Data sheet
RE22D01_10
Issue 10, 12th September 2023

RE22 rotary magnetic shaft encoder

The RE22 is a compact, high-speed rotary magnetic encoder designed for use in harsh environments. The traditional design allows for easy integration to existing machines.

A magnet is mounted to the shaft within the encoder body. Rotation of this magnet 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 of up 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 IP53.

The RE22 can be used in a wide range of applications including marine, medical, print, converting, industrial automation, metal working and instrumentation.

Product range

RE22AC
Analogue with a single sine/cosine cycle per revolution

RE22BC
Complementary analogue outputs with a single sine/cosine cycle per revolution

RE22DC
BiSS C interface with up to 8,192 positions per revolution and optional revolution counter

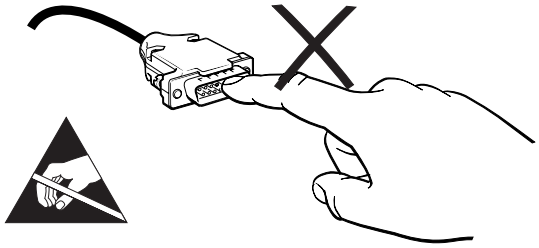
RE22IC
Incremental with 80 to 2,048 pulses per revolution (320 to 8,192 counts per revolution with x 4 evaluation)

RE22SC
Synchro serial interface (SSI) with 320 to 8,192 positions per revolution

RE22Vx
Linear voltage output in a range of variants

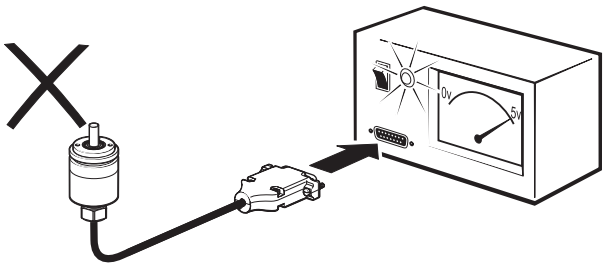
- **High speed operation to 30,000 rpm**
- **Compact - 22 mm diameter body**
- **Absolute - to 13 bit (8,192 ppr)**
- **Industry standard absolute, incremental, analogue and linear output formats**
- **Accuracy to ±0.3°**
- **Simple integration**

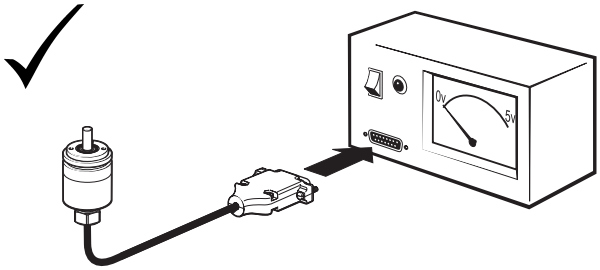
Storage and handling



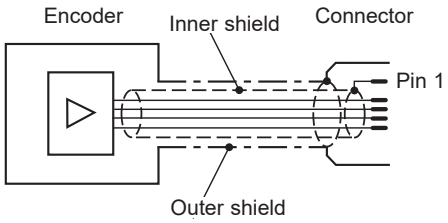
IMPORTANT: Power to RE22 encoders must be supplied from a DC SELV supply complying with the essential requirements of EN (IEC) 60950 or similar specification.

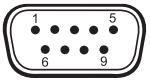
The RE22 series encoders have been designed to the relevant EMC standards, but must be correctly integrated to achieve EMC compliance. In particular, attention to shielding arrangements is critical.





Connections





D' type connector - 9 way

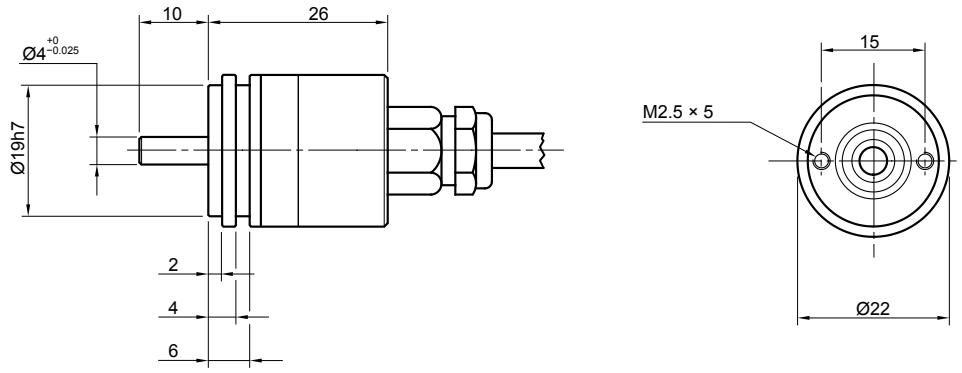
	RE22AC		RE22BC		RE22DC		RE22IC		RE22SC		RE22V	
Pin nr.	**Function**	**Wire colour**	**Function**	**Wire colour**	**Function**	**Wire colour**	**Function**	**Wire colour**	**Function**	**Wire colour**	**Function**	**Wire colour**
1	Shield - see connection diagram		Shield - see connection diagram				Shield - 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 , >R40 static bend radius
Connector options	'D' type connector - 9 way Flying lead
Mass	Encoder unit 1 m cable (no connector) IP53 axial cable 68 g, side cable 60 g.
Environmental sealing	IP53 EN 60529:1992

Installation drawing
Dimensions and tolerances in mm

IP53
Axial cable exit



Radial cable exit

Special option 06
Flat, D-shaped shaft

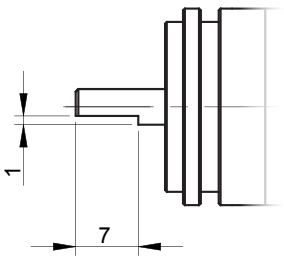


Table of expected bearing life ratings in hours

Speed (rpm)	Rad. load 5 N	Rad. load 10 N	Rad. load 15 N	Rad. load 20 N
500	205,401	98,455	54,569	33,333
1,000	102,700	49,227	27,285	16,667
2,000	51,350	24,613	13,642	8,333
5,000	20,540	9,845	5,457	3,333
10,000	10,270	4,923	2,728	1,667
15,000	6,847	3,282	1,819	1,111
30,000	5,135	2,461	1,364	833

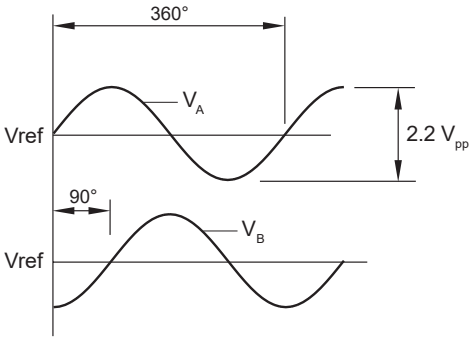
Maximum recommended shaft loads: radial 20N, axial 10N

RE22AC – 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 +120 °C

Timing diagram



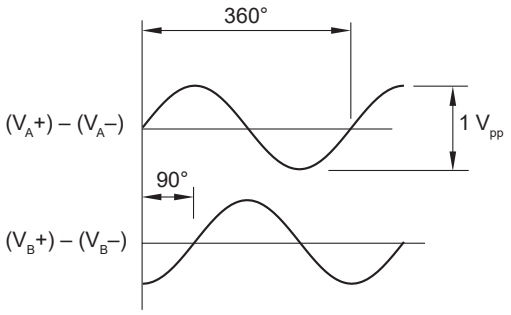
V_A leads V_B by 90° for clockwise rotation of magnetic actuator.

RE22BC – 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 +120 °C

Timing diagram

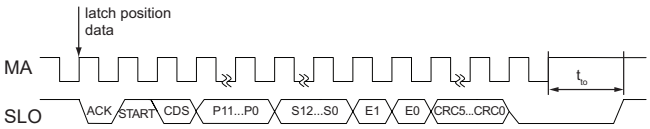


V_A leads V_B by 90° for clockwise rotation of magnetic actuator.

RE22DC – 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)
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 +120 °C
Max MA frequency	8 MHz

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

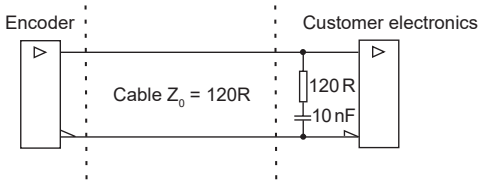
Error	E0	E1
No error	1	1
Amplitude error	0	1
Too high velocity	1	0
Undervoltage; Configuration; System error	0	0

* 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



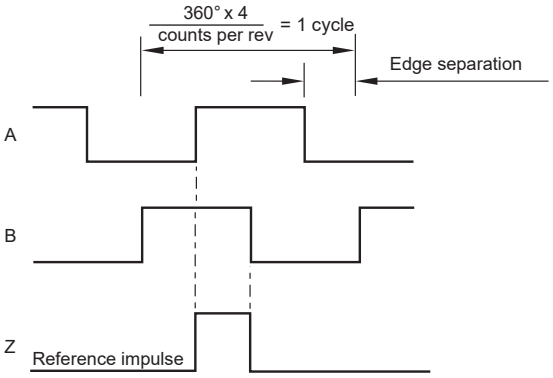
RE22IC – Incremental outputs

Square wave differential line driver to RS422

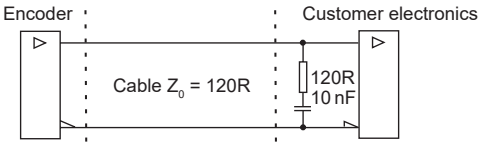
Power supply	V_{dd} = 5 V ±5 %
Power consumption	Max. 35 mA
Output signals	A, B, Z, A–, B–, Z– (RS422)
Accuracy	Typ. ±0.5°
Hysteresis	0.18°
Resolution	80 to 2,048 pulses per revolution (320, 400, 500, 512, 800, 1,000, 1,024, 1,600, 2,000, 2,048, 4,096, 8,192 counts per revolution)
Maximum speed	30,000 rpm
Maximum cable length	50 m
Operating temperature	−40 °C to +120 °C

Timing diagram

Complementary signals not shown



Recommended signal termination

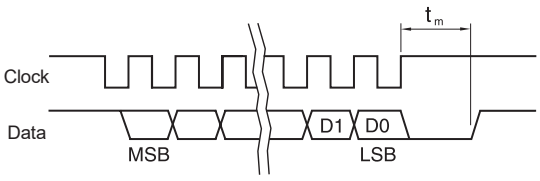


RE22SC – Absolute binary synchro-serial interface (SSI)

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 +120 °C

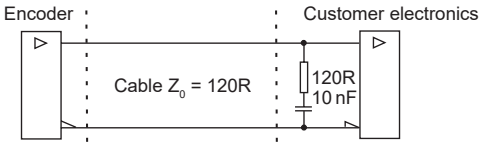
Timing diagram



Clock ≤ 4 MHz 12.5 µs ≤ t_m ≤ 20.5 µs

Recommended signal termination

For data output lines only



RE22Vx – Linear voltage output

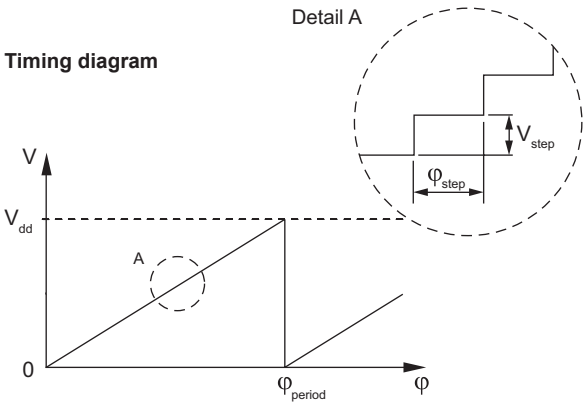
Power supply	V_{dd} = 5 V ±5 %
Power consumption	Typ. 26 mA
Output voltage	0 V to V_{dd}
Output loading	Max. 10 mA
Nonlinearity	1 %
Maximum speed	30,000 rpm
Maximum cable length	20 m
Operating temperature	−40 °C to +120 °C

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°

Output type and electrical variant

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

Timing diagram



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

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

Part numbering

Encoder part number
eg **RE22SC0409B10A3A00**

RE22 SC 04 09B 10 A 3 A 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
04 - 4 mm

Resolution
For output types **AC** and **BC**:
01S - One sine/cosine wave per revolution

For output type **Vx**:
10B - 1,024 positions per revolution

For output types **DC, IC** and **SC** (counts or 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	

Cable length
10 - 1.0 meter (10 meters if **0M** is chosen)

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

Body style and cable exit
2 - Cylindrical body, radial cable exit
3 - Cylindrical body, axial cable exit

Environment and material
A - IP53, aluminium body (standard)

Special requirements
00 - None
06 - With flat, D-shaped shaft
0M - Cable length in meters

NOTE: Not all combinations are valid.

Series	Output type	Shaft size	Resolution	Cable length	Connector option	Body style and cable exit	Environment	Special requirements
RE22	AC	04	01S	10	A / F	2 / 3	A	00 / 06 / 0M
	BC							
	DC		09B / D50 / D40 / D32 / 10B / 1D0 / D80 / 11B / 2D0 / 1D6 /12B / 13B 09M / M50 / M40 / M32 / 10M / 1M0 / M80 / 11M / 2M0 / 1M6 /12M / 13M					
	IC		09B / D50 / D40 / D32 / 10B / 1D0 / D80 / 11B / 2D0 / 1D6 /12B / 13B					
	SC							
	Vx		10B					

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Document issues

Issue	Date	Page	Corrections made
1	13. 1. 2011	-	New document
2	9. 7. 2015	2	Storage and handling info added; connections diagram and table added
		3	Installation drawing tolerances updated, flat D-shaped shaft drawing added
		4–6	Temperature range amended
		6	Parallel output removed
		7	Parallel output removed, resolution options updated and special option 06 added
3	18. 5. 2018	5	Resolutions amended
4	4. 7. 2018	General	Resolutions amended
5	28. 2. 2019	3	IP64/68 radial cable exit drawing removed
6	2. 10. 2019	1	Speed changed
7	2. 2. 2022	General	DC output added
8	19. 5. 2022	2	DC output wire color amended, cable data amended
		General	IP64/IP68 deleted
9	19. 1. 2023	4	BC output temperature amended, revolution counter added
10	12. 9. 2023	5	DC output temperature amended