

# **RM44 and RM58** Rotary Magnetic Encoders with AM4096

The RM44/RM58 is an encoder for integration onto electric motors or other devices for measuring shaft position and rotational speed.

The solid metal housing provides highest IP protection classes, high EMC immunity, extended operating temperature range and best possible shock and vibration resistance.



# **Features and benefits**

- Industry standard output formats
- Up to 12 bit resolution
- Up to 4,096 counts per revolution for 5 V or 24 V incremental power supply
- Accuracy up to ±0.5°

- Easy to install with self locating design
- Excellent price-performance ratio
- ▶ Fully sealed to IP68





# **General information**

The encoder system consists of a magnet/magnetic actuator\* and a separate encoder body. The rotation of the magnetic actuator is read and processed by a custom encoder chip in the encoder body to obtain the required output format. A system accuracy of  $\pm 0.5^{\circ}$  can be achieved with the supplied magnet. For easy integration onto or into the shaft, a range of magnetic actuators is also available. The output signals are provided in industry standard absolute, incremental, analogue sinusoidal and linear voltage formats. Available are resolutions of up to 12 bit absolute SSI and/or 4,096 counts per revolution incremental for 5 V or 24 V power supply.



\* Magnetic actuator is magnet inside metal housing.

If you need a shaft encoder, please refer to the **RE58 data sheet**, which describes how RM44 can be converted into an RE58 by adding a flange.



# Product range

RM44/RM58AC	RM44/RM58BC	RM44/RM58Ix
Analogue with a single sine/cosine cycle per revolution.	Analogue complementary sinusoidal output with a single sine/cosine period per revolution.	Incremental with 80 to 2,048 pulses per revolution (320 to 4,096 counts per revolution with x 4 evaluation).
RM44/RM58SC	RM44/RM58SI	
Synchro serial interface (SSI) with 320	Synchro serial interface (SSI with 320	

Synchro serial interface (SSI) with 320 to 4,096 positions per revolution.

Synchro serial interface (SSI with 320 to 4,096 positions per revolution and incremental with 80 to 2,048 pulses per revolution (320 to 4,096 counts per revolution with x 4 evaluation).

# Selection guide

		Power supply		
Product	Available outputs	5 V	24 V	
	AC - Analogue sinusoidal outputs	$\checkmark$	-	
	BC – Analogue complementary sinusoidal outputs	$\checkmark$	-	
	IA - Incremental, push-pull	-	~	
RM44 / RM58	IC - Incremental, RS422	$\checkmark$	-	
	IE - Incremental, open collector NPN	$\checkmark$	-	
	SC - Absolute binary synchro-serial interface (SSI), RS422	$\checkmark$	-	
	SI - Absolute binary synchro-serial (SSI) + Incremental, RS422	$\checkmark$	-	

# Storage and handling





-40 °C to +125 °C (IP64) -40 °C to +85 °C (IP68) -30 °C to +80 °C (for AC output)





Power to RM44 encoders must be supplied from a DC SELV supply complying with the essential requirements of EN (IEC) 60950 or similar specification. The RM44 series encoders have been designed to the relevant EMC standards, but must be correctly integrated to achieve EMC compliance. In particular, attention to shielding arrangements is critical.





#### Readhead is ESD sensitive - handle with care.

Do not touch electronic circuit, wires or sensor area without proper ESD protection or outside of ESD controlled environment.

### Packaging

Each encoder is packed individually in an antistatic bag.

#### Magnet packaging:

- RMM44A2A00 (individually packed) for sample quantities only
- RMM44A2C00 (packed in tubes)
- RMM44A3A00 (individually packed) for sample quantities only
- RMM44A3C00 (packed in tubes)



# **Dimension drawings**

Dimensions and tolerances are in mm. Dimensions without tolerance values are in accordance with ISO 2768-m.

### **RM44**



#### Clockwise (CW) rotation of magnetic actuator







Ø11.4 min.

0.5





# **Installation drawing**



The magnet should not be in direct contact with ferrous material. When using the RMM44 magnet, the shaft must be non-ferrous.

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# **Installation tolerances**

### Installation tolerances for RM44/RM58



– Encoder 📃 - Magnet

# **Technical specifications**

### Mechanical data

Housing material	Zamak
Cable	Outside diameter 5 mm
Mass	Encoder unit 1 m cable (no connector) IP64 112 g, IP68 129 g Magnetic actuator <2 g

### **Environmental data**

Operating and storage temperature	–40 °C to +125 °C (IP64) –40 °C to +85 °C (IP68) –30 °C to +80 °C (for AC output)
Environmental sealing	IP64 (IP68 optional) EN 60529
EMC compliance	EN 61326
Shock	100 G (6 ms, standard EN 60068-2-27:2009)
Vibration	40 G (55 Hz–2000 Hz, standard EN 60068-2-6:2008)
Temperature drift error	0.004°/°C



15 pin

# **Electrical connections**

#### 9 pin D-type connector (male type)



	A	2	В	:	IA,	IC	IE		so	:
Pin Nr.	Function	Wire colour	Function	Wire colour	Function	Wire colour	Function	Wire colour	Function	Wire colour
1				Shiel	d - see conn	ection dia	gram			
2	V <sub>A</sub>	Black	V <sub>A</sub>	Green	Z+	White	Z	White	Clock	White
3	V <sub>B</sub>	Brown	V <sub>B</sub>	Brown	B+	Green	В	Green	Clock-	Brown
4	NC	-	NC	-	A+	Grey	А	Grey	NC	-
5	$V_{dd}$	Red	$V_{dd}$	Red	$V_{dd}$	Red	$V_{dd}$	Red	$V_{dd}$	Red
6	NC	-	V <sub>A-</sub>	Yellow	Z-	Brown	NC	-	Data	Green
7	NC	-	V <sub>B-</sub>	White	B-	Yellow	NC	-	Data-	Yellow
8	NC	-	NC	-	A-	Pink	NC	-	NC	-
9	GND	Orange	GND	Blue	GND	Blue	GND	Blue	GND	Blue

#### 9-way connector pin-out







15-pin connector pin-out

]5.8 ±0.4	
39.3 ±0.4	

	S	I
Pin Nr.	Func- tion	Wire colour
1	Shi	eld
2	A+	Grey
3	A-	Pink
4	B+	Green
5	B-	Yellow
6	Z+	White
7	Z-	Brown
8	$V_{dd}$	Red
9	Clock+	Black
10	Clock-	Violet
11	NC	-
12	Data+	Grey/ Pink
13	Data-	Red/ Bue
14	NC	-
15	GND	Blue

### Shield connection

Figure below shows a recommended shield termination in order to ensure electromagnetic compatibility.



Housing of the encoder is galvanically connected with the housing of the connector via the cable outer shield. The encoder system must be correctly integrated to achieve EMC compliance. In particular, attention to shielding arrangements is essential.

### Cable

Output type	IA, IC, IE, SC, BC	AC	SI
Cable specification	LI12YC12Y	LiYCY	LI12YC
Configuration	$4 \times 2 \times 0.14 \text{ mm}^2$ (Twisted pairs)	4 x 0.20 mm <sup>2</sup>	12 x 0,14 mm <sup>2</sup>
Outer diameter		Approx. 5 mm	
Wires AWG	AWG 26	AWG 24	AWG 26
Rated Voltage	250 V	300 V	150 V
Mass	38 g/m	38 g/m	40 g/m

# **Output types**

# AC – Analogue sinusoidal outputs

2 channels V<sub>A</sub> V<sub>B</sub> sinusoids (90° phase shifted, single ended)

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Power supply	$V_{dd} = 5 V \pm 5 \%$
Current consumption	Max. 30 mA
Outputs	Single ended
Internal serial impedance	100 Ω
Signal amplitude	2.2 ±0.2 V <sub>pp</sub>
Signal offset (V <sub>ref</sub> )	2.5 V ±1 %
Maximum speed	60,000 rpm
Operating temperature	-30 °C to +80 °C

### Timing diagram





# BC – Analogue complementary sinusoidal outputs

2 channels  $V_{\scriptscriptstyle A}$  and  $V_{\scriptscriptstyle B}$  differential sinusoids

#### Specifications

Power supply	$V_{dd} = 5 V \pm 5 \%$
Current consumption	Max. 30 mA
Outputs	Differential
Internal serial impedance	10 Ω
Signal amplitude	0.5 ±0.1 V <sub>pp</sub>
Signal offset (V <sub>ref</sub> )	0 ±5 mV
Maximum speed	30,000 rpm
Operating temperature	–40 °C to +125 °C (IP64) –40 °C to +85 °C (IP68)

### Timing diagram



# IA – Incremental, push-pull

24 V supply Square wave output

#### Specifications

V <sub>dd</sub> = 8 V to 26 V
50 mA
A, B, Z, A–, B–, Z– (RS422)
30 mA
Typ. ±0.5°
0.18°
8 to 1,024 pulses per revolution (32, 64, 128, 256, 512, 1024, 2048, 4096 counts per revolution)
30,000 rpm
–40 °C to +125 °C (IP64) –40 °C to +85 °C (IP68)

### Timing diagram

Complementary signals not shown



B leads A for clockwise rotation of magnetic actuator.



# IC – Incremental, RS422

Square wave differential line driver to RS422

#### Specifications

1			
Power supply	$V_{dd} = 5 V \pm 5 \%$		
Current consumption	Max. 35 mA		
Output signals         A, B, Z, A-, B-, Z- (RS422)			
Accuracy	Typ. ±0.5°		
Hysteresis	0.18°		
Resolution	8 to 1,024 pulses per revolution (32, 64, 128, 256, 512, 1024, 2048, 4096 counts per revolution)		
Maximum speed	30,000 rpm		
Operating temperature	-40 °C to +125 °C (IP64) -40 °C to +85 °C (IP68)		

Timing diagram Complementary signals not shown



B leads A for clockwise rotation of magnetic actuator.

#### **Recommended signal termination**



# IE – Incremental, open collector, NPN

Low cost alternative for ball bearing encoders

#### Specifications

•					
Power supply	$V_{dd} = 5 V \pm 5 \%$				
Current consumption35 mA (not loaded)					
Output signals	A, B, Z				
Maximum output load 20 mA					
Accuracy	Typ. ±0.5°				
Hysteresis	0.18°				
Resolution	8 to 1,024 pulses per revolution (32, 64, 128, 256, 512, 1024, 2048, 4096 counts per revolution)				
Maximum speed	30,000 rpm				
Operating temperature	–40 °C to +125 °C (IP64) –40 °C to +85 °C (IP68)				

### Timing diagram



B leads A for clockwise rotation of magnetic actuator.

#### **Recommended signal termination**





# SC – Absolute binary synchro-serial interface (SSI), RS422

Serial encoded absolute position measurement

#### **Specifications**

1			
Output code	Natural binary		
Power supply	$V_{dd} = 5 V \pm 5 \%$		
Current consumption     Max. 35 mA			
Data output	Serial data (RS422)		
Data input     Clock (RS422)			
Accuracy	Typ. ±0.5°		
Hysteresis	0.18°		
Resolution	32, 64, 128, 256, 512, 1024, 2048, 4096 positions per revolution		
Maximum speed	30,000 rpm		
Operating temperature	-40 °C to +125 °C (IP64) -40 °C to +85 °C (IP68)		

#### Timing diagram



Position increases for clockwise rotation of magnetic actuator.

#### **Recommended signal termination**

For data output lines only



# SI – Absolute binary synchro-serial (SSI) + Incremental, RS422

Complex feedback device for absolute position at start up as well as during operation + incremental outputs. Both the incremental and the SSI output always have the same fixed resolution.

Specifications	
Output code	Natural binary
Power supply	$V_{dd} = 5 V \pm 5 \%$
Current consumption	Max. 35 mA
Incremental outputs	A, B, Z, A–, B–, Z– (RS422)
Data output	Serial data (RS422)
Data input	Clock (RS422)
Accuracy	Тур. ±0.5°
Hysteresis	0.18°
Resolution	8 to 1,024 pulses per revolution (32, 64, 128, 256, 512, 1024, 2048, 4096 counts per revolution)
Maximum speed	30,000 rpm
Operating temperature	–40 °C to +125 °C (IP64) –40 °C to +85 °C (IP68)

#### **Timing diagram - SSI**



Position increases for clockwise rotation of magnetic actuator.

# Timing diagram - Incremental Complementary signals not shown



B leads A for clockwise rotation of magnetic actuator.

### **Recommended signal termination**

For incremental signals + SSI data output lines only





# Part numbering

	RM44	IC	00	12B	10	F	2	E	96
Series									
RM44 - Ø44 mm body									
RM58 - Ø58 mm body									
Output type									
AC - Absolute analogue single ended, 5 V IE - Incremental, Open Collector, NPN	I, 5 V								
<b>BC</b> - Absolute analogue differential, 5 V <b>SC</b> - Absolute binary synchro-serial (St	SI), RS422	2, 5 V							
IA - Incremental, Push-pull, 8 V to 26 V SI - SSI + Incremental, RS422, 5 V									
IC - Incremental, RS422, 5 V									
Shaft size									
<b>00</b> - N/A									
Prodution									
Resolution For AC/BC:									
<b>01S</b> - One sine/cosine period per revolution									
For <b>Ix, Sx</b> output types (counts/positions per revolution):									
Binary									
05B - 32 08B - 256 11B - 2048									
06B - 64 09B - 512 12B - 4096									
07B - 128 10B - 1024									
Cable length									
<b>10</b> - 1.0 meter (or 10 meters if <b>1M</b> special requirement is chosen)									
Connector options									
<b>A</b> - 'D' type connector - 9 way									
<b>B</b> - 'D' type connector - 15 way (for output type SI only)									
<b>F</b> - Flying lead (no connector)									
Body style and cable exit									
2 - Cylindrical body, radial cable exit									
Environment and material									
E - IP64, die-cast body (Zinc alloy), standard EMC grade (standard)									
<b>F</b> - IP68, die-cast body (Zinc alloy), standard EMC grade									
Currented warming warman to									
Special requirements 9M - With AM4096 and cable length in meters									

**9M** - With AM4096 and cable length in meters **96** - With AM4096 - up to 12 bit

Not all part number combinations are valid. Please refer to the table of available combinations below.

### Table of available combinations

Series	Output type	Shaft size	Resolution	Cable length	Connector option	Body style and cable exit	Material	Special requirements
	AC		045					
	BC		015					
RM44 /	IA		05B / 06B / 07B / 08B / 09B / 10B / 11B / 12B	10	A / F	2	E/F	9M / 96
	IC	00						
	IE							
	SC		050710071107120					
	SI				B/F			

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# Magnetic actuator and magnet ordering information

### Actuator for integration onto shaft





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

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

# 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 absol	ute (512 cpr incremental)
RMA04A2A00 – ID = Ø4 mm	<b>RMA10A2A00</b> – ID = Ø10 mm
<b>RMA05A2A00</b> – ID = Ø5 mm	<b>RMA19A2A00</b> – ID = Ø3/16" mm
<b>RMA06A2A00</b> – ID = Ø6 mm	<b>RMA25A2A00</b> – ID = Ø1/4" mm
RMA08A2A00 – ID = Ø8 mm	<b>RMA37A2A00</b> – ID = Ø3/8" mm
For resolutions from 10 bit abso above	blute (800 cpr incremental) and
4.5010	
<b>RMA04A3A00</b> – ID = Ø4 mm	<b>RMA10A3A00</b> – ID = Ø10 mm
<b>RMA05A3A00</b> – ID = Ø5 mm	<b>RMA19A3A00</b> – ID = Ø3/16" mm
RMA06A3A00 – ID = Ø6 mm	<b>RMA25A3A00</b> – ID = Ø1/4" mm
<b>RMA08A3A00</b> – ID = Ø8 mm	<b>RMA37A3A00</b> – ID = Ø3/8" mm

#### 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)

If you need a shaft encoder, please refer to the **RE58 data sheet**, which describes how the RM44 can be converted into an RE58 by adding a flange.



# Accessories





USB interface (for incremental encoders) <u>E201-9Q</u>



USB interface (for SSI communication interface) **E201-95** 



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### Document issues

Issue	Date	Page	Description
1	6. 12. 2024	General	Redesign of RM44D06

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