

# RM22 series non-contact rotary encoders



**The RM22 is a compact, high-speed rotary magnetic encoder designed for use in harsh environments. The non-contact two part design removes the need for seals or bearings ensuring long-term reliability and simple installation.**

The encoder comprises a magnetic actuator and a separate encoder body. Rotation of the magnetic actuator is sensed by a custom encoder chip within the body, and processed to give the required output format.

The encoder chip processes the signals received to provide resolutions to 13 bit (8,192 positions per revolution) with high operational speeds. Output signals are provided in industry standard absolute, incremental, analogue or linear formats.

The compact encoder body is just 22 mm in diameter and provides dirt immunity up to IP68.

The RM22 can be used in a wide range of applications including marine, medical, print, converting, industrial automation, metal working, motor control and instrumentation.

#### Product range

**RM22A** - analogue with a single sine/cosine cycle per revolution

**RM22B** - complementary analogue outputs with a single sine/cosine cycle per revolution

**RM22I** - incremental with 80 to 2,048 pulses per revolution (320 to 8,192 counts per revolution with x 4 evaluation)

**RM22S** - synchro serial interface (SSI) with 320 to 8,192 positions per revolution

**RM22P** - absolute parallel interface with 512 positions per revolution (9 bit)

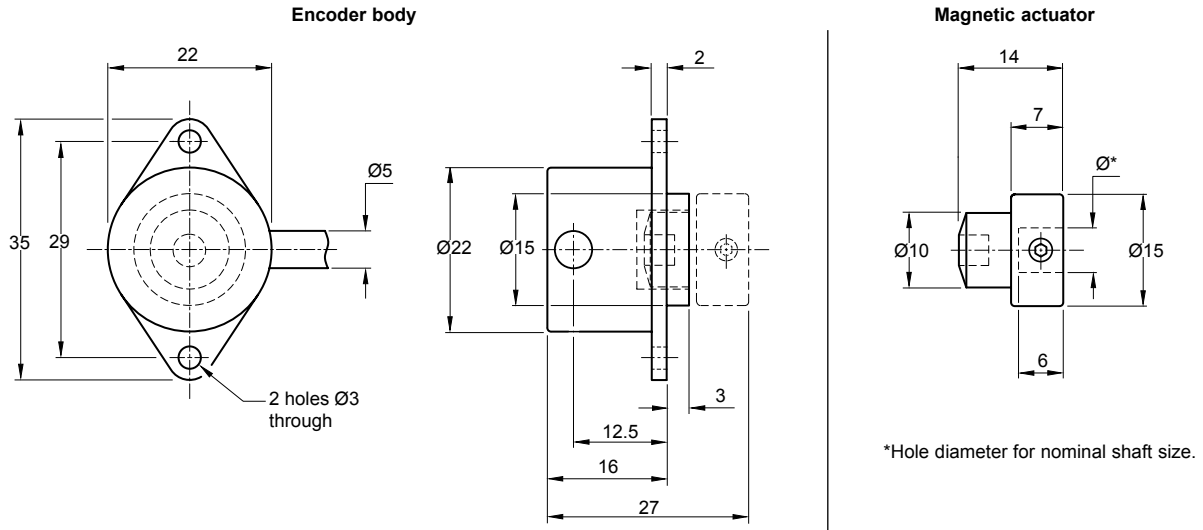
**RM22V** - linear voltage output in a range of variants

#### System features:

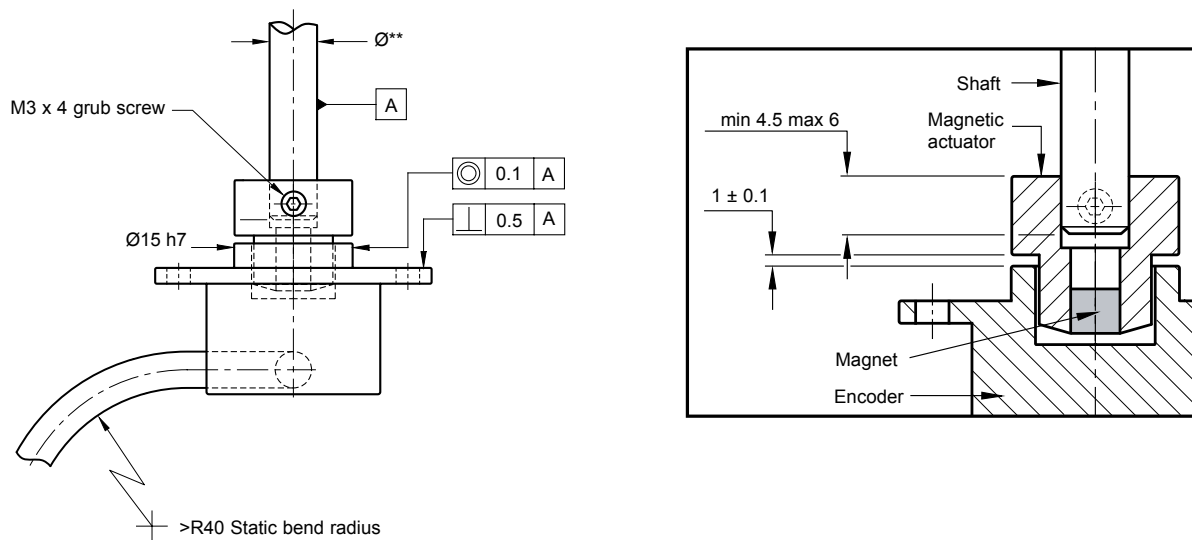
- Excellent immunity to IP68
- Non-contact, frictionless design
- High speed operation to 30,000 rpm
- Compact - 22 mm diameter body
- Absolute - to 13 bit (8,192 positions per revolution)
- Industry standard absolute, incremental, analogue and linear output formats
- Accuracy to  $\pm 0.5^\circ$
- Simple installation

**RM22 dimensions**

Dimensions and tolerances in mm



**RM22 installation drawing**



\*\*Nominal shaft size with tolerance h7.

**Operating and electrical specifications**

<b>Humidity (for IP64 version)</b>	Storage 95% maximum relative humidity (non-condensing) (IEC 61010-1) Operating 80% maximum relative humidity (non-condensing) (IEC 61010-1)
<b>Acceleration</b>	Operating 500 m/s <sup>2</sup> BS EN 60068-2-7:1993 (IEC 68-2-7:1983)
<b>Shock (non-operating)</b>	1000 m/s <sup>2</sup> , 6 ms, 1/2 sine BS EN 60068-2-27:1993 (IEC 68-2-27:1987)
<b>Vibration (operating)</b>	100 m/s <sup>2</sup> max at 55 to 2000 Hz BS EN 60068-2-6:1996 (IEC 68-2-6:1995)
<b>EMV compliance</b>	BS EN 61326
<b>Cable</b>	Outside diameter 5 mm
<b>Mass</b>	Encoder unit 1 m cable (no connector) 48 g. Magnetic actuator 12 g
<b>Environmental sealing</b>	IP64 (IP68 optional) BS EN 60529

## RM22I – Incremental outputs

Square wave differential line driver to RS422A

<b>Power supply</b>	$V_{dd} = 5\text{ V} \pm 5\%$
<b>Power consumption</b>	23 mA for 9 bit resolution 35 mA for all other resolutions
<b>Output signals</b>	A, B, Z, A-, B-, Z- (RS422A)
<b>Max. cable length</b>	50 m
<b>Connector options</b>	9 pin 'D' type plug (standard) Flying lead
<b>Temperature</b>	Operating -25 °C to +85 °C (-40 °C to +125 °C option 08)* Storage -40 °C to +125 °C
<b>Edge separation</b>	Min. 1 $\mu\text{s}$

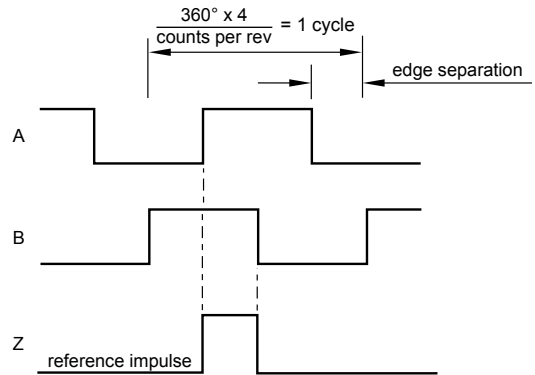
\* Only available with IP64 sealing

Resolution options (counts per rev)	Maximum speed (rpm)	Accuracy*	Hysteresis
320, 400, 500	30,000	$\pm 0.7^\circ$	0.18°
512	30,000	$\pm 0.7^\circ$	0.45°
800, 1,000, 1,024	20,000	$\pm 0.5^\circ$	0.18°
1,600, 2,000, 2,048	10,000	$\pm 0.5^\circ$	0.18°
4,096	5,000	$\pm 0.5^\circ$	0.18°
8,192	2,500	$\pm 0.5^\circ$	0.18°

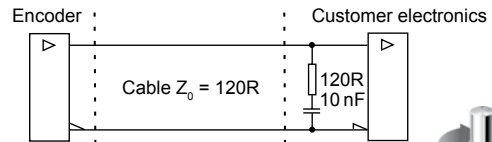
\* Worst case within operational parameters including magnet position and temperature.

## Timing diagram

(complementary signals not shown)



## Recommended signal termination



B leads A for clockwise rotation of magnetic actuator



## RM22S – Absolute binary synchro-serial interface (SSI)

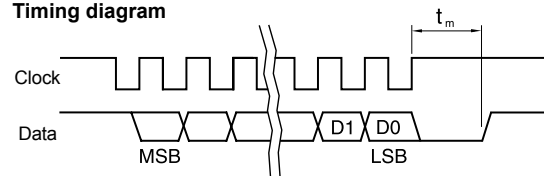
Serial encoded absolute position measurement

<b>Output code</b>	Natural binary
<b>Power supply</b>	$V_{dd} = 5\text{ V} \pm 5\%$
<b>Power consumption</b>	23 mA for 9 bit resolution 35 mA for all other resolutions
<b>Repeatability</b>	$\leq 0.07^\circ$
<b>Data outputs</b>	Serial data (RS422A)
<b>Data inputs</b>	Clock (RS422A)
<b>Max. cable length</b>	100 m (at 1 MHz)
<b>Connector options</b>	9 pin 'D' type plug (standard) Flying lead
<b>Temperature</b>	Operating -40 °C to +125 °C (IP64) -40 °C to +85 °C (IP68) Storage -40 °C to +85 °C

Resolution options (positions per rev)	Maximum speed (rpm)	Accuracy*	Hysteresis
320, 400, 500	30,000	$\pm 0.7^\circ$	0.18°
512	30,000	$\pm 0.7^\circ$	0.45°
800, 1,000, 1,024	20,000	$\pm 0.5^\circ$	0.18°
1,600, 2,000, 2,048	10,000	$\pm 0.5^\circ$	0.18°
4,096	5,000	$\pm 0.5^\circ$	0.18°
8,192	2,500	$\pm 0.5^\circ$	0.18°

\* Worst case within operational parameters including magnet position and temperature.

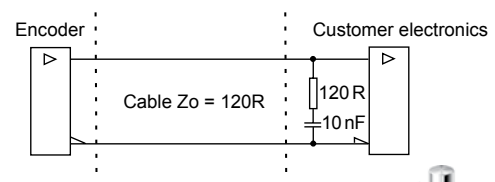
## Timing diagram



Clock  $\leq 900\text{ kHz}$   $16\ \mu\text{s} \leq t_m \leq 22\ \mu\text{s}$  (for 9 bit resolution)  
Clock  $\leq 4\text{ MHz}$   $12.5\ \mu\text{s} \leq t_m \leq 20.5\ \mu\text{s}$  (for all other resolutions)

## Recommended signal termination

(For data output lines only)



Position increases for clockwise rotation of magnetic actuator



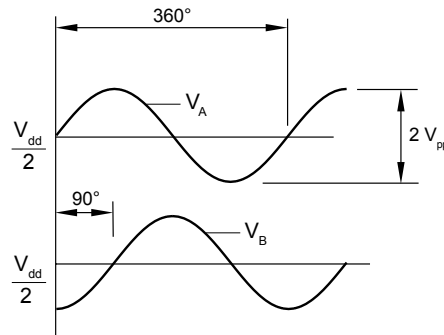
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**RM22A – Analogue sinusoidal outputs**

2 channels  $V_A$   $V_B$  sinusoids (90° phase shifted, single ended)

<b>Power supply</b>	$V_{dd} = 5\text{ V} \pm 5\%$
<b>Power consumption</b>	20 mA
<b>Outputs</b>	Signal amplitude $2 \pm 0.2 V_{pp}$ Signal offset $\frac{V_{dd}}{2} \pm 5\text{ mV}$
<b>Max. output frequency</b>	500 Hz
<b>Max. cable length</b>	3 m
<b>Connector options</b>	9 pin 'D' type plug (standard) Flying lead
<b>Temperature</b>	Operating $-40\text{ }^\circ\text{C}$ to $+125\text{ }^\circ\text{C}$ (IP64) $-40\text{ }^\circ\text{C}$ to $+85\text{ }^\circ\text{C}$ (IP68) Storage $-40\text{ }^\circ\text{C}$ to $+85\text{ }^\circ\text{C}$
<b>Maximum speed</b>	30,000 rpm
<b>Internal serial impedance</b>	720 $\Omega$

**Timing diagram**



$V_A$  leads  $V_B$  by  $90^\circ$  for clockwise rotation of magnetic actuator

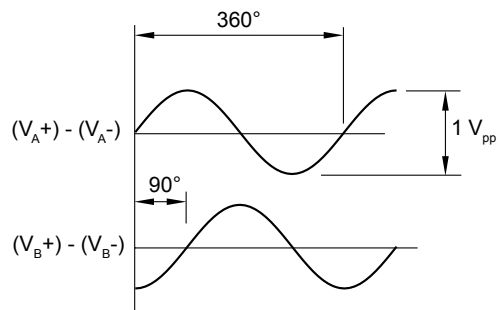


**RM22B – Analogue complementary sinusoidal outputs**

2 channels  $V_A$  and  $V_B$  differential sinusoids in quadrature ( $90^\circ$  phase shifted)

<b>Power supply</b>	$V_{dd} = 5\text{ V} \pm 5\%$
<b>Power consumption</b>	20 mA
<b>Outputs</b>	Signal amplitude $0.5 \pm 0.1 V_{pp}$ Signal offset $\frac{V_{dd}}{2} \pm 5\text{ mV}$
<b>Max. output frequency</b>	500 Hz
<b>Max. cable length</b>	20 m
<b>Connector options</b>	9 pin 'D' type plug (standard) Flying lead
<b>Temperature</b>	Operating $-25\text{ }^\circ\text{C}$ to $+85\text{ }^\circ\text{C}$ Storage $-25\text{ }^\circ\text{C}$ to $+85\text{ }^\circ\text{C}$
<b>Maximum speed</b>	30,000 rpm
<b>Internal serial impedance</b>	100 $\Omega$

**Timing diagram**



$V_A$  leads  $V_B$  by  $90^\circ$  for clockwise rotation of magnetic actuator

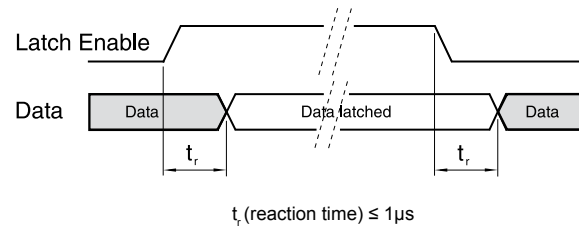


## RM22P – Absolute binary parallel interface

Parallel absolute position measurement

<b>Output code</b>	Natural binary
<b>Power supply</b>	$V_{dd} = 5\text{ V} \pm 5\%$
<b>Power consumption</b>	20 mA without load
<b>Output voltage</b>	$V_H \geq 4\text{ V}$ at $-I_H \leq 3\text{ mA}$ $V_L \leq 1\text{ V}$ at $I_L \leq 3\text{ mA}$
<b>Resolution</b>	9 bit (512 positions per revolution)
<b>Hysteresis</b>	$0.45^\circ$
<b>Accuracy</b>	$\pm 0.7^\circ$
<b>Repeatability</b>	$\leq 0.07^\circ$
<b>Data outputs</b>	D0 (LSB) - D8 (MSB)
<b>Data inputs</b>	LE - latch enable input signal, active high Maximum sampling rate 500 kHz
<b>Max. cable length</b>	30 m
<b>Connector options</b>	15 pin 'D' type plug (standard) Flying lead
<b>Temperature</b>	Operating $-40\text{ }^\circ\text{C}$ to $+125\text{ }^\circ\text{C}$ (IP64) $-40\text{ }^\circ\text{C}$ to $+85\text{ }^\circ\text{C}$ (IP68) Storage $-40\text{ }^\circ\text{C}$ to $+85\text{ }^\circ\text{C}$
<b>Maximum speed</b>	30,000 rpm

### Timing diagram

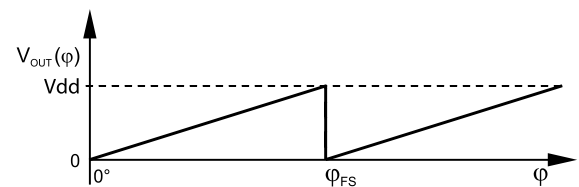


Position increases for clockwise rotation of magnetic actuator

## RM22V – Linear voltage output

<b>Power supply</b>	$V_{dd} = 5\text{ V} \pm 5\%$
<b>Power consumption</b>	20 mA typical
<b>Output voltage</b>	0 V to $V_{dd}$
<b>Output loading</b>	Max. 10 mA
<b>Nonlinearity</b>	1 %
<b>Max. cable length</b>	20 m
<b>Connector options</b>	9 pin 'D' type plug (standard) Flying lead
<b>Temperature</b>	Operating $-40\text{ }^\circ\text{C}$ to $+125\text{ }^\circ\text{C}$ (IP64) $-40\text{ }^\circ\text{C}$ to $+85\text{ }^\circ\text{C}$ (IP68) Storage $-40\text{ }^\circ\text{C}$ to $+85\text{ }^\circ\text{C}$
<b>Maximum speed</b>	30,000 rpm

### Electrical output/shaft position



### Output type and electrical variant

$\phi_{FS}$	360°	180°	90°	45°
CW	VA	VB	VC	VD
CCW	VE	VF	VG	VH



Image shows clockwise rotation of magnetic actuator

**RM22 ordering code**

Encoder system = Encoder body + Magnetic actuator



**RM22 SC 00 09B 10 A 1 B 00**

**Output type**

- AC - Analogue sinusoidal 2 V<sub>pp</sub>
- BC - Analogue complementary sinusoidal
- IC - Incremental/RS422A
- PC - Absolute binary parallel
- SC - Absolute binary synchro - serial (SSI)
- V<sub>x</sub> - Linear voltage:

Analogue linear voltage output 0 V to 5 V, supply 5 V DC				
	360°	180°	90°	45°
CW	VA	VB	VC	VD
CCW	VE	VF	VG	VH

**Shaft size**

00 - N/A

**Resolution**

09B - 512 counts or positions per revolution (one sine/cosine wave per revolution – for output types AC and BC)

**IC and SC only**

**Decimal**

D32 – 320      D80 – 800      2D0 – 2,000  
 D40 – 400      1D0 – 1,000  
 D50 – 500      1D6 – 1,600

**Binary**

09B – 512      11B – 2,048      13B – 8,192  
 10B – 1,024      12B – 4,096

**Special requirements**

- 00 - None
- 08 - Extended operating temperature range (for output type IC and IP64 only)

**Environment**

- B - IP64, Aluminium body (standard)
- C - IP68, Aluminium body
- J - IP68, Stainless steel body

**Body style and cable exit**

- 1 - Flanged body, radial cable exit

**Connector option**

- A - 'D' type connector - 9 way
- B - 'D' type connector - 15 way (for output type PC only)
- F - Flying lead (no connector)

**Cable length**

- 10 - 1 metre

**NOTE:** Not all combinations are valid.

**For output resolutions of 9-bit (512 count per revolution), please select one of the following magnetic actuators:**

- |                             |                              |
|-----------------------------|------------------------------|
| RMA04A2A00 - 4 mm dia shaft | RMA10A2A00 - 10 mm dia shaft |
| RMA05A2A00 - 5 mm dia shaft | RMA19A2A00 - 3/16" dia shaft |
| RMA06A2A00 - 6 mm dia shaft | RMA25A2A00 - 1/4" dia shaft  |
| RMA08A2A00 - 8 mm dia shaft | RMA37A2A00 - 3/8" dia shaft  |

**For output resolutions of 10-bit (1024 count per revolution) or higher, please select one of the following magnetic actuators:**

- |                             |                              |
|-----------------------------|------------------------------|
| RMA04A3A00 - 4 mm dia shaft | RMA10A3A00 - 10 mm dia shaft |
| RMA05A3A00 - 5 mm dia shaft | RMA19A3A00 - 3/16" dia shaft |
| RMA06A3A00 - 6 mm dia shaft | RMA25A3A00 - 1/4" dia shaft  |
| RMA08A3A00 - 8 mm dia shaft | RMA37A3A00 - 3/8" dia shaft  |

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## Document issues

Issue	Date	Page	Corrections made

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