

## RE16 / RM16

### Super Small Incremental and Absolute Encoders

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.

SUPER  
SMALL  
SIZE

HIGH  
OPERATING  
SPEED

HIGH  
ACCURACY



### Features and benefits

- ▶ Super small size – 16 mm diameter body
- ▶ Non-contact, frictionless design
- ▶ 5 V power supply versions
- ▶ High speed operation up to 30,000 rpm
- ▶ Industry standard incremental, SSI and linear voltage output formats
- ▶ Accuracy  $\pm 0.3^\circ$
- ▶ RoHS compliant



## General information

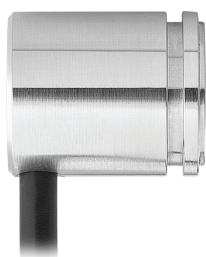
The rotation of the magnetic actuator is read and processed by a custom encoder chip within the body to provide incremental, SSI or linear voltage outputs. The encoder chips process the received signals with up to 12 bit resolution (4,096 counts per revolution) at high operating speeds.

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



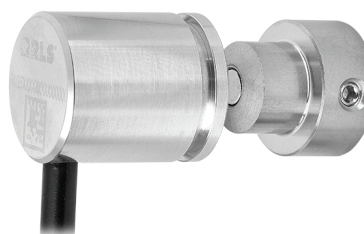
Encoder body

+



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



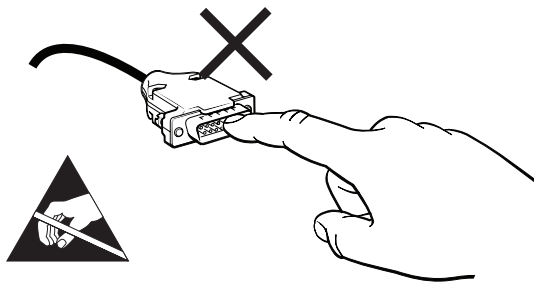
-40 °C to +125 °C

### Humidity

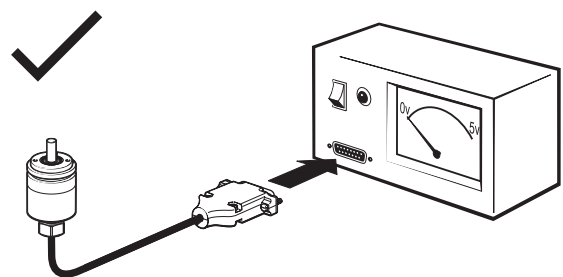
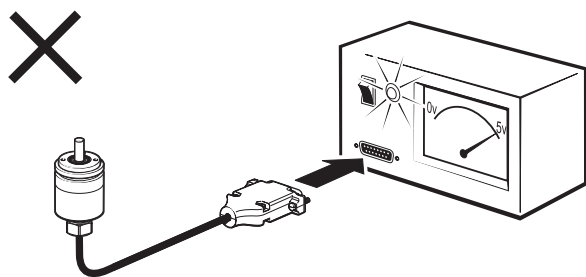


RM16: IP67

RE16: IP67 on electronic, IP40 on mechanic side



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



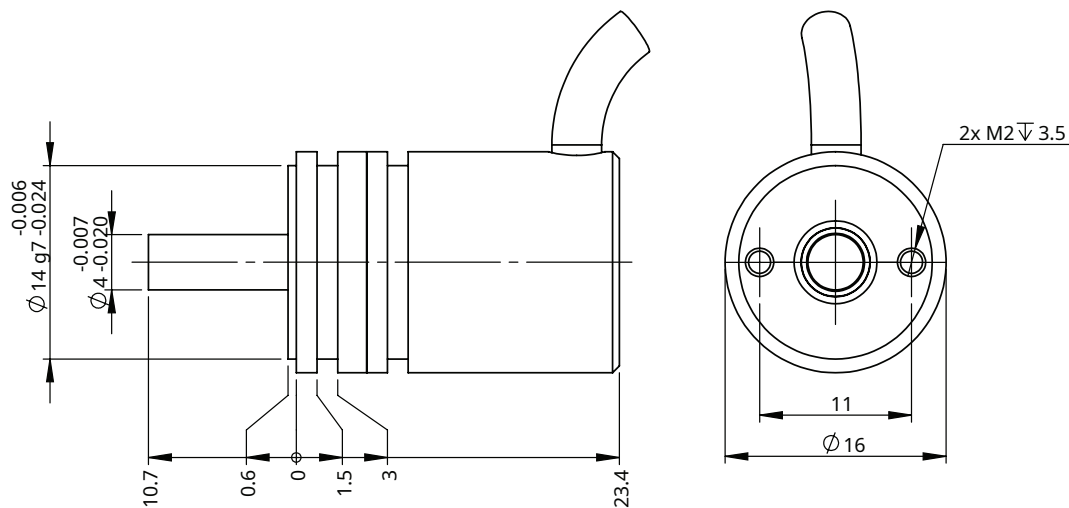
## Packaging

Each encoder is packed in antistatic bag.

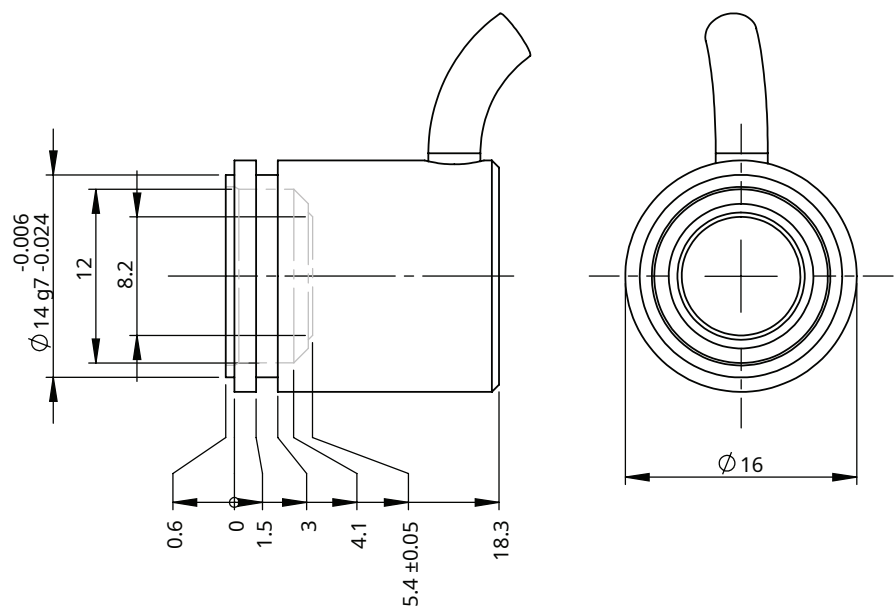
# Dimensions

Dimensions and tolerances are in mm.

## RE16



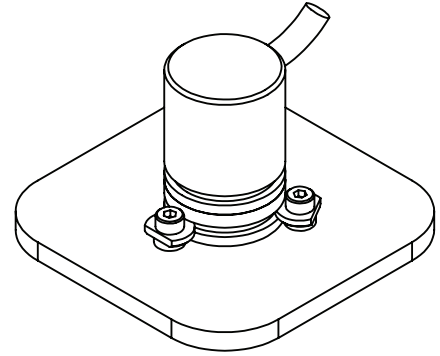
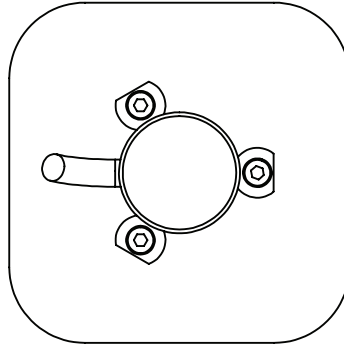
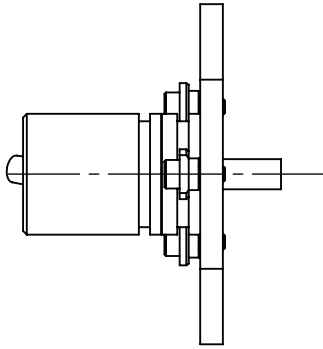
## RM16



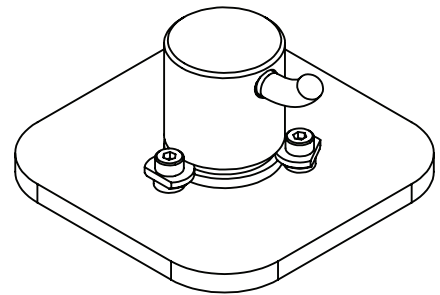
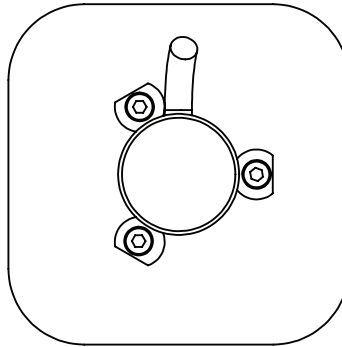
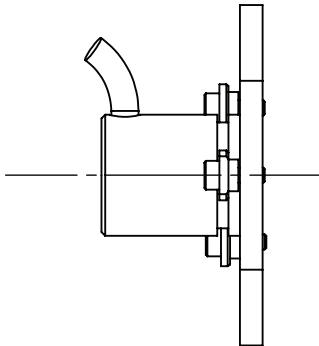
# Installation drawings

Dimensions and tolerances are in mm.

## RE16

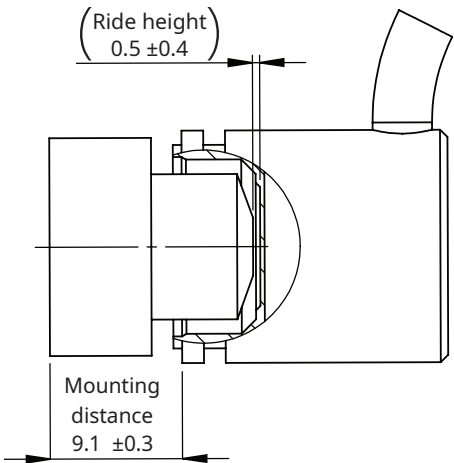


## RM16



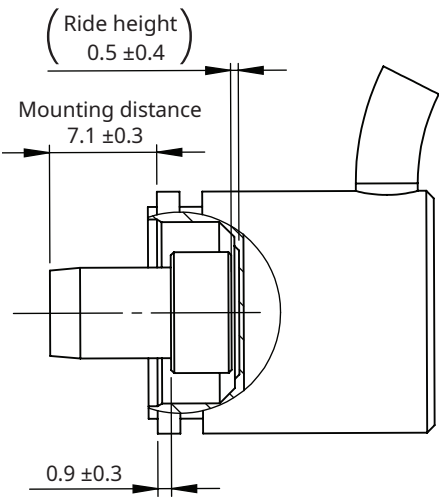
RM16 with RMA actuator

---



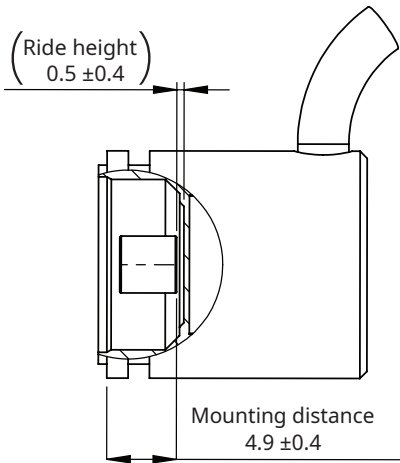
RM16 with RMH06 actuator

---



RM16 with RMM44Axx00 magnet

---

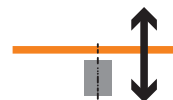


# Installation tolerances

## Installation tolerances for RM16

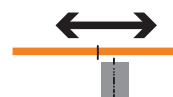
### Mounting distance

See installation drawings of encoder assemblies on [page 6](#).



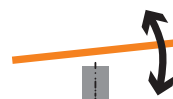
### Radial displacement (concentricity)

$\pm 0.3$  mm



### Perpendicularity

$\pm 0.3^\circ$



— - Encoder   ■ - Magnet

## Technical specifications

### System data

<b>Accuracy</b>	RE16: $\pm 0.3^\circ$ RM16: $\pm 0.5^\circ$
<b>Hysteresis</b>	$0.17^\circ$
<b>Temperature drift error</b>	$0.005^\circ/\text{°C}$

### Mechanical data

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

### Environmental data

<b>Operating and storage temperature</b>	$-40^\circ\text{C}$ to $+125^\circ\text{C}$
<b>Environmental sealing</b>	RE16: IP67 on electronic, IP40 on mechanic side RM16: IP67
<b>Shock</b>	100 G (6 ms, standard EN 60068-2-27:2009)
<b>Vibration</b>	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			
<b>Brown</b>	$V_{dd}$	$V_{dd}$	$V_{dd}$
<b>White</b>	GND	GND	GND
<b>Green</b>	A	Data+	$V_{out}$
<b>Yellow</b>	B	Data-	
<b>Grey</b>	Z	Clock-	
<b>Pink</b>		Clock+	



# Output types

## Incremental, single ended

RE16/RM16 ID

### Specifications

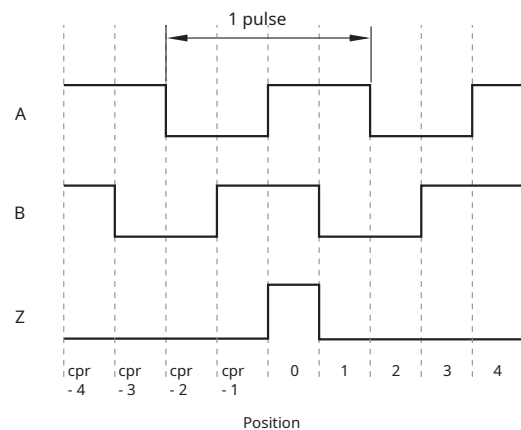
<b>Power supply</b>	$V_{dd} = 5\text{ V} \pm 5\%$
<b>Current consumption</b>	Typ. 26 mA
<b>Output signals</b>	A, B, Z (single ended)
<b>Resolution</b>	32, 64, 128, 256, 512, 1024, 2048, 4096 cpr

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 =  $4 \times \text{ppr}$ ). **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)

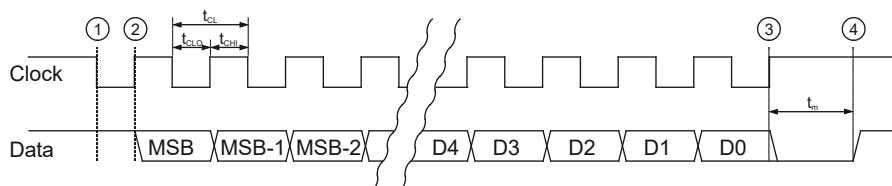
RE16/RM16 SC

### Specifications

<b>Power supply</b>	$V_{dd} = 5\text{ V} \pm 5\%$
<b>Current consumption</b>	Typ. 26 mA
<b>SSI Data output</b>	Data, RS422
<b>SSI Clock input</b>	Clock, RS422
<b>Resolution</b>	5, 6, 7, 8, 9, 10, 11, 12 bit
<b>Clock frequency</b>	$\leq 4\text{ MHz}$

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.

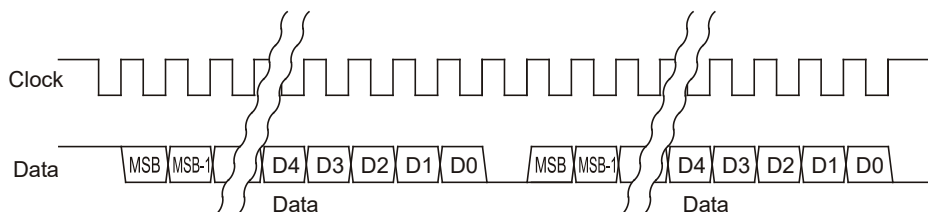
Parameter	Symbol	Min.	Typ.	Max.	Unit
<b>Clock period</b>	$t_{CL}$	0.25		$2 \times t_m$	$\mu\text{s}$
<b>Clock high</b>	$t_{CHi}$	0.1		$t_m$	$\mu\text{s}$
<b>Clock low</b>	$t_{CLO}$	0.1		$t_m$	$\mu\text{s}$
<b>Monoflop time</b>	$t_m$	15	19	25	$\mu\text{s}$



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

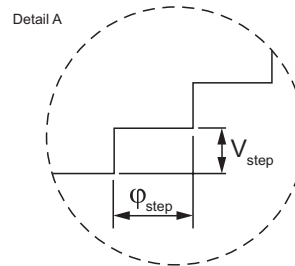
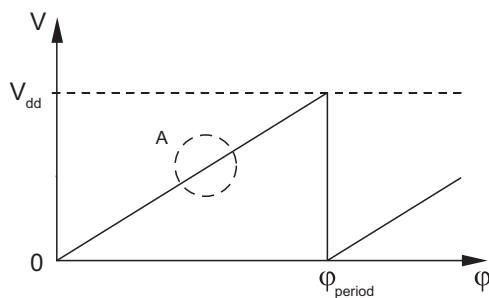
RE16/RM16 Vx

### Specifications

<b>Power supply</b>	$V_{dd} = 5\text{ V} \pm 5\%$
<b>Current consumption</b>	Typ. 26 mA
<b>Output voltage</b>	0 V to $V_{dd}$
<b>Output load</b>	Max. 2 mA
<b>Resolution of DAC</b>	10 bit
<b>Nonlinearity</b>	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 ( $N_{\text{period}}$ ) can be 1, 2, 4 or 8, representing one full swing over an angle ( $\phi_{\text{period}}$ ) 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 ( $\phi_{\text{step}}$ ) and the resulting change in the output voltage ( $V_{\text{step}}$ ). The number of steps in one period ( $N_{\text{step}}$ ) 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

$$\phi_{\text{step}} = \frac{\phi_{\text{period}}}{N_{\text{step}}} \quad V_{\text{step}} = \frac{V_{dd}}{N_{\text{step}}}$$

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

$\phi_{\text{period}}$	$N_{\text{period}}$	$N_{\text{step}}$	$\phi_{\text{step}}$
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

$\phi_{\text{period}}$	360°	180°	90°	45°
<b>Rotation</b>				
<b>Clockwise</b>	VA	VB	VC	VD
<b>Counterclockwise</b>	VE	VF	VG	VH

# Part numbering

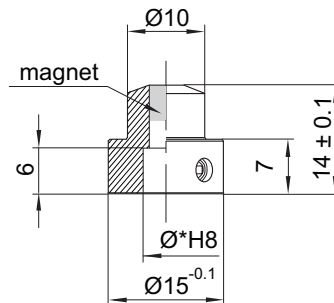
	RE16	ID	04	10B	10	F	2	P	10
<b>Series</b>									
<b>RE16</b> - Rotary Magnetic encoder, 16 mm diameter body									
<b>RM16</b> - Rotary Magnetic encoder, contactless, 16 mm diameter body									
<b>Output type</b>									
<b>ID</b> - Incremental, single ended, no driver, 5V									
<b>SC</b> - Synchro-serial (SSI), RS422, 5 V									
<b>Vx</b> - Linear voltage:									
	360°	180°	90°	45°					
CW	<b>VA</b>	<b>VB</b>	<b>VC</b>	<b>VD</b>					
CCW	<b>VE</b>	<b>VF</b>	<b>VG</b>	<b>VH</b>					
<b>Shaft size</b>									
<b>00</b> - NA (for RM16 only)									
<b>04</b> - 4 mm (for RE16 only)									
<b>Resolution</b>									
For <b>ID</b> and <b>SC</b> (counts per revolution)					For <b>Vx</b> (counts per revolution)				
<b>12B</b> - 4096		<b>08B</b> - 256			<b>10B</b> - 1024				
<b>11B</b> - 2048		<b>07B</b> - 128							
<b>10B</b> - 1024		<b>06B</b> - 64							
<b>09B</b> - 512		<b>05B</b> - 32							
<b>Cable length</b>									
<b>10</b> - 1 m									
<b>Connector</b>									
<b>F</b> - Flying lead (no connector)									
<b>Body style and cable exit</b>									
<b>2</b> - Cylindrical body, radial cable exit									
<b>Environment and material</b>									
<b>F</b> - IP67									
<b>P</b> - IP67 on electronic, IP40 on mechanic side									
<b>Special requirements</b>									
<b>10</b> - 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 / 9B / 8B / 7B / 6B / 5B	10	F	2	P	10	
	Vx		10B						
RM16	ID / SC	00	12B / 11B / 10B / 9B / 8B / 7B / 6B / 5B				F		
	Vx		10B						

# Magnetic actuator and magnet ordering information

## Actuator for integration onto shaft



**Shaft** = Ø\*h7  
**Fixing:** Grub screw provided

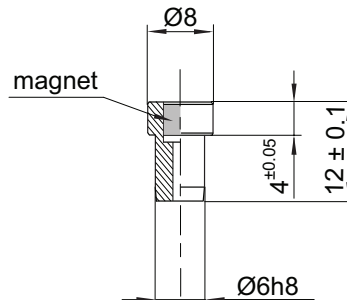
\* Hole diameter for nominal shaft size.  
 See table on the right for more information on available shaft sizes.

### Part numbers:

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

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

## Actuator for integration into shaft



**with N-pole marker**



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

### Part numbers:

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

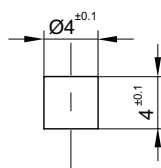
For resolutions from 10 bit absolute (800 cpr incremental) and above  
**RMH06A3A00**

### With N-pole marker 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)

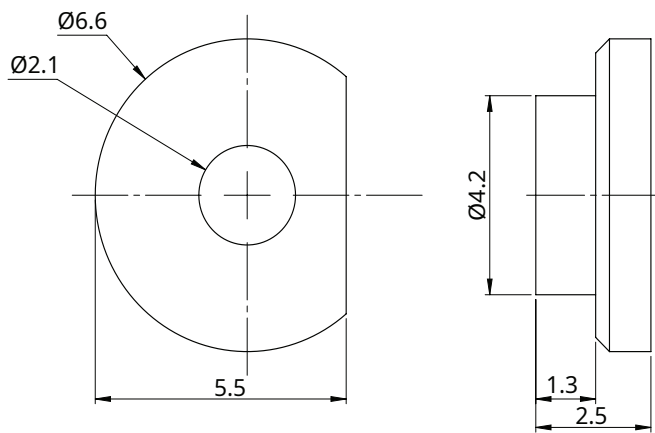
## Accessories



Installation accessory set  
**ACC072**

### ACC072 – Installation accessory set

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



## Head office

---

### RLS Merilna tehnika d. o. o.

Poslovna cona Žeje pri Komendi  
Pod vrbami 2  
SI-1218 Komenda  
Slovenia

T +386 1 5272100  
E [mail@rls.si](mailto:mail@rls.si)  
[www.rls.si](http://www.rls.si)

## Global support

---

Visit our [website](#) to contact your nearest sales representative.

### Document issues

Issue	Date	Page	Description
1	28. 2. 2023	-	New document

This product is not designed or intended for use outside the environmental limitations and operating parameters expressly stated on the product's datasheet. Products are not designed or intended for use in medical, military, aerospace, automotive or oil & gas applications or any safety-critical applications where a failure of the product could cause severe environmental or property damage, personal injury or death. Any use in such applications must be specifically agreed to by seller in writing, and is subject to such additional terms as the seller may impose in its sole discretion. Use of products in such applications is at buyer's own risk, and buyer will indemnify and hold harmless seller and its affiliates against any liability, loss, damage or expense arising from such use. Information contained in this datasheet was derived from product testing under controlled laboratory conditions and data reported thereon is subject to the stated tolerances and variations, or if none are stated, then to tolerances and variations consistent with usual trade practices and testing methods. The product's performance outside of laboratory conditions, including when one or more operating parameters is at its maximum range, may not conform to the product's datasheet. Further, information in the product's datasheet does not reflect the performance of the product in any application, end-use or operating environment buyer or its customer may put the product to. Seller and its affiliates make no recommendation, warranty or representation as to the suitability of the product for buyer's application, use, end-product, process or combination with any other product or as to any results buyer or its customer might obtain in their use of the product. Buyer should use its own knowledge, judgment, expertise and testing in selecting the product for buyer's application, end-use and/or operating environment, and should not rely on any oral or written statement, representation, or samples made by seller or its affiliates for any purpose. EXCEPT FOR THE WARRANTIES EXPRESSLY SET FORTH IN THE SELLER'S TERMS AND CONDITIONS OF SALE, SELLER MAKES NO WARRANTY EXPRESS OR IMPLIED WITH RESPECT TO THE PRODUCT, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE, WHICH ARE DISCLAIMED AND EXCLUDED. All sales are subject to seller's exclusive terms and conditions of sale which, where the seller is (a) RLS Merilna tehnika d. o. o., are available at <https://www.rls.si/eng/salesterms>, (b) Renishaw, Inc., are available at <https://www.renishaw.com/legal/en/-42186>, or (c) another person, are available on request, and in each case, are incorporated herein by reference, and are the exclusive terms of sale. No other terms and conditions apply. Buyer is not authorized to make any statements or representations that expand upon or extend the environmental limitations and operating parameters of the products, or which imply permitted usage outside of that expressly stated on the datasheet or agreed to in writing by seller.

RLS Merilna tehnika d. o. o. has made considerable effort to ensure the content of this document is correct at the date of publication but makes no warranties or representations regarding the content. RLS Merilna tehnika d. o. o. excludes liability, howsoever arising, for any inaccuracies in this document. © 2023 RLS d. o. o.