

## RoLin™ miniature packaged incremental magnetic encoder sensor system



**RoLin™ is a component level encoder consisting of a RLM readhead and a magnetic scale or ring. It has been designed for embedded motion control applications as a position control loop element.**

**The information carrier is a periodically magnetised scale with a pole length of 2 mm. Radial or axial reading of the ring is possible.**

State of the art position sensing ensures highly repeatable position measurement under wide installation tolerances and temperature ranges.

Position information is output in incremental quadrature and parallel, SSI or BiSS format with the option of a periodic reference mark (every pole). When SSI or BiSS




communication protocol is selected the value of internal period counter (1 pole = 1 period) can be output. 8 bit, 12 bit or 24 bit counter lengths can be selected. Optionally, period counter can be reset when traversing the reference mark (if selected).

Maximum speed depends on the chosen resolution and minimum edge separation time; e.g. for linear applications to 7 m/s at 1 µm and to 75 m/s at 10 µm. For more information about maximum speed in rotary and linear applications download MR or MS datasheet from [RLS media center](#).

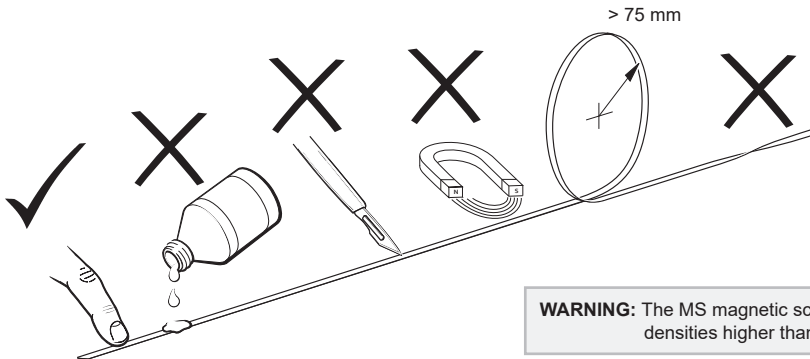
A self-diagnosis feature enables the sub-system to diagnose potential failures of the encoder which are signalled on the Error line using a PWM formatted code.

- Incremental ABZ, TTL or RS422 logic level
- SSI or BiSS, TTL logic level
- High speed operation
- Bidirectional reference mark
- High reliability from proven non-contact sensing technology
- Pin / Flex cable options
- Self-diagnosis feature
- CE compliant, including RoHS – see [Declaration of conformity](#)

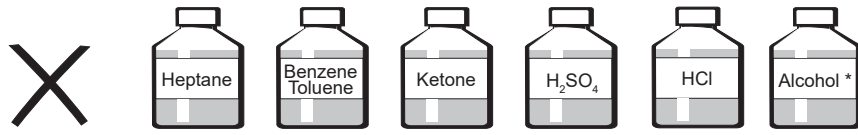
### Readhead selection guide

	RLM with pins	RLM with flex cable	RLM with RS422 flex cable
			
<b>Fixing of readhead</b>	By soldering	Mounting bracket	Mounting bracket
<b>Connection to system PCB</b>	Direct soldering to PCB	With flex cable and zif connector	With flex cable and zif connector
<b>Available flex cable output lengths</b>	-	75 mm	136 mm
<b>Overall distance to subsequent device</b>	Distance depends on loading characteristics and edge separation time; generally: <300 mm	Distance depends on loading characteristics and edge separation time; generally: <300 mm	>50 m (with FPC and extension cables)
<b>Output type</b>	SSI, BiSS-C and Incremental, no line driver (A, B, Z)	SSI, BiSS-C and Incremental, no line driver (A, B, Z)	Incremental, RS422 line driver (A, B, Z, A-, B-, Z-)
<b>Error signal</b>	Available	Available	Not available
<b>ESD susceptibility of all pins</b>	±2 kV (HBM 100 pF, discharge through 1.5 kΩ)	±2 kV (HBM 100 pF, discharge through 1.5 kΩ)	±2 kV (HBM 100 pF, discharge through 1.5 kΩ)

### Storage and handling



**WARNING:** The MS magnetic scale should not be exposed to magnetic field densities higher than 50 mT on its surface, as it can damage the scale.



\* Use of alcohol for cleaning is considered safe, however, it is not allowed to immerse the scale in alcohol.



For radial and axial ring storage and handling download MR data sheet from [RLS media center](#).

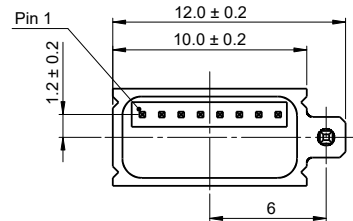
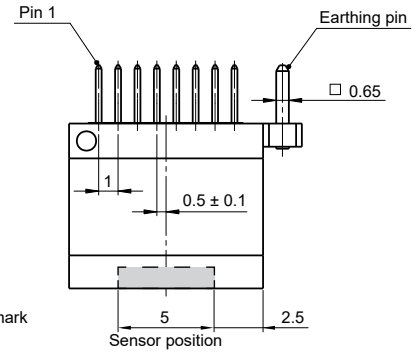
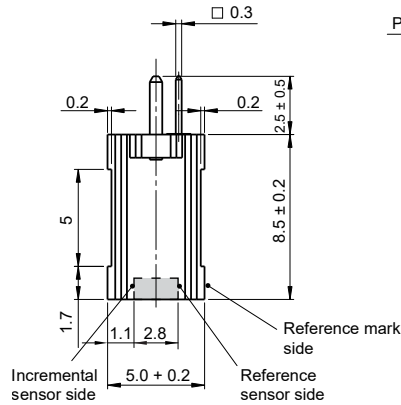
## RLM readhead with pins for direct soldering to PCB

Dimensions and tolerances are in mm.

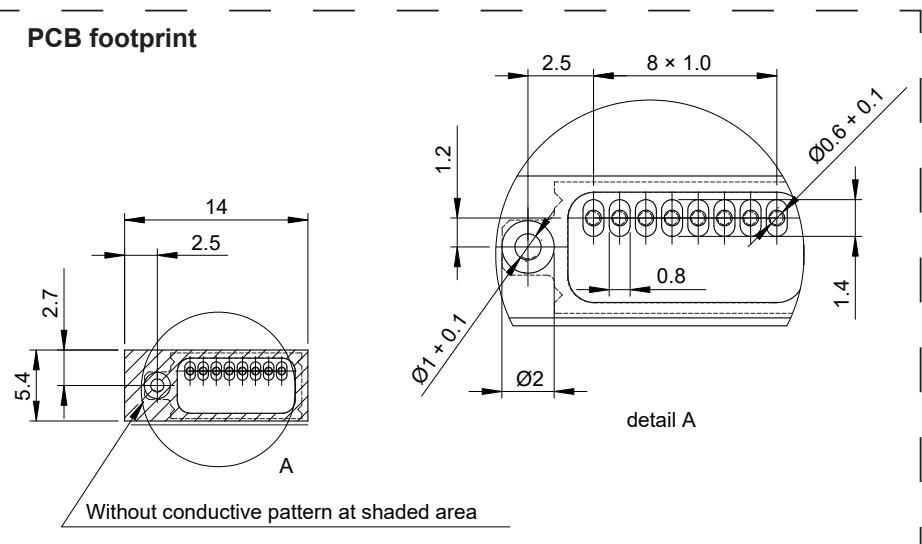


### Pinout

Pin	Signal	Function
1	SLO	Output
2	MA	Input
3	Error	Output
4	V <sub>dd</sub> (+5 V)	Power
5	GND (0 V)	Power
6	A	Output
7	Z	Output
8	B	Output



### PCB footprint

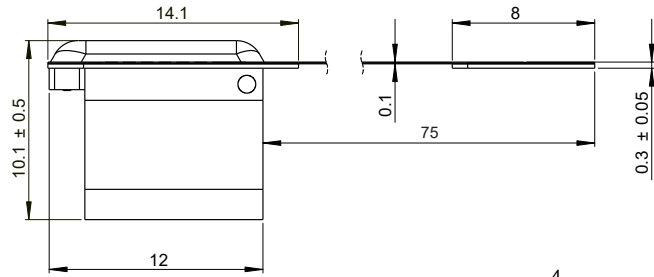
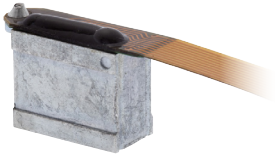


**Note:** Hand soldering temperature:  
 T<sub>max</sub> 260 °C; t<sub>max</sub> 5 s  
 Flow soldering not allowed.

Data sheet  
RLMD01\_09

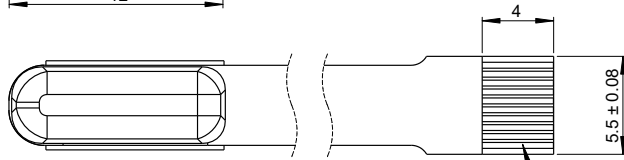
**RLM readhead with flex cable**

Dimensions and tolerances are in mm.



**Connections**

Pad	Signal	Function
1	-	Case
2	SLO	Output
3	MA	Input
4	Error	Output
5	V <sub>dd</sub> (+5 V)	Power
6	GND (0 V)	Power
7	A	Output
8	Z	Output
9	B	Output
10	-	Case



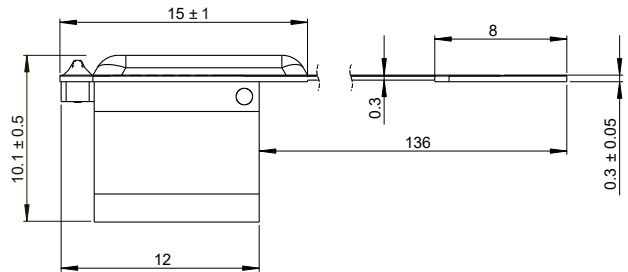
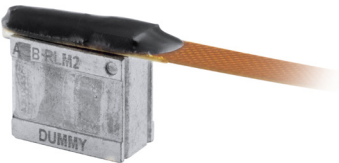
Dynamic bend radius: 5 mm  
Static bend radius: 1 mm

Mating connectors\*:  
Molex - 51281-1094  
Molex - 52745-1097  
Molex - 52746-1071  
JST - 10FLH-SM1-TB  
JST - 10FLH-RSM1-TB

\* Not provided.

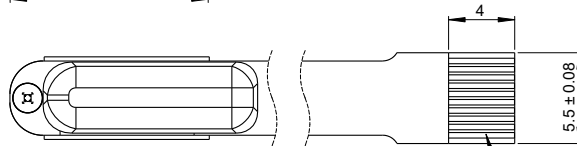
**RLM readhead with RS422 flex cable**

Dimensions and tolerances are in mm.



**Connections**

Pad	Signal	Function
1	-	Case
2	A	Output
3	A-	Output
4	B-	Output
5	V <sub>dd</sub> (+5 V)	Power
6	GND (0 V)	Power
7	B	Output
8	Z-	Output
9	Z	Output
10	-	Case

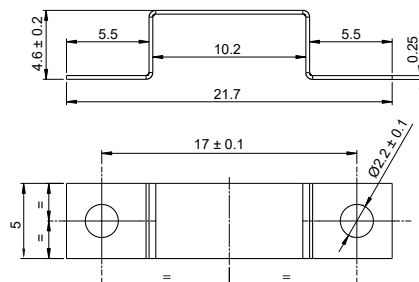
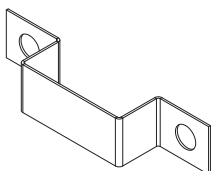


Dynamic bend radius: 20 mm  
Static bend radius: 5 mm

Note: Error signal not output

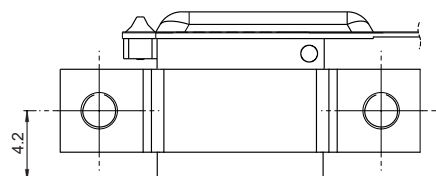
**Mounting bracket dimensions**

Dimensions and tolerances are in mm.



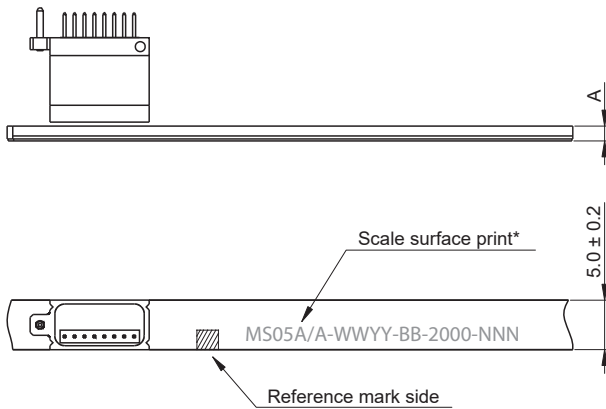
**Position of installation holes**

Recommended use of M2 screws with washers.



## Installation tolerances

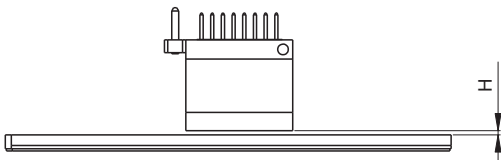
Dimensions and tolerances are in mm.



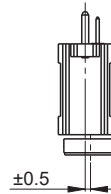
	Magnetic scale thickness (A)	Ride height (H)
With back-adhesion tape (option A)	$1.5 \pm 0.15$	0.1–0.8
With back-adhesion tape, with cover foil (option B)	$1.6 \pm 0.15$	0.1–0.7
No back-adhesion tape (option I)	$1.3 \pm 0.15$	0.1–0.8
No back-adhesion tape, with cover foil (option N)	$1.4 \pm 0.15$	0.1–0.7

\* For scale surface print description refer to [MS01 datasheet](#).

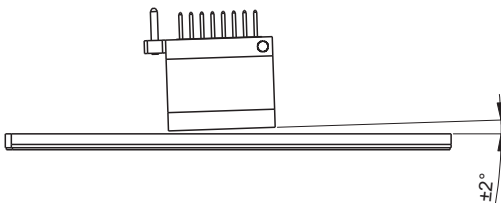
### Ride height



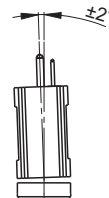
### Lateral offset



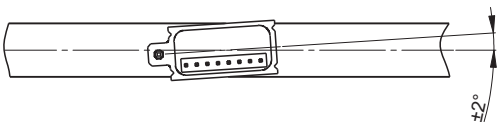
### Pitch



### Roll



### Yaw



For radial and axial ring installation tolerances download MR datasheet from [RLS media center](#).

## Technical specifications

System data	
Maximum length for MS05 scale	50 m
Pole length	2 mm
System accuracy	±40 µm
Linear expansion coefficient for MS scale	~ 17 × 10 <sup>-6</sup> /K
Repeatability	Better than unit of resolution for movement in the same direction
Hysteresis	< 3 µm up to 0.2 mm ride height
Hand soldering (for pin variant only)	T <sub>max</sub> 260 °C; t <sub>max</sub> 5 s

### Available resolutions and maximum speed for linear applications:

Part numbering	Resolution (µm)	Counts / 2 mm	Maximum speed (m/s)									
			K	A	B	C	D	E	F	G	H	
13B	≈ 0.244	8,192	1.82	0.91	0.23	0.11	0.06	0.03	0.02	0.01	0.01	
12B	≈ 0.488	4,096	3.65	1.82	0.46	0.23	0.12	0.06	0.05	0.02	0.01	
11B	≈ 0.976	2,048	7.30	3.65	0.91	0.46	0.24	0.12	0.10	0.05	0.02	
2D0	1	2,000	7.47	3.73	0.93	0.47	0.24	0.12	0.10	0.05	0.02	
1D6	1.25	1,600	9.33	4.67	1.17	0.58	0.30	0.16	0.12	0.06	0.03	
10B	≈ 1.953	1,024	14.58	7.30	1.82	0.91	0.48	0.24	0.19	0.10	0.05	
1D0	2	1,000	14.93	7.47	1.87	0.93	0.49	0.25	0.20	0.10	0.05	
D80	2.5	800	18.67	9.33	2.34	1.17	0.61	0.31	0.25	0.12	0.06	
09B	≈ 3.906	512	29.17	14.58	3.65	1.82	0.95	0.49	0.38	0.19	0.10	
D50	4	500	29.87	14.93	3.73	1.87	0.97	0.50	0.39	0.20	0.10	
D40	5	400	37.33	18.67	4.67	2.34	1.22	0.62	0.49	0.25	0.12	
D32	6.25	320	46.67	23.33	5.84	2.91	1.52	0.78	0.61	0.31	0.16	
08B	≈ 7.812	256	58.34	29.17	7.30	3.65	1.90	0.97	0.77	0.39	0.19	
D20	10	200	74.67	37.33	9.33	4.67	2.43	1.24	0.98	0.50	0.25	
D16	12.5	160	80.00	46.87	11.75	5.81	3.06	1.53	1.23	0.61	0.31	
07B	15.625	128	80.00	58.34	14.58	7.30	3.81	1.94	1.53	0.77	0.39	
D10	20	100	80.00	75.00	18.80	9.30	4.90	2.45	1.96	0.98	0.49	
D08	25	80	80.00	80.00	23.50	11.63	6.13	3.06	2.45	1.23	0.61	
06B	31.25	64	80.00	80.00	29.17	14.58	7.62	3.89	3.07	1.55	0.78	
D04	50	40	80.00	80.00	47.00	23.25	12.25	6.13	4.90	2.45	1.23	
05B	62.5	32	80.00	80.00	58.34	29.17	15.22	7.78	6.14	3.10	1.56	
04B	125	16	n/a	80.00	80.00	58.34	30.43	15.56	12.28	6.19	3.11	
03B	250	8	n/a	n/a	80.00	80.00	60.86	31.11	24.56	12.39	6.23	
Minimum edge separation (µs)			0.07	0.12	0.50	1	2	4	5	10	20	
Maximum count frequency (MHz)			15	8	2	1	0.5	0.25	0.2	0.1	0.05	
Part numbering			K	A	B	C	D	E	F	G	H	

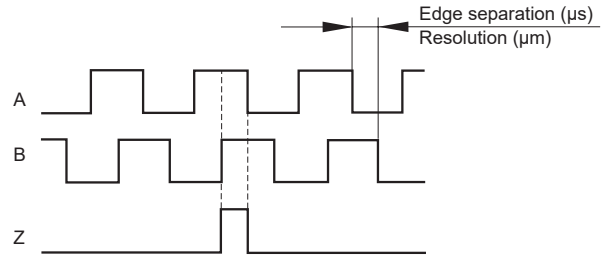
For rotary maximum speed table refer to MR datasheet from [RLS media center](#).

Mechanical data	
Readhead housing material	ZnAl4Cu1 - zamak 5
Mass	RLM readhead 1.4 g (without flex), 1.6 g (with flex); magnetic scale MS05 30 g/m; for radial and axial rings download MR datasheet from <a href="#">RLS media center</a>
Environmental	
Temperature	Operating With flex cable: -20 °C to +85 °C
	Without flex cable: -40 °C to +85 °C
	Storage -40 °C to +85 °C
Vibrations (55 Hz to 2000 Hz)	300 m/s <sup>2</sup> (IEC 60068-2-6)
Shocks (11 ms)	300 m/s <sup>2</sup> (IEC 60068-2-27)
RoHS	Compliant with EU Directive 2002/95/EC

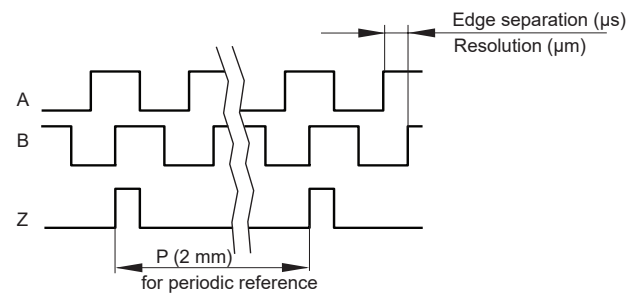
## RLM2DE – BiSS-C + Incremental, no line driver

<b>Power supply</b> (voltage on readhead)	4.75 V to 5.5 V Reverse polarity protection
<b>Current consumption</b>	< 25 mA (without load)
<b>Output signals</b>	A, B, Z, Error, SLO
<b>Saturation voltage hi</b> (I = -4 mA)	$V_{dd} - 0.4$ V
<b>Saturation voltage lo</b> (I = 4 mA)	0.4 V
<b>Rise and fall time</b> ( $c_c = 50$ pF)	60 ns
<b>Input signals</b>	MA
<b>Threshold voltage hi</b>	2 V
<b>Threshold voltage lo</b>	0.8 V
<b>Permissible MA clock frequency</b>	8 MHz
<b>Reference signal</b>	1 or more square-wave pulse Z
<b>Timeout (Tto)</b>	1.5 $\mu$ s

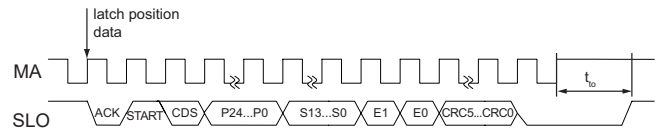
Timing diagram – Incremental, unique reference mark



Timing diagram – Incremental, periodic reference mark



Timing diagram – BiSS-C



Data	Length	Description
P24 – P0	0 to 24 bit	Period counter value (length depends on the settings chosen)*
S12 – S0	3 to 13 bit	Position inside the period (length depends on the resolution)
E1 – E0	2 bit	Error data
CRC5 – CRC0	5 to 6 bit	Cyclic redundancy check data; polynomial 0 × 25; inverted bit output

\* Optionally, period counter can be reset at the reference mark (options E, F and G - see part numbering on [page 10](#)).

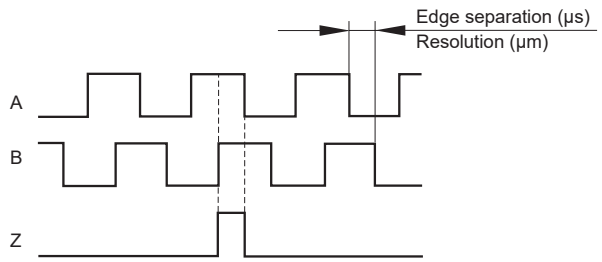
Error	E0	E1
No error	1	1
Amplitude error	0	1
Too high velocity	1	0
Undervoltage; Configuration; System error	0	0

For more information on BiSS-C protocol please visit their [webpage](#).

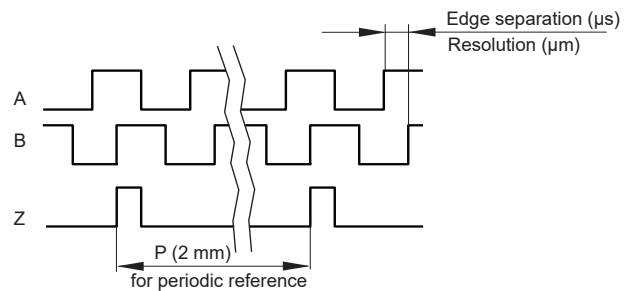
### RLM2HD – Incremental, no line driver

<b>Power supply</b> (voltage on readhead)	4.75 V to 5.5 V Reverse polarity protection
<b>Current consumption</b>	<25 mA (without load)
<b>Output signals</b>	A, B, Z
<b>Saturation voltage hi</b> (I = -4 mA)	$V_{dd} - 0.4$ V
<b>Saturation voltage lo</b> (I = 4 mA)	0.4 V
<b>Rise and fall time</b> ( $c_c = 50$ pF)	60 ns
<b>Reference signal</b>	1 or more square-wave pulse Z

Timing diagram – Incremental, unique reference mark



Timing diagram – Incremental, periodic reference mark

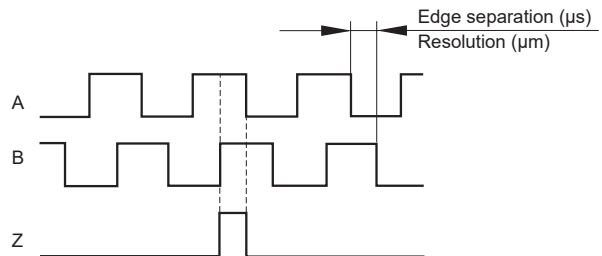


### RLM2IC – Incremental, RS422

<b>Power supply</b> (voltage on readhead)	4.75 V to 5.5 V Reverse polarity protection
<b>Current consumption</b>	<30 mA (without load)
<b>Output signals</b>	A, B, Z, A-, B-, Z-
<b>High level output voltage</b> ( $I_{OH} = -20$ mA)	>2.4 V
<b>Low level output voltage</b> ( $I_{OL} = 20$ mA)	<0.4 V
<b>Rise and fall time</b> ( $c_c = 50$ pF)	<10 ns
<b>Reference signal</b>	1 or more square-wave pulse Z and its inverted pulse Z-

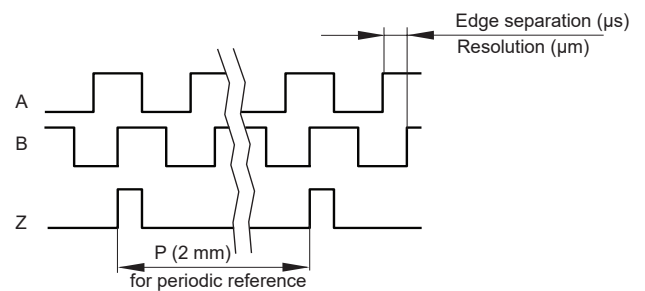
Timing diagram – Incremental, unique reference mark

Inverted signals are not shown



Timing diagram – Incremental, periodic reference mark

Inverted signals are not shown

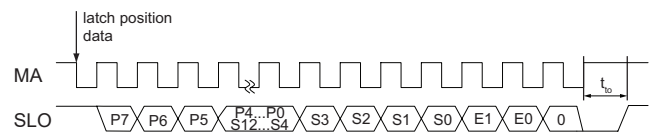




## RLM2SJ – SSI + Incremental, no line driver

<b>Power supply</b> (voltage on readhead)	4.75 V to 5.5 V Reverse polarity protection
<b>Current consumption</b>	<25 mA (without load)
<b>Output signals</b>	A, B, Z, Error, SLO
<b>Saturation voltage hi</b> (I = -4 mA)	$V_{dd} - 0.4$ V
<b>Saturation voltage lo</b> (I = 4 mA)	0.4 V
<b>Rise and fall time</b> ( $c_c = 50$ pF)	60 ns
<b>Input signals</b>	MA
<b>Threshold voltage hi</b>	2 V
<b>Threshold voltage lo</b>	0.8 V
<b>Permissible MA clock frequency</b>	4 MHz
<b>Reference signal</b>	1 or more square-wave pulse Z
<b>Timeout (Tto)</b>	20 $\mu$ s

## Timing diagram – SSI



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

Data	Description
<b>P0 - P7</b>	Period counter value (length depends on the settings chosen)*
<b>S0 - S13</b>	Position inside the period (length depends on the resolution)
<b>E1 - E0</b>	Error data

\* Optionally, period counter can be reset at the reference mark (options E, F and G - see part numbering on [page 10](#)).

## Error output

To enable the successful diagnosis of faults, different types of errors are signalled on the Error line using a PWM formatted code as detailed below. In the case of amplitude or frequency failure the PWM cycle frequency is approximately 16.5 Hz (cycle duration: 60.7 ms).

Failure mode	Error output	Possible cause of failure
No error	High	Ride height too high
Amplitude error	Low: 75 % High: 25 %	Readhead removed from scale / ring Demagnetisation of magnetic scale / ring
Frequency error	Low: 50 % High: 50 %	Speed too high
Undervoltage	Low	Power supply low

If an error in amplitude occurs, the conversion process is terminated and the incremental output signals are halted. An error in amplitude rules out the possibility of an error in frequency.

Error output is an open collector type with built in pull up resistor. It can be used in "wired-or" configuration with other error signals in the system.

## Reference mark options

### Option A: With reference sensor

Magnetic scale or ring should be ordered with reference mark. If required, the cover foil can be installed over the reference mark.

### Option B: No reference sensor

### Option C: Periodic reference mark as per scale pitch (every 2 mm)

Reference periods correspond to pole length of magnetisation. Magnetic scale or ring should be ordered with **no** reference mark

## Interpolation factor (resolution)

### Formula for linear application resolution

$$\text{Resolution } (\mu\text{m}) = \frac{2000}{\text{Interpolation}}$$

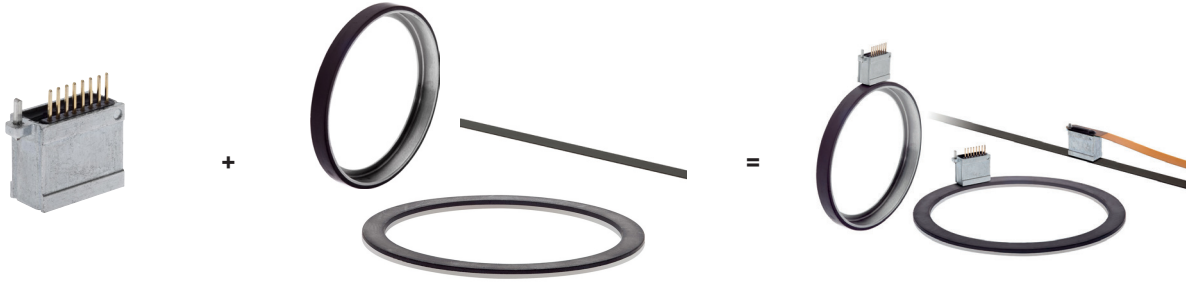
### Formula for rotary application resolution

$$\text{Resolution (ppr)} = \frac{\text{cpr}}{4}$$

$$\text{Resolution (cpr)} = \text{Pole number} \times \text{Interpolation}$$

For radial and axial ring resolution download MR datasheet from [RLS media center](#).

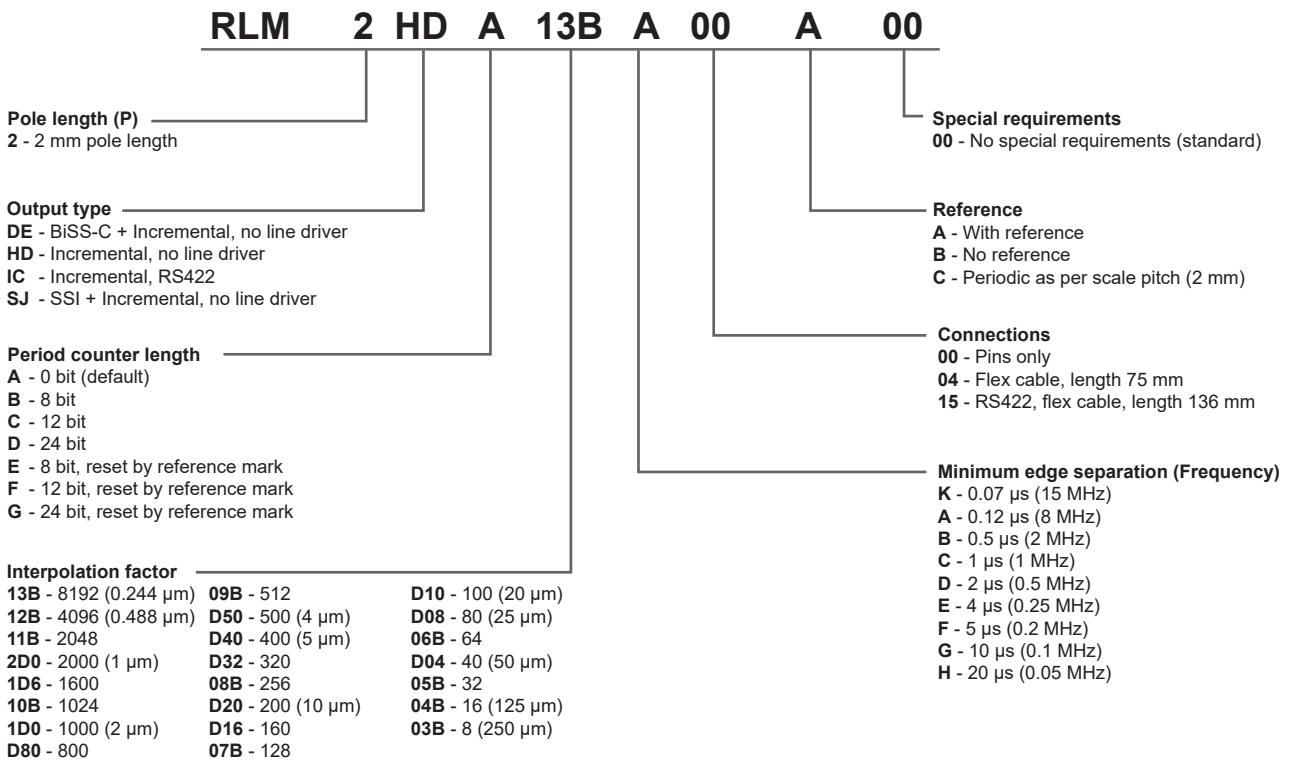
### Readhead part numbering



**RLM readhead**  
eg. RLM2HDA13BA00A00

**Magnetic scale / ring**  
eg. MS05BM100AM010 for scale /  
MR047B040A076B00 for ring

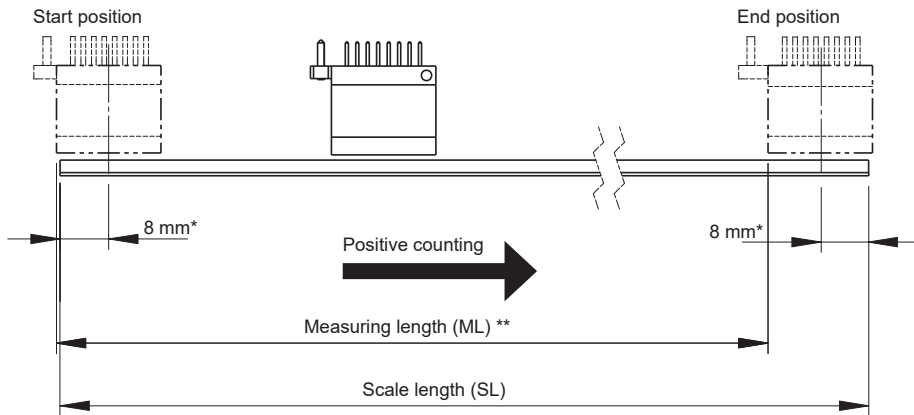
**RoLin™ system**



Series	Output type	Period counter length	Interpolation factor	Minimum edge separation	Connections	Reference	Special Requirements	
RLM2	IC	A	xxx*	K/A/B/C/D/E /F/G/H	15	A/B/C	00	
			04B	A/B/C/D/E/F /G/H		B/C		
			03B	B/C/D/E/F/ G/H		B/C		
	HD		xxx*	K/A/B/C/D/E /F/G/H	00 / 04 / 15	A/B/C		
			04B	A/B/C/D/E/F /G/H		B/C		
			03B	B/C/D/E/F/ G/H		B/C		
	DE/SJ		A/B/C/D/E /F/G	xxx*	K/A/B/C/D/E /F/G/H	00 / 04 / 15		A/B/C
				04B	A/B/C/D/E/F /G/H			B/C
				03B	B/C/D/E/F/ G/H			B/C

For radial and axial ring part numbering refer to MR datasheet from [RLS media center](#).

## Magnetic scale part numbering



\* Minimum distance of reference mark from left edge is 8 mm.

\*\* Beginning of measuring length from elasto-ferrite layer edge is 0 mm.  
 $ML = SL - 10 \text{ mm}$

**MS05 B M100 A M010**

**Accuracy grade**  
**B** -  $\pm 40 \mu\text{m/m}$

**Scale length**  
**xxxx** - Where xxxx equals scale length in cm  
**Mxxx** - Where xxx equals scale length in mm  
 (for scale lengths below 1 m)

**Position of reference mark**

**0000** - No reference mark

**Dxxx** - Distance coded reference mark; where xxx equals basic increment in mm

**Mxxx** - Where xxx equals position of magnetised reference mark in mm

**xxxx** - Where xxxx equals position of magnetised reference mark in cm

**NOTE:** Reference mark position will be within  $\pm 0.1 \text{ mm}$  from requested position.

**Options**

**A** - VHB back-adhesive tape (standard)

**B** - VHB back-adhesive tape, with cover foil\*

**I** - No back-adhesive tape

**N** - No back-adhesive tape, with cover foil\*

\* Cover foil supplied separately.

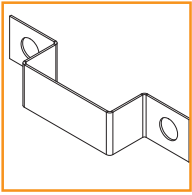
## Cover foil part numbering

**CF05 1000**

**Width of cover foil**  
**CF05** - Width 5 mm

**Foil length**  
**xxxx** - Where xxxx equals foil length in cm (eg. 0400 equals 400 cm of foil)

### Accessories part numbering



Mounting bracket  
**RLMMB01**



USB encoder interface  
**E201**



Connector adapters FFC to DB9 (connect to E201):  
**RLACC001** for RLM2IC  
**RLACC002** for RLM2HD  
**RLACC003** for RLM2DE and RLM2SJ  
**RLACC004** for RLM2IC



Magnet viewer  
**MM0001**

## Head office

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

**T** +386 1 5272100  
**F** +386 1 5272129  
**E** [mail@rls.si](mailto:mail@rls.si)  
**www.rls.si**

## Document issues

Issue	Date	Page	Corrections made
5	25. 11. 2014	2	Updated installation drawing dimension tolerance
		3	Magnetic scale thickness information updated
		4	Ring dimension tolerances updated; installation note added
		7	Edge separation and reference notes added
		8	Part numbering Options added
6	22. 12. 2014	1, 12	Period counter options added and explained
7	14. 1. 2015	7	76 pole ring resolutions corrected
8	18. 9. 2017	1	Ring reference and RoHS added
		2	Storage added
		6	Technical specifications amended
		7, 8	Output description added
		10, 11, 12, 13	Readhead, magnetic scale and accessories part numbering amended
9	14. 2. 2020	5	Installation drawing amended
		6	Temperature range amended
			Maximum speed table amended
		7, 8, 9	Current consumption amended

This product is not designed or intended for use outside the environmental limitations and operating parameters expressly stated on the product's datasheet. Products are not designed or intended for use in medical, military, aerospace, automotive or oil & gas applications or any safety-critical applications where a failure of the product could cause severe environmental or property damage, personal injury or death. Any use in such applications must be specifically agreed to by seller in writing, and is subject to such additional terms as the seller may impose in its sole discretion. Use of products in such applications is at buyer's own risk, and buyer will indemnify and hold harmless seller and its affiliates against any liability, loss, damage or expense arising from such use. Information contained in this datasheet was derived from product testing under controlled laboratory conditions and data reported thereon is subject to the stated tolerances and variations, or if none are stated, then to tolerances and variations consistent with usual trade practices and testing methods. The product's performance outside of laboratory conditions, including when one or more operating parameters is at its maximum range, may not conform to the product's datasheet. Further, information in the product's datasheet does not reflect the performance of the product in any application, end-use or operating environment buyer or its customer may put the product to. Seller and its affiliates make no recommendation, warranty or representation as to the suitability of the product for buyer's application, use, end-product, process or combination with any other product or as to any results buyer or its customer might obtain in their use of the product. Buyer should use its own knowledge, judgment, expertise and testing in selecting the product for buyer's application, end-use and/or operating environment, and should not rely on any oral or written statement, representation, or samples made by seller or its affiliates for any purpose. EXCEPT FOR THE WARRANTIES EXPRESSLY SET FORTH IN THE SELLER'S TERMS AND CONDITIONS OF SALE, SELLER MAKES NO WARRANTY EXPRESS OR IMPLIED WITH RESPECT TO THE PRODUCT, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE, WHICH ARE DISCLAIMED AND EXCLUDED. All sales are subject to seller's exclusive terms and conditions of sale which, where the seller is (a) RLS merilna tehnika d.o.o., are available at <https://www.rls.si/customer-service>, (b) Renishaw, Inc., are available at <http://www.renishaw.com/Shop/legal/en/-42186>, or (c) another person, are available on request, and in each case, are incorporated herein by reference, and are the exclusive terms of sale. No other terms and conditions apply. Buyer is not authorized to make any statements or representations that expand upon or extend the environmental limitations and operating parameters of the products, or which imply permitted usage outside of that expressly stated on the datasheet or agreed to in writing by seller.

RLS merilna tehnika d.o.o. has made considerable effort to ensure the content of this document is correct at the date of publication but makes no warranties or representations regarding the content. RLS merilna tehnika d.o.o. excludes liability, howsoever arising, for any inaccuracies in this document. © 2020 RLS d.o.o.