RE16 / RM16
Super Small Incremental and Absolute Encoders

SUPER SMALL SIZE

HIGH OPERATING SPEED

HIGH ACCURACY

The RE16 and RM16 are compact, sealed, miniature, high speed rotary magnetic encoders designed for use in space-constrained applications. The encoder body is only 16 mm in diameter in an aluminium housing.

Features and benefits

- Super small size – 16 mm diameter body
- 5 V power supply versions
- High speed operation up to 30,000 rpm
- Industry standard incremental, SSI and linear voltage output formats
- Accuracy ±0.3°
- RoHS compliant

INDUSTRIAL AUTOMATION | MEDICAL | PACKAGING | TEXTILES | AGRICULTURE

General information

The rotation of the magnetic actuator is read and processed by a custom encoder chip within the body to provide incremental, SSI or linear voltage outputs. The encoder chips process the received signals with up to 12 bit resolution (4,096 counts per revolution) at high operating speeds.
Designed for direct integration into high-volume OEM applications, the RE16/RM16 encoders can be used in a wide range of applications, including motor control and industrial automation.

RE16 encoder

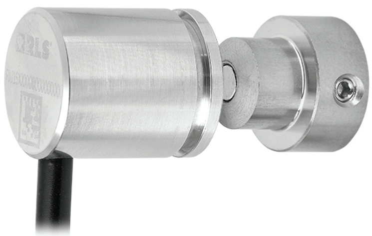
RM16 encoder

Encoder body

+

Actuator

=



Encoder system

Product range

RE16/RM16 I

Incremental with 8 to 1,024 pulses per revolution (32 to 4,096 counts per revolution).

RE16/RM16 S

Absolute with synchro serial interface (SSI) with 5 to 12 bit resolution (32 to 4,096 positions per revolution).

RE16/RM16 V

Linear voltage output with ramp from 0 V to 5 V.

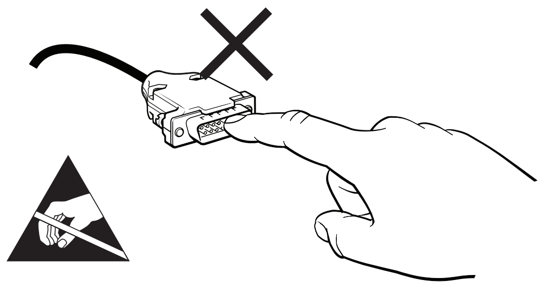
Storage and handling

Operating and storage temperature

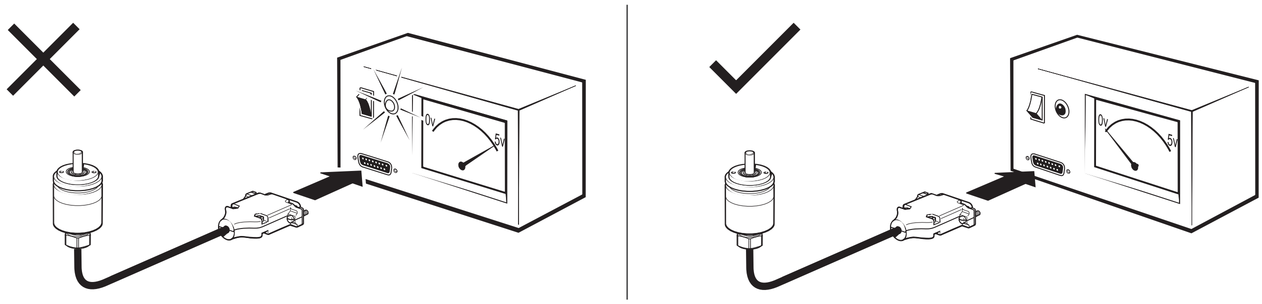
RE16: –30 °C to +125 °C
RM16: –40 °C to +125 °C

Humidity

RE16: IP67 on electronic, IP40 on mechanic side
RM16: IP67



The RE16/RM16 encoders must be powered from a DC SELV supply that meets the basic requirements of EN (IEC) 60950 or similar specification.



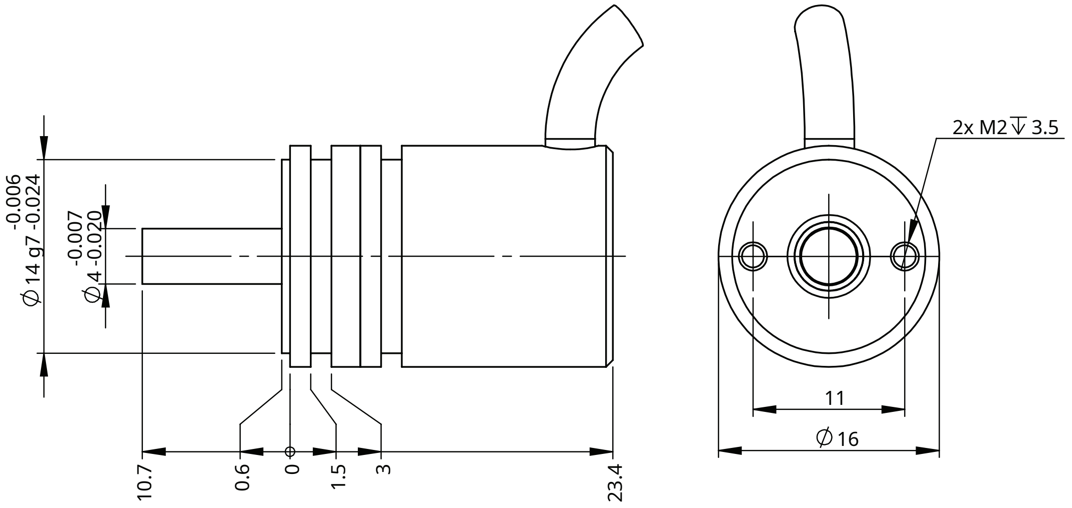
Packaging

Each encoder is packed in antistatic bag.

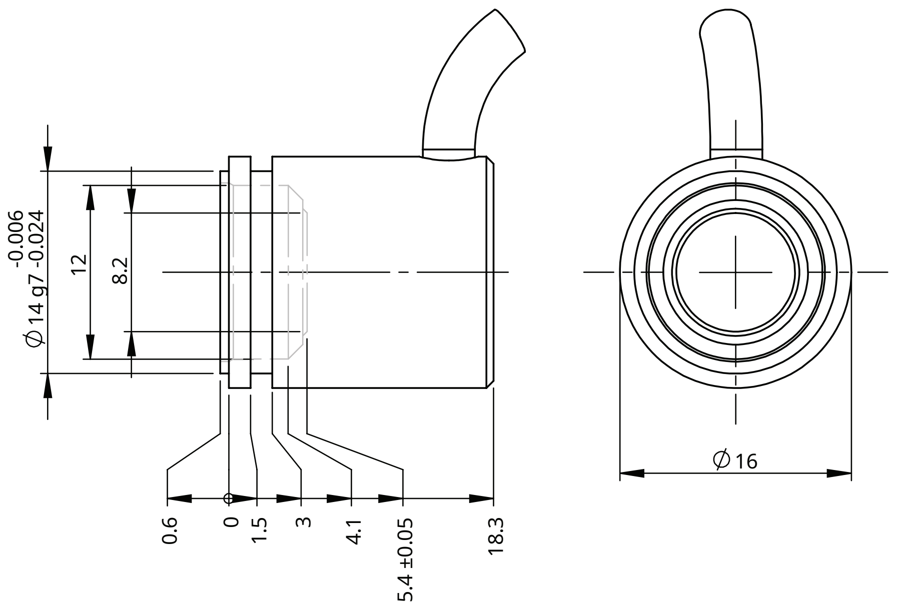
Dimensions

Dimensions and tolerances are in mm.

RE16



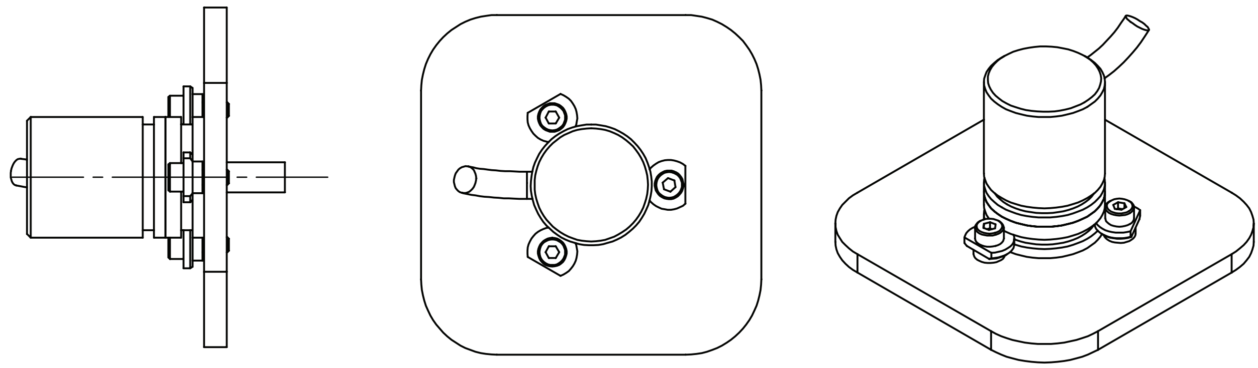
RM16

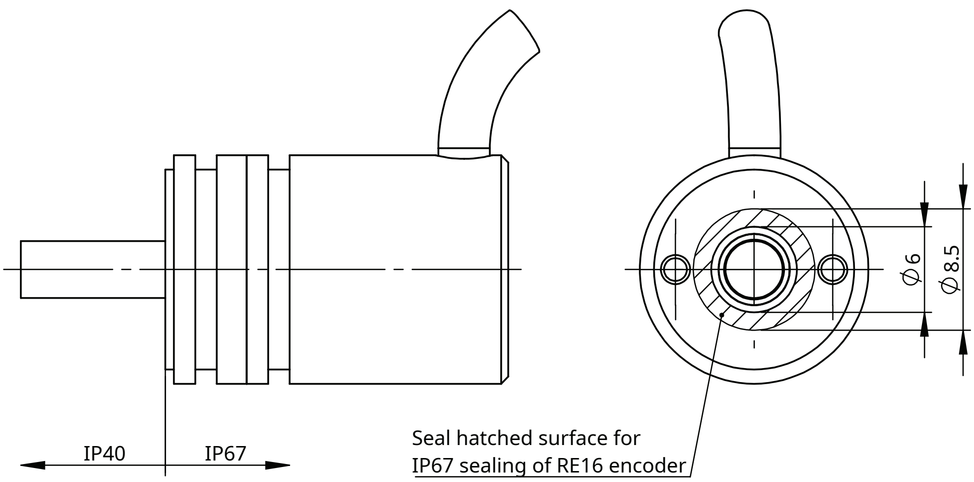


Installation drawings

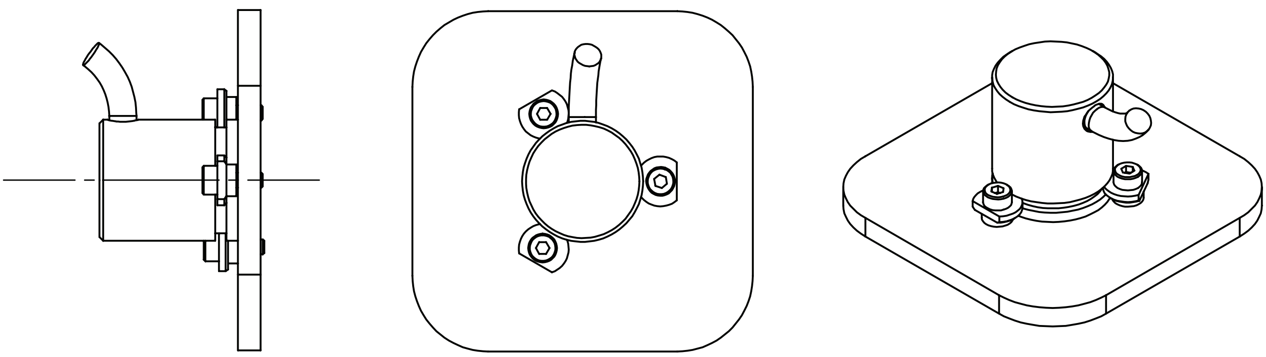
Dimensions and tolerances are in mm.

RE16

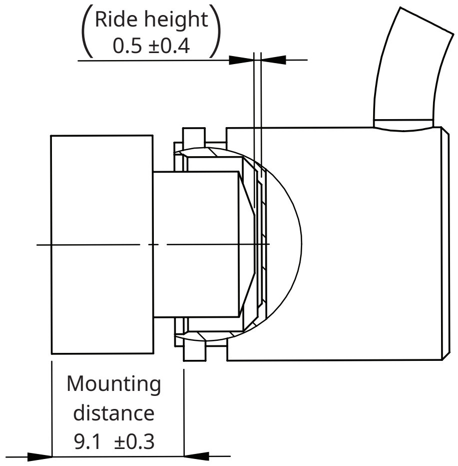




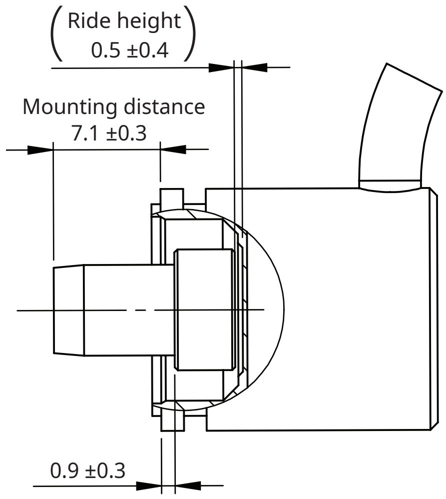
RM16



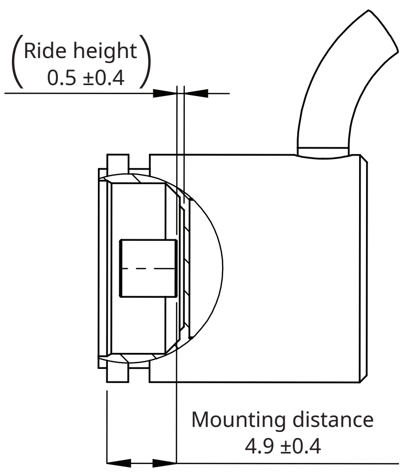
RM16 with RMA actuator



RM16 with RMH06 actuator

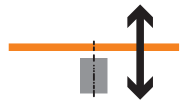
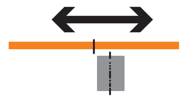
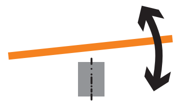


RM16 with RMM44Axx00 magnet



Installation tolerances

Installation tolerances for RM16

Mounting distance	See installation drawings of encoder assemblies on **page 6.**	
Radial displacement (concentricity)	±0.3 mm	
Perpendicularity	±0.3°	

- Encoder   - Magnet

Technical specifications

System data

Accuracy	RE16: ±0.3° RM16: ±0.5°
Hysteresis	0.17°
Temperature drift error	0.005°/°C

Mechanical data

Housing material	Aluminium
Mass	RE16: 33 g (with 1 m cable) RM16: 28 g (with 1 m cable)
Wire thickness	AWG28
Maximum speed	30,000 rpm
Maximum cable length	10 m
Maximum radial load	10 N (RE16)
Maximum axial load	20 N (RE16)

Environmental data

Operating and storage temperature	RE16: –30 °C to +125 °C RM16: –40 °C to +125 °C
Environmental sealing	RE16: IP67 on electronic, IP40 on mechanic side RM16: IP67
Shock	100 G (6 ms, standard EN 60068-2-27:2009)
Vibration	40 G (55 Hz–2000 Hz, standard EN 60068-2-6:2008)

Electrical connections

	RE16/RM16 ID	**RE16/RM16 SC**	**RE16/RM16 Vx**
Wire colour	**ABZ**	**SSI**	**Linear voltage**
	Shield - Connected to encoder body		
Brown	V_{dd}	V_{dd}	V_{dd}
White	GND	GND	GND
Green	A	Data+	V_{out}
Yellow	B	Data–	
Grey	Z	Clock–	
Pink		Clock+	

Output types

Incremental, single ended

RE16/RM16 ID

Specifications

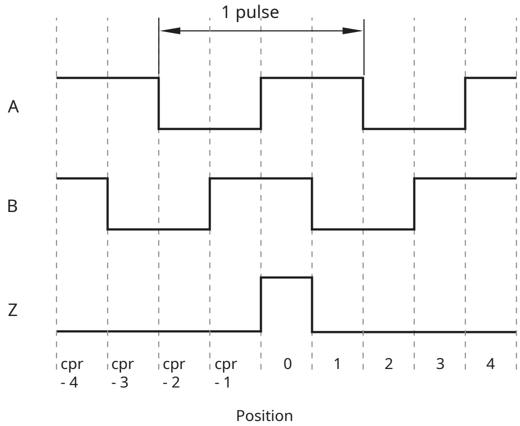
Power supply	V_{dd} = 5 V ± 5 %
Current consumption	Typ. 26 mA
Output signals	A, B, Z (single ended)
Resolution	32, 64, 128, 256, 512, 1024, 2048, 4096 cpr

There are three signals for the incremental output: A, B and Z. Signals A and B are quadrature signals, shifted by 90°, and signal Z is a reference mark. The reference mark signal is produced once per revolution. The width of the Z pulse is 1/4 of the quadrature signal period and it is synchronised with the A and B signals. The position of the reference mark is at zero. The graph on the right shows the timing diagram of A, B and Z signals with clockwise rotation of the magnet. B leads A for clockwise rotation.

With incremental outputs it is important to know the difference between ppr (pulses per revolution) and cpr (counts per revolution = 4 × ppr). **Pulses per revolution** is the number of periods on one of the quadrature signals in one revolution. **Counts per revolution** is the number of changes of state on both channels in one revolution and is achieved by electronically multiplying by four, using both the rising and the falling edges on both channels.

Timing diagram

Complementary signals not shown



Synchro serial interface (SSI)

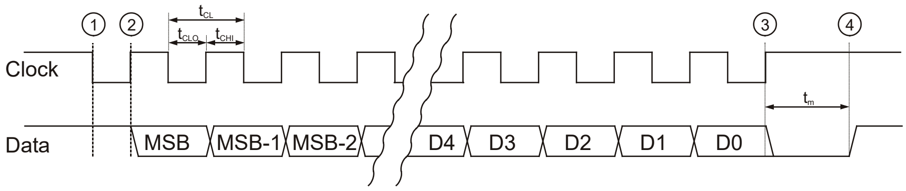
RE16/RM16 SC

Specifications

Power supply	V_{dd} = 5 V ± 5 %
Current consumption	Typ. 26 mA
SSI Data output	Data, RS422
SSI Clock input	Clock, RS422
Resolution	5, 6, 7, 8, 9, 10, 11, 12 bit
Clock frequency	≤ 4 MHz

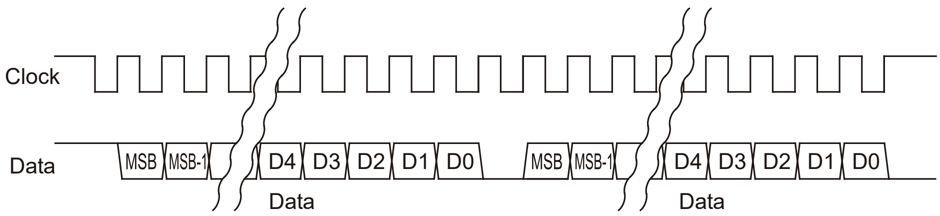
Serial output data is available in up to 12 bit natural binary code through the SSI protocol. With the clockwise magnet rotation, the value of the output data increases.

Parameter	Symbol	Min.	Typ.	Max.	Unit
Clock period	t_{CL}	0.25		2 × t_m	µs
Clock high	t_{CHI}	0.1		t_m	µs
Clock low	t_{CLO}	0.1		t_m	µs
Monoflop time	t_m	15	19	25	µs



Timing diagram for SSI output

The controller interrogates the encoder for its positional value by sending a pulse train to the Clock input. The Clock signal must always start from high. The first high/low transition (point 1) stores the current position data in a parallel/serial converter and the monoflop is triggered. With each transition of the Clock signal (high/low or low/high) the monoflop is retriggered. At the first low/high transition (point 2) the most significant bit (MSB) of the binary code is transmitted through the Data pin to the controller. At each subsequent low/high transition of the Clock the next bit is transmitted to the controller. While reading the data the t_{CHI} and t_{CLO} must be less than t_{mMin} to keep the monoflop set. After the least significant bit (LSB) is output (point 3) the Data goes to low. The controller must wait longer than t_{mMax} before it can read updated position data. At this point the monoflop time expires and the Data output goes to high (point 4).
If the controller continues sending the Clock pulses after the data is read without waiting for t_m, the same data will be output again and between the two outputs one logic zero will be output. The length of the data depends on the resolution of the encoder.



SSI multi-read of the same position data

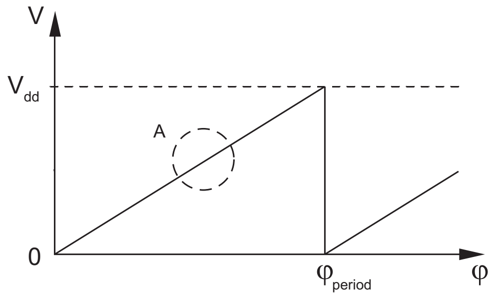
Linear voltage, single ended

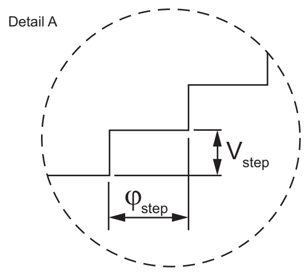
RE16/RM16 Vx

Specifications

Power supply	V_{dd} = 5 V ± 5 %
Current consumption	Typ. 26 mA
Output voltage	0 V to V_{dd}
Output load	Max. 2 mA
Resolution of DAC	10 bit
Nonlinearity	1 %

The digital relative angular position information is converted into linear voltage with a built-in 10 bit D/A converter. The linear output voltage swing ranges from 0 V and V_{dd} (5 V). The number of periods within one revolution (N_{period}) can be 1, 2, 4 or 8, representing one full swing over an angle (φ_{period}) of 360°, 180°, 90° or 45° respectively. The signal is made up of steps which represent the angular movement needed to register a change in the position (φ_{step}) and the resulting change in the output voltage (V_{step}). The number of steps in one period (N_{step}) is given in the table below.
For clockwise rotation of the magnetic actuator, the output voltage increases. For counterclockwise rotation, the output voltage decreases.





Timing diagram for linear voltage output

$$\varphi_{step} = \frac{\varphi_{period}}{N_{step}} \qquad V_{step} = \frac{V_{dd}}{N_{step}}$$

φ_{period} = Angle covered in one period (one sawtooth)
V_{period} = Output voltage range for one period
φ_{step} = Step angle (angular movement needed to register a change in the position)
V_{step} = Output voltage range for one step
N_{period} = Number of periods in one revolution
N_{step} = Number of steps in one period

φ_{period}	N_{period}	N_{step}	φ_{step}
360°	1	1024	0.35°
180°	2	1024	0.18°
90°	4	1024	0.09°
45°	8	512	0.09°

Output type and electrical variant

Rotation \ φ_{period}	360°	180°	90°	45°
Clockwise	VA	VB	VC	VD
Counterclockwise	VE	VF	VG	VH

Part numbering

RE16 ID 04 10B 10 F 2 P 10

Series

RE16 - Rotary Magnetic encoder, 16 mm diameter body
RM16 - Rotary Magnetic encoder, contactless, 16 mm diameter body

Output type

ID - Incremental, single ended, no driver, 5V
SC - Synchro-serial (SSI), RS422, 5 V
Vx - Linear voltage:

	360°	180°	90°	45°
CW	**VA**	**VB**	**VC**	**VD**
CCW	**VE**	**VF**	**VG**	**VH**

Shaft size

00 - NA (for RM16 only)
04 - 4 mm (for RE16 only)

Resolution

For **ID** and **SC** (counts per revolution)

12B - 4096
11B - 2048
10B - 1024
09B - 512
08B - 256
07B - 128
06B - 64
05B - 32

For **Vx** (counts per revolution)

10B - 1024

Cable length

10 - 1 m

Connector

F - Flying lead (no connector)

Body style and cable exit

2 - Cylindrical body, radial cable exit

Environment and material

F - IP67
P - IP67 on electronic, IP40 on mechanic side

Special requirements

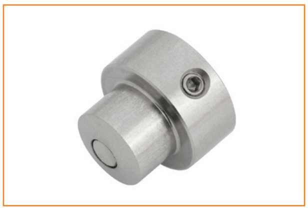
10 - No special requirements (standard)

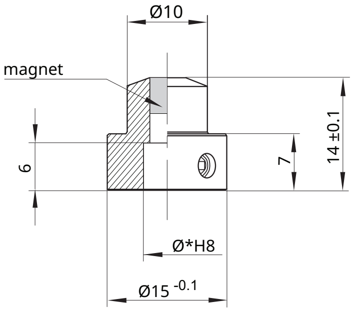
Table of available combinations

Series	Output type	Shaft size	Resolution	Cable length	Connector	Body style and cable exit	Environment and material	Special requirements
RE16	ID / SC	04	12B / 11B / 10B / 09B / 08B / 07B / 06B / 05B	10	F	2	P	10
	Vx		10B					
RM16	ID / SC	00	12B / 11B / 10B / 09B / 08B / 07B / 06B / 05B				F	
	Vx		10B					

Magnetic actuator and magnet ordering information

Actuator for integration onto shaft





Shaft = Ø*h7
Fixing: Grub screw provided

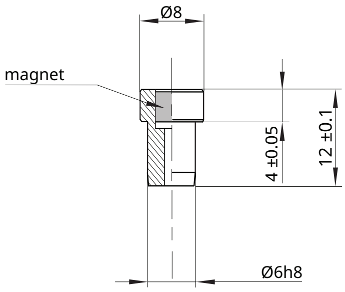
* Hole diameter for nominal shaft size.
  See table on the right for more information on available shaft sizes.

Part numbers:

For resolutions up to 9 bit absolute (512 cpr incremental)
RMA04A2A00 – Ø4 mm shaft
RMA05A2A00 – Ø5 mm shaft
RMA06A2A00 – Ø6 mm shaft
RMA08A2A00 – Ø8 mm shaft
RMA10A2A00 – Ø10 mm shaft
RMA19A2A00 – Ø3/16″ shaft
RMA25A2A00 – Ø1/4″ shaft
RMA37A2A00 – Ø3/8″ shaft

For resolutions from 10 bit absolute (800 cpr incremental) and above
RMA04A3A00 – Ø4 mm shaft
RMA05A3A00 – Ø5 mm shaft
RMA06A3A00 – Ø6 mm shaft
RMA08A3A00 – Ø8 mm shaft
RMA10A3A00 – Ø10 mm shaft
RMA19A3A00 – Ø3/16″ shaft
RMA25A3A00 – Ø1/4″ shaft
RMA37A3A00 – Ø3/8″ shaft

Actuator for integration into shaft



Part numbers:

For resolutions up to 9 bit absolute (512 cpr incremental)
RMH06A2A00

For resolutions from 10 bit absolute (800 cpr incremental) and above
RMH06A3A00

with N-pole marker

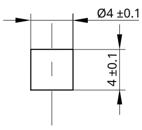
Hole = Ø6G7
Fixing: Adhesive (recommended – LOCTITE 648 or 2701)

With N-pole marker scribed to a ±5° accuracy:

For resolutions up to 9 bit absolute (512 cpr incremental)
RMH06A2A02

For resolutions from 10 bit absolute (800 cpr incremental) and above
RMH06A3A02

Magnet for direct recessing in non-ferrous shafts



Fixing: Adhesive (recommended – LOCTITE 648 or 2701)

Part numbers:

For resolutions up to 9 bit absolute (512 cpr incremental)
RMM44A2A00 (individually packed) – for sample quantities only
RMM44A2C00 (packed in tubes)

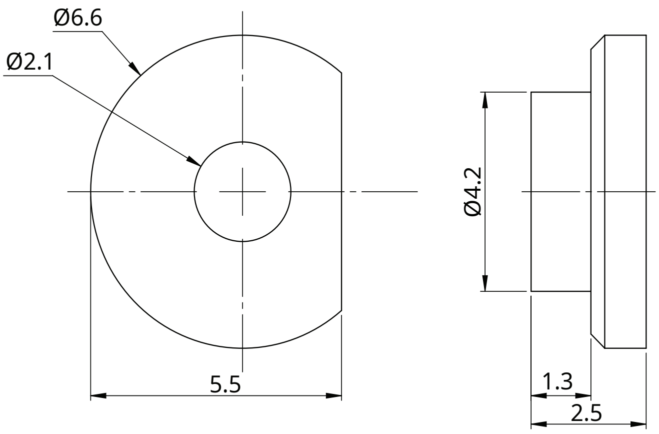
For resolutions from 10 bit absolute (800 cpr incremental) and above
RMM44A3A00 (individually packed) – for sample quantities only
RMM44A3C00 (packed in tubes)

Accessories

Installation accessory set
ACC072

ACC072 – Installation accessory set

Dimensions and tolerances are in mm. All dimensions are according to ISO2768-f.



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Document issues

Issue	Date	Page	Description
1	28. 2. 2023	-	New document
2	4. 4. 2023	5	Installation drawings added
		3, 8	Operating and storage temperature amended