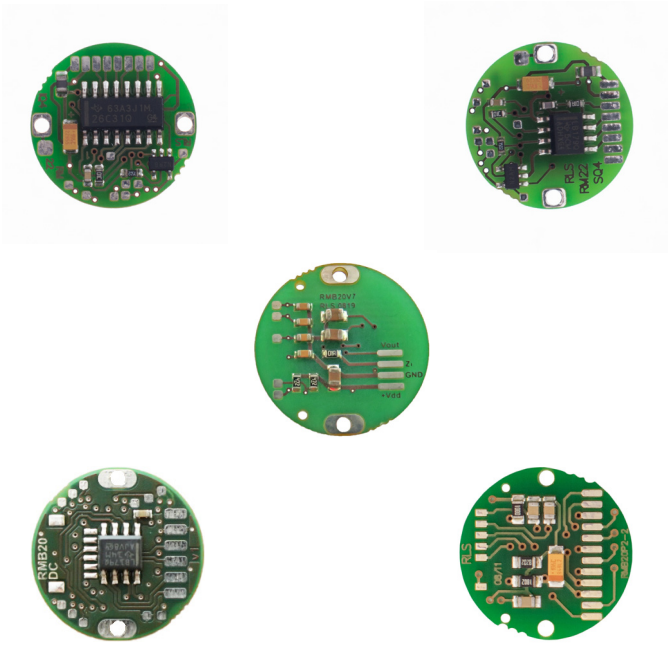
Data sheet
RMB20D01_18
Issue 18, 20th Jaunary 2023

RMB20 angular magnetic encoder module



The RMB20 encoder module provides the functionality of the RM22 encoder in a compact component format for simple customer integration. With a PCB diameter of only 20 mm the module fits into miniature designs.

The encoder module consists of a magnetic actuator and a separate sensor board. Rotation of the magnetic actuator is sensed by a custom encoder chip mounted on the sensor board, and processed to give the required output format. Output signals are provided in industry standard absolute, incremental, analogue, commutation and linear formats.

The RMB20 can be designed into equipment used in a wide range of applications including marine, medical, print, converting, industrial automation, motor control and instrumentation.

Product range

RMB20DC
BiSS C interface with up to 8,192 counts per revolution and optional revolution counter.

RMB20IC
Incremental with 80 to 2,048 pulses per revolution (320 to 8,192 counts per revolution with x4 evaluation).

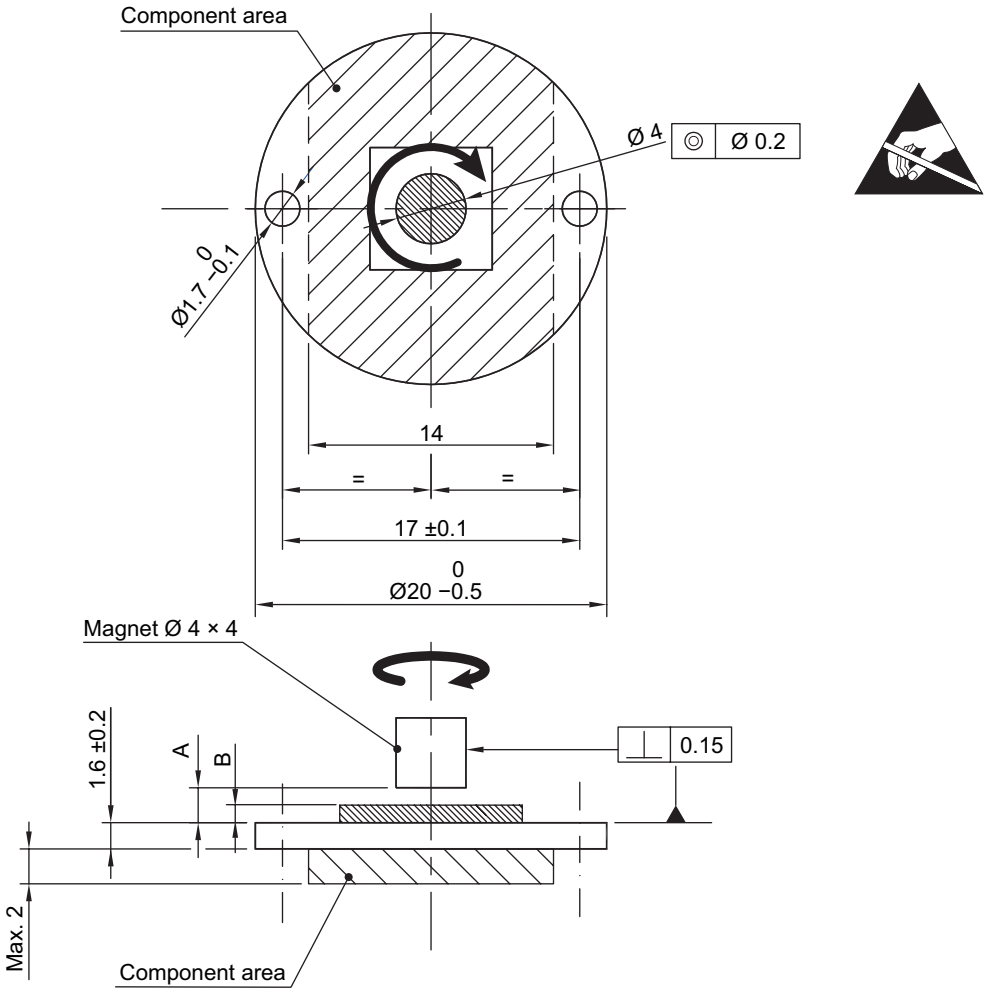
RMB20PC
Absolute parallel interface with 512 positions per revolution (9 bit).

RMB20SC
Synchro serial interface (SSI) with 320 to 8,192 positions per revolution.

RMB20Vx
Linear voltage output in a range of variants.

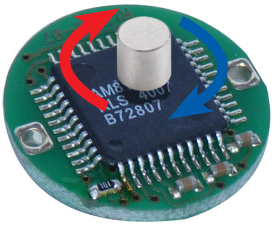
- 20 mm diameter circular module
- 5 V power supply
- High speed operation to 60,000 rpm
- Absolute - to 13 bit resolution (8,192 counts per revolution)
- Industry standard absolute, incremental, commutation and linear voltage output formats
- Accuracy to ±0.5°

Installation drawing



Module	A PCB surface to magnet distance [mm]	B Chip height [mm]
RMB20 DC	2.50 ± 0.2	Max. 1.00
RMB20 IC	3.50 ± 0.2	Max. 1.60
RMB20 PC		
RMB20 SC		
RMB20 Vx	2.80 ± 0.5	Max. 2

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 ±0.1 mm (mid point between the 2 mounting holes).



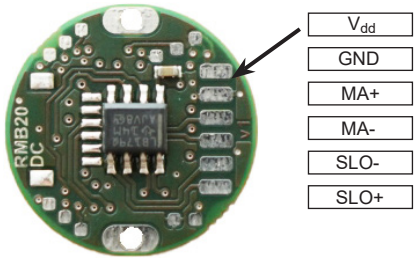
Clockwise (CW) rotation of magnet

RMB20DC – Absolute natural binary BiSS C interface

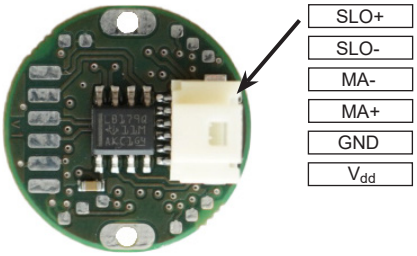
Output code	Natural binary
Power supply	V_{dd} = 5 V ±5 %
Current consumption	Max. 50 mA
Clock input	MA (RS422)
Data output	SLO (RS422)
Accuracy	Typ. ±0.5°
Hysteresis	0.18°
Resolution	320, 400, 500, 512, 800, 1,000, 1,024, 1,600, 2,000, 2,048, 4,096, 8,192 positions per revolution
Revolution counter	12 bit (4096 revolutions)
Maximum speed	30,000 rpm
Operating temperature	–40 °C to +125 °C –40 °C to +105 °C (with connector)
Max MA frequency	8 MHz

Connections

RMB20DC



RMB20DC with connector

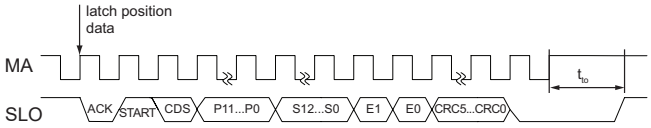


Connector type
Molex 501568-0607

Mating connector
Molex 501330-0600 (not provided)

Crimp terminal
501334-0000 (not provided)

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

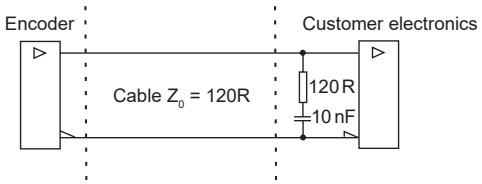
Error	E0	E1
No error	1	1
Amplitude error	0	1
Too high velocity	1	0
Undervoltage; Configuration; System error	0	0

* 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



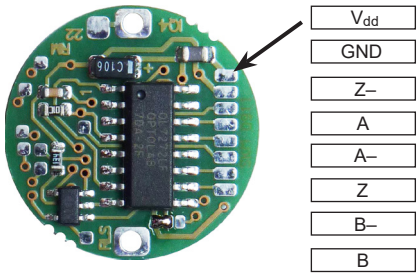
RMB20IC – Incremental, RS422

Square wave differential line driver to RS422

Power supply	V_{dd} = 5 V ±5%
Current 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
Temperature Operating and storage	–40 °C to +125 °C

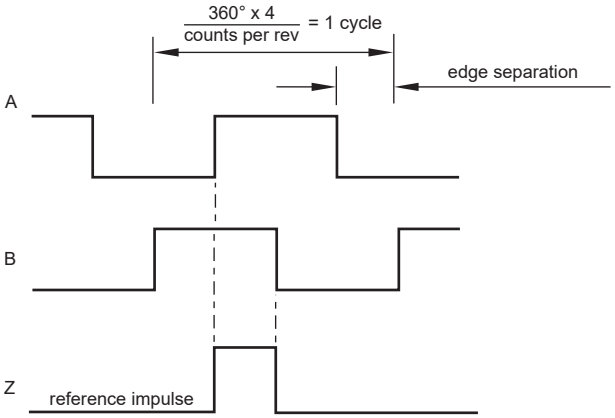
Connections

RMB20IC



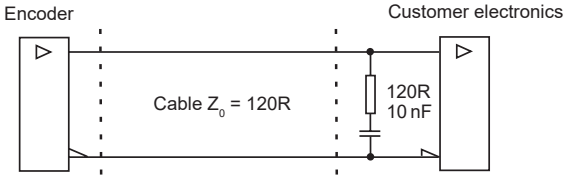
Timing diagram

Complementary signals not shown



B leads A for clockwise rotation of magnet.

Recommended signal termination

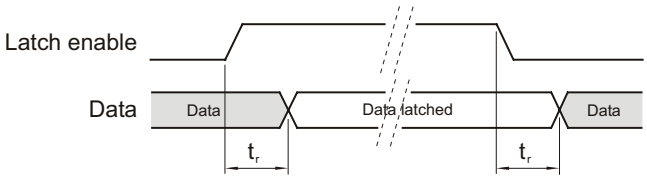


RMB20PC – Absolute binary parallel interface

Parallel absolute position measurement

Output code	Natural binary
Power supply	V_{dd} = 5 V ±5%
Current consumption	20 mA without load
Data outputs	D0 (LSB) - D8 (MSB)
Data input	LE - latch enable input signal, active high Maximum sampling rate 500 kHz
Output voltage	$V_H \geq 4$ V at $-I_H \leq 3$ mA $V_L \leq 1$ V at $I_L \leq 3$ mA
Accuracy	±0.7°
Hysteresis	0.45°
Resolution	9 bit (512 positions per revolution)
Maximum speed	60,000 rpm
Temperature Operating and storage	–40 °C to +125 °C

Timing diagram

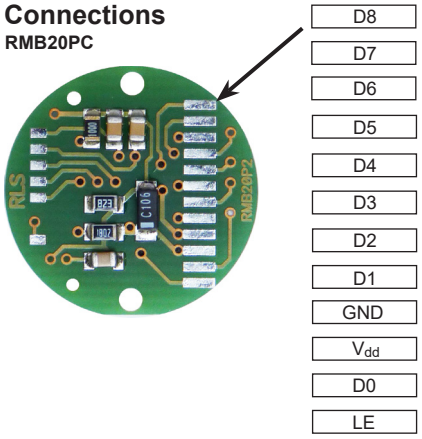


t_r (reaction time) ≤ 1 µs

Position increases for clockwise rotation of magnet.

Connections

RMB20PC

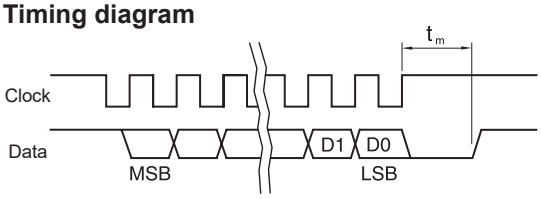


RMB20SC – Absolute binary synchro-serial interface (SSI)

Serial encoded absolute position measurement

Output code	Natural binary
Power supply	V_{dd} = 5 V ±5 %
Current consumption	23 mA for 9 bit resolution 35 mA for all other resolutions
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
Repeatability	≤ 0.07°
Maximum speed	30,000 rpm
Temperature Operating and storage	–40 °C to +125 °C

Timing diagram

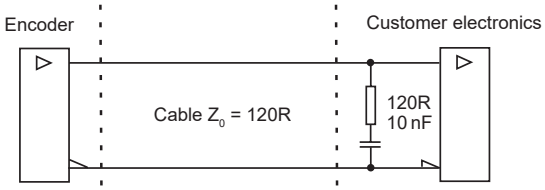


Clock ≤ 4 MHz 12.5 µs ≤ t_m ≤ 20.5 µs (for all other resolutions)
Clock ≤ 900 kHz 16 µs ≤ t_m ≤ 22 µs (for 9 bit resolution)

Position increases for clockwise rotation of magnet.

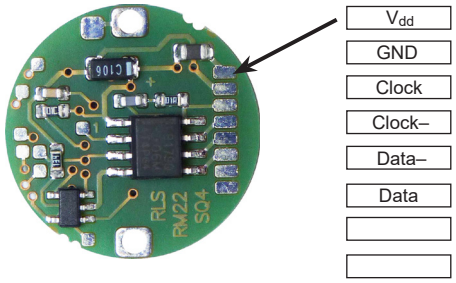
Recommended signal termination

For data output lines only

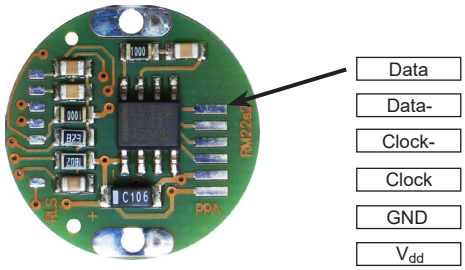


Connections

RMB20SC - all other resolutions



RMB20SC - 9 bit resolution only



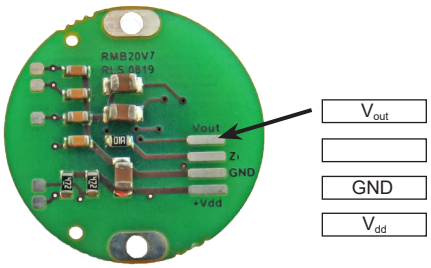
Data sheet
RMB20D01_18

RMB20Vx – Linear voltage output

Power supply	V_{dd} = 5 V ±5 %
Current consumption	Typ. 26 mA
Output voltage	0 V to V_{dd}
Output load	Max. 2 mA
Nonlinearity	1 %
Maximum speed	30,000 rpm
Temperature Operating and storage	–40 °C to +125 °C

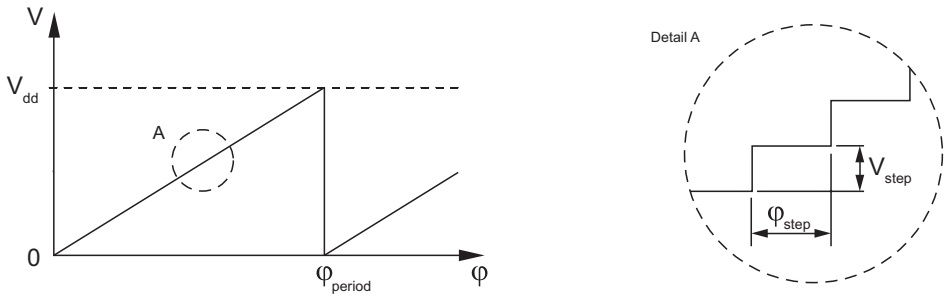
Connections

RMB20V



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.



Timing diagram for linear voltage output

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

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

φ_{period}	N_{period}	N_{step}	φ_{step}
360°	1	1024	0.35°
180°	2	1024	0.18°
90°	4	1024	0.09°
45°	8	512	0.09°

Output type and electrical variant

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

Part numbering

RMB20 IC 09B C 10

Output type
DC - Absolute natural binary BiSS C, RS422
IC - Incremental, RS422
PC - Absolute binary parallel
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**

Special requirements*
1 - No special requirements (standard for **Vx**)
10 - No special requirements (standard for **DC, IC, PC** and **SC**)
C0 - With Molex connector (for **DC** only)

Shape
C - Circular

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

Decimal			Binary		
D32 - 320	**D80** - 800	**2D0** - 2000	**07B** - 128	**10B** - 1024	**13B** - 8192
D40 - 400	**1D0** - 1000		**08B** - 256	**11B** - 2048	
D50 - 500	**1D6** - 1600		**09B** - 512	**12B** - 4096	

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

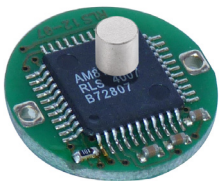
Decimal			Binary		
M32 - 320	**M80** - 800	**2M0** - 2000	**07M** - 128	**10M** - 1024	**13M** - 8192
M40 - 400	**1M0** - 1000		**08M** - 256	**11M** - 2048	
M50 - 500	**1M6** - 1600		**09M** - 512	**12M** - 4096	

For **PC**:
08B - 256 steps per revolution

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

NOTE: Not all combinations are valid.

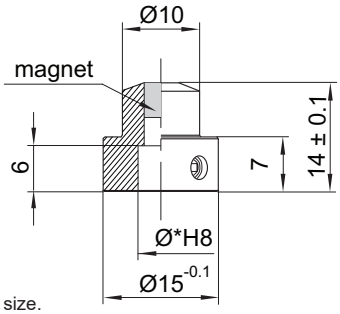
* For sample quantities of RMB20 supplied with a magnet please add “KIT” to the end of the required RMB20 part number, eg. RMB20IC09BC10KIT.



Series	Output type	Resolution	Shape	Special requirements
RMB20	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	C	10 / C0
	IC	2D0 / 1D6 / 1D0 / D80 / D50 / D40 / D32 / 12B / 13B / 11B / 10B / 09B / 08B / 07B		10
	SC	2D0 / 1D6 / 1D0 / D80 / D50 / D40 / D32 / 12B / 13B / 11B / 10B / 09B / 08B / 07B		
	Vx	10B		1

Magnetic actuator and magnet ordering information

Actuator for integration onto shaft



Shaft = Ø*h7
Fixing: Grub screw provided

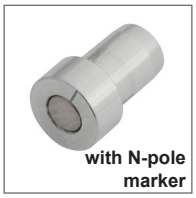
* Hole diameter for nominal shaft size. See table on the right for more information on available shaft sizes.

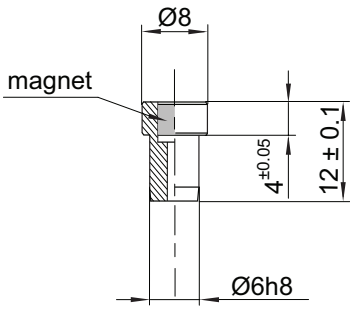
Part numbers:

For resolutions up to 9 bit absolute (512 cpr incremental)
RMA04A2A00 – Ø4 mm shaft **RMA10A2A00** – Ø10 mm shaft
RMA05A2A00 – Ø5 mm shaft **RMA19A2A00** – Ø3/16" shaft
RMA06A2A00 – Ø6 mm shaft **RMA25A2A00** – Ø1/4" shaft
RMA08A2A00 – Ø8 mm shaft **RMA37A2A00** – Ø3/8" shaft

For resolutions from 10 bit absolute (800 cpr incremental) and above
RMA04A3A00 – Ø4 mm shaft **RMA10A3A00** – Ø10 mm shaft
RMA05A3A00 – Ø5 mm shaft **RMA19A3A00** – Ø3/16" shaft
RMA06A3A00 – Ø6 mm shaft **RMA25A3A00** – Ø1/4" shaft
RMA08A3A00 – Ø8 mm shaft **RMA37A3A00** – Ø3/8" shaft

Actuator for integration into shaft





Hole = Ø6G7
Fixing: Glue (recommended – LOCTITE 648 or 2701)

Part numbers:

For resolutions up to 9 bit absolute (512 cpr incremental)
RMH06A2A00

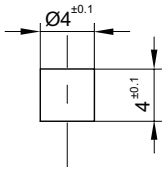
For resolutions from 10 bit absolute (800 cpr incremental) and above
RMH06A3A00

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: Glue (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)

Head office

RLS Merilna tehnika d. o. o.
Poslovna cona Žeje pri Komendi
Pod vrbami 2
SI-1218 Komenda
Slovenia

T +386 1 5272100
E mail@rls.si
www.rls.si

Document issues

Issue	Date	Page	Amendments done
10	8. 4. 2016	4, 5	RMB20IC and RMB20SC Connections 9-bit resolution deleted
		6	RMB20Vx description amended
		7	Ordering code amended
11	3. 6. 2016	2, 3	RMB20IC and RMB20SC Connections 9 bit resolution added
12	6. 10. 2016	3	RMB20BC timing diagram and pinout order amended
		4	IC output temperature and Current consumption amended, connections 9 bit resolution deleted
		7	Special requirements option 12 added, resolution binary table amended, ordering table added
13	5. 7. 2018	4, 5	Resolutions amended
14	8. 8. 2019	6	New version of RMB20Vx added
15	30. 8. 2019	2	Dimensions image change
16	27. 9. 2021	2	Dimensions image change
17	2. 2. 2022	General	AC, BC output removed, DC added
18	20. 1. 2023	General	Revolution counter added