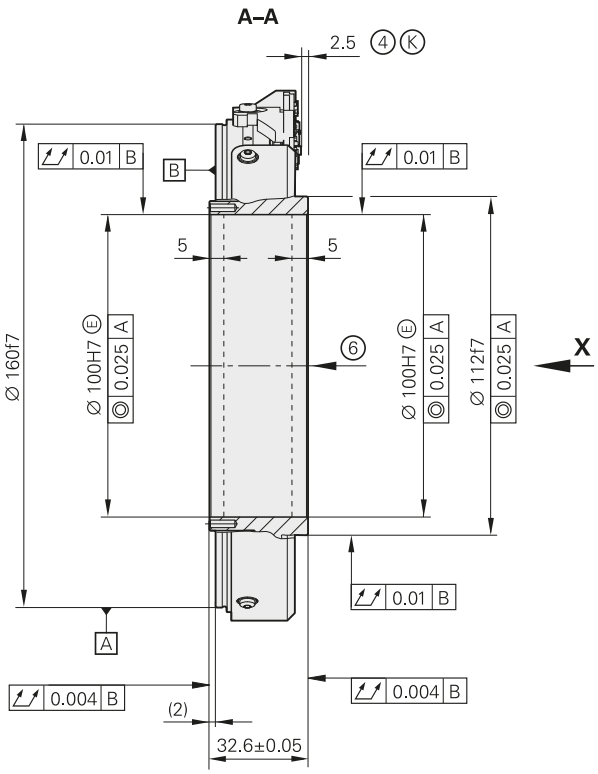
	Incremental **MRP 8080**	*Absolute* **MRP 8010**
Shaft	Hollow through shaft D = 100 mm	
Max. perm. axial load[3]	300 N (load at center)	
Max. perm. radial load[3]	100 N	
Max. perm. tilting moment[3]	6 Nm	
Contact stiffness	*Axial:* 684 N/µm *Radial:* 367 N/µm (calculated values)	
Resistance to tilt	1250 Nm/mrad (calculated values)	
Mechanically perm. speed	300 rpm	
Moment of friction	≤ 0.2 Nm	
Starting torque	≤ 0.2 Nm	
Max. transferable shaft torque[3]	10 Nm	
Moment of inertia of rotor	$2.8 \cdot 10^{-3}$ kgm^2	
Radial guideway accuracy	Measured at distance h = 124 mm: ≤ 0.15 µm	
Non-reproducible radial guideway accuracy	Measured at distance h = 124 mm: ≤ 0.20 µm	
Axial guideway accuracy	≤ ±0.15 µm	
Axial shaft runout	≤ 4 µm	
Wobble of the axis	0.5″	
Vibration 55 to 2000 Hz **Shock** 6 ms	≤ 200 m/s^2 (EN 60 068-2-6) ≤ 100 m/s^2 (EN 60 068-2-27)	
Protection EN 60529[2]	IP20	IP00[1] or IP40
Operating temperature **Storage temperature**	0 °C to 50 °C 0 °C to 50 °C	
Relative air humidity	≤ 75 % without condensation	
Mass	2.15 kg (without cable or connector)	

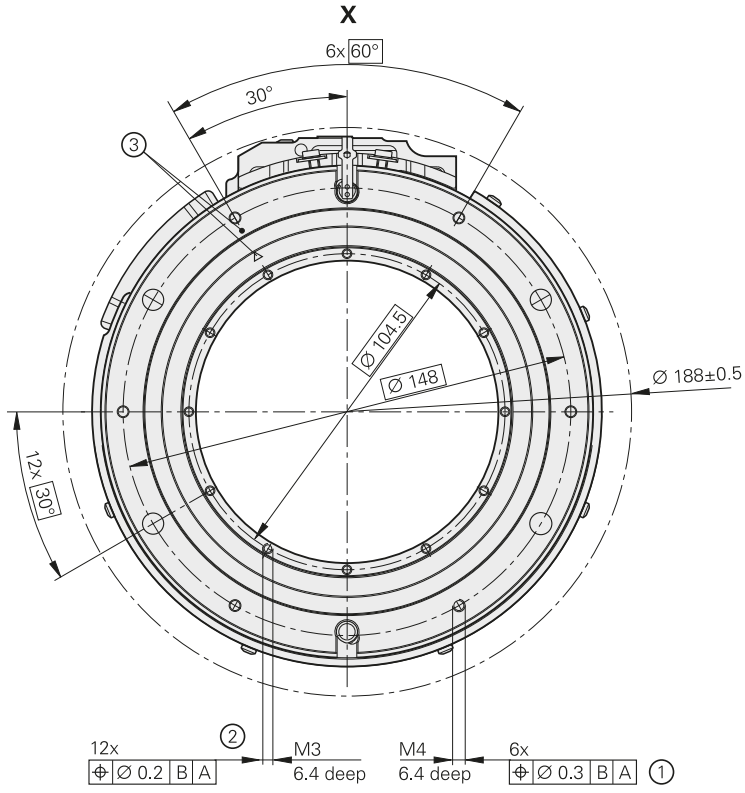
* Please select when ordering
1) CE compliance of the complete system must be ensured by taking the correct measures during installation
2) In the mounted condition
3) Purely static load, without additional vibration or shock load

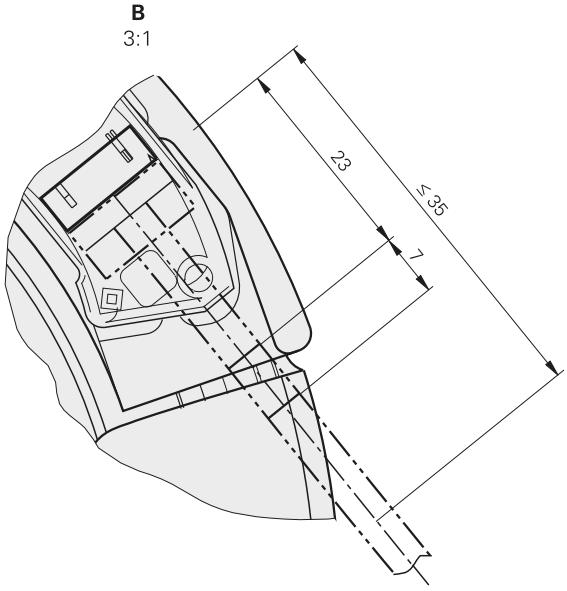
MRP 8010 with cover

MRP 8000 series
MRP 8010







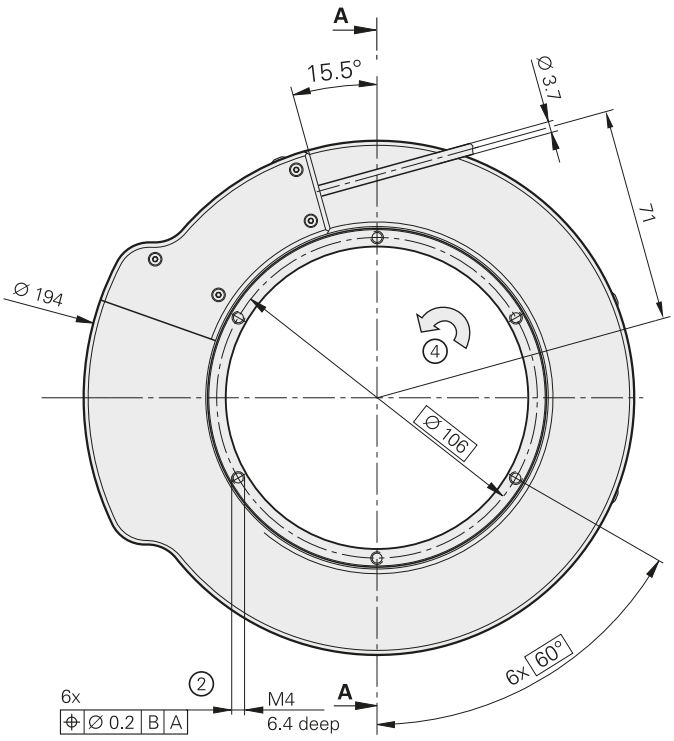


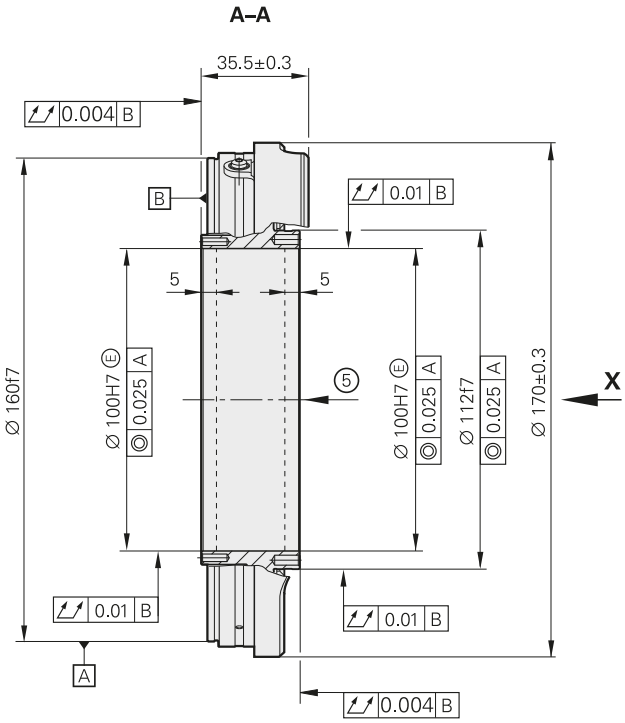
mm

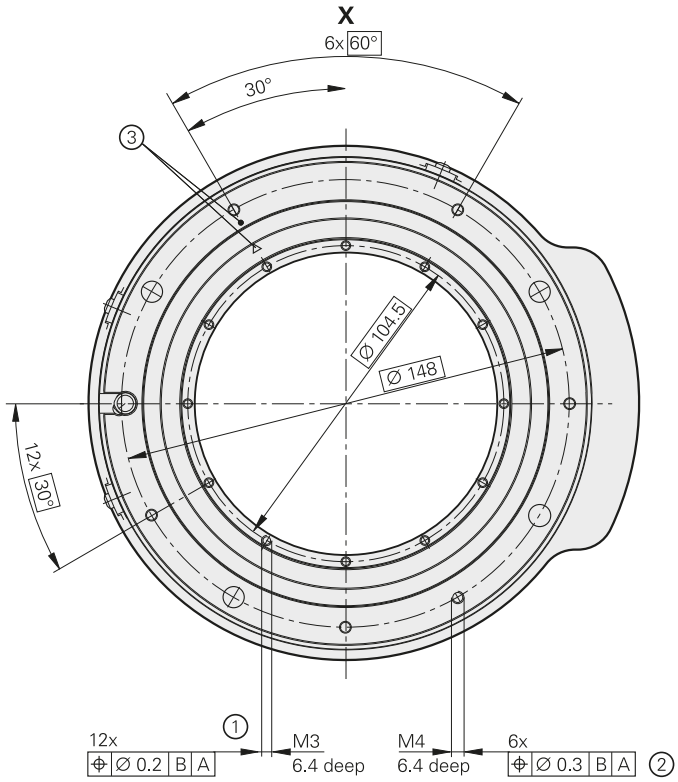
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm

K = Required mating dimensions
① = Tightening torque values of M4 – 8.8 cylinder head screws: 2.5 ± 0.13 Nm
② = Tightening torque values of M3 – 8.8 cylinder head screws the: 1.1 ± 0.05 Nm
③ = Mark for 0° position ±5°
④ = Minimum distance
⑤ = Direction of shaft rotation for output signals as per the interface description
⑥ = Required direction for axial forces

MRP 8010 with cover





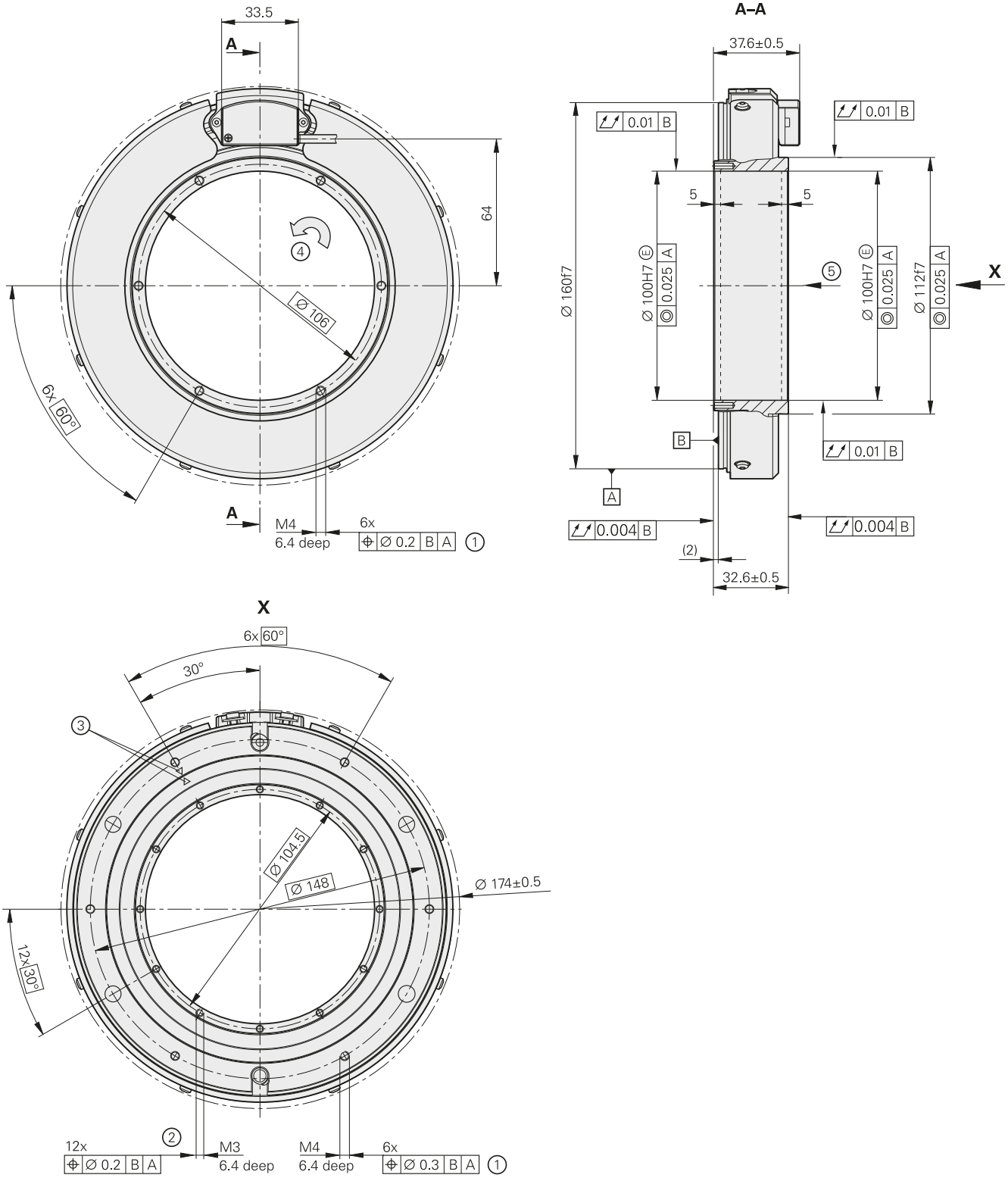


mm

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

① = Tightening torque values of the M3 – 8.8 cylinder head screws: 1.1 ±0.05 Nm
② = Tightening torque values of the M4 – 8.8 cylinder head screws: 2.5 ±0.13 Nm
③ = Mark for 0° position ±5°
④ = Direction of shaft rotation for output signals as per the interface description
⑤ = Required direction for axial forces

MRP 8080

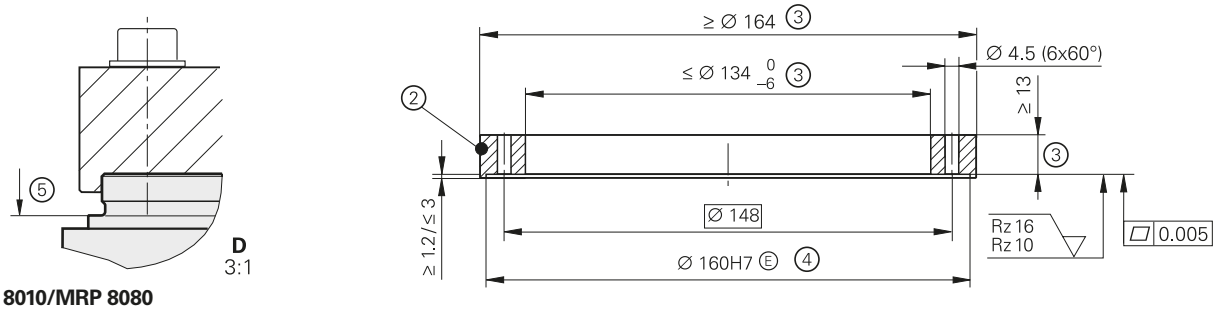


mm

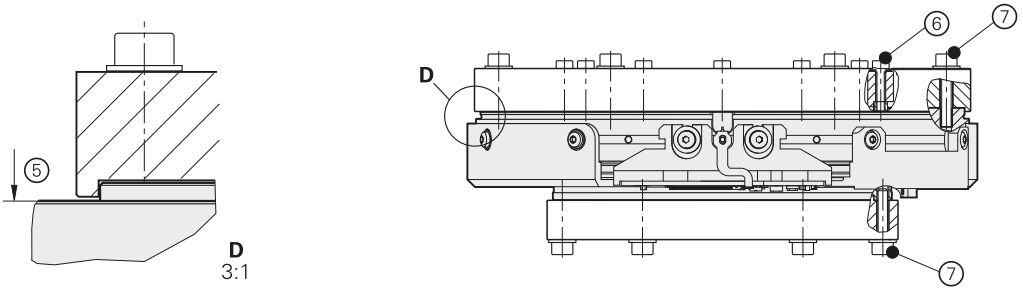
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm

① = Tightening torque values of M4 – 8.8 cylinder head screws: 2.5 ± 0.13 Nm
② = Tightening torque values of M3 – 8.8 cylinder head screws the: 1.1 ± 0.05 Nm
③ = Mark for 0° position ±5°
④ = Direction of shaft rotation for output signals as per the interface description
⑤ = Required direction for axial forces

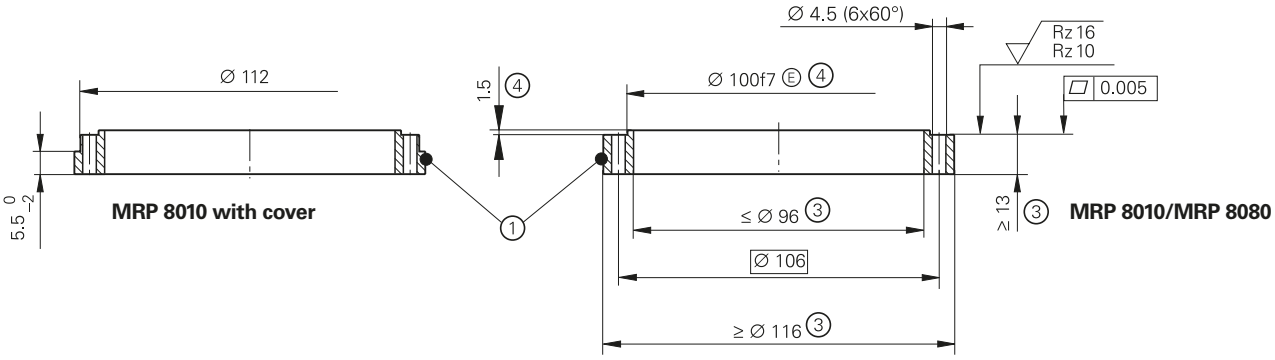
Dimensions of mounting parts



MRP 8010/MRP 8080



MRP 8010 with cover



Note the information on mechanical design types and mounting.

① = Rotor
② = Stator (do not use as rotor)
③ = Required mating dimensions for transfer of maximum permissible loads as per specifications
④ = Optional recommended mating dimensions
⑤ = Do not use edge as dead stop!
⑥ = Screw, ISO 4762 – M3 – 8.8. Materially bonding threadlocker required. Washer, ISO 7092 – 3 – 200HV
Tightening torque 1.1±0.05 Nm
⑦ = Screw, ISO 4762 – M4 – 8.8. Materially bonding threadlocker required. Washer, ISO 7092 – 4 – 200HV
Tightening torque 2.5±0.13 Nm

Interfaces

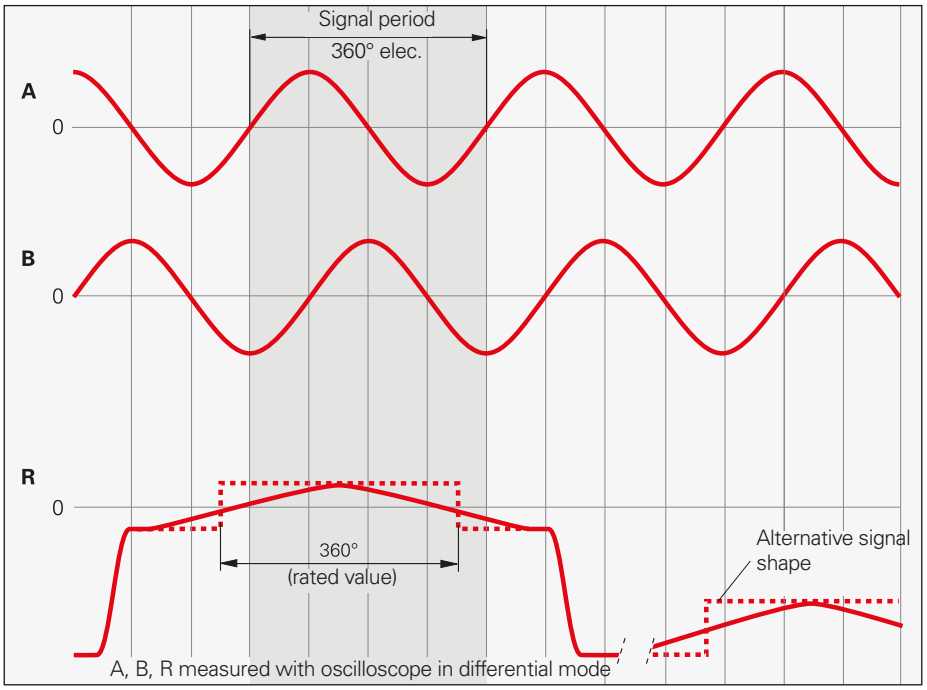
∿ 1 V_{PP} incremental signals

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 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.

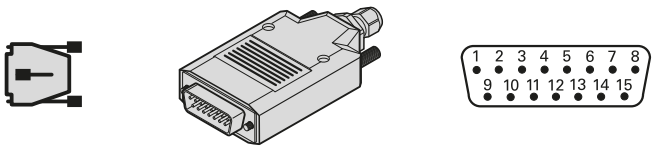
The **reference mark signal** R has an unambiguous assignment to the incremental signals. The output signal might be somewhat lower next to the reference mark.

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

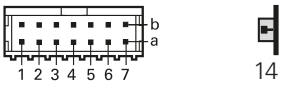


Pin layout

15-pin D-sub connector



14-pin PCB connector



	Voltage supply				Incremental signals						Other signals		
	4	**12**	**2**	**10**	**1**	**9**	**3**	**11**	**14**	**7**	**5/6/8/15**	**13**	**/**
	1b	**7a**	**5b**	**3a**	**6b**	**2a**	**3b**	**5a**	**4b**	**4a**	**/**	**/**	**/**
	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

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!

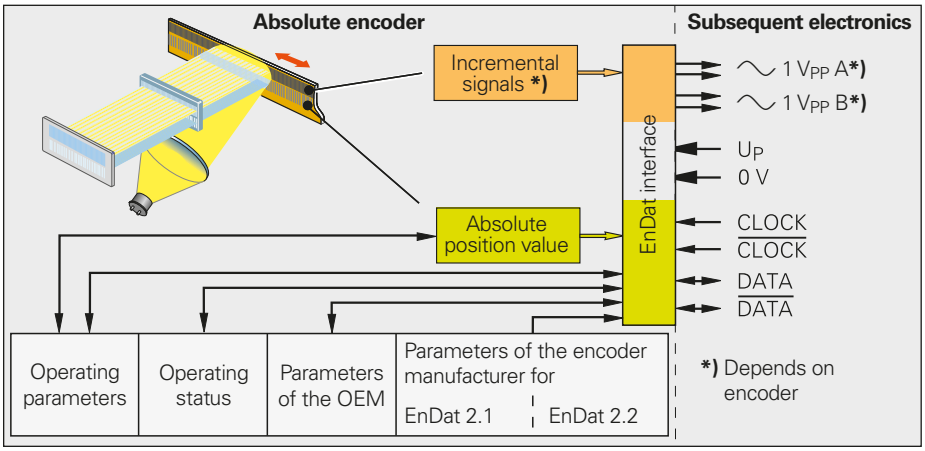
Interfaces
Position values in EnDat

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.

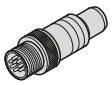
Ordering designation	Command set	Incremental signals
EnDat01	EnDat 2.1 or EnDat 2.2	With
EnDat21		Without
EnDat02	EnDat 2.2	With
EnDat22	EnDat 2.2	Without

Versions of the EnDat interface

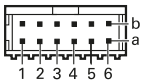


Pin layout

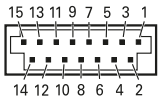
8-pin coupling or flange socket M12



12-pin PCB connector



15-pin PCB connector



	Voltage supply				Position values			
M12	**8**	**2**	**5**	**1**	**3**	**4**	**7**	**6**
12	**1b**	**6a**	**4b**	**3a**	**6b**	**1a**	**2b**	**5a**
15	**13**	**11**	**14**	**12**	**7**	**8**	**9**	**10**
	UP	**Sensor** UP	**0 V**	**Sensor** 0 V	**DATA**	**$\overline{\text{DATA}}$**	**CLOCK**	**$\overline{\text{CLOCK}}$**
	Brown/Green	Blue	White/Green	White	Gray	Pink	Violet	Yellow

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

Cables

1 V_{PP} cable

PUR encoder cable Ø 3.7 mm [6(2 × 0.05 mm²)]			
Complete With 14-pin PCB connector and 15-pin D-sub connector (female)		1160480-xx	
PUR connecting cable [6(2 x 0.19 mm²)] A_P = 0.19 mm²			
PUR connecting cable [4(2 x 0.14 mm²) + (4 x 0.5 mm²)] A_P = 0.5 mm²		Ø 8 mm	Ø 6 mm[1]
Complete With D-sub connector (female, 15-pin) and M23 connector (male, 12-pin)		331693-xx	355215-xx
With one connector With D-sub connector (female, 15-pin)		332433-xx	355209-xx
Complete With D-sub connector (female) and D-sub connector (male), 15-pin		335074-xx	355186-xx
Cable only		816317-xx	816323-xx

[1] Cable length for Ø 6 mm: max. 9 m A_P: Cross section of power supply lines

EnDat cables

PUR encoder cable Ø 3.7 mm [(4 × 0.06 mm²) + 4 × 0.06 mm²]		
Complete With 15-pin PCB connector and 8-pin M12 coupling (male)		1137151-xx
Complete With 12-pin PCB connector and 8-pin M12 coupling (male)		1129083-xx
PUR connecting cable Ø 6 mm [(4 × 0.14 mm²) + (4 × 0.34 mm²)]; A_P = 0.34 mm²		
Complete With M12 connector (female) and M12 coupling (male), 8 pins each		368330-xx
With one connector With 8-pin M12 connector (female)		634265-xx

A_P: Cross section of power supply lines Ø: Cable diameter

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