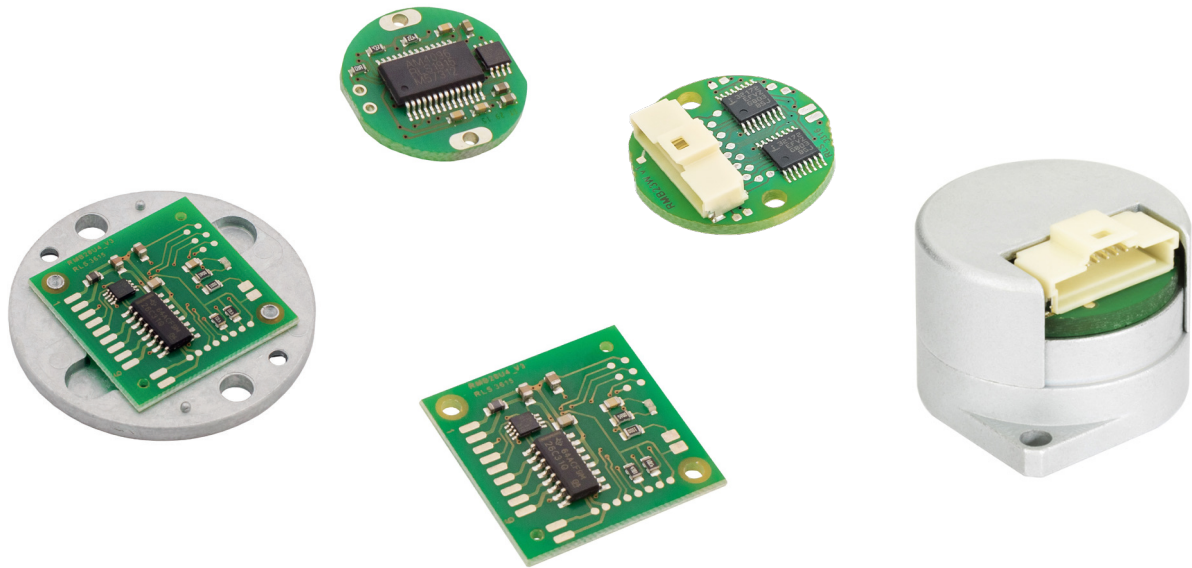


# Commutation and incremental magnetic encoder solutions



## Commutation and incremental encoders for motor applications

**OnAxis™ commutation magnetic rotary encoder range is designed for use in motor feedback applications requiring both A, B, Z incremental and U, V, W commutation signals.**

Robust non-contact OnAxis sensor technology provides ultimate long term reliability and with simple installation costs of ownership are minimal. Installation is simplified with a range of magnetic actuators and mounting options for the encoder. A simple zero position programming then removes the need for careful alignment of the encoder to starting position of the rotor.

Resolutions are available from 64 to 2,048 pulses per revolution (256 to 8,192 counts per revolution with ×4 evaluation). U,V,W commutation

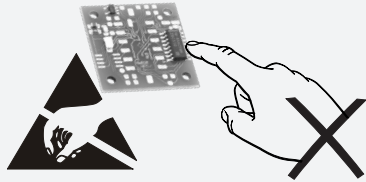
signals are simultaneously output with 1 to 8 pole pairs (2 to 16 poles).

Commutation encoders are available in different design variants and sizes, from 20 mm diameter encoder module RMB20 to 44 mm diameter encoder module on a metal flange RMF44 or as RMC22 and RMC35 on a metal flange with a removable metal cap to allow easy installation and zeroing. The functionality of all the above mentioned encoders is based on the AM4096 magnetic encoder IC which provides reliable operation in tough environments. More on the functionalities of AM4096 magnetic encoder IC can be found in [AM4096 data sheet](#).

- Robust non-contact OnAxis encoders
- Resolutions from 256 to 8192 counts per revolution
- U, V, W commutation signals
- Encoder module sizes from 20 mm diameter to 44 mm diameter
- Operate in tough environments
- CE compliant, including RoHS - see Declaration of conformity

# UVW encoder technical specifications

Product	Dimensions	Available outputs	Commutation outputs	Incremental outputs	Power supply	Maximum speed
RMB29	29 mm × 29 mm	Ex	U, V, W	-	5 V ±10 %	30,000 rpm
RMB20	Ø20 mm	Ux				
RMB23	Ø23 mm	Wx	U, V, W and U+, U-, V+, V-, W+ W-	A, B, Z, A-, B-, Z- (RS422)		
RMB28	28 mm × 28 mm	Ux, Wx				
RMF44	Ø44 mm					
RM44	Ø44 mm					
RMC22	Ø22 mm	Ux	U, V, W			
RMC35	Ø35 mm					



## WARNING!

### ESD protection

Encoder modules are ESD sensitive - handle with care. Do not touch electronic circuit or sensor area without proper ESD protection or outside of ESD controlled environment.

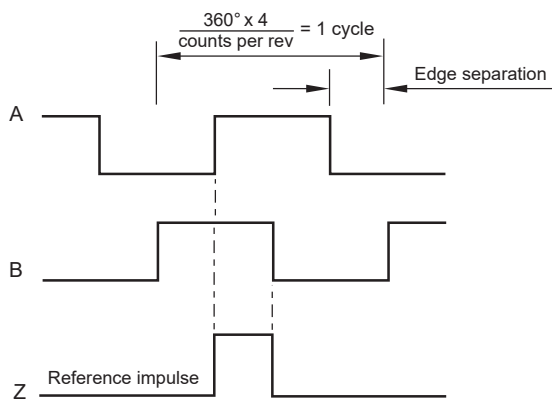
# Output types

## Incremental outputs

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 synchronized with the A and B signals. The position of the reference mark is at zero. The chart below shows the timing diagram of A, B and Z signals with clockwise (CW) rotation of the magnet and positive counting direction. B leads A for CW rotation.

### Timing diagram - Incremental

Complementary signals not shown

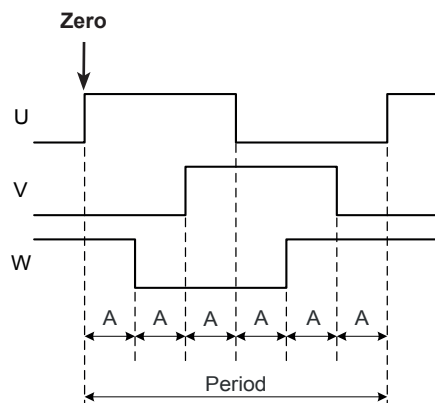


## Commutation outputs

UVW outputs can be output as digital signals. The number of signal periods (P) equals number of pole pairs. The timing diagram shows the signals when the position data is increasing. The U signal always starts at zero position regardless the signal period length. The resolution should be set to 4096 to ensure accurate transitions of the signals.

### Timing diagram - Commutation

Complementary signals not shown

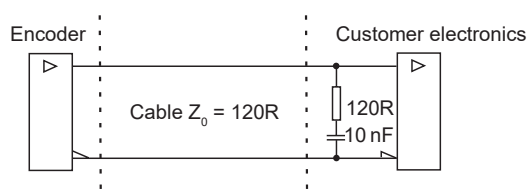


### UVW outputs

Pole	A	Period	Pole pairs*
2	60°	360°	one
4	30°	180°	two
6	20°	120°	three
8	15°	90°	four
10	12°	72°	five
12	10°	60°	six
14	8.57°	51.42°	seven
16	7.50°	45°	eight

\* Number of pole pairs equals number of periods per revolution.

## Recommended signal termination - for complementary signals only



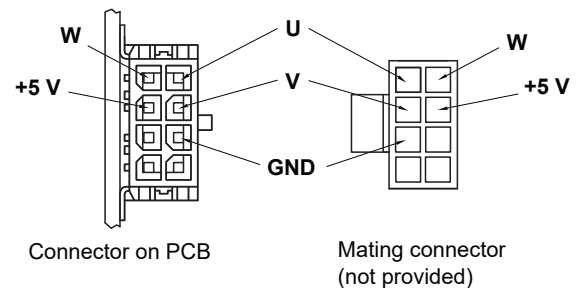
# RMB29Ex

## Output specifications

Power supply	5 V $\pm$ 10 %
Current consumption	30 mA (not loaded)
Maximum speed	30,000 rpm
Accuracy	Typ. $\pm$ 0.5°
Commutation outputs	U, V, W
Number of poles for commutation outputs	2, 4, 6, 8, 10, 12, 14, 16
Temperature	−40 °C to +105 °C
Operating and storage	(Limited by connector. All other components used are specified for operation from −40 °C to +125 °C)

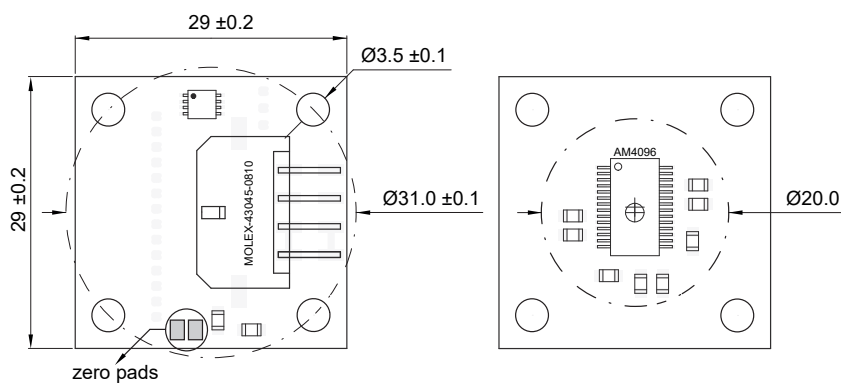
## Connections

With pads or with Molex connector:

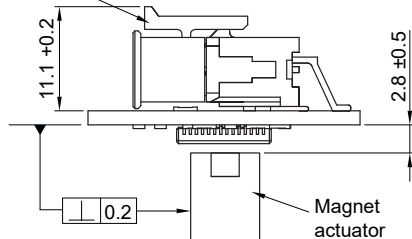


## Dimensions and installation tolerance

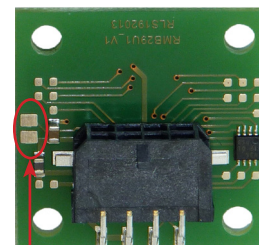
Dimensions and tolerances in mm.



Mating connector



**NOTE:** For the accuracy specified the center line of the magnet needs to be square to the chip within 2° and aligned within the center of the board  $\pm$ 0.1 mm (mid point between the 2 mounting holes).



Zeroing pads

**Connector on board**

Molex 43045-0810

**Mating connector** (Not provided)

**Shell:** Molex 43025-0800

**8 pin crimp:** Molex 43030-0010

**NOTE:** Product without connector is not conformal coated.



Clockwise rotation of magnetic actuator.

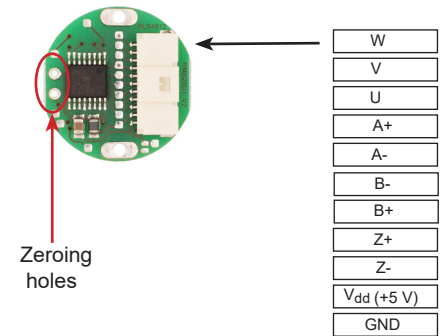
# RMB20Ux

## Output specifications

Power supply	5 V $\pm$ 10 %
Current consumption	30 mA (not loaded)
Maximum speed	30,000 rpm
Accuracy	Typ. $\pm$ 0.5°
Incremental outputs	A, B, Z, A-, B-, Z- (RS422)
Incremental resolutions	256, 512, 1,024, 2,048, 4,096 cpr
Commutation outputs	U, V, W
Number of poles for commutation outputs	2, 4, 6, 8, 10, 12, 14, 16
Temperature	-40 °C to +125 °C
Operating and storage	-40 °C to +105 °C for option 10 (with connector)

## Connections

With pads or with Molex connector:



### Connector on board

Molex 501568-1107

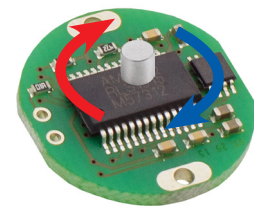
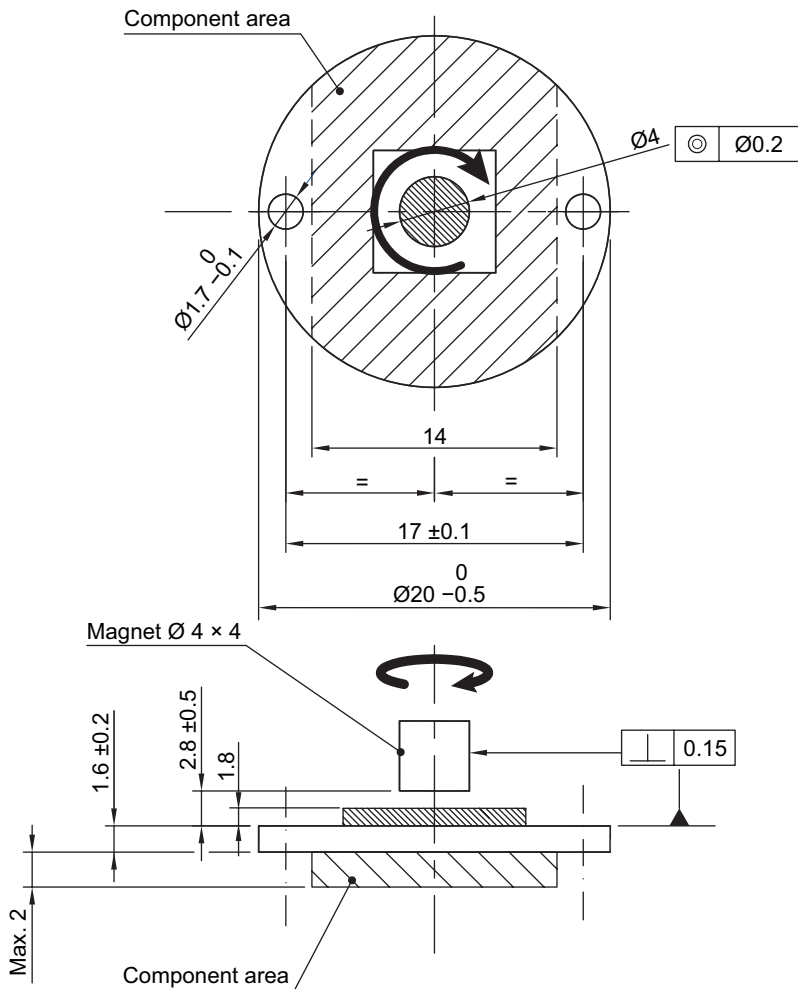
Mating connector (Not provided)

Shell: Molex 501330-1100

Crimp terminal: Molex 501334-xxxx

## Dimensions and installation tolerance

Dimensions and tolerances in mm.



Clockwise rotation of magnetic actuator.

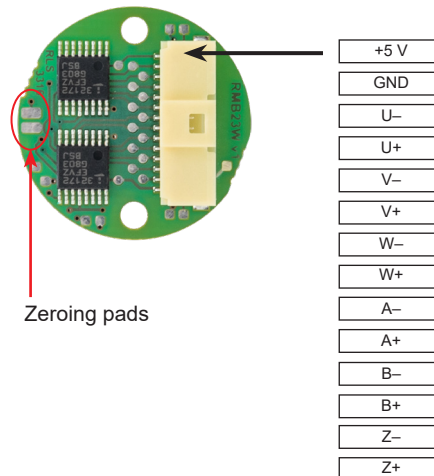
**NOTE:** For the accuracy specified the center line of the magnet needs to be square to the chip within 2° and aligned within the center of the board  $\pm$ 0.1 mm (mid point between the 2 mounting holes).

# RMB23Wx

## Output specifications

<b>Power supply</b>	5 V $\pm 10\%$
<b>Current consumption</b>	30 mA (not loaded)
<b>Maximum speed</b>	30,000 rpm
<b>Accuracy</b>	Typ. $\pm 0.5^\circ$
<b>Incremental outputs</b>	A, B, Z, A-, B-, Z- (RS422)
<b>Incremental resolutions</b>	256, 512, 1,024, 2,048, 4,096 cpr
<b>Commutation outputs</b>	U, V, W, U-, V-, W- (RS422)
<b>Number of poles for commutation outputs</b>	2, 4, 6, 8, 10, 12, 14, 16
<b>Temperature</b>	$-40^\circ\text{C}$ to $+105^\circ\text{C}$
Operating and storage	

## Connections



### Connector on board

Molex 501568-1407

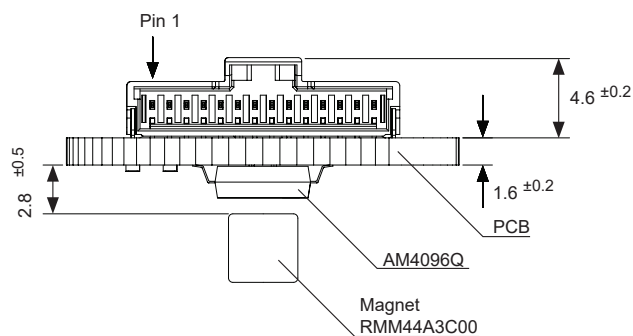
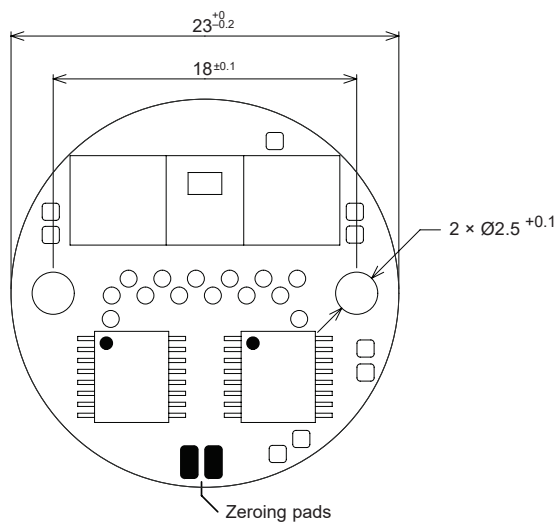
**Mating connector** (Not provided)

**Shell:** Molex 501330-1400

**Crimp terminal:** Molex 501334-xxxx

## Dimensions and installation tolerance

Dimensions and tolerances in mm.



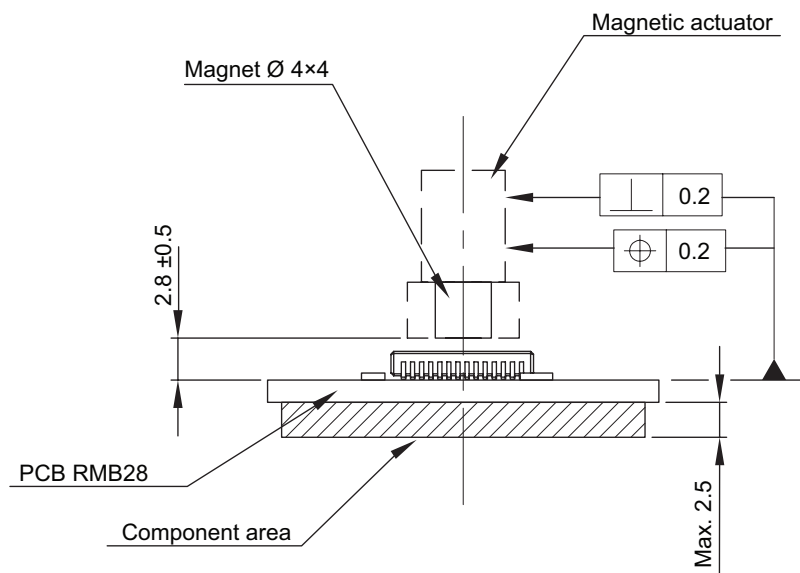
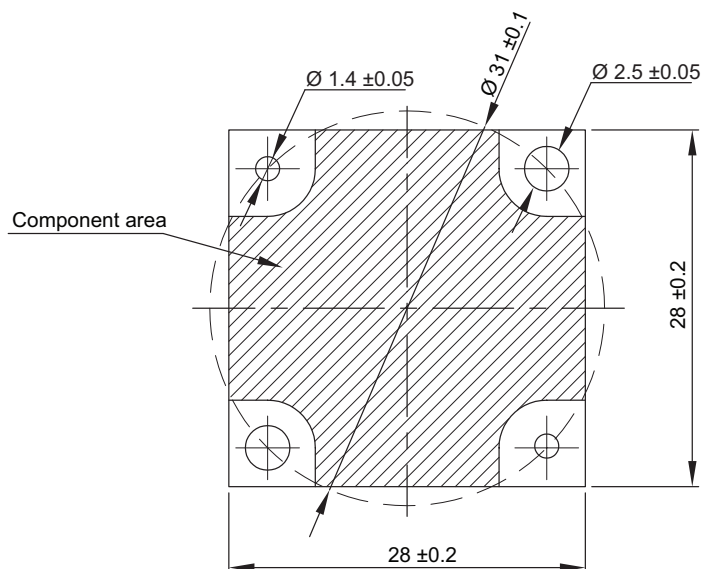
# RMB28Ux / RMF44Ux

## Output specifications

Power supply	5 V $\pm$ 10 %
Current consumption	30 mA (not loaded)
Maximum speed	30,000 rpm
Accuracy	Typ. $\pm$ 0.5°
Incremental outputs	A, B, Z, A-, B-, Z- (RS422)
Incremental resolutions	256, 320, 400, 500, 512, 800, 1,000, 1,024, 1,600, 2,000, 2,048, 4,096, 8,192 cpr
Commutation outputs	U, V, W ( $\pm$ 24 mA output drive)
Number of poles for commutation outputs	2, 4, 6, 8, 10, 12, 14, 16
Temperature	-40 °C to +125 °C
Operating and storage	-40 °C to +105 °C for option 12 (with connector)

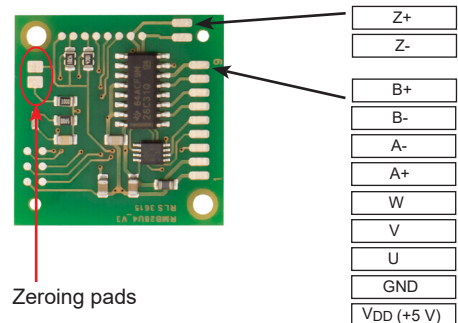
## RMB28Ux / RMB28Wx dimensions and installation tolerance

Dimensions and tolerances in mm.



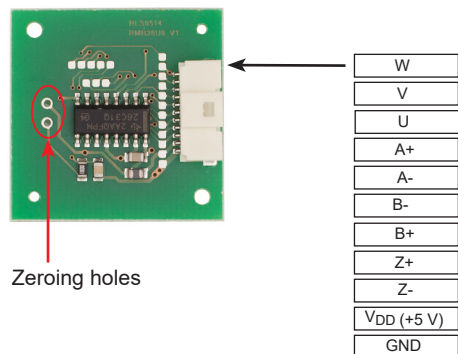
## Connections

With pads:



Zeroing pads

With Molex connector:



Zeroing holes

### Connector on board

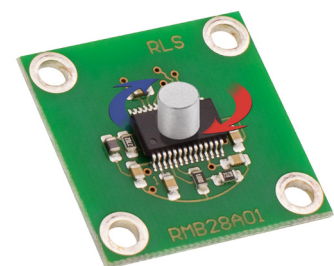
Molex 501568-1107

Mating connector (Not provided)

Shell: Molex 501330-1100

Crimp terminal: Molex 501334-xxxx

**NOTE:** Image may not represent actual product as components can vary based on chosen resolution.

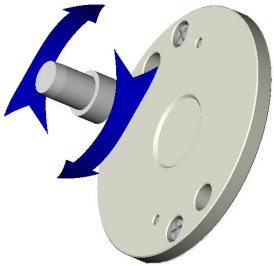
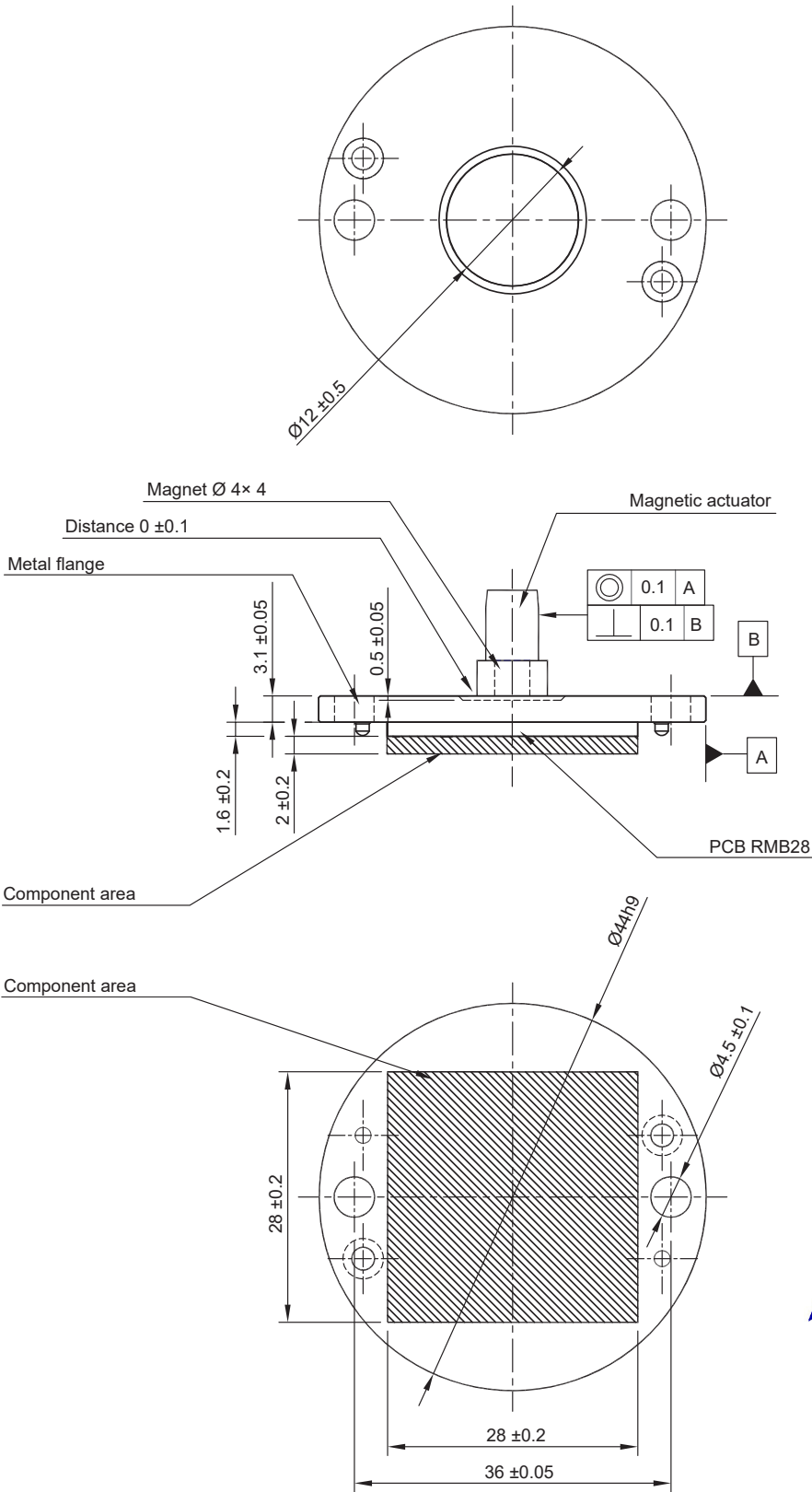


Clockwise rotation of magnetic actuator.

# RMB28Ux / RMF44Ux continued

## RMF44Ux / RMF44Wx dimensions and installation tolerance

Dimensions and tolerances in mm.



Clockwise rotation of magnetic actuator.



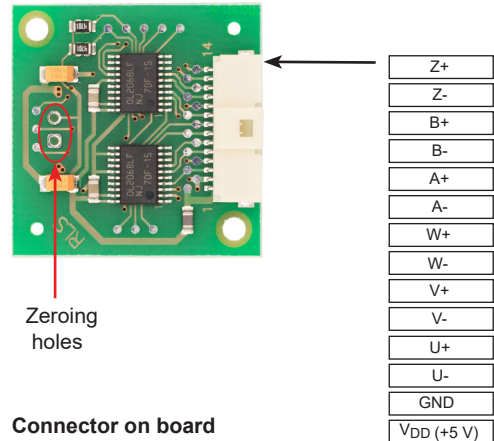
# RMB28Wx / RMF44Wx

## Output specifications

<b>Power supply</b>	5 V $\pm$ 10 %
<b>Current consumption</b>	30 mA (not loaded)
<b>Maximum speed</b>	30,000 rpm
<b>Accuracy</b>	Typ. $\pm$ 0.5°
<b>Incremental outputs</b>	A, B, Z, A-, B-, Z- (RS422)
<b>Incremental resolutions</b>	256, 512, 1,024, 2,048, 4,096 cpr
<b>Commutation outputs</b>	U, V, W, U-, V-, W- (RS422)
<b>Number of poles for commutation outputs</b>	2, 4, 6, 8, 10, 12, 14, 16
<b>Temperature</b>	-40 °C to +125 °C
Operating and storage	-40 °C to +105 °C for option 12 (with connector)

## Connections

With pads or with Molex connector:



### Connector on board

Molex 501568-1407

**Mating connector** (Not provided)

**Shell:** Molex 501330-1400

**Crimp terminal:** Molex 501334-xxxx

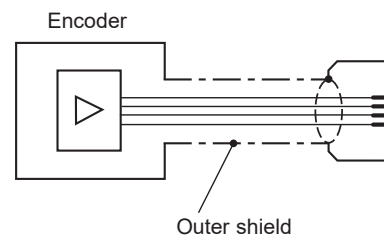
# RM44Ux / Wx

## Output specifications

<b>Power supply</b>	5 V $\pm$ 10 %
<b>Current consumption</b>	30 mA (not loaded)
<b>Accuracy</b>	Typ. $\pm$ 0.5°
<b>Hysteresis</b>	0.18°
<b>Maximum speed</b>	30,000 rpm
<b>Incremental outputs</b>	A, B, Z, A-, B-, Z- (RS422)
<b>Incremental resolutions</b>	256, 320, 400, 500, 512, 800, 1,000, 1,024, 1,600, 2,000, 2,048, 4,096, 8,192 cpr
<b>Commutation outputs (for Ux)</b>	U, V, W ( $\pm$ 24 mA output drive)
<b>Commutation outputs (for Wx)</b>	U, V, W, U-, V-, W- (RS422)
<b>Number of poles for commutation outputs</b>	2, 4, 6, 8, 10, 12, 14, 16
<b>Temperature</b>	-40 °C to +125 °C (IP64)
Operating and storage	-40 °C to +85 °C (IP68)
<b>Mass</b>	45 g

\* RM44 with external zeroing is available with binary resolutions only.

## Connections

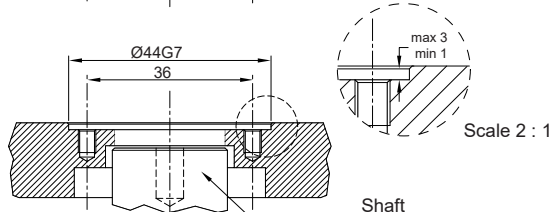
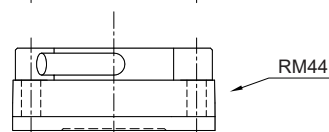
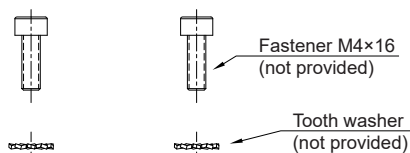
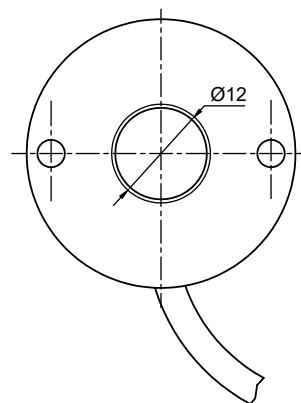
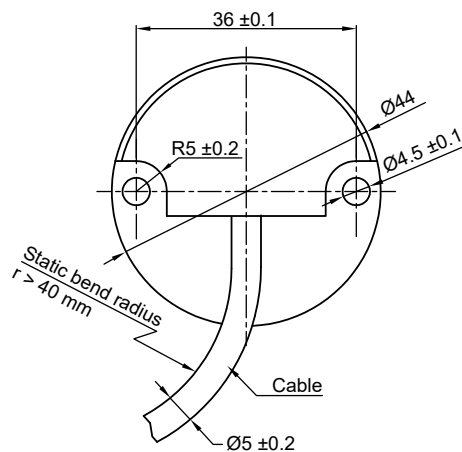
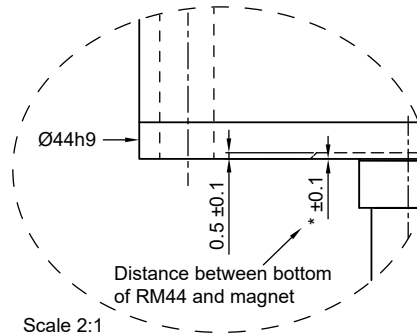
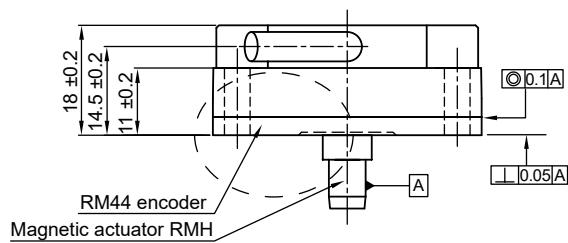


RM44Ux		RM44Wx	
Function	Wire colour	Function	Wire colour
V <sub>dd</sub>	Red	V <sub>dd</sub>	Red
GND	Blue	GND	Blue
A	Grey	U-	Green/Black
A-	Pink	U+	Black
B	Green	V-	Brown/Black
B-	Yellow	V+	Violet
Z	White	W-	White/Black
Z-	Brown	W+	Yellow/Black
U	Black	A-	Pink
V	Violet	A+	Grey
W	Grey/Violet	B-	Yellow
		B+	Green
		Z-	Brown
		Z+	White

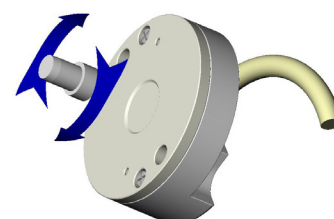
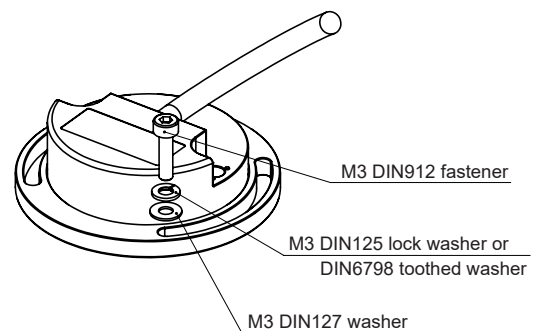
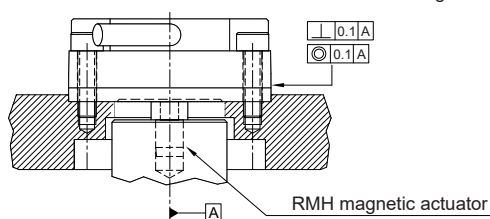
# RM44Ux / Wx continued

## RM44Ux / RM44Wx dimensions and installation tolerance

Dimensions and tolerances in mm.



Material must be non-magnetic if RMH magnetic actuator is not used

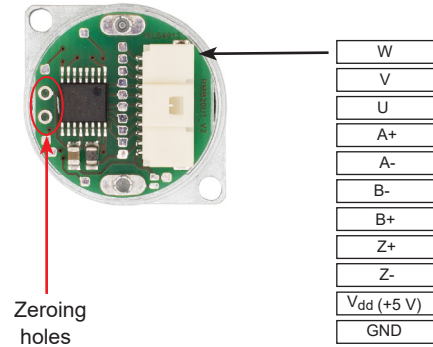


# RMC22Ux

## Output specifications

Power supply	5 V $\pm$ 10 %
Current consumption	30 mA (not loaded)
Maximum speed	30,000 rpm
Accuracy	Typ. $\pm$ 0.5°
Hysteresis	0.17°
Incremental outputs	A, B, Z, A-, B-, Z- (RS422)
Incremental resolutions	256, 512, 1,024, 2,048, 4,096 cpr
Commutation outputs	U, V, W ( $\pm$ 24 mA output drive)
Number of poles for commutation outputs	2, 4, 6, 8, 10, 12, 14, 16
Temperature Operating and storage	-40 °C to +105 °C (Limited by connector. All other components used are specified for operation from -40 °C to +125 °C)
Mass	22 g

## Connections



### Connector on board

Molex 501568-1107

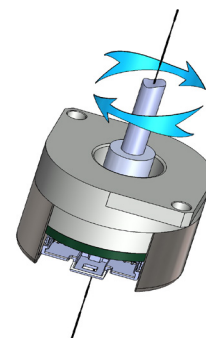
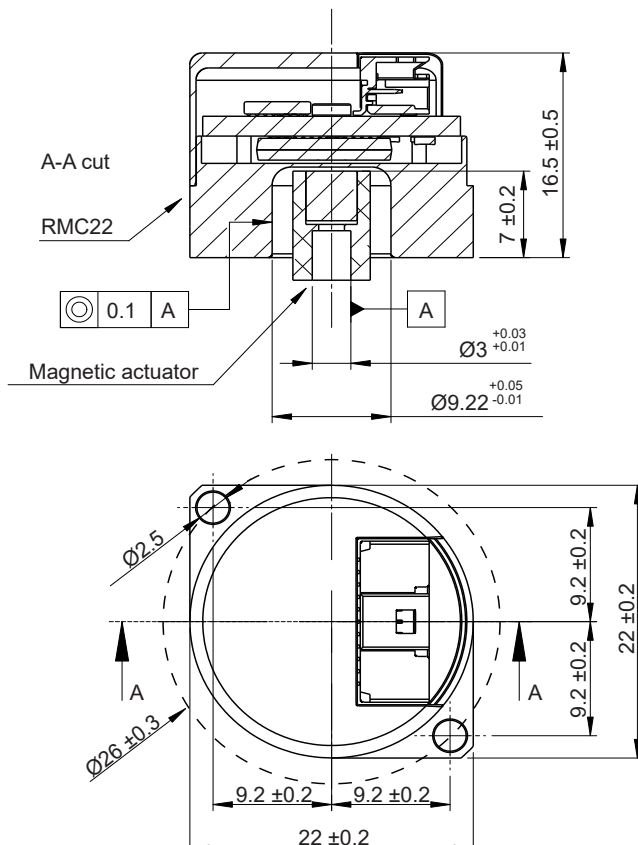
**Mating connector** (Not provided)

**Shell:** Molex 501330-1100

**Crimp terminal:** Molex 501334-xxxx

## Dimensions and installation tolerance

Dimensions and tolerances in mm.



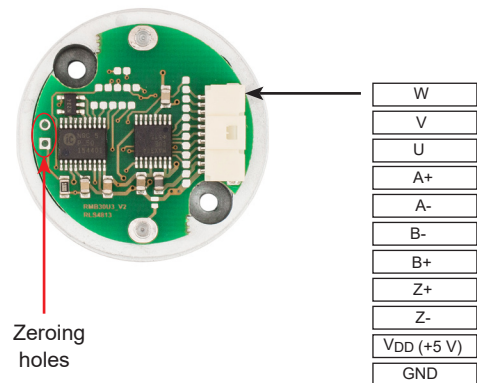
Clockwise rotation of magnetic actuator.

# RMC35Ux

## Output specifications

Power supply	5 V $\pm 10\%$
Current consumption	40 mA (not loaded)
Accuracy	Typ. $\pm 0.5^\circ$
Hysteresis	0.18°
Maximum speed	30,000 rpm
Incremental outputs	A, B, Z, A-, B-, Z- (RS422)
Incremental resolutions	256, 320, 400, 500, 512, 800, 1,000, 1,024, 1,600, 2,000, 2,048, 4,096, 8,192 cpr
Commutation outputs	U, V, W ( $\pm 24$ mA output drive)
Number of poles for commutation outputs	2, 4, 6, 8, 10, 12, 14, 16
Temperature	-40 °C to +105 °C
Operating and storage	(Limited by connector. All other components used are specified for operation from -40 °C to +125 °C)
Mass	45 g

## Connections



### Connector on board

Molex 501568-1107

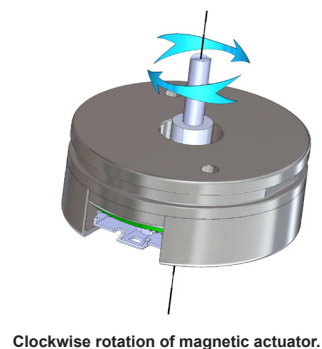
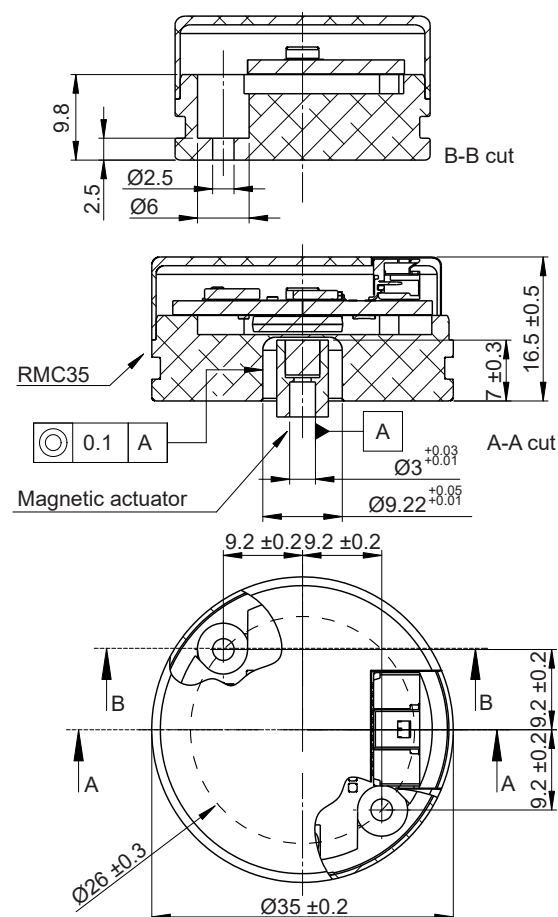
**Mating connector** (Not provided)

**Shell:** Molex 501330-1100

**Crimp terminal:** Molex 501334-xxxx

## Dimensions and installation tolerance

Dimensions and tolerances in mm.



# RMC22 / RMC35 continued

## Installation procedure

### 1. Install the magnetic actuator

Use glue to fix the magnetic actuator to the shaft (recommended LOCTITE 648). Actuator should protrude by 7 mm.

### 2. Install the flange with the encoder module on the mounting surface

Screw the flange to the mounting surface using 2 screws (not provided).

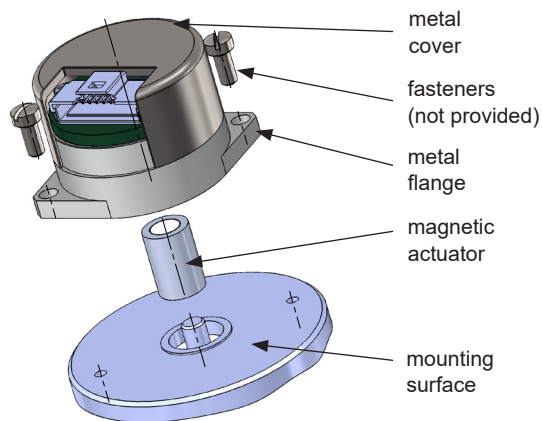
### 3. Set the zero position of the encoder (see below for details)

### 4. Cover the encoder with the metal cover

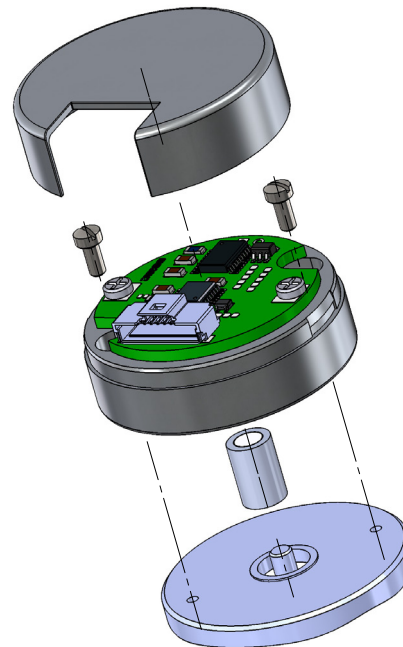
Place the metal cover over the encoder and gently press it in position. Be sure to align the opening with the connector.

### 5. Plug in the mating connector

*RMC22 installation*



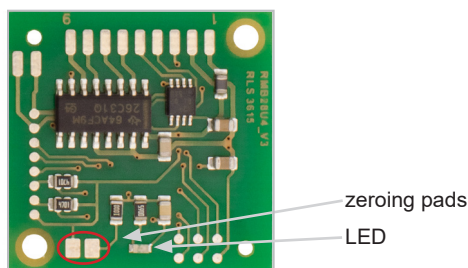
*RMC35 installation*



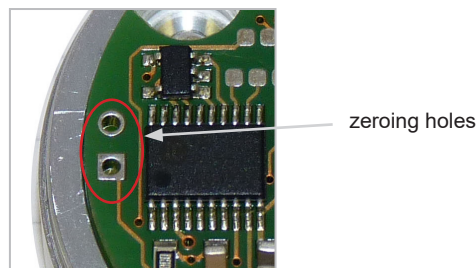
# Zero position setting procedure

Encoder zero position can be easily set by shortening the zeroing pads on the board. After locking the motor at the mechanical zero position short together the two zeroing pads.

The output angle position data can be zeroed at any angle with resolution of 0.0879°.



RMB28U zeroing example



RMC35U zeroing example

The zeroing pads can be shorted to set the zero position of the encoder. If the zeroing is successful, the LED flashes red.

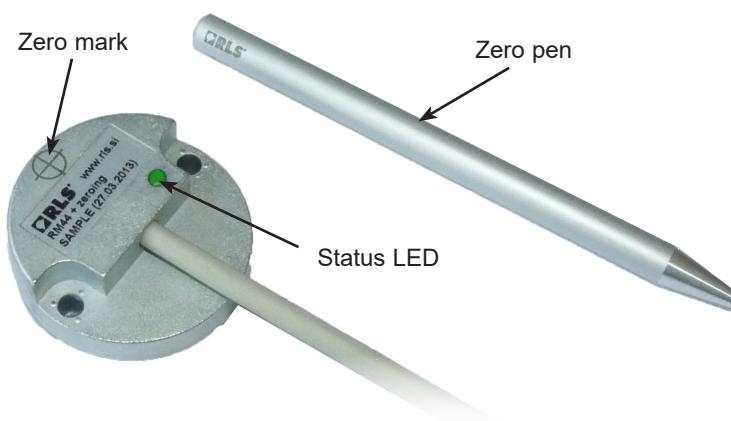
The zeroing holes can be shorted to set the zero position of the encoder.

## External zeroing

**The RM44 encoder-sensor base unit is designed for integration onto electric motors or other devices for shaft position and velocity measurement.**

The RM44 with external zeroing is designed for setting the encoder zero position by using zero pen. It is designed for power supply voltage of 5 V only.

For electrical characteristics and dimensional drawings please refer to RM44 data sheet (RM44D01).



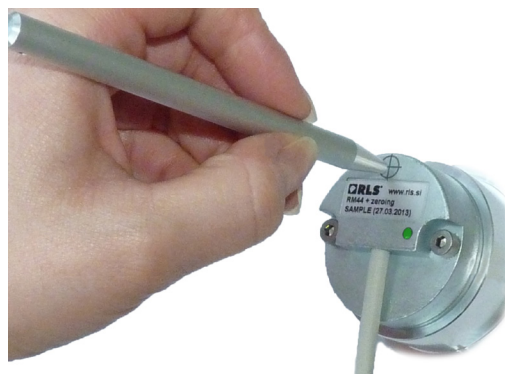
### 1. Install the magnetic actuator and RM44 encoder.

Please refer to RM44 data sheet (RM44D01) for more information.

### 2. Set the mechanical zero position.

### 3. Use the zero pen to set the encoder zero position (see image):

- 3.1 Touch the Zero mark with the apex of the Zero pen - the status LED goes off.
- 3.2 Hold the Zero pen for 3 seconds.
- 3.3 The new Zero position is set when status LED goes RED.

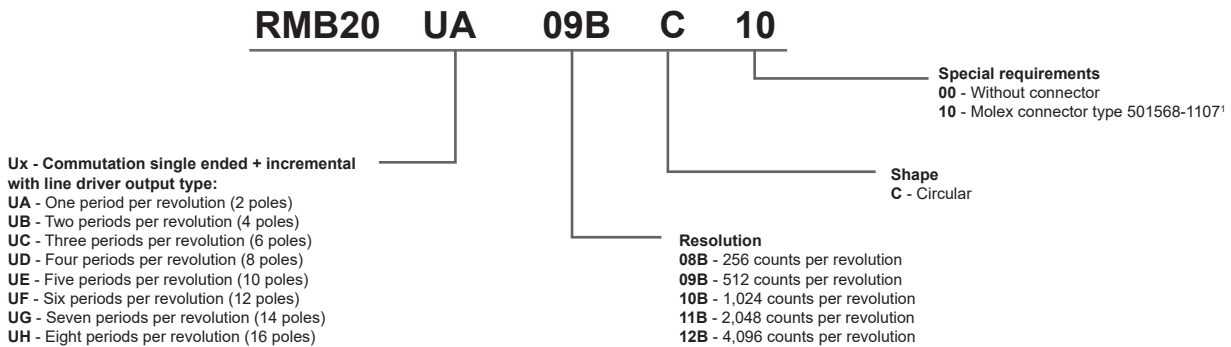


## Status indicator LED

LED	Status
Green	Normal operation
Red	Zero position
No light	Presence of Zero pen

# UVW part numbering

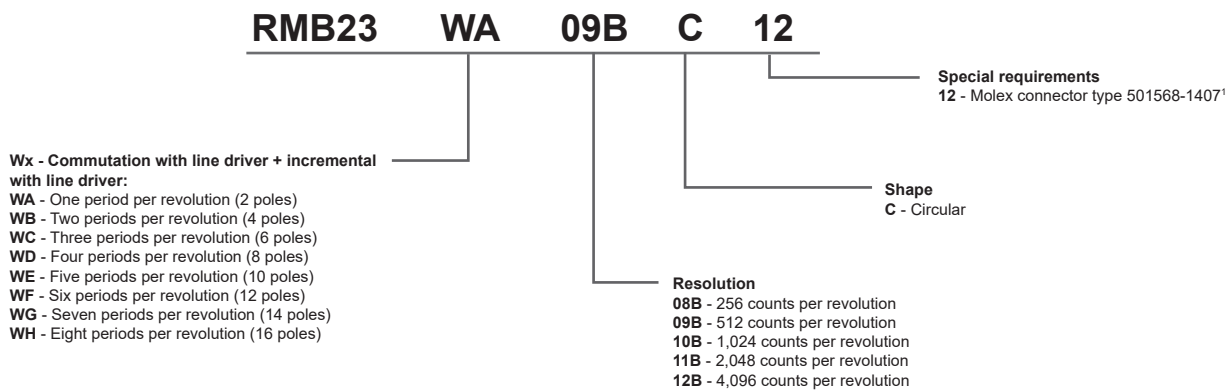
## RMB20Ux (commutation and incremental complementary) part numbering



<sup>1</sup> Mating connector not provided.

Series	Output type	Resolution	Shape	Special requirements
RMB20	UA / UB / UC / UD / UE / UF / UG / UH	12B / 11B / 10B / 09B / 08B	C	00 / 10

## RMB23Wx (commutation, commutation complementary and incremental complementary) part numbering



<sup>1</sup> Mating connector not provided.

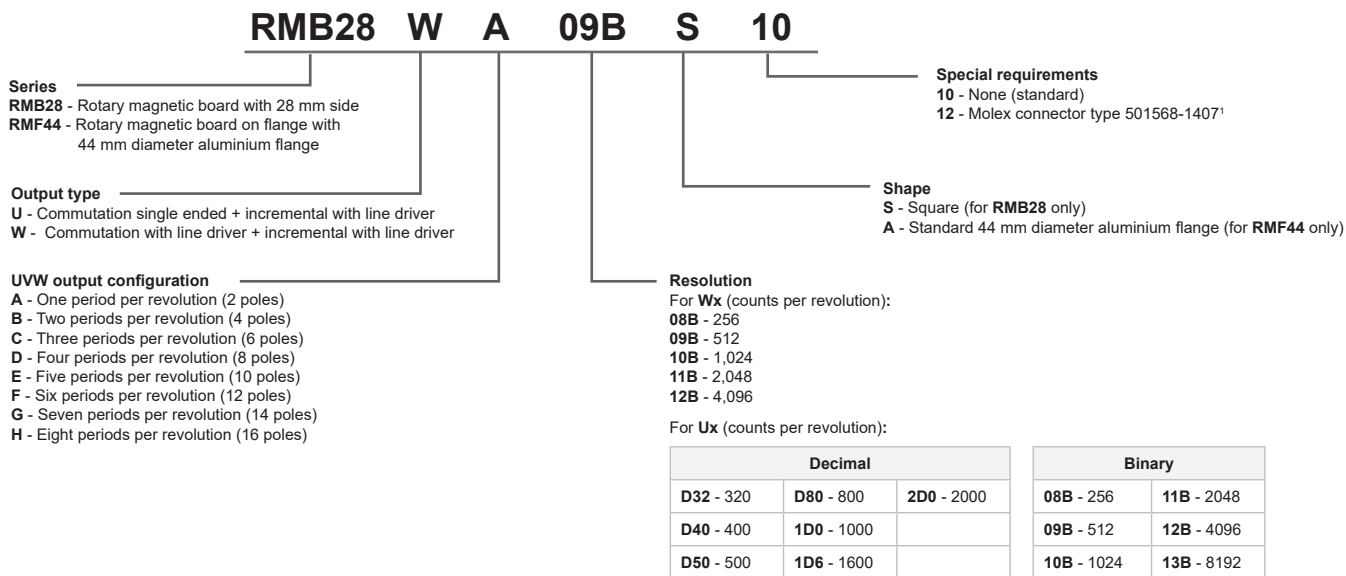
**Please note!**

Not all combinations are valid. Please check below table for available options.

Series	Output type	Resolution	Shape	Special requirements
RMB23	WA / WB / WC / WD / WE / WF / WG / WH	12B / 11B / 10B / 09B / 08B	C	12

# UVW part numbering continued

**RMB28Ux / RMF44Ux and RMB28Wx / RMF44Wx (commutation, commutation complementary and incremental complementary) part numbering**



<sup>1</sup> Mating connector not provided.

**Please note!**

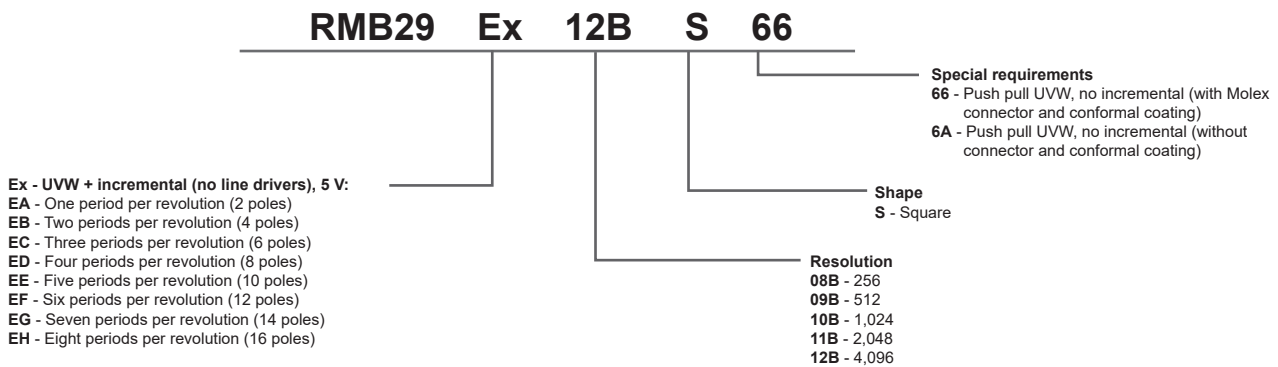
Not all combinations are valid. Please check below table for available options.

Series	Output type	Resolution	Shape	Special requirements
RMB28	UA / UB / UC / UD / UE / UF / UG / UH	2D0 / 1D6 / 1D0 / D80 / D50 / D40 / D32 / 13B / 12B / 11B / 10B / 09B / 08B	S	10 / 12
	WA / WB / WC / WD / WE / WF / WG / WH	12B / 11B / 10B / 09B / 08B		
Series	Output type	Resolution	Shape	Special requirements
RMF44	UA / UB / UC / UD / UE / UF / UG / UH	2D0 / 1D6 / 1D0 / D80 / D50 / D40 / D32 / 13B / 12B / 11B / 10B / 09B / 08B	A	10 / 12
	WA / WB / WC / WD / WE / WF / WG / WH	12B / 11B / 10B / 09B / 08B		



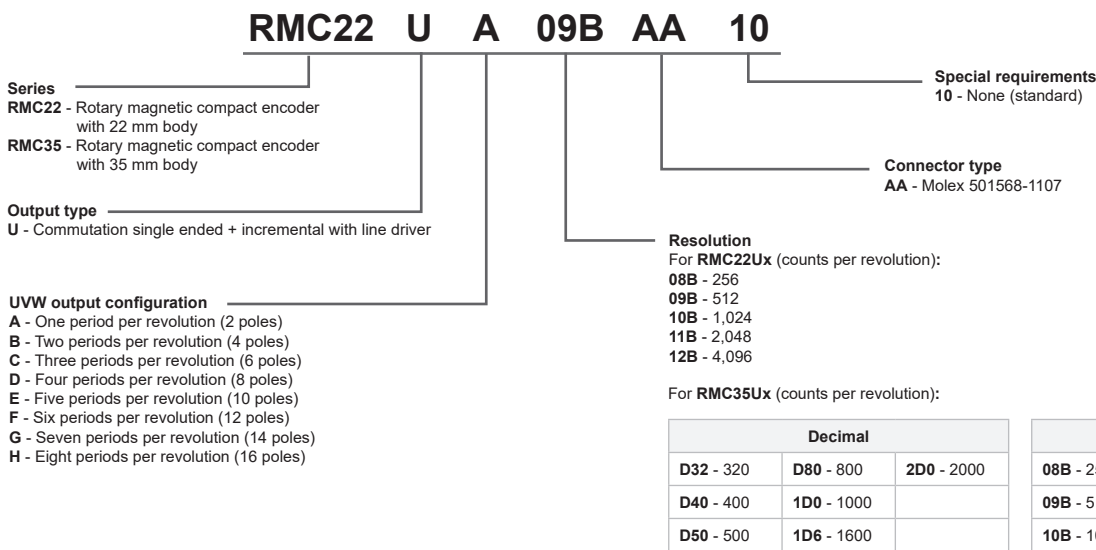
# UVW part numbering continued

## RMB29Ex commutation part numbering



Series	Output type	Resolution	Shape	Special requirements
<b>RMB29</b>	EA / EB / EC / ED / EE / EF / EG / EH	12B / 11B / 10B / 09B / 08B	S	66 / 6A

## RMC22Ux and RMC35Ux part numbering



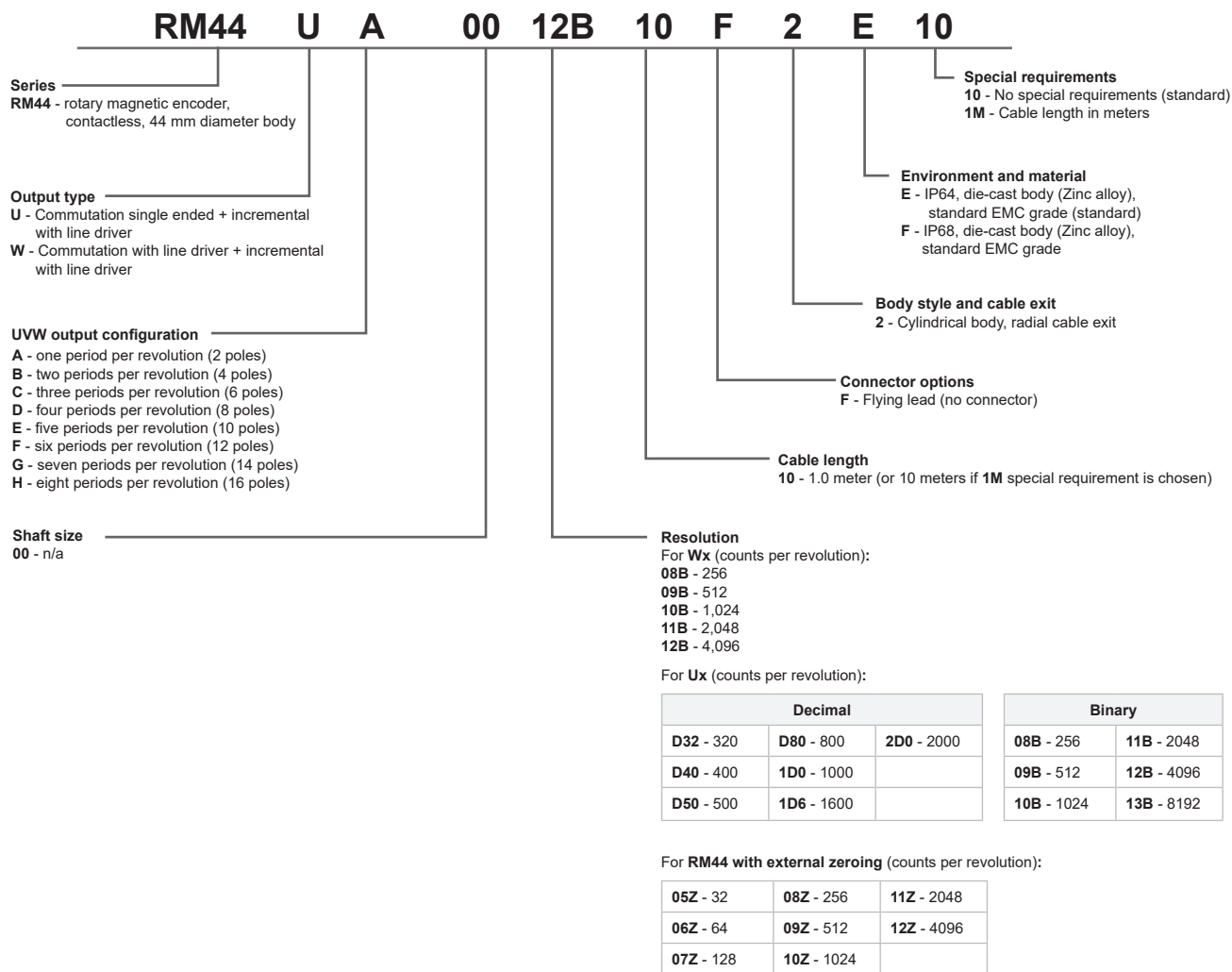
### Please note!

Not all combinations are valid. Please check below table for available options.

Series	Output type	Resolution	Connector type	Special requirements
<b>RMC22</b>	UA / UB / UC / UD / UE / UF / UG / UH	12B / 11B / 10B / 09B / 08B	AA	10
<b>RMC35</b>		2D0 / 1D6 / 1D0 / D80 / D50 / D40 / D32 / 13B / 12B / 11B / 10B / 09B / 08B		

# UVW part numbering continued

## RM44Ux / Wx (commutation and incremental complementary) part numbering



**Please note!**

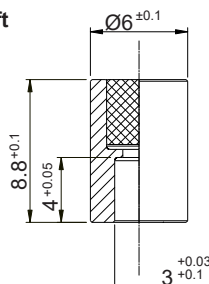
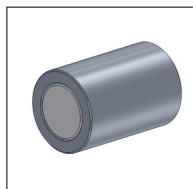
Not all combinations are valid. Please check below table for available options.

Series	Output type	Shaft size	Resolution	Cable length	Connector type	Body style	Environment and material	Special requirements
RM44Ux	UA / UB / UC / UD / UE / UF / UG / UH	00	2D0 / 1D6 / 1D0 / D80 / D50 / D40 / D32 / 13B / 12B / 11B / 10B / 09B / 08B	10	F	2	E / F	10 / 1M
	WA / WB / WC / WD / WE / WF / WG / WH		12B / 11B / 10B / 09B / 08B					
RM44Ux with external zeroing	UA / UB / UC / UD / UE / UF / UG / UH		12Z / 11Z / 10Z / 09Z / 08Z / 07Z / 06Z / 05Z					

# Magnetic actuator and magnet part numbering

Dimensions and tolerances in mm.

## Actuator for integration onto shaft

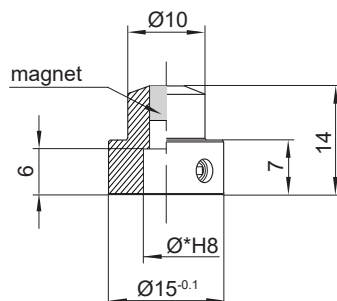


Fixing: Glue (recommended – LOCTITE 648 or LOCTITE 2701)

### Part number:

For resolutions from 10 bit absolute (800 cpr incremental) and above  
**RMA03A3A07** – Ø3 mm shaft

## 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:

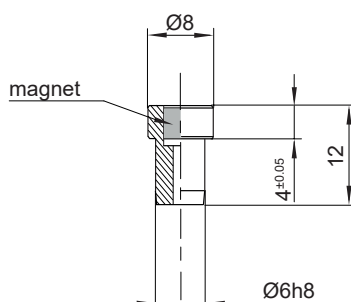
For resolutions up to 9 bit absolute (512 cpr incremental)

<b>RMA04A2A00</b> – Ø4 mm shaft	<b>RMA10A2A00</b> – Ø10 mm shaft
<b>RMA05A2A00</b> – Ø5 mm shaft	<b>RMA19A2A00</b> – Ø3/16" shaft
<b>RMA06A2A00</b> – Ø6 mm shaft	<b>RMA25A2A00</b> – Ø1/4" shaft
<b>RMA08A2A00</b> – Ø8 mm shaft	<b>RMA37A2A00</b> – Ø3/8" shaft

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

<b>RMA04A3A00</b> – Ø4 mm shaft	<b>RMA10A3A00</b> – Ø10 mm shaft
<b>RMA05A3A00</b> – Ø5 mm shaft	<b>RMA19A3A00</b> – Ø3/16" shaft
<b>RMA06A3A00</b> – Ø6 mm shaft	<b>RMA25A3A00</b> – Ø1/4" shaft
<b>RMA08A3A00</b> – Ø8 mm shaft	<b>RMA37A3A00</b> – 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 scribed to a ±5° accuracy:

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

**RMH06A2A02**

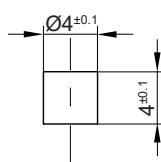
For resolutions from 10 bit absolute (800 cpr incremental) and above

**RMH06A3A02**

Hole = Ø6G7

Fixing: Glue (recommended – LOCTITE 648 or 2701)

## Magnet for direct recessing in non-ferrous shafts



### 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)

Fixing: Glue (recommended – LOCTITE 648 or 2701)

# Accessories part numbering



Zeroing pen  
Part number: ZEROPEN00

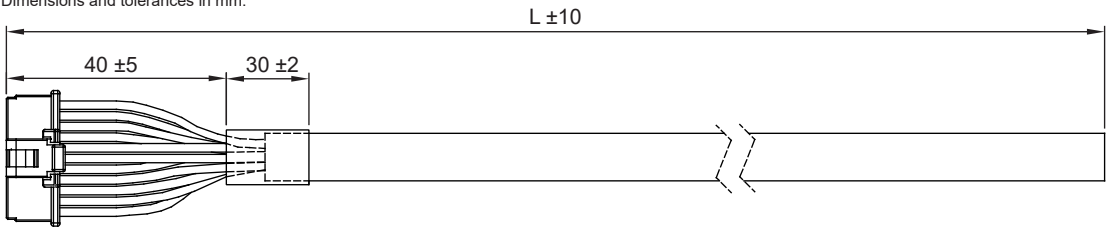
## Cable assembly

Cable specifications for connection of Molex 501330-1100, 12 core

Part numbers	ACC001 (cable length: 30 cm) ACC002 (cable length: 50 cm) ACC003 (cable length: 100 cm)
Connector	Molex 501330-1100, 11 pins
Wire diameter	AWG26 (0.14 mm²)
Sheath color	Grey (RAL7032)
Rated voltage	250 V
Operating temperature	From –30 °C to +125 °C
Environmental conformation	RoHS conform 73/23/EWG-Guideline CE conform Halogen free

## Dimensions

Dimensions and tolerances in mm.



Pin	Wire color
1	Blue
2	Red
3	Brown
4	White
5	Green
6	Yellow
7	Grey
8	Pink
9	Black
10	Violet
11	Grey/Pink



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## Document issues

Issue	Date	Page	Amendments done
1	26. 6. 2017	-	New document
2	26. 3. 2018	7	RMF44 installation drawing amended
		8, 16	RM44 Wx output added
3	19. 9. 2019	2, 6, 15	RMB23 Wx module added
		7	Technical drawing RMF44 amended
		8, 11	Resolutions amended
		10, 11	Magnet tolerance in RMC22Ux and RMC35Ux / Wx installation drawings amended
		20-21	ACC for RMC35W added
4	2. 4. 2020	2, 12, 17	RMC Wx module removed
		20	Accessories part numbering amended
		21	ACC for RMC35W removed
5	27. 9. 2021	10	RM44 dimensions amended

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