Data sheet
RM22D01_05
Issue 5, 19th January 2023

RM22 rotary magnetic encoder

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

RM22AC

Analogue with a single sine/cosine cycle per revolution

RM22BC

Complementary analogue outputs with a single sine/cosine cycle per revolution

RM22DC

BiSS C interface with up to 8,192 counts per revolution and optional revolution counter.

RM22IC

Incremental with 80 to 2,048 pulses per revolution (320 to 8,192 counts per revolution with x 4 evaluation)

RM22SC

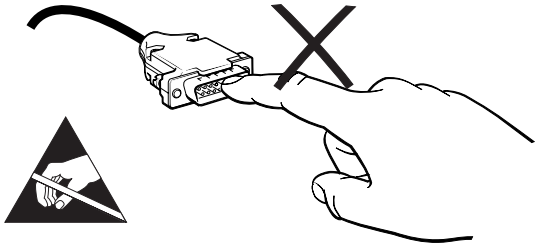
Synchro serial interface (SSI) with 320 to 8,192 positions per revolution

RM22Vx

Linear voltage output in a range of variants

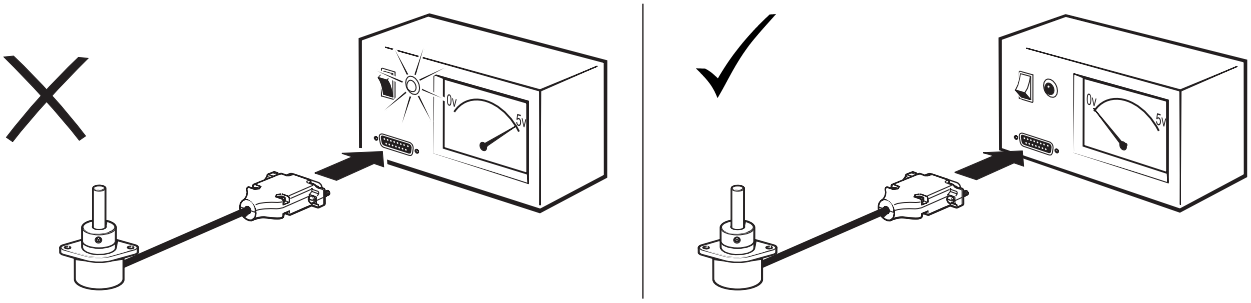
- **Excellent immunity to IP68**
- **Non-contact, frictionless design**
- **High speed operation to 30,000 rpm**
- **Compact - 22 mm diameter body**
- **Absolute - to 13 bit (8,192 positions per revolution)**
- **Industry standard absolute, incremental, analogue and linear output formats**
- **Accuracy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

Storage and handling

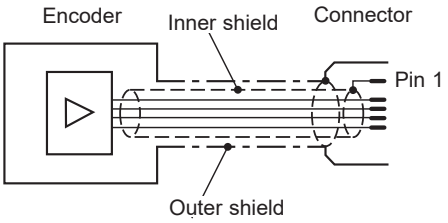


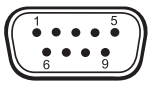
IMPORTANT: Power to RM22 encoders must be supplied from a DC SELV supply complying with the essential requirements of EN (IEC) 60950 or similar specification.

The RM22 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.



Connections





D' type connector - 9 way

Pin nr.	RM22AC		RM22BC		RM22DC		RM22IC		RM22SC		RM22V	
	Function	**Wire colour**	**Function**	**Wire colour**	**Function**	**Wire colour**	**Function**	**Wire colour**	**Function**	**Wire colour**	**Function**	**Wire colour**
1	Shield - see connection diagram		Shield - see connection diagram				Shield - see connection diagram		Shield - see connection diagram			
2	V_A	Green	V_{A+}	Green	MA+	White	Z	White	Clock	White	NC	–
3	V_B	Brown	V_{B+}	Brown	MA–	Brown	B	Green	Clock–	Brown	V_{out}	Green
4	NC	–	NC	–	NC	–	A	Grey	NC	–	NC	–
5	V_{dd}	Red	V_{dd}	Red	V_{dd}	Red	V_{dd}	Red	V_{dd}	Red	V_{dd}	Red
6	NC	–	V_{A-}	Yellow	SLO+	Green	Z–	Brown	Data	Green	NC	–
7	NC	–	V_{B-}	White	SLO–	Yellow	B–	Yellow	Data–	Yellow	NC	–
8	NC	–	NC	–	NC	–	A–	Pink	NC	–	NC	–
9	GND	Blue	GND	Blue	GND	Blue	GND	Blue	GND	Blue	GND	Blue

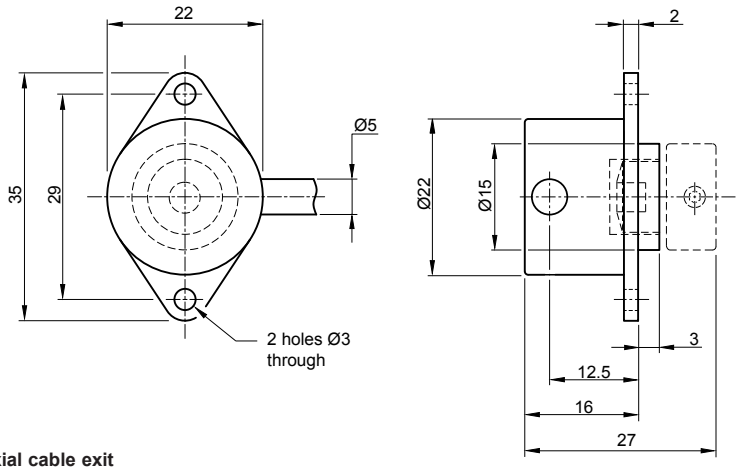
Operating and electrical specifications

EMC compliance	EN 61326
Cable	Outside diameter 5 mm
Connector options	'D' type connector - 9 way Flying lead
Mass	Encoder unit 1 m cable (no connector): 48 g; magnetic actuator: 12 g
Environmental sealing	IP64 (IP68 optional) EN 60529

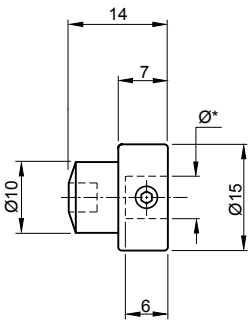
Dimensions

Dimensions and tolerances in mm

Radial cable exit

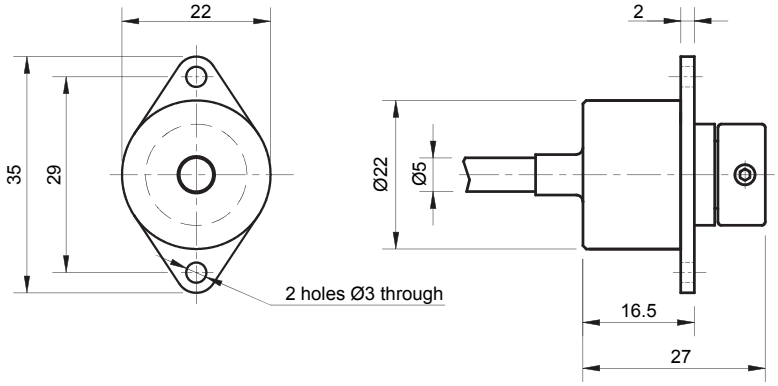


Magnetic actuator



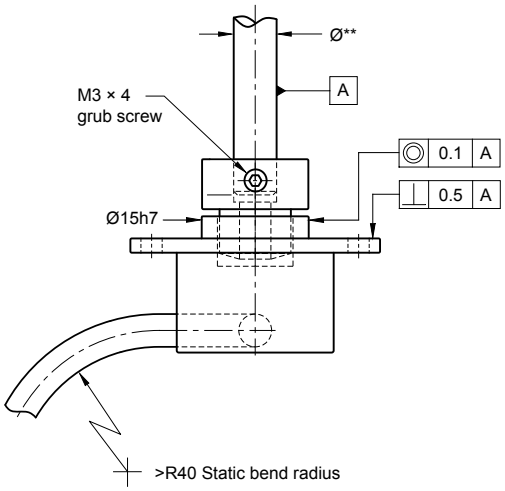
* Hole diameter for nominal shaft size.

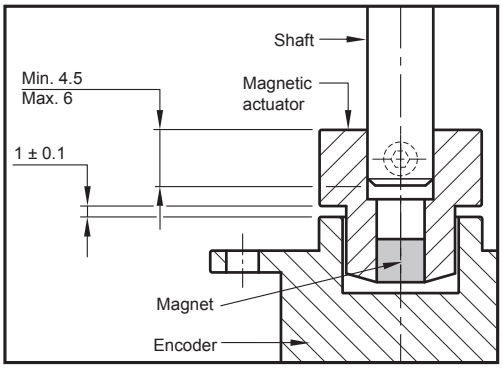
Axial cable exit



Clockwise (CW) rotation of magnetic actuator.

Installation drawing





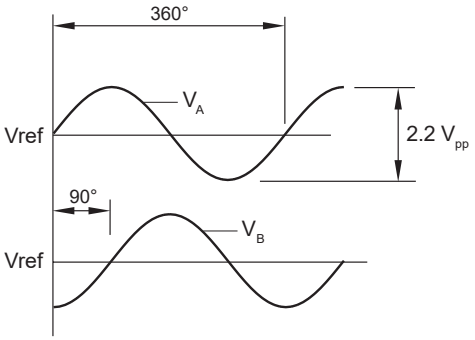
** Nominal shaft size with tolerance h7.

RM22AC – Analogue sinusoidal outputs

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

Power supply	V_{dd} = 5 V ± 5 %
Power consumption	30 mA
Outputs	Single ended Signal amplitude 2.2 ±0.2 V_{pp} Signal offset (Vref) 2.5 V ±1 %
Internal serial impedance	10 Ω
Maximum speed	30,000 rpm
Maximum cable length	3 m
Operating temperature	–40 °C to +125 °C (IP64) –40 °C to +85 °C (IP68)

Timing diagram



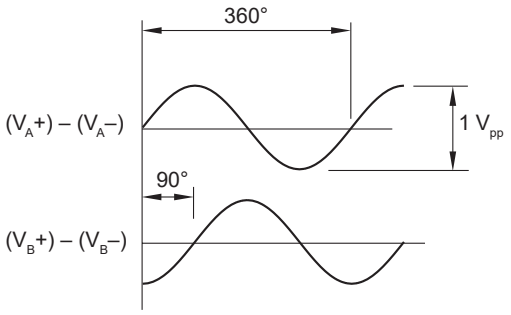
V_A leads V_B by 90° for clockwise rotation of magnetic actuator.

RM22BC – Analogue complementary sinusoidal outputs

2 channels V_A and V_B differential sinusoids in quadrature (90° phase shifted)

Power supply	V_{dd} = 5 V ±5 %
Power consumption	30 mA
Outputs	Differential Signal amplitude 0.5 ±0.1 V_{pp} Signal offset (Vref) 0 ±5 mV
Internal serial impedance	10 Ω
Maximum speed	30,000 rpm
Maximum cable length	20 m
Operating temperature	–40 °C to +85 °C (IP68)

Timing diagram

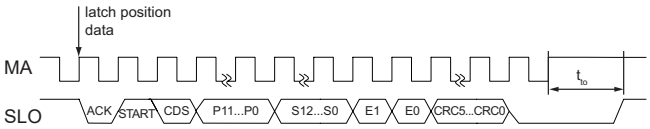


V_A leads V_B by 90° for clockwise rotation of magnetic actuator.

RM22DC – Absolute natural binary BiSS C interface

Output code	Natural binary
Power supply	V_{dd} = 5 V ±5 %
Current consumption	Max. 50 mA
Clock input	MA (RS422)
Data output	SLO (RS422)
Max MA frequency	8 MHz
Accuracy	Typ. ±0.5°
Hysteresis	0.18°
Resolution	320, 400, 500, 512, 800, 1,000, 1,024, 1,600, 2,000, 2,048, 4,096, 8,192 positions per revolution
Revolution counter	12 bit (4096 revolutions)
Maximum speed	30,000 rpm
Operating temperature	–40 °C to +125 °C (IP64) –40 °C to +85 °C (IP68)

Timing diagram – BiSS C



Data	Length	Description
P11 – P0	0 or 12 bit	Revolution counter value when enabled (see Part numbering/ resolution)*
S12 – S0	7 to 13 bit	Position inside the revolution (length depends on the resolution)
E1 – E0	2 bit	Error data
CRC5 – CRC0	5 to 6 bit	Cyclic redundancy check data; polynomial 0x43; inverted bit output

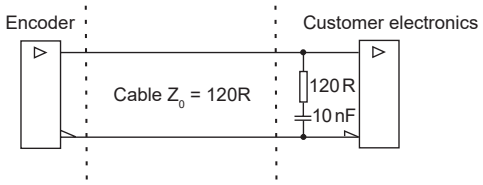
Error	E0	E1
No error	1	1
Amplitude error	0	1
Too high velocity	1	0
Undervoltage; Configuration; System error	0	0

* The revolution counter counts the number of mechanical revolutions of the shaft or magnet of the encoder. Counting is possible only when the encoder is powered. When the encoder is powered off, the revolution counter is reset to 0.

For more information on BiSS C protocol please visit www.biss-interface.com.

Recommended signal termination

For data output lines only



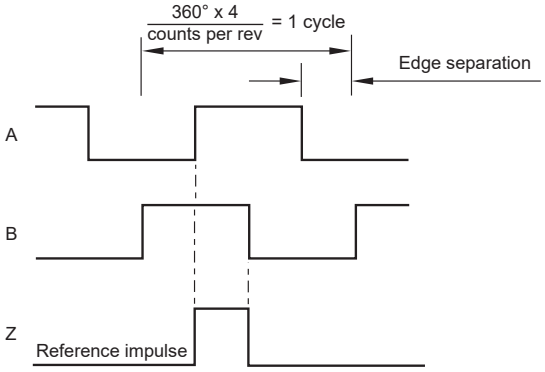
RM22IC – Incremental, RS422

Square wave differential line driver to RS422

Power supply	V_{dd} = 5 V ±5 %
Power consumption	Max. 35 mA
Output signals	A, B, Z, A–, B–, Z– (RS422)
Accuracy	Typ. ±0.5°
Hysteresis	0.18°
Resolution	80 to 2,048 pulses per revolution (320, 400, 500, 512, 800, 1,000, 1,024, 1,600, 2,000, 2,048, 4,096, 8,192 counts per revolution)
Maximum speed	30,000 rpm
Maximum cable length	50 m
Operating temperature	–40 °C to +125 °C (IP64) –40 °C to +85 °C (IP68)

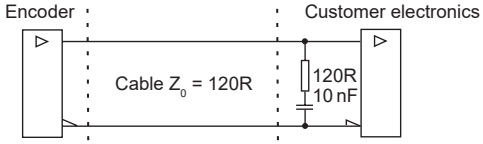
Timing diagram

Complementary signals not shown



B leads A for clockwise rotation of magnetic actuator.

Recommended signal termination

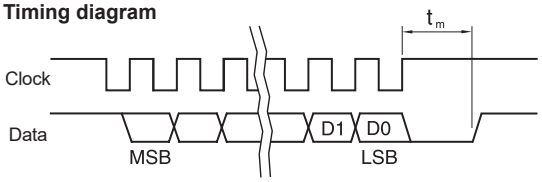


RM22SC – Absolute binary synchro-serial interface (SSI)

Serial encoded absolute position measurement

Output code	Natural binary
Power supply	V_{dd} = 5 V ±5 %
Power consumption	Max. 35 mA
Data output	Serial data (RS422)
Data input	Clock (RS422)
Accuracy	Typ. ±0.5°
Hysteresis	0.18°
Resolution	320, 400, 500, 512, 800, 1,000, 1,024, 1,600, 2,000, 2,048, 4,096, 8,192 positions per revolution
Maximum speed	30,000 rpm
Maximum cable length	100 m (at 1 MHz)
Operating temperature	–40 °C to +125 °C (IP64) –40 °C to +85 °C (IP68)

Timing diagram

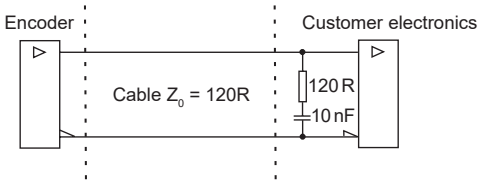


Clock ≤ 4 MHz 12.5 µs ≤ t_m ≤ 20.5 µs

Position increases for clockwise rotation of magnetic actuator.

Recommended signal termination

For data output lines only

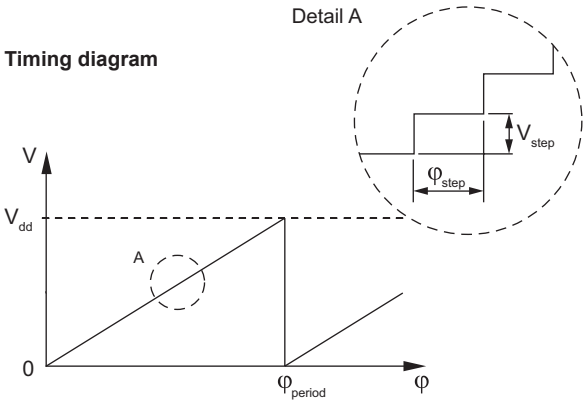


RM22Vx – Linear voltage output

Alternative for potentiometers

Power supply	V_{dd} = 5 V ± 5 %
Power consumption	Typ. 26 mA
Output voltage	0 V to V_{dd}
Output loading	Max. 10 mA
Nonlinearity	1 %
Maximum speed	30,000 rpm
Maximum cable length	20 m
Operating temperature	–40 °C to +125 °C (IP64) –40 °C to +85 °C (IP68)

Timing diagram



φ_{period}	N_{period}	N_{step}	φ_{step}
360°	1	1,024	0.35°
180°	2	1,024	0.18°
90°	4	1,024	0.09°
45°	8	512	0.09°

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

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

Output type and electrical variant

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

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.

Part numbering

Encoder system = Encoder body + Magnetic actuator

=

+

Encoder body part number
eg **RM22SC0009B10A1B00**

Magnetic actuator
eg **RMA06A2A00**

RM22 SC 00 09B 10 A 1 B 00

Output type
AC - Analogue sinusoidal 2 V_{pp}
BC - Analogue complementary sinusoidal
DC - Absolute natural binary BiSS C, RS422
IC - Incremental, RS422
SC - Absolute binary synchro - serial (SSI), RS422
Vx - Linear voltage:

Linear voltage output 0 - 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
For **AC** and **BC**:
01S - One sine/cosine wave per revolution

For **DC, IC** and **SC** (counts/positions per revolution):

Decimal			Binary	
D32 - 320	**D80** - 800	**2D0** - 2000	**09B** - 512	**12B** - 4096
D40 - 400	**1D0** - 1000		**10B** - 1024	**13B** - 8192
D50 - 500	**1D6** - 1600		**11B** - 2048	

For output types **DC** with enabled 12 bit revolution counter:

Decimal			Binary	
M32 - 320	**M80** - 800	**2M0** - 2000	**09M** - 512	**12M** - 4096
M40 - 400	**1M0** - 1000		**10M** - 1024	**13M** - 8192
M50 - 500	**1M6** - 1600		**11M** - 2048	

For **Vx:**
10B - 1,024 steps per revolution

Special requirements
00 - No special requirements (standard)
0M - Cable length in meters

Environment and material
B - IP64, Aluminium body (standard)
C - IP68, Aluminium body
J - IP68, Stainless steel body (for Body style 1 only)

Body style and cable exit
1 - Flanged body, radial cable exit
4 - Flanged body, axial cable exit

Connector option
A - 'D' type connector - 9 way
F - Flying lead (no connector)

Cable length
10 - 1 meter (or 10 meters if **0M** special requirement is chosen)

NOTE: Not all combinations are valid.

Magnetic actuator ordering information

Actuator for integration onto shaft

Shaft = Ø*h7
Fixing: Grub screw provided

* Hole diameter for nominal shaft size.

Part numbers:

For resolutions of 9 bit absolute (512 cpr incremental)

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

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

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

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Document issues

Issue	Date	Page	Corrections made
1	13. 1. 2009	-	New layout
2	14. 2. 2017	2	Storage and handling, connections added
		3	Axial cable exit drawing added
		6	Linear voltage power consumption updated, Parallel output removed
		7	Parallel output and extended operating temperature range removed, magnetic actuator ordering info and special option 0M added
		General	Data sheet design updated
3	4. 7. 2018	4, 5	Resolution amended
4	2. 2. 2022	General	DC output added
5	19. 1. 2023	General	DC output wire color amended, revolution counter added